CITY OF CAMAS

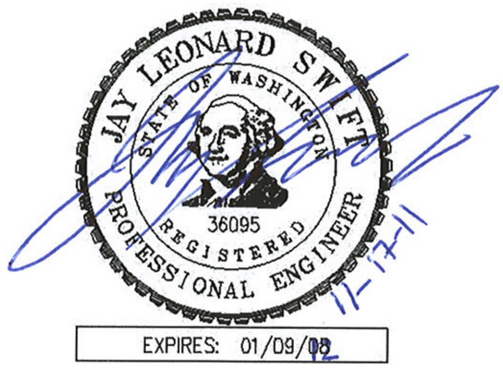
GENERAL SEWER/WASTEWATER FACILITY PLAN

May 2007
Revised November 2009
and November 2011

Gray & Osborne, Inc.
CONSULTING ENGINEERS

CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN



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Gray & Osborne, Inc.
Seattle

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EXECUTIVE SUMMARY

INTRODUCTION

This *General Sewer/Wastewater Facilities Plan* (Plan) for the City of Camas addresses the City's planning needs for wastewater collection, transmission, treatment, and disposal for the 20-year planning period. The Plan was prepared in accordance with the provisions of the Revised Code of Washington (RCW), Section 90.48, *Water Pollution Control*, Washington Administrative Code (WAC) Section 173-240-050, *General Sewer Plan*, and WAC 173-240-060, *Engineering Report*. Development of the Plan has been coordinated with the City's 2004 *Comprehensive Plan*, Clark County planning efforts, and with the City's 2001 *Water System Comprehensive Plan*.

The purpose of the Plan is to develop a Capital Improvement Plan to provide wastewater infrastructure to meet the City's needs for a 20-year planning period. Flows and loadings to the City's sewage collection and treatment systems are projected to grow substantially due to robust growth within the City's Urban Growth Area. The Plan provides proposed conceptual designs, cost estimates, a schedule, and a financing plan for recommended major facility improvements. The projects described in the Plan are consistent with Washington State regulations relating to the prevention and control of discharge of pollutants into waters of the state, anti-degradation of existing and future beneficial uses of ground waters, and anti-degradation of surface waters.

Sewage collection for the City is provided by a combination of gravity sewers, pump stations, force mains and Septic Tank Effluent Pump (STEP) systems. Wastewater treatment for the City is provided by the City's conventional activated sludge Wastewater Treatment Facility (WWTF).

PLANNING CRITERIA

Chapters 2 –4 of the Plan include discussion of general planning issues including growth management, land use, zoning, features of the service area and population projections. Regulatory issues that are relevant to the planning and implementation of wastewater service improvements are discussed.

In Chapter 3, planning, land use and population projections are discussed. Per discussion with City staff, annual growth rates of 7.2 percent and 1.0 percent were used, respectively, to project future City population for 2005 – 2010 and 2011 – 2025. Use of these growth rates yields a 49 percent population increase by 2015 and a 64 percent population increase by 2025. The growth rates are more conservative (yield a higher overall population) than those presented in the City's 2004 Comprehensive Plan. Based on current growth projections, the population within the City's sewer service area (essentially the UGA) will grow from approximately 16,000 to over 29,000 by year 2025.

EXISTING FACILITIES

WASTEWATER COLLECTION SYSTEM

For the purposes of this report, the City of Camas WWTF collection system is divided into 15 collection areas, or drainage basins. These collection areas predominantly follow the natural drainage patterns of the City's service area. Sanitary sewer lines in downtown Camas, and areas to the immediate north and east of downtown, are predominantly gravity pipes, while the majority of the rest of the City is served by septic tank effluent (STE) systems. Since 1985, over 3,500 sewer connections have been added to the City's system, with most of these connections using STE facilities. It is estimated that over half of the current total sanitary sewage flow to the wastewater treatment facility consists of flow from STE systems, and that about 80 to 90 percent of the wastewater generated by new connections originates from STE systems. When the solids storage capacity of a septic tank is reached, the tank is pumped out and the resultant septage is hauled by tank truck to the City's wastewater treatment facility.

There are currently 23 pump stations serving the City. The Main Pump Station conveys the majority of the City's sewage under the Washougal River to the WWTF.

WASTEWATER TREATMENT FACILITY

The City's activated sludge wastewater treatment facility (WWTF) has a maximum month capacity of 6.1 mgd flow and 5,616 lb/d of BOD_5. The WWTF includes a headworks with mechanical fine screen, aeration basins with selectors and oxic/anoxic zones for nitrogen removal operating in a Modified Ludzak-Ettinger (MLE) configuration, primary and secondary clarifiers, effluent filtration, UV disinfection, effluent pump station, aerobic digesters and a sludge dewatering centrifuge.

WASTEWATER CHARACTERISTICS AND FLOWS

In Chapter 6, the quantity of wastewater generated in the sewer service area is estimated from WWTF flow meter readings and water consumption records during recent years. Wastewater flow originates from single-family residential and multi-family, commercial and industrial sources. The City has a number of light industrial and technical businesses that provide a significant percentage of total employment and wastewater flow within the City. Most notable are WaferTech, Heraeus Shin-Etsu America, C-Tech, Sharp, Linear Technology, and Underwriters Laboratories. The average annual flow (AAF) from each source type is estimated as 85% of metered winter potable water consumption, based on an analysis of water consumption and wastewater flow records.

The current and projected 10-year and 20-year Equivalent Residential Units (ERUs) and flows (without consideration of further expansion of the Urban Growth Area) are summarized in Table ES-1. The projected flows and ERUs are based on use of the aforementioned growth assumptions applied to all customer classes, except the industrial category. Future industrial flows are projected based on industry expansion plans and the permitted flows in the State Waste Discharge Permits. Infiltration and inflow (I/I) were assumed to remain constant throughout the planning period; reductions in I/I are expected to be balanced by increases as the sewer system is expanded and additional infrastructure ages.

TABLE ES-1

Current and Projected Future Wastewater Flows

Wastewater ERUs and Flows	**Sewer ERUs**			
Customer Type	**2005**	**2015**	**2025**	**Buildout**
Single-Family Residential	5,613	8,363	9,205	13,608
Multi-family Residential	729	1,086	1,196	7,546
Commercial	652	972	1,070	2,176
Industrial	6,224	9,857	12,556	25,537
City	52	77	85	173
TOTAL	13,270	20,356	24,112	49,039
Projected Flows (mgd)				
Total Base Flow	1.98	3.03	3.59	7.31
Low-strength Industrial Reserve	0	0.70	1.40	1.40
Average Annual Flow	2.29	4.04	5.30	7.62
Maximum Month	3.09	4.84	6.10	8.42
Peak Day	7.03	8.78	10.04	12.36
Peak Hour	9.93	11.47	13.44	17.06

Future loadings to the Camas WWTF were projected in a similar manner as future WWTF flows, and are summarized in Table ES-2.

TABLE ES-2

Current and Projected WWTF Loadings

ERUs and Loadings	2005	2015	2025	Buildout
Total ERUs	13,270	20,356	24,112	49,039
Annual Average BOD_5, (lb/d)	2,218	3,437	4,099	8,197
Max Month BOD_5, (lb/d)	3,039	4,708	5,615	11,230
Annual Average TSS, (lb/d)	3,191	4,937	5,883	11,791
Max Month TSS, (lb/d)	4,339	6,715	8,001	16,036
Annual Average NH_3-N, (lb/d)	730	1,149	1,389	2,686
Max Month NH_3-N, (lb/d)	1,029	1,618	1,956	3,788
Annual Average TKN, (lb/d)	1,017	1,588	1,917	3,726
Max Month TKN, (lb/d)	1,367	2,130	2,573	4,995

COLLECTION SYSTEM IMPROVEMENTS

In Chapter 7, an evaluation of the City's collection system is presented and cost estimates are provided for capital improvement projects to address collection system deficiencies.

A computerized hydraulic model was used to assess the capacity of existing facilities and to plan future facilities for year 2025 flows.

Major problems identified and recommendations included:

- Rehabilitation is recommended for several gravity sewer pipes due to poor condition and infiltration and inflow observed during television inspection. Additionally, City staff have observed significant corrosion and odors in gravity sewers where STEP systems discharge into gravity sewers, significant corrosion in STEP pump stations, and corrosion-induced failure of sanitary sewer components. Pipes are assigned a priority ranking for rehabilitation depending upon the quantity and nature of defects (and I/I) that were noted. Additionally, a number of pipes lacked adequate capacity for 2025 flows, and therefore, replacing pipes with larger diameter lines to increase capacity is recommended.

- The wet well for the Main Pump Station is too small, provides poor access and contributes to the potential of clogging the pumps. Modifications recommended include a grinder and a larger wet well.

- The capacity of the Lacamas Creek Pump Station must be increased to 450 gpm to accommodate projected year 2025 flows.

- The 21-inch STEP Main that transports wastewater from the Western Service Area to the 6th and Joy STEP terminus has adequate capacity for 2025 flows. However, the City has concerns about the durability of this line, which is constructed of 100-psi pipe and has numerous taps. Thus, this line is recommended for replacement in phases in years 2016 through 2025. Plans for rehabilitation of this line should consider additional capacity requirements and alternatives for flow routing and satellite treatment associated with providing sewer service for an expanded UGA.

- The gravity sewer lines and Main Pump Station downstream of the 6th and Joy STEP terminus do not have sufficient capacity to transport 2025 flows. It is recommended that flows be bypassed from these lines in a new STEP Main to the WWTF. The line would cross the Washougal River on a new pedestrian bridge that is being constructed within the next two years. This alignment would require obtaining easements for routing the force main through the various properties. The total length of the force main in this alternative is approximately 8,300 feet.

Table ES-3 identifies the 15-year schedule, and estimated costs in 2006 dollars, for recommended collection system improvements. Total costs shown for the projects include engineering, construction, construction administration, tax and contingency.

TABLE ES-3

Recommended 15-Year Schedule and Cost Estimates for Collection System Capital Improvements

Basin and Project	Reason for Priority	Total Estimated Cost	Project Year Total	Year to be Completed
Investigative Activities				
Basin 10, TV Inspection and Flow Metering	Inf 2	$15,000	$15,000	2007
Purchase flow meters (2)	Inf 2	$25,000	$25,000	2007
TV Inspection and Flow Metering, Basin 2	Inf 1	$15,000	$15,000	2008
Inspect Condition of Force Main from Main Pump Station	Inf 1	$10,000	$10,000	2009
STEP Collection System				
Basin 6, STEP Main Bypass of Main Pump station	C2	$4,480,000	$4,480,000	2010
Replace 21-inch STEP Main	To be Determined			2016-2025
Pump Stations				
Annual Pump Station Rehabilitation and Conversion Allowance	Corrosion, Maintenance	$150,000	$150,000	2006-2015
Basin 5, Main Pump Station – Wet Well and Screening Improvements	C2	$900,000	$900,000	2010
Gravity Collection System				
Basin and Project	**Reason for Priority**	**Total Estimated Cost**	**Project Year Total**	**Year to be Completed**
Basin 1, Project 1	C1, PC,Inf1, S	$776,194	$1,154,243	2007
Basin 2, Project 2	C1, PC, Inf2	$378,049		
Basin 3s, Project 6	C1, PC, Inf4, S	$588,071	$1,421,066	2008
Basin 3s, Project 3	C1, PC, Inf4	$832,995		
Basin 1, Project 2	PC, Inf1	$437,285	$1,245,697	2009
Basin 1, Project 3	PC, Inf1	$466,496		
Basin 1, Project 4	PC, Inf1	$341,916		
Basin 4, Project 2	C2, PC, Inf2	$573,604	$1,219,478	2010
Basin 6, Project 1	C2, Inf5, S	$645,874		
Basin 1, Project 5	PC, Inf1	$347,140	$1,488,567	2011
Basin 2, Project 1	C1, Inf2	$691,171		
Basin 4, Project 3	PC, Inf2	$450,256		
Basin 4, Project 1	PC, Inf2	$714,208	$1,401,209	2012
Basin 4, Project 4	PC, Inf2	$687,001		
Basin 3n, Project 3	PC, Inf3	$545,080	$1,431,307	2013
Basin 3n, Project 1	PC, Inf3	$886,227		
Basin 3n, Project 2	PC, Inf3	$611,636	$1,083,513	2014
Basin 3n, Project 4	PC, Inf3	$471,877		
Basin 5, Project 2	C1, Inf6	$708,507	$708,507	2015
Basin 3n, Project 5	C2, Inf3	$813,853	$813,853	2016
Basin 3s, Project 1	PC, Inf4	$473,788	$814,034	2017

TABLE ES-3 – (continued)

Recommended 15-Year Schedule and Cost Estimates for Collection System Capital Improvements

Basin and Project	Reason for Priority	Total Estimated Cost	Project Year Total	Year to be Completed
Basin 3s, Project 5	PC, Inf4	$340,246		
Basin 3s, Project 4	PC, Inf4	$827,692	$953,293	2018
Basin 6, Project 3	C2, Inf5	$125,601		
Basin 3s, Project 2	PC, Inf4	$557,395	$1,064,698	2019
Basin 6, Project 2	C2, Inf5	$507,303		
Basin 5, Project 1	C2, Inf6	$442,423	$864,815	2020
Basin 10, Project 1	C2, Inf2	$422,392		
Basin 15, Project 1	Crown Road	$1,300,000	$1,300,000	2021

Key:
C1 - needs immediate capacity improvement
C2 - will eventually need capacity improvement
PC - poorest condition due to broken pipe and/or severe root intrusion with subsequent unacceptable infiltration
MC - moderately bad pipe due to cracks and/or some root intrusion - some infiltration
Inf 1 - 1998 I/I Study showed this basin to have the highest I & I
Inf 2 - 1998 I/I Study showed this basin to have the 2nd highest I & I
Inf 3 - 1998 I/I Study showed this basin to have the 3rd highest I & I
Inf 4 - 1998 I/I Study showed this basin to have the 4th highest I & I
Inf 5 - 1998 I/I Study showed this basin to have the 5th highest I & I
Inf 6 - 1998 I/I Study showed this basin to have the 6th highest I & I
S - surcharging is known to occur.
Note: All costs are in 2006 dollars.

WASTEWATER TREATMENT FACILITY IMPROVEMENTS

In Chapter 8, the regulatory and design basis for necessary modifications to the City's WWTF is described. The performance of the WWTF is discussed and evaluated. A recommended capital improvement plan with cost estimates is presented. Chapter 8 also summarizes the results of a mixing zone analysis for the City's WWTF diffuser.

MIXING ZONE STUDY

In 2004, the City authorized Cosmopolitan Engineering to conduct an effluent dye study for Camas using the then current design flows that Ecology had cited in the City's 2004 NPDES permit fact sheet. Based on the field tests, parameters within the UM3 model used by Ecology were calibrated to more closely match measured dilution. Cosmopolitan Engineering then used Ecology's UM3 model, calibrated based on the results of the dye study, to calculate dilution factors and determine NPDES permit limits for year 2025 projected flows. The results of the mixing zone analysis demonstrated a substantial increase in dilution if modifications were made to the diffuser so that it discharged vertically. Because the Camas outfall discharges in the same direction as the river flows, and at similar velocities, there is low turbulence and only moderate dilution in the mixing zone. A change from a horizontal discharge to a vertical discharge would increase dilution about four-fold based on the UM3 model Ecology has used to model dilution in the Camas mixing zone. The mixing zone analyses were finalized, after discussion with Ecology, in Cosmopolitan memoranda dated January 20, 2009 (for an 8-port diffuser configuration), and February 19, 2009 (for a 16-port diffuser configuration).

A letter was issued by Ecology on October 21, 2009, indicating approval of the mixing zone analysis provided in the January 20, 2009, for the 8-port configuration. The approval letter dated October 21, 2009, notes the ratios identified in the memo dated January 20, 2009, may be used for "estimation of the reasonable potential for limits for toxic pollutants not already subject to permit limits (e.g., metals)." A letter was issued by Ecology on November 25, 2009, indicating similar approval of the mixing zone analysis for the 16-port diffuser. As noted in the memorandum from Cosmopolitan dated February 19, 2009, among the metals, only cadmium showed a reasonable potential to exceed water quality standards. The cadmium exceedance is based on one sample (87 µg/L in June 2006) that appears to be a statistical outlier, and may in fact be an artifact of the sampling process. Additional sampling and analysis conducted since June 2006 with clean sampling techniques has not detected cadmium.

Ecology's letter dated October 21, 2009, notes that regarding pollutants presently subject to NPDES permit limits (i.e., ammonia), "it is within Ecology's discretion to conclude that monthly ammonia limits are appropriately protective since daily limits are based on the effluent's variability and these monthly limits. Accordingly, Ecology will have the basis to remove the daily maximum limits for ammonia from the permit with the completion of this outfall upgrade, and it is our intention to do so. Monthly average limits for ammonia will continue to be applicable to the discharges – either the limits presently in the permit, or limits similar to those, with some adjustment for seasonality." Similarly, Ecology's letter dated November 25, 2009, reiterates Ecology's expectation to "retain the monthly average limit for ammonia, as we have discussed previously."

In accordance with the letters dated October 21, 2009 and November 25, 2009, and discussions with Ecology, it is understood that, after completion of the outfall modifications, Ecology would modify Condition S1.A of the City's NPDES permit by deleting the maximum daily ammonia limits. Thus, for total ammonia limits, only the monthly average limits of 20 mg/L in summer and 7 mg/L in winter would remain. These proposed ammonia limits have been used as the basis of evaluations and calculations for this Plan. As noted in Chapter 8, the 16-port configuration was recommended based on WWTP hydraulics and modifications to implement this configuration were completed in 2010.

LIQUID STREAM IMPROVEMENTS

Each major process unit in the WRF is evaluated in Chapter 8 for its ability to adequately treat 10-year (2015) and 20-year (2025) projected flows and loadings based on industry-standard design criteria. The capacity of the mechanical fine screening, activated sludge process aeration, secondary clarifier, and UV disinfection systems are found to be inadequate for the 20-year flows and loadings. Thus, additional capacity is recommended for these process units. A second mechanical fine screen, third secondary clarifier, a fourth aeration blower with upgraded blower control system, and a fourth UV disinfection system bank of lights should be installed. Additionally, modifications to the aeration basins, including the anoxic selectors and the baffle walls between the anoxic and aerobic zones, are recommended to improve SVI control, reduce back-mixing between the zones, and increase removal of TSS, BOD, and ammonia. Due to concerns about possible industrial discharge of inhibitory substances, it is recommended that development of local limits and implementation of a pretreatment program be considered. Also, software to track WWTF maintenance is recommended.

Tables ES-4 and ES-5, respectively, provide WWTF capital improvement costs for Phase 2A (under construction from 2010 to 2012) and Phase 2B (construction expected to begin in 2012). Costs include engineering, construction management, sales tax, and contingency.

TABLE ES-4

Cost Estimates for Phase 2A WWTF Upgrades to Accommodate 2025 Flows and Loadings
(Solids and Septage Handling Improvements Not Included; See Table ES-6)

No.	Item	Quantity	Unit Price	Amount
1	Mobilization/Demobilization	1 LS	$250,000	$ 250,000
2	Mechanical Fine Screen	1 LS	$125,000	$ 125,000
3	Blower (#4)	1 LS	$60,000	$ 60,000
4	Demolish Existing Aerobic Digester No. 1	1 LS	$40,000	$ 40,000
5	AB Modifications (Selectors and Divider Walls)	1 LS	$40,000	$ 40,000
6	Internal Recycle Pump Enclosure	1 LS	$15,000	$ 15,000
7	Additional Bank of Lamps for UV Disinfection	1 LS	$45,000	$ 45,000
8	Dissolved Oxygen and Ammonia Monitors	1 LS	$65,000	$ 65,000
9	Computer, PLC and SCADA Upgrades	1 LS	$55,000	$ 55,000
10	Security Upgrades	1 LS	$10,000	$ 10,000
11	Loading Dock	1 LS	$35,000	$ 35,000
12	WWTF Outfall Modifications	1 LS	$40,000	$ 40,000
13	Pretreatment Management Software	1 LS	$12,000	$ 12,000
14	Mobilization/Demobilization	1 LS	$250,000	$ 250,000

Subtotal ....$ 792,000
Construction Contingency (20%) ....$ 158,400
Subtotal ....$ 950,000
Washington State Sales Tax (7.9%) ....$ 76,000
Total Estimated Construction Cost $1,025,000
Engineering, Administrative & Legal Services (20%) ....$ 205,000
Total Estimated Project Cost...$1,230,000

TABLE ES-5

Cost Estimates for Phase 2B WWTF Upgrades to Accommodate 2025 Flows and Loadings

(Solids and Septage Handling Improvements Not Included; See Table ES-6.)

No.	Item	Quantity	Unit Price	Amount
1	Mobilization/Demobilization	1 LS	$160,000	$ 160,000
2	Secondary Clarifier No. 3	1 LS	$1,050,000	$1,050,000
3	Effluent Filter	1 LS	$750,000	$ 750,000

Subtotal $1,960,000
Construction Contingency (20%) .... $ 392,000
Subtotal $2,352,000
Washington State Sales Tax (7.9%) .... $ 185,800
Total Estimated Construction Cost $2,537,800
Engineering, Administrative & Legal Services (20%) .... $ 270,500
Total Estimated Project Cost $2,808,000

SOLIDS TREATMENT IMPROVEMENTS

An evaluation of solids treatment capacity is provided in Chapter 9. Current solids treatment by aerobic digestion produces Class B biosolids that are dewatered and hauled to land application sites by contract. Due to the age of, and lack of capacity in, the aerobic digesters, and the City's desire to produce Class A biosolids, it is recommended that the City construct new anaerobic digesters and a sludge drying system that together will produce Class A biosolids that can be used within the community for landscaping.

Class B biosolids pose a greater risk to public health and safety than Class A biosolids. When biosolids meet the Class A standard, they are subject to fewer restrictions for land application as long as they also meet the lower (WAC 173-308) Table 3 pollutant concentration thresholds and vector attraction reduction standards. After construction of this project, the Camas WWTF will produce biosolids that meet the lower pollutant threshold limits, Class A pathogen reduction requirements, and vector attraction reduction requirements, which will allow the biosolids to be eligible for relatively unrestricted application. Biosolids in this category are referred to as "Exceptional Quality" (EQ). EQ biosolids can be containerized and sold or given away in quantities up to 1 metric ton. Class A biosolids require a higher level of treatment than Class B biosolids; however, Class A biosolids have a lower level of risk to environmental and public health.

Application of Class A biosolids to areas within the local community for landscape purposes provides inherent value to the region's natural resources and green spaces. The sludge dryer will produce a 90 percent solid, pelletized product that is much easier and safer to handle, transport, and apply. The sludge dryer will reduce biosolids volumes to approximately 25 percent of existing volumes. In 2005, the City applied approximately 820 tons of Class B biosolids. In 2008, once the sludge dryer is brought online the City will produce approximately 180 tons of Class A biosolids (includes a 7.2 percent annual growth increase).

The conversion from aerobic digestion to anaerobic digestion provides a reduction in power demands decreasing the environmental impact of the sludge digestion process. The existing aerobic digesters utilize five 25-horsepower surface aerators, originally purchased in 1972, operating 24 hours a day 7 days a week. The surface aerators will no longer be in operation when the City switches to anaerobic digestion. Anaerobic digestion produces methane gas which will be used as an energy source for heating the reactor; the net energy consumption for anaerobic digestion is less than for aerobic digestion. Power costs will decrease by approximately 10 percent. Additionally, the conversion from aerobic digestion to anaerobic digestion will eliminate the generation of aerosols associated with the digestion process.

SEPTAGE STORAGE TANK

To provide adequate treatment of septage collected from the community and delivered to the WWTF, the City will construct a septage storage tank including cover, aeration system, and venting to the odor control system. The implementation uses an existing tank (500,000 gallons), reducing the environmental impact of construction, and increasing the reliability for the STEP systems. Septage loads occasionally contain toxins that could upset the biological processes in the plant; a properly sized sludge storage basin will allow for slow metering of septage into the plant to avoid upsets. A letter dated August 12, 2005, from the Department of Ecology recommends, “that the odor control features needed with such digesters should also be extended to a transfer and holding tank area where septic tank contents can be delivered at the POTW.” The new septage storage tank will include a cover, aeration system, and odor control system, and therefore, will directly eliminate the concerns of the Department of Ecology indicated in the letter dated August 12, 2005. Furthermore, the odor control biofilter system will be expanded.

TABLE ES-6

Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce a Class A Biosolid Preliminary Project Cost Estimate (2007 Dollars)

No.	Item	Quantity	Unit Price	Amount
1.	Mobilization/Demobilization	1 LS	$720,000	$ 720,000
2.	Demolition	1 LS	$40,000	$ 40,000
3.	Anaerobic Digester/Dig. Building	1 LS	$750,000	$ 750,000
4.	Digester Sludge Heating System	1 LS	$231,000	$ 231,000
5.	Digester Gas Equipment	1 LS	$152,000	$ 152,000
6.	Digester Covers	1 LS	$650,000	$ 650,000
7.	Digester Mixing System	1 LS	$300,000	$ 300,000
8.	Digester Recirculation Pumps	1 LS	$79,000	$ 79,000
9.	WAS/Septage/Centrate Tank	1 LS	$280,000	$ 280,000
10.	WAS Thickening System	1 LS	$237,000	$ 237,000
11.	Digested Sludge Pumps	1 LS	$40,000	$ 40,000
12.	Plant Drain Pump Station No. 2	1 LS	$70,000	$ 70,000
13.	Sludge Storage Building Modifications	1 LS	$185,000	$ 185,000
14.	Sludge Dryer System	1 LS	$2,300,000	$ 2,300,000
15.	Odor Control Filter and Equipment	1 LS	$252,000	$ 252,000
16.	Dewatering	1 LS	$75,000	$ 75,000
17.	Earthwork	1 LS	$100,000	$ 100,000
18.	Miscellaneous Metals	1 LS	$80,000	$ 80,000
19.	Painting	1 LS	$150,000	$ 150,000
20.	Site Work	1 LS	$120,000	$ 120,000
21.	Mechanical/Yard Piping	1 LS	$275,000	$ 275,000
22.	Electrical	1 LS	$520,000	$ 520,000

Subtotal .... $ 7,606,000
Construction Contingency (20%) .... $ 1,521,000
Subtotal .... $ 9,127,000
Washington State Sales Tax (7.9%) .... $ 721,000
Total Estimated Construction Cost.. $ 9,848,000
Engineering, Administrative, and Legal Services (20%) .... $ 1,969,000
TOTAL ESTIMATED PROJECT COST.. $11,817,000

As noted in Chapter 9, it is also recommended that a digester gas treatment system using iron sponge technology be installed. The estimated total project cost for engineering, permitting, and construction of the digester gas treatment system is $500,000. When these estimated capital costs are added to the cost for the selected biosolids alternative (Alternative 1B, Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids), the total capital cost estimate is $12,317,000. The installation of this digester gas treatment system is planned to be completed during Phase 2B construction in 2012.

EVALUATION OF REUSE

Chapter 10 presents an evaluation of the feasibility of either reusing effluent from the City of Camas WWTF modified to generate reuse quality water (Alternative No. 1) or constructing a new water reclamation facility (WRF) at the north end of Lacamas Lake near Camp Currie to treat wastewater and produce water for reuse (Alternative No. 2). The chapter includes a detailed description of regulatory requirements and design criteria for various reuse alternatives. Possibilities considered include reuse by major industries, irrigation, stream flow augmentation, and wetlands banking for mitigation.

Table ES-7 summarizes costs for the two major alternatives evaluated for water reclamation and reuse in the City of Camas. Production of reclaimed water is considered economically feasible if the cost of producing reclaimed water is less than or equal to the cost of purchasing water or developing additional water rights. The cost to develop and acquire the additional water rights from the four pending applications will not exceed a conservative estimate of $5 million. At this time, production of reclaimed water is not economically feasible since adequate water rights are available at a relatively low cost, and the cost to produce reclaimed water is significantly more expensive than the cost to develop and acquire additional water rights.

TABLE ES-7

Comparison Of Water Reclamation Alternatives[1]

	Alternative No. 1 Modify Existing WWTF	Alternative No. 2 Construct a Satellite WRF
Peak Hour Reuse Water Production	6.1 mgd	4.4 mgd
Capital Cost	$9,388,000	$23,900,000
Annual O&M Cost	$90,000	$252,000
20-year Present Worth	$11,806,000	$30,600,000

(1) Inflation assumed at 3 percent. 2006 dollars.

FINANCIAL ANALYSIS

Chapter 11 presents an analysis of funding strategies for the City of Camas to finance recommended wastewater system capital improvements presented in the previous chapters. The financial status of the sewer utility, funding sources, and recommended funding programs to pay for the scheduled improvements are discussed.

Residential, commercial, and industrial customers pay a monthly service charge and a volume charge. Customers outside the city pay 150 percent of the inside-city rate. The City imposes a sewer system development charge (SDC) for all new connections to the sewer system to finance improvements of general benefit to the wastewater system that are required to service future growth.

CHAPTER 1

INTRODUCTION

GENERAL

This *General Sewer/Wastewater Facilities Plan* (2006 Plan) for the City of Camas addresses the City's planning needs for wastewater collection, transmission, treatment, and disposal for the 20-year planning period. This Plan was prepared in accordance with the provisions of the Revised Code of Washington (RCW), Section 90.48, *Water Pollution Control*, Washington Administrative Code (WAC) Section 173-240-050, *General Sewer Plan*, and WAC 173-240-060, *Engineering Report.* Development of the Plan has been coordinated with the City's 2004 *Comprehensive Plan*, Clark County planning efforts, and with the City's 2001 *Water System Comprehensive Plan*.

The 2006 Plan provides proposed conceptual designs, cost estimates, schedule, and financing plan for recommended major facility improvements. A State Environmental Policy Act (SEPA) checklist is provided in Appendix A. The projects described in the 2006 Plan are consistent with Washington State regulations relating to the prevention and control of discharge of pollutants into waters of the state, anti-degradation of existing and future beneficial uses of ground waters, and anti-degradation of surface waters.

The City of Camas is located within Clark County in southwest Washington State as shown in Figure 1-1.

SCOPE OF WORK

Since the 2006 Plan is intended to be both a General Sewer Plan and a Wastewater Facilities Plan, the 2006 Plan evaluates both the wastewater collection system and the wastewater treatment system in detail. This evaluation includes collection and treatment system modeling, analysis and a capital improvement plan with cost analysis and schedule. The scope of work for the 2006 Plan includes the following items:

- Background data
- Service area characteristics
- Population and land use
- Regulatory criteria
- Projected future flow and loadings to the Wastewater Treatment Facility (WWTF)
- Pertinent performance and design criteria for system facilities
- Evaluation of the WWTF

- Computer model and evaluation of wastewater collection system
- Evaluation of water reuse alternatives
- Identification of system improvements with cost estimates
- Financing plan for capital improvement plan
- Environmental analysis

RELATED PLANNING DOCUMENTS

The following documents were consulted in the preparation of this Wastewater Comprehensive Plan:

GROWTH MANAGEMENT ACT (GMA) RELATED PLANS, POLICIES AND DEVELOPMENT REGULATIONS

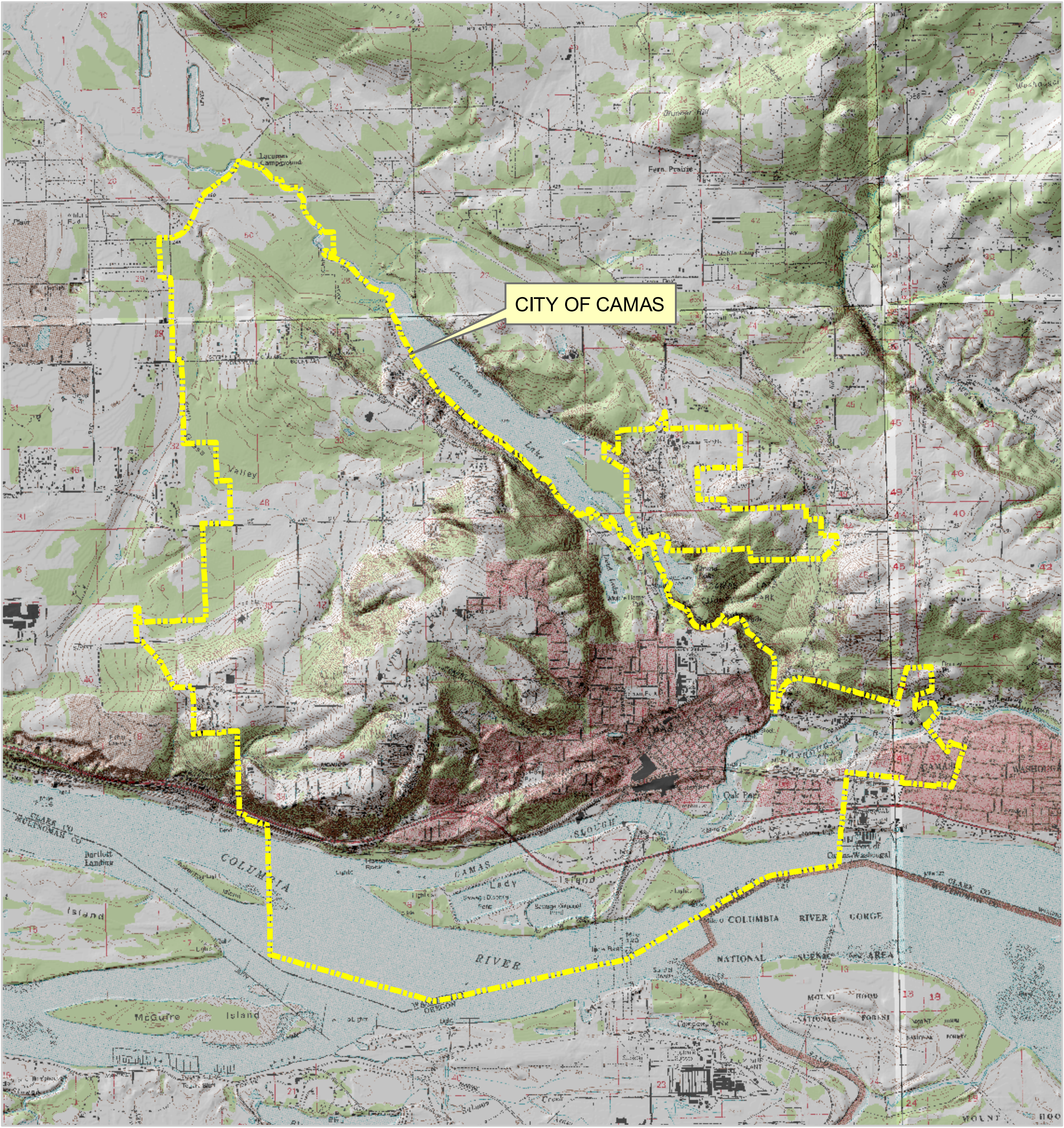
City of Camas Comprehensive Plan, City of Camas, March 2004.

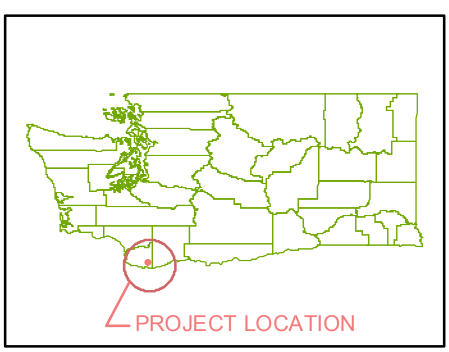
The City of Camas Comprehensive Plan, which was prepared by City of Camas staff and a consultant team, was originally adopted in 1994 and subsequently updated in March 2004. This document was developed to comply with the Growth Management Act (GMA), and is consistent with the planning policies of Clark County. The Comprehensive Plan addresses land use, transportation, housing, parks, recreation and open space, cultural and historic resources, environmental resources, economic development, capital facilities and utilities, and an implementation element. The Comprehensive Plan for the City of Camas provides:

- Policies and recommendations to direct public and private decisions affecting future growth and development,
- A framework of goals and policies adaptable to the changing attitudes and resources of the region,
- A long-range vision, based on community values and goals, of how citizens want Camas to look and function in the future as well as guidance for achieving that vision, and
- Guidelines for making decisions on growth, land use, transportation, public facilities, and services, parks, and open space.

In January 2007, the City adopted a Sensitive Lands Ordinance.

The March 2004 Comprehensive Plan used an annual growth rate of 2 percent for the City for 20-year growth projections. Per discussion with City staff, this growth rate is considered too low (since the City has averaged 7 percent growth) and discussions with the County are ongoing to increase the projected growth rate, as well as to set the city's future Urban Growth Boundary. As discussed in Chapter 3, more realistic growth rates have been used for projecting future wastewater flows and loadings.





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CITY OF CAMAS

GENERAL SEWER/WASTEWATER
FACILITY PLAN
FIGURE 1-1
VICINITY MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Clark County Comprehensive Plan, September 2004.

Clark County's first Comprehensive Plan under the GMA was adopted in 1994. An update to this plan was formally adopted by ordinance in September 2004. This document details 12 planning elements necessary for the proper management of growth that are consistent with the requirements. These 12 elements include: land use, housing, rural and natural resources, environmental, transportation, capital facilities and utilities, parks and open space, historic preservation, economic development, community design, annexation, and procedures for planning. In addition to a discussion of each element, the comprehensive plan includes a Community Framework Plan, which provides guidelines and policies for cities within the County in developing their Comprehensive Plans.

WASTEWATER SYSTEM PLANNING

City of Camas Wastewater Facilities Plan, Part 1, March 1977/Part 2, December 1979, CH2M Hill.

This Plan included evaluation of alternatives for providing sewer service to the areas to the north and west of downtown (Ostenson Canyon, Forest Home, Northeast Prune Hill, and the area to the south of Lacamas Lake).

In this report, an I/I study estimated that a peak of 4.7 mgd of I/I - an amount determined to be "excessive" by EPA's definition - was entering into the Camas system.

Recommended system improvements to reduce I/I included:

- routing stormwater away from sewer pipe in Basin 4 with a trench drain,
- repairing and replacing broken pipe and damaged manholes,
- plugging inactive and faulty service connections, and
- disconnecting roof and fountain drains and catch basins.

According to subsequent reports by CH2M Hill, all recommended improvements were made except the replacement of faulty service connections, which was determined to be too great a financial burden on property owners.

Two new sewer lines were built after the Part One of this report was issued. Sewers were extended north of the then city limits along Fargo Street (Basin 3 North), and additional sewers were constructed in West Camas in Basin 10.

City of Camas Sewerage Facilities Plan, March 1987, Parametrix, Inc.

This report focused on the plan for construction of STEP systems for the Lacamas Heights area (Basin 15) and other areas to the west of downtown Camas. The authors found that the average dry weather flows at this time were 0.37 mgd.

City of Camas Evaluation of Sewer System Alternatives, April 1993, CH2M Hill.

This report provided an evaluation of the City's existing septic tank effluent (STE) systems, and considered alternatives to provide sewer service to the unsewered areas within the Urban Growth Boundary (UGB) and projected future UGB, including areas of current West Camas and north of Lacamas Lake. The report recommended the City implement a combined STE conventional gravity approach to providing sewer service to the study area.

City of Camas Wastewater Facilities Plan, October 1994, CH2M Hill.

This plan included a series of technical memoranda evaluating potential treatment plant improvements, sludge disposal options, and outfall improvements. The report recommended immediate construction of a secondary clarifier, future improvements to the headworks and aeration basins, and phased construction of aerobic sludge digestion or lime stabilization facilities.

City of Camas Wastewater Facility Plan, June 1997, Gray & Osborne.

The *City of Camas Wastewater Facility Plan* (1997 Plan) discusses the conditions of the existing WWTP and expansions needed to serve the projected population growth throughout the 15-year planning period, 2000-2015.

The proposed process scheme for the expanded City of Camas Wastewater Treatment Plant was that of a secondary activated sludge plant with Phase I solids treatment by aerobic digestion. At the time, Phase II solids treatment facilities were proposed to be anaerobic sludge digesters, to be constructed by 2010. The secondary activated sludge process with solids treatment by aerobic digestion, along with new headworks, clarifiers, sludge dewatering and ultraviolet disinfection, was completed and came on line in 2002.

Alternatives for Phase II solids treatment will be further reviewed in this 2006 Plan.

City of Camas Sewer System Infiltration and Inflow Study, Gray & Osborne Inc., August 1998

The *City of Camas Sewer System Infiltration and Inflow Study* evaluated the City's wastewater collection system and recommended improvements to reduce excessive infiltration and inflow (I/I). The study achieved the following objectives:

- Quantified the amount of I/I entering the sewer system,
- Determined the sources of I/I entering the system,
- Evaluated the technical feasibility and cost-effectiveness of potential sewer system rehabilitation projects to remove excessive I/I,

- Evaluated the technical feasibility and cost-effectiveness of potential wastewater treatment plant improvement projects to treat excessive I/I, and
- Provided a prioritized list of sewer system rehabilitation and treatment plant improvements, including estimated costs.

WATER SYSTEM COMPREHENSIVE PLANS

<u>*City of Camas Water System Comprehensive Plan*,</u> Gray & Osborne, Inc., February 2002

The *City of Camas Water System Comprehensive Plan* discusses the existing water system facilities, water usage and design criteria, conservation programs, system expansion, and water system improvements. The recommended system improvements include replacement of aging and undersized water mains, improvements to the City's maintenance and operations facilities, replacement of collapsed wells, and new source development and water right acquisition. The plan also highlights conservation measures to be implemented, these include:

- Distribution of water conservation devices,
- Water audits,
- Central control of irrigation systems,
- A leak detection study for the distribution system and Butler Reservoir.

WATERSHED PLANNING

<u>*Lewis/Salmon-Washougal Watershed Plan*</u>, Washington Department of Ecology and Lower Columbia Fish Recovery Board, approved by Planning Unit December 2004.

The City of Camas is a participating member in the planning unit of the Lewis, Salmon & Washougal Watershed Plan (WRIAs 27/28). The following table includes a list of all entities that participate in this planning unit. The Lewis/Salmon-Washougal Watershed Plan was unanimously adopted by the planning unit on December 13, 2004. The Plan addresses issues such as water supply, water quality, instream flows, and habitat protection. The Washington State Department of Ecology, Watershed Planning, website (as of May 2005) included the following list of findings from the Plan:

- *Most communities, with the exception of Kalama and Woodland, rely on groundwater sources for public drinking water supplies.*
- *Major public water system managers anticipate significant population growth, with groundwater the most feasible source of new water. The primary issue for these water systems is acquisition of new water rights.*
- *Water system plans may not address projected growth in water demand in the commercial and industrial sector. Small public water systems are not projected to grow much in the future.*

- *Water use in the agricultural sector is not well documented. Agriculture water use is likely declining in the region.*
- *Stream in two WRIAs are low elevation rain-fed systems with very low late summer and early fall flows.*
- *Using reclaimed water from municipal and industrial supply is not practical now but may be in the future.*
- *Low Stream flow has been identified as a limiting factor for salmon throughout the two WRIA areas.*

TABLE 1-1

Lewis, Salmon and Washougal Watershed Plan

Planning Unit Representation[(1)]	
Clark County	Port of Kalama
Cowlitz County	Clark Skamania Fly Fishers
Skamania County	Woodland Diking District
City of Camas	Weyerhauser
City of Battle Ground	Clark EDC
City of Kalama	Fish First
Cit of La Center	C-W Fish and Wildlife League
City of Washougal	Citizen-at-Large
City of Ridgefield	USFS
City of Vancouver	Responsible Growth Forum
City of Woodland	Cowlitz PUD
City of Yacolt	Department of Ecology
Cowlitz Tribe	Department of Fish & Wildlife
Clark County PUD	Department of Natural Resources
	Department of Agriculture

(1) Washington State Department of Ecology, Watershed Planning, website (May 2005)

STORMWATER COMPREHENSIVE PLANS

Stormwater Management Manual for the Puget Sound Basin, Washington Department of Ecology, 1992 (Puget Sound Manual).

Stormwater Management Manual for Western Washington, Volume II, Washington Department of Ecology, August 2001 (2001 Western Washington Manual).

The City has adopted the Ecology stormwater management manuals listed above. The Puget Sound Manual is used for the design of new stormwater facilities to detain stormwater runoff, and the Best Management Practices (BMPs) from the 2001 Western Washington Manual are used to avoid environmental impacts during construction. Such erosion prevention and sediment control measures include construction entrances, temporary sediment ponds, filter fences and interceptor trenches. In terms of detention, the 2005 manual results in large detention facilities that are difficult to incorporate into areas intended for development and redevelopment. However, as a result of the February 2007 issuance of the NPDES Phase II Stormwater Permit, the City will need to adopt all minimum requirements (including detention) from the 2005 Manual, or equivalent measures.

The 2005 Western Washington Manual can be downloaded from Ecology's website or a hard copy can be ordered. The 2005 manual was updated to "correct errors, clarify statements, update design criteria and procedures, and apply recent research" (www.ecy.wa.gov/programs/wq/stormwater).

The City also controls stormwater through National Pollutant Discharge Elimination (NPDES) permits and its municipal code as described below:

- NPDES and Waste Discharge Permits are issued for construction activities equal to or greater than one acre.
- As of February 17, 2007, NPDES Phase II permits cover separate municipal storm sewer systems. (The permit is currently in place, although it is being legally contested by numerous Washington cities.)
- The City of Camas Erosion Control Plan, Municipal Code, Title 15.32, sets out sediment and erosion control requirements for construction projects and small parcels.

Due to significant changes in wetland protection policies, the City updated the 1991 Plan with the production of the 1998 Comprehensive Flood and Drainage Management Plan (1998 Plan). The newer wetland policies limited the ability of the City to use existing wetlands for stormwater drainage, which was a major approach of the 1991 Plan. The City of Camas is an area that has developed as an urban area and experiences typical problems associated with increased development versus stormwater management.

CHAPTER 2

SEWER STUDY AREA

The City of Camas is located in southeastern Clark County, approximately 12 miles east of Vancouver at the confluence of the Columbia and Washougal Rivers. The City is bordered by the Columbia River to the south, the City of Washougal and Woodburn Hill to the east, the City of Vancouver and Grass Valley to the west, and Lake Lacamas and Lacamas Park to the north.

The City is comprised of approximately 7,400 acres and 15,400 residents. The City has a number of light industrial and technical businesses that provide a large percentage of the total employment within the City. Most notable are WaferTech, a semiconductor and chip manufacturer; Georgia Pacific, that operates a large mill within the City; and Underwriters Laboratories.

SEWER SERVICE AREAS

CITY OF CAMAS

The City of Camas current sewer service area includes approximately 7,700 acres within its corporate boundaries and its Urban Growth Boundary (UGB) as shown on Figure 2-1. The collection system consists of a mixture of conventional gravity sewer systems and septic tank effluent (STE) systems. The sewage collection system consists of over 80 miles of mains and laterals that serve three drainage basins:

1. The Fisher basin extends from Fisher Swale on the west, to Lacamas/Round Lake on the east and north, and Prune Hill in the south. Sewer service within this basin is provided by means of STE systems, gravity mains, and pumping facilities.

2. The second basin includes the central business district and the area extending northwest up to the summit of Prune Hill and along its south border. This basin is primarily served with a conventional gravity sewer.

3. A third basin includes the area west of downtown along the Columbia River which includes a combination of conventional gravity sewers, STE systems, and pump stations.

ADJACENT SEWER SERVICE AREAS

Clark County

Clark County operates and maintains the Salmon Creek Wastewater Treatment Plant and the Clark Regional Wastewater District maintains the sewer collection system that primarily serves the unincorporated area of Hazel Dell. The treatment plant receives 85 percent of influent flow from Hazel Dell and less than 100,000 gallons per day (gpd) from the City of Battleground and the community of Hockinson. The Salmon Creek WWTP is an activated sludge plant rated for 10.3 mgd maximum month flow, with aeration basins, secondary clarifiers ultraviolet disinfection and an outfall in the Columbia River. At the Salmon Creek WWTP, sludge is thickened, blended, digested anaerobically, dewatered and the biosolids are stored, hauled away, and land applied.

The City of Vancouver provides sewer service to county residents adjacent to its corporate boundaries. The rest of the County is served by individual septic systems.

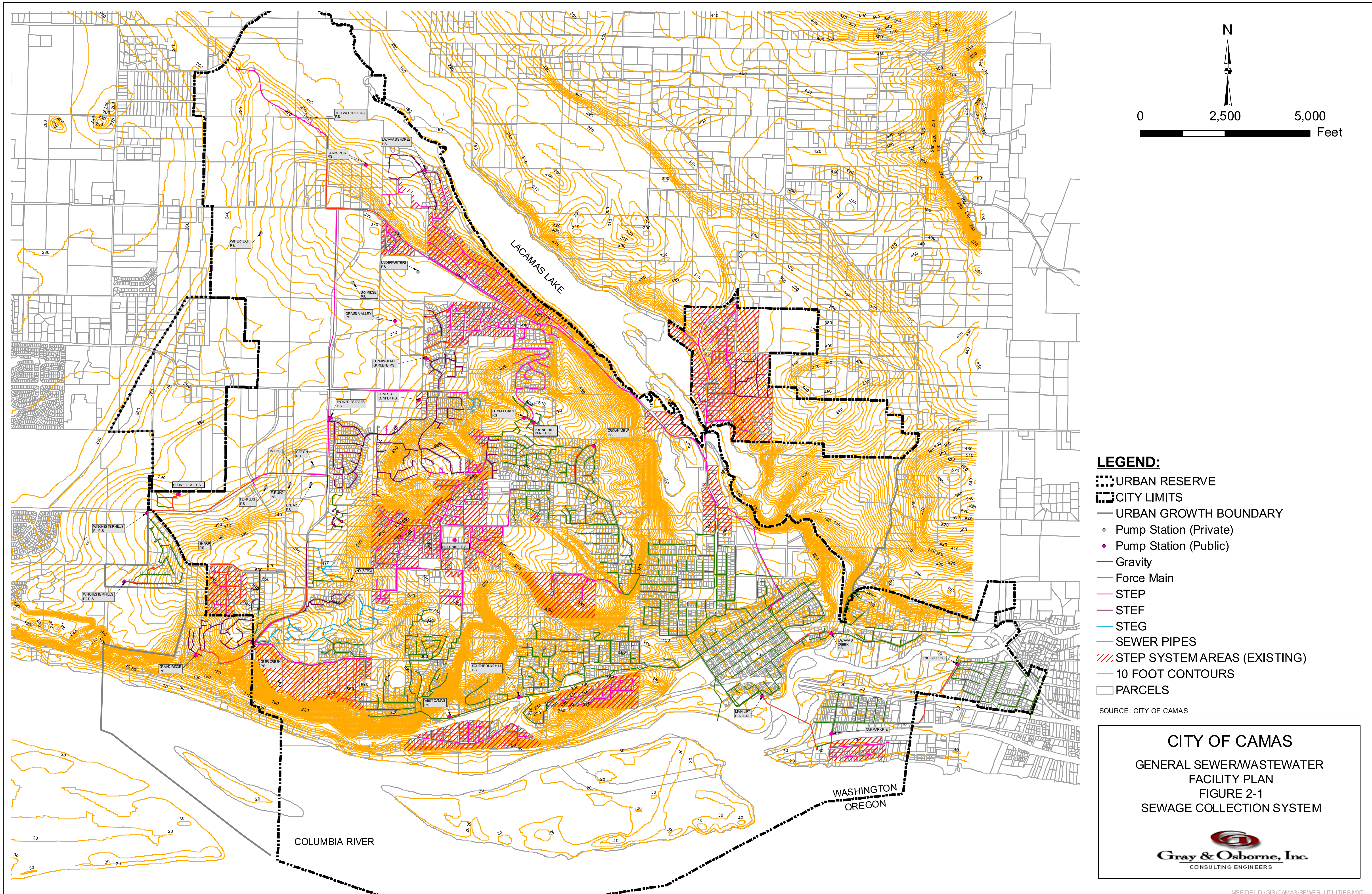
City of Vancouver

The City of Vancouver and its sewer service area abuts the Camas UGB from the Columbia River to the north end of the Camas UGB. Vancouver's sewer service area population was 46,000 in 2003. Vancouver's sewage collection system includes about 650 miles of wastewater pipes and 29 pumping stations with developers adding 15 to 20 miles of new pipe each year. The City's collection system is divided into three sections: the Westside Basin, Eastside Basin, and Diversion Basin. All flows from the Eastside basin are treated at the Marine Park Facility. The flows from the Diversion Basin may be divided between the Marine Park facility and Westside Treatment Facility which also serves the City of Vancouver.

The Marine Park Facility and Westside Treatment Facility are activated sludge plants with six aeration basins each, secondary clarifiers (four for Marine Park and five for Westside), ultraviolet disinfection and outfalls in the Columbia River. Scum and solids removed from both the primary and secondary clarifiers at both WWTPs are incinerated in a fluidized bed furnace at the Westside WWTP; the solids from the Marine Park WWTP are pumped through a force main, and then conveyed through a gravity sewer, to the Westside WWTP. The maximum month rated capacities for the two plants are 16.1 mgd for the Marine Park Facility and 28.26 mgd for the Westside Treatment Facility.

City of Washougal

The City of Washougal is directly east of Camas and adjoins the Camas Urban Growth Boundary (UGB) from the Columbia River up to the base of Lacamas Park. Washougal's collection system includes six duplex sewage pumping stations and approximately 8,000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LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
LEGEND:
URBAN RESERVE
CITY LIMITS
URBAN GROWTH BOUNDARY
Pump Station (Private)
Pump Station (Public)
Gravity
Force Main
STEP
STEF
STEG
SEWER PIPES
STEP SYSTEM AREAS (EXISTING)
10 FOOT CONTOURS
PARCELS
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
FIGURE 2-1
SEWAGE COLLECTION SYSTEM
Gray & Osborne, Inc.
CONSULTING ENGINEERS

feet of force mains. Washougal's WWTP consists of an extended aeration activated sludge system with an oxidation ditch, secondary clarifier, disinfection by chlorination and an outfall in the Columbia River. A lagoon basin is used as storage for peak influent flows, while three other lagoons are used for sludge storage. The facility was designed for a maximum month capacity of 2.24 mgd.

NATURAL ENVIRONMENT

TOPOGRAPHY

Camas is located on terrain characterized by steep slopes, with a flat plateau centered in the core of the City. Approximately 1,237 acres within the city are classified as steep and unstable slopes. The downtown and older parts of the city are located on flat ground and are almost at the level of the Columbia River. These areas are surrounded on three sides by Prune Hill and other steep slopes, with the Columbia River forming the southern boundary. Residential areas to the north and west of downtown are built on slopes ranging from 5 to15 percent. The elevation within the city ranges from 20 feet above sea level to 752 feet at the Upper Prune Hill Standpipe located at the top of Prune Hill.

Figure 2-2 is a USGS topographic map showing the varying elevations within the City's sewer service area.

SOILS AND GEOLOGY

Camas is located within the alluvial fan of the Columbia River and associated deposits. The majority of the soils within the City are classified as Hillsboro-Dollar-Cove Association by the SCS. This soil class is defined as deep, dominantly level to sloping, well-drained to very poorly drained, medium textured terrace soil. The area near Lacamas Lake, and portions of land that fall within the City's service area are classified as Hesson Olympic Association. This soil class is deep, nearly level to steep, moderately fine textured soils. A more detailed definition of the types and locations of the soil classifications within the Wastewater Service Area is presented in Figure 2-3, based on an NRCS Soil Survey of Clark County, Washington.

CLIMATE

Major weather stations in the vicinity of Camas are located in Vancouver and Skamania. The City of Camas is located approximately 12 miles east of Vancouver and 20 miles west of Skamania. Table 2-1 and 2-2 provide precipitation data for both weather stations.

TABLE 2-1

Vancouver Station Precipitation 1995-2004

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1995	7.69	3.41	4.25	4.19	1.98	2.05	1.32	0.00	1.98	4.62	10.68	6.63	48.80
1996	7.44	10.58	2.85	5.40	4.65	0.94	0.70	0.23	2.79	6.17	9.42	13.26	64.43
1997	9.27	2.55	6.88	3.62	2.00	3.07	0.65	1.77	3.00	7.37	5.11	4.72	50.01
1998	7.46	5.72	4.69	1.01	6.18	1.37	0.40	0.00	1.27	3.92	11.15	7.06	50.23
1999	7.74	8.91	4.67	1.79	2.22	2.44	0.15	0.79	0.14	2.50	7.51	4.93	43.79
2000	6.38	5.62	3.53	1.79	3.07	1.01	0.21	0.35	0.54	3.76	2.99	2.17	31.42
2001	2.07	1.62	3.21	2.55	1.34	2.72	0.76	0.90	1.54	3.50	7.72	7.75	35.68
2002	7.20	3.65	4.15	2.46	2.39	1.36	0.44	0.21	1.23	0.68	2.45	10.41	36.63
2003	8.36	3.35	5.90	6.64	1.77	0.03	0.00	0.10	1.24	2.77	4.37	8.57	43.10
2004	4.59	4.61	2.22	2.21	1.68	1.21	0.02	2.58	1.53	4.07	2.78	3.78	31.28
Ave	6.82	5.00	4.24	3.17	2.73	1.62	0.47	0.69	1.53	3.94	6.42	6.93	43.54
Min	2.07	1.62	2.22	1.01	1.34	0.03	0.00	0.00	0.14	0.68	2.45	2.17	31.28
Max	9.27	10.58	6.88	6.64	6.18	3.07	1.32	1.77	3.00	6.17	11.15	13.26	64.43

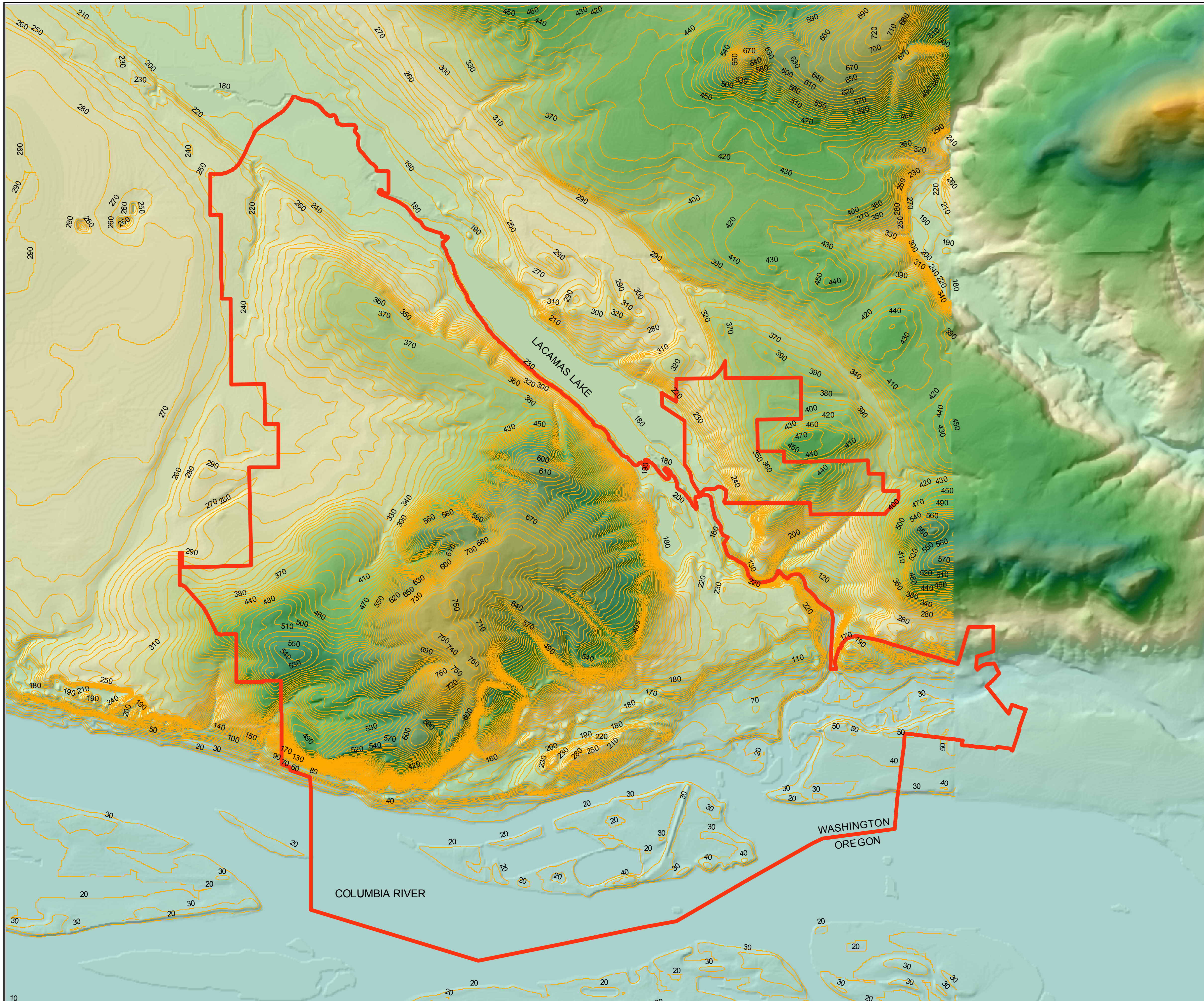
SOURCE: NOAA, National Virtual Data System, Vancouver station (144).

TABLE 2-2

Skamania Fish Hatchery Precipitation 1995-2004

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1995	12.27	10.51	6.59	6.97	3.39	5.39	1.77	0.00	5.61	9.66	23.55	12.01	97.72
1996	13.49	16.50	5.87	9.43	7.36	2.61	0.57	0.42	5.14	13.78	17.00	20.83	113.00
1997	14.62	5.89	15.40	10.62	3.30	4.51	2.62	2.19	5.27	13.60	7.72	8.31	94.05
1998	12.19	10.13	10.76	3.83	9.38	3.98	0.23	0.16	2.96	5.46	14.47	18.34	91.89
1999	12.01	14.43	8.18	2.44	8.30	5.12	1.68	2.00	0.44	4.94	17.21	14.30	91.05
2000	10.02	14.32	5.64	4.84	7.72	3.16	0.32	0.18	3.44	6.98	5.58	6.05	68.25
2001	4.71	3.41	8.14	7.08	4.40	5.58	1.10	2.03	1.48	7.85	11.77	14.32	71.87
2002	12.18	8.49	8.50	6.81	2.41	4.04	0.20	0.24	1.69	2.07	5.10	13.12	64.85
2003	11.92	7.20	15.03	8.33	3.89	0.42	0.16	0.06	3.68	5.87	9.66	13.45	79.67
2004	14.09	8.49	4.72	2.75	6.53	3.36	0.05	7.15	5.22	8.36	12.02	13.76	86.50
Ave	11.75	9.94	8.88	6.31	5.67	3.82	0.87	1.44	3.49	7.86	12.41	13.45	85.88
Min	4.71	3.41	4.72	2.44	2.41	0.04	0.16	0.06	0.44	2.07	5.10	6.05	64.85
Max	14.09	10.51	15.40	10.62	9.38	5.39	1.77	7.15	5.61	13.78	23.55	20.83	113.00

SOURCE: NOAA, National Virtual Data System, Skamania Fish Hatchery station (130).



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SCALE 1" = 3000'

LEGEND:

- CITY LIMITS
- 10 FOOT CONTOURS

CITY OF CAMAS

GENERAL SEWER/WASTEWATER FACILITY PLAN
TOPOGRAPHY MAP
FIGURE 2-2

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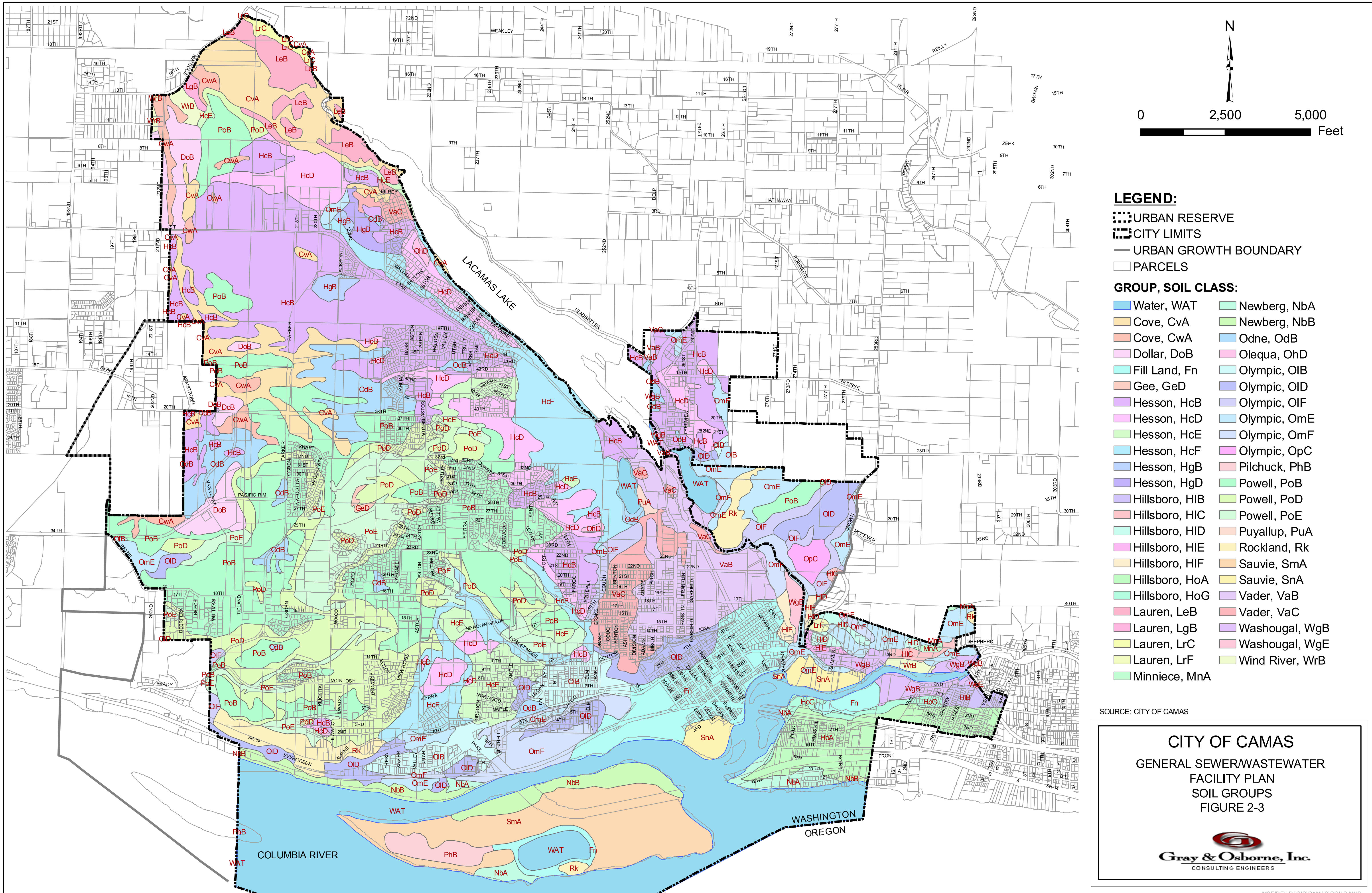
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LEGEND:
URBAN RESERVE
CITY LIMITS
URBAN GROWTH BOUNDARY
PARCELS
GROUP, SOIL CLASS:
Water, WAT
Cove, CvA
Cove, CwA
Dollar, DoB
Fill Land, Fn
Gee, GeD
Hesson, HcB
Hesson, HcD
Hesson, HcE
Hesson, HcF
Hesson, HgB
Hesson, HgD
Hillsboro, HIB
Hillsboro, HIC
Hillsboro, HID
Hillsboro, HIE
Hillsboro, HIF
Hillsboro, HoA
Hillsboro, HoG
Lauren, LeB
Lauren, LgB
Lauren, LrC
Lauren, LrF
Minniece, MnA
Newberg, NbA
Newberg, NbB
Odne, OdB
Olequa, OhD
Olympic, OIB
Olympic, OID
Olympic, OIF
Olympic, OmE
Olympic, OmF
Olympic, OpC
Pilchuck, PhB
Powell, PoB
Powell, PoD
Powell, PoE
Puyallup, PuA
Rockland, Rk
Sauvie, SmA
Sauvie, SnA
Vader, VaB
Vader, VaC
Washougal, WgB
Washougal, WgE
Wind River, WrB
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
SOIL GROUPS
FIGURE 2-3
Gray & Osborne, Inc.
CONSULTING ENGINEERS
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The climate in Skamania is highly distinct from that in Vancouver. Skamania lies at the southern base of the Cascade Mountains which block rain clouds from traveling any further east. Consequently, Skamania receives considerably more rainfall than Vancouver. Since Camas is essentially an equal distance between these stations, annual rainfall is a blend of the two. An interpolation of precipitation data for both stations produced a 10-year annual average precipitation of 75.35 inches. The 10-year maximum month precipitation for Vancouver is 13.26 inches in December and 23.5 inches in November at the Fish Hatchery, a 43 percent difference. The 10-year minimum annual precipitation at Vancouver is 0.00 inches in both July and August, and 0.04 inches in June at the Fish Hatchery.

Temperature in Camas ranges from a high of 61 degrees, to a minimum of 41 degrees, and a mean of 51 degrees. Winds generally come from the east-southeast with the exception of April to September when they come from the northeast. High easterly winds come on a year-round basis from the Columbia River Gorge.

SITE SENSITIVE AREAS

The following section summarizes information regarding site-sensitive/critical areas presented in the *City of Camas Comprehensive Plan,* March 2004. Critical areas within the sewer service area include those classified as streams and watercourses, wetlands, frequently flooded areas, critical aquifer recharge areas, geologically hazardous areas, and fish and wildlife habitat conservation areas. Title 16, Environment, and Title 18, Zoning, of the Camas municipal code provides protection to site sensitive areas. Municipal code 16.50.240 (A), Critical area protective mechanism, states the follow policy:

> *Identified critical areas and their associated buffers or management zones shall be protected and preserved through a permanent protective mechanism acceptable to the city. This may include placing the critical area and its associated buffer or management zone in a separate tract; executing a protective easement; or dedicating the critical areas and its associated buffer or management zone to a public agency or public or private land trust. The mechanism shall provide for maintenance of the critical area and is associated buffer or management zone.*

In addition, the City of Camas Comprehensive Plan includes a high level of environmental stewardship as stated below:

> *One of the most demanding roles the City of Camas must fulfill is that of chief steward of the city's environment. The city has the authority to regulate land use and the responsibility to implement federal and state statues. Therefore, the city must endeavor at all times to ensure that its environment is managed wisely. The city encourages the preservation, restoration, and improvement of the natural environment. The city*

> *encourages all residents and businesses to explore ways to contribute to protecting the environment.*

The following plans and regulations were prepared for the protection of the natural environment within Camas:

- Parks, Recreation, and Open Space Comprehensive Plan, adopted January 2000.
- Revised Shoreline Management Master Program, adopted 1998.
- Sensitive Areas and Open Space Ordinance, adopted January 2007.

The site sensitive areas within the sewer service area are described further below.

Surface Water

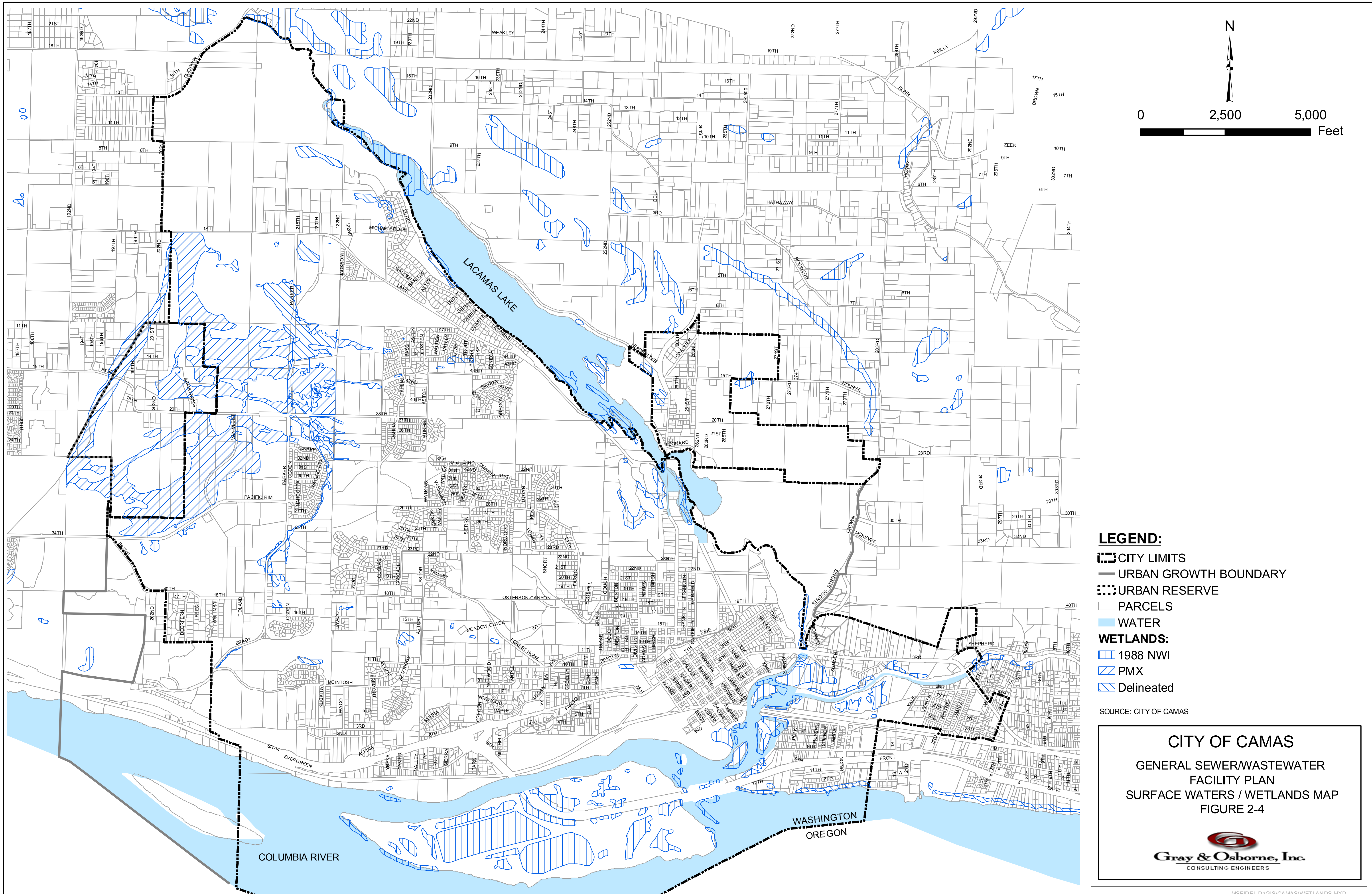
Lakes and streams are classified as sensitive areas due to the variety of plants and animals that they support. Camas' wet climate and sloping terrain provides flows to many streams and creeks. These watercourses drain into the Columbia and Washougal Rivers, or into the surrounding lakes. The major surface waters located within the Camas area include the Columbia and Washougal Rivers; Lake Lacamas; Jones, and Boulder Creeks; and Round and Fallen Leaf Lakes. The intent of municipal code, 16.06.030, Ground and Surface Water Quality, is to prevent adverse effects to water quality in the Camas area. The major surface waters are shown in Figure 2-4.

Wetlands

The Growth Management Act defines wetlands as areas that have surface or ground water that supports vegetation typically adapted in saturated soil conditions. Wetlands support valuable and complex ecosystems and consequently development is severely restricted if not prohibited in most wetlands and buffer areas around the wetland. There are approximately 1,200 acres within the City that are classified as wetlands. The major wetlands within the City of Camas are located on Lady Island, along the Washougal River, and adjacent to Lake Lacamas and Round and Fallen Leaf Lakes. The intent of the City's municipal code, 18.31.050, Wetland standards, is to prevent adverse effects to wetlands and wetland buffers from development effects. Figure 2-4 also shows wetland areas within the Camas UGA.

Frequently Flooded Areas

Flood hazard areas are areas adjacent to lakes, rivers, and streams that are prone to flooding during peak runoff periods. Construction of buildings and other development in these areas is regulated in accordance with flood hazard construction standards. The Camas 100-year flood plain map (land that has a 1 percent chance of flooding each year)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LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
PARCELS
WATER
WETLANDS:
1988 NWI
PMX
Delineated
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
SURFACE WATERS / WETLANDS MAP
FIGURE 2-4
Gray & Osborne, Inc.
CONSULTING ENGINEERS
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is depicted in Figure 2-5. Proposed development projects within 300 feet of a frequently flooded area are required by municipal code 16.80 to provide a critical area report.

Critical Aquifer Recharge Areas

The City of Camas uses groundwater as a significant portion of its water supply. The City has twelve groundwater wells, eight of which are active. Since the majority of the wells are in the vicinity of downtown, critical aquifer recharge areas are important areas to protect. Camas Municipal Code 16.70.050, Aquifer Recharge Areas, requires a professional aquifer recharge area critical report for all proposed activities in such areas.

Geologically Hazardous Areas

Clark County exhibits traces of its geologic history including repeated inundation by fluctuating sea levels during glacial epochs, the sedimentary processes of the Columbia River, volcanic activity, periodic earthquakes, and other tectonic activity. There is an active fault in the region that runs under Lacamas Lake, and there are approximately 1,237 acres within the City that are classified as steep and unstable slopes. Figure 2-6 is a map of the steep slopes in Camas.

Seismic hazard areas are those with low-density soils that are more likely to experience greater damage due to seismic-induced subsidence, liquefaction, or landslides. Seismic hazard areas are regulated mainly with respect to public safety and with the exception of a severe earthquake, these hazard areas do not impact wastewater facilities. United States is divided into seismic hazard zones based upon historic documents. These zones range from category 1 to 4, with 4 representing the highest risk. Camas is Category 4, which means that the Camas building code must have the highest construction standards.

Fish and Wildlife Habitat Conservation Areas

Sensitive fish and wildlife habitat is defined as areas which meet the definition of a "Fish and Wildlife Habitat Critical Area" pursuant to WAC 365-190-080(5) and is essential for maintaining specifically listed species in suitable habitats. Any proposed activity within 300 feet of these areas, including construction related to wastewater collection systems, requires that a habitat assessment be prepared. Table 2-3 summarizes the priority anadromous and resident fish species in the Camas area.

The Columbia and Washougal Rivers provide habitat for Threatened species such as Columbia Chinook, Chum, and Steelhead salmon. Fish and wildlife habitat areas that are within the Camas UGB are shown on Figure 2-7.

TABLE 2-3

Priority Anadromous and Resident Fish Species(1)

Species	Status	Columbia River	Washougal River	Little Washougal River	Boulder Creek	Jones Creek
Chinook	Threatened	√	√			
Coho						
Sockeye						
Winter Steelhead	Threatened	√	√	√	√	√
Resident Cutthroat Trout	Candidate	√	√			
Resident Chum	Threatened	√				

(1) Checkmark indicates species is present.

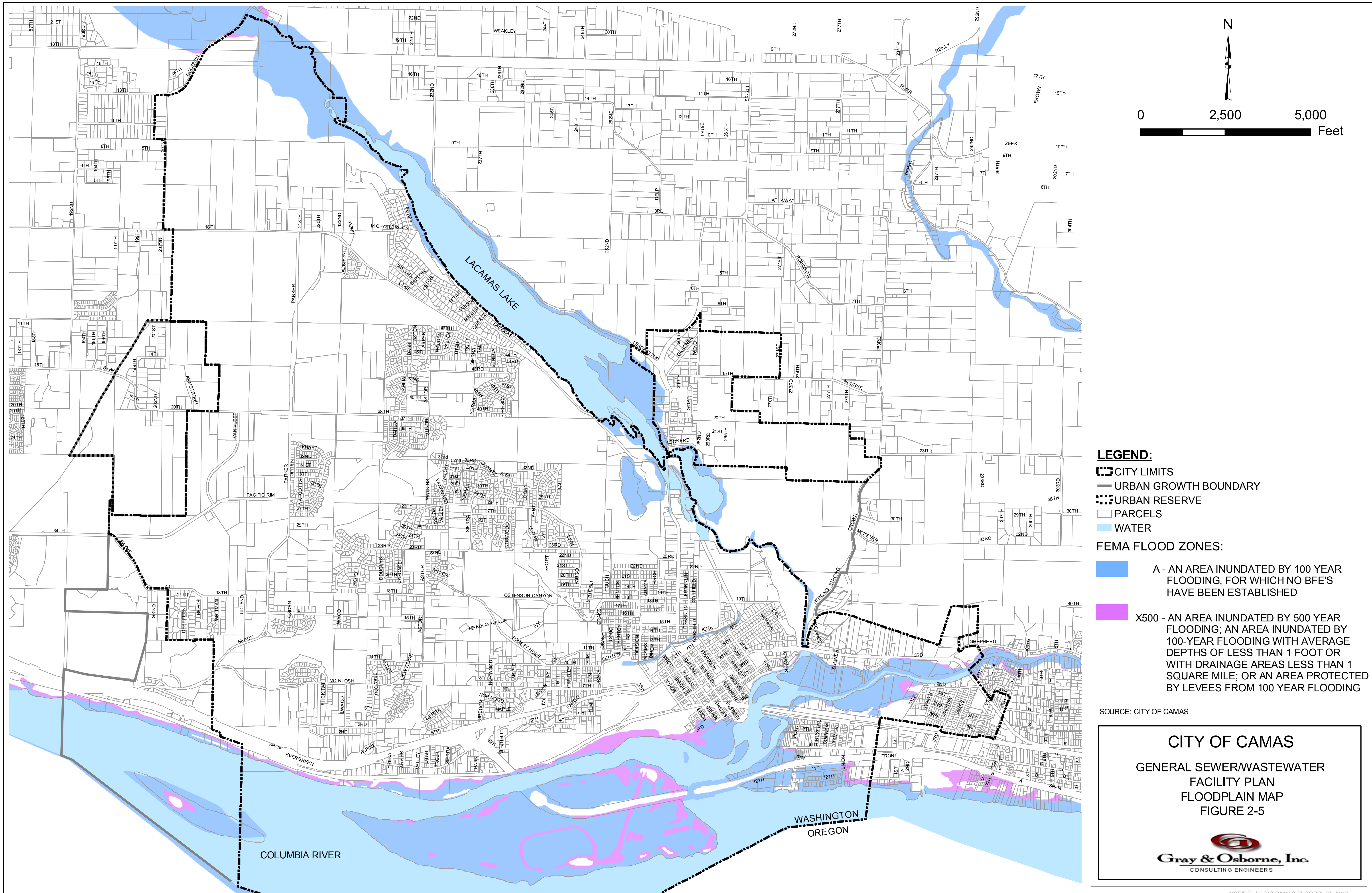
Open Space Network

The City has developed quickly and is running out of open space and land for neighborhood parks. The City of Camas 2000 Parks and Open Space Comprehensive Plan identified approximately 2,000 acres of sensitive areas that could easily form a network of interconnected natural open space. Due to the growth in population and the high level of commercial and technology development in the last 10 years, the City's priority is to preserve as much open space as possible. The City's Open Space Network will connect any available open space with a trail system, including wooded hillsides, steep slopes, wetlands, City and County parks, school sites, and proposed neighborhood parks and special uses areas. There is already a trail system that includes 441 miles of existing and proposed trails and pathways in and around the City. Figure 2-8 shows the proposed Open Space Network.

WATER SYSTEM

The City of Camas owns and operates a water source, treatment, transmission, distribution, and storage system. The water system serves the entire City limits and UGA. The system consists of 13 pressure zones, ranging from a hydraulic grade of 852 feet in the Upper Prune Hill area to 343 feet in the downtown area in the Butler Zone. The City currently operates eight groundwater wells, one treatment plant, over 100 miles of pipe, seven reservoirs, seven booster stations, and 46 pressure reducing valves (PRVs).

The City of Camas currently has municipal water rights issued by Department of Ecology (Ecology) for an instantaneous surface water diversion of 1,570 gallons per minute (gpm). The annual surface water diversion allocated to the City is 2,550 acre-feet. The City also holds water rights for instantaneous withdrawal from its wells totaling 8,975 gallons per minute (gpm).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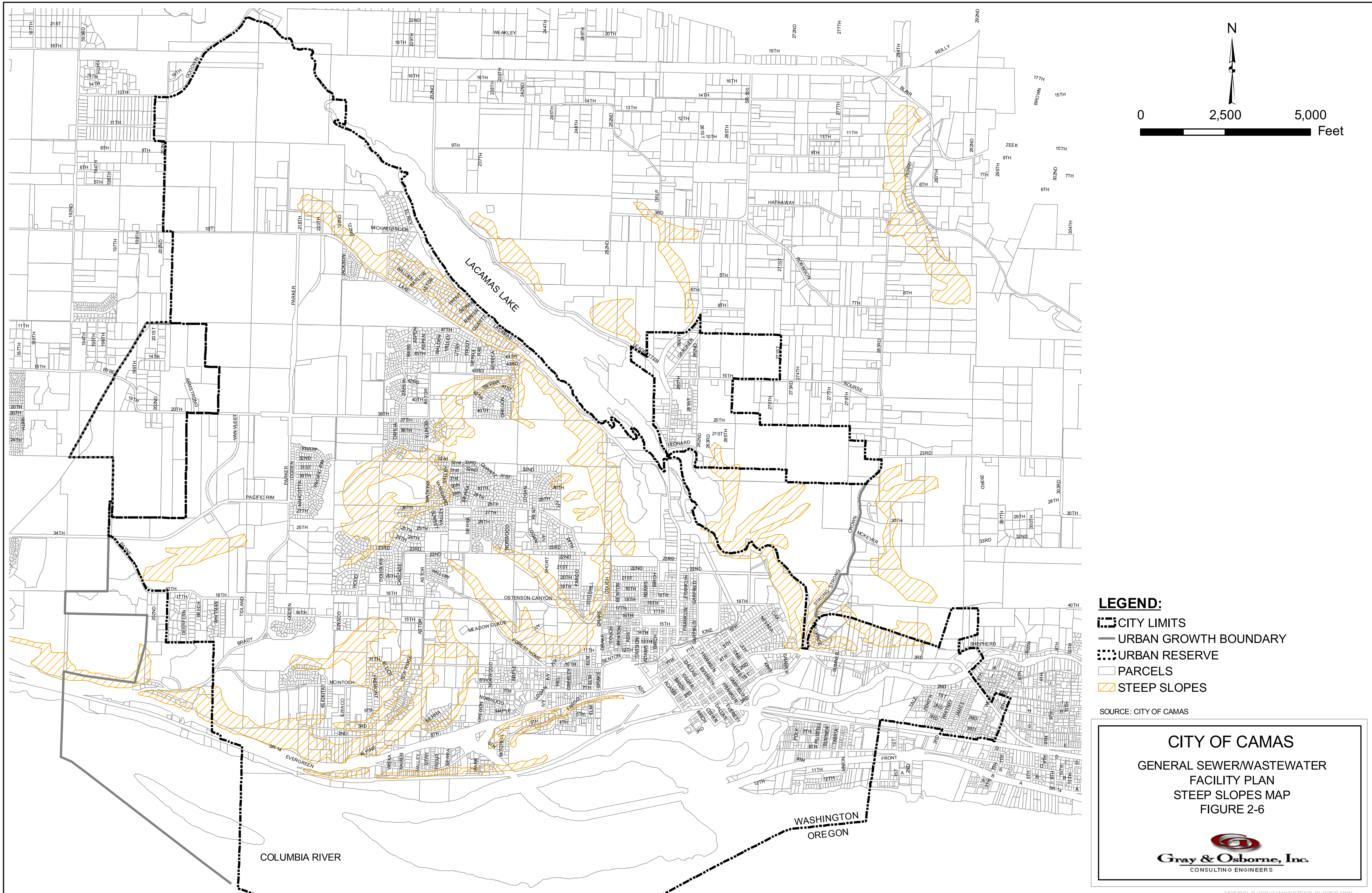
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
PARCELS
WATER
FEMA FLOOD ZONES:
A - AN AREA INUNDATED BY 100 YEAR FLOODING, FOR WHICH NO BFE'S HAVE BEEN ESTABLISHED
X500 - AN AREA INUNDATED BY 500 YEAR FLOODING; AN AREA INUNDATED BY 100-YEAR FLOODING WITH AVERAGE DEPTHS OF LESS THAN 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; OR AN AREA PROTECTED BY LEVEES FROM 100 YEAR FLOODING
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
FLOODPLAIN MAP
FIGURE 2-5
Gray & Osborne, Inc.
CONSULTING ENGINEERS
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
SR-14
EVERGREEN
MSEIDEL D:\GIS\CAMAS\FLOODPLAIN.MXD



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LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
PARCELS
STEEP SLOPES
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
STEEP SLOPES MAP
FIGURE 2-6
Gray & Osborne, Inc.
CONSULTING ENGINEERS
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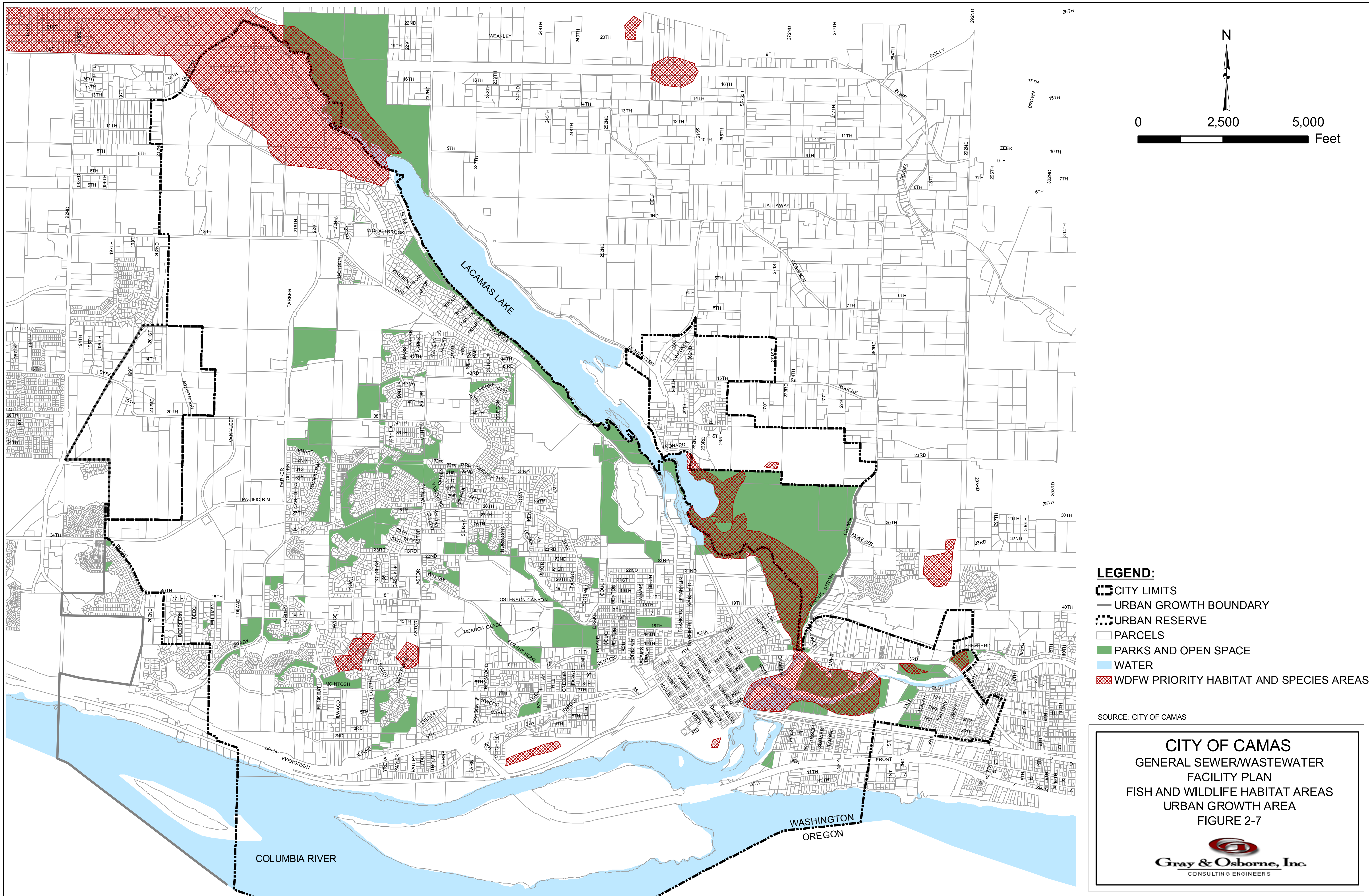

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Feet
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
PARCELS
PARKS AND OPEN SPACE
WATER
WDFW PRIORITY HABITAT AND SPECIES AREAS
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
FISH AND WILDLIFE HABITAT AREAS
URBAN GROWTH AREA
FIGURE 2-7
Gray & Osborne, Inc.
CONSULTING ENGINEERS
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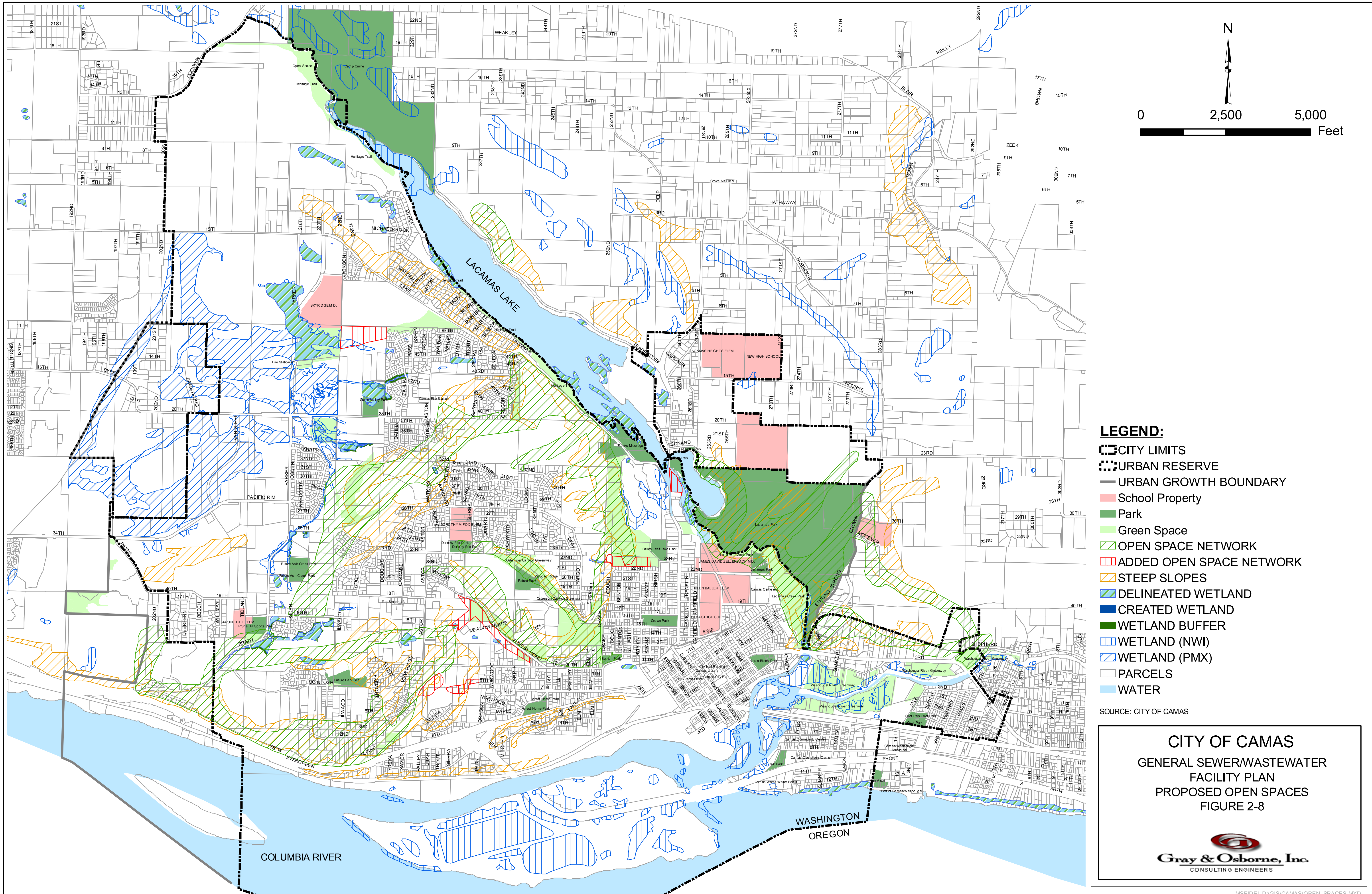
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Feet
LEGEND:
CITY LIMITS
URBAN RESERVE
URBAN GROWTH BOUNDARY
School Property
Park
Green Space
OPEN SPACE NETWORK
ADDED OPEN SPACE NETWORK
STEEP SLOPES
DELINEATED WETLAND
CREATED WETLAND
WETLAND BUFFER
WETLAND (NWI)
WETLAND (PMX)
PARCELS
WATER
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
PROPOSED OPEN SPACES
FIGURE 2-8
Gray & Osborne, Inc.
CONSULTING ENGINEERS
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
MSEIDEL D:\GIS\CAMAS\OPEN_SPACES.MXD

A history of the City's water system is included in Table 2-4. The City's water system began operation in 1913 with the construction of the Jones Creek Intake and the Butler Reservoir. The City drilled Well Nos. 1 and 2 in 1936. The City constructed the Chlorination Plant in 1952 and the Filter Plant in 1965, signifying the beginning of treatment of the City's water.

The City's surface water is chlorinated and filtered. Chlorination of the surface water with liquid sodium hypochlorite occurs at the City's chlorination facilities , located several miles upstream of the filter plant. The City of Camas operates two 750 gpm pressure filters (1,500 gpm total). The filters provide layers of media that vary from coarse to fine and provide the physical filtration required. The City also treats with fluoride, alum and polymer for coagulation, and sodium hydroxide (caustic soda) for pH adjustment at the filter plant.

Treatment of the City's groundwater sources includes chlorination, fluoridation, and caustic soda addition. Wells 5, 6, and 9 have individual chemical feed equipment while a single facility serves Wells 7, 8, 10, 11, and 12.

In compliance with the lead –copper rule, the City began pH adjustment to all of its sources in April 2000. Corrosion control treatment includes the addition of caustic soda at the wells and filter plant. Well No. 9, located in the 544 Zone, has water quality characteristics different from the other wells and does not require pH adjustment.

Areas outside the City limits currently served water include the Grand Ridge and Winchester Hills communities to the west of the City limits (these areas are also provided sewer service) and the Gregg Service area to the northeast (which is not currently provided sewer service).

TABLE 2-4

History of the Camas Water System

Date	Event
1845	Camas first settled
1913	Jones Creek Intake constructed
1913	0.6 MG Butler Reservoir, South Half
1923	0.6 MG Butler Reservoir, North Half (1.2 MG total)
1931	Boulder Creek Intake constructed
1935	0.5 MG Lower Prune Hill Reservoir
1936	Wells No. 1 and No. 2 constructed
1945	Well No. 3 constructed
1948	Butler Booster Station-800 gpm
1949	Forest Home Booster Station-450 gpm
1952	Chlorination Plant-injects chlorine into water from Jones Creek and Boulder Creek before it goes to the Filter Plant
1959	Well No. 4 constructed
1965	Filter Plant-1,200 gpm-filters water from Jones Creek and Boulder Creek intakes
1965	10th Street Booster Station
1968	Well No. 5 constructed
1969	Well No. 6 constructed
1971	Well No. 7 constructed
1971	1.5 MG Lower Prune Hill Reservoir
1971	0.75 MG Upper Prune Hill Reservoir
1971	Lower Prune Hill Booster Station-500 gpm, 500 gpm, 750 gpm
1977	Well No. 8 constructed 1,350 gpm
1978	0.1 MG Gregg Reservoir
1978	Gregg Booster Station-500 gpm
1988	Telemetry System installed
1993	2.0 MG Lacamas Reservoir
1993	Lacamas Booster Station-500 gpm, 500 gpm, 1,500 gpm
1998	Forest Home Booster Station Upgrade – 1,000 gpm
1999	Butler Booster Station Upgrade
2000	Telemetry upgraded
2000	Well No. 9 constructed
2001	Angelo Booster Station constructed – 3,000 gpm capacity
2001	Lower Prune Hill Booster Station Upgrade – 1,000 gpm replacement pump
2002	Upper Prune Hill Reservoir (2.4 MG) and Booster Station (2,900 gpm capacity) constructed
2003	Wells 10,11 and 12 drilled
2003	Wells 11 and 12 developed
2004	Well 10 developed and Washougal Wellfield Chemical Treatment Facility constructed.

CHAPTER 3

LAND USE AND PLANNING CRITERIA

Since the development of the City's 1997 *Wastewater Comprehensive Plan* and 2001 *Water System Plan*, the City has developed a 2004 amendment to the *City of Camas Comprehensive Plan*. The 2004 Comprehensive Plan will be used to further describe land use and provide planning criteria for this chapter.

PLANNING PERIOD

In order to provide wastewater services for future growth, the wastewater system is in need of continuous evaluation and improvement. A planning period for the evaluation of the wastewater utility should be long enough to be useful for an extended period of time, but not so long as to be impractical. The planning period for this *General Sewer/Wastewater Facility Plan* is from 2005 through 2025, coinciding with a 20-year planning interval.

EXISTING LAND USE

Table 3-1 shows a summary of existing land use in the City. Residential land use makes up about 46 percent of the City of Camas' total land area. Over 90 percent of this land consists of single-family residential units. In general, the single-family homes are concentrated south of Lake Lacamas, bounded by NW Parker Street to the west and Lacamas Park/Downtown Camas on the east. Multi-family development is concentrated at the confluence of the Washougal and Columbia Rivers, the northern portion of downtown Camas, and to two small areas on the east and west sides of the urban growth boundary. The existing commercial land use in Camas consists of 270 acres, most of which is in the downtown area, which is located on the east side of the Washougal River, where the Washougal and Columbia Rivers meet. Other business areas include Neighborhood commercial and Regional commercial. There is currently about 975 acres of industrial zoned areas concentrated south and east of downtown along the Camas Slough and on Lady Island. Along much of the west side of the UGA are light industrial and business park sites totally 1,717 acres. These zones are bordered by NW Parker Street to the east, NW 18th Avenue to the south, and NE Goodwin Road and Camp Currie to the north. The City has two major areas dedicated as parks, Camp Currie that is located on the north tip of Lacamas Lake and Lacamas Park located on the southern tip of the Lake.

TABLE 3-1

City of Camas Zoning and Land Use[1]

Land Use Designation	Acres	Percent
Single-Family	3102.4	42.0%
Multi-Family	288.6	3.9%
Commercial	269.8	3.6%
Industrial	974.4	13.2%
Light Industrial/Business Park	1717.9	23.2%
Parks	626.3	8.5%
Green Space	379.2	5.1%
Public Facilities	36.2	0.5%
Total	7394.8	100.0%

SOURCE: City of Camas, *2004 Comprehensive Plan*, Table 4.

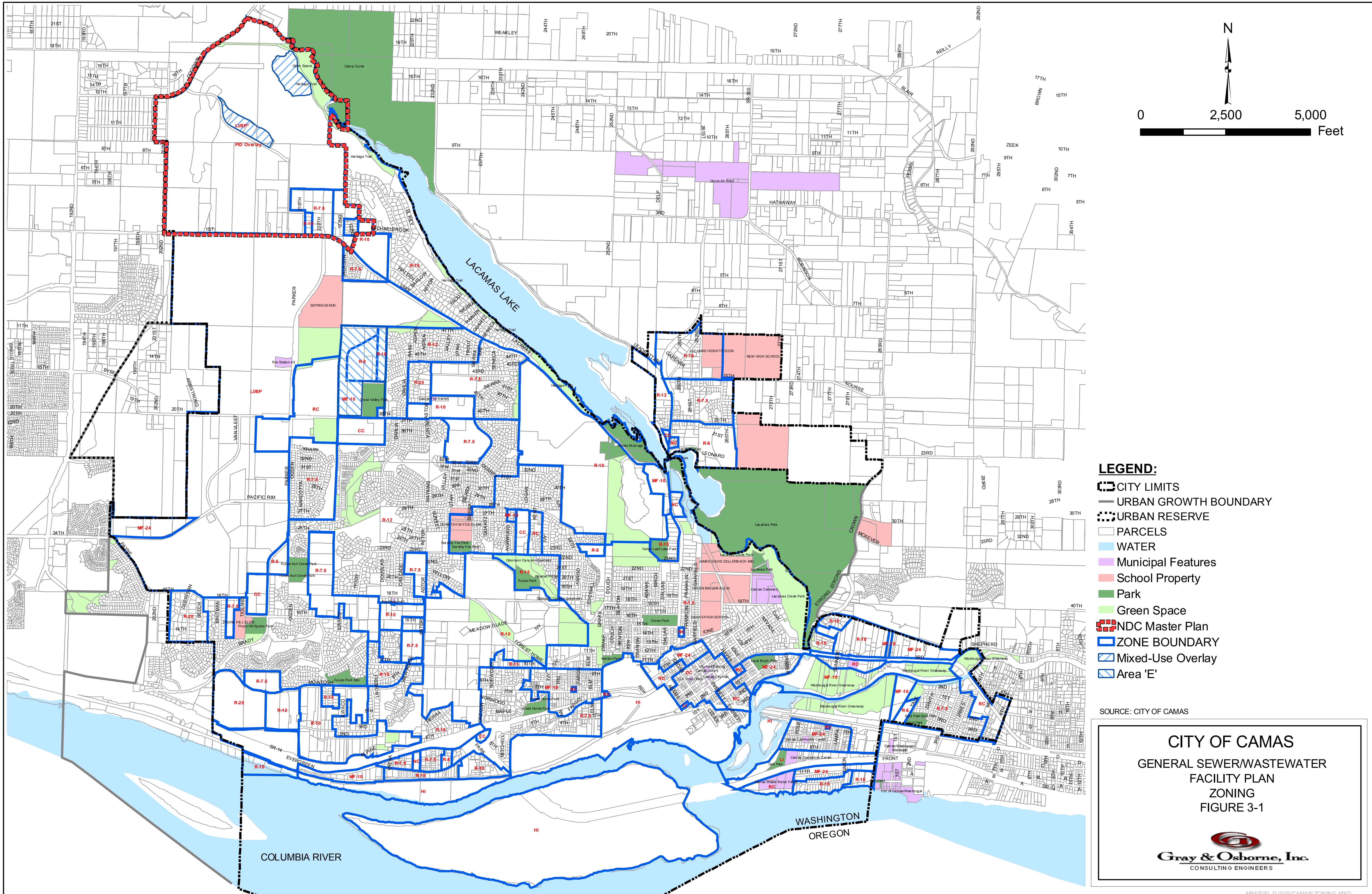
(1) Tables 1, 4, and 5 in the City's 2004 Comprehensive Plan does not include parks, green space and public facilities in compiling a total of 6,401 acres

Figure 3-1 shows the zoning within Camas and Figure 3-2 shows existing land use.

FUTURE LAND USE

The City's 2004 Comprehensive Plan included an analysis of the Clark County Buildable Lands Report, 1995-2000. This report indicated that the City of Camas and its UGA "could accommodate approximately 6,500 people and just over 3,100 jobs." New construction is currently taking place along Lacamas Lake, on and below Prune Hill, and in Grass Valley where the topography is flat and is conducive to residential development. The City has a number of areas within its UGA that will be annexed within the next few years as shown on Figure 3-3, Urban Growth Boundary Expansion. Also, as shown in Figure 3-3, there are several possible ultimate future urban growth boundaries for the City, particularly in the area northeast of Lacamas Lake. The City is currently discussing with the County and other stakeholders what the ultimate boundary will be: (1) the draft discussion area, (2) the new urban reserve, or (3) the entire Gregg Service Area. However, per City staff, based on the most recent discussions (October 2006), the likely boundaries and land use for the City's UGA in the Gregg service area (north and east parts of the City) in the near term will be as shown in Figure 3-4.

Figure 3-5, Future Land Use, shows developments that are currently active within the City's UGB.



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Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
PARCELS
WATER
Municipal Features
School Property
Park
Green Space
NDC Master Plan
ZONE BOUNDARY
Mixed-Use Overlay
Area 'E'
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
ZONING
FIGURE 3-1
Gray & Osborne, Inc.
CONSULTING ENGINEERS
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
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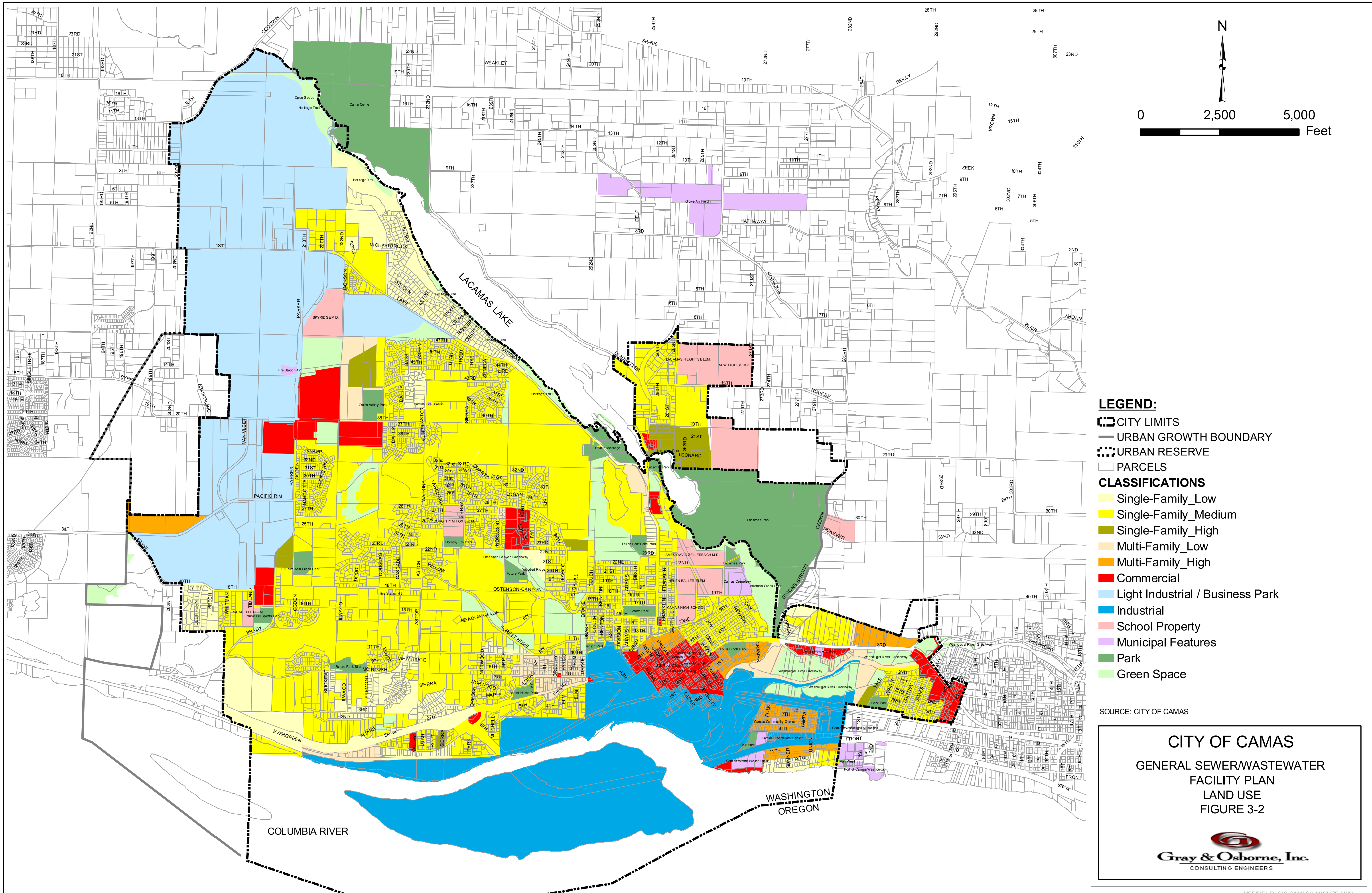


CITY OF CAMAS

GENERAL SEWER/WASTEWATER FACILITY PLAN

LAND USE

FIGURE 3-2

Two objectives of the City's Land Use Element, as it relates to accommodating future growth within is UGB, are restated below:

- *Accommodate the projected growth through well-planned utilization of its land and, as warranted, a judicious process of expansion of the Urban Growth Boundary;*
- *Focus on continued growth of the Business Parks (Cascade Business Park and North Dwyer Creek Subarea) as employment centers.*

ADJACENT JURISDICTIONS

City of Vancouver

The City of Vancouver lies wholly within Clark County and borders Camas to the west. The City of Vancouver was incorporated in 1857 and has a 2004 population of 152,900. While several Vancouver neighborhoods border the Camas UGB, Camas does not provide sewer service to these areas.

City of Washougal

City of Washougal resides wholly within Clark County and borders the Camas UGB in the southeast. Washougal was incorporated in 1908 and has a 2004 population of 10,770. Camas has a force main from the One Stop Lift Station that travels through Washougal that provides no service to Washougal customers.

CURRENT POPULATION

The Washington State Office of Financial Management (OFM) provided a history of population for Camas over a 20-year period, 1994 to 2004, as shown in Table 3-2. Since the OFM data for housing units is currently available only to 2002, this plan will use population data from that same year to calculate persons per household (pph). OFM estimated the number of housing units in Camas at 5,153. The City's 2002 population was estimated to be 13,540. This equates to an average population of 2.6 pph. This number is consistent with OFM estimates for Clark County at 2.65 pph for year 2005.

TABLE 3-2

City of Camas Historical Population 1994 to 2004

Year	Population	Annual Growth Rate
1994	7,693	--
1995	8,355	8.61%
1996	9,356	11.98%
1997	10,213	9.16%
1998	11,169	9.36%
1999	11,929	6.80%
2000	12,534	5.07%
2001	12,970	3.48%
2002	13,540	4.39%
2003	14,200	4.87%
2004	15,360	8.17%
2005	15,460	0.65%
2006	15,880	2.72%
Average		**6.3%**

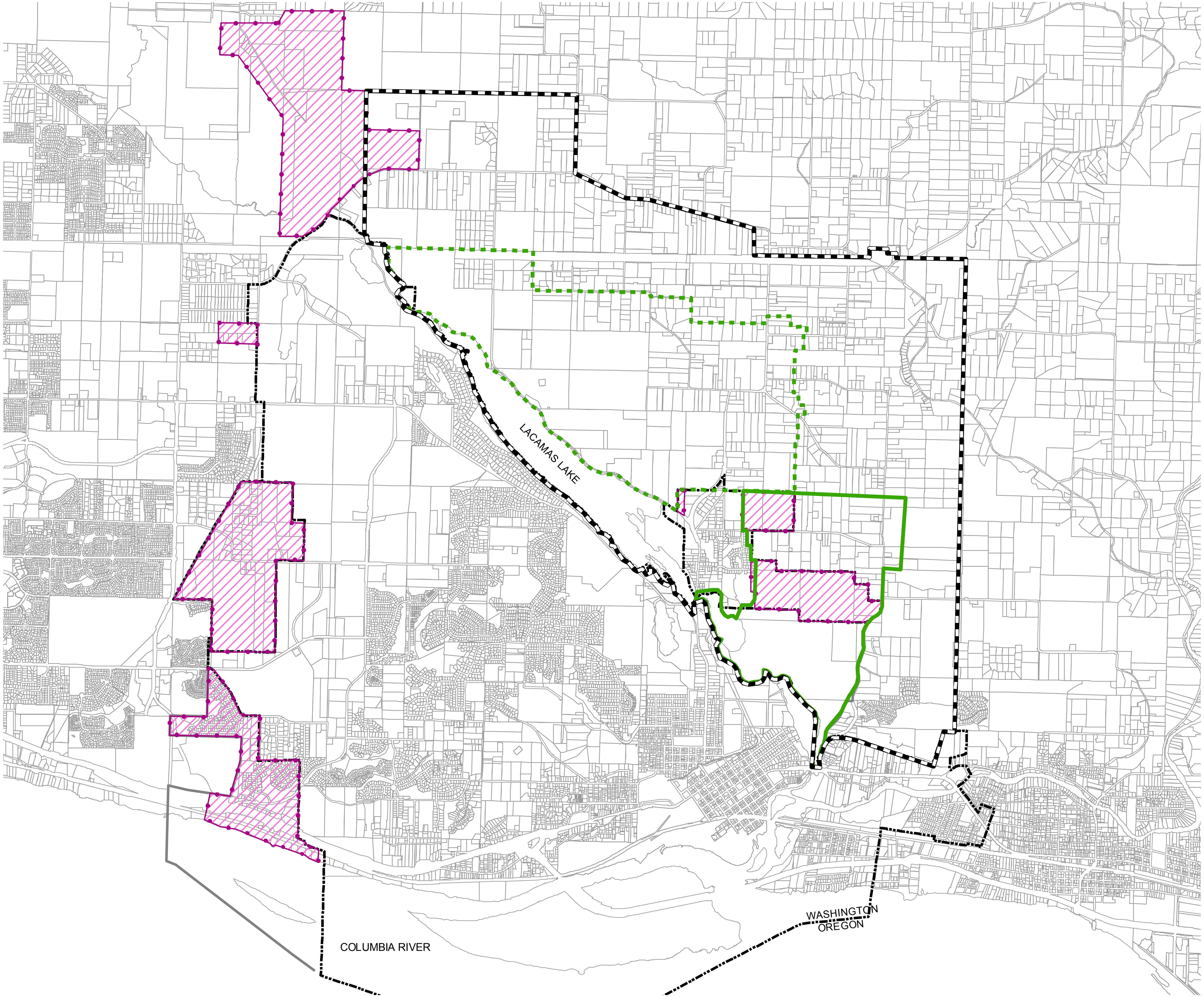
SOURCE: Washington State Office of Financial Management (OFM).
Population estimated as of April 1 of each year.

PROJECTED FUTURE CITY POPULATION

The City's *2004 Comprehensive Plan* indicated that Clark County allocated an additional 7,000 people within the Camas corporate boundaries over the next 20 years. Therefore, the projected 2025 population within its current boundaries was estimated to be 22,360, and including the population within its UGB, was estimated to be 24,700, as noted in the 2004 *City Comprehensive Plan*. However, this value is less than the 2020 UGA population cited in the 2001 *City of Camas Water System Comprehensive Plan*, of 28,890, and is not considered to be representative of current growth rates. Per discussion with City staff, representative growth rates and projected annexation boundaries and rates will be established jointly by the City and County in the near future. However, for the purposes of this plan, representative and reasonably conservative growth rates must be established for future wastewater flows and loadings.

Alternatives for estimating growth in the City's projected population are shown in Table 3-3, based on:

1. The City's 2004 *Comprehensive Plan*



N

0 3,200 6,400 Feet

LEGEND:

- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- UGB EXPANSION - PROPOSED IN 2004 COMP. PLAN
- PROPOSED URBAN RESERVE (9/27/05)
- DRAFT DISCUSSION AREA (10/24/06)
- POTENTIAL GREGG SERVICE AREA BASIN
- PARCELS

SOURCE: CITY OF CAMAS

CITY OF CAMAS

GENERAL SEWER/WASTEWATER FACILITY PLAN
ALTERNATIVES FOR
URBAN GROWTH BOUNDARY EXPANSION
FIGURE 3-3

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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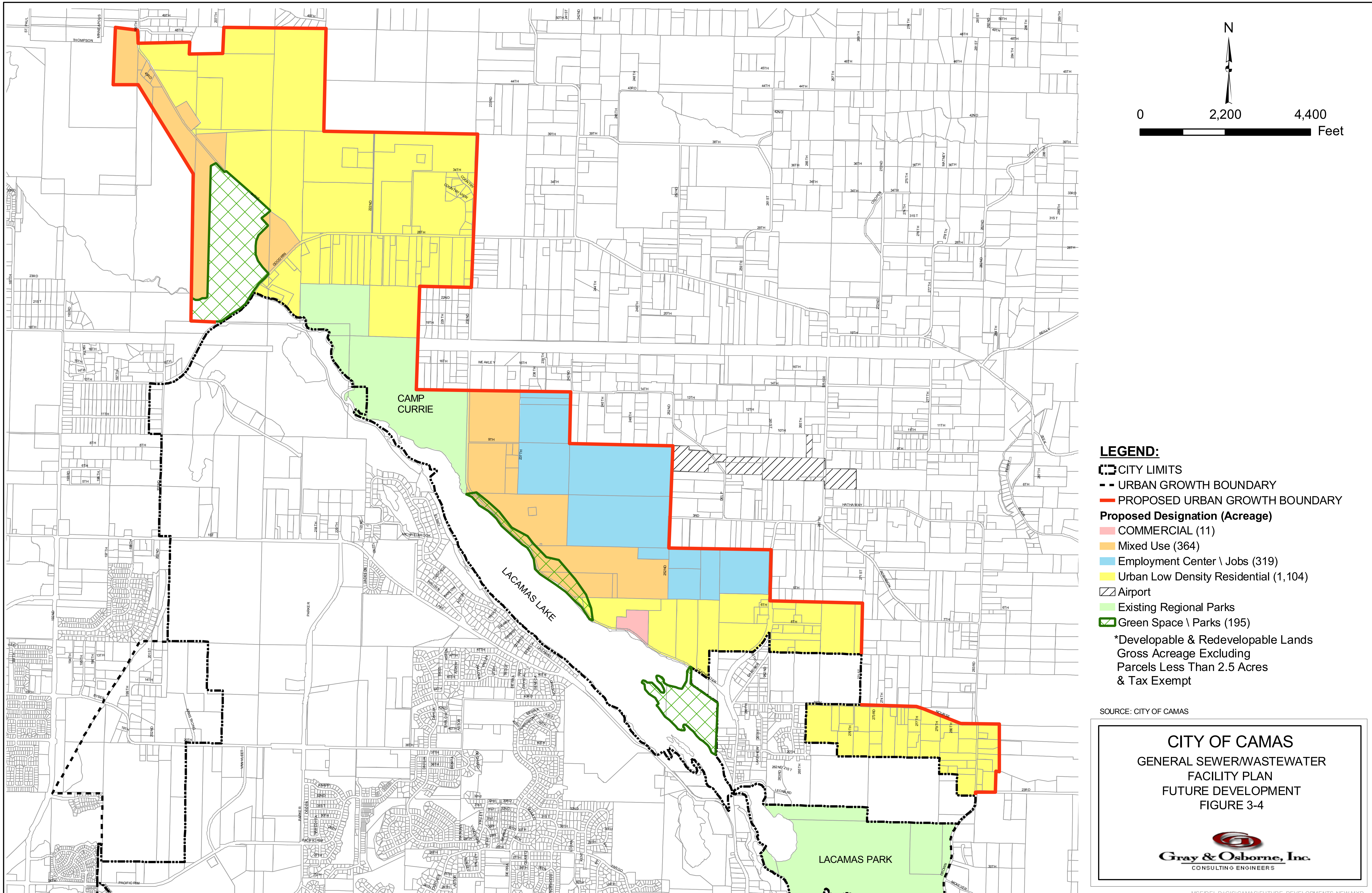
CAMP CURRIE
LACAMAS LAKE
LACAMAS PARK
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2,200
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Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
PROPOSED URBAN GROWTH BOUNDARY
Proposed Designation (Acreage)
COMMERCIAL (11)
Mixed Use (364)
Employment Center \ Jobs (319)
Urban Low Density Residential (1,104)
Airport
Existing Regional Parks
Green Space \ Parks (195)
*Developable & Redevelopable Lands
Gross Acreage Excluding
Parcels Less Than 2.5 Acres
& Tax Exempt
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
FUTURE DEVELOPMENT
FIGURE 3-4
Gray & Osborne, Inc.
CONSULTING ENGINEERS
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2. The more aggressive growth rate shown in the City's 2001 *Water Comprehensive Plan,* along with the UGA boundaries shown in Figure 3-4.

3. Five years of an annual growth rate of 7.2 percent, reflective of current growth rates, followed by 15 years of 1.0 percent annual growth per discussion with City staff. Overall, these growth rates yield more conservative (i.e., higher) projections of future population than the 2004 Comprehensive Plan, and are considered to be more accurate and up-to-date than either the 2004 Comprehensive Plan or the 2001 Water Plan.

TABLE 3-3

City of Camas Projected Population

Year	Projected Population within City Limits(1)	Projected Population Within UGA(2)	Projected Population Within UGA	Projected Water Service Area Population	Projected Population within City Limits	Projected Population Within UGA
Basis	**2004 Comp Plan**		**2001 Water Plan**		**Current estimates(5)**	
2005	15,710(1)	15,710(1)			15,710	16,714
2006	16,060(1)	16,060(1)	17,512	18,277	16,841	17,917
2007	16,410	17,010			18,054	19,207
2008	16,760	17,360			19,354	20,590
2009	17,110	17,710			20,747	22,072
2010	17,460	18,060			22,241	23,662
2015	19,210	22,160			23,375	24,869
2020	20,960	23,910	28,890	30,859	24,568	27,863
2025	22,360	24,700	34,000(3)	36,000(3)	25,821	29,284
Buildout		52,847(7)	43,687	54,253(4)		52,847(7)

(1) Population shown is for the corporate boundaries of the City of Camas, and is based on 7,000 new people over the next 20 years per Clark County allocations (City of Camas 2004 Comprehensive Plan, page 1-7). 2005 and 2006 populations shown are for December 31 of the year shown

(2) The City's projected 2025 population, inclusive of the UGB, was noted in the Comprehensive Plan as 24,700, or roughly 10,000 more people within the UGB over the next 20 years.

(3) Based on linear extrapolation of growth rate in 2001 Water System Plan.

(4) Including 10,566 in Gregg Service Area based on a density of four homes per acre in the residential areas shown in Figure 3-4.

(5) Based on current estimates of 7.2 percent for 5 years and 1.0 percent for following 15 years, per City staff.

(6) There were 386 water service connections outside the City boundaries within the UGA in 2005 (386 *2.6 = 1004 people).

(7) See Table 3-4.

The City of Camas is bounded by the corporate boundaries of Vancouver on the west and Washougal at the southeast UGB; therefore no expansion of the sewer service area will occur in these regions. Alternatives for future annexations are shown in Figures 3-3 and 3-4. As shown by Figure 3-3, there are several alternatives for the City's ultimate UGB, particularly to the north and the northeast of the City. The 2004 *Comprehensive Plan* showed only small areas in east Camas (east of Lacamas Lake) as proposed UGB expansion. City staff believes ultimately that the City UGB and sewer service boundary will extend all the way to the Gregg Service Area boundary shown in Figure 3-3. Recent discussions with the County and stakeholders, however, have resulted in planning maps showing the substantially smaller area indicated by the 10/24/06 DRAFT Discussion Area and Proposed Urban Reserve Boundary in Figure 3-3, and the boundaries shown in Figure 3-4. Current negotiations with the County and stakeholders may result in revisions to these boundaries, but for now the boundaries shown in Figure 3-4 are used for projections. The projected Camas buildout population within the existing UGA, based on Table 5 in the 2004 Comprehensive Plan, is summarized in Table 3-4.

TABLE 3-4

City of Camas Projected Buildout Population
(Based on 2004 Comprehensive Plan)

Zoning Classification(1)	Acres	Dwellings Units per Acre	Dwelling Units	Projected Buildout Population
R5	8.1	8.7	70	199
R7.5	1,004.2	5.8	5,824	16,483
R10	835.4	4.3	3,592	10,166
R12	759.9	3.6	2,736	7,742
R15	432.4	2.9	1,254	3,549
R20	62.4	2.1	131	371
MF10	115.3	10	1,153	3,263
MF18	41	18	738	2,089
MF24	132.3	24	3,175	8,986
TOTAL	**6,353**		**18,674**	**52,847**

(1) The density of dwelling units (DU) for the City's zoning classification is as follows: the number after R indicates the average lot size, in thousands of square feet, for single-family residential zoning, while the number after the MF indicates the average dwelling units per acre for multi-family.

SEWER CONNECTIONS

Table 3-5 provides an estimate of the average number of sewer connections to the City of Camas sewer system from 2002-2005, based on billing records obtained from the City's Finance Department.

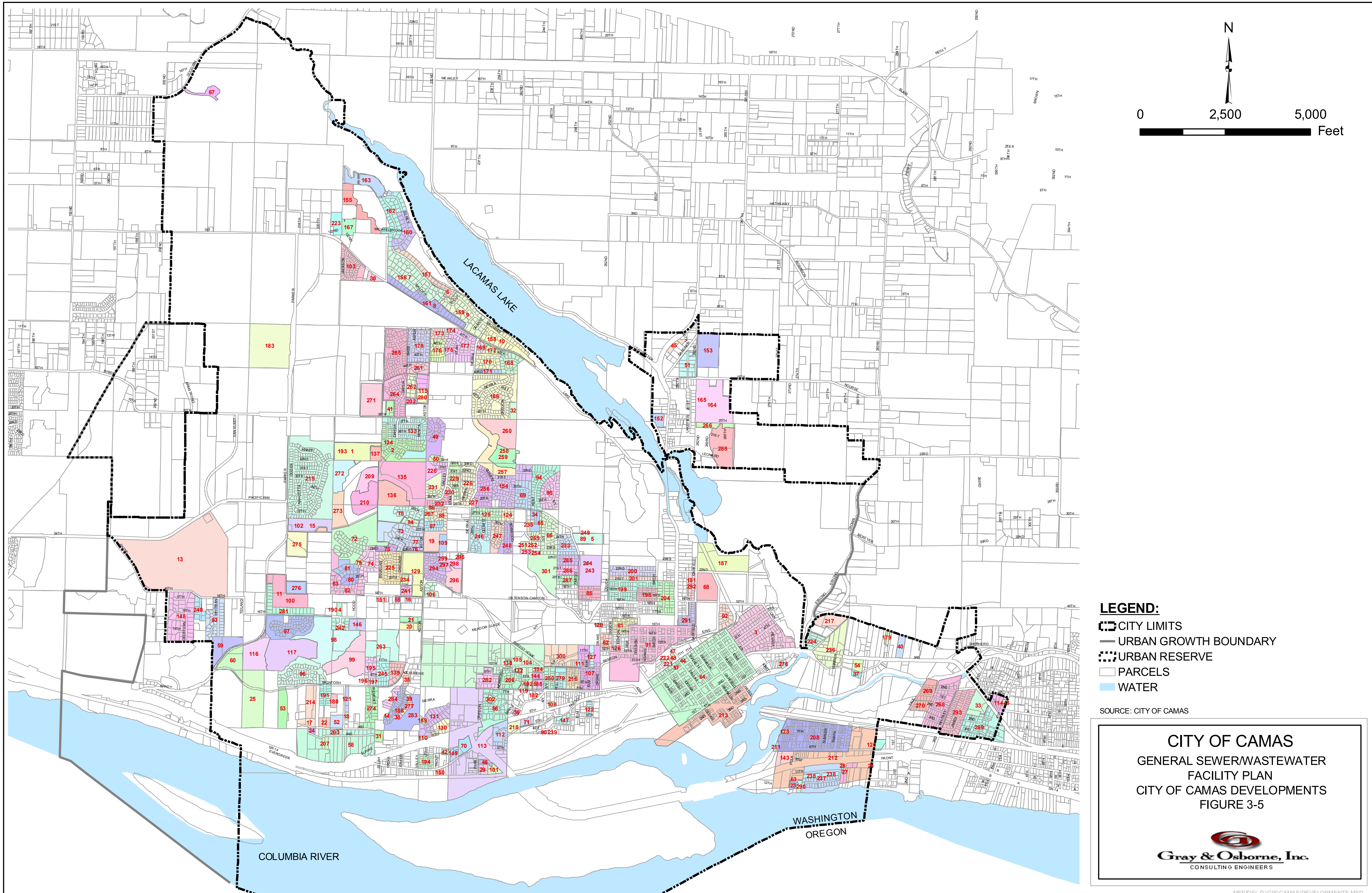

N
0
2,500
5,000
Feet
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
PARCELS
WATER
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
CITY OF CAMAS DEVELOPMENTS
FIGURE 3-5
Gray & Osborne, Inc.
CONSULTING ENGINEERS
MSEIDEL D:\GIS\CAMAS\DEVELOPMENTS.MXD

TABLE 3-5

City of Camas Average Sewer Service Connections by Customer Class[(1)]

	2002	2003	2004	2005
Single-Family Residential	4,850	5,131	5,419	5,546
Multi-family Residential	298	336	376	414
Commercial	179	183	197	202
Industrial	29	31	30	31
City	30	30	30	31
TOTAL	**5,386**	**5,711**	**6,052**	**6,223**

(1) Both water and sewer billing data provided by the City's new billing database were used to estimate the number of connections in the customer classes.

INDUSTRIES IN THE SEWER SERVICE AREA

As required by its NPDES permit, the City completed an Industrial User Survey (IUS) in early 2005. The survey identified nine Significant Industrial Users (SIUs) and five Minor Industrial Users (MIUs). The SIUs identified included:

1. Bodycote, Inc.
2. Brown's Chevron
3. Columbia Litho, Inc.
4. Heraeus Shin-Etsu America
5. C-Tech
6. Linear Technology
7. Sharp Electronics Corporation
8. Shell Oil Products
9. Wafertech

The MIUs included:

1. Georgia Pacific
2. Furuno USA Inc.
3. Lemon Aid Automotive
4. Post Record
5. Westlie Motors

A description of some of the major SIUs follows. Additional information regarding the quantity and nature of their discharges is provided in Chapter 6.

LANDA

LANDA, incorporated in 1969, builds pressure washing equipment, automatic parts washers, evaporators, and wastewater treatment/recycle systems. The company produces a wide range of types and sizes of these products. The raw materials used in the manufacturing processes are pre-formed metal tubing, pipe, sheet and plate and surface coating materials. Metals utilized are steel, stainless steel, and aluminum. Surface coatings are the powder type, which are applied using electrostatic charge and are baked on.

The manufacturing processes are cutting, forming, welding, cleaning, surface-coating, assembly, and product testing. To a large extent, components (pumps, motors, filters, tanks, plumbing, and controls) of the end products are procured from other manufacturers, often off-the-shelf items made for other specific or general purposes. These components are arranged and assembled, along with some components made by LANDA, into the various products which LANDA has designed to perform the special functions already mentioned.

SHARP

The Sharp Laboratories of America, Inc. (SLA) is a wholly owned subsidiary of Sharp Electronics Corporation in Mahwah New Jersey. SLA operates at the Camas, Washington location which is owned by Sharp Electronics Corporation (SEC). SLA is a research and development (R&D) facility, conducting R&D in the areas of multimedia (e.g., video, imaging, telecommunications, software, copiers, printers, etc.), integrated circuits (ICs), and Liquid Crystal Display-Thin Film Transistor (LCD-TFT) technologies.

SLA does no manufacturing; the main product is intellectual property and patents resulting from research and development activities.

HERAEUS SHIN-ETSU AMERICA

Heraeus Shin-Etsu America, Inc. has operated a quartz glass manufacturing industry in Camas since 1991. The facility is jointly owned by Heraeus Amersil, Inc. and Shin-Etsu Quartz Products. The finished product is a high purity glass crucible that is used in the semi-conductor industry in the manufacture of silicon wafers. The facility consumes 300,000 pounds of silica sand per month to produce 6,500 pieces of high purity glass crucibles.

LINEAR TECHNOLOGY

Linear Technology Corporation (LTC) has operated a semiconductor wafer production in Camas since 1996. LTC specializes in developing new market niches, and thus are a relatively low production facility. Production is significantly influenced by market conditions. At full production, their output capability is approximately 5,000 wafer starts per week. Currently, production is about 1,500 to 1,700 wafer starts per week. LTC currently has about 200 employees and operates 24 hours a day, 7 days per week, but with restricted shifts.

WAFERTECH

WaferTech is a semiconductor integrated circuit (IC) fabrication facility. Blank silicon wafers are used as the main raw material in the IC fabrication process. The ICs are constructed on the surface of the blank wafers by conveying the wafers through a number of different process areas. Process areas include Etching, Photolithography, Diffusion, Implant, Physical Vaporized Deposition, Chemical Vapor Deposition, Chemical/Mechanical Polishing (CMP), and Backside Grinding (BG). Wafers proceed through the process areas several times in various sequences depending on the specific type of IC. The end products of the fabrication process are wafers that contain several different types of ICs, or “die,” which are packaged and shipped to WaferTech’s clients. The WaferTech facility produces Mixed Mode, Logic, and SRAM wafers. Finished product quantities can vary significantly depending on customer demand. However, full capacity of the facility is 45,000 wafers per month.

CHAPTER 4

REGULATORY REQUIREMENTS

INTRODUCTION

Federal and state regulatory requirements were used in developing the design criteria for improvements to the City of Camas's wastewater collection, treatment, and disposal facilities. The purpose of this Chapter is to identify and summarize the regulations that affect the planning, design, and approval of improvements discussed in this report.

This chapter does not describe each regulation in detail; rather, it addresses important facets of the regulations that affect the planning and design process. Subsequent sections of this report address technical requirements of the regulations at a level of detail appropriate for the evaluation provided by that section. For instance, Chapters 7, 8, and 9 contain more detailed information regarding wastewater collection and treatment system and biosolids management regulations.

FEDERAL AND STATE STATUTES, REGULATIONS AND PERMITS

This section discusses some of the various federal and state laws that may affect wastewater system construction and operations, as well as other relevant permits, programs, and regulations.

FEDERAL CLEAN WATER ACT

The Federal Water Pollution Control Act is the principal law regulating the water quality of the nation's waterways. Originally enacted in 1948, it was significantly revised in 1972 and 1977, when it was given the common title of the "Clean Water Act" (CWA). The CWA has been amended several times since 1977. The 1987 amendments replaced the Construction Grants program with the Water Pollution Control State Revolving Fund (SRF) that provides low-cost financing for a range of water quality infrastructure projects.

The National Pollutant Discharge Elimination System (NPDES) program was established by Section 402 of the CWA and its subsequent amendments. The Department of Ecology administers NPDES permits for the U.S. Environmental Protection Agency (EPA). Most NPDES permits have a 5-year term and place limits on the quantity and quality of pollutants that may be discharged. The City's current NPDES permit, No. WA0020249, is attached as Appendix B. The City's current permit effluent limits are shown in Table 5-3 in Chapter 5. Condition S.1 of the City's permit requires the treatment plant effluent to meet limits for 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform bacteria, pH, and total ammonia.

Condition S.2.lists monitoring requirements including influent and effluent flow, BOD_5, TSS, pH, temperature, total ammonia, fecal coliform, priority pollutant metals, oil and grease and cyanide. A program to address oil and grease is also required. The City must monitor twice per 5 years for effluent whole effluent toxicity, and conduct quarterly and yearly priority pollutant monitoring of its influent and effluent in support of its industrial pretreatment program. Additionally, per the terms of the City's coverage under the Statewide Biosolids permit, the City must annually test its biosolids for pollutants and compliance with pathogen reduction and vector attraction reduction criteria.

Condition S.4.A specifies the WWTF design capacity for maximum month BOD_5 loading is 5,616 lbs/day and 6,405 lbs/day for TSS. The peak hour flow, dry weather monthly average, and maximum month average flow capacities for the WWTF are 11.09, 2.86 and 6.10 million gallons per day (mgd), respectively. Condition S.4.B requires the City to prepare a plan to maintain adequate capacity when flows and loadings to the WWTF exceed 85 percent of design capacity for 3-consecutive months.

Chapter 8 of this Plan includes an evaluation of the WWTF operating conditions and provides recommendations for improving and maintaining adequate treatment capacity to ensure long-term NPDES permit compliance.

Section 307 of the CWA established the National Pretreatment Program. This program is designed to protect publicly owned treatment works (POTWs) and limits the amount of industrial or other non-residential pollutant discharged to municipal sewer systems. The City's pretreatment program is summarized and evaluated in Chapter 10 of this Plan.

PROPOSED CAPACITY, MANAGEMENT, OPERATION AND MAINTENANCE REGULATIONS

EPA has proposed a new round of regulations titled Capacity, Management Operation and Maintenance (CMOM). Though the regulations are yet to be formally adopted by EPA, some municipalities are anticipating the adoption and have moved forward with implementation. CMOM focuses on the failure of collection systems and requires a program for long-term financing and repair. Under its authority granted by the federal Clean Water Act, EPA seeks to address sanitary sewer overflows (SSO) under the CMOM program. It is expected that elements of CMOM could be incorporated into NPDES permits.

In general the CMOM requirements can be summarized in the following elements:

1. General performance standards including system maps, information management, and odor control.

2. Program documentation including the goals, organizational and legal authority of the organization operating the collection system.

3. An overflow response plan that requires response in less than 1 hour and is demonstrated to have sufficient and adequate personnel and equipment, etc. Estimated volumes and duration of overflows must be accurately measured and reported to the regulatory agency.

4. System evaluation requires that the entire system be cleaned on a scheduled basis (for example, once every 5 years), be regularly TV inspected, and that a program for short and long term rehabilitation replacement be generated. EPA has proposed, as a rule of thumb, a 1.5 to 2 percent system replacement rate which implies that an entire collection system is replaced somewhere in the range of a 50- to 70-year time period.

5. A capacity assurance plan that will use flow meters to model I&I, ensure lift stations are properly operated and maintained, and that source control is maintained.

6. A self-audit program to evaluate and adjust performance.

7. A communication program to communicate problems, costs, and improvements to the public and decision-makers.

EPA is considering some changes in design standards for collection systems including requiring that sanitary sewer overflows not occur except in extreme storms. They have also decided that they will not predefine the type of storm, leaving that decision to the design engineer.

FEDERAL ENDANGERED SPECIES ACT

On March 16, 1999, the National Marine Fisheries Service (NMFS) listed the Puget Sound Chinook as "threatened" under the Endangered Species Act (ESA). In 1999, the United States Fish and Wildlife Service (USFWS) listed the Bull Trout as "threatened." ESA listings impact activities that affect salmon and trout habitat, such as water use, land use, construction activities, and wastewater disposal. Impacts to the greater Camas area may include longer timelines for permit applications, and more stringent regulation of construction impacts and activities in riparian corridors.

In response to existing and proposed ESA listings of salmon, steelhead, and trout species throughout Washington State, Governor Locke established the Office of Salmon Recovery in 1997 to direct the State's salmon recovery efforts. Rather than attempting to avert additional ESA listings, the Statewide Strategy provides local input into, and maintains some local control over, the salmon recovery regulatory processes that affects the majority of Washington State.

In order to minimize liability under the ESA, local governments need to demonstrate that their land use regulations will not result in a prohibited "take" of a listed species, including adverse modification of critical habitat.

Per the *City of Camas Comprehensive Plan (2002 Amendment),* Camas provides (or likely provides) habitat for the following species listed as endangered by the WDFW: Great Blue Heron, Wood Duck, Columbian Black-tailed Deer, Pileated Woodpecker and Bald Eagle. Other species that may occur in the Camas area that are listed as Candidate or Threatened species include the following: Little Willow Flycatcher, Northern Red-legged Frog and Spotted Frog. In addition, Chinook salmon and Bull trout are expected to be present in the vicinity of the outfall and could potentially impact future WWTF and outfall modifications.

RECLAIMED WATER STANDARDS

The standards for the use of reclaimed water are outlined in RCW 90.46 and in a separate document published by the Washington State Department of Health and Ecology entitled "Water Reclamation and Reuse Standards." Reclaimed water is the effluent derived from a wastewater treatment system that has been adequately and reliably treated, such that it is no longer considered sewage and is suitable for a beneficial use or a controlled use that would not otherwise occur. The legislature has declared that "the utilization of reclaimed water by local communities for domestic, agricultural, industrial, recreational, and fish and wildlife habitat creation and enhancement purposes (including wetland enhancement) will contribute to the peace, health, safety, and welfare of the people of the State of Washington."

The *Water Reclamation and Reuse Standards* define the water quality standards for reclaimed water. The City of Camas WWTF does not generate reclaimed water; however, an evaluation of the feasibility of reuse, either generated at the existing WWTF (after appropriate modifications) or a possible new satellite WWTF, is provided in Chapter 9. The generation of Class "A" reclaimed water has four minimum requirements that are described below:

Continuously Oxidized - Wastewater that at all times has been stabilized such that the monthly average BOD_5 and TSS are less than 30 mg/L, is non-putrescable and contains dissolved oxygen.

Continuously Coagulated - Oxidized wastewater that at all times has been treated by a chemical or equally effective method to destabilize and agglomerate colloidal and finely suspended matter prior to filtration.

Continuously Filtered - Oxidized and coagulated wastewater that at all times has been passed through a filtering media so that the turbidity of the filtered effluent does not exceed an average of 2 nephelometric turbidity units (NTU), determined monthly, and does not exceed 5 NTU at any time.

Continuously Disinfected - Oxidized, coagulated and filtered wastewater that at all times has been disinfected to destroy or inactivate pathogenic organisms. A group of indicator microorganisms, coliform bacteria, are used to measure the effectiveness of the disinfection process. The Class "A" reclaimed water standard is a total coliform density of 2.2 per 100 milliliters (ml) for the median of the last 7 days of samples, with no sample having a density greater than 23 per 100 ml.

NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) was established in 1969 and requires federal agencies to determine environmental impacts on all projects requiring federal permits or funding. Federally delegated activities such as NPDES permits or Section 401 Certification are considered state actions and do not require NEPA compliance. If a project involves federal action (through, for example, an Army Corps of Engineers Section 404 permit), and is determined to be environmentally insignificant, a Finding of No Significant Impact (FONSI) is issued, otherwise an Environmental Assessment (EA) or Environmental Impact Statement (EIS) would be required. NEPA is not applicable to projects that do not include a federal component.

FEDERAL CLEAN AIR ACT

The Federal Clean Air Act requires all wastewater facilities to plan to meet the air quality limitations of the region. The City falls in the jurisdiction of the Southwest Clean Air Agency. The Southwest Clean Air Agency (SWCAA) is responsible for enforcing federal, state and local outdoor air quality standards and regulations in Clark, Cowlitz, Lewis, Skamania and Wahkiakum counties of southwest Washington state. The Camas generator is permitted by SWCAA.

STATE STATUTES, REGULATIONS AND PERMITS

STATE WATER POLLUTION CONTROL ACT

The intent of the state Water Pollution Control Act is to "maintain the highest possible control standards to ensure the purity of all waters of the state consistent with public health and the enjoyment…the propagation and protection of wildlife, birds, game, fish and other aquatic life, and the industrial development of the state." Under the Revised Code of Washington (RCW) 90.48 and the Washington Administrative Code (WAC) 173-240, Ecology issues permits for wastewater treatment facilities and land application of wastewater under WAC 246-271.

Submission of Plans and Reports for Construction of Wastewater Facilities, WAC 173-240

Prior to construction or modification of domestic wastewater facilities, engineering reports and plans, and specifications must be submitted to and approved by Ecology.

This regulation outlines procedures and requirements for the development of an engineering report that thoroughly examines the engineering and administrative aspects of a domestic wastewater facility project. This state regulation defines a facility plan as an engineering report under federal regulations, 40 CFR Part 35.

Key provisions of WAC 173-240 are provided below:

- An engineering report for a wastewater facility project must contain everything required for a general sewer plan unless an up-to-date general sewer plan is on file with Ecology.
- An engineering report shall be sufficiently complete so that plans and specifications can be developed from it without substantial changes.
- A wastewater facility engineering report must be prepared under the supervision of a professional engineer.

Criteria for Sewage Works Design, Washington State Department of Ecology

Ecology has published design criteria for collection systems and wastewater treatment plants. While these criteria are not legally binding, their use is strongly encouraged by Ecology since the criteria are used by the agency to review engineering reports for upgrading wastewater treatment systems. Commonly referred to as the "Orange Book," these design criteria primarily emphasize unit processes through secondary treatment, and also includes criteria for planning and design of wastewater collection systems. Any expansion or modification of the City of Camas collection system and/or WWTF plant will require continued conformance with Ecology criteria.

Certification of Operators of Wastewater Treatment Plants, WAC 173-230

Wastewater treatment plant operators are certified by the state Water and Wastewater Operators Certification Board. The operator assigned overall responsibility for operation of a wastewater treatment plant is defined by WAC 173-230 as the "operator in responsible charge." This individual must have state certification at or above the classification rating of the plant.

The City of Camas WWTF is currently assigned a Class 4 rating and the operating staff assigned to the plant have the required certification. (One of the operators has a Class 4 certification; two have Class 3 certification, and one has Class 2 certification.)

SURFACE-WATER QUALITY STANDARDS (WAC 173-201A)

In the State of Washington, WAC 173-201A establishes water quality standards for surface waters based on maintaining public health, recreational use and protection of fish, shellfish, and wildlife. Surface water quality standards include five groups: AA (extraordinary), A (excellent), B (good), C (fair), and Lake Class. Each class has its own characteristic use and measurable criteria. Measurable parameters used to distinguish the different surface water classifications include fecal coliform levels, dissolved oxygen concentration, temperature, pH, and turbidity. The surface water criteria include twenty-nine toxic substances, including ammonia, residual chlorine, several heavy metals, polychlorinated biphenyls (PCBs), and pesticides.

It is the policy of the State of Washington to maintain existing beneficial uses of surface water by preventing degradation of existing water quality. However, certain allowances are made by Ecology for discharging treated wastewater into a surface water that enable a temporary or mitigated degradation to occur. These allowances are made by establishing mixing zones and determining the assimilative capacity of the receiving water.

Discharging to surface water requires an NPDES permit issued by Ecology under WAC 173-220. Wastewater treatment plants must generally meet technology-based limits that include 30 mg/L Total Suspended Solids (TSS) and 30 mg/L 5-day Biochemical Oxygen Demand, BOD_5 (typically termed "30 –30 limits"). Additionally, under WAC 173-201A-060, State Water Quality Standards, Ecology is authorized to condition NPDES permits so that the discharge meets water quality standards. Therefore, other permit conditions in addition to or more stringent than the 30-30 limits could be added to ensure that the water quality of the receiving water is not degraded. For example, the City has limits of 20 mg/L TSS and 20 mg/L BOD_5 due to the dilute nature of its influent and requirements to percent removal for TSS and BOD_5. In addition, effluent limits for ammonia were included in the City's 2004 permit.

Ecology has issued changes to its water quality standards. The changes are pending approval from the EPA. These proposed changes include changing the current class-based system to a use-based system. Depending on the use of the particular water body, water quality standards for temperature and dissolved oxygen in the water body could change also. Ecology has also proposed changing the indicator of bacteriological contamination from fecal coliform to enterococci for some water bodies.

STATE ENVIRONMENTAL POLICY ACT

WAC 173-240-050 requires a statement in all wastewater comprehensive plans regarding proposed projects in compliance with the State Environmental Policy Act (SEPA), if applicable. The capital improvements proposed in this plan will fall under SEPA regulations. A SEPA checklist is included in Appendix A of this report for use in the environmental review for the project. In most cases a determination of non-significance is issued (DNS); however, if a project will have a probable significant adverse environmental impact an environmental impact statement (EIS) will be required.

ACCREDITATION OF ENVIRONMENTAL LABORATORIES (WAC 173-050)

The State of Washington established a requirement that all laboratories reporting data to comply with NPDES permits must be generated by an accredited laboratory. This accreditation program establishes specific tasks for quality control and quality assurance

(QA/QC) that are intended to ensure the integrity of laboratory procedures. Accreditation requirements must be met for any on-site laboratory or outside laboratory used to analyze samples. Only accredited laboratories may be used for analyses reported for compliance with NPDES permits. In planning for an on-site laboratory, staffing must be sufficient to allow for QA/QC procedures to be performed. The Camas WWTF lab is currently accredited for determination of the following parameters TSS, BOD_5, ammonia, dissolved oxygen , pH and fecal coliform.

MINIMAL STANDARDS FOR SOLID WASTE HANDLING (WAC 173-304)

Grit and screenings are not subject to the sludge regulations in WAC 173-308, but their disposal is regulated under the state solid waste regulations, WAC 173-304. Waste placed in a municipal solid waste landfill must not contain free liquids, nor exhibit any of the criteria of a hazardous waste as defined by WAC 173-303. To be placed in a municipal solid waste landfill, grit, screenings, and incinerator ash must pass the paint filter test. This test determines the amount of free liquids associated within the solids, and includes the toxic characteristic leachate procedure (TCLP) test, which determines if the waste has hazardous characteristics.

WETLANDS

Dredging and Filling Activities in Natural Wetlands (Section 404 of the Federal Water Pollution Control Act)

A Corps permit is required when locating a structure, excavating, or discharging dredged or fill material in waters of the United States or transporting dredged material for the purpose of dumping it into ocean waters. Typical projects requiring these permits include the construction and maintenance of piers, wharves, dolphins, breakwaters, bulkheads, jetties, mooring buoys, and boat ramps.

If wetland fill activities cannot be avoided, the negative impacts can be mitigated by creating new wetland habitat in upland areas. If other federal agencies agree, the Corps would generally issue a permit.

Wetlands Executive Order 11990

This order directs federal agencies to minimize degradation of wetlands and enhance and protect the natural and beneficial values of wetlands. This order could affect siting of lift stations and sewer lines.

SHORELINE MANAGEMENT ACT

The Shoreline Management Act of 1971 (RCW 90.58) establishes a broad policy giving preference to shoreline uses that protect water quality and the natural environment, depend on proximity to the water, and preserve or enhance public access to the water.

The Shoreline Management Act jurisdiction extends to lakes or reservoirs of 20 acres or greater, streams with a mean annual flow of 20 cubic feet per second (CFS) or greater, marine waters, and an area inland 200 feet from the ordinary high water mark. Projects are reviewed by local governments according to state guidelines and a local Shoreline Master Program. The Camas wastewater treatment plant and portions of the collection system are located within shoreline areas.

The City implemented its own Shoreline Master Program in 1998.

FLOODPLAIN DEVELOPMENT PERMIT

Local governments that participate in the National Flood Insurance Program are required to review projects in a mapped floodplain and impose conditions to reduce potential flood damage from flood water. A Floodplain Development Permit is required prior to construction, including projects involving wastewater collection facilities.

HYDRAULIC PROJECT APPROVAL

Under the Washington State Hydraulic Code (WAC 220-110), the WDFW requires a hydraulic project approval (HPA) for activities that will "use, divert, obstruct, or change the natural flow or bed" of any waters of the state. For City activities such as pipeline crossings of streams or WWTF outfall modifications, an HPA will be required. The HPA will include provisions necessary to minimize project specific and cumulative impacts to fish.

CITY SEWER ORDINANCES AND PLANNING POLICIES

The Camas Municipal Code, Title 13, Division II, addresses rules and regulations for the City's sewer system. Table 4-1 lists the chapters in Title 13. These chapters of the municipal code have been included in Appendix C. As shown in Table 4-1, the sewer ordinances address such issues as requirements for connections to sewer system, STEP systems, permits for sewer installation by developers, rates for sewer service, development requirements for private sewer systems, conditions for sewer service extensions, and sewage pretreatment regulations.

TABLE 4-1

Camas Municipal Code Sewer System

Chapter	Title	Description
13.60	Sanitary Disposal System	Provides general information such as a permits, required connection, flush toilet for private system, non-conforming systems, enforcement, and penalties for violations.
13.60.040	Construction-Permit Required	Establishes that it is unlawful to construct any means of sewerage disposal without first acquiring a permit.
13.60.050	Connection-Required	Includes requirements for connections to sewer system when it is available.
13.60.060	Private System-Flush Toilet	Requires all homes and businesses, where there are no public sewer lines available, to provide a private water flush toilet.
13.60.080	Enforcement	City Health Officers duty to enforce provisions of Chapter 13.60.
13.60.90 13.60.100	Violations	Anyone who violates or refuses or fails to comply with Chapter 13.60 shall be guilty of a misdemeanor and submit to fines or imprisonment.
13.62	Septic Tank Effluent Pumping Systems	Provides general information such as standard specifications, application to connect, inspection fee, right-of-entry, ownership, damage and repair, and landscaping.
13.62.010	Definitions	Includes definitions related to STE and STEP systems.
13.64	Sewer Service Charges	Provides rate schedule for residential and commercial and industrial users, describes adjustment for broken water lines, and sets connection rates.
13.68	Sewer Use	
13.68.010	Definitions	Definitions relating to NPDES permit effluent parameters, wastes, buildings, etc.
13.68.020	Use Provisions	Prohibition of hazardous and inappropriate discharges to the sewer.
13.68.030	Inspection	Inspections to ensure compliance with this chapter.
13.68.050 13.68.060	Violation	Written notice of violation and noncompliance is a misdemeanor and a conviction shall be fined and imprisoned not to exceed 60 days.
13.72	Sewer Service Development Charge	Provides rules and fees for property owners who seek to connect property to the sewer system of the city to be assessed a charge in order that such property shall bear its equitable share of the cost of the sewer system

CHAPTER 5

EXISTING FACILITIES

INTRODUCTION

This Chapter describes existing facilities that compose the City of Camas's wastewater collection and treatment systems. These facilities include pressure and gravity sewers, pump stations, wastewater treatment facilities, and river outfall.

WASTEWATER COLLECTION SYSTEM

Septic Tank Effluent (STE) Systems

In 1985, the City of Camas adopted a wastewater collection plan which was based on the use of septic tank effluent (STE) systems for new residential, commercial and industrial connections to the City sewer. In this type of system, a significant portion of the suspended solids in the raw wastewater settle out in the STE tank at the customer's property. The solids remain in the tank for 5 to 7 years and are partially stabilized by biological digestion. When the solids storage capacity of a tank is reached, the tank is pumped out and the resultant septage is hauled by tank truck to the City's wastewater treatment facility. All STE tanks, except commercial tanks and certain private, custom installations, are owned and maintained by the City. Custom installations are inspected regularly for compliance with City ordinances. As part of the City's sewer system maintenance program, all City-owned tanks receive ongoing maintenance.

There are three major types of STE systems, which include:

- STEP: Septic Tank Effluent Pump systems
- STEF: Septic Tank Effluent Filter systems
- STEG: Septic Tank Effluent Gravity Flow systems

Most of the STE systems at Camas are STEP systems.

Since 1985, over 3,500 sewer connections have been added to the City's system, with most of these connections using STE facilities. It is estimated that over half of the current total sanitary sewage flow to the wastewater treatment facility consists of flow from STE systems, and that about 80 to 90 percent of the wastewater generated by new connections originates from STE systems. As of 2005, there were 6,223 sewer utility customers.

The use of STE systems has resulted in a decrease in the strength of the influent wastewater entering the treatment facility, as compared to typical domestic wastewater.

Medium strength wastewater is estimated to have both BOD_5 and TSS concentrations of 220 mg/L (Metcalf and Eddy, 2nd Edition), and the existing secondary treatment standard of 85 percent removal of pollutants is based on typical influent BOD_5 and TSS concentrations of 200 mg/L. According to USEPA publication 660/K-93/001 (January 1993), a typical septic tank provides a 40 to 50 percent reduction in BOD_5 and a 60 to 80 percent reduction in TSS. Based on this removal performance for typical domestic wastewater, a septic tank would be expected to produce an effluent with BOD_5 concentration in the range of 100 to 130 mg/L and TSS in the range of 40 to 90 mg/L. Samples from the City's wastewater treatment facility influent during the dry weather months of July through September 2004-2005 indicated average BOD_5 and TSS concentrations of 150 mg/L and 180 mg/L, respectively. These influent concentrations are somewhat lower than those normally associated with typical domestic wastewater, and indicate substantial amounts of low-strength septic tank effluent. Since infiltration and inflow would be low during these dry weather months, the low influent strength can partially be attributed to the BOD_5 and TSS removal in the City's STE systems.

Another factor in the low influent strength is dilution by low strength industrial flows. About one third of the Camas water supply is consumed by industries, and much of this is discharged to the WWTF at lower strength (for BOD_5 and TSS, but not necessarily for other pollutants) than ordinary municipal wastewater. Wafertech, for instance, one of the City's largest dischargers, is known to discharge wastewater low in BOD_5 and TSS but high in TKN (Total Kjeldahl Nitrogen, the sum of organic and ammonia nitrogen).

Although the use of STE systems will decrease the strength of the City's influent, hauling and treatment of septage from the STE systems at the City's WWTF will add substantially to the demands of the solids handling system and contribute to BOD_5 and TKN loadings through internal recycle streams.

Pump Stations

The City of Camas has sixteen major pump stations within its sanitary sewer system. The locations of these pump stations are shown in Figure 2-2. Basic information about the pump stations is included in Table 2-1. Only the Main Pump Station has variable frequency drive (VFD) control. A description of the various basins in which the pump stations are located appears in the next section.

TABLE 5-1

Pump Stations

	Pump Station	Location	Basin No. Located In	Qty. of Pumps	Pump Motor Size (HP)	Pump Capacity (gpm, ea.)	Total Station Capacity (gpm, w/1 out of service)	TDH (ft.)	Force Main Dia. (in.)
1	Main	SE 3rd and Dallas	5	3	125	3,850	7,700	85	18
2	Oak Park	SE 9th and SE Polk	8	2	10	350	350	57	6
3	One Stop	NE 2nd and Yale	9	2	5	231	231	36.2	6
4	South Prune Hill	NW 6th and Oregon	10	2	15	510	510	39	10
5	West Camas	NW 6th Avenue and NW 6th Place	1	2	30	810	810	74	6
6	Crown View Plaza	NW Kent and NW Ivy	3	2	25	325	325	126	6
7	Lacamas Creek	NE 3rd Loop and NE 3rd Avenue	7	2	18	300	300	79	6
8	Parker Estates	NW Parker Street and NW Knapp Lane	13	2	20	312	312	120	6
9	Winchester Hills No. 1	NW Pacific Rim Blvd. and NW Payne Road	13	2	6	148	148	74.5	4
10	Winchester Hills No. 2	West end of SE 42nd Street	13	2	5	125	125	65	4
11	Grand Ridge	SE Grand Ridge Drive	11	2	10	65	65	160	4
12	Brady Road	SE Brady Road and NW MacIntosh Road	11	2	35	500	500	154	8
13	Sunningdale Gardens 1	NW Dahlia Loop	14	2	5	95	94	63	4
14	Lacamas Shores	NW Lacamas Shores Drive and NW El Rey Drive	14	2	15	200	200	175	6
15	Prune Hill Park	NW Sierra Drive and NW 35th Circle	13	2	7.5	350	350	53	6
16	Hunter Ridge Estates				Not	yet	submitted		
17	Larkspur	End of NW Larkspur	14	2	23	264	264	154	4
18	Hillshire	End of NW Artz Court		2	10	175	175	70.1	6
19	Stoneleaf	NW 25th and NW Knight	13	2	23	423	423	81	6
20	Two Creeks "A"	NW Quinault and NW 72nd Loop	14	2	10	166	166	71	6
21	Two Creeks "B"	NW Camas Meadows Drive	14	2	35	221	221	222	6
22	Grass Valley	West end of NW 45th Avenue	14	2	23	173	176	203	6

Gravity Collection System

Sanitary sewer lines in downtown Camas, and areas to the immediate north and east of downtown, were constructed from the 1920s through the 1950s. The first sewer lines in this core area were constructed of vitrified clay pipe (VCP); subsequently, cast iron, and concrete pipe, were added. Much of this original sewer pipe is still in place today. As the City has grown, primarily to the northwest and southeast of downtown, additional concrete pipe has been added to the system. Since the 1980s, improved sewer construction and pipe materials have been used, including non-porous piping materials (PVC pipe) and rubber-gasket type joints to reduce infiltration and improve the condition of the sanitary sewer system. The sewer systems installed in the 1990s for many of the residential and commercial developments on the periphery of Camas have been septic tank effluent (STE) systems with small diameter HDPE and PVC pipes.

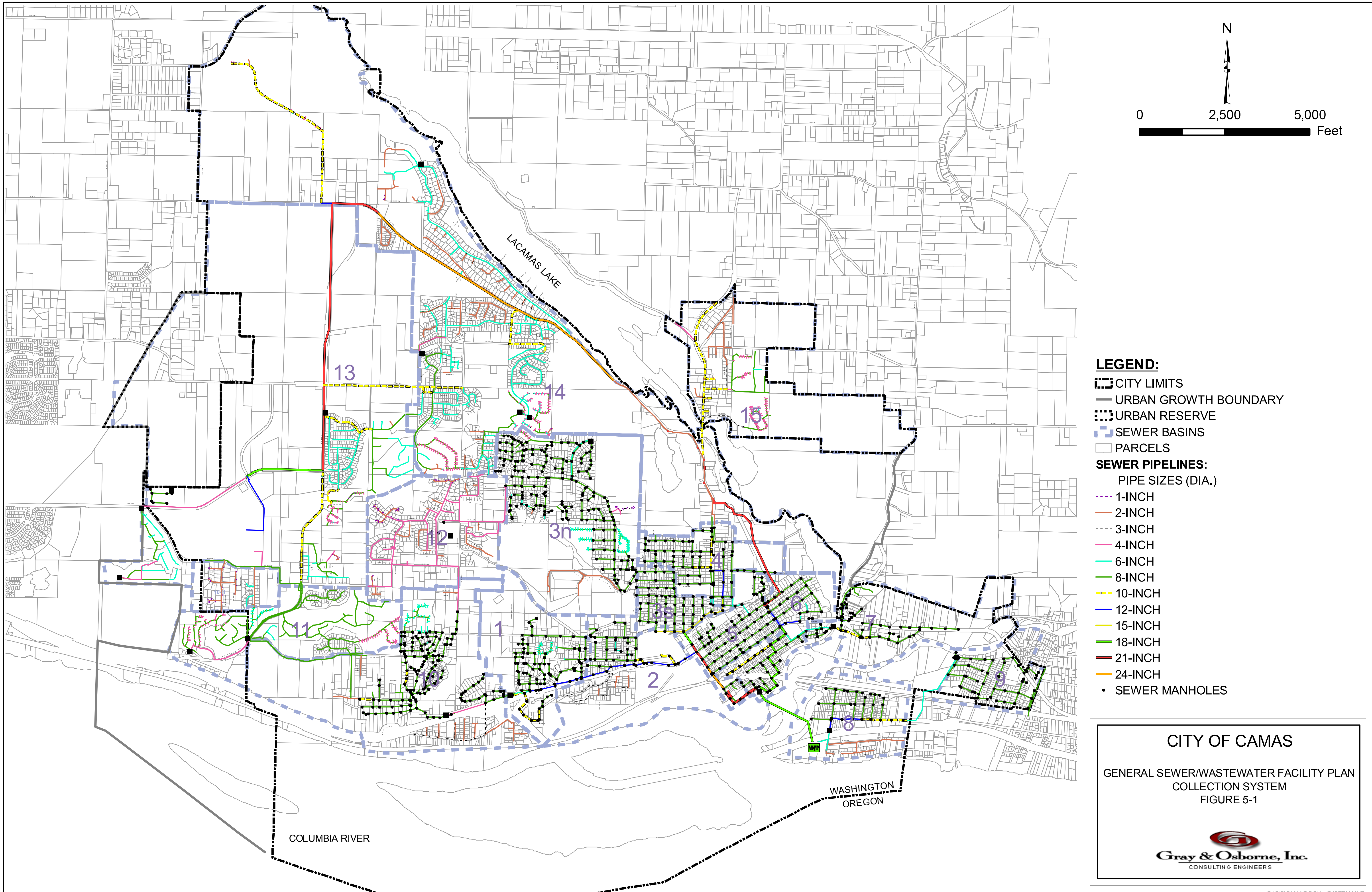
Figure 2-2 shows the existing sewer system. Wastewater is discharged to the City's secondary wastewater treatment facility, which has an outfall on the Columbia River. The sewer system service area in Camas generally slopes toward the confluence of the Washougal and Columbia Rivers, where the treatment facility is located. Thus, much of the collection system consists of gravity sewers. However, the system also contains pump stations, pressure lines, and the STE systems. STE systems are concentrated in the northern and western portions of the City. The current system consists of 2-inch to 27-inch-diameter pipe, constructed of VCP, concrete, cast iron and PVC. Figure 2-3 shows the sewer system with sewer pipe diameters identified.

A summary of the various diameters and the percentage of each within the City's gravity sewer system are provided in Table 2-2. This summary is an estimate based on manhole inspections conducted in 1998, review of as-built drawings and previous television inspection and information provided by the City.

The City's sanitary sewer system also contains approximately 800 manholes. These manholes vary in construction material from all brick to the newer precast concrete manholes. The older, all brick and concrete block manholes present a greater opportunity for infiltration to occur, due to the mortar joints between the bricks or concrete blocks, than the newer precast manholes.

Collection Areas

For the purposes of this report, the City of Camas WWTF collection system is divided into 15 collection areas, or drainage basins. These collection areas predominantly follow the natural drainage patterns of the City's service area. The fifteen major basins are shown in Figure 2-2. The locations and names of the different basins are generally consistent with and equivalent to those used in previous reports. However, basin boundaries have been modified to reflect new developments and new flow routing, including changes to the direction of flow in pressure lines and new gravity sewer lines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5,000
Feet
LACAMAS LAKE
13
14
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1
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10
2
9
8
COLUMBIA RIVER
WASHINGTON
OREGON
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
PARCELS
SEWER PIPELINES:
PIPE SIZES (DIA.)
1-INCH
2-INCH
3-INCH
4-INCH
6-INCH
8-INCH
10-INCH
12-INCH
15-INCH
18-INCH
21-INCH
24-INCH
SEWER MANHOLES
CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
COLLECTION SYSTEM
FIGURE 5-1
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CONSULTING ENGINEERS

(particularly in Basins 11, 12, 13). As discussed in Chapter 7, the 15 basins have been subdivided into smaller basins for the purposes of modeling the sewer system.

TABLE 5-2

Sewer Pipe Summary
(All lengths in feet)

Pipe Diameter	Pipe Length(ft.)		Sewer Type	Pipe Length (ft.)
4	48,670		Gravity	291,540
6	85,764		Force Main	41,925
8	238,396		STEP	53,427
10	39,095		STEF	27,171
12	9,569		STEG	13,376
15	2,733		Unknown	35,000
18	8,329			
21	19,569			
24	9,369			
TOTAL	**462,000 feet (87.5 miles)**			

The sewers in the downtown core area, including Basins 2, 5, 6, 7, 8, and 9, were constructed on alluvial deposits of silt and gravel. The groundwater table in this area fluctuates with the river elevation. Sewers constructed in the hills to the north and west of downtown, including those in Basins 3, 4, and 12, are constructed in sandstone deposits located above the groundwater table. During extended rainy periods, however, the soil around the sewers may become saturated, with the sandstone layer underneath acting as an aquitard. The sewer trench may then act as a natural drain for runoff, channeling the runoff water along the sewer pipe until it reaches a defect in the pipe or in a manhole, where it enters the sewer system and contributes to I/I.

The following section describes the boundaries and land use designations of each basin, as well as information about the sewer lines within each basin.

<u>Basin 1</u>

Basin 1 consists of an area of about 230 acres in West Camas around Forest Home Park. The approximate boundaries of this basin are SR 14 on the south, Forest Home Road on the north, and Ivy Street on the east. The designated land use in most of Basin 1 is single-family residences.

Sewage from Basin 1 is conveyed by gravity to the south through two separate 8-inch concrete pipe systems installed in 1962. The flow is conveyed into a 12-inch vitrified clay (VCP) main from these two system at separate connections east of the West Camas Pump Station. The 12-inch VCP main transports the sewage to Basin 2 to the east.

Basin 2

Basin 2 consists of an area of about 200 acres east of Forest Home Park and just west of downtown. The approximate boundaries of this basin are the Camas Slough on the south, Ivy Street (and Basin 1) on the west, NW Ivy Drive (and Basin 3) on the north, and a boundary just west of Adams Street near downtown. Basin 2 includes areas with designated land use for single- and multi-family residences, and a large area designated for heavy industrial for portions of the Georgia Pacific pulp and paper mill.

The area of Basin 2 north of NW 6th Avenue is served predominantly by vitrified clay pipe installed in the 1930s. Sewage from this area flows by gravity to the south into the 12-inch VCP main, which conveys the sewage to the east and into Basin 5. The area of Basin 2 south of NW 6th Avenue is served by a STEP system that includes 2-inch and 6-inch pipe. Sewage from the south side of NW 6th Avenue is ultimately conveyed north to the same 12-inch main accepting flow from the north side of NW 6th Avenue. A number of sewer pipes in Basin #2 have been recently replaced with HDPE pipe.

Basin 3

Basin 3 is a relatively long and narrow basin located near the geographic center of the current Camas city limits. Basin 3 is divided into Basin 3 North, consisting of about 460 acres and Basin 3 South, consisting of about 91 acres. Basin 3 North includes much of Crown Hill and the area around NW Fargo Road, which leads up to Crown Hill from the downtown area. The approximate boundaries of Basin 3 North are Forest Home Road to the south, NW Sierra Street to the west, NW 32nd Avenue to the north, and NW Fargo Road and NW Drake Street to the east. Basin 3 South includes the area just to the northwest of downtown. The approximate boundaries of Basin 3 South are NW Drake Street to the west, NW 18th Avenue and Crown Park to the north, and the Georgia Pacific facility water supply ditch to the southeast. The designated land use for a majority of the land within Basin 3 is for single-family residences, with smaller portions of the land zoned for multi-family residences and parks.

The northeastern and northwestern sections of Basin 3 North, respectively, are served by 8-inch concrete pipe (installed in the late 1970s and early 1980s), and 8-inch PVC (installed in 1994). Sewage from these areas is conveyed by gravity to the Crown View Plaza Pump Station, from which it is pumped south through a force main and then flows by gravity to the southeast and Basin 3 South. The southwest corner of Basin 3 North, along NW Ostenson Canyon Road, is served by a STEP system, while the southeast corner, along NW Fargo, is served by 8-inch pipe installed in 1962. Sewage from Basin 3 South is conveyed by 8-inch vitrified clay pipe installed in the 1930s, as well as a 15-inch main that conveys the combined flow to Basin 5. In the last six years, a gravity sewer on NW 27th was replaced between NW Sierra Street and NW Norwood Street, and a force main was replaced on Kent Street.

Basin 4

Basin 4 consists of an area of about 140 acres just north of downtown. Basin 4 borders Basin 3 South and Crown Park on the southwest. The approximate other boundaries are Couch Street to the west, NW 22nd Street, Fallen Leaf Park and Zellerbach Middle School to the north, and Camas High School to the southeast. This basin includes a "panhandle," to the east around NE 19th Avenue. The designated land use in Basin 4 consists of single- and multi-family residences, parks, and schools.

The majority of Basin 4 is serviced by gravity flow 8-inch concrete and VCP pipe, and additional sections of 10-, 12-, and 15-inch pipe. Combined flow from these pipes flows into an 18-inch line that transmits the flow along the southern border of Basin 3 South and into Basin 5. In the last 6 years, sewers have been rehabilitated on NE Garfield Street between NE 22nd Avenue and NE 15th Avenue, and on NE 18th Avenue between Division and Dallas Streets.

Basin 5

Basin 5 consists of an area of about 120 acres in downtown Camas. The approximate boundaries of this basin are Basins 2, 3 and 4 to the west and north, Joy Street to the northwest, and NE 3rd Avenue to the southeast. Basin 5 also includes a "panhandle" south of the railroad tracks near the Main Pump Station. Most of the designated land use in Basin 5 is commercial and industrial, with smaller portions to the north for municipal use and multi-family residences.

The majority of Basin 5 is served by 8-inch VCP pipe installed from 1927 to 1951. Relatively short sections have been recently replaced with concrete and PVC pipe, including a section of sewer on 3rd Avenue from Adams Street to Cedar Street within the last 5 years. Flow from Basin 5 enters a 24-inch trunk line flowing along Adams Street. This trunk line flows into a 21-inch line before entering the Main Pump Station, where the flow combines with that from Basin 6. The Main Pump Station pumps the combined flow across the Washougal River through a force main and into the treatment facility.

Basin 6

Basin 6 consists of an area of about 110 acres in downtown Camas. The approximate boundaries of this basin are NE 3rd Avenue (and Basin 5) to the west, Lacamas Creek Park to the east, and the railroad tracks and Washougal River to the south. Most of the designated land use in Basin 6 is commercial and multi-family, with smaller areas within the basin designated for parks and heavy industrial facilities.

Basin 6 is served primarily by 8-, 10-, and 12-inch pipes (installed in 1927 to 1951) flowing by gravity. Sewage from these pipes, as well as flow from the 24-inch STEP line in Basin 14, flows into an 18-inch trunk line in Basin 6 that discharges into the Main Pump Station.

<u>Basin 7</u>

Basin 7 consists of an area of about 160 acres immediately to the east of downtown Camas. The approximate boundaries of this basin are Lacamas Creek Park (and Basin 6) to the west, the Washougal River to the south, and a boundary running parallel to and north of NE 3rd Avenue N to the north. Basin 7 is zoned for single- and multi-family residences, commercial facilities, and parks.

Basin 7 is served by 8-inch concrete pipe that was installed from 1927 to 1951. Sewage is conveyed by gravity through this system to the Lacamas Creek Pump Station, from which sewage travels by 6-inch force main to Basin 6.

<u>Basin 8</u>

Basin 8 consists of an area of 170 acres near the confluence of the Washougal and Columbia rivers, across the Washougal River from downtown Camas. The approximate boundaries of this basin are the Columbia River to the south the Washougal River to the north and west, and a boundary running parallel to and east of Union Street to the east. The designated land use in Basin 8 is single- and multi-family residences, light industry, commercial facilities and municipal facilities, including the City of Camas WWTF and Operations Center.

The area in Basin 8 to the north of SR 14 is served by 8- and 12-inch concrete gravity lines, which transfer sewage to the Oak Park Pump Station and through the force main and into the treatment facility. Sewage from the area to the south of SR 14 is pumped by a STEP system into the force main where it merges with the flow from the north side of SR 14.

<u>Basin 9</u>

Basin 9 consists of an area of about 100 acres on the extreme eastern boundary of the City limits along 3rd Avenue NE. The approximate boundaries of this basin are the Washougal River to the north, Yale Street and Goot Park to the west, Lechner Street to the east, and the railroad tracks to the south. Basin 9 is zoned for single- and multi-family residences, parks and commercial facilities.

Sewage from Basin 9 is conveyed by gravity flow though 8-inch concrete pipe (installed in 1972) to the One Stop Pump Station. From here, flow from this basin is conveyed through a 6-inch force main to Basin 8.

<u>Basin 10</u>

Basin 10 consists of an area of about 550 acres in the western part of Camas, centered around Prune Hill. This basin is bordered on the east by Basin 1. The approximate other boundaries of this basin are the Camas Slough to the south, Klickitat Street to the west and a northern boundary of NW McIntosh to in the western portion and NW 18th Avenue in the east. The vast majority of the land in this basin is designated for single-family housing with small sections of multi-family houses, parks, and commercial facilities in the south portion of the basin.

Sewage from the north side of SR 14 in Basin 10 generally flows by gravity through 8-inch concrete pipe (installed in 1982). STEP effluent from Basin 12 enters Basin 10 in a 4-inch STEP line on NW Astor Street. Additionally, a PVC line installed in the 1990s runs down Fremont Street. Sewage from these lines is conveyed to the south, where near SR 14, it reaches the West Camas Pump Station, where the sewage is pumped into Basin 1 to the east. The south side of SR 14 is served by a STEP system that combines with the flow from the north side of SR 14 in Basin 10 upstream of the South Prune Hill Pump Station.

Basin 11

Basin 11 consists of an area of about 410 acres in the extreme southwestern corner of Camas. The approximate boundaries of this basin are Fremont Street (and Basins 10 and 12) to the east, Basin 10 to the south, the Camas Urban Growth Boundary to the west. Most of the area of Basin 11 is designated for single-family housing.

Basin 11 is served primarily by STEP, STEF and STEG systems consisting of 2-inch, 6-inch, and 8-inch pipe. A small section around NW Whitman St. is served by a 6-inch gravity main and a STEF system. Sewage from Basin 11 is ultimately collected by the Brady Road Pump Station and conveyed to the north, where it flows into Basin 13 on NW Brady Road. Sewage collected from the southwest corner of Basin 11 is conveyed by the Grand Ridge Pump Station to the Brady Road Pump Station.

Basin 12

Basin 12 consists of an area of about 270 acres in central-west Camas, including Dorothy M. Fox Elementary School and portions of Prune Hill. Basin 12 borders Basins 1, 3 and 10 on the west and south. The approximate extent of Basin 12 to the north is NW 28th Avenue, while to the west the boundary is west of NW Hood Street, Columbia Summit Drive, and NW Ilwaco Court. Most of Basin 12 is designated for single-family housing, while the northeast corner is designated for schools and parks.

Sewage from Basin 12 is conveyed to the south (to Basin 10) by a STEP system. The diameters of pipes in this basin are 2 and 4 inches.

Basin 13

Basin 13 consists of an area of about 1,700 acres along the western border of the Camas city limits. Basin 13 borders Basins 11, 12, and 14 to the south, southeast, and east, respectively, while the west boundary is near the Camas Urban Growth Boundary. Most of Basin 13 is designated for light industrial, while portions are designated for single-family residences, commercial facilities, and schools. Basin 13 includes several large industries, including Wafertech, Linear, Sharp, Landa, and Heraeus Shin Etsu.

Sewage in Basin 13 is conveyed through STEP systems (10- and 18-inch pipes) and STEF systems (6- and 10-inch pipes) into a 21-inch pressure line. The 21-inch line, which was installed in 1991, conveys sewage north to Basin 14. The southwest corner of Basin 13 is served by the Winchester Hills 1 and Winchester Hills 2 Pump Stations, and the western portion is served by the Parker Estates Pump Station.

<u>Basin 14</u>

Basin 14 consists of an area of about 1,800 acres in northern Camas stretching from just north of downtown to the northwest corner of the Camas City limits on Lacamas Lake. This basin borders Lacamas Lake on the north and Basins 13, 12, 3, and 4 to the south. The majority of the land in Basin 14 has land use designations for single-family housing, with sections devoted to commercial facilities, multi-family housing, schools, parks and public facilities.

Most of Basin 14 is served by a STEP system. However, the area near El Rey Drive is served by a STEG system, and the area around NW Valley Street is served by STEF. Sewage in Basin 14 is conveyed by 2-, 4-, 6-, 8-, 10-, and 24-inch pipes to a 24-inch trunk line that runs southeast along Lacamas Lake to Basin 6. Pump stations in Basin 14 include the Lacamas Shores Pump Station serving the area just south of the northwest corner of Lacamas Lake, and Sunningdale Gardens 1, Sunningdale Gardens 2, and Summit Oaks Pump Stations serving the area south of central Lacamas Lake.

<u>Basin 15</u>

Basin 15 consists of an area of 180 acres north of Round Lake in the Lacamas Heights area. The area is outside of the Camas city limits, but inside the urban growth boundary. The approximate boundaries of this basin are Round Lake to the south, Lacamas Lake to the southwest, west of Everett Street to the west, and Lacamas Heights Elementary School to the northwest. Most of Basin 15 is designated for single-family residences, with portions designated for parks and schools (Lacamas Heights Elementary School). Camas High School is located just east of Basin 15.

Basin 15 is served by a STEP system that ultimately pumps sewage south to Basin 14. The collection system includes 2-inch and 4-inch pipes that discharge into a 10-inch line that connects with the main in Basin 14.

WASTEWATER TREATMENT FACILITY

The original wastewater treatment facility (WWTF) was constructed in 1972. The facility was rated at 2.33 mgd capacity using a complete mix activated sludge system operating in an extended aeration configuration. The original facility was modified in 1994 by the expansion of the sludge drying beds, increasing the waste solids handling capacity.

The facility underwent several improvements in 1995. The original comminutor was replaced with an automatic mechanical fine screen and the small feedwell on the existing secondary clarifier was replaced with a larger, more efficient feedwell and energy dissipating inlet. Process control improvements included:

- Addition of a programmable logic controller (PLC) to control the operation of the aerators and enhance nitrification during cold weather conditions thus elevating the pH.

- Addition of a PLC control program and a motorized actuator on the aeration basin bypass valve to automatically bypass peak flows to the secondary clarifiers, thereby reducing high solids flux rate of MLSS to the secondary clarifier to help control effluent TSS.

- Installation of a polymer feed system to automatically add polymer to the clarifier influent and thus improve solids settling and help control effluent TSS during high flows.

In 1997 an additional secondary clarifier was constructed.

The facility was upgraded and expanded to 6.1 mgd capacity in 2000. The existing aeration basins were converted to aerobic digesters, and the new treatment facility included a headworks with mechanical fine screen, primary and secondary clarifiers, aeration basin with selectors and oxic/anoxic zones for nitrogen removal, effluent filtration, UV disinfection, effluent pump station and a sludge dewatering centrifuge. New laboratory/office, equipment, and effluent filter/UV disinfection buildings, sludge storage facility, and a soil biofilter for odor control were also constructed.

In 2002, an alkalinity addition and control system was added that stores and feeds 25 percent sodium hydroxide to the headworks or aeration basins. The system consists of two 10,000-gallon tanks in a secondary containment enclosure, two peristaltic pumps, and piping to convey the alkalinity source to the feed points.

The Department of Ecology issued the current City of Camas NPDES operating permit effective December 1, 2004, granting the City the request for a relaxed percent removal of influent BOD and TSS from the previous permit due to dilute influent from WaferTech industries and to the many Septic Tank Effluent Pump (STEP) tanks throughout the system. The permit requires 70 percent removal of influent TSS and BOD and effluent concentrations of both TSS and BOD of 20 mg/L. The permit was renewed effective December 1, 2004 and expires November 30, 2009.

Figures 5-2 and 5-3 show a process schematic and a layout/process schematic for the WWTF. The WWTF liquid stream treatment processes include influent screening, primary settling, biological treatment in aeration basins, secondary settling, and UV disinfection. Sludge handling includes degritted primary sludge and waste activated sludge co-thickened in the gravity thickener. Thickened sludge and scum from primary clarifiers, gravity thickener, secondary clarifiers, and the aeration splitter box is transferred to the aerobic digesters then dewatered by a polymer fed centrifuge. Sludge from the centrifuge is conveyed by a screw conveyor to the Sludge Storage Building. A brief description of each unit process and facility component for the existing facility follows.

HEADWORKS

The headworks are designed for flow metering, screening and influent flow sampling. Influent first passes through a 24-inch Parshall flume for influent flow measurement before approaching the mechanical fine screen with a bar spacing of 1/4-inch. If the fine screen is out of service or if the influent flow exceeds 11.1 mgd, the excess wastewater is diverted to the manual bypass coarse bar screen, with a bar spacing of 3/4-inch. The screenings are transported by a screenings screw conveyor to a dumpster located adjacent to the headworks structure. pH and dissolved oxygen are also measured at the headworks.

PRIMARY CLARIFIERS

Two 60-foot-diameter circular primary clarifiers remove grit and other settleable solids from the screened wastewater. The flow split between the two clarifiers is controlled by slide gates in the primary clarifier splitter box at the end of the headworks. The grit-laden sludge is pumped to the grit removal facility by three 10-hp recessed impeller torque flow pumps with a capacity of 220 gpm at a TDH of 32 feet. Scum collected from the primary clarifiers is conveyed by gravity to the primary clarifier scum pump station.

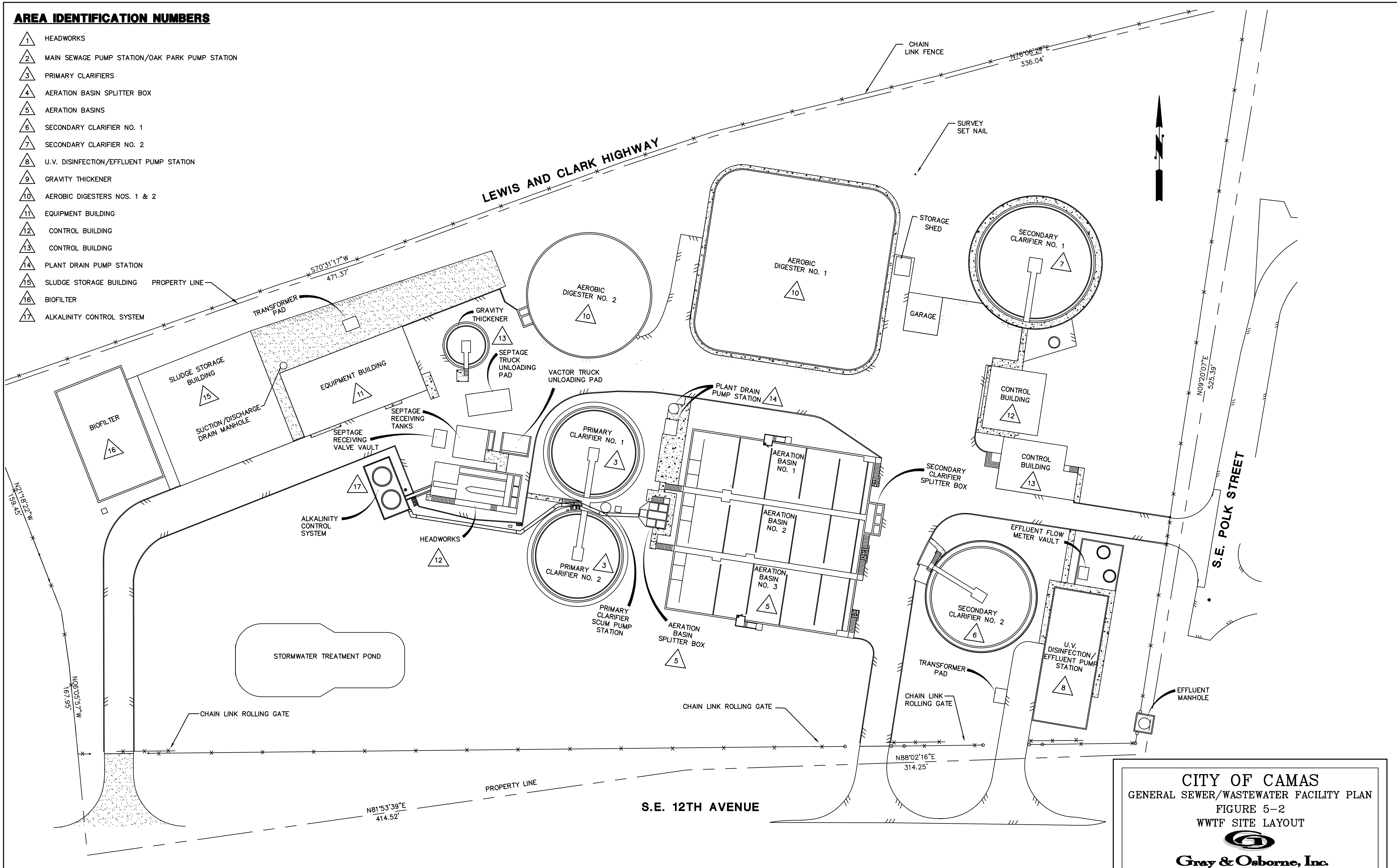
AERATION BASINS

In the aeration basin splitter box, primary effluent is mixed with Return Activated Sludge (RAS). Alkalinity chemical addition for pH control can be added at the aeration basin splitter box, or at the headworks.

Biological treatment of the wastewater is provided in the three 100,800 cubic feet aeration basins. The basins contain selector, anoxic, and aerobic activated sludge zones configured in a predenitrification mode. Aeration and mixing is accomplished using an

AREA IDENTIFICATION NUMBERS

1. HEADWORKS
2. MAIN SEWAGE PUMP STATION/OAK PARK PUMP STATION
3. PRIMARY CLARIFIERS
4. AERATION BASIN SPLITTER BOX
5. AERATION BASINS
6. SECONDARY CLARIFIER NO. 1
7. SECONDARY CLARIFIER NO. 2
8. U.V. DISINFECTION/EFFLUENT PUMP STATION
9. GRAVITY THICKENER
10. AEROBIC DIGESTERS NOS. 1 & 2
11. EQUIPMENT BUILDING
12. CONTROL BUILDING
13. CONTROL BUILDING
14. PLANT DRAIN PUMP STATION
15. SLUDGE STORAGE BUILDING
16. BIOFILTER
17. ALKALINITY CONTROL SYSTEM



SITE PLAN
SCALE: 1"=30'

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 5-2
WWTF SITE LAYOUT

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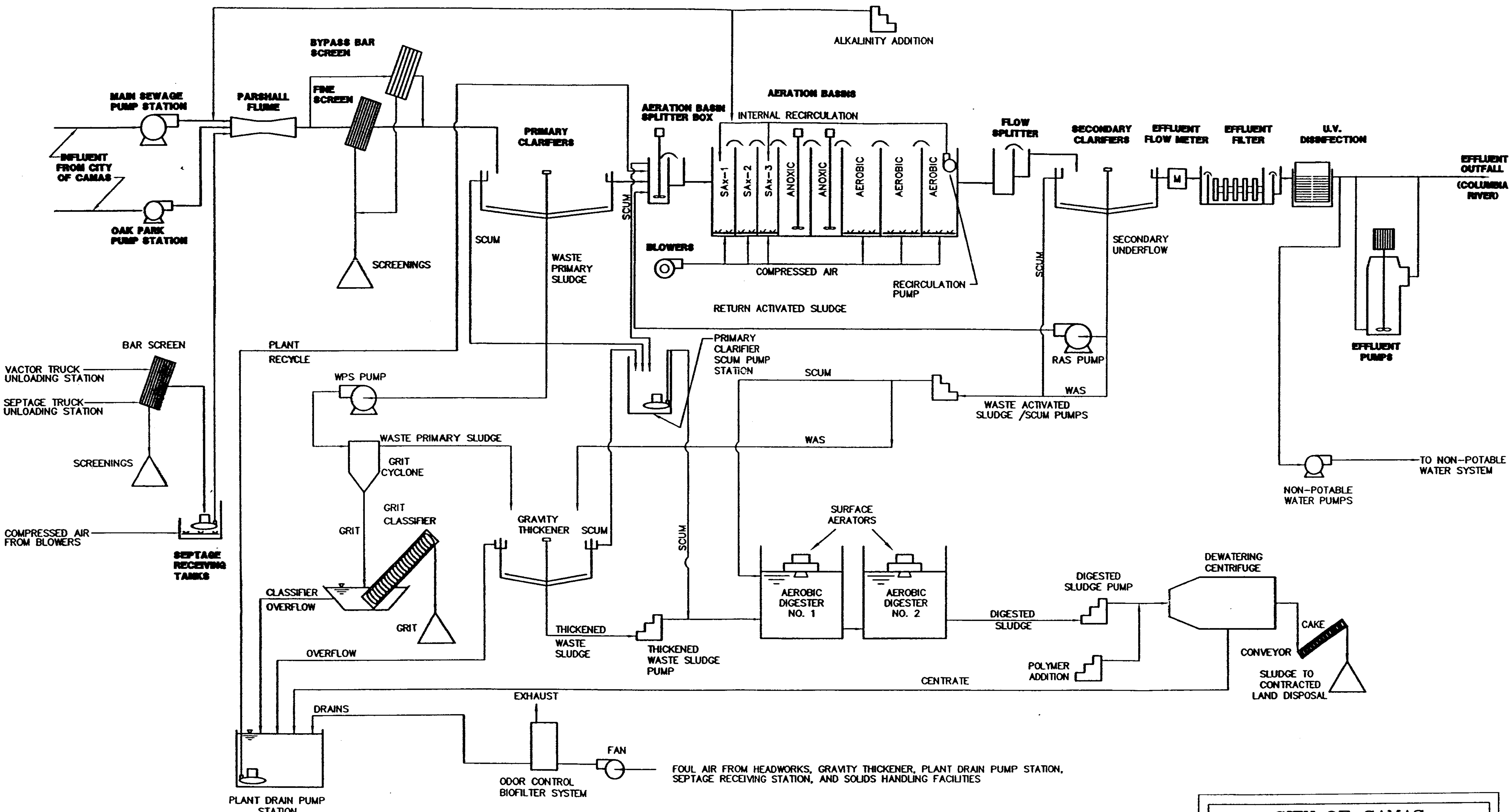

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 5-3
WWTF PROCESS SCHEMATIC

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CONSULTING ENGINEERS

air distribution system consisting of fine and coarse bubble diffusers. Air is supplied to the diffusers by three 150-hp multi-stage centrifugal blowers. Submersible mixers provide mixing for the anoxic zones. Low head, high-volume 4-hp propeller pumps recirculate nitrified mixed liquor from the aerobic zones back to the selector zones operating with a capacity of 3,125 gpm at a TDH of 1.7 feet.

SECONDARY CLARIFIERS

Two 75-foot circular secondary clarifiers provide efficient and effective solids separation producing high quality effluent. The return activated sludge (RAS) underflow from the secondary clarifiers is pumped back to the aeration basin splitter box using four 10-hp submersible pumps. Each pump is equipped with a variable frequency drive to allow the RAS flow to vary as a function of facility flow. Waste activated sludge (WAS) is removed from the secondary clarifiers and pumped to the gravity thickener using three 5-hp plunger pumps. Scum from the secondary clarifiers is also pumped directly to the aerobic digesters by the 5-hp WAS/Scum Pumps.

EFFLUENT FILTERS

The secondary clarifier effluent flows by gravity to two fabric-covered disk filters, for additional removal of suspended and colloidal matter. Flow is measured using a magnetic flow meter upstream of the disk filters. The filters are used to help the WWTF meet the required percent removal requirement (70 percent removal) when influent flows are diluted by infiltration and inflow.

ULTRAVIOLET DISINFECTION

After filtration the effluent is exposed to the ultraviolet (UV) disinfection system. The UV disinfection system consists of mercury, low pressure lamps configured in a horizontal open channel. There are a total of 288 lamps configured in three banks in one channel (96 lamps per bank).

EFFLUENT PUMP STATION AND OUTFALL

The effluent from the UV disinfection system passes into the effluent pump wet well. The wet well drains to the effluent and outfall manholes, which connect with the outfall diffuser in the Columbia River. Under high river conditions, head loss is too great for gravity flow; the effluent is pumped to the Columbia River using three vertical propeller effluent pumps. The outfall consists of a 36-inch outfall pipeline with 6-inch risers spaced every 10 feet along the pipe. The sixteen risers have 90-degree bends such that they discharge in the same direction as the current. Eight of the 16 ports are currently capped and are reserved for future use.

GRIT REMOVAL

Primary sludge is pumped from the primary clarifiers by four recessed impeller pumps to the primary sludge degritting room where two cyclones separate the grit slurry from the sludge. Grit is separated from the grit slurry by an auger classifier and the dewatered grit is collected in a watertight dumpster for disposal.

SLUDGE THICKENING

The degritted sludge flows by gravity into the gravity thickener for co-thickening with the WAS. The thickened waste sludge is transferred by a progressive cavity pump to the aerobic digesters.

SCUM PUMP STATION

Scum from the primary clarifiers, gravity thickener, and the aeration basin splitter box is conveyed by gravity to the primary clarifier scum pump station. This submersible pump station transfers the scum to the aerobic digesters.

AEROBIC DIGESTION

Two aerobic digesters in series stabilize the thickened waste sludge and the scum. The aerobic digesters are open tanks with mechanical aerators. Sludge flows by gravity from the first digester to the second.

SLUDGE DEWATERING

The digested sludge pumps pump sludge from the second aerobic digester to the dewatering centrifuge. Polymer is fed into the digested sludge for conditioning before sludge enters the centrifuge. The thickened sludge cake from the centrifuge is moved to the Sludge Storage Building by a solids conveyor, and the centrate flows to the facility drain pump station.

SEPTAGE RECEIVING STATION

A septage receiving station is provided to receive septage from septage trucks and vactor trucks. Septage is screened, stored, aerated and pumped to the treatment facility headworks. The City receives septage only from customer STE tanks within the City's sewer service area.

ODOR CONTROL

The headworks area, septage receiving station, gravity thickener, facility drain pump station, and solids handling facilities are incorporated into the odor control system. The off-gases are collected by the biofilter fan and vented to the odor control facility that is equipped with a soil biofilter.

DESIGN CRITERIA

The design criteria for the Camas Wastewater Treatment Facilities, as presented in the 1997 Wastewater Facility Plan and the current City's NPDES permit, are shown in Table 5-3.

As required by the City's NPDES permit, when either the actual flow or waste load reaches 85 percent of the design capacity or, when the projected increases would reach design capacity within 5 years, whichever occurs first, the City is required to submit to the Department of Ecology a plan and a schedule for continuing to maintain capacity at the facility sufficient to achieve the effluent limitations and other conditions of the NPDES permit.

The City's effluent limits for ammonia were first issued in 2004 (the current permit). In accordance with communications with Ecology, it is understood that, after completion of upcoming outfall modifications, Ecology will modify Condition S1.A of the City's NPDES permit by deleting the maximum daily ammonia limits. Thus, for total ammonia limits, only the monthly average limits of 20 mg/L in summer and 7 mg/L in winter will remain. These proposed ammonia limits have been used as the basis of evaluations and calculations for this Plan.

TABLE 5-3

Wastewater Treatment Facility Existing NPDES Permit Limits

<table>
<tr><th colspan="3">NPDES Influent Design Criteria</th></tr>
<tr><th colspan="2">Parameter</th><th>Value</th></tr>
<tr><td colspan="2">Maximum Month Flow (MGD)</td><td>6.10</td></tr>
<tr><td colspan="2">Maximum Monthly Loading, BOD_5 (lb/d)</td><td>5,616</td></tr>
<tr><td colspan="2">Maximum Monthly Loading, TSS (lb/d)</td><td>6,405</td></tr>
<tr><th colspan="3">NPDES Effluent Limitations(1)</th></tr>
<tr><th>Parameter</th><th>Average Monthly</th><th>Average Weekly</th></tr>
<tr><td>5-day Biochemical Oxygen Demand (BOD_5)(2)</td><td>20 mg/L, 1017 lbs/day
70% removal of influent BOD</td><td>30 mg/L, 1525 lbs/day</td></tr>
<tr><td>Total Suspended Solids (TSS)[c]</td><td>20 mg/L, 1017 lbs/day
70% removal of influent TSS</td><td>30 mg/L, 1525 lbs/day</td></tr>
<tr><td>Fecal Coliform Bacteria</td><td>200/100 mL</td><td>400/100 mL</td></tr>
<tr><td>pH</td><td colspan="2">Daily minimum is equal to or greater than 6 and daily maximum is less than or equal to 9.</td></tr>
<tr><th>Parameter</th><th>Average Monthly</th><th>Maximum Daily(2)</th></tr>
<tr><td>Total Ammonia (as NH_3-N) Summer(3)</td><td>20 mg/L</td><td>41 mg/L</td></tr>
<tr><td>Total Ammonia (as NH_3-N) Winter(3)</td><td>7 mg/L</td><td>15 mg/L</td></tr>
</table>

(1) The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean.

(2) The maximum daily effluent limitation is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day.

(3) Summer ammonia limits apply to the months of June through September. Winter ammonia limits apply to the months of October through May.

CHAPTER 6

EXISTING AND PROJECTED WASTEWATER FLOWS AND CHARACTERISTICS

INTRODUCTION

In this Chapter, the existing wastewater characteristics for the service area will be analyzed and projections made for future conditions.

Adequate design of wastewater treatment and conveyance facilities requires the determination of the quantity and quality of wastewater generated from each of the contributing sources. Typically, wastewater is predominantly domestic in origin with lesser amounts contributed by commercial and industrial businesses and by public use facilities such as schools, parks, hospitals, and municipal functions. However, the City of Camas WWTF has a significant amount of flow from industrial sources also. Additionally, significant infiltration and inflow (I/I) contributions result from groundwater and surface water entering the sewer system during periods of high groundwater levels and rainfall, respectively, as occurs in many other communities in western Washington.

DEFINITIONS OF TERMS

The terms and abbreviations used in the analysis are described below, listed in alphabetical order.

AVERAGE ANNUAL FLOW

Average Annual Flow is the average daily flow over a calendar year. This flow parameter is used to estimate annual operation and maintenance costs for treatment and lift station facilities.

AVERAGE DRY WEATHER FLOW

Average Dry Weather Flow is wastewater flows during periods when the groundwater table is low and precipitation is at its lowest of the year. The dry weather flow period in western Washington normally occurs during June through September. During this time, the wastewater strength is highest, due to the lack of dilution with the ground and surface water components of infiltration and inflow. The higher strength coupled with higher temperatures and longer detention times in the sewer system create the greatest potential for system odors during this time. The average dry weather flow is the average daily flow during the three lowest consecutive flow months of the year. For this study, average flows for July, August, and September are used.

BIOCHEMICAL OXYGEN DEMAND (BOD)

Biochemical Oxygen Demand (BOD) is a measure of the oxygen required by microorganisms in the biochemical oxidation (digestion) of organic matter. BOD is an indicator of the organic strength of the wastewater. If BOD is discharged untreated to the environment, biodegradable organics will deplete natural oxygen resources and result in the development of septic (anaerobic) conditions. BOD data together with other parameters are used in the sizing of the treatment facilities and provide a measurement for determining the effectiveness of the treatment process. BOD is expressed as a concentration in terms of milligrams per liter (mg/L) and as a load in terms of pounds per day (lb/d). The term BOD typically refers to a 5-day BOD, often written BOD_5, since the BOD test protocol requires five days for completion. BOD_5 of a wastewater is composed of two components – a carbonaceous oxygen demand ($CBOD_5$) and a nitrogenous oxygen demand ($NBOD_5$). The use of $CBOD_5$ as a parameter for evaluating wastewater strength removes the influence of nitrogenous components, including ammonia and organic nitrogen.

CHLORINE

Chlorine is a chemical element that acts as a strong oxidant when exposed to certain components of organic matter. Chlorine is widely used as a disinfectant in wastewater treatment, and is available both in gaseous (elemental chlorine) and solution forms (hypochlorite). Chlorine is a toxic chemical and is lethal to aquatic biota if present in too high a concentration. Additionally, some organic constituents may react with the chlorine to interfere with chlorination or form toxic compounds, such as chloroform, that can have long-term adverse effect on the beneficial uses of the waters to which they are discharged. To minimize the effects of potentially toxic chlorine residuals on the environment, it has sometimes been found necessary to dechlorinate wastewater treated with chlorine or substitute alternative disinfection systems such as ultraviolet disinfection, as the City of Camas uses. The City occasionally uses hypochlorite for other purposes at the WWTF.

CONTAMINANTS OF CONCERN

Contaminants of concern in wastewater, in addition to chlorine, BOD and TSS discussed elsewhere in this section, include nutrients, priority pollutants, heavy metals and dissolved organics. The City's NPDES permit requires the removal of biodegradable organics ($CBOD_5$), suspended solids and pathogens. Many of the more stringent standards that have been developed and applied recently to other facilities deal with the removal of nutrients and priority pollutants.

Nutrients such as nitrogen and phosphorus, along with carbon, are essential requirements for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life. When discharged in excessive amounts on land, they can also lead to the pollution of groundwater. Additionally, in too high a concentration, nutrients, particularly ammonia, can be toxic to aquatic life.

Priority pollutants are organic and inorganic compounds selected on the basis of their known or suspected carcinogenicity, mutagenicity, teratogenicity, or high acute toxicity. Many of these compounds are found in wastewater. Inorganic constituents, including heavy metals, are often present in wastewater due to commercial and industrial activities and may have to be removed if the presence of the metals will adversely affect the receiving water, or, if the wastewater is to be reused. Some heavy metals (most notably copper) can be present in wastewater due to leaching from drinking water pipes. Per the terms of its NPDES permit, Camas is required to monitor for heavy metals in WWTF influent and effluent quarterly and sludge once during the permit cycle.

DOMESTIC WASTEWATER

Domestic Wastewater is wastewater generated from single and multifamily residences, permanent mobile home courts, and group housing facilities such as nursing homes. Domestic wastewater flow is generally expressed as a unit flow based on the average contribution from each person per day. The unit quantity is expressed in terms of gallons per capita per day (gpcd).

EQUIVALENT RESIDENTIAL UNIT (ERU)

An Equivalent Residential Unit (ERU) is a baseline wastewater generator that represents the average single family residential household. An ERU can also express the average annual flow contributed by a single-family household, in units of gallons per day, or an annual average loading (of 5-day biochemical oxygen demand or total suspended solids) contributed by a single-family household, in units of pounds per day.

INFILTRATION

Infiltration is groundwater entering a sewer system by means of defective pipes, pipe joints or manhole walls. Infiltration quantities exhibit seasonal variation in response to groundwater levels. Storm events or irrigation trigger a rise in the groundwater levels and increase infiltration. The greatest infiltration is observed following significant storm events prolonged periods of precipitation. Since infiltration is related to the total amount of piping and appurtenances in the ground and not to any specific water use component, it is generally expressed in terms of the total land area being served. The unit quantity generally used is gallons per acre per day.

INFLOW

Inflow is surface water entering the sewer system from yard, roof and footing drains, from cross connections with storm drains and through holes in manhole covers. Peak inflow occurs during heavy storm events when storm sewer systems are taxed beyond their capacity, resulting in hydraulic backups and local ponding. Inflow, like infiltration, can be expressed in terms of gallons per capita day or gallons per acre per day.

WWTF flow records are utilized to characterize combined infiltration and inflow (I/I) in the Camas system in terms of peak hour, peak day, maximum month, and average annual I/I.

MAXIMUM MONTH FLOW (TREATMENT DESIGN FLOW)

Maximum Month Flow is the highest monthly flow during a calendar year. In western Washington, the maximum month flow normally occurs in the winter due to the presence of more I/I. This wintertime flow is composed of the normal domestic, commercial and public use flows with significant contributions from inflow and infiltration. The predicted maximum month flow at the end of the design period is used as the design flow for sizing treatment processes and selecting treatment equipment.

NON-RESIDENTIAL WASTEWATER

Non-residential wastewater is wastewater generated from commercial activities, such as restaurants, retail and wholesale stores, service stations, and office buildings, and industrial flow (process wastewater, rinse water and other industrial activities). Non-residential wastewater quantities for commercial and industrial wastewater are expressed in this Plan in terms of equivalent residential units (ERUs).

PEAK HOUR FLOW

Peak Hour Flow is the highest hourly flow during a calendar year. The peak hour flow in western Washington usually occurs in response to a significant storm event preceded by prolonged periods of rainfall which have previously developed a high groundwater table in the service area. Peak hour flows are used in sizing the hydraulic capacity of wastewater collection, treatment and pumping components. Peak hour flow is typically determined from treatment facility flow records and projected future flows.

SUSPENDED SOLIDS

Suspended Solids is the solid matter carried in the waste stream. The Total Suspended Solids (TSS) in a wastewater sample is determined by filtering a known volume of the sample, drying the filter paper and measuring the increase in weight of the filter paper. TSS is expressed in the same terms as BOD; milligrams per liter for concentration and pounds per day for mass load. The amount of TSS in the wastewater is used in the sizing of treatment facilities and provides another measure of the treatment effectiveness. The concentration of TSS in wastewater affects the treatment facility biosolids production rate, treatment and storage requirements, and ultimate disposal requirements.

WASTEWATER

Wastewater is water-carried waste from residential, business, industry and public use facilities, together with quantities of groundwater and surface water which enter the sewer system through defective piping and direct surface water inlets. The total wastewater flow is quantitatively expressed in millions of gallons per day (mgd).

EXISTING WASTEWATER FLOWS AND LOADING

WWTF records for the 7-year period from 1998 through 2004 were reviewed and analyzed to determine current wastewater characteristics and influent loadings. Current wastewater flows and loadings were then used in conjunction with projected population data to determine projected future wastewater flows and loadings.

WASTEWATER FLOWS AT CITY OF CAMAS WWTF

Table 6-1 summarizes reported WWTF effluent flows for the 8-year period of 1998 to 2005. The monthly average effluent WWTF flows ranged from 1.10 mgd to 3.09 mgd.

The 2005 dry season average of 1.98 mgd includes 0.08 mgd average dry season infiltration, based on an analysis of WWTF effluent flow indicated by circular flow charts. Hence, base flow (sanitary flow without infiltration and inflow) is estimated to be 1.90 mgd.

The WWTF monitors effluent flow (the flow upstream of the outfall) and influent (the flow entering the WWTF, upstream of the mechanical fine screen).

TABLE 6-1

Historical WWTF Effluent Flows (1998 to 2004)

Flow Type	1998	1999	2000	2001	2002	2003	2004	2005
Average Base Sanitary Flow	1.20	1.20	1.25	1.30	1.35	1.40	1.75	1.90
Average Dry Weather Flow(1)	1.48	1.61	1.43	1.34	1.44	1.49	1.93	1.98
Annual Average Flow	2.00	2.00	1.81	1.64	1.76	1.88	2.10	2.29
Maximum Monthly Flow	2.97	2.85	2.98	2.59	2.40	2.49	2.71	3.09
Peak Day Flow	5.19	5.11	4.91	4.37	4.46	5.63	4.23	7.03
Peak Hour Flow	6.9	6.5	--	--	--	6.5	--	8.8(2)

(1) Average of July, August, September.

(2) Peak flow occurred on December 31, 2005. As described later in the chapter, an estimated 1.1 mgd was constrained by pipe capacity and did not reach the WWTP during the peak hour storm event.

Monthly discharge monitoring report (DMR) data for this period are provided in Appendix D and summarized in Table 6-2. Graphical representations of daily and average monthly WWTF flows, and influent BOD_5/TSS loadings for the period from 1998 through 2005 are shown in Figures 6-1, 6-2, and 6-3, respectively.

Peak day and peak hour flows occurred during a major storm event on December 30, 2005. Reported influent flow at the WWTP was 7.03 mgd, and the reported peak hour flow was 8.8 mgd.

TABLE 6-2

Summary of Discharge Monitoring Reports (DMRs)
WWTF Influent Monthly Averages

Year	Avg. Monthly Flow mgd	Min. Daily Flow mgd	Max. Daily Flow mgd	BOD5 (mg/L)	BOD5 (lb/d)	TSS (mg/L)	TSS (lb/d)
Jan-98	2.61	1.45	4.62	90	1,959	125	2,721
Feb-98	2.18	1.68	3.40	121	2,200	150	2,727
Mar-98	2.31	1.51	4.54	90.5	1,744	138.5	2,668
Apr-98	1.62	1.42	1.95	166	2,241	153	2,066
May-98	2.21	1.41	4.37	129	2,378	150	2,765
Jun-98	1.70	1.44	2.38	150	2,127	152	2,155
Jul-98	1.50	1.35	1.60	150	1,877	157	1,964
Aug-98	1.47	1.34	1.56	143	1,752	141	1,727
Sep-98	1.47	1.28	1.96	172	2,114	164	2,016
Oct-98	1.53	1.35	2.05	168	2,148	151	1,931
Nov-98	2.40	1.46	`	195	3,898	138	2,759
Dec-98	2.97	1.72	5.19	117	2,898	121	2,997
Jan-99	2.80	1.73	4.92	166	3,876	90	2,102

TABLE 6-2 – (continued)

Summary of Discharge Monitoring Reports (DMRs)
WWTF Influent Monthly Averages

Year	Avg. Monthly Flow mgd	Min. Daily Flow mgd	Max. Daily Flow mgd	BOD5 (mg/L)	BOD5 (lb/d)	TSS (mg/L)	TSS (lb/d)
Feb-99	2.85	1.79	4.86	139	3,304	103	2,448
Mar-99	2.50	1.74	4.72	172	3,580	136	2,831
Apr-99	1.79	1.48	2.50	182	2,715	192	2,865
May-99	1.69	1.37	2.41	198	2,796	198	2,796
Jun-99	1.68	1.44	2.94	190	2,657	250	3,497
Jul-99	1.62	1.49	2.08	188	2,538	188	2,538
Aug-99	1.62	1.52	1.71	192	2,591	234	3,158
Sep-99	1.60	1.42	1.76	216	2,882	260	3,469
Oct-99	1.61	1.32	2.15	217	2,907	259	3,469
Nov-99	2.30	1.60	5.11	176	3,369	250	4,785
Dec-99	2.00	1.28	4.11	136	2,268	235	3,920
Jan-00	2.27	1.27	4.91	65	1,231	81	1,533
Feb-00	2.16	1.45	4.01	103	1,857	145	2,615
Mar-00	1.83	1.38	2.46	151	2,306	139	2,123
Apr-00	1.35	1.10	1.84	135	1,519	126	1,418
May-00	1.49	1.27	2.31	145	1,802	488	6,064
Jun-00	1.41	1.17	1.89	213	2,503	231	2,714
Jul-00	1.47	1.16	1.90	196	2,405	298	3,656
Aug-00	1.36	1.23	1.45	164	1,866	258	2,935
Sep-00	1.45	1.26	1.97	173	2,089	259	3,128
Oct-00	1.92	1.28	3.16	156	2,502	363	5,822
Nov-00	2.98	1.95	4.72	157	3,907	232	5,774
Dec-00	1.97	1.52	3.65	154	2,531	171	2,811
Jan-01	1.65	1.39	2.26	172	2,371	193	2,661
Feb-01	1.68	1.36	3.05	156	2,190	153	2,148
Mar-01	1.75	1.35	3.13	144	2,103	203	2,964
Apr-01	1.69	1.33	2.75	158	2,224	186	2,618
May-01	1.41	1.11	2.11	195	2,296	252	2,968
Jun-01	1.42	1.24	1.88	175	2,072	205	2,428
Jul-01	1.36	1.19	1.68	182	2,061	211	2,390
Aug-01	1.33	1.21	1.84	150	1,669	181	2,014
Sep-01	1.34	1.18	1.72	177	1,972	215	2,396
Oct-01	1.49	1.26	2.31	158	1,958	172	2,132
Nov-01	2.01	1.46	4.37	125	2,099	147	2,468
Dec-01	2.59	1.55	4.21	91	1,969	113	2,445
Jan-02	2.40	1.56	4.10	110	2,200	326	6,520
Feb-02	2.13	1.50	3.87	126	2,235	119	2,111

TABLE 6-2 – (continued)

Summary of Discharge Monitoring Reports (DMRs)
WWTF Influent Monthly Averages

Year	Avg. Monthly Flow mgd	Min. Daily Flow mgd	Max. Daily Flow mgd	BOD5 (mg/L)	BOD5 (lb/d)	TSS (mg/L)	TSS (lb/d)
Mar-02	2.20	1.50	3.53	100	1,834	110	2,017
Apr-02	1.77	1.34	3.02	130	1,919	140	2,067
May-02	1.54	1.37	1.76	127	1,633	133	1,710
Jul-02	1.46	1.29	1.55	134	1,629	156	1,897
Aug-02	1.42	1.25	1.53	133	1,574	139	1,645
Sep-02	1.43	1.29	1.67	147	1,757	120	1,434
Oct-02	1.45	1.29	2.07	131	1,581	139	1,677
Nov-02	1.50	1.32	1.84	130	1,626	166	2,077
Dec-02	2.07	1.35	4.46	115	1,981	132	2,273
Jan-03	2.43	1.67	4.78	95	1,925	108	2,189
Feb-03	2.22	1.52	5.63	101	1,869	97	1,795
Mar-03	2.49	1.63	4.15	99	2,054	106	2,199
Apr-03	2.05	1.74	2.63	110	1,883	128	2,191
May-03	1.67	1.41	1.89	151	2,103	152	2,117
Jun-03	1.52	1.42	1.61	160	2,028	190	2,409
Jul-03	1.48	1.36	1.57	145	1,793	169	2,090
Aug-03	1.45	1.35	1.54	164	1,983	226	2,733
Sep-03	1.55	1.44	1.86	182	2,351	206	2,661
Oct-03	1.62	1.34	2.05	156	2,106	159	2,147
Nov-03	1.90	1.51	3.09	148	2,349	160	2,539
Dec-03	2.17	1.88	5.34	137	2,475	148	2,674
Jan-04	2.71	1.98	4.23	127	2,867	129	2,912
Feb-04	2.42	1.77	3.80	112	2,261	105	2,120
Mar-04	1.95	1.60	2.66	136	2,211	133	2,162
Apr-04	1.63	1.16	1.88	133	1,804	133	1,804
May-04	1.92	1.72	2.51	146	2,339	157	2,515
Jun-04	2.00	1.77	2.60	146	2,430	211	3,512
Jul-04	1.83	1.70	1.95	155	2,371	175	2,677
Aug-04	2.00	1.72	2.73	140	2,329	169	2,812
Sep-04	1.95	1.71	2.44	138	2,242	170	2,762
Oct-04	2.09	1.74	2.64	144	2,508	227	3,953
Nov-04	2.20	1.84	3.55	125	2,294	161	2,954
Dec-04	2.49	2.08	3.26	110	2,287	126	2,620
Jan-05	2.26	1.94	3.01	102	1,923	109	2,055
Feb-05	2.17	1.81	3.23	104	1,878	106	1,914
Mar-05	2.35	1.86	4.73	116	2,270	148	2,896
Apr-05	2.16	1.37	3.29	91	1,636	111	1,996
May-05	2.61	1.98	3.74	102	2,218	128	2,783

TABLE 6-2 – (continued)

Summary of Discharge Monitoring Reports (DMRs)
WWTF Influent Monthly Averages

Year	Avg. Monthly Flow mgd	Min. Daily Flow mgd	Max. Daily Flow mgd	BOD5 (mg/L)	BOD5 (lb/d)	TSS (mg/L)	TSS (lb/d)
Jun-05	2.07	1.86	2.53	118	2,033	208	3,584
Jul-05	1.92	1.78	2.05	147	2,358	242	3,881
Aug-05	1.98	1.85	2.16	123	2,032	186	3,073
Sep-05	2.03	1.90	3.34	130	2,201	213	3,606
Oct-05	2.21	1.95	4.33	137	2,527	235	4,335
Nov-05	2.67	2.15	4.92	118	2,624	179	3,980
Dec-05	3.09	2.05	7.03	118	3,042	160	4,125
Ave.	**1.94**	**1.51**	**3.00**	**143**	**2,252**	**175**	**2,745**
Max.	**3.09**	**2.15**	**7.03**	**217**	**3,907**	**488**	**6,520**
Min.	**1.33**	**1.10**	**1.45**	**65**	**1,231**	**81**	**1,418**

HISTORICAL INFLUENT LOADING AT WWTF

The annual average and maximum month BOD_5 and TSS mass loading for 1998 through 2005 are listed in Table 6-3.

TABLE 6-3

WWTF Influent Annual Average BOD_5 and TSS(1)

Year	Annual Average Effluent Flow (mgd)	Annual Average BOD_5 (lb/d)	Annual Average TSS (lb/d)	Maximum Month BOD_5 (lb/d)	Maximum Month TSS (lb/d)
1998	1.998	2,278	2,375	3,898	2,997
1999	2.004	2,957	3,156	3,876	4,785
2000	1.806	2,210	3,383	3,907	6,064
2001	1.644	2,082	2,469	2,371	2,968
2002	1.760	1,815	2,312	2,235	6,520
2003	1.879	2,077	2,312	2,475	2,733
2004	2.098	2,329	2,734	2,867	3,953
2005	2.290	2,228	3,186	3,042	4,335
Average(1)	**1.935**	**2,247**	**2,741**	**3,084**	**4,294**

(1) Average of monthly averages.

Influent loadings decreased in 2000 and 2001 relative to 1998 and 1999, then increased significantly in 2003 through 2005.

As shown in Figures 6-1 through 6-4, the data indicate that the design flow of 6.1 mgd for the existing facility has not been exceeded as a monthly average over the period of 1998 to 2005. Similarly, the maximum loading, per the NPDES permit, of 5,616 lb/day BOD_5 and 6,405 lb/day TSS have not been exceeded as a monthly average during this period.

EXISTING EQUIVALENT RESIDENTIAL UNITS (ERUS)

To determine the number of residential units with sewer service, water consumption, water billing and sewer billing records were reviewed.

SEWER CONNECTIONS

Table 3-4 provided the average number of sewer service connections by year and customer class. As seen in the Table 3-4, the majority of the sewer service connections are in the single-family residential customer class. The average numbers of connections in 2005 were 5,546 single-family residential, 414 multi-family, 202 commercial, 31 industrial and 31 City (6,223 total connections).

WINTER WATER CONSUMPTION

The City's winter water consumption has increased over the past seven years in all of the customer classes (except City consumption). The winter water use is used to estimate wastewater volumes entering the collection system because the amount of winter water consumption typically is equal to wastewater flow except for a minor amount of water that does not enter the sewer system (such as winter irrigation flows, spills and evaporation).

Winter water consumption records for the period of 2001 through 2005 were available from the City's computer billing database. Table 6-4 presents the winter water consumption in millions of gallons per day (mgd) by customer class obtained from the database. A more detailed summary of winter water consumption records is provided in Appendix E.

Figure 6-1
City of Camas WWTP
Daily Average Influent Flows

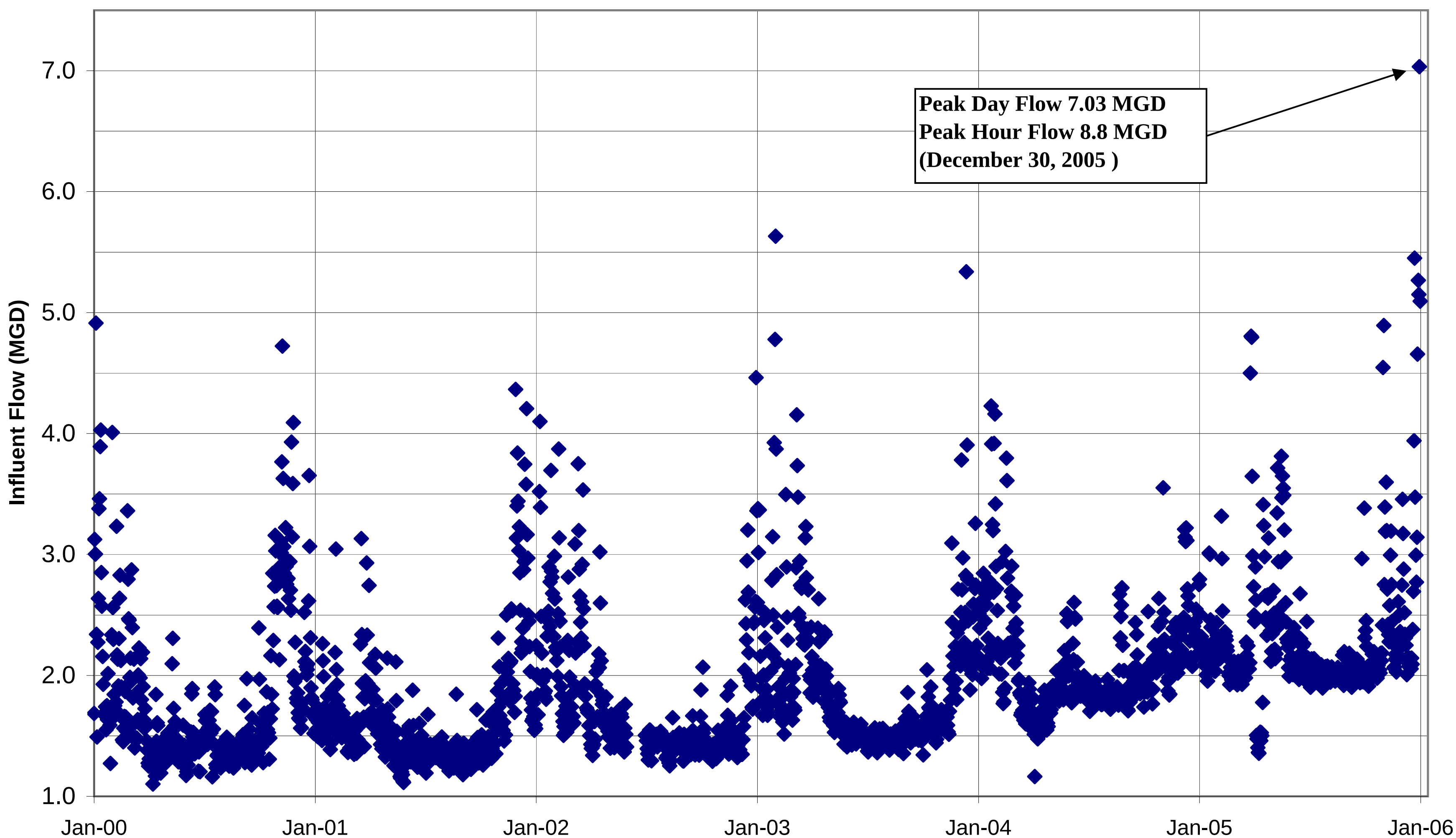


Figure 6-2
Monthly Peak Day WWTF Effluent Flow

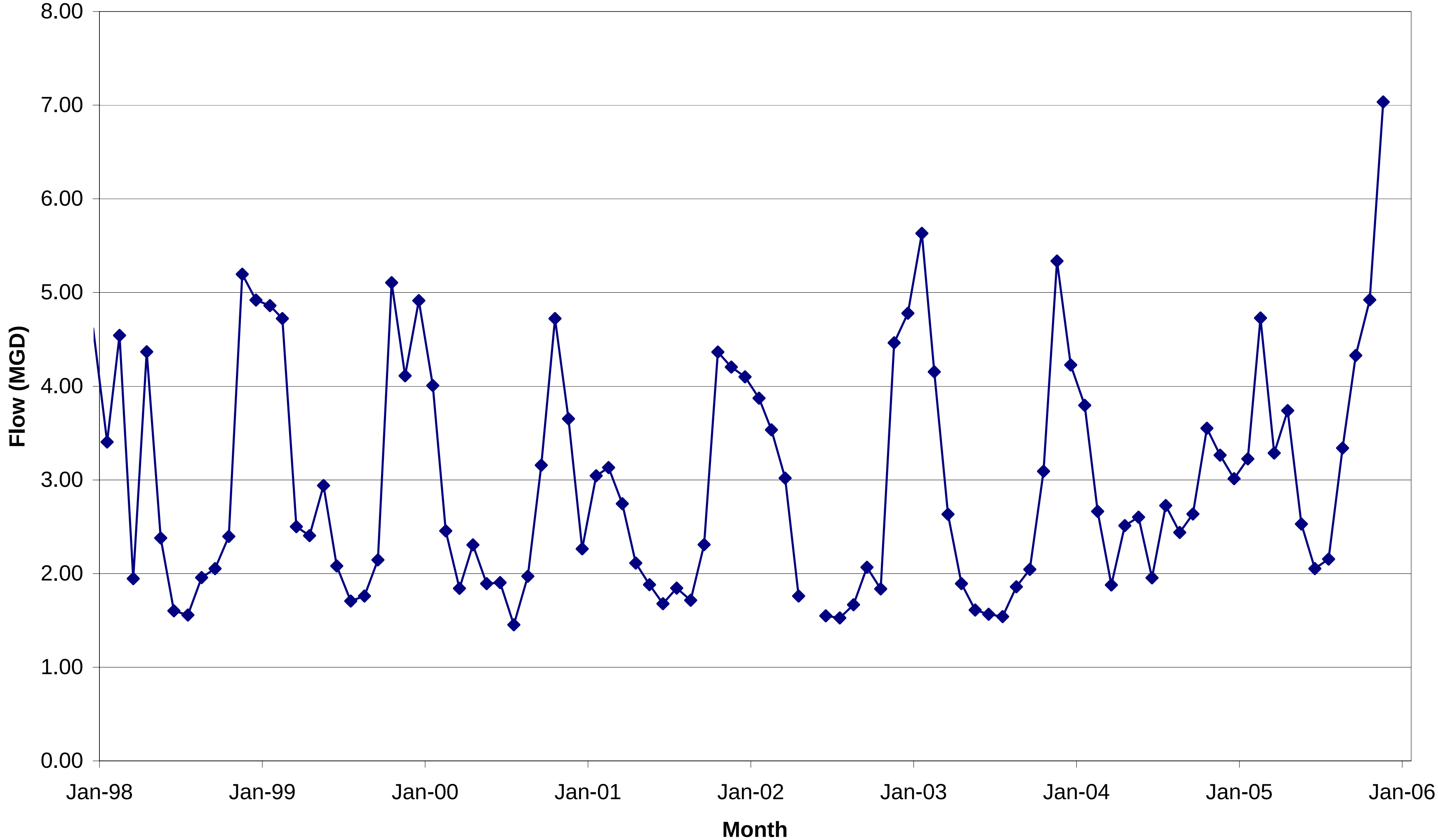


Figure 6-3
Monthly Average WWTF Effluent Flow

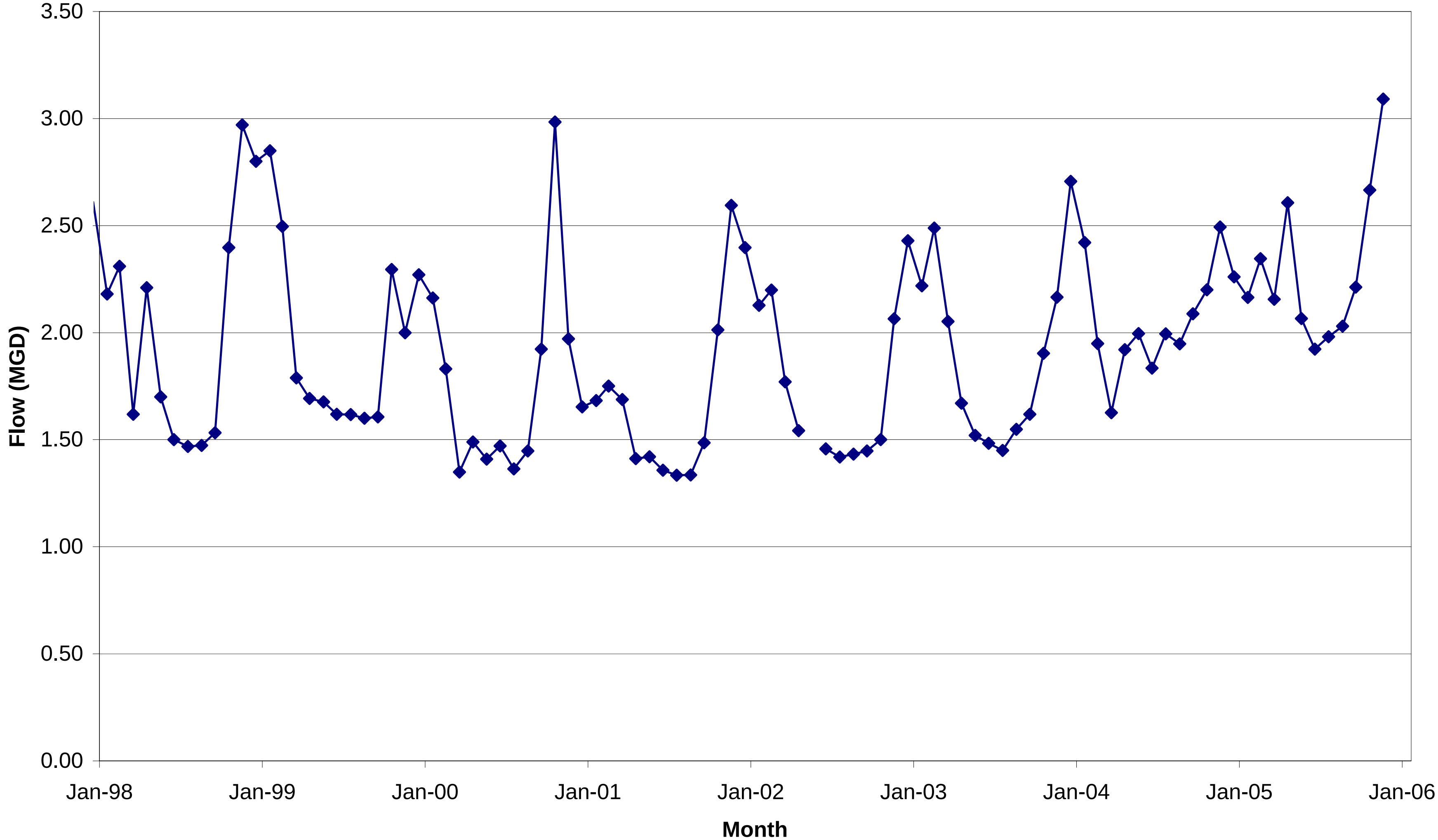


Figure 6-4
Monthly Average Influent Loading

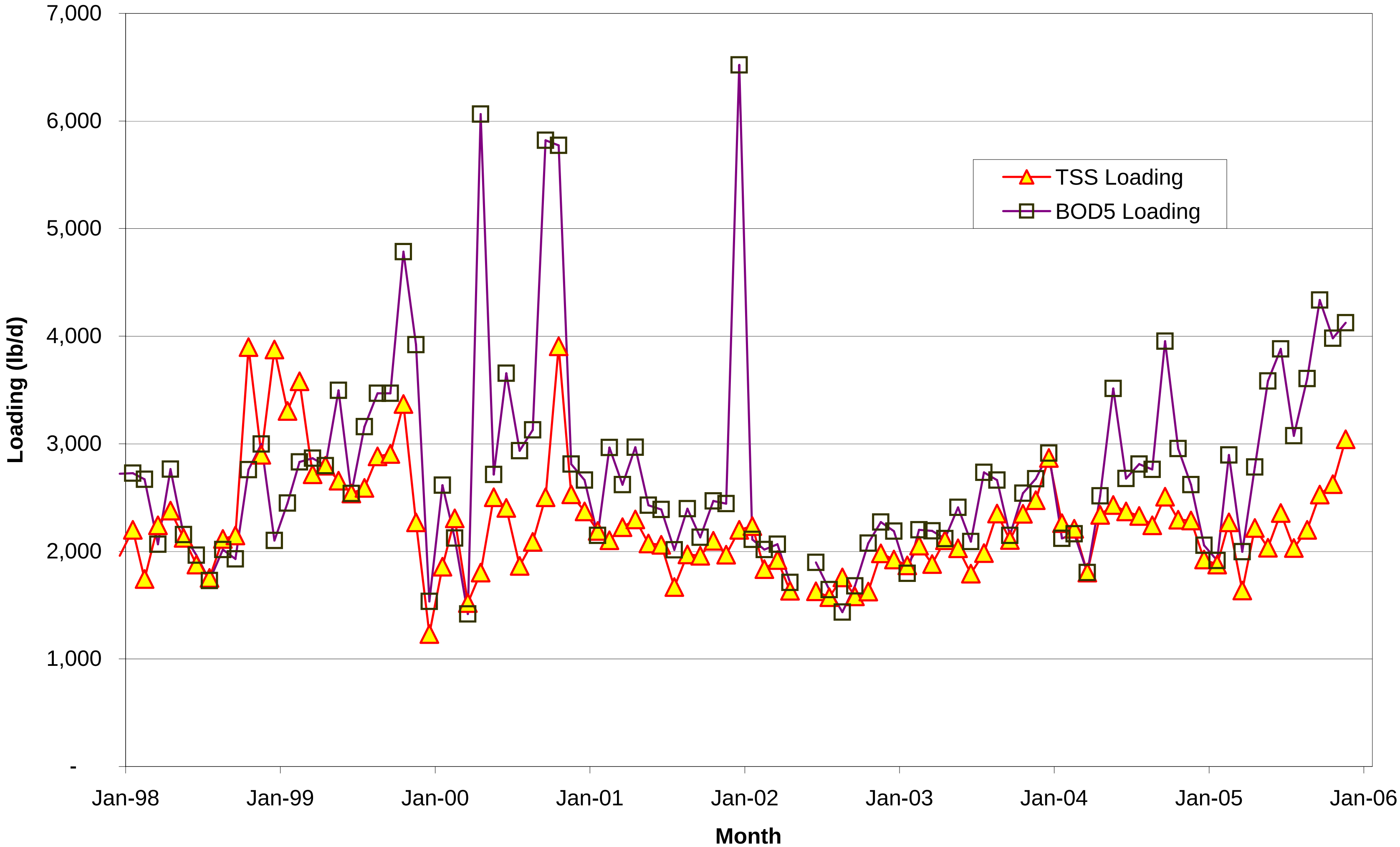


TABLE 6-4

Winter Water Use by Year and Customer Class

Customer Type	Winter Water Use by Sewer Customers (mgd)(1)			
	2001-2002	**2002-2003**	**2003-2004**	**2004-2005**
Single-Family Residential	0.849	0.866	0.955	0.983
Multi-family Residential	0.115	0.108	0.122	0.128
Commercial	0.093	0.098	0.125	0.114
Industrial	0.950	0.955	1.120	1.091
City	0.028	0.006	0.004	0.009
TOTAL	**2.034**	**2.033**	**2.326**	**2.325**

(1) Water consumption is totaled and billing completed on the 15th of every odd month. Thus, winter is defined as November 16 to March 15 for the purposes of this analysis.

As shown in Table 6-4, the total winter water use ranged from 2.034 mgd to 2.326 mgd.

EQUIVALENT RESIDENTIAL UNITS

Use of Equivalent Residential Units (ERUs) is a way to express the amount of water or sewer use by non-residential customers as an equivalent number of residential customers. Table 6-5 summarizes the City's winter water consumption ERU value for 2001 to 2005.

TABLE 6-5

Camas Single Family Residential (SFR) Equivalent Residential Units (ERUs) and Winter Water Use 2001 to 2005

	2001-2002	**2002-2003**	**2003-2004**	**2004-2005**
SFR Winter Water Use (gpd)	848,943	865,842	955,383	982,766
SF Residential Service Connections	4,631	5,066	5,407	5,613
ERU value (gpd/ERU)	**183.3**	**170.9**	**176.7**	**175.1**

As shown in Table 6-5, the average daily single-family residential winter water use (which is equivalent to one water use ERU) for the City from 2001 to 2005 ranged from a high of 183.3 gpd/ERU to a low of 170.9 gpd/ERU.

The *wastewater* ERU value is calculated based on *winter* water use (in order to exclude irrigation flows). For the City of Camas, it is estimated that 15 percent of the winter water consumption does not enter the wastewater collection system (such as winter irrigation flows, spills and evaporation), so the wastewater ERU value is calculated by dividing the winter water use for single-family residential (SFR) units by the number of single-family units and multiplying by 0.85. Based on 2004 to 2005 water use records, average winter single-family residential water use is 176 gallons per SFR household. Eighty-five percent of this value is 149 gallons per SFR household or ERU**.** Thus, the wastewater ERU value is 149 gpd/ERU.

Table 6-6 summarizes current wastewater ERUs based on an analysis of winter water use during the winter of 2004 to 2005. As previously discussed, each wastewater ERU is defined as 149 gpd/ERU.

TABLE 6-6

Current Wastewater ERUs

CUSTOMER TYPE	Average Winter Water Use (mgd)	85% of Average Winter Water Use (mgd)	Sewer ERUs	% of Total ERUs
Single-Family Residential	0.983	0.835	5,613	42.3%
Multi-family Residential	0.128	0.109	729	5.5%
Commercial	0.114	0.097	652	4.9%
Industrial	1.091	0.927	6,224	46.9%
City	0.0091	0.008	52	0.4%
TOTAL	**2.325**	**1.976**	**13,271**	**100%**

INFILTRATION AND INFLOW

The amount of infiltration and inflow (I/I) can be estimated on an annual average, maximum month, and maximum day basis by subtracting the dry weather flow at the WWTF from the annual average, maximum month, and maximum day flows at the WWTF.

For this report, infiltration and inflow is expressed in units of gallons per acre per day (gpad). The total area of the City of Camas is approximately 7,400 acres. The *developed* sewer service area, which includes the majority of Camas plus small areas to the southeast, is comprised of approximately 4,400 acres.

As stated earlier the City experienced an exceptional storm event on December 30, 2005, including a daily average influent flow of 7.03 mgd and a peak hour flow of 8.8 mgd (and corresponding effluent flows of 7.7 mgd and 9.3 mgd, respectively). Previous analysis of flow charts that recorded WWTF effluent flow showed that peak hour flow prior to this date was 6.5 mgd on February 1, 2005. WWTF influent is predominantly pumped flow from the Main Lift Station.

Table 6-7 summarizes the infiltration/inflow analysis for current conditions. The data contained in this table is useful as a baseline for evaluating changes in infiltration and inflow in the future. This data is also used to estimate future flows.

TABLE 6-7

Estimated Infiltration and Inflow

Flow Type	Influent Flow at WWTF (mgd)	Base Flow (mgd)	I/I (mgd)	Service Area (acre)[(1)]	I/I (gpad)
Annual Average (2005)	2.29	1.9	0.39	4,400	89
Max. Month	3.09	1.9	1.19	4,400	270
Peak Day	7.03	1.9	5.13	4,400	1,166
Peak Hour	9.93 [(2)]	3.46 [(2,3)]	6.47 [(2)]	4,400	1,471

(1) Developed areas only in the Camas sewer service area (total acreage of the City is 7,400 acres).
(2) Includes an estimated 1.1 mgd, based on sewer system hydraulic modeling, of "constrained I/I" that did not reach the WWTP during the peak hour storm event that would be expected to reach the WWTP after increasing pipe sizes.
(3) A peaking factor of 1.8 (peak hour to annual average) is applied to baseflow to calculate peak hour diurnal flow.

Infiltration and Inflow Analysis Using EPA Criteria

Another analysis of infiltration and inflow was performed to compare estimates of per capita I/I to EPA criteria. These infiltration and inflow rates are summarized in Table 6-8.

The U.S. EPA manual entitled *I/I Analysis and Project Certification* provides recommended guidelines for determining if infiltration and/or inflow is excessive.

1. To determine if excessive *infiltration* is occurring, a threshold value of 120 gallons per capita per day (gpcd) is used. This infiltration value is based on an average daily flow over a seven to fourteen day non-rainfall period during seasonal high ground water conditions.

2. To determine if excessive *inflow* is present in a collection system, the USEPA uses a threshold value of 275 gpcd. If the average daily flow (excluding major commercial and industrial flows greater than 50,000 gpd each) during periods of significant rainfall exceeds 275 gpcd, the amount of inflow is considered excessive.

TABLE 6-8

Per Capita Infiltration and Inflow Based on EPA Criteria

Parameter	EPA Criteria for Excessive I/I (gpcd)	Estimated Camas I/I Value (gpcd)
EPA Excessive Infiltration Criteria	120	62
EPA Excessive Inflow Criteria	275	382

Infiltration

Rainfall records from the National Oceanic and Atmospheric Administration show a 7-day period, February 14 through 20, 2005, during which only trace amounts of rainfall were measured. This would also be a period of relatively high groundwater. The average daily flow recorded during this time period is 1.99 mgd. (The highest daily flow was 2.237 mgd.) Since the intent of the EPA criteria was to only include domestic flows, 1.024 mgd of commercial and industrial flow was neglected. With a total population of sewer users in 2005 of 15,710, and a residential flow of 0.97 mgd (equal to 1.99 mgd minus 1.024 mgd) for this period, the "EPA I/I Infiltration Value" for Camas is estimated at 62 gpcd. Because this value is less than the EPA guideline of 120 gpcd, Camas is not considered to have excessive infiltration by EPA criteria.

Inflow

The maximum day influent flow at the WWTF over the period of 1998 to 2004 was 7.03 mgd (recorded on December 30, 2005), as shown in Table 6-1. Since the intent of the EPA criteria was to only include domestic (residential) flows, the estimated 1.024 mgd of commercial and industrial flow was neglected. With a total population of sewer users in 2005 of 15,710, and a non-commercial flow of 6.01 mgd (equal to 7.03 mgd minus 1.024 mgd) for this day, the "EPA I/I Inflow Value" for Camas is estimated at 383 gpcd. Because this value is greater than the EPA guideline of 275 gpcd, Camas is considered to have excessive inflow by EPA criteria.

INDUSTRIAL FLOWS

As shown in Table 6-4, winter water use by industries in Camas ranged from 0.95 mgd to 1.12 mgd the winter of 2001 to 2002 to 2004 to 2005. Assuming 85 percent of the winter water use is discharged to the sewer, 0.81 mgd to 0.95 mgd was discharged. Table 6-9 summarizes the following information for the industrial dischargers to the City sewer:

- Annual water consumption (excluding flows explicitly labeled as irrigation) for 2002 through 2004.

- Current permitted and estimated actual wastewater flows for 2005 based on review of the City's NPDES permit, State Waste Discharge Permits, DMRs and the City's recent Industrial User Survey.

- Projected flows for annual average, maximum month, peak day and peak hour flows based on the assumption that all industries are discharging maximum permitted flows by 2025. Peaking factors of 1.15 for maximum month to annual average, 1.25 for peak day to annual average, and 1.2 for peak hour to peak day have been used, in the absence of more specific information, based on a review of DMRs and diurnal discharge patterns. A reserve of 500,000 gallons per day annual average flow has been allocated for year 2025 to accommodate unanticipated growth of existing industries and potential new industries. 2015 flows were calculated assuming linear growth of flows from 2005 to 2025.

- Projected ERUs are provided based on projected annual average flows and the ERU value of 149 gpd/ERU.

Additional information about the volume and character of industrial flows of some of the major Significant Industrial Users (SIUs) is provided below, based on information in NPDES permit fact sheets and other sources. As discussed above and in Chapter 3, the City recently completed an Industrial User Survey that detailed the activities and discharge characteristics of its SIUs, Minor Industrial Users (MIUs) and domestic-equivalent dischargers.

C-TECH

C-Tech, incorporated as LANDA in 1969, builds pressure washing equipment, automatic parts washers, evaporators, and wastewater treatment/recycle systems. The manufacturing processes are cutting, forming, welding, cleaning, surface-coating, assembly, and product testing. A water-based cleaning process is used to prepare parts for surface coating. (No volatile organic solvents are used.) There is some wastewater discharge from this recycle process, and there are accumulated residuals (which are disposed of as solid or hazardous wastes). There is also a wastewater discharge from product testing and one from the charging of ion exchange media used in some water treatment products. As shown in Table 6-9, C-Tech is permitted for a discharge of 43,000 gpd, but currently consumes and discharges 5,000 to 7,000 gpd.

Water containing a cleaning agent is continuously reused in the parts washing process and evaporated when it is no longer effective, leaving no liquid discharge. Rinse water is also continuously reused, but carry-over of the cleaning agent (Chemcoa 1022, containing phosphoric acid) from the washing unit to the rinsing unit necessitates the constant blow-down (and replenishment with clean water) of about 5 gallons per minute to maintain adequate rinse water quality. The blow-down occurs for eight to ten hours per day, and is the only discharge from the parts washing process. Occasionally, the two rinse tanks, like the wash tank must be drained and cleaned (quarterly or semi-annually). When this happens, the contents are not discharged, but evaporated, with the residue properly disposed of as a solid waste, according to its designation.

The major wastestream discharged to the WWTF is from product testing. This water (which comes from the City's supply) is exposed only to the internal surfaces of the components of the product being tested. A small amount of methanol is added to some of the products after testing to assure that any residual test water will not freeze and damage the product. The excess is blown back out of the product and some of this methanol enters the product testing wastewater stream.

C-Tech is expanding into water treatment products which include an ion exchange unit process. The ion exchange resin must be charged, which requires passing a concentrated sodium chloride solution through the resin. It is estimated that 300 to 900 pounds per month of sodium chloride will be used and discharged in the total flow of 260,000 to 476,000 gallons per month.

SHARP

The Sharp Laboratories of America, Inc. (SLA) is a research and development (R&D) facility, conducting R&D in the areas of multimedia (e.g., video, imaging, telecommunications, software, copiers, printers, etc.), integrated circuits (ICs), and Liquid Crystal Display-Thin Film Transistor (LCD-TFT) technologies. The IC and LCD laboratories generate an average wastewater flow of about 20,000 gpd, with peak daily discharges of 31,000 gpd. Testing is conducted in small "clean rooms" using equipment and processes such as photomasking, stripping, etching, chemical, metal organic, and physical vapor deposition, rinsing and drying of wafers and LCD glass. Sharp is permitted for a maximum daily discharge of 48,000 gpd and an average monthly discharge of 35,500 gpd.

The IC Process Technology Labs perform research and development related to various processes and chemicals used in the development of integrated circuits. Basic processes, chemicals, and equipment are those found in a typical wafer or IC manufacturing facility, but the volume is very low, as would be expected in R&D. The LCD Process Technology Lab performs research and development related to various processes and chemicals used in the development of Liquid Crystal Displays (LCDs). Basic processes, chemicals, and equipment are those found in a typical LCD manufacturing facility, but R&D is limited to only the Thin Film Transistor or TFT portion of a completed LCD device. Again, volume is very low, as would be expected in R&D. In addition to the process groups mentioned above, some wastewater is generated by basic facilities maintenance and janitorial cleaning services.

The majority of wastewater is generated from air pollution control (air scrubber) equipment. Some additional wastewater is generated from rinsing, etching, stripping, cleaning, anodic oxidation, polishing, and reverse osmosis processes. These processes utilize chemicals such as polishing slurry, sulfuric acid, phosphoric acid, hydrogen peroxide, ammonium hydroxide, ammonium tartrate, ammonium fluoride, and hydrofluoric acid. The photodeveloping stations use tetramethylammonium hydroxide and surfactants. Deionized water is used for all processes and rinsing, except for air scrubbing. Reverse osmosis and ion exchange are used to deionize the water. The wastewater and concentrate from the deionization process enter the sanitary sewer through the neutralization treatment tank.

The photographic process for both IC and LCD processes consists of several rinses with deionized water. The rinses from these processes are combined with the wastewater streams and treated if necessary by a pH neutralization system prior to discharge to the sanitary sewer. Three air scrubbers treat exhaust from fume hoods, benches and tools that generate corrosive emissions. The IC scrubber generates about 170 gallons per day, the LCD scrubber generates about 11,500 gallons per day. The gas pad scrubber only generates wastewater in the event of an emergency. The wastewater generated from the scrubbers is routed to the pH neutralization tanks (one in each lab) prior to being discharged to the sanitary sewer.

Potential pollutants in the raw wastewater from these R&D activities include residues of the various cleaning agents (solvents, surfactants, corrosives), fluoride, and metals. Sharp is permitted for a discharge of up to 17.4 mg/L fluoride and has discharged as high as 9.2 mg/L fluoride as a monthly average. Sharp discharges 300 month of a 10 percent boric acid solution to the City of Camas wastewater treatment plant. Such a small amount is not expected to cause any disruption to the City's wastewater treatment or collection systems. However, it is recommended that the City require that, prior to discharge, the boric acid solution be diluted with copious amounts of water and neutralized to a pH range of 6 to 9. The boric acid discharge, if diluted into the City's influent would dilute the boron to < 0.01 mg/L and lower. The range of threshold concentrations of boron reported to inhibit the activated sludge process is 0.05 to 100 mg/L, while the threshold for inhibition of biological nitrification is reported as < 1.0 mg/L boron. Thus, the boron in the Sharp discharge should not cause inhibition of the treatment process at the City's wastewater treatment plant. However, it is recommended that requests to discharge any larger volumes of this waste stream be scrutinized carefully. Significantly increased volumes could cause boron to exceed the inhibitory concentrations mentioned above.

A pH neutralization and monitoring system comprises the only wastewater treatment system for this facility.

HERAEUS SHIN-ETSU AMERICA

Heraeus Shin-Etsu America, Inc.'s quartz glass manufacturing facility is permitted for a discharge of a maximum of 35,000 gallons of wastewater per day, and has recently discharged an average of about 12,000 gallons per day, as shown in Table 6-9. At Heraues' facility, sand is purified using heat and hydrogen chloride and then formed into stainless steel molds and fused into quartz glass crucibles using a high power electric arc. The fusion equipment and quartz glass is cooled during and after the process with an open tower process cooling water system. The crucibles thus formed are sand blasted to remove loose sand from the outside surface and then rinsed with deionized water. The tops of the crucibles are then cut to height and the outside diameter is ground to meet customer specifications. Deionized water is used as coolant for the cutting and grinding operations. The crucibles are finally rinsed with deionized water. Depending upon customer specifications some crucibles are pressure washed with high pressure water jet using deionized water.

All wastewater generated during this process is sent to the onsite pretreatment system. Crucibles that pass inspection are etched with hydrofluoric acid solution, rinsed with deionized water, and dried with heat. Wastewater generated is again sent to the onsite pretreatment system.

Two distinct wastewater streams are generated at Heraeus Shin-Etsu America Inc. as discussed below:

1. A fluoride-containing waste stream including wastewater produced during hydrofluoric acid etching of the crucibles and subsequent washing with deionized water and heat drying (batch), Acid (HF) fume scrubber wastewater, lab wastewater, and furnace cleaning wastewater (batch).

   The fluoride containing wastewater is treated in a fluoride treatment system where lime is added to treat fluoride. This is followed by pH neutralization, coagulation/flocculation, and settling. Sludge produced is dewatered using filter press and the sludge cake is disposed of with the facility's other solid wastes. The supernatant is combined with treated non-fluoride waste stream before being discharged to the Camas sanitary sewer.

2. Non-fluoride containing wastewater from finishing operations, gas scrubber blowdown, non-contact process cooling water blowdown, reverse osmosis containment stormwater, waste treatment chemical storage, and reverse osmosis reject water.

The pH of the non-fluoride waste stream is neutralized before this stream is combined with the treated fluoride waste stream and subsequent discharge to the sanitary sewer.

LINEAR TECHNOLOGY

Linear Technology Corporation (LTC) has operated a semiconductor wafer production facility in Camas since 1996. At full production, their output capability is approximately 5,000 wafer starts per week. Currently, production is about 1,500-1,700 wafer starts per week. LTC currently has about 200 employees and operates 24 hours a day, 7 days per week, but with restricted shifts. As shown in Table 6-9, LTC is permitted for a maximum day discharge of 299,000 gpd and has recently discharged an average of about 180,000 to 190,000 gpd.

LTC uses the following processing steps: diffusion, oxidation, photolithography, deposition, etching, cleaning, and grinding. Supporting operations include air handling, fume wet scrubbers, cooling water, and reverse osmosis to produce de-ionized water. Wastewater sources include: neutralized acid wastewater, treated hydrofluoric acid wastewater, process rinse water, gray water, reverse osmosis reject waste, condensate, fume control scrubber blowdown, cooling water, boiler blowdown, and cooling tower blowdown.

LTC has two main treatment processes: acid wastewater neutralization (AWN) using sodium hydroxide, and the fluoride treatment system (FTS), which precipitates fluoride as calcium fluoride using calcium chloride. FTS discharge, scrubber blowdown, and excess gray water are treated in the AWN system, then discharged to the Camas sewer system.

LTC is permitted for a maximum of 32 mg/L fluoride and has discharged as high as 11 mg/L fluoride.

WAFERTECH

Wafertech, a semiconductor integrated circuit (IC) fabrication facility, is the largest industrial discharger to the City's sewer system. As shown in Table 6-9, Wafertech is permitted for 1,437,500 gallons per day (maximum day) and currently discharges an average of about 500,000 gpd. Wafertech has a substantial wastewater treatment system including the following:

- **DI/TMAH Neutralization:** The system automatically neutralizes tetramethylammoniumhydroxide (TMAH) wastewater and the wastewater from the regeneration of the deionizing (DI) unit with the addition of sulfuric acid.

- **Ammonia Stripper:** The ammonia stripper removes the ammonia from alkaline wastewater in a packed bed tower using a two-pass, semi-continuous batch process. The treated wastewater is collected in the stripper sump tank and then pumped to the HF batch treatment system.

- **HF Batch Treatment for Fluoride Removal:** This process precipitates fluoride using $CaCl_2$, forming insoluble calcium fluoride salts. Precipitated fluoride sludge is removed by sedimentation in a clarifier.

- **Chemical/Mechanical Polish and Back-grind Treatment:** Treatment of this wastewater includes flocculation/clarification with the use of a polymer, NaOH, and sulfuric acid. Effluent flows to the cooling towers.

- **Acid Waste Neutralization:** Water coming from the fabrication process is neutralized in these tanks using NaOH and sulfuric acid and then sent to the recycle system.

- **Recycle System:** The recycle treatment system includes activated carbon beds to remove low-level organics and residual oxidants from the treated water. Following this step, multivalent and some monovalent cations and anions are removed using ion exchange, and the water is sterilized with ultraviolet lamps and treated with reverse osmosis.

Wafertech has recently applied for, received approval for, discharge of a biocide. The MSDS for the biocide supplied with the original request indicated the biocide contains three hazardous substances: Dibromoacetonitrile (5 %), 2,2-Dibromo-3-nitrilopropionamide (30%), and Polyethylene Glycol (30%). The 0.18-gallon per day biocide discharge, if diluted into WaferTech's current average daily flow of 444,000 gallons, would result in a dilution (weight / volume) of 1,900,000 x and dilute the biocide in the discharge to 0.53 mg/L. Substantial additional dilution would occur when the discharge reached the City's wastewater treatment plant, further diluting the biocide to approximately 0.1 mg/L (100 ug/L). Because little information is available regarding the possible inhibitory potential of the biocide, the City should have some concerns about the proper use and discharge of this biocide at Wafertech, and there should be procedures for reporting to the City any changes to the use, or any spills of this chemical at its application point.

Wafertech's discharge contains high concentrations of total dissolved solids (mostly calcium, sodium, chloride, sulfate, and fluoride). As stated in Wafertech's State Waste Discharge fact sheet:

> "ion imbalances arising from TDS can cause toxicity to the common whole effluent toxicity (WET) test organisms. The Permittee's discharge to the City of Camas wastewater treatment plant (WWTP) contains very high concentrations of TDS (4,800 *mg/L*) consisting of several of the ions known to adversely affect organisms in toxicity tests. The proposal to add the sulfuric acid wastestream to this discharge would increase TDS to 5,200 *mg/L* and increase the amount of sulfate discharged to the city WWTP.

> The City of Camas may someday be required by its NPDES permit to demonstrate compliance with chapter 173-205 WAC by monitoring the effluent discharge for whole effluent toxicity."

The fact sheet also discusses the possibility of osmotic stress on bacteria due to the high TDS. To date, nitrification inhibition testing performed by the City has not shown any negative effects from Wafertech's effluent. However, it is recommended that the City periodically monitor Wafertech's discharge for toxicity and inhibitory effects.

CHARACTERISTICS OF COMBINED INDUSTRIAL WASTEWATER

Table 6-10 provides the known characteristics, including conventional parameters and major ions, of the major industrial discharges, based on review of DMRs, permit fact sheets and operating records. Insufficient data exists to estimate the concentrations of these constituents for the combined industrial flow; however, since Wafertech's flow comprises the majority of the combined flow, the composition of the combined industrial stream will be assumed to be similar to that from Wafertech. Compared to domestic wastewater, the combined industrial wastewater is more dilute with respect to BOD_5 and TSS, significantly more concentrated (about an order of magnitude) with respect to calcium, sodium, chloride, sulfate, and fluoride, and about double the strength of ammonia and TKN.

TABLE 6-10

Reported Characteristics of Major Industrial Discharges[(1)]

		Wafertech	Linear	Sharp	Landa	Underwriter's Lab	Heraeus Shin Etsu
Flow (gpd, Year 2025)		1,000,000	260,000	30,870	37,400	8,700	30,400
BOD5	mg/L	16.6	N/A	N/A	40	N/A	N/A
TSS	mg/L	24	N/A	N/A	24	N/A	78
Ammonia-N	mg/L	53.2	N/A	N/A	N/A	N/A	N/A
TKN	mg/L	67.8	N/A	N/A	N/A	N/A	3.5
Nitrate plus Nitrite Nitrogen	mg/L	2.76	N/A	N/A	N/A	N/A	N/A
Calcium	mg/L	393	N/A	N/A	N/A	N/A	N/A
Sodium	mg/L	403	N/A	N/A	N/A	N/A	N/A
Chloride	mg/L	896	N/A	N/A	N/A	N/A	N/A
Sulfate	mg/L	621	N/A	N/A	23	N/A	N/A
Fluoride	mg/L	12	11	9.2	1.7	N/A	8
Alkalinity	mg/L	80	N/A	N/A	N/A	N/A	N/A

(1) N/A indicates Not Analyzed or Not Reported.

PROJECTED SEWER SERVICE AREA POPULATION, ERUS AND FLOWS

As discussed in Chapter 3, according to the Office of Financial Management (OFM), the City of Camas estimated 2005 population is 15,710. In the City's Comprehensive Plan, the City's projected 2025 population, within City limits was noted as 22,460 and inclusive of the Urban Growth Area, was noted as 24,700, a 57 percent increase in the UGA population from 2005. Year 2015 population is projected to be 19,210 within City limits and 22,160 within the Urban Growth Area, a 41 percent increase in the UGA population from 2005. However, use of these population increases, which are based on an annual population growth rate of 2.3 percent, is not considered to be reflective of the actual City growth rate, which has averaged 7.2 percent over the last ten years, as shown in Table 3-2. Per discussion with City staff, annual growth rates of 7.2 percent and 1.0 percent were used, respectively, to project future City population for next 5 years and subsequent 15 years. Use of these growth rates yields a 49 percent population increase by 2015 and a 64 percent population increase by 2025.

The current and projected 10-year and 20-year ERUs and flows (without consideration of further expansion of the Urban Growth Area) are summarized in Table 6-11. The projected flows and ERUs are based on use of the growth assumptions applied to all customer classes except the industrial category. Projected future industrial flows developed in Table 6-9 are used, which have somewhat higher growth rates (a 58 percent increase by 2015 and a 102 percent increase by 2025 of industrial flows). In addition to the flows indicated in Table 6-11, a special industrial reserve of 0.7 mgd for 2015 and 1.4 mgd for 2025 has been included for low strength wastewater (less than 8 mg/L BOD_5, 10 mg/L TSS, and 10 mg/L TKN).

I/I is assumed to be constant throughout the period. (In other words, increases in I/I due to the addition of new pipes and deterioration of old pipes are assumed to equal to decreases in I/I due to ongoing I/I reduction efforts.)

Future WWTF flows are projected based on a dry weather flow of 149 gpd/ERU. To estimate future annual average, maximum month, and peak day flows, the I/I flowrates were added to the base level wastewater flows derived from the population projections to obtain the respective future WWTF influent flowrates.

TABLE 6-11

Current and Projected Future

Wastewater ERUs and Flows	Sewer ERUs			
Customer Type	**2005**	**2015**	**2025**	**Buildout(2)**
Single-Family Residential	5,613	8,363	9,205	13,608
Multi-family Residential	729	1,086	1,196	7,546
Commercial	652	972	1,070	2,176
Industrial	6,224	9,857	12,556	25,537
City	52	77	85	173
TOTAL	13,270	20,356	24,112	49,039
Projected Flows (mgd)(1)				
Total Base Flow	1.98	3.03	3.59	7.31
Low-strength Industrial Reserve	0	0.70	1.40	Included in Industrial ERUs
Average Annual Flow	2.29	4.04	5.30	7.62
Maximum Month	3.09	4.84	6.10	8.42
Peak Day	7.03	8.78	10.04	12.36
Peak Hour	9.93(3)	11.47	13.44	17.06

(1) I/I assumed to remain constant during planning period. However, currently "constrained I/I" is projected to reach WWTP in future. See Note #3.

(2) Buildout ERUs and flows assume that commercial, industrial and City ERUs grow at the same rate as the overall population.

(3) Includes an estimated 1.1 mgd of "constrained I/I" that did not reach the WWTP during the peak hour storm event that would be expected to reach the WWTP after increasing pipe sizes.

EXISTING AND PROJECTED INFLUENT BOD_5 AND TSS LOADING

Influent monitoring data for BOD_5 and TSS concentrations and loadings reported in DMRs includes the influence of septage receiving on the concentrations, since the monitoring point is downstream of the septage receiving point. Some of the significant variability observed in BOD_5 and TSS concentrations and loadings is likely due to the receipt of septage, which is not received every day or every week.

EXISTING BOD_5 LOADING

Monthly average influent BOD_5 loadings ranged from 1,231 lb/d to 3,907 lb/d for the 8-year period of analysis as shown in Table 6-2 and Figure 6-1. The monthly average influent BOD_5 rated loading of 5,616 lb/d was never exceeded during the 7-year period of analysis. The average influent BOD_5 concentration for the 6-year period is 143 mg/L, which would be considered low strength domestic wastewater. The average BOD_5 loading for the 7 years, as summarized in Table 6-3, was 2,252 lb/d.

With a service population of 15,710 for 2005, and an annual average BOD_5 loading of 2,228 lb/d, the 2005 annual average BOD_5 loading was 0.142 lb/cap/d. This value is lower than the DOE Orange Book criteria of 0.2 lb/cap/d, likely due to the presence of dilute STEP system discharges. Reported maximum monthly loadings were significantly higher in 1998-2000 than in 2001-2005. However, the 2001 to 2005 data is considered to be more representative of current loading.

To convert the maximum month BOD_5 loading to a per capita and an ERU basis, the 2005 service population of 15,710 and number of ERUs (13,271) and maximum month BOD_5 of 3,042 lbs for 2001-2005 were used to calculate a maximum month per capita and ERU BOD_5 loading of 0.194 lb/cap/d and 0.229 lb/ERU/d, respectively. The ratio, for 2005, of the maximum month BOD_5 loading to the annual average BOD_5 loading is 3,042: 2,228 or 1.37:1. This ratio is used in the development of future flow and loadings to the WWTF later in the chapter.

EXISTING TOTAL SUSPENDED SOLIDS LOADING

A review of Table 6-2 shows that monthly average TSS loadings ranged from 1,418 lb/d to 6,520 lb/d. The monthly average influent rated TSS loading of 6,405 lb/d was exceeded once during the 7-year period of analysis. This exceedance is not considered representative of actual current loadings. The 2005 average loading of 3,186 lb/d and a 2005 service population and average ERUs of 15,710 and 13,271, respectively, translate to an annual average TSS loading for 2005 of approximately 0.203 lb/cap/d or 0.240 lb/ERU/d.

The 2005 maximum month TSS loading is 4,335 lbs/d. Using the same values for the 2005 service population and average ERUs of 15,710 and 13,271, yields a maximum month value of 0.276 lbs TSS/cap/d or 0.327 lb/ERU/d. The ratio of the maximum month TSS loading to the annual average TSS loading is 4,335 : 3,186 or 1.36:1. This ratio is used in the development of future flow and loadings to the WWTF later in the chapter.

EXISTING AMMONIA NITROGEN AND TKN LOADING

Current (2005) average influent ammonia loading to the Camas WWTP is about 730 lb/d (average of 39 mg/L). Maximum month (May 2005) ammonia loading was 930 lb/d. TKN in the City's influent and septage is not frequently monitored, but a typical NH_3-N / TKN ratio or domestic wastewater is 0.62 (equal to 25 mg/L NH_3-N / 40 mg/L TKN).

The influent NH_3-N / TKN ratio actually may be higher than that for typical domestic wastewater (0.62), due to the impact of preferential STEP tank removal of organic nitrogen over ammonia. However, since STEP tank septage is ultimately brought to the

WWTP, the overall NH_3-N/TKN ratio for influent plus septage is likely closer to the 0.62 value.

Wafertech's average flow for 2004-2005 was about 560,000 gpd. Average ammonia and TKN concentrations (per NPDES fact sheet characterization and verified in recent DMRs) and loadings for Wafertech are:

Ammonia -N	53.2 mg/L, 248 lb/d
TKN	67.8 mg/L, 317 lb/d

Thus, Wafertech contributes ~ 317 lb /1177 lb, or about 27 percent, of the TKN load to the WWTP. Non-Wafertech average loadings are thus calculated to be 482 lb/d (730 lb/d minus 248 lb/d) ammonia and 860 lb/d (1177 lb/d minus 317 lb/d) TKN.

To facilitate the projection of future ammonia and TKN loadings, Wafertech and non-Wafertech loadings are considered separately, and non-Wafertech industrial wastewater is considered to be at domestic strength. The 2005 average non-Wafertech ammonia loading of 482 lb/d and a 2005 service population and average non-Wafertech ERUs of 15,710 and 9,299, respectively, translate to an annual average ammonia loading for 2005 of approximately 0.0465 lb/cap/d or 0.0518 lb/non-Wafertech ERU/d.

The 2005 maximum month non-Wafertech ammonia loading was 682 lbs/d. Using the same values for the 2005 service population and average non-Wafertech ERUs of 15,710 and 9,299, yields a maximum month value of 0.0592 lb NH_3-N/cap/d or 0.0733 lb NH_3-N/ERU/d. The ratio of the maximum month ammonia loading to the annual average ammonia loading is 682:482 or 1.41.:1. This ratio is used in the development of future flow and loadings to the WWTF later in the chapter.

For the estimated current 3,971 Wafertech ERUs, the average ammonia loadings are 0.0625 lb/Wafertech ERU/d, and maximum month is estimated to be 0.0813 lb/Wafertech ERU/d, based on historical ratios of maximum month to average annual concentrations.

Non-Wafertech TKN loadings are estimated based on an ammonia/TKN ratio of 0.62, and Wafertech's TKN loadings are estimated based on an ammonia/TKN ratio of 0.78, based on the composition of Wafertech's wastewater.

PROJECTED FUTURE WASTEWATER LOADINGS

Future WWTF maximum month BOD_5 and TSS loadings are estimated by multiplying the projected number of ERUs by the respective ERU-based loadings, and adding additional loading for a low-strength industrial reserve as indicated below. Future ERU-based annual average BOD_5 and TSS loadings are estimated using the ratio of the maximum month to annual average loadings of these parameters. The current maximum month BOD_5 and TSS loadings are 0.229 lb BOD_5/ERU/d and 0.327 lb TSS/ERU/d. The ratio of the maximum month to annual average BOD_5 is 1.37:1. The ratio of the maximum month to annual average TSS is 1.36:1. Table 6-12 provides a summary of projected future WWTF influent BOD_5 and TSS loadings.

It is assumed that STEP system septage will continue to be hauled to the WWTP at the current rate, relative to the flow discharged, for the 20-year period. Thus, the composition of domestic wastewater plus STEP septage is assumed to stay the same.

The strength of the combined industrial wastewater with regard to BOD_5 and TSS *for the industrial ERUs* indicated in Table 6-11 discharged to the City is assumed to be that of domestic wastewater for this analysis. The industrial ERUs in Table 6-11 include a reserve of 0.50 MGD of domestic strength industrial wastewater beyond the NPDES-permitted maximum flows. (It is likely that the combined industrial wastewater is more dilute than domestic, but due to a lack of information regarding BOD_5 and TSS concentrations for current and future industries, use of domestic concentrations is appropriate and conservative.) However, the *industrial low-strength reserve* of 0.7 mgd for 2015 and 2025 for 1.4 mgd shown in Table 6-11 is assumed to be low strength (e.g., pretreated) with concentrations not exceeding 8 mg/L BOD_5, 10 mg/L TSS, and 10 mg/L TKN.

Ammonia nitrogen concentrations and loadings are estimated based on the projected number of Wafertech and non-Wafertech ERUs. Non-Wafertech TKN loadings are estimated based on a ammonia/TKN ratio of 0.62, and industrial TKN loadings are estimated based on a ammonia/TKN ratio of 0.78, based on the composition of Wafertech's wastewater.

TABLE 6-12

Current and Projected WWTF Loadings

ERUs and Loadings	2005	2015	2025	Buildout
Total ERUs	13,270	20,356	24,112	49,039
Annual Average $BOD_{5,}$ (lb/d)	2,218	3,437	4,099	8,197
Max Month $BOD_{5,}$ (lb/d)	3,039	4,708	5,615	11,230
Annual Average TSS, (lb/d)	3,191	4,937	5,883	11,791
Max Month TSS, (lb/d)	4,339	6,715	8,001	16,036
Annual Average NH_3-N, (lb/d)	730	1,149	1,389	2,686
Max Month NH_3-N, (lb/d)	1,029	1,618	1,956	3,788
Annual Average TKN, (lb/d)	1,017	1,588	1,917	3,726
Max Month TKN, (lb/d)	1,367	2,130	2,573	4,995

As shown in Table 6-12, the projected year 2025 maximum month TSS loadings without UGA Expansion exceeds the rated WWTF capacity of 6,405 lb/d, and BOD_5 capacity of 5,616 lb/d is reached by 2025.

Analysis of flows within each basin, as well as each major sewer line and at each lift station, is provided in Chapter 7, Collection System Evaluation and Recommendations.

CHAPTER 7

COLLECTION SYSTEM EVALUATION

In Chapter 7, an evaluation of the City's collection system is provided and cost estimates are provided for capital improvement projects to address collection system deficiencies. The evaluation of the collection system includes:

- Review of previous reports
- Evaluation of pump stations and pump station run time meter data collected in 1998-2005
- Field observations
- Evaluation of television inspection
- Evaluation of results of sewer system modeling (described in more detail in Appendix F and Appendix G)
- Evaluation of information provided by City staff

Following the evaluation, collection system capital improvement projects are proposed.

REVIEW OF PREVIOUS REPORTS REGARDING THE COLLECTION SYSTEM

<u>City of Camas Sewerage Facilities Plan</u>, March 1987, Parametrix, Inc.

This report focused on the plan for construction of STEP systems for the Lacamas Heights area (Basin 15) and other areas to the west of downtown Camas. Average dry weather flows at this time were 0.37 mgd.

<u>City of Camas Evaluation of Sewer System Alternatives</u>, April 1993, CH2M Hill.

This report provided an evaluation of the City's existing septic tank effluent (STE) systems, and considered alternatives to provide sewer service to the unsewered areas within the Urban Growth Boundary (UGB) and projected future UGB, including areas of current West Camas and north of Lacamas Lake. The report recommended the City implement a combined STE/conventional gravity approach to providing sewer service to the study area.

City of Camas Wastewater Facilities Plan, October 1994, CH2M Hill.

This Plan provided a capital improvement plan through 2043, including recommended upgrades to all of the City's pump stations. The then current total peak I/I in the system was estimated to be 3.54 mgd. Based on a new present worth analysis, it was concluded in this report that it was more cost-effective by a factor of about three to treat the I/I by adding capacity to the treatment plant than it was to remove I/I from the system.

City of Camas Sewer System Infiltration and Inflow Study, August 1998, Gray & Osborne.

The *City of Camas Sewer System Infiltration and Inflow Study* evaluated the City's wastewater collection system and recommended improvements to reduce excessive infiltration and inflow (I/I). According to EPA criteria, the City had excessive inflow and infiltration entering its sewer system. Based on the findings of previous reports and employee interviews, and the above criteria, it was decided to focus field investigations in an I/I study on Basins 1, 2, 3, 4, 5, 6, 7 and 10.

An estimate of I/I for each basin was developed based on the flow monitoring conducted. The basins with the highest estimated I/I were (in order from highest) Basins 3 North, 4, 1, and 2. The estimates of I/I in each basin have been updated and are presented in Table 7-3 in this Plan.

The I/I Study recommended that the City complete the following tasks between 1999 and 2005:

1. Sewer Main repairs in Basin 1 (NW Ivy Street), Basin 2 (NW 10th Avenue), Basin 3 (multiple projects, including NW 11th, NW Ivy Lane, NW 15th Avenue, NW 30th Avenue), Basin 4 (NE Everett Street), Basin 6 (SE 3rd Avenue), and Basin 10 (NW 11th Avenue).

2. TV inspection of 71,000 feet of sewer main and 92,000 feet of side sewer in Basins 1, 2, and 4.

3. Manhole repairs in all the non-STEP basins.

4. Repairs to catch basins in Basins 2, 3, 4, 5, and 6.

5. Installation of an effluent filter at the WWTP to enable the plant to achieve 85 percent removal of BOD_5 and TSS during periods of dilute influent due to I/I.

All of these major recommendations were completed.

304 Stainless Steel Saddle Failure Analysis Report, December 5, 2001, MDE Engineers

This report discussed a failure analysis of a 304 stainless steel saddle removed from the sewer near the Prune Hill Estates Sub-division. The analysis, conducted using microscopy and long-term microbiological testing, determined the presence of sulfate reducing bacteria, which led to microbiologically influenced corrosion and the failure of the saddle. The sulfate likely was present from the oxidation of sulfide that had formed due to anaerobic conditions in the STEP system.

This report is included as Appendix H.

MAJOR FIELD OBSERVATIONS

City staff has reported the following major observations regarding the collection system:

- Significant sewer system surcharging during storms in Basins 1, 2, 3 South, and 6. Surcharging occurred in the vicinity of Manholes 1-1-3 through 1-1-3, Manholes 3-1-6 through 3-1-10, and Manholes 6-1-2 through 6-1-3.
- Significant corrosion and odors in gravity sewers in Basin 10, Basin 5 and Basin 3-North where STEP systems discharge into gravity sewers.
- Significant corrosion in STEP pump stations, especially the Brady Road Pump station. A list of pump station issues is included in Table 7-1.
- Corrosion-induced failure of sanitary sewer components, as discussed in the *304 Stainless Steel Saddle Failure Analysis Report* listed above.

EVALUATION OF PUMP STATIONS

FIELD OBSERVATIONS

Based on inspections, field measurements and communications with City staff, City pump stations were evaluated for the purposes of this Plan. A summary of the evaluations is provided in Table 7-1.

As shown in Table 7-1, a number of the stations have significant corrosion issues, particularly those in areas with STEP systems. Additionally, a number of stations have high run-time hours and low MEGs and need to be upgraded within the 20-year planning period.

TABLE 7-1

Pump Station Evaluations

Pump Station	Basin	MEG Reading(1)	Total Run-Time Hours(1) Pump 1/Pump 2	Inspection Notes
Main	5	NR(2)	NR	Poor access to wet well, small wet well
Oak Park	8	NR	NR	Good condition
One Stop	9	NR	NR	Good condition
South Prune Hill	10	NR	NR	Good condition.
West Camas	1	NR	NR	Some corrosion of ductile iron pipes.
Crown View Plaza	3	NR	NR	Good condition, but grease accumulation
Parker Estates	13	2070/3500	3407/2727	Significant corrosion of bolts and piping
Winchester Hills No. 1	13	0/4000	2964/1209	Significant corrosion of bolts and piping
Winchester Hills No. 2	13	120/3680	3529/2407	Significant corrosion in valve vaults
Grand Ridge	11	4000/1400	119/1766	Minor corrosion observed
Brady Road	11	7.81/4000	3298/3881	Severe corrosion of bolts and piping
Sunningdale Grdns. 1	14	NR	NR	Significant corrosion of bolts and piping
Lacamas Shores	14	152/142	1583/1187	Significant corrosion of bolts and piping
Prune Hill Park		12/40.2	6670/6382	Significant corrosion of bolts and piping

(1) Based on inspections in March 2005
(2) NR = Not reported.

In order to optimize performance and streamline maintenance, the City has standardized its new pump stations around a several components, including the following:

- ROMTEC pump stations with conical bottom
- Flygt pumps
- Multitrode level sensors
- Monitor Pro run-time monitoring and MT2PC controls
- Sonotrol telemetry for alarms only
- Generators
- Odor control at STEP stations

As pump stations are upgraded, components will be converted to the standardized items as practicable.

PUMP STATION RUN-TIME DATA

Estimated historical wastewater flows for several drainage basins, based on pump station run-time data, are provided in Appendix I. For the purposes of this report, it was generally assumed that, when running, each pump was pumping at its design capacity.

Because run-time data is not recorded every day, some of the flows are averages of 2 or 3 day's flows.

Key daily pump station run-time data and corresponding WWTP influent flows are summarized in Table 7-2. This table includes the following flows:

- 2005 average baseflow based on an evaluation of winter water use and summer dry weather flow
- Daily flows for December 22, 2005, with the *third highest* daily flow since 2000, and I/I calculated by subtracting the base flow from the 12/22/05 flow for each pump station and WWTP influent
- Daily flows for December 31, 2005, with the *highest* daily flow since 2000, and I/I calculated by subtracting the base flow from the 12/31/05 flow for each pump station and WWTP influent
- Percentage of total I/I for 12/22/05 and 12/31/05, calculated by dividing the I/I for each pump station into the WWTP influent flow.

TABLE 7-2

Pump Station Run-Time Data and Infiltration and Inflow (Daily Flows)

		2005 Ave. Baseflow		12/22/05			12/31/05		
Pump Station	**Sub-Basin(s) Served**	**Base Flow (mgd)**	**% of Total Base Flow**	**Flow (mgd)**	**I/I (mgd)**	**% of Total I/I**	**Flow (mgd)**	**I/I (mgd)**	**% of Total I/I**
Lacamas Creek	7 all	0.041	2%	0.236	0.195	5%	0.22	0.175	3%
Crown View	3nH	0.066	3%	0.189	0.122	3%	0.32	0.257	5%
West Camas	10A-E, 12	0.191	10%	0.909	0.718	20%	0.78	0.586	11%
South Prune Hill	10 all, 12	0.147	8%	0.814	0.667	19%	0.74	0.597	12%
WWTP Influent	**All**	**1.90**	**100%**	**5.45**	**3.55**	**100%**	**7.03**	**5.13**	**100%**

As shown in Table 7-2, I/I enters the system from the basins served by all of the basins evaluated. The basins where the highest amount of I/I enters the collection system, among those evaluated, include those served by the West Camas and South Prune Hill Pump Station, which received 11 to 20 percent of the total I/I entering the system. The information in Table 7-2 was used for calibration and corroboration of the sewer system hydraulic model.

A number of basins are served only by the Main Pump Station. Since the Main Pump Station is controlled by variable frequency drives, and thus has a variable flow rate pumped, an accurate quantification of flows from this station is not possible from the runtime data.

DISCUSSION OF SPECIFIC PUMP STATIONS

Brady Road Pump Station

The Brady Road Pump Station serves Basin 11 in the southwest corner of Camas. The Brady Road Pump Station receives STEP effluent from the Grand Ridge Pump Station to the southwest and individual STEP systems throughout Basin 11, and pumps the combined flows up Brady Road to NW Parker Street. The pump station houses two 20-hp STEP effluent pumps.

As shown in Table 7-1, the Brady Road Pump station has exhibited severe corrosion due to STEP effluent. This pump station will be rehabilitated in 2007. A memorandum prepared for the Brady Road Pump station upgrade is included in Appendix J.

Main Pump Station

The Main Pump Station is a wet well –dry well station and conveys sewage from almost the entire service area (excepting only Basins 8 and 9) across the Washougal River to the WWTP. The Main Pump Station has variable frequency drive (VFD) control. The *peak hour* capacity of the Main Pump Station is 7,700 gpm (11.1 mgd). Based on WWTP influent records, *peak hour flows* from the Main Pump Station have approached 9 mgd. An evaluation of the Main Pump Station's capability to accommodate the 2025 flow is provided in the discussion of sewer system hydraulic modeling later in this chapter.

The Main Pump Station has a very small wet well that hinders both maintenance and the ability of instruments to control pump operation. The pumps cycle too frequently and there is little reaction time to respond to changes in flow. The small wet well makes it extremely difficult to stop the pumps for even a short maintenance activity. As discussed later in this chapter, it is recommended that this wet well be enlarged.

Lacamas Creek Pump Station

Lacamas Creek Pump Station is a wet well – dry well station serving Basin 7 in the southeast corner of the City, and conveys Basin 7 flow to Manhole 6-1-9 in Basin 6. The *peak hour* capacity of the Lacamas Creek Pump Station is 300 gpm (0.432 mgd). As shown in Appendix I and Table 7-2, although base flow is only 0.041 mgd, daily average flows from the Lacamas Creek Pump Station have reached 0.23 mgd.

The Lacamas Creek Pump Station could be upgraded to accommodate flows from a new Crown Road Sewer line that would serve the Southeast Gregg Service Area (the east side of Basin 15). This new sewer could connect to existing Manhole 7-3-5 at Crown Road in

Basin 7. At Manhole 7-1-1, sewage from Crown Road would mix with flow from the rest of Basin 7. This possible collection system configuration is discussed later in this chapter.

Other Pump Stations

As shown in Table 7-1, a number of pump stations particularly those exposed to STEP effluent, have experienced significant corrosion. Additionally, a number of pump stations need to have their pumps replaced, as indicated by the MEG readings provided in Table 7-1. Per discussion with City staff, the City will need to budget for, on average, one to two major upgrades of pump stations per year. Typically, when upgraded the pump stations are provided with standardized features of the "Camas spec," including Flygt pumps, Multitrode level sensors, Monitor Pro run-time monitoring and MT2PC controls, Sonotrol telemetry for alarms only.

As shown in Table 7-3, a number of pump stations are approaching or exceeding capacity, and may need to be upgraded if efforts to decrease infiltration and inflow or to reroute flows are not successful. The flows in Table 7-3 are estimated current *peak hour* flows, and are generally 20 to 50 percent higher than the historical peak day flows calculated from run-time data.

As discussed below in the Evaluation of Sewer System Modeling section, the hydraulic modeling indicates that current estimated peak hour flows to the Main Pump Station are 1.1 mgd (765 gpm) less than would occur if flow were not constrained from reaching the Main Pump Station by over-capacity sewer pipes. Thus, after upsizing sewer pipes tributary to the Main Pump Station, 1.1 mgd additional flow at the Main Pump Station would be expected if the historical peak hour storm events occurred.

Additional information regarding alternatives for pump station improvements is provided later in this chapter.

TABLE 7-3

Flows To Pump Stations

Pump Station	Basin No.	Pump Capacity (gpm, each)	Total Station Pumping Capacity (gpm, w/1 out of service)	Current Estimated Peak Hour Flow (gpm)
Main	5	3,850	7,700	6,106[(1)]
Oak Park	8	350	350	213
One Stop	9	231	231	100
South Prune Hill	10	510	510	776
West Camas	1	810	810	1052
Crown View Plaza	3	325	325	391
Lacamas Creek	7	300	300	265

(1) If flow upstream was unconstrained, estimated total peak hour flow would be 6,871 gpm.

EVALUATION OF WESTERN SERVICE AREA AND STEP COLLECTION SYSTEM

As discussed above, City staff have observed significant corrosion and odors in gravity sewers where STEP systems discharge into gravity sewers, significant corrosion in STEP pump stations, and corrosion-induced failure of sanitary sewer components. Maintenance of the STEP collection system, and impacts from STEP effluent on the other portions of the collection system, constitute a significant maintenance burden on City staff.

The City has installed two stations where a chemical odor control agent, Bioxide is fed into STEP mains. (Bioxide provides an alternative electron acceptor, nitrate, to prevent the formation of odors from the generation of sulfide from the reduction of sulfate.) One of these stations is near Round Lake, downstream of where the STEP main serving the Western Service Area is joined by the STEP main from Basin 15. The other Bioxide station is located on NW18th Avenue upstream of where the STEP Main serving Basin 12 discharges STEP effluent to Basin 10. The Round Lake Bioxide station has been successful at reducing corrosion and odor to some degree, though the other station is less effective, and annual Bioxide costs have reached $65,000.

Based on the problems associated with STEP areas, City staff wish to install gravity sewers instead of STEP systems where feasible, in the future. Where possible, new developments will be required to use conventional gravity systems. Where conventional systems are not feasible, housing developments of over 15 units will be required to convey sewage to small regional pump stations.

As detailed in the discussion of the hydraulic model, the 21-inch STEP Main that transports wastewater from the Western Service Area to the STEP terminus at NE 6th Avenue and Joy Street has adequate capacity for 2025 flows. However, the City has concerns about the durability of this line, which is constructed of 100-psi pipe and has numerous taps. Thus, this line is recommended for replacement in phases in years 2016 through 2025. The gravity sewer lines and Main Pump Station downstream of the 6th and Joy STEP terminus do not have sufficient capacity to transport 2025 flows. Thus, it is recommended that flows from the 21-inch STEP Main be bypassed in a new STEP Main to the WWTP, as discussed in the Collection System Improvements discussion below.

EVALUATION OF GRAVITY COLLECTION SYSTEM

As discussed above, City staff has observed significant sewer system surcharging during storms in Basins 1, 3 South, and 6 due to I/I. The City has rehabilitated a number of sewers identified as deficient in the *1998 I/I Study*, and has conducted television inspection of problem areas identified in the *1998 I/I Study*. Review of those inspections is discussed below. To date, the City has not required rehabilitation of side sewers on private property; however, if rehabilitation of public sewers removes an insufficient amount of I/I, the City may require rehabilitation of private sewers, which have previously been identified as a source of I/I.

As discussed in the Collection System Improvements section below, construction of a new gravity sewer line down Crown Road to service new development in the eastern portion of Basin 15 is recommended.

Review of Television Inspection Videos

City staff provided sewer system television inspection videos, covering a period of November 1997 through January 2002, for problem areas in Basins 1, 2, 3n, 3S, and 4. TV inspection of these areas was recommended in the *1998 I/I study*. Based on a review of documentation provided with the tapes, a number of pipelines were identified as needing repair or replacement. Major defects were considered to be:

- Greater than 20 percent of joints leak
- I/I is estimated to be greater than 0.75 gpm
- Broken pipes, circumferential cracking, holes
- Poor condition
- Plugging due to roots
- Lateral cracking in conjunction with qualifier (e.g., roots, pinhole leaks)

Pipes were assigned a priority ranking for rehabilitation depending upon the quantity and nature of defects that were noted. Pipes in poor condition are identified in Figures 7-1 through 7-4.

EVALUATION OF SEWER SYSTEM MODELING

As described in Appendix F, the major sewer lines of the City's collection system were modeled with the MOUSE hydraulic model software, developed by DHI, Inc. This model has three main functions: (1) to assess the ability of the existing system to transport current flows; (2) to make recommendations for future improvements to convey projected future flows; and (3) to determine the effects of individual future developments and additions to the system. A capacity evaluation was performed by generating the peak hour flow to each modeled collection system component from the contributing area and units or connections. The output from this model was used to evaluate the capacity of the existing collection system and to identify improvements that will be necessary in the future. Each model run identifies sewers that may be hydraulically deficient if a peak hour flow event happened with the estimated or projected populations.

Fifteen basins (catchments) were delineated based on the natural drainage patterns of the City's service area. The fifteen basins are similar to those evaluated in the *1998 I/I Study*, except the boundaries have been changed to reflect development, annexations and rerouting of flows since 1998. The basins were further subdivided into smaller subbasins, as shown in Figures G-1 through G-11 in Appendix G. Flows for each subbasin were determined based on the number and zoning of the parcels within the subbasin. Parcel information was provided in the "camparc" parcels shape file supplied by the City. All developed parcels zoned residential within the basin were considered to be single ERUs and ascribed a flow of 149 gallons per day, the average daily flow per ERU as developed in Chapter 6.

A peaking factor was used to determine the peak hour diurnal base flow. The peaking factor for residential flows was calculated using an equation provided by the *1998 Department Of Ecology Criteria for Sewage Works Design* (Orange Book). The equation calculates a peaking factor based on population. As population increases, the peaking factor decreases to account for greater attenuation of flows in the presumed larger system.

$$PeakingFactor = \left(18 + \sqrt{Population/1000}\right) / \left(4 + \sqrt{Population/1000}\right)$$

A peak hour to peak day peaking factors of 1.75 was used for I/I –related flows, based on an examination of historical influent flow records.

The Camas network is comprised of gravity sewer, STEP (septic tank effluent pump) and force main systems. The model did not evaluate the network components (pumps and sewer lines associated with individual homes and subdivisions) of the STEP systems within the City. The portions of the network serviced by STEP systems were modeled based on the assumption that the system behaved essentially as a gravity system. This assumption is valid due to the similarity in flow patterns of gravity flow to that from a large number of STEP tanks.

In addition to residentially zoned parcels, flows were also ascribed to parcels zoned commercial, industrial, and other (school/church). Parcels zoned commercial were ascribed a flow rate of 3,000 gallons per acre per day. Industrial flow rates were based on the permitted flow and water consumption and sewage production records of the individual industry as described in Chapter 6. School and church parcels were ascribed a flow rate based on attending populations. The Department of Ecology ascribes a base flow of 10 gallons per day per student for schools with cafeterias but no showers, and 15 gallons per day per student with for schools with cafeterias and showers, including infiltration. School flows were peaked by a factor of three, assuming an 8-hour school day. This value was considered a conservative estimate of the flows as infiltration within the school system is also peaked.

Peak hour Infiltration and inflow (I&I) was added to the base flow from each basin based on average I&I rates in terms of gpad established in the *1998 I/I Study* normalized to a peak hour I/I rate, and adjusted to reflect changes in developed acreage in each basin. Additionally, the flow from Basin 10 was increased substantially based on an analysis of run-time data from the West Camas and South Prune Hill Pump Stations. I/I estimates used in the model are summarized in Table 7-4. Total I//I of 5.13 mgd peak day and 6.57 mgd peak hour were used based on historical flow records. The hydraulic modeling indicates that current estimated peak hour flows to the Main Pump Station are 1.1 mgd (765 gpm) less than would occur if flow was not constrained from reaching the Main Pump Station by over-capacity sewer pipes. Thus, after upsizing sewer pipes tributary to the Main Pump Station, 1.1 mgd additional I/I at the Main Pump Station would be expected if the historical peak hour storm events occurred.

The flow developed for each subbasin was entered into the network system at the input nodes as shown in Figures G-1 to G-11 in Appendix G. The input nodes were generally located at the upstream end of the network system of each sub-basin to provide a level of conservatism in the flows within each subbasin.

Future flows for residential parcels in the basins were developed utilizing a peak design flow of 149 gallons per ERU. Undeveloped parcels within the basin were ascribed a number of ERUs based on the size and established zoning of the parcel. Basins were assumed to grow at the growth rates established in Chapter 6 over the 20-year planning period.

If a basin reached theoretical buildout prior to accepting the allotted number of ERUs based on the growth rate, these ERUs were transferred to basins with available parcels to handle the growth. The transfer of ERUs to other basins was in part based on discussions with the City regarding known developments within the basins.

Commercial flows were similarly increased based on available commercial acreage. I/I rates were increased at the rate of increase of additional acreage of service area. The model evaluated flows generated in the years 2006, 2015, and 2025.

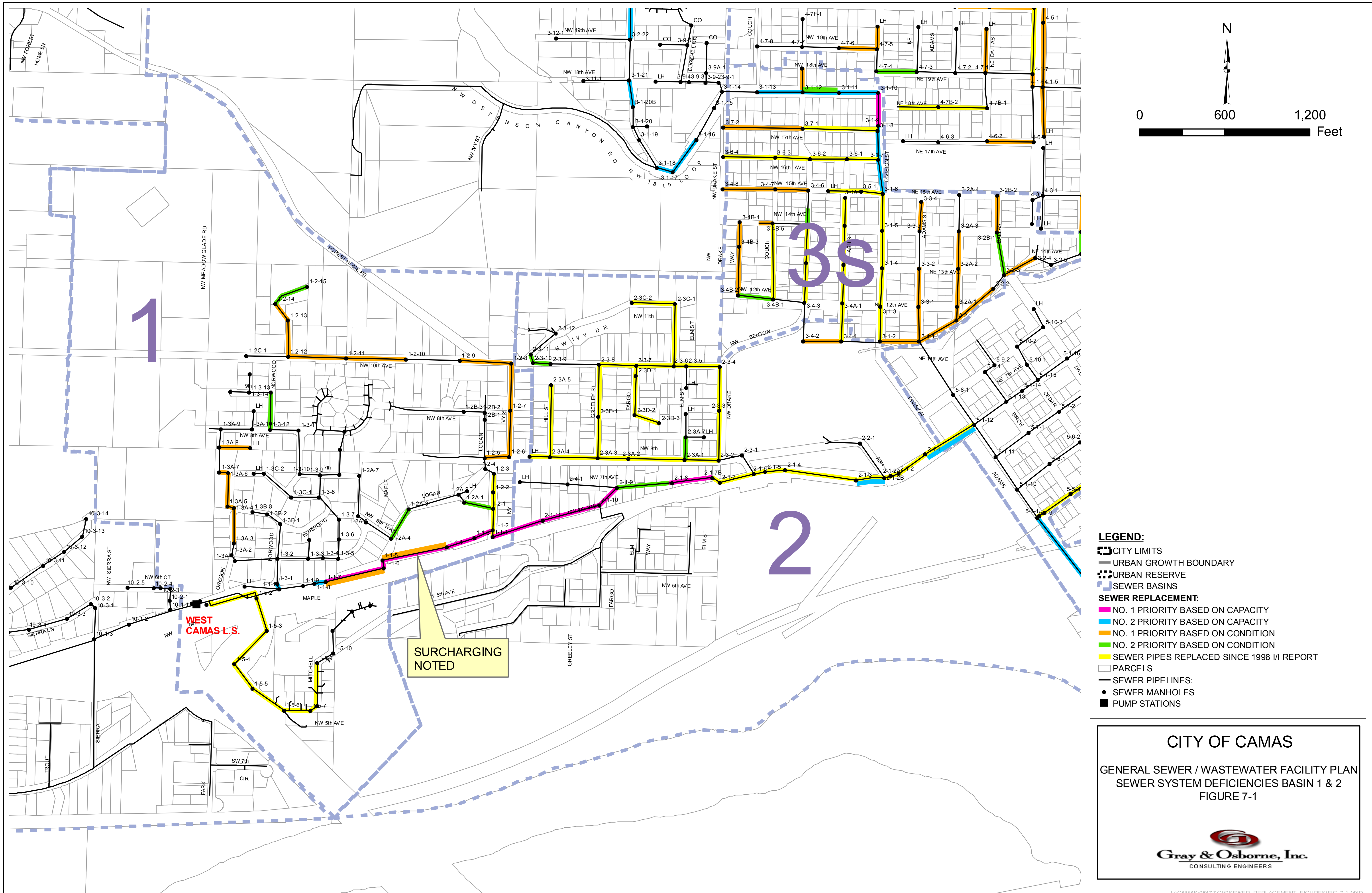
TABLE 7-4

I/I Estimates Used for Hydraulic Model

	Total Area (2006)	**Developed Area (2006)**		**Total I/I**					
		(acres)	**% of Total**	**(gpd) Peak Day**	**(gpd) Peak Hour**	**% of Total**	**gpad Total Peak Day**	**gpad Developed Peak Day**	**gpad Developed Peak Hour**
1	231	95	2.7%	1,109,217	1,420,576	24%	4,802	11,676	14,953
2	203	58	1.6%	453,957	581,384	9%	2,236	7,827	10,024
3 South	91	43	1.2%	149,790	191,837	3%	1,646	3,483	4,461
3 North	462	216	6.1%	1,065,951	1,365,165	20%	2,307	4,935	6,320
4	142	88	2.5%	735,301	941,701	14%	5,178	8,356	10,701
5	129	46	1.3%	54,177	69,384	1%	420	1,178	1,508
6	111	57	1.6%	119,136	152,577	2%	1,073	2,090	2,677
7	163	91	2.6%	166,718	213,516	3%	1,023	1,832	2,346
8	171	68	1.9%	13,563	17,370	< 1%	79	199	255
9	105	80	2.3%	14,133	18,100	< 1%	135	177	226
10	548	286	8.1%	705,011	902,909	14%	1,287	2,465	3,157
11	411	154	4.4%	11,756	15,056	< 1%	29	76	98
12	270	167	4.7%	46,531	59,592	< 1%	172	279	357
13	1700	1022	28.9%	261,126	334,424	5%	154	256	327
14	1787	963	27.2%	193,326	247,593	4%	108	201	257
15	184	100	2.8%	40,546	51,927	1%	220	405	519
Total	**6,708**	**3,534**	**100.0%**	**5,130,000**	**6,570,000**	**100%**	**N/A**	**N/A**	**N/A**

RESULTS OF HYDRAULIC MODEL

The model results show a number of areas with capacity issues within the City's system. A pipe was determined to be over capacity if the flow through the pipe, as determined by the model, was greater than the theoretical maximum flow the pipe could effectively convey. The majority of the capacity deficiencies identified were within Basins 1, 2, and 3 North. Many of these areas with capacity problems, particularly those identified in Basins 1 and 2 are a result of undersized pipes and shallow slopes.


N
0
600
1,200
Feet
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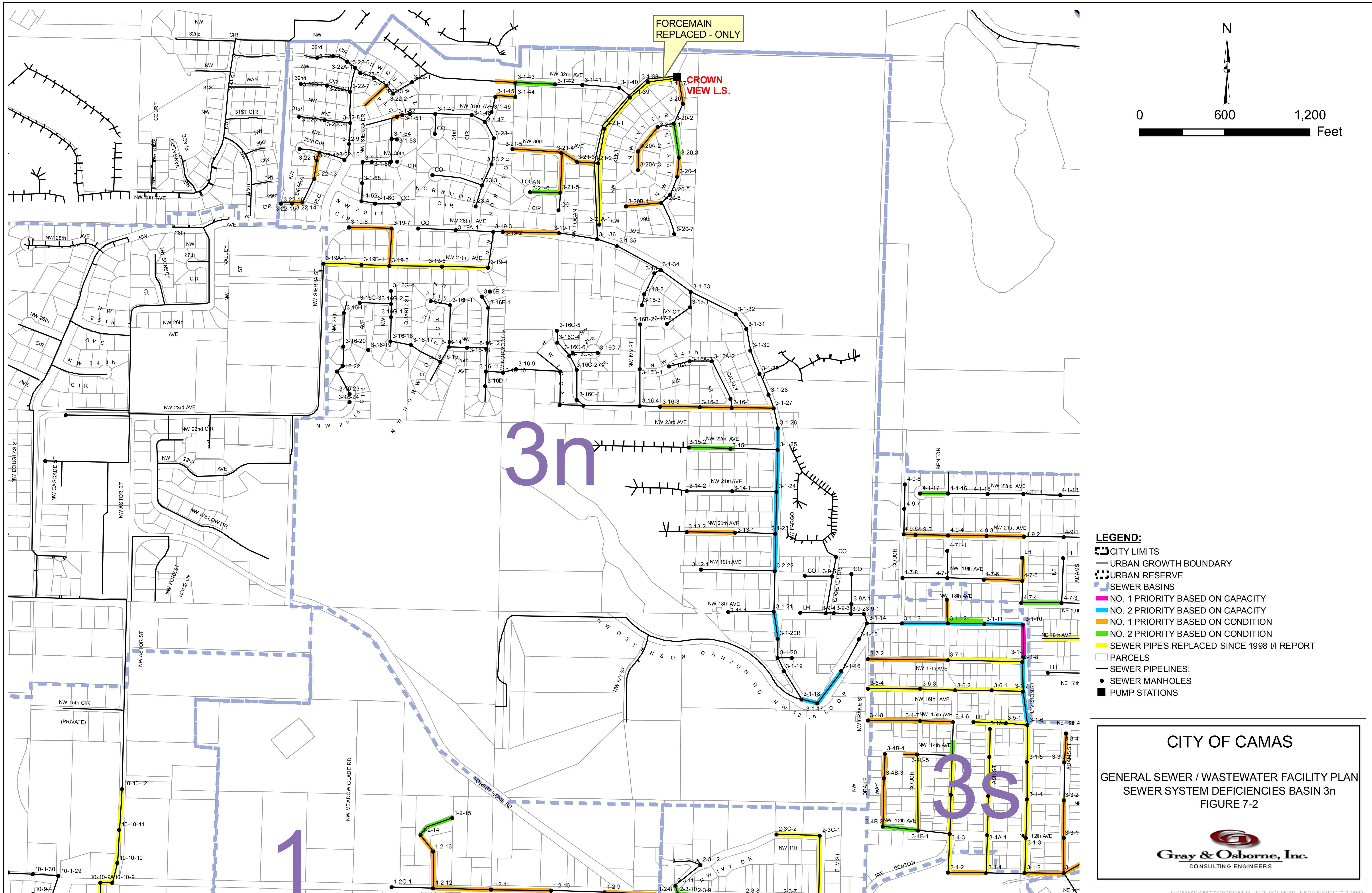
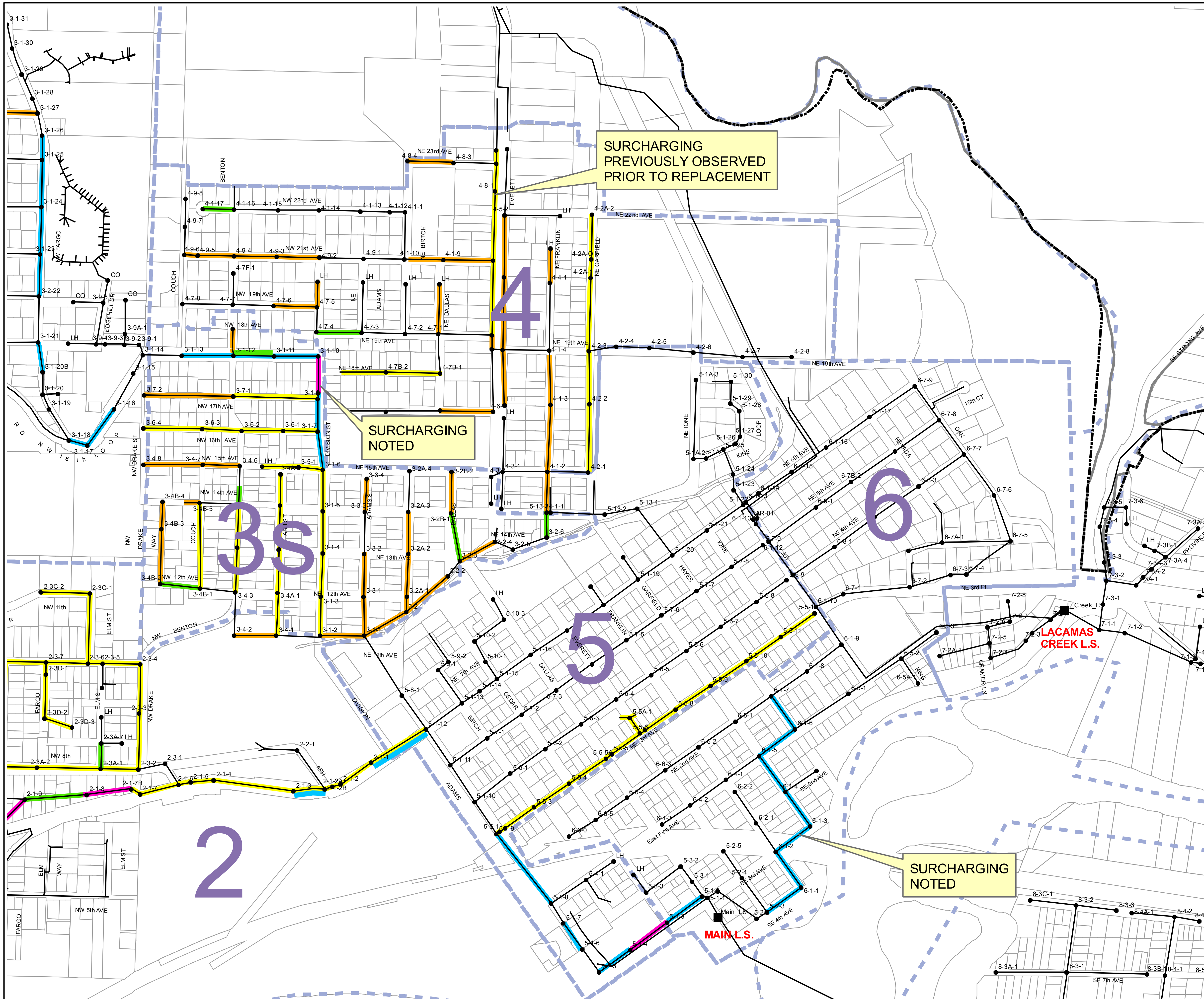
2
3s
WEST CAMAS L.S.
SURCHARGING NOTED
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
SEWER REPLACEMENT:
NO. 1 PRIORITY BASED ON CAPACITY
NO. 2 PRIORITY BASED ON CAPACITY
NO. 1 PRIORITY BASED ON CONDITION
NO. 2 PRIORITY BASED ON CONDITION
SEWER PIPES REPLACED SINCE 1998 I/I REPORT
PARCELS
SEWER PIPELINES:
SEWER MANHOLES
PUMP STATIONS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM DEFICIENCIES BASIN 1 & 2
FIGURE 7-1
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-1.MXD



FORCEMAIN REPLACED - ONLY
CROWN VIEW L.S.
N
0
600
1,200
Feet
3n
3s
1
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
NO. 1 PRIORITY BASED ON CAPACITY
NO. 2 PRIORITY BASED ON CAPACITY
NO. 1 PRIORITY BASED ON CONDITION
NO. 2 PRIORITY BASED ON CONDITION
SEWER PIPES REPLACED SINCE 1998 I/I REPORT
PARCELS
SEWER PIPELINES:
SEWER MANHOLES
PUMP STATIONS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM DEFICIENCIES BASIN 3n
FIGURE 7-2
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-2.MXD



LEGEND:

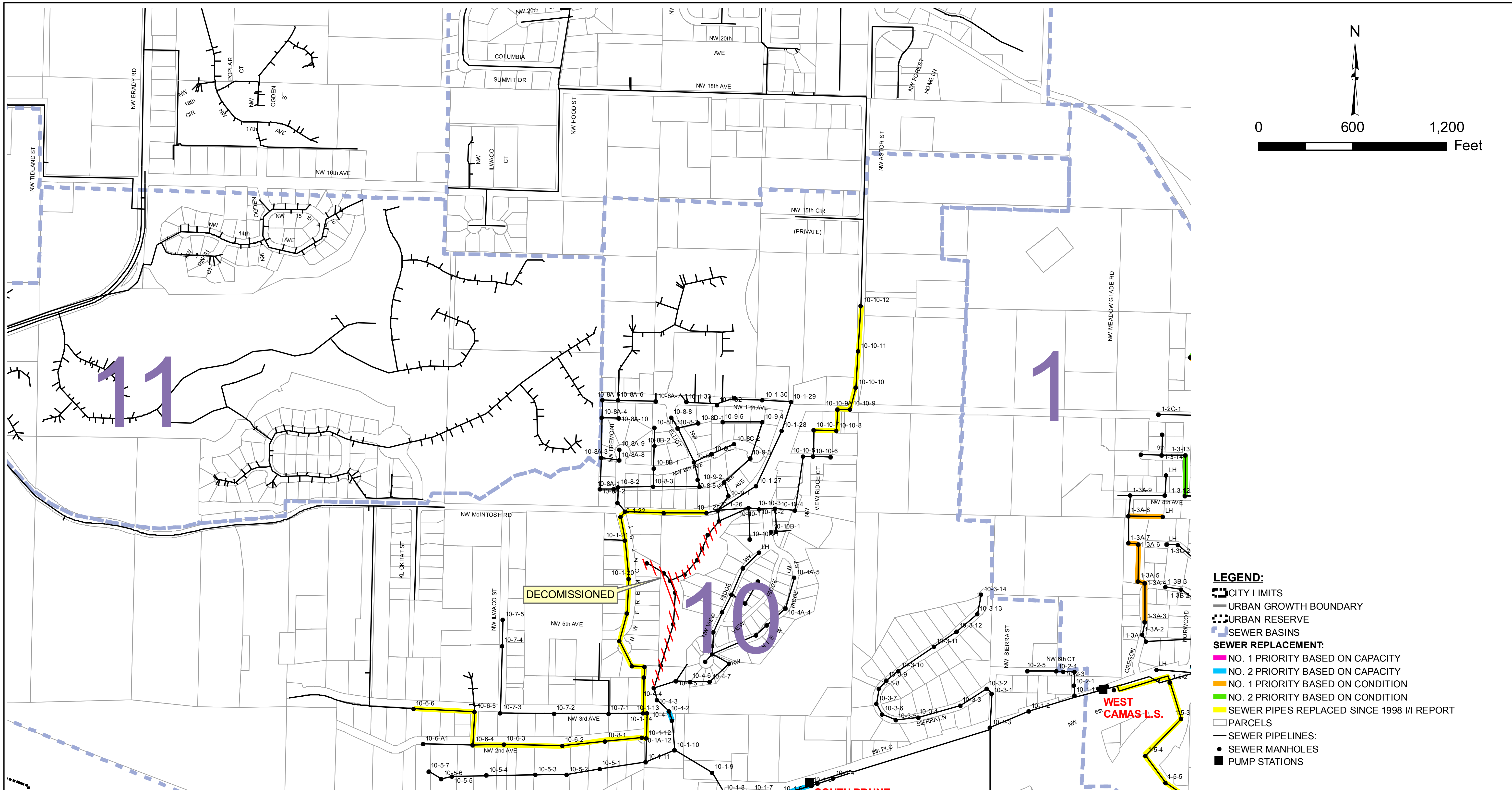
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- NO. 1 PRIORITY BASED ON CAPACITY
- NO. 2 PRIORITY BASED ON CAPACITY
- NO. 1 PRIORITY BASED ON CONDITION
- NO. 2 PRIORITY BASED ON CONDITION
- SEWER PIPES REPLACED SINCE 1998 I/I REPORT
- PARCELS
- SEWER PIPELINES:
- SEWER MANHOLES
- PUMP STATIONS

CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM DEFICIENCIES BASIN 3s, 4, 5 & 6
FIGURE 7-3

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-3.MXD



CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM DEFICIENCIES BASIN 1 & 2
FIGURE 7-4

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-4.MXD

Figures 7-1 through 7-4 show the gravity collection system deficiencies based on the hydraulic modeling conducted. The criteria for listing a sewer as "deficient" are that, at peak hour flow, the pipe is full and a manhole surcharge depth exceeds 1 foot. Deficiencies were categorized as a number one or two priority based upon the degree to which the flow is expected to exceed capacity and upon the degree of surcharging, as shown in Appendix F.

TABLE 7-5

Modeled 2025 Flows to Pump Stations

Pump Station	Basin No.	Pump Capacity (gpm, each)	Total Station Pumping Capacity (gpm, w/1 out of service)	Modeled Current Peak Hour Flow (gpm)	Modeled 2025 Peak Hour Flow (gpm)
Main	5	3,850	7,700	6,106	9,378
Oak Park	8	350	350	213	238
One Stop	9	231	231	100	102
South Prune Hill	10	510	510	776	849
West Camas	1	810	810	1,052	1,150
Crown View Plaza	3	325	325	391	396
Lacamas Creek	7	300	300	265	407

Table 7-5 shows the projected 2025 flow to the major pump stations, based on the hydraulic modeling of the current collection system. Several pump stations are projected to be over capacity unless one of the following occurs:

- The capacity of the pump station is upgraded,
- Infiltration and inflow upstream of the pump station is removed, or
- Upstream flows are diverted.

As discussed below, it is recommended that flows from the STEP main to the Main Pump Station be diverted to a new line over the Lacamas River. This new line would also accommodate flows from the proposed Crown Road sewer such that the capacity of the existing Lacamas Creek Pump Station would not need to be increased. It is expected that the remainder of the projected pump station capacity exceedances can be prevented by I/I reduction, i.e., that repair and replacement of pipes and rehabilitation of side sewers will reduce infiltration and inflow such that pump stations will not have to be upgraded. Otherwise, the capacity of some pump stations may have to be increased.

COLLECTION SYSTEM CAPITAL IMPROVEMENT PROJECTS

Recommended collection system capital improvement projects for the pump stations and the gravity sewers are listed below, with costs estimates presented for each. Projects were grouped based upon qualifiers that included geography, capacity, condition, known surcharging, propensity for infiltration and inflow, and dollar amounts. Project segments with the most deficiencies were rated the most in need of replacement or repair. Everything being equal, upstream project segments were rated highest, such that repairing them first would relieve the load on downstream problematic segments. Finally, pipeline segments were grouped to keep yearly pipeline project costs to under $1.5 million in 2006 dollars.

The projects are shown in Figures 7-5 through 7-8.

PUMP STATIONS

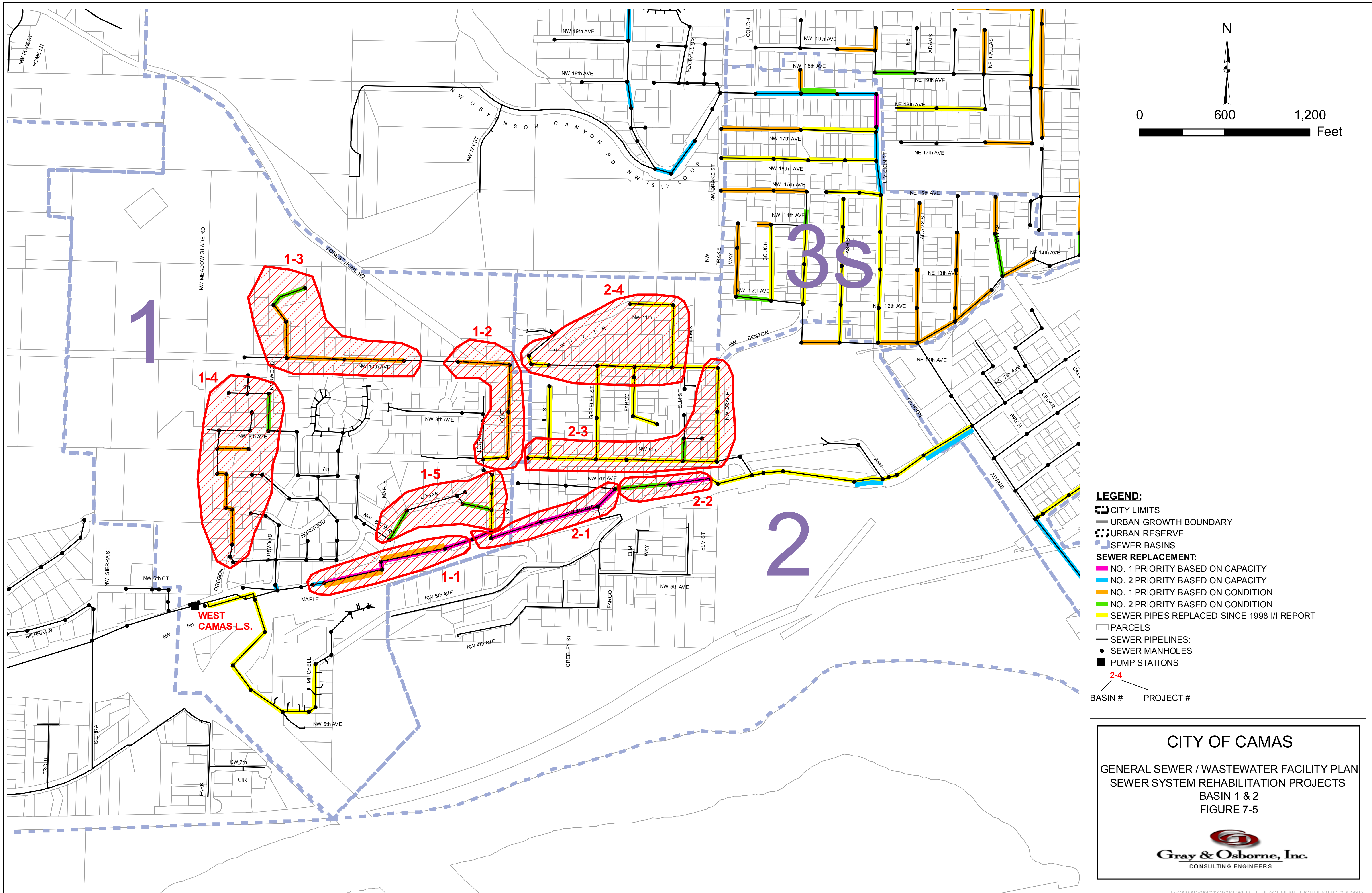
Pump Station Upgrade Schedule

Per discussion with City staff, the City will need to budget for, on average, one to two major upgrades of pump station per year. Typically, when upgraded, the pump stations are provided with portions of the "Camas spec," including Flygt pumps, Multitrode level sensors, Monitor Pro run-time monitoring and MT2PC controls, Sonotrol telemetry for alarms only. An annual allowance of $150,000 has been included for this purpose. The first pump stations to be upgraded will be the Brady Road and Winchester Hill Pump Stations, scheduled for 2007. These pump stations are prioritized based on the significant corrosion identified in inspections, as summarized in Table 7-1.

Upgrades to the Lacamas Creek and Main Pump Stations are required due to capacity and are addressed separately below.

Lacamas Creek Pump Station

Modeling results indicate that the Lacamas Creek Pump Station has insufficient excess capacity to pump the additional flows from the proposed 450 homes associated with new development in the east side of Basin 15. As described below, this new area of development is expected to be served by a developer-financed pump station and a new gravity sewer line on Crown Road. Current excess capacity at the Lacamas Creek Pump Station could accommodate additional flows from only approximately 235 new homes. Pump station improvements would be required in order to provide a station capacity of approximately 0.592 mgd (410 gpm) at the Lacamas Creek Pump Station in order to convey peak hour flows for the entire 450 homes. (Note: pump station capacities are noted with one pump on standby, as required by Department of Ecology criteria.)

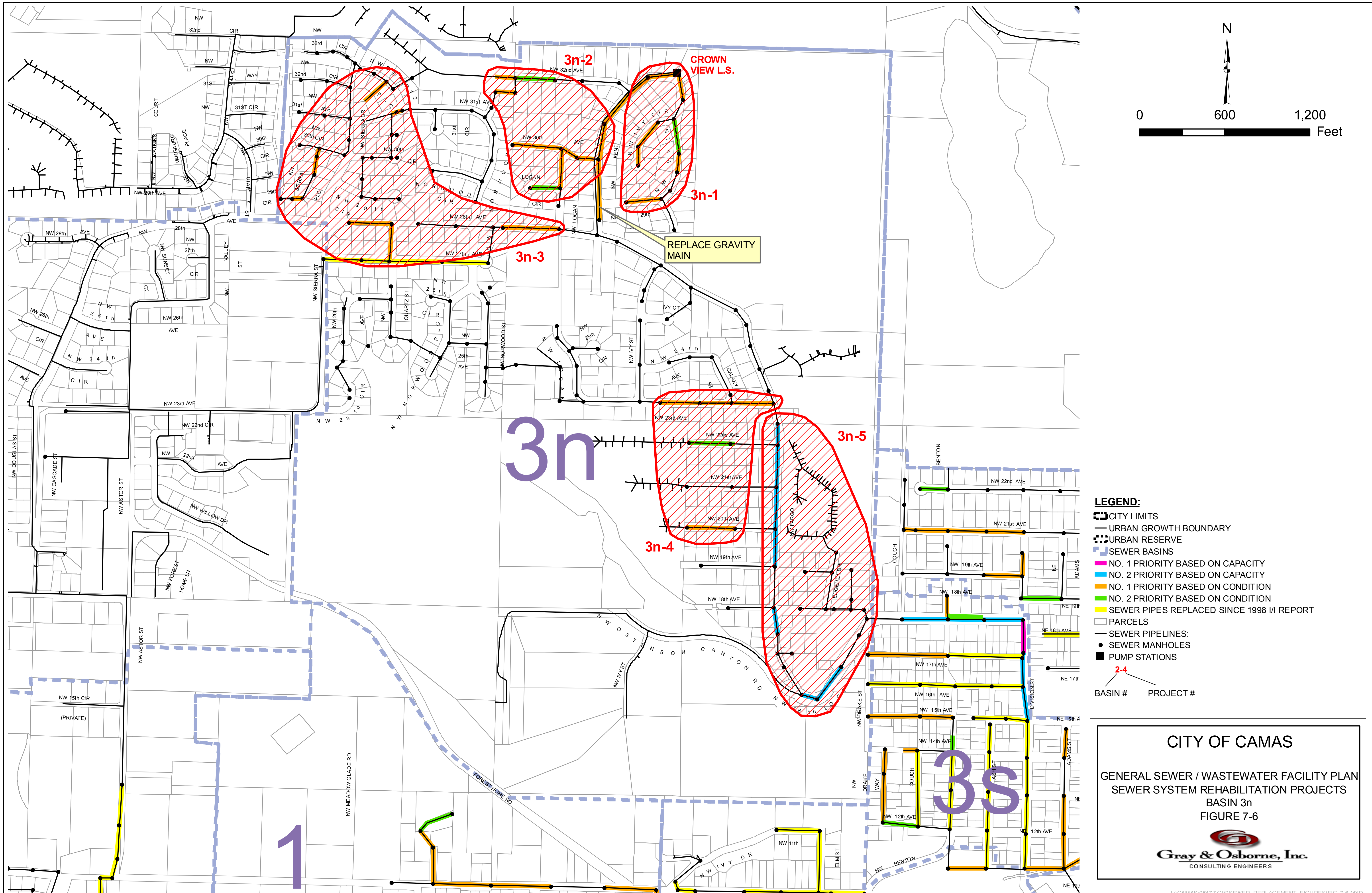


CITY OF CAMAS

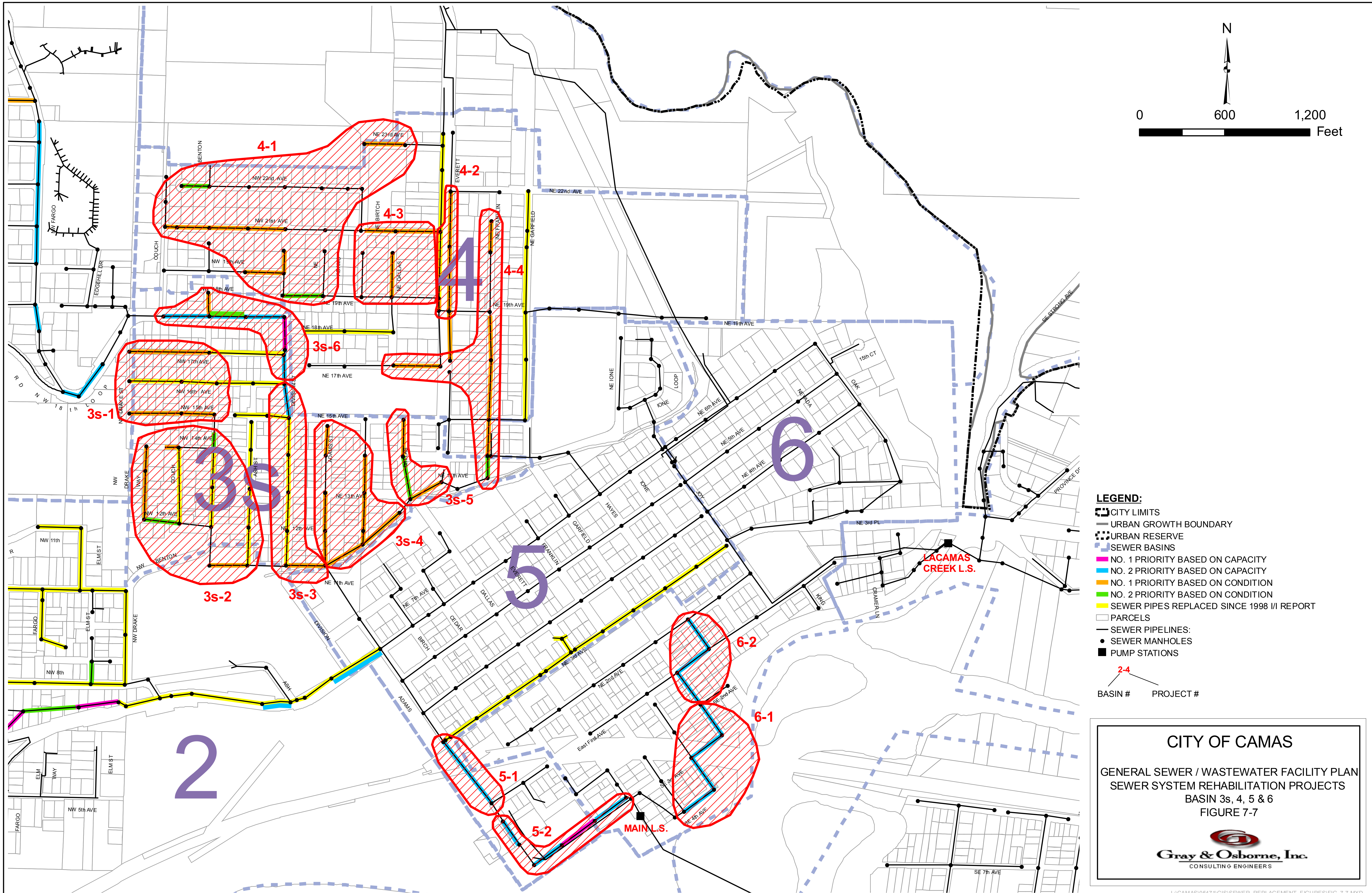
GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM REHABILITATION PROJECTS
BASIN 1 & 2
FIGURE 7-5

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-5.MXD



CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM REHABILITATION PROJECTS
BASIN 3n
FIGURE 7-6
Gray & Osborne, Inc.
CONSULTING ENGINEERS
N
0
600
1,200
Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
NO. 1 PRIORITY BASED ON CAPACITY
NO. 2 PRIORITY BASED ON CAPACITY
NO. 1 PRIORITY BASED ON CONDITION
NO. 2 PRIORITY BASED ON CONDITION
SEWER PIPES REPLACED SINCE 1998 I/I REPORT
PARCELS
SEWER PIPELINES:
SEWER MANHOLES
PUMP STATIONS
2-4
BASIN #
PROJECT #
3n
3s
1
3n-1
3n-2
3n-3
3n-4
3n-5
CROWN VIEW L.S.
REPLACE GRAVITY MAIN
NW OSTENSON CANYON RD
FOREST HOME RD
NW MEADOW GLADE RD
NW 23rd AVE
NW 22nd AVE
NW 21st AVE
NW 20th AVE
NW 19th AVE
NW 18th AVE
NW 17th AVE
NW 16th AVE
NW 15th AVE
NW 14th AVE
NW 12th AVE
NW 28th AVE
NW 27th AVE
NW 32nd AVE
NW 31st AVE
NW SIERRA ST
NW IVY ST
DIVISION ST
L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-6.MXD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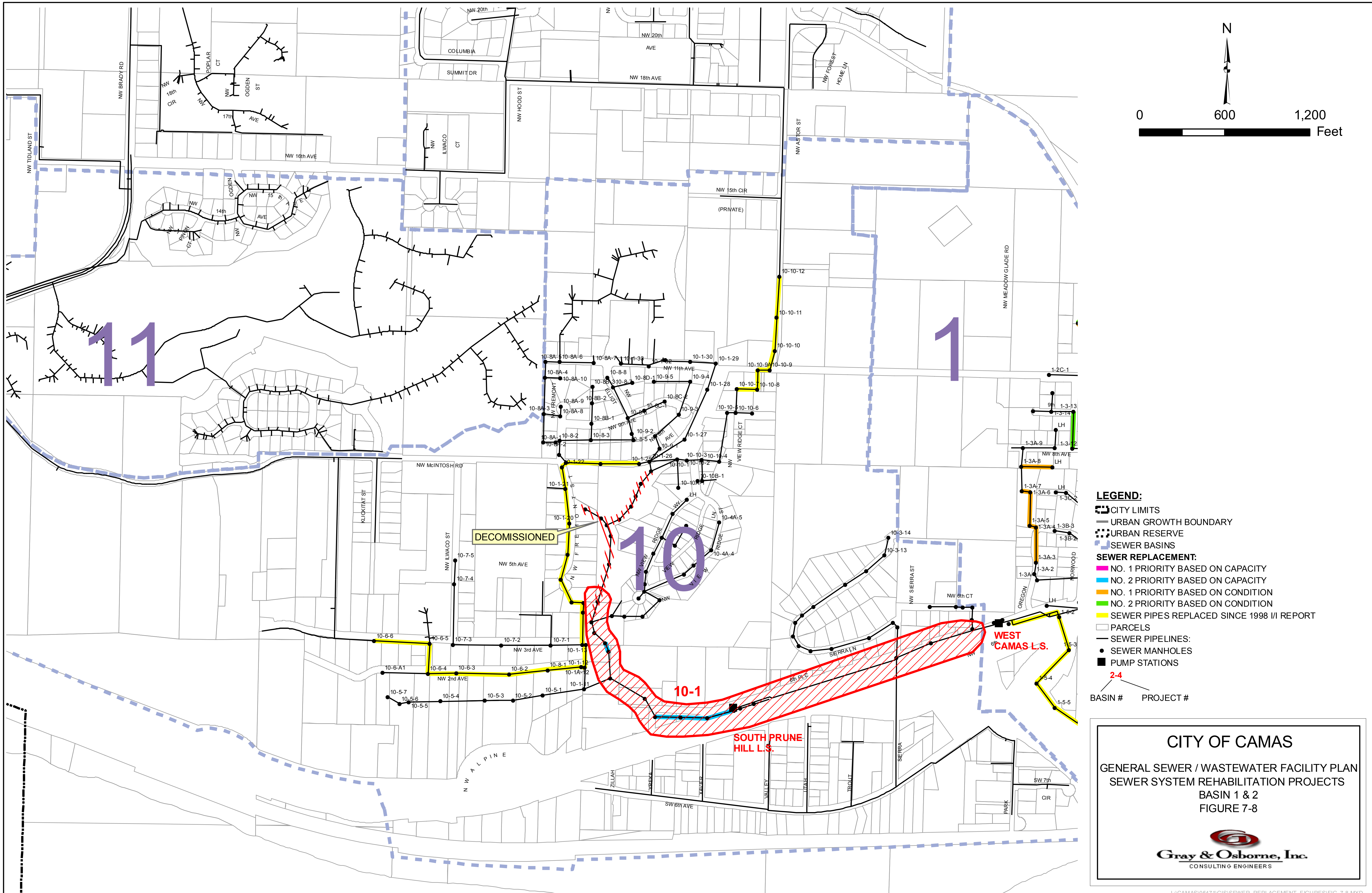
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
NO. 1 PRIORITY BASED ON CAPACITY
NO. 2 PRIORITY BASED ON CAPACITY
NO. 1 PRIORITY BASED ON CONDITION
NO. 2 PRIORITY BASED ON CONDITION
SEWER PIPES REPLACED SINCE 1998 I/I REPORT
PARCELS
SEWER PIPELINES:
SEWER MANHOLES
PUMP STATIONS
2-4
BASIN #
PROJECT #
4-1
4-2
4-3
4-4
3s-1
3s-2
3s-3
3s-4
3s-5
3s-6
5-1
5-2
6-1
6-2
2
3s
4
5
6
LACAMAS CREEK L.S.
MAIN L.S.
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM REHABILITATION PROJECTS
BASIN 3s, 4, 5 & 6
FIGURE 7-7
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-7.MXD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1,200
Feet
11
1
10
DECOMISSIONED
10-1
SOUTH PRUNE HILL L.S.
WEST CAMAS L.S.
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
SEWER REPLACEMENT:
NO. 1 PRIORITY BASED ON CAPACITY
NO. 2 PRIORITY BASED ON CAPACITY
NO. 1 PRIORITY BASED ON CONDITION
NO. 2 PRIORITY BASED ON CONDITION
SEWER PIPES REPLACED SINCE 1998 I/I REPORT
PARCELS
SEWER PIPELINES:
SEWER MANHOLES
PUMP STATIONS
2-4
BASIN #
PROJECT #
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
SEWER SYSTEM REHABILITATION PROJECTS
BASIN 1 & 2
FIGURE 7-8
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\SEWER_REPLACEMENT_FIGURES\FIG_7-8.MXD

The Lacamas Creek Pump station could be relatively easily expanded to accommodate the peak hour flow of 0.592 mgd (410 gpm) anticipated from the combination of the entire 450 home development and existing flows by simply replacing the existing PACO pumps with larger pumps and providing a new electrical control panel. The estimated cost for this upgrade is $140,000. Cost estimates are provided in Appendix K. PACO no longer manufactures or sells the pumps that are currently at the pump station. Replacements for PACO pumps are manufactured by ABS and marketed as Pumpex pumps by Pumptech in the northwest.

The pump station capacity could be expanded to as much as 550 gpm by replacing the existing pumps with new pumps; however, this would require major electrical upgrades to the pump station. Expanding beyond 550 gpm would require considerably more expense, including replacing the force main, use of a different pump family, and additional associated mechanical and electrical pump station modifications.

Main Pump Station

As shown in Table 7-5, projected 2025 flows to the Main Pump Station exceed its capacity (7,700 gpm). As previously discussed, the Main Pump Station has a very small wet well that complicates both maintenance and the ability of instruments to control pump operation.

The size of the wet well needs to be increased to provide reliable operation and maintenance of the pump station. Additionally, since projected peak hour flows exceed the capacity of the Main Pump Station, either modifications to the station to increase capacity or rerouting of flows, will be required.

As discussed earlier in this chapter, based on sewer system modeling, and observations of surcharging by City staff, it is evident that the sewer reach between Manholes 6-1-13 to 5-5-1, upstream of the Main Pump Station, is over capacity at current flows, due to infiltration and inflow during storm events. With future increases in flow due to growth in the City, this area may be at risk of surcharges or overflows during storm events. If flow from the STEP Main serving the Western Service Area, then these lines have sufficient capacity for year 2025 flows.

There are two alternatives to addressing capacity deficiencies at this pump station:

1. modifications to the Main Pump Station and upstream sewers to increase capacity, or

2. rerouting of flows.

<u>Alternative 1 – Increasing the Capacity of Main Pump Station</u>

Under Alternative No. 1, the Main Pump Station would be upgraded to accommodate the projected peak hour year 2025 flow of 11,600 gpm. The existing wet well would be expanded and the pumps, motors and emergency generator must be replaced, as well as the electrical and control system upgraded. The estimated cost for this upgrade is $1.4 to $1.7 million. In addition, the following additional projects must be completed to avoid future sewer system surcharging in the downtown area if Alternative 1 is chosen:

- Replacing 1,051 lineal feet of 18-inch pipe with 21-inch pipe along East First Avenue and along Garfield and Hayes Streets. The lines are currently undersized to handle the expected flows. A portion of this segment is known to surcharge. (Shown as Project 6-1 in Figure 7-7. Estimated cost is $650,000. This project is not required if Alternative 2 is selected.)

- Replacing 815 lineal feet of 18-inch pipe with 21-inch pipe along East First Avenue and along Garfield and Hayes Streets. The lines are currently undersized to handle the expected flows. (Shown as Project 6-2 in Figure 7-7. Estimated cost is $507,000. This project is not required if Alternative 2 is selected.)

- Additionally, the Lacamas Creek Pump Station must be upgraded to accommodate flows from the new Crown Road sewer.

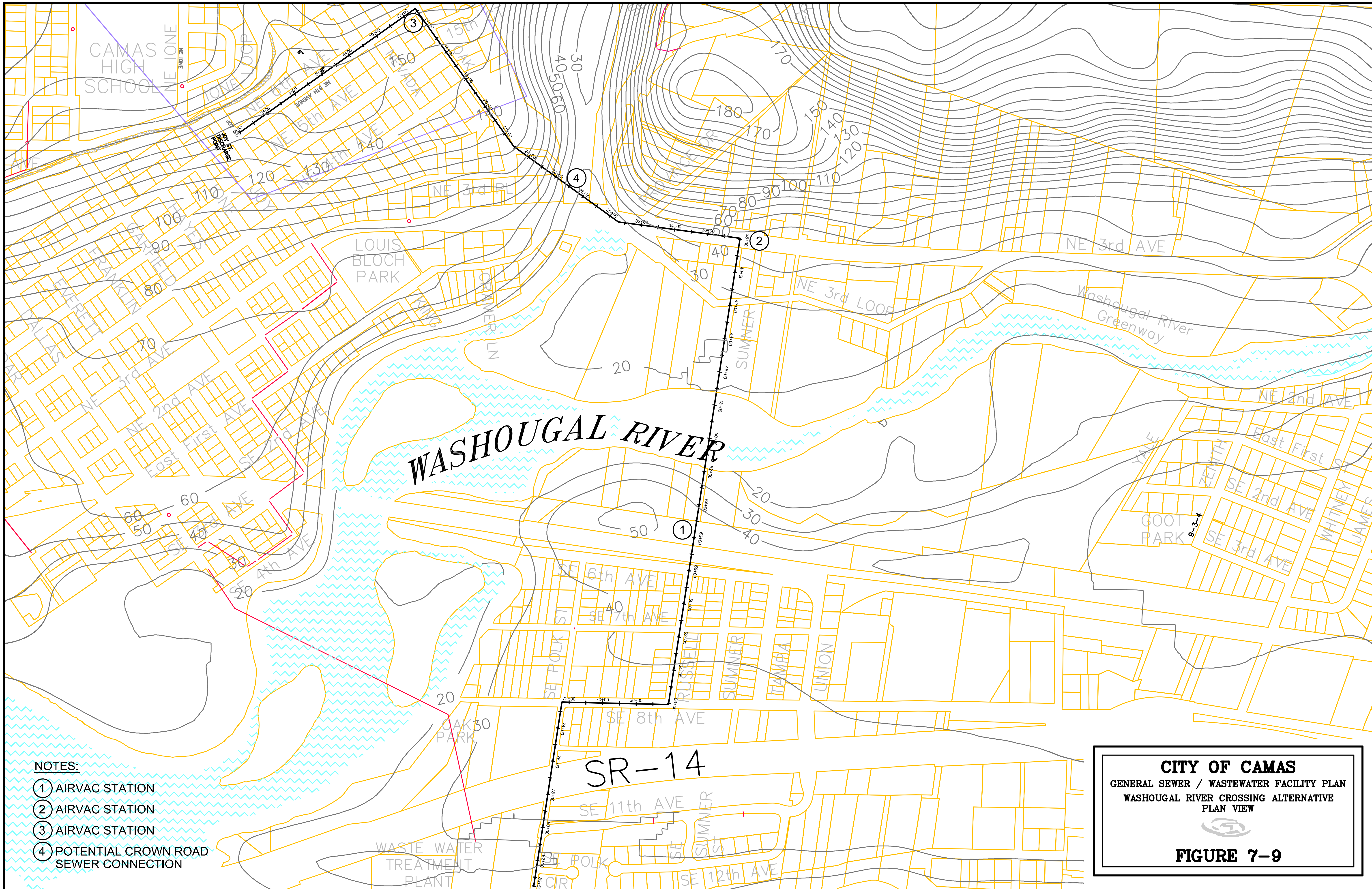
<u>Alternative 2 – STEP Main Bypass</u>

As described above, the gravity sewer lines and Main Pump Station downstream of the 6th and Joy STEP terminus do not have sufficient capacity to transport 2025 flows. In Alternative 2, these flows would be bypassed from these lines in a new STEP Main to the WWTP. Plan and profile views of a possible routing of this line are shown in Figures 7-9, 7-10 and 7-11. The line would cross the Washougal River on a new pedestrian bridge that is being constructed within the next 2 years. This alignment would require obtaining easements for routing the force main through the various properties. The total length of the force main under this alternative is approximately 8,300 feet.

The estimated project cost for construction of the STEP Main Bypass is $4.48 million. Construction of the STEP Main Bypass would allow future growth in the sewer service area and expansion of the UGA.

<u>Discussion</u>

Alternative 2 is the recommended alternative, since it would provide initial improvements that will allow future growth in the sewer service area and expansion of the UGA. It

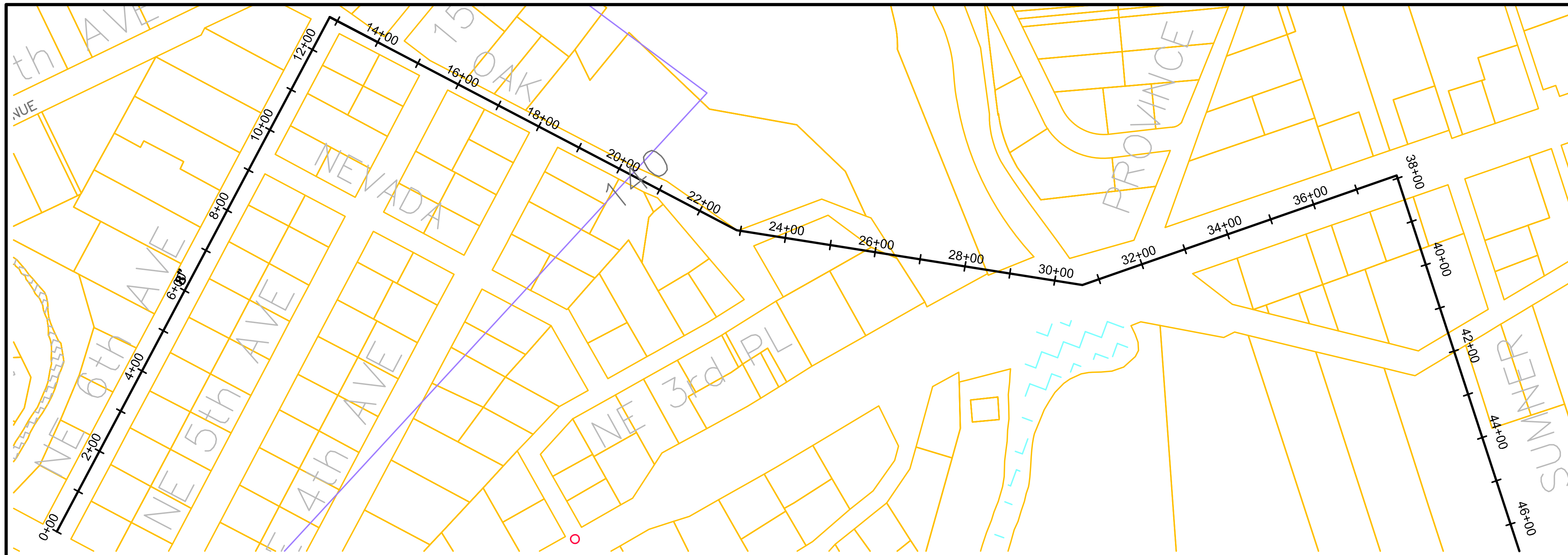

WASHOUGAL RIVER
SR-14
CAMAS HIGH SCHOOL
LOUIS BLOCH PARK
GOOT PARK
OAK PARK
WASTE WATER TREATMENT PLANT
Washougal River Greenway
NE 3rd AVE
NE 3rd LOOP
NE 3rd PL
NE 2nd AVE
East First St
SE 2nd AVE
SE 3rd AVE
SE 4th AVE
SE 6th AVE
SE 7th AVE
SE 8th AVE
SE 11th AVE
SE 12th AVE
NE 5th AVE
NE 6th AVE
15th
OAK
NEVADA
SUMNER
RUSSELL
TAMPA
UNION
SE POLK ST
ZENITH
WHITNEY
JAMES
YALE
CRAMER LN
KING
GARFIELD
FRANKLIN
EVERETT
DALLAS
NE IONE
IONE LOOP
JOY ST. DISCHARGE POINT
NOTES:
1 AIRVAC STATION
2 AIRVAC STATION
3 AIRVAC STATION
4 POTENTIAL CROWN ROAD SEWER CONNECTION
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
WASHOUGAL RIVER CROSSING ALTERNATIVE
PLAN VIEW
FIGURE 7-9

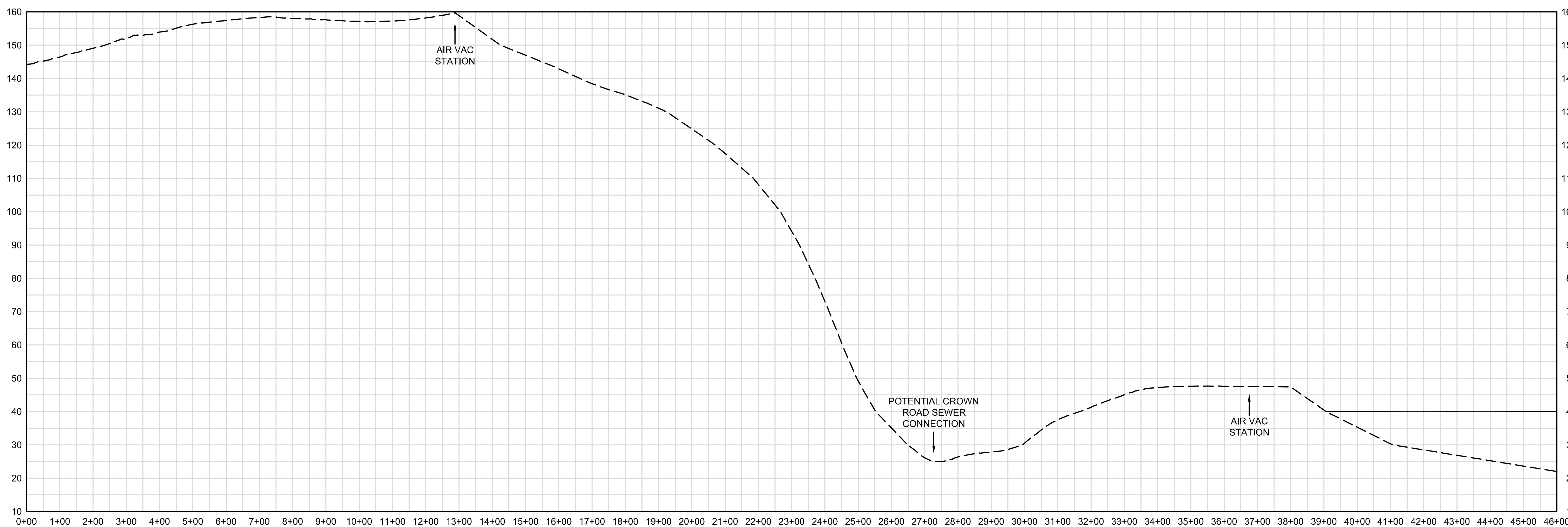
CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN

WASHOUGAL RIVER CROSSING ALTERNATIVE PROFILE

FIGURE 7–10



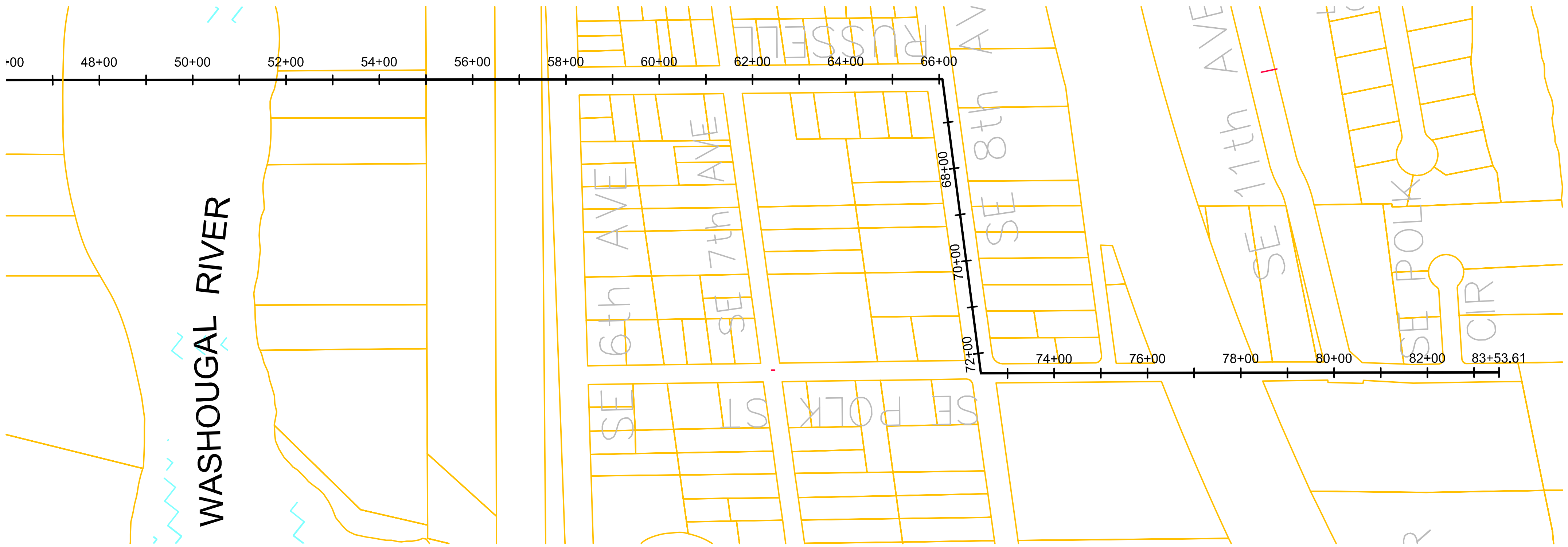


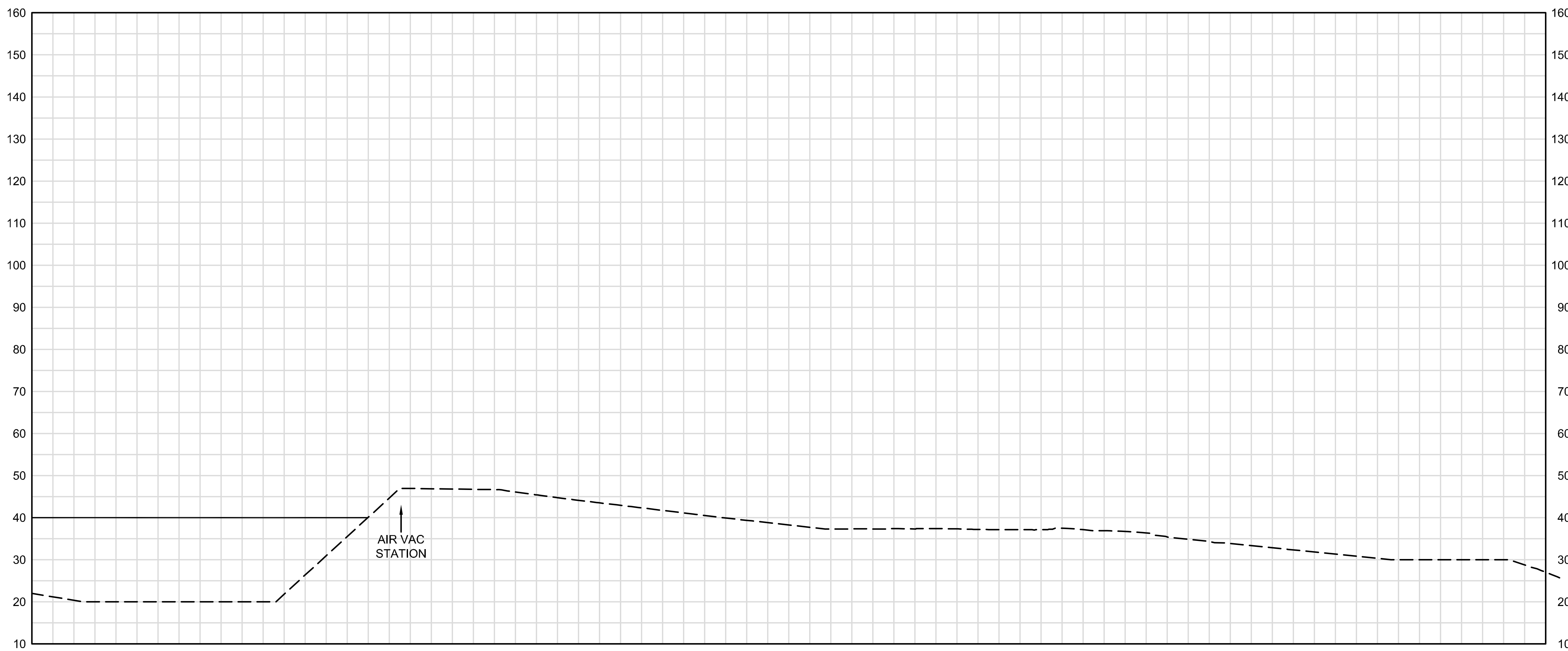
CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN

WASHOUGAL RIVER CROSSING ALTERNATIVE PROFILE

FIGURE 7-11





would also keep the majority of STEP flows out of gravity sewers near the downtown area.

As described above, construction of a new wet well for the Main Pump Station is recommended for either alternative, due to concerns about lack of available space for maintenance and future upgrades, and ongoing safety concerns. The new wet well could be a precast wet well installed adjacent to the existing wet well. It should be possible to use the existing wet well and change-over to the new wet well with minimum disruption. A coarse mechanical screen or grinder would be installed to reduce downstream maintenance and reliability concerns. A coarse mechanical screen would require a dumpster or other container and handling of screenings, which would require a building or other structure near or under the road. A grinder system (e.g., Muffin Monster) would require less maintenance and not require a structure for handling screenings, and is thus recommended. The estimated cost for a new wet well and grinder system is $900,000.

It is recommended that the force main from the Main Pump Station be inspected, since the line has been in place since 1972 without inspection.

Detailed cost estimates are included in Appendix K.

GRAVITY SEWER REPLACEMENT

This section includes discussion of alternative means of gravity sewer rehabilitation, as well as capital improvement projects to replace portions of the gravity sewer collection system.

METHODS FOR PIPELINE AND MANHOLE REHABILITATION

Different methods of rehabilitation for trunk sewers and manholes reaching the end of their design life are described in this section.

Pipe Replacement by Open Cut

Pipe replacement by open cut installation has been the conventional way to rehabilitate sewer pipes in past years. This method requires either removing the existing sewer pipe and installing new pipe on the same alignment or abandoning the existing pipe and installing new pipe on a different alignment. Surface restoration costs when the sewer segment is located in a paved roadway are high and generally will cause more disruption to the area in terms of the number of working days to construct the work than a trenchless rehabilitation method.

The advantage of this method is the hydraulic capacity of the sewer segment can be increased by selecting a larger pipe diameter. Furthermore, when existing sewer segments are observed to have major sags and side sewer laterals are separated from the mainline, this method becomes the preferred option.

Cured-in-Place Pipe

Cured-in-place pipe (CIPP) is a method of rehabilitation where a new pipe is formed within an existing pipe. A resin impregnated liner is inserted into the sewer segment from the manhole and extended to the other manhole, expanded using hydrostatic head of water to press the liner firmly against the existing host pipe and heated to activate the resin to cure against the host pipe. Active side sewers are reinstated by remote controlled cutters used in conjunction with CCTV video inspection. Typically a CIPP installer will clean, internally televise (with close circuit television, CCTV) the sewer segment (before and after the installation) and take exact inside pipe diameter dimensions prior to mobilizing.

The thickness of the liner (7.5 mm minimum) and physical properties of the resins can be specified to suit the specific application. When the resin cures, the inside diameter becomes smaller than the host pipe, but the hydraulic capacity may not be reduced, as the Manning’s roughness coefficient becomes lower than that for the host pipe. It is desirable to maintain sewage flow at a self-cleansing velocity of 2 feet per second based on full flow conditions and Manning’s roughness coefficient of 0.013. Generally, the capacity of the CIPP – rehabilitated segments will increase slightly for pipe diameters over 18 inches due to the new pipe having a lower Manning’s roughness coefficient; however, for pipe sizes of 8, 10, 12, and 15 inches, the hydraulic capacity will decrease by approximately 17, 11, 6, and 2 percent, respectively.

The advantages of using this technology is it is the least disruptive to the surface and can be completed in a relatively short period of time as opposed to pipe replacement by open cut or other trenchless methods.

Pipe segments that would be candidates for this method should have little to no sags, side sewer laterals intact with the mainline and segment slope that provides a self-cleansing velocity of 2 feet per second.

Pipe Bursting

Pipe bursting is a semi-trenchless method capable of increasing the diameter of the existing host pipe by using a pneumatically powered bursting head to pull in a welded High Density Polyethylene Pipe (HDPE). The pipe bursting process is the only trenchless pipe rehabilitation method that allows the installation to increase the diameter of the sewer pipes without excavating. Active laterals are individually excavated for reinserting into the new pipe. There are several methods that can be used for pipe bursting. In the most common method, a pneumatic pipe bursting head is inserted from one manhole and pulled through a breakable host pipe by a winch, the percussive action breaks apart the existing pipe as the head moves through the pipe and displaces the pipe fragments into the surrounding pipe zone. The head can be equipped with an expander that can further displace the host pipe fragments. The replacement pipe is usually standard diameter (SDR) 17 HDPE to protect against gouging during pipe installation.

Sewer segments that are candidates for this method are in areas that require the benefits of minimal surface disturbance such as resident, business or environmental areas, increasing hydraulic capacity, silty-clay soil conditions, and an easily breakable host pipe. This method will not eliminate sags in the mainline. Depth is also a factor in considering sewer segments for pipe bursting; exceptionally deep sewers require proper shoring and dewatering, and pipe drag due to the weight of the soil is an issue.

Difficult pipe bursting conditions are encountered in sandy gravel soils with cobbles and the host pipe material is reinforced concrete. As a rule of thumb, contractors can install pipe that is up to double the diameter of the existing pipe.

Sliplining

Sliplining is a rehabilitation method that inserts a new High Density Polyethylene (HDPE) pipe inside a host pipe, decreasing the resulting inside diameter. The annular space between the host and new pipe is back-grouted, providing additional structural capacity. Access to the host pipe is provided from an existing manhole, and active laterals are reconnected to the mainline by an open cut installation using gasketed *Insert-a-Tee* connections.

Sliplining creates minimal surface disturbances and results in a shorter construction period compared to pipe replacement by excavation. However, sliplining decreases hydraulic capacity and does not eliminate sags in mainline and broken laterals.

CIPP Internal Point Repair

Cured-in-place-pipe internal point repair rehabilitates damaged pipe using a resin-impregnated tube, up to 10 feet in length with diameters from 6 to 24 inches, without digging.

This method is used for repairing localized structural defects due to localized settling, an offset joint, excess loading conditions, corrosion or poor initial construction in an otherwise sound sewer pipe. Point repairs may stop infiltration at the location of the repair, but the groundwater may find another location to enter the pipe.

Point repairs are non-disruptive and completed from the surface by inserting a resin-impregnated tube through a manhole into the pipe to the place of repair using visual monitoring. Once the tube is in place, the point repair is pressed against the host pipe walls and cured in place.

Point repairs are non-disruptive to the ground surfaces and can be completed in a few hours without disrupting sewage flow.

Chemical Grouting

Chemical grouting is a solution to prevent infiltration in structurally adequate sewer systems. It is the oldest pipeline rehabilitation process and was first developed and applied in 1955.

Grouting chemicals are forced through cracks and joints extending out into the surrounding soil where it gels with the soil to form a waterproof collar around a leaking pipe or manhole. This watertight collar adheres to the outer surface of the pipe or manhole and will remain indefinitely unless removed by an excavation.

Manhole Rehabilitation

The City's sewer system manholes are generally in good condition. However, within the 20-year planning period, some of the older manholes may need to be rehabilitated or replaced. Manholes are rehabilitated to correct structural deficiencies, to address maintenance concerns, and eliminate I/I. Some manhole rehabilitation options include lining, sealing, grouting, or replacing various components of the entire manhole.

Inflow typically occurs through holes in the manhole lid or around the manhole rim and lid. Manhole lids can be sealed by replacing them with new watertight covers, by sealing existing covers through the use of rubber cover gaskets with rubber vent and pick hole plugs, by installing water-tight inserts under the existing manhole covers or raising the manhole rim. Grouting is also commonly employed to reduce infiltration.

Historically, manhole voids were repaired by hand with cement. However this is considered a temporary solution. Today, aging brick and concrete manholes are not only repaired to stop ground water infiltration, but are structurally rehabilitated with a cementitious and/or epoxy coating.

Before the cementitious coating is sprayed onto the inside of the mortar and brick, CMU, or precast concrete manhole, a chemical grout is applied to the inside of the manhole to dry the brick or concrete. Once the inside surface is satisfactorily dry, a cementitious and/or epoxy coating is sprayed on the inside of the manhole, creating a durable corrosion-resistant manhole-within-a-manhole that is designed to eliminate infiltration caused by hydrostatic pressure from groundwater.

Side Sewers

The City has implemented a TV inspection program, using outside vendors. As a result, many failed pipes have been identified. However, failed pipes are not the only potential source of infiltration and inflow. Side sewers can also contribute significantly to the problem. Collapsed or leaking service laterals or side sewers are common in many sewer systems. Side sewers are usually installed at shallow depths with a minimum self-cleansing grade from the building or residential unit to the property line. From the property line to the main sewer line, the grade may change abruptly as the side sewer descends to the elevation of the main sewer line.

Research studies sponsored by the USEPA indicate that a significant percentage of I/I is often caused by defects in side sewers, including cracked, broken, or open-jointed pipes, which can allow storm-induced infiltration. In addition to I/I from the laterals, infiltration frequently results from a leaky connection of the lateral to the main sewer and leakage at main sewer joints close to the lateral.

The potential for infiltration from service connections depends on the number of connections and total length of the connection lines. In some instances, the total length of service connections can be equal to or greater than the sewer main length. Effective infiltration control of side sewers requires testing and repairing by grouting or replacement to ensure long-term effectiveness. Service connections can also transport water from inflow sources such as roof drains, basement and foundation drains, and basement sump pumps that are illegally connected to the side sewer. Inflow control requires an effective disconnection and enforcement program.

NEW GRAVITY SEWERS

Crown Road

Per discussion between developers seeking to construct subdivisions in the east side of Basin 15 and the City, hydraulic model analyses were run to determine the improvements that were necessary to provide the Gregg Reservoir Annexation (formerly known as the Loyal Lands Development) with sewer service for approximately 700 houses. Based on the topography of the Gregg Reservoir Annexation (GRA) area, it is proposed that approximately 50 acres (250 homes) in the northwest portion of the 700 home GRA development will be served by the existing STEP system on Leonard Road in Basin 15. The remaining estimated 90 acres (450 homes) are proposed to be served by a new gravity sewer line to the southeast of the GRA area along Crown Road. A memorandum discussing service to these areas is included in Appendix L.

The year 2025 peak hour flow for the Northwest GRA Service Area (served by STEP) is projected to be 141,000 gpd, while the peak hour flow for the Southeast GRA Service Area (served by gravity on Crown Road) is projected to be 351,900 gpd.

A new developer-financed pump station sited at the southern end of the east side of the GRA area could serve the entire eastern GRA. The pump station would convey the collected sewage approximately 900 feet to the proposed new Crown Road Sewer line. The new Crown Hill Sewer line serving the Southeast Gregg Service Area would connect to existing Manhole 7-3-5 at Crown Road in Basin 7. From here, there are two alternatives to convey the flow to the treatment plant. Under Alternative 1, at Manhole 7-1-1, sewage from Crown Road would mix with flow from the rest of Basin 7. This combined flow would be then conveyed to the Lacamas Creek Pump station, where it would be pumped to Manhole 6-1-9. At Manhole 6-1-9, the flow from Basin 7 would merge with the flow from Basins 6, 11, 13, 14, and 15. At the Main Pump Station, this combined flow would be combined with flow from Basins 1, 2, 3, 4, 5, 10, and 12.

Under Alternative 2, flow from the Crown Road sewer would be merged with flow from in the STEP Main Bypass.

The following describes flow routing, system modeling, and necessary system improvements for Alternative 1.

<u>New Crown Road Sewer to Manhole 7-3-5</u>

Modeling results show a pipe size of 8 inches connecting to the existing system would be sufficient to handle the flow generated from the 450 homes proposed from the new development in the east side of Basin 15.

The estimated cost for this new gravity line is $1.30 million dollars. A detailed cost estimate for this project is included in Appendix K.

<u>Manhole 7-3-5 to Lacamas Creek Pump Station</u>

The existing system currently has enough excess capacity to convey the additional flows from the new development in the east side of Basin 15.to the Lacamas Creek Pump Station.

<u>Lacamas Creek Pump Station and Force Main to Manhole 6-1-9</u>

As previously discussed, modeling results indicate that the Lacamas Creek Pump station has insufficient excess capacity to pump the additional flows from the proposed 450 homes associated with the new development. Current excess capacity at the pump station could accommodate additional flows from only approximately 235 new homes based on our analysis. Pump station improvements would require a pumping capacity of approximately 0.592 mgd (410 gpm) at the Lacamas Creek Pump station in order to convey peak hour flows for the entire 450 homes. Such an expansion would be required assuming the STEP Main Bypass is not constructed.

The pump station could be expanded to as much as 550 gpm by replacing the existing pumps with new pumps; however, this would require major electrical upgrades to the pump station. Expanding beyond 550 gpm would require considerably more expense, including replacing the force main, use of a different pump family, and additional associated mechanical and electrical pump station modifications.

Gravity Sewer from Manhole 6-1-9 to the Main Pump Station

The results of the model indicate that the existing system has sufficient excess capacity to convey the additional flows resulting from the 700 homes in the proposed development.

Recommendations and Cost Estimates

Given concerns regarding solids deposition associated with mixing gravity flows from the Crown Road Sewer with flows from the STEP Bypass, it is recommended that the Lacamas Creek Pump Station be upgraded. Plans for improvements to this pump station should consider additional capacity requirements and alternatives for flow routing and satellite treatment associated with providing sewer service for an expanded UGA. Depending on the magnitude and routing of future flows associated with an expanded UGA, the City may wish to replace the Lacamas Creek Pump Station with a new station on adjacent property.

Table 7-5 summarizes projected City costs to provide service to the GRA area. Detailed cost estimates are provided with the memo in Appendix L. Cost estimates are total project costs including tax, engineering and contingency. Developer costs, including the new developer pump station and force main, are not included. Construction of the Crown Road sewer is listed as Project 15-1 in the Gravity Collection System Capital Improvement Projects system below.

TABLE 7-6

Capital Costs to Provide Sewer Service to the GRA Area

Item	Cost Estimate
Crown Road Sewer (8" diameter)	$1,300,000
Upgrade Lacamas Creek Pump Station to 410 gpm	$ 140,000
TOTAL	**$1,440,000**

REPLACEMENT OF EXISTING SEWER LINES

Fifteen gravity collection system replacement/rehabilitation projects were identified in the development of this Plan. Each project is briefly described below. Total costs for the projects, which include engineering, construction, construction administration, tax and contingency, are shown in Table 7-6. The projects are shown in Figures 7-5 through 7-8. Detailed cost estimates are included in Appendix K.

Project 1-1

Project 1-1 replaces 221 lineal feet of 8-inch pipe with 10-inch pipe, 112 lineal feet of 12-inch pipe with 15-inch pipe, 668 lineal feet of 12-inch pipe with 21-inch pipe, and 413 lineal feet of 12-inch pipe with 24-inch pipe along NW 6th Avenue. The lines are currently undersized to handle the expected projected future flows. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration. Portions of this segment have been known to surcharge.

Project 1-2

Project 1-2 replaces 1062 lineal feet of 8-inch pipe with 8-inch pipe along NW 8th Avenue, Ivy Street and NW 10th Avenue. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 1-3

Project 1-3 replaces 34 lineal feet of 6-inch pipe with 6-inch pipe and 1,093 lineal feet of 8-inch pipe with 8-inch pipe along NW 10th Avenue and adjacent areas. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 1-4

Project 1-4 replaces 845 lineal feet of 8-inch pipe with 8-inch pipe along Norwood Drive and NW Norwood Street and parallel to NW 8th Avenue. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 1-5

Project 1-5 replaces 891 lineal feet of 8-inch pipe with 8-inch pipe along Logan and NW Ivy Streets. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 2-1

Project 2-1 is essentially an extension of Project 1-1 and replaces 388 lineal feet of pipe with 12-inch pipe, 843 lineal feet pipe with 21-inch pipe, and 20 lineal feet of pipe with 30-inch pipe along NW 6th Avenue. The lines are currently undersized to handle the projected future flows.

Project 2-2

Project 2-2 is essentially an extension of Project 2-1 and replaces 354 lineal feet of 12-inch pipe with 15-inch pipe, and 320 lineal feet of 12-inch pipe with 18-inch pipe along NW 6th Avenue. The lines are currently undersized to handle the expected required hydraulic capacity. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 3 North-1

Project 3n-1 replaces 2,300 lineal feet of 8-inch pipe with 8-inch pipe along NW 29th Avenue, NW Ivy Circle, Kent and NW Ivy Lane. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 3 North-2

Project 3n-2 replaces 1,432 lineal feet of 8-inch pipe with 8-inch pipe along NW Logan Circle, NW Logan Street, NW 30th avenue, and 32nd Avenue. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 3 North-3

Project 3n-3 replaces 1,322 lineal feet of 8-inch pipe with 8-inch pipe along NW Sierra Place, NW Quartz Street and Place, NW 28th Avenue, NW Quartz Place, and NW 31st Avenue. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 3 North-4

Project 3n-4 replaces 1,087 lineal feet of 8-inch pipe with 8-inch pipe along NW 20th Avenue, NW 22nd Avenue, and NW 23rd Avenue. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 3 North-5

Project 3n-5 replaces 1680 lineal feet of 8-inch pipe with 10-inch pipe and 276 lineal feet of 8-inch pipe with 12-inch pipe along NW Fargo Street and NW 18th Loop. The lines are currently undersized to handle the expected flows.

Project 3 South-1

Project 3S-1 replaces 951 lineal feet of 8-inch pipe with 8-inch pipe along NW 15th and 17th Avenues. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 3 South-2

Project 3S-2 replaces 1,020 lineal feet of 8-inch pipe with 8-inch pipe and 261 lineal feet of 15-inch pipe with 15-inch pipe along Drake Way, and NW 11th, 12th and 14th Avenues. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 3 South-3

Project 3S-3 replaces 258 lineal feet of 8-inch pipe with 8-inch pipe, 1,057 lineal feet of 8-inch pipe with 10-inch pipe, 258 lineal feet of 8-inch pipe with 12-inch pipe, and 261 lineal feet of 15-inch pipe with 15-inch pipe along 11th Avenue and Division Street. The lines are currently undersized to handle the expected flows. (Note: these lines were recently replaced with 8-inch HDPE. In lieu of replacement, the City could monitor surcharges and flow in this area to confirm the need for replacement.)

Project 3 South-4

Project 3S-4 replaces 1,187 lineal feet of 8-inch pipe with 8-inch pipe and 662 lineal feet of 15-inch pipe with 15-inch pipe along NE Adams and NE Birch Streets. The lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 3 South-5

Project 3S-5 replaces 553 lineal feet of 8-inch pipe with 8-inch pipe and 229 lineal feet of 15-inch pipe with 15-inch pipe along Dallas Street. The lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 3 South-6

Project 3S-6 replaces 184 lineal feet of 8-inch pipe with 8-inch pipe, 866 lineal feet of 8-inch pipe with 10-inch pipe, and 242 lineal feet of 8-inch pipe with 15-inch pipe along Division and Benton Streets and NW 18th Avenue. The lines are currently undersized to handle the expected flows. The portion of the segment along Division Street is known to surcharge. (Note: these lines were recently replaced with 8-inch HDPE. In lieu of replacement, the City could monitor surcharges and flow in this area to confirm the need for replacement.)

Project 4-1

Project 4-1 replaces 1,769 lineal feet of 8-inch pipe with 8-inch pipe along NE and NW 19th Avenues, NW 21st and 22nd Avenues, and Division Street. The lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 4-2

Project 4-2 replaces 851 lineal feet of 8-inch pipe with 8-inch pipe and 550 lineal feet of 10-inch pipe with 10-inch pipe along Everett Street. The lines are currently undersized to handle the expected flows. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 4-3

Project 4-3 replaces 1,181 lineal feet of 8-inch pipe with 8-inch pipe along NE 19th and NW 21st Avenues and along NE Dallas Street. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 4-4

Project 4-4 replaces 283 lineal feet of 8-inch pipe with 8-inch pipe, 1,010 lineal feet of 12-inch pipe with 12-inch pipe, and 140 lineal feet of 15-inch pipe with 15-inch pipe along NE 17th Avenue and NE Franklin Street. One or more lines have root intrusion, or have serious cracks and/or holes, allowing infiltration.

Project 5-1

Project 5-1 replaces 551 lineal feet of 24-inch pipe with 30-inch pipe along Adams Street. The lines are currently undersized to handle the expected flows.

Project 5-2

Project 5-2 replaces 467 lineal feet of 21-inch pipe with 24-inch pipe, 240 lineal feet of 21-inch pipe with 30-inch pipe, and 289 lineal feet of 21-inch pipe with 36-inch pipe along Adams Street and SE Third Avenue. The lines are currently undersized to handle the expected flows.

Project 10-1

Project 10-1 replaces 1,205 lineal feet of 8-inch pipe with 10-inch pipe and 186 lineal feet of 8-inch pipe with 12-inch pipe along NW 6th Place. The lines are currently undersized to handle the expected flows.

Project 15-1

Project 15-1 constructs the new Crown Road sewer line as discussed above.

STEP SYSTEM IMPROVEMENT PROJECTS

STEP Main Replacement

As detailed in the discussion of the hydraulic model, the 21-inch STEP Main that transports wastewater from the Western Service Area to the 6th and Joy STEP terminus has adequate capacity for 2025 flows. However, the City has concerns about the durability of this line, which is constructed of 100-psi pipe and has numerous taps. Thus, this line is recommended for replacement in phases in years 2016 through 2025. Plans for rehabilitation of this line should consider additional capacity requirements and alternatives for flow routing and satellite treatment associated with providing sewer service for an expanded UGA.

STEP Main Extension

As described above, the gravity sewer lines and Main Pump Station downstream of the 6th and Joy STEP terminus do not have sufficient capacity to transport 2025 flows.

Thus, it is recommended that these flows be bypassed from these lines in a new STEP Main to the WWTP. Plan and profile views of a possible routing of this line are shown in Figures 7-9, 7-10, and 7-11. The line would cross the Washougal River on a new pedestrian bridge that is being constructed within the next two years. This alignment would require obtaining easements for routing the force main through the various properties. The cost estimate for the STEP Main Extension is $4.48 million dollars. The detailed project cost estimate is included in Appendix K.

ADDITIONAL INVESTIGATIVE ACTIVITIES

Additional investigative activities are recommended to determine sources of I/I to enable removal of I/I sources. Basin 10 appears to be a major source of I/I; thus, it is recommended that television inspection be conducted in Basin 10 this winter, and Basin 2 (around the Mill) the following winter.

Also, it is recommended that the City purchase and utilize two sewer flow meters to assist in measuring flows in the collection system. The flow meters could be installed before and after major rehabilitation projects to allow measurement of flow reductions associated with particular projects. The flow meters should be deployed in Basin 10 this winter, and Basin 2 (around the Mill) the following winter.

Finally, it is recommended that the City record run-time data on a daily basis at all of their pump stations, especially during storm events, to enhance understanding of flows in the system.

COLLECTION SYSTEM EXTENSIONS WITHIN THE UGA

Memoranda prepared to address design flows in areas within the UGA are included in Appendix J (for Basin 11 and the Brady Road Pump Station) and Appendix L (for the Crown Road Sewer servicing the Gregg Service Area).

COLLECTION SYSTEM CAPITAL IMPROVEMENT PROJECT SUMMARY

Table 7-6 identifies the 15-year schedule, and projected costs in 2006 dollars, for collection system improvements. Total costs for the projects, including engineering, construction, construction administration, tax and contingency, are provided. Detailed cost estimates are included in Appendix K.

TABLE 7-7

Recommended 15-Year Schedule and Cost Estimates for Collection System Capital Improvements

Basin and Project	Reason for Priority	Total Estimated Cost	Project Year Total	Year to be Completed
Investigative Activities				
Basin 10, TV Inspection and Flow Metering	Inf 2	$15,000	$15,000	2007
Purchase flow meters (2)	Inf 2	$25,000	$25,000	2007
TV Inspection and Flow Metering, Basin 2	Inf 1	$15,000	$15,000	2008
Inspect Condition of Force Main from Main Pump Station	Inf 1	$10,000	$10,000	2009
STEP Collection System				
Basin 6, STEP Main Bypass of Main Pump station	C2	$4,480,000	$4,480,000	2010
Replace 21-inch STEP Main	To be Determined			2016-2025
Pump Stations				
Annual Pump Station Rehabilitation and Conversion Allowance	Corrosion, Maintenance	$150,000	$150,000	2006-2015
Basin 5, Main Pump Station – Wet Well and Screening Improvements	C2	$900,000	$900,000	2010
Gravity Collection System				
Basin and Project	**Reason for Priority**	**Total Estimated Cost**	**Project Year Total**	**Year to be Completed**
Basin 1, Project 1	C1, PC,Inf1, S	$776,194	$1,154,243	2007
Basin 2, Project 2	C1, PC, Inf2	$378,049		
Basin 3s, Project 6	C1, PC, Inf4, S	$588,071	$1,421,066	2008
Basin 3s, Project 3	C1, PC, Inf4	$832,995		
Basin 1, Project 2	PC, Inf1	$437,285	$1,245,697	2009
Basin 1, Project 3	PC, Inf1	$466,496		
Basin 1, Project 4	PC, Inf1	$341,916		
Basin 4, Project 2	C2, PC, Inf2	$573,604	$1,219,478	2010

TABLE 7-7 – (continued)

Recommended 15-Year Schedule and Cost Estimates for Collection System Capital Improvements

Basin and Project	Reason for Priority	Total Estimated Cost	Project Year Total	Year to be Completed
Basin 6, Project 1	C2, Inf5, S	$645,874		
Basin 1, Project 5	PC, Inf1	$347,140	$1,488,567	2011
Basin 2, Project 1	C1, Inf2	$691,171		
Basin 4, Project 3	PC, Inf2	$450,256		
Basin 4, Project 1	PC, Inf2	$714,208	$1,401,209	2012
Basin 4, Project 4	PC, Inf2	$687,001		
Basin 3n, Project 3	PC, Inf3	$545,080	$1,431,307	2013
Basin 3n, Project 1	PC, Inf3	$886,227		
Basin 3n, Project 2	PC, Inf3	$611,636	$1,083,513	2014
Basin 3n, Project 4	PC, Inf3	$471,877		
Basin 5, Project 2	C1, Inf6	$708,507	$708,507	2015
Basin 3n, Project 5	C2, Inf3	$813,853	$813,853	2016
Basin 3s, Project 1	PC, Inf4	$473,788	$814,034	2017
Basin 3s, Project 5	PC, Inf4	$340,246		
Basin 3s, Project 4	PC, Inf4	$827,692	$953,293	2018
Basin 6, Project 3	C2, Inf5	$125,601		
Basin 3s, Project 2	PC, Inf4	$557,395	$1,064,698	2019
Basin 6, Project 2	C2, Inf5	$507,303		
Basin 5, Project 1	C2, Inf6	$442,423	$864,815	2020
Basin 10, Project 1	C2, Inf2	$422,392		
Basin 15, Project 1	Crown Road	$1,300,000	$1,300,000	2021

Key:
C1 - needs immediate capacity improvement
C2 - will eventually need capacity improvement
PC - poorest condition due to broken pipe and/or severe root intrusion with subsequent unacceptable infiltration
MC - moderately bad pipe due to cracks and/or some root intrusion - some infiltration
Inf 1 - 1998 I/I Study showed this basin to have the highest I & I
Inf 2 - 1998 I/I Study showed this basin to have the 2nd highest I & I
Inf 3 - 1998 I/I Study showed this basin to have the 3rd highest I & I
Inf 4 - 1998 I/I Study showed this basin to have the 4th highest I & I
Inf 5 - 1998 I/I Study showed this basin to have the 5th highest I & I
Inf 6 - 1998 I/I Study showed this basin to have the 6th highest I & I
S - surcharging is known to occur.
Note: All costs are in 2006 dollars.

CHAPTER 8

WASTEWATER TREATMENT FACILITY EVALUATION

The purpose of this chapter is to evaluate the wastewater treatment facility (WWTF) for its ability to meet its treatment objectives based on projected future flows and loadings, and provide recommendations for improvements. The treatment plant effluent quality must meet maximum monthly average limits of 20 mg/L for TSS and 20 mg/L for BOD_5, as well as limits for ammonia, fecal coliform, and pH. These criteria were discussed in Chapter 5 and are listed in Table 5-3.

This evaluation focuses on the following treatment issues at current and design loadings:

- Analysis of WWTF flow and loading projections;
- Projection of NPDES permit limits;
- TSS and BOD removal, including biological treatment performance and solids/liquid separation in the secondary clarifiers and cloth media filters;
- Removal of ammonia-nitrogen;
- Ability to denitrify (for total nitrogen removal) at current and design loadings (Although not required by the City's NPDES permit, denitrification is desired for process stability, energy savings, alkalinity recovery and pH control.);
- Disinfection;
- Standby power considerations; and
- Other WWTF requirements.

Solids handling and biosolids management are discussed in Chapter 9.

RECENT WWTF IMPROVEMENTS

The facility was upgraded and expanded to 6.1 mgd capacity in 2000. The existing aeration basins were converted to aerobic digesters, and the new treatment facility included a headworks with mechanical fine screen, primary and secondary clarifiers, aeration basin with selectors and oxic/anoxic zones for BOD_5 and ammonia-nitrogen removal, centrifugal aeration blowers, effluent filters, UV disinfection system, effluent pump station, gravity thickener, a sludge dewatering centrifuge, and various associated pumping and conveyance facilities. New laboratory/office, equipment, and effluent filter/UV disinfection buildings, dewatered biosolids storage facility, and a soil biofilter for odor control were also constructed.

In 2002, an alkalinity addition and control system was added to control aeration basin and plant effluent pH. The facilities store and feed 25 percent sodium hydroxide to either the headworks or the aeration basins. The system includes two 10,000-gallon tanks in a secondary containment enclosure, two peristaltic pumps, and piping to convey the alkalinity source to the feed points.

Phase 2A WWTF Improvements to the WWTF were approved by Ecology in 2009 and are currently being constructed. Construction includes two new primary anaerobic digesters, a new sludge storage tank, new sludge dryer, additional aeration blower, additional bank of ultraviolet disinfection lamps, aeration basin modifications, enlarged odor control biofilter, new septage centrate/WAS storage centrate/WAS tank, and operational control systems that will integrate the new systems with the existing WWTF systems. The engineering basis for these improvements is described later in this chapter (for liquid stream improvements) and in Chapter 9 (for solids stream improvements).

The Department of Ecology issued the current City of Camas NPDES operating permit effective December 1, 2004, granting the City the request for a relaxed percent removal of influent BOD and TSS from the previous permit due to dilute influent from industries and because of the many septic tank effluent pump (STEP) tanks throughout the system. The permit requires 70 percent removal of influent TSS and BOD and effluent concentrations of both TSS and BOD of 20 mg/L. The permit was renewed effective December 1, 2004, and expired November 30, 2009.

The City's effluent limits for ammonia were first issued in 2004 (the current permit) and are based on the use of default parameters in the mixing zone dilution model UM3 and historical river pH data. With the encouragement of Ecology, the City has obtained additional information that may lead to a modification of the ammonia permit limits (including deletion of daily maximum limits for ammonia) through an effluent dye study. Additionally, the City obtained the necessary approvals to modify its diffuser to increase dilution in the river and completed this work early in the Phase 2A project in 2010. This issue is discussed in more detail below.

HISTORICAL PLANT PERFORMANCE

Historical performance with regard to removal of BOD_5, TSS, fecal coliform, bacteria, and ammonia is discussed below.

BOD_5 AND TSS REMOVAL

Monthly average effluent TSS and BOD_5 concentrations for the period of 1998 to 2005 are shown on Figure 8-1. The Camas WWTF has exhibited good performance and has generally met its permit effluent limits for BOD_5 and TSS. Average monthly effluent values for the period of 1998 to 2005 were 7 mg/L for TSS and 13 mg/L for BOD_5. The maximum month effluent limits for BOD_5 concentration in the City's NPDES permit was exceeded once during this period, while the TSS limit was not exceeded. As shown on Figure 8-1, effluent TSS and BOD_5 concentrations decreased substantially after completion of the upgrades in 2000; however, in the period of 2004 to 2005, concentrations increased slightly but remain within limits.

FIGURE 8-1
City of Camas WWTP
Monthly Average Effluent BOD5 and TSS Concentrations

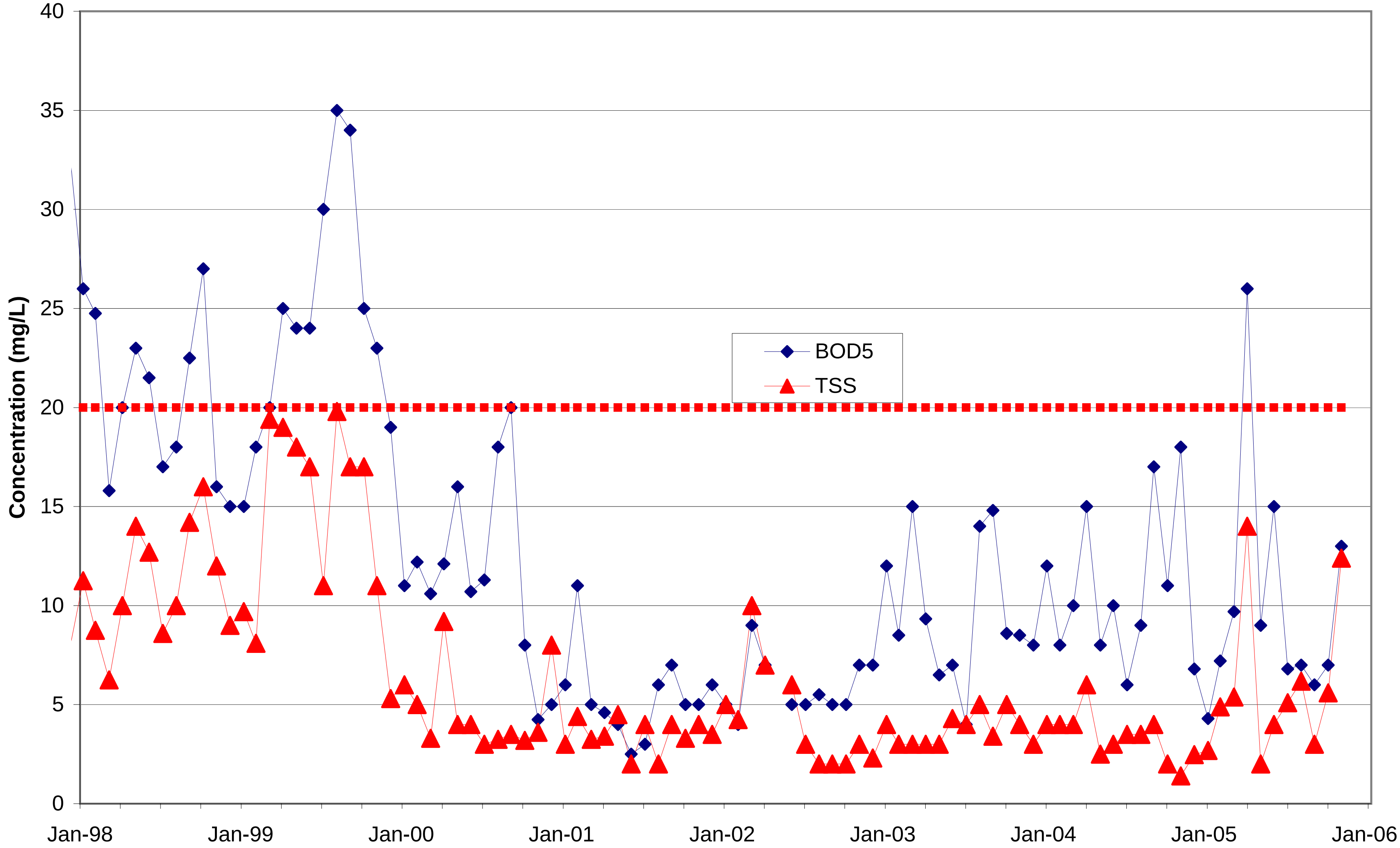
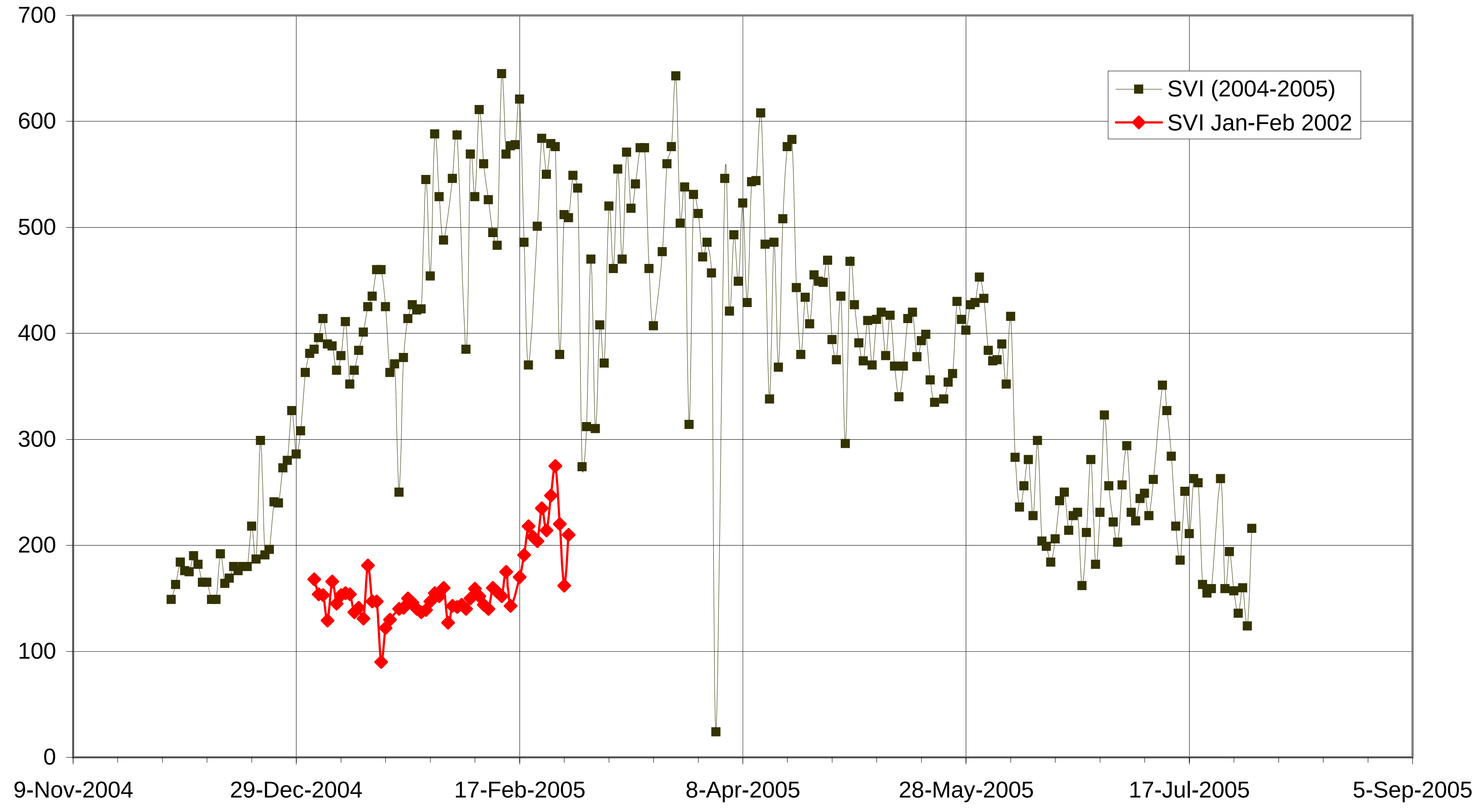


FIGURE 8-2
Sludge Volume Index (SVI)
City of Camas WWTP



Appendix M provides a series of charts that compare performance in 2001 to 2002 with that in 2004 to 2006. The higher effluent concentrations of BOD_5 and TSS in 2004 to 2006 are related to changes in the sludge volume index (SVI). SVI is a measure of how well sludge settles. The lower the SVI the better settling characteristics of the sludge. As shown on Figure 8-2, SVIs increased quite dramatically from 2002 to 2005, from 100 to 200 ml/g to 200 to 600 ml/g. SVIs exceeding 200 to 300 ml/g are indicative of poorly settling (bulking) sludge. As discussed later in this chapter, low F/M in the selector will lead to the growth of filaments and high SVIs since the selector relies on a relatively high F/M in the selector to encourage the growth of floc-forming bacteria, which have higher growth rates than filamentous bacteria at high soluble BOD concentrations. However, operation at too *high* of a F/M (greater than about 10 to 12 lb BOD_5/lb MLSS) can yield the formation of a viscous, non-filamentous ("hydrous") bulking sludge that also settles poorly and also yields high SVIs (Metcalf and Eddy, 2002). Although there are established design criteria for selector F/M, there typically is a plant-specific optimal range of selector F/M that is best determined by trial and error. Recommendations for selector modifications are provided later in this chapter.

FECAL COLIFORM REMOVAL

Since 1998, the WWTF has consistently met its fecal coliform limits of 200 MPN/100 ml average weekly and 400 MPN/100 ml average monthly. Monthly average effluent fecal coliform concentrations for the period of 1998 to 2005 are shown on Figure 8-3. Although generally excellent performance has been observed and the system has been compliant with permit criteria, the disinfection system has shown some variability in performance, with typically several samples each year over 100 MPN/100 ml. These sporadic single high fecal coliform measurements have not caused violations of the monthly average limit, and have been observed with other facilities, are likely the result of occasional lack of homogeneity during sampling (inclusion of heterogeneous particulate) rather than actual performance issues with the disinfection system.

AMMONIA REMOVAL

Effluent ammonia concentrations are summarized on Figure 8-4. As shown, WWTF effluent ammonia concentrations have been highly variable. Data suggests that nitrification performance may have been diminished by inhibition. One potential cause of inhibition is fuel oil, since evidence suggests that dumping of diesel into the collection system has occurred. A detailed evaluation of nitrification performance and recommendations are included in the Plant Evaluation at New Design Loadings section below.

ANALYSIS OF WWTF FLOW AND LOADING PROJECTIONS

Figures 6-1 through 6-4 showed monthly average flow and loadings to the City of Camas WWTF for the period of 1998 through 2005. This data, along with effluent flows and loadings for the same period, is presented in Tables 6-1 and 6-2. A summary of current and projected flows and loadings is provided in Table 8-1.

FLOW

As shown in Table 8-1, the projected maximum month influent flows to the WWTF approach, but do not exceed, the rated capacity of the WWTF (6.10 mgd) for the 20-year period. However, projected peak day and peak hour flows do exceed design values, requiring an evaluation of the capacity of the plant to treat the higher flows.

LOADING

As shown in Table 8-1, the projected maximum month BOD_5 loading to the WWTF approaches, but does not exceed, the rated capacity of the WWTF (5,616 lb/d) for the 20-year period. However, projected maximum month TSS, TKN, and ammonia nitrogen loadings do exceed the design values for the current plant, requiring an evaluation of the capacity of the plant to treat the higher loadings.

TABLE 8-1

Comparison of Design Criteria and Current and Projected Future Flow and Loadings

Parameter	Design Criteria	85% of NPDES Permitted Design Criteria(2)	Current Value	Projected 2015 Value	Projected 2025 Value
Average Annual Flow (mgd)	3.77	—	2.29	4.04	5.30
Maximum Month Flow(1) (mgd)	6.10	5.19	3.09	4.84	6.10
Peak Day Flow (mgd)	7.8	—	7.03	8.78	10.04
Peak Hour Flow (mgd)	11.09	—	9.93	11.47	13.44
Average Annual BOD_5 Loading(1) (lb/d)	—	—	2,218	3,437	4,099
Maximum Month BOD_5 Loading (lb/d)	5,616	4,774	3,039	4,708	5,616
Average Annual TSS Loading (lb/d)	—	—	3,191	4,937	5,883
Maximum Month TSS Loading(1) (lb/d)	6,405	5,444	4,339	6,715	8,001
Average Annual NH_3-N Loading (lb/d)	—	—	730	1,149	1,389
Maximum Month NH_3-N Loading (lb/d)	—	—	1,029	1,618	1,956
Average Annual TKN Loading (lb/d)	—	—	1,017	1,588	1,917
Maximum Month TKN Loading (lb/d)	942	—	1,367	2,130	2,573

(1) Condition S4.A of City's NPDES permit.
(2) Condition S4.B of City's NPDES permit.

Additional planning and development of capital improvement projects for expansion of WWTF capacity will be needed at the WWTF based on future capacity concerns at the WWTF. This need is due to the requirement in the City's NPDES permit that when

FIGURE 8-3
City of Camas WWTF
Monthly Average Effluent Fecal Coliform

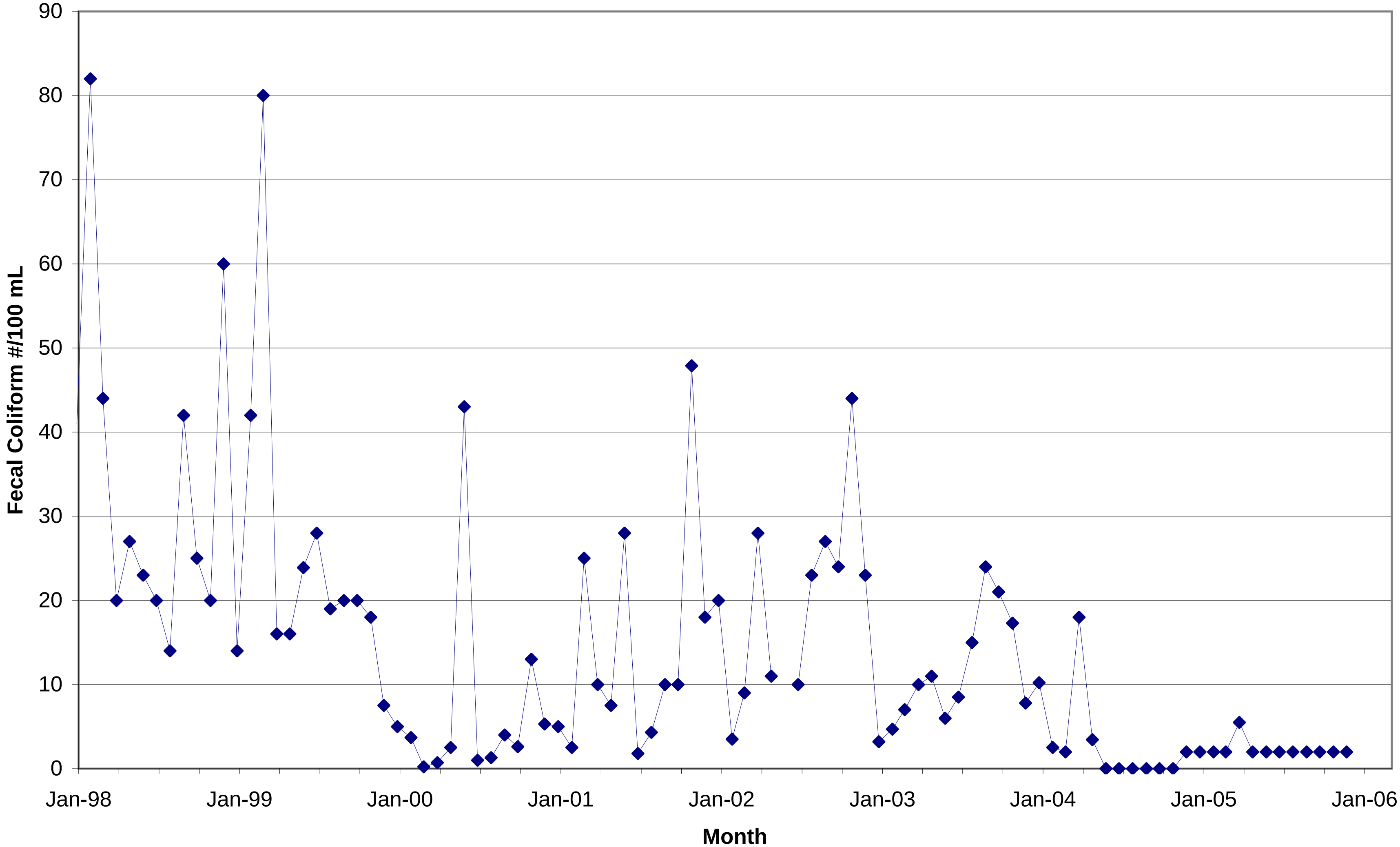
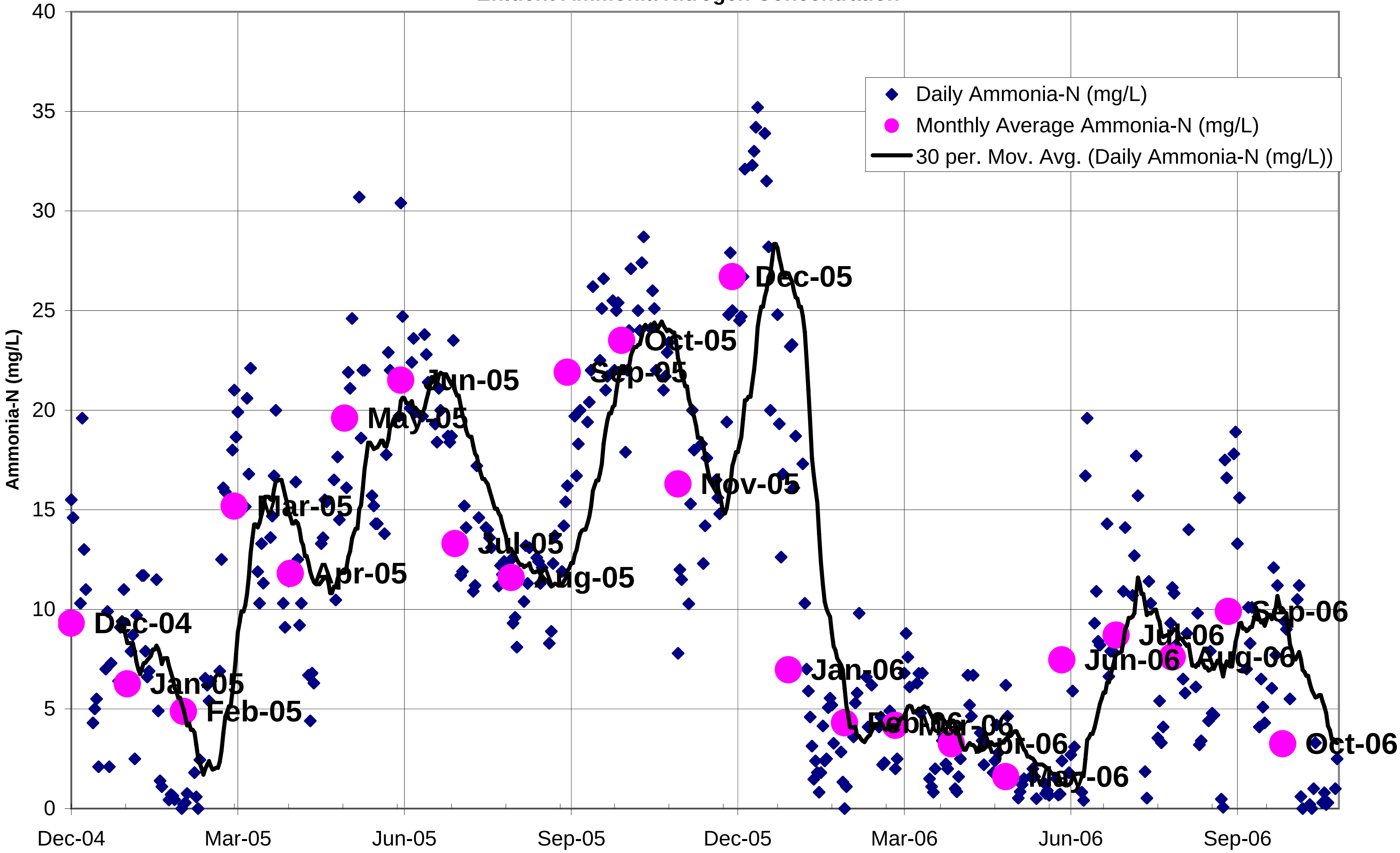


FIGURE 8-4
City of Camas WWTF
Effluent Ammonia Nitrogen Concentration



actual monthly average influent flow or loading to the WWTF exceed 85 percent of design criteria for 3 consecutive months, or if the City has *projected* increases in wastewater flow or loading that would cause exceedance of design capacity within 5 years, the City must submit a plan and schedule to maintain adequate capacity to Ecology. The 85 percent and 5-year requirements are needed to provide sufficient time for municipalities to plan, design, and construct sufficient capacity. Based on projections, the City may exceed the 85 percent flow criterion prior to 2025, unless infiltration and inflow are reduced significantly. As shown on Figure 8-5, it is projected that the maximum month influent flow will exceed 85 percent of capacity in 2018 and will exceed 85 percent of permitted capacity for 3 consecutive months by 2020. Based on this figure, the City may need to submit another plan and schedule to maintain adequate capacity to Ecology by 2020.

The maximum month flow projected in this plan for year 2025 is the same as the design criteria for the existing plant. However, the projected values for year 2025 for the following parameters exceed the corresponding design criteria for the existing plant:

- Average Annual Flow
- Peak Day Flow
- Peak Hour Flow
- Maximum Month TSS Loading
- Maximum Month TKN Loading

The maximum month TSS and TKN parameters for the existing plant are projected to be exceeded by 2015. The ability of the WWTF to successfully accommodate the increases in these flow and loading parameters is addressed below.

PROJECTION OF FUTURE NPDES PERMIT LIMITS

Dye Tracer and Mixing Zone Study

In 2004, the City authorized Cosmopolitan Engineering to conduct an effluent dye study for Camas using the then-current design flows that Ecology had cited in the City's 2004 NPDES Permit Fact Sheet. A copy of the Dye Tracer and Mixing Zone Study (Study) is included in Appendix N. Field tests for the dye study were conducted by Cosmopolitan on February 16, 2005 and October 4, 2005. Based on the field tests, parameters within the UM3 model used by Ecology were calibrated to more closely match measured dilution.

Cosmopolitan Engineering then used Ecology's UM3 model, calibrated based on the results of the dye study, to calculate dilution factors and determine NPDES permit limits for year 2025 projected flows shown in Table 8-1. The results are summarized in Part III of the Cosmopolitan report, included in Appendix N.

In accordance with comments from Ecology, the critical dilutions identified in the Study for the outfall modified (for vertical discharge through Tideflex diffusers) were amended in a pair of technical memoranda dated January 20, 2009 (for an 8-port diffuser configuration) and February 19, 2009 (for a 16-port diffuser configuration). These memoranda are included in the back of Appendix N.

The results of the mixing zone analysis demonstrated a substantial increase in dilution if modifications were made to the diffuser so that it discharged vertically. Because the Camas outfall discharges in the same direction as the river flows and at similar velocities, there is low turbulence and poor dilution in the mixing zone. A change from a horizontal discharge to a vertical discharge would increase dilution about four-fold based on the UM3 model Ecology has used to model dilution in the Camas mixing zone.

The dilution factors established in the memoranda are summarized in Table 8-1B.

TABLE 8-1B

Critical Dilution Factors Established in Mixing Zone Analysis

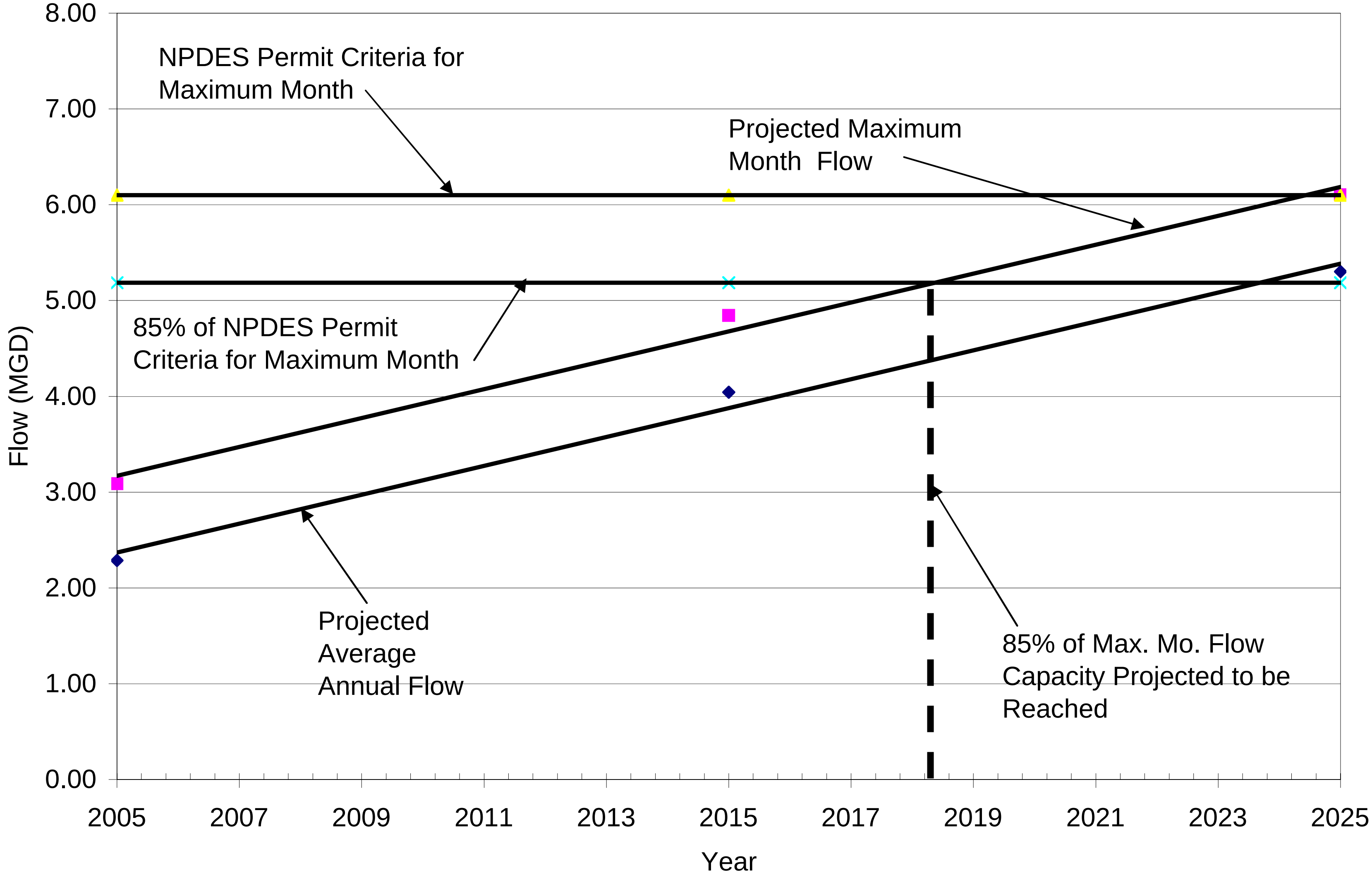
Condition	8-Port		16-Port	
	Acute	**Chronic**	**Acute**	**Chronic**
Winter	19:1	122:1	23:1	121:1
Summer	27:1	156:1	27:1	185:1

As noted in the memoranda, projected water quality-based permit limits were assessed for metals based on effluent samples taken in 2005 to 2008 and historical ambient pollutant concentrations cited in the NPDES Permit Fact Sheet.

A letter was issued by Ecology on October 21, 2009, indicating approval of the mixing zone analysis provided in the memorandum dated January 20, 2009, for the 8-Port configuration. The approval letter dated October 21, 2009, notes the applicable ratios in Table 8-1B may be used for "estimation of the reasonable potential for limits for toxic pollutants not already subject to permit limits (e.g., metals)." A letter was issued by Ecology on November 25, 2009, indicating approval of the mixing zone analysis for the 16-port diffuser. (As noted later in the Outfall section later in this chapter, the 16-port configuration was recommended based on WWTP hydraulics and modifications to implement this configuration were completed in 2010.)

As noted in the memorandum from Cosmopolitan dated February 19, 2009, among the metals only cadmium showed a reasonable potential to exceed water quality standards. The cadmium exceedance is based on one sample (87 µg/L in June 2006) that appears to be a statistical outlier and may in fact be an artifact of the sampling process. Additional sampling and analysis conducted since June 2006 with clean sampling techniques have not detected cadmium.

FIGURE 8-5
Projected Versus Currently Permitted
Camas WWTF Influent Flows



Ammonia Limits

Ecology's letter dated October 21, 2009, notes that regarding pollutants presently subject to NPDES permit limits (i.e., ammonia), "it is within Ecology's discretion to conclude that monthly ammonia limits are appropriately protective since daily limits are based on the effluent's variability and these monthly limits. Accordingly, Ecology will have the basis to remove the daily maximum limits for ammonia from the permit with the completion of this outfall upgrade, and it is our intention to do so. Monthly average limits for ammonia will continue to be applicable to the discharges – either the limits presently in the permit, or limits similar to those, with some adjustment for seasonality." Similarly, Ecology's letter dated November 25, 2009, reiterates Ecology's expectation to "retain the monthly average limit for ammonia, as we have discussed previously."

In accordance with the letters dated October 21, 2009 and November 25, 2009, and discussions with Ecology, it is understood that now that the City has completed the outfall modifications, Ecology will modify Condition S1.A of the City's NPDES permit by deleting the maximum daily ammonia limits in the City's revised NPDES permit expected to be issued in 2011. Thus, for total ammonia limits, only the monthly average limits of 20 mg/L in summer and 7 mg/L in winter will remain.

These proposed ammonia limits have been used as the basis of evaluations and calculations for this plan.

PLANT EVALUATION AT NEW DESIGN CRITERIA

A new hydraulic profile, based on the WWTF flows summarized in Table 8-2, is provided on Figure 8-6. The profile indicates flooding of the weirs in the troughs in the secondary clarifier splitter box. As indicated in Table 8-5, it is recommended that the weirs be raised to 33.87 feet (approximately 3/4 inch) to accommodate the new projected peak hour flows. Additional impacts of the increase in projected peak hour flows are described in the evaluation of process units below.

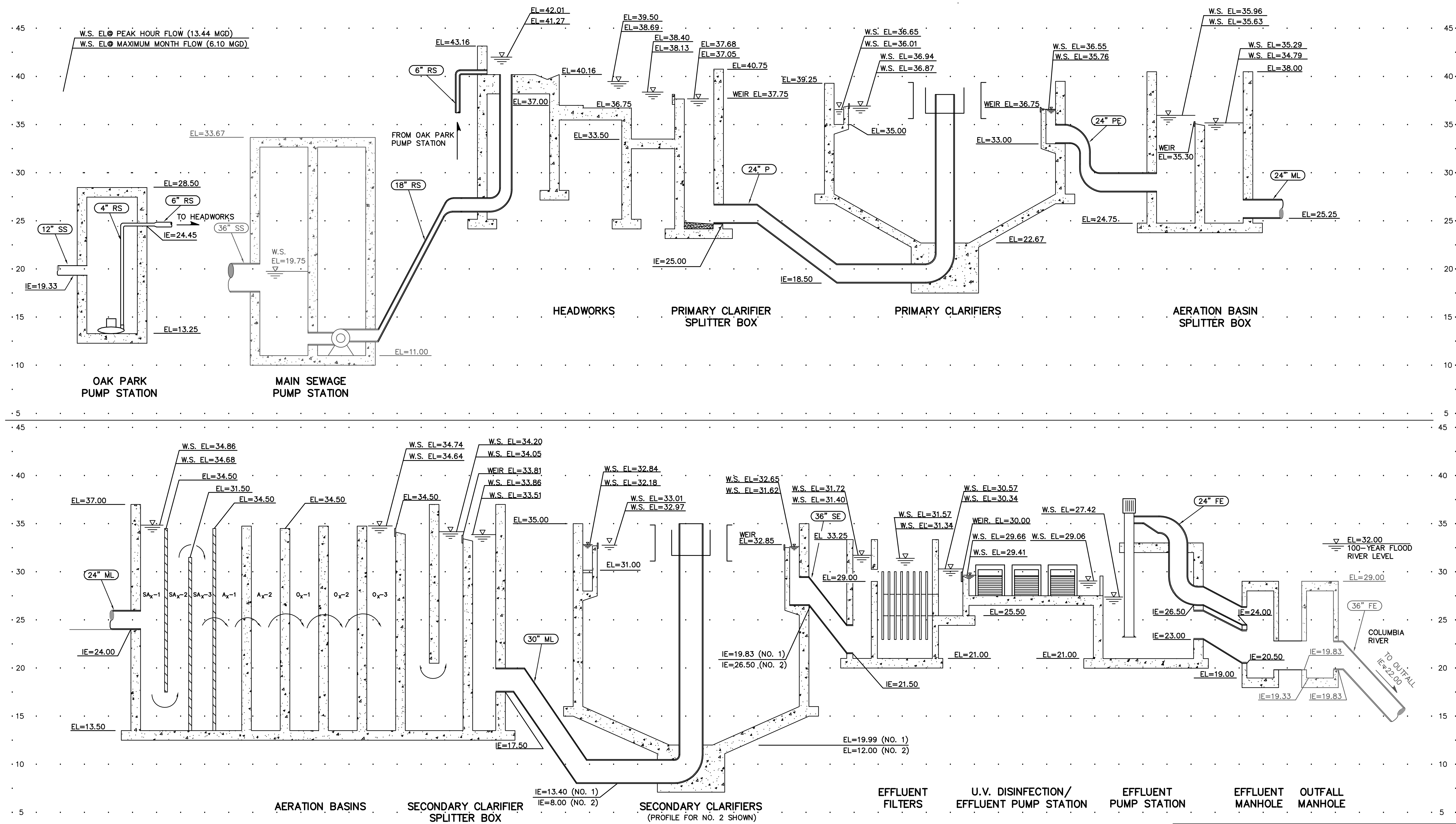
In the following sections, the capacities of major WWTF components at 2015 and 2025 projected flows and loadings are evaluated and where applicable, compared to accepted design criteria such as published in the Ecology *Criteria for Sewage Works Design* (2008), WEF *Manual of Practice #8* (2010), and Metcalf and Eddy *Wastewater Engineering* (4th Edition, 2003). This evaluation is also summarized in Table 8-2. Abbreviations used in this table include:

- AAF = Annual Average Flow
- MMF = Maximum Month Flow
- PDF = Peak Day Flow
- PHF = Peak Hour Flow

TABLE 8-2

Comparison of Component Design Criteria and Projected Flow and Loadings

Component (Parameter)	Capacity/Criteria	Reference[(3)]	2015 Operating Condition (meets criteria?)	2025 Operating Condition (meets criteria?)
Mechanical Fine Screen (capacity)	12.78 mgd PHF	Manufacturer	11.47 (yes)	13.44 (no)
Primary Clarifiers (overflow rate)	800 – 1,200 gpd/ft^2 AAF	Ecology, 2008	715 (yes)[(1)]	938 (yes)
	2,000–3,000 gpd/ft^2 PHF	Ecology, 2008	2,029 (yes)	2,378 (yes)
Primary Clarifiers (weir loading)	10,000–40,000 gpd/lf AAF	Ecology, 2008	10,745 (yes)	14,096 (yes)
	MMF		12,872 (yes)	16,223 (yes)
	PHF		30,505 (yes)	35,745 (yes)
Primary Clarifiers (detention time)	≤2.5 hr AAF	Ecology, 2008	2.5 (yes)	1.9 (yes)
	MMF		2.1 (yes)	1.7 (yes)
	PHF		1.16 (yes)	1.01 (yes)
Biological Selector (detention time at max. mo. flow)	10–45 min. design 5–25 min. design 20–60 min. design	Ecology, 2008 WEF, 2010 M&E, 2003	24.7 (yes)	31. (yes)
Biological Selector (F/M ratio) 1st Compartment	3–8 lb BOD/lb MLSS	M&E, 2003	6.4 (yes)	5.1 (yes) [(3)]
3 Compartments	2 lb BOD/lb MLSS	M&E, 2003	1.6 (yes)	1.7 (yes) [(3)]
Aeration Capacity (TKN capacity at projected BOD load)	Analysis in Table 8-5 2,130 lb/d (2015) 2,573 lb/d (2025)	G&O, 2006	2,170 (no)	2,024 (no)
Aeration Basin Solids Retention Time (SRT)	9.5 days MMF (7–20 days)	M&E, 2003	11.9 days (yes)	9.5 days (yes)



HYDRAULIC PROFILE

SCALE: VERT 1"=10'-0", HORIZ NOT TO SCALE

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-6
WWTF HYDRAULIC PROFILE

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471 WW Fac Plan\Figures\FIG8-6.DWG, 8-6, 2/21/2007 11:57:21 AM, 0.5:1, BY: M NAGEL

TABLE 8-2 (continued)

Comparison of Component Design Criteria and Projected Flow and Loadings

Component (Parameter)	Capacity/Criteria	Reference[3]	2015 Operating Condition (meets criteria?)	2025 Operating Condition (meets criteria?)
Secondary Clarifiers[4] (overflow rate) Max. Month	<700 gpd/ft^2, MMF 300–1,000 gpd/ft^2, MMF	Ecology, 2008 WEF, 2010	621 (Clar. 2) (yes) 475 (Clar. 1) (yes)	782 (Clar. 2) (no) 598 (Clar. 1) (yes)
Peak Day	600–800 gpd/ft^2, design	M&E, 2003	1,126 (Clar. 2) (no) 861 (Clar. 1) (no)	1,288 (Clar. 2) (no) 985 (Clar. 1) (no)
Peak Hour	1,000–1,600 gpd/ft^2, design	WEF, 2010	1,471 (Clar. 2) (yes) 1,125 (Clar. 1) (yes)	1,724 (Clar. 2) (no) 1,318 (Clar. 1) (no) [4]
Secondary Clarifiers[4] (solids loading rate) Max. Month	4.8–24 lb/ft^2-d 20–30 lb/ft^2-d	M&E, 2003 WEF, 2010	21.9 (Clar. 2) (yes) 16.4 (Clar. 1) (yes)	27.6 (Clar. 2) (no) 20.7 (Clar. 1) (no) [4]
Peak Day (hour)	34 lb/ft^2-d 50 lb/ft^2-d	M&E, 2003 WEF, 2010	39.8 (Clar. 2) (yes/no) 29.8 (Clar. 1) (yes)	45.5 (Clar. 2) (yes/no) 34.1 (Clar. 1) (yes/no)
Filtration System (capacity)	6.1 mgd (max. mo.)	Manufacturer	4.84 (no) [5]	6.1 (no) [5]
UV Disinfection System (capacity)	9.15 mgd peak day	Manufacturer	8.78 (yes)	10.04 (no)
	6.1 mgd (max. mo.)	Manufacturer	4.84 (yes)	6.1 (yes)
Effluent Pumps	13.44 mgd (peak hour)[2]	Manufacturer	11.47 (yes)	13.44 (yes)

(1) Sources include Water Environment Federation (WEF), the Washington State Department of Ecology (Ecology), and Metcalf and Eddy (M&E). See the reference list at the end of the chapter.
(2) See discussion in text.
(3) Projected operating conditions at 2015 and 2025 meet criteria; however, due to settling issues, current operation does not meet criteria.
(4) Projected operating conditions at 2015 and 2025 meet criteria; however, high SVIs preclude operation near upper range of criteria.
(5) Although filtration system has a manufacturer's rated capacity to meet 2015 and 2025 operating conditions, the system is not currently operable and will be replaced as described later in the text.

HEADWORKS

The headworks includes a 24-inch Parshall flume for influent flow measurement and a mechanical fine screen with a bar spacing of 1/4 inch. Prior to 2007, if the fine screen was out of service or if the influent flow exceeded 11.1 mgd, the excess wastewater was diverted to the manual bypass coarse bar screen, with a bar spacing of 3/4 inch. The former screen had many problems and was considered unreliable due to maintenance burdens.

Two new 6 mm screens were installed in Phase 2A (in 2008 to 2011) to:

- Provide adequate capacity for the projected year 2025 flow of 13.4 mgd. (The capacity of each screen is 7 mgd.)
- Improve the reliability of the screening operation.

The Parshall flume, with a capacity of 21.4 mgd, can accommodate 2025 flows.

PRIMARY CLARIFIERS

Two 60-foot-diameter circular primary clarifiers remove grit and other settleable solids from the screened wastewater. The grit-laden sludge is pumped to the grit removal facility by three 10-horsepower recessed impeller torque flow pumps with a capacity of 220 gpm at a TDH of 32 feet. Scum collected from the primary clarifiers is conveyed by gravity to the primary clarifier scum pump station. As shown in Table 8-2, the primary clarifiers have adequate capacity for year 2015 and year 2025 flows.

AERATION CAPACITY

Biological treatment of the wastewater is provided in the aeration basins. The activated sludge in the basins is mixed and supplied with oxygen by blowers through submerged air distribution piping and diffusers. Automatic control of aeration blower output is accomplished based on continuous measurement of the dissolved oxygen (D.O.) in the aeration basins by submerged D.O. probes. As shown in Table 8-1, year 2025 TKN (which is predominantly converted to ammonia in the WWTF) exceeds the existing design concentrations. Thus, the aeration basins must be evaluated for their ability to accommodate the increased TKN.

The aeration basin oxygen demand is decreased by the process of denitrification and by the periodic wasting of biomass growth. In the *Wasteload Assessment Report – Aeration System Capacity Analysis* (Gray & Osborne, May 2006), the recorded airflow delivered by the blowers in operation at the WWTF was correlated to the actual, approximate oxygen required to achieve BOD and ammonia removal. A correlation factor, *K*, was determined to describe the correlation between the actual oxygen required (AOR) and the airflow (standard cubic feet per minute, scfm) delivered:

$$\text{scfm} = K \times \text{AOR}$$

Average airflow values were used for the calculation. The correlation factor, *K*, is an expression of the efficiency of the blowers and the air diffusion system to deliver oxygen. The AOR is defined by the following equation:

$$\text{AOR} = 1.3 \times \text{BOD}_{\text{removed}} + 4.57 \times \text{TKN}_{\text{oxidized}} - 2.86 \times \text{DN} - 1.42 \times \text{P}_{\text{x,bio}}$$

The $\text{BOD}_{\text{removed}}$ is the amount of BOD oxidized and the $\text{TKN}_{\text{oxidized}}$ is the nitrogen oxidized to ammonia. DN is the amount of nitrogen denitrified which results in a decrease in oxygen demand. $\text{P}_{\text{x,bio}}$ is the amount of biomass wasted. The AOR was determined using biological kinetic factors, stoichiometric factors, and actual plant conditions and performance for the time period from March 2006 through April 2006. Assumptions used in this analysis are presented in Table 8-3. Values for biological kinetic and stoichiometric factors were assumed based on typical values presented in *Wastewater Engineering* (Metcalf and Eddy, 4$^{\text{th}}$ Edition, 2003). The treatment plant was operating with two aeration basins, an MLSS concentration of approximately 2,000 mg/L and an aerobic SRT of approximately 11.4 days at approximately 16 degrees C between March 2006 and April 2006. During this period, effluent BOD_5 averaged 6 mg/L and effluent ammonia averaged 3.7 mg/L.

TABLE 8-3

Assumptions for Determination of Correlation Factor (*K*) and BOD_5 and Ammonia Loads

Parameter	Value	Units	Source
2 AB Volume	2.6	MG	Measured
Kinetic and Stoichiometric Constants			
Primary BOD Effluent/BOD Influent	0.7	None	Typical
$bCOD/BOD_5$ Ratio	1.64	None	Typical
(WAS) $bTKN/P_{x,bio}$ Ratio	0.12	None	Typical
Initial Assumed Fraction of TKN Consumed	0.7	None	Typical
nbTKN/TKN Ratio	0.05	None	Typical
NH_4/TKN Ratio	0.7	None	Typical
Fraction of Nitrified Nitrogen Denitrified	0.6	None	Estimated
Y_H (heterotrophic yield)	0.4	lb/lb	Typical
Y_n (heterotrophic yield)	0.12	lb/lb	Typical
f_d (fraction of cell mass remaining as cell debris)	0.15	lb/lb	Typical
$k_{d,20}$ (endogenous heterotrophic decay coefficient)	0.12	d^{-1}	Typical
$k_{dn,20}$ (endogenous nitrogenous decay coefficient)	0.17	d^{-1}	Typical
$\mu_{m,\ max,\ 20}$ (heterotrophic growth rate)	6.0	g/g*d	Typical
$\mu_{n,\ max,\ 20}$ (autotrophic growth rate)	0.9	d-1	Typical
K_s (substrate half-saturation coefficient)	20	g/m^3	Typical
$K_{n,20}$ (ammonia half-saturation coefficient)	0.7	g/m^3	Typical
K_o (oxygen half-saturation coefficient)	0.5	g/m^3	Typical
Design Temperature	15	°C	Measured
$\mu_{m,\ max,\ t}$ (heterotrophic growth rate)	4.28	g/g*d	Calculated
$k_{d,t}$ (endogenous heterotrophic decay coefficient)	0.099	d^{-1}	Calculated
$\mu_{n,\ max,\ t}$ (autotrophic growth rate)	0.636	g/g*d	Calculated
$k_{dn,t}$ (endogenous nitrogenous decay coefficient)	0.1474	d^{-1}	Calculated
$K_{n,t}$ (ammonia half-saturation coefficient)	0.541	g/m^3	Calculated
Additional Assumptions for BOD_5 and Ammonia Load Calculations			
Average *K* (airflow/AOR)	0.2775	scfm/lb/d	Calculated
MLSS Concentration	2,000	mg/L	Measured
WAS	1,157	lb/d	Measured
SRT	11.4	d	Measured

The correlation factor, *K*, was then used to estimate the aeration system capacity for biological removal of both carbonaceous and nitrogenous loads, given the air available and delivered by a maximum of two blowers in service. The blowers at the Camas WWTF are each rated at 1,650 standard cubic feet per minute (scfm) at 9.5 psig. Assuming two blowers in service (3,300 scfm total air available), 95 percent removal of BOD_5, and complete nitrification, the influent BOD_5 and ammonia loads that can be treated are summarized in Table 8-4. The values used for the calculation are presented in greater detail in Table 8-5.

As shown in Table 8-4, the maximum TKN the WWTF can treat while treating a design loading of 5,620 lb/d BOD_5 is 2,024 lb/d. Thus, the analysis shows that the existing blowers cannot accommodate the projected 2025 design loadings of 5,616 lb/d BOD_5 and TKN of 2,573 lb/d simultaneously. An additional blower is required.

TABLE 8-4

Projected BOD and Ammonia Load Capacity with Two Blowers (3,300 scfm total) in Service(1)

BOD Load (lb/d)	Ammonia Load (lb/d)
1,000	2,805
1,500	2,721
2,000	2,636
2,500	2,552
3,000	2,467
3,500	2,382
4,000	2,298
4,500	2,213
5,000	2,129
5,620	2,024

(1) BOD_5 and ammonia loads on each row are calculated loads that can be treated using the existing aeration blowers, assuming two aeration basins online, an aerobic SRT of 11.4 days, 95 percent BOD removal, and complete nitrification. Also assumes that basin dissolved oxygen is maintained at minimum concentration to achieve full nitrification. In actual operation, less than 100 percent nitrification will be achieved.

TABLE 8-5

Evaluation of Oxygen Demand with Two Blowers in Service

BOD_{in} (lb/d)	BOD_r (lb/d)	TKN_{ox} (lb/d)	P_{xbio} (lb/d)	DN (lb/d)	AOR (lb/d)	Airflow (scfm)	*K* (scfm/lb/d)	$Ammonia_{in}$ Capacity (lb/d)
1,000	950	3,955	443	2,373	11,893	3,300	0.2775	2,805
1,500	1,425	3,815	597	2,289	11,893	3,300	0.2775	2,721
2,000	1,900	3,676	752	2,206	11,893	3,300	0.2775	2,636
2,500	2,375	3,536	907	2,122	11,893	3,300	0.2775	2,552
3,000	2,850	3,397	1,061	2,038	11,893	3,300	0.2775	2,467
3,500	3,325	3,258	1,216	1,955	11,893	3,300	0.2775	2,382
4,000	3,800	3,118	1,371	1,871	11,893	3,300	0.2775	2,298
4,500	4,275	2,979	1,525	1,787	11,893	3,300	0.2775	2,213
5,000	4,750	2,839	1,680	1,704	11,893	3,300	0.2775	2,129
5,620	5,339	2,667	1,872	1,600	11,893	3,300	0.2775	2,024

Nitrification and Denitrification

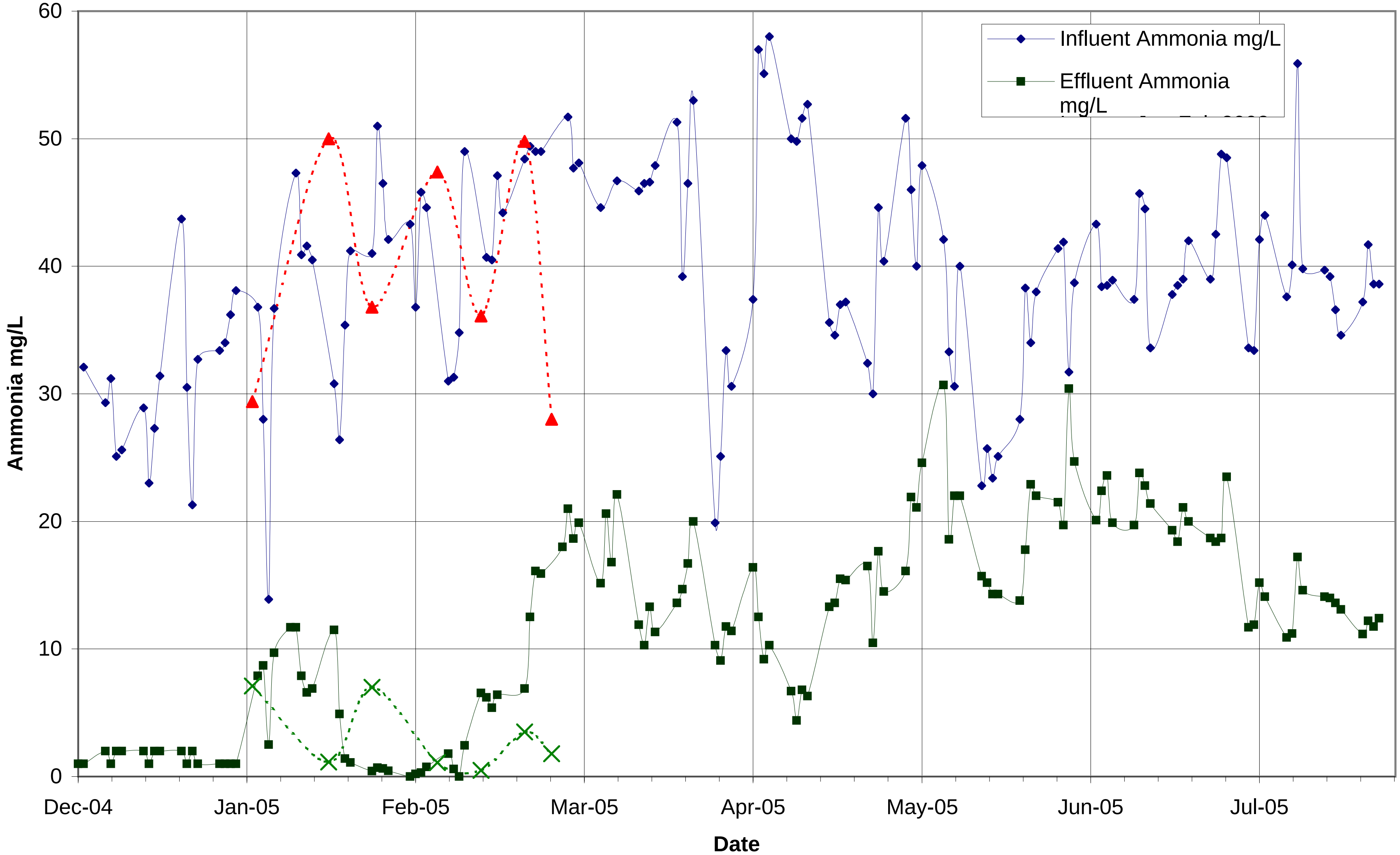
In untreated domestic wastewater, nitrogen will be found primarily in the form of organic nitrogen ammonium ion (NH_4^+). Analytically organic nitrogen and total ammonia nitrogen are measured simultaneously with Total Kjeldahl Nitrogen (TKN). If nitrate or nitrite is present in the wastewater, the TKN test will not include them. Ammonia in wastewater is dissolved (soluble). Organic nitrogen can be soluble (e.g., urea) or particulate (e.g., insoluble proteins). Organic nitrogen can be converted to ammonium through bacterial decomposition and hydrolysis of urea and other organic compounds. Nitrification is the process whereby ammonium is oxidized to nitrate; this process is typically ascribed to two different autotrophic (using inorganic carbon as a carbon source) genera of microorganisms, *Nitrosomonas* and *Nitrobacter*. Denitrification is the process that transforms nitrate to nitrogen gas by heterotrophic (using organic carbon as a carbon source) denitrifying microorganisms in the absence of oxygen. Biological treatment systems can be designed to nitrify and denitrify by providing the proper conditions for the nitrifying and denitrifying microorganisms.

Nitrification is defined as the oxidation of ammonia to nitrate. The oxidation occurs in two steps – the oxidation of ammonia to nitrite by the bacterium *Nitrosomonas* followed by the oxidation of nitrite to nitrate by the bacterium *Nitrobacter*. The stoichiometric equations for nitrification are:

Step 1: $2NH_4^+ + 3O_2 \rightarrow 2NO_2^- + 4H^+ + 2H_2O$ (Performed by *Nitrosomonas*)
Step 2: $2NO_2^- + O_2 \rightarrow 2NO_3^-$ (Performed by *Nitrobacter*)

$NH_4^+ + 2O_2 \rightarrow NO_3^- + 2H^+ + 2H_2O$ (Overall Reaction)

FIGURE 8-7
City of Camas WWTP
Influent and Effluent Ammonia (mg/L)



Influent and effluent concentrations for ammonia at the Camas WWTF for 2004 to 2006 are compared to 2002 performance on Figure 8-7. As shown, the efficacy of ammonia removal has decreased since 2002. To achieve consistent nitrification:

1. It is necessary to maintain the desired SRT (>9.5 days) by operating at a high enough MLSS.

2. Aeration basin temperature must be sufficiently high.

3. The biomass must be maintained in suspension.

4. Sufficient alkalinity must be present to meet the requirement for nitrification and keep the pH near the optimal range. Nitrification results in the decrease in bicarbonate alkalinity as well as an increase in the carbon dioxide concentration, both of which lower the pH. If the wastewater has a relatively low alkalinity to provide buffering capacity, a significant drop in pH can occur. In turn, the low pH can significantly reduce the rate of nitrification. Below a pH of 7.2, the nitrification rate falls precipitously, approaching zero at a pH of 6. Approximately 7.2 mg of bicarbonate alkalinity (as $CaCO_3$) are required to neutralize the hydrogen ions produced by the oxidation of 1 mg of ammonium nitrogen to nitrite.

5. The dissolved oxygen must be maintained at 2 mg/L or higher.

6. Concentrations of toxic metals and compounds must be very low (below inhibitory thresholds).

7. Extreme variation in influent conditions, including pH, TKN, and ammonia, should be minimized.

For a minimum temperature of 12 degrees C, the required minimum aerobic SRT for a nitrifying system is 4.75 days (see calculations, Appendix O). With a safety factor of 2.0, the design SRT is 9.5 days. The projected aerobic SRT with the current nitrification-denitrification scheme for years 2025 is 9.5 days. The Camas WWTF has adequate capacity to nitrify at 2025 flows and loadings, provided that discharge of inhibitory materials is controlled. Periodic failure, as occurred in 2005, to fully nitrify suggests the possibility of inhibition.

An activated sludge computer modeling program was used to model and evaluate the capacity of the Camas WWTF. The model was created using Hydromantis, Inc. General Purpose Simulator (GPS-X Version 5.0) software and physical design data for the treatment facility. GPS-X uses a series of mathematical algorithms to simulate the activated sludge and secondary clarification processes. The results of this evaluation indicate that the existing three aeration basin treatment trains with three secondary clarifiers have sufficient capacity to meet permit limits and achieve sufficient nitrification to yield an effluent ammonia concentration of less than 1 mg/L at the maximum month design flow and loads. Additional calculations were performed to confirm the results of the activated sludge model. The results of the model and calculations are provided in Appendix O.

In general, as the MLSS is increased, leading to very long SRTs, the ability to provide for a sludge that settles well becomes more difficult. However, operation at too *low* of an MLSS can also lead to poorly settling sludge, since the selector used to facilitate the growth of easily settlable, floc-forming bacteria in the aeration basins has an optimal range of food-to-mass ratio (F/M) that is a function of the MLSS concentration (F/M = lb BOD_5/d/lb MLSS).

It is recommended that the City continue to monitor potential causes of occasional poor nitrification at the Camas WWTF. The high ammonia load combined with low BOD load is not an influent characteristic that would prevent full nitrification, assuming other environmental conditions (dissolved oxygen, SRT, temperature, pH, toxics) are favorable. A likely explanation of the inability of the WWTF to fully nitrify in the past is the presence of materials in the influent that are toxic to the nitrifying bacteria. Environmental conditions in the Camas activated sludge appear on the surface to be conducive to good nitrification efficiency, yet high ammonia levels in the effluent have, at times, continued to be measured. Additional possible factors contributing to nitrification problems may be fluctuating TKN/ammonia loading (potentially caused, to some degree, by receipt of City septage) and during use of a single basin at high influent ammonia loading at low hydraulic and solids retention times.

CONTROL OF SLUDGE SETTLEABILITY

Biological Selectors

The selectors provide compartmentalization to create an environment with a high F/M ratio to favor the growth of floc-forming (readily settling) organisms, and produce a low sludge volume index (SVI). The lower the SVI, the better settling characteristics of the sludge. This is a key operating parameter for the operation of activated sludge systems, since poorly settling sludge (SVI >150 ml/g) may require selector modifications, operational modifications, or increased clarification capacity. Based on a review of recent operating records (in 2005 and 2006), SVIs have been quite variable. Examining a 2-month period of operation with one basin online (July to August 2006), reveals that SVIs ranged from 200 to 400 ml/g in early July and dropped to 100 to 150 ml/g as the biomass acclimated to operation with the single basin.

The probable cause of filamentous growth in the Camas activated sludge system is the low F/M and high dissolved oxygen in the biological selector zones at the inlet of the aeration basin. Low F/M is the result of a weak wastewater entering the WWTF, due to the significant amount of low-BOD industrial wastewater and the large number of STEP systems in the community. High dissolved oxygen in the selector zones is due to the use of air to mix the selector volume, and because of the addition of dissolved oxygen contained in the internal basin recycle from the last aerobic zone (to return nitrates).

The City has experienced problems with poor settling solids (high SVI) when two basins are in operation, probably due to filamentous bacteria growth in the bioselectors caused by low F/M and high dissolved oxygen concentrations. The resulting poor floc formation (bulking sludge) has led to solids washout in the secondary clarifiers. Consequently, the City has found that operation of a single aeration basin results in fewer filaments and a better settling sludge, which reduce the risk of effluent TSS violations. However, it is true that additional aeration basin volume should increase nitrification performance, and thus modifications to the selector, as discussed below, are recommended.

In the interim, recommended actions to help control the growth of filamentous bacteria at the Camas WWTF include the following:

1. Turn down the air supply to the selectors as low as possible, while leaving enough airflow to prevent settling. Since the flow to the aeration basin has already been settled, there should not be many suspended solids anyway, and the airflow can be kept low. Recommended dissolved oxygen concentration is 0 to 0.3 mg/L. (Note: new fluorescence-type oxygen meters have now been installed in Phase 2A that can measure accurately to this low dissolved oxygen concentration.) It is most important to keep a low dissolved oxygen concentration during the peak load periods of the day, when the available BOD is greatest.

2. Close the valve on the recycle line to the first selector zone, forcing all the recycle flow to the third selector zone. This change will keep dissolved oxygen in the recycle from entering the first selector zone.

3. If necessary, occasionally reduce the filament population by chlorinating the RAS, or injecting hydrogen peroxide into the RAS. About 2 to 4 days of chlorination or hydrogen peroxide addition should be adequate. Even if the selectors are operated at low dissolved oxygen now, it will take a very long time to reduce the filaments unless chlorination or hydrogen peroxide injection is performed to kill the existing population. This treatment can be performed without killing the nitrifiers if the dose is controlled. The recommended dose should be discussed with Gray & Osborne before performing this action.

4. Maintain the dissolved oxygen concentration in the last aerobic zone, from which internal recycle originates, at about 2 mg/L to prevent excessive amounts of dissolved oxygen from being returned to the biological selector and anoxic zone.

It is recommended that the divider walls in the selectors be moved to provide a design F/M gradient of 6:3:1.5 lb BOD/lb MLSS in the three selector compartments at current operating conditions. An additional issue that may have contributed to problems with solids settling performance (as well as nitrification and scum accumulation) is hydraulic short-circuiting due to back mixing in the aeration basins. The divider walls in the aeration basins are being converted in Phase 2A from their “end-around” configuration to an “overflow” configuration with sufficient head loss to prevent back mixing. Additionally, fiberglass enclosures are being constructed around the internal recycle pumps to reduce dissolved oxygen in the internal recycle stream. Finally, online probes will be installed in Phase 2A to monitor influent and effluent ammonia to provide a more effective and robust means of control.

ALKALINITY ADDITION

It is conceivable that the sodium in the sodium hydroxide currently used at the Camas WWTF to supplement influent alkalinity is adversely affecting settling. Research has shown that the ratio of monovalent to divalent cations is an indicator for potential settling and dewatering problems at wastewater treatment plants. High ratios (greater than approximately 2:1) of monovalent (predominantly sodium and potassium) to divalent cations (calcium and magnesium) have been associated with poor settling and dewatering properties, and a high sodium concentration has been found to be a potential problem. If high sodium concentration negatively impacts settling, the effect can be reversed by the addition of divalent cations (calcium and magnesium) or reduction in the monovalent cations (Higgins, et al, 1999). However, it is not expected that the use of sodium hydroxide has any impact, since: (1) SVIs were low (settling was good) in previous years when the City was using sodium hydroxide, and (2) Wafertech discharges a high concentration of calcium that should counteract the impact of sodium.

Switching to calcium-based or magnesium-based alkalinity sources certainly is not a panacea to avoid impacts to WWTPs, since these other cations can cause problems when present at high concentrations. Calcium phosphate precipitation can take place when the concentrations of both species are high enough to exceed the solution product at any given pH (even at relatively low levels such as a 100 mg/L of calcium and 50 mg/L of orthophosphorus phosphate). At facilities with hard water or those that add lime to increase the alkalinity of the water, lime can result in a significant increase of overall energy costs in the digester. This increase derives from increased required digester retention time (heating, mixing) and required digester volume (retention time, primary solids removal). Furthermore, the reduced volatile solids destruction causes higher sludge hauling costs and reduced gas production. Magnesium has been shown to precipitate as well.

It is not recommended that the rate of chemical addition be flow paced to the WWTF influent flow, since the demand for supplemental alkalinity is highly dependent on other factors such as influent alkalinity, nitrification and denitrification rates, acid-base reactions, and influent BOD, which affect alkalinity requirements enough to prevent good control of pH by flow-paced chemical injection.

The sizing of the existing alkalinity storage system was based on 2-week nitrification requirements for a projected maximum month 2017 TKN loading of 2,227 lb/d (an alkalinity addition requirement of 51.4 kilo-equivalents), which is less than the projected 2025 loading of 2,573 lb/d. However, the WWTF could receive its alkalinity source once per week and have more than enough capacity for the 20-year planning period. It is projected that the WWTF will need to need to replace the storage tanks once in the 20-year planning period (projected for 2015).

SECONDARY CLARIFIERS

The WWTF has two secondary clarifiers in current operation. Under current normal conditions, only Clarifier No. 2 is operated. Both clarifiers are operated during high seasonal flow conditions. Clarifier No. 2 has a greater capacity than the Clarifier No. 1, and the recommended flow split is approximately 60:40 when both clarifiers are in operation.

The factors that influence the performance of secondary clarifiers include the clarifier overflow rate, solids loading rate and sludge settleability/removal. Because there is no certainty that selector and other modifications will reduce SVI to below 150 ml/g, the Camas WWTF clarifiers should be not designed and operated at the upper range of design overflow and solids loading rates.

Clarifier Overflow Rate

As shown in Table 8-2 at design flow, the 2008 Ecology Design Criteria lists 700 gallons per day per square foot (gpd/ft^2) as a recommended limit for secondary clarifiers settling oxidation ditch mixed liquor. WEF Manual of Practice #8 and Metcalf and Eddy list <u>maximum month</u> design ranges of 300 to 1,000 gpd/ft^2 and 200 to 400 gpd/ft^2, respectively. At projected year 2015 and 2025 flows, the clarifier overflow rate approaches or exceeds some of these criteria.

WEF Manual of Practice #8 and Metcalf and Eddy also list peak flow design ranges of 1,000 to 1,600 gpd/ft^2 and 600 to 800 gpd/ft^2, respectively. At projected year 2025 flows, the peak clarifier overflow rate approaches or exceeds some of the WEF criteria. (The 2008 Ecology design criteria do not address this parameter.)

Solids Loading Rate

As shown in Table 8-3, the maximum *design* solids loading rate recommended by Metcalf and Eddy and WEF are 24 and 30 lb/ft^2-d, respectively. At the design maximum month flow and loadings the respective solids loading rates are 16.4 (for Clarifier No. 1) and 21.9 lb/ft^2-d (for Clarifier No. 2) for year 2015, and 20.7 (for Clarifier No. 1) and 27.6 lb/ft^2-d (for Clarifier No. 2) year 2025.

The *peak* solids loading rate recommended by Metcalf and Eddy and WEF are 34 and 50 lb/ft^2-d, respectively. At projected year 2015 and year 2025 peak day flows and loadings, the respective peak solids loading rates are 29.8 (for Clarifier No. 1) and 39.8 lb/ft^2-d (for Clarifier No. 2) for year 2015, and 34.1 (for Clarifier No. 1) and 45.5 lb/ft^2-d (for Clarifier No. 2) for year 2025.

It is possible that modifications to the selector as described above, combined with occasional RAS chlorination or other measures, would result in successful operation of the existing clarifiers without additional clarifiers throughout much of the 20-year planning period. However, since several of the clarifier criteria are exceeded at 2025 flows and loadings as shown in Table 8-2, it is recommended that the City plan to construct an additional clarifier and associated piping and pumps.

FILTRATION FACILITIES

The WWTF effluent filtration system was installed as part of the Phase 1 upgrade in 2000. The filtration system, manufactured by Aqua Aerobics, consists of two parallel fabric media filters, located in the UV Disinfection Building. Each filter consists of a steel tank, 12 fabric media-covered disks, backwash system, sludge removal system, high-pressure spray wash system, and disk drive assembly. The capacity of each filter is 3.0 mgd (maximum month). The City of Camas NPDES permit requires total suspended solids (TSS) removal as follows:

- Monthly average effluent TSS concentration shall not exceed 20 mg/L.
- Monthly average effluent TSS discharge shall not exceed 1,017 lb/d.
- Monthly average TSS removal shall be 70 percent or greater.

The filtration system was installed to ensure the City can meet the TSS removal requirements in its NPDES permit year round. However, the filtration system has had operational problems the last few years and the filters have been out of operation for much of that period. The City has experienced occasional violations of the TSS removal requirements in their NPDES permit. WWTF staff has reported a number of problems with operating the Aqua Aerobic filters. The most prominent issue is the buildup of biological growth on the interior of the filter fabric, which occurs because the backwash system consists only of intermittent flow reversal through the fabric and does not include spray washing. Other reported issues include inoperative valves, deterioration of the backwash pumps, and an inability to replace outdated parts.

Ecology has recently advised the City that they must either rehabilitate or replace the existing effluent filters to prevent future TSS removal violations. Ecology has previously noted that the City enjoys a relaxed requirement for TSS removal rates (70% minimum) due to the City's unique circumstances that include significant contributions from septic tank effluent pumping/gravity (STEP/STEG) systems, and dilute industrial flows that combine with inflow/infiltration during wet weather to create an influent that is far more dilute than what is typical for municipal wastewater treatment plants. In the past, Ecology has indicated that if the City operates the effluent filters to achieve adequate TSS removal, they will be able to maintain the 70 percent removal limit in the NPDES permit in lieu of the standard technology-based limit of 85 percent (minimum) removal that is required for most municipal treatment plants.

Figure 8-8 shows a schematic of the Aqua Aerobic Aqua Disk filtration system. Figure 8-9 shows a plan view and Figure 8-10 shows a section view of the existing filter installation at the City of Camas WWTF. The filtration system is designed for a maximum head loss of 1.06 feet at 6 mgd (3 mgd per filter train). When head loss exceeds 1.06 feet, the secondary effluent flows over a weir and bypasses the filters through channels around each filter basin. Thus with both filter trains in operation, flows in excess of 6 mgd go directly to the UV disinfection system. To provide better flow control through the UV system, the overflow weirs that allow flow to bypass the filters are being removed and replaced with serpentine weirs, one in each bypass channel, as part of the Phase 2 upgrade now underway. The two existing concrete basins that house the filters are 16 feet long by 8.5 feet wide by 12.25 feet deep. The basins are entirely below the building floor level. An open-channel horizontal lamp UV system is downstream; secondary clarifiers are upstream.

Because of the problems with the existing filtration system, potential alternatives were evaluated to either rehabilitate or replace the existing system. A memorandum detailing this evaluation is included in Appendix S. Appendix T provides a summary of information regarding filter operation and maintenance obtained from other treatment facilities using the filters under consideration.

Evaluation of Alternatives

Five different equipment representatives that represent six different filter manufacturers were contacted for this evaluation. However, as detailed in Appendix A, the alternatives ultimately evaluated in more detail include:

1. Rehabilitating the existing Aqua Aerobic filter,
2. Replacing the existing filter with a Kruger Hydrotech filter, and
3. Replacing the existing filter with a Nova Ultrascreen filter.

<u>Alternative No. 1 – Rehabilitate Existing Aqua Aerobic Fabric Disk Filter</u>

There are actually two options for rehabilitation of the existing Aqua Aerobic filtration system (A) a phased approach or (B) complete and immediate rehabilitation. The phased approach would involve getting one filter train back in service by replacing only those parts needed to operate one filter train and rehabilitating the second filter train at some later date. Since the PLC on Filter No. 2 is not operable and would be more expensive to put back in service, for this alternative Filter No. 1 would be rehabilitated. The WWTF staff states that the backwash pumps are in need of replacement and thus would be a necessary component of any rehabilitation of the existing filtration system.

The minimum level of work needed to get one filter train back in service would involve the following:

- Replace the seals and gaskets on the center tube.
- Replace all fabric media and frames.
- Replace springs on the suction backwash assemblies.
- Replace the two backwash pumps.
- Replace the air solenoid bubbler panel.

This alternative would include replacing the two existing air weirs on the filter inlet with electric-actuated slide gates to allow each filter to be isolated individually. The estimated cost for the single filter rehabilitation alternative is $155,000, including sales tax, contingency, design engineering, and construction administration. A cost breakdown is included in Table S-1A of Appendix S.

The estimated cost for the full rehabilitation alternative is $481,000, including sales tax, contingency, design engineering, construction administration, and HMI programming. A cost breakdown is included in Table S-1B of Appendix S.

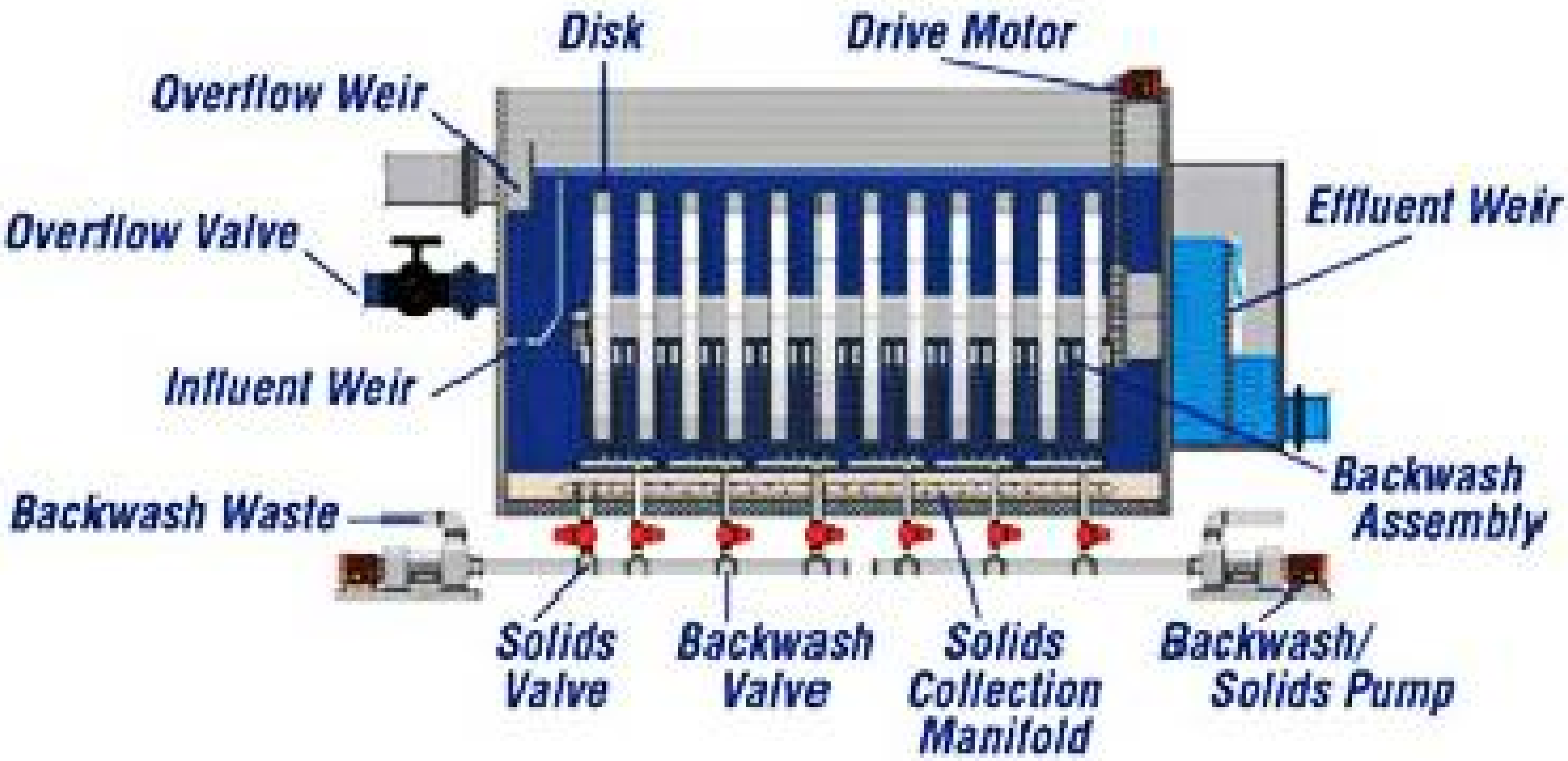
The proposed cloth for both the limited and the full rehabilitation of the Aqua Aerobic filter is intended to be less prone to biological fouling and require less cleaning, but maintenance will still need to include periodic use of chlorine to keep the filter fabric clean. Based on discussions with a number of existing wastewater treatment plants using this system, for most, regular cleaning using a bleach solution was a normal part of the filter operation and maintenance at one plant, although some plants were able to use cleaning methods that did not require chlorine.

<u>Alternative No. 2 – Replace Existing Filter with Kruger Hydrotech Disk Filter</u>

With this alternative, the existing filters would be removed and replaced with two new cloth media (woven polyester screen) disk filters (10 microns). A schematic of the Kruger Hydrotech filter is shown on Figure 8-11. Preliminary installation drawings are shown on Figures 8-12 and 8-13.

A summary of the design criteria for the Kruger filter is listed below:

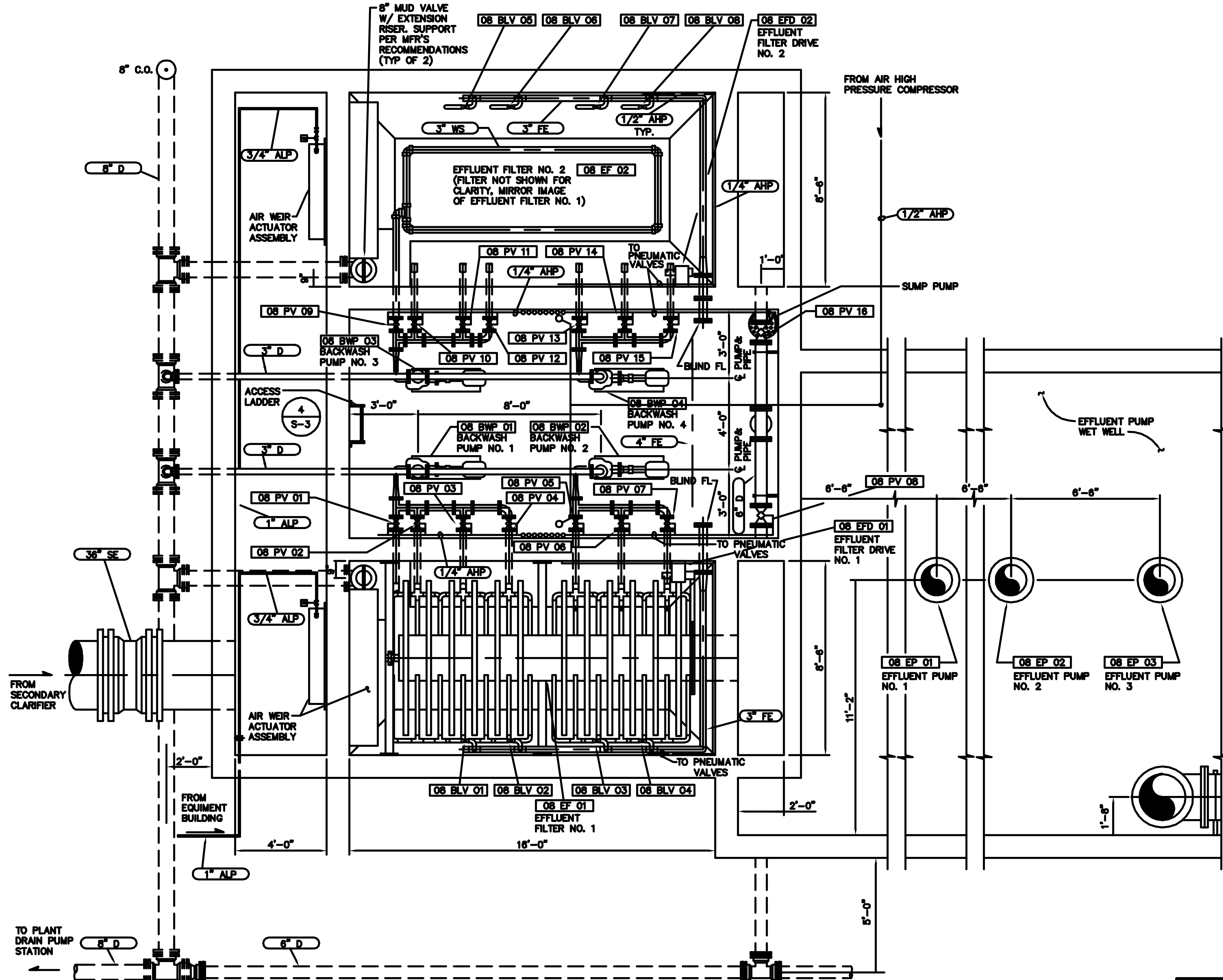
Number of Units:	2
Number of Disks per Unit:	12
Filter Area per Unit:	723 ft^2
Submerged Filter Area per Unit:	470 ft^2
Peak Hydraulic Loading:	4.43 gpm/ft^2



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8–8
EXISTING AQUA AEROBIC FILTER SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\11505 WWTF Design Phase 2B\Facility Plan Revision\Figures\Figure 8-9.dwg, 8-9, 8/18/2011 1:40:47 PM, 1:1, BY: MNAGEL

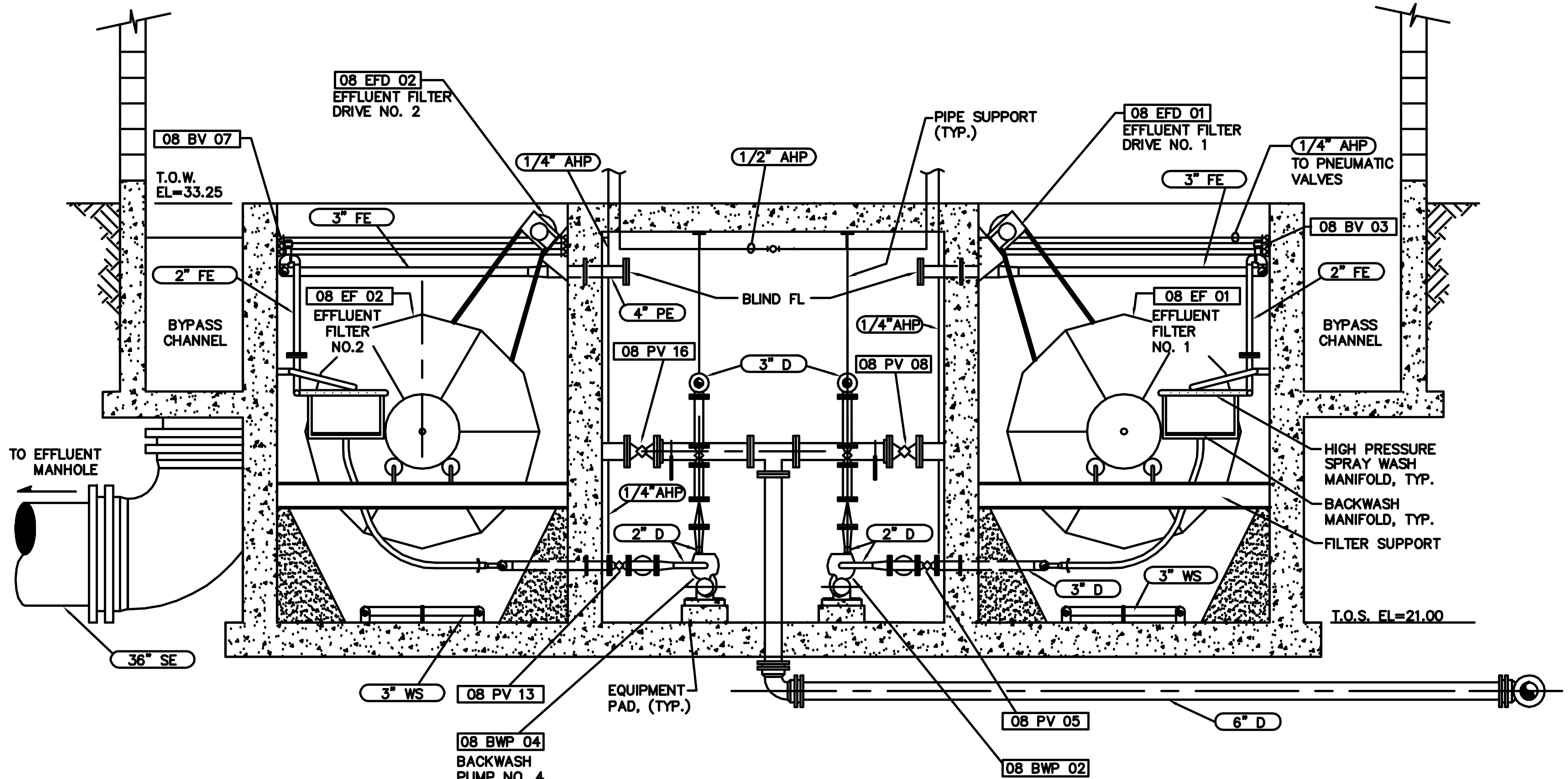


U.V. DISINFECTION/EFFLUENT PUMP STATION - LOWER PLAN

SCALE: 3/8"=1'-0"

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-9
EXISTING AQUA AEROBIC FILTER PLAN

Gray & Osborne, Inc.
CONSULTING ENGINEERS

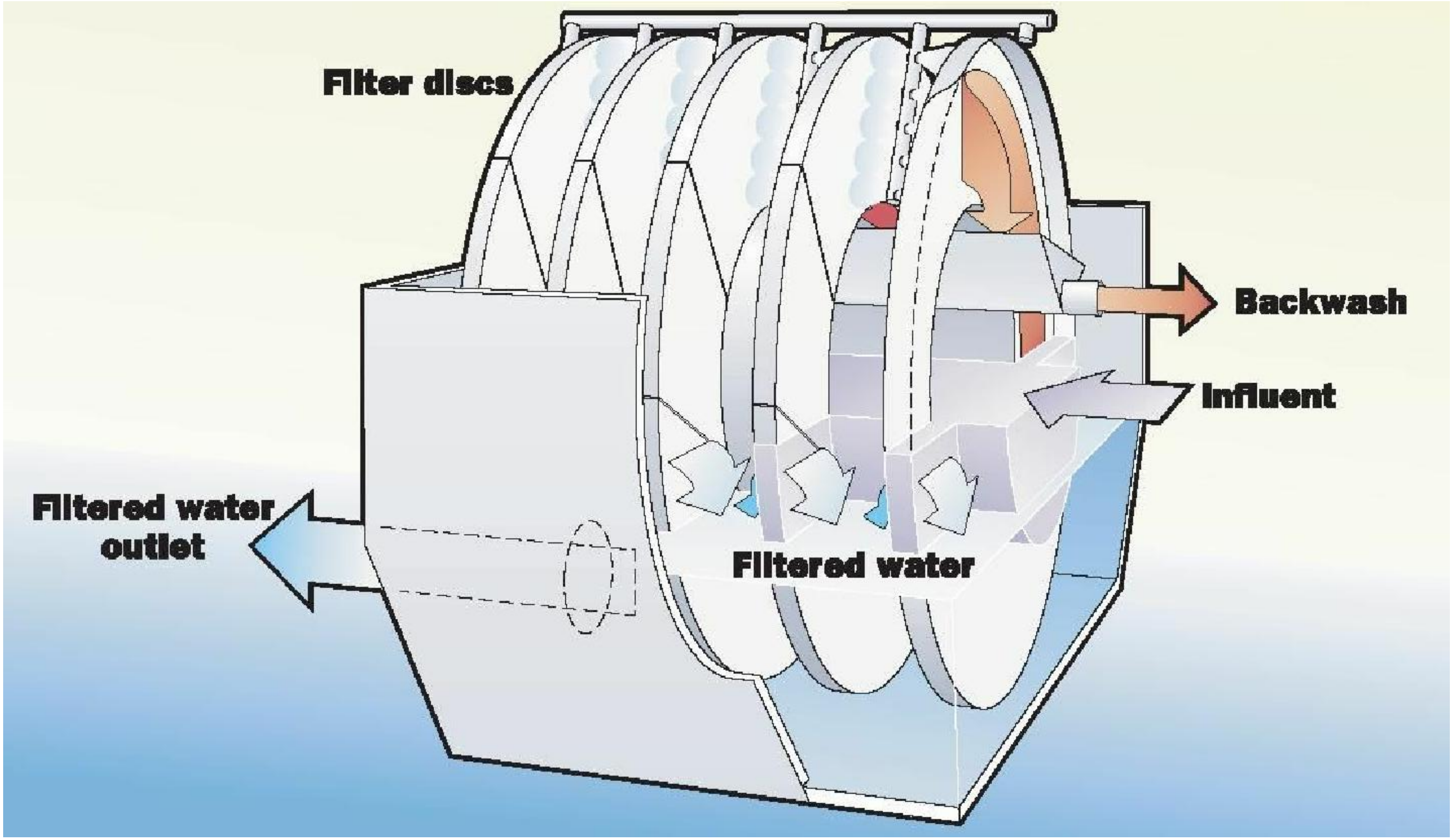


SECTION A —
SCALE: 1/4"=1'-0"

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-10
EXISTING AQUA AEROBIC FILTER SECTION

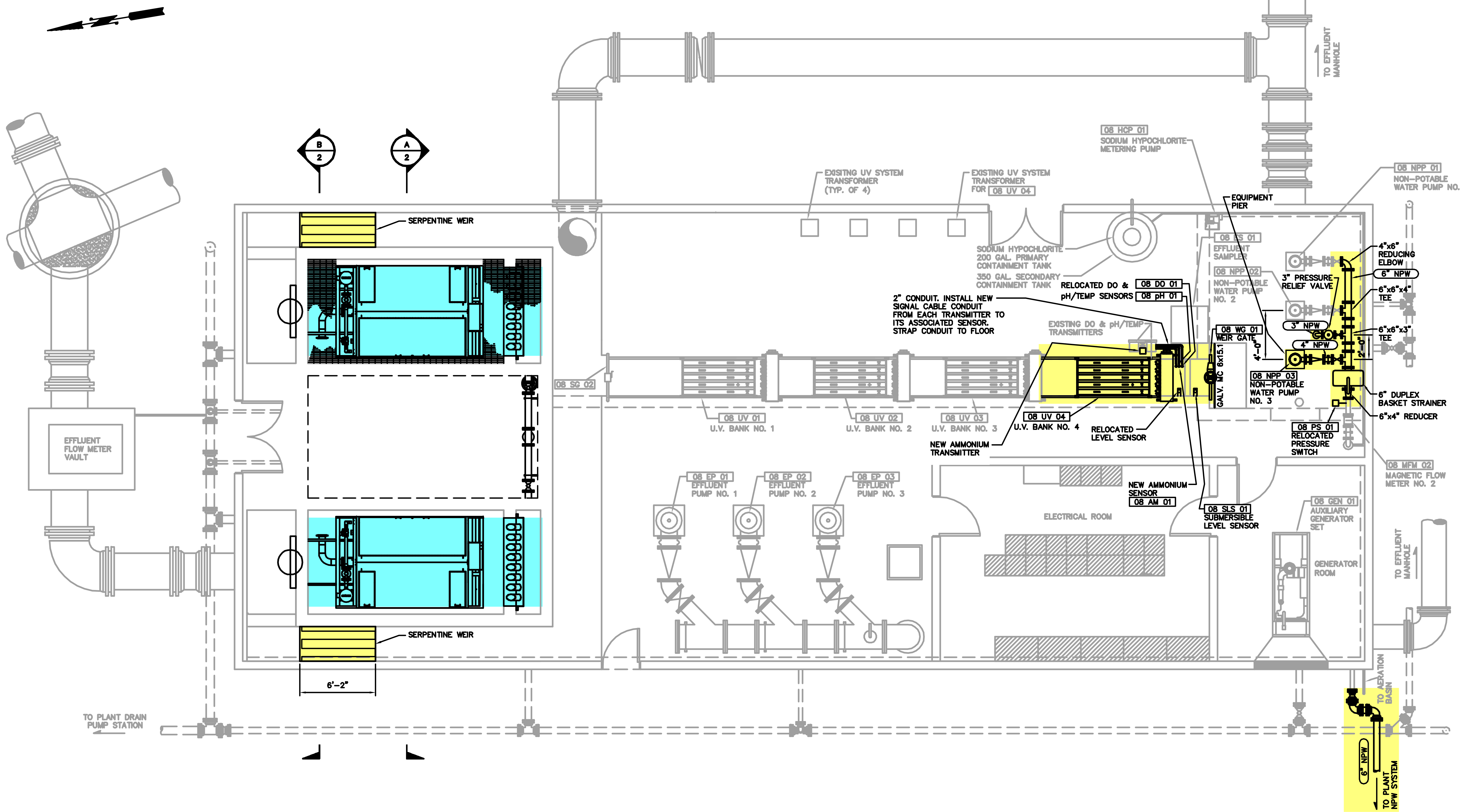
Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\11505 WWTF DESIGN PHASE 2B\FACILITY PLAN REVISION\FIGURES\FIGURE 8-10.DWG, 8-10, 8/18/2011 1:48:18 PM, 1:1, BY: MNAGEL



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-11
KRUGER HYDROTECH FILTER SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS



U.V. DISINFECTION/EFFLUENT PUMP STATION - UPPER MODIFICATIONS PLAN

SCALE: 1/8"=1'-0"

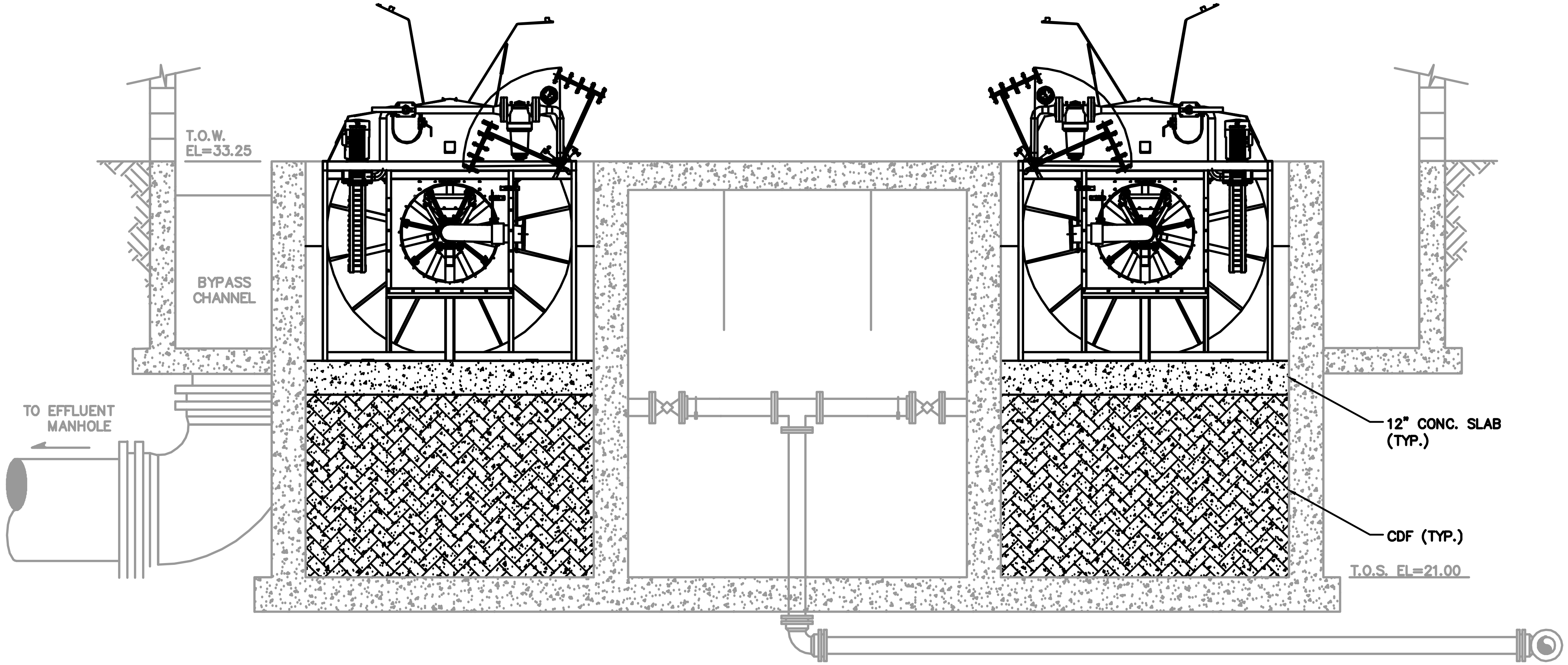
(SOURCE: SHEET M8-1, CITY OF CAMAS WWTF IMPROVEMENTS, PHASE 2)

PHASE 2A UPGRADES

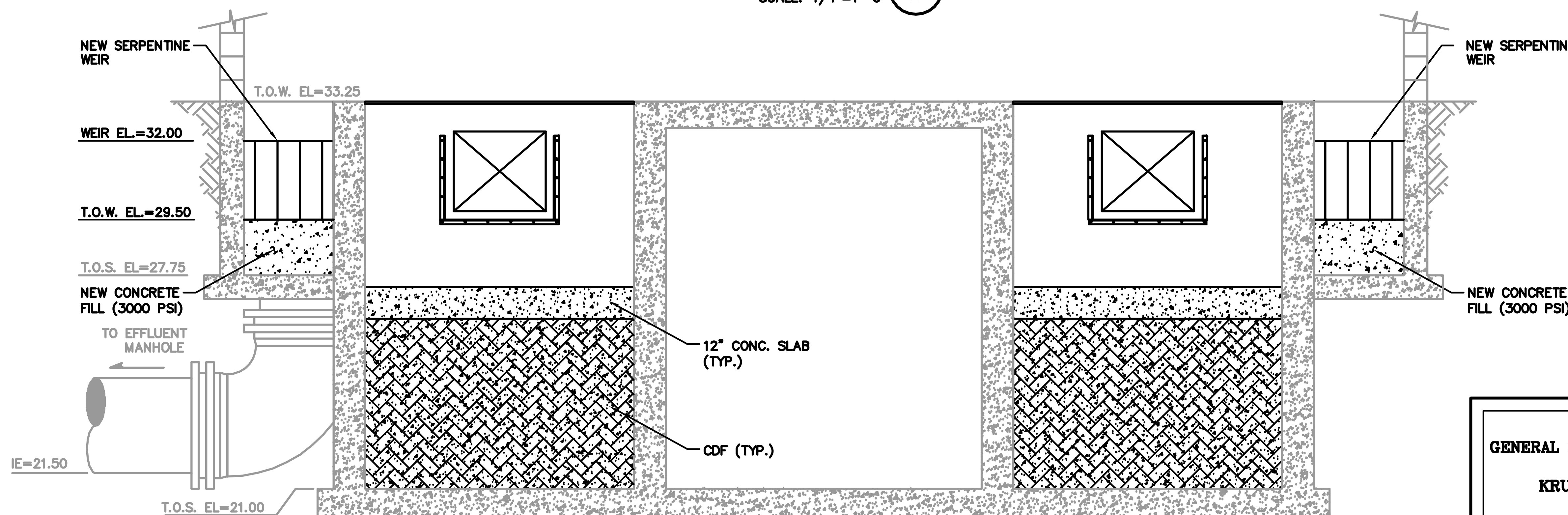
FILTER INSTALLATION (PHASE 2B)

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-12
KRUGER FILTER PLAN VIEW

Gray & Osborne, Inc.
CONSULTING ENGINEERS



SECTION A
SCALE: 1/4"=1'-0"



SECTION B
SCALE: 1/4"=1'-0"

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-13
KRUGER FILTER SECTION VIEWS

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\11505 WWTF Design Phase 2B\Facility Plan Revision\Figures\Figure 8-13.dwg, 8-13, 8/18/2011 1:41:40 PM, 1:1, BY: MNAGEL

Kruger indicates their filter can operate within the 1.06 feet of available head across the filter system and achieve treatment of at least 3 mgd per filter train. Any flow through the filter that exceeds available head will be bypassed through the existing bypass channels.

The estimated cost for this alternative is $936,000, including sales tax, contingency, design engineering, construction administration, and HMI programming. Appendix S, Table S-2, provides a breakdown of the estimated project cost. It will be necessary to modify the existing UV/Effluent Pump Station Building to install the filter because the existing doorway is not large enough to get the skid-mounted filter inside. The empty weight of the Kruger filter is 5,610 pounds per filter (12-disk model). A new double door with a minimum clear space of 8'-4" high by 8'-4" wide would be installed to replace the existing 7-foot-high by 6-foot-wide double door. Additionally, it will be necessary to fill both of the existing filter basins with concrete to raise the level of basins to provide the proper hydraulic profile for the filtration system. Building modifications are included in the cost estimate.

Alternative No. 3 – Replace Existing Filter with Nova Ultrascreen Disk Filter

With this alternative, the existing filters would be removed and replaced with two new disk filters that use an AISI 316 stainless steel mesh media (15 to 25 microns). Schematics showing the filter operation are found on Figure 8-14. Preliminary installation drawings are attached as Figures 8-15 and 8-16.

A summary of the design criteria for this filter is listed below:

Number of Units:	2
Number of Disks per Unit:	12
Filter Area per Unit:	264 ft^2
Peak Hydraulic Loading:	16 gpm/ft^2

Nova indicates their filter can operate within the 1.06 feet of available head across the filter system and treat at least 3 mgd per filter train. Any flow through the filter that exceeds available head will be bypassed through the existing bypass channels.

The estimated cost for this alternative is $1,107,000, including sales tax, contingency, design engineering, construction administration, and HMI programming. Appendix S, Table S-3, provides a breakdown of the estimated project cost. It will be necessary to modify the existing UV/Effluent Pump Station Building to install the filter because the existing doorway is not large enough to get the skid-mounted filter inside. The empty weight of the Nova filter is 8,500 pounds. A new double door with a minimum clear space of 8'-4" high by 8'-4" wide would be installed to replace the existing 7-foot-high by 6-foot-wide double door. Additionally, it will be necessary to fill both of the existing filter basins with concrete to raise the level of basins to provide the proper hydraulic profile for the filtration system. Building modifications are included in the cost estimate.

<u>Summary</u>

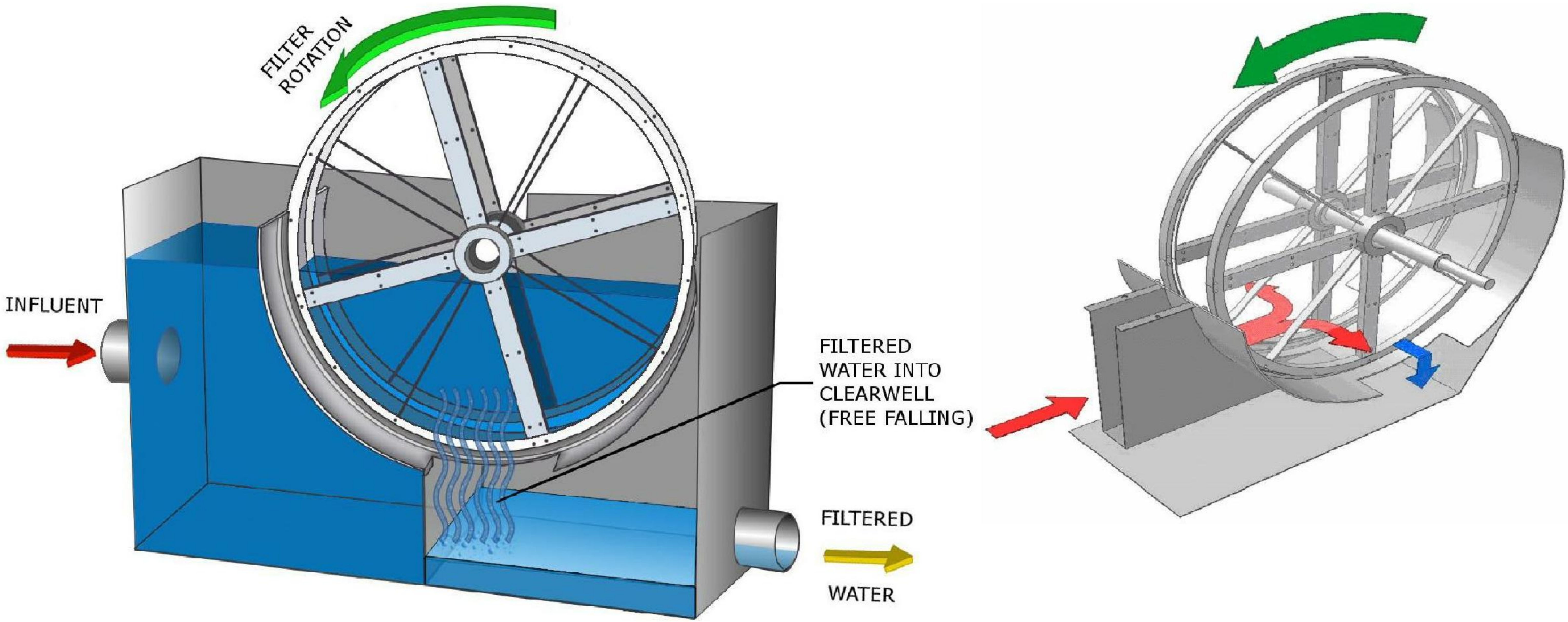
The three alternatives and their estimated project costs are listed below.

- Alternative No. 1A – Rehabilitate one Aqua Aerobic Filter: $155,000 (includes limited work on Filter No. 1 only, which still has an operating PLC).
- Alternative No. 1B – Completely rehabilitate both Aqua Aerobic Filters: $481,000
- Alternative No. 2 – Replace existing filter with Kruger Hydrotech Filter: $936,000
- Alternative No. 3 – Replace existing filter with Nova Ultrascreen Filter: $1,107,000

Rehabilitating a single Aqua Aerobic filter train is the least expensive capital cost alternative. However, implementing this option may result in higher operation and maintenance costs. Given the availability of funding and requirements for competitive bidding, it is recommended that an evaluated bid format is used (assuming approval of this format by the funding agencies). The three alternatives can be competitively bid; however, since Nova's system has an integral steel tank and the Kruger system does not, Nova has indicated that they will not bid unless there is an "evaluated bid" wherein additional factors beyond just capital cost are weighed.

ULTRAVIOLET DISINFECTION SYSTEM

Filtered effluent from the disk filters flows by gravity through the UV channel where disinfection occurs. Three banks of Trojan 3000 (low-pressure low-intensity) UV lamps operate in series within the disinfection channel. The system is rated for disinfection at a peak instantaneous flow of 6.1 mgd, each bank with a capacity up to 3.05 mgd. The third bank provides redundancy; it will be called in case of a major alarm on either in-use bank and provides treatment for the peak day flow (7.8 mgd). With the third bank on, the system capacity is 9.15 mgd. For the purposes of developing the CIP at the end of this chapter, it is assumed that one additional UV bank with low-pressure low-intensity lamps will be added providing a peak day capacity of 12.2 mgd and a maximum month capacity of 9.15 mgd.



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-14
NOVA ULTRASCREEN FILTER SCHEMATIC

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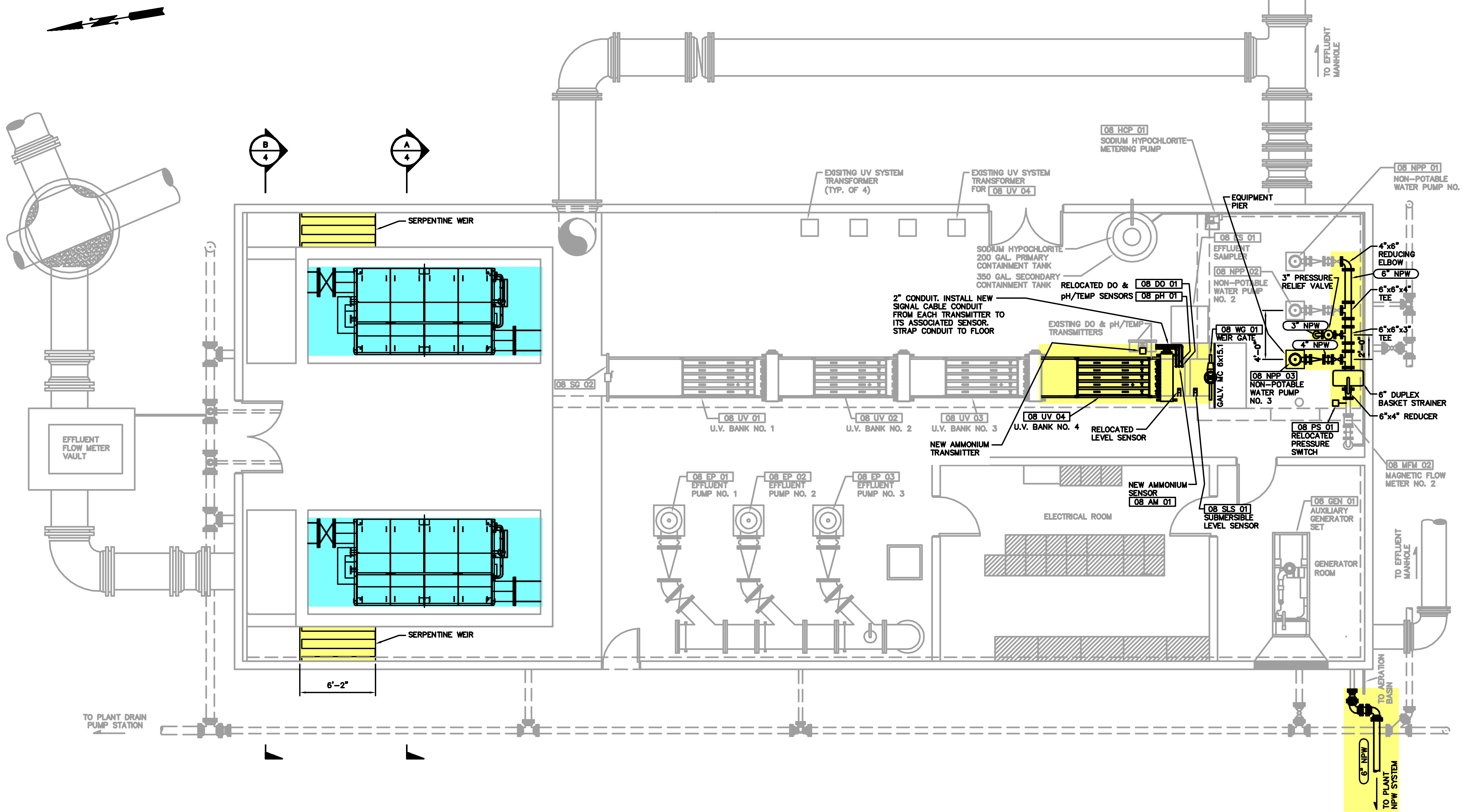

U.V. DISINFECTION/EFFLUENT PUMP STATION - UPPER MODIFICATIONS PLAN

SCALE: 1/8"=1'-0"

(SOURCE: SHEET M8-1, CITY OF CAMAS WWTF IMPROVEMENTS, PHASE 2)

PHASE 2A UPGRADES

FILTER INSTALLATION (PHASE 2B)

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-15
NOVA FILTER PLAN VIEW

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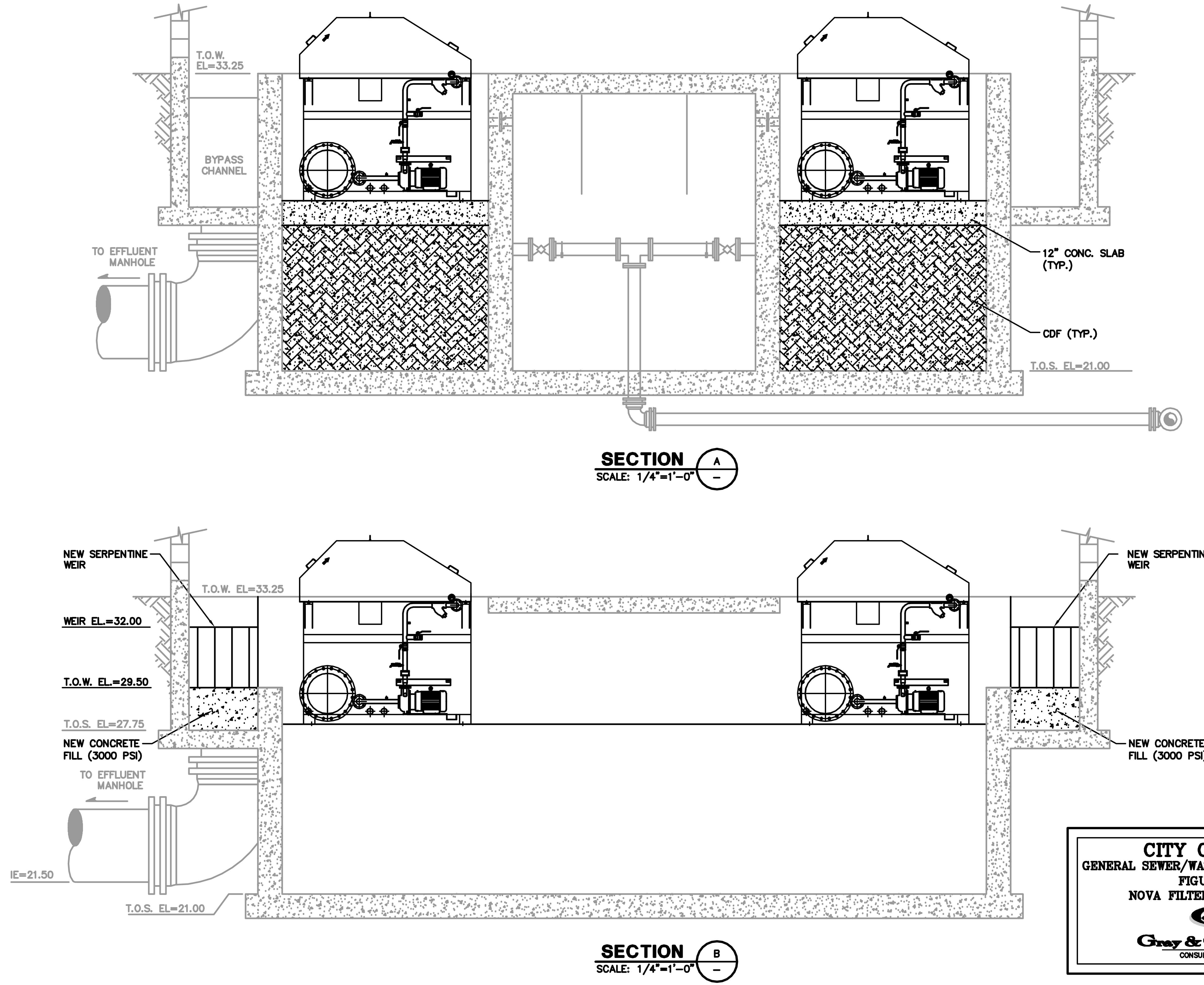
L:\CAMAS\11505 WWTF DESIGN PHASE 2B\FACILITY PLAN REVISION\FIGURES\FIGURE 8-15.DWG, 8-15, 8/18/2011 1:44:48 PM, 1:1, BY: MNAGEL



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8-16
NOVA FILTER SECTION VIEWS

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L:\CAMAS\11505 WWTF Design Phase 2B\Facility Plan Revision\Figures\Figure 8-16.dwg, 8-16, 8/18/2011 1:41:17 PM, 1:1, BY: MNAGEL

Impacts of Industrial Dischargers

There has been speculation by Ecology that the performance of the City's UV system has been impacted by industrial discharges. Reductions in ultraviolet transmittance (UVT) below design values could conceivably occur due to process upsets that increase solids loading to the UV system that blocks transmission of UV light. Also, a number of substances, including iron and synthetic organic compounds discharged by a number of industries, can pass through the WWTF and lower effluent UVT significantly (Swift, et al., 2001, 2003). Industries that have been found in recent years to cause this problem include:

- Printed Circuit Board Manufacturers
- Central Waste Treatment Facilities
- Organic Chemical Manufacturers
- Instant Coffee Producers

The following recommendations are made for routine monitoring of industrial impacts to UV disinfection:

1. When there is a significant deterioration in disinfection performance, the City should monitor UVT once a week on an effluent 24-hour composite sample with the City's laboratory bench-top transmittance meter.

2. If UVT is less than 60 percent (more than 10 percentage units below the design of 70 percent), the City should measure the transmittance of the effluent after laboratory filtration through a 0.45-micron filter. If UVT is still low, the presence of dissolved UV-absorbing constituents is indicated.

3. The City should save a liter of any low dissolved transmittance sample, preferably in glass bottles rated for semivolatile organic compound preservation. (However, based on previous studies Gray & Osborne has conducted, the most likely UV-absorbing constituents that could be discharged from computer component manufacturing cannot be determined with conventional methods used for volatile and semivolatile analysis, and require high-performance liquid chromatography and substantial method development.)

4. If low dissolved transmittance samples are identified, the City should contact its largest industries and jointly test the dissolved transmittance of their wastewater and quantify the "absorbance loading" of the major waste streams. If low effluent transmittance is a recurring problem, the installation of an online transmittance meter and an accompanying alarm is recommended. If indications are that the low effluent transmittance is due to an industrial discharge, the City may wish to develop local limits for transmittance.

EFFLUENT PUMPS

The effluent pumps are vertical propeller, wet pit, mixed flow pumps rated at 4,300 gpm at 18 feet of TDH. Transitions between gravity and pumped effluent flow are performed automatically when the pumps are placed in "auto" mode. Whenever the level of the Columbia River rises, gravity effluent discharge will be stopped by the closing of the flap gate in the Effluent Manhole.

The operation of two of the three effluent pumps can pump the design peak hour flow of 13.4 mgd at 100-year flood elevation at a water surface elevation of 29.0 feet in the effluent pump station (this is a pump station depth = 8 feet, which is 1 foot above the ultrasonic level sensor high level alarm and 1 foot below the float switch Pump 1 call).

OUTFALL

The existing 36-inch corrugated metal pipe (CMP) Camas WWTP outfall extends approximately 850 feet south into the Columbia River channel. The diffuser portion of the outfall is located along the outer 150 feet of the pipe. The outfall included 16 vertical risers, each with 90-degree bends pointed downstream. Prior to 2010, the eight diffusers closest to shore were capped off and were not in operation. The eight risers in use discharged effluent parallel to the flow of the Columbia River.

Because the Camas outfall discharged in the same direction as the river flows and at similar velocities, there was low turbulence and poor dilution in the mixing zone. A change from a horizontal discharge to a vertical discharge increased dilution about four-fold based on the UM3 model Ecology has used to model dilution in the Camas mixing zone. In 2010, the eight unused diffuser risers were uncapped and put into use. All sixteen risers were reoriented vertically and Tideflex Valves were installed on the ends of the risers to minimize entrainment of debris in the diffuser pipe.

SEPTAGE HANDLING

The City currently receives sanitary septage from two sources: Wafertech septic tanks and City STEP tanks. The 4,000 gallons of septage from Wafertech is currently brought by a contracted hauler to the City WWTF every other week. For the purposes of estimating future quantities of septage, Wafertech septage is projected to grow at the same rate as its wastewater flow, to 4,000 gallons delivered 1 day *every week*.

The septage from City STEP tanks is currently hauled by a contractor and deposited in manholes in the City's collection system at various points (mostly in Gravity Basins 5 and 6). City septage is currently hauled typically for 5 consecutive days every other week during dry months (April through October) and less frequently during wet months. During hauling periods, five to seven STEP tanks with 1,500 to 3,000 gallons of septage each per day are hauled and deposited in the collection system (approximately 7,500 to 20,000 gallons total per day during hauling periods).

Originally, all the STEP tanks for individual residences were 1,500 gallons; however, new STEP tanks for individual residences are typically 3,000 gallons and new clusters of homes are often served by larger tanks. Within a year, the number of STEP tanks pumped per year will be increased from 600 to 800. The number is expected to increase in the future as additional sewer customers (ERUs) are added to the City. For the purposes of estimating future quantities of septage, the number of tanks is expected to grow at the same rate as ERUs (i.e., by a total of 81 percent) to 1,450 by year 2025. It was also assumed that the average tank size in 2025 is 2,250 gallons (i.e., equal numbers of 1,500-gallon and 3,000-gallon tanks, and 2,250 gallons of tankage *per residence* in a cluster). Thus, projected annual City STEP septage production for 2025 is 3.26 million gallons, or 8,900 gallons per day on average. However, it is assumed that up to 30,000 gallons of City septage (up to 34,000 including Wafertech septage) will still be sent to the City WWTF as a maximum day septage volume.

Because incoming septage is accounted for by influent flow and composite concentrations and loading data, the growth of septage loading is included in year 2025 projections in Table 6-12. However, because it is not introduced continuously into the WWTF, the impact of loading of key constituents must be examined. There is little data regarding the strength of STEP septage from Camas customers; however, the strength can be estimated based on conservative septage design criteria published by EPA and WEF. Table 8-6 presents the combined projected loading from City and Wafertech septage for year 2025. As shown in Table 8-6, septage is typically much higher strength than normal domestic wastewater. Using the conservative EPA design values in Table 8-6, the projected maximum day year 2025 septage BOD_5, TSS, and TKN loading accounts for 48 percent, 72 percent, and 10 percent, respectively, of the total year 2025 maximum month loading shown in Table 6-12. Given the potential short-term impact of septage and high variability in concentration ranges reported by EPA and summarized in Table 8-6, it is recommended that the City analyze several batches of septage to determine actual concentrations.

There are several concerns with the current septage management scheme:

- Deposition of debris in the collection system.

- Clogging of debris in the headworks.

- Variability and strength of loadings of TKN, TSS, and BOD to the WWTF. Fluctuating, high loads of TKN into the liquid treatment process can result in breakthrough of ammonia into the effluent.

- Potential for toxicity/inhibition.

TABLE 8-6

Typical Septage Characteristics(1)(2)

Parameter	Range (EPA) (mg/L)	Average (EPA) (mg/L)	Suggested Design Value (EPA) (mg/L)	Ratio of Septage Design Concentrations to Typical Municipal Wastewater	2025 Average Day Loading to Camas WWTF (lb/d)	2025 Maximum Day Loading to Camas WWTF (lb/d)
Total Solids	1,100–130,500	34,100	40,000	56	3,002	11,342
Total Volatile Solids	350–71,400	23,100	25,000	68	1,877	7,089
Total Suspended Solids	310–93,400	12,900	15,000	68	1,126	4,253
Volatile Suspended Solids	95–51,500	9,000	10,000	61	751	2,836
5-day Biochemical Oxygen Demand	440–78,600	6,500	7,000	32	525	1,985
Soluble BOD_5	—	800	800	6	60	227
Chemical Oxygen Demand	1,500–703,000	31,900	15,000	30	1,126	4,253
Total Kjeldahl Nitrogen	66–1,060	590	700	18	53	198
Ammonia-N	3–116	97	150	6	11	43
Total Phosphorus	20–760	210	250	31	19	71
Alkalinity	520–4,200	970	1,000	10	75	284
Oil and Grease	210–23,400	5,600	8,000	80	600	2,268
pH	1.5–12.6	—	6.0	—	—	—

(1) Based on *WEF Septage Handling Manual of Practice No. 24, 1997,* based on information reported by the EPA in 1984 and 1994.
(2) All units are in mg/L, except pH.

Due to the concerns regarding deposition in the collection system, the City desires to receive the majority of future septage at the WWTF. Because of the concerns regarding the impacts of septage on WWTF operation, the City desires the flexibility to store septage and meter it into the WWTF liquid stream or solids treatment stream (potentially blending the septage with waste activated sludge). This flexibility will be provided by adding an additional 30,000-gallon septage storage tank. The new additional holding tank will be equipped with a new positive displacement blower, coarse-bubble air diffusion system, submersible septage pumps, and discharge piping to allow septage from this tank to be pumped to the existing storage tanks, headworks, or solids handling system. Typically, septage should be metered to the headworks so that the solids in the septage can be removed in the primary clarifiers, pumped to the hydrocyclones for grit removal, and transferred to the gravity thickener for thickening, and finally pumped to the anaerobic digesters. The new tank also will allow storage and evaluation of potentially toxic or high-strength batches of septage prior to treatment, particularly if treating septage impacts WWTF operation in the future. Additionally, given the likelihood of variability in TKN, TSS, and BOD loadings due to septage treatment and industrial flows, it would be useful to more frequently quantify these parameters in *influent* with and without septage, and note whether septage is included in the influent stream.

It is recommended that under typical conditions, the majority of future septage will be treated with the liquid stream, where primary clarification and grit removal will aid in reducing impacts to the WWTF. After the septage loading of BOD and TKN is better understood, more specific plans to manage the septage introduction into the plant can be formulated. If the impacts to liquid stream performance are determined to be significant at current loadings, the City can partially direct septage loads directly to the anaerobic digester. If the City pumps the septage directly to the digesters, City staff will need to monitor septage loading and digester performance to verify that the inclusion of septage is not causing inhibition, shock loading, or other problems in the digestion process, since it is possible that the concentrations of ammonia and toxic pollutants in some batches of septage may exceed inhibitory or shock-loading thresholds for anaerobic digestion or reach.

Costs for septage handling modifications are included in Chapter 9 with the other solids handling improvements.

ELECTRICAL AND SCADA SYSTEMS

Based on a review of electric utility billings, the available electrical capacity at the plant is sufficient for the loads associated with the new equipment discussed in this chapter (and the anaerobic digester and sludge dryer discussed in Chapter 9) with plenty of margin for additional loads in the future. It is not anticipated that the sludge dryer will be served by the WWTF generator; therefore, no increase in generator capacity is required or anticipated for the 20-year planning period.

It is recommended that the City replace its existing computers, uninterruptible power supplies, SCADA software, and PLC firmware with current versions of these items. Additionally, it is recommended that the City add online ammonia for WWTF influent and effluent to complement the existing laboratory measurement of ammonia.

INDUSTRIAL PRETREATMENT/FOG CONTROL EVALUATION

As a POTW (publicly owned treatment works) without pretreatment program responsibilities delegated to it from the Department of Ecology, the Camas WWTF is not required to fulfill significant requirements regarding pretreatment program management, other than what is in its NPDES permit. However, as discussed below, considering the large number of industries, apparent history of discharge of inhibitory materials, large number of restaurants/fast-food establishments, automotive facilities, and potential problems from industrial and FOG disposal in the sewer, it is recommended that the City consider developing elements of a pretreatment program including:

- A program to control fats, oils, and grease;
- Development of local limits to control industrial discharges from significant industrial users; and
- The purchase of a software program to manage information from industrial dischargers and FOG and staffing to manage the pretreatment program.

FATS, OILS, AND GREASE

Fats, oil, and grease (FOG) can have negative impacts on wastewater collection and treatment systems. Two types of FOG pollutants are common to wastewater systems. Petroleum-based oil and grease ("non-polar" FOG) occur at businesses using oil and grease, such as automotive service facilities and car washes. Non-polar FOG typically has the potential to cause toxicity or inhibition to WWTF biological processes. Animal- and vegetable-based oil and grease ("polar" FOG) are discharged by restaurants, fast-food outlets, and other food processing facilities. Most wastewater collection system blockages can be traced to polar FOG. Blockages in the wastewater collection system can cause sewage spills, manhole overflows, or sewage backups in homes and businesses. Per discussion with WWTF staff, the City has had a couple of blockages in the downtown area, some of which resulted in overflows and flooding of a restaurant upstream of the One Stop Pump Station.

It is recommended that the City consider instituting a program to reduce the discharge of FOG into the sewer. One tool for such a program is to provide an incentive in commercial sewer rates for proper sizing and management of grease *interceptors.* Restaurants would obtain the incentive by proper sizing of grease interceptors and submission of a FOG Control Plan, but would lose the incentive if they failed to submit pumping receipts at required intervals or if inspections indicated that the grease interceptor was not being adequately maintained (more than 1/3 full of grease and/or sediment). The incentive, with limited exceptions, should not be provided for grease *traps,* which often fail to adequately remove FOG.

SIGNIFICANT INDUSTRIAL USERS

As required by its NPDES permit, the City completed an Industrial User Survey (IUS) in early 2005. The survey identified nine significant industrial users (SIUs) and five minor industrial users (MIUs). The SIUs identified included:

1. Bodycote, Inc.
2. Brown's Chevron
3. Columbia Litho, Inc.
4. Heraeus Shin-Etsu America
5. C-Tech
6. Linear Technology
7. Sharp Electronics Corporation
8. Shell Oil Products
9. Wafertech

The MIUs included:

1. Georgia Pacific
2. Furuno USA, Inc.
3. Lemon Aid Automotive
4. Post Record
5. Westlie Motors

Industrial wastewater (and wastewater from commercial enterprises that is industrial in nature) does not typically have the same concentrations of organics, solids, and nutrients found in residential wastewater. Industrial wastewater can also contain higher concentrations of trace pollutants which are toxic to the biological treatment process used in the WWTF. Any industry siting in the sewer service area that has a discharge potentially deleterious to the wastewater collection or treatment systems must be required to provide adequate on-site industrial pretreatment, consistent with the City's pretreatment program, to prevent such impacts.

Considering the relatively large proportion of industrial flow and relatively large number of industries in the City, it is recommended that the City consider developing local limits for the protection of its WWTF. Local limits are developed to implement site-specific prohibitions to protect against the discharge of pollutants at a quantity or rate that may cause pass-through or interference at (or otherwise detrimentally impact) a POTW.

PRETREATMENT PROGRAM

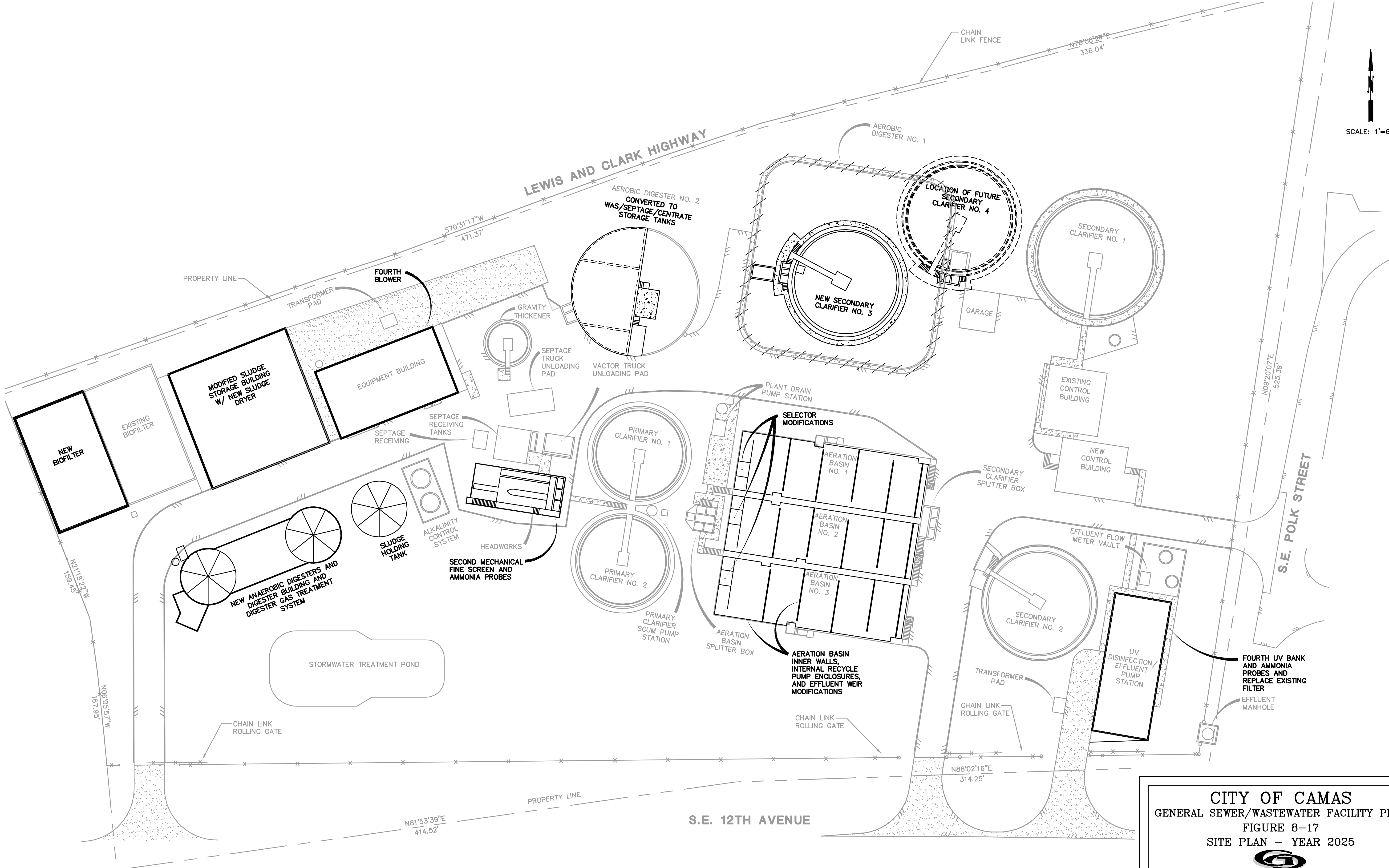
It is recommended that the City consider the purchase of a computer program to track its industrial users. There are several options for pretreatment management database programs. Vendors include LINKO, Operator 10, PACS, and PREWIN. All of these software programs offer similar functions to the user. In general, each program has the ability to:

- Store industrial user information;
- Store sample and result information;
- Make queries of stored information;
- Store certain industry specific information (flow rates, pretreatment processes, etc.);
- Import and export capabilities, also LIMS compatibility;
- Generate reports and letters of violation; and
- Log notes, phone calls, track maintenance records, etc.

Costs, depending on the vendor and the features in the system, range between $2,500 and $20,000, including tax.

RECOMMENDED WWTF PLAN

The recommended future (year 2025) site layout and process flow diagram for the WWTF showing recommended improvements from both Chapter 8 and Chapter 9 (biosolids treatment) are presented on Figures 8-17 and 8-18. Tables 8-7 and 8-8 provide costs for the capital improvement projects for Phases 2A (under construction from 2010 to 2012) and Phase 2B (construction expected to begin in 2012). Costs are estimated total project costs in 2007 dollars and include engineering, construction management, sales tax, and contingency. Costs for Phase 2B are estimated total project costs in 2010 dollars and include engineering, construction management, sales tax, and contingency.



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8–17
SITE PLAN – YEAR 2025

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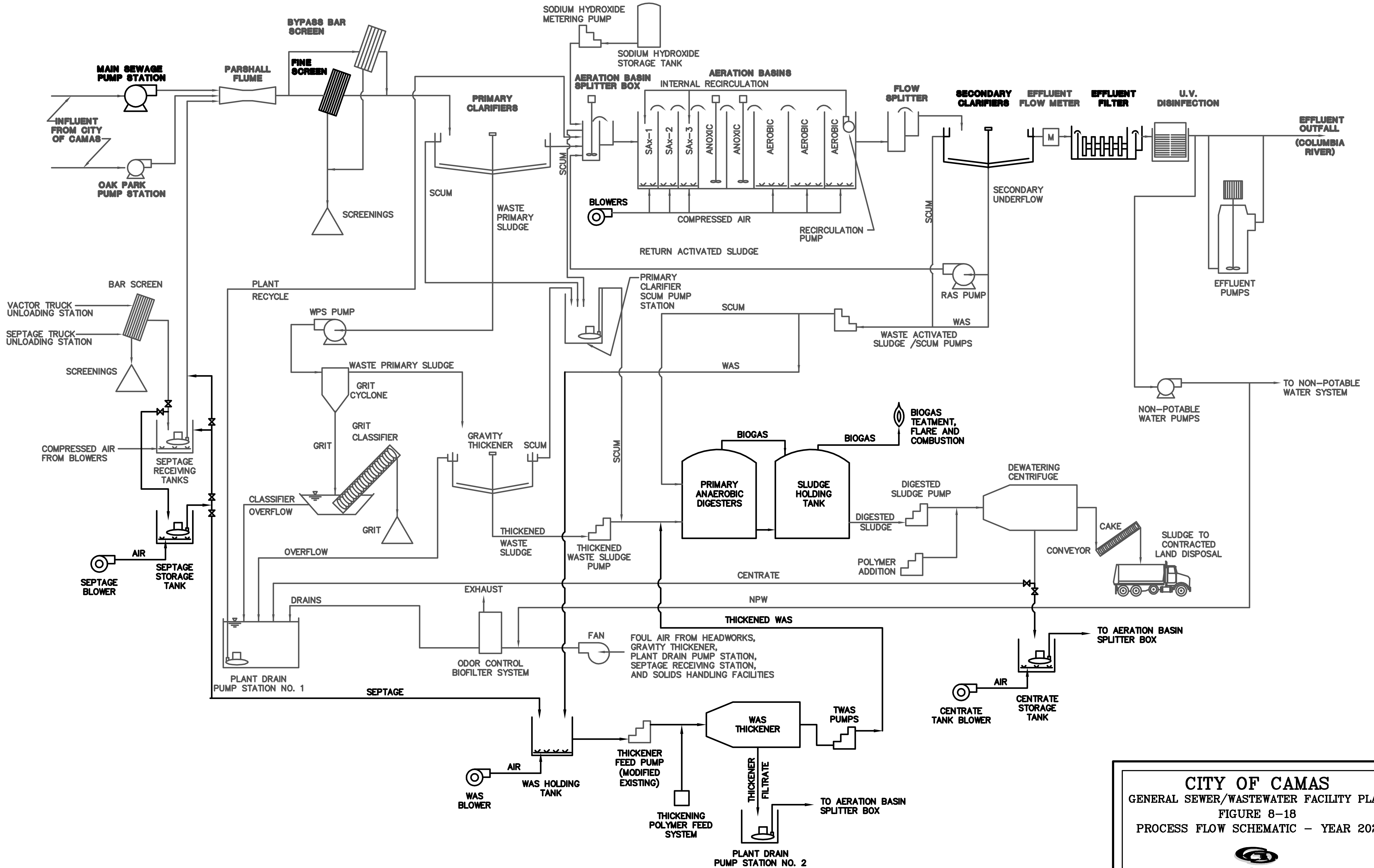

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 8–18
PROCESS FLOW SCHEMATIC – YEAR 2025

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TABLE 8-7

Cost Estimates for Phase 2A WWTF Upgrades to Accommodate 2025 Flows and Loadings (Solids and Septage Handling Improvements Not Included; See Chapter 9.)

No.	Item	Quantity	Unit Price	Amount
1	Mobilization/Demobilization	1 LS	$250,000	$ 250,000
2	Mechanical Fine Screen	1 LS	$125,000	$ 125,000
3	Blower (No. 4)	1 LS	$60,000	$ 60,000
5	Demolish Existing Aerobic Digester No. 1	1 LS	$40,000	$ 40,000
6	AB Modifications (Selectors and Divider Walls)	1 LS	$40,000	$ 40,000
7	Internal Recycle Pump Enclosure	1 LS	$15,000	$ 15,000
8	Additional Bank of Lamps for UV Disinfection	1 LS	$45,000	$ 45,000
9	Dissolved Oxygen and Ammonia Monitors	1 LS	$65,000	$ 65,000
10	Computer, PLC, and SCADA Upgrades	1 LS	$55,000	$ 55,000
11	Security Upgrades	1 LS	$10,000	$ 10,000
12	Loading Dock	1 LS	$35,000	$ 35,000
13	WWTF Outfall Modifications	1 LS	$40,000	$ 40,000
14	Pretreatment Management Software	1 LS	$12,000	$ 12,000

Subtotal ....$ 792,000
Construction Contingency (20%) ....$ 158,000
Subtotal ....$ 950,000
Washington State Sales Tax (7.9%)..$ 76,000
Total Estimated Construction Cost $1,025,000
Engineering, Administrative & Legal Services (20%) ....$ 205,000
Total Estimated Project Cost..$1,230,000

TABLE 8-8

Cost Estimates for Phase 2B WWTF Upgrades to Accommodate 2025 Flows and Loadings (Solids and Septage Handling Improvements Not Included; See Chapter 9)

No.	Item	Quantity	Unit Price	Amount
1	Mobilization/Demobilization	1 LS	$160,000	$ 160,000
2	Secondary Clarifier No. 3	1 LS	$1,050,000	$1,050,000
3	Effluent Filter	1 LS	$750,000	$ 750,000

Subtotal $1,960,000
Construction Contingency (20%) ....$ 392,000
Subtotal $2,352,000
Washington State Sales Tax (7.9%)..$ 185,800
Total Estimated Construction Cost $2,537,800
Engineering, Administrative & Legal Services (20%) ....$ 270,500
Total Estimated Project Cost..$2,808,000

REFERENCES

1. Higgins, Miller and Sobeck, *Improving Industrial Wastewater Treatment Using Divalent Cation Addition,* WEFTEC 1999

2. Swift, Wilson, Johnson and Jacobsen, *The Impact of UV-Absorbing Wastewater from a Printed Circuit Board Manufacturing Facility on the Performance of a Municipal UV Disinfection System*, WEFTEC 2001

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4. *Wastewater Engineering,* Metcalf and Eddy, 4th edition, 2003

5. Swift, Wilson and Jacobsen, *Controlling WWTP Effluent Transmittance Through Industrial Pretreatment Limits,* 2005 WEF Disinfection Conference

6. *Criteria for Sewage Works Design*, Washington State Department of Ecology, 2008

7. *Manual of Practice #8,* WEF, 2010

CHAPTER 9

BIOSOLIDS TREATMENT AND MANAGEMENT

INTRODUCTION

This Chapter summarizes current federal and State biosolids regulations, discusses the City's current biosolids treatment and management program, provides a discussion of wastewater solids treatment alternatives, and recommends a process for treating solids generated at the expanded Camas WWTF. Alternatives for disposal and/or utilization of the treated solids (biosolids) are also discussed and a recommended plan for their management is provided.

BIOSOLIDS REGULATIONS

Regulations pertaining to biosolids include 40 CFR Part 403, WAC 173-308, and WAC 173-200.

40 CFR PART 503

Federal 40 CFR Part 503, regulating the disposition of municipal sewage sludge, went into effect in 1993. The 503 rule applies to the sewage sludge generated from municipal wastewater systems, i.e., municipal wastewater treatment systems, and domestic septic tanks. EPA allows states the ability to enforce their own version of biosolids regulations. Under 40 CFR 503, these state biosolids regulations must be at least as stringent as the federal 503 regulations.

WAC-173-308 BIOSOLIDS MANAGEMENT

The State of Washington has adopted its own regulations governing the use or disposal of biosolids, WAC 173-308. These regulations became effective in March 1998 and are enforced by the State Department of Ecology (Ecology). The requirements in WAC 173-308 are very similar to the requirements of the federal 503 regulations.

There are three fundamental elements of the federal 503 and State 308 regulations that establish minimum criteria for beneficial use of biosolids:

1. Pollutant concentrations and application rates;
2. Pathogen reduction measures; and
3. Vector attraction reduction measures.

Pollutant Concentrations and Application Rates

Maximum allowable concentrations in biosolids are established for nine heavy metals (arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc). If a biosolids sample exceeds the ceiling concentration in Table 1 of WAC 173-308 of any of these metals, it cannot be land applied. A second pollutant threshold concentration is identified for Exceptional Quality (EQ) biosolids in WAC 173-308 Table 3. If biosolids are shown to be below these concentrations, they may be considered EQ, and thus be eligible for relatively unrestricted land application, provided they meet other EQ requirements. To be considered EQ, biosolids must not only meet the EQ *pollutant* requirement, but also meet Class "A" pathogen reduction requirements and vector attraction reduction requirements (see below).

As shown in Table 9-1, historical Camas biosolids pollutant concentrations have not exceeded Table 1 or Table 3 concentrations. However, molybdenum concentrations have been within 10 percent of ceiling and EQ limits.

Cumulative trace pollutant loading rates for biosolids are designated for these nine heavy metals. These rates cannot be exceeded during the life of an application site. Once a cumulative loading limit is reached for a particular limiting pollutant, the land can no longer receive biosolids containing any level of the limiting pollutant. Annual trace pollutant loading rates are also set for the same nine heavy metals.

TABLE 9-1

Historical Camas Biosolids Pollutant Concentrations

	Units	WAC-173-308 Table 3 Threshold (EQ)	WAC-173-308 Table 1 Ceiling Conc. Limits	Camas Biosolids[1]			
				2001	2002	2003	2005
Arsenic	mg/kg	41	75	26	21	5	3.2
Cadmium	mg/kg	39	85	0.55	1.35	<0.2	2.0
Copper	mg/kg	1,500	4,300	604	605	1	640
Lead	mg/kg	300	840	16	12	<0.2	21
Mercury	mg/kg	17	57	0.42	1.61	0.30	0.80
Molybdenum	mg/kg	75	75	41	68	10	71
Nickel	mg/kg	420	420	11	51	126	26.8
Selenium	mg/kg	100	100	<1.5	<1.0	<3	5.6
Zinc	mg/kg	2,800	7,500	580	654	49	1,030
Nitrate/Nitrite-N	mg/kg	NA	NA	ND	ND	ND	20
Total Kjeldahl N	mg/kg	NA	NA	ND	ND	ND	50,500
Ammonia N	mg/kg	NA	NA	ND	ND	ND	4,500
Phosphate P	mg/kg	NA	NA	ND	ND	ND	35,600

TABLE 9-1 – (continued)

Historical Camas Biosolids Pollutant Concentrations

	Units	WAC-173-308 Table 3 Threshold (EQ)	WAC-173-308 Table 1 Ceiling Conc. Limits	Camas Biosolids(1)			
				2001	2002	2003	2005
Total Solids	%	NA	NA	ND	ND	ND	17.8
Volatile Solids	%	NA	NA	ND	ND	ND	12.9
pH	pH units	NA	NA	ND	ND	ND	6.11

(1) Biosolids are aerobically digested and dewatered by centrifuge.
NA = Not applicable.
ND = No data.

Pathogen Reduction Requirements

In order for biosolids to be land applied, they must meet specific criteria demonstrating a minimum level of treatment to reduce the density or limit growth of pathogenic bacteria. By meeting these minimum criteria, a biosolids sample is referred to as meeting Class "B" pathogen reduction requirements. The term "Class B biosolids" is sometimes erroneously referred to as any biosolids meeting all minimum criteria that allow the biosolids to be land applied, which is not the case. Biosolids must meet vector attraction reduction requirements and minimum pollutant concentration standards as well as Class "B" pathogen reduction requirements (at a minimum) in order to be acceptable for land application.

Class "B" biosolids must meet one or more of three alternative criteria for pathogen reduction described in the 503 and 308 regulations. A higher level of treatment known as a Process to Further Reduce Pathogens (PFRP) will permit biosolids to meet Class "A" pathogen reduction requirements. The 503 and 308 regulations provide six alternative PFRP standards for Class "A" biosolids. When biosolids meet the Class "A" standard, they are subject to fewer restrictions for land application as long as they also meet the lower (WAC 173-308) Table 3 pollutant concentration thresholds and vector attraction reduction standards.

Vector Attraction Reduction Requirements

The third minimum requirement for biosolids to be land applied is the vector attraction requirement. This measure is designed to make the biosolids less attractive to disease-carrying pests such as rodents and insects. These measures typically reduce the liquid content and/or volatile solids content of the biosolids or they make the biosolids relatively inaccessible to vector contact by soil injection or tilling. The 503 and 308 regulations list seven alternative treatment techniques and/or laboratory tests that would qualify a sludge as meeting vector attraction reduction requirements. If biosolids are not treated by one of the listed treatment techniques to provide vector attraction reduction and if it does not pass the laboratory tests for vector attraction reduction, then it can meet the requirements during land application by subsurface injection or immediate tilling into the ground.

Management Practices

For biosolids that are Class "B" with respect to pathogens and have met the three criteria discussed above, the 503 and 308 regulations identify specific management practices that must be followed during land application of biosolids. The biosolids must be applied at a rate that is equal to or less than the agronomic rate. The placement of biosolids on land cannot adversely affect a threatened or endangered species. Biosolids cannot be applied to ground in a manner that would cause it to enter wetlands or a surface water body (e.g., on frozen ground or snow-covered ground) nor can it be applied within 10 meters or less of a surface water. Class "B" biosolids may not be applied to lawns or gardens.

If biosolids meet lower pollutant threshold limits, Class "A" pathogen reduction requirements, and vector attraction reduction requirements, they are eligible for relatively unrestricted application. Biosolids in this category are referred to as "Exceptional Quality" (EQ). EQ biosolids can be containerized and sold or given away in quantities up to 1 metric ton provided a label or information sheet is provided with:

1. The biosolids preparer's name and address;

2. Sufficient information (nitrogen concentrations) for the recipient to determine an agronomic rate of application; and

3. A statement that application is prohibited except in accordance with instructions provided with the container.

Monitoring Requirements

Monitoring frequencies are based on quantities of biosolids produced. (It is not generally necessary to verify that pathogen and vector attraction reduction measures are met for each individual load of biosolids that is land applied, per WAC 173-308-150(3).) The actual monitoring frequencies will depend on the frequency of applications.

Recordkeeping, Reporting, and Certifications

The 503 and 308 regulations have specific recordkeeping, reporting, and certification requirements for land application of biosolids. The general biosolids permit implements requirements for recordkeeping and reporting in accordance with WAC 173-308-290 and –295. Records must be kept for meeting all pathogen reduction and vector attraction reduction requirements for biosolids and domestic septage. For biosolids, records must be kept of analyses performed for meeting trace pollutant criteria. Ecology requires that *all* facilities, regardless of size, make annual reports to both Ecology's headquarters and the appropriate regional office, by March 1 of each year.

Permitting

WAC 173-308-310 lists permitting requirements for municipalities managing biosolids. The primary permit required for biosolids management activities is *the State General Permit for Biosolids Management*. When applying for coverage under the General Permit, the permittee must carry out public notice as required under WAC 173-308-310(11), and public hearings if required in accordance with WAC 173-308-310(12), and comply with requirements of the State Environmental Policy Act (SEPA) as stipulated under WAC 173-308-310(030). Public notice requirements for facilities subject to this permit vary depending on the purpose the notice is serving and the quality of biosolids being managed. Notification must be made to the general public, affected local health departments, and interested parties.

SOLIDS TREATMENT ALTERNATIVES PRESELECTION

The *1997 Wastewater Facility Plan* recommended expansion of the biosolids management system in two phases. Phase I was designed for biosolids treatment approximately up to 2007, and Phase II recommendations were designed for biosolids treatment to 2027. Phase I, which was constructed in 2002, consisted of expanding the existing aerobic digestion system and installing a gravity thickener for sludge thickening and a centrifuge for dewatering. The waste solids are currently thickened in a gravity thickener and thickened sludge is pumped to the aerobic digester, which provides a retention time of at least 60 days, meeting Class B biosolids requirements for pathogen reduction as a Process to Significantly Reduce Pathogens (PSRP). The digested sludge is then dewatered with a centrifuge to approximately 20 percent solids. The digested, dewatered sludge is trucked and hauled to a land application site by a contractor. Chapter 5 of this report provides a detailed description of the solids treatment process and presents the design criteria for each of the individual solids treatment components. The existing WWTF site plan and the process flow schematic are shown in Figures 5-2 and 5-3, respectively.

The *1997 Wastewater Facility Plan* provided an analysis of four solids treatment alternatives for Phase II expansion complete with capital and O&M costs for each alternative. The four alternatives analyzed for Phase II are listed below, followed by a description of each process:

- Aerobic Digestion
- Anaerobic Digestion
- Lime Stabilization
- Incineration

AEROBIC DIGESTION

Aerobic digestion is similar to the activated sludge process. Waste solids from the underdrains of primary and secondary clarifiers is conveyed to the aerobic digesters. The sludge is aerated and mixed in the digesters to provide oxygen to microorganisms which break down available food to carbon dioxide, water, and cell tissue. As the supply of available food is depleted, the microorganisms begin to consume their own cell mass to obtain energy for cell maintenance. When this occurs, cell mass is oxidized aerobically to form carbon dioxide, water, and ammonia. A major objective of aerobic digestion is to reduce the mass of the solids for disposal. This reduction takes place predominantly with the biodegradable (organic) content of the sludge, although there may be some removal of inorganics through biological processes as well.

ANAEROBIC DIGESTION

In the anaerobic digestion process, the organic material in mixtures of settled primary and waste activated sludges is converted biologically, in the absence of oxygen, to a variety of end products, including methane (CH_4) and carbon dioxide (CO_2). The process is carried out in a heated, mixed, airtight reactor which receives solids from the underdrains of the primary and secondary clarifiers. Sludge, introduced continuously or intermittently, is retained in the reactor for varying periods of time. The stabilized sludge, withdrawn continuously or intermittently from the reactor, is reduced in organic and pathogen content and is nonputrescible.

LIME STABILIZATION

In the lime stabilization process, lime is added to untreated sludge in sufficient quantity to raise the pH to 12 or higher. The high pH does not allow survival of microorganisms; therefore, the sludge will not putrefy, create odors, or pose a health hazard as long as the sludge is maintained at this pH level. Lime may be added to sludge prior to dewatering (termed “lime pretreatment”) or after dewatering (termed “lime post treatment”). Usually, either hydrated lime, $Ca(OH)_2$, or quicklime, CaO, are used for lime stabilization.

INCINERATION

Sewage sludge incineration involves the thermal oxidation of sewage sludge in a furnace termed an “incinerator.” Byproducts of the incineration process include off-gases, ash residue, and wastewater. In a municipal sludge application, the incinerator receives dewatered primary and secondary sludges for incineration. Sewage treatment solids waste streams such as screenings and scum can also be fed to the incinerator. The use of an incinerator negates the need for the digestion process.

ALTERNATIVE BIOSOLIDS MANAGEMENT CONSIDERATIONS

Consideration of alternative systems was based on compatibility with the existing solids treatment system and their ability to yield a biosolids product that can be economically disposed of or utilized offsite. Both aerobic and anaerobic digestion can yield a Class B biosolid with respect to pathogens if adequate detention time (digester volume) is provided. Lime stabilization and incineration are also capable of producing Class B biosolids if certain process requirements are met. Each of the alternatives can be constructed within the constraints of the existing WWTF site boundaries and would be able to handle projected solids loadings.

The four alternatives presented above and the recommended alternative provided in the *1997 Wastewater Facility Plan* are considered valid for this current Plan because the current projected influent wastewater loading for the year 2025 is similar to that projected for the Phase II design period presented in the 1997 Plan. The capital and O&M cost estimates provided in the *1997 Wastewater Facility Plan* are also considered valid for relative comparison purposes because material, construction, and energy costs for each alternative have increased proportionally.

The City of Camas has recently been in communication with the City of Washougal about the possibility of having the City of Camas treat Washougal biosolids in an effort to reduce the costs associated with biosolids treatment and disposal for both cities by sharing the capital and O&M cost burden. The City of Camas would therefore like to compare the capital and O&M costs for both the alternative of treating Camas biosolids only and the alternative of treating Camas and Washougal biosolids together. Therefore, one of the four alternatives has been preselected for a detailed cost comparison of the two biosolids loading options to produce a Class B biosolid for the year 2025 based on the analysis and recommendations of the *1997 Wastewater Facility Plan*. The costs associated with the various Class B biosolids disposal options are discussed in the following Biosolids Management Alternatives section of this chapter. Additionally, the options to expand the biosolids treatment process to produce a Class A biosolids are also addressed.

SOLIDS TREATMENT PRESELECTION ALTERNATIVE COMPARISON SUMMARY

A comparison summary of the four biosolids treatment preselection alternatives consistent with the analysis performed in the *1997 Wastewater Facility Plan* is presented in Table 9-2.

TABLE 9-2

Camas WWTF Solids Treatment Preselection Alternative Summary

	Aerobic Digestion	Anaerobic Digestion	Lime Stabilization	Incineration
Compatibility with Current Disposal Method	Process can meet the pathogen reduction requirements of a Class B biosolid if the biosolids are agitated with air or oxygen to maintain aerobic conditions for a specific time and at a specific temperature, ranging from 40 days at 20°C to 60 days at 15°C.	Process can meet the pathogen reduction requirements of a Class B biosolid if the biosolids are treated in the absence of air for a specific time and at a specific temperature, ranging between 15 days at 35°C to 55°C and 60 days at 20°C.	To meet Class B standards, enough lime must be added to the biosolids to immediately raise the pH to 12 and to remain above 12 after 2 hours of contact.	Incineration would be compatible with 40 CFR 503 requirements as it would destroy the biosolids and negate the need for disposal. There would be a remaining ash that would require disposal.
Adaptability to Higher Level of Treatment	Process is not recognized as a Process to Further Reduce Pathogens (PFRP) by 40 CFR 503 which is required to produce a Class A biosolid. However, modifications to the process could be made to upgrade the digestion method to thermophillic aerobic digestion which is recognized as a PFRP. In place of facilities upgrades, additional changes in operations including monitoring for fecal coliforms may result in a process approved by the Department of Ecology as a PFRP.	Process is not recognized as a Process to Further Reduce Pathogens (PFRP) by 40 CFR 503 which is required to produce a Class A biosolid. However, additional changes in operations including monitoring for fecal coliforms may result in a process approved by the Department of Ecology as a PFRP. These potential process changes include pasteurization and heat drying.	Lime stabilization can be used to meet pathogen reduction requirements for Class A. The pH of the biosolids must be maintained at 12 or higher for at least 72 hours, with temperature during the 72-hour period greater than 52°C for at least 12 hours. After 72 hours at pH above 12, the biosolids must be air-dried to greater than 50 percent total solids.	There would be no need to adapt the technique for a higher level of treatment as the biosolids would be destroyed by thermal oxidation.

TABLE 9-2 – (continued)

Solids Treatment Preselection Alternative Summary

	Aerobic Digestion	Anaerobic Digestion	Lime Stabilization	Incineration
Operational Considerations	This aerobic digestion process is already in place at the Camas WWTP and is familiar to the plant operators. The process is relatively easy to operate and produces supernatants low in biological oxygen demand, suspended solids, and nitrogen. The relatively rapid bacteria growth rates allow more flexibility to handle changes in waste loadings to the digester. The process is also relatively low in labor demand. However, the process is susceptible to foaming problems and may produce solids that are relatively difficult to dewater. The absence of temperature control may also limit the ability of the plant to meet 40 CFR 503 regulations for pathogen and vector attraction reduction. Aeration energy requirements results in high O&M costs.	Anaerobic digestion is a proven technology that results in a greater reduction in sludge mass than aerobic digestion. Biosolids derived from anaerobic digestion are generally more stable and contain the least amount of volatile solids than those derived from aerobic digestion. Thus, the solids are more likely to meet 40 CFR 503 requirements. Anaerobic digestion produces methane gas which can be used as an energy source for heating the reactor giving the process more temperature control. However, due to the slow growth rate of the bacteria that produce methane, the ability to adjust to changes in waste loadings and temperature is less than for aerobic digestion. Therefore, the process requires good process control and is more susceptible to upsets than aerobic digestion.	The lime stabilization process is relatively simple to operate with limited process control requirements. However, the lime and quicklime are relatively difficult to handle. The chemicals are often non-homogeneous and contain consolidated “chunks” that can clog feed hoppers. The method is relatively high in maintenance requirements and requires more maintenance than aerobic and anaerobic digestion. In addition, the process results in a high pH biosolids and a net increase in biosolids mass with a corresponding increase in storage requirements. Also, lime is a caustic dry chemical and its handling can be hazardous to workers. Special procedures to prevent chemical contact with skin and dust inhalation are required.	Incineration would require a relatively high level of process control. The technique is reliable, but would require a dedicated full-time plant operator at all times the incinerator is in operation. The operator would be responsible for incineration and other sludge handling processes. Incineration would require operating permits from the Southwest (Washington) Air Pollution Control Authority (SWAPCA). Incinerator control efficiencies are specific to incinerator design and would have to be verified by stack tests during test burns. Regulations 40 CFR 503, NAAQS, and NESHAP place restrictions on beryllium, mercury, lead, arsenic, cadmium, chromium, nickel, and total hydrocarbon releases. The ability to obtain the necessary permits for operation at this alternative screening stage is difficult to determine without stack test results.

TABLE 9-2 – (continued)

Solids Treatment Preselection Alternative Summary

	Aerobic Digestion	Anaerobic Digestion	Lime Stabilization	Incineration
Economic Analysis	Moderate High Capital Cost and O&M Cost	Moderate Capital Cost and Low O&M Cost	Low Capital Cost and High O&M Cost	Very High Capital Cost and Low O&M Cost
Aesthetics	The stabilization process does not generally generate nuisance odors. However, there may be nuisance odors associated with sludge storage.	Anaerobic digestion is the least offensive sludge treatment alternative. Treatment occurs in enclosed reactors with recycle and use of the waste gases (methane). Solids derived from this process are usually less odorous than those produced by aerobic digestion.	Lime treatment does not destroy the volatile solids in the sludge. Therefore, as the pH in the sludge drops after treatment, significant odors and biological regrowth can occur. The potential for reoccurrence of odors and the elevated pH of the sludge may limit the number and types of customers who would be willing to accept the treated sludge.	An incinerator would be the most visible treatment technique of those evaluated, although odor problems are anticipated to be minimal due to destruction of the biosolids. However, there is the potential for public opposition to an incinerator.

RECOMMENDED PRESELECTION ALTERNATIVES

Anaerobic digestion was the recommended option for Phase 2 expansion because it had the lowest combined present worth capital cost and O&M cost, required the least land area, and required the least amount of handling of hazardous chemicals of the four alternatives as presented in the *1997 Wastewater Facility Plan*. As previously discussed, the design criteria for the design period of this plan have not changed significantly from that of Phase 2 for the *1997 Wastewater Facility Plan*; therefore, anaerobic digestion is the recommended alternative to produce Class B biosolids. This plan considers two separate alternative criteria for the year 2025: Alternative No. 1 considers the treatment of Camas WWTF biosolids only, and Alternative No. 2 considers treatment of both Camas and Washougal WWTF biosolids. These alternatives are further broken down into two separate Subcategories A and B: Subcategory A for each of the alternatives considers the treatment of the design biosolids loading to Class B biosolids via anaerobic digestion, and Subcategory B for each alternative considers the treatment of the design biosolids loading to produce Class A biosolids. The summary of the alternatives considered is presented below:

- Alternative No. 1A: Anaerobic Digestion of Camas WWTF Biosolids and Contract Disposal of Class B Biosolids
- Alternative No. 2A: Anaerobic Digestion of Camas and Washougal WWTF Biosolids and Contract Disposal of Class B Biosolids
- Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids
- Alternative No. 2B: Anaerobic Digestion of Camas and Washougal WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids

The options to expand these two alternatives to produce Class A biosolids are discussed later in this chapter as Alternatives No. 2A and No. 2B. A description of the biosolids treatment Alternatives No. 1A and No. 1B (to provide Class B biosolids) and a capital and O&M cost estimate for each alternative are presented below.

ALTERNATIVE NO. 1A: ANAEROBIC DIGESTION OF CAMAS WWTF BIOSOLIDS

The design criteria for this alternative are presented in Table 9-3. The maximum month and annual average influent wastewater TSS loadings are based on the 2025 projected values. The maximum month influent wastewater BOD_5 is based on the current NPDES permit value. The annual average influent wastewater BOD_5 value is estimated by multiplying the maximum month BOD_5:TSS ratio by the annual average TSS value.

TABLE 9-3

Alternative No. 1A: Anaerobic Digestion of Camas WWTF Biosolids Design Criteria (Design Year 2025)

	Maximum Month	Annual Average
WWTF Influent BOD_5 (lb/d)	5,616	4,099
WWTF Influent TSS (lb/d)	8,001	5,883
Waste Primary Sludge (lb/d)	5,990	4,409
Waste Activated Sludge (lb/d)	3,218	2,353
Total Waste Sludge (lb/d)	9,208	6,762

This alternative combines thickened waste primary sludge (WPS) and thickened waste activated sludge (WAS) and stabilizes the mixed solids in an anaerobic digester. Site layout and process flow schematic are presented on Figures 9-1 and 9-2, respectively. Anaerobic digestion is a proven method of solids treatment with wide application in municipal treatment. Digestion yields methane gas, a useful byproduct that can be used to reduce energy consumption at the WWTF. Anaerobic digestion is designated by the EPA 503 regulations as a Process to Significantly Reduce Pathogens (PSRP). Anaerobic digestion yields Class B biosolids with respect to pathogens if the mean cell residence time within the digesters is between 15 days at 35 to 55 degrees C and 60 days at 20 degrees C.

The requirement for vector attraction reduction is satisfied if the volatile solids content is lowered by 38 percent or more. Class B biosolids may be applied to agricultural land, forest sites, public contact sites, and reclamation sites. However, unlike Class A biosolids, Class B biosolids cannot be sold or given away and are subject to restrictions pertaining to crop harvesting, animal grazing, and public contact.

The existing Aerobic Digester No. 2 will be modified to serve as a holding tank with three separate compartments for WAS, dewatering centrifuge centrate, and septage storage. Each of the three holding tanks will have a dedicated aeration blower and coarse-bubble diffuser system. Submersible centrifugal pumps will be installed in the centrate storage tank to transfer centrate to the aeration basin splitter box during low plant influent load periods. Submersible centrifugal pumps will be installed in the septage storage tank to allow septage to be transferred to the headworks. Additional septage discharge piping will be installed to allow the septage to also be transferred to the existing septage receiving tank or to the WAS storage tank, where it can be mixed with the WAS and transferred to the WAS thickener.

The existing digested sludge pumps will be used to transfer WAS from the WAS holding tank to the sludge thickening system, which will be located in the new digester building. The new sludge thickening system will consist of a rotary screen thickener, thickening polymer addition system, thickener magnetic flow meter, and two thickened WAS pumps. Thickened WAS will drop from the rotary screen thickener drum into a hopper equipped with two progressing cavity thickened WAS pumps, which will transfer thickened WAS to the digesters. Two new progressing cavity digested sludge pumps will be installed in the digester building to pump digested sludge to the existing dewatering centrifuge from the sludge storage tank or the anaerobic digester.

The existing thickened waste sludge pump will pump the thickened WPS from the existing gravity thickener to the new anaerobic digesters. The volume and surface area of the existing gravity thickener will be sufficient to thicken the WPS. The existing gravity thickener will be modified to include a non-potable dilution water supply line to maintain the overflow rate of 25 gal/ft^2/d. The existing dewatering centrifuge has a rated capacity of 160 gpm and the new digested sludge pumps will have a rated capacity of 160 gpm at 30 psi. With a digested sludge rate of 18,000 gpd and the pumping capacity of 160 gpm, the centrifuge will be required to operate approximately 10 hours per week during maximum month loading conditions for the 2025 design year. The centrifuge will be required to operate approximately 17 hours per week during annual average loading conditions for the design 2025 year. The existing primary sludge pumps, grit removal system, WAS pumps, and thickened waste sludge pumps have sufficient capacity to treat the biosolids associated with the design year 2025.

Two primary anaerobic digesters and one sludge holding tank are proposed for this alternative. The volume of the primary digesters would provide sufficient capacity to produce Class B biosolids for the year 2025. The new digesters would be built west of the existing headworks at the location shown on Figure 9-1. Digested sludge from the primary digesters will be routed to the new sludge holding tank.

The new primary digesters will each have a diameter of 35 feet, a side water depth of 25 feet, and a working volume of 24,100 cubic feet (180,000 gallons). A fixed cover will be installed on each of the new primary digesters and the sludge holding tank. A new Digester Control Building will be constructed between the digesters to house the heat exchangers, gas boiler, sludge thickening system, recirculation pumps, digested sludge pumps and associated piping, and control equipment. A new second plant drain pump station will be constructed adjacent to the Digester Building to pump the drain flows from the Digester Building to the aeration basin splitter box.

Design hydraulic retention time and volatile solids loading in the primary digesters for the year 2025 are projected to be 20 days and 6,760 lb VSS/d, respectively, under monthly maximum flow conditions in the year 2025. The primary digesters will be heated to a temperature of approximately 35 degrees C using energy derived from the methane gas produced during digestion. The design hydraulic retention time and operating temperatures will allow the process to meet the Class B pathogen reduction criteria in the WAC 173-308 regulations as well as the criteria for vector attraction reduction (38 percent VSS reduction or greater).

The new primary digesters will be mixed with top-mounted mechanical mixers. Heat for the primary digesters will be provided by a hot water boiler capable of burning either digester gas or commercial natural gas. Each primary digester will have one spiral heat exchanger for heating of thickened feed sludges. Two recirculation pumps and a backup will be provided for the digesters to allow for heating of digester contents. Digester equipment will be housed within a new Control Building. Digested sludge from the primary digesters will be conveyed by gravity to the sludge holding tank. Sludge within the sludge holding tank will not be heated or mixed. Excess gas will be burned at a waste gas burner which will be located near the digester complex.

The design criteria for the primary anaerobic digesters, sludge holding tank, and associated equipment are provided below.

Alternative No. 1A Anaerobic Digesters Design Criteria

Item	Equipment Data
Primary Anaerobic Digesters	
Quantity of New Primary Digesters	2
Volume (each)	24,000 ft^3
Diameter	35 ft
Side Water Depth	25 ft
Total Primary Digester Volume	48,000 ft^3
Influent Sludge Feed Rate	18,000 gpd
Hydraulic Retention Time	20 days
Influent Sludge Solids Concentration	5.6%
Total Solids Loading	8,400 lb/d
Volatile Solids Loading	6,760 lb/d
Volatile Solids Loading	0.14 lb VS/ft^3/d
Digester Operating Temperature	35°C to 38°C
Estimated Volatile Solids Reduction	40%
Sludge Holding Tank	
Quantity	1
Volume	12,000 ft^3
Diameter	35 ft
Side Water Depth	12.4 ft
Sludge Flow Rate	18,000 gpd
Effluent Sludge Solids Concentration	3.3%
Hydraulic Retention Time	5 days

Item	Equipment Data
Digester Mixing	
Type of Mixing	Mechanical
Number of Mixers per Digester	1
Mixer Pump Capacity	9,000 gpm
Turnover Time	20 minutes
Motor Size	10 hp
Heating	
Quantity of Boilers	1
Boiler Type	Fire Tube
Boiler Size	1,004,000 Btu/hr
Quantity of Spiral Heat Exchangers	2
Heat Exchanger Type	Spiral
Heat Exchanger Capacity	500,000 Btu/hr
Quantity of Boiler Water Pumps	2
Boiler Water Pump Type	Centrifugal
Boiler Water Pump Capacity	200 gpm
Boiler Water Pump TDH	23 ft
Boiler Water Pump Motor Size	7.5 hp
Recirculation Pumps	
Type	Rotary Lobe
Quantity of Pumps	3
TDH	23 ft
Pump Capacity	200 gpm
Motor Size	7.5 hp
WAS Storage Tank	
Volume	150,000 gal
Number of Aeration Blowers	1
Blower Type	Positive Displacement
Blower Capacity	320 scfm
Blower Discharge Pressure	4.6 psig
Blower Motor Size	15 hp
Centrate Storage Tank	
Volume	45,000 gal
Number of Aeration Blowers	1
Blower Type	Positive Displacement
Blower Capacity	120 scfm
Blower Discharge Pressure	4.6 psig
Blower Motor Size	5 hp
Number of Centrate Pumps	2
Pump Type	Submersible Centrifugal

Item	Equipment Data
Septage Storage Tank	
Volume	30,000 gallons
Number of Aeration Blowers	1
Blower Type	Positive Displacement
Blower Capacity	80 scfm
Blower Discharge Pressure	4.6 psig
Blower Motor Size	5 hp
Number of Septage Pumps	2
Pump Type	Submersible Centrifugal
WAS Thickener	
Quantity	1
Type	Rotary Screen Thickener
Flow Capacity	200 gpm
Feed Solids	1%
Thickened Solids	5% to 7%
Motor Sizes:	5 hp
Flocculator	1 hp
Drum Main Drive	2 hp
Booster Pump	2 hp
Thickening Polymer Feed System	
Quantity	1
Type	2-Tank
Polymer Type	Liquid or Dry
Mixing Tank Volume	520 gal
Holding Tank Volume	500 gal
Solution Feed Pump Capacity	100 gph
Active Polymer Capacity	2 lb/hr
Volumetric Screw Feeder Motor Size	1/4 hp
Liquid Polymer Feed Pump Motor Size	1/2 hp
Solution Feed Pump Motor Size	3/4 hp
Thickened WAS Pumps	
Quantity	2
Type	Progressing Cavity
Capacity	50 gpm
Pump Head	60 psi
Motor Size	10 hp
Digested Sludge Pumps	
Quantity	2
Type	Progressing Cavity
Capacity	160 gpm
Pump Head	60 psi
Motor Size	10 hp

Item	Equipment Data
Plant Drain Pump Station No. 2	
Quantity of Pumps	2
Type of Pumps	Submersible Centrifugal
Capacity	500 gpm
Pump Head	40 ft
Motor Size	10 hp

A new Digester Control Building will be constructed to house process equipment and piping used to operate the new digesters. The equipment will include the boiler, two spiral heat exchangers, two boiler water pumps, three recirculation pumps, two digested sludge pumps, and the WAS thickening system. Process piping will include conveyance for raw thickened sludge, sludge recirculation, digested sludge, bypass and emergency piping routes, drains, gas handling, and valving for distributing feed sludge. The control building will be located between the two digesters. The size of the control building will be 1,800 square feet.

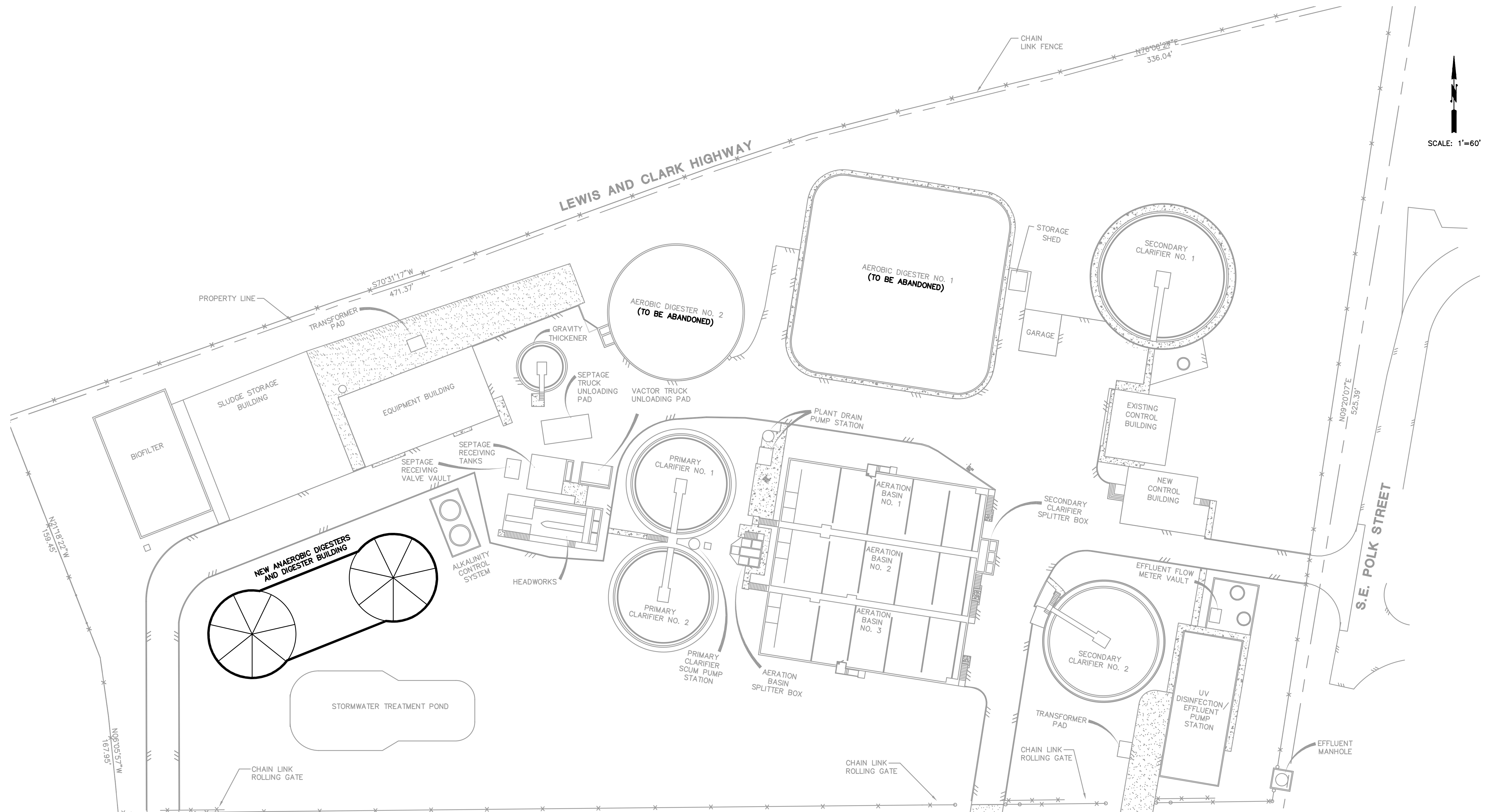
The capital and O&M costs associated with Alternative No. 1A are presented in Tables 9-4 and 9-5, respectively. The O&M cost for Alternative No. 1A includes the cost of contracted biosolids hauling off site.

TABLE 9-4

Alternative No. 1A: Anaerobic Digestion of Camas Biosolids Preliminary Project Cost Estimate (2007 Dollars)

No.	Item	Quantity	Unit Price	Amount
1.	Mobilization/Demobilization	1 LS	$450,000	$ 450,000
2.	Demolition	1 LS	$40,000	$ 40,000
3.	Anaerobic Digester/Sludge Holding Tank/Digester Building	1 LS	$750,000	$ 750,000
4.	Digester Sludge Heating System	1 LS	$231,000	$ 231,000
5.	Digester Gas Equipment	1 LS	$152,000	$ 152,000
6.	Digester Covers	1 LS	$650,000	$ 650,000
7.	Digester Mixing System	1 LS	$300,000	$ 300,000
8.	Digester Recirculation Pumps	1 LS	$79,000	$ 79,000
9.	WAS/Septage/Centrate Tank	1 LS	$280,000	$ 280,000
10.	WAS Thickening System	1 LS	$237,000	$ 237,000
11.	Digested Sludge Pumps	1 LS	$40,000	$ 40,000
12.	Plant Drain Pump Station No. 2	1 LS	$70,000	$ 70,000
13.	Dewatering	1 LS	$75,000	$ 75,000
14.	Earthwork	1 LS	$100,000	$ 100,000
15.	Miscellaneous Metals	1 LS	$50,000	$ 50,000
16.	Painting	1 LS	$90,000	$ 90,000
17.	Site Work	1 LS	$100,000	$ 100,000
18.	Mechanical/Yard Piping	1 LS	$250,000	$ 250,000
19.	Electrical	1 LS	$350,000	$ 350,000

Subtotal $4,294,000
Construction Contingency (20%) .... $ 859,000
Subtotal $5,153,000
Washington State Sales Tax (7.9%) .... $ 407,000
Total Estimated Construction Cost $5,560,000
Engineering, Administrative, and Legal Services (20%) $1,112,000
TOTAL ESTIMATED PROJECT COST $6,672,000



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9–1
BIOSOLIDS TREATMENT ALTERNATIVE NO. 1A
SITE PLAN

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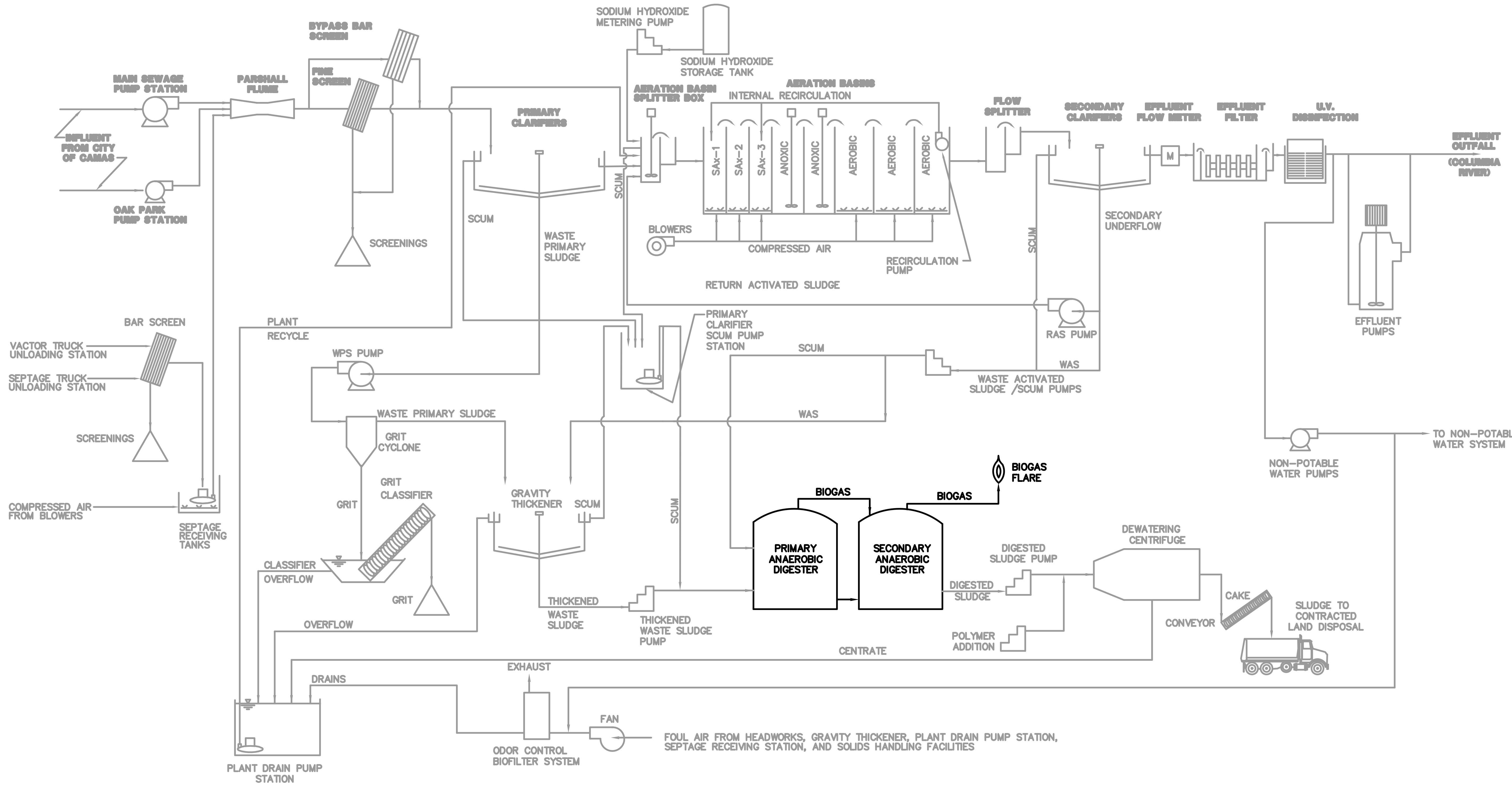

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9-2
BIOSOLIDS TREATMENT ALTERNATIVE NO. 1A
PROCESS FLOW SCHEMATIC

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L:\CAMAS\05471 WW Fac Plan\Figures\FIG9-2.dwg, 9-2, 9/29/2006 11:42:34 AM, 1:1, By: M Nagel

TABLE 9-5

Alternative No. 1A: Anaerobic Digestion of Camas Biosolids O&M Cost Estimate (Design Year 2025)

Item	Costs (Year 2007 $)
Labor ($38/hr)	$ 79,000
Power ($0.07/kWh)	$ 41,000
Polymer ($2.50/lb)	$ 48,000
Natural Gas ($1.15/therm)	$ 12,000
Contracted Hauling and Land Application ($60/wet ton)	$225,000
Equipment Maintenance and Repair	$ 11,000
Testing/Permitting	$ 5,000
Total Annual Cost	**$421,000**

ALTERNATIVE NO. 2A: ANAEROBIC DIGESTION OF CAMAS AND WASHOUGAL WWTF BIOSOLIDS

The design criteria for this alternative are presented in Table 9-6 and are equivalent to the design criteria for Alternative No. 1A with the addition of thickened WAS from the City of Washougal WWTF. The design TSS loading (lb TSS/d) criteria for the thickened WAS from Washougal was provided by Wallis Engineering. This alternative assumes that Washougal will thicken their WAS to 4 percent prior to hauling to the Camas WWTF. A site layout and process flow schematic for Alternative No. 2A are presented on Figures 9-3 and 9-4, respectively.

TABLE 9-6

Alternative No. 2A: Anaerobic Digestion of Camas WWTF and Washougal WWTF Biosolids Design Criteria (Design Year 2025)

	Maximum Month	Annual Average
Camas WWTF Influent BOD_5 (lb/d)	5,616	4,030
Camas WWTF Influent TSS (lb/d)	8,001	5,883
Camas Waste Primary Sludge (lb/d)	6,428	4,754
Camas Waste Activated Sludge (lb/d)	3,439	2,528
Camas WAS Flow (gpd) @ 1% solids	41,200	30,300
Washougal Waste Activated Sludge (lb/d)	4,476	3,715
Washougal Waste Activated Sludge Flow (gpd) @ 4% solids	13,400	11,100
Total Waste Activated Sludge (lb/d)	7,916	6,243
Total Waste Sludge (lb/d) to Digesters	13,038	9,993
Total Waste Sludge Flow to Digesters (gpd)	28,900	22,200
Digester Waste Sludge Concentration (%)	5.4%	5.4%

Additional WAS holding tank volume for the Washougal sludge is required for this option to provide sufficient holding capacity to allow a steady flow of sludge to the primary anaerobic digesters. The sludge holding tank will have a volume of 165,000 gallons to provide a holding capacity for 3 days of Washougal and Camas WAS at maximum month loading conditions. A sludge loading pump is required to transfer sludge from the sludge hauling truck to the sludge holding tank, and a dedicated blower and coarse-bubble diffuser system are required to keep the sludge aerated and prevent foul odors. For this alternative, the Camas primary sludge and WAS will be treated identically as described for Alternative No. 1A, with the exception that the Camas WAS will be commingled and stored with the Washougal WAS in a common WAS storage tank. The combined WAS mixture will then be transferred to the new WAS thickening system.

The existing Aerobic Digester No. 2 will be modified to serve as a holding tank with three separate compartments for the combined Camas and Washougal WAS, dewatering centrifuge centrate, and septage. Each of the three holding tanks will have a dedicated aeration blower and coarse-bubble diffuser system. Submersible centrifugal pumps will be installed in the centrate storage tank to transfer centrate to the aeration basin splitter box during low plant influent load periods. Submersible centrifugal pumps will be installed in the septage storage tank to allow septage to be transferred to the headworks. Additional septage discharge piping will be installed to allow the septage to also be transferred to the existing septage receiving tank or to the WAS storage tank, where it can be mixed with the WAS and transferred to the WAS thickener.

The existing digested sludge pumps will be used to transfer WAS from the WAS holding tank to the sludge thickening system, which will be located in the new Digester Building. The new sludge thickening system will consist of a rotary screen thickener, thickening polymer addition system, thickener magnetic flow meter, and two thickened WAS pumps. Thickened WAS will drop from the rotary screen thickener drum into a hopper equipped with two progressing cavity thickened WAS pumps, which will transfer thickened WAS to the digesters. Two new progressing cavity digested sludge pumps will be installed in the Digester Building to pump digested sludge to the existing dewatering centrifuge from the sludge holding tank or the anaerobic digesters.

The existing thickened waste sludge pump will pump the thickened WPS from the existing gravity thickener to the new anaerobic digesters. The volume and surface area of the existing gravity thickener will be sufficient to thicken the WPS. The existing gravity thickener will be modified to include a non-potable dilution water supply line to maintain the overflow rate of 25 gal/ft^2/d. The existing dewatering centrifuge has a rated capacity of 160 gpm and the new digested sludge pumps will have a rated capacity of 160 gpm at 30 psi. With a digested sludge rate of 28,000 gpd and the pumping capacity of 160 gpm, the centrifuge will be required to operate approximately 20 hours per week during maximum month loading conditions for the 2025 design year. The centrifuge will be required to operate approximately 16 hours per week during annual average loading conditions for the design 2025 year. The existing primary sludge pumps, grit removal system, WAS pumps, and thickened waste sludge pumps have sufficient capacity to treat the biosolids associated with the design year 2025.

Two primary anaerobic digesters and one sludge holding tank are proposed for this alternative. The volume of the primary digesters would provide sufficient capacity to produce Class B biosolids for the year 2025. The new digesters would be built west of the existing headworks at the location shown on Figure 9-3. Digested sludge from the primary digesters will be routed to the new sludge holding tank.

The new primary digesters will each have a diameter of 35 feet, a side water depth of 40 feet, and a working volume of 38,600 cubic feet (289,000 gallons). A fixed cover will be installed on each of the new primary digesters and the sludge holding tank. A new Digester Control Building will be constructed between the digesters to house the heat exchangers, gas boiler, sludge thickening system, recirculation pumps, digested sludge pumps and associated piping, and control equipment. A new second plant drain pump station will be constructed adjacent to the Digester Building to pump the drain flows from the Digester Building to the aeration basin splitter box.

Design hydraulic retention time and volatile solids loading in the primary digesters for the year 2025 are projected to be 20 days and 6,760 lb VSS/d, respectively, under monthly maximum flow conditions in the year 2025. The primary digesters will be heated to a temperature of approximately 35 degrees C using energy derived from the methane gas produced during digestion. The design hydraulic retention time and operating temperatures will allow the process to meet the Class B pathogen reduction criteria in the WAC 173-308 regulations as well as the criteria for vector attraction reduction (38 percent VSS reduction or greater).

The new primary digesters will be mixed with top-mounted mechanical mixers. Heat for the primary digesters will be provided by a hot water boiler capable of burning either digester gas or commercial natural gas. Each primary digester will have one spiral heat exchanger for heating of thickened feed sludges. Two recirculation pumps and a backup will be provided for the digesters to allow for heating of digester contents. Digester equipment will be housed within a new Control Building. Digested sludge and from the primary digesters will be conveyed by gravity to the sludge holding tank. Sludge within the sludge holding tank will not be heated or mixed. Excess gas will be burned at a waste gas burner which will be located near the digester complex.

The design criteria for the primary anaerobic digesters, sludge holding tank, and associated equipment are provided below.

Alternative No. 2A Anaerobic Digesters Design Criteria

Item	Equipment Data
Primary Anaerobic Digesters	
Quantity of New Primary Digesters	2
Volume (each)	38,600 ft^3
Diameter	35 ft
Side Water Depth	40 ft
Total Primary Digester Volume	77,200 ft^3
Influent Sludge Feed Rate	28,900 gpd
Hydraulic Retention Time	20 days
Influent Sludge Solids Concentration	5.4%
Total Solids Loading	13,000 lb/d
Volatile Solids Loading	10,600 lb/d
Volatile Solids Loading	0.11, lb VS/ft^3/d
Digester Operating Temperature	35°C to 38°C
Estimated Volatile Solids Reduction	40%
Sludge Holding Tank	
Quantity	1
Volume	19,300 ft^3
Diameter	35 ft
Side Water Depth	20 ft
Sludge Flow Rate	28,900 gpd
Effluent Sludge Solids Concentration	3.4%
Hydraulic Retention Time	5 days
Digester Mixing	
Type of Mixing	Mechanical
Number of Mixers per Digester	1
Mixer Pump Capacity	14,000 gpm
Turnover Time	20 minutes
Motor Size	15 hp
Heating	
Quantity of Boilers	1
Boiler Type	Fire Tube
Boiler Size	1,004,000 Btu/hr
Quantity of Spiral Heat Exchangers	2
Heat Exchanger Type	Spiral
Heat Exchanger Capacity	750,000 Btu/hr
Quantity of Boiler Water Pumps	2
Boiler Water Pump Type	Centrifugal
Boiler Water Pump Capacity	300 gpm
Boiler Water Pump TDH	29 ft
Boiler Water Pump Motor Size	10 hp

Item	Equipment Data
Recirculation Pumps	
Type	Rotary Lobe
Quantity of Pumps	3
Pump Capacity	300 gpm
TDH	30 ft
Motor Size	10 hp
WAS Storage Tank	
Volume	165,000 gal
Number of Aeration Blowers	1
Blower Type	Positive Displacement
Blower Capacity	450 scfm
Blower Discharge Pressure	4.6 psig
Blower Motor Size	20 hp
Centrate Storage Tank	
Volume	45,000 gal
Number of Aeration Blowers	1
Blower Type	Positive Displacement
Blower Capacity	120 scfm
Blower Discharge Pressure	4.6 psig
Blower Motor Size	5 hp
Number of Centrate Pumps	2
Pump Type	Submersible Centrifugal
WAS Loading Pumps	
Type	Progressing Cavity
Quantity of Pumps	1
Pump Capacity	100 gpm
TDH	60 psi
Motor Size	15 hp
Septage Storage Tank	
Volume	30,000 gal
Number of Aeration Blowers	1
Blower Type	Positive Displacement
Blower Capacity	80 scfm
Blower Discharge Pressure	4.6 psig
Blower Motor Size	5 hp
Number of Septage Pumps	2
Pump Type	Submersible Centrifugal

Item	Equipment Data
WAS Thickener	
Quantity	1
Type	Rotary Screen Thickener
Flow Capacity	200 gpm
Feed Solids	1%
Thickened Solids	5% to 7%
Motor Sizes	5 hp
Flocculator	1 hp
Drum Main Drive	2 hp
Booster Pump	2 hp
Thickening Polymer Feed System	
Quantity	1
Type	2-Tank
Polymer Type	Liquid or Dry
Mixing Tank Volume	520 gal
Holding Tank Volume	500 gal
Solution Feed Pump Capacity	100 gph
Active Polymer Capacity	2 lb/hr
Volumetric Screw Feeder Motor Size	1/4 hp
Liquid Polymer Feed Pump Motor Size	1/2 hp
Solution Feed Pump Motor Size	3/4 hp
Thickened WAS Pumps	
Quantity	2
Type	Progressing Cavity
Capacity	50 gpm
Pump Head	60 psi
Motor Size	10 hp
Digested Sludge Pumps	
Quantity	2
Type	Progressing Cavity
Capacity	160 gpm
Pump Head	60 psi
Motor Size	10 hp
Plant Drain Pump Station No. 2	
Quantity of Pumps	2
Type of Pumps	Submersible Centrifugal
Capacity	500 gpm
Pump Head	40 ft
Motor Size	10 hp

The capital and O&M costs associated with Alternative No. 2A are presented in Tables 9-7 and 9-8, respectively. The O&M cost for Alternative No. 2A includes the cost of contracted biosolids hauling off site.

TABLE 9-7

Alternative No. 2A: Anaerobic Digestion of Camas and Washougal Biosolids
Preliminary Project Cost Estimate (2007 Dollars)

No.	Item	Quantity	Unit Price	Amount
1.	Mobilization/Demobilization	1 LS	$540,000	$ 540,000
2.	Demolition	1 LS	$40,000	$ 40,000
3.	Anaerobic Digester/Dig. Building	1 LS	$1,150,000	$1,150,000
4.	Digester Sludge Heating System	1 LS	$253,000	$ 253,000
5.	Digester Gas Equipment	1 LS	$167,000	$ 167,000
6.	Digester Covers	1 LS	$650,000	$ 650,000
7.	Digester Mixing System	1 LS	$340,000	$ 340,000
8.	Digester Recirculation Pumps	1 LS	$87,000	$ 87,000
9.	WAS/Septage/Centrate Tank	1 LS	$300,000	$ 300,000
10.	WAS Thickening System	1 LS	$237,000	$ 237,000
11.	Digested Sludge Pumps	1 LS	$40,000	$ 40,000
12.	Plant Drain Pump Station No. 2	1 LS	$70,000	$ 70,000
13.	Dewatering	1 LS	$75,000	$ 75,000
14.	Earthwork	1 LS	$220,000	$ 220,000
15.	Miscellaneous Metals	1 LS	$60,000	$ 60,000
16.	Painting	1 LS	$110,000	$ 110,000
17.	Site Work	1 LS	$120,000	$ 120,000
18.	Mechanical/Yard Piping	1 LS	$305,000	$ 305,000
19.	Electrical	1 LS	$430,000	$ 430,000

Subtotal $5,194,000
Construction Contingency (20%) $1,038,000
Subtotal $6,232,000
Washington State Sales Tax (7.9%) ....$ 492,000
Total Estimated Construction Cost...$6,725,000
Engineering, Administrative, and Legal Services (20%) $1,345,000
TOTAL ESTIMATED PROJECT COST.......................................$8,070,000

TABLE 9-8

Alternative No. 2A: Anaerobic Digestion of Camas and Washougal Biosolids O&M Cost Estimate (Design Year 2025)

Item	Costs (Year 2007 $)
Labor ($38/hr)	$ 79,000
Power ($0.07/kWh)	$ 70,000
Polymer ($2.50/lb)	$ 75,000
Natural Gas ($1.15/therm)	$ 16,000
Contracted Hauling and Land Application ($60/wet ton)	$350,000
Equipment Maintenance and Repair	$ 14,000
Testing/Permitting	$ 5,000
Total Annual Cost	**$609,000**

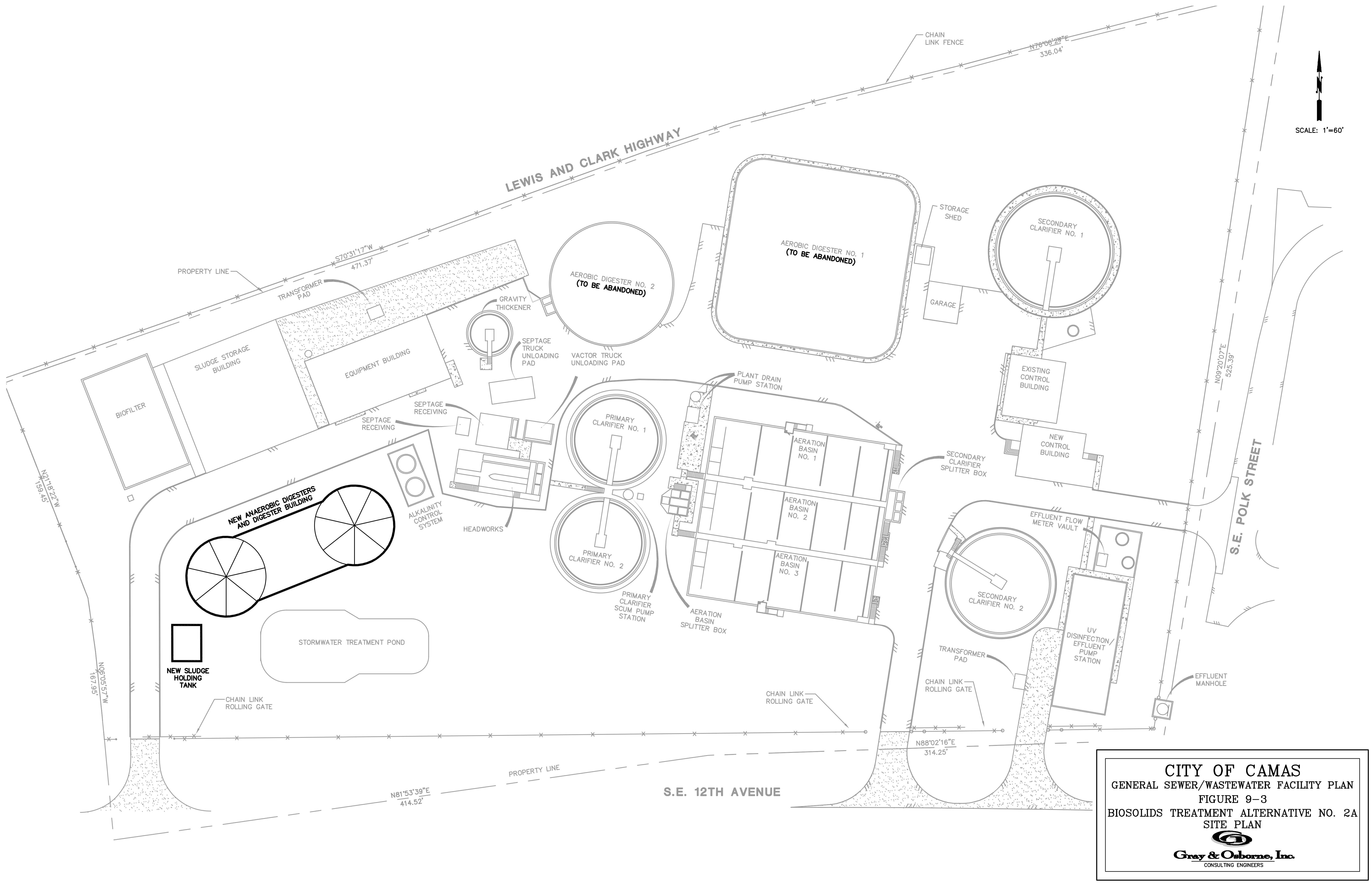
BIOSOLIDS MANAGEMENT ALTERNATIVES

The City of Camas currently disposes of its Class B biosolids by contracting with a sludge hauler, which is consistent with the recommendations of the *1997 Wastewater Facility Plan*. Continued disposal of Class B biosolids by a contract hauler will be compared to an option to produce Class A biosolids. The options considered for biosolids treatment to produce Class A biosolids include composting, lime stabilization, and sludge drying.

Composting of the WWTF biosolids was eliminated due to the high land area, labor, and O&M requirements. This process is highly labor intensive and requires a large amount of bulking agents such as sawdust, straw, wood chips, tree trimmings, etc., to be mixed with the sludge. Due to these reasons and the risks associated with potential odor problems, this option was eliminated.

Lime stabilization was discussed previously in this chapter and was considered as a treatment option in the *1997 Wastewater Facility Plan*. This treatment process is relatively high in maintenance requirements and results in a net increase in biosolids mass with a corresponding increase in storage and application requirements due to the addition of lime to the biosolids. Lime is a caustic dry chemical and its handling can be hazardous to workers. Therefore, special procedures to prevent chemical contact with skin and dust inhalation are required. Based on the relatively high maintenance requirements, the safety risks involved, and the difficulties of disposing of high pH biosolids, lime stabilization was eliminated as an option.

A detailed comparison the continued land application of Class B biosolids and the option to produce Class A biosolids by the method of sludge drying is provided below. For both treatment alternatives, treating Camas-only biosolids and treating Camas and Washougal



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9-3
BIOSOLIDS TREATMENT ALTERNATIVE NO. 2A
SITE PLAN

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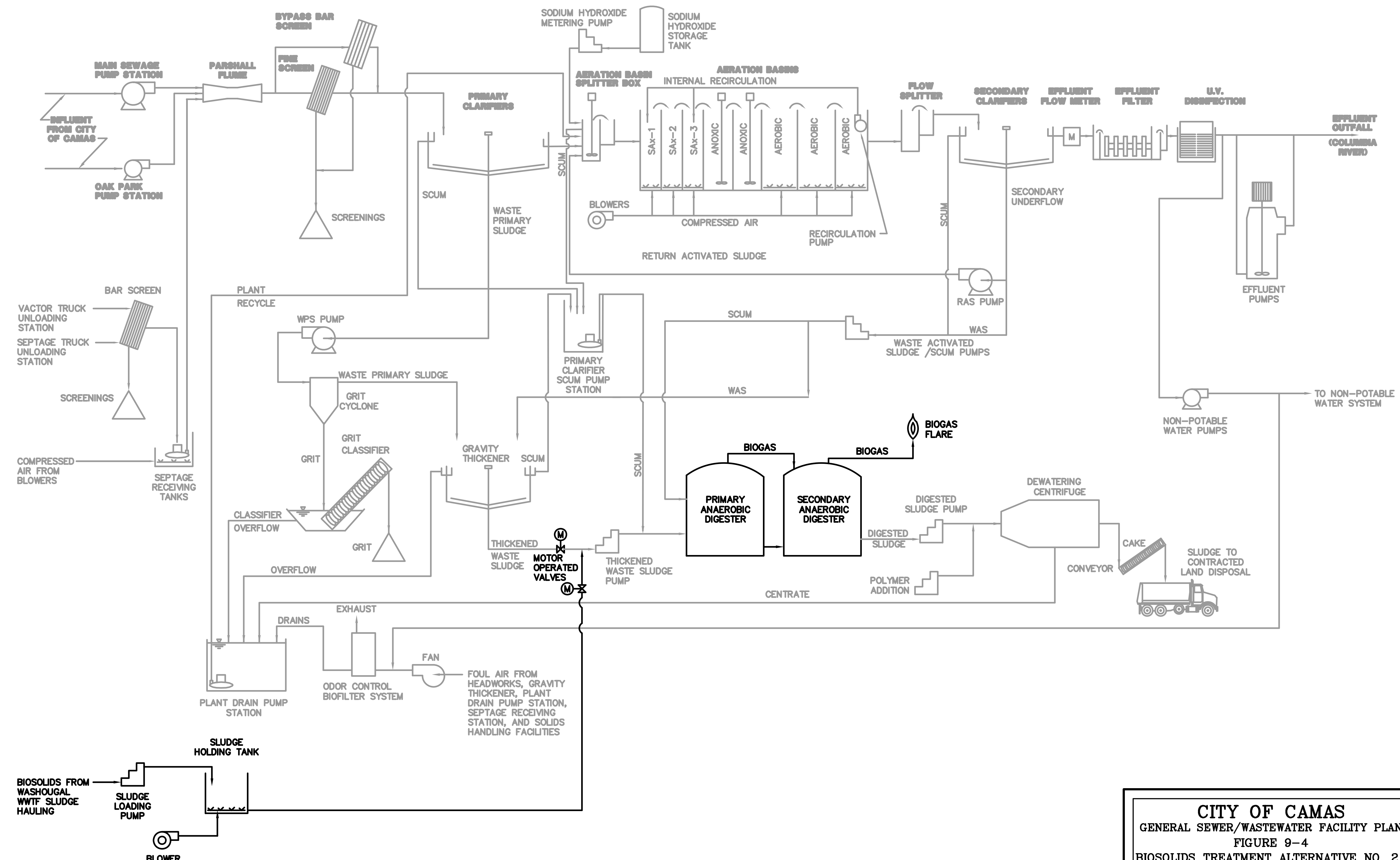

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9-4
BIOSOLIDS TREATMENT ALTERNATIVE NO. 2A
PROCESS FLOW SCHEMATIC

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L:\CAMAS\05471 WW Fac Plan\Figures\FIG9-4.dwg, 9-4, 9/29/2006 11:41:33 AM, 1:1, By: M NAGEL

biosolids together are evaluated. The biosolids management alternatives considered are listed below.

- Alternative No. 1A: Anaerobic Digestion of Camas WWTF Biosolids and Contract Disposal of Class B Biosolids
- Alternative No. 2A: Anaerobic Digestion of Camas and Washougal WWTF Biosolids and Contract Disposal of Class B Biosolids
- Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids
- Alternative No. 2B: Anaerobic Digestion of Camas and Washougal WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids

Alternatives No. 1A and No. 2A are discussed in the preceding sections of this chapter. Alternatives No. 1B and No. 2B are discussed below, followed by a comparison of all four alternatives.

ALTERNATIVE NO. 1B: ANAEROBIC DIGESTION OF CAMAS WWTF BIOSOLIDS FOLLOWED BY SLUDGE DRYING TO PRODUCE CLASS A BIOSOLIDS

A site layout and process flow schematic for Alternative No. 1B are presented on Figures 9-5 and 9-6, respectively. For this alternative, it is assumed that a new sludge dryer system will be installed at the existing Sludge Storage Building. A drying system with a capacity of 1.54 wet tons per hour is required. Based on the projected maximum month and annual average quantities of dewatered sludge at 20 percent solids, the dryer would have the following operational features:

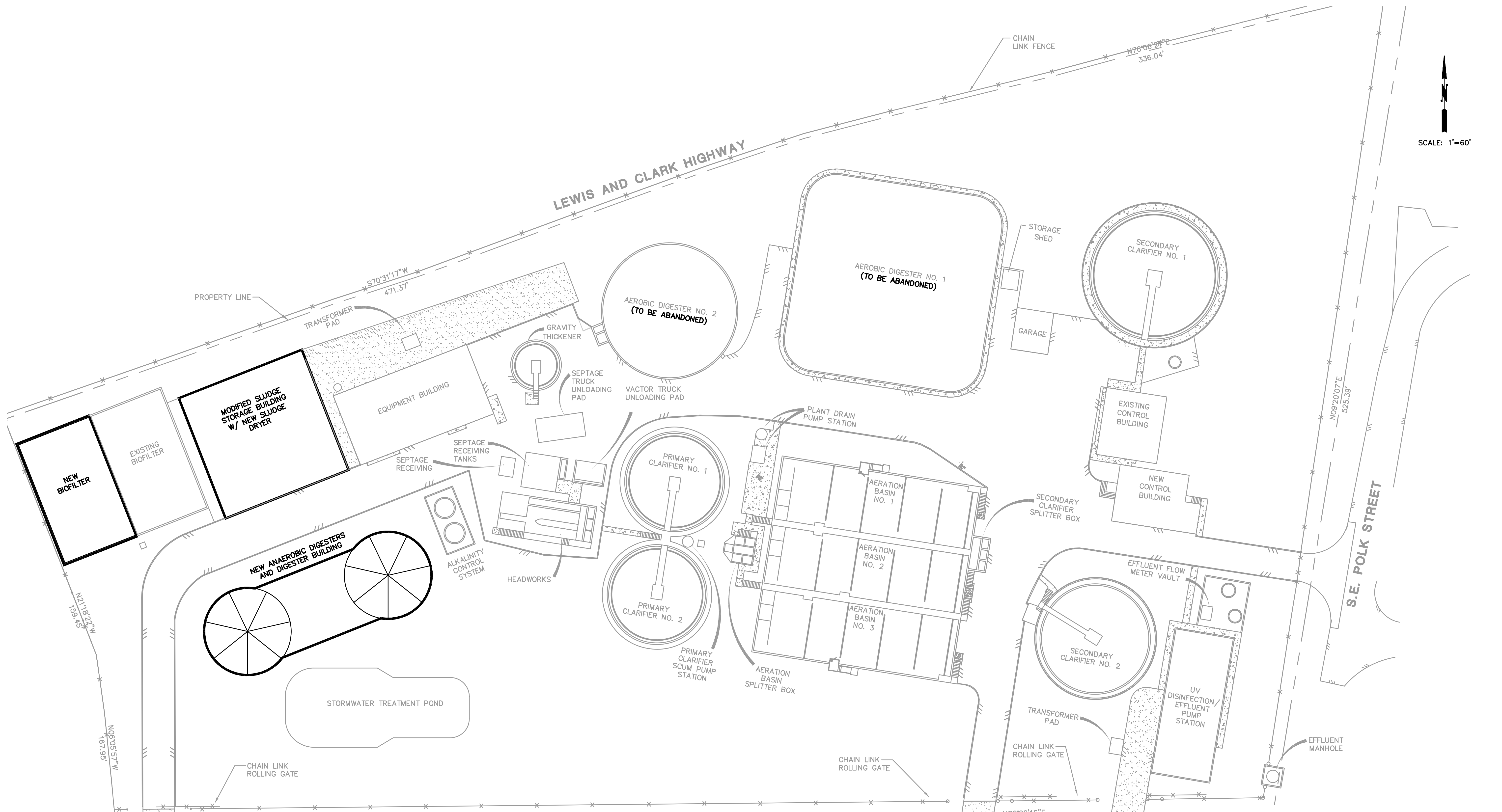
Sludge Dryer Operation	
Capacity	1.54 wet tons/hr
Hours of Operation/Workday (249 workday/yr)	
Maximum Month	16
Annual Average	12
Drying Energy Required	1,400 Btu/lb H_2O
Electricity Required	63 kW
Nonpotable Water Required	242 gpm
Potable Water Required	44 gpm

The existing Sludge Storage Building will be modified to be an enclosed structure to house the new sludge drying system. Providing an enclosed structure for the sludge drying system provides freeze protection of the system, allows for odor control, and increases the efficiency of the system during cold weather. Additional odor control facilities that would be installed for this alternative include a new additional biofilter,

biofilter fan, humidification tower, and odor control ducts. The design criteria for the odor control system are presented below:

Odor Control System	
Type	Biofilter
Quantity of Units	1 new, 1 existing
System Size	3,600 ft^2
Media Depth	63 inches
Biofilter Fan	
Type	Centrifugal
Quantity of Units	1 new, 1 existing
Fan Capacity	3,600 scfm
Fan Motor Size	15 hp

The capital and O&M costs associated with Alternative No. 1B are presented in Tables 9-9 and 9-10, respectively.



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9–5
BIOSOLIDS TREATMENT ALTERNATIVE NO. 1B
SITE PLAN

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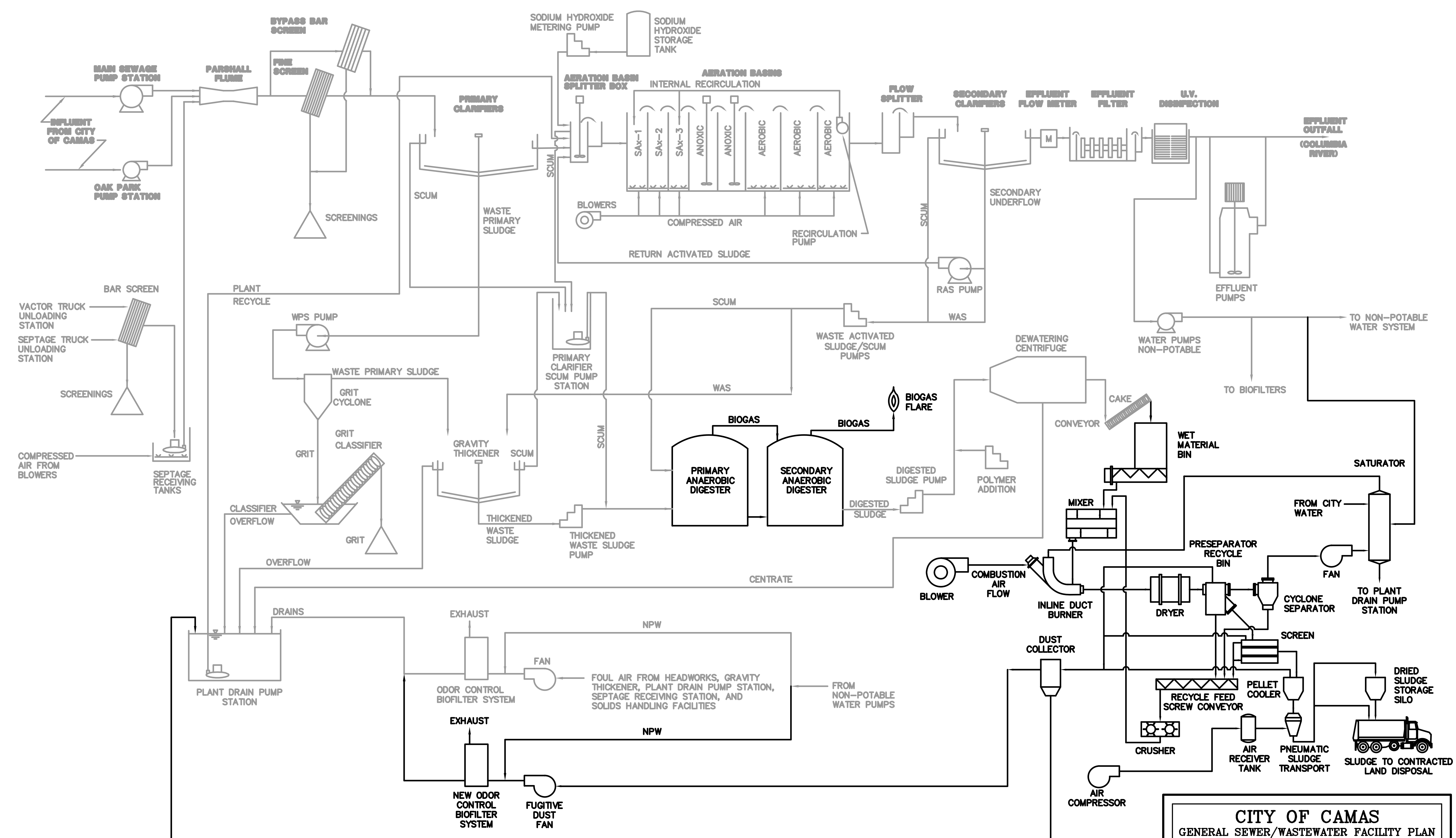

CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9-6
BIOSOLIDS TREATMENT ALTERNATIVE NO. 1B
PROCESS FLOW SCHEMATIC

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CONSULTING ENGINEERS

L:\CAMAS\05471 WW Fac Plan\Figures\FIG9-6.dwg, 9-6, 9/29/2006 11:40:15 AM, 1:1, By: M NAGEL

TABLE 9-9

Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids Preliminary Project Cost Estimate (2007 Dollars)

No.	Item	Quantity	Unit Price	Amount
1.	Mobilization/Demobilization	1 LS	$720,000	$ 720,000
2.	Demolition	1 LS	$40,000	$ 40,000
3.	Anaerobic Digester/Dig. Building	1 LS	$750,000	$ 750,000
4.	Digester Sludge Heating System	1 LS	$231,000	$ 231,000
5.	Digester Gas Equipment	1 LS	$152,000	$ 152,000
6.	Digester Covers	1 LS	$650,000	$ 650,000
7.	Digester Mixing System	1 LS	$300,000	$ 300,000
8.	Digester Recirculation Pumps	1 LS	$79,000	$ 79,000
9.	WAS/Septage/Centrate Tank	1 LS	$280,000	$ 280,000
10.	WAS Thickening System	1 LS	$237,000	$ 237,000
11.	Digested Sludge Pumps	1 LS	$40,000	$ 40,000
12.	Plant Drain Pump Station No. 2	1 LS	$70,000	$ 70,000
13.	Sludge Storage Building Modifications	1 LS	$185,000	$ 185,000
14.	Sludge Dryer System	1 LS	$2,300,000	$ 2,300,000
15.	Odor Control Filter and Equipment	1 LS	$252,000	$ 252,000
16.	Dewatering	1 LS	$75,000	$ 75,000
17.	Earthwork	1 LS	$100,000	$ 100,000
18.	Miscellaneous Metals	1 LS	$80,000	$ 80,000
19.	Painting	1 LS	$150,000	$ 150,000
20.	Site Work	1 LS	$120,000	$ 120,000
21.	Mechanical/Yard Piping	1 LS	$275,000	$ 275,000
22.	Electrical	1 LS	$520,000	$ 520,000

Subtotal ....$ 7,606,000
Construction Contingency (20%) ....$ 1,521,000
Subtotal ....$ 9,127,000
Washington State Sales Tax (7.9%) ....$ 721,000
Total Estimated Construction Cost...$ 9,848,000
Engineering, Administrative, and Legal Services (20%) ....$ 1,969,000
TOTAL ESTIMATED PROJECT COST $11,817,000

TABLE 9-10

Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids O&M Cost Estimate (Design Year 2025)

Item	Costs (Year 2007 $)
Labor ($38/hr)	$159,000
Power ($0.07/kWh)	$ 54,000
Polymer ($2.50/lb)	$ 48,000
Natural Gas ($1.15/therm)	$105,000
Potable Water ($4.80/ccf)	$ 50,000
Non-Potable Water ($1.00/ccf)	$ 58,000
Equipment Maintenance and Repair	$ 37,000
Testing/Permitting	$ 15,000
Total Annual Cost	**$526,000**

ALTERNATIVE NO. 2B: ANAEROBIC DIGESTION OF CAMAS AND WASHOUGAL WWTF BIOSOLIDS FOLLOWED BY SLUDGE DRYING TO PRODUCE CLASS A BIOSOLIDS

A site layout and process flow schematic for Alternative No. 2B are presented on Figures 9-7 and 9-8, respectively. For this alternative, it is assumed that a new sludge dryer system will be installed at the existing Sludge Storage Building. A drying system with a capacity of 2.54 wet tons per hour has been selected. Based on the projected maximum month and annual average quantities of dewatered sludge at 20 percent solids, the dryer would have the following operational features:

Sludge Dryer Operation	
Capacity	2.54 wet tons/hr
Hours of Operation/Workday (249 workday/yr)	
Maximum Month	12
Annual Average	11
Drying Energy Required	1,800 Btu/lb H_2O
Electricity Required	120 kW
Nonpotable Water Required	400 gpm
Potable Water Required	72 gpm

The existing Sludge Storage Building will be modified to be an enclosed structure to house the new sludge drying system. Providing an enclosed structure for the sludge drying system provides freeze protection of the system, allows for odor control, and increases the efficiency of the system during cold weather. Additional odor control facilities that would be installed for this alternative include a new additional biofilter,

biofilter fan, humidification tower, and odor control ducts. The design criteria for the odor control system are presented below:

Odor Control System	
Type	Biofilter
Quantity of Units	1 new, 1 existing
System Size	3,600 ft^2
Media Depth	63 inches
Biofilter Fan	
Type	Centrifugal
Quantity of Units	1 new, 1 existing
Fan Capacity	3,600 scfm
Fan Motor Size	15 hp

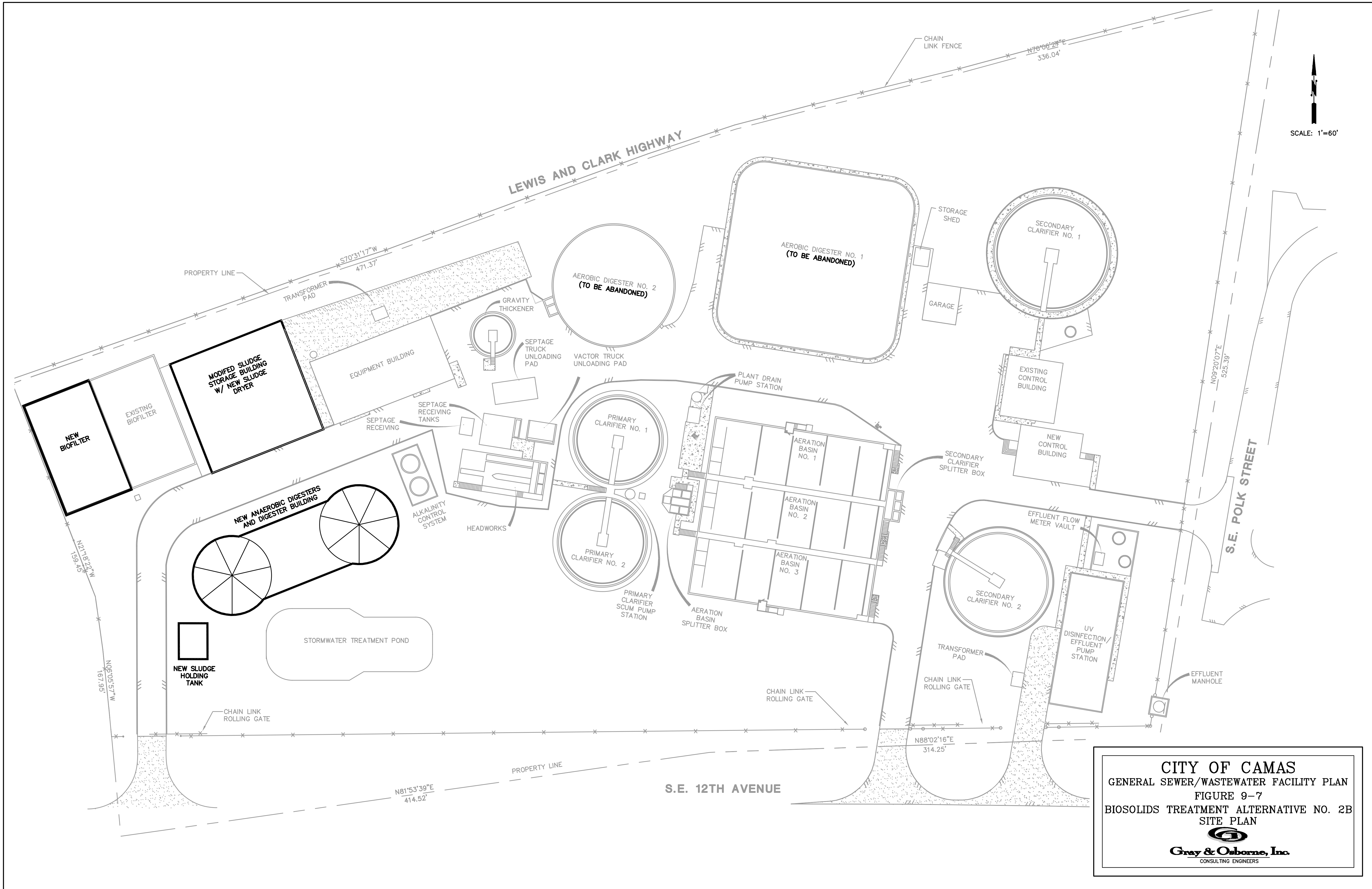
The capital and O&M costs associated with Alternative No. 2B are presented in Tables 9-11 and 9-12, respectively.

TABLE 9-11

Alternative No. 2B: Anaerobic Digestion of Camas and Washougal WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids Preliminary Project Cost Estimate (2007 Dollars)

No.	Item	Quantity	Unit Price	Amount
1.	Mobilization/Demobilization	1 LS	$540,000	$ 540,000
2.	Demolition	1 LS	$40,000	$ 40,000
3.	Anaerobic Digester/Dig. Building	1 LS	$1,150,000	$ 1,150,000
4.	Digester Sludge Heating System	1 LS	$253,000	$ 253,000
5.	Digester Gas Equipment	1 LS	$167,000	$ 167,000
6.	Digester Covers	1 LS	$650,000	$ 650,000
7.	Digester Mixing System	1 LS	$340,000	$ 340,000
8.	Digester Recirculation Pumps	1 LS	$87,000	$ 87,000
9.	WAS/Septage/Centrate Tank	1 LS	$300,000	$ 300,000
10.	WAS Thickening System	1 LS	$237,000	$ 237,000
11.	Digested Sludge Pumps	1 LS	$40,000	$ 40,000
12.	Plant Drain Pump Station No. 2	1 LS	$70,000	$ 70,000
13.	Sludge Storage Building Modifications	1 LS	$185,000	$ 185,000
14.	Sludge Dryer System	1 LS	$3,000,000	$ 3,000,000
15.	Odor Control Filter and Equipment	1 LS	$252,000	$ 252,000
16.	Dewatering	1 LS	$75,000	$ 75,000
17.	Earthwork	1 LS	$220,000	$ 220,000
18.	Miscellaneous Metals	1 LS	$90,000	$ 90,000
19.	Painting	1 LS	$160,000	$ 160,000
20.	Site Work	1 LS	$140,000	$ 140,000
21.	Mechanical/Yard Piping	1 LS	$330,000	$ 330,000
22.	Electrical	1 LS	$600,000	$ 600,000

Subtotal ....$ 8,926,000
Construction Contingency (20%) ....$ 1,785,000
Subtotal $10,711,000
Washington State Sales Tax (7.9%) ....$ 846,000
Total Estimated Construction Cost...$11,557,000
Engineering, Administrative, and Legal Services (20%) ....$ 2,311,000
TOTAL ESTIMATED PROJECT COST $13,868,000



CITY OF CAMAS
GENERAL SEWER/WASTEWATER FACILITY PLAN
FIGURE 9-7
BIOSOLIDS TREATMENT ALTERNATIVE NO. 2B
SITE PLAN

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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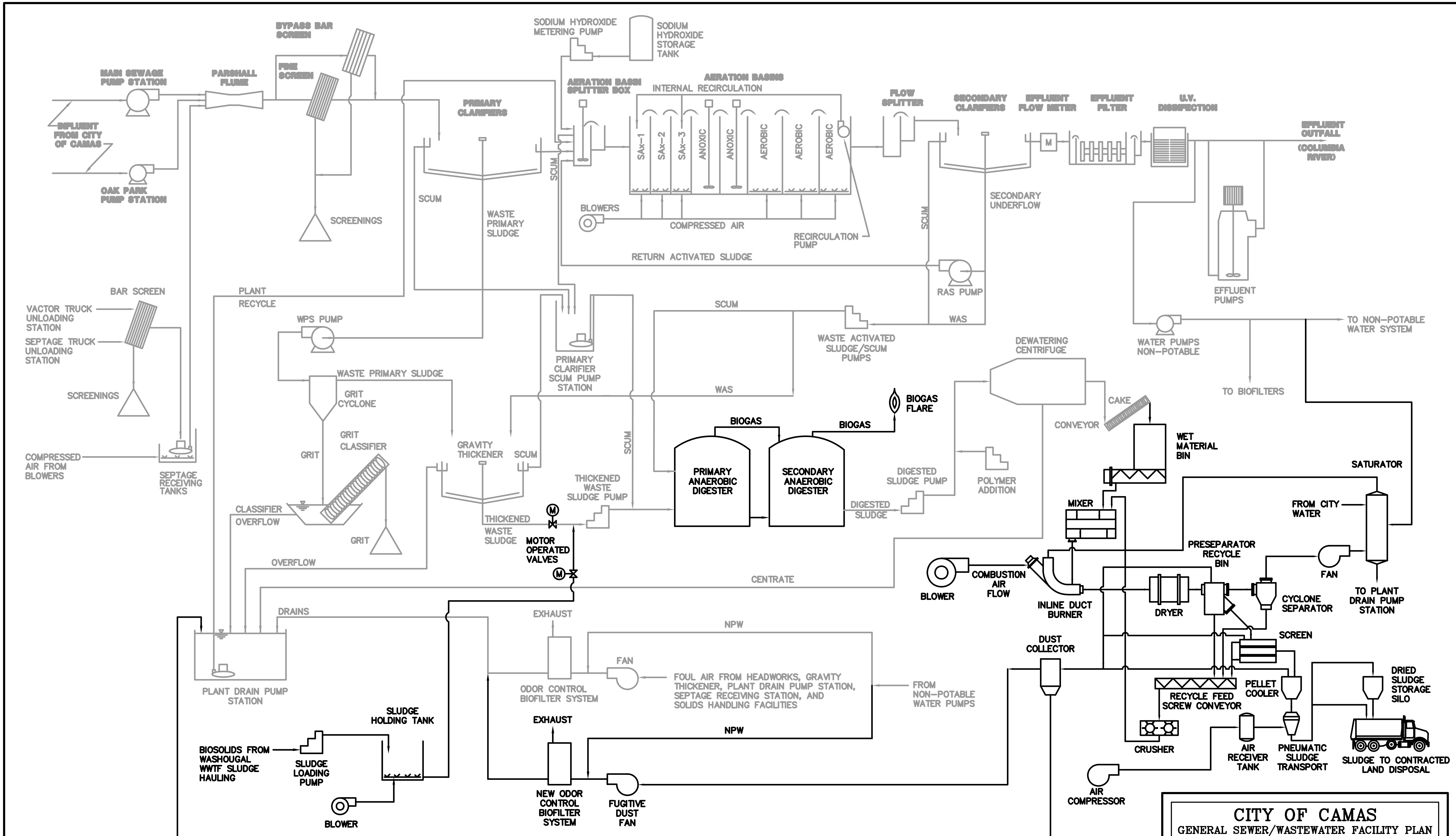

CITY OF CAMAS

GENERAL SEWER/WASTEWATER FACILITY PLAN

FIGURE 9-8

BIOSOLIDS TREATMENT ALTERNATIVE NO. 2B
PROCESS FLOW SCHEMATIC

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CONSULTING ENGINEERS

TABLE 9-12

Alternative No. 2B: Anaerobic Digestion of Camas and Washougal WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids O&M Cost Estimate (Design Year 2025)

Item	Costs (Year 2007 $)
Labor ($38/hr)	$159,000
Power ($0.07/kWh)	$ 93,000
Polymer ($2.50/lb)	$ 75,000
Natural Gas ($1.15/therm)	$207,000
Non-Potable Water ($1.00/ccf)	$ 33,000
Equipment Maintenance and Repair	$ 50,000
Testing/Permitting	$ 15,000
Total Annual Cost	**$632,000**

COMPARISON OF BIOSOLIDS TREATMENT AND DISPOSAL ALTERNATIVES AND SELECTED ALTERNATIVE

A comparison of the capital and annual operation and maintenance costs for the four biosolids treatment and disposal alternatives is provided in Table 9-13.

TABLE 9-13

Biosolids Treatment and Disposal Alternatives Comparison

Alternative	Capital Cost(1)	Annual O&M Cost(1)
No. 1A Anaerobic Digestion of Camas Biosolids and Contracted Hauling	$ 6,672,000	$421,000
No. 2A: Anaerobic Digestion of Camas and Washougal Biosolids and Contracted Hauling	$ 8,070,000	$609,000
No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids	$11,817,000	$526,000
No. 2B: Anaerobic Digestion of Camas and Washougal WWTF Biosolids Followed by Drying to Produce Class A Biosolids	$13,868,000	$632,000

(1) 2007 dollars.

The selected option is Alternative No. 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce Class A biosolids. This selection is based on: (1) Washougal's May 2007 decision to treat and manage their biosolids on their own, (2) concern regarding future viability of land application sites for Class B biosolids, and (3) the desires of Camas to control future biosolids management.

DIGESTER GAS TREATMENT

Digester gas typically contains methane concentrations of 60 to 70 percent, by volume, and carbon dioxide concentrations of 30 to 35 percent, by volume, along with trace amounts of nitrogen, hydrogen, and hydrogen sulfide. The heat content of biogas is typically between 500 and 700 Btu/ft^3, with an average design value of 640 Btu/ft^3 (WEF MOP-8, 2009). Heat for the primary digesters will be provided by a hot water boiler capable of burning either digester gas or commercial natural gas. Digester gas will also be used as fuel for the biosolids dryer. Excess gas will be burned in a waste gas burner. With design VSS destruction of 3,291 lb/d and gas production of 49,368 (ft^3/d), the design Ratio of Digester Gas to Liquid (v/v) is 20.6. Limits for sulfur emissions are in the City's clean air permit issued by the Southwest Washington Clean Air Association (SWCAA). The boiler, dryer and waste gas burner SO_2 limits are 2,853, 5,046, and 601 lb/yr, respectively. The WWTF Hydrogen Sulfide Emission Limit is 687 lb/yr.

Since the majority of sulfate conveyed to the anaerobic digester will typically be converted to sulfide, any increase in WWTF sulfate loading has the potential to increase sulfide in the digester. Generated sulfide (denoted total sulfide) consists of three species: H_2S (unionized sulfide or hydrogen sulfide), HS^- and S^{-2}. The dissolution of H_2S in water forms the equilibrium system:

$$H_2S \leftarrow\!=\!\rightarrow H^+ + HS \leftarrow\!=\!\rightarrow 2H^+ + S^{-2}$$

The decimal fraction of un-ionized H_2S (the toxic and volatile form) in solution is a function of pH and can be determined from the following equation:

$$H_2S = [1 + 1.02 * 10^{(pH-7)}]^{-1}$$

The percentage of un-ionized H_2S drops from 90 percent at pH 6.0 to 50 percent at pH 7.0 to 10 percent at pH 8.0. This variation is most significant in anaerobic treatment since the pH range of anaerobic reactors is maintained between pH 6.0 and 8.0 with the generally accepted optimal pH for methane production being between pH 6.8 and 7.5. Thus, a considerable portion of the sulfide formed in the digester will be present as hydrogen sulfide in the digester gas. Most of the hydrogen sulfide in the biogas will be converted to sulfur dioxide upon combustion in the boiler, sludge dryer, and waste gas burner, and these SO_2 and H_2S emissions are regulated.

As was determined in testing completed in 2009 and summarized in the *April 2010 Neutralized Sulfuric Acid Disposal Study, (Disposal Study),* the concentration of sulfate in Camas influent is higher than in typical domestic wastewater due to the presence of sulfate in industrial discharges. As measured in 2009, the Camas influent was four to five times stronger with respect to sulfate (140 to 150 mg/L vs. 30 mg/L) and about 50 percent stronger with respect to TDS (700 to 800 mg/L vs. 500 mg/L), relative to typical medium-strength domestic wastewater ranges noted in *Wastewater Engineering,* *Disposal and Reuse* (Metcalf and Eddy, 2003). Industrial discharges accounted for 25 to 40 percent of Camas WWTF influent daily flow and between 25 and 85 percent of Camas WWTF influent loadings for the major constituents evaluated, including more than 60 percent of the sulfate and TDS.

Proposed additional industrial sulfate loading could nearly double the amount of sulfate currently entering the plant. However, based on the information in the *Disposal Study*, it is projected that the increase in total sulfur entering the anaerobic digester will increase by a lesser amount (<20%) because most of the sulfur entering the digester appears to be in the biomass, and the additional proposed amount does not appear to concentrate significantly in the biomass. As shown in Table 9-14, it is projected that hydrogen sulfide concentrations as high as 0.9 percent may be present in the untreated digester gas. As discussed below, this concentration is high enough to cause problems with the boiler and biosolids dryer, as well as requiring additional treatment to meet SWCAA requirements.

The increase in digester gas has the potential to increase corrosion within the gas handling and heating systems and the new sludge dryer. Acids will form in locations where moisture is present, due to the combustion of H_2S, forming SO_2. Based on discussions with the sludge dryer manufacturer, it is recommended that the volumetric concentration of hydrogen sulfide in the digester gas not exceed 1 percent (10,000 ppm) to minimize corrosion and other impacts detrimental to equipment. In order to maximize the life of all the gas handling, heating, and dryer equipment, it is recommended that gas concentrations be kept well below this level. Because of this, a hydrogen sulfide removal system is being designed to be incorporated during the digester system construction.

Per discussion with Clint Lamoreaux, P.E., at SWCAA, the potential high hydrogen sulfide concentrations will likely result in the following requirements:

1. The City will need to submit a SWCAA permit modification application reflecting the higher projected digester gas concentration.

2. SWCAA will likely require reduction of the hydrogen sulfide concentrations in the digester gas, if the actual concentration approaches or exceeds 1 percent. The permit can be written such that this requirement goes into effect only if the concentrations are, in fact, as high (or nearly so) as projected since there is some uncertainty about the concentrations.

3. The requirement to reduce concentrations in digester gas, if imposed, would likely be based on a revised BACT evaluation. Per Mr. Lamoreaux, it is not expected that a human health evaluation (and ambient impact analysis) will drive the permit modification. However, if the concentrations are as high as or higher than 1 percent, SWCAA will have some safety concerns and will want to verify that all air release valves, etc., have adequate safeguards and all gas is combusted.

4. Based on additional discussion with Mr. Lamoreaux (phone conversation, August 2010), the digester gas will need to be treated to remove hydrogen sulfide to 0.1 percent (1,000 ppm). Based on this requirement, the target treated hydrogen sulfide concentration is 0.05 percent (500 ppm).

Several technologies are available to control hydrogen sulfide in digester gas. The desired percent removal for the Camas system is 94 to 95 percent, as shown in Table 9-14. Potential liquid phase controls include iron precipitation and pH control. Precipitation of iron sulfide has relatively low capital costs but typically has relatively high chemical costs and increased sludge production. In other plants that use iron compounds, the iron has precipitated on the sleeves housing ultraviolet disinfection lamps, leading to significant increases in the glass sleeve cleaning frequency. The pH control option has been shown to have relatively high chemical costs. Although increasing the pH will reduce hydrogen sulfide generation in the digester, digester performance may be affected and the biosolids produced may have more odors, especially when mixed with other materials (topsoil, compost, etc.) when the pH is closer to neutral.

TABLE 9-14

Projected Flows and Concentrations of Solids and Sulfur Entering the Digester at Startup and Projected 2025 Operating Conditions

	Units	2012 (Startup) Average Annual	2012 (Startup) Maximum Month	2025 Average Annual	2025 Maximum Month
Digester Gas Production	ft^3/d	25,045	34,131	36,258	49,368
Ratio of Dig. Gas to Liquid Feed	v/v	20.6	20.6	20.6	20.5
Estimated Max. Hydrogen Sulfide Concentration in Digester Gas	% (mg/kg)	0.88% (8,800)	0.86% (8,600)	0.84% (8,400)	0.83% (8,300)
Minimum Removal Requirements					
SWCAA Required Treated Hydrogen Sulfide Concentration in Digester Gas	% (mg/kg)	0.10% (1,000)	0.10% (1,000)	0.10% (1,000)	0.10% (1,000)
Required Percent Removal		88.6%	88.4%	88.0%	87.9%
Removal Requirements with Safety Factor					
Target Treated Hydrogen Sulfide Concentration in Digester Gas	% (mg/kg)	0.05% (500)	0.05% (500)	0.05% (500)	0.05% (500)
Desired Percent Removal	%	94.3%	94.2%	94.0%	94.0%

Gas phase treatment alternatives are available, each with its own advantages and disadvantages, including catalytic oxidation, wet chemical scrubbers, iron sponge scrubbers, and biological oxidation. Based on discussion with staff at the Fox Metro Water Reclamation District in Illinois who successfully remove sulfide from digester gas with an iron sponge filter, use of an iron sponge filter is a promising alternative. Per

Katehis, et al. (2003), iron sponge and dry iron oxide filter systems typically are the most cost-effective systems for removal of up to 100 to 200 pounds of sulfur a day (the range at Camas). Based on this guidance, the discussions with Fox Metro and other plants and consultation with City staff, an iron sponge filter is being designed to remove H_2S from the gas stream. The system will be installed immediately downstream of the digester, after the condensate and sediment trap or condensate accumulator. The iron sponge uses iron-oxide impregnated wood chips as a scrubbing media. Hydrogen sulfide reacts with iron oxide to form elemental iron, elemental sulfur, and water. The iron sponge requires periodic regeneration, which is accomplished by the injection of air to the system, resulting in the removal of the sulfur and re-oxidation of iron to form iron oxide.

The recommended system is a MARCAB Model 1207-756 Gas Scrubber, or equivalent. This unit is 12 feet in diameter with an overall height of approximately 11 feet. The unit would be equipped with an in-vessel regeneration system and contain 756 cubic feet of Iron Sponge. At 36,258 cubic feet per day and 8,300 ppm of sulfide, the media would last approximately 6 months prior to the first regeneration. At that time, the vessel would be taken offline, filled with water, and have air bubbled through it to re-oxidize it. This would be performed again at approximately 10 months and a final time prior to media replacement at approximately 12 months (average annual media cost is approximately $16,000). After the final regeneration of the media, it is vacuumed out and disposed of at a standard landfill. A smaller iron sponge system, with 3 days' worth of iron, will be provided as a backup when the main gas scrubber is out of service. Isolation valves and piping will be installed for converting between the two units. Additional information regarding the design of the digester gas treatment system is included in Appendix U.

The estimated total project cost for engineering, permitting, and constructing the digester gas treatment system is $500,000, and projected annual operating costs *at 2025 design conditions* are $25,000. When these estimated capital and operating costs are added to the cost for the selected biosolids alternative (Alternative 1B: Anaerobic Digestion of Camas WWTF Biosolids Followed by Sludge Drying to Produce Class A Biosolids) the total capital and annual operating cost estimates are $12,317,000 and $551,000, respectively. The installation of this digester gas treatment system is planned to be completed in Phase 2B in 2012.

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CHAPTER 10

EVALUATION OF REUSE

INTRODUCTION

Wastewater reclamation can potentially be cost effective through reducing potable water costs, creating an additional new water supply, and generating revenue by selling reclaimed water to customers for irrigation and other non-potable water uses. The production and beneficial use of reclaimed water is the development of a new water supply. This chapter presents an evaluation of the feasibility of reusing effluent from the City of Camas WWTF or constructing a new water reclamation facility (WRF) to treat wastewater and produce water for reuse.

REGULATIONS CONCERNING REUSE

The regulations governing water reuse in the State of Washington are the Water Reclamation and Reuse (Reuse) Standards (September 1997). The Reuse Standards, which were developed jointly by the Washington Departments of Health and Ecology, are directed primarily toward the public health aspects of water reuse. The use of reclaimed water must also meet the applicable water quality standards. An application to a surface water body is required to comply with the Surface Water Quality Standards (WAC 173-201A). Likewise, an application of reclaimed water to groundwater is required to comply with the Groundwater Quality Standards (WAC 173-200).

WATER RECLAMATION AND REUSE STANDARDS

The legislation authorizing water reuse in this state, Chapter 90.46 RCW, Reclaimed Water Use, was passed in 1992. This initial legislation required the Washington Departments of Health (DOH) and Ecology (Ecology) to jointly develop interim standards for the implementation of water reclamation and reuse. The Water Reclamation and Reuse Interim Standards were issued as interim standards in 1993 and became final in September 1997. The Department of Ecology is currently drafting an update to the Standards; the update is expected to be promulgated in 2009-2010.

The Reuse Standards apply to reclaimed wastewater that is utilized for a direct beneficial use. The primary focus of the Reuse Standards is to provide for the protection of public health.

TREATMENT CRITERIA

The Reuse Standards establish the treatment and water quality requirements for reclaimed water based on four classifications, Class A, B, C and D, and the class necessary for application to various uses. The class of reclaimed water is dependent upon the degree of stabilization and disinfection provided by the treatment process *prior* to any reuse application. Class A is the highest quality of reclaimed water, while Class D is essentially the equivalent of a wastewater effluent meeting secondary treatment standards. These treatment requirements are shown in Table 10-1.

TABLE 10-1

Reclaimed Water Treatment Requirements

Reuse Class	Continuously Oxidized[(1)]	Continuously Coagulated[(2)]	Continuously Filtered[(3)]	Disinfection[(4)] (Total Coliform Density)	
				7-Day Median Value	Single Sample
D	Yes	No	No	≤240/100 mL	No standard
C	Yes	No	No	≤23/100 mL	240/100l
B	Yes	No	No	≤2.2/100m1	23/100 mL
A	Yes	Yes	Yes	≤2.2/100 mL	23/100 mL

(1) **Continuous Oxidation.** Oxidized wastewater is defined as wastewater in which the organic matter has been stabilized. The concentration of five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) cannot exceed 30 mg/L on a monthly average basis. The wastewater must be non-putrescable (i.e., no foul smell) and must contain dissolved oxygen.

(2) **Continuous Coagulation.** Coagulated wastewater is defined as an oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated prior to filtration by the addition of chemicals or an equally effective method.

(3) **Continuous Filtration.** Filtered wastewater is defined as an oxidized, coagulated wastewater that has been passed through natural undisturbed soils or filter media, such as sand or anthracite. The resulting turbidity, as determined by an approved laboratory method, cannot exceed an average operating turbidity of 2 nephelometric turbidity units (NTU) on a monthly average basis. The turbidity cannot exceed 5 NTU at any time. The turbidity must be monitored continuously.

(4) **Disinfection.** Disinfected wastewater is defined as wastewater in which pathogenic organisms have been destroyed by physical, chemical or biological means. Disinfection standards generally use coliform density as the representative measure of pathogen destruction.

GROUNDWATER RECHARGE

Reclaimed water may be used to recharge groundwater by surface percolation or through direct injection. Reclaimed water must meet Class A treatment criteria in order to be used for groundwater recharge by surface percolation. The quality of the reclaimed water must also meet the "groundwater recharge criteria," which are defined in the Reuse Standards as the equivalent of the DOH Drinking Water Standards. A major contaminant of concern in groundwater is nitrate nitrogen (NO_3^--N). The Reuse Standards contain a requirement that, for surface percolation, the treatment process "include an additional step to reduce nitrogen prior to the final discharge to groundwater."

Groundwater recharge projects must also be in compliance with the state's groundwater regulations in Chapter 173-200 WAC. This regulation contains groundwater quality criteria that are to be met in the saturated zone. The groundwater quality criteria are very similar to the Drinking Water Standards, and consequently, the groundwater recharge criteria mentioned above.

Direct injection is permitted to a drinking water aquifer as well as a non-drinking water aquifer. The treatment criteria for direct injection, particularly to a drinking water aquifer, require additional treatment beyond that required to produce Class A reclaimed water. Groundwater recharge through direct injection is not considered as a potential use for reclaimed water in Camas because there are several other alternatives available to the City at this time that do not require the additional treatment beyond Class A. Therefore, additional discussion of the treatment requirements for direct injection will not be presented here.

Recharge of groundwater with reclaimed water would require a State Waste Discharge Permit issued by Ecology. Ecology may also require the development of a groundwater monitoring program to ensure degradation does not occur. Application of Class A reclaimed water to land for the purpose of irrigation, if applied at agronomic rates with no intent to recharge the groundwater, is not expected to require a State Waste Discharge Permit or a groundwater monitoring program.

STREAMFLOW AUGMENTATION

Reclaimed water may be discharged to provide flow augmentation to a stream for flow enhancement, fish and wildlife habitat, irrigation supply, or water right replenishment or transfer. A beneficial use of the reclaimed water must be established for the project to be accepted as a stream flow augmentation project.

Discharge of reclaimed water for the purpose of stream flow augmentation must comply with Chapter 173-201A WAC, the regulation that establishes water quality standards for surface water in this state. A stream flow augmentation project would require review and approval by the Washington Department of Fish and Wildlife (WDFW). If in stream work was necessary, a Hydraulic Project Approval (HPA) from WDFW might also be required. Streamflow augmentation is a potential option for reuse for the City of Camas.

RELIABILITY CRITERIA

The level of treatment reliability required for water reclamation facilities is a major difference from conventional wastewater treatment. The Reuse Standards require *continuous* compliance, which means that the treatment standard must be met on a continuous basis or the treated water cannot be used as reclaimed water.

The Reuse Standards contain a number of operational and reliability requirements for a water reclamation facility. Some key requirements are summarized below:

- Equipment and process failures must be signaled by an alarm condition.
- Emergency storage or disposal must be provided in the event of plant failure.
- Bypassing of treatment facilities to the point of use is not allowed for untreated or partially treated water.
- Standby power supply must be provided for alarms and automatic actuating valves and other equipment and devices necessary to provide immediate short-term disposal or storage upon failure of any treatment system component.
- Operators must be certified to the levels required of municipal wastewater treatment plants with similar process equipment.
- Operating records must be provided to DOH as well as Ecology.

ALTERNATIVE DISPOSAL AND STORAGE

Short-term storage or an alternative disposal system (e.g., an outfall) must be provided for use in situations where the reclaimed water cannot be used due to bad weather, reduced demand, etc. Provision must also be made for storage or disposal of water that does not meet the treatment and water quality criteria, perhaps due to a treatment upset, equipment failure, etc. If the facility does not have an outfall discharge or some other disposal alternative, emergency storage must be provided for at least 20 days of flow. Storage areas must be equipped with pumps and valving to route the inadequately treated water back through the reclamation facility once it is operating properly. Diversion to a different type of reuse requiring a lesser quality of reclaimed water is also possible if the quality is sufficient for that particular use.

REDUNDANT PROCESS UNITS AND EQUIPMENT

The Reuse Standards require reliability for individual treatment units such as biological treatment, secondary clarification, coagulation, filtration, and disinfection. Generally, if long-term storage or an alternative disposal method is not available, one of two reliability features must be provided: (1) the facility must have redundant units each capable of treating the entire flow or (2) short-term storage with standby replacement equipment provided. The City of Camas has an alternative disposal method, the outfall, and therefore, is not required to provide redundant units or short-term storage. Coagulation and chlorination unit processes must have standby chemical feed equipment provided, regardless of storage and disposal options, to ensure uninterrupted chemical feed.

REUSE AREA CRITERIA

The Reuse Standards include a number of requirements that apply to the actual point of use for the reclaimed water. These requirements are primarily for the protection of public health, although some apply to operation and maintenance concerns and water quality protection.

Reclaimed Water Classification by Type of Use

Table 10-2 presents a comprehensive list of approved uses of reclaimed water and the class of reclaimed water required for each. It is recommended that if the City of Camas wishes to produce reclaimed water, Class A water be produced to allow for maximum reuse opportunity. Class A reclaimed water is approved for all identified uses of reclaimed water listed in Table 10-2. There are no public health limitations on its use except that it cannot be used for potable drinking water. Additional treatment would be required for the reclaimed water to be utilized for direct aquifer recharge through groundwater injection.

TABLE 10-2

Reclaimed Water Classification by Type of Use

Use	Class of Reclaimed Water Required			
	Class A	Class B	Class C	Class D
Irrigation of Non-Food Crops				
Trees and fodder, fiber, and seed crops	YES	YES	YES	YES
Sod, ornamental plants for commercial use, pasture to which milking cows or goats have access	YES	YES	YES	NO
Irrigation of Food Crops				
Spray Irrigation:				
All food crops	YES	NO	NO	NO
Food crops which undergo physical or chemical processing sufficient to destroy all pathogenic agents	YES	YES	YES	YES
Surface Irrigation:				
Food crops where there is no reclaimed water contact with edible portion of crop	YES	YES	NO	NO
Root crops	YES	NO	NO	NO
Orchards and vineyards	YES	YES	YES	YES
Food crops which undergo physical or chemical processing sufficient to destroy all pathogenic agents	YES	YES	YES	YES
Landscape Irrigation				
Restricted access areas (e.g. cemetaries, freeway landscaping)	YES	YES	YES	NO
Open access areas (e.g. golf courses, parks, playgrounds, etc.)	YES	NO	NO	NO
Impoundments				
Landscape impoundments	YES	YES	YES	NO
Restricted recreational impoundments	YES	YES	NO	NO
Nonrestricted recreational impoundments	YES	NO	NO	NO
Fish Hatchery Basins	YES	YES	NO	NO
Decorative Fountains	YES	NO	NO	NO
Flushing of Sanitary Sewers	YES	YES	YES	YES
Street Cleaning				
Street sweeping, brush dampening	YES	YES	YES	NO
Street washing, spray	YES	NO	NO	NO
Washing of Corporation Yards, Lots, and Sidewalks	YES	YES	NO	NO
Dust Control (Dampening Unpaved Roads, Other Surfaces)	YES	YES	YES	NO
Dampening of Soil for Compaction (Construction, Landfills, etc)	YES	YES	YES	NO
Water Jetting for Consolidation of Backfill Around Pipelines				
Pipelines for reclaimed water, sewage, storm drainage, gas, electrical	YES	YES	YES	NO
Fire Fighting and Protection				
Dumping from aircraft	YES	YES	YES	NO
Hydrants or sprinkler systems in buildings	YES	NO	NO	NO
Toilet and Urinal Flushing	YES	NO	NO	NO
Ship Ballast	YES	YES	YES	NO
Washing Aggregate and Making Concrete	YES	YES	YES	NO
Industrial Boiler Feed	YES	YES	YES	NO
Industrial Cooling				
Aerosols or other mist not created	YES	YES	YES	NO
Aerosols or other mist created (e.g. cooling towers, spraying)	YES	NO	NO	NO
Industrial Process				
Without exposure of workers	YES	YES	YES	NO
With exposure of workers	YES	NO	NO	NO

Setbacks from Potable Water Systems

The Reuse Standards establish criteria for siting and identifying water reclamation projects and their facilities. Water reclamation storage facilities, valves and piping must be clearly labeled and adequate measures must be taken to prevent cross connections between potable water and reclaimed water lines. Minimum separation distances between reclaimed water lines and potable water lines are similar to those required for sewer lines. A minimum horizontal separation of 10 feet and a minimum vertical separation of 18 inches must be maintained between the two.

The Reuse Standards also include setback requirements for the four classifications of reclaimed water. Setback distances are required from potable water supply pipelines, wells, property lines, water bodies, etc.; distances vary depending on the class of reclaimed water. Table 10-3 summarizes setback requirements for water reclamation facilities.

TABLE 10-3

Setback Distances for Reclaimed Water

	Minimum Distance to Potable Water Well (Feet)			
Reclaimed Water Use/Facility	**Class A**	**Class B**	**Class C**	**Class D**
Spray or Surface irrigation	50	50	100	300
Unlined storage pond or impoundment	500	500	500	1000
Lined storage pond or impoundment	100	100	100	200
Pipeline	50	100	100	300
Minimum distance between irrigation area and public areas	0	50	50	100

Cross-Connection Control Requirements

The proponent of a water reuse program is required to establish a cross-connection control and inspection program consistent with WAC 246-290-490 to prevent contamination of the potable water supply. The program must be developed in coordination with the potable water supplier and be reviewed and approved by DOH. Documentation must address cross-connection control equipment, oversight responsibilities, and operation, inspection and testing activities.

All valves, piping, outlets, and storage facilities in the reclaimed water system must be clearly identified as containing reclaimed water with a warning against use as drinking water. The public must be provided notification of the use of reclaimed water at all use areas with signs, written notices, or other methods.

Residual Chlorine Requirements for Distribution System Protection

The Reuse Standards recommend that a chlorine residual of 0.5 mg/L be maintained during conveyance from the reclamation plant to the use area. This provision is meant as an operation and maintenance measure to prevent biological growth in the pipeline and sprinkler heads.

GROUNDWATER QUALITY

The State of Washington recognizes the potential benefit of replenishing groundwater with reclaimed water, thus, groundwater recharge is allowed under current state regulations. As stated previously, a discharge of reclaimed water to groundwater for the purpose of recharge must comply with Chapter 173-200 WAC, the Groundwater Quality Standards. The Groundwater Quality Standards apply to all groundwaters of the state that occur in the saturated zone beneath the land surface. While groundwater may support a number of beneficial uses, the overriding basis for the regulations is to protect all groundwater as a potential drinking water source. Accordingly, the groundwater quality criteria in WAC 173-200 are human health based standards, which, for many parameters, are equivalent to the DOH Drinking Water Standards.

PARAMETERS OF CONCERN

According to the regulations, the reclaimed water must be applied in a manner that “will not cause pollution of any groundwaters below the root zone.” Compared to surface water, groundwater is relatively immobile. Groundwater residence times can vary from a few weeks to thousands of years. This fact alone makes the assimilative capacity of groundwater limited. Once reaching an underground aquifer the physical and chemical characteristics of water change slowly.

The parameters of major concern with the recharge of reclaimed municipal wastewater are nitrogen and pathogenic bacteria. The Reuse Standards require treatment equivalent to Class A reclaimed water for groundwater recharges by surface percolation. This treatment level is expected to ensure that pathogen levels in the groundwater will not exceed drinking water standards (<1 total coliform/100 mL).

Nitrate nitrogen (NO_3^--N) is the form of nitrogen of greatest concern because of its potential impact on human health. The groundwater standard for nitrate is 10 mg/L, the same as the current drinking water standard. Nitrate is a highly soluble and mobile species. If it is not taken up in the root zone, it will readily migrate to groundwater. Reduced forms of nitrogen such as organic nitrogen and ammonia are readily oxidized to nitrate. Reduction of total nitrogen (TN) to less than 10 mg/L prior to land application is required if application rates exceed agronomic requirements. If agronomic application rates are used it is not essential that the applied water is <10 mg/L TN; however, monitoring of groundwater and soil is a prudent step to ensure groundwater quality is not adversely affected by the application.

ANTIDEGRADATION

The goal of the Groundwater Quality Standards is to prevent degradation of groundwater quality beyond existing background conditions. Degradation to the extent that pollutant concentrations exceed background levels can be allowed when "an overriding consideration of the public interest will be served" and "all contaminants have been provided with all known, available, and reasonable methods of prevention, control and treatment (AKART) prior to entry." This policy is known as "anti-degradation."

Chapter 90.46 RCW, however, includes language that allows additional flexibility for the use of reclaimed water. The legislation states that reclaimed water may be applied to groundwater if the reclaimed water meets the "groundwater recharge criteria." The groundwater recharge criteria are defined in RCW 90.46 as "contaminant criteria found in the drinking water quality standards adopted by the State Board of Health." This allowance, in effect, supersedes the anti-degradation policy stated in the Groundwater Quality Standards. When reclaimed water is used to recharge groundwater (i.e., penetrate below the root zone) by surface spreading, it is only necessary that the application not cause the DOH Drinking Water Standards to be exceeded in the groundwater that is being recharged.

MONITORING

It is anticipated monitoring would be required for a groundwater recharge project to monitor groundwater impacts and ensure there is no significant degradation. When establishing a monitoring program, it is generally necessary to determine ambient groundwater conditions including the direction of flow and groundwater quality up gradient of the land application area. This characterization is based on a minimum of eight samples taken over a period of not less than 12 months, with no two samples taken in the same month. Ongoing monitoring requirements would be established by Ecology in the State Waste Discharge Permit.

SURFACE WATER QUALITY

The discharge of reclaimed water to surface water to augment streamflow will be subject to Chapter 173-201A WAC, the State Surface Water Quality Standards. The Surface Water Quality Standards are based on maintaining public health, recreational use and protection of fish, shellfish and wildlife. Surface water quality standards are broken into five groups: AA (extraordinary), A (excellent), B (good), C (fair) and Lake Class. Each class has its own characteristic use and measurable criteria. Parameters used to distinguish the different surface water classifications include fecal coliform, dissolved oxygen, temperature, pH and turbidity. The surface water quality criteria include 29 toxic substances, including ammonia, residual chlorine, several heavy metals, polychlorinated biphenyls (PCBs) and common and persistent pesticides.

The goal of the surface water quality standards is to maintain existing beneficial uses of surface water by preventing degradation of existing water quality. However, some allowances are made for discharges into a surface water that enable a temporary or mitigated degradation to occur. These allowances are made by establishing *mixing zones* and determining the *assimilative capacity* of the receiving water.

MIXING ZONES

Mixing zones may be granted when the water quality criteria cannot be achieved by the wastewater treatment process. Before a mixing zone is granted, the discharger is required to apply AKART, "all known, available, and reasonable methods of prevention, control, and treatment," prior to discharge. AKART represents the most current methodology that can be reasonably required for preventing, controlling or treating the pollutants in the discharge.

The mixing zone is the portion of the water body where mixing results in the dilution of the discharge with the receiving water. If a mixing zone is granted, water quality standards may be exceeded within the mixing zone. However, at the outer limit of the mixing zone, water quality standards must be met. For toxic substances, the standards include acute and chronic toxicity criteria that may result in both acute and chronic mixing zones.

ASSIMILATIVE CAPACITY

Assimilative capacity describes the surface water's ability to accept pollutant loadings without a permanent degradation of water quality and impairment of beneficial uses. Ecology annually conducts waste load capacity studies for watersheds across the state. The studies are used to determine the assimilative capacity of the water body for various pollutants such as BOD_5, chlorine, ammonia, metals, etc. For example, the assimilative capacity of a surface water with respect to BOD_5 will be based on the mass of an oxygen-depleting substance (e.g., organic matter and ammonia) that can be discharged into a surface water without depleting dissolved oxygen to levels that would be detrimental to aquatic life.

TECHNOLOGY-BASED VERSUS WATER QUALITY-BASED STANDARDS

Treatment of discharges to surface water from wastewater treatment facilities are required to meet minimum "technology-based" standards for secondary treatment presented in Chapter 173-221-040 WAC. The technology-based standards are presented in Table 10-4.

TABLE 10-4

Technology-Based Standards

Parameter	Monthly Average	Weekly Average
BOD_5	30 mg/l	45 mg/l
TSS	30 mg/l	45 mg/l
Fecal Coliform(1)	200/100 ml	400/100 ml
pH	Between 6.0 and 9.0	

(1) Geometric average.
(2) Monthly average removal cannot be less than 85 percent.

If these minimum limits are not sufficient for the discharge to meet the "water quality-based" standards established in WAC 173-201A, more stringent limits and/or additional limits must be developed by Ecology. For water reclamation facilities, the "health-based" criteria established in the Reuse Standards would supersede water quality criteria for parameters that are more stringent (e.g., total coliform).

PARAMETERS OF CONCERN

The primary parameters of concern in providing stream flow augmentation with reclaimed water are dissolved oxygen, temperature, nitrogen, phosphorous, chlorine, and potentially metals. Dissolved oxygen is critical for the viability of aquatic life in the stream. It can be depleted through the breaking down of organic matter and the conversion of ammonia-nitrogen to nitrate-nitrogen. Ammonia, chlorine, and metals are toxic to fish and other aquatic life at levels above the water quality criteria. Elevated temperature is detrimental and even fatal to aquatic life and results in lower dissolved oxygen levels.

WATER RIGHTS

RCW 90.46.120 states that "the Owner of a wastewater treatment facility that is reclaiming water with a permit issued under this chapter has the exclusive right to any reclaimed water generated by the wastewater treatment facility."

However, guidance from Department of Ecology indicates that the reclaimed water should normally be retained and utilized in the general use area or basin from which the water originated and for which the original water right was issued. The Reuse Standards require proponents of groundwater recharge projects to provide information on the intended water rights status (i.e., artificial storage or abandonment of the reclaimed water). RCW 90.46.120 further states that when proposed uses of reclaimed water are intended to augment or replace potable water supplies, such uses must be reflected in the potable water purveyor's water comprehensive plan.

The City of Camas would hold the water rights for most of the water being transported to the water reclamation facility, and as the producer of the reclaimed water, would retain the water rights over it. It is not anticipated at this time that holding the rights to the reclaimed water would impact the potable water rights currently held by the City. However, the City would need to perform a Water Rights Impairment Analysis for any uses of its reclaimed water. This analysis is required by the Water Reclamation and Reuse Standards to ensure that any diversions that occur due to new reclaimed water uses will not impair the previous uses of the water or infringe on the City's rights to the water. This issue will be of particular concern in evaluating groundwater recharge and stream flow augmentation projects because the City will not want to surrender any rights to its reclaimed water.

CURRENT WATER SYSTEM

Based on the water rights analysis in the City's *2001 Water System Comprehensive Water System Plan*, the City of Camas currently does not have adequate water supply capacity to meet maximum day demand requirements through the year 2020. However, since the 2001 Plan, the City has maximized their current sources and is in the process of securing water rights to meet the demands over the next twenty years. The *2001 Water System Comprehensive Plan* sited several alternatives for the City to maximize current sources and developed a CIP to ensure adequate water rights to meet the demands for the 20-year planning period. The following list updates the completed projects and status of remaining projects:

- In an effort to maximize capacities of existing sources and water rights the City has:

    - Replaced Well Nos. 1, 2, and 3 with Well Nos. 10, 11, and 12; and
    - Replacement well for Well No. 4 has been drilled and will be equipped in 2007.

- The City is in the process of transferring existing water rights from Georgia Pacific to the City.

- The City may attempt to expedite the identification of water rights in the region for purchase and transfer by participating in the Department of Ecology's Cost Recovery Program to expedite the water right application.

The City must acquire additional water rights in the immediate future and for the 20-year planning period; however, the actual time period and quantity depends on the needs of the planned Phase 2 and Phase 3 of WaferTech, which has yet to be determined. Nonetheless, the City has begun to maximize the capacities of existing water sources and water rights and has been exploring opportunities to expedite the process to fulfill the immediate need for additional water rights. The long-term capacity needs will most likely be met once the water rights from Georgia Pacific are transferred to the City.

Although the City does not have a need to develop additional water rights at this time, the potential for reclaimed water is evaluated. There may be a need for reclaimed water in the future, particularly if the proposed water rights transfer is delayed or unsuccessful.

POTENTIAL FOR REUSE

The potential applications for reclaimed water in the Camas area include industrial process water, irrigation, constructed wetlands for mitigation banking, and stream flow augmentation. Each reuse application is first discussed, and then the treatment alternatives are described. The advantages and disadvantages of the reuse application alternatives are highlighted in the discussion below.

INDUSTRIAL PROCESS WATER

The City of Camas' five largest water users and their 1999 and 2004 average daily demand (from the *2001 Water System Plan*) are presented in Table 10-5.

TABLE 10-5

City of Camas Five Largest Water Users

Customer	1999 Average Daily Demand(1) (MGD)	2004 Average Daily Demand(1) (MGD)
Wafertech Industries	0.32	0.56
Georgia Pacific	0.32	NA(2)
Linear Technologies	0.10	0.19
Hewlett Packard	0.03	NA(2)
Sharp Electronics	0.02	0.02

(1) Excludes Irrigation.
(2) Not Analyzed.

WaferTech, the City's largest individual water user, is planning to construct two additional fabrication plants in the City of Camas. WaferTech will have a substantial increase in the daily water demand if the two fabrication plants are constructed. It is projected that WaferTech will require as much as 3.5 mgd once the two fabrication plants are operating (*2001 Water System Plan*). Currently, WaferTech uses potable water for the industrial processes; the potable water is treated with reverse osmosis (RO) at the WaferTech facility. It is possible WaferTech could use a significant amount of reclaimed water for their industrial process.

The potential users of reclaimed water for industrial processes also include Underwriters Laboratories and Heraeus Shin-etsu. The industries listed in Table 10-5, Underwriters Laboratories, and Heraeus Shin-etsu could also potentially use reclaimed water for irrigation purposes. Most of the industrial facilities have significant sized lawns that require irrigation during the dry season.

WaferTech has a projected daily water demand of 3.5 mgd and the remaining industrial customers have a combined projected daily water demand of 1.73 mgd by 2020 (*2001 Water System Plan*). Some of this water demand will be for non-industrial, non-irrigation uses such as toilet flushing. The total reclaimed water potentially used by industrial processes and irrigation of the lawns at the industries is estimated at 4.73 mgd (approximately 90 percent of the total water demand).

The advantage to using reclaimed water for an industrial process is that it is a potential application for year-round use of reclaimed water. The distribution system could be costly; however, most of the industries that will use reclaimed water are clustered near the northwest boundary of the City of Camas. The distribution system from a satellite water reclamation facility (WRF) situated at the north end of Lacamas Lake to the northwest corridor of the City is presented on Figure 10-1. The proximity of a satellite WRF to the industrial corridor could allow the distribution system to be cost effective. It may be an option to site a water reclamation facility on-site at the WaferTech facility since most of the reclaimed water produced will be used at the facility; however, this option is not evaluated at this time.

IRRIGATION

Reclaimed water could be used for irrigation and landscaping purposes during the summer months. The Camas region has an annual average rainfall of approximately 75 inches, but the summer rainfall can average as little as 0.56 inches per month (Chapter 2). Due to the significant amount of rainfall during winter months, reclaimed water could only be used for irrigation during the summer months. Distribution will be cost-prohibitive if all parks and public property throughout the City of Camas are considered. Therefore, only the properties in the vicinity of the WWTF are considered for irrigation with reclaimed water, including some of the City's public parks, municipal property (includes City Hall, the Community Center, and the Library) and, public schools, and the Camas Cemetery. Table 10-6 lists the estimated potential reclaimed water usage rates for irrigation purposes at these properties. The irrigation usage rates are based on an irrigation rate of 14 inches/year and an irrigation season of 3 months/year. The total potential peak day demand for irrigation is 0.338 mgd, applying a peak factor of two to the average usage. The limitation of using reclaimed water for irrigation purposes is that irrigation is only necessary approximately 3 months per year.

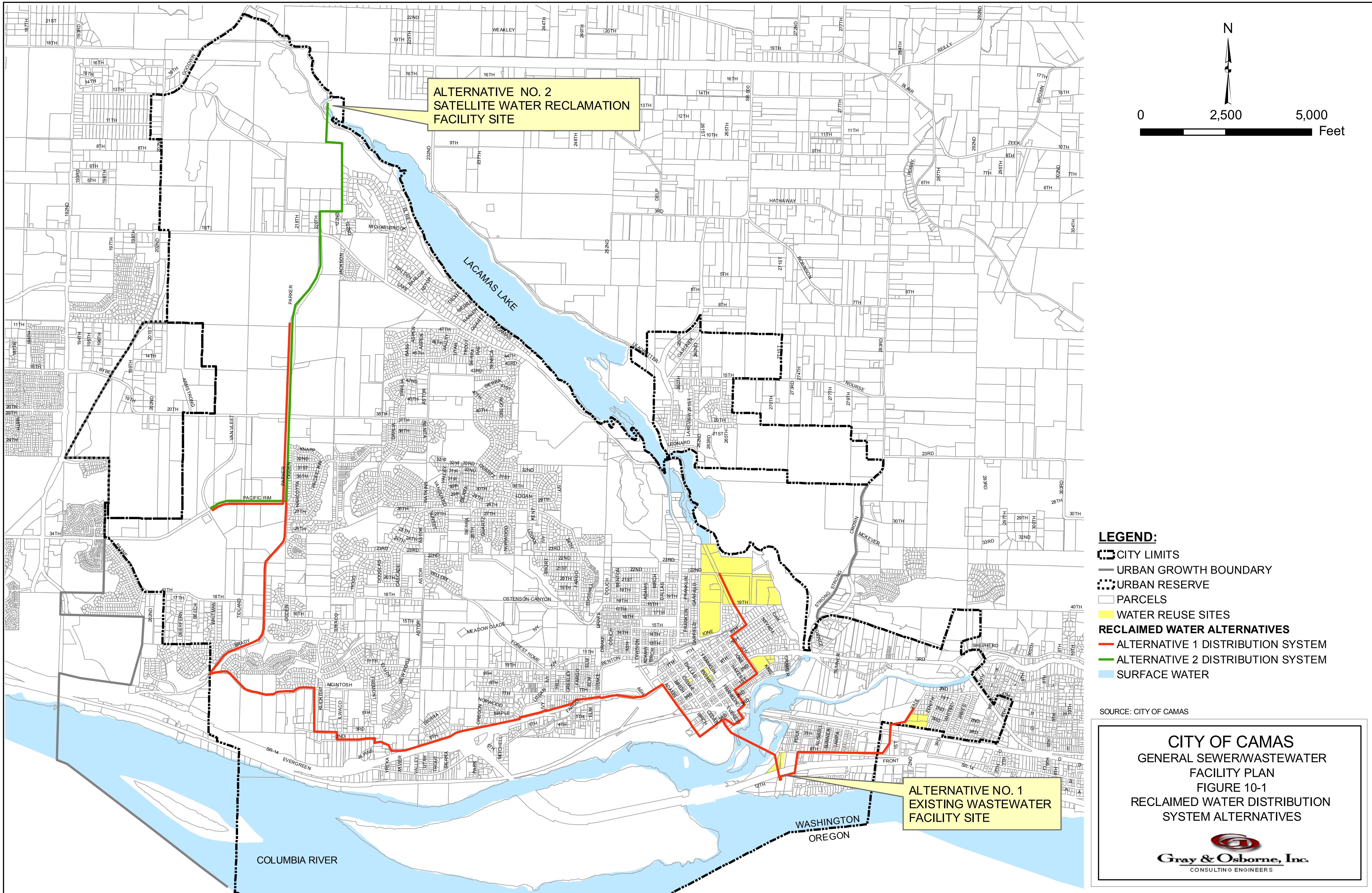
ALTERNATIVE NO. 2
SATELLITE WATER RECLAMATION
FACILITY SITE
ALTERNATIVE NO. 1
EXISTING WASTEWATER
FACILITY SITE
LACAMAS LAKE
COLUMBIA RIVER
WASHINGTON
OREGON
N
0
2,500
5,000
Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
PARCELS
WATER REUSE SITES
RECLAIMED WATER ALTERNATIVES
ALTERNATIVE 1 DISTRIBUTION SYSTEM
ALTERNATIVE 2 DISTRIBUTION SYSTEM
SURFACE WATER
SOURCE: CITY OF CAMAS
CITY OF CAMAS
GENERAL SEWER/WASTEWATER
FACILITY PLAN
FIGURE 10-1
RECLAIMED WATER DISTRIBUTION
SYSTEM ALTERNATIVES
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471 WW Fac Plan\GIS\RECLAIMED_WATER.MXD

TABLE 10-6

Potential Reclaimed Water Usage Rates(1)

Irrigation/Landscaping Use(1)	Irrigated Area (Acres)	Annual Average Usage (MG/year)	Peak Day (gpd)
Public Schools	10	3.8	0.084
Other Municipal Property	3	1.1	0.025
Camas Cemetery	12	4.6	0.101
Public Parks	15	6	0.127
Total Potential Reclaimed Water Usage			**0.338**

(1) Irrigation rate based on 14 inches per year over a 3-month irrigation season, and peak day factor of 2.0.

The irrigation sites and the distribution system from the existing WWTF are identified on Figure 10-1. The advantage of irrigation is that there are several potential irrigation sites clustered in the southeast corridor of the City, near the existing treatment facility; therefore, distribution costs could be reasonable if the existing plant is modified to a water reclamation facility. The disadvantage to irrigation as a reuse application is that irrigation is only necessary during summer months; during the remaining months the City would not need to reclaim water and would have to use the existing outfall.

MITIGATION WETLANDS BANK

The City of Camas has received funding to establish a mitigation wetlands bank in the Lacamas Watershed. A mitigation wetlands bank typically involves a larger mitigation wetlands site, providing more ecological value than several smaller mitigation wetlands. Furthermore, the potential for success of a mitigation wetland bank is greater than a smaller mitigation wetland. Mitigation wetland banks require the up-front compensation prior to impacting an existing wetland at a site undergoing development. With proper implementation and guidelines, mitigation wetland banks have the potential to increase ecological benefits, save money for project applicants, and improve efficiencies in application and permitting processes. Reclaimed water could be used to enhance the wetlands mitigation bank.

The mitigation wetlands bank in the Lacamas Watershed project will acquire 63 acres on Fifth Plain Creek, a tributary to Lacamas Creek. The property includes a 26-acre riparian zone as well as connected wetlands and uplands. The City has received funding to restore/enhance 24 acres of the site, and the remaining 39 acres will be utilized for future restoration as banking revenues are received.

Hydrogeological studies will be required to determine the suitability of the site for the purpose of using reclaimed water. Furthermore, monitoring wells will be required if the site is developed for the use of reclaimed water. The disadvantage to using reclaimed water for the wetlands mitigation bank is that both the hydrogeological studies and the monitoring wells will be very costly. The advantage to using reclaimed water for the wetlands mitigation bank is the potential for year-round use.

STREAM FLOW AUGMENTATION

The reclaimed water could be used to augment stream flows in the Dwyer Creek basin. The habitat in the Dwyer Creek basin has been compromised due to increased development in the drainage basin. The City could augment stream flows in Dwyer Creek to enhance habitat in the drainage basin. The City would have to work with the Washington State Departments of Ecology and Fish and Wildlife to develop a stream flow augmentation system at Dwyer Creek using reclaimed water. Issues associated with this alternative that have to be addressed are as follows:

- Establish beneficial use for the additional stream flow.
- Direct discharge of reclaimed water into Dwyer Creek may not be allowed. Based on past experience, this may require the construction of an additional structure, a lined pond and a conveyance channel to reaerate, cool and polish the reclaimed water prior to its introduction to Dwyer Creek.
- Flow of reclaimed water into the creek may be required to be maintained at a constant rate 24-hours a day year round.
- The City will have to determine the quantity of water they are willing to permanently give up in order to use their reclaimed water for stream flow augmentation. Once the water begins flowing into the creek, any interruption of flow could have adverse impacts on the creek’s habitat.
- Hydraulic capacity of the creek channel as well as in-stream flow goals must be established by the Department of Fish and Wildlife.
- Water quality impacts to the small stream must be established. This impact includes the effect of parameters such as dissolved oxygen, nutrients, toxics and coliform bacteria.

EVALUATION OF ALTERNATIVES

The City of Camas has several alternatives available for the production of reclaimed water. The reuse application varies with the treatment alternative based on the proximity of the reclaimed water production site. Alternatives available to the City include:

- Alternative No. 1 - Modify the Existing Treatment facility for a Reuse Application of Irrigation and Industrial Process Water.
- Alternative No. 2 - Construct a Satellite Water Reclamation Facility for a Reuse Application of Industrial Process Water and Irrigation.
- Alternative No. 3 - Construct a Satellite Water Reclamation Facility for a Reuse Application of Wetlands Banking Mitigation.
- Alternative No. 4 - Construct a Satellite Water Reclamation Facility for a Reuse Application of Stream flow Augmentation.

Alternatives No. 3 and No. 4 are not evaluated at this time since many of the total project costs will be very similar to the cost of Alternative No. 2. The treatment costs will be the same and the distribution costs may be similar; however, Alternatives No.3 and No. 4 will require hydrogeological studies to determine if either of these sites is adequate for a reuse application. Furthermore, the cost of hydrological studies, permitting, and monitoring wells could be cost prohibitive. Alternatives No. 1 and No. 2 are evaluated in greater detail.

ALTERNATIVE NO. 1 – MODIFY THE EXISTING WWTF FOR A REUSE APPLICATION OF IRRIGATION AND INDUSTRIAL PROCESS WATER

The City could modify the existing WWTF to produce Class A water reclamation. The Class A reclaimed water treatment process will be designed for the peak hour flow of 4.73 mgd. The remaining effluent would likely be discharged out the outfall. The peak hour reclaimed water demands are projected at 4.73 mgd at this time. The advantage to modifying the existing facility is that most of the infrastructure exists already at the treatment facility.

Additional electrical reliability components would be required for the Class A water reclamation facility. The generator capacity must also be upgraded to meet Reliability Class I and additional alarms and telemetry would be required. However, additional equipment reliability components are not required since the City has an existing outfall as an alternative disposal method. The City would be required to provide a UV disinfection system designed to produce Class A reclaimed water. The newest edition of the Department of Ecology's Criteria for Sewage Works Design requires the UV disinfection system for reuse applications to comply with the 2003 Guidelines published by the National Water Research Institute (NWRI) in collaboration with the American Water Works Association Research Foundation (AWWARF).

CONCEPTUAL DESIGN AND COST ESTIMATE

Coagulation and Filtration

The City's existing Aqua-Aerobics AquaDisk fabric filter has been approved for Title 22 reuse applications. This filter utilizes a series of rotating disks, which can be continuously backwashed while the filter continues to operate. Periodically, flow to the filter must be stopped to allow for a more intense washing of the fabric as well as to clean out solids that deposit in the filter tank. The existing filters are designed to treat a peak hour flow of 6.1 mgd (24 disks with 0.25 mgd approximate capacity per disk). The system would be reconfigured so that an alarm will trigger when the peak hour flow is greater than 6.1 mgd, at that point, the flow will be diverted to the outfall.

UV Disinfection

The City has an existing low pressure / high intensity UV disinfection system capable of treating a peak hour design flow of 6.1 mgd. An inline UV disinfection system could provide the additional UV dose needed to meet the requirements for Class A reclaimed water. The UV disinfection system would be installed downstream of the existing UV disinfection system. The peak hour reuse water demand currently is estimated at 4.73 mgd. However, the secondary treatment system has a peak hour design capacity of 6.1 mgd and the existing filters have sufficient capacity to treat a Class A reclaimed water peak hour flow of 6.1 mgd. Rather than limit the Class A reclaimed water production peak hour flow capacity to 4.73 mgd (the projected peak hour demand), it is only slightly more expensive to design the inline UV disinfection system to a peak hour flow of 6.1 mgd. The additional reclaimed water peak hour design flow capacity of 6.1 mgd allows for the potential to reuse a greater amount of treated effluent in the future should the beneficial reuse alternatives become more cost effective.

The inline ultraviolet disinfection system for NWRI compliance results in addition capital and operating cost of the UV system, due to several factors:

- Use of conservative design transmittance; the 10^{th} percentile of transmittance measured three times per day for 6 months or 55 percent, whichever is higher. The design transmittance is projected at 65 percent.
- Use of a *validated* (based on performance testing of seeded pathogens) design delivered dosage of 100 mJ/cm^2
- Use of conservative lamp fouling and end-of-life factors
- Flowrate, UV intensity and UV transmittance must be monitored continuously. Monitoring these three parameters will allow continuous monitoring of calculated operational dose, which is also required by the

Guidelines. Additionally, turbidity must be monitored continuously.

- UV intensity monitors must be calibrated at least monthly. UV transmittance monitors and turbidity monitors must be calibrated in accordance with manufacturer's recommendations. Laboratory measurements of UV transmittance must be used to verify the accuracy of on-line transmittance monitoring equipment on a weekly basis.

- The UV system must be operated at the same velocity range and flow per lamp as used for performance validation, and with total headloss less than or equal to that measured in equipment validation testing.

Alarms and Telemetry

The use of reclaimed water in open access areas demands a higher level of quality control than normal WWTF operations. An alarm system would need to be installed so that if the coagulation, filtration, or disinfection systems fail, then reclaimed water production will cease, the operator will be notified, and effluent will be directed to the WWTF outfall.

Storage

Industrial water users require water and produce wastewater at sporadic times of the day, Irrigation water is often applied to open access areas at night from about 12:00 a.m. to 4:00 a.m., so that water has time to percolate into the ground before public contact. Reclaimed water will be generated in larger amounts during the diurnal peak hours and will be generated in smaller amounts throughout the night. To match reclaimed water production and reclaimed water demand, 200,000 gallons of equalizing storage onsite at the WWTF is recommended. In addition, the industrial users of reuse water may also opt to provide additional reuse water storage onsite at the industrial facility. The City would also have the option to discharge reclaimed water via the outfall during periods of peak reclaimed water production and low reclaimed water demand.

Distribution

A pump station will be required to maintain pressure in the reclaimed water distribution system and to convey the reclaimed water to the irrigation sites and the industries that will use reclaimed water. The preliminary cost of the pump station is estimated at $110,000. The distribution system totals 25,540 linear feet and is presented on Figure 10-1.

The capital costs to modify the existing facility and construct the irrigation distribution system are summarized in Tables 10-7 and 10-8. The O&M costs for Alternative No. 1 are the costs above the O&M costs already incurred by the City for operating the existing WWTF are minimal. An annual O&M cost estimate includes one additional full time employee (FTE) and additional power costs to operate the UV disinfection system and the alarm system.

TABLE 10-7

Alternative No. 1 – Modify Existing Facility for Production of Reclaimed Water for Irrigation and Industrial Process Treatment Costs (2006 Dollars)

Item	Quantity	Unit	Unit Price	Total Price
Mobilization/Demobilization	1	LS	$134,583	$134,583
Class "A" Inline UV Disinfection System	1	LS	$300,000	$300,000
200,000 Gallon Storage Tank	200	CY	$750	$150,000
Reuse Pumps	2	EA	$60,000	$120,000
Standby Generator	1	LS	$76,000	$76,000
Subtotal				$780,583
Site Work (5% of subtotal)				$68,000
Piping (12% of subtotal)				$162,000
Alarms/electrical (20% of subtotal)				$270,000
Painting (3% of subtotal)				$41,000
Misc. metals (2% of subtotal)				$27,000
Subtotal				$1,348,583
Contingency (25%)				$338,000
Sales Tax (7.9%)				$134,000
Total Construction Cost				**$1,820,583**
Engineering and Administrative Costs (25%)				$456,000
Total Estimated Project Cost				**$2,277,000**

TABLE 10-8

Alternative No. 1 – Modify Existing Facility for Production of Reclaimed Water for Irrigation and Industrial Process Distribution Costs (2006 Dollars)

Item	Quantity	Unit	Unit Price	Total Price
Mobilization/Demobilization	1	LS	$349,000	$349,000
Booster Pump Station	1	LS	$500,000	$500,000
Irrigation Supply Piping	33,000	LF	$80	$2,640,000
Subtotal				$3,489,000
Contingency (25%)				$873,000
Sales Tax (7.9%)				$345,000
Total Construction Cost				**$4,707,000**
Engineering and Administrative Costs (25%)				$1,177,000
Total Estimated Project Cost				**$5,884,000**

ALTERNATIVE NO. 2 – CONSTRUCT A SATELLITE WATER RECLAMATION FACILITY FOR A REUSE APPLICATION OF INDUSTRIAL PROCESS AND IRRIGATION

For Alternative No. 2, the City would construct a satellite water reclamation facility sited at the north end of Lacamas Lake near Camp Currie. The location is in the vicinity of the customers that would use the reclaimed water produced at the facility, although the City would be required to negotiate with the County to locate the satellite WRF in the County Park. The satellite WRF would treat commercial, industrial, and residential flows and loadings from Basin Nos. 11, 12, and 13, and about two-thirds of the total flows and loadings from Basin No. 1. The flows from these basins would be rerouted to the satellite WRF and no longer be treated at the existing WWTF site. The satellite water reclamation facility would serve as a scalping plant. Only the liquid stream would be treated at the satellite WRF, solids would be pumped through city sewers and treated at the existing treatment facility. (Some minor modifications would be needed to the STEP line to accommodate the conveyance of solids.) The existing WWTF would continue to treat the flows from the remaining basins. The existing outfall would continue to serve the flows treated at the existing WWTF; furthermore, the existing outfall could serve as a backup to the WRF if needed. The water reclamation facility would be sized for the 2025 peak hour flow of Basin Nos. 11, 12, and 13, and about two-thirds of the flow from Basin No. 1, estimated in Chapter 6 at 4.73 mgd. The maximum month design flow for the satellite WRF would be 2.1 mgd, equal to the maximum month design flow estimated for these basins in Chapter 6.

CONCEPTUAL DESIGN AND COST ESTIMATE

The reclaimed water system would require tertiary treatment, storage, and distribution. This section will briefly describe each component of the process and provide a cost estimate, based on costs for other water reclamation facilities in the State, including those at Sequim, Ephrata and Royal City.

The preferred alternative for construction of the satellite water reclamation facility is a membrane bioreactor (MBR) activated sludge process. The MBR process produces a very high quality effluent in a small footprint. In an MBR, secondary effluent is separated from the activated sludge solids by filtration through membranes submerged in the aeration basin, instead of separated by gravity in secondary clarifiers. The membrane filters produce a higher quality than typical tertiary filters, such as sand or cloth disc filters. Therefore, secondary clarifiers and tertiary filters are not required for MBR systems, and the facility footprint is smaller than for a reclaimed water facility using conventional activated sludge. Waste activated sludge is removed directly from the aeration basin, and would be pumped to the existing treatment facility for further treatment.

Influent Pump Station

The Lacamas Shores L.S. would be modified to serve as an influent pump station to the satellite WRF. Construction of a main sewer trunk to the satellite WRF will be required to convey influent from the influent pump station.

Headworks

The headworks would consist of an influent flow meter, sampler, mechanical fine screens, and a grit removal system. MBR processes require at least 3-mm fine screening to protect the membrane cassettes. Two mechanical fine screens (band screen or rotary drum) will be placed in two parallel channels, each sized for the maximum hydraulic flow of 4.73 mgd (one duty, one standby). A bypass bar screen will not be provided because its operation, even temporarily, could allow material into the MBR basin that may damage the membrane cassettes. The grit removal system would consist of an aerated grit chamber, a grit slurry pump, grit hydrocyclone, and classifier. Grit would be collected in a dumpster, while degritted slurry is returned to the grit chamber.

Membrane Bioreactor

In this particular process, solids in the aeration basin would be separated from the liquid by an in-basin membrane unit. The membrane microfilter system evaluated in this section is produced by Kubota, and marketed in the US by Enviroquip, Inc. Other membrane systems are available that may be used for the satellite WRF. In the Kubota system, membrane cassettes containing large numbers of flat-plate membranes (with nominal 0.4 μm pores) are placed directly into the aeration basin to provide clarification and filtration. Air is added through coarse-bubble diffusers mounted directly below the membrane cassettes to scour the membrane surfaces. The flow of air upward along the membranes promotes flow of mixed liquor upward across the membrane surfaces. Permeate (membrane effluent) passes through the membrane walls into the interior of the flat-plate membrane in a cross-flow pattern, with the driving force provided by either the elevation difference between the aeration basin water depth and the elevation of the downstream processes, or by permeate suction pumps.

In-place cleaning of the membranes with chlorine solution should be performed every 6 months, by injecting a chemical cleaning solution into the permeate lines and allowing the solution to soak in the interior of the membrane. Chemical solution tanks and feed pumps are provided. In addition, the manufacturer suggests periodically relaxing the membranes, by closing the permeate valves while continuing to scour the membranes with air, for 1 minute per 10 minutes of operation.

Operation of the aeration basin is not controlled by the gravity settling characteristics of the mixed liquor (as measured by the SVI). Therefore, the mixed liquor concentration can be maintained at three to four times the typical concentrations used in activated sludge processes. For this MBR, it is recommended to operate at a mixed liquor suspended solids (MLSS) concentration of 10,000 mg/L. Due to the high MLSS concentration, longer solids retention times (SRT) can be maintained in a tank with a short hydraulic retention time (HRT). The SRT is controlled by the rate that excess sludge is removed from the reactor. To remove excess sludge, the basins are equipped with waste activated sludge (WAS) pumps that transfer the sludge to the aerobic digestion system. Reducing the WAS removal rate will lengthen the SRT and increase the MLSS concentration. Membrane bioreactors have operated at concentrations up to 20,000 mg/L, without a negative long-term effect on membrane life.

Internal recycle pumps would transfer mixed liquor from the MBR tanks to the pre-aeration tanks, to keep the influent wastewater in contact with the activated sludge. Coarse bubble aeration diffusers would provide process air in the pre-aeration tanks. The MBR tanks are aerated by diffusers mounted to the bottom of the membrane cassettes. Two MBR tanks would be provided in parallel, allowing one tank to be taken off-line for maintenance or repair independently. In addition, redundant membrane cassettes would be provided in each tank to allow a cassette to be taken offline while providing treatment of the design flow.

Membrane permeate would flow by gravity or through permeate pumps to the UV disinfection facility. Permeate lines are equipped with pressure gauges and effluent magnetic flow meters.

Kubota membranes have a standard warranty of 5 years; replacement is recommended after 8 to 10 years. Extended warrantees are available, in which, for a fixed annual fee, the manufacturer will replace membranes as needed to maintain the design flux rate and performance.

The membrane bioreactor would be sized for a maximum month design flow of 2.1 mgd.

Coagulation and Filtration

The Class A reclaimed water standards require continuous oxidation, coagulation, filtration and disinfection of the wastewater. The MBR process will not produce higher quality effluent (in terms of BOD, TSS and turbidity) with the addition of coagulation or flocculation processes. Without coagulation, MBRs produce reclaimed water with higher quality than reclaimed water from conventional tertiary processes. The Washington State Departments of Ecology and Health have indicated that they would accept the MBR process without coagulation in a water reclamation application on a case-by-case basis. Therefore, coagulation facilities are not included in this evaluation.

Filtration is provided by the membrane microfilters in the MBR process.

UV Disinfection

Numerous UV disinfection systems that meet the Class A disinfection criteria have been installed in Washington State. Pilot testing has demonstrated that microfiltration membranes are capable of physically removing most bacteria, generally meeting the Class A disinfection standard (2.2 total coliform/100 mL) prior to disinfection. Pilot testing has demonstrated that virus removal is highly variable, and has been measured at less than 1-log (90 percent) removal in some pilot tests (City of San Diego, Point Loma Wastewater Treatment Plant). This is because viruses are generally smaller than the pore size of the microfilter.

The Washington State Department of Ecology's Criteria for Sewage Works Design has indicated that the future requirements of the UV disinfection must follow the National Water Research Institute (NWRI) guidelines. The implications of the NWRI guidelines on the design of the UV disinfection system are highlighted earlier in this chapter. However, MBR effluent requires a *validated* (based on performance testing of seeded pathogens) design delivered dosage of 80 mJ/cm^2. The UV disinfection system will be designed to disinfect the peak hour design flow of 4.73 with one bank out of service.

Alarms and Telemetry

An alarm system will be installed to notify staff if MBR or disinfection systems fail, or if the reclaimed water quality falls below an acceptable level. At this point, the reclaimed water production will cease and effluent will be pumped to the existing WWTF for further treatment and ultimately will be discharged via the City's existing outfall.

Storage

Industrial water users require water and produce wastewater at sporadic times of the day, Irrigation water is often applied to open access areas at night from about 12:00 a.m. to 4:00 a.m., so that water has time to percolate into the ground before public contact. Reclaimed water will be generated in larger amounts during the diurnal peak hours and will be generated in smaller amounts throughout the night. To match reclaimed water production and reclaimed water demand, 200,000 gallons of equalizing storage onsite at the WWTF is recommended. In addition, the industrial users of reuse water may also opt to provide additional reuse water storage onsite at the industrial facility. The City would also have the option to discharge reclaimed water via the outfall during periods of peak reclaimed water production and low reclaimed water demand.

Solids Handling

Mixed liquor must be wasted from the aeration basin to maintain a constant MLSS concentration and sludge age in the activated sludge system. The waste activated sludge (WAS) would be pumped to a city sewer for conveyance to the existing WWTF.

Distribution

A pump station would be required to maintain a pressure in the reclaimed water distribution system and to convey reclaimed water to the industrial corridor.

The capital costs to construct a satellite WRF and for the distribution system are summarized in Tables 10-9 and 10-10. The O&M costs for Alternative No. 2 are estimated based on experience from other existing water reclamation facilities throughout the State. It is estimated that the satellite WRF and distribution system will add 1 FTE to the City's labor requirement. Annual equipment maintenance costs are estimated as three percent of the initial equipment capital cost. In addition, UV lamps will need to be replaced, with an average replacement rate of 40 percent per year ($12,000) and the annual UV power requirements are estimated at $8,000. The membrane cartridges must be periodically replaced, with an average life of eight to 10 years. The cost of an extended warranty, which includes replacement of membranes as needed, was quoted at $25,000 per year. The membranes would also require sodium hypochlorite, and possibly oxalic acid, as cleaning chemicals. The total annual O&M cost for Alternative No. 2 is estimated at $200,000.

TABLE 10-9

Alternative No. 2 – Construct a Satellite Water Reclamation Facility with a Reuse Application of Industrial Process and Irrigation Treatment Costs (2006 Dollars)

Item	Quantity	Unit	Unit Price	Total Price
Mobilization/Demobilization	1	LS	$295,000	$295,000
Influent Pump Station and Distribution System	1	LS	$800,000	$800,000
Headworks (incl. fine screens, grit removal)	1	LS	$477,000	$477,000
MBR concrete tanks	1	LS	$608,000	$608,000
MBR equipment	1	LS	$5,200,000	$5,200,000
WAS Pump Station and Piping to Sewer	1	LS	$300,000	$300,000
Class "A" UV Disinfection System	1	LS	$350,700	$350,700
UV Disinfection System Channel	20	CY	$750	$15,000
Effluent flow meter and sampler	1	LS	$30,000	$30,000
200,000 Gallon Storage Tank	200	CY	$750	$150,000
Standby Generator	1	LS	$100,000	$100,000
Subtotal				$8,325,700
Site Work (5% of subtotal)				$417,000
Piping (12% of subtotal)				$1,000,000
Alarms/electrical (20% of subtotal)				$1,666,000
Painting (3% of subtotal)				$250,000
Misc. metals (2% of subtotal)				$167,000
Subtotal				$11,825,700
Contingency (25%)				$2,957,000
Sales Tax (7.9%)				$1,168,000
Total Construction Cost				**$15,950,700**
Engineering and Administrative Costs (25%)				$3,988,000
Total Estimated Project Cost				**$19,938,700**

TABLE 10-10

Alternative No. 2 – Construct a Satellite Water Reclamation Facility with a Reuse Application of Industrial Process and Irrigation Distribution Costs (2006 Dollars)

Item	Quantity	Unit	Unit Price	Total Price
Mobilization/Demobilization	1	LS	$235,000	$235,000
Supply Pump Station	1	LS	$110,000	$110,000
Subtotal				$345,000
Site Work (5% of subtotal)				$18,000
Piping (15% of subtotal)				$52,000
Alarms/electrical (15% of subtotal)				$52,000
Painting (3% of subtotal)				$11,000
Misc. metals (2% of subtotal)				$7,000
Irrigation Supply Piping	15,200	LF	$80	$1,216,000
Subtotal				$1,701,000
Contingency (25%)				$426,000
Sales Tax (7.9%)				$169,000
Total Construction Cost				**$2,296,000**
Engineering and Administrative Costs (25%)				$574,000
Total Estimated Project Cost				**$2,870,000**

FEASIBILITY OF REUSE

BENEFITS OF REUSE

The City and the surrounding community can benefit indirectly from the use of reclaimed water. The reuse application to augment streamflows in Dwyer Creek and for wetlands mitigation banking both will have potential environmental and social benefits to the City of Camas that are difficult to evaluate. For example, creating wetlands and enhancing Dwyer Creek can provide additional outdoor recreational uses for the community. The application to use reclaimed water for irrigation of parks and playfields can add value to the community as a whole, potentially increasing property values. In addition, reusing water for irrigation and industrial uses rather than using potable water supports a cultural value of conserving the quality and quantity of the City's water resources.

Industrial water customers can benefit from the production of reuse water by having a flexible and reliable alternative water source. Initially, industrial use of reclaimed water would likely require the industry to invest additional time and costs to adapt the existing system to the use of reclaimed water. However, the additional cost could potentially be minimal to retrofit the existing system since many of the industries currently have additional water treatment components that are applied to the potable water that they are currently purchasing.

ECONOMIC FEASIBILITY

Production of reclaimed water is considered economically feasible if the cost of producing reclaimed water is less than or equal to the cost of purchasing water or developing additional water rights. The 20-year present worth for reuse Alternative No. 1 and Alternative No. 2 is presented in Table 10-11. The cost for Alternative No. 1, to modify the existing WWTF, is much less than the cost for Alternative No. 2, to construct a satellite WRF. However, at this time, production of reclaimed water is not economically feasible since adequate water rights are available at a relatively low cost. It is likely the City will acquire additional water rights through a transfer from Georgia Pacific. The cost to develop and acquire the additional water rights from Georgia Pacific will not exceed a conservative estimate of 5 million dollars. The cost to produce reclaimed water is significantly more expensive than the cost to develop and acquire additional water rights from Georgia Pacific.

TABLE 10-11

Comparison of Alternatives(1)
(2006 Dollars)

	Alternative No. 1 Modify Existing WWTF	Alternative No. 2 Construct a Satellite WRF
Peak Hour Reuse Water Production	6.1 mgd	4.73 mgd
Capital Cost	$ 8,161,000	$ 22,808,700
Annual O&M Cost (2004)	$ 90,000	$ 200,000
20-year Present Worth	$ 10,579,334	$ 28,182,775

(1) Inflation assumed at 3 percent.

The alternatives for reuse may be reevaluated in the future as treatment costs become more competitive.

CHAPTER 11

FINANCIAL ANALYSIS

This chapter presents a synopsis of funding for the City of Camas to finance recommended wastewater system capital improvements presented in the previous chapters. Sewer rates, system development charges, the financial status of the sewer utility, and funding sources to pay for the scheduled improvements are discussed.

FINANCIAL STATUS OF EXISTING SEWER UTILITY

SEWER RATES

The sewer rates are presented in Chapter 13.64 of the City's municipal code, which is included in Appendix C. Chapter 13.64 establishes a variable sewer rate for 2010 through 2013. The monthly sewer rates for each customer class are summarized in Table 11-1.

TABLE 11-1

Monthly Sewer Rates (1)

Customer Class	Charge	2010	2011	2012	2013
Residential					
Inside City	Monthly Service Charge	$17.87	$19.82	$20.71	$21.33
	Volume Charge ($/ccf)	$ 2.72	$ 3.02	$ 3.15	$ 3.25
Outside City	Monthly Service Charge	$26.81	$29.73	$31.06	$32.00
	Volume Charge ($/ccf)	$ 4.08	$ 4.52	$ 4.73	$ 4.87
Commercial and Industrial					
Inside City	Monthly Service Charge	$ 8.55	$ 9.48	$ 9.91	$10.21
	Volume Charge ($/ccf)	$ 3.64	$ 4.03	$ 4.22	$ 4.34
Outside City	Monthly Service Charge	$12.82	$14.22	$14.86	$15.30
	Volume Charge ($/ccf)	$ 5.46	$ 6.05	$ 6.32	$ 6.51

(1) Source: Chapter 13.64 City of Camas Municipal Code.
(2) Multifamily residential are billed monthly as commercial customers.

The City's sewer rates are based on the January 2010 *City of Camas Utilities Rate Study* (*2010 Rate Study*) included as Appendix V. The City adopted the majority of the recommendations in the *2010 Rate Study*, including accepting the overall revenue recommendations necessary to fund the improvements identified in this Plan. The City elected to apply a volume charge to its residential customers in addition to the volume charge recommended for commercial and industrial customers in the *2010 Rate Study*. Thus, all customers (residential, commercial, and industrial) are charged a monthly flat-rate service charge and a variable volume charge based on winter water use.

Customers outside the City pay 150 percent of the inside-City rate. Multifamily residential customers are billed as commercial customers.

SEWER SYSTEM DEVELOPMENT CHARGES

The City of Camas imposes a sewer system development charge (SDC) for all new connections to the sewer system to finance improvements of general benefit to the wastewater system that are required to service future growth. SDCs are generally established as one-time charges assessed against new sewer customers as a way to recover a part of the cost of additional system capacity constructed for their use. Chapter 13.72 of the City's municipal code defines the sewer system development charges. The intent is that all new system customers will pay an equitable share for existing and planned facilities of general benefit. Typical items of construction financed by the sewer system development charge are wastewater treatment facilities, pump stations, interceptors, and other general improvements that benefit the entire system. SDCs are levied on single-family, multifamily, commercial, and industrial users.

The City has two classifications of commercial customers. Commercial I customers are charged based on the size of the water meter. Commercial II customers are nonresidential customers that contribute higher-than-average flows or loads to the sewer system and include industrial and unusual requirement customers. Commercial II customers pay an SDC determined by the Public Works Director; the factors used to determine the Commercial II SDC include average daily flow, peaking factor, and BOD and TSS loads. SDCs for the North Urban Growth Area (NUGA) recently annexed into the City were calculated separately, and are higher than the rest of the City. The SDC for residential and Commercial I customer classes are summarized in Table 11-2. The SDCs are based on the January 2010 *City of Camas Utilities Rate Study* included as Appendix V.

TABLE 11-2

Sewer System Development Charges[1]

Meter Size	Non-NUGA	NUGA
Residential	$ 2,493	$ 4,420
Commercial I		
5/8 inch	$ 2,493	$ 4,420
3/4 inch	$ 3,740	$ 6,630
1 inch	$ 6,234	$ 11,050
1.5 inches	$ 12,467	$ 22,101
2 inches	$ 19,948	$ 35,361
3 inches	$ 39,896	$ 70,722
4 inches	$ 62,337	$110,503
6 inches	$124,674	$221,006
8 inches	$199,478	$353,609

(1) Source: Chapter 13.72 City of Camas Municipal Code.
(2) SDCs for the new North Urban Growth Area (NUGA) were calculated separately from the rest of the City.

FINANCIAL STATUS OF EXISTING SEWER UTILITY

An analysis of historical and projected future financial operations for the sewer utility for the years 2009 through 2013 is summarized in the January 2010 *City of Camas Utilities Rate Study* included as Appendix V. Exhibits 4.1 and 4.2 in the *2010 Rate Study*, respectively, provide the Sewer Utility Capital Fund Summary and the Sewer Utility Revenue Requirement Summary for funding the collection system and Phase 2A WWTF projects identified in Chapters 7, 8, and 9 in this plan.

Table 11-3 summarizes the Phase 2A and Phase 2B WWTF project costs. The costs include the actual construction bid and contracted engineering costs for Phase 2A, currently under construction, and the construction cost estimate and contracted engineering costs for Phase 2B.

TABLE 11-3

Phases 2A and 2B WWTF Upgrade Costs

Costs	Construction Cost and Contingency	Project Management and Engineering	Total
Phase 2A Project Administration/ Management	$ 0	$ 100,000	$ 100,000
Phase 2A Construction Management	$ 0	$1,066,575	$ 1,066,575
Phase 2A Construction (bid amount and contingency)	$12,466,052	$ 0	$12,466,052
Phase 2B Planning, Design, and Construction Management	$ 0	$ 354,706	$ 354,706
Phase 2B Construction Estimate	$ 2,855,000	$ 0	$ 2,855,000
Total	**$15,321,052**	**$1,521,281**	**$16,842,333**

FUNDING SOURCES

Funding for the Phases 2A and 2B WWTF projects is summarized in Table 11-4. The funding sources include a grant/forgivable principal package from the Ecology Green Project Reserve State Revolving Fund (SRF) program and a Public Works Trust Fund (PWTF) loan.

TABLE 11-4

Funding Sources for Phases 2A and 2B WWTF Upgrade

Funding Source	Terms	Amount
Ecology Green Project Reserve SRF Forgivable Principal (L1100005)	Forgivable Principal	$ 1,771,650
Ecology Green Project Reserve SRF Loan (L1100005)	2.8%, 20 years	$ 1,771,650
Ecology SRF Loan Amendment (L1100005)	2.8%, 20 years	$ 3,300,000
Public Works Trust Fund (PWTF) Loan (PC08-951-007)	0.5%, 20 years	$10,000,000
Total		**$16,843,300**

The collection system projects identified in the Plan will be funded by a combination of available grants and loans and through the City's sewer rates and system development charges. A summary of currently available state funding sources is provided in Table 11-5. In addition to state funding sources, funding is available through the U.S. EPA State and Tribal Assistance Grant, Revenue Bonds, General Obligation Bonds, and Utility Local Improvement Districts.

TABLE 11-5

State Funding Sources for Design and Construction of Wastewater Conveyance and Treatment Facilities

Program	Eligible Projects	Eligible Applicants	Funding Available
Preconstruction Only			
PWTF Preconstruction Public Works Trust Fund – Preconstruction Program	Preconstruction activities such as preliminary engineering, design, bid document preparation, right-of-way acquisition, environmental studies, and cultural/historic project review.	Counties, cities, special-purpose districts, and quasi-municipal organizations that meet certain requirements (contact a Client Service Representative for more information). No school or port districts. (*) NEW: • **Affordability Index:** Affordability Index (AI) is a measure of the consumers' financial ability to pay for utility services. Applicants that qualify for AI terms can receive lower cost terms. • **Performance Based Incentives:** Projects that meet contract incentives may qualify for slightly lower interest rate or longer repayment term (policy would be considered by Public Works Board upon reestablishment of PWTF Preconstruction board).	Loan $1 million per jurisdiction each biennium: • Must complete work within 24 months. **Affordability Index (*):** • Rates and terms vary based on an Affordability Index (which assesses a utilities ability to sustain the utility. • Interest Rates: 0.25% to 2% • Repayment Terms: For non-distressed, 5-year term, or 20-year term if construction funds are acquired before first loan principal payment. • 0.5% to 2% depending on local match; 5%, 10%, or 15% local match required.

TABLE 11-5 (continued)

State Funding Sources for Design and Construction of Wastewater Conveyance and Treatment Facilities

Program	Eligible Projects	Eligible Applicants	Funding Available
Preconstruction Only (continued)			
Ecology Revolving Fund Ecology, Washington State Water Pollution Control Revolving Loan Fund	Design projects associated with publicly owned wastewater treatment facilities planning and implementation of nonpoint source pollution control activities.	• **General Revolving Fund Category:** Counties, cities, towns, conservation districts, or other political subdivision, municipal or quasi-municipal corporations, and tribes. • **Special Preconstruction Category Set-Aside:** Jurisdictions listed above with a population of 25,000 or less and a MHI below the statewide average. • **Special Preconstruction Category Set-Aside (Distressed Communities):** Jurisdictions listed above with a population of 25,000 or less and a MHI below 80% of the statewide average.	**General Revolving Fund Category and Special Preconstruction Category Set-Aside:** Loan, at either (SFY 2013 interest rates): • 2.7% interest for 6- to 20-year term, or • 1.4% interest for 5-year term. **Special Preconstruction Category Set-Aside (Distressed Communities):** 50% forgivable principal loan and 50% loan at either (SFY 2013 interest rates): • 2.7% interest for 6- to 20-year term, or • 1.4% interest for 5-year term.
RCAC Rural Community Assistance Corporation Feasibility and Predevelopment Loans	Water and/or wastewater planning, environmental work, and other work to assist in developing an application for infrastructure improvements.	Nonprofit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less, or 10,000 or less if guaranteed by USDA Rural Development financing.	• Maximum $50,000 for feasibility loan. • Maximum $350,000 for predevelopment loan. • 1-year term. • 5.5% interest rate.
Construction and Design/Construction			
CDBG-GP Community Development Block Grant – General Purpose Grant Program	Final design and construction of domestic wastewater, drinking water, side connections, stormwater, streets, bridge, community facility, economic development, and housing rehabilitation projects.	Projects must principally benefit low- to moderate-income people in non-entitlement cities and counties: • Cities or towns with fewer than 50,000 people. • Counties with fewer than 200,000 people.	**Grant:** • Up to $1 million. • No match required, but local contribution and gap financing preferred.

TABLE 11-5 (continued)

State Funding Sources for Design and Construction of Wastewater Conveyance and Treatment Facilities

Program	Eligible Projects	Eligible Applicants	Funding Available
Construction and Design/Construction (continued)			
PWTF Public Works Trust Fund – Construction Program	New construction, replacement, and repair of existing infrastructure for domestic water, sanitary sewer, stormwater, solid waste, road, or bridge projects and reasonable growth.	Counties, cities, special-purpose districts, and quasi-municipal organizations that meet certain requirements (contact a Client Service Representative for more information). No school or port districts. (*) NEW: • **Affordability Index:** Affordability Index (AI) is a measure of the consumers' financial ability to pay for utility services. Applicants that qualify for AI terms can receive lower cost terms. • **Performance-Based Incentives:** Projects that meet contract incentives can qualify for slightly lower interest rate or longer repayment term.	**Loan:** • $10 million per jurisdiction each biennium. • Must complete work within 60 months. • Rates and terms vary based on an Affordability Index (which assesses a utility's ability to sustain the utility). • Interest Rates: 0.25% to 2%. • Repayment Term: 20 or 30 years. **Non-Distressed Communities:** • 0.5 to 2 percent depending on local match; 5%, 10%, or 15% local match required. • For non-distressed, 5-year term, or 20-year term if construction funds are acquired before first loan principal payment.
Ecology Revolving Fund Ecology Washington State Water Pollution Control Revolving Loan Fund	Construction projects associated with publicly owned wastewater treatment facilities planning and implementation of nonpoint source pollution control activities.	• **General Revolving Fund Category:** Counties, cities, towns, conservation districts, or other political subdivision, municipal or quasi-municipal corporations, and tribes. • **Hardship Assistance:** Jurisdictions listed above with a population of 25,000 or less.	Loan, at either (SFY2013 interest rate): • 2.7% interest for 6- to 20-year term, or • 1.4% interest for 5-year term. **Hardship Assistance:** For wastewater treatment facilities construction may be available in the form of a reduced interest rate or forgivable principal, based on a sliding scale for hardship. Hardship funding available for existing residential need portion of facility only.

TABLE 11-5 (continued)

State Funding Sources for Design and Construction of Wastewater Conveyance and Treatment Facilities

Program	Eligible Projects	Eligible Applicants	Funding Available
Construction and Design/Construction (continued)			
Ecology Centennial Ecology, Centennial Clean Water Program	Hardship funding for construction projects associated with publicly owned wastewater treatment facilities. Planning and implementation of nonpoint source pollution control activities.	Counties, cities, towns, conservation districts, or other political subdivision, municipal or quasi-municipal corporations, and tribes. • **Hardship Grant Assistance:** Jurisdictions listed above with a population of 25,000 or less.	Grants, loans in some cases. **Hardship Grant Assistance:** For wastewater treatment facilities construction may be available in the form of a reduced interest rate or forgivable principal, based on a sliding scale for hardship. Hardship funding available for existing residential need portion of facility only.
CERB Community Economic Revitalization Board, Construction Program	Projects must support significant job creation or significant private investment in the state: • Bridges, roads and railroad spurs, domestic and industrial water, sanitary and storm sewers. • Electricity, natural gas, and telecommunications. • General purpose industrial buildings, port facilities.	• Counties, cities, towns, port districts, special districts. • Federally recognized tribes. • Municipal and quasi-municipal corporations with economic development purposes.	Loans, grants in unique cases: • Public facility projects required by private sector expansion and job creation. • Projects without a committed business allowed for rural areas. • $1 million maximum per project, per policy. • Interest rates vary. • 20-year term maximum. • Requires 10% minimum match. • Applicants must demonstrate gap in public project funding and need for CERB assistance. • CERB is authority for funding approvals.

TABLE 11-5 (continued)

State Funding Sources for Design and Construction of Wastewater Conveyance and Treatment Facilities

Program	Eligible Projects	Eligible Applicants	Funding Available
Construction and Design/Construction (continued)			
RCAC **Rural Community Assistance Corporation** Construction Loans	Water, wastewater, solid waste, and stormwater facilities that primarily serve low-income rural communities. Can include predevelopment costs.	Non-profit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less, or 10,000 population or less if using Rural Development financing as the takeout.	• Maximum $2 million with commitment letter for permanent financing. • Security in permanent loan letter of conditions. • 1- to 3-year term at 5.5% interest rate. • 1% loan fee.
RCAC **Rural Community Assistance Corporation** Intermediate Term Loan	Water, wastewater, solid waste, and stormwater facilities that primarily serve low-income rural communities.	Non-profit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less.	• For smaller capital needs, normally not to exceed $100,000. • Maximum 20-year term. • 5% interest rate. • 1% loan fee.

U.S. EPA STATE AND TRIBAL ASSISTANCE GRANT (STAG)

Local jurisdictions within the State of Washington can apply to the State and Tribal Assistance Grant program through the office of their local Congressional representative. The Congressional representative will work to add the project as a line item to the VA/HUD Appropriations Bill. Applicants can obtain grant funds up to approximately $2 million.

REVENUE BONDS

The most common source of funds for construction of major utility improvements is the sale of revenue bonds. These are tax-free bonds issued by a city. The major source of funds for debt service on revenue bonds is from monthly sewer service charges. In order to qualify to sell revenue bonds marketable to investors, the bonds typically have contractual provisions for the city to meet debt coverage requirements. The city must show that its annual net operating income (gross income less operation and maintenance expenses) is must be equal to or greater than a factor, typically 1.2 to 1.4 times the annual debt service on all par debt. If a coverage factor has not been specified, it will be determined at the time of any future bond issues.

GENERAL OBLIGATION BONDS

A city may by council action or special election issue general obligation bonds to finance almost any project of general benefit to the city. The bonds are repaid by tax assessments levied against all privately owned properties within the city. This includes vacant property that would not otherwise contribute to the cost of the specific improvements. This type of bond issue is usually reserved for municipal improvements that are of general benefit to the public, such as arterial streets, bridges, lighting, municipal buildings, firefighting equipment, parks, and water and wastewater facilities. General obligation bonds are the most attractive bonds to investors because they are backed by the municipality's full taxing authority and carry the lowest rate of interest of any type of bond that a city may issue.

Disadvantages of general obligation bonds include the following:

- Voter approval is often required. The City will incur the legal costs of drafting a ballot measure and pay for the cost of holding a special election. There is also the additional cost of investing staff time in public education of the need for the project, yet there is always uncertainty to the outcome of elections.

- There are legal, as well as practical limits on the amount of general obligation debt a city can issue. Financing capital improvements through general obligation debt reduces the ability of the City to issue additional general obligation debt, which is often the only source of outside financing for many general government facilities.

UTILITY LOCAL IMPROVEMENT DISTRICTS

Another potential source of funds for improvements can be obtained through the formation of Utility Local Improvement Districts (ULIDs) involving a special assessment made against properties benefiting by the improvements. ULID bonds are further backed by a legal claim to the revenues generated by the utility, similar to revenue bonds.

Sewer system expansion is a frequent application of ULID financing. Typically, ULIDs are formed by the city at the written request (by petition) of the property owners within a specific section of the city's service area. Upon receipt of a sufficient number of signatures or petitions and acceptance by the city council, the local improvement area is formed. Therefore, a sewer system is designed for that particular area in accordance with the city's sewer comprehensive plan. Each separate property in the ULID is assessed in accordance with the special benefits the property receives from the water or wastewater system improvements. A citywide ULID could form part of a financing package for large-scale capital projects such as sewer line extensions or replacements that benefit all residents in the service area. The assessment places a lien on the property that must be paid in full upon sale of the property. ULID participants have the option of paying their assessment immediately upon receipt, thereby reducing the portion of the costs financed by the ULID bonds.

The advantages of ULID financing, as opposed to rate financing, to the property owner include:

- The ability to avoid interest costs by early payment of assessments.
- If the ULID assessment is paid in installments, it may be eligible to be deducted from federal income taxes.
- Low-income senior citizens may be able to defer assessment payments until the property is sold.
- Some Community Block Grant funds are available to property owners with incomes near or below poverty level. Funds are available only to reduce assessments.

The major disadvantage to the ULID process is that it may be politically difficult to approve formation. The ULID process may be stopped if 40 percent of the property owners protest its formation. Also, there are significant legal and administrative costs associated with the ULID process, which increases total project costs by approximately 30 percent over other financing options.

APPENDIX A

SEPA CHECKLIST

CITY OF CAMAS

616 Northeast Fourth Avenue
P.O. Box 1055
Camas, Washington 98607
PH: 360-834-6864 • F: 360-834-1535
http://www.ci.camas.wa.us

COMMUNITY DEVELOPMENT DEPARTMENT

Date Published: March 30, 2010

To Whom It May Concern:

Please find enclosed a Determination of Nonsignificance (DNS) for the **General Sewer/Wastewater Facility Plan** that was issued pursuant to the State Environmental Policy Act (SEPA) Rules, Chapter 197-11, Washington Administrative Code. The enclosed review comments reflect evaluation of the environmental checklist by the lead agency as required by WAC 197-11-330(1)(a)(i).

A CD is enclosed that contains the General Sewer/Wastewater Facility Plan.

Written comments may be submitted on this determination within fourteen (14) days of its issuance, April 13, 2010, after which the DNS will be reconsidered in light of the comments received.

Please address all correspondence to:

City of Camas, SEPA Official
Community Development Department
616 NE Fourth Avenue / P.O. Box 1055
Camas, Washington 98607

Distribution

Bureau of Indian Affairs
C-Tran
Camas School District, Heidi Rosenberg
Camas Mayor Paul Dennis
Camas City Administrator, Lloyd Halverson
Camas Council Members (7)
Camas Engineering Department, James Carothers
Camas Fire Department, Randy Miller
Camas Finance Director, Joan Durgin
Camas Parks and Recreation, Jerry Acheson
Camas Planning Commission (7)
Camas Police Chief, Mitch Lackey
Camas Public Works Director, Monte Brachmann
Camas Public Library, David Zavortink
Chinook Indian Nation
Cultural Resource Program, Cowlitz Indian Tribe, Dave Burlingame
Cultural Resource Program, Yakama Indian Nation, Clifford Washines
Cultural Resource Program, Yakama Indian Nation, Johnson Meninick
Clark County Department of Transportation, Steve Schulte
Clark County Parks Department, Jeroen Kok
Clark County Natural Resources Council
Clark Public Utilities
CPU Const., Service Manager
Department of Ecology
Department of Fish and Wildlife
Department of Natural Resources, SEPA Center
Department of Natural Resources, Pacific Cascade Region
Parks & Recreation Commission
Port of Camas-Washougal
Post Record Publications
Southwest Air Pollution Control Authority
US Army Corps of Engineers
Washington Office of Archaeology & Historic Preservation
UCAN (United Camas Neighborhood Association)

STATE ENVIRONMENTAL POLICY ACT

DETERMINATION OF NON-SIGNIFICANCE

CASE NO: SEPA10-08 – City of Camas General Sewer/Wastewater Facility Plan

APPLICANT: City of Camas

REQUEST: Adopt the City of Camas General Sewer / Wastewater Facility Plan.

Location:
The proposal covers the corporate limits of the City of Camas.

Legal Description:
The planning area is bounded by:
Portions of Township 2 North, Range 3E, Sections 17, 20, 21, 27, 28, 29, 32, 33, 34, 35 and 36;
Portions of Township 1 North, Range 3 E, Sections 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16; and
Portions of Township 1 North Range 4E, Section 7, and further defined as the Camas City Limits.

SEPA Determination:
Determination of Non-Significance (DNS).

Comment Deadline:
April 13, 2010

As lead agency under the State Environmental Policy Act (SEPA) Rules [Chapter 197-11, Washington Administrative Code (WAC)], the City of Camas must determine if there are possible significant adverse environmental impacts associated with this proposal. The options include the following:

- DS = Determination of Significance (The impacts cannot be mitigated through conditions of approval and, therefore, requiring the preparation of an Environmental Impact Statement (EIS).
- MDNS = Mitigated Determination of Non-Significance (The impacts can be addressed through conditions of approval), or;
- DNS = Determination of Non-Significance (The impacts can be addressed by applying the Camas Municipal Code).

Published: Post Record on *March 30, 2010.*
Posted: Camas Post Office, City Hall, Camas Library, & City of Camas web site at:
http://www.ci.camas.wa.us/govern/publicnotice.htm

Determination:
Determination of Non-Significance (DNS). The City of Camas, as lead agency for review of this proposal, has determined that this proposal does not have a probable significant adverse impact on the environment. An Environmental Impact Statement (EIS) is not required under RCW 43.21C.030(2)(e). This decision was made after review of a completed environmental checklist and other information on file with the City.

Date of Publication & Comment Period:
Publication date of this DNS is March 30, 2010, and is issued under WAC 197-11-340. The lead agency will not act on this proposal until the close of the 14-day comment period which ends on April 13, 2010.

SEPA Appeal Process:
An appeal of any aspect of this decision, including the SEPA determination and any required mitigation, must be filed with the Community Development Department within fourteen (14) calendar days from the date of the decision notice. The letter of appeal should contain the following information.

1. The case number designated by the City of Camas and the name of the applicant; and,
2. The name and signature of each person or group (petitioners) and a statement showing that each petitioner is entitled to file an appeal as described under Section 16.28.060 of the Camas Municipal Code. If multiple parties file a single petition for review, the petition shall designate one party as the contact representative with the City Planner. All contact with the City Planner regarding the petition, including notice, shall be with this contact person.

The appeal request and appropriate fee is to be submitted to the Community Development Department between 8:00 a.m. and 5:00 p.m. Monday through Friday, at the address listed below:

Appeal to the City of Camas SEPA Official
Community Development Department
616 NE Fourth Avenue / P.O. Box 1055
Camas, Washington 98607

Staff Contact Person: James Carothers (360) 817-1561
Responsible Official: Phil Bourquin (360) 817-1562

Phil Bourquin, Community Development Director and Responsible Official	**March 30, 2010** **Date**

Published: Post Record on *March 30, 2010.*
Posted: Camas Post Office, City Hall, Camas Library, & City of Camas web site at: http://www.ci.camas.wa.us/govern/publicnotice.htm

WAC 197-11-960 Environmental checklist.

ENVIRONMENTAL CHECKLIST

Purpose of checklist:

The State Environmental Policy Act (SEPA), chapter 43.21C RCW, requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. An environmental impact statement (EIS) must be prepared for all proposals with probable significant adverse impacts on the quality of the environment. The purpose of this checklist is to provide information to help you and the agency identify impacts from your proposal (and to reduce or avoid impacts from the proposal, if it can be done) and to help the agency decide whether an EIS is required.

Instructions for applicants:

This environmental checklist asks you to describe some basic information about your proposal. Governmental agencies use this checklist to determine whether the environmental impacts of your proposal are significant, requiring preparation of an EIS. Answer the questions briefly, with the most precise information known, or give the best description you can.

You must answer each question accurately and carefully, to the best of your knowledge. In most cases, you should be able to answer the questions from your own observations or project plans without the need to hire experts. If you really do not know the answer, or if a question does not apply to your proposal, write "do not know" or "does not apply." Complete answers to the questions now may avoid unnecessary delays later.

Some questions ask about governmental regulations, such as zoning, shoreline, and landmark designations. Answer these questions if you can. If you have problems, the governmental agencies can assist you.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Use of checklist for nonproject proposals:

Complete this checklist for nonproject proposals, even though questions may be answered "does not apply." IN ADDITION, complete the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (part D).

For nonproject actions, the references in the checklist to the words "project," "applicant," and "property or site" should be read as "proposal," "proposer," and "affected geographic area," respectively.

A. BACKGROUND

1. Name of proposed project, if applicable:

City of Camas General Sewer / Wastewater Facility Plan (hereinafter called "Facility Plan")

2. Name of applicant: **City of Camas**

3. Address and phone number of applicant and contact person:

Monte Brachmann
616 NE Fourth Avenue
Camas, Washington 98607
360 834-6864 ext. 4416
Email address: mbrachmann@ci.camas.wa.us

4. Date checklist prepared: **February 10, 2010**

5. Agency requesting checklist: **Washington Department of Ecology**

6. Proposed timing or schedule (including phasing, if applicable):

The City of Camas General Sewer/ Wastewater Facilities Plan was revised and approved by Ecology in November 2009. Construction of proposed Phase 2 improvements to the Camas WWTF and the Main Pump Station will begin in late winter 2010. Collection system improvements will be completed from 2010- 2022.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

Phase 2 WWTF improvements, outfall modifications, Main Pump Station improvements, and other collection system improvements will provide service to the expanding population of Camas and the surrounding area through 2025 (projected population 25,000). Additional improvements to the wastewater system will be required to provide service beyond 2025.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

- **City of Camas Shoreline Substantial Development Application**
- **City of Camas Conditional Use Permit Application**
- **State Environmental Review Process (SERP) Environmental Assessment**
- **Hydraulic Project Approval (Washington Department of Fish and Wildlife)**
- **Aquatic Easement (Washington State Department of Natural Resources)**

Construction work involving installation of underwater pipelines or work in wetlands requires a CWA Section 404 Permit and possibly a River and Harbors Act Section 10 permit from the Army Corps of Engineers. In-water work requires a Hydraulic Project Approval from the Washington Department of Fish and Wildlife. Work involving underwater pipelines requires a Right of Entry Approval or lease from the Washington State Department of Natural Resources. Work at the WWTF would require a Shoreline Permit and local Filling and Grading and Electrical Permits.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.

No.

10. List any government approvals or permits that will be needed for your proposal, if known.

- **Department of Ecology approval of Facility Plan**
- **Shoreline Exemption – Issued for Phase 2 and outfall (10-2-09)**
- **City of Camas Conditional Use Permit**
- **SEPA DNS/MDNS issued 10-6-09**
- **Executive Order 0505 compliance/approval from the Department of Archaeology & Historic Preservation**

- **City of Camas Building Permit**
- **Endangered Species Act compliance (if federal funding or a federal permit are involved).**

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.)

1. **Main Sewage Pump Station: Camas will construct a series of major improvements to increase reliability and reduce maintenance requirements at its main sewage pump station that pumps nearly all of the City's sewage under the Washougal River to the WWTF. The existing wet well will be enlarged and a grinder facility will be installed to grind debris to prevent clogging of the pumps.**

2. **Wastewater Treatment Plant: Camas will construct a $15-20 million upgrade to the existing Wastewater Treatment Plant to increase capacity and ensure redundancy that will ultimately ensure public health and safety and enhance the environmental value of the region's natural resources. The design will include a new primary anaerobic digester, new secondary anaerobic digester, new sludge dryer, additional aeration blower, additional bank of ultraviolet disinfection lamps, aeration basin modifications, enlarged odor control biofilter, outfall modifications, new septage storage tank, and operational control systems that will integrate the new systems with the existing plant systems.**

3. **Collection System: Camas will institute a program of pump station upgrades and sewer pipe rehabilitation throughout the City.**

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

- **The Camas WWTF is located at the intersection of Polk Street and Eleventh Avenue.**
- **The Main Pump Station is located at Dallas Street & SE 4th.**
- **The other pump stations and sewer pipes are located throughout the City.**

These facilities are located in Section 11, 12, 13 & 14 in Township 1 North, Range 3 East Willamette Meridian in the City of Camas.

B. ENVIRONMENTAL ELEMENTS

1. Earth

a. General description of the site (circle one): *Flat*, rolling, *hilly*, steep slopes, mountainous, other . . . . . .

b. What is the steepest slope on the site (approximate percent slope)?

The WWTF and Main Pump Station sites are relatively flat (maximum slope ~3%). The locations where the other pump stations will be upgraded and sewer pipes rehabilitated vary from flat to hilly (maximum slope 30%)

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any prime farmland.

According to USGS Maps for the area, Hillsboro soils are present on the Camas WWTF Site. Soils at the Main Pump Station Site include fill and Sauvie soils. A variety of soils exist in the rest of Camas where pump station improvements and sewer pipe rehabilitation will occur, predominantly Hesson, Hillsboro, Olympic, Washougal and Powell.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

No.

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.

Proposed WWTF improvements will involve significant amounts (~10,000 cu. yd.) of excavation and fill on the existing site. Proposed improvements at the Main Pump Station and other pump stations will occur predominantly within the existing footprint (< 100 cu. yd. of fill per pump station). Excavation and fill for pipe rehabilitation improvements will vary widely, from 10. cu. yd. to 1,000 cu. yd., depending on the location and rehabilitation technology selected.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.

Erosion could occur in work areas where excavated soils are exposed to wind and rain. Erosion control measures will be undertaken as part of each project to prevent migration of sediment.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

The percentage of impervious surfaces at the Main Pump Station will likely remain essentially the same (likely approximately 90%). Improvements at the Camas WWTF will include new anaerobic digesters, and a new septage storage tanks. These large structures will increase the percentage of impervious surfaces on the site from approximately 50% to 60-65%.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Construction Best Management Practices, BMPs, for the control of sedimentation and erosion will be implemented during construction to minimize the amount of turbid runoff leaving the work site. Excavated materials will be covered in the event of heavy rain or wind. Silt fences will be installed between ground disturbing activities and adjacent sensitive areas. Straw bales will be utilized to filter turbid runoff prior to discharge into local streams. Major ground-disturbing activities will be restricted to the drier summer months to minimize the potential for erosion on the construction site and sedimentation of adjacent sensitive areas.

2. Air

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.

None associated with preparation of the Facilities Plan. Construction of the proposed improvements to the Camas WWTF, Main Pump Station, and collection system will require use of gas or diesel-fueled heavy machinery. In addition, earth-moving activities have the potential to generate dust.

Operation of the upgraded WWTF and pump stations will have the potential to generate offensive odors.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

None known.

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

Construction vehicle emission controls will be properly operated and maintained. An enlarged odor control biofilter will be installed at the Camas WWTF to control odors.

3. Water

a. Surface:

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

The Columbia River flows east to west within 200 feet south of the Camas WWTF. The Lacamas Creek Pump Station is located approximately 200 feet north of the Washougal River. The Main Pump Station is slightly more than 200 feet from the Washougal River.

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.

Much of the work proposed on the site of the Camas WWTF will be on structures between 200 and 400 feet from the Columbia River. The anaerobic digesters and digester building will be constructed approximately 200 feet from the river. The work for the Main Pump Station and Lacamas Creek Pump Station may occur within 200 feet of the Washougal River. Construction of the STEP Main Bypass Line will require work over and adjacent to the Washougal River; however, that project will be addressed in another SEPA checklist. Work on other pump stations and sewer line rehabilitation will not require work within 200 feet of water bodies.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected.
Indicate the source of fill material.

No fill or dredge material will be placed in surface waters or wetlands associated with the proposed improvements to the Main Pump Station and WWTF. It is possible, but unlikely, that wetland fill may be required for some of the collection system improvements.

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.

It may be necessary to pump water from the trenches prepared for installation of some of the other large structures proposed for the Camas WWTF site.

5) Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.

According to the City of Camas FIRM Panel Number 530026 0002B (February 18, 1981), both the Camas WWTF and the Main Pump Station are located within the 100-year floodplain. The other facilities are out of the floodplain.

6) Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.

The Camas WWTF will discharge up to 6.1 MGD (as a monthly average) of wastewater effluent treated to secondary standards to the Columbia River and the Main Pump Station has a current capacity of 7,700 gpm.

4. Ground:

1) Will ground water be withdrawn, or will water be discharged to ground water? Give general description, purpose, and approximate quantities if known.

During construction dewatering, groundwater may be withdrawn from trenches for the new

digesters and other large structures on the site of the Camas WWTF. Groundwater may also be withdrawn for collection system improvements, depending on the technology selected.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals. . . ; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

No waste materials will be discharged to the ground associated with Phase 2 of the Camas Wastewater Facilities Improvement Projects. It is likely that upgrading the WWTF and the Main Pump Station will allow the City to allow more homes & businesses in the service area to connect to the system.

c. Water runoff (including stormwater):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

Construction of the proposed improvements to the Camas WWTF (and possibly certain collection system improvements, depending on the rehabilitation method chosen) will require excavation of significant amounts of soil. Construction BMPs for the control of sedimentation and erosion will be implemented during construction to minimize turbid water leaving the sites. Silt fences will be positioned between work areas and sensitive areas. Straw bales will be used to filter turbid runoff during storm events. Runoff from impervious surfaces at the Camas WWTF Site will be routed either to stormwater drains or discharged into the WWTF waste stream for treatment.

2) Could waste materials enter ground or surface waters? If so, generally describe.

The Camas WWTF will discharge municipal wastewater treated to secondary standards to the Columbia River via the existing outfall. As part of the project, the outfall ports will be modified; 8 ports currently closed will be opened, and all 16 ports will be outfitted with Tideflex diffuser valves. (These outfall modifications were covered by another SEPA checklist.)

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:

Runoff from impervious surfaces at the Camas WWTF Site will be routed either to stormwater drains or discharged into the WWTF waste stream for treatment. For all projects, construction BMPs for the control of sedimentation and erosion will be implemented during construction to minimize turbid water leaving the sites. Silt fences will be positioned between work areas and sensitive areas. Straw bales will be used to filter turbid runoff during storm events. The upgraded WWTF will discharge municipal wastewater effluent treated to secondary standards to the Columbia River. The proposed upgrade will provide adequate treatment capacity for the City of Camas through 2025.

4. **Plants**

a. Check or circle types of vegetation found on the site:

__X__ deciduous tree: $\boxed{\text{alder}}$, $\boxed{\text{maple}}$, aspen, other: $\boxed{\text{cottonwood}}$, $\boxed{\text{Oregon ash}}$

__X__ evergreen tree: $\boxed{\text{fir}}$ cedar, pine, other

__X__ shrubs

__X__ grass

__X__ pasture

_____ crop or grain

_____ wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other

_____ water plants: water lily, eelgrass, milfoil, other

——— other types of vegetation

b. What kind and amount of vegetation will be removed or altered?

Minor amounts of grasses and shrubs on the Camas WWTF Site will be permanently removed to make room for the new digesters and other large new infrastructure on the site. Work at the Main Pump Station will not disturb a significant amount of vegetation, as much of the area where the new wet well will be the Pump Station is paved. It is expected that minor amounts of grasses and shrubs will be temporarily or permanently removed to complete the other collection system improvements, depending on the rehabilitation methods chosen.

c. List threatened or endangered species known to be on or near the site.

None known.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

Disturbed soils not covered with new wastewater treatment infrastructure will be hydroseeded with native grasses to stabilize soils.

5. **Animals**

a. Circle any birds and animals which have been observed on or near the site or are known to be on or near the site:

birds: hawk, heron, eagle, songbirds, other:
mammals: deer, bear, elk, beaver, other:
fish: bass, salmon, trout, herring, shellfish, other:

b. List any threatened or endangered species known to be on or near the site.

Bald eagles (formerly listed as threatened, recently delisted) may forage along the Washougal River at any time. Bald eagles are currently building a nest on Lady Island, which is approximately one mile (and out of line-of-sight) from the project area. Chinook salmon and chum salmon (threatened) are present in the Washougal River. Lower Columbia River chinook, Lower Columbia River steelhead, Lower Columbia River coho and Columbia River chum all pass the Camas WWTF Outfall during their annual migrations. These fish spawn from mid summer through the winter, with a minimum number of smolts present during the month of August. The Washington Department of Fish & Wildlife Priority Habitat & Species Maps and Report indicated that purple martins nest in the vicinity of Camas.

Green sturgeon were recently listed as "threatened" and it is possible that they could be present in the Columbia River near Camas.

Eulachon, or Columbia River smelt, have been proposed for listing.

c. Is the site part of a migration route? If so, explain.

Camas lies along the Pacific Flyway for migratory waterfowl. Approximately 20 Evolutionarily Significant Units and Distinct Population Segments of Columbia River salmon migrate up and down the Columbia River past the Camas WWTF annually.

d. Proposed measures to preserve or enhance wildlife, if any:

Upgrading the Camas WWTF to provide adequate wastewater treatment, conveyance and disposal through the year 2025 will improve and preserve water quality for migratory salmonids and other wildlife dependent upon the Columbia River.

6. Energy and natural resources

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

Electricity will be utilized to meet the increased energy requirements for the upgraded Camas WWTF, Main Pump Station, and other pump stations, where required. Additionally, digester gas from the anaerobic digesters will be utilized for heating the digesters. The proposed WWTF Upgrade will install a digester gas collection system and boiler to utilize this gas. Natural gas will be used to supplement the digester gas.

b. Would your project affect the potential use of solar energy by adjacent properties?
If so, generally describe.

None of the proposed structures associated with improvements to the WWTF, the Main Pump Station, or other collection system improvements will be tall enough to affect the potential use of solar energy by adjacent properties.

c. What kinds of energy conservation features are included in the plans of this proposal?
List other proposed measures to reduce or control energy impacts, if any:

Proposed improvements to the Camas WWTF and the Main Pump Station will be located to function by gravity as much as possible. Collection and combustion of digester gas to heat the sludge digestion process will also save energy. All new pumps and blowers will be modern, energy-efficient models.

7. Environmental health

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste that could occur as a result of this proposal?
If so, describe.

No.

1) Describe special emergency services that might be required.

No special emergency services would be required during construction and operation of the proposed improvements to the Camas WWTF and the Main Pump Station.

2) Proposed measures to reduce or control environmental health hazards, if any:

- **Construction equipment will be fitted with emergency spill clean-up kits and operators will be trained in their use.**
- **Emergency eyewash and shower facilities are present on the site of the Camas WWTF in the event of exposure to hazardous materials.**
- **Flagging will likely be provided during construction of the new pump station wet well.**

b. **Noise**

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

Noises from SR 14 and marine traffic on the Columbia River are audible at the Camas WWTF; however, neither of these noise sources will impact the proposed WWTF Upgrades. No noise is expected to impact the Main Pump Station or other collection system improvements.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

The only potential major increase in noise associated with the proposed improvements to the Camas WWTF would be associated with the additional aeration blower. However, the noise increase will not be noticed off-site, as the blower will be sited in a building.

The new sewage grinder installed at the Main Pump Station will generate noise; however, the grinder will be underground so off-site noise impact will be minimal. Little or no off-site noise increase is expected from the other collection system projects.

3) Proposed measures to reduce or control noise impacts, if any:

New noise-generating equipment will generally be housed in buildings or underground to reduce off-site noise and mitigate any impacts.

8. Land and shoreline use

a. What is the current use of the site and adjacent properties?

The site of the Camas WWTF improvements contains the existing wastewater treatment facilities; adjacent land use is primarily residential. The site of the Main Pump Station Improvement Project includes the Pump Station; adjacent properties have residential or commercial uses.

b. Has the site been used for agriculture? If so, describe.

Not in recent times, for any of the projects addressed in this checklist.

c. Describe any structures on the site.

The site of the proposed WWTF Improvement Project includes the existing wastewater treatment structures – concrete treatment tanks and buildings housing equipment. The Main Pump Station Site includes a building, existing pumps, reservoirs and piping currently required to convey most of the City of Camas wastewater across/under the Washougal River. The other pump station sites predominantly include in-ground tanks housing existing pumps, external control panels on grade and piping.

d. Will any structures be demolished? If so, what?

No structures will be demolished at the Camas WWTF site; however, some structures may be modified to assume new functions.

e. What is the current zoning classification of the site?

Camas WWTF: Municipal RC
Main Pump Station: HI Industrial
Other Collection System (Pump Stations and Sewer Pipes): Varies; most are zoned residential.

f. What is the current comprehensive plan designation of the site?

WWTF: Municipal Feature
Main Pump Station: Industrial

Other Collection System (Pump Stations and Sewer Pipes): Varies; most are residential.

g. If applicable, what is the current shoreline master program designation of the site?

The WWTF Site, Main Pump Station Site, and sites of other collection system improvements are all designated Urban.

h. Has any part of the site been classified as an "environmentally sensitive" area? If so, specify.

No.

i. Approximately how many people would reside or work in the completed project?

None would reside there. 5 – 6 people would work at the upgraded WWTF.

j. Approximately how many people would the completed project displace?

None

k. Proposed measures to avoid or reduce displacement impacts, if any:

No displacement impacts anticipated.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

The proposed project is involves upgrading existing facilities to provide adequate wastewater treatment and conveyance for the growing population of the City of Camas.

9. Housing

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

None

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

None

c. Proposed measures to reduce or control housing impacts, if any:

None required

10. Aesthetics

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

The new digester building at the WWTF will be the tallest new building at approximately 18 feet tall, and will be CMU. There would be no change in the height of buildings for the collection system projects.

b. What views in the immediate vicinity would be altered or obstructed?

Views in the vicinity of the WWTF would not change significantly. The new digesters would be built on the site, which may impact views from a few adjacent homes. Because the digester will be south of the sludge storage building, it will be screened from north neighbors.

c. Proposed measures to reduce or control aesthetic impacts, if any:

New above-ground structures will be constructed and/or painted to blend into the existing structures and surroundings. Trees around the WWTF site will screen the view of new structures from most homes.

11. Light and glare

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

No light or glare impacts are anticipated at the existing Main Pump Station Site associated with the proposed improvements. A few new area lights are likely to be installed around the perimeter of the expanded Camas WWTF; these lights would be operated primarily at night, or during foggy conditions.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

Any new lights at the WWTF would be directed inward (i.e. away from the Columbia River and SR 14) to avoid becoming safety issues. New large structures will be partially buried to minimize disturbance of existing views.

c. What existing off-site sources of light or glare may affect your proposal?

Navigation lights along the Columbia River may impact the location and direction of any new lights on the WWTF site.

d. Proposed measures to reduce or control light and glare impacts, if any:

Any new lights at the WWTF would be directed inward (i.e. away from the Columbia River and SR 14) to avoid becoming safety issues.

12. Recreation

a. What designated and informal recreational opportunities are in the immediate vicinity?

Boating, swimming, fishing and windsurfing occur along the Columbia River south of the Camas WWTF.

b. Would the proposed project displace any existing recreational uses? If so, describe.

No.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

No impacts to recreational uses anticipated.

13. Historic and cultural preservation

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.

None known on the site of the Camas WWTF. The Cultural Resources Survey for the Camas WWTF determined that several archaeological sites are located within a mile of the project area. A portion of the project area is on a portion of the first Donation Land Claim in what is now Washington State. A boat landing and surrounding community of Parkersville were established on a portion of the property east of the project area. Survey and auger testing in 1996 yielded a small number of flakes in areas where future construction is planned. A recommendation for additional testing in the vicinity of these lithics was made to clarify the nature of the material (Cultural Resources Reconnaissance of the Camas WWTF Site, Northwest Archaeological Associates, Inc., December 1996).

b. Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.

The Cultural Resources Survey for the Camas WWTF determined that several archaeological sites are located within a mile of the project area.

c. Proposed measures to reduce or control impacts, if any:

Gray & Osborne, Inc. contracted with Archaeological Investigations Northwest of Portland Oregon to conduct a cultural resources survey and prepare a report for review by the Washington Department of Archaeology and Historic Preservation, the Yakima Nation and the Cowlitz Tribe.

The collection system projects will be generally completed within the existing footprint of the sites

involved.

14. Transportation

a. Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.

SR 14 provides access to the area surrounding the Camas WWTF, which is located at the intersection of SE Polk Street and SE 11th Avenue. The Main Pump Station is located near the intersection of SE Dallas Street and SE Fourth Avenue; this area lies approximately one-half mile northwest of the WWTF site, and can be accessed from downtown Camas via SE Sixth Avenue.

b. Is site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?

No. The nearest transit stop is ~1 mile away at SE 8th and Union.

c. How many parking spaces would the completed project have? How many would the project eliminate?

The WWTF has 6 parking spaces. Proposed improvements to the Camas WWTF will not permanently impact the number of parking spaces available.

The Main Pump Station has 1 parking space. Upgrades to the Main Pump Station will extend into the cul-de-sac off 4th St. and/or generally occur within the existing footprint, so parking will not be affected. Parking of maintenance vehicles will occur along 4th St.. Other collection system improvements are not expected to significantly impact parking.

d. Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).

Improvements to the WWTF and pump stations will not require new roads or streets or improvements to existing roads or streets. Sewer rehabilitation may be followed by road improvements, depending on the rehabilitation method chosen and its impact on roads.

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

The Main Pump Station is located approximately six blocks south of the Burlington Northern Railroad, and within a block of the Washougal River. The Columbia River is located approximately one-third of a mile to the south of the Pump Station and approximately 100 feet south of the Camas WWTF site. The Columbia River is the main water transportation route to eastern Washington. The other collection system projects are located throughout the City.

f. How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.

The completed WWTF project will result in fewer vehicular trips per day than current, since anaerobic digestion and mechanical drying will reduce the volume of biosolids produced from that generated currently.

The collection system projects would not impact the number of vehicular trips.

g. Proposed measures to reduce or control transportation impacts, if any:

The completed WWTF project will result in fewer vehicular trips per day, since anaerobic digestion and mechanical drying will reduce the volume of biosolids produced from that generated currently.

Construction of the new wet well at the Main Pump Station will likely involve flagging to avoid impacting truck traffic along 4th St.

15. **Public services**

a. Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.

No.

b. Proposed measures to reduce or control direct impacts on public services, if any.

Upgrading the Camas WWTF will provide adequate wastewater treatment and disposal to allow the facility to meet the requirements of its NPDES Permit through the planning period (2025). Upgrading the Main Pump Station and completing other collection system improvements would provide public wastewater conveyance from Camas to the WWTF over the same time period.

16. Utilities

a. Circle utilities currently available at the site: electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, other.

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity that might be needed.

Water service at the WWTF and Main Pump station is provided by the City of Camas. Gas and Electrical Service are provided by NW Natural Gas and Clark Public Utilities, respectively. Telephone service is provided by Verizon.

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: ....

Date Submitted: .... March 1, 2010 ....

D. SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS

(do not use this sheet for project actions)

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment.

When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?

Upgrading the Camas WWTF, the Main Pump Station and the rest of the City's collection system will improve wastewater conveyance and treatment in the City's service area through the planning period. Once construction is complete, water quality in the Columbia River near the WWTF Outfall would be improved. Upgrading the Main Pump Station will provide adequate wastewater conveyance through the planning period and proposed upgrades to the biofilter will improve/preserve air quality in the vicinity of the station.

Proposed measures to avoid or reduce such increases are:

Upgrading the Camas WWTF, the Main Pump Station and the rest of the collection system will improve wastewater conveyance and treatment in the City's service area through the planning period.

During construction of improvements recommended in the plan, BMPs for the control of sedimentation and erosion will be implemented to protect water quality in nearby surface waters.

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

Operation of proposed improvements to the City of Camas WWTF, the Main Pump Station and the rest of the collection system will result in improved conditions for fish and aquatic wildlife in the vicinity of the WWTF Outfall in the Columbia River through the planning period (2025). Construction of the proposed improvements will occur on, or immediately adjacent to, existing infrastructure so that impacts to vegetation will be limited to removal of small areas of grasses and shrubs on the WWTF site.

Proposed measures to protect or conserve plants, animals, fish, or marine life are:

Construction BMPs for control of sedimentation and erosion will be implemented to minimize potential for adverse impacts to water quality and aquatic habitat. Mufflers and other noise-

abatement equipment on construction machinery will be properly operated and maintained to minimize potential impacts on wildlife in the area.

3. How would the proposal be likely to deplete energy or natural resources?

Upgrading the Camas WWTF, the Main Pump Station and other pump stations with state-of-the-art components will improve reliability and minimize energy consumption at these facilities through the planning period.

Proposed measures to protect or conserve energy and natural resources are:

New wastewater treatment processes at the Camas WWTF will be designed to flow by gravity as much as practicable. New pumps, blowers and other equipment at the WWTF and Main Pump Station will be modern energy-efficient models. Sludge digester gas will be collected and used to heat the digester to conserve natural gas.

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

Both the Camas WWTF and the Main Pump Station are located within the 100-year floodplain of the Columbia and Washougal Rivers. Improving the quality of effluent produced by the Camas WWTF will improve water quality and aquatic habitat in the Columbia River near the WWTF outfall. Habitat for listed salmonids in the Columbia River will be improved and maintained through the planning period. There are no federally designated Wild or Scenic Rivers, prime farmlands or wetlands in the project areas.

Proposed measures to protect such resources or to avoid or reduce impacts are:

All work and ground disturbance associated with the proposed improvements for the Camas WWTF and the Main Pump Station will occur within the developed grounds, and the footprint of any new structures will be minimized to reduce potential impacts to the floodplain (construction of new infrastructure at the WWTF would not result in a one-foot increase in the elevation of the 100-year floodplain). An archaeological/cultural resources survey will be conducted in the project area for the Camas WWTF and the Main Pump Station improvements to identify any cultural, archaeological or historic significance. In the event that such materials are encountered during construction, work will be stopped and the Washington Department of Archaeology and Historic Preservation and the Cowlitz Tribe will be consulted.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

Construction of proposed improvements to the Camas WWTF, the Main Pump Station, and other pump stations and sewer pipes will not change land/shoreline use at these sites. Upgrading these facilities will allow planned development to occur in the City of Camas through the planning period in conjunction with the Comprehensive Plan.

Proposed measures to avoid or reduce shoreline and land use impacts are:

Improvements to the Camas WWTF, the Main Pump Station and other pump stations will occur within the grounds of the existing sites, so that shoreline and land use impacts will be minimal. Work at other pump stations and sewer pipes will not generally not change land/shoreline use at these sites.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

Construction and operation improvements to the Camas WWTF and Main Pump Station proposed in the Facilities Plan will provide adequate wastewater treatment and conveyance for the City of Camas through the planning period with minimal potential for adverse impacts on transportation, public services or other utilities.

Proposed measures to reduce or respond to such demand(s) are:

None.

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

Improvements to the Camas WWTF and the Main Pump Station proposed in the Facilities Plan will comply with all local, state and federal laws and requirements for the protection of the environment.

CITY OF CAMAS
616 Northeast Fourth Avenue
P.O. Box 1055
Camas, Washington 98607
PH: 360-834-6864 • F: 360-834-1535
http://www.ci.camas.wa.us

COMMUNITY DEVELOPMENT DEPARTMENT

Date Published: October 6, 2009

To Whom It May Concern:

Please find enclosed a Determination of Nonsignificance (DNS) for the **Camas Wastewater Treatment Facility Renovation (SEPA09-20)** that was issued pursuant to the State Environmental Policy Act (SEPA) Rules, Chapter 197-11, Washington Administrative Code. The enclosed review comments reflect evaluation of the environmental checklist by the lead agency as required by WAC 197-11-330(1)(a)(i). Copies of the following documents are available upon request from the Community Development Department. The documents include:

- Narrative of compliance with Camas Municipal Codes
- Engineer's Cost Estimate
- Memorandum from Gray & Osborne, Consulting Engineers regarding NPDES permit
- Clark County Assessor's Packet
- Clark County Critical Area Maps
- Preliminary Construction Drawings (General Site, Mechanical, Electrical, Structural and Plumbing)

Written comments may be submitted on this determination within fourteen (14) days of October 6, 2009. On October 20, 2009, the DNS may be reconsidered in light of the comments received.

Please address all correspondence to:

City of Camas, SEPA Official
Community Development Department
616 NE Fourth Avenue / P.O. Box 1055
Camas, Washington 98607

Distribution

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Clark County Parks Department, Jeroen Kok
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Department of Ecology
Department of Fish and Wildlife
Department of Natural Resources, SEPA Center
Department of Natural Resources, Pacific Cascade Region
Department of Transportation
Parks & Recreation Commission
Port of Camas-Washougal
Post Record Publications
Southwest Air Pollution Control Authority
US Army Corps of Engineers
Washington Office of Archaeology & Historic Preservation
UCAN (United Camas Neighborhood Association)
Property Owners within 300 feet

STATE ENVIRONMENTAL POLICY ACT

DETERMINATION OF NON-SIGNIFICANCE

Mail Comments to:
City of Camas
Community Development Director
P.O. Box 1055
Camas, WA 98607

CASE NO:	SEPA09-20 (Camas Wastewater Treatment Facility Renovation, City file #SPRV09-09)
APPLICANT:	City of Camas, Public Works Department
REQUEST:	Equipment upgrades to both the main sewage pump station and the wastewater treatment facility. This project will reduce maintenance issues and improve handling capacity of these facilities to serve the City until 2025.
LOCATION:	1129 SE Polk Street, Camas, WA
Legal Description:	NW & SW ¼, S13, T1N, R35 and Tax parcel #87360-000
SEPA Determination:	Determination of Non-Significance
Comment Deadline:	October 20, 2009, at 5:00 p.m.

As lead agency under the State Environmental Policy Act (SEPA) Rules [Chapter 197-11, Washington Administrative Code (WAC)], the City of Camas must determine if there are possible significant adverse environmental impacts associated with this proposal. The options include the following:

- DS = Determination of Significance (The impacts cannot be mitigated through conditions of approval and, therefore, requiring the preparation of an Environmental Impact Statement (EIS).
- MDNS = Mitigated Determination of Non-Significance (The impacts can be addressed through conditions of approval), or;
- DNS = Determination of Non-Significance (The impacts can be addressed by applying the Camas Municipal Code).

Determination:
Determination of Non-Significance (DNS). The City of Camas, as lead agency for review of this proposal, has determined that this proposal does not have a probable significant adverse impact on the environment. An Environmental Impact Statement (EIS) is not required under RCW 43.21C.030(2)(e). This decision was made after review of a completed environmental checklist and other information on file with the City.

Date of Publication & Comment Period:

Publication date of this DNS is **October 6, 2009**, and is issued under WAC 197-11-340. The lead agency will not act on this proposal until the close of the 14-day comment period which ends on **October 20, 2009**.

SEPA Appeal Process:

An appeal of any aspect of this decision, including the SEPA determination and any required mitigation, must be filed with the City Clerk within fourteen (14) calendar days from the date of the decision notice. The letter of appeal should contain the following information:

1. The case number designated by the City of Camas, and the name of the applicant; and
2. The name and signature of each person or group (petitioners), and a statement showing that each petitioner is entitled to file an appeal as described within the Camas Municipal Code. If multiple parties file a single petition for review, then the petition shall designate one party as the contact representative with the Planning Department. All contact with the Planning Department regarding the petition, including notice, shall be with this contact person.

The appeal request is to be submitted to the City Clerk between 8:00 a.m. and 5:00 p.m. Monday through Friday, at the address listed below:

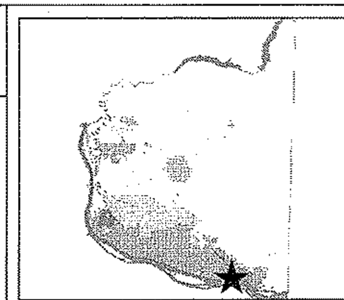
Appeal to the City of Camas SEPA Official
Community Development Department
616 NE Fourth Avenue / P.O. Box 1055
Camas, Washington 98607

Staff Contact Person: Sarah Fox, Planner II (360) 817-1562 ext. 4269
Responsible Official: Phil Bourquin (360) 817-1562

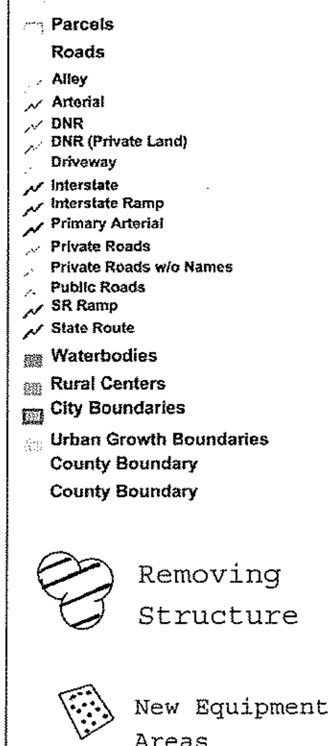
Phil Bourquin, Community Development Director and SEPA Official

10-01-09
Date

Wastewater Treatment Facility Renovation (SEPA09-20)



Legend



0 200 400 600 ft.

Map center: 45° 34' 43.0" N, 122° 23' 37.6" W

Scale: 1:2,011

Data published, and maintained by the Geographic Information System division of the Department of Assessment and GIS, Clark County, Washington

WAC 197-11-960 Environmental checklist.

ENVIRONMENTAL CHECKLIST

Purpose of checklist:

The State Environmental Policy Act (SEPA), chapter 43.21C RCW, requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. An environmental impact statement (EIS) must be prepared for all proposals with probable significant adverse impacts on the quality of the environment. The purpose of this checklist is to provide information to help you and the agency identify impacts from your proposal (and to reduce or avoid impacts from the proposal, if it can be done) and to help the agency decide whether an EIS is required.

Instructions for applicants:

This environmental checklist asks you to describe some basic information about your proposal. Governmental agencies use this checklist to determine whether the environmental impacts of your proposal are significant, requiring preparation of an EIS. Answer the questions briefly, with the most precise information known, or give the best description you can.

You must answer each question accurately and carefully, to the best of your knowledge. In most cases, you should be able to answer the questions from your own observations or project plans without the need to hire experts. If you really do not know the answer, or if a question does not apply to your proposal, write "do not know" or "does not apply." Complete answers to the questions now may avoid unnecessary delays later.

Some questions ask about governmental regulations, such as zoning, shoreline, and landmark designations. Answer these questions if you can. If you have problems, the governmental agencies can assist you.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Use of checklist for nonproject proposals:

Complete this checklist for nonproject proposals, even though questions may be answered "does not apply." IN ADDITION, complete the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (part D).

For nonproject actions, the references in the checklist to the words "project," "applicant," and "property or site" should be read as "proposal," "proposer," and "affected geographic area," respectively.

A. BACKGROUND

1. Name of proposed project, if applicable:

Facilities Plan: Camas WWTF and Main Sewage Pump Station Improvements, Phase 2.

2. Name of applicant: **City of Camas**
3. Address and phone number of applicant and contact person:

Monte Brachman
616 NE Fourth Avenue
Camas, Washington 98607
360 834-6864 ext. 4416
mbrachman@ci.camas.wa.us

4. Date checklist prepared: **September 2009**
5. Agency requesting checklist: **Washington Department of Ecology & City of Camas**
6. Proposed timing or schedule (including phasing, if applicable):

Construction of proposed improvements to the Camas WWTF and the Main Pump Station is anticipated to begin in late spring or early summer 2010.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

Phase 2 Wastewater System Improvements will provide service to the expanding population of Camas and the surrounding area through 2025 (projected population 25,000). Additional improvements to the wastewater system will be required to provide service beyond 2025.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

- **State Environmental Review Process (SERP) Environmental Assessment**
- **Critical Aquifer Recharge Area (CARA) review**

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.

Minor modifications to the Camas WWTF outfall to the Columbia River are being processed under a separate SEPA Checklist and Determination of Non Significance. Permits required for the outfall modifications include:

- **Rivers & Harbors Act, Section 10 Permit**
- **Hydraulic Project Approval from WDFW**
- **Shoreline Exemption (outfall)**

10. List any government approvals or permits that will be needed for your proposal, if known.

- **SEPA DNS/MDNS**
- **Executive Order 0505 compliance/approval from the Department of Archaeology & Historic Preservation**
- **Building Permit**
- **Grading Permit**
- **Endangered Species Act consultation and concurrence from USFWS and NMFS.**

The outfall portion of the proposed project is currently under review.

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.)

1. **Main Sewage Pump Station:** Camas will construct a series of major improvements to increase reliability and reduce maintenance requirements at its main sewage pump station that pumps nearly all of the City's sewage under the Washougal River to the WWTF. The existing wet well will be enlarged and a grinder facility will be installed to grind debris to prevent clogging of the pumps.

2. **Wastewater Treatment Facility:** Camas will construct a $15-20 million upgrade to the existing Wastewater Treatment Facility to improve sludge/biosolids handling capacity and ensure redundancy that will ultimately ensure public health and safety and enhance the environmental value of the region's natural resources. The design will include two new primary anaerobic digesters, a new sludge storage tank, new sludge dryer, additional aeration blower, additional bank of ultraviolet disinfection lamps, aeration basin modifications, enlarged odor control

The percentage of impervious surfaces at the Main Pump Station will remain approximately the same. Improvements at the Camas WWTF will include new anaerobic digesters and new septage storage tanks. These large structures will increase the area of impervious surfaces by approximately 8,000 square feet, while removal of the aerobic digester will reduce the impervious area by about 15,000, resulting in a net reduction of about 7,000 square feet of impervious surfaces at the WWTF site.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Construction BMPs, for the control of sedimentation and erosion will be implemented during construction to minimize the amount of turbid runoff leaving the work site. Excavated materials will be covered in the event of heavy rain or wind. Silt fences will be installed between ground disturbing activities and adjacent sensitive areas. Straw bales will be utilized to filter turbid runoff prior to discharge into local streams. Major ground-disturbing activities will be restricted to the drier summer months to minimize the potential for erosion on the construction site and sedimentation of adjacent sensitive areas.

a. Air

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.

Construction of the proposed improvements to the Camas WWTF and the Main Pump Station will require use of gas or diesel-fueled heavy machinery. In addition, earth-moving activities have the potential to generate dust.

Operation of the upgraded WWTF and Main Pump Station will have the potential to generate offensive odors. However, standard practices will be employed to minimize the potential for odor generation. Expansion of the odor control biofilter will provide additional odor control on the WWTF site.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

None known.

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

Construction vehicle emission controls will be properly operated and maintained. An enlarged odor control biofilter will be installed at the Camas WWTF to control odors as the plant loading increases through the planning period (2025).

3. **Water**

a. Surface:

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

The Columbia River flows east to west within 200 feet south of the Camas WWTF. The Main Pump Station is located slightly more than 200 feet from the Washougal River.

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.

Work proposed on the site of the Camas WWTF that lies within 200 feet of the Columbia River will occur within an existing building and will not modify the footprint, so no Shoreline permitting will be required. The anaerobic digesters will be installed in an existing building approximately 200 feet from the Columbia River. Work at the Main Pump Station will occur slightly more than 200 feet from the Washougal River.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

No fill or dredge material will be placed in surface waters or wetlands associated with the proposed improvements to the Main Pump Station and the Camas WWTF.

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.

It may be necessary to pump water from the trenches prepared for installation of the new secondary clarifiers and some of the other large structures proposed for the Camas WWTF site.

5) Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.

According to Flood Insurance Rate Map (FIRM) Panel Number 530026 0002B (February 18, 1981), both the Camas WWTF and the Main Pump Station are located within the 100-year floodplain.

6) Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.

The Camas WWTF discharges up to 6.1 MGD of wastewater effluent treated to secondary standards to the Columbia River and the Main Pump Station has a current capacity of 7,700 gpm. Once the upgraded WWTF is in operation, the Maximum Month Flow Capacity will remain the same; however, solids handling capacity at the facility will be significantly improved.

b. Ground:

1) Will ground water be withdrawn, or will water be discharged to ground water? Give general description, purpose, and approximate quantities if known.

During construction, groundwater may be withdrawn from trenches for the new digesters and other large structures proposed on the site of the Camas WWTF.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals. . . ; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

No waste materials will be discharged to the ground associated with Phase 2 of the Camas Wastewater Facilities Improvement Projects. It is likely that upgrading the WWTF and the Main Pump Station will allow the City to provide sewer service to more homes and businesses in the service area.

c. Water runoff (including stormwater):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

Construction of the proposed improvements to the Camas WWTF will require excavation of significant amounts of soil. Construction BMPs for the control of sedimentation and erosion will be implemented during construction to minimize the volume of turbid runoff leaving the site. Silt fences will be positioned between work areas and sensitive areas. Straw bales will be used to filter turbid runoff during storm events. Runoff from impervious surfaces at the Camas WWTF site will be routed either to stormwater drains or discharged into the WWTF waste stream for treatment.

2) Could waste materials enter ground or surface waters? If so, generally describe.

The Camas WWTF will discharge municipal wastewater treated to secondary standards to the Columbia River via the existing outfall.

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:

Runoff from impervious surfaces at the Camas WWTF site will be routed either to stormwater drains or discharged into the WWTF waste stream for treatment. Construction BMPs for the control of sedimentation and erosion will be implemented during construction to minimize turbid water leaving the site. Silt fences will be positioned between work areas and sensitive areas. Straw bales will be used to filter turbid runoff during storm events. The upgraded WWTF will discharge municipal wastewater effluent treated to secondary standards to the Columbia River. The proposed upgrade will provide adequate treatment capacity for the City of Camas through 2025.

4. **Plants**

a. Check or circle types of vegetation found on the site:

__X__ deciduous tree: alder, maple, aspen, cottonwood, Oregon ash other

_____ evergreen tree: fir, cedar, pine, other
_X_ shrubs
_X_ grass
_____ pasture
_____ crop or grain
_____ wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other
_____ water plants: water lily, eelgrass, milfoil, other
_____ other types of vegetation

b. What kind and amount of vegetation will be removed or altered?

Work at the Main Pump Station will not disturb a significant amount of vegetation, as the area surrounding the Pump Station is paved. Minor amounts of grasses and shrubs on the Camas WWTF site will be permanently removed to make room for the new digesters and other large new infrastructure on the site.

c. List threatened or endangered species known to be on or near the site.

None known.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

Disturbed areas not covered with new wastewater treatment infrastructure will be hydroseeded with native grasses to stabilize soils.

5. **Animals**

a. Circle any birds and animals which have been observed on or near the site or are known to be on or near the site:

birds: hawk, heron, eagle, songbirds, other:
mammals: deer, bear, elk, beaver, other:
fish: bass, salmon, trout, herring, shellfish, other:

b. List any threatened or endangered species known to be on or near the site.

Chinook salmon and chum salmon (threatened) are present in the Washougal River. Lower Columbia River chinook, Lower Columbia River steelhead, Lower Columbia River coho and Columbia River chum, which are all listed as "threatened" pass the Camas WWTF outfall during their annual migrations. These fish spawn from mid summer through the winter, with a minimum number of smolts present during the month of August. The Washington Department of Fish & Wildlife Priority Habitat & Species Maps and Report indicated that purple martins nest in the vicinity of Camas.

c. Is the site part of a migration route? If so, explain.

Camas lies along the Pacific Flyway for migratory waterfowl. Approximately 14 Evolutionarily Significant Units and Distinct Population Segments of Columbia River salmon, trout and two species of sturgeon migrate up and down the Columbia River past the Camas WWTF.

d. Proposed measures to preserve or enhance wildlife, if any:

Upgrading the Camas WWTF to provide adequate wastewater treatment, conveyance and disposal through the year 2025 will improve and preserve water quality for migratory salmonids and other fish and wildlife dependent upon the Columbia River as the human population in the area grows.

6. **Energy and natural resources**

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

Electricity will be utilized to meet the increased energy requirements for the upgraded Camas WWTF and Main Pump Station. The proposed WWTF Upgrade will install a digester gas collection system and boiler to utilize this gas, which will reduce the amount of natural gas or electricity required to heat the sludge digestion process and to dry the biosolids.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.

None of the proposed structures associated with improvements to the WWTF or the Main Pump Station will be tall enough to affect the potential use of solar energy by adjacent properties.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

Proposed improvements to the Camas WWTF and the Main Pump Station will be designed and located to function by gravity as much as possible. Collection and combustion of digester gas to heat the sludge digestion process and dry biosolids will also save energy. All new pumps and blowers will be modern, energy-efficient models. Upgrades to the aeration system controls will increase the efficiency of the blower operations.

7. **Environmental health**

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste that could occur as a result of this proposal? If so, describe.

Flammable gases such as methane and hydrogen sulfide will be formed in the digester. These gases will be properly collected, treated and burned to heat the digestion process.

1) Describe special emergency services that might be required.

No special emergency services would be required during construction and operation of the proposed improvements to the Camas WWTF and the Main Pump Station.

2) Proposed measures to reduce or control environmental health hazards, if any:

- **Construction equipment will be fitted with emergency spill clean-up kits and operators will be trained in their use.**

biofilter, new septage centrate/WAS storage centrate/WAS tank, and operational control systems that will integrate the new systems with the existing WWTF systems.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

- **The Camas WWTF is located at the intersection of Polk Street and Eleventh Avenue**
- **The Main Pump Station is located at Dallas Street & SE 4th**

These facilities are located in Sections 11, 12, 13 & 14 in Township 1 North, Range 3 East Willamette Meridian in the City of Camas.

B. ENVIRONMENTAL ELEMENTS

1. **Earth**

a. General description of the site (circle one): ***Flat,*** rolling, hilly, steep slopes, mountainous, other . . . . . .

b. What is the steepest slope on the site (approximate percent slope)?

The Camas WWTF and Main Pump Station sites are fairly flat, as slopes do not exceed 2%.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any prime farmland.

According to USGS Maps for the area, Hillsboro soils are present on the Camas WWTF Site. Soils at the Main Pump Station Site include fill and Sauvie soils.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

No.

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.

Proposed WWTF improvements will involve significant amounts of excavation and fill on the existing site (approximately 10,000cy). Proposed Pump Station improvements will occur within the existing footprint.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.

Erosion could occur in work areas where excavated soils are exposed to wind and rain. Construction best management practices (BMPs) for the control of sedimentation and erosion will be implemented during construction.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

- **Emergency eyewash and shower facilities are present on the site of the Camas WWTF in the event of exposure to hazardous materials.**
- **Phase 2 includes a new digester boiler exhaust, a waste gas burner flare, and a new odor control biofilter. Digester gas will be collected, treated and burned to heat the digestion process and to dry sludge.**

b. **Noise**

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

Noises from SR 14 and marine traffic on the Columbia River are audible from the Camas WWTF; however, neither of these noise sources will impact the proposed WWTF and Pump Station upgrades.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

The only potential major increase in noise associated with the proposed improvements to the Camas WWTF would be associated with the new/additional aeration blower. However, the noise increase will not be noticed off-site, as the new blower will be installed in a sound attenuating building.

The new sewer grinder installed at the Main Pump Station will generate noise; however the grinder will be located underground, so off-site noise impacts will be minimal.

3) Proposed measures to reduce or control noise impacts, if any:

New noise-generating equipment will generally be housed in buildings or underground to reduce off-site noise and mitigate any adverse impacts.

8. **Land and shoreline use**

a. What is the current use of the site and adjacent properties?

The site of the Camas WWTF improvements contains the existing wastewater treatment facilities; adjacent land use is primarily residential with some open space. The site of the Main Pump Station Improvement Project includes the Pump Station and surrounding residential and industrial uses.

b. Has the site been used for agriculture? If so, describe.

Not in recent times.

c. Describe any structures on the site.

The site of the proposed WWTF Improvement Project includes the existing wastewater treatment structures – concrete treatment tanks and buildings housing equipment. The Main Pump Station

Site includes the existing pumps, reservoirs and piping currently required to convey most of the City of Camas wastewater across/under the Washougal River.

d. Will any structures be demolished? If so, what?

The existing aerobic digester will be demolished at the Camas WWTF site and some structures will be modified to assume new functions.

e. What is the current zoning classification of the site?

Camas WWTF: Municipal RC
Main Pump Station: HI Industrial

f. What is the current comprehensive plan designation of the site?

WWTF: Municipal \Feature
Main Pump Station: Industrial

g. If applicable, what is the current shoreline master program designation of the site?

The Camas WWTF and Main Pump Station sites are both designated as "Urban."

h. Has any part of the site been classified as an "environmentally sensitive" area? If so, specify.

A portion of the WWTF site is located within 200 feet of the Columbia River and Shoreline Jurisdiction.

i. Approximately how many people would reside or work in the completed project?

None would reside at the WWTF, but 5-6 people would work at the upgraded facility.

j. Approximately how many people would the completed project displace?

None.

k. Proposed measures to avoid or reduce displacement impacts, if any:

Not applicable.

Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

The proposed project involves upgrading existing facilities to provide adequate wastewater treatment and conveyance for the growing population of the City of Camas.

9. **Housing**

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

None.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

None.

c. Proposed measures to reduce or control housing impacts, if any:

None required.

10. **Aesthetics**

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

The new digester at the WWTF would be approximately 18 feet tall and it will be CMU. There would be no change in the height of buildings on the Main Pump Station Site.

b. What views in the immediate vicinity would be altered or obstructed?

Views in the vicinity of the WWTF would not change significantly. The new digester would be built on the site, which may impact views from a few adjacent homes. The new digester will be screened from residential views by the sludge storage building.

c. Proposed measures to reduce or control aesthetic impacts, if any:

New above-ground structures will be painted to blend into the existing structures. Existing trees will screen the view of the WWTF from most adjacent houses.

11. **Light and glare**

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

No light or glare impacts are anticipated at the existing Main Pump Station Site associated with the proposed improvements. A few new area lights are likely to be installed around the perimeter of the expanded Camas WWTF; these lights would be operated primarily at night, or during foggy conditions.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

Any new lights at the WWTF would be directed inward (i.e. away from the Columbia River and SR 14) to avoid becoming safety issues. New large structures will be partially buried to minimize disturbance of existing views, and views of some new structures will be blocked by existing equipment on the WWTF site.

c. What existing off-site sources of light or glare may affect your proposal?

Navigation lights along the Columbia River may impact the location and direction of any new lights on the WWTF site.

d. Proposed measures to reduce or control light and glare impacts, if any:

Any new lights at the WWTF would be directed inward (i.e. away from the Columbia River and SR 14) to avoid becoming safety issues.

12. **Recreation**

a. What designated and informal recreational opportunities are in the immediate vicinity?

None on the WWTF and main pump station sites. However, boating, swimming, fishing and windsurfing occur along the Columbia River south of the Camas WWTF. Fishing, wading and swimming occur along the Washougal River.

b. Would the proposed project displace any existing recreational uses? If so, describe.

No.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

None required.

13. **Historic and cultural preservation**

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.

There are no places or objects eligible for national, state or local preservation registers known to be on the site of the Camas WWTF or the main pump station. The Cultural Resources Survey for the Camas WWTF determined that several archaeological sites are located within a mile of the project area. A portion of the project area is located within the first Donation Land Claim in what is now Washington State. A boat landing and surrounding community of Parkersville were established on a portion of the property east of the project area. Survey and auger testing in 1996 yielded a small number of flakes in areas where future construction is planned. A recommendation for additional testing in the vicinity of these lithics was made to clarify the nature of the material (Cultural Resources Reconnaissance of the Camas WWTF Site, Northwest Archaeological Associates, Inc., December 1996).

b. Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.

The Cultural Resources Survey for the Camas WWTF determined that several archaeological sites are located within a mile of the project area.

c. Proposed measures to reduce or control impacts, if any:

Gray & Osborne, Inc. has contracted with Archaeological Investigations Northwest of Portland, Oregon to conduct a cultural resources survey and prepare a report for review by the Washington Department of Archaeology and Historic Preservation, the Yakima Nation and the Cowlitz Tribe. This report was forwarded to the DAHP and the Tribes by the Public Works Board. Terry Dale of the Public Works Board confirmed that there have been no responses to the Cultural Resources Report for the project from the consulted tribes, and that the Robert Whitlam, State Archaeologist concurred with the determination of no historic properties affected.

14. **Transportation**

a. Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.

SR 14 provides access to the area surrounding the Camas WWTF, which is located at the intersection of SE Polk Street and SE 11th Avenue. The Main Pump Station is located near the intersection of SE Dallas Street and SE Fourth Avenue; this area lies approximately one-half mile northwest of the WWTF site, and can be accessed from downtown Camas via SE Sixth Avenue.

b. Is site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?

The Camas WWTF is not currently served by public transit. The nearest bus stop is approximately one mile away near the intersection of 8th and Union.

c. How many parking spaces would the completed project have? How many would the project eliminate?

The Camas WWTF has six designated parking spaces. Proposed improvements to the Camas WWTF will not permanently impact the number of parking spaces available. The Main Pump Station has one parking space. Upgrades to the Main Pump Station will extend into the cul-de-sac off Fourth Street and/or generally occur within the existing footprint, so parking will not be affected. Parking of maintenance vehicles will occur along Fourth Street.

d. Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).

No. Improvements to the WWTF and Main Pump Station will not require new roads or streets, or improvements to existing roads or streets.

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

The Main Pump Station is located approximately six blocks south of the Burlington Northern Railroad, and within a block of the Washougal River. The Columbia River is located approximately one-third of a mile to the south of the Pump Station and approximately 300 feet south of the Camas WWTF. The Columbia River is the main water transportation route to eastern Washington.

f. How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.

Implementation of the proposed project will result in fewer vehicular trips to the WWTF, because the anaerobic digestion and mechanical drying technologies proposed will reduce the volume of biosolids produced (and requiring disposal) from the amount currently generated.

g. Proposed measures to reduce or control transportation impacts, if any:

Additional trips could be scheduled to occur during low traffic periods. Construction of the new wet well at the main pump station will likely involve flagging to avoid truck traffic along Fourth Street.

15. **Public services**

a. Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.

No.

b. Proposed measures to reduce or control direct impacts on public services, if any.

Upgrading the Camas WWTF will provide adequate wastewater treatment and disposal to allow the facility to meet the requirements of its NPDES Permit through the planning period (2025). Upgrading the Main Pump Station would provide public wastewater conveyance from Camas to the WWTF over the same time period.

16. **Utilities**

a. Circle utilities currently available at the site: **electricity, natural gas, water, refuse service, telephone, sanitary sewer,** septic system, other.

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity that might be needed.

Water service at the WWTF and Main Pump Station is provided by the City of Camas. Gas and electrical service are provided by Northwest Natural Gas and Clark Public Utilities, respectively. Telephone service is provided by Verizon.

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: Jim Dougherty

Date Submitted: September 15, 2009

WAC 197-11-960 Environmental checklist.

ENVIRONMENTAL CHECKLIST

Purpose of checklist:

The State Environmental Policy Act (SEPA), chapter 43.21C RCW, requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. An environmental impact statement (EIS) must be prepared for all proposals with probable significant adverse impacts on the quality of the environment. The purpose of this checklist is to provide information to help you and the agency identify impacts from your proposal (and to reduce or avoid impacts from the proposal, if it can be done) and to help the agency decide whether an EIS is required.

Instructions for applicants:

This environmental checklist asks you to describe some basic information about your proposal. Governmental agencies use this checklist to determine whether the environmental impacts of your proposal are significant, requiring preparation of an EIS. Answer the questions briefly, with the most precise information known, or give the best description you can.

You must answer each question accurately and carefully, to the best of your knowledge. In most cases, you should be able to answer the questions from your own observations or project plans without the need to hire experts. If you really do not know the answer, or if a question does not apply to your proposal, write "do not know" or "does not apply." Complete answers to the questions now may avoid unnecessary delays later.

Some questions ask about governmental regulations, such as zoning, shoreline, and landmark designations. Answer these questions if you can. If you have problems, the governmental agencies can assist you.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Use of checklist for nonproject proposals:

Complete this checklist for nonproject proposals, even though questions may be answered "does not apply." IN ADDITION, complete the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (part D).

For nonproject actions, the references in the checklist to the words "project," "applicant," and "property or site" should be read as "proposal," "proposer," and "affected geographic area," respectively.

A. BACKGROUND

1. Name of proposed project, if applicable:

   Camas WWTF Improvements, Phase 2B.

2. Name of applicant: **City of Camas**

3. Address and phone number of applicant and contact person:

   Eric Levison
   616 NE Fourth Avenue
   Camas, Washington 98607
   360 834-6864 ext. 4416
   elevison@ci.camas.wa.us

4. Date checklist prepared: **September 2011**

5. Agency requesting checklist: **Washington Department of Ecology & City of Camas**

6. Proposed timing or schedule (including phasing, if applicable):

   Construction of proposed improvements to the Camas WWTF is anticipated to begin in late spring or early summer 2012.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

Phase 2B Wastewater System Improvements will provide service to the expanding population of Camas and the surrounding area through 2025 (projected population 25,000). Additional improvements to the wastewater system will be required to provide service beyond 2025.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

- **State Environmental Review Process (SERP) Environmental Assessment (already completed)**
- **Critical Aquifer Recharge Area (CARA) review (already completed)**
- **A previous SEPA Environmental Checklist was completed and a DNS issued (SEPA 09-20 Camas Wastewater Treatment Facility Renovation, City file # SPRV09-09) for the Phase IIA improvements at the WWTF described in the Facility Plan. These improvements are currently under construction.**

  An additional previous SEPA Environmental Checklist was completed and a DNS issued (SEPA 10-08 City of Camas General Sewer / Wastewater Facility Plan) for other improvements described in the General Sewer / Wastewater Facility Plan Facility Plan.

  Because of these previous SEPAs, this new SEPA only addresses the Phase IIB WWTF improvements.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.

Approval of Facility Plan Revision by the Department of Ecology.

10. List any government approvals or permits that will be needed for your proposal, if known.

- **SEPA DNS/MDNS**
- **Executive Order 0505 compliance/approval from the Department of Archaeology & Historic Preservation (already completed)**
- **Building Permit**
- **Grading Permit**
- **Endangered Species Act consultation and concurrence from USFWS and NMFS (already completed).**
- **Southwest Clean Air Agency**

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.)

Phase 2B includes construction of the following components :

- **A hydrogen sulfide (H_2S) scrubber to treat WWTF digester gas produced by the new anaerobic digester system**
- **Secondary Clarifier No. 3**
- **Modifications to the sludge storage building**
- **A new effluent filtration system**
- **Other related instrumentation.**

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

- **The Camas WWTF is located at 1129 SE Polk St. (the intersection of SE Polk Street and Eleventh Avenue.) These facilities are located in Sections 11, 12, 13 & 14 in Township 1 North, Range 3 East Willamette Meridian in the City of Camas.**

B. ENVIRONMENTAL ELEMENTS

1. **Earth**

a. General description of the site (circle one): ***Flat,*** rolling, hilly, steep slopes, mountainous, other . . . . . .

b. What is the steepest slope on the site (approximate percent slope)?

The Camas WWTF is fairly flat, as slopes do not exceed 2%.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any prime farmland.

According to USGS Maps for the area, Hillsboro soils are present on the Camas WWTF Site.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

No.

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.

Proposed WWTF improvements will involve significant amounts of excavation and fill on the existing site (approximately 10,000 cy). However, this work is being done within the footprint of an existing aerobic digester.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.

Erosion could occur in work areas where excavated soils are exposed to wind and rain. Construction best management practices (BMPs) for the control of sedimentation and erosion will be implemented during construction.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

The hydrogen sulfide (H2S) scrubber is the only item for which construction will increase impervious surface, as the new effluent filtration system will be installed to replace the existing filtration system in the existing footprint of the existing filtration system and the new secondary clarifier will be constructed in the existing aerobic digester footprint. The net increase in impervious area will be about 600 square feet.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Construction BMPs, for the control of sedimentation and erosion will be implemented during construction to minimize the amount of turbid runoff leaving the work site. Excavated materials will be covered in the event of heavy rain or wind. Silt fences will be installed between ground disturbing activities and adjacent sensitive areas. Straw bales will be utilized to filter turbid runoff prior to discharge into local streams. Major ground-disturbing activities will be restricted to the drier summer months to minimize the potential for erosion on the construction site and sedimentation of adjacent sensitive areas.

2. Air

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.

Construction of the proposed improvements to the Camas WWTF will require use of gas or diesel-fueled heavy machinery. In addition, earth-moving activities have the potential to generate dust.

Operation of the upgraded WWTF will have the potential to generate offensive odors. However, standard practices will be employed to minimize the potential for odor generation.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

None known.

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

Construction vehicle emission controls will be properly operated and maintained. An enlarged odor control biofilter has been installed at the Camas WWTF to control odors as the

plant loading increases through the planning period (2025). Particularly dusty areas will be watered down to control fugitive dust.

3. **Water**

a. Surface:

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

The Columbia River flows east to west within 200 feet south of the Camas WWTF.

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.

Work proposed on the site of the Camas WWTF that lies within 200 feet of the Columbia River will occur within an existing building and will not modify the footprint, so no Shoreline permitting will be required.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

No fill or dredge material will be placed in surface waters or wetlands associated with the proposed improvements to the Camas WWTF.

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.

It may be necessary to pump groundwater from the excavation required for installation of the new secondary clarifier proposed for the Camas WWTF site.

5) Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.

According to Flood Insurance Rate Map (FIRM) Panel Number 530026 0002B (February 18, 1981), the Camas WWTF is located within the 100-year floodplain.

6) Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.

The Camas WWTF discharges up to 6.1 MGD of wastewater effluent treated to secondary standards to the Columbia River. Once the upgraded WWTF is in operation, the Maximum Month Flow Capacity will remain the same.

b. Ground:

1) Will ground water be withdrawn, or will water be discharged to ground water? Give general description, purpose, and approximate quantities if known.

During construction, groundwater may be withdrawn from the excavation required for the new clarifier proposed on the site of the Camas WWTF.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals. . . ; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

No waste materials will be discharged to the ground associated with Phase 2B of the Camas Wastewater Facilities Improvement Projects. It is likely that upgrading the WWTF will allow the City to provide sewer service to more homes and businesses in the service area.

c. Water runoff (including stormwater):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

Construction of the proposed improvements to the Camas WWTF will require excavation of significant amounts of soil. Construction BMPs for the control of sedimentation and erosion will be implemented during construction to minimize the volume of turbid runoff leaving the site. Silt fences will be positioned between work areas and sensitive areas. Straw wattles or other approved BMPs will be used to filter turbid runoff during storm events. Runoff from impervious surfaces at the Camas WWTF site will be routed either to stormwater drains or discharged into the WWTF waste stream for treatment.

2) Could waste materials enter ground or surface waters? If so, generally describe.

The Camas WWTF will discharge municipal wastewater treated to secondary standards to the Columbia River via the existing outfall.

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:

Runoff from impervious surfaces at the Camas WWTF site will be routed either to the existing stormwater treatment system or be conveyed back into the WWTF process units for treatment. For all projects, construction BMPs for the control of sedimentation and erosion will be implemented during construction to minimize turbid water leaving the site. Silt fences will be positioned between work areas and sensitive areas. Straw wattles or other approved BMPs will be used to filter turbid runoff during storm events. The upgraded WWTF will discharge municipal wastewater effluent treated to secondary standards to the Columbia River. The proposed upgrade will provide adequate treatment capacity for the City of Camas through 2025.

4. **Plants**

a. Check or circle types of vegetation found on the site:

__X__ deciduous tree: alder, maple, aspen, cottonwood, Oregon ash other

__X__ evergreen tree: fir, cedar, pine, other

__X__ shrubs

__X__ grass

_____ pasture

———— crop or grain
———— wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other
———— water plants: water lily, eelgrass, milfoil, other
———— other types of vegetation

b. What kind and amount of vegetation will be removed or altered?

Minor amounts of grasses, up to 400 s.f., will be permanently removed to allow for construction of the Hydrogen Sulfide Air Scrubber.

c. List threatened or endangered species known to be on or near the site.

None known.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

Disturbed areas not covered with new wastewater treatment infrastructure will be hydroseeded with native grasses to stabilize soils.

5. **Animals**

a. Circle any birds and animals which have been observed on or near the site or are known to be on or near the site:

birds: hawk, heron, eagle, songbirds, other:
mammals: deer, bear, elk, beaver, other:
fish: bass, salmon, trout, herring, shellfish, other:

b. List any threatened or endangered species known to be on or near the site.

Chinook salmon and chum salmon (threatened) are present in the Washougal River. Lower Columbia River chinook, Lower Columbia River steelhead, Lower Columbia River coho and Columbia River chum, which are all listed as "threatened" pass the Camas WWTF outfall during their annual migrations. These fish spawn from mid summer through the winter, with a minimum number of smolts present during the month of August. The Washington Department of Fish & Wildlife Priority Habitat & Species Maps and Report indicated that purple martins nest in the vicinity of Camas.

c. Is the site part of a migration route? If so, explain.

Camas lies along the Pacific Flyway for migratory waterfowl. Approximately 14 Evolutionarily Significant Units and Distinct Population Segments of Columbia River salmon, trout and two species of sturgeon migrate up and down the Columbia River past the Camas WWTF.

d. Proposed measures to preserve or enhance wildlife, if any:

Upgrading the Camas WWTF to provide adequate wastewater treatment, conveyance and disposal through the year 2025 will improve and preserve water quality for migratory salmonids and other fish and wildlife dependent upon the Columbia River as the human population in the area grows.

6. **Energy and natural resources**

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

Electricity will be utilized to meet the increased energy requirements for the upgraded Camas WWTF. The proposed WWTF Upgrade will install a hydrogen sulfide scrubber to allow use of the digester gas collection system and boiler using this gas, which will reduce the amount of natural gas or electricity required to heat the sludge digestion process and to dry the biosolids.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.

None of the proposed structures associated with improvements to the WWTF will be tall enough to affect the potential use of solar energy by adjacent properties.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

Proposed improvements to the Camas WWTF will be designed and located to function by gravity as much as possible. All new pumps and blowers will be modern, energy-efficient models. Upgrades to the aeration system controls will increase the efficiency of the blower operations.

7. **Environmental health**

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste that could occur as a result of this proposal? If so, describe.

Flammable gases such as methane and hydrogen sulfide will be formed in the digester. These gases will be properly collected, treated and burned to heat the digestion process.

1) Describe special emergency services that might be required.

No special emergency services would be required during construction and operation of the proposed improvements to the Camas WWTF.

2) Proposed measures to reduce or control environmental health hazards, if any:

- **Construction equipment will be fitted with emergency spill clean-up kits and operators will be trained in their use.**
- **Emergency eyewash and shower facilities are present on the site of the Camas WWTF in the event of exposure to hazardous materials.**
- **Phase 2 includes a new scrubber to treat gas going to the new digester boiler exhaust, a waste gas burner flare, and a new odor control biofilter. Digester gas will be collected, treated and burned to heat the digestion process and to dry sludge.**

b. **Noise**

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

Noises from SR 14 and marine traffic on the Columbia River are audible from the Camas WWTF; however, neither of these noise sources will impact the proposed WWTF Station upgrades.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

The new equipment added to the WWTF processes will not produce significant noise. No increase in traffic is expected.

3) Proposed measures to reduce or control noise impacts, if any:

New noise-generating equipment will generally be housed in buildings or underground to reduce off-site noise and mitigate any adverse impacts.

8. **Land and shoreline use**

a. What is the current use of the site and adjacent properties?

The site of the Camas WWTF improvements contains the existing wastewater treatment facilities; adjacent land use is primarily residential with some open space.

b. Has the site been used for agriculture? If so, describe.

Not in recent times.

c. Describe any structures on the site.

The site of the proposed WWTF Improvement Project includes the existing wastewater treatment structures – concrete treatment tanks and buildings housing equipment.

d. Will any structures be demolished? If so, what?

The existing aerobic digester and effluent filtration system will be demolished at the Camas WWTF site and a new secondary clarifier and new effluent filtration system constructed.

e. What is the current zoning classification of the site?

Camas WWTF: Municipal RC

f. What is the current comprehensive plan designation of the site?

WWTF: Municipal \Feature

g. If applicable, what is the current shoreline master program designation of the site?

The Camas WWTF is designated as "Urban."

h. Has any part of the site been classified as an "environmentally sensitive" area? If so, specify.

A portion of the WWTF site is located within 200 feet of the Columbia River and Shoreline Jurisdiction.

i. Approximately how many people would reside or work in the completed project?

None would reside at the WWTF, but 5-6 people will work at the upgraded facility.

j. Approximately how many people would the completed project displace?

None.

k. Proposed measures to avoid or reduce displacement impacts, if any:

Not applicable.

Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

The proposed project involves upgrading existing facilities to provide adequate wastewater treatment and conveyance for the growing population of the City of Camas.

9. **Housing**

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

None.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

None.

c. Proposed measures to reduce or control housing impacts, if any:

None required.

10. **Aesthetics**

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

The new piping to provide digester gas to the scrubber along the digester at the WWTF would be approximately 18 feet tall and it will be ductile iron.

b. What views in the immediate vicinity would be altered or obstructed?

Views in the vicinity of the WWTF would not change significantly.

c. Proposed measures to reduce or control aesthetic impacts, if any:

New above-ground structures will be painted to blend into the existing structures and surrounding vegetation. Existing trees will screen the view of the WWTF from most adjacent houses.

11. **Light and glare**

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

A few new area lights are likely to be installed around the perimeter of the expanded Camas WWTF; these lights would be operated primarily at night, or during foggy conditions.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

Any new lights at the WWTF would be directed inward (i.e. away from the Columbia River and SR 14) to avoid becoming safety issues. New large structures will be partially buried to minimize disturbance of existing views, and views of some new structures will be blocked by existing equipment on the WWTF site.

c. What existing off-site sources of light or glare may affect your proposal?

Navigation lights along the Columbia River may impact the location and direction of any new lights on the WWTF site.

d. Proposed measures to reduce or control light and glare impacts, if any:

Any new lights at the WWTF would be directed inward (i.e. away from the Columbia River and SR 14) to avoid becoming safety issues.

12. **Recreation**

a. What designated and informal recreational opportunities are in the immediate vicinity?

None on the WWTF site. However, boating, swimming, fishing and windsurfing occur along the Columbia River south of the Camas WWTF. Fishing, wading and swimming occur along the Washougal River.

b. Would the proposed project displace any existing recreational uses? If so, describe.

No.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

None required.

13. **Historic and cultural preservation**

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.

There are no places or objects eligible for national, state or local preservation registers known to be on the site of the Camas WWTF. The Cultural Resources Survey for the Camas WWTF determined that several archaeological sites are located within a mile of the project area. A portion of the project area is located within the first Donation Land Claim in what is now Washington State. A boat landing and surrounding community of Parkersville were established on a portion of the property east of the project area. Survey and auger testing in 1996 yielded a small number of flakes in areas where future construction is planned. A recommendation for additional testing in the vicinity of these lithics was made to clarify the nature of the material (Cultural Resources Reconnaissance of the Camas WWTF Site, Northwest Archaeological Associates, Inc., December 1996).

b. Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.

The Cultural Resources Survey for the Camas WWTF determined that several archaeological sites are located within a mile of the project area.

c. Proposed measures to reduce or control impacts, if any:

Gray & Osborne, Inc. contracted with Archaeological Investigations Northwest of Portland, Oregon to conduct a cultural resources survey and prepare a report for review by the Washington Department of Archaeology and Historic Preservation, the Yakima Nation and the Cowlitz Tribe. This report was forwarded to the DAHP and the Tribes by the Public Works Board. Terry Dale of the Public Works Board confirmed that there have been no responses to the Cultural Resources Report for the project from the consulted tribes, and that the Robert Whitlam, State Archaeologist concurred with the determination of no historic properties affected.

14. **Transportation**

a. Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.

SR 14 provides access to the area surrounding the Camas WWTF, which is located at 1129 SE Polk Street (the intersection of SE Polk Street and SE 11th Avenue).

b. Is site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?

The Camas WWTF is not currently served by public transit. The nearest bus stop is approximately one mile away near the intersection of SE 8th and Union.

c. How many parking spaces would the completed project have? How many would the project eliminate?

The Camas WWTF has six designated parking spaces. Proposed improvements to the Camas WWTF will not permanently impact the number of parking spaces available.

d. Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).

No. Improvements to the WWTF will not require new roads or streets, or improvements to existing roads or streets.

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

The Columbia River is located approximately 300 feet south of the Camas WWTF. The Columbia River is the main water transportation route to eastern Washington.

f. How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.

None.

g. Proposed measures to reduce or control transportation impacts, if any:

None.

15. **Public services**

a. Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.

No.

b. Proposed measures to reduce or control direct impacts on public services, if any.

Upgrading the Camas WWTF will provide adequate wastewater treatment and disposal to allow the facility to meet the requirements of its NPDES Permit through the planning period (2025).

16. **Utilities**

a. Circle utilities currently available at the site: **electricity, natural gas, water, refuse service, telephone, sanitary sewer,** septic system, other. **See underlined items.**

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity that might be needed.

Water service at the WWTF is provided by the City of Camas. Gas and electrical service are provided by Northwest Natural Gas and Clark Public Utilities, respectively. Telephone service is provided by Verizon.

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: .... ERIC LEVISON ....

Date Submitted: .... NOVEMBER 16, 2011 ....

APPENDIX B

CURRENT NPDES PERMIT

Issuance Date: November 3, 2004
Effective Date: December 1, 2004
Expiration Date: November 30, 2009

WASHINGTON STATE DEPARTMENT OF ECOLOGY

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE PERMIT NO. WA0020249

State of Washington
Department Of Ecology
Olympia, Washington 98504-7600

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

City of Camas

P.O. Box 1055

Camas, WA 98607

Plant Location: 12th and Polk Street	Receiving Water: Columbia River
Water Body I.D. No.: Old ID:WA-CR-1010 New ID: 1220169456238	Discharge Location: Latitude: 45° 34' 36" N Longitude: 122° 23' 28" W
Plant Type: Activated sludge with filtration capability and UV disinfection	

is authorized to discharge in accordance with the special and general conditions that follow.

Kelly Susewind P.E., P.G.
Southwest Regional Manager
Water Quality Program
Washington State Department of Ecology

TABLE OF CONTENTS

SPECIAL CONDITIONS

GENERAL CONDITIONS

SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions of this permit for additional submittal requirements.

Permit Section	Submittal	Frequency	First Submittal Date
S3.	Discharge Monitoring Report	Monthly	January 15, 2005
S3.E	Noncompliance Notification	As necessary	
S4.B.	Plans for Maintaining Adequate Capacity	As necessary	
S4.D.	Notification of New or Altered Sources	As necessary	
S4.E.	Infiltration and Inflow Evaluation	Annually	May 15, 2005
S4.F.	Waste load Assessment	Annually	May 15, 2005
S6.D.	Industrial User Survey	1/permit cycle	October 15, 2008
S8.A.	Acute Toxicity Characterization Data	2/permit cycle: Once in winter and Once in Summer	Testing shall begin by February 1, 2005, with the first data submittal by April 15, 2005
S8.C.	Acute Toxicity Compliance Monitoring Reports	Biannually if an acute limit is needed.	November 15, 2006, if needed
S8.D	Acute Toxicity: “Causes and Preventative Measures for Transient Events.”	As necessary	
S8.D	Acute Toxicity TI/TRE Plan	As necessary	
S8.E	If No Limit is Required, then Re-test Effluent for Acute Toxicity with Permit Renewal Application	2/permit cycle	October 15, 2008: Once in the Last Summer & Once in the Last Winter Prior to Submission of the Renewal Application)
S9.A	Chronic Toxicity Characterization Data	2/permit cycle: Once in winter and Once in Summer	Testing shall begin by February 1, 2005, with the fist data submittal by April 15, 2005
S9.A	Chronic Toxicity Tests Characterization Summary Report	1/permit cycle	90 days following the last characterization sampling event
S9.D	Chronic Toxicity: “Causes and Preventative Measures for Transient Events.”	As necessary	
S9.D	Chronic Toxicity TI/TRE Plan	As necessary	

Permit Section	Submittal	Frequency	First Submittal Date
S9.E	If no Limit is Required then Re-test Effluent for Chronic Toxicity with Permit Renewal Application	2/permit cycle	October 15, 2008: Once in the Last Summer & Once in the Last Winter Prior to Submission of the Renewal Application
S10.	Outfall Evaluation	1/permit cycle	November 15, 2008
G1.	Notice of Change in Authorization	As necessary	
G4.	Reporting Planned Changes	As necessary	
G5.	Engineering Report for Construction or Modification Activities	As necessary	
G7.	Application for Permit Renewal	1/permit cycle	February 15, 2009
G21	Reporting Anticipated Non-compliance	As necessary	
G22	Reporting Other Information	As necessary	

SPECIAL CONDITIONS

S1. DISCHARGE LIMITATIONS

A. Effluent Limitations

All discharges and activities authorized by this permit shall be consistent with the terms and conditions of this permit. The discharge of any of the following pollutants more frequently than, or at a level in excess of, that identified and authorized by this permit shall constitute a violation of the terms and conditions of this permit.

Beginning on the effective date of this permit and lasting through the expiration date the Permittee is authorized to discharge municipal wastewater at the permitted location subject to complying with the following limitations:

	EFFLUENT LIMITATIONS[a]: OUTFALL # 001	
Parameter	**Average Monthly**	**Average Weekly**
Biochemical Oxygen Demand (5 day)	20 mg/L, 1,017 lbs/day 70% removal of influent BOD	30 mg/L, 1,525 lbs/day
Total Suspended Solids	20 mg/L, 1,017 lbs/day 70% removal of influent TSS	30 mg/L, 1,525 lbs/day
Fecal Coliform Bacteria	200/100 ml	400/100 ml
pH	Daily minimum is equal to or greater than 6 and the daily maximum is less than or equal to 9.	
Parameter	**Average Monthly**	**Maximum Daily[b]**
Total Ammonia (as NH_3-N) (summer)[c]	20 mg/L	41 mg/L
Total Ammonia (as NH_3-N) (winter)[c]	7 mg/L	15 mg/L
[a]The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean.		
[b]The maximum daily effluent limitation is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day.		
[c]Summer ammonia limits apply to the months of June through September. Winter ammonia limits apply to the months of October through May.		

B. Mixing Zone Descriptions

The maximum boundaries of the mixing zones are defined according to Chapter 173-201(A) Washington Administrative Code (WAC) as follows:

1. Not extend in a downstream direction for a distance from the discharge ports greater than three hundred feet plus the depth of water over the discharge ports; or

2. Extend upstream for a distance of over 100 feet;

3. Not utilize greater than 25 percent of the flow; and not occupy greater than 25 percent of the width of the water body.

Therefore, the chronic mixing zone boundary is 321 feet downstream during 7Q10 Columbia River discharge conditions. The acute mixing zone boundary is 32 feet downstream. The dilution ratios determined by the Department of Ecology (Department) in March 2004 were summer acute of 8:1, summer chronic of 45:1, and winter acute of 7:1 and winter chronic of 24:1.

S2. MONITORING REQUIREMENTS

A. Monitoring Schedule

The Permittee shall monitor in accordance with the following schedule:

Category	Parameter	Units	Sample Point	Minimum Sampling Frequency	Sample Type
Wastewater Influent	Flow	MGD	Parshall Flume	Continuous[a]	Recording On-line
Wastewater Influent	BOD_5	mg/L, lbs/day	Influent sampling station	4/week	24-hr composite
Wastewater Influent	TSS	mg/L, lbs/day	Influent sampling station	4/week	24-hr composite
Wastewater Influent	pH	Standard Units	Influent sampling station	Continuous[a]	Recording On-line
Wastewater Influent	Total Ammonia	mg/L	Influent sampling station	4/week	24-hr composite
Wastewater Influent	Oil and grease, priority pollutant metals, and cyanide	µg/L	Influent sampling station	Quarterly[d]	24-hr composite, except grab for O&G

Category	Parameter	Units	Sample Point	Minimum Sampling Frequency	Sample Type
Wastewater Effluent	Flow	MGD	Prior to filter	Continuous[a]	Recording On-line
Wastewater Effluent	BOD_5	mg/L, lbs/day, % Removal[b]	Final effluent[c] Sampling Station After UV	4/week	24-hr composite
Wastewater Effluent	TSS	mg/L, lbs/day, % Removal[b]	Final effluent[c] Sampling Station After UV	4/week	24-hr composite
Wastewater Effluent	pH	Standard Units	Final effluent[c] Sampling Station After UV	Continuous[a]	Recording On-line
Wastewater Effluent	Temperature (daily max)	°C	Final effluent[c] Sampling Station After UV	Contiuous[a]	Recording (on-line or download)
Wastewater Effluent	Total Ammonia	mg/L	Final effluent[c] Sampling Station After UV	4/week	24-hr composite
Wastewater Effluent	Fecal Coliform	Org./100 ml	Final effluent[c] Sampling Station After UV	Daily	Grab
Wastewater Effluent	Oil and grease, priority pollutant metals, and cyanide	µg/L	Final effluent[c] Sampling Station After UV	Quarterly[d]	24-hr composite, except grab for O&G
Sludge	priority pollutantmetals	mg/kg	sludge	1 sample taken 30 days after an influent sample	grab
Pretreatment	Priority Pollutant Scan for non metals as outlined in 40 CFR 122, Appendix D, Table II. Sample influent, and effluent, annually by 24-hour composite and sludge				

Category	Parameter	Units	Sample Point	Minimum Sampling Frequency	Sample Type
	annually by a grab sample.				
Acute Toxicity Testing	As specified in section S8.				
Chronic Toxicity Testing	As specified in section S9.				

[a] Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance. Sampling shall be taken twice daily when continuous monitoring is not possible. Temperature may be recorded with either a down loadable data logger (thermister known as TIDBITs) on may be on-line. Reporting shall be of the daily maximum and minimum values determined over the period.

[b] Percent removal of BOD and TSS shall be calculated with the following algorithm (concentrations in mg/L): (Average Monthly Influent Concentration - Average Monthly Effluent Concentration/Average Monthly Influent Concentration).

[c] "Final Effluent" means wastewater which is exiting, or has exited, the last treatment process or operation. Typically, this is after or at the exit from the chlorine contact chamber or other disinfection process.

[d] Quarterly means testing and reporting with the March, June, September and December DMRs.

B. Sampling and Analytical Procedures

Samples and measurements taken to meet the requirements of this permit shall be representative of the volume and nature of the monitored parameters, including representative sampling of any unusual discharge or discharge condition, including bypasses, upsets and maintenance-related conditions affecting effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit shall conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 Code of Federal Regulations (CFR) Part 136 or to the latest revision of *Standard Methods for the Examination of Water and Wastewater* (APHA), unless otherwise specified in this permit or approved in writing by the Department.

C. Flow Measurement

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the quantity of monitored flows. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements are consistent with the accepted industry standard for that type of device. Frequency of calibration shall be in conformance with manufacturer's recommendations and at a minimum frequency of at least one calibration per year. Calibration records shall be maintained for at least three years.

D. Laboratory Accreditation

All monitoring data required by the Department shall be prepared by a laboratory registered or accredited under the provisions of, *Accreditation of Environmental Laboratories*, Chapter 173-50 WAC. Flow, temperature, settleable solids, conductivity, pH, and internal process control parameters are exempt from this requirement. Conductivity and pH shall be accredited if the laboratory must otherwise be registered or accredited. The Department exempts crops, soils, and hazardous waste data from this requirement pending accreditation of laboratories for analysis of these media.

S3. REPORTING AND RECORDKEEPING REQUIREMENTS

The Permittee shall monitor and report in accordance with the following conditions. The falsification of information submitted to the Department shall constitute a violation of the terms and conditions of this permit.

A. Reporting

The first monitoring period begins on the effective date of the permit. Monitoring results shall be submitted monthly. Monitoring data obtained during each monitoring period shall be summarized, reported, and submitted on a Discharge Monitoring Report (DMR) form provided, or otherwise approved, by the Department. DMR forms shall be received by the Department no later than the 15th day of the month following the completed monitoring period, unless otherwise specified in this permit. Priority pollutant analysis data shall be submitted no later than 45 days following the monitoring period. Unless otherwise specified, all toxicity test data shall be submitted within 60 days after the sample date. The report(s) shall be sent to the Southwest Regional Office, Department of Ecology, P.O. BOX 47775, Olympia, Washington 98504-7775.

All laboratory reports providing data for organic and metal parameters shall include the following information: sampling date, sample location, date of analysis, parameter name, CAS number, analytical method/ number, method detection limit (MDL), laboratory practical quantitation limit (PQL), reporting units, and concentration detected.

Discharge Monitoring Report forms must be submitted monthly whether or not the facility was discharging. If there was no discharge during a given monitoring period, submit the form as required with the words "no discharge" entered in place of the monitoring results.

B. Records Retention

The Permittee shall retain records of all monitoring information for a minimum of three years. Such information shall include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. This period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by the Department.

C. Recording of Results

For each measurement or sample taken, the Permittee shall record the following information: 1) the date, exact place, method, and time of sampling or measurement; 2) the individual who performed the sampling or measurement; 3) the dates the analyses were performed; 4) the individual who performed the analyses; 5) the analytical techniques or methods used; and 6) the results of all analyses.

D. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by this permit using test procedures specified by Condition S2 of this permit, then the results of such monitoring shall be included in the calculation and reporting of the data submitted in the Permittee's DMR.

E. Noncompliance Notification

In the event the Permittee is unable to comply with any of the terms and conditions of this permit due to any cause, the Permittee shall:

1. Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance, correct the problem and, if applicable, repeat sampling and analysis of any noncompliance immediately and submit the results to the Department within 30 days after becoming aware of the violation.

2. Immediately notify the Department of the failure to comply.

3. Submit a detailed written report to the Department within 30 days (five days for upsets and bypasses), unless requested earlier by the Department. The report shall contain a description of the noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

F. Maintaining a Copy of This Permit

A copy of this permit must be kept at the treatment plant and be made available upon request to the public or the Department inspectors.

S4. FACILITY LOADING

A. Design Criteria

Flows or waste loadings of the following design criteria for the permitted treatment facility shall not be exceeded:

Average flow for the maximum month:	6.10 mgd
Monthly average dry weather flow:	2.86 mgd
Instantaneous peak flow (hourly)	11.09 mgd
BOD_5 loading for maximum month:	5,616 lbs/day*
TSS loading for maximum month:	6,405 lbs/day

*The rated BOD capacity presumes that ammonia concentrations are approximately 20 percent of BOD_5 concentrations. For higher ammonia concentrations, BOD_5 capacity is reduced by four pounds for every extra pound of ammonia.

B. Plans for Maintaining Adequate Capacity

The Permittee shall submit to the Department a plan and a schedule for continuing to maintain capacity when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months; or

2. When the projected increase would reach design capacity within five years, whichever occurs first. If such a plan is required, it shall contain a plan and schedule for continuing to maintain capacity. The capacity as outlined in this plan must be sufficient to achieve the effluent limitations and other conditions of this permit. This plan shall address any of the following actions or any others necessary to meet the objective of maintaining capacity.

3. Analysis of the present design including the introduction of any process modifications that would establish the ability of the existing facility to achieve the effluent limits and other requirements of this permit at specific levels in excess of the existing design criteria specified in paragraph A above.

4. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system.

5. Limitation on future sewer extensions or connections or additional waste loads.

6. Modification or expansion of facilities necessary to accommodate increased flow or waste load.

7. Reduction of industrial or commercial flows or waste loads to allow for increasing sanitary flow or waste load.

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by the Department prior to any construction. The plan shall specify any contracts, ordinances, methods for financing, or other arrangements necessary to achieve this objective.

C. Duty to Mitigate

The Permittee is required to take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment

D. Notification of New or Altered Sources

The Permittee shall submit written notice to the Department whenever any new discharge or a substantial change in volume or character of an existing discharge into the Publicly Owned Treatment Works (POTW) is proposed which: (1) would interfere with the operation of, or exceed the design capacity of, any portion of the POTW; (2) is not part of an approved general sewer plan or approved plans and specifications; or (3) would be subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act. This notice shall include an evaluation of the POTW's ability to adequately transport and treat the added flow and/or waste load, the quality and volume of effluent to be discharged to the POTW, and the anticipated impact on the Permittee's effluent [40 CFR 122.42(b)].

E. Infiltration and Inflow Evaluation

1. The Permittee shall conduct an infiltration and inflow evaluation. Refer to the U.S. EPA publication, *I/I Analysis and Project Certification*, available as Publication No. 97-03 at: Publications Office, Department of Ecology, P.O. Box 47600, Olympia, Washington 98504-7600. Plant monitoring records may be used to assess measurable infiltration and inflow.

2. A report shall be prepared which summarizes any measurable infiltration and inflow. If infiltration and inflow have increased by more than 15 percent from that found in the first report based on equivalent rainfall, the report shall contain a plan and a schedule for: (1) locating the sources of infiltration and inflow; and (2) correcting the problem.

3. The report shall be submitted by **May 15, 2005,** and **annually** thereafter.

F. Wasteload Assessment

The Permittee shall conduct an **annual** assessment of their flow and waste load and submit a report to the Department by **May 15, 2005,** and **annually** thereafter. The report shall contain the following: an indication of compliance or noncompliance with the permit effluent limitations; a comparison between the existing and design monthly average dry weather and wet weather flows, peak flows, BOD, and total suspended solids loadings; and the percentage increase in these parameters since the last annual report. Because of the industrial loading to Camas, the report shall detail the oxygen consumption of ammonia and BOD against the oxygen delivery capability of the plant (lbs of oxygen required for treatment vs. oxygen delivery capacity of the POTW). The report shall also state the present and design population or population equivalent, projected population growth rate, and the estimated date upon which the design capacity is projected to be reached, according to the most restrictive of the parameters above. The interval for review and reporting may be modified if the Department determines that a different frequency is sufficient.

S5. OPERATION AND MAINTENANCE

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems, which are installed by a Permittee only when the operation is necessary to achieve compliance with the conditions of this permit.

A. Certified Operator

An operator certified for at least a Class IV plant by the state of Washington shall be in responsible charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a Class III plant shall be in charge during all regularly scheduled shifts.

B. O & M Program

The Permittee shall institute an adequate operation and maintenance program for the entire sewage system. Maintenance records shall be maintained on all major electrical and mechanical components of the treatment plant, as well as the sewage system and pumping stations. Such records shall clearly specify the frequency and type of maintenance recommended by the manufacturer and shall show the frequency and type of maintenance performed. These maintenance records shall be available for inspection at all times.

C. Short-term Reduction

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limitations on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee shall give written notification to the Department, if possible, 30 days prior to such activities, detailing the reasons for, length of time of, and the potential effects of the reduced level of treatment. This notification does not relieve the Permittee of its obligations under this permit.

D. Electrical Power Failure

The Permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations either by means of alternate power sources, standby generator, or retention of inadequately treated wastes.

The Permittee shall maintain Reliability Class II (EPA 430-99-74-001) at the wastewater treatment plant, which requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions.

E. Prevent Connection of Inflow

The Permittee shall strictly enforce their sewer ordinances and not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

F. Bypass Procedures

Bypass, which is the intentional diversion of waste streams from any portion of a treatment facility, is prohibited, and the Department may take enforcement action against a Permittee for bypass unless one of the following circumstances (1, 2, or 3) is applicable.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

   Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limitations or other conditions of this permit, or adversely impact public health as determined by the Department prior to the bypass. The Permittee shall submit prior notice, if possible at least 10 days before the date of the bypass.

2. Bypass which is unavoidable, unanticipated and results in noncompliance of this permit.

   This bypass is permitted only if:

   a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

   b. There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment downtime (but not if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance), or transport of untreated wastes to another treatment facility.

   c. The Department is properly notified of the bypass as required in Condition S3E of this permit.

3. Bypass which is anticipated and has the potential to result in noncompliance of this permit

The Permittee shall notify the Department at least 30 days before the planned date of bypass. The notice shall contain: (1) a description of the bypass and its cause; (2) an analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing; (3) a cost-effectiveness analysis of alternatives including comparative resource damage assessment; (4) the minimum and maximum duration of bypass under each alternative; (5) a recommendation as to the preferred alternative for conducting the bypass; (6) the projected date of bypass initiation; (7) a statement of compliance with State Environmental Policy Act (SEPA); (8) a request for modification of water quality standards as provided for in WAC 173-201A-110, if an exceedance of any water quality standard is anticipated; and (9) steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

For probable construction bypasses, the need to bypass is to be identified as early in the planning process as possible. The analysis required above shall be considered during preparation of the engineering report or facilities plan and plans and specifications and shall be included to the extent practical. In cases where the probable need to bypass is determined early, continued analysis is necessary up to and including the construction period in an effort to minimize or eliminate the bypass.

The Department will consider the following prior to issuing an administrative order for this type bypass:

a. If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.

b. If there are feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.

c. If the bypass is planned and scheduled to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, the Department will approve or deny the request. The public shall be notified and given an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Approval of a request to bypass will be by administrative order issued by the Department under Revised Code of Washington (RCW) 90.48.120.

G. <u>Operations and Maintenance Manual</u>

The approved Operations and Maintenance Manual shall be kept available at the treatment plant and all operators shall follow the instructions and procedures of this manual.

S6. PRETREATMENT

A. General Requirements

The Permittee shall work with the Department to ensure that all commercial and industrial users of the POTW are in compliance with the pretreatment regulations promulgated in 40 CFR Part 403 and any additional regulations that may be promulgated under Section 307(b) (pretreatment) and 308 (reporting) of the Federal Clean Water Act.

B. Wastewater Discharge Permit Required

The Permittee shall not allow significant industrial users (SIUs) to discharge wastewater to the Permittee's sewerage system until such user has received a wastewater discharge permit from the Department in accordance with Chapter 90.48 RCW and Chapter 173-216 WAC, as amended.

C. Identification and Reporting of Existing, New, and Proposed Industrial Users

1. The Permittee shall take continuous, routine measures to identify all existing, new, and proposed SIUs and potential significant industrial users (PSIUs) discharging or proposing to discharge to the Permittee's sewerage system (see Appendix B of Fact Sheet for definitions).

2. Within 30 days of becoming aware of an unpermitted existing, new, or proposed industrial user who may be an SIU, the Permittee shall notify such user by registered mail that, if classified as an SIU, they shall be required to apply to the Department and obtain a State Waste Discharge Permit. A copy of this notification letter shall also be sent to the Department within this same 30-day period.

3. The Permittee shall also notify all PSIUs, as they are identified, that if their classification should change to an SIU, they shall be required to apply to the Department for a State Waste Discharge Permit within 30 days of such change.

D. Industrial User Survey

The Permittee shall complete and submit to the Department an Industrial User Survey listing all SIUs and PSIUs discharging to the POTW. The survey shall be conducted once during the permit cycle and shall be received by the Department by **October 15, 2008**. At a minimum, the list of SIUs and PSIUs shall be developed by means of a telephone book search, a water utility billing records search, and a physical reconnaissance of the service area. Information on PSIUs shall at least include: the business name, telephone number, address, description of the industrial process(es), and the known wastewater volumes and characteristics. For assistance with the development of the Industrial User Survey, the Permittee shall refer to the Department's guidance document entitled "Performing an Industrial User Survey."

E. Duty to Enforce Discharge Prohibitions

1. In accordance with 40 CFR 403.5(a), the Permittee shall not authorize or knowingly allow the discharge of any pollutants into its POTW which cause pass through or interference, or which otherwise violates general or specific discharge prohibitions contained in 40 CFR Part 403.5 or WAC-173-216-060.

2. The Permittee shall not authorize or knowingly allow the introduction of any of the following into their treatment works:

   a. Pollutants which create a fire or explosion hazard in the POTW (including, but not limited to waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21).

   b. Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, or greater than 11.0 standard units, unless the works are specifically designed to accommodate such discharges.

   c. Solid or viscous pollutants in amounts that could cause obstruction to the flow in sewers or otherwise interfere with the operation of the POTW.

   d. Any pollutant, including oxygen demanding pollutants, (BOD, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW.

   e. Petroleum oil, nonbiodegradable cutting oil, or products of mineral origin in amounts that will cause interference or pass through.

   f. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity which may cause acute worker health and safety problems.

   g. Heat in amounts that will inhibit biological activity in the POTW resulting in interference but in no case heat in such quantities such that the temperature at the POTW headworks exceeds 40ºC (104ºF) unless the Department, upon request of the Permittee, approves, in writing, alternate temperature limits.

   h. Any trucked or hauled pollutants, except at discharge points designated by the Permittee.

   i. Wastewaters prohibited to be discharged to the POTW by the Dangerous Waste Regulations (Chapter 173-303 WAC), unless authorized under the Domestic Sewage Exclusion (WAC 173-303-071).

3. All of the following are prohibited from discharge to the POTW unless approved in writing by the Department under extraordinary circumstances (such as a lack of direct discharge alternatives due to combined sewer service or the need to augment sewage flows due to septic conditions):

a. Noncontact cooling water in significant volumes.

b. Stormwater, and other direct inflow sources.

c. Wastewaters significantly affecting system hydraulic loading, which do not require treatment, or would not be afforded a significant degree of treatment by the system.

4. The Permittee shall notify the Department if any industrial user violates the prohibitions listed in this section.

S7. RESIDUAL SOLIDS

Residual solids include screenings, grit, scum, primary sludge, waste activated sludge, and other solid waste. The Permittee shall store and handle all residual solids in such a manner so as to prevent their entry into state ground or surface waters. The Permittee shall not discharge leachate from residual solids to state surface or ground waters. The Permittee shall comply with WAC 173-308 and any associated order for handling biosolids.

S8. ACUTE TOXICITY

A. Effluent Characterization

The Permittee shall conduct acute toxicity testing on the final effluent to determine the presence and amount of acute (lethal) toxicity. The two acute toxicity tests listed below shall be conducted on each sample taken for effluent characterization.

Effluent characterization for acute toxicity shall be conducted twice in one year. Acute toxicity testing shall follow protocols, monitoring requirements, and quality assurance/quality control procedures specified in this section. A dilution series consisting of a minimum of five concentrations and a control shall be used to estimate the concentration lethal to 50 percent of the organisms (LC_{50}). The percent survival in 100 percent effluent shall also be reported.

Testing shall begin by **February 1, 2005**. A written report shall be submitted to the Department **April 15, 2005**. Acute toxicity tests shall be conducted with the following species and protocols:

1. Fathead minnow, *Pimephales promelas* (96 hour static-renewal test, method: EPA/600/4-90/027F).

2. Daphnid, *Ceriodaphnia dubia*, *Daphnia pulex*, or *Daphnia magna* (48 hour static test, method: EPA/600/4-90/027F). The Permittee shall choose one of the three species and use it consistently throughout effluent characterization.

B. Effluent Limit for Acute Toxicity

The Permittee has an effluent limit for acute toxicity if, after completing one year of effluent characterization, either:

1. The median survival of any species in 100 percent effluent is below 80 percent, or

2. Any one test of any species exhibits less than 65 percent survival in 100 percent effluent.

If an effluent limit for acute toxicity is required by this subsection at the end of one year of effluent characterization, the Permittee shall immediately complete all applicable requirements in subsections C, D, and F.

If no effluent limit is required by this subsection at the end of one year of effluent characterization, then the Permittee shall complete all applicable requirements in subsections E and F.

The effluent limit for acute toxicity is no acute toxicity detected in a test concentration representing the acute critical effluent concentration (ACEC).

In the event of failure to pass the test described in subsection C of this section for compliance with the effluent limit for acute toxicity, the Permittee is considered to be in compliance with all permit requirements for acute whole effluent toxicity as long as the requirements in subsection D are being met to the satisfaction of the Department.

The ACEC means the maximum concentration of effluent during critical conditions at the boundary of the zone of acute criteria exceedance assigned pursuant to WAC 173-201A-100. The zone of acute criteria exceedance is authorized in Section S1 of this permit. The ACEC equals 14.3 percent effluent (dilution factor of 7:1).

C. Monitoring for Compliance With an Effluent Limit for Acute Toxicity

Monitoring to determine compliance with the effluent limit shall be conducted biannually for the remainder of the permit term using each of the species listed in subsection A on a rotating basis and performed using at a minimum 100 percent effluent, the ACEC, and a control. The Permittee shall schedule the toxicity tests in the order listed in the permit unless the Department notifies the Permittee in writing of another species rotation schedule. The percent survival in 100 percent effluent shall be reported for all compliance monitoring.

If testing is required because of an acute toxicity limit, an acute toxicity compliance monitoring report is required by **November 15, 2006**, and twice a year thereafter.

Compliance with the effluent limit for acute toxicity means no statistically significant difference in survival between the control and the test concentration representing the ACEC. The Permittee shall immediately implement subsection D if any acute toxicity test conducted for compliance monitoring determines a statistically significant difference in survival between the control and the ACEC using hypothesis testing at the 0.05 level of significance (Appendix H, EPA/600/4-89/001). If the difference in survival between the control and the ACEC is less than 10 percent, the hypothesis test shall be conducted at the 0.01 level of significance.

D. Response to Noncompliance With an Effluent Limit for Acute Toxicity

If the Permittee violates the acute toxicity limit in subsection B, the Permittee shall begin additional compliance monitoring within one week from the time of receiving the test results. This additional monitoring shall be conducted weekly for four consecutive weeks using the same test and species as the failed compliance test. Testing shall determine the LC_{50} and effluent limit compliance. The discharger shall return to the original monitoring frequency in subsection C after completion of the additional compliance monitoring.

If the Permittee believes that a test indicating noncompliance will be identified by the Department as an anomalous test result, the Permittee may notify the Department that the compliance test result might be anomalous and that the Permittee intends to take only one additional sample for toxicity testing and wait for notification from the Department before completing the additional monitoring required in this subsection. The notification to the Department shall accompany the report of the compliance test result and identify the reason for considering the compliance test result to be anomalous. The Permittee shall complete all of the additional monitoring required in this subsection as soon as possible after notification by the Department that the compliance test result was not anomalous. If the one additional sample fails to comply with the effluent limit for acute toxicity, then the Permittee shall proceed without delay to complete all of the additional monitoring required in this subsection. The one additional test result shall replace the compliance test result upon determination by the Department that the compliance test result was anomalous.

If all of the additional compliance monitoring conducted in accordance with this subsection complies with the permit limit, the Permittee shall search all pertinent and recent facility records (operating records, monitoring results, inspection records, spill reports, weather records, production records, raw material purchases, pretreatment records, etc.) and submit a report to the Department on possible causes and preventive measures for the transient toxicity event which triggered the additional compliance monitoring.

If toxicity occurs in violation of the acute toxicity limit during the additional compliance monitoring, the Permittee shall submit a Toxicity Identification/Reduction Evaluation (TI/RE) plan to the Department. The TI/RE plan submittal shall be within 60 days after the sample date for the fourth additional compliance monitoring test. If the Permittee decides to forgo the rest of the additional compliance monitoring tests required in this subsection because one of the first three additional compliance monitoring tests failed to meet the acute toxicity limit, then the Permittee shall submit the TI/RE plan within 60 days after the sample date for the first additional monitoring test to violate the acute toxicity limit. The TI/RE plan shall be based on WAC 173-205-100(2) and shall be implemented in accordance with WAC 173-205-100(3).

E. Monitoring When There Is No Permit Limit for Acute Toxicity

The Permittee shall test final effluent once in the last summer and once in the last winter prior to submission of the application for permit renewal. All species used in the initial acute effluent characterization or substitutes approved by the Department shall be used and results submitted to the Department as a part of the permit renewal application process.

If no limit is required, then testing will still be required twice in the last year before the permit is due to expire. The testing data will be required by **October 15, 2008**.

F. Sampling and Reporting Requirements

1. All reports for effluent characterization or compliance monitoring shall be submitted in accordance with the most recent version of Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* in regards to format and content. Reports shall contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data on floppy disk for electronic entry into the Department's database, then the Permittee shall send the disk to the Department along with the test report, bench sheets, and reference toxicant results.

2. Testing shall be conducted on 24-hour composite effluent samples. Composite samples taken for toxicity testing shall be cooled to 4 degrees Celsius while being collected and shall be sent to the lab immediately upon completion. Grab samples must be shipped on ice to the lab immediately upon collection. If a grab sample is received at the testing lab within one hour after collection, it must have a temperature below 20°C at receipt. If a grab sample is received at the testing lab within 4 hours after collection, it must be below 12°C at receipt. All other samples must be below 8°C at receipt. The lab shall begin the toxicity testing as soon as possible but no later than 36 hours after sampling was ended. The lab shall store all samples at 4°C in the dark from receipt until completion of the test.

3. All samples and test solutions for toxicity testing shall have water quality measurements as specified in Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* or most recent version thereof.

4. All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA manual listed in subsection A and the Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If test results are determined to be invalid or anomalous by the Department, testing shall be repeated with freshly collected effluent.

5. Control water and dilution water shall be laboratory water meeting the requirements of the EPA manual listed in subsection A or pristine natural water of sufficient quality for good control performance.

6. The whole effluent toxicity tests shall be run on an unmodified sample of final effluent.

7. The Permittee may choose to conduct a full dilution series test during compliance monitoring in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the ACEC.

8. All whole effluent toxicity tests, effluent screening tests, and rapid screening tests that involve hypothesis testing, and do not comply with the acute statistical power standard of 29 percent as defined in WAC 173-205-020, must be repeated on a fresh sample with an increased number of replicates to increase the power.

S9. CHRONIC TOXICITY

A. Effluent Characterization

The Permittee shall conduct chronic toxicity testing on the final effluent. The two chronic toxicity tests listed below shall be conducted on each sample taken for effluent characterization.

Testing shall begin by **February 1, 2005**. A written report shall be submitted to the Department **April 15, 2005**.

Effluent testing for chronic toxicity shall be conducted twice in one year. The Permittee shall conduct chronic toxicity testing during the effluent characterization on a series of at least five concentrations of effluent in order to determine appropriate point estimates. This series of dilutions shall include the ACEC. The Permittee shall compare the ACEC to the control using hypothesis testing at the 0.05 level of significance as described in Appendix H, EPA/600/4-89/001.

Chronic toxicity tests shall be conducted with the following two species and the most recent version of the following protocols:

Freshwater Chronic Toxicity Test Species		Method
Fathead minnow	*Pimephales promelas*	EPA/600/4-91/002
Water flea	*Ceriodaphnia dubia*	EPA/600/4-91/002

B. Effluent Limit for Chronic Toxicity

After completion of effluent characterization, the Permittee has an effluent limit for chronic toxicity if any test conducted for effluent characterization shows a significant difference between the control and the ACEC at the 0.05 level of significance using hypothesis testing (Appendix H, EPA/600/4-89/001) and shall complete all applicable requirements in subsections C, D, and F.

If no significant difference is shown between the ACEC and the control in any of the chronic toxicity tests, the Permittee has no effluent limit for chronic toxicity and only subsections E and F apply.

The effluent limit for chronic toxicity is no toxicity detected in a test concentration representing the chronic critical effluent concentration (CCEC).

In the event of failure to pass the test described in subsection C, of this section, for compliance with the effluent limit for chronic toxicity, the Permittee is considered to be in compliance with all permit requirements for chronic whole effluent toxicity as long as the requirements in subsection D are being met to the satisfaction of the Department.

The CCEC means the maximum concentration of effluent allowable at the boundary of the mixing zone assigned in Section S1 pursuant to WAC 173-201A-100. The CCEC equals 4.2 percent effluent (based on a dilution factor of 24:1).

If no test resulted in a NOEC less than the ACEC or if no significant difference is shown between the ACEC and the control in any of the chronic toxicity tests, the Permittee has no effluent limit for chronic toxicity and only subsections E and F apply.

C. Monitoring for Compliance With an Effluent Limit for Chronic Toxicity

Monitoring to determine compliance with the effluent limit shall be conducted biannually for the remainder of the permit term using each of the species listed in subsection A on a rotating basis and performed using at a minimum the CCEC, the ACEC, and a control. The Permittee shall schedule the toxicity tests in the order listed in the permit unless the Department notifies the Permittee in writing of another species rotation schedule.

If testing is required because of a chronic toxicity limit, a chronic toxicity compliance monitoring report is required by **November 15, 2006**, and twice a year thereafter.

Compliance with the effluent limit for chronic toxicity means no statistically significant difference in response between the control and the test concentration representing the CCEC. The Permittee shall immediately implement subsection D if any chronic toxicity test conducted for compliance monitoring determines a statistically significant difference in response between the control and the CCEC using hypothesis testing at the 0.05 level of significance (Appendix H, EPA/600/4-89/001). If the difference in response between the control and the CCEC is less than 20 percent, the hypothesis test shall be conducted at the 0.01 level of significance.

In order to establish whether the chronic toxicity limit is eligible for removal from future permits, the Permittee shall also conduct this same hypothesis test (Appendix H, EPA/600/4-89/001) to determine if a statistically significant difference in response exists between the ACEC and the control.

D. Response to Noncompliance With an Effluent Limit for Chronic Toxicity

If a toxicity test conducted for compliance monitoring under subsection C determines a statistically significant difference in response between the CCEC and the control, the Permittee shall begin additional compliance monitoring within one week from the time of receiving the test results. This additional monitoring shall be conducted monthly for three consecutive months using the same test and species as the failed compliance test. Testing shall be conducted using a series of at least five effluent concentrations and a control in order to be able to determine appropriate point estimates. One of these effluent concentrations shall equal the CCEC and be compared statistically to the nontoxic control in order to determine compliance with the effluent limit for chronic toxicity as described in subsection C. The discharger shall return to the original monitoring frequency in subsection C after completion of the additional compliance monitoring.

If the Permittee believes that a test indicating noncompliance will be identified by the Department as an anomalous test result, the Permittee may notify the Department that the compliance test result might be anomalous and that the Permittee intends to take only one additional sample for toxicity testing and wait for notification from the Department before completing the additional monitoring required in this subsection. The notification to the Department shall accompany the report of the compliance test result and identify the reason for considering the compliance test result to be anomalous. The Permittee shall complete all of the additional monitoring required in this subsection as soon as possible after notification by the Department that the compliance test result was not anomalous. If the one additional sample fails to comply with the effluent limit for chronic toxicity, then the Permittee shall proceed without delay to complete all of the additional monitoring required in this subsection. The one additional test result shall replace the compliance test result upon determination by the Department that the compliance test result was anomalous.

If all of the additional compliance monitoring conducted in accordance with this subsection complies with the permit limit, the Permittee shall search all pertinent and recent facility records (operating records, monitoring results, inspection records, spill reports, weather records, production records, raw material purchases, pretreatment records, etc.) and submit a report to the Department on possible causes and preventive measures for the transient toxicity event which triggered the additional compliance monitoring.

If toxicity occurs in violation of the chronic toxicity limit during the additional compliance monitoring, the Permittee shall submit a Toxicity Identification/Reduction Evaluation (TI/RE) plan to the Department. The TI/RE plan submittal shall be within 60 days after the sample date for the third additional compliance monitoring test. If the Permittee decides to forgo the rest of the additional compliance monitoring tests required in this subsection because one of the first two additional compliance monitoring tests failed to meet the chronic toxicity limit, then the Permittee shall submit the TI/RE plan within 60 days after the sample date for the first additional monitoring test to violate the chronic toxicity limit. The TI/RE plan shall be based on WAC 173-205-100(2) and shall be implemented in accordance with WAC 173-205-100(3).

E. Monitoring When There Is No Permit Limit for Chronic Toxicity

The Permittee shall test final effluent once in the last summer and once in the last winter prior to submission of the application for permit renewal. All species used in the initial chronic effluent characterization or substitutes approved by the Department shall be used and results submitted to the Department as a part of the permit renewal application process.

If no limit is required, then testing will still be required twice in the last year before the permit is due to expire. The testing data will be required by **October 15, 2008**.

F. <u>Sampling and Reporting Requirements</u>

1. All reports for effluent characterization or compliance monitoring shall be submitted in accordance with the most recent version of Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* in regards to format and content. Reports shall contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data on floppy disk for electronic entry into the Department's database, then the Permittee shall send the disk to the Department along with the test report, bench sheets, and reference toxicant results.

2. Testing shall be conducted on 24-hour composite effluent samples. Composite samples taken for toxicity testing shall be cooled to 4 degrees Celsius while being collected and shall be sent to the lab immediately upon completion. Grab samples must be shipped on ice to the lab immediately upon collection. If a grab sample is received at the testing lab within one hour after collection, it must have a temperature below 20°C at receipt. If a grab sample is received at the testing lab within 4 hours after collection, it must be below 12°C at receipt. All other samples must be below 8°C at receipt. The lab shall begin the toxicity testing as soon as possible but no later than 36 hours after sampling was ended. The lab shall store all samples at 4°C in the dark from receipt until completion of the test.

3. All samples and test solutions for toxicity testing shall have water quality measurements as specified in Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* or most recent version thereof.

4. All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA manual listed in subsection A and the Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If test results are determined to be invalid or anomalous by the Department, testing shall be repeated with freshly collected effluent.

5. Control water and dilution water shall be laboratory water meeting the requirements of the EPA manual listed in subsection A or pristine natural water of sufficient quality for good control performance.

6. The whole effluent toxicity tests shall be run on an unmodified sample of final effluent.

7. The Permittee may choose to conduct a full dilution series test during compliance monitoring in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the ACEC and the CCEC.

8. All whole effluent toxicity tests, effluent screening tests, and rapid screening tests that involve hypothesis testing, and do not comply with the chronic statistical power standard of 39 percent as defined in WAC 173-205-020, must be repeated on a fresh sample with an increased number of replicates to increase the power.

S10. OUTFALL EVALUATION

The Permittee shall inspect, once per permit the submerged portion of the outfall line and diffuser to document its integrity and continued function. If conditions allow for a photographic verification, it shall be included in the report. By **November 15, 2008**, the inspection report shall be submitted to the Department.

GENERAL CONDITIONS

G1. SIGNATORY REQUIREMENTS

All applications, reports, or information submitted to the Department shall be signed and certified.

A. All permit applications shall be signed by either a principal executive officer or a ranking elected official.

B. All reports required by this permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described above and submitted to the Department.

2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

C. Changes to authorization. If an authorization under paragraph B.2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph B.2 above must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a document under this section shall make the following certification:

> I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

G2. RIGHT OF INSPECTION AND ENTRY

The Permittee shall allow an authorized representative of the Department, upon the presentation of credentials and such other documents as may be required by law:

A. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.

B. To have access to and copy - at reasonable times and at reasonable cost - any records required to be kept under the terms and conditions of this permit.

C. To inspect - at reasonable times - any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.

D. To sample or monitor - at reasonable times - any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G3. PERMIT ACTIONS

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the Permittee) or upon the Department's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5.

A. The following are causes for terminating this permit during its term, or for denying a permit renewal application:

1. Violation of any permit term or condition.

2. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.

3. A material change in quantity or type of waste disposal.

4. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination [40 CFR Part 122.64(3)].

5. A change in any condition that requires either a temporary or permanent reduction, or elimination of any discharge or sludge use or disposal practice controlled by the permit [40 CFR Part 122.64(4)].

6. Nonpayment of fees assessed pursuant to RCW 90.48.465.

7. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

B. The following are causes for modification but not revocation and reissuance except when the Permittee requests or agrees:

1. A material change in the condition of the waters of the state.

2. New information not available at the time of permit issuance that would have justified the application of different permit conditions.

3. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.

4. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.

5. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR Part 122.62.

6. The Department has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.

7. Incorporation of an approved local pretreatment program into a municipality's permit.

C. The following are causes for modification or alternatively revocation and reissuance:

1. Cause exists for termination for reasons listed in A1 through A7 of this section, and the Department determines that modification or revocation and reissuance is appropriate.

2. The Department has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G8) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new Permittee.

G4. REPORTING PLANNED CHANGES

The Permittee shall, as soon as possible, but no later than 60 days prior to the proposed changes, give notice to the Department of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in: 1) the permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b); 2) a significant change in the nature or an increase in quantity of pollutants discharged; or 3) a significant change in the Permittee's sludge use or disposal practices. Following such notice, and the submittal of a new application or supplement to the existing application, along with required engineering plans and reports, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation of the terms and conditions of this permit.

G5. PLAN REVIEW REQUIRED

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications shall be submitted to the Department for approval in accordance with Chapter 173-240 WAC. Engineering reports, plans, and specifications shall be submitted at least 180 days prior to the planned start of construction unless a shorter time is approved by the Department. Facilities shall be constructed and operated in accordance with the approved plans.

G6. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit shall be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. DUTY TO REAPPLY

The Permittee shall apply for permit renewal by **February 15, 2009**.

G8. TRANSFER OF THIS PERMIT

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Department.

A. Transfers by Modification

Except as provided in paragraph (B) below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

B. Automatic Transfers

This permit may be automatically transferred to a new Permittee if:

1. The Permittee notifies the Department at least 30 days in advance of the proposed transfer date.

2. The notice includes a written agreement between the existing and new Permittees containing a specific date transfer of permit responsibility, coverage, and liability between them.

3. The Department does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under this subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

G9. REDUCED PRODUCTION FOR COMPLIANCE

The Permittee, in order to maintain compliance with its permit, shall control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

G10. REMOVED SUBSTANCES

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

G11. DUTY TO PROVIDE INFORMATION

The Permittee shall submit to the Department, within a reasonable time, all information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee shall also submit to the Department upon request, copies of records required to be kept by this permit.

G12. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G13. ADDITIONAL MONITORING

The Department may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G14. PAYMENT OF FEES

The Permittee shall submit payment of fees associated with this permit as assessed by the Department.

G15. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to $10,000 and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to $10,000 for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

G16. UPSET

Definition – “Upset” means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that: 1) an upset occurred and that the Permittee can identify the cause(s) of the upset; 2) the permitted facility was being properly operated at the time of the upset; 3) the Permittee submitted notice of the upset as required in Condition S3.E; and 4) the Permittee complied with any remedial measures required under S4.C of this permit.

In any enforcement proceeding the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G17. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

G18. DUTY TO COMPLY

The Permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G19. TOXIC POLLUTANTS

The Permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G20. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this Condition, punishment shall be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four years, or by both.

G21. REPORTING ANTICIPATED NON-COMPLIANCE

The Permittee shall give advance notice to the Department by submission of a new application or supplement thereto at least 180 days prior to commencement of such discharges, of any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility or activity which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Department.

G22. REPORTING OTHER INFORMATION

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Department, it shall promptly submit such facts or information.

G23. COMPLIANCE SCHEDULES

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

FACT SHEET FOR NPDES PERMIT WA0020249

CITY OF CAMAS

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INTRODUCTION

The Federal Clean Water Act (FCWA, 1972, and later modifications, 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One of the mechanisms for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System (NPDES) of permits, which is administered by the Environmental Protection Agency (EPA). The EPA has authorized the state of Washington to administer the NPDES permit program. Chapter 90.48 Revised Code of Washington (RCW) defines the Department of Ecology's (Department) authority and obligations in administering the wastewater discharge permit program.

The regulations adopted by the state include procedures for issuing permits [Chapter 173-220 Washington Administrative Code (WAC)], technical criteria for discharges from municipal wastewater treatment facilities (Chapter 173-221 WAC), water quality criteria for surface and ground waters (Chapters 173-201A and 200 WAC), and sediment management standards (Chapter 173-204 WAC). These regulations require that a permit be issued before discharge of wastewater to waters of the state is allowed. The regulations also establish the basis for effluent limitations and other requirements which are to be included in the permit. One of the requirements (WAC 173-220-060) for issuing a permit under the NPDES permit program is the preparation of a draft permit and an accompanying fact sheet. Public notice of the availability of the draft permit is required at least thirty days before the permit is issued (WAC 173-220-050). The fact sheet and draft permit are available for review (see <u>Appendix A--Public Involvement</u> of the fact sheet for more detail on the Public Notice procedures).

The fact sheet and draft permit have been reviewed by the Permittee. Errors and omissions identified in this review have been corrected before going to public notice. After the public comment period has closed, the Department will summarize the substantive comments and the response to each comment. The summary and response to comments will become part of the file on the permit and parties submitting comments will receive a copy of the Department's response. The fact sheet will not be revised. Comments and the resultant changes to the permit will be summarized in Appendix D--Response to Comments.

GENERAL INFORMATION	
Applicant	City of Camas
Facility Name and Address	City of Camas Wastewater Treatment Plant P.O. Box 1055 Camas, WA 98507
Type of Treatment	Activated sludge with filtration capability and UV disinfection
Discharge Location	Columbia River Latitude: 45º 34' 36" N Longitude: 122º 23' 28" W.
Water Body ID Number	Old ID No. WA-CR-1010, New ID No. 1220169456238

BACKGROUND INFORMATION

DESCRIPTION OF THE FACILITY

The City of Camas wastewater treatment starts in the collection system where over a thousand customers have septic tanks that discharge to the centralized sewage treatment plant. There are also several industrial customers. These sources have resulted in dilute influent to the plant. The plant itself has influent screening, primary clarifiers, followed by an activated sludge system. Primary clarifiers are used to remove sludge and grit. To control pH, a sodium hydroxide solution or lime slurry may be mixed in downstream of the influent Parshall flume or mixed in at the aeration splitter box. The wastewater flows to up to three separate aeration basins which are designed for nitrogen removal via selectors, anoxic zones, and internal recycle. The effluent then flows to secondary clarifiers and then on to optional cloth filters. The effluent is disinfected with UV lights before being discharged to the Columbia River.

HISTORY

The existing facility for the City of Camas (City) was originally constructed in 1972 and has had several modifications since that time. The latest upgrade and expansion was completed in February of 2000. The current system should be able to effectively treat flows projected through the year 2015. The solids treatment was split into two phases with the first phase having been completed in 2000 and the second phase to be completed in 2007 and last through 2027.

COLLECTION SYSTEM STATUS

The collection system is comprised partly of conventional gravity flow sewers and septic tank effluent (STE). Most of these STE systems discharge by gravity to the pump stations and treatment plant and therefore do not have individual pumps. There were over 1,500 STE systems installed from 1985 to 1997 (facility plan was written in 1997). The City is not continuing to install new septic tanks. The Inflow and Infiltration (I/I) from the STE tanks appears to be negligible. However, I/I from the rest of the system does appear to be excessive according to the 1997 facility plan. The City has a continuing I/I reduction program. Because the City has Septic tanks discharging to the system, which reduced the loading to the plant, the City applied for exemption from the 85 percent removal requirement under the previous permit. The 1999 permit was granted with an 83 percent removal requirement for BOD and 81 percent for TSS. The City has again applied for a further reduction of these removal requirements. The City also receives dilute wastewater from Wafer Tech, one of several industrial customers. As of 1997, approximately one-third of the flow to the sewage treatment plant was from STE systems. There are seven pump stations serving the City, all of which are conventional gravity/lift systems.

TREATMENT PROCESSES

The wastewater for approximately one-third of the city starts at a septic tank where solids settle out and effluent flows by gravity to the treatment plant. The STE systems are checked on a yearly basis and pumped when full, which is three to five years for residences and as short as six-months for some businesses.

The treatment plant receives influent at the headworks where the flow is measured at a Parshall flume and a 24-hour sampler is available. The wastewater next passes through an inclined rotating fine screen or course bypass-screen and then on to two primary clarifiers (See the plant Schematic in Appendix B). The effluent from the primary clarifiers can be mixed with sodium-hydroxide or lime slurry to control pH as a result of industrial effluent from Wafer Tech. The pH control may also aid in the nitrogen removal process. Grit and sludge from the primary clarifiers is sent to the solids handling system which will be discussed later.

The flow enters one of three aeration basins that each has three selector zones. Aeration and mixing is driven by course and then fine bubble diffusers. The selector zones are followed by two anoxic zones, and then followed by three oxic zones. On-line dissolved oxygen (DO) meters aid in control of aeration blowers that are set to automatically turn on at certain DO levels.

The flow from the aeration basins can be returned for internal recycling or sent on to the two secondary clarifiers. The clarifiers are conventional round center-feed systems that allow for return activated sludge and waste activated sludge.

A magnetic flow meter follows the secondary clarifiers. A fabric filtration system manufactured by AQUADISC may be used if the TSS is not low enough to satisfy limits. The final treatment consists of UV disinfection which is set up in three horizontal banks with 12 modules each. There are a total of 288 bulbs for peak flow and redundancy requirements.

The plant is an activated sludge process with flow greater than one MGD, which according to WAC 173-230-140 places the facility at a Class IV certification. Because of the use of filtration the facility is considered to be tertiary treatment. The lead operator in charge of the treatment plant must therefore have a Class IV certification or higher and the operator in charge of each shift must be certified at Class III or higher. There are currently four operators working at the plant with each having one of the following certifications: Group I, II, III, and IV. The plant hours of operation are 6:00 a.m. to 4:30 p.m. during the weekdays and from 7:00 a.m. to 3:00 p.m. on weekends.

The facility upgrades were financed through a variety of sources with a large part coming from a State Revolving Fund (SRF) Loan for 20 years and a Public Works Trust Fund (PWTF) loan for 10 years, and through revenue bonds. A new facility plan upgrade is budgeted and scheduled for late 2004. The next plant upgrade is scheduled to include engineering for the new construction in 2005, design and bid for new construction in 2006, and the actual construction to take place in 2007. There is a 1998 refunding bond which has a life until April 2016, and there is a PWTF loan that will continue to be paid back until July 2019. A 1998 Department loan will be paid until September 2020. There is also a Department loan for an additional secondary clarifier which has a life through April 2017.

DISCHARGE OUTFALL

Secondary treated and disinfected effluent is discharged from the facility via an outfall into the Columbia River. The outfall extends approximately 850-feet from the north bank of the Columbia River and terminates at a depth of approximately 21 feet below Columbia River Datum (CRD) during low flows. The outfall is constructed of a 36-inch diameter corrugated steel pipe that terminates in a 150-foot long diffuser. The diffuser currently consists of eight 6-inch diameter port risers that are on 10-foot centers. All ports are in a vertical position and all are discharging horizontally downstream. Eight more ports are in place but closed off with blind flanges which were proposed to be opened during the plant expansion in 2007. Recent dilution modeling by the Department in March 2004 does not show an improvement in acute dilution in opening the diffuser flanges at the current design flow.

RESIDUAL SOLIDS

Solids are screened at the headworks. Solids from the primary clarifiers are sent first to a grit removal system, and then the liquid part goes on to a gravity thickener. Thickened sludge and scum are sent to one of two aerobic digesters that work in tandem. The digested sludge is mixed with a polymer to aid in thickening and dewatered at a centrifuge. The final sludge cake or biosolids are stored under cover until shipped off-site.

Grit is shipped off site for use in as soil amendments and rags, scum, and screenings are drained and disposed of as solid waste at the local solid waste transfer station. Solids removed from the final biosolids storage area are sent off-site to Fire Mountain Farms, or another permitted biosolids facility.

PERMIT STATUS

The previous permit for this facility was issued on February 19, 1999. The previous permit placed effluent limitations on 5-day Biochemical Oxygen Demand (BOD_5), Total Suspended Solids (TSS), pH, Fecal Coliform bacteria, Total Residual Chlorine, and Ammonia (narrative).

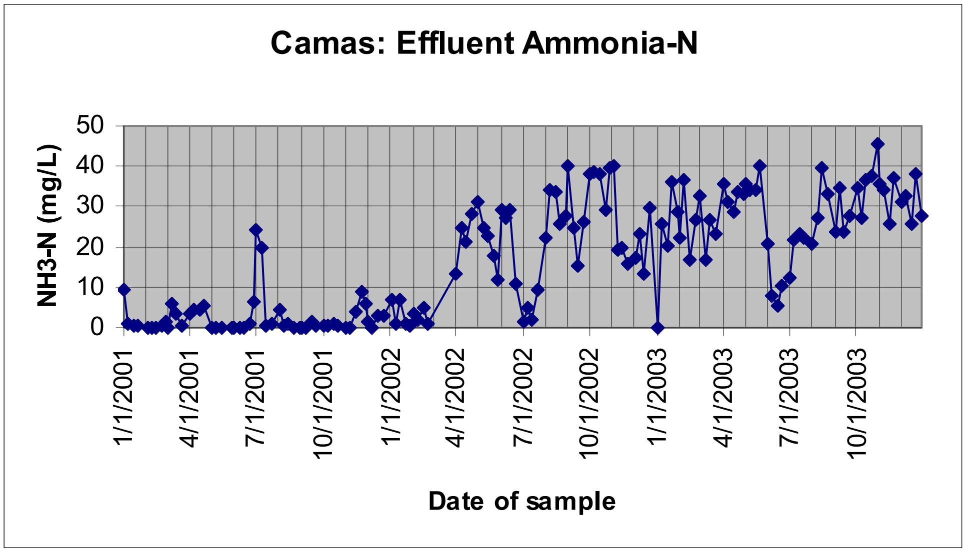
An application for permit renewal was submitted to the Department on August 21, 2003, and accepted by the Department on October 23, 2003.

SUMMARY OF COMPLIANCE WITH THE PREVIOUS PERMIT

The facility received its last inspection on February 25, 2004. The facility appeared to be operating properly at that time.

Since the upgrade of the plant in February 2000 there have been no violations of permit conditions, based on Discharge Monitoring Reports (DMRs) submitted to the Department. However, there has been a narrative ammonia limit in the permit that states "Optimize plant operation for nitrification and monitor." It appears that the plant was doing a good job of removing ammonia from January 2001 through March 2002. But in the last two years, from April of 2002, the facility has not been optimizing removal of ammonia (see figure 1 below).

Figure 1: Ammonia Removal at Camas from January 2001 to October 2003



Ammonia toxicity will be explained more thoroughly under "Considerations for Surface Water Quality" and "Toxic Pollutants" below.

The facility has stated in their 1997 facility plan that Inflow and Infiltration (I/I) is a problem. Federal regulation states that infiltration is excessive when average daily flow during a 7-14 day, non-rainfall period of seasonal high groundwater, is greater than 120 gallons per capita day (gpcd). Inflow is excessive when the average daily flow during periods of significant rainfall, such as during a storm event that causes ponding, is greater than 275 gpcd or causes hydraulic overloading of the treatment plant.

A March 2003 I/I report showed average rainfall for each month and therefore included rainfall and non-rainfall periods. The report shows the gallons per capita day (GPCD) which is the highest monthly flows divided by the population equivalent served. This GPCD is shown in the table below:

Year	Highest monthly flow	Population Equivalent	GPCD	Total Yearly Rainfall (in.)
2002	2.398	13,500	177.6	40.21
2001	2.594	12,500	207.5	35.12
2000	2.984	12,000	248.7	34.66

The report shows that I/I in general have been going down slightly each year over each of the last three years. It is not clear if this is due to a decrease in rainfall or any reductions on the part of the City. The 177.6 gpcd is still higher than the 120 gpcd that is considered excessive for the infiltration rate. It is therefore recommended that the City continue a program of fixing I/I problems, monitoring, and issuing a report each year.

WASTEWATER CHARACTERIZATION

The concentration of pollutants in the discharge was reported in the NPDES application and in discharge monitoring reports. The effluent is characterized as follows:

Table 1: Wastewater Characterization. Plant Upgraded in February 2000. Data examined for March 2000 through January 2004. (The following statistics are based on the monthly averages reported in the DMRs except for the ammonia which was calculated with all available daily entries.)

Parameter	Concentration
Flow	1.76 mgd (Avg.), 2.56 mgd (95th percentile)
BOD	218 lbs/day (95th percentile) 15.7 mg/L (95th percentile) 87% removal (5th percentile)
TSS	104 lbs/day (95th percentile) 7.75 mg/L (95th percentile) 95% removal (5th percentile)
pH (July 2000 – January 2004) pH was not under control until July 2000	6.03 S.U. (min), 6.1 (5th percentile) 8.13 S.U. (max), 7.6 (95th percentile)
Ammonia	**Summer (June – Sept)** 37 mg/L (95th percentile, 33 samples from June '02 – Sept '03) **Winter (Oct – May)** 39.1 mg/L (95th percentile, 67 samples from Jan '02 – Dec '03)
Fecal Coliform	120 org./100ml (95th percentile of 7-day geomean) 28 org./100ml (95th percentile of 30-day geomean)

The flow has been well within the design flow of the facility. Under phase I, which was completed in 2000 the facility was designed to treat a maximum monthly flow of 6.1 mgd and an average annual flow of 3.77 mgd. The flow averaged 1.76 mgd and was less than 2.56 mgd 95 percent of the time. BOD was within the allowable limit of 955 lbs/day and the plant was under 218 lbs/day 95 percent of the time. The BOD concentration was below 15.7 mg/L 95 percent of the time with a design limit was 30 mg/L on a monthly basis. The facility was able to remove 87 percent of the BOD 95 percent of the time. The minimum removal of BOD was limited to 83 percent.

The plant was within the allowable TSS limit of 1217 lbs/day and was under 104 lbs/day 95 percent of the time. With a concentration limit of 30 mg/L the facility was below 7.75 mg/L TSS. The facility was able to remove 95 percent of the TSS 95 percent of the time. The minimum removal of TSS was limited to 81 percent.

The facility has applied for a lower BOD and TSS removal rate which will be discussed later in this fact sheet.

The pH never went above 8.13 or below 6.03 standard units which kept the facility within the pH limits of 6.0 to 9.0 standard units.

As stated above the ammonia does not appear to have been optimized during the last two years of operation.

The fecal coliform was kept within the limits of 200 to 400 org/100 ml with the fecal coliform below 120 org/100 ml 95 percent of the time.

SEPA COMPLIANCE

The facility plan of 1994 would have required State Environmental Policy Act (SEPA) compliance. No other actions related to this permit have triggered SEPA compliance.

PROPOSED PERMIT LIMITATIONS

Federal and state regulations require that effluent limitations set forth in a NPDES permit must be either technology- or water quality-based. Technology-based limitations for municipal discharges are set by regulation (40 CFR 133, and Chapters 173-220 and 173-221 WAC). Water quality-based limitations are based upon compliance with the Surface Water Quality Standards (Chapter 173-201A WAC), Ground Water Standards (Chapter 173-200 WAC), Sediment Quality Standards (Chapter 173-204 WAC) or the National Toxics Rule (Federal Register, Volume 57, No. 246, Tuesday, December 22, 1992.) The most stringent of these types of limits must be chosen for each of the parameters of concern. Each of these types of limits is described in more detail below.

The limits in this permit are based in part on information received in the application and through an examination of DMRs. The effluent constituents in the application were evaluated on a technology- and water quality-basis. The limits necessary to meet the rules and regulations of the state of Washington were determined and included in this permit. The Department does not develop effluent limits for all pollutants that may be reported on the application as present in the effluent. Some pollutants are not treatable at the concentrations reported, are not controllable at the source, are not listed in regulation, and do not have a reasonable potential to cause a water quality violation. Effluent limits are not always developed for pollutants that may be in the discharge but not reported as present in the application. In those circumstances the permit does not authorize discharge of the non-reported pollutants. Effluent discharge conditions may change from the conditions reported in the permit application. If significant changes occur in any constituent, as described in 40 CFR 122.42(a), the Permittee is required to notify the Department. The Permittee may be in violation of the permit until the permit is modified to reflect additional discharge of pollutants.

DESIGN CRITERIA

In accordance with WAC 173-220-150 (1)(g), flows or waste loadings shall not exceed approved design criteria.

The design criteria for this treatment facility are taken from the 1998 facility plan and the 2002 As Built Drawing Plans prepared by Gray and Osborne, Inc. and are as follows:

Table 2: Design Standards for the Camas WWTP.

Parameter	Design Quantity
Monthly average flow (max. month)	6.10 mgd
Monthly average dry weather flow	2.86 mgd
Instantaneous peak flow (hourly)	11.09 mgd
BOD_5 influent loading	5,616 lbs/day
TSS influent loading	6,405 lbs/day
TKN loading	942 lbs/day

The population equivalent used in the above design criteria is 23,548 (from the 1997 facility plan projected for the year 2015).

TECHNOLOGY-BASED EFFLUENT LIMITATIONS

Municipal wastewater treatment plants are a category of discharger for which technology-based effluent limits have been promulgated by federal and state regulations. These effluent limitations are given in the Code of Federal Regulations (CFR) 40 CFR Part 133 (federal) and in Chapter 173-221 WAC (state). These regulations are performance standards that constitute all known available and reasonable methods of prevention, control, and treatment for municipal wastewater.

The following technology-based limits for pH, fecal coliform, BOD_5, and TSS are taken from Chapter 173-221 WAC are:

Table 3: Technology-based Limits from Regulation (Before Changes to BOD and TSS. See table 4).

Parameter	Limit
pH:	shall be within the range of 6 to 9 standard units.
Fecal Coliform Bacteria	Monthly Geometric Mean = 200 organisms/100 ml Weekly Geometric Mean = 400 organisms/100 ml
BOD_5 (concentration)	Average Monthly Limit is the most stringent of the following: - 30 mg/L - may not exceed fifteen percent (15%) of the average influent concentration * Average Weekly Limit = 45 mg/L
TSS (concentration)	Average Monthly Limit is the most stringent of the following: - 30 mg/L - may not exceed fifteen percent (15%) of the average influent concentration * Average Weekly Limit = 45 mg/L

*The previous permit had reduced limits for percent removal of BOD and TSS. This reduced limit was 83 percent removal for BOD and 81 percent removal for TSS. The Permittee has requested to have the percent removal requirement relaxed further due to dilute influent from WaferTech industries and due to the many STEP tanks throughout the system. Our permit guidance allows for BOD and TSS removal rates to be reduced in cases of dilute influent.

Because the influent is diluted, this means the effluent concentration limits should also be reduced. Gray and Osborne, the Permittee's consultant, submitted a final faxed letter on May 23, 2000, after a series of communications requesting a lower percent removal in the permit.

The consultants have shown that the influent during the maximum monthly flow of 6.1 mgd is comprised of 3.134 mgd from WaferTech and Linear Technologies and 2.966 mgd from conventional domestic, commercial, and I/I.

With the safeguard of a maximum limit of 20 mg/L for effluent BOD and TSS, a 70 percent removal rate is acceptable. This is based on several calculations as follows:

(Plant design loading)/(plant design flow)(8.34 lbs/gal) = (5,616 lbs./d BOD)/6.1 mgd)(8.34 lbs/gal) = 110 mg/L BOD.

The results for TSS are slightly higher, but a compromise was made to keep both TSS and BOD the same. The reduction rate was calculated as follows:

Removal of TSS and BOD = 0.83/(1+(3.134/2.966)(20/110)) = 70 percent

The effluent mass loading will need to be reduced to account for the reduced permit limit. The rationale for this is to maintain consistency with the method of calculating mass effluent limits. The Permittee had requested to have the effluent mass loading limit reduced from 1,217 lbs/day to 1,115 lbs/day. However, using the standard method of calculating mass effluent limit, the following effluent loading was determined for BOD and TSS:

Monthly effluent mass loadings (lbs/day) were calculated as the maximum monthly design flow (6.1 mgd) x Concentration limit (20 mg/L) x 8.34 (conversion factor) = mass limit 1,017 lbs/day.

The technology-based mass limits are based on WAC 173-220-130(3)(b) and 173-221-030(11)(b).

The weekly average effluent mass loading is calculated as 1.5 x monthly loading = 1,525 lbs/day.

Table 4: Technology-based Limits (After Changes to BOD and TSS Due to Dilute Influent).

Parameter	Limit
pH:	shall be within the range of 6 to 9 standard units.
Fecal Coliform Bacteria	Monthly Geometric Mean = 200 organisms/100 ml Weekly Geometric Mean = 400 organisms/100 ml
BOD_5 (concentration)	Average Monthly Limit is the most stringent of the following: - 20 mg/L - may not exceed thirty percent (30%) of the average influent concentration Average Weekly Limit = 30 mg/L
TSS (concentration)	Average Monthly Limit is the most stringent of the following: - 20 mg/L - may not exceed thirty percent (30%) of the average influent concentration Average Weekly Limit = 30 mg/L

SURFACE WATER QUALITY-BASED EFFLUENT LIMITATIONS

In order to protect existing water quality and preserve the designated beneficial uses of Washington's surface waters, WAC 173-201A-060 states that waste discharge permits shall be conditioned such that the discharge will meet established Surface Water Quality Standards. The Washington State Surface Water Quality Standards (Chapter 173-201A WAC) is a state regulation designed to protect the beneficial uses of the surface waters of the state. Water quality-based effluent limitations may be based on an individual waste load allocation (WLA) or on a WLA developed during a basin-wide total maximum daily loading study (TMDL).

NUMERICAL CRITERIA FOR THE PROTECTION OF AQUATIC LIFE

"Numerical" water quality criteria are numerical values set forth in the state of Washington's Water Quality Standards for Surface Waters (Chapter 173-201A WAC). They specify the levels of pollutants allowed in a receiving water while remaining protective of aquatic life. Numerical criteria set forth in the

Water Quality Standards are used along with chemical and physical data for the wastewater and receiving water to derive the effluent limits in the discharge permit. When surface water quality-based limits are more stringent or potentially more stringent than technology-based limitations, they must be used in a permit.

NUMERICAL CRITERIA FOR THE PROTECTION OF HUMAN HEALTH

The state was issued 91 numeric water quality criteria for the protection of human health by the U.S. EPA (EPA 1992). These criteria are designed to protect humans from cancer and other disease and are primarily applicable to fish and shellfish consumption and drinking water from surface waters.

NARRATIVE CRITERIA

In addition to numerical criteria, "narrative" water quality criteria (WAC 173-201A-030) limit toxic, radioactive, or deleterious material concentrations below those which have the potential to adversely affect characteristic water uses, cause acute or chronic toxicity to biota, impair aesthetic values, or adversely affect human health. Narrative criteria protect the specific beneficial uses of all fresh (WAC 173-201A-130) and marine (WAC 173-201A-140) waters in the state of Washington.

ANTIDEGRADATION

The state of Washington's Antidegradation Policy requires that discharges into a receiving water shall not further degrade the existing water quality of the water body. In cases where the natural conditions of a receiving water are of lower quality than the criteria assigned, the natural conditions shall constitute the water quality criteria. Similarly, when receiving waters are of higher quality than the criteria assigned, the existing water quality shall be protected. More information on the State Antidegradation Policy can be obtained by referring to WAC 173-201A-070.

One difficulty in implementing this policy is that the natural conditions of the water cannot be easily discerned from the conditions in the ambient environment as they exist today.

The Department has reviewed existing records and is unable to determine if ambient water quality is either higher or lower than the designated classification criteria given in Chapter 173-201A WAC; therefore, the Department will use the designated classification criteria for this water body in the proposed permit. The discharges authorized by this proposed permit should not cause a loss of beneficial uses.

A Total Maximum Daily Load Study (TMDL) is underway for the Columbia River System for Temperature. There are several parameters listed in the 303(d) list of limited water bodies. The 1998 303(d) listing of WRIA 28 has listings for Arsenic, fecal coliform, sediment bioassay, temperature, and total dissolved gas.

The total dissolved gas is almost entirely a product of excess water spilled at the upstream hydropower facilities and is not a product of wastewater facilities. The fecal coliform listings are a mile or more downstream of the Camas discharge.

Because the Camas facility uses UV disinfection, the discharge rates should be low enough that no fecal coliform will be detectable downstream at the 303(d) listed areas.

The arsenic was listed both upstream and downstream of the City of Camas in the 303(d) list, however the background in the vicinity of the Camas outfall was measured several orders of magnitude below the water quality criterion for arsenic. Arsenic was measured in the effluent but at low levels that were near the background levels. The sediment bioassay was down more than a mile and their does not appear to be toxics in the discharge that would settle out in the sediments.

There are temperature listings along most of the length of the Columbia. Diminishing riparian vegetation, increase thermal absorption due to dams (with shallower backwaters due to silt buildup), return flows from irrigation, and increased numbers of thermal discharges have all had significant effects on the Columbia River temperature as a whole. From relevant data, we have concluded that the POTW is not a significant source of thermal pollution.

The 90th percentile value for temperature in the summer months (June-September of 2000 - 2003) in the Columbia at Washougal was 21.48ºC based on 453 data points. This is above the temperature criterion for this section of the Columbia which is 20ºC.

A temperature TMDL is being done for the Columbia and Snake Rivers. However the TMDL is not completed. The temperature studies have shown that the main cause of the increased temperature in the system is the solar gain in the reservoirs (Ecology, 2004). More will be discussed about temperature at the Camas discharge later in this fact sheet.

CRITICAL CONDITIONS

Surface water quality-based limits are derived for the waterbody's critical condition, which represents the receiving water and waste discharge condition with the highest potential for adverse impact on the aquatic biota, human health, and existing or characteristic water body uses.

MIXING ZONES

The Water Quality Standards allow the Department to authorize mixing zones around a point of discharge in establishing surface water quality-based effluent limits. Both "acute" and "chronic" mixing zones may be authorized for pollutants that can have a toxic effect on the aquatic environment near the point of discharge. The concentration of pollutants at the boundary of these mixing zones may not exceed the numerical criteria for that type of zone. Mixing zones can only be authorized for discharges that are receiving all known, available, and reasonable methods of prevention, control and treatment (AKART) and in accordance with other mixing zone requirements of WAC 173-201A-100.

The National Toxics Rule (EPA, 1992) allows the chronic mixing zone to be used to meet human health criteria. A new dilution modeling study was conducted by the Department in March of 2004 using available data (See Appendix C).

DESCRIPTION OF THE RECEIVING WATER

The facility discharges to the Columbia River which is designated as a Class A receiving water in the vicinity of the outfall. Other nearby point source outfalls include the City of Washougal which is more than one mile upstream and the Fort James Camas L.L.C. paper mill, which is more than a mile downstream. All other outfalls are significantly more than a mile up or down stream. Significant nearby non-point sources of pollutants include stormwater from city and roads in the area.

Characteristic uses of Class A water include the following: water supply (domestic, industrial, agricultural); stock watering; fish migration; fish rearing, spawning and harvesting; wildlife habitat; primary contact recreation; sport fishing; boating and aesthetic enjoyment; commerce and navigation.

Water quality of this class shall meet or exceed the requirements for all or substantially all uses.

SURFACE WATER QUALITY CRITERIA

Applicable criteria are defined in Chapter 173-201A WAC for aquatic biota. In addition, U.S. EPA has promulgated human health criteria for toxic pollutants (EPA 1992). Criteria for this discharge are summarized below:

Fecal Coliforms	100 organisms/100 ml maximum geometric mean
Dissolved Oxygen	8 mg/L minimum
Temperature	20 degrees Celsius maximum or incremental increases above background
pH	6.5 to 8.5 standard units
Turbidity	less than 5 NTUs above background
Toxics	No toxics in toxic amounts (see Appendix C for numeric criteria for toxics of concern for this discharge)

CONSIDERATION OF SURFACE WATER QUALITY-BASED LIMITS FOR NUMERIC CRITERIA

Pollutant concentrations in the proposed discharge exceed water quality criteria with technology-based controls which the Department has determined to be AKART. A mixing zone is authorized in accordance with the geometric configuration, flow restriction, and other restrictions for mixing zones in Chapter 173-201A WAC and are defined as follows:

> A dilution analysis was last conducted in 1994 before the new plant came on-line. Some of the ambient conditions in the Columbia River have changed over time and more detailed information regarding temperature is now available through the USGS and ACOE web sites. The 1994 dilution analysis used UDKHDEN dilution model which tends to over predict the dilution compared to the UM3 model for these waters. The model also used a flux average model prediction rather than a centerline prediction which is recommended in the Department guidance for unidirectional water. The 1994 study assumed that the diffuser would have all 16 ports open, however; only 8 of the 16 ports were open. The other ports were closed with a blind flange.

It was therefore determined that, because of all these reasons, a new dilution analysis should be run. The considerations that went into the dilution model and the results of all of the model runs conducted by the Department in March 2004 are shown in Appendix C.

The UM3 model was run 25 times for both a critical summer and critical winter seasons. These runs produced four dilution factors that will be used in the following situations:

	Acute	Chronic
Aquatic Life (summer)	8	48
Aquatic Life (winter)	7	24
Human Health, Carcinogen		24
Human Health, Non-carcinogen		24

The summer low flow season is June through September and the winter is October through May.

Pollutants in an effluent may affect the aquatic environment near the point of discharge (near field) or at a considerable distance from the point of discharge (far field). Toxic pollutants, for example, are near-field pollutants--their adverse effects diminish rapidly with mixing in the receiving water. Conversely, a pollutant such as BOD is a far-field pollutant whose adverse effect occurs away from the discharge even after dilution has occurred. Thus, the method of calculating water quality-based effluent limits varies with the point at which the pollutant has its maximum effect.

The derivation of water quality-based limits also takes into account the variability of the pollutant concentrations in both the effluent and the receiving water.

The critical summer condition for the Columbia River is the seven day average low river flow with a recurrence interval of ten years (7Q10). The critical winter conditions used a median river flow and a high river flow that used the seven day average high flow with a recurrence interval of ten years (7Q90). Ambient data at critical conditions in the vicinity of the outfall were taken from a variety of reports. The flow, velocity and physical river data were taken from the 1994 Wastewater Facilities Plan by CH2MHill which was used in the 1994 dilution study. The temperature was taken from the USGS/ACOE web pages for the Columbia River dissolved gas network. The summer temperatures were taken from the Camas/Washougal station which had hourly data from May through late September. The maximum daily values were used to establish a 90th percentile. The winter temperatures were taken from the Warrendale station which is the nearest station with winter data. The pH percentiles were determined by combining two sets of data. There was only 12 months of monthly pH sampling. In 2002-2003 the Department sampled pH and a number of other parameters used in this report at station 28A100 which is near Vancouver Washington on the Columbia. In 1994 the USGS sampled pH 11 times. Because the pH sampling was so minimal, these two data sources were combined. The other conventional parameters and metals come from the 2002-2003 the Department sampling at station 28A100, which may be found at: http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?theyear=&tab=prelim_data&scrolly=267&wria=28&sta=28A100.

Ambient Columbia River Conditions Used In This Report

Parameter	Value used		
	Low	Med	High
Flow	81,400 cfs (7Q10)	192,400 cfs (Median)	522,000 cfs (7Q90)
Velocity	0.26 m/sec	0.58 m/sec	0.99 m/sec
Depth	21 ft	26.6 ft	40.9 ft
Temperature	21.48^{o}C (summer 90th percentile based on 453 points) 15.13 ^{o}C (winter 90th based on 728 points) 12.6 ^{o}C (yearly median based on 1125 points) 4.6 ^{o}C (winter 10th percentile based on 728 points)		
pH (high)	8.46 S.U. (winter 90th percentile based on 15 data points) 7.988 S.U. (summer 90th percentile based on 8 data points)		
Dissolved Oxygen	8.9 mg/L (10th percentile)		
Total Ammonia-N	27 µg/L (summer geomean x 1.74, approximates 90th percentile for small pop.) 19 µg/L (winter geomean x 1.74, approx. 90th percentile)		
Fecal Coliform	28 org./100 ml (summer geomean x 1.74, approx. 90th percentile) 7 org./100 ml (winter geomen x 1.74, approx. 90th percentile)		
Turbidity	5.14 NTU 90th percentile		
Hardness	48.75 mg/L as CaCO3 (10th percentile)		

Arsenic	1.12 µg/L (90th percentile)
Cadmium	0.525 µg/L (90th percentile dissolved)
Chromium	0.415 µg/L (90th percentile dissolved)
Copper	0.86 µg/L (90th percentile dissolved)
Lead	0.06 µg/L (90th percentile dissolved)
Nickel	0.555 µg/L (90th percentile dissolved)
Silver	0.1 µg/L (90th percentile dissolved)
Zinc	2.0 µg/L (90th percentile dissolved)
All Other Metals	0.0 (below detection limits)

BOD_5--Under critical conditions there is no predicted violation of the Water Quality Standards for Surface Waters. Therefore, the technology-based effluent limitation for BOD_5 was placed in the permit.

The impact of BOD on the receiving water was modeled using simple mixing (as shown in table C3 in Appendix C), at critical condition and with the technology-based effluent limitation for BOD_5 described under "Technology-Based Effluent Limitations" above. A Streeter-Phelps (Dosag) analysis was also run for summer and winter conditions. The Dosag was run with zero BOD input and with a conservative BOD based on high ammonia. Ambient DO was 8.9 mg/L. With initial dilution DO was 8.59 mg/L. With the far field reduction predicted by Dosag the final DO would be 8.58. The DO criterion is 8.0 mg/L. The conservative assumption shows a DO reduction of only 0.01 mg/L which is not enough to put the final DO below the criterion.

<u>Temperature and pH</u>--The impact of pH and temperature were modeled using the calculations from EPA, 1988. The input variables were dilution factor 45, upstream temperature 21.48^{o}C, upstream pH 7.99, upstream alkalinity 53(as mg $CaCO_3$/L), effluent temperature of 22^{o}C was assumed, effluent pH of 6, effluent pH of 9, and effluent alkalinity 150 (as mg $CaCO_3$/L). Effluent temperature appears not to have been monitored since before the 1994 dilution study which used the above effluent temperature. Using simple mixing, the temperature would increase by 0.01^{o}C, which is well below 0.3^{o}C and the maximum pH is already well below the criterion of 9.0 S.U.

The differential between the effluent and ambient temperature is always very small which results in a small amount of energy dissipated into the Columbia. It is not possible at this time to determine if the contribution from all point sources is greater than 1.1^{o}C as specifically stated in the water quality standards for this segment of the Columbia River. This analysis requires a TMDL. As stated earlier in this report, a TMDL is in progress that will attempt to determine temperature allocations for each existing source. Because the Columbia is an interstate waterway with federal hydropower facilities, the TMDL is being conducted by EPA. At this time, the loading from all municipal point sources appears to be very small compared to the solar heating in the reservoirs and some of the industrial sources. “The dams appear to be the major cause of warming of the temperature regimes of the rivers.” (EPA, 2001)

Under critical conditions there is no predicted violation of the Water Quality Standards for Surface Waters. Therefore, the technology-based effluent limitations for pH was placed in the permit and temperature was not limited.

<u>Fecal coliform</u>--The numbers of fecal coliform were modeled by simple mixing analysis using the technology-based limit of 400 organisms per 100 ml and a dilution factor of 45.

Under critical conditions there is no predicted violation of the Water Quality Standards for Surface Waters with the technology-based limit. Therefore, the technology-based effluent limitation for fecal coliform bacteria was placed in the proposed permit. With UV disinfection and proper maintenance, the Permittee should have no problem meeting the water quality criteria for fecal coliform.

<u>Toxic Pollutants</u>--Federal regulations (40 CFR 122.44) require NPDES permits to contain effluent limits for toxic chemicals in an effluent whenever there is a reasonable potential for those chemicals to exceed the surface water quality criteria. This process occurs concurrently with the derivation of technology-based effluent limits. Facilities with technology-based effluent limits defined in regulation are not exempted from meeting the Water Quality Standards for Surface Waters or from having surface water quality-based effluent limits.

The following toxics were determined to be present in the discharge: ammonia, and heavy metals. The Permittee also examined 78 priority pollutant chemicals that were required in the application and all were below detection. A reasonable potential analysis (See Appendix C, Table C2) was conducted on the ammonia and metals to determine whether or not effluent limitations would be required in this permit.

A winter critical condition and a summer critical condition were examined. The only parameter that appeared to have a reasonable potential for violating water quality standards was ammonia. The parameters used in the critical condition modeling are as follows: summer acute dilution factor 8 , summer chronic dilution factor 45, winter acute dilution factor 7, winter chronic dilution factor 24, receiving water hardness of 48.75, summer pH of 7.99, and winter pH of 8.46. The high pH appears to be a driving factor along with the high effluent ammonia detected over the last two years of operation. The 90th percentile ammonia concentration was 37 mg/L in the summer and 39.1 mg/L in the winter from 2002 through 2003. The reasonable potential analysis shows that ammonia is likely to violate water quality standards in both the summer and winter.

A permit limit was calculated for both summer and winter ammonia (See Appendix C, Table C4). These calculations show:

Ammonia limits

Season of limit	Average Monthly	Maximum Daily
Summer Limit (June – Sept)	20 mg/L	41 mg/L
Winter Limit (Oct – May)	7 mg/L	15 mg/L

Because the Camas facility has the ability to nitrify and denitrify to remove ammonia, it should have no trouble meeting these limits. Data from January 2001 through March of 2002 shows the facility is able to operate in such a manner as to remove ammonia.

Water quality criteria for metals in Chapter 173-201A WAC are based on the dissolved fraction of the metal.

The Permittee may provide data clearly demonstrating the seasonal partitioning of the dissolved metal in the ambient water in relation to an effluent discharge. Metals criteria may be adjusted on a site-specific basis when data is available clearly demonstrating the seasonal partitioning in the ambient water in relation to an effluent discharge.

Metals criteria may also be adjusted using the water effects ratio approach established by USEPA, as generally guided by the procedures in USEPA Water Quality Standards Handbook, December 1983, as supplemented or replaced.

Valid ambient background data and effluent data were available for arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc. Ambient data was not available on selenium, and thallium, therefore a background of zero was assumed. The lowest dilution factors of 7 for acute and 24 for chronic were used. Calculations using all applicable data resulted in a determination that there is no reasonable potential for the discharge of these metals to cause a violation of water quality standards. All other metals were assumed to be below detection. This determination assumes that the Permittee meets the other effluent limits of this permit.

WHOLE EFFLUENT TOXICITY

The Water Quality Standards for Surface Waters require that the effluent not cause toxic effects in the receiving waters. Many toxic pollutants cannot be detected by commonly available detection methods. However, toxicity can be measured directly by exposing living organisms to the wastewater in laboratory tests and measuring the response of the organisms. Toxicity tests measure the aggregate toxicity of the whole effluent, and therefore this approach is called whole effluent toxicity (WET) testing. Some WET tests measure acute toxicity and other WET tests measure chronic toxicity.

Acute toxicity tests measure mortality as the significant response to the toxicity of the effluent. Dischargers who monitor their wastewater with acute toxicity tests are providing an indication of the potential lethal effect of the effluent to organisms in the receiving environment.

Chronic toxicity tests measure various sub lethal toxic responses such as retarded growth or reduced reproduction. Chronic toxicity tests often involve either a complete life cycle test of an organism with an extremely short life cycle or a partial life cycle test on a critical stage of one of a test organism's life cycles. Organism survival is also measured in some chronic toxicity tests.

Accredited WET testing laboratories have the proper WET testing protocols, data requirements, and reporting format. Accredited laboratories are knowledgeable about WET testing and capable of calculating an NOEC, LC_{50}, EC_{50}, IC_{25}, etc. All accredited labs have been provided the most recent version of the Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* which is referenced in the permit. Any Permittee interested in receiving a copy of this publication may call the Department Publications Distribution Center (360) 407-7472 for a copy. The Department recommends that Permittees send a copy of the acute or chronic toxicity sections(s) of their permits to their laboratory of choice.

An effluent characterization for acute and chronic toxicity was conducted during the previous permit term. In accordance with WAC 173-205-060, the Permittee must repeat this effluent characterization for the following reason:

> The Permittee has made changes to processes, materials, or treatment that could result in an increase in effluent toxicity. In accordance with WAC 173-205-060(1), the proposed permit requires another effluent characterization for toxicity. The Permittee has also experienced an increase in industrial discharge and cannot demonstrate that the new source is nontoxic or that the pretreatment program and local limits are adequate to control toxicity from the new source. In accordance with WAC 173-205-060(1), the proposed permit requires another effluent characterization for toxicity.

HUMAN HEALTH

Washington's water quality standards now include 91 numeric health-based criteria that must be considered in NPDES permits. These criteria were promulgated for the state by the U.S. EPA in its National Toxics Rule (Federal Register, Volume 57, No. 246, Tuesday, December 22, 1992).

The Department has determined that the effluent is likely to have chemicals of concern for human health. The discharger's high priority status is based on its status as a major discharger.

A determination of the discharge's potential to cause an exceedance of the water quality standards was conducted as required by 40 CFR 122.44(d). The reasonable potential determination was evaluated with procedures given in the Technical Support Document for Water Quality-Based Toxics Control (EPA/505/2-90-001) and the Department's Permit Writer's Manual (Ecology Publication 92-109, July, 1994). The determination indicated that the discharge has no reasonable potential to cause a violation of water quality standards, thus an effluent limit is not warranted.

SEDIMENT QUALITY

The Department has promulgated aquatic sediment standards (Chapter 173-204 WAC) to protect aquatic biota and human health. These standards state that the Department may require Permittees to evaluate the potential for the discharge to cause a violation of applicable standards (WAC 173-204-400).

The Department has determined through a review of the discharger characteristics and effluent characteristics that this discharge has no reasonable potential to violate the Sediment Management Standards.

GROUND WATER QUALITY LIMITATIONS

The Department has promulgated Ground Water Quality Standards (Chapter 173-200 WAC) to protect uses of ground water. Permits issued by the Department shall be conditioned in such a manner so as not to allow violations of those standards (WAC 173-200-100).

This Permittee has no discharge to ground and therefore no limitations are required based on potential effects to ground water.

COMPARISON OF EFFLUENT LIMITS WITH THE EXISTING PERMIT ISSUED FEB 1999

Parameter	Existing Limits (Phase II)		Proposed Limits	
	Avg Monthly	**Avg Weekly**	**Avg Monthly**	**Avg Weekly**
BOD_5	30 mg/L	45 mg/L	20 mg/L	30 mg/L
	955 lb/day	1,432 lb/day	1,017 lb/day	1,525 lb/day
	83% removal		70% removal	
TSS	30 mg/L	45 mg/L	20 mg/L	30 mg/L
	1217 lb/day	1,825 lb/day	1,017 lb/day	1,525 lb/day
	81% removal		70% removal	
Fecal coliform bacteria	200/100 ml	400/100 ml	200/100 ml	400/100 ml
Ammonia	Optimize plan operation for nitrification and monitor		**Avg Monthly**	**Max Daily**
			20 mg/L (summer)	41 mg/L (summer)
			7 mg/L (winter)	15 mg/L (winter)
pH	Shall not be outside the range 6.0 to 9.0		Shall not be outside the range 6.0 to 9.0	

MONITORING REQUIREMENTS

Monitoring, recording, and reporting are required (WAC 173-220-210 and 40 CFR 122.41) to verify that the treatment process is functioning correctly and the effluent limitations are being achieved.

Monitoring for effluent temperature is being required to further characterize the effluent. This pollutant could have a significant impact on the quality of the surface water. The Permittee will again be required to test for metals which are recognized as priority pollutants during the last two years of the permit term. Four samples are to be collected using clean sampling methods. This sampling is necessary to assure that new industrial discharges do not contain priority pollutants and that the Camas WWTP can effectively treat the wastewater.

Monitoring of sludge quantity and quality is necessary to determine the appropriate uses of the sludge. Sludge monitoring is required by the current state and local solid waste management program and also by EPA under 40 CFR 503.

The monitoring schedule is detailed in the proposed permit under Condition S.2. Specified monitoring frequencies take into account the quantity and variability of discharge, the treatment method, past compliance, significance of pollutants, and cost of monitoring. The required monitoring frequency is consistent with agency guidance given in the current version of the Department's *Permit Writer's Manual* (July 1994) for an activated sludge plant of greater than 2.0 mgd.

LAB ACCREDITATION

With the exception of certain parameters the permit requires all monitoring data to be prepared by a laboratory registered or accredited under the provisions of Chapter 173-50 WAC, *Accreditation of Environmental Laboratories.* The laboratory at this facility is accredited for: Ammonia, Biological Oxygen Demand (BOD/CBOD), Dissolved Oxygen, pH, Solids-Total Suspended, and Microbiology—Fecal coliform (count).

OTHER PERMIT CONDITIONS

REPORTING AND RECORDKEEPING

The conditions of S3 are based on the authority to specify any appropriate reporting and recordkeeping requirements to prevent and control waste discharges (WAC 173-220-210).

PREVENTION OF FACILITY OVERLOADING

Overloading of the treatment plant is a violation of the terms and conditions of the permit. To prevent this from occurring, RCW 90.48.110 and WAC 173-220-150 require the Permittee to take the actions detailed in proposed permit requirement S.4 to plan expansions or modifications before existing capacity is reached and to report and correct conditions that could result in new or increased discharges of pollutants. Condition S.4 restricts the amount of flow.

OPERATION AND MAINTENANCE (O&M)

The proposed permit contains Condition S.5 as authorized under RCW 90.48.110, WAC 173-220-150, Chapter 173-230 WAC, and WAC 173-240-080. It is included to ensure proper operation and regular maintenance of equipment, and to ensure that adequate safeguards are taken so that constructed facilities are used to their optimum potential in terms of pollutant capture and treatment.

RESIDUAL SOLIDS HANDLING

To prevent water quality problems the Permittee is required in permit Condition S7 to store and handle all residual solids (grit, screenings, scum, sludge, and other solid waste) in accordance with the requirements of RCW 90.48.080 and State Water Quality Standards, WAC 173-201A, and Biosolids Handling regulations covered under WAC 173-308.

The final use and disposal of sewage sludge from this facility is regulated by U.S. EPA under 40 CFR 503, and by the Department under Chapter 70.95J RCW and Chapter 173-308 WAC. The disposal of other solid waste is under the jurisdiction of the local County Health Department.

PRETREATMENT

Federal and State Pretreatment Program Requirements

Under the terms of the addendum to the "Memorandum of Understanding between Washington Department of Ecology and the United States Environmental Protection Agency, Region 10" (1986), the Department has been delegated authority to administer the Pretreatment Program [i.e. act as the Approval Authority for oversight of delegated Publicly Owned Treatment Works (POTWs)]**.** Under this delegation of authority, the Department has exercised the option of issuing wastewater discharge permits for significant industrial users discharging to POTWs which have not been delegated authority to issue wastewater discharge permits.

There are a number of functions required by the Pretreatment Program which the Department is delegating to such POTWs because they are in a better position to implement the requirements (e.g. tracking the number and general nature of industrial dischargers to the sewerage system). The requirements for a Pretreatment Program are contained in Title 40, Part 403 of the Code of Federal Regulations. Under the requirements of the Pretreatment Program [40 CFR 403.8(f)(1)(iii)], the Department is required to approve, condition, or deny new discharges or a significant increase in the discharge for existing significant industrial users (SIUs) [40 CFR 403.8 (f)(1)(i)].

The Department is responsible for issuing State Waste Discharge Permits to SIUs and other industrial users of the Permittee's sewer system. Industrial dischargers must obtain these permits from the Department prior to the Permittee accepting the discharge [WAC 173-216-110(5)] (Industries discharging wastewater that is similar in character to domestic wastewater are not required to obtain a permit. Such dischargers should contact the Department to determine if a permit is required.). Industrial dischargers need to apply for a State Waste Discharge Permit 60 days prior to commencing discharge. The conditions contained in the permits will include any applicable conditions for categorical discharges, loading limitations included in contracts with the POTW, and other conditions necessary to assure compliance with state water quality standards and biosolids standards.

The Department requires this POTW to fulfill some of the functions required for the Pretreatment Program in the NPDES permit (e.g. tracking the number and general nature of industrial dischargers to the sewage system). The POTW's NPDES permit will require that all SIUs currently discharging to the POTW be identified and notified of the requirement to apply for a wastewater discharge permit from the Department. None of the obligations imposed on the POTW relieve an industrial or commercial discharger of its primary responsibility for obtaining a wastewater discharge permit (if required), including submittal of engineering reports prior to construction or modification of facilities [40 CFR 403.12(j) and WAC 173-216-070 and WAC 173-240-110, et seq.].

Wastewater Permit Required

RCW 90.48 and WAC 173-216-040 require SIUs to obtain a permit prior to discharge of industrial waste to the Permittee's sewerage system. This provision prohibits the POTW from accepting industrial wastewater from any such dischargers without authorization from the Department.

Requirements for Routine Identification and Reporting of Industrial Users

The NPDES permit requires non-delegated POTWs to “take continuous, routine measures to identify all existing, new, and proposed SIUs and potential significant industrial users (PSIUs) discharging to the Permittee's sewerage system.” Examples of such routine measures include regular review of business tax licenses for existing businesses and review of water billing records and existing connection authorization records. System maintenance personnel can also be diligent during performance of their jobs in identifying and reporting as-yet unidentified industrial dischargers. Local newspapers, telephone directories, and word-of-mouth can also be important sources of information regarding new or existing discharges. The POTW is required to notify an industrial discharger, in writing, of their responsibilities regarding application for a state waste discharge permit and to send a copy of the written notification to the Department. The Department will then take steps to solicit a state waste discharge permit application.

Requirements for Performing an Industrial User Survey

This POTW has the potential to serve significant industrial or commercial users and is required to perform an Industrial User Survey. The goal of this survey is to develop a list of SIUs and PSIUs, and of equal importance, to provide sufficient information about industries which discharge to the POTW, to determine which of them require issuance of state waste discharge permits or other regulatory controls.

An Industrial User Survey is an important part of the regulatory process used to prevent interference with treatment processes at the POTW and to prevent the exceedance of water quality standards. The Industrial User Survey also can be used to contribute to the maintenance of sludge quality, so that sludge can be a useful biosolids product rather than an expensive waste problem. An Industrial User Survey is a rigorous method for identifying existing, new, and proposed significant industrial users and potential significant industrial users. A complete listing of methodologies is available in the Department guidance document entitled "Conducting an Industrial User Survey."

Duty to Enforce Discharge Prohibitions

This provision prohibits the POTW from authorizing or permitting an industrial discharger to discharge certain types of waste into the sanitary sewer. The first portion of the provision prohibits acceptance of pollutants which cause pass through or interference. The definitions of pass through and interference are in Appendix B of the fact sheet.

The second portion of this provision prohibits the POTW from accepting certain specific types of wastes, namely those which are explosive, flammable, excessively acidic, basic, otherwise corrosive, or obstructive to the system. In addition wastes with excessive BOD, petroleum based oils, or which result in toxic gases are prohibited to be discharged. The regulatory basis for these prohibitions is 40 CFR Part 403, with the exception of the pH provisions which are based on WAC 173-216-060.

The third portion of this provision prohibits certain types of discharges unless the POTW receives prior authorization from the Department. The discharges include cooling water in significant volumes, stormwater and other direct inflow sources, and wastewaters significantly affecting system hydraulic loading, which do not require treatment.

Support by the Department for Developing Partial Pretreatment Program by POTW

The Department has committed to providing technical and legal assistance to the Permittee in fulfilling these joint obligations, in particular assistance with developing an adequate sewer use ordinance, notification procedures, enforcement guidelines, and developing local limits and inspection procedures.

OUTFALL EVALUATION

Proposed permit Condition S.10 requires the Permittee to conduct an outfall inspection and submit a report detailing the findings of that inspection. The purpose of the inspection is to determine the condition of the discharge pipe and diffusers and to determine if sediment is accumulating in the vicinity of the outfall.

GENERAL CONDITIONS

General Conditions are based directly on state and federal law and regulations and have been standardized for all individual municipal NPDES permits issued by the Department.

PERMIT ISSUANCE PROCEDURES

PERMIT MODIFICATIONS

The Department may modify this permit to impose numerical limitations, if necessary to meet Water Quality Standards, Sediment Quality Standards, or Ground Water Standards, based on new information obtained from sources such as inspections, effluent monitoring, outfall studies, and effluent mixing studies.

The Department may also modify this permit as a result of new or amended state or federal regulations.

RECOMMENDATION FOR PERMIT ISSUANCE

This proposed permit meets all statutory requirements for authorizing a wastewater discharge, including those limitations and conditions believed necessary to protect human health, aquatic life, and the beneficial uses of waters of the State of Washington. The Department proposes that this permit be issued for five years.

REFERENCES FOR TEXT AND APPENDICES

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2001. Columbia/Snake River Temperature TMDL Problem Assessment. USEPA Region 10, Seattle, Washington.

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1985. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water. EPA/600/6-85/002a.

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Gray and Osborne, Inc.

1997. City of Camas Wastewater Facility Plan. G&O No. 95723. Seattle, Washington

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Tsivoglou, E.C., and J.R. Wallace.

1972. Characterization of Stream Reaeration Capacity. EPA-R3-72-012. (Cited in EPA 1985 op.cit.)

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Laws and Regulations(http://www.ecy.wa.gov/laws-rules/index.html)

2003, March. Paul Pickett, Mike Herold. Department of Ecology. Personal communication regarding the Columbia River temperature TMDL.

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Water Pollution Control Federation.

1976. Chlorination of Wastewater.

Wright, R.M., and A.J. McDonnell.

1979. In-stream Deoxygenation Rate Prediction. Journal Environmental Engineering Division, ASCE. 105(EE2). (Cited in EPA 1985 op.cit.)

APPENDIX A--PUBLIC INVOLVEMENT INFORMATION

The Department has tentatively determined to reissue a permit to the applicant listed on page 1 of this fact sheet. The permit contains conditions and effluent limitations which are described in the rest of this fact sheet.

Public notice of application was published on May 4, 2004, in the *Camas-Washougal Post* to inform the public that an application had been submitted and to invite comment on the reissuance of this permit.

The Department will publish a Public Notice of Draft (PNOD) on August 17, 2004, in the *Camas-Washougal Post* to inform the public that a draft permit and fact sheet are available for review. Interested persons are invited to submit written comments regarding the draft permit. The draft permit, fact sheet, and related documents are available for inspection and copying between the hours of 8:00 a.m. and 5:00 p.m. weekdays, by appointment, at the regional office listed below. Written comments should be mailed to:

Carey Cholski
Water Quality Permit Administrator
Department of Ecology
Southwest Regional Office
P.O. Box 47775
Olympia, WA 98504-7775

Any interested party may comment on the draft permit or request a public hearing on this draft permit within the 30-day comment period to the address above. The request for a hearing shall indicate the interest of the party and the reasons why the hearing is warranted. The Department will hold a hearing if it determines there is a significant public interest in the draft permit (WAC 173-220-090). Public notice regarding any hearing will be circulated at least 30 days in advance of the hearing. People expressing an interest in this permit will be mailed an individual notice of hearing (WAC 173-220-100).

Comments should reference specific text followed by proposed modification or concern when possible. Comments may address technical issues, accuracy and completeness of information, the scope of the facility's proposed coverage, adequacy of environmental protection, permit conditions, or any other concern that would result from issuance of this permit.

The Department will consider all comments received within 30 days from the date of public notice of draft indicated above, in formulating a final determination to issue, revise, or deny the permit. The Department's response to all significant comments is available upon request and will be mailed directly to people expressing an interest in this permit.

Further information may be obtained from the Department by telephone, (360) 407-6554, or by writing to the address listed above.

This permit and fact sheet were written by Eric Schlorff.

APPENDIX B--GLOSSARY

Acute Toxicity--The lethal effect of a pollutant on an organism that occurs within a short period of time, usually 48 to 96 hours.

AKART-- An acronym for "all known, available, and reasonable methods of prevention, control, and treatment".

Ambient Water Quality--The existing environmental condition of the water in a receiving water body.

Ammonia--Ammonia is produced by the breakdown of nitrogenous materials in wastewater. Ammonia is toxic to aquatic organisms, exerts an oxygen demand, and contributes to eutrophication. It also increases the amount of chlorine needed to disinfect wastewater.

Average Monthly Discharge Limitation --The highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month (except in the case of fecal coliform). The daily discharge is calculated as the average measurement of the pollutant over the day.

Average Weekly Discharge Limitation -- The highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week. The daily discharge is calculated as the average measurement of the pollutant over the day.

Best Management Practices (BMPs)--Schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the State. BMPs include treatment systems, operating procedures, and practices to control: plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs may be further categorized as operational, source control, erosion and sediment control, and treatment BMPs.

BOD_5--Determining the Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of organic material present in an effluent that is utilized by bacteria. The BOD_5 is used in modeling to measure the reduction of dissolved oxygen in a receiving water after effluent is discharged. Stress caused by reduced dissolved oxygen levels makes organisms less competitive and less able to sustain their species in the aquatic environment. Although BOD is not a specific compound, it is defined as a conventional pollutant under the federal Clean Water Act.

Bypass--The intentional diversion of waste streams from any portion of a treatment facility.

CBOD5 – The quantity of oxygen utilized by a mixed population of microorganisms acting on the nutrients in the sample in an aerobic oxidation for five days at a controlled temperature of 20 degrees Celsius, with an inhibitory agent added to prevent the oxidation of nitrogen compounds. The method for determining CBOD5 is given in 40 CFR Part 136.

Chlorine--Chlorine is used to disinfect wastewaters of pathogens harmful to human health. It is also extremely toxic to aquatic life.

Chronic Toxicity--The effect of a pollutant on an organism over a relatively long time, often 1/10 of an organism's lifespan or more. Chronic toxicity can measure survival, reproduction or growth rates, or other parameters to measure the toxic effects of a compound or combination of compounds.

Clean Water Act (CWA)--The Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, 97-117; USC 1251 et seq.

Combined Sewer Overflow (CSO)--The event during which excess combined sewage flow caused by inflow is discharged from a combined sewer, rather than conveyed to the sewage treatment plant because either the capacity of the treatment plant or the combined sewer is exceeded.

Compliance Inspection - Without Sampling--A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations.

Compliance Inspection - With Sampling--A site visit to accomplish the purpose of a Compliance Inspection - Without Sampling and as a minimum, sampling and analysis for all parameters with limits in the permit to ascertain compliance with those limits; and, for municipal facilities, sampling of influent to ascertain compliance with the percent removal requirement. Additional sampling may be conducted.

Composite Sample--A mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing a minimum of four discrete samples. May be "time-composite"(collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increased while maintaining a constant time interval between the aliquots).

Construction Activity--Clearing, grading, excavation and any other activity which disturbs the surface of the land. Such activities may include road building, construction of residential houses, office buildings, or industrial buildings, and demolition activity.

Continuous Monitoring –Uninterrupted, unless otherwise noted in the permit.

Critical Condition--The time during which the combination of receiving water and waste discharge conditions have the highest potential for causing toxicity in the receiving water environment. This situation usually occurs when the flow within a water body is low, thus, its ability to dilute effluent is reduced.

Dilution Factor--A measure of the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. Expressed as the inverse of the effluent fraction e.g., a dilution factor of 10 means the effluent comprises 10% by volume and the receiving water 90%.

Engineering Report--A document which thoroughly examines the engineering and administrative aspects of a particular domestic or industrial wastewater facility. The report shall contain the appropriate information required in WAC 173-240-060 or 173-240-130.

Fecal Coliform Bacteria--Fecal coliform bacteria are used as indicators of pathogenic bacteria in the effluent that are harmful to humans. Pathogenic bacteria in wastewater discharges are controlled by disinfecting the wastewater. The presence of high numbers of fecal coliform bacteria in a water body can indicate the recent release of untreated wastewater and/or the presence of animal feces.

Grab Sample--A single sample or measurement taken at a specific time or over as short period of time as is feasible.

Industrial User-- A discharger of wastewater to the sanitary sewer which is not sanitary wastewater or is not equivalent to sanitary wastewater in character.

Industrial Wastewater--Water or liquid-carried waste from industrial or commercial processes, as distinct from domestic wastewater. These wastes may result from any process or activity of industry, manufacture, trade or business, from the development of any natural resource, or from animal operations such as feed lots, poultry houses, or dairies. The term includes contaminated storm water and, also, leachate from solid waste facilities.

Infiltration and Inflow (I/I)--"Infiltration" means the addition of ground water into a sewer through joints, the sewer pipe material, cracks, and other defects. "Inflow" means the addition of precipitation-caused drainage from roof drains, yard drains, basement drains, street catch basins, etc., into a sewer.

Interference -- A discharge which, alone or in conjunction with a discharge or discharges from other sources, both:

Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal and;

Therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued there under (or more stringent State or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including State regulations contained in any State sludge management plan prepared pursuant to subtitle D of the SWDA), sludge regulations appearing in 40 CFR Part 507, the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act.

Major Facility--A facility discharging to surface water with an EPA rating score of > 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Maximum Daily Discharge Limitation--The highest allowable daily discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. The daily discharge is calculated as the average measurement of the pollutant over the day.

Method Detection Level (MDL)--The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is above zero and is determined from analysis of a sample in a given matrix containing the analyte.

Minor Facility--A facility discharging to surface water with an EPA rating score of < 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Mixing Zone--A volume that surrounds an effluent discharge within which water quality criteria may be exceeded. The area of the authorized mixing zone is specified in a facility's permit and follows procedures outlined in State regulations (Chapter 173-201A WAC).

National Pollutant Discharge Elimination System (NPDES)--The NPDES (Section 402 of the Clean Water Act) is the Federal wastewater permitting system for discharges to navigable waters of the United States. Many states, including the State of Washington, have been delegated the authority to issue these permits. NPDES permits issued by Washington State permit writers are joint NPDES/State permits issued under both State and Federal laws.

Pass through -- A discharge which exits the POTW into waters of the–State in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation), or which is a cause of a violation of State water quality standards.

pH--The pH of a liquid measures its acidity or alkalinity. A pH of 7 is defined as neutral, and large variations above or below this value are considered harmful to most aquatic life.

Potential Significant Industrial User--A potential significant industrial user is defined as an Industrial User which does not meet the criteria for a Significant Industrial User, but which discharges wastewater meeting one or more of the following criteria:

a. Exceeds 0.5 % of treatment plant design capacity criteria and discharges <25,000 gallons per day or;

b. Is a member of a group of similar industrial users which, taken together, have the potential to cause pass through or interference at the POTW (e.g. facilities which develop photographic film or paper, and car washes).

The Department may determine that a discharger initially classified as a potential significant industrial user should be managed as a significant industrial user.

Quantitation Level (QL)-- A calculated value five times the MDL (method detection level).

Significant Industrial User (SIU)--

1) All industrial users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N and;

2) Any other industrial user that: discharges an average of 25,000 gallons per day or more of process wastewater to the POTW (excluding sanitary, noncontact cooling, and boiler blow-down wastewater); contributes a process wastestream that makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the Control Authority* on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement (in accordance with 40 CFR 403.8(f)(6)).

Upon finding that the industrial user meeting the criteria in paragraph 2, above, has no reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement, the Control Authority* may at any time, on its own initiative or in response to a petition received from an industrial user or POTW, and in accordance with 40 CFR 403.8(f)(6), determine that such industrial user is not a significant industrial user.

*The term "Control Authority" refers to the Washington State Department of Ecology in the case of non-delegated POTWs or to the POTW in the case of delegated POTWs.

State Waters--Lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, wetlands, and all other surface waters and watercourses within the jurisdiction of the state of Washington.

Stormwater--That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a storm water drainage system into a defined surface water body, or a constructed infiltration facility.

Technology-based Effluent Limit--A permit limit that is based on the ability of a treatment method to reduce the pollutant.

Total Suspended Solids (TSS)--Total suspended solids are the particulate materials in an effluent. Large quantities of TSS discharged to a receiving water may result in solids accumulation. Apart from any toxic effects attributable to substances leached out by water, suspended solids may kill fish, shellfish, and other aquatic organisms by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids can screen out light and can promote and maintain the development of noxious conditions through oxygen depletion.

Upset--An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventative maintenance, or careless or improper operation.

Water Quality-based Effluent Limit--A limit on the concentration or mass of an effluent parameter that is intended to prevent the concentration of that parameter from exceeding its water quality criterion after it is discharged into a receiving water.

APPENDIX C--TECHNICAL CALCULATIONS

Several of the Excel® spreadsheet tools used to evaluate a discharger's ability to meet Washington State water quality standards can be found on the Department's homepage at (http://www.ecy.wa.gov/programs/wq/wastewater/index.html

Table C1

Calculation Of Ammonia Concentration and Criteria for fresh water. Based on EPA Quality Criteria for Water (EPA 400/5-86-001) and WAC 173-201A. Revised 1-5-94 (corrected total ammonia criterion). Revised 3/10/95 to calculate chronic criteria in accordance with EPA Memorandum from Heber to WQ Stds Coordinators dated July 30, 1992.

Summer (June - Sept) based on temperature from USGS gages at Washougal 2000-2003. The pH is based on 1994 data from USGS combined with 2002 data from Ecology EAP (7 data points).

INPUT
1. Ambient Temperature (deg C; 0<T<30)
2. Ambient pH (6.5<pH<9.0)
3. Acute TCAP (Salmonids present- 20; absent- 25)
4. Chronic TCAP (Salmonids present- 15; absent- 20)

OUTPUT
1. Intermediate Calculations:
   - Acute FT
   - Chronic FT
   - FPH
   - RATIO
   - pKa
   - Fraction Of Total Ammonia Present As Un-ionized

2. Un-ionized Ammonia Criteria
   Acute (1-hour) Un-ionized Ammonia Criterion (ug NH3/L)
   Chronic (4-day) Un-ionized Ammonia Criterion (ug NH3/L)

3. Total Ammonia Criteria:
   Acute Total Ammonia Criterion (mg NH3+ NH4/L)
   Chronic Total Ammonia Criterion (mg NH3+ NH4/L)

4. Total Ammonia Criteria expressed as Nitrogen:
   Acute Ammonia Criterion as mg N
   Chronic Ammonia Criterion as N

Calculation Of Ammonia Concentration and Criteria for fresh water. Based on EPA Quality Criteria for Water (EPA 400/5-86-001) and WAC 173-201A. Revised 1-5-94 (corrected total ammonia criterion). Revised 3/10/95 to calculate chronic criteria in accordance with EPA Memorandum from Heber to WQ Stds Coordinators dated July 30, 1992.

Winter (October - May) based on temperature from USGS gages at Warrendale 2000-2003 (winter data not available at Washougal). The pH is based on 1994 data from USGS combined with 2002 data from Ecology EAP (14 data points).

INPUT
1. Ambient Temperature (deg C; 0<T<30)
2. Ambient pH (6.5<pH<9.0)
3. Acute TCAP (Salmonids present- 20; absent- 25)
4. Chronic TCAP (Salmonids present- 15; absent- 20)

OUTPUT
1. Intermediate Calculations:
    Acute FT
    Chronic FT
    FPH
    RATIO
    pKa
    Fraction Of Total Ammonia Present As Un-ionized

2. Un-ionized Ammonia Criteria
   Acute (1-hour) Un-ionized Ammonia Criterion (ug NH3/L)
   Chronic (4-day) Un-ionized Ammonia Criterion (ug NH3/L)

3. Total Ammonia Criteria:
   Acute Total Ammonia Criterion (mg NH3+ NH4/L)
   Chronic Total Ammonia Criterion (mg NH3+ NH4/L)

4. Total Ammonia Criteria expressed as Nitrogen:
   Acute Ammonia Criterion as mg N
   Chronic Ammonia Criterion as N

Table C2: Reasonable Potential Calculation for Ammonia and Metals								
				State Water Quality Standard		Max concentration at edge of...		
	Metal Criteria Translator as decimal	Metal Criteria Translator as decimal	Ambient Concentration (metals as dissolved)	Acute	Chronic	Acute Mixing Zone	Chronic Mixing Zone	**LIMIT REQ'D?**
Parameter	Acute	Chronic	*ug/L*	*ug/L*	*ug/L*	*ug/L*	*ug/L*	
Ammonia (Summer Dry)	1.00	1.00	27.0000	5370.61	976.98	5370.61	917.60	YES
Ammonia (Winter Wet	1.00	1.00	19.0000	5407.31	1590.59	7562.64	1733.46	YES
Arsenic	1.00	1.00	1.1200	1.96	1.36	2.29	1.39	NO
Cadmium	0.94	0.94	0.5250	0.52	0.52	0.52	0.52	NO
Chromium	0.32	0.86	0.4150	1.44	1.26	1.85	1.34	NO
Copper	1.00	1.00	0.8600	3.68	1.68	4.81	1.76	NO
Lead	0.47	0.47	0.0600	0.26	0.12	0.34	0.12	NO
Nickel	1.00	1.00	0.5550	2.95	1.25	3.90	1.31	NO
Silver	0.85	NA	0.1000	0.27	NA	0.34	NA	NO
Zinc	1.00	1.00	2.0000	13.85	5.46	18.60	5.77	NO

		INPUTS FOR ABOVE REASONABLE POTENTIAL							
	Effluent percentile value		Max effluent conc. measured (metals as total recoverable)	Coeff Variation		# of samples	Multiplier	Acute Dil'n Factor	Chronic Dil'n Factor
Parameter		*Pn*	*ug/L*	*CV*	*s*	*n*			
Ammonia (Summer Dry)	0.95	0.913	36540.00	0.60	0.55	33	1.17	8	45
Ammonia (Winter Wet	0.95	0.956	39100.00	0.60	0.55	67	0.97	7	24
Arsenic	0.95	0.473	2.70	0.60	0.55	4	2.59	7	24
Cadmium	0.95	0.473	0.20	0.60	0.55	4	2.59	7	24
Chromium	0.95	0.473	9.30	0.60	0.55	4	2.59	7	24
Copper	0.95	0.473	8.00	0.60	0.55	4	2.59	7	24
Lead	0.95	0.473	1.20	0.60	0.55	4	2.59	7	24
Nickel	0.95	0.473	6.70	0.60	0.55	4	2.59	7	24
Silver	0.95	0.473	0.60	0.60	0.55	4	2.59	7	24
Zinc	0.95	0.473	33.00	0.60	0.55	4	2.59	7	24

Table C3

Dissolved oxygen concentration following initial dilution.

References: EPA/600/6-85/002b and EPA/430/9-82-011

Based on Lotus File IDOD2.WK1 Revised 19-Oct-93

INPUT	
1. Dilution Factor at Mixing Zone Boundary:	24
2. Ambient Dissolved Oxygen Concentration (mg/L):	8.9
3. Effluent Dissolved Oxygen Concentration (mg/L):	2
4. Effluent Immediate Dissolved Oxygen Demand (mg/L):	0
OUTPUT	
Dissolved Oxygen at Mixing Zone Boundary (mg/L):	8.61

Table C4: Ammonia Limits Calculation

Permit Limit Calculation Summary

PARAMETER	Acute Dil'n Factor	Chronic Dil'n Factor	Metal Criteria Translator Acute	Metal Criteria Translator Chronic	Ambient Concentration *ug/L*	Water Quality Standard Acute *ug/L*	Water Quality Standard Chronic *ug/L*	Average Monthly Limit (AML) ug/L	Maximum Daily Limit (MDL) ug/L
Ammonia (summer dry)	8.0	45.00	1.00	1.00	27.0000	5100.0000	830.0000	**20242.9**	**40611.0**
Ammonia (winter wet)	7.00	24.00	1.00	1.00	19.00	2100.00	470.00	**7270.5**	**14586.0**

Waste Load Allocation (WLA) and Long Term Average (LTA) Calculations

Statistical variables for permit limit calculation

WLA Acute *ug/L*	WLA Chronic *ug/L*	LTA Acute *ug/L*	LTA Chronic *ug/L*	LTA Coeff. Var. (CV) *decimal*	LTA Prob'y Basis *decimal*	Limiting LTA *ug/L*	Coeff. Var. (CV) *decimal*	AML Prob'y Basis *decimal*	MDL Prob'y Basis *decimal*	# of Samples per Month *n*	
40611	36162.00	13039.5	19073.0	0.60	0.99	13039.5	0.60	0.95	0.99	4.00	1.00
14586	10843.00	4683.3	5719.0	0.60	0.99	4683.3	0.60	0.95	0.99	4.00	1.00

Table C5

Calculation of pH of a mixture of two flows.

Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

Based on Lotus File PHMIX2.WK1 Revised 19-Oct-93

INPUT	
1. DILUTION FACTOR AT MIXING ZONE BOUNDARY	45.000
1. UPSTREAM/BACKGROUND CHARACTERISTICS	
Temperature (deg C):	21.43
pH:	7.99
Alkalinity (mg CaCO3/L):	53.00
2. EFFLUENT CHARACTERISTICS	
Temperature (deg C):	22.00
pH:	7.64
Alkalinity (mg CaCO3/L):	150.00
OUTPUT	
1. IONIZATION CONSTANTS	
Upstream/Background pKa:	6.37
Effluent pKa:	6.37
2. IONIZATION FRACTIONS	
Upstream/Background Ionization Fraction:	0.98
Effluent Ionization Fraction:	0.95
3. TOTAL INORGANIC CARBON	
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	54.28
Effluent Total Inorganic Carbon (mg CaCO3/L):	158.03
4. CONDITIONS AT MIXING ZONE BOUNDARY	
Temperature (deg C):	21.44
Alkalinity (mg CaCO3/L):	55.16
Total Inorganic Carbon (mg CaCO3/L):	56.58
pKa:	6.37
pH at Mixing Zone Boundary:	7.96

Table C6: PREDICTED DILUTIONS FOR THE CITY OF CAMAS

Model Run	**Ambient Conditions**				**Effluent Conditions**						**Final Centerline Dilution**	
New 2004	**River Discharge Rate (cfs)**	**Discharge Depth ft (m)**	**Current Speed (m/s)**	**Amb. Temp (deg C)**	**Flow Rate (mgd) Chron Dry**	**Acut Dry**	**Chron Wet**	**Acut Wet**	**Max (2015)**	**Eff. Temp (deg C)**	**Acute Dilution (32 feet)**	**Chronic Dilution (321 feet)**
NC1	81,400	21.0 (6.4)	0.26	21.48	1.55					22.0		**45**
NC2						**2.195**					**8**	
NC8	192,200	26.6 (8.1)	0.58	15.13			2.98			10.0		60
NC9								5.632			9	
NC10									7.8		10	43
NC13				4.6			2.98			10.0		33
NC14								5.632			8	
NC15									7.8		10	49
NC18				**12.6**			2.98			16.0		44
NC19								5.632			9	
NC20									7.8		10	38
NC22B	522,000	40.9 (12.5)	0.99	12.6			2.5			16.0		**24**
NC24								5.632			**7**	
NC25									7.8		8	37

TABLE C7: MODEL RUNS NOT RELEVANT

Model Run	**Ambient Conditions**				**Effluent Conditions**						**Final Centerline Dilution**	
New 2004	**River Discharge Rate (cfs)**	**Discharge Depth ft (m)**	**Current Speed (m/s)**	**Amb. Temp (deg C)**	**Flow Rate (mgd) Chron Dry**	**Acut Dry**	**ChronWet**	**Acut Wet**	**Max (2015)**	**Eff. Temp (deg C)**	**Acute Dilution (32 feet)**	**Chronic Dilution (321 feet)**
NC2A	81,400	21.0 (6.4)	0.26	21.48		**2.195**				22.0	5	
NC3							2.98					49
NC4								5.632			11	
NC5									7.8		12	39
NC6	192,200	26.6 (8.1)	0.58	15.13	1.55					10.0		63
NC7						**2.195**					5	
NC11				4.6	1.55					10.0		18
NC12						2.195					5	
NC13A							2.98					18
NC16				**12.6**	1.55					16.0		59
NC17						2.195					5	
NC21	522,000	40.9 (12.5)	0.99	12.6	1.55					16.0		27
NC22						2.195					1.7	
NC22A						2.195					3.8	
NC23							2.98					24
NC24A								5.632			3	

NC2A, NC13A, NC22A and NC24A were model runs with all 16 diffuser ports open. All other runs have only 8 ports open.

MODEL RUNS NOT USED FOR CAMAS

The following model runs were not found to be relevant because of a variety of reasons (see table C7). Model runs NC2A, NC13A, NC22A, and NC24A were model runs with all 16 diffuser ports open. The diffuser currently has only half of the diffuser ports open. All runs in table C6 above have only 8 ports open. During the summer low river flows, only the low effluent flows of 1.55 and 2.195 were kept in table C6 of the predicted dilution factors as required in the Department dilution guidance. The model runs shown in table C7 representing higher effluent flows were determined unlikely to occur during the summer low flows. Likewise, the model runs that represented low effluent flows were unlikely to occur during the winter and spring months when the ambient river flows were higher. Therefore, only the flows at 2.98, 5.632, and 7.8 mgd were kept in table C6. Model Run NC22B shown in table C6 represents the effluent flow expected in the spring (February – May) run-off period and is based on the maximum day flow for that period. Therefore the model run using 2.195 mgd was not displayed in table C6.

CONSIDERATIONS FOR DILUTION MODELING

The dilution ratios were recalculated due to changes in the guidance for dilution modeling that the Department of Ecology uses. When the modeling was last conducted in 1994, Ecology allowed flux average dilution for chronic boundary dilution. Ecology uses centerline dilution for both the acute and chronic boundaries in unidirectional waters. The original current velocity analysis conducted for the 1994 CH2M Hill report shows unidirectional flow. A dilution study conducted for the City of Vancouver also showed unidirectional water. The 1994 analysis for Camas used the UDKHDEN model. UDKHDEN was used for the Salmon Creek POTW discharge downstream of Camas and the model was found to slightly over predict dilution compared to the UM3 model based on a dye study and dilution modeling. The UDKHDEN model appears to do a better job of predicting the dilution factor when there are a lot of obstructions such as boulder and pilings in the river. Therefore the UM3 model was run in March 2004 using visual plumes. A port contraction coefficient of 0.61 was used because the ports were considered to be sharp edged. The results are shown in the above tables C6 and C7.

Following public comments in September2004, the dilution models were reexamined and a couple of errors were found. These errors were limited to an incorrect port spacing and port depth used in the following runs: NC1, NC2, NC8, NC9, NC19, NC20, NC22B, NC24, and NC25. These errors were not in the ambient or effluent conditions shown in table C6 but rather in not using these same conditions through out the model runs. These model runs were rerun and resulted in one or two points in each dilution factor. In a couple of cases the dilution went down when the port depth should have been in shallower water.

How the mixing zone model inputs were derived

Ambient Flow

The 1994 analysis of river discharge rate, discharge depth, and current speed (velocity) for Camas in 1994 appeared to be reasonable and should not have changed over time. The first discharge rate of 81,400 cfs is the 7Q10 flow and represents the dry season flow. The discharge depth of 21.0 feet (6.4 m) is the calculated depth at that flow. The current speed of 0.26 m/s was determined from drift card observations and is shown in the 1994 report. The median flow of 0.58 m/s and the winter maximum flow of 0.99 m/s were also taken from the 1994 report.

Ambient Temperature

The 21.48º C summer water temperature (June-September) represents a recalculation using Summer temperatures from July through October from the Army Corps of Engineers (ACOE) and USGS dissolved gas data base for Washougal. This temperature data may be found at: http://oregon.usgs.gov/projs_dir/pn307.tdg.

The summer maximum temperature of 21.48º C is based on a 90th percentile of daily maximums and used 453 data points from 2000-2003. All of the ambient temperature data was recalculated using ACOE/USGS data rather than use the 1994 data. Winter temperature data is not available at the Washougal station; therefore, data from the Warrendale station were used instead. This appears to be the only temperature station operating in this section of the river during the winter months. The 15.13ºC is a winter maximum which was determined using a 90th percentile of daily maximums from October through May for 2000 through 2003 and represents 728 data points. The yearly average of 12.6ºC was determined as a mean of daily means for all temperatures from October 2000 through September 2003 and represents 1,125 data points. The winter low of 4.6ºC was determined as 5th percentile of daily minimums from October through May for 2000 through 2003.

Effluent Flows

The effluent flows were recalculated because conditions at the plant have changed (plant upgraded in 2000) and the flows could be determined from discharge monitoring records (DMRs). The Department guidance requires that the flow-rate to use depends on how close to design capacity the plant is presently operating. The facility is operating at less than 85 percent of design flow; therefore, the flow-rate we used for the acute boundary is the highest daily maximum plant effluent flow for the past three years during the season in which the critical condition is likely to occur. The summer critical season was based on the daily maximum flow for June to September of 2000 to 2003 which was 2.195 mgd. The winter maximum flow for October through May of 2000 to 2003 was 5.632 mgd.

The POTW flow rate corresponding to the calculation of the chronic mixing zone ratio is: the highest monthly average plant flow for the past three years during the season in which the critical condition is likely to occur. During the summer the maximum average monthly flow would be 1.55 mgd. The winter maximum average monthly flow was 2.98 mgd which was used for the 1994 study. We also included the maximum projected flow the plant was designed to handle by 2015 which was 7.8 mgd. This maximum projected flow of 7.8 mgd was also used in the new analysis. Because this 7.8 mgd is a maximum flow expected only during winter months, model runs using this flow were eliminated from the summer acute and chronic results shown in table C6 above.

Effluent Temperature

The effluent temperatures were borrowed from the 1994 study because temperature has not been monitored regularly at the upgraded plant and the original values appear reasonable. These values include: 22.0ºC for the summer maximum, 10.0ºC for the winter minimum, and 16.0ºC for the average temperature.

Dilution Ratios Based on Updated Modeling Results:

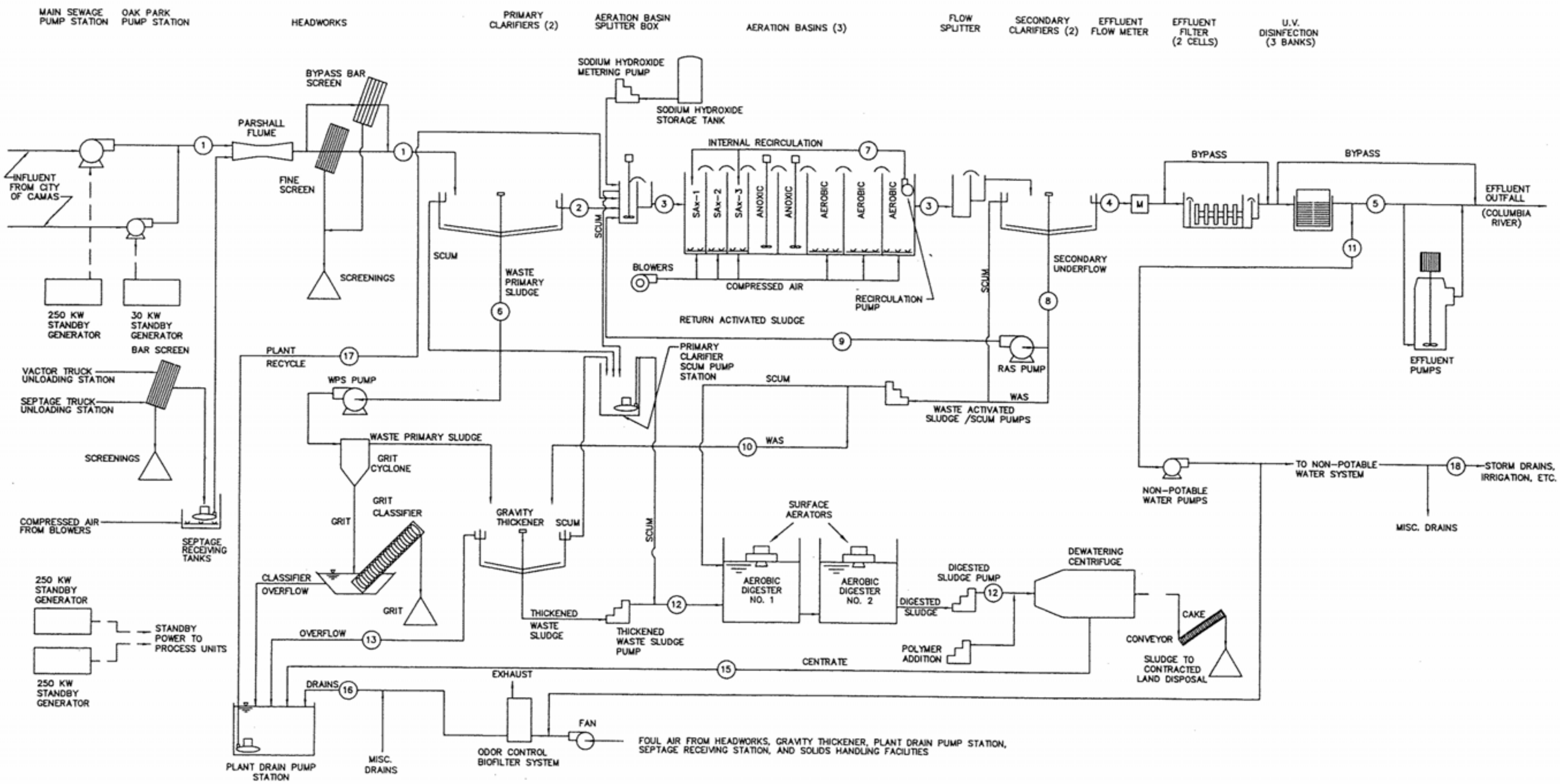
The dilution values are derived using the best modeling tool currently available together with updated values for effluent conditions as described in the preceding paragraphs. These values are:

Condition	Dilution Factor	POTW flow (mgd)	River Flow (cfs)	River Velocity (m/s)	Number of Ports open
Summer acute	8	2.195	81,400	0.26	8
Summer chronic	45	1.55	81,400	0.26	8
Winter acute	7	5.632	522,000	0.99	8
Winter chronic	24	2.5	522,000	0.99	8

During the critical summer condition, the river was at the 7Q10 flow and effluent flows were reasonably low at the max monthly average flow of 1.55 mgd and the max daily flow of 2.195 mgd for the summer for a dilution value of 8:1. The lowest chronic value observed in the model runs for the summer season was 45:1.

The lowest acute dilution factor occurring during the winter season was 7:1. This value occurred when the ambient flow was highest and when plant flow was matched with the winter maximum daily flow of 5.632 mgd and average yearly temperatures. The lowest chronic flow during the winter season was 24:1 which occurred when the ambient flow was at a maximum, ambient and effluent temperatures were median and effluent flow was at 2.5 mgd. The effluent flow of 2.5 mgd represents the average daily flow for the months of February through May when the spring floods occur. The maximum daily effluent flow during this same spring period is 5.632 mgd.

The difference between 8 ports open and all 16 open: 8 ports appears to show an increase in acute dilution and a reduction in chronic dilution in almost all cases. This difference is a few points for both acute and chronic. A difference of a few points in the chronic factors does not make as big a difference as a few point does in the acute factors, e.g., model runs for acute dilution NC24 and NC24A where 6.5.



WATER BALANCE

1. INFLUENT Q = 6.10 MGD
2. PE Q = 6.047 MGD
3. MIXED LIQUOR Q = 8.236 MGD
4. SE Q = 6.177 MGD
5. EFFLUENT Q = 6.01 MGD
6. WPS Q = 0.053 MGD
7. IR Q = 13.5 MGD
8. SEC. UNDERFLOW Q = 2.059 MGD
9. RAS Q = 2.024 MGD
10. WAS Q = 0.035 MGD
11. NPW Q = 0.168 MGD
12. TWS Q = 0.02 MGD
13. THICKENER OF Q = 0.068 MGD
14. DEWATERED CAKE Q = 0.002 MGD
15. CENTRATE Q = 0.018 MGD
16. DRAINS Q = 0.079 MGD
17. PDD Q = 0.165 MGD
18. UNRECOVERED NPW Q = 0.089 MGD

DESCRIPTION OF PROCESS

Influent wastewater is measured, sampled and screened at the headworks. Primary clarifiers remove sludge and grit. The primary effluent flows to aeration basins designed for nitrogen removal, with selectors, anoxic zones, and internal recycle. Secondary effluent passes through a cloth disc filter and a UV disinfection channel before discharge to the Columbia River. Effluent pumps are available for use in high river flow periods. Primary sludge and WAS are co-thickened in a gravity thickener and pumped to aerobic digesters. Digested sludge is dewatered using a centrifuge and hauled off-site for land application.

LEGEND

IR	INTERNAL RECYCLE
OF	OVERFLOW
PDD	PLANT DRAIN PUMP DISCHARGE
PE	PRIMARY EFFLUENT
RAS	RETURN ACTIVATED SLUDGE
SE	SECONDARY EFFLUENT
TWS	THICKENED WASTE SLUDGE
WAS	WASTE ACTIVATED SLUDGE
WPS	WASTE PRIMARY SLUDGE

CITY OF CAMAS
NPDES PERMIT APPLICATION
FIGURE 2
PROCESS FLOW SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

APPENDIX D--RESPONSE TO COMMENTS

On September 20, 2004, the following comments were received by the City of Camas, Department of Public Works. The responses represent the Department's review and action.

Comments on the Permit

Comment 1:

Page 1, Delete "Extended air" from the Plant Type description. The treatment plant activated sludge process is not an extended air process.

Response:

This change will be made to the permit.

Comment 2:

Page 6, Section S1.A: No effluent limitations for ammonia should be included in the permit, based on a lack of reasonable potential to exceed water quality standards using the CORMIX mixing zone model for the treatment plant diffuser. See also Comment No.15 below.

Response:

The Department disagrees that the UM3 model used was in error and will address this issue under point 15. Therefore the ammonia limit will remain.

Comment 3:

Page 7-8, Section S2.A. Monitoring Schedule: The expanded monitoring requirements in the draft permit are not justified and would significantly burden the City with additional capital (incubators and other test apparatus) and labor (greater than 0.25 additional FTE) costs. The superior record of O&M performance and the history of compliance by the City's treatment plant and its operations staff indicate that current levels of monitoring are adequate. Larger treatment facilities in this state are required by their NPDES permits to monitor parameters such as BOD, TSS, and ammonia on a schedule of three times per week, yet this draft permit requires the City to monitor these parameters five times per week. The City requests that the frequency of testing for these influent and effluent constituents be reduced from the level in the draft permit. Plant operating staff has also estimated that the cost of additional equipment needed to perform the added testing is in the range of $10,000. Operating staff has also raised concerns with regard to the additional lab time taking them away from other important maintenance functions that are required to operate and maintain the plant at its peak efficiency. Increasing the lab testing frequencies will cause other areas of the operation to shift downward on the priority list for the operating staff.

Response:

The City of Camas WWTP has a design capacity of 6.10 mgd. The Department policy for monitoring requires plants to monitor five times per week for BOD and TSS when the facility has a design capacity of greater than 5.0 mgd. The Department has reviewed the City's performance and determined that the City's performance on BOD & TSS over the last two years is good. However, Camas is grown and has one of the largest percentages of industrial flows for any of our municipal facilities. This industrial wastewater has great potential to cause upset in the plant which could cause a BOD or Ammonia violations. Therefore, the Department will reduce the monitoring frequency from five (5) days per week to four (4) days per week for BOD, TSS, and Ammonia.

Comment 4:

Page 8, Section S2.A: In the "Pretreatment" category, the priority pollutant scan for non-metals should indicate that the sample for sludge will be a grab sample rather than a 24-hour composite.

Response:

This change will be made to the permit.

Comment 5:

Page 8, Section S2.A: In the "Wastewater Effluent" category, the "Parameter" should be listed as "Oil and grease, priority pollutant metals, and cyanide" rather than "Oil and grease, priority pollutant metals, and cyanide."

Response:

This change will be made to the permit.

Comment 6:

Page 8, Section S2.A: In the "Sludge" category, the parameter should be listed as "priority pollutant metals," rather than "priority pollutants metals." Units should be "mg/kg", not "ug/L."

Response:

This change will be made to the permit.

Comment 7:

Page 12, Section S4.A: The footnote in the Design Criteria incorrectly limits the plant treatment capacity at influent ammonia concentrations greater than a certain percentage of the influent BOD5 concentration. We assume that this limit is based on a perceived inadequacy by the Department of the design capacity of the plant's blower and aeration system to handle higher ammonia loads. This proposed limit does not consider additional system capacity due to cell uptake of ammonia, BOD5 removal in the anoxic denitrification zone, allowable ammonia residual in the effluent, excess blower capacity at actual backpressures, and excess oxygen transfer efficiency provided by the actual diffuser system. It is requested that this limit be deleted from the permit. High loadings of ammonia, such as from industrial sources, will be limited by pretreatment requirements if these loadings are limiting the plant's ability to maintain adequate dissolved oxygen in the treatment process.

Response:

The footnote referred to in this comment in essence requires that BOD capacity be reduced by a factor equal to about four pounds of BOD for every pound of ammonia over 20 percent of the

BOD loading concentration. This reflects the level at which our experience tells us that ammonia concentrations would exceed domestic loadings for this pollutant. The condition is needed because the POTW was designed to accommodate wastewater essentially domestic in strength and nature. Section S4 recognizes the BOD loading capacity anticipated, but did not include the ammonia capacity the POTW was designed to treat. This was done to provide the POTW additional flexibility to accept higher ammonia loadings, but the oxygen demanding effects of accepting such loadings still need to be recognized. Additional ammonia loadings accordingly reduce the POTWs ability to accept other oxygen demanding pollutants (carbonaceous BOD). Presently the POTW is receiving a high proportion of its ammonia loadings from a semiconductor manufacturer. The POTW must treat both BOD and ammonia by its permit, and both require the oxygenation of wastewater. Therefore, both carbonaceous BOD loadings and ammonia loadings are competing for the oxygen delivery capacity of the treatment plant.

In addition, the footnote in S4 relating to the capacity allows that the Permittee would begin reducing its BOD capacity when ammonia exceeded 20 percent of the rated BOD capacity. This means that the rated BOD capacity of 5,616 lb/day would be reduced when ammonia loadings to the POTW exceed 1,120 lbs/day. The Permittee (in comment 6) argues that adjustment should be made to account for certain other mechanisms in which ammonia uptake is realized. The Permittee (in comment 11) notes that the design nitrogen loading is 942 lbs/day TKN, not 1,017 lbs/day ammonia. Since TKN is the sum of ammonia and organic nitrogen, and is measured as a weight of nitrogen, it would normally be higher than the ammonia concentration as ammonia is normally about 60 percent of influent TKN, and organic nitrogen comprises the other 40 percent. Therefore, the 942 lbs/day TKN equates to about 565.2 lbs/day of ammonia-N, or (17/14)*565.2 = 686 lbs/day of ammonia (when reported as a weight of the ammonia molecule rather than the nitrogen atoms in the ammonia molecule). Therefore, allowing ammonia loadings to equal 20 percent of BOD rated capacity before reducing raw BOD loading capacity is already quite generous, and doesn't require further upward adjustment in the Department's opinion.

<u>*Response to Specific Portions of This Comment (In Order)*</u>:

<u>Comment 8a</u>:

"We assume that this limit is based on a perceived inadequacy by the Department of the design capacity of the plant's blower and aeration system to handle higher ammonia loadings."

<u>Response</u>:

The Department perceives no deficiency in the POTWs ability to accommodate its rated flow and loadings, however, the rated ammonia loading is representative of the anticipated domestic load at the rated flow and BOD loading of the POTW. The permit condition requires the POTW to accordingly reduce its BOD capacity if it desires to allow higher than domestic ammonia loadings. Such additional ammonia loadings were not anticipated when the POTW was designed.

<u>Comment 8b</u>:

"The proposed limit does not consider additional system capacity due to cell uptake of ammonia."

<u>Response</u>:

When the POTW was designed, the design rating did allow a factor for cell uptake of ammonia, however when additional ammonia is added (through industrial discharges), additional cell uptake of ammonia does not occur beyond that already anticipated. Therefore, while its appropriate to reduce aeration requirements for a portion of the ammonia because some ammonia is used by cell production, this consideration has already been accounted for in the design loading for ammonia. The additional ammonia loadings don't spur more cell growth, and therefore such loadings should not be reduced for (bacteria) cell uptake.

Comment 8c:

"The proposed limit does not consider additional system capacity due to... …BOD5 removal in the anoxic denitrification zone…".

Response:

Under anoxic conditions, nitrates are reduced to nitrogen gas when the oxygen from the nitrate molecules are used as a source of oxygen for digestion of carbonaceous BOD. The POTW was constructed as a step-feed system, with the ability to be run in a mode where raw wastewater is introduced at a point where ammonia had been nitrified (oxidized) to nitrates, and the denitrification process could occur. During our inspections, the facility has not been employing the step-feed system to denitrify its effluent (and the POTW is not required to do so or to produce a de-nitrified effluent). If the POTW is operating in a denitrifying mode, and can show consistent total nitrate levels of 10 mg/L or less, it would be strong evidence that denitrification has been successfully employed. Then if they can project how they would continue to employ this process at their rated flow and loading rates, Ecology would be hard pressed not to consider this evidence, especially if it were part of a comprehensive POTW re-rating. To date such evidence has not been provided.

Comment 8d:

"The proposed limit does not consider additional system capacity due to... …allowable ammonia residual in the effluent…".

Response:

The POTW would need to nitrify to meet current ammonia limits even if there were no non-domestic sources of ammonia. Therefore, the Department presumes that additional ammonia loadings in the POTWs influent directly relate to either increases to the effluent concentrations or loadings that must be removed by the treatment process (through aeration). Again, what we are talking about is the loadings of ammonia over and above what domestic wastewater would contain.

Comment 8e:

"The proposed limit does not consider additional system capacity due to... …excess blower capacity at actual backpressures…".

Response:

The City has provided no evidence to support the inference that backpressures are less than their designer presumed they would be when the POTW was designed. The vast majority of blower backpressure is due to the depth of water above the diffusers in the aeration basin. Even if the POTW built aeration basins shallower than plans showed, there would be no need to revisit the presumptions used. If aeration basins were shallower, the oxygen transfer efficiency would proportionately decrease, and there still would not be a net increase in oxygen delivery capacity. The comment provides no rationale for adjusting the backpressures used in designing this POTW. Even were the diffuser backpressures measured, and were less than what the designer presumed, aerators are subject to fouling over time, and the rating provided for this POTW is based on anticipating a degree of reduced performance for fouling.

Comment 8f:

"The proposed limit does not consider additional system capacity due to... ...excess oxygen transfer efficiency provided by the actual diffuser system."

Response:

The City has provided no evidence of any kind to support the inference that the oxygen transfer efficiency might be greater than their designer presumed it would be when the POTW was designed. If the POTW wishes to engage in a facility rerating, then the procedures outlined in the Department's "Criteria for Sewage Works Design", Ecology, 1998, need to be followed. No data has been provided to the Department that allow for such an assessment, and no desire for a facility rerating has been expressed to date. The Department finds that there is equal basis to speculate that the oxygen transfer efficiency may be lower than presumed in the design of this facility.

Comment 8g:

"It is requested that this limit be deleted from the permit."

Response:

The proposed footnote is not a limit, but a mechanism for adjusting the rated capacity of the POTW. It is needed as significant non-domestic loadings of oxygen demanding pollutants are anticipated to be discharged to this POTW, and it is necessary to account for the amount of the POTWs oxygen delivery capacity required for their treatment.

Comment 8h:

"High loadings of ammonia, such as from industrial sources, will be limited by pretreatment requirements if these loadings are limiting the plant's ability to maintain adequate dissolved oxygen in the treatment process."

Response:

The Department administers a pretreatment permit for each of the principal non-domestic dischargers to the POTW. The Department's permits will continue to reflect the loading limits for oxygen demanding pollutants (BOD and ammonia) which the City agrees to accept from these sources of indirect discharges to the POTW. Other agreements by the City such as user contracts should be in place to provide the ability of the POTW to respond to more immediate problems at the POTW. The Department is glad to have this confirmation that such authorities and mechanisms exist. They are, however, not proactive measures to prevent non-compliance. Once the POTW finds that agreed-to loadings from industries and domestic sources are too much for the POTW to handle, it may take several years to install additional capacity at the POTW. The effects of additional ammonia loadings on the POTWs BOD capacity can easily be anticipated through the means spelled out in the footnote in question. The Department's position is that such problems should be avoided wherever possible. The intent of this footnote is to do just that, and our review finds that the draft wording is appropriate.

<u>Comment 9</u>:

Fact Sheet, Page 1: Delete “extended air” from Type of Treatment description in table.

<u>Response</u>:

This change will be made to the permit.

<u>Comment 10</u>:

Fact Sheet, Page 2, 1st paragraph: Delete “extended air” in first sentence. Regarding 2nd sentence, either lime slurry or sodium hydroxide will be used to adjust pH (operator’s option). The primary clarifiers are not used to mix the lime slurry or sodium hydroxide. The application and mixing points are either downstream of the influent Parshall flume or at the aeration basin splitter box.

<u>Response</u>:

This change will be written into the permit.

The following comments were made on the fact sheet.

<u>Comment 11</u>:

Fact Sheet, Page 2, last paragraph, 2nd sentence: The selector zones are followed by two anoxic mixing zones.

<u>Response</u>:

This change will be written into the Fact Sheet.

<u>Comment 12</u>:

Fact Sheet, Page 3, 2nd paragraph, last sentence: There are a total of 288 UV lamps.

<u>Response</u>:

This change will be written into the Fact Sheet.

<u>Comment 13</u>:

Fact Sheet, Page 7, Table 2: The nitrogen design loading is 942 lbs/day TKN, not 1,017 lbs/day ammonia.

<u>Response</u>:

This change will be made to the Fact Sheet. The Permittee should note that this line was not carried over into the permit.

Comment 14:

Fact Sheet, Page 8, last line: Plant design loading is 5,616 lbs/day, not 5.616 lbs/day.

Response:

This change will be made to the permit.

Comment 15:

Fact Sheet, Page 18: The Proposed Limits for TSS (30/45 mg/L) in the Effluent Limits table do not agree with the effluent limitations in section S1 of the permit, page 6.

Response:

The permit was correct. The permit was finished after the fact sheet and the fact sheet will need to be changed to show what is now in the permit. The limits in the permit for both BOD and TSS were reduced to 20 mg/L and 30 mg/L to recognize the fact that the facility could produce a BOD and TSS in the effluent even though the influent removal rate was decreased for dilute influent.

Flows from semi-conductor industries in Camas have slowly ramped up to the point where they are up to 38 percent of flows in some months. The concession of requiring only a 70 percent removal rate for BOD and TSS was based on the presumption that such flows would eventually consume up to 52 percent of the POTWs flows at their 6.1 MGD design capacity (for the currently constructed phase). Therefore, the flows are in line with the prior analyses in this regard.

With respect to I&I, our analysis showed that over the past year, I&I flows have been as much as 45 percent of monthly average flows (January 2004). When dilute flows from semi-conductor industries are subtracted from the equation, I&I flows in this month were 1.2 MG of the remaining 2.14 MG of flows. This means that I&I flows of 1.2 MGD exceeded domestic flows of 0.94 MG, and far exceeded our target of 40 percent or less of domestic flows (at ~130 percent). Therefore, the I&I requirements of this permit are an essential component of future management of the wastewater infrastructure in this community.

Comment 16:

Fact Sheet, Page 30: An ambient river pH of 8.0 should be used for winter conditions for the un-ionized ammonia and reasonable potential calculations. A pH of 8.0 was used for the un-ionized ammonia and reasonable potential calculations for the Salmon Creek WWTP outfall in similar calculations performed earlier in 2004. This value is based on data taken at Ecology Station 28A100 with modern monitoring techniques in 2002-2003. A pH of 8.46, based on data collected in 1994, does not reflect current conditions.

Response:

The Department disagrees with this assessment. The Department thinks the analysis conducted by USGS in 1994 is of high quality and should be used along side of the Department 2002-2003 data. It is unfortunate that the only recent data available on pH is very limited. Because of the small populations in both data sets, the Department thought it would be best to combine the data. The high pH values seen in 1994 were of concern and although the pH in 2002 is lower, it is still high. The Department does not want to base the important calculations for ammonia toxicity on one year of data when it is known that pH has been high in the past. Permit writers must consider the worst case scenario to protect the aquatic life. If is the 1994 data reflects the pH in the Columbia at certain times, it is a serious condition when ammonia is present. The comment above also quotes the Salmon Creek permit which is in the process of being re-written. It is likely that Salmon Creek and Vancouver Marine Park NPDES permits will use this same analysis of pH and will therefore likely use the pH of 8.46 for reasonable potential calculations. This pH value represents the best information we have at this time and the value will be used as is in the new permit. During the next permit cycle, the Permittee may want to have a program to sample the ambient water on a regular basis for pH in a study that has quality control and quality assurance. A sampling program where pH has been sampled more than twice per month over two years would be most beneficial to each of the Permittees involved.

Comment 17:

Fact Sheet, Page 37: The 1994 Wastewater Facilities Plan for the City of Camas analyzed the treatment plant discharge diffuser with the computer software model UDKHDEN. As reported in the current Fact Sheet, the Washington State Department of Ecology (WDOE) in 2004 ran a new series of modeling scenarios utilizing the UM3 model. According to WDOE the reason for changing the model was that UDKHDEN "tends to over predict the dilution compared to the UM3 model for these waters. The model also used a flux average model prediction rather than a centerline prediction which is recommended in the Department guidance for unidirectional water."

The UM3 model was run 25 times by WDOE for both critical summer and critical winter season conditions. These runs produced four dilution factors that [were] used in the following situations:"

	Acute	**Chronic**
Aquatic Life (summer)	8	48
Aquatic Life (winter)	5	22
Human Health, Carcinogen		22
Human Health, Non-carcinogen		22

The City's consultant, Gray & Osborne, Inc., modeled the City of Camas diffuser using the CORMIX mixing zone model with the identical input values used by WDOE based on the draft NPDES Permit, Fact Sheet, and hard copy UM3 model runs provided by WDOE (see attached CORMIX model run data). In addition, Gray & Osborne checked their CORMIX model results by having Dr. Robert Doneker, P.E., (Portland State University) a developer of the CORMIX model, independently model the Camas diffuser (see Dr. Doneker letter attached). The dilution results are characterized below for both the UM3 and CORMIX models based on *Table C6: Predicted Dilutions for the City of Camas*, contained within the NPDES Fact Sheet.

Model Run	**Discharge Season**	**UM3**		**CORMIX**	
		Acute Dilution (32 feet)	**Chronic Dilution (321 feet)**	**Acute Dilution (32 feet)**	**Chronic Dilution (321 feet)**

NC1	Summer		48	501	662
NC2	Summer	8		354	470
NC8	Winter		60	80	549
NC9	Winter	**5**		92	332
NC10	Max.	11	43	89	263
NC13	Winter		33	746	1,013
NC14	Winter	8		396	537
NC15	Max.	10	49	287	388
NC18	Winter		44	746	1,013
NC19	Winter	9		396	537
NC20	Max.	11	38	287	388
NC22B	Winter		**22**	*>1,000	*>2,000
NC24	Winter	6		1,023	1,472
NC25	Max.	7	33	739	1,064

*Estimated dilution values

In the model run NC22B, the input parameters of the small discharge velocity relative to the high ambient velocity will provide wake-like conditions without any jet mixing. This wake attachment is a dynamic interaction of the effluent plume with the bottom that is forced by the receiving water crossflow. This is an actual physical condition that occurs with these input variables. The UM3 model or other similar models do no have the capability to predict that this process is even occurring. The dilution values derived from the UM3 modeling for model run NC22B are not valid since UM3 is not capable of modeling this known physical process.

The two model results are drastically different and would indicate that effluent ammonia limits are not necessary due to the significant increase in dilution as shown by the CORMIX model results. The following table shows the respective minimum dilution values for both a critical summer and critical winter season.

Discharge Season	**UM3**		**CORMIX**	
	Acute Dilution (32 feet)	**Chronic Dilution (321 feet)**	**Acute Dilution (32 feet)**	**Chronic Dilution (321 feet)**
Summer	8	48	354	470
Winter	5	22	80	332
Human Health, Carcinogen		22		332
Human Health, Non-carcinogen		22		332

Please note that UM3 uses a jet-integral model for near field mixing, which should only be applied to a stable near-field without dynamic attachments. Stable discharge conditions usually occur with a combination of strong buoyancy, weak momentum and deep water. The location of the City of Camas diffuser in the Columbia River is conducive to recirculation phenomena of unstable discharge conditions, created by shallow water and low buoyancy, near-horizontal discharges. This local recirculation leads to re-entrainment of already mixed water back into the buoyant jet region. Boundary interactions control discharge stability in the vicinity of the discharge. The CORMIX model accounts for both vertical and lateral boundaries, which are always present in the Columbia River. Determination of flow stability is particularly important for near-field mixing of riverine discharges. The UM3 model does not address the effects of vertical or horizontal boundaries or the stability of the discharge. It assumes the ambient water body is infinite. Therefore, use of the CORMIX model is recommended for modeling the Camas diffuser.

Response:

The Department does not agree that the UM3 (Visual Plumes) is the wrong model to use for this section of the Columbia. The UM3 and UDKHDEN models were used in other permits in this stretch of the Columbia River. The UM3 model was shown to better match the dilution observed during a dye study for the Salmon Creek outfall. The Salmon Creek outfall diffuser is in similar shallow conditions as the Camas outfall. The Vancouver Marine Park outfall and diffuser was also modeled and a dye study was conducted to calibrate the model. The UDKHDEN model was used and fit well with the dye study data. At this time there is no reason to believe that CORMIX will do a better job in modeling the discharge plume at Camas. The results of the CORMIX data provided in comment 15 are 2-3 orders of magnitude higher than those provided by either UM3 for Camas or any of the other facility dilution studies mentioned above.

The following comments are made specifically on the use of CORMIX2:

1. CORMIX2 uses a 2-D prediction model in the nearfield and assumes the discharge from 8 ports ensues from a 2-dimensional slot of equivalent port area. This attempts to approximate the details of the merging process of the individual jets from each port/nozzle. This approximation impairs the prediction of dilution factors within the nearfield zone where the acute zone boundary (32 feet) is located and the plumes from the individual ports are not merged, as assumed. The 3-dimensional UM3 (Visual Plumes) prediction shows that the acute zone is within the nearfield zone where the plumes have not merged. A CORMIX1 analysis using one of the 8 ports also suggests that the regulatory mixing zone (acute zone) is well within the nearfield region.

2. A 3-D analyses of plume(s) in the nearfield is most appropriate and can be done by using UM3 interface in Visual Plumes.

3. In module MOD238 of the output file for CORMIX2, the dilution factors are flux averaged. The dilution factors for freshwater in unidirectional flow should be based on centerline concentrations (the Department's Permit Writer's Manual). Thus, the dilution factors predicted by CORMIX2 (flux average) are not comparable to those of UM3 (centerline). In UM3 prediction file the centerline dilution is approximately 1/3 of the flux average dilution factors.

4. The ambient flow rate (3017.49 m3/s = 106561 cfs, see output "session report") used in CORMIX2 analyses (see Case NC9)was much lower compared to the flow rate (192,000 cfs) used in UM3 analyses. This would imply that the ambient river dimensions are wrong assuming that the ambient current used was correct. Other cases were not checked.

5. The plume is also characterized by passive diffusive mixing in the farfield region which in CORMIX2 is accomplished through a constant diffusion for bounded channels. UM3 interface in Visual Plumes also uses constant diffusivity (in Brooks farfield solution) to predict farfield dilution. However, the farfield dilution prediction depends upon the nearfield model output for initial conditions; therefore it is important that the nearfield dilution be as accurately predicted as possible.

6. In model run NC22B the discharge velocity at each port is 76 percent of the ambient velocity which is not a relatively small number as alluded to in the comments

7. There was also a comment suggesting the presence of local recirculation at the outfall and that this would lead to re-entrainment of already mixed water back into the buoyant jet region. First, there was no physical basis provided to indicate presence of local recirculation. Secondly, the re-entrainment of already mixed water would tend to reduce dilution factor compared to entrainment of ambient water that has not previously mixed with the effluent. Thirdly, the plume is not buoyant as eluded to (see Case NC9).

Due to the large difference in dilution prediction between UM3 (Visual Plumes) and CORMIX2 and the discussion provided above, the Department will only consider CORMIX2 if it is field verified, i.e. through a dye study. The Permittee may wish to conduct such a study over the life of the new permit. This is not required, but the Permittee may do so to satisfy and perfect the dilution factors used. The Department will not hold the permit up for these future studies.

Following these comments, the Department reexamined the dilution modeling conducted by Ecology for the permit and all details and parameters that went into them. As a result a couple of errors were found. These errors were limited to an incorrect port spacing and port depth used in the following runs: NC1, NC2, NC8, NC9, NC19, NC20, NC22B, NC24, NC25. These errors were not in the ambient or effluent conditions shown in table C6 but rather in not using these same conditions as we said we did through out the model runs. These model runs were rerun and resulted in one or two points in each dilution factor. In a couple of cases the dilution went down when the port depth should have been in shallower water, e.g., the dry season chronic dilution went from 48 to 45. The winter acute dilution went from 5 to 6.5, therefore the number was rounded to 7 and all the reasonable potential evaluations were recalculated. The previous low acute dilution occurred during medium river discharge, however, after recalculating this dilution was no longer the lowest. The new lowest acute dilution occurred during the high flows and average yearly temperatures (See table C6 in Appendix C of this fact sheet).

The resultant changes did not make a large difference in the reasonable potential evaluation and resulted in only minor changes to limits already proposed.

It should be noted that the Permittee is required to provide the Department all pertinent information which they wish considered in development of their permit with the permit application. From this information and the best information available to the Department we develop a permit. In the future, the Permittee is encouraged to provide all information it wishes to be considered with its application for permit renewal.

APPENDIX C

SEWER ORDINANCE

City of Camas Municipal Code

Title 13 – Public Services-Division II

CHAPTER 13.60 SANITARY DISPOSAL SYSTEM

13.60.010 Administration--Receipt deposit.

The sanitary sewage disposal system of the city, including the treatment plant and all other parts of such system and all additions and improvements thereto and extensions thereof, which may be made hereafter, shall be considered as a part of and belonging to the water works utility of the city. The cost of the construction and installation of the hereinafter provided additions, improvements and extensions and the cost of maintenance and operation of such system as improved shall be charged to the water works utility of the city, and any rates and charges which may be collected hereafter for sewage disposal service shall be paid into the "water and sewer revenue fund" of the city, to be hereafter created. (Prior code § 13.24.010)

13.60.020 Applicability.

Sections 13.60.020 through 13.60.110 shall apply to all territory embraced within the corporate limits of the city and areas of police jurisdiction thereof. (Prior code § 10.08.010)

13.60.030 Approved means required.

On and after the first day of May, 1949, it is unlawful to maintain or use any residence, place of business or other building or place where persons reside, congregate or are employed which is not provided with means for the disposal of human excreta, waste from kitchen sinks, bathtubs, slop receptacles, laundry and dishwater, waste and all organic matter, liquid and solid, which may be classified as harmful to health either by flush-toilet connected with a sewerage system or septic tank, approved by the city health officer, or his authorized agent. (Prior code § 10.08.020)

13.60.040 Construction--Permit required.

On and after May 1, 1949, it shall be unlawful to construct any means of sewerage or excreta disposal such as septic tanks without having first obtained a permit from the city health officer or his authorized representative. (Prior code § 10.08.030)

13.60.050 Connection--Required when.

A. All property owners whose property abuts a street or alley in which there is a public sanitary sewer or which is within one hundred fifty feet of a public sanitary sewer may be required to connect their private drains and sewers to the city sanitary sewer system at the direction of the city engineer. Those properties which abut a street or alley in which there is a public sanitary sewer or which are located within one hundred fifty feet of a public sanitary sewer, and which are located within a designated health hazard area or which pose a threat to the general health, shall be connected to the sanitary sewer. Such connection shall be in the most direct manner possible and with a separate connection for each residence or structure.

B. There is imposed upon those property owners who are within the area served by the sanitary system and who refuse to connect to such sanitary sewer system a penalty in an amount equal to the charge that would have been made for sewer service if such property had been connected to the sanitary sewer system. Such penalties as provided herein shall accrue monthly until such property is connected to the sanitary sewer system. All penalties collected pursuant to this provision shall be considered revenue of the sanitary sewer system. (Ord. 1874 § 1, 1992; Ord. 1828 § 1, 1991: prior code § 10.08.040)

13.60.055 Lien.

A. The city shall have a lien against premises to which sewer service is available for delinquent and unpaid charges for sewer services, for penalties levied pursuant to Section 13.60.050(B), for unpaid connection charges, and for unpaid sewer system development charges. All such delinquent charges shall bear interest at the rate of eight percent per annum. Such lien shall be superior to all other liens and encumbrances except general taxes and local and special assessments.

B. Notice of such sewage lien shall be provided in accordance with RCW 35.67.210, and such sewage lien may be foreclosed as provided by RCW 35.67.220 through 35.67.250. (Ord. 1828 § 2, 1991)

3.60.060 Private system--Flush-toilet.

Every residence, place of business or other building or place where persons congregate, reside or are employed and which does not abut a street or alley in which there is a public sanitary sewer shall be provided with a private water-flush toilet by the owner or agent of the premises; said water-flush toilet system to be built or rebuilt, constructed and maintained in such a manner as to meet the requirements of construction and maintenance hereinafter described.

Private Sewer System:

At any residence, place of business or other building where there is installed a water-flush system of excreta and waste disposal which is not connected to a public sewer system approved by the State Department of Health and city health officer, and where the customary users do not exceed ten in number, there shall also be established or installed a private sewerage disposal system, the disposal system to consist of a septic tank with submerged “T's” for inlets and outlets and a system of underground drains for the disposal of the septic tank effluent. The tank and drains shall be so constructed as to meet the requirements of construction and maintenance hereafter described.

1. Septic Tanks.

   The sizes of septic tanks shall be as follows:

   Minimum size 67 cubic feet -- 500 gallons
   Serving 8 persons 87 cubic feet -- 650 gallons
   Serving 10 persons 100 cubic feet -- 750 gallons

   Septic tanks shall have a covered manhole of sufficient size to allow the cleaning of the tank.

2. Drains.

   Sufficient four inch open joint drain tile shall be provided and the construction and maintenance shall be such that the overflow from the septic tank, kitchen sinks, bathtubs, laundry trays, and other organic wastes shall not directly or indirectly drain or discharge over or upon the surface of the ground or into any stream, bodies of surface or groundwater either natural or artificial.

   Drain tile shall be laid on a flat grade not to exceed one-half-inch fall in ten feet. One hundred feet of drain shall be recognized as a minimum for four persons or less; serving over four persons, twenty-five feet of drain per person. The open joints of the drain tiles shall be loosely wrapped with strips of asphalt roofing or tar paper to exclude sand and silt.

3. Drain Line Trenches.

   Drain line trenches shall be eighteen inches in width and eighteen inches to two feet in depth. The drain line shall be laid in a bed of crushed stone or clean gravel covering the full width of the trench. The bottom of the drain tile shall be twelve inches above the bottom of the ditch and the gravel then filled in around the tile in such a manner as to completely cover the tile. The backfilling of the trench shall provide an earth covering of not less than ten inches nor more than eighteen inches; provided, however, that variations of the depth of the tile may be made upon written approval of the city health officer, or his duly authorized agent.

4. Subsurface Drainage.

   When the groundwater conditions are such that the soil will not receive the drainage from the drain tile described in subsection A2 of this section, a subsurface drainage system shall be provided for the purpose of reducing the groundwater table. The subsurface drain tile shall consist of two horizontal lines of four inch tile, one on each side of and parallel to the septic tank drain tile, a distance of five feet horizontally from the septic tank drain tile and a vertical distance of two feet below the septic tank drain tile. Subsurface drain lines shall be laid in trenches eighteen inches in width, with open joints loosely wrapped with strips of asphalt roofing or tar paper to exclude sand and gravel or sand and silt, in a bed of crushed stone or clean gravel covering the full width of the trench. The outlet end of the subsurface drain tile may discharge onto the surface of the ground or into an open ditch or waterway. There shall not be any physical connection between the subsurface drainage tile and the sanitary drainage tile which the effluent from the septic tank is discharged into.

5. Filter Trench.

When the porosity of the soil is such that it will not receive the drainage from the drain tile described subsection A2 of this section, a filter trench shall be substituted for the drain line. The filter trench shall consist of 2 four-inch drain tiles, one laid directly above the other in the same ditch. The lower tile shall be laid in the bottom of the ditch and four feet of clean coarse sand and gravel placed over it. The joints of the lower tile shall be loosely wrapped with strips of asphalt roofing or tar paper to exclude the sand and gravel. The upper four-inch tile line shall be laid on top of the two-foot bed of sand and coarse cinders, clean gravel or crushed stone shall be placed around the upper tile so as to cover it completely. The following lengths of filter trench shall be required:

Minimum 80 feet
Serving 8 persons 100 feet
Serving 10 persons 125 feet

The backfilling of the trench shall provide an earth covering of from ten to fourteen inches. Both the upper and lower drain tile of the filter trench shall be laid on a flat grade not to exceed one-half-inch fall in ten feet.

The ditch used in construction of the filter trench shall be three feet in width and not less than five feet in depth.

6. Dry Wells.

Dry wells may be acceptable in certain areas where soil conditions and groundwater table is satisfactory. Approval of area subject to Health Department. In no case shall the dry well be less than eight feet in depth below the lowest point of inlet; diameter not to be less than four feet. In cases where no primary treatment (septic tank) is provided, then it shall be necessary to provide a grease trap of ample size.
At any residence, place of business or other building where there is installed a water-flush system of excreta and waste disposal which is not connected to a public sewer system approved by the State Department of Health or city health officer or his authorized agent and where the customary users exceed ten in number the plans and construction of which in each separate case, shall be approved by the State Department of Health or city health officer or his authorized agent. (Prior code § 10.08.050)

13.60.070 Nonconforming system--Nuisance.

Any privy or private sewerage disposal system existing or being maintained which does not conform to the requirements of Sections 13.60.020 through 13.60.110 shall be and is declared a nuisance, dangerous and a menace to the public health and the city health officer or his authorized agent of Camas, Washington, shall have the power and authority to abate any such nuisance in accordance with the provisions of this Sections 13.60.020 through 13.60.110. (Prior code § 10.08.060)

13.60.080 Enforcement.

It shall be the duty of the city health officer or his authorized agent to enforce the provisions of Sections 13.60.020 through 13.60.110 and in the performance of this duty the health officer or his duly authorized agent is authorized to enter at any reasonable hour any premises as may be necessary in the enforcement of Sections 13.60.020 through 13.60.110. (Prior code § 10.08.070)

13.60.090 Violation--Penalty.

Any person, firm or corporation who violates or refuses or fails to comply with any of the provisions of Sections 13.60.020 through 13.60.110 shall be guilty of a misdemeanor and shall be punished by a fine of not less than twenty-five dollars nor more than one hundred dollars, or imprisoned in the city jail for a period of thirty days or by both such fine and prison term. (Prior code § 10.08.080)

13.60.100 Violation--Each day a separate offense.

Every person, firm or corporation shall be deemed guilty of a separate offense for each and every day during any portion of which any violation of any provisions of Sections 13.60.020 through 13.60.110 is committed, continued, or permitted by such person, firm or corporation and shall be punishable therefore as provided by Sections 13.60.020 through 13.60.110. (Prior code § 10.08.090)

13.60.110 Severability.

If any section, subsection, sentence, clause or phrase of Sections 13.60.020 through 13.60.110 is for any reason held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of Sections 13.60.020 through 13.60.110. The city council of the city declares that it would have passed Sections 13.60.020 through 13.60.110 and each section, subsection, sentence, clause and phrase thereof, irrespective of the fact that any one or more other sections, subsections, sentences, clauses or phrases be declared invalid or unconstitutional. (Prior code § 10.08.100)

CHAPTER 13.62 SEPTIC TANK EFFLUENT PUMPING SYSTEMS

13.62.010 Definitions.

Unless the context specifically indicates otherwise, the terms used in this chapter shall have the following meanings:

"City" means the city of Camas.

"Control unit" means an electrical panel with pump switches that is mounted in an easily accessible location at separate STEP or STE service.

"Owner" means any individual, firm, partnership, corporation, company, association, or any other legal entity which holds title to property upon which a STEP or STE system now or hereafter is located.

"Right-of-entry agreement" means an agreement which permits the city to access an owner's property to maintain and inspect an STEP or STE system.

"Service box" means a utility box located at the property line that houses the valve and discharge line which runs from the pump to the main sewage transmission line.

"Standard specifications" means those specifications and standards set forth in a manual entitled "City of Camas, Septic Tank Effluent Pumping (STEP) System."

"STE system" means a sanitary sewage system which operates by siphonage instead of pumping and which contains a high-level alarm and electrical panel.

"STEP system" means a sanitary sewage system which utilizes a high head pump, alarms, and a control panel to pump waste from a collection tank into pressurized mainlines.

"Use provisions" means the provisions set forth in Section 13.68.020 of this code. (Ord. 1901 § 2, 1992)

13.62.020 Standard specifications adopted.

The manual entitled "City of Camas, Septic Tank Effluent Pumping (STEP) System" is adopted by reference and incorporated herein as the standard specifications for STEP and STE sanitary sewer systems. (Ord. 1901 § 3, 1992)

13.62.030 Application to connect.

Any property owner seeking to connect his property to the sanitary sewer system of the city by means of a STEP system shall file an application with the public works department on a form provided by the city. The application shall contain the name and address of the owner, the location of the property to be connected to the sanitary sewer system, the nature of the structure to be constructed on the subject property, the proposed use of the subject property, the proposed location of the STEP system, the design of the STEP system, and such other information as the public works department may require. Upon receipt of any such application, the public works director, or his authorized designee, shall review the application and grant the same if he determines that the subject property is suitable for use of a STEP sanitary sewer system, and if the design, location and other information set forth in the application comply with the standards and specifications adopted by the city for STEP systems and the criteria set forth in this chapter. (Ord. 1901 § 4, 1992)

13.62.040 Installation responsibility--Inspection fee.

A. The individual owner shall be responsible for and shall pay for the installation of the STEP/STE system, including but not limited to, service connection per CMC 13.64.050 if required, the tank, pump apparatus, control box, electrical wiring, conduit, plumbing from the structure to the tank, plumbing from the tank to the service box, excavation and backfill material. The city shall, prior to installation, determine the appropriate size tank.

B. During and at the completion of installation, the STEP/STE system shall be inspected by the city to insure that it has been properly installed. There shall be a fee of one hundred fifty dollars for inspection of the STEP system, which fee shall be collected by the building department at the time the permit for connection to the municipal sewer system is issued. (Ord. 2381 § 1, 2004: Ord. 1901 § 5, 1992)

13.62.050 Right-of-entry agreement.

Any owner seeking to connect his property to the sanitary sewer system of the city by means of a STEP system shall be required to execute a right-of-entry agreement authorizing the city and its employees to have access to the owner's property for the purpose of maintaining and inspecting the STEP system and appurtenances thereto. Such right-of-entry agreement shall be executed upon approval of an application for a STEP system. (Ord. 1901 § 6, 1992)

13.62.050 Right-of-entry agreement.

Any owner seeking to connect his property to the sanitary sewer system of the city by means of a STEP system shall be required to execute a right-of-entry agreement authorizing the city and its employees to have access to the owner's property for the purpose of maintaining and inspecting the STEP system and appurtenances thereto. Such right-of-entry agreement shall be executed upon approval of an application for a STEP system. (Ord. 1901 § 6, 1992)

13.62.060 Ownership of system.

A. Residential. After inspection and acceptance of an installed STEP system on residential property, the city shall be the owner of all components of the STEP system with the exception of the sewer line from the structure to the tank, which shall be owned by the property owner. The city will be responsible for maintaining the components of the STEP system owned by the city, and in addition will be responsible for pumping the STEP tank and disposing of waste material when required. The owner will be responsible for maintaining the sewer line connecting the tank to the structure on the subject property. The owner will further be responsible for paying for all electrical costs associated with the operation of the STEP system.

B. Commercial and Industrial. All STEP systems serving commercial, industrial, and other nonresidential properties shall be owned by the owner of the subject property, except for the service box at the point where the STEP system connects to the city sanitary sewer system, which shall be owned by the city. The owner shall be responsible for maintaining all components of the STEP system and its ownership, and shall be responsible for pumping the STEP tank as needed and for disposing of the waste in an approved manner. The owner shall further be responsible for paying all electrical costs associated with the operation of the STEP system. (Ord. 1901 § 7, 1992)

13.62.070 Damage to STEP system--Repair costs.

The cost of repairing any damage to a STEP system which has resulted from the negligence, gross negligence, or intentional acts of the owner shall be the responsibility of the owner. This responsibility includes any clogging which may result due to improper use of the STEP system by the owner. (Ord. 1901 § 8, 1992)

13.62.080 Landscaping over STEP or STE tanks.

Under no circumstances will STEP or STE users be permitted to cover any portion of the riser lids to the access chambers of the septic tanks associated with the sewer system. The riser lid to the access chamber shall be accessible at all times to insure proper and timely emergency and/or maintenance response to the system. Accessible shall mean visible to the naked eye and with a minimum distance of one-inch separation from the top of the riser lid to the adjacent ground surface.

The owner of any property having a system found not to be in compliance with this requirement shall be notified by mail and shall have four weeks to correct the noted deficiency. Any corrective measures not completed within the specified time shall be completed by the city, and any costs associated with such corrections shall be billed to the property owner. (Ord. 2051 § 1, 1996)

CHAPTER 13.64 SEWER SERVICE CHARGES

13.64.010 Monthly sewer service charge--Sewer service available.

All customers shall be charged for sanitary sewer service where sanitary sewer service is available in accordance with the rates set forth in Table 13.64.010.

Table 13.64.010
City of Camas Sewer Rate Schedule

RESIDENTIAL

Customer Class		2003	2004	2005	2006	2007	2008
Inside City	Monthly Service Charge	$20.75	$22.25	$22.60	$23.05	$23.55	$24.05
Outside City	Monthly Service Charge	31.13	33.38	33.90	34.58	35.33	36.08

COMMERCIAL AND INDUSTRIAL

Customer Class		2003	2004	2005	2006	2007	2008
Inside City	Monthly Service Charge	$4.65	$4.65	$5.00	$5.25	$5.50	$5.75
	Volume Charge ($/ccf)	2.10	2.15	2.25	2.30	2.35	2.45
Outside City	Monthly Service Charge	6.98	6.98	7.50	7.88	8.25	8.63
	Volume Charge ($/ccf)	3.15	3.23	3.38	3.45	3.53	3.68

(Ord. 2352 § 1, 2004: Ord. 2282 § 2, 2000: Ord. 2251 § 1, 1999: Ord. 1999 § 1, 1994; Ord. 1853 § 1, 1992: Ord. 1697 § 1, 1989: Ord. 1664 § 1, 1988: prior code § 13.08.280)

13.64.020 Adjustment--Commercial.

Those commercial and industrial customers whose sewer charges increase substantially during summer months due to the watering of lawns and shrubbery and whose existing service was installed prior to November 15, 1999, may make application with the finance department for adjustment of their sewer charges. If the finance department finds that there is an undue increase which is attributable to watering of lawns and shrubbery, then the sewer charges shall be adjusted so that the monthly charge is equal to the average of the charges incurred in the months of November through May, inclusive. Those commercial and industrial customers that connect to the water system after November 15, 1999, and that do not want additional sewer charges due to irrigation, shall be required to install a separate water meter solely for irrigation. Any person whose application for adjustment is denied may appeal the decision of the water department to the board of adjustment. (Ord. 2229 § 1, 1999: prior code § 13.08.285)

13.64.030 Adjustment for broken water line.

A. Non-residential customers may apply for a reduction in sewer charges when, due to a broken water line on the customer's premises, the sewer charge is substantially increased. The amount of the reduction shall be the difference between the average of the two prior sewer billings and the current sewer billing.
B. Eligibility for the adjustment provided herein shall be contingent upon repair of the broken water line as provided for in Section 13.44.030, Camas Municipal Code. Any adjustment allowed shall be limited to a maximum of two billing periods. (Ord. 2339 § 1, 2003)

13.64.040 Septage users.

A. There is imposed upon customers of the city of Camas water and sewer utility who have septic tanks or chemical toilets and reside within the city limits a service charge of five cents per gallon when waste from the septic tank or chemical toilet is dumped into the city sanitary sewer system.

B. Septic tank waste or chemical toilet waste generated outside of the city limits of Camas may not be dumped into the city sanitary sewer system. (Ord. 1977 § 1, 1994: Ord. 1942 § 1, 1993: Ord. 1853 § 2, 1992: Ord. 1697 § 2, 1989: Ord. 1664 § 2, 1988: prior code § 13.08.295)

13.64.050 Connection charges for STEP systems.

A. Except as hereinafter provided, the connection charge for connecting a STEP/STE sewer system to the Camas municipal sewer system shall be the cost of materials, the costs of labor for city personnel at then prevailing rate for such personnel, and the amount of any fees or charges required to be paid to any third parties in order to make such connection.
B. The connection charge for connecting a STEP/STE sewer system to the Camas municipal sanitary sewer system with a one inch service line or less shall be one thousand four hundred dollars, or the actual cost to the city calculated in accordance with subsection A of this section, whichever is greater.
C. No connection charge will be assessed if a service line has already been installed connecting the subject property to the city sanitary sewer system. (Ord. 2381 § 2, 2004: Ord. 1934 § 1, 1993: Ord. 1923 § 1, 1993)

CHAPTER 13.68 SEWER USE

13.68.010 Definitions.

Unless the context specifically indicates otherwise, the meaning of terms used in this chapter shall be as follows:

A. “Apartment” means any multiple-family dwelling having units which have separate kitchen plumbing facilities.

B. “BOD” (denoting biochemical oxygen demand) means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five days at twenty degrees Centigrade, expressed in parts per million by weight.

C. “Building drain” means that part of the lowest horizontal piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer, beginning five feet outside the inner face of the building wall.

D. “Building sewer” means the extension from the building drain to the public sewer or other place of disposal.

E. “Garbage” means solid wastes from the preparation, cooking, and dispensing of food, and from the handling, storage and sale of produce.

F. “Industrial wastes” means the liquid wastes from industrial processes as distinct from sanitary sewage.

G. “Natural outlet” means any outlet into a watercourse, pond, ditch, lake or other body of surface or ground water.

H. “Person” means any individual, firm, company, association, society, corporation or group.

I. “pH” means the logarithm of the reciprocal of the weight of hydrogen ions in grams per liter of solution.

J. “Properly shredded garbage” means the wastes from the preparation, cooking and dispensing of food that have been shredded to such degree that all particles will be carried freely under the flow conditions normally prevailing in public sewers, with no particle greater than one-half inch in any dimension.

K. “Public sewer” means a sewer in which all owners of abutting properties have equal right, and is controlled by public authority.

L. “Sanitary sewer” means a sewer which carries sewage and to which storm, surface and ground waters are not intentionally admitted.

M. “Sewage” means a combination of the water-carried wastes from residences, business buildings, institutions, and industrial establishments, together with such ground, surface and storm waters as may be present.

N. “Sewage treatment plant” means any arrangement of devices and structures used for treating sewage.

O. “Sewage works” means all facilities for collecting, pumping, treating and disposing of sewage.

P. “Sewer” means a pipe or conduit for carrying sewage.

Q. “Shall” is mandatory. “May” is permissive.

R. “Storm sewer” or “storm drain” means a sewer which carries storm and surface waters and drainage, but excludes sewage and polluted industrial wastes.

S. “Superintendent” means the water-sewer superintendent of the city of Camas, or his authorized deputy or representative.

T. “Suspended solids” means solids that either float on the surface of, or are in suspension in water, sewage or other liquids; and which are removable by laboratory filtering.

U. “Watercourse” means a channel in which a flow of water occurs, either continuously or intermittently. (Prior code § 13.28.010)

13.68.020 Use provisions.

A. No person shall discharge or cause to be discharged any stormwater, surface water, ground water, roof runoff, subsurface drainage, cooling water or unpolluted industrial process waters to any sanitary sewer. Any person in violation of this subsection shall have ninety days to take appropriate corrective action following notification of such violation by the public works director. The public works director, for good cause, may extend such time period for remedial action an additional ninety days.
B. Stormwater and all other unpolluted drainage shall be discharged to such sewers as are specifically designated as combined sewers or storm sewers, or to a natural outlet approved by the superintendent. Industrial cooling water or unpolluted process waters may be discharged, upon approval of the superintendent, to a storm sewer, combined sewer or natural outlet.
C. Except as hereinafter provided, no person shall discharge or cause to be discharged any of the following described water or wastes to any public sewer:
    1. Any liquid or vapor having a temperature higher than one hundred fifty degrees Fahrenheit;
    2. Any water or waste which may contain more than one hundred parts per million by weight, of fat, oil or grease;
    3. Any gasoline, benzene, naphtha, fuel oil, motor oil, lubricants or other flammable or explosive liquid, solid or gas;

4. Any garbage that has not been properly shredded;
5. Any ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, paunch manure, or any other solid or viscous substance capable of causing obstruction to the flow in sewers or other interference with the proper operation of the sewage works;
6. Any waters or wastes having a Ph lower than 5.5 or higher than 9.0, or having any other corrosive property capable of causing damage or hazard to structures, equipment, and personnel of the sewage works;
7. Any waters or wastes containing a toxic or poisonous substance in sufficient quantity to injure or interfere with any sewage treatment process, constitute a hazard to humans or animals, or create any hazard in the receiving waters of the sewage treatment plant;
8. Any waters or wastes containing suspended solids of such character and quantity that unusual attention or expense is required to handle such materials at the sewage treatment plant;
9. Any noxious or malodorous gas or substance capable of creating a public nuisance.

D. The admission into the public sewers of any waters or wastes having a five-day biochemical oxygen demand greater than three hundred parts per million by weight, or containing more than three hundred fifty parts per million by weight of suspended solids, or containing any quantity of substances having the characteristics described in subsection C of this section, or having an average daily flow greater than two percent of the average daily sewage flow of the city, shall be subject to the review and approval of the superintendent. Where necessary, in the opinion of the superintendent, the owner shall provide, at his expense, such preliminary treatment as may be necessary to reduce the biochemical oxygen demand to three hundred parts per million and the suspended solids to three hundred fifty parts per million by weight, or reduce objectionable characteristics or constituents to within the maximum limits provided for in subsection C of this section, or control the quantities and rates of discharge of such waters or wastes. Plans, specifications, and any other pertinent information relating to proposed preliminary treatment facilities shall be submitted for the approval of the superintendent and of the Water Pollution Control Commission of the state, and no construction of such facilities shall be commenced until said approvals are obtained in writing.

E. Where preliminary treatment facilities are provided for any waters or wastes, they shall be maintained continuously in satisfactory and effective operation, by the owner at his expense.

F. When required by the superintendent, the owner of any property served by a building sewer carrying industrial wastes shall install a suitable control manhole in the building sewer to facilitate observation, sampling and measurement of the wastes. Such manhole, when required, shall be accessibly and safely located, and shall be constructed in accordance with plans approved by the superintendent. The manhole shall be installed by the owner at his expense, and shall be maintained by him so as to be safe and accessible at all times.

G. All measurements, tests, and analyses of the characteristics of waters and wastes to which reference is made shall be determined in accordance with “Standard Methods for the Examination of Water and Sewage,” and shall be determined at the control manhole provided for in subsection F of this section or upon suitable samples taken at said control manhole. In the event that no special manhole has been required, the control manhole shall be considered to be the nearest downstream manhole in the public sewer to the point at which the building sewer is connected.

H. Grease, oil and sand interceptors shall be provided, when in the opinion of the superintendent, they are necessary for the proper handling of liquid wastes containing grease in excessive amounts, or any flammable wastes, sand, and other harmful ingredients, except that such interceptors shall not be required for private living quarters. All interceptors shall be of a type and capacity approved by the superintendent and shall be located as to be readily and easily accessible for cleaning and inspection.
   Where installed, all grease, oil and sand interceptors shall be maintained by the owner, at his expense, in continuously efficient operations at all times.

I. No statement contained in this chapter shall be construed as preventing any special agreement or arrangement between the city and any industrial concern whereby an industrial waste of unusual strength or character may be accepted by the city for treatment, subject to payment therefore by the industrial concern. (Ord. 2197 § 1, 1999; prior code § 13.28.020)

13.68.030 Inspection.

The superintendent and other duly authorized employees of the city bearing proper credentials and identification shall be permitted to enter upon all properties for the purpose of inspecting, observing, measuring, sampling, and testing sewer connections, operations, and facilities in accordance and to insure compliance with the provisions of this chapter. No such entry or inspection shall be made without the consent of the owner or occupant of such building or premises unless the city employee shall have obtained a search warrant, or unless exigent circumstances exist that would justify an inspection and entry without obtaining a warrant. (Ord. 1610 § 1, 1986: prior code § 13.28.030)

13.68.040 Damage prohibited.

No unauthorized person shall maliciously, wilfully, or negligently break, damage, destroy, uncover, deface or tamper with any structure, appurtenance, or equipment which is a part of the municipal sewage works. (Prior code § 13.28.040(a))

13.68.050 Violation--Notice.

Any person found to be violating any provision of this chapter shall be served in person or by mail by the city with written notice stating the nature of the violation and providing for the satisfactory correction thereof within thirty days from the date of such service. The offender shall, within the period of time stated in such notice, permanently cease all violations. (Prior code § 13.28.040(b))

13.68.060 Violation--Designated--Penalty.

Any person violating Section 13.68.040 and any person who shall continue any violation beyond the time limit provided for in Section 13.68.050 shall be guilty of a misdemeanor, and upon conviction thereof shall be fined in an amount not exceeding one hundred dollars or by imprisonment in the city jail not to exceed sixty days or by both such fine and imprisonment for each violation. Each day in which any such violation continues shall be deemed a separate offense. (Prior code § 13.28.040(c))

13.68.070 Violation--Liability.

Any person violating any of the provisions of this chapter shall become liable to the city for any expense, loss or damage occasioned by the city by reason of such violation. (Prior code § 13.28.040 (d))

CHAPTER 13.72 SEWER SERVICE DEVELOPMENT CHARGE

13.72.010 Purpose.

Pursuant to the authority conferred upon cities and towns by RCW 35.92.020 and 35.92.025, the city council of the city finds that property owners who seek to connect property to the sewer system of the city should be assessed a charge in order that such property shall bear its equitable share of the cost of the sewer system. The council further finds that the charge should be based upon the property owner's anticipated use of the sewer system as related to the historical cost of the sewer system and the projected cost of additions to the sewer system to meet new demand. That portion of the charge based upon the historical costs of the sewer system shall be measured by the undepreciated value of the sewer system and plant in service at the time the charge is imposed. That portion of the charge based upon the projected cost of future improvements shall be based upon appropriate studies by engineers and/or financial consultants. The charge imposed by this chapter shall be denominated as a "sewer system development charge" and shall be in addition to any sewer connection or permit fees imposed by other ordinances of the city. (Ord. 2119 § 1, 1997: prior code § 13.30.010)

13.72.020 Definitions.

Unless otherwise specifically defined, the terms used in this chapter shall have the following meanings:

"Average day flow" means the average volume of waste water flowing from a user over a twenty-four-hour period measured in million gallons per day (MGD).

"Biochemical oxygen demand (BOD)" means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five days at twenty degrees Centigrade, and shall be measured in pounds per day.

"City" means that use classification for the city and other public or nonprofit customers whose waste flows are typical of those associated with single-family residential structures.

"Commercial I" means that use classification of nonresidential properties who contribute flows to the sewer system except those users classified as Commercial II.

"Commercial II" means that use classification of nonresidential property owners who contribute higher than average flows or strengths to the sewer system, and shall include industrial and unusual requirement customers.

"Engineer" means the engineer of the city of Camas, or his duly authorized deputies or representatives.

"Industrial and unusual requirement customers" means that use classification of nonresidential property owners who contribute sewage with a flow and strength in excess of the Commercial II class.

“Multifamily” means that use classification of residential property owners whose structure contains two or more residential dwelling units.
“Peaking factors” means the numeric value resulting from the peak hour flow volume divided by the average day flow volume.

“Sewer system” means all facilities for collecting, transporting, pumping, treating and disposing of sewage.

“Sewage” means a combination of water-carried waste from residences, business buildings, institutions and industrial establishments, together with such ground, surface, and storm waters as may be present.

“Single-family” means that use classification of residential property owners whose structure contains one residential dwelling unit.

“Suspended solids (SS)” means solids that either float on the surface of or are suspended in water, sewage, or other liquids, and which are removable by laboratory filtering, and which shall be measured in pounds per day.

“City” means that use classification for the city and other public or nonprofit customers whose waste flows are typical of those associated with single-family residential structures. (Ord. 2119 §§ 2, 3, 1997; Ord. 1830 §§ 1--3, 1991; prior code § 13.30.020)

13.72.030 Imposition.

Except as provided in Section 13.72.040, there is imposed on every property that connects to the city sewer system of the city a sewer system development charge, which charge shall be assessed in accordance with the rates set forth in Section 13.72.050 and shall be collected prior to inspection by the city of the connection of the sewer line to the structure on the property owner's premises. (Prior code § 13.30.030)

A. Credit for Prior Connection.

   1. Those properties that have been disconnected from the city's sewer system since January 1, 1972, shall receive a credit for the prior connection.
   2. The credit for the prior connection shall be in an amount equal to the sewer system development charge for the use classification of the prior connection, and the sewer system development charge imposed under this chapter shall be the difference between the amount due under the present use classification less the amount that would have been assessed under the use classification for the prior connection; provided, however, that the city shall not be required to reimburse the property owner in the event that the credit exceeds the sewer system development charge for the new connection.

B. Credit. Those properties that are not presently connected to the city's sewer system but which have been assessed and paid a monthly sewer service charge shall receive a credit against the sewer system development charge in an amount equal to the total monthly sewer service charges paid prior to connection. (Ord. 2310 § 1, 2002; Prior code § 13.30.040)

13.72.050 Application.

A. Any property owner seeking to connect his property to the sewer system of the city shall file with the engineer an application to be on a form provided by the city. The application shall contain the name and address of the property owner, the location of the property to be connected to the sewer system, the nature of the structure to be constructed on the subject property, the proposed use of the subject property, and any other relevant information deemed necessary by the engineer to process the application.

B. Upon receipt of the completed application, the engineer shall designate the use classification of the property as single-family, multi-family, Commercial I, Commercial II, or industrial and unusual customer requirement. The applicant shall then be informed in writing by the engineer of the amount of the sewer system development charge, which shall be based upon the use classification of the property and shall be in accordance with the rates set forth in Section 13.72.060. (Prior code § 13.30.050)

13.72.060 Rates.

A. The sewer system development charge for properties classified as single-family, multifamily, city, and commercial I shall be as follows:

Meter Size	Equivalent Meter Factors	Sewer Utility
Residential		
All	All	$ 2,349
Commercial		
5/8”	1	$ 2,349
3/4”	1.5	3,523
1”	2.5	5,872
1.5”	5	11,745
2”	8	18,792
3”	16	37,584
4”	25	58,725
6”	50	117,449
8”	80	187,919

B. The sewer system development charge for properties classified as commercial II, including industrial and unusual customer requirements, shall be determined by the public works director. The factors used to determine the commercial II system development charges shall include the average daily flow, peaking factor, BOD pounds per day, and SS pounds per day. (Ord. 2355 § 1, 2004: Ord. 1830 § 4, 1991; prior code § 13.30.060)

Table 13.72.060
Commercial II Worksheet

Reimbursement Fee	**Historic**	**Future**	**Units**	**Charge**
Average Day Flow (MGD)	$0.00	+ $1,550,000.00	X ______	= $ _______
Peaking Factor	$1,168,000.00	+ $492,000.00	X ______	= $ _______
BOD (Lbs/Day)	$0.00	+ $1,659.00	X ______	= $ _______
SS (Lbs/Day)	$0.00 Total $_____	+ $1,014.00	X ______	= $ _______

13.72.070 Payment of sewer system development charge.

A. The sewer system development charge owing under the provisions of this chapter shall be paid by the applicant at the time of issuance of the plumbing permit or building permit, whichever shall first occur, or as scheduled by a separate agreement with the city.

B. No sewer service shall be furnished to the property of any person seeking to connect to the sewer system of the city until the sewer system development charge imposed by this chapter has been paid to the city treasurer or until such time as the city and the applicant have entered into a separate agreement providing for the payment of such sewer system development charge. (Ord. 1872 § 1, 1992: prior code § 13.30.070)

13.72.080 Revenue disposition.

All revenues collected pursuant to this chapter shall be paid into the water and sewer capital reserve fund, and shall be used for the purpose of financing system improvements. Such revenues shall not be used to offset current operation or maintenance costs. (Prior code § 13.30.080)

13.72.090 Appeal.

A. Any applicant aggrieved by the amount of the sewer system development charge found by the engineer to be required under the provisions of this chapter, may appeal to the board of adjustment from such finding by filing a written notice of appeal with the city clerk within twenty days from the time such property owner is given notice of such amount. The chairman of the board of adjustment shall cause a notice of the time and place of hearing to be mailed to the applicant. At such hearing, the applicant shall be entitled to be heard and to introduce evidence on his own behalf. The board of adjustment shall thereupon ascertain the correct amount of the sewer system development charge, and the city clerk shall immediately notify the appellant thereof, by mail, which amount, together with the costs of appeal, if appellant is unsuccessful therein, must be paid within ten days after such notice is given.

B. The chairman of the board of adjustment may, by subpoena, require the attendance at any appeal of any person, and may also require him to produce any pertinent books and records. Any person served with such subpoena shall appear at the time and place therein stated, and shall produce the books and records required, if any, and shall testify truthfully under oath administered by the chairman in charge of the hearing on appeal, as to any matter required of him pertinent to the appeal, and it is unlawful for him to fail or refuse to do so. (Prior code § 13.30.090)

13.72.100 Notice recordation.

Pursuant to RCW 65.08.170, the engineer shall cause to be recorded in the office of the auditor of Clark County a notice in the form and containing the information prescribed by said statute. (Prior code § 13.30.100)

APPENDIX D

FLOW, LOADING, AND EFFLUENT QUALITY DATA

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	January
Facility Name	CAMAS STP	Year	2002
Receiving Water	Columbia River	Plant Operator	J. Dickinson
Plant Type	Activated Sludge System	Population	12500

FINAL LIMITS

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			7-02 R
1			1.559	6.68											
2	99	82	2.244	7.1	6	94	112	2	98	37		7.1			.666
3	123	154	2.008	6.69	4	97	67	2	99	33					.12
4			1.841	6.3							720				.16
5			1.675	6.5											.12
6			1.980	6.41											.34
7			3.52	6.43											.78
8			4.10	6.24							7				.65
9	79	150	3.391	6.67	1	99	28	4	97	113					.02
10	81	42	2.487	6.30	9	89	187	6	86	124	7				∅
11			2.182	6.57								1.14			.01
12			1.954	6.6											.13
13			2.002	6.03											.11
14			2.00	6.03							29				.01
15			1.854	6.87											∅
16	141	170	1.822	6.77	6	96	91	4	98	61	39	7.0			∅
17	200	2320	1.872	6.68	13	94	203	7	99	109					.23
18			1.802	6.33											.05
19			2.004	6.20											.38
20			2.325	6.61											.17
21			2.455	6.52											.11
22			2.530	6.30							40				.46
23	77	82	2.898	6.35	4	95	97	5	94	121					.06
24	80	77	2.399	6.7	3	96	60	1	99	20		1.1			.06
25			2.773	6.6							28				.79
26			3.694	6.6											.23
27			2.861	6.11											.33
28			2.810	6.5							14				.25
29			2.679	6.45											.04
30	101	76	2.318	6.7	8	92	155	1	99	19		.48			.16
31	115	104	2.320	6.30	4	97	77	3	97	58	0				.07
Total		(104)	74.359												.44
	AVG 110	AVG 326	AVG 2.398	MIN 6.03	AVG 6	AVG 95	AVG 108	AVG 3.5	AVG 97	AVG 69.5	GEM 20	AVG 3.364			6.94"
Permit				6	30	83	966	30	81	1217	200				
	AVW 171	AVW 1245	MAX 4.10	MAX 7.10	AVW 8.5		AVW 147	AVW 5.5		AVW 118.5	GM7 70	MAX 7.1			
Limits				9	45		1217	45		1825	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249		Month	February
Facility Name	CAMAS STP	*FINAL LIMITS*	Year	2002
Receiving Water	Columbia River		Plant Operator	J. Dickinson
Plant Type	Activated Sludge System		Population	12500

	INFLUENT		EFFLUENT												
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			R-2-7
1			2.985	6.5											.01
2			2.631	6.3											.06
3			2.231	6.32											.08
4			2.20	6.30											⊖
5			2.124	6.47							51	3.5			.21
6	143	164	1.991	6.51	8	94	133	4	98	66					.50
7	91	84	2.509	6.57	4	96	84	1	99	21					.92
8			3.871	6.08							0				.02
9			3.139	6.28											.02
10			2.449	6.15											.20
11			2.235	6.45											ø
12			1.907	6.36											⊖
13	130	138	1.832	6.75	3	98	46	4	97	61	0	1.8			⊖
14	150	145	1.684	6.93	3	98	42	2	99	28					⊖
15			1.619	6.8							0				.06
16			1.503	6.84											⊖
17			1.577	6.66											.03
18			1.523	6.50							4				.4
19			1.681	6.55											⊖
20	120	87	1.746	6.89	6	95	87	5	94	73					.19
21	135	96	1.536	6.78	11	92	140	6	94	77		4.9			.01
22			1.657	6.53							8				.87
23			2.290	6.59											.02
24			2.814	6.55											⊖
25			2.208	6.38											⊖
26			1.986	6.36								1.0			⊖
27	132	144	1.828	6.22	5	96	76	8	94	122	3				ø
28	106	96	1.833	6.50	3	97	46	7	93	107					⊖
29															
30															
31															
Total			59.583												
	AVG 126	AVG 119	AVG 2.127	MIN 6.08	AVG 5	AVG 96	AVG 82	AVG 5	AVG 96	AVG 69	GEM 3.5	AVG 2.8			3.65
Permit				6	30	83	956	30	81	1217	200				
	AVW 140	AVW 142	MAX 3.871	MAX 6.93	AVW 8.5		AVW 114	AVW 7.5		AVW 115	GM7 75	MAX 4.9			
Limits				9	45		1217	45		1826	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law that I have personally examined the information submitted herein; and based on my inquiry of those individuals immediately responsible, I believe the information to be accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and/or imprisonment. (Penalties under statutes 18 & 33 U.S.C. may include fines up to $10,000 and/or maximum imprisonment of five years.)

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	March
Facility Name	CAMAS STP	Year	2002
Receiving Water	Columbia River	Plant Operator	J. Dickinson
Plant Type	Activated Sludge System	Population	12500

FINAL LIMITS

	INFLUENT		EFFLUENT												
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAINFALL "
1			1.740	6.26							44				Ø
2			1.655	6.29											Ø
3			1.595	6.62											Ø
4			1.662	6.60							6				.04
5			1.605	6.68											.97
6	91	110	1.919	6.97	1	99	16	2	98	32		12.9			.47
7	78	92	3.087	6.66	1	99	26	8	91	206					.04
8			2.185	6.45											.07
9			1.877	6.90											.19
10			1.905	6.89											.22
11			2.273	6.65							40				.92
12			3.750	6.58											.28
13	59	38	3.198	6.61	8	79	48	8	79	213					.28
14	108	69	2.876	6.86	3	97	72	2	97	48					.08
15			2.655	6.45							4	9.6			.12
16			2.440	6.6											.09
17			2.308	6.79											.25
18			2.608	6.53							4				.67
19			2.920	6.42											.03
20	95	44	3.533	6.92	3	97	88	4	91	118					Ø
21	93	108	2.550	7.01	4	96	85	2	98	43		9.3			Ø
22			2.246	6.6							2				Ø
23			1.931	6.83											.17
24			1.824	6.74											.03
25			1.923	6.96											Ø
26			1.729	6.91							22				.01
27	105	92	1.711	7.0	6	94	86	2	98	29					Ø
28	171	324	1.694	7.01	3	98	42	6	98	85		24.6			Ø
29			1.692	6.8							4				Ø
30			1.585	6.71											Ø
31			1.502	6.53											Ø
Total			68.178												
	AVG 100	AVG 110	AVG 2.199	MIN 6.26	AVG 4	AVG 95	AVG 58	AVG 4.25	AVG 94	AVG 97	GEM 9	AVG 14.1			4.93"
Permit				6	30	83	958	30	81	1217	200				
	AVW 138	AVW 208	MAX 3.533	MAX 7.01	AVW 6		AVW 87	AVW 5		AVW 131	GM7 15	MAX 24.6			
Limits				9	45		1217	45		1825	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249
Facility Name **CAMAS STP** *FINAL LIMITS*
Receiving Water Columbia River
Plant Type Activated Sludge System

Month April
Year 2002
Plant Operator J. Dickinson
Population 12500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			1.501	6.62							5				Ø
2			1.428	6.76											Ø
3	175	138	1.395	6.90	7	96	81	37	73	430	2	13.4			Ø
4	159	172	1.401	7.14	16	90	201	14	92	164					Ø
5			1.338	7.00											.17
6			1.419	7.37											.06
7			1.429	7.08											.04
8			1.619	7.11											.07
9			1.473	7.12							124	25			.71
10	126	84	1.924	7.27	9	93	144	6	93	96	15				.26
11	104	124	2.029	7.26	14	87	237	2	98	34					.01
12			1.883	7.04											.21
13			1.658	7.5											.50
14			2.076	7.10											.04
15			2.179	6.94							32	21.4			.15
16			2.064	6.94											.59
17	90	126	3020	7.14	11	88	277	2	98	50	120				.1[illegible]
18	91	84	2.599	6.95	7	92	152	6	93	130					[illegible]
19			2.120	6.85											Ø
20			1.831	7.09											Ø
21			1.760	7.00											Ø
22			1.793	7.06							24				Ø
23			1.689	6.94								28			Ø
24	132	104	1.611	6.9	3	98	40	4	96	54					Ø
25	165	286	1.646	7.3	4	98	55	6	98	82					Ø
26			1.576	7.13							150				.68
27			1.823	7.08											.01
28			1.668	6.72											Ø
29			1.617	7.00											Ø
30			1.540	6.87											
31			53.[illegible]	109											
Total															
	AVG 130	AVG 140	AVG 1.770	MIN 6.62	AVG 9	AVG 93	AVG 148	AVG 10	AVG 93	AVG 130	GEM 28	AVG 22			3.62
Permit				6	30	83	955	30	81	1217	200				
	AVW 167	AVW 195	MAX 3.020	MAX 7.37	AVW 12		AVW 215	AVW 26		AVW 297	GM7 60	MAX 28			
Limits				9	45		1217	45		1825	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	May
Facility Name	CAMAS STP	Year	2002
Receiving Water	Columbia River	Plant Operator	J. Dickinson
Plant Type	Activated Sludge System	Population	12500

FINAL LIMITS

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN IN.
1	138	90	1.494	7.23	12	91	150	4	96	50		31			Ø
2	111	156	1.488	7.15	6	95	74	15	90	186	12				.01
3			1.500	7.05											Ø
4			1.397	7.23											Ø
5			1.494	7.02											.07
6			1.679	6.94							14				.03
7			1.653	6.86								25			Ø
8	136	120	1.604	7.22	3	98	40	5	96	67	42				Ø
9	112	66	1.582	6.63	13	88	172	5	92	66					.05
10			1.595	6.86											Ø
11			1.403	6.79											Ø
12			1.412	6.92											Ø
13			1.521	6.99							11				.07
14			1.594	6.83											Ø
15	129	142	1.511	7.01	4	97	50	6	96	76	1	23			Ø
16	122	130	1.558	6.97	4	97	52	4	97	52					.24
17			1.526	6.79											Ø
18			1.461	6.92											.09
19			1.498	6.53											.11
20			1.72	6.76							22				.05
21			1.672	6.65											.04
22	148	159	1.682	6.65	5	97	70	8	95	112	4	18			.07
23	123	104	1.655	6.78	5	96	69	9	91	124					Ø
24			1.569	6.79											Ø
25			1.435	6.80											.03
26			1.438	6.94											.02
27			1.368	6.79											.15
28			1.564	6.81											.37
29	164	220	1.760	6.93	9	95	132	8	96	117	4				.11
30	87	142	1.513	6.50	8	91	101	4	97	50	151	12			.14
31			1.410	6.88											Ø
Total			49.328												
	AVG 127	AVG 133	AVG 1.542	MIN 6.50	AVG 7	AVG 95	AVG 91	AVG 7	AVG 95	AVG 90	GEM 11	AVG 22			1.65
Permit				6	30	83	958	30	81	1217	200				
	AVW 136	AVW 181	MAX 1.760	MAX 7.23	AVW 9		AVW 117	AVW 10		AVW 118	GM7 25	MAX 31			
Limits				9	45		1217	45		1825	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	JULY
Facility Name	CAMAS STP	Year	2002
Receiving Water	Columbia River	Plant Operator	JIM DICKINSON
Plant Type	Activated Sludge System	Population	12500

FINAL LIMITS

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			1.505	6.94											Ø
2			1.508	6.88							8				Ø
3	157	230	1.459	6.69	2	99	24	7	97	85		1.7			.05
4	149	158	1.393	6.72	5	97	58	3	98	35					Ø
5			1.351	6.74							1				Ø
6			1.301	6.50											Ø
7			1.367	6.48											.16
8			1.548	6.45							90				.04
9			1.545	6.67											Ø
10	140	134	1.486	6.63	5	96	67	10	93	124		4.8			Ø
11	145	286	1.293	6.63	3	98	32	5	98	54					Ø
12			1.465	6.45							5				Ø
13			1.407	6.46											Ø
14			1.416	6.35											Ø
15			1.513	6.26							10	1.8			Ø
16			1.508	7.10											Ø
17	109	118	1.450	7.31	7	94	85	11	91	133					Ø
18	139	160	1.505	7.01	3	98	38	1	99	13					Ø
19			1.512	6.83							40				Ø
20			1.431	7.0											Ø
21			1.408	6.74											Ø
22			1.459	6.82							12				Ø
23			1.458	6.93											Ø
24	148	124	1.498	6.96	3	98	37	3	98	37		9.6			Ø
25	93	66	1.504	6.84	8	91	100	9	86	113	4				Ø
26			1.537	6.88											Ø
27			1.442	6.78											Ø
28			1.438	6.63											Ø
29			1.492	6.97											Ø
30			1.509	7.04							12				Ø
31	127	130	1.485	7.09	7	94	87	2	98	25					Ø
Total			45.193												
	AVG 134	AVG 156	AVG 1.458	MIN 6.26	AVG 5	AVG 96	AVG 59	AVG 6	AVG 95	AVG 69	GEM 10	AVG 4.5			.25
Permit				6	30	83	955	30	81	1217	200				
	AVW 153	AVW 210	AVW 1.548	MAX 7.31	AVW 5.5		AVW 69	AVW 7.5		AVW 89	GM7 22	MAX 9.6			
Limits				9	45		1217	45		1825	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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Jim Dickinson - Chief Opr.
Name and Title

Jim Dickinson
Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	August
Facility Name	CAMAS STP	*FINAL LIMITS*	Year 2002
Receiving Water	Columbia River	Plant Operator	J. Dickinson
Plant Type	Activated Sludge System	Population	13500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1	148	162	1.482	7.16	RS ~~6~~7	R 9~~6~~5	74	6	96	74		22.2			Ø
2			1.422	7.25											Ø
3			1.406	6.87											.02
4			1.316	7.13											Ø
5			1.425	7.13							25				Ø
6			1.334	7.17											Ø
7	111	130	1.331	7.17	2	98	22	2	98	22					Ø
8	93	106	1.376	7.18	4	~~99~~	46	1	99	11		34.1			Ø
9			1.276	7.14		JD 96					10				Ø
10			1.251	7.12											Ø
11			1.301	7.01											Ø
12			1.409	6.92							7	33.9			Ø
13			1.457	7.07											Ø
14	126	130	1.475	7.06	6	95	74	3	98	37					Ø
15	140	166	1.465	6.85	5	96	61	3	98	37	30				Ø
16			1.486	6.98											Ø
17			1.413	7.13											Ø
18			1.373	7.22							152				Ø
19			1.482	7.13							12				Ø
20			1.485	7.01											0
21	157	126	1.475	7.08	9	94	111	8	94	98					Ø
22	151	154	1.457	7.14	4	97	49	1	99	12		25.9			Ø
23			1.445	6.86											Ø
24			1.450	6.83											Ø
25			1.412	7.09											Ø
26			1.525	6.96							32				Ø
27			1.516	7.06											Ø
28	150	172	1.510	6.89	7.5	95	94	3	98	38		27.9			Ø
29	121	106	1.455	7.10	4	97	49	3	97	36					Ø
30			1.427	6.94							26				Ø
31			1.379	6.88											
Total			44.016												
	AVG 133	AVG 139	AVG 1.419	MIN 6.83	AVG 5	AVG 96	AVG 64	AVG 3	AVG 97	AVG 40.5	GEM 23	AVG 28.8			.02
Permit				6	30	83	955	30	81	1217	200				
	AVW 154	AVW 148	MAX 1.525	MAX 7.25	AVW 6		AVW 80	AVW 4.5		AVW 55	GM7 43	MAX 34.1			
Limits				9	45		1217	45		1826	400				

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GM7=highest 7-day Geometric Mean

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Permit No. WA0020249

Facility Name CAMAS STP

Receiving Water Columbia River

Plant Type Activated Sludge System

FINAL LIMITS

Month September

Year 2002

Plant Operator J. Dickinson

Population 13500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAINFALL
1			1.295	6.85											0
2			1.291	6.94											0
3			1.512	6.85							104				0
4	123	120	1.362	7.00	6	95	66	2	98	22		39.9			0
5	213	106	1.353	6.83	3	99	34	4	96	45	86				0
6			1.392	7.04											0
7			1.423	6.72											0
8			1.438	6.93											0
9			1.492	6.88							0				0
10			1.454	6.79											0
11	216	116	1.428	6.66	2	99	24	1	99	12	5				0
12	118	160	1.463	6.78	4	97	49	4	98	49					0
13			1.470	6.84								24.7			0
14			1.345	6.83											0
15			1.365	6.88											0
16			1.537	6.68											.29
17			1.666	6.87							38				.03
18	121	102	1.541	6.89	4	97	51	3	97	39		15.1			0
19	121	142	1.410	6.81	4	97	47	3	98	35					0
20			1.493	6.64							137				0
21			1.342	6.79											0
22			1.392	6.93											0
23			1.475	6.88							19				0
24			1.447	6.87											—
25	111	100	1.443	6.72	15	86	181	0	100	0					0
26	156	110	1.408	6.85	6	96	70	2	98	23	33				0
27			1.428	6.80								26.3			0
28			1.340	6.90											.05
29			1.348	6.93											.35
30			1.662	6.99											.69
31															
Total			43.015												
	AVG 147	AVG 120	AVG 1.433	MIN 6.64	AVG 5.5	AVG 96	AVG 65	AVG 2	AVG 98	AVG 28	GEM 27	AVG 26.5			1.41"
Permit				6	30	83	956	30	81	1217	200				
	AVW 168	AVW 138	MAX 1.666	MAX 7.04	AVW 10.5		AVW 125.5	AVW 3		AVW 37	GM7 93	MAX 39.9			
Limits				9	45		1217	45		1826	400				

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GM7=highest 7-day Geometric Mean

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Permit No.	WA0020249		Month	October
Facility Name	CAMAS STP	*FINAL LIMITS*	Year	2002
Receiving Water	Columbia River		Plant Operator	Jim Dickinson
Plant Type	Activated Sludge System		Population	13500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			1.881	6.91							70				.01
2	158	206	1.509	7.0	9	94	113	7	97	88		37.9			.11
3	110	144	1.549	7.14	6	98	78	3	98	39					.75
4			2.068	6.85		95.JD									.02
5			1.524	7.0											.07
6			1.560	6.95											0
7			1.459	7.01											0
8			1.426	6.95											0
9	140	112	1.386	6.88	6	96	69	2	98	23	10	38.4			0
10	131	104	1.375	7.04	1	99	11	2	98	23					.04
11			1.337	7.07							0				0
12			1.332	6.85											0
13			1.323	7.11											0
14			1.439	6.86											0
15			1.423	6.97							142				0
16	139	110	1.366	7.14	6	96	68	1	99	11		38.2			0
17	133	134	1.358	7.01	5	96	57	4	97	45					0
18			1.400	6.91							88				0
19			1.326	6.86											0
20			1.289	6.86											0
21			1.431	7.06							20				0
22			1.387	6.92											0
23	114	102	1.391	7.07	7	94	81	2	98	23		29			0
24	174	260	1.392	6.77	3	98	35	1	99	12	14				0
25			1.415	6.78											0
26			1.312	6.84											.01
27			1.322	6.92											.05
28			1.454	6.93							68				.03
29			1.545	6.80											0
30	110	134	1.423	6.83	3	97	36	1	99	12		39.4			0
31	99	81	1.464	6.91	7	93	85	1	99	12					0
Total			44.8668												
	AVG 131	AVG 139	AVG 1.447	MIN 6.80	AVG 5	AVG 96	AVG 63	AVG 2	AVG 98	AVG 29	GEM 24	AVG 37			1.09
Permit				6	30	83	958	30	81	1217	200				
	AVW 144	AVW 181	MAX 2.068	MAX 7.14	AVW 7.5		AVW 96	AVW 5		AVW 64	GM7 110	MAX 39.4			
Limits				9	45		1217	45		1825	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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Name and Title ______________________ Signature ______________________

Permit No. WA0020249

Facility Name CAMAS STP

FINAL LIMITS

Receiving Water Columbia River

Plant Type Activated Sludge System

Month November

Year 2002

Plant Operator J. Dickinson

Population 13500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			Cl-O/R
1			1.475	6.79							186				Ø
2			1.375	6.90											Ø
3			1.383	6.72											Ø
4			1.490	6.71											Ø
5			1.465	6.91							80				Ø
6	105	156	1.465	6.91	3	97	37	1	99	12		40.1			Ø
7	124	140	1.438	6.87	3	98	36	1	99	12					.42
8			1.497	6.73							206				.08
9			1.407	6.83											.06
10			1.573	6.50											.02
11			1.428	6.52											.53
12			1.519	6.70							39				.62
13	170	200	1.836	6.75	10	94	153	3	99	46					.42
14	123	150	1.670	6.50	9	93	125	2	99	28		19.5			.01
15			1.505	6.62							144				Ø
16			1.350	6.77											.14
17			1.543	6.74											Ø
18			1.542	6.65											.58
19			1.91	6.58							85				Ø
20	104	124	1.626	6.56	1	99	14	2	98	27		19.9			Ø
21	141	252	1.514	6.53	1	99	13	2	99	25					Ø
22			1.495	6.66							1				.01
23			1.396	6.50											.01
24			1.425	6.58											Ø
25			1.538	6.55											Ø
26			1.513	6.50							1				Ø
27	127	138	1.433	6.85	7	94	84	Ø	100	Ø		16			Ø
28	144	166	1.460	6.53	4	97	49	2	99	24					Ø
29			1.423	6.68							96				Ø
30			1.32	6.64											
31															
Total			45.0	14											
	AVG 130	AVG 166	AVG 1.50	MIN 6.50	AVG 5	AVG 96	AVG 64	AVG 2	AVG 99	AVG 22	GEM 44	AVG 23.8			2.90
Permit				6	30	85	1955	30	85	1217	200				
	AVW 136	AVW 188	MAX 1.836	MAX 6.91	AVW 10		AVW 139	AVW 2.5		AVW 37	GM7 120	MAX 40.1			
Limits				9	45		1217	45		1825	400				

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Name and Title

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Permit No.	WA0020249		Month	December
Facility Name	CAMAS STP	FINAL LIMITS	Year	2002
Receiving Water	Columbia River		Plant Operator	Jim Dickinson
Plant Type	Activated Sludge System		Population	13500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			5-?D
1			1.421	6.52											⊖
2			1.456	6.52							46				⊖
3			1.484	6.62											.05
169 off 4	[illegible]	232	1.385	6.36	5	97	58	4	98	46	70	17.5			.01
5	79	122	1.464	6.64	1	99	12	0	100	0					⊖
6			1.481	6.60											⊖
7			1.347	6.51											0
8			1.347	6.35											ø
9			1.469	6.47								23.3			.42
10		252	1.576	6.39				2	99	26	30				.39
11	133	118	1.660	6.50	10	92	138	7	94	96	10				.47
12	90	74	2.043	6.60	5	94	85	2	97	34					1.03
13			2.626	6.67											.62
14			2.428	6.38											.12
15			2.294	6.10											1.14
16			2.947	6.63							224				.32
17			3.201	6.23											.24
18	86	52	2.688	6.60	4	96	90	2	96	45					.14
19	92	112	2.188	6.45	12	87	219	6	95	109	8	13.5			⊖
20			1.984	6.31											.33
21			1.954	6.41											.14
22			1.979	6.27											.23
23			1.915	6.40											.23
24			1.737	6.65							55				.08
25	130	106	1.720	6.74	5	96	72	5	95	72					.37
26	138	122	1.745	6.73	11	92	160	1	99	15		29.9			.69
27			2.430	6.72							0				.12
28			2.444	6.70											.42
29			2.562	6.36											.59
30			2.611	6.75											1.24
31			4.462	6.25											.12
Total			62.692												
	AVG 115	AVG 132	AVG 2065	MIN 6.1	AVG 7	AVG 94	AVG 104	AVG 3	AVG 97	AVG 49	GEM 23	AVG 21			9.30
Permit				6	30	83	956	30	81	217	200				
	AVW 134	AVW 148	MAX 4.462	MAX 6.75	AVW 8		AVW 155	AVW 4		AVW 77	GM7 40	MAX 29.9			
Limits				9	45		1217	45		1826	400				

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Permit No.	WA0020249		Month January
Facility Name	CAMAS STP	FINAL LIMITS	Year 2003
Receiving Water	Columbia River		Plant Operator Jim Dickinson
Plant Type	Activated Sludge System		Population 13500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1	86	108	3.361	6.21	8	91	224	1	99	28					.06
2	69	86	2.603	6.21	6	91	130	1	99	22	2	0			.64
3			3.379	6.28											.48
4			3.016	6.38											.21
5			3.367	6.32											0
6			2.555	6.54							80				0
7			2.158	6.58								25.5			0
8	100	132	1.979	6.60	3	97	50	4	97	66					0
9	70	58	1.889	6.50	6	91	95	4	93	63					0
10			1.795	6.76							0				0
11			1.670	6.56											.60
12			2.004	6.61											.28
13			2.454	6.52							1				.41
14			2.521	6.46											/
15	115	120	2.310	6.87	6	95	116	1	99	19		20.3			0
16	101	100	1.996	6.63	7	93	117	1	99	17					0
17			1.885	6.82							8				0
18			1.736	6.70											0
19			1.670	6.59											0
20			1.701	6.61											0
21			1.800	6.60							4				.35
22	96	114	1.756	6.81	3	97	44	3	97	44		35.9			.33
23	107	188	2.211	7.21	4	96	74	2	98	37					.28
24			2.038	6.44							0				.22
25			2.179	6.74											.59
26			2.786	6.40											.15
27			3.147	6.28							<1				.20
28			2.50	6.33											.05
29	124	96	2.179	6.90	12	90	218	3	97	55		28.7			1.35
30	78	76	3.926	6.72	13	83	426	3	98	98	7				1.40
31			4.779	6.41											1.23
Total			75.35												
	AVG 95	AVG 108	AVG 2.43	MIN 6.21	AVG 7	AVG 92	AVG 149	AVG 2.3	AVG 97	AVG 45	GEM 3.2	AVG 22.1			8.83
Permit				6	30	85	955	30	85	1217	200				
	AVW 108	AVW 151	MAX 4.779	MAX 7.21	AVW 12.5		AVW 322	AVW 4		AVW 76	GM7 12	MAX 35.9			
Limits				9	45		1217	45		1825	400				

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GM7=highest 7-day Geometric Mean

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	February
Facility Name	CAMAS STP	Year	2003
Receiving Water	Columbia River	Plant Operator	J. Dickinson
Plant Type	Activated Sludge System	Population	13500

FINAL LIMITS

Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
	INFLUENT				EFFLUENT										
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L	RAIN		
1			5.632	6.27									.06		
2			3.871	6.46									.08		
3			2.832	6.62									.03		
4			2.399	7.07							2		0		
5	52	100	2.11	6.81	11	79	194	2	98	35		22.2	0		
6	83	64	1.906	6.95	11	87	175	0	100	0			0		
7			1.765	6.56							10		0		
8			1.658	6.61									0		
9			[illegible]42	6.59									.04		
10			1.833	7.04									0		
11			1.712	6.66							4		0		
12	159	172	1.482	7.22	19	88	267	5	97	70			0		
13	95	86	1.615	7.02	5	95	67	2	98	27		36.4	0		
14			1.656	6.68							3		.01		
15			1.515	6.80									.44		
16			1.837	6.74									.50		
17			1.972	6.83									1.13		
18			3.496	6.34							3		.13		
19	29	56	2.897	6.44	7	76	48	1	98	24		16.9	.17		
20	195	68	2.481	6.55	16	92	331	1	98	21			.06		
21			2.291	6.54							1		.04		
22			2.080	6.62									.02		
23			2.009	6.29									0		
24			2.020	6.80									0		
25			1868	6.74							2		0		
26	89	108	1.824	6.81	19	79	289	13	88	198		26.6	0		
27	105	122	1.728	6.70	9	91	130	11	91	159			0		
28			1.738	6.77							190		.04		
29															
30															
31															
Total			62.17												
	AVG 101	AVG 97	AVG 2.219	MIN 6.27	AVG 12	AVG 86	AVG 188	AVG 4	AVG 96	AVG 67	GEM 4.7	AVG 25.5	2.75"		
Permit				6	30	83	956	30	81	1217	200				
	AVW 127	AVW 129	MAX 5.632	MAX 7.22	AVW 14		AVW 210	AVW 12		AVW 179	GM7 20	MAX 36.4			
Limits				9	45		1217	45		1826	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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Name and Title

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Permit No.	WA0020249		Month	March
Facility Name	CAMAS STP	FINAL LIMITS	Year	2003
Receiving Water	Columbia River		Plant Operator	J. Dickinson
Plant Type	Activated Sludge System		Population	13500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			1.629	6.86											0
2			1.572	6.73											.22
3			1859	6.83											0
4			1.735	6.78											.11
5	126	110	1.711	7.02	9	93	128	3	97	43	23	32.5			.48
6	104	76	2.090	7.0	11	89	192	1	99	17	5				1.18
7			2.891	6.67											.60
8			4.154	6.42											.49
9			3.735	6.57											.05
10			3474	6.56							4				0
11			2.512	6.67											.07
12	77	64	2.248	7.09	9	88	169	5	92	94		16.6			.65
13	74	78	2.946	6.75	12	84	295	2	97	49					.22
14			2.745	6.39							3				.15
15			2.418	6.66											.23
16			2.720	6.53											.24
17			2.755	6.49											0
18			2.307	6.61							<1				.11
19	134	164	2.259	6.77	6	98	113	1	99	19		26.9			[illegible]
20	86	140	2.385	6.77	6	93	119	2	99	40					.41
21			2.252	6.78											.68
22			3.139	6.53							23				.23
23			3.230	6.24											.09
24			2.808	6.55											.07
25			2.384	6.82											.50
26	112	170	2.371	6.90	8	93	158	7	96	138	27	23.5			.07
27	80	44	2.707	6.83	7	91	158	1	98	23					.01
28			2.291	6.65											0
29			1.995	6.92							4				0
30			1.856	6.48											.33
31			1964	6.67											.18
Total			77.14												
	AVG 99	AVG 106	AVG 2.488	MIN 6.24	AVG 8.5	AVG 91	AVG 166.5	AVG 3	AVG 97	AVG 53	GEM 7	AVG 24.8			7.49
Permit				6	30	83	1955	30	81	1217	200				
	AVW 115	AVW 152	MAX 4.154	MAX 7.09	AVW 10.5		AVW 232	AVW 3.5		AVW 81	GM7 23	MAX 32.5			
Limits				9	45		1217	45		1825	400				

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	APRIL
Facility Name	CAMAS STP *FINAL LIMITS*	Year	2003
Receiving Water	Columbia River	Plant Operator	J. DICKINSON
Plant Type	Activated Sludge System	Population	13500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1		88	2.399	6.7				2	98	40	20				.22
2	79		2.156	6.68	13	84	167								.04
3	110	90	2.043	7.01	12	89	216	6	93	107	10				.05
4			1.821	6.82								35.4			.05
5			1.974	6.85											.26
6			1.965	6.62											.11
7			2.105	6.51											.08
8			1.931	6.74								31.4			.18
9	117	74	1.915	7.19	10	91	161	1	97	16	88				.12
10	162	158	2.072	6.82	14	91	224	1	99	16	18				.18
11			1.879	6.71											.13
12			2.391	6.69											.56
13		JD	2.633	6.65											.03
14		2.277	~~2.059~~	6.45											.03
15			2.039	6.93							5	28.9			.03
16	217	100	2.084	7.06	33	85	561	4	96	68					.46
17	181	102	2.298	6.57	30	83	521	3	97	52					.28
18			2.014	6.64							0				~~0~~
19			1.889	6.81											0
20			1.929	6.80											.13
21			1.944	6.78			JD								.02
22			1.787	6.73	6↓	94↓	92↓				0	33.6			.09
23	101	118	2.360	6.94	~~16~~	~~88~~	~~199~~	1	99	15					.50
24	147	322	2.337	6.94	6	96	117	2	99	39	1.6				.08
25			2.053	6.95											.15
26			1.995	6.86											.03
27			1.882	6.84											.01
28			1.903	6.68											.14
29			1.736	6.68							20	33.2			.07
30	101	103	1.746	6.91	6	94	87	6	94	87					.01
31															
Total			61.557												4.04
	110	128	2.052	6.45	15	90	238	3	97	49	10	32.5			
Permit				8	30	83	956	30	83	[illegible]	200				
	199	220	2.633	7.19	31.5		541	3.5		74	28	35.4			
Limits				9	45		[illegible]	45		[illegible]	400				

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GM7=highest 7-day Geometric Mean

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	May
Facility Name	CAMAS STP	*FINAL LIMITS* Year	2003
Receiving Water	Columbia River	Plant Operator	J. Dickinson
Plant Type	Activated Sludge System	Population	13500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			Cl-R
1	153	184	1.653	7.12	13	92	189	5	97	73	5				Ø
2			1.622	7.06											Ø
3			1.699	6.81											.23
4			1.853	6.68											.23
5			1.746	7.00											.08
6			1.616	6.81							5				.01
7	169	142	1.659	7.16	12	93	162	3	98	40					.15
8	139	188	1.586	6.98	3	98	42	1	99	14	11				Ø
9			1.529	6.84								35.4			Ø
10			1.591	6.83											Ø
11			1.632	6.87											.10
12			1.668	6.69											.01
13			1.548	6.72							0				Ø
14	104	108	1.611	7.10	4	96	52	5	95	65		34.1			Ø
15	213	184	1.692	6.93	13	94	175	3	98	40	0				.13
16			1.892	6.73											.61
17			1.838	6.77											.34
18			1.788	6.67											Ø
19			1.775	6.99											Ø
20			1.616	6.91								34.3			Ø
21	94	96	1.597	7.00	6	94	81	3	97	40	10				Ø
22	174	141	1.564	7.35	18	90	240	5	96	67	47				Ø
23			1.510	6.79											Ø
24			1.524	6.51											.10
25			1.432	6.67											.01
26			1.616	6.58											Ø
27			1.512	6.71											Ø
28	152	126	1.612	6.99	5	97	63	2	98	25	7	39.9			Ø
29	164	202	1.429	6.80	10	94	134	2	99	27	35				Ø
30			1.410	6.70											Ø
31			1.477	6.71											Ø
Total			51.889												2.0
	AVG 151	AVG 152	AVG 1.67	MIN 6.51	AVG 9.33	AVG 94	AVG 126	AVG 3	AVG 97	AVG 43	GEM 11	AVG 36			
Permit				8	30	83	1956	30	81	1217	200				
	AVW 159	AVW 165	MAX 1.892	MAX 7.35	AVW 12		AVW 161	AVW 4		AVW 54	GM7 20	MAX 39.9			
Limits				9	45		1217	45		1826	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249		Month	June
Facility Name	CAMAS STP	*FINAL LIMITS*	Year	2003
Receiving Water	Columbia River		Plant Operator	J. Dickinson
Plant Type	Activated Sludge System		Population	13500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			J-ØR
1			1.571	6.42											ø
2			1.504	6.54											ø
3			1.513	6.54								20.6			ø
4	226	213	1.507	6.75	7	97	88	2	99	25	3				ø
5	165	172	1.498	6.84	10	94	126	2	99	25					ø
6			1.447	6.54							13				ø
7			1.424	6.57											ø
8			1.559	6.79											ø
9			1.561	6.62											ø
10			1.612	6.59								7.8			ø
11	197	180	1.520	7.01	16	92	215	1	99	13	30				ø
12	119	118	1.511	7.05	3	97	38	1	99	13					.11
13			1.573	6.65							7				.06
14			1.433	6.32											ø
15			1.518	6.46											ø
16			1.519	6.72								5.6			ø
17			1.533	7.08											ø
18	148	276	1.576	7.04	2	99	26	4	99	51	0				ø
19	177	290	1.551	7.28	3	98	39	3	99	39					ø
20			1.521	6.75											.18
21			1.485	6.63							0				.17
22			1.596	6.43											ø
23			1.562	6.92											ø
24			1.495	6.66											ø
25	120	142	1.445	6.88	4	97	50	3	98	37	5	10.6			ø
26	131	126	1.5	7.21	7	95	95	6	95	72	26				ø
27			1.5	6.72											ø
28			1.5	6.74											ø
29			1.5	6.67											ø
30			1.5	6.77											ø
31															
Total			45.565												
	AVG 160	AVG 190	AVG 1.520	MIN 6.32	AVG 6.5	AVG 96	AVG 85	AVG 3	AVG 98	AVG 34	GM 6	AVG 11.15			.52"
Permit				8	30	83	955	30	8	217	200				
	AVW 196	AVW 283	MAX 1.612	MAX 7.21	AVW 9.5		AVW 126.5	AVW 4.5		AVW 54.5	GM7 13	MAX 20.6			
Limits				9	45		1217	45		1326	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	July
Facility Name	CAMAS STP *FINAL LIMITS*	Year	2003
Receiving Water	Columbia River	Plant Operator	J. Dickinson
Plant Type	Activated Sludge System	Population	14200

	INFLUENT		EFFLUENT												
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			5-0R
1			1.5/est	6.77								12.6			Ø
2	191	80	1.423	6.98	5	97	63	8	90	100	5				Ø
3	123	144	1.374	6.94	4	97	47	2	99	24	30				Ø
4			1.368	6.78											Ø
5			1.424	6.85											Ø
6			1.509	6.76											Ø
7			1.521	6.73							32				Ø
8			1.512	6.77											Ø
9	93	106	1.529	6.90	10	89	126	6	94	76		21.9			Ø
10	112	108	1.476	7.07	4	96	51	2	98	26	18				Ø
11			1.477	6.70											Ø
12			1.432	6.68											Ø
13			1.529	6.34											Ø
14			1.55	6.73											Ø
15			1.567	6.76							4				Ø
16	133	240	1.494	6.81	9	93	118	9	96	118		23.3			Ø
17	215	258	1.498	7.00	6	97	75	4	98	50					Ø
18			1.40	6.72							13				Ø
19			1.360	6.63											Ø
20			1.463	6.44											Ø
21			1.488	6.70											Ø
22			1.519	6.63							5				Ø
23	130	170	1.558	6.85	7	95	89	2	99	25		22.3			Ø
24	143	188	1.465	6.83	4	97	52	4	98	52	30				Ø
25			1.458	6.56											Ø
26			1.468	6.66											Ø
27			1.533	6.82											Ø
28			1.561	6.78							2				Ø
29			1.526	6.62											Ø
30	194	284	1.518	6.65	2	99	25	2	99	25					Ø
31	119	112	1.496	6.93	16	87	203	4	96	51	2				Ø
Total			44.572												
	AVG 145	AVG 169	AVG 1.483	MIN 6.34	AVG 7	AVG 95	AVG 85	AVG 4.3	AVG 97	AVG 55	GM 8.5	AVG 20			Ø
Permit				6	30	83	955	30	81	217	200				
	AVW 174	AVW 249	MAX 1.567	MAX 7.07	AVW 9		AVW 114	AVW 6.5		AVW 84	GM7 27	MAX 23.3			
Limits				9	45		1217	45		1825	400				

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249
Facility Name CAMAS STP — *FINAL LIMITS*
Receiving Water Columbia River
Plant Type Activated Sludge System

Month AUGUST
Year 2003
Plant Operator JIM DICKINSON
Population 14 200

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			1.507	6.66											
2			1.486	6.75											Ø
3			1.453	6.78											Ø
4			1.464	6.61							20				Ø
5			1.412	6.63											Ø
6	209	350	1.408	6.66	3	99	35	1	99	12		20.6			.05
7	168	152	1.396	7.15	3	98	35	6	96	70					Ø
8			1.382	6.75							9				Ø
9			1.457	6.76											.01
10			1.516	6.76											.01
11			1.505	6.70							23				Ø
12			1.422	6.73											Ø
13	211	296	1.500	682	2	99	24	1	99	12		27.4			Ø
14	141	234	1.487	7.30	4	97	50	5	98	63	35				Ø
15			1.493	7.11											Ø
16			1.447	7.07											Ø
17			1.461	7.11											Ø
18			1.539	7.13											Ø
19			1.452	7.24							53				Ø
20	66	218	1.436	7.43	7	89	85	7	97	85					Ø
21	185	180	1.430	7.02	3.5	98	42	1	99	12		39.6			Ø
22			1.498	7.29							20				Ø
23			1.387	7.08											.02
24			1.400	7.24											Ø
25			1.449	7.23							12				Ø
26			1.446	7.09											Ø
27	158	208	1.433	7.32	5	97	60	4	98	48		33.4			Ø
28	176	170	1.437	7.43	5	97	60	3	98	36					Ø
29			1.422	7.07							46				Ø
30			1.474	6.99											Ø
31			1.353	7.21											
Total			44.955												0.09
	AVG 164	AVG 226	AVG 1.45	MIN 6.61	AVG 4	AVG 97	AVG 49	AVG 4	AVG 98	AVG 42	GEM 15	AVG 30			
Permit				6	30	85	1958	30	85	1217	200				
	AVW 789	AVW 265	MAX 1.539	MAX 7.43	AVW 5		AVW 64	AVW 4		AVW 49	GM7 40	MAX 39.6			
Limits				9	45		1217	45		1826	400				

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Permit No.	WA0020249	Month	September
Facility Name	CAMAS STP	Year	2003
Receiving Water	Columbia River	Plant Operator	J. Dickinson
Plant Type	Activated Sludge System	Population	14200

FINAL LIMITS

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			Rain
1			1.593	6.95											Ø
2			1.531	7.01											Ø
3	190	222	1.642	7.39	14	93	179	4	98	51	86				Ø
4	183	124	1.547	7.0	18	90	246	5	96	68		24			Ø
5			1.462	7.05							44				Ø
6			1.481	7.04											.03
7			1.858	7.01											.56
8			1.618	7.01											.15
9			1.702	7.04								34.5			.12
10	146	166	1.608	7.11	6	96	85	7	96	99	143				.05
11	213	262	1.571	7.23	5	98	67	3	99	40					.03
12			1.442	7.00							195				Ø
13			1.455	6.80											.02
14			1.551	6.93											Ø
15			1.605	7.09							30				.08
16			1.658	7.01											.18
17	176	190	1.524	7.29	4	98	55	4	98	55		23.7			.06
18	159	260	1.519	7.16	10	94	127	3	99	38	1000				.04
19			1.515	7.33											.0[illegible]
20			1.474	6.8											.02
21			1.597	6.99											Ø
22			1.526	7.24											Ø
23			1.565	7.29							1				Ø
24	217	190	1.488	7.10	42	81	548	11	94	144		27.7			Ø
25	171	236	1.464	7.09	15	91	186	6	97	74					Ø
26			1.502	6.91							1				0
27			1.467	6.8											Ø
28			1.516	7.10							0				Ø
29			1.535	7.07											Ø
30			1.458	7.10											Ø
31															
Total			46.474									24			
	AVG 182	AVG 206	AVG 1.549	MIN 6.80	AVG 14	AVG 93	AVG 187	AVG 5	AVG 97	AVG 71	GM 19	AVG 27.5			1.36
Permit				6	30	83	958	30	81	1217	200				
	AVW 194	AVW 225	MAX 1858	MAX 7.39	AVW 29		AVW 367	AVW 8.5		AVW 109	GM7 55	MAX 34.5			
Limits				9	45		1217	45		1825	400				

175

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GM7=highest 7-day Geometric Mean

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Name and Title ______________________ Signature ______________________

Permit No.	WA0020249		Month	October
Facility Name	CAMAS STP	FINAL LIMITS	Year	2003
Receiving Water	Columbia River		Plant Operator	Jim Dickinson
Plant Type	Activated Sludge System		Population	14200

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAINFALL
1	152	164	1.469	7.32	8	95	97	4	98	49	76	34.8			0
2	196	178	1.474	7.3	12	94	147	5	97	61					.02
3			1.342	7.13							64				.02
4			1.480	6.8											0
5			1.614	6.92											0
6			1.564	7.04							54				.08
7			1.569	7.07											.02
8	201	272	1.663	6.93	7	97	92	2	99	26		27.3			.02
9	65	58	2.045	7.23	61	6	846	3	95	42					1.31
10			1.607	7.09							5				.05
11			1.822	6.5											.35
12			1.734	6.95											0
13			1.726	6.98							6				.03
14			1.644	7.01											0
15	139	127	1.904	7.23	6	96	82	4	97	55		36.4			.55
16	179	138	1.715	7.36	22	87	349	5	96	79	33				0
17			1.520	6.91											0
18			1.612	6.5											.29
19			1.737	6.86											0
20			1.691	7.03											.01
21			1.628	7.00							633				0
22	222	318	1.625	7.24	9	96	122	3	99	41		37.5			.14
23	146	126	1.579	7.41	7	95	95	4	97	54					.01
24			1.443	7.11							2				0
25			1.472	6.5											0
26			1.537	7.15											0
27			1.568	7.21							5				.01
28			1.531	7.27											.13
29	124	106	1.673	7.50	6	95	77	3	97	38		45.5			.05
30	138	98	1.590	7.51	10	93	140	1	99	14					0
31			1.609	7.27							10				0
Total			50.189												3.09
	AVG 156	AVG 159	AVG 1.619	MIN 6.5	AVG 148	AVG 85	AVG 205	AVG 3.4	AVG 97	AVG 46	GEM 21	AVG 36.3			
Permit				6	30	83	958	30	81	1217	200				
	AVW 184	AVW 222	MAX 2045	MAX 7.51	AVW 34		AVW 469	AVW 4.5		AVW 67	GM7 37	MAX 45.5			
Limits				9	45		1217	45		1825	400				

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	NOVEMBER
Facility Name	CAMAS STP *FINAL LIMITS*	Year	2003
Receiving Water	Columbia River	Plant Operator	JIM DICKINSON
Plant Type	Activated Sludge System	Population	14200

	INFLUENT		EFFLUENT												
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			RAIN
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			
1			1.608	7.5											7
2			1.717	7.22											0
3			1.675	7.19							3				0
4	140	180	1.645	7.21	5	96	69	3	98	41		35.8			0
5	121	112	1.581	7.43	6	95	79	3	97	40					0
6			1.567	7.40											0
7			1.586	7.12							20				0
8			1.539	7.5											.01
9			1.664	7.18											.01
10			1.707	7.20							14				.30
11	162	222	1.655	7.13	10	94	138	8	96	110					.01
12	214	196	1.589	7.35	10	95	132	7	96	93		34.4			0
13			1.533	7.38											0
14			1.514	7.10							0				.11
15			1.704	7.5											.28
16			1.968	7.21											.42
17			1.795	7.30							10				.14
18	155	160	1.984	7.02	10	94	165	6	96	99		25.5			.93
19	92	106	3.093	7.24	9	90	232	3	97	77					.57
20			2.437	7.28											.17
21			2.160	6.98							142				.24
22			1.987	7.40											.05
23			2.078	7.02											.26
24			2.160	7.14							42				.21
25	148	146	2.240	7.11	10	93	187	4	97	75					.25
26	150	158	1.951	7.36	9	94	146	5	97	81	161	37.2			.03
27			1.800	7.36											.01
28			2.351	7.20											1.27
29			2.714	7.14											.03
30			2.188	7.13											.27
31															
Total			57.09												
	AVG 148	AVG 160	AVG 1.903	MIN 6.98	AVG 8.6	AVG 94	AVG 144	AVG 5	AVG 97	AVG 77	GM 17.3	AVG 33			5.57
Permit				6	30	85	1958	30	85	1217	200				
	AVW 188	AVW 209	MAX 3.093	MAX 7.50	AVW 10		AVW 199	AVW 7.5		AVW 102	GM7 82	MAX 37.2			
Limits				9	45		1217	45		1825	400				

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	DECEMBER
Facility Name	CAMAS STP	FINAL LIMITS	Year 2003
Receiving Water	Columbia River	Plant Operator	JIM DICKINSON
Plant Type	Activated Sludge System	Population	14200

	INFLUENT		EFFLUENT												
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			2.114	7.15											.02
2	103	48	2.088	7.09	9	91	157	2	96	35	48	31.3			.34
3	127	184	2.080	7.34	10	92	173	5	97	87					Ø
4			2.522	7.41											1.12
5			3.781	7.03							278				.68
6			2.706	7.15											.22
7			2.973	6.83											.37
8			2.427	6.92											.02
9	120	202	2.135	6.95	10	92	178	7	97	125		32.7			.15
10	130	130	2.272	7.17	7	95	133	5	96	94	2				.20
11			2.522	7.26											.61
12			2.827	7.06							5				.38
13			5.337	7.19											2.11
14			3.904	6.60											.08
15			2.797	6.79							15				Ø
16	167	246	2.451	7.01	7	96	143	3	99	61					.13
17	169	174	2.214	7.21	10	94	185	6	97	110		25.6			Ø
18			2.089	7.12											Ø
19			1.881	6.97							5				.04
20			2.046	7.32											.41
21			2.154	7.05							7				.03
22			2.012	7.06											Ø
23	145	120	2.006	7.01	10	93	167	2	98	33					.25
24	144	132	2.483	7.26	5	97	104	3	98	62	2				.66
25			2.590	7.23								38.1			.06
26			2.223	7.03											.30
27			2.717	7.12											.36
28			3.258	7.10											.45
29			2.746	6.83							2				Ø
30	143	153	2.246	6.81	7	95	131	4	97	75		27.8			
31	124	92	2.156	7.11	9	93	162	4	96	72	3				
Total			67.146												
	AVG 137	AVG 148	AVG 2.166	6.60	AVG 8.5	AVG 94	AVG 153	AVG 4	AVG 97	AVG 75	7.8	AVG 31			8.99
Permit				8.5	30	83	956	30	83	217	200				
	168	210	5.337	MAX 7.41	9.5		164	6		AVW 110	115.5	38.1			
Limits				9	45		1217	45		1825	400				

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GM7=highest 7-day Geometric Mean

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249
Facility Name CAMAS STP
Receiving Water Columbia River
Plant Type Activated Sludge System

FINAL LIMITS

Month January
Year 2004
Plant Operator J. Dickinson
Population 14200

Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
	INFLUENT				EFFLUENT										
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			Rain
1			2.149	7.16											
2			2.592	6.76											.45
3			2.511	7.11											.22
4			2.390	7.07											.05
5			2.139	6.93											0
6	176	182	2.092	7.12	8	95	140	2	99	35	2				.25
7	153	172	1.975	7.09	6	96	99	2	99	33					.15
8			2.075	7.25											.30
9			2.703	6.96							10	40.0			.20
10			2.844	7.10											.05
11			2.733	7.07											0
12			2.635	6.91											.01
13	182	116	2.45	6.92	4.5	96	92	2	98	41	3	31.4			.03
14	145	124	2.704	6.92	13	91	293	2	98	45					.01
15			2.583	7.12											.32
16			2.114	6.93											.08
17			2.060	7.10							13				.05
18			2.307	7.00											.03
19			2.785	7.14											.06
20	95	132	2.214	6.98	3	97	55	2	98	37	200				.06
21	128	118	2.058	6.89	18	86	309	9	92	154		28.0			0
22			2.157	7.11											0
23			4.227	6.99											.49
24			3.914	6.87							7				1.39
25			3.249	6.81											.31
26			3.198	6.83											.24
27	145	114	2.687	6.83	9	94	202	3	97	67	7	22.8			.08
28	73	72	3.918	7.10	6	92	196	2	97	65					.20
29			4.162	7.04											.95
30			3.418	6.72											.51
31			2.902	6.99							20				.05
Total			84.215												.19
	avg 127	avg 129	avg 2.707	min 6.72	avg 8	avg 93	avg 173	avg 3	avg 97	avg 60	gm 10.2	avg 30.5			6.73
Permit				8	30	83	1958	30	83	2117	200				
	avw 165	avw 177	max 4.227	max 7.25	avw 10.5		avw 199	avw 5.5		avw 96	gm7 37.4	max 40			
Limits				6	45		3217	45		3326	400				

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	February
Facility Name	CAMAS STP *FINAL LIMITS*	Year	2004
Receiving Water	Columbia River	Plant Operator	J. DICKINSON
Plant Type	Activated Sludge System	Population	14200

	INFLUENT		EFFLUENT												
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			2.717	6.87											.23
2			2.536	6.90											.02
3	173		2.264	6.92	12	93	227					29.9			.18
4	58	92	2.175	7.23	7	88	127	4	96	75					.03
5		41	2.012	7.15				3	93	54	4				.05
6			2.222	7.21							2				.39
7			2.148	7.12											.09
8			2.141	6.89											.02
9			2.010	6.98							3				0
10	102	116	2.941	6.95	5	95	123	3	97	74		31.6			0
11	131	118	1.859	7.03	7	95	109	2	98	31					0
12			1.768	7.11											0
13	*		1.783	6.94							6				.22
14			1.890	6.92											.29
15			1.896	6.73											.21
16			3.026	6.86							4				.64
17	120	116	3.797	7.23	28	77	887	6	95	190					1.20
18	81	54	3.611	6.97	16	80	482	3	94	90					.19
19			2.805	7.29											0
20			2.265	7.01							1	24.7			.01
21			2.204	6.72											0
22			2.245	6.82											.05
23			2.229	7.23							0				.38
24	129	224	2.271	7.00	10	92	189	3	99	57					.21
25	101	78	2.696	7.33	9	91	202	5	94	112		24.5			.51
26			2.903	7.28							3				.23
27			2.650	7.04											.31
28			2.388	6.72											.02
29			2.572	7.02											.29
30															
31															
Total			70.02												
	avg 112	avg 105	avg 2.421	min 6.72	avg 12	avg 89	avg 293	avg 4	avg 96	avg 85	gm 2.5	avg 27.6			5.77
Permit				8	30	83	1956	30	81	[illegible]	200				
	max 117	max 151	max 3.797	max 7.33	avw 22		avw 685	avw 4.5		avw 140	gm7 4.2	max 31.6			
Limits				9	45		[illegible]	45		1826	400				

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	MARCH
Facility Name	CAMAS STP	Year	2004
Receiving Water	Columbia River	Plant Operator	J. DICKINSON
Plant Type	Activated Sludge System	Population	14200

FINAL LIMITS

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			2.279	7.17							3				Ø
2	107	102	2.102	7.20	9	92	158	9	91	158		30.5			.03
3	95	66	2.663	7.43	2.5	97	56	5	92	111					.59
4			2.435	7.26							1				.10
5			2.368	7.14											.31
6			2.165	7.11											.10
7			2.246	7.13											.01
8			1.953	7.09							2				Ø
9	115	90	1.968	7.14	6	95	98	4	96	66					Ø
10	135	148	1.855	7.36	5	96	77	1	99	15	0				Ø
11			1.838	7.34											Ø
12			1.673	7.27											.01
13			1.690	6.78											Ø
14			1.815	7.24											Ø
15			1.713	7.17	↓8	93	111				0				Ø
16	121	104	1.659	7.21	~~4~~	~~96~~	~~58~~	4	96	55		32.9			Ø
17	108	88	1.631	7.44	5	95	95	2	98	27					Ø
18			1.776	7.35							3				.10
19			1.617	7.23											.10
20			1.599	6.84											Ø
21			1.713	7.15											Ø
22			1.669	7.13							0				Ø
23	164	206	1.65	7.15	10	94	138	4	98	55		38.0			.16
24	133	130	1.694	7.29	7	95	99	1	99	14					.07
25			1.939	7.43											.31
26			1.886	7.19							2				.26
27			1.806	6.76											Ø
28			1.780	7.12											Ø
29			1.826	7.20											.08
30	151	155	1.787	7.29	16	89	238	5	97	75					.14
31	233	236	1.701	7.62	13	94	184	2	99	28	15				Ø
Total			58.496												
	AVG 136	AVG 133	AVG 1.949	MIN 6.76	AVG 8	AVG 94	AVG 125	AVG 4	AVG 97	AVG 60	GM 2	AVG 33.8			2.28
Permit	[illegible]	[illegible]	[illegible]	[illegible]	30	83	[illegible]	30	83	[illegible]	200	[illegible]			
	AVW 192	AVW 196	MAX 2.663	MAX 7.62	AVW 15		AVW 211	AVW 7		AVW 135	GM7 5	MAX 38			
Limits	[illegible]	[illegible]	[illegible]	[illegible]	45	[illegible]	[illegible]	45	[illegible]	[illegible]	400	[illegible]			

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month April
Facility Name CAMAS STP | *FINAL LIMITS* | Year 2004
Receiving Water Columbia River | Plant Operator J. Dickinson
Plant Type Activated Sludge System | Population 14200

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			Rain
1			1.66	7.48											0
2			1.542	7.38							2				0
3			1.512	6.78											0
4			1.163	7.15											0
5			1.525	7.22											0
6	67	58	1.555	7.19	11	84	143	5	91	65					0
7	119	180	1.597	7.41	12	90	160	7	96	93	69				0
8			1.547	7.52											0
9			1.476	7.22							117				0
10			1.495	6.78											0
11			1.564	7.12											0
12			1.606	7.38							20				0
13	186	142	1.545	7.33	10	94	129	7	95	90		39.8			.06
14	116	126	1.707	7.36	5	96	71	1	99	14					.48
15			1.706	7.49											.05
16			1.586	7.42							11				.01
17			1.612	6.90											.03
18			1805	7.15							6				.08
19			1.784	7.20											.28
20	126	106	1.877	7.26	5	96	78	3	97	47					.44
21	118	106	1.820	7.40	9	92	137	5	95	76		27.7			0
22			1.634	7.26							5				0
23			1.567	7.26											0
24			1.549	6.89											0
25			1.605	7.30											0
26			1.577	7.54											0
27	191	218	1.838	7.32	9	95	138	3	99	46					0
28	157	130	1.844	7.61	16	90	246	9	93	138	24	49.6			0
29			1.820	7.14											0
30			1.688	7.19							72				0
31															
Total			48.806												
	AVG 133	AVG 133	AVG 1.626	MIN 6.78	AVG 10	AVG 92	AVG 138	AVG 4	AVG 96	AVG 71	GM 18	AVG 39			1.43"
Permit	[illegible]	[illegible]	[illegible]	[illegible]	30	83	[illegible]	30	[illegible]	[illegible]	200	[illegible]			
	AVW 174	AVW 174	MAX 1877	MAX 7.61	AVW 12.5		AVW 192	AVW 6		AVW 92	GM7 48	MAX 49.6			
Limits	[illegible]	[illegible]	[illegible]	[illegible]	45	[illegible]	[illegible]	45	[illegible]	[illegible]	400	[illegible]			

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249

Facility Name CAMAS STP — *FINAL LIMITS*

Receiving Water Columbia River

Plant Type Activated Sludge System

Month May

Year 2004

Plant Operator J. Dickinson

Population 14200

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			Rain
1			1.717	6.8											Ø
2			1.824	7.51											Ø
3			1.832	7.36											Ø
4	126	124	1.915	7.29	12	90	192	5	96	80					Ø
5	~~127~~	188	1.841	7.40	13	90	200	4	98	61	233	43.5			Ø
6	127↑		1.786	7.46											.01
7			1.839	7.54							84				.20
8			1.884	7.08											.11
9			1.918	7.25											Ø
10			2.037	7.26											.18
11	149	101	1.921	7.36	11	93	176	14	86	224					.02
12	169	117	1.935	7.54	19	89	307	4	97	65	Ø				.01
13			1.871	7.62								47.8			Ø
14			1.788	7.15							Ø				Ø
15			1.859	6.87											.04
16			1.937	7.08											Ø
17			1.895	7.33							Ø				.06
18	134	95	1.903	7.30	20	85	317	5	95	79					Ø
19	166	264	1.890	7.36	20	88	315	8	97	126					
20			1.844	7.42								55.2	JD		Ø
21			1.798	7.35							Ø	~~64.5~~			.02
22			2.089	6.88											.59
23			2.206	6.89											.19
24			1.998	7.33											Ø
25	143	180	1.842	7.23	8	94	123	3	98	46	Ø				Ø
26	150	188	2.014	7.38	17	89	286	5	97	84		49.4			.10
27			2.513	7.30											.07
28			2.446	7.25							Ø				.02
29			2.127	6.76											.01
30			1.995	6.77											.02
31			2.088	6.78											
Total			~~64.51~~	60.552											
	AVG 146	AVG 157	AVG 1.921	6.76	AVG 15	AVG 90	AVG 240	AVG 6	AVG 96	AVG 96	GEM 3.44	AVG 48.9			1.65
Permit				6.8	30	83	956	30	83	717	200				
	159	184	2.513	7.62	20		AVW 316	9		745	140	55.2			
Limits				9	45		1217	45		1076	400				

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GM7=highest 7-day Geometric Mean

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Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	JUNE
Facility Name	CAMAS STP *FINAL LIMITS*	Year	2004
Receiving Water	Columbia River	Plant Operator	J. DICKINSON
Plant Type	Activated Sludge System	Population	14500

	INFLUENT		EFFLUENT												
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			
1	143	124	1.864	7.25	6	96	93	1	99	16					⊖
2	125	116	1.857	7.42	4	97	62	2	98	31	⊖				⊖
3			1.861	7.53								35.7			⊖
4			1.773	7.33							⊖				⊖
5			1.994	6.81											⊖
6			2.264	7.34											.54
7			2.129	7.14							⊖				.37
8	137	307	2.603	7.23	7	95	152	2	99	43					.51
9	165	296	2.480	7.55	7	96	145	2	99	41					.10
10			2.465	7.38							⊖	20.8			⊖
11			2.105	7.26											⊖
12			1.972	6.71											⊖
13			2.109	7.16											⊖
14			1.995	7.27											⊖
15	158	258	1.931	7.23	6	96	97	3	99	48	⊖				⊖
16	125	122	1.911	7.44	4	97	64	3	98	48		36.8			⊖
17			1.893	7.42											⊖
18			1.830	7.11							⊖				⊖
19			1.830	6.70											⊖
20			1.924	7.21											⊖
21			1.890	7.15							⊖				⊖
22	170	274	1.921	7.19	15	91	240	2	99	32		35.2			⊖
23	122	204	1.915	7.40	9	93	144	4	98	64					⊖
24			1.998	7.38											⊖
25			1.835	7.28							⊖				⊖
26			1.855	6.77											/
27			1.931	7.45											/
28			1.968	7.49											⊖
29	120	146	1.888	7.49	15	88	236	3	98	47					/
30	191	266	1.902	7.52	8	96	127	3	99	48	⊖				⊖
31															
Total			59.89	3											
	146	211	1.996	6.70	8	94.5	136	2.5	98.6	42	0	32.1			1.52
Permit	[illegible]	[illegible]	[illegible]	8	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	156	302	2.603	7.55	12		194	3		48	0	36.8			
Limits	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

AVG=Average AVW=Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

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Name and Title ______________________ Signature ______________________

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	JULY
Facility Name	CAMAS STP *FINAL LIMITS*	Year	2004
Receiving Water	Columbia River	Plant Operator	JIM DICKINSON
Plant Type	Activated Sludge System	Population	14500

	INFLUENT		EFFLUENT												
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			1.787	7.37											Ø
2			1.829	7.21											/
3			1.872	6.97											/
4			1.702	7.14											Ø
5			1.938	7.13											/
6	194	190	1.887	7.21	9	95	142	4	98	63	Ø<1	JD			Ø
7	115	118	1.913	7.40	5	96	80	2	98	32					/
8			1.861	7.51							Ø<1	JD			Ø
9			1.821	7.05								18.4			Ø
10			1.808	6.48											/
11			1.850	6.46											Ø
12			1905	7.12											.12
13	173	142	1.953	7.07	7.5	93	122	6	96	98	Ø<1	JD			Ø
14	137	129	1.843	7.36	12	91	187	3	98	47					Ø
15			1.864	7.24								36.5			Ø
16			1.762	7.25							Ø<1	JD			Ø
17			1.864	7.41											/
18			1.821	7.22											.12
19			1.842	7.28							Ø<1	JD			Ø
20	186	232	1.842	7.25	4	98	61	1	99	15					Ø
21	157	208	1.813	7.36	28	82	423	1	99	15		27.6			/
22			1.866	7.21							Ø<1	JD			Ø
23			1.759	7.13											Ø
24			1.760	7.18											/
25			1.856	7.28											Ø
26			1.811	7.24							JD				Ø
27	133	166	1.810	7.26	8	94	121	4	98	60	Ø<1	31.2			Ø
28	206	216	1.786	7.32	6	97	89	1	99	15					Ø
29			1.821	7.46							<1				Ø
30			1.832	7.24											Ø
31			1.787	7.24											Ø
Total			56.805												
	AVG 155	AVG 175	AVG 1.834	MIN 6.46	AVG 10	AVG 93	AVG 153	AVG 3	AVG 98	AVG 43	GM <1	AVG 28.4			.24
Permit				8	30	83	1955	30	[illegible]	217	200				
	AVW 172	AVW 220	MAX 1.953	MAX 7.51	AVW 16		AVW 242	AVW 4.5		AVW 73	GM7 <1	MAX 36.5			
Limits				9	45		[illegible]	45		325	400				

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	August
Facility Name	CAMAS STP — FINAL LIMITS	Year	2004
Receiving Water	Columbia River	Plant Operator	Jim Dickinson
Plant Type	Activated Sludge System	Population	14500

	INFLUENT				EFFLUENT										
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			1.866	7.22											Ø
2			1.966	7.16							<1				Ø
3	180	210	1.817	7.20	4	98	61	2	99	30					Ø
4	152	130	1.887	7.30	6	96	94	4	97	63					.36
5			1.847	7.31								37.9			Ø
6			1.911	7.22							<1				.35
7			1.721	6.58											Ø
8			1.840	7.15											Ø
9			1.764	7.18							<1				Ø
10	150	196	1.805	7.11	8	95	120	5	97	75					Ø
11	106	108	1.803	7.31	4	96	60	1	99	15					Ø
12			1.831	7.34								29.5			Ø
13			1.809	7.31							<1				Ø
14			1.847	6.59											Ø
15			1.879	7.16											Ø
16			1.897	7.19											Ø
17	147	142	1.854	7.25	9	94	139	5	96	77	<1	.5			Ø
18	201	312	1.905	7.28	3	99	48	2	99	32					Ø
19			1.850	7.30											Ø
20			1.753	7.06							<1				Ø
21			2.041	6.62											.67
22			2.671	7.23											.58
23			2.310	7.16											.28
24	104	92	2.485	7.08	6	94	124	5	95	104					.96
25	126	98	2.580	6.96	9.5	92	204	5	95	107		15.3			.29
26			2.725	7.05							<1				.42
27			2.249	7.38							<1				Ø
28			2.038	6.51											Ø
29			2.036	7.02											Ø
30			2.040	7.26							<1				Ø
31	93	230	1.820	7.53	8	91	121	3	98	[illegible]					Ø
Total			62.247												
	AVG 140	AVG 169	AVG 1.995	MIN 6.51	AVG 6	AVG 95	AVG 108	AVG 3.5	AVG 97	AVG 65	GEM <1	AVG 20.8			3.91
Permit				[illegible]	30	83	[illegible]	30	[illegible]	[illegible]	200				
	AVW 174	AVW 227	MAX 2.725	MAX 7.53	AVW 8		AVW 764	AVW 5		AVW 706	GM7 <1	MAX 37.9			
Limits				[illegible]	45		[illegible]	45		[illegible]	400				

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249
Month SEPT
Facility Name CAMAS STP
FINAL LIMITS
Year 04
Receiving Water Columbia River
Plant Operator
Plant Type Activated Sludge System
Population 14500

	INFLUENT			EFFLUENT											
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			[illegible]
1	109	115	1.861	7.12	3	97	47	2	98	31					.06
2			1.887	7.04											.02
3			1.760	7.44							<1				0
4			1.719	6.50											0
5			1.707	7.09											0
6			1.902	7.15											0
7	144	139	1.852	7.10	11	92	170	3	98	46	<1				0
8	126	212	1.779	7.28	9	93	134	5	98	74		22.3			0
9			1.920	7.23											0
10			1.799	7.09							<1				.14
11			1.881	6.55											/
12			1.993	6.78											.16
13			2.057	7.30											.10
14	132	108	1.951	7.20	7	95	114	3	97	49	<1				.12
15	133	278	1.959	7.27	10	92	163	3	99	49		20			.01
16			2.049	7.36											.40
17			2.438	7.11							<1				1.06
18			2.075	6.55											.09
19			2.337	7.44											.29
20		206	2.169	7.34				5	98	86					0
21	175	102	2.051	6.98	15	91	257	4	96	66	<1	28.7			0
22	120		1.985	7.36	9	93	149								0
23			1.943	7.24											0
24			1.917	7.21							<1				0
25			1.848	6.62											0
26			1.984	7.21											0
27			1.940	6.92							<1				0
28	185	258	1.901	7.00	12	94	190	4	98	63					0
29	117	113	1.911	7.20	9	92	143	3	97	48		24.9			0
30			1.865	7.34											0
31															
Total			58.44												
	AVG 138	AVG 170	AVG 1.948	MIN 6.50	AVG 9	AVG 93	AVG 152	AVG 3.5	AVG 98	AVG 57	GM <1	AVG 23.9			2.45
Permit	[illegible]	[illegible]	[illegible]	[illegible]	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	200	[illegible]	[illegible]	[illegible]	[illegible]
	AVW 151	AVW 186	MAX 2.438	MAX 7.44	AVW 12		AVW 203	AVW 4.5		AVW 76	GM7 <1	MAX 28.7			
Limits	[illegible]	[illegible]	[illegible]	[illegible]	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	400	[illegible]	[illegible]	[illegible]	[illegible]

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA0020249	Month	October
Facility Name	CAMAS STP FINAL LIMITS	Year	2004
Receiving Water	Columbia River	Plant Operator	Jim Dickinson
Plant Type	Activated Sludge System	Population	14500

	INFLUENT		EFFLUENT												
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			3-DR
1			1.738	7.29							<1				⊖
2			1.861	6.60											—
3			1.923	7.02											⊖
4			1.888	7.23											⊖
5	168	260	2.042	7.22	4	98	68	6	98	102	<1				.81
6	140	192	1.970	7.26	5	96	82	8	96	131		10.7			.01
7			1.863	7.40											.42
8			2.527	7.48							<1				.64
9			2.079	7.34											.05
10			2.079	6.91											⊖
11			2.031	7.12											⊖
12	172	262	1.888	7.35	11	94	173	2	99	31	<1				⊖
13	*		1.888	7.55											.01
14	131	202	1.873	7.08	10	92	156	4	98	62	<1	25.3			⊖
15			1.765	7.28											⊖
16			1.885	7.28											.35
17			2.131	7.37											.15
18			2.241	7.34							<1				.51
19	135	232	2.253	7.43	34	75	639	5	98	94					.12
20	172	341	2.129	7.38	22	87	391	2	99	36		21.0			.35
21			2.149	7.47											.06
22			2.022	7.40							<1				.10
23			2.110	6.89											.24
24			2.131	7.37											.01
25			2.406	7.18							<1				.62
26	117	128	2.636	7.30	33	72	725	2	98	44					.15
27	116	198	2.231	7.15	15	87	279	1	99	19		21.6			.01
28			2.195	7.30											.13
29			2.102	7.17							<1				.25
30			2.445	6.68											.28
31			2.268	7.34											.05
Total			63.749												
	avg 144	avg 227	avg 2.088	6.6	avg 17	avg 88	avg 314	avg 4	avg 98	avg 65	<1	avg 19.65			5.32
Permit				[illegible]	30	83	1955	30	[illegible]	[illegible]	200				
	154	287	2.636	7.55	28		515	7		117	<1	25.3			
Limits				9.0	45		[illegible]	45		[illegible]	400				

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month NOVEMBER

Facility Name CAMAS STP — FINAL LIMITS — Year 2004

Receiving Water Columbia River — Plant Operator JIM DICKINSON

Plant Type Activated Sludge System — Population 14500

	INFLUENT		EFFLUENT												
Frequency	2/wk	2/wk	Cont	7/wk	2/wk	CALC	2/wk	2/wk	CALC	2/wk	2/wk	1/wk			
Date	BOD 5-day 20 D mg/L	TSS mg/L	FLOW MGD	pH Standard Units	BOD 5-day 20 D mg/L	BOD Removal Percent	BOD 5-day 20 d lbs/day	TSS mg/L	TSS Removal Percent	TSS lbs/day	Fecal Coliform #/100 ml	Ammonia-Nitrog mg/L			RAIN
1			2.285	7.17							<1				.11
2	120	156	3.552	7.19	18	85	533	5	97	59			← 22.4		.75
3	107	104	2.523	7.18	14	87	295	2	98	42					Ø
4			2.297	7.22							<1				Ø
5			2.267	7.09											Ø
6			2.120	6.56											Ø
7			2.144	7.21											Ø
8			2.060	7.30											Ø
9	165	286	1.950	7.07	14	92	228	1	99	16	<1	29.7			.01
10	122	180	1.870	7.20	11	91	172	2	99	31					.01
11			1.981	7.17											Ø
12			1.837	6.89							<1				.01
13			1.845	6.49											Ø
14			1.976	6.89											Ø
15			2.268	7.12											.43
16	102	168	2.634	7.04	11	89	187	2	99	34	<1				.12
17	115	120	2.265	7.11	11	90	208	1	99	19					.45
18			2.387	7.03								27.1			.0
19			2.108	6.87							<1				Ø
20			2.109	6.82											Ø
21			2.151	6.96											.07
22			2.123	6.89							<1				.05
23	134	125	2.438	7.14	6.5	95	132	1	99	20		26.8			.43
24	143	204	2.391	7.17	9	94	179	2	99	40	<1				.10
25			2.300	7.08											.01
26			2.020	7.06											.08
27			2.068	7.15											.03
28			2.160	6.85											.03
29			2.181	6.94											Ø
30	117	108	2.358	7.05	6	95	118	1	99	20		24.6			.26
31															.20
Total			66.0	68											
	AVG 125	AVG 161	AVG 2.20	MIN 6.56	AVG 11	AVG 91	AVG 228	AVG 2	AVG 99	AVG 31	GEM <1	AVG 26.5			2.62
Permit				8	30	85	956	30	85	217	200				
	AVW 144	AVW 233	MAX 3.552	MAX 7.30	AVW 16		AVW 414	AVW 3.5		AVW 51	GM7 <1	MAX 29.7			
Limits				9	45		1217	45		1825	400				

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month DEC. | Year 2004

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator

Plant Type Activated Sludge w/UV Disinfection | Population

Frequency	4/WEEK	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR							
Date	TSS LBS/DAY	pH STANDARD UNITS	EFFLUENT CONT. TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L	R0-Cl_2						
1	19	7.26	17.1	15.5		<1			0						
2	18	7.11	16.9	14.6		<1			0						
3		7.29	16.9			<1			0						
4		6.50	16.8			<1			.29						
5		7.34	16.8			<1			.11						
6	42	7.14	16.6	10.3		<1			.19						
7	27	7.02	16.5	19.6		<1			.66						
8	58	7.00	16.6	13.0		<1			.20						
9	52	7.29	16.4	11.0		<1			.39						
10		6.82	16.3			<1			.40						
11		6.83	15.6			12			Ø						
12		6.88	15.5			<1			Ø						
13	45	7.44	16.7	4.3		<1			.33						
14	22	7.35	16.4	5.0		<1			.07						
15	40	6.97	16.8	5.5		<1			Ø						
16	38	6.91	16.4	2.1		<1			Ø						
17		6.70	16.3			<1			Ø						
18		6.82	16.6			<1			Ø						
19		6.86	16.5			<1			.04						
20	34	6.85	16.6	7.0		<1			Ø						
21	23	6.82	16.5	9.9		<1			.65						
22	41	6.73	16.3	7.1		<1			.02						
23	20	6.80	16.1	7.3		<1			Ø						
24		6.85	16.1			<1			Ø						
25		6.91	16.17			10			.49						
26		6.93	16.2			<1			Ø						
27	20	6.91	16.0	6.4		<1			Ø						
28	20	6.91	15.6	9.1		<1			.10						
29	20	6.92	15.6	9.4		<1			.12						
30	19	6.94	15.6	11.0		<1			.07						
31		7.00	15.6			<1			.74						
Total															
	AVG 31	MIN 6.50		AVG 9.3	AVG	GEM 2	AVG	AVG	4.87						
Permit	1017	6		7	20	200									
	AVW 44.75	MAX 7.44	MXD 17.1	MXD 19.6	MXD	GM7 2									
Limits	1525	9		15	41	400									

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Name and Title

Signature

...cility Name City of Camas

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14500

	INFLUENT									EFFLUENT					
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	PH STANDARD UNITS	AMMONIA MG/L	OIL & GREASE UG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L	TSS % REMOVAL
1	2.329	136	2642	112	2175	6.97				2.394	12	91	233	1	99
2	2.212			90	1660	7.33				2.280				1	99
3	2.098					7.43				1.90					
4	2.189					6.50				2.277					
5	2.419					7.57				2.478					
6	2.480	100	2068	119	2461	7.30	29.3			2.515	24	76	503	2	98
7	3.264	91	2435	95	2542	7.32	31.2			3.208	18	80	482	1	99
8	3.143	80	2097	90	2359	6.95	25.1			3.225	30	63	807	2	98
9	3.107			65	1684	7.59	25.6			3.237				2	97
10	3.219					6.49				3.446					
11	3.115					6.69				3.271					
12	2.715					7.06				2.819					
13	2.657	103	2282	121	2681	7.49	28.9			2.672	23	78	513	2	98
14	2.579	116	2495	83	1805	7.42	23.0			2.608	25	78	544	1	99
15	2.408	81	1687	84	1687	7.39	27.3			2.420	22	73	444	2	98
16	2.285	122	2325	77	1467	7.37	31.4			2.282	19	84	362	2	97
17	2.123					6.10				2.132					
18	2.147					6.24				2.168					
19	2.126					7.13				2.129					
20	2.075	120	2077	105	1817	7.12	43.7			2.067	11	91	190	2	98
21	2.710	119	2690	89	2012	7.18	30.5			2.710	9	92	203	1	99
22	2.406	94	1886	79	1585	7.08	21.3			2.463	15	84	308	2	97
23	2.322	117	2266	110	2130	7.10	32.7			2.398	26	78	520	1	99
24	2.276					6.37				2.284					
25	2.444					7.11				2.480					
26	2.548					6.15				2.62					
27	2.347	108	2114	100	1957	7.06	33.4			2.428	18	83	364	1	99
28	2.277	115	2184	126	2393	6.98	34.0			2.349	5	96	98	1	99
29	2.343	144	2814	117	2286	7.01	36.2			2.410	14	90	281	1	99
30	2.186	119	2170	119	2170	7.02	38.1			2.327	10	92	194	1	99
31	2.751					6.82				2.857					
Total	~~2.493~~ 74.185									78.85					
	AVG 2.493	AVG 110	AVG 2265	AVG 98.9	AVG 2048	MIN 6.10	AVG 30.7	AVG	AVG	AVG 2.543	AVG 18	AVG 83	AVG 378	AVG 1.4	AVG 98.4
Permit	6.1		5616		6405						20	70	1017	20	70
	MAX 3.264	MAX 144	MAX 2814	MAX 126	MAX 2681	MAX 7.59	MAX 43.7			MAX 3.446	AVW 22		AVW 466	AVW 1.75	
Limits											30		1525	30	

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month January | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator Jim Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 14,500

	INFLUENT									EFFLUENT					
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH STANDARD UNITS	AMMONIA MG/L	OIL & GREASE UG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L	TSS % REMOVAL
1	2.795					6.82				2.880					
2	2.503					6.93				2.569					
3	2.304	89	1710	96	1845	6.16	36.8			2.337	9	90	175	1	998
4	2.319	116	2243	149	2882	6.38	28.0			2.343	5	96	98	12	90
5	2.206	129	2373	102	1877	6.98	13.9			2.231	8	94	149	6	94
6	2.169	117	2116	114	2118	6.74	36.7			2.228	6	95	111	2	98
7	2.157					6.68				2.253					
8	2.181					6.28				2.230					
9	2.144					6.10				2.281					
10	2.101	102	1787	76	1332	7.54	47.3			2.149	8	92	143	1	99
11	2.075	~~102~~ 59	~~1787~~ 1021	78	1350	7.54	40.9			2.075	~~8~~ 7	88	123	1	99
12	2.003	58	969	46	768	7.62	41.6			2.003	9	84	152	1	99
13	2.005	122	2040	135	2257	7.90	40.5			2.026	9	93	152	1	99
14	1.937					7.74				1.953					
15	2.085					7.61				2.091					
16	2.199					7.67				2.109					
17	3.013	110	2764	148	3719	7.59	30.8			2.625	6	95	131	1	99
18	3.000	110	2752	89	2227	7.36	26.4			2.801	7	94	164	1	99
19	2.460	114	2339	97	1990	7.46	35.4			2.490	10	91	208	8	92
20	2.398			85	1700	7.47	41.2			2.443				1	99
21	2.129	55	1099			7.46				2.155	7	84	143		
22	2.156					7.53				2.154					
23	2.274					7.54				2.272					
24	2.130	155	2753	181	3215	7.50	41.0			2.175	8	95	145	1	99
25	2.037	111	1886	104	1767	7.87	50.5			2.081	6	95	104	1	99
26	2.101	97	1665	106	1857	7.49	46.5			2.165	2	99	36	2	.98
27	2.034	89	1510	111	1883	7.54	42.1			2.148	2	98	36	1	99
28	2.123					7.55				2.175					
29	2.434					7.47				2.506					
30	2.334					7.74				2.386					
31	2.255	104	1956	130	2445	7.17	43.3			2.306	7	93	135	1	99
Total															
	AVG 2.261	AVG 102	AVG 1940	AVG 108.6	AVG 2072	MIN 6.10	AVG 37.8	AVG	AVG	AVG 2.278	AVG 6.8	AVG 92.7	AVG 129.7	AVG 2.47	AVG 97.6
Permit	6.1		5616		6405						20	70	1017	20	70
	MAX 3.013	MAX 155	MAX 2764	MAX 181	MAX 3719	MAX 7.90	MAX 50.5			MAX 2.880	AVW 8.25		AVW 161.5	AVW 5.25	
Limits											30		1525	30	

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month January — Year 2005

Facility Name: City of Camas — County: Clark

Receiving Water: Columbia River — Plant Operator: Jim Dickinson

Plant Type: Activated Sludge w/UV Disinfection — Population: 14,500

Frequency	4/WEEK	CONT	CONT (EFFLUENT CONT.)	4/WEEK	4/WEEK	DAILY	4/YR	4/YR							
Date	TSS LBS/DAY	pH MAX STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L	PH MIN. STD. UNITS						Rainfall
1		7.0				<1			6.92						.08
2		6.92				<1			6.79						0
3	19	6.92	14.9	7.9		<1			6.88						0
4	234	7.26	14.7	8.7		<1			6.38						0
5	112	7.26	14.6	2.5		<1			7.17						0
6	37	7.19	15.1	9.7		<1			7.15						0.11
7		7.19	15.0			<1			7.17						.18
8		7.19	14.8			3			7.11						.02
9		7.17	15.07	1.7		<1			7.11						.06
10	18	7.10	14.6	1.7		<1			7.05						0
11	17	7.11	14.8	7.9		<1			7.04						0
12	17	7.09	15.20	6.6		<1			7.02						.07
13	17	7.11	15.4	6.9		<1			7.05						0
14		7.11	15			8			6.93						0
15		7.11	14.2			3			7.00						.01
16		7.13	14.2			1			7.04						.06
17	22	7.11	15.2	11.5		<1			7.07						.83
18	23	6.87	14.4	4.9		8			6.78						.02
19	166	7.05	15.0	1.4		<1			6.45						0
20	20	7.14	15.21	1.1		<1			6.92						0
21		6.96	15.4			<1			6.88						.08
22		7.03	15.6			<1			6.99						.01
23		7.05	15.8			<1			7.01						0
24	18	7.05	15.8	.40		<1			7.01						0
25	17	7.05	15.6	.73		<1			6.99						.01
26	36	7.05	15.61	.64		<1			7.03						.09
27	18	7.05	15.8	.45		<1			7.01						0
28		7.05	15.6			<1			6.99						.47
29		6.99	15.61			1.5			6.81						.13
30		6.94	15.81			<1			6.83						.04
31	19	7.06	15.8	0.0		<1			6.96						.01
Total															
	AVG 47.6	MIN 6.87		AVG 4.88	AVG	GEM 2	AVG	AVG	MIN 6.38						2.28
Permit	1017	6		7	20	200									
	AVW 100.5	MAX 7.26	MXD 15.81	MXD 11.7	MXD	GM7 2.11			MAX 7.17						
Limits	1625	9		15	41	400									

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Name and Title — Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

ermit No. WA0020249 Month February Year 2005

County Clark

Facility Name City of Camas

Plant Operator JIM DICKINSON

Receiving Water Columbia River

Population 14500

Plant Type Activated Sludge w/UV Disinfection

Frequency	4/WEEK	CONT	CONT (EFFLUENT CONT.)	4/WEEK	4/WEEK	DAILY	4/YR	4/YR							
Date	TSS LBS/DAY	pH STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L	PH MINIMUM						RAIN
1	53	7.07	15.6	.20		<1			6.92						⊖
2	37	7.01	15.8	.30		<1			6.94						.02
3	37	7.00	15.6	.75		4			6.40						.05
4		7.00	15.6			<1			6.98						.26
5		7.07	15.60			2			6.89						.19
6		7.09	15.40			<1			7.00						.61
7	25	7.00	14.60	1.8		<1			6.96						⊖
8	21	7.00	14.40	.59		<1			6.52						⊖
9	19	6.95	14.8	⊖		<1			6.89						⊖
10	78	7.06	14.8	2.45		<1			6.23						⊖
11		7.43	16.40			<1			6.98						.05
12		7.19	15.20			<1			7.06						.30
13		7.21	15.40	6.54		14			7.15						.08
14	19	7.19	15.2	6.2		<1			7.08						⊖
15	56	7.08	15.0	5.4		<1			7.02						⊖
16	92	7.04	14.9	6.4		<1			7.00						⊖
17	89	7.02	14.9			<1			6.98						⊖
18		7.58	16.10			<1			6.83						⊖
19		7.06	16.30			1			6.98						⊖
20		7.08	15.3			<1			7.04						⊖
21	34	7.13	15.3	~~48.4~~	6.9	<1			7.04						⊖
22	68	7.11	15.3	~~49.4~~	12.5	<1			7.09						⊖
23	51	7.13	15.31	16.10		2			7.07						⊖
24	34	7.17	15.71	15.9		<1			7.11						⊖
25		7.17	15.91			<1			7.09						⊖
26		7.09	15.91			2			7.02						⊖
27		7.16	15.91			4			7.09						.11
28	69	7.09	16.11	18.23		<1			7.02						.14
29															
30															
31															
Total															1.81
	AVG 48.9	MIN 6.95		AVG 6.26	AVG	GEM 2	AVG	AVG	6.23						
Permit	1017	6		7	20	200									
	AVW 64	MAX 7.58	MAX 16.4	MAX 18.23	MAX	GM7 2			7.15						
Limits	1625	9		15	41	400									

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month February | Year 2005

Facility Name: City of Camas | County: Clark

Receiving Water: Columbia River | Plant Operator: JIM DICKINSON

Plant Type: Activated Sludge w/UV Disinfection | Population: 14 500

	INFLUENT									EFFLUENT					
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L	TSS % REMOVAL
1	2.119	127	2244	123	2213	7.61	36.8			2.157	2	98	44	3	98
2	2.128	88	1562	57	1012	7.52	45.8			2.192	3	97	55	2	96
3	2.139	113	2016	114	2034	7.35	44.6			2.203	5	92	96	2	98
4	2.131					6.81				2.139					
5	2.201					6.58				2.274					
6	3.225					6.81				3.318					
7	2.761	96	2211	80	1842	6.65	31.0			2.965	6	94	148	1	99
8	2.492	59	1226	70	1455	7.30	31.3			2.533	3	95	63	1	99
9	2.279	88	1673	85	1616	7.46	34.8			2.333	3	97	58	1	99
10	2.241	59	1103	74	1383	7.46	49.0			2.341	5	95	98	4	95
11	2.165					7.15				2.168					
12	2.368					7.51				2.360					
13	2.349					7.72				2.325					
14	2.215	106	1958	93	1718	7.56	40.7			2.294	4	96	77	1	99
15	2.166	149	2692	113	2041	7.53	40.5			2.237	6	96	112	3	97
16	2.133	72	1281	92	1636	7.52	47.1			2.205	7	90	129	5	95
17	1.998	113	1883	102	1700	7.53	44.2			2.142	5	96	89	5	95
18	1.967					7.02				2.018					
19	1.906					7.57				1.998					
20	1.903					7.57				1.924					
21	2035	106	1799	116	1969	7.60	~~48.4~~ 48.4			2.066	5	95	86	2	98
22	1.965	125	2049	113	1852	7.92	49.4			2.038	4	97	68	4	96
23	1.946	~~108~~ 118	1915	99	1607	7.75	49			2042	3	97	51	3	97
24	1.921	141	2259	254	4069	7.55	49.0			2.030	3.1	98	52	2	99
25	1.808					7.66				1.945					
26	1.925					7.32				1.992					
27	2.070					7.66				2.116					
28	2.052	109	1865	101	1728	7.65	46.6			2.060	5	95	86	4	96
29															
30															
31															
Total															
	AVG 2.165	AVG 104.3	AVG 1858.5	AVG 105.5	AVG 1867	MIN 6.58	AVG 43	AVG	AVG	AVG 2.229	AVG 4.3	AVG 95.5	AVG 82	AVG 2.69	AVG 97.25
Permit	6.1		5616		6405						20	70	1017	20	78
	MAX 3.225	MAX 149	MAX 2692	MAX 254	MAX 4069	MAX 7.92	MAX 49.4			MAX 3.318	AVW 5.5		AVW 101.8	AVW 6.5	
Limits											30		1525	30	

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Name and Title | Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

ermit No. WA0020249 — Month March — Year 2005

acility Name City of Camas — County Clark

eiving Water Columbia River — Plant Operator JIM DICKINSON

ant Type Activated Sludge w/UV Disinfection — Population 14500

EFFLUENT CONT.

Frequency	4/WEEK	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR							
Date	TSS LBS/DAY	pH STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L	PH MINIMUM						RAIN
															.01
1	138	7.11	16.21	21		<1			7.09						.03
2	136	7.09	16.41	18.65		<1			7.05						⊖
3	33	7.14	16.61	19.9		<1			7.03						⊖
4		7.16	16.61			<1			7.11						⊖
5		7.14	16.81			<1			7.09						⊖
6		7.11	17.01			5			7.06						⊖
7	17	7.11	17.0	15.16		<1			7.04						⊖
8	50	7.10	17.41	20.6		<1			7.04						⊖
9	85	7.07	16.9	16.8		<1			7.04						⊖
10	52	7.07	17.61	22.1		<1			6.7						⊖
11		7.16	17.81			<1			7.05						⊖
12		7.18	17.81			<1			7.11						⊖
13		7.18	17.61			<1			7.09						⊖
14	84	7.36	17.59	11.89		<1			6.74						⊖
15	223	7.08	17.37	10.30		<1			7.04						.17
16	71	7.10	16.93	13.3		<1			7.04						⊖
17	52	7.06	17.17	11.32		<1			7.02						.08
18		7.13	17.19			<1			7.02						.55
19		7.18	16.74			1			7.08						.14
20		7.24	16.52			<1			7.10						⊖
21	104	7.13	16.74	13.61		<1			7.08						⊖
22	37	7.10	16.57	14.68		<1			7.07						.10
23	17	7.15	16.13	16.70		<1			7.08						.01
24	85	7.15	16.5	20		<1			7.10						.31
25		7.24	16.78			2			7.08						2.06
26		7.21	21.50			<1			7.17						.44
27		7.19	15.31			<1			7.06						.53
28	200	7.08	14.70	10.3		<1			7.01						.09
29	122	7.04	14.51	9.1		<1			6.99						.05
30	224	7.13	15.11	11.75		6			7.04						.08
31	137	7.22	15.31	11.42		<1			7.09						
Total									6.70						4.65
	AVG 98.2	MIN 7.04		AVG 15.18	AVG	GEM 2	AVG	AVG							
Permit	1017	6		7	20	200									
	AVW 170.8	MAX 7.36	21.5	MOD 22.1	MOD	GM7 2			7.17						
Limits	1625	9		15	41	400									

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 Month March Year 2005

Facility Name City of Camas County Clark

Receiving Water Columbia River Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection Population 14 500

	INFLUENT									EFFLUENT					
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L	TSS % REMOVAL
1	2.010	104	1743	103	1726	7.52	51.7			2.074	5	95	86	8	92
2	1.983	123	2034	111	1836	7.68	47.7			2.038	6	95	102	8	93
3	1.907	106	1685	106	1686	7.65	48.1			1.956	9.5	97	155	2	98
4	1.864					7.64				1.922					
5	1.954					7.79				2.023					
6	2.035					7.73				2.117					
7	2.007	135	2260	158	2645	7.61	44.6			2.08	8	94	139	1	99
8	1.919	154	2465	256	4097	7.61	53.4			2.024	12	92	203	3	99
9	1.929	111	1786	162	2606	7.60	46.7			2.027	6.5	94	110	5	97
10	1.955	107	1745	184	3216	7.55	46.7			2.096	8	93	140	3	98
11	1.831					7.66				1.989					
12	1.886					7.62				1.926					
13	2.032					7.66				2.061					
14	1.983	114	1885	116	1918	7.65	45.9			2.009	11	90	184	5	96
15	1.969	109	1499	124	2036	8.05	46.5			2.055	4	96	69	13	90
16	2.035	141	2393	153	2285	7.53	46.6			2.143	7.5	95	134	4	97
17	1.955	119	1940	153	2495	7.50	47.9			2.070	4	97	69	3	98
18	1.896					7.13				1.979					
19	2.296					7.37				2.276					
20	2.218					7.15				2.168					
21	2.071	161	2780	200	3454	7.24	51.3			2.086	11	93	194	6	97
22	2.053	142	2431	150	2568	7.24	39.2			2.244	5	96	94	2	99
23	2.012	180	3020	322	5403	7.74	46.5			2.051	4	98	68	1	99
24	1.989	140	2322	192	3184	6.83	53			2.053	2	99	34	5	97
25	1.979					6.16				2.166					
26	4.443					6.43				4.499					
27	4.727					6.56				4805					
28	4.700	56	2195	60	2351	6.38	19.9			4.796	14	75	560	5	92
29	3.587	69	2064	89	2662	5.96	25.1			3.646	6	91	182	4	96
30	2.920	77	1875	69	1680	6.23	33.4			2988	9	88	224	9	87
31	2.606	75	1636	103	2239	6.31	30.6			2.733	5	93	114	6	94
Total															
	AVG 2346	AVG 116	AVG 2092	AVG 148	AVG 2636	MIN 6.16	AVG 43.4	AVG	AVG	AVG 2.420	AVG 7.2	AVG 93	AVG 151	AVG 4.89	AVG 95.6
Permit	6.1		5616		6405						20	70	1017	20	78
	MAX 4.727	MAX 180	MAX 3020	MAX 322	MAX 4097	MAX 8.05	MAX 53.6			MAX 4.805	AVW 8.6		AVW 270	AVW 6.25	
Limits											30		1525	30	

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month April | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

	INFLUENT									EFFLUENT					
Frequency	CONT.	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT.	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	PH STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE MG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L	TSS % REMOVAL
1	2.468					6.03				2.498					
2	2.337					7.24				2.447					
3	2.706					7.14				2.896					
4	2.552	140	2980	182	3874	6.77	37.4			2.623	17	88	388	6	97
5	1.452	57	690	85	1029	6.38	57.0			1.503	7	88	88	1	99
6	1.377	101	1160	70	804	7.04	55.1			1.476	10	90	123	6	91
7	1.438	65	780	56	672	7.13	58.0			1.402	15	77	175	7	87.5
8	1.381					7.33				1.362					
9	1.370					6.69				1.355					
10	1.492					6.41				1.467					
11	1.538	91	1167	72	924	6.10	50			1.53	8	91	102	6	92
12	1.493	54	672	62	772	6.10	49.8			1.457	7	87	85	9	85
13	1.455	83	1007	151	1832	7.38	51.6			1.527	12	86	153	9	94
14	1.406	107	1255	101	1184	7.53	52.7			1.502	9	92	113	8	92
15	1.734					7.11				1.775					
16	3.285					7.15				3.411					
17	3.170					6.78				3.239					
18	2.899	93	2249	106	2563	5.94	35.6			2.981	8	91	199	7	93
19	2.567	116	2483	133	2847	6.61	34.6			2.659	9	92	200	5	96
20	2.366	98	1934	186	3670	6.61	37.0			2.476	6	94	124	3	97
21	2.315	113	2182	160	3089	5.95	37.2			2.452	12	[illegible]	[illegible]	2	99
22	2.241					5.78				2.332					
23	2.581					5.69				2.665					
24	2.581					5.67				2.639					
25	3.073	94	2409	106	2717	5.65	32.4			3.135	14	79	366	5	95
26	2.575	78	1675	76	1632	5.45	30			2.650	6	92	133	3	96
27	2.360	81	1594	98	1929	7.15	44.6			2.458	6	93	123	4	96
28	2.234	90	1677	124	2310	6.7	40.4			2.366	10	89	197	5	96
29	2.098					6.38				2.117					
30	2.130					6.27				2.199					
31															
Total	64.674														
	AVG 2.156	AVG 91	AVG 1620	AVG 111	AVG 1991	MIN 5.45	AVG 43.96	AVG	AVG	AVG 2.220	AVG 9.75	AVG 88.6	AVG 176	AVG 5.38	AVG 94.1
Permit	6.1		5616		6405						20	70	1017	20	78
	MAX 3.285	MAX 140	MAX 2980	MAX 186	MAX 3874	MAX 7.53	MAX 58.0			MAX 3.411	AVW 12.25		AVW 205	AVW 8	
Limits											30		1525	30	

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Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 Month APRIL Year 2005

Facility Name City of Camas County Clark

Receiving Water Columbia River Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection Population 14500

EFFLUENT CONT.

Frequency	4/WEEK	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR							
Date	TSS LBS/DAY	PH STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L	PH MINIMUM						RAIN (IN)
1		7.88	15.91			<1			7.15						0.07
2		9.07	15.91			<1			7.91						.16
3		9.05	15.71			2			7.16						.40
4	131	7.16	15.71		16.4	4			7.03						.01
5	12.5	7.05	15.91		12.5	<1			6.99						.01
6	74	7.14	16.31		9.2	<1			6.99						.03
7	82	7.13	16.71		10.3	<1			7.05						.45
8		7.07	17.11			<1			6.99						.46
9		7.07	17.31			<1			6.96						.02
10		6.99	17.31			<1			6.92						.46
11	77	7.09	17.31		6.7	<1			7.01						.04
12	109	7.12	17.31		4.4	<1			7.01						.04
13	114	7.12	17.31		6.8	<1			7.05						.60
14	100	7.12	17.31		6.3	<1			7.05						.01
15		7.29	16.71			<1			6.87						.49
16		7.29	16.71			2			6.87						.11
17		7.33	16.71			<1			7.09						.38
18	174	7.34	15.91		13.3	<1			6.58						.01
19	111	7.67	16.31		13.6	5			6.93						0
20	62	7.67	16.71		15.5	<1			6.93						0
21	41	7.08	16.71		15.4	<1			7.03						0
22		7.06	17.51			<1			6.99						.27
23		7.01	16.91			<1			6.97						.36
24		6.99	16.91			<1			6.97						.46
25	131	7.01	16.71		16.5	<1			6.97						.07
26	66	7.03	17.11		10.47	1			6.96						0
27	82	7.13	17.51		17.65	<1			7.0						0
28	99	7.39	17.51		14.5	<1			7.0						0
29		7.43	17.31			11.5			7.39						.01
30		7.41	18.10						7.32						0
31															
Total															4.92
	AVG 99	MIN 6.99		AVG 11.8	AVG	GEM 5.48	AVG	AVG	6.58						
Permit	1017	5		7	20	200									
	AVW 103	MAX 9.07	MXD 18.1	MXD 17.65	MXD	GM7 3.4			7.91						
Limits	1525	9		15	41	400									

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month May | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

	INFLUENT									EFFLUENT					
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	PH STANDARD UNITS	AMMONIA MG/L	OIL & GREASE UG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L	TSS % REMOVAL
1	2.220					6.36				2.345					
2	2.148	112	2006	97	1738	6.28	51.6			2.435	12	89	244	4	96
3	2.112	81	1427	136	2396	6.37	46			2.702	8	90	180	10	93
4	2.192	155	2839	154	2815	6.8	40			2.515	18	88	378	6	96
5	2.152	116	2082	101	1813	6.0	47.9			2.215	18	84	333	5	95
6	2.029					5.63				2.139					
7	2.084					5.52				2.178					
8	2.302					5.59				2.388					
9	3.269	133	3626	242	6747	7.19	42.1			3.343	35	74	976	16	93
10	3.612	57	1717	87	2621	7.02	33.3			3.716	12	79	372	3	97
11	2.878	64	1536	158	3792	6.90	30.6			2.942	7	89	172	6	96
12	2.486	75	1555	100	2073	6.79	40.0			2.593	17	77	368	~~[illegible]~~5	~~89~~ 95 JD
13	2.367					6.83				2.464					
14	2.394					6.99				2.486					
15	2.843					6.78				2.938					
16	3.740	90	2807	218	6800	6.82	22.8			3.813	45	50	1240	45	79
17	3.429	94	2688	152	4347	6.82	25.7			3.470	52	45	1505	27	82
18	3.601	83	2493	97	2913	6.58	23.4			3.649	33	60	1004	27	72
19	3.468	82.5	2386	126	3644	6.60	25.1			3.549	36	55	1087	11	91
20	3.404					5.77				3.490					
21	3.175					5.20				3.201					
22	2.965					4.87				2.974					
23	2.588	135	2914	133	2871	4.93	28.0			2.601	19	86	412	7	95
24	2.411	93	1870	71	1428	5.11	38.3			2.442	31	66	631	45	37
25	2.275	119	2258	80	1517	6.57	34			2.301	48	60	921	18	78
26	2.274	115	2181	90	1706	6.26	38			2.274	40	65	759	16	82
27	2.082					6.06				2.232					
28	1.968					5.83				2.064					
29	1.977					6.34				1.993					
30	2.085	124	2156	130	2261	6.34	41.4			2.13	22	82	391	2	98
31	2.291	116	2216	127	2427	6.98	41.9			2.316	16	86	309	1	99
Total															
	AVG 2.607	AVG 102	AVG 2264	AVG 128	AVG 2995	MIN 4.87	AVG 36.1	AVG	AVG	AVG 2.706	AVG 26	AVG 74	AVG 927	AVG 14	AVG 87
											20	70	1017	20	78
Permit	6.1		5616		6405										
	MAX 3.74	MAX 155	MAX 3626	MAX 242	MAX 6800	MAX 7.19	MAX 51.6			MAX 3.813	AVW 42		AVW 1209	AVW 28	
											30		1525	30	
Limits															

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONTHLY

Permit No. WA0020249 | Month May | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14500

EFFLUENT CONT

Frequency	4/WEEK	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR							
Date	TSS LBS/DAY	pH STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L	PH MINIMUM						R-2-7
1		7.41	18.11			4			7.32						0.8
2	81	7.37	18.11		← 16.10	6			7.30						.08
3	225	7.84	18.71		← 21.9	<1			7.34						.19
4	126	7.84	18.71		← 21.1	<1			7.34						.14
5	92	7.82	18.30		← 24.6	<1			7.60						.03
6		7.83	18.50			<1			7.89						.01
7		8.04	18.51			<1			7.83						.08
8		8.18	18.22			8			7.79						.41
9	446	7.83	18.82		← 30.7	60			7.66						.74
10	93	8.14	18.22		← 18.6	<1			7.24						.35
11	147	8.16	17.01		← 22.0	<1			7.24						0
JD/108 12	~~907~~	8.34	17.81		← 22.0	<1			7.62						0
13		7.84	18.21			<1			7.62						.22
14		8.03	18.41			1			7.84						.03
15		8.12	18.41			TNTC			7.75						.40
16	1431	8.12	18.41	15.7		<1			7.62						.47
17	781	8.10	18.01	15.2		<1			7.48						.61
18	822	7.59	17.21	14.3		<1			7.29						.07
19	325	7.38	17.20	14.3		<1			7.27						.48
20		7.38	17.01			<1			7.23						.28
21		7.34	16.81			<1			7.23						.26
22		7.31	17.01			<1			7.22						.04
23	152	7.35	17.81	13.8		<1			7.22						0
24	916	7.37	18.41	17.17		21			7.37						0
25	345	7.46	18.82	22.9		10			7.37						0
26	303	7.55	19.41	22		<1			7.44						0
27		7.61	19.80			<1			7.48						0
28		7.55	19.81			<1			7.51						0
29		7.61	19.41			<1			7.48						.05
30	~~4~~36	7.48	19.58	21.5		<1			7.44						0
31	19	7.51	18.94	19.7		<1			6.66						.40
Total															
	AVG 358	MIN 7.31		AVG 19.6	AVG	GEM 2	AVG	AVG	6.66						6.14
Permit	1037	6		7	20	200									
	AVW 837	MAX 8.34	MOD 19.81	MOD 30.7	MOD	GM7 3			7.89						
Limits	1625	9		15	41	400									

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GM7=highest 7-day Geometric Mean

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Name and Title

Signature

Permit No. WA0020249		Month JUNE	Year 2005
Facility Name City of Camas		County Clark	
Receiving Water Columbia River		Plant Operator JIM DICKINSON	
Plant Type Activated Sludge w/UV Disinfection		Population 14500	

Frequency	4/WEEK	CONT	CONT (EFFLUENT CONT)	4/WEEK	4/WEEK	DAILY	4/YR	4/YR								
Date	TSS LBS/DAY	pH STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L	PH MINIMUM							Rain
1	38	7.51	19.2		30.4	<1			6.66							0.23
2	18	7.40	18.73		24.7	<1			7.36							0.01
3		7.38	19.16			<1			7.36							0
4		7.36	19.4			<1			7.34							.18
5		7.38	18.98			<1			7.32							.36
6	40	7.36	18.56		20.1	2			7.30							.17
7	19	7.32	18.59		22.4	<1			7.27							.06
8	18	7.29	19.61		23.6	<1			7.25							0
9	53	7.27	19.6		19.9	<1			7.19							0
10		7.26	19.4			<1			7.24							.15
11		7.31	19.35			<1			7.26							.23
12		7.31	19.61			<1			7.22							.02
13	17	7.26	19.81		19.7	<1			7.22							0
14	32	7.24	19.61		23.8	<1			7.22							.01
15	35	7.24	20.0		22.8	<1			7.20							0
16	22	7.22	19.81		21.4	<1			7.20							.88
17		7.31	19.05			<1			7.20							.02
18		7.31	19.7			<1			7.26							.01
19		7.28	20.13			<1			7.22							.20
20	19	7.24	20.61		19.3	<1			7.17							0
21	36	7.20	20.21		18.4	<1			7.17							.07
22	57	7.20	20.41		21.1	<1			7.15							.11
23	70	7.22	20.62		20	<1			7.15							0
24		7.30	20.81			<1			7.22							0
25		7.30	20.81			<1			7.28							0
26		7.28	20.61			<1			7.26							.26
27	41	7.30	20.21		18.7	<1			7.28							.25
28	53	7.30	19.81		18.4	<1			7.21							0
29	71	7.30	20.8		18.7	<1			7.17							0
30	89	7.26	21.21		23.5	<1			7.15							0
31																
Total																
	AVG 33	7.2		AVG	AVG 21.5	GEM 2	AVG	AVG	6.66							3.22"
Permit	1017	6		7	20	200										
	AVW 64	MAX 7.51	MAX 21.21	MAX	MAX 30.4	GM7 2			7.36							
Limits	1625	9		15	41	400										

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month JUNE | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

	INFLUENT									EFFLUENT					
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L	TSS % REMOVAL
1	2.218	102	1887	91	1683	7.23	31.7			2.255	2	98	40	2	98
2	2.124	84	1488	90	1594	6.07	38.7			2.158	1	99	18	1	99
3	1.949					5.92				2.062					
4	1.966					6.39				2.005					
5	2.359					5.93				2.411					
6	2.266	177	3256	380	6991	7.36	43.3			2.395	21	88	419	2	99
7	2.26	158	2978	259	4882	7.86	38.4			2.323	13	92	252	1	99
8	2.076	104	1801	182	3151	7.22	38.5			2.129	8	92	142	1	99
9	1.987	116	1927	151	2502	7.21	38.9			2.138	24	79	427	3	98
10	1.992					7.31				2.164					
11	1.978					7.31				2.019					
12	2.066					7.18				2.155					
13	1.99	123	2041	149	2473	7.24	37.4			2.062	3	98	52	1	99
14	1.967	127	2023	176	2803	7.25	45.7			1.967	4	97	66	2	99
15	1.963	104	1703	125	2046	7.28	44.5			2.088	7	93	122	2	98
16	2.529	105	3164	217	4577	7.31	33.6			2.676	10	93	223	1	99
17	2.198					7.31				2.302					
18	2.037					7.16				2.148					
19	2.162					7.15				2.263					
20	2.115	142	2504	181	3175	7.17	37.8			2.243	13	91	244	1	99
21	2.046	143	2440	270	4607	7.17	38.5			2.162	8	94	144	2	99
22	2.165	144	2528	607	10656	7.39	39			2.266	12	92	226	3	100
23	1.996	83	1381	378	6292	7.10	42			2.093	5	93	87	4	99
24	1.857					7.18				1.962					
25	1.855					7.58				1.956					
26	2.018					7.18				2.067					
27	2.392	102	2035	126	2514	7.43	39.0			2.446	5	95	102	2	98
28	2.084	121	2103	132	2294	7.21	42.5			2.147	2	98	36	3	98
29	2.047	91	1554	112	1912	7.21	48.8			2.134	3	97	53	4	96
30	1.954	91	1483	112	1825	7.25	48.5			2.138	15	84	267	5	89
31															
Total															
	AVG 2.066	AVG 118	AVG 2128	AVG 208	AVG 3665	MIN 5.92	AVG 40.4	AVG	AVG	AVG 2.176	AVG 9	AVG 93	AVG 162	AVG 2	98
Permit	6.1		5616		6405						20	70	1017	20	78
	MAX 2.529	MAX 144	MAX 3256	MAX 607	MAX 10656	MAX 7.86	MAX 48.8			MAX 2.676	AVW 16.5		AVW 310	AVW 7	
Limits											30		1525	30	

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WASTEWATER TREATMENT PLANT MONITORING REPORT

.(No. WA0020249 — Month JULY — Year 2005

..ity Name City of Camas — County Clark

..eceiving Water Columbia River — Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection — Population 14500

Frequency	4/WEEK	CONT	CONT (EFFLUENT CONT)	4/WEEK	4/WEEK	DAILY	4/YR	4/YR							
Date	TSS LBS/DAY	pH STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L	PH MINIMUM						RAIN
1		7.28	21.01			<1			7.24						0
2		7.26	20.81			<1			7.22						0
3		7.25	21.22			<1			7.18						0
4	50	7.25	21.41	11.7 →		<1			7.16						0
5	18	7.23	21.42	11.9 →		<1			7.14						.06
6	87	7.20	21.41	15.2 →		<1			7.14						0
7	88	7.23	21.61		14.1	<1			7.14						0
8		7.26	21.01			<1			7.19						.48
9		7.24	20.79			<1			7.21						.05
10		7.28	21.0			<1			7.24						0
11	17	7.26	21.41	10.9 →		<1			7.24						0
12	65	7.24	21.59	14.2 →		<1			7.21						0
13	84	7.24	21.59		17.2	<1			7.17						0
14	102	7.21	22		14.6	<1			7.17						0
15		7.19	22.21			<1			7.17						0
16		7.23	22.01			<1			7.17						0
17		7.23	22.22			<1			7.21						0
18	17	7.25	22.61		14.1	<1			7.21						0
19	67	7.26	22.61		14.0	<1			7.17						0
20	69	7.26	22.6		13.6	<1			7.13						.11
21	104	7.18	22.62		13.1	4			7.07						.01
22		7.21	21.63			<1			7.07						0
23		7.34	21.63			2			7.16						0
24		7.36	22.62			<1			7.25						0
25	66	7.31	22.62		11.2	1			7.13						0
26	16	7.31	22.8		12.2	1			7.09						0
27	131	7.17	23.21		11.75	<1			7.11						0
28	104	7.17	23.21		12.4	<1			7.13						0
29		7.18	23.21			<1			7.13						0
30		7.18	23.22			1			7.13						0
31		7.18	23.22			<1			7.14						0
Total															.71
	AVG 68	7.17		AVG	AVG 13.3	GEM 2	AVG	AVG	7.07						
Permit	1017	6		7	20	200									
	AVW 79	7.36	23.22	AVW	AVW 17.2	GM7 2			7.25						
Limits	1625	9		15	41	400									

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month JULY — Year 2005

Facility Name: City of Camas — County: Clark

Receiving Water: Columbia River — Plant Operator: JIM DICKINSON

Plant Type: Activated Sludge w/UV Disinfection — Population: 14 500

	INFLUENT									EFFLUENT					
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	PH STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE MG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L	TSS % REMOVAL
1	1.829					7.28				1.987					
2	1.845					7.22				1.941					
3	1.782					7.23				1.903					
4	1.856	109	1681	141	2183	7.21	33.6			2.002	9	92	148	3	98
5	1.982	125	2066	153	2529	7.31	33.4			2.137	7	94	125	1	99
6	1.979	101	1667	165	2723	7.23	42.1			2.086	9	91	157	5	97
7	1.897	120	1000	169	2674	7.19	44.0			2.099	47	61	392	5	97
8	2.046					7.69				2.128					
9	2.019					7.28				2.138					
10	2.032					7.33				2.118					
11	2.054	196	3340	237	4060	7.24	37.6			2.081	14	93	243	1	99
12	1.945	133	2157	252	4088	7.19	40.1			1.941	24	82	389	4	98
13	1.976	175	2884	446	7350	7.24	55.9			2.012	8	95	134	5	99
14	1.924	220	3530	330	5295	7.21	39.8			2.042	31	86	528	6	98
15	1.834					7.25				1.975					
16	1.869					7.23				1.982					
17	1.861					7.23				1.966					
18	1.94	221	3576	418	6763	7.29	39.7			2.047	9	96	154	1	99
19	1.905	115	1827	212	3368	7.29	39.2			2.020	14	88	236	4	98
20	1.946	205	3327	376	6102	7.28	36.6			2.070	15	93	259	4	99
21	1.959	102	1666	235	3839	7.26	34.6			2.088	10	90	174	6	97
22	1.913					7.23				1.947					
23	1.923					7.34				1.943					
24	1.86					7.25				1.895					
25	1.934	137	2210	168	2710	7.25	37.2			1.971	10	93	164	4	98
26	1.917	85	1359	110	1759	7.34	41.7			1.966	8	91	131	1	99
27	1.887	115	1810	157	2471	7.16	38.6			1.967	12	90	197	8	95
28	1.99	187	3104	306	5079	7.15	38.6			2.073	12	94	207	6	98
29	1.862					7.15				1.919					
30	1.91					7.19				1.998					
31	1.951					7.28				2.076					
Total															
	AVG 1.923	AVG 147	AVG 2325	AVG 242	AVG 3937	MIN 7.15	AVG 39.5	AVG	AVG	AVG 1.95	AVG 15	AVG 89	AVG 227	AVG 4	AVG 98
Permit	6.1		5616		6405						20	70	1017	20	78
	MAX 2.054	181	MAX 3576	MAX 418	MAX 7350	MAX 7.69	MAX 55.9			MAX 2.138	AVW 19		AVW 324	AVW 4.75	
Limits											30		1525	30	

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month AUGUST — Year 2005

Facility Name: City of Camas — County: Clark

Receiving Water: Columbia River — Plant Operator: JIM DICKINSON

Plant Type: Activated Sludge w/UV Disinfection — Population: 14500

Frequency	4/WEEK	CONT	CONT (EFFLUENT CONT)	4/WEEK	4/WEEK	DAILY	4/YR	4/YR								
Date	TSS LBS/DAY	pH STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L	PH MINIMUM							Rain
1	51	7.22	22.6		12.5	<1			7.18							0
2	84	7.22	22.87		9.3	<1			7.12							0
3	17	7.17	23.1		9.6	<1			7.12							0
4	32	7.17	22.3		8.1	<1			7.12							0
5		7.17	22.7			<1			7.14							0
6		7.17	23.3			<1			7.12							0
7		7.17	23.3			<1			7.10							0
8	51	7.36	23.3		10.4	<1			7.10							0
9	83	7.28	23.3		13.2	2			7.19							0
10	84	7.24	22.9		11.3	2			7.17							0
11	136	7.17	22.7		13.1	1			7.13							0
12		7.15	22.9			<1			7.08							0
13		7.17	22.3			<1			7.06							0
14		7.15	22.6			4			7.08							0
15	153	7.18	23.6		12.6	<1			7.09							0
16	67	7.18	23.5		12.4	<1			7.09							.06
17	138	7.14	22.7		11.3	<1			7.08							0
18	101	7.17	23.3		12.1	3			7.05							0
19		7.24	23.6			<1			6.64							0
20		7.12	23.5			6			7.07							0
21	135	7.14	23.5			2			7.07							0
22	~~8~~	7.17	22.9		8.3	<1			7.09							0
23	68	7.17	22.5		8.9	<1			7.13							0
24	102	7.22	22.7		12.3	<1			7.14							0
25	163	7.16	23.1		13.7	<1			7.04							0
26		7.06	23.3			8			7.00							0
27		7.16	23.3			8			6.99							0
28		7.08	23.2			1			6.99							.68
29	108	7.21	22.8		11.9	<1			7.01							0
30	67	7.28	22.8		14.2	<1			7.03							0
31	17	7.23	23.0		15.4	<1			7.15							
Total																.74"
	AVG 87	MIN 7.06		AVG	AVG 11.6	GEM 2	AVG	AVG	6.64							
Permit	1017	5		7	20	200										
	AVW 117	MAX 7.36	MAX 23.6	MAX	MAX 15.4	GM7 2			7.19							
Limits	1525	9		15	41	400										

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Name and Title ____________________ Signature ____________________

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month August | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 14 500

	INFLUENT									EFFLUENT					
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	PH STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE MG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L	TSS % REMOVAL
1	1.964	138	2260	168	2752	7.26	35.5			2039	9	93	153	3	98
2	1.897	93	1471	134	2120	7.26	40.4			2.004	7	92	117	5	96
3	1.931	121	1949	154	2408	7.17	35.3			2.064	15	88	258	1	99
EST 4	1.845	173	2662	210	3231	7.18	40.6			1.957	7	96	114	2	99
Est. 5	1.850					7.15				1.945					
6	1.918					7.10				1.971					
7	2.04					7.29				2.07					
8	2.032	86	1459	192	3254	7.29	41.2			2.056	6	93	103	3	98
9	1.977	130	2142	178	2935	7.33	41.6			1.999	7	95	117	5	97
10	1.986	117	1938	131	2170	7.27	38.3			2.017	8	93	135	5	96
11	1.979	164	2707	306	5050	7.25	36.1			2.038	6	96	102	8	97
12	1.969					7.17				1.999					
13	1.927					7.31				1.952					
14	1.983					7.52				2.038					
15	1.992	143	2376	264	4386	7.20	40.7			2.039	6	96	102	9	96
16	2.003	139	2322	202	3374	7.26	64.2			2.015	6	96	101	4	98
17	2.024	120	2026	202	3410	7.34	38.6			2.065	6	95	103	8	96
18	1.925	147	2360	238	3821	7.33	40.1			2.022	5	97	84	6	97
19	1.928					7.33				2.020					
20	1.964					7.24				2.011					
21	2.027					6.76				2.045					
22	2.017	149	2510	250	4205	6.02	36.2			2.025	9	94	156	8	97
23	2.024	151	2549	300	5064	5.80	39.6			2.026	5	97	84	4	99
24	1.995	96	1597	148	2462	5.82	39.3			2.050	5	95	85	6	96
25	2.054	95	1627	117	2004	7.57	38.5			2.167	9	91	163	9	92
26	1.898					5.86				1.950					
27	1.903					6.92				1.918					
28	2.202					6.89				2.197					
29	2.155	107	1923	181	3253	6.29	39.4			2.164	6	94	108	6	97
30	1.997	96	1599	134	2232	7.04	38.5			2.023	4	96	67	4	97
31	2.017	76	1278	32	538	6.11	38.2			2.055	6	92	103	1	97
Total															
	AVG 1.981	AVG 123	AVG 2040	AVG 186	AVG 3088	MIN 5.8	AVG 40.1	AVG	AVG	AVG 2.030	AVG 6.8	AVG 94	AVG 118	AVG 5.1	AVG 97
Permit	6.1		5616		6405						20	70	1017	20	78
	MAX 2.155	MAX 173	MAX 2707	MAX 306	MAX 5064	MAX 7.57	MAX 64.2			MAX 2.197	AVW 10		AVW 161	AVW 6.75	
Limits											30		1525	30	

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certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month Sept | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 15360

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE UG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	1.994	106	1763	224	3725	5.88	5.97	40			2.07	4	96	69	6
2	1.983					5.90	7.04				1.991				
3	2.017					6.34	6.60				2.038				
4	1.929					6.23	6.94				1.946				
5	2.155	183	3289	218	3918	6.23	7.16	48.6			2.182	7	96	127	3
6	2.028	134	2266	192	3247	6.24	7.16	38.4			2.12	11	92	194	4
7	1.961	121	1979	170	2780	6.04	6.64	41.2			2.007	18	85	301	6
8	1.986	139	2302	182	3014	6.59	7.32	37			2.022	9	94	152	7
9	1.899					6.85	7.39				1.901				
10	1.983					6.84	7.17				1.975				
11	2.098	84	1382			5.91	7.29				2.111	7	92	116	
12	1.973			123	2024	5.73	7.29	34.4			1.995				8
13	1.995	117	1947	199	3311	6.71	7.17	43.0			1.994	5	96	83	3
14	1.957	211	3444	338	5516	6.59	7.17	42			1.963	9	96	147	9
15	1.991	93	1544	100	1660	6.36	7.17	47.6			2.049	6	94	104	6
16	1.992					6.25	7.03				1.958				
17	1.951					6.45	7.14				1.964				
18	2.135					6.69	7.19				2.134				
19	2.069	141	2433	228	3934	3.84	7.22	43.2			2.07	3	98	52	5
20	1.983	104	1720	91	1505	6.28	7.13	43.6			1.972	5	95	82	20
21	1.962	105	1718	188	3076	6.28	7.18	48.7			1.972	3	97	49	8
22	1.954	128	2085	428	6974	5.52	7.38	46			2.034	7	95	118	5
23	1.832					6.76	7.15				1.939				
24	1.906					6.66	7.11				1.943				
25	2.053					6.55	7.18				2.086				
26	1.933	212	3417	302	4869	5.95	7.54	46.3			1.965	8	96	131	3
27	1.948	134	2177	222	3610	6.01	7.25	39			1.950	1	99	16	5
28	1.912	96	1531	118	1881	6.75	7.15	40			1.947	7	93	114	2
29	2.005	109	1657	292	4883	6.66	7.32	39.8			2.029	7	94	121	5
30	3.341					6.54	7.32				3.383				
31															
Total															
	AVG 2.030	AVG 130	AVG 2156	AVG 213	AVG 3525	MIN 3.84		AVG 42.3	AVG	AVG	AVG 2.057	AVG 7	AVG 95	AVG 116	AVG 6.18
Permit	6.1		5616		6405							20	70	1017	20
	MAX 3.341	MAX 212	MAX 3444	MAX 428	MAX 6974		MAX 7.54	MAX 48.7			MAX 3.383	AVW 11		AVW 194	AVW 9.5
Limits												30		1525	30

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No, influent

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 Month Sept Year 2005

Facility Name City of Camas County Clark

Receiving Water Columbia River Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection Population 15360

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					Rain
1	97	104	7.06	7.19	23.2	16.2→		<1							Ø
2			6.34	7.35	23.0			<1							Ø
3			7.09	7.18	23			<1							/
4			7.11	7.20	23			1							Ø
5	99	55	7.1	7.20	23		19.7	<1							Ø
6	98	71	7.13	7.22	22.6		16.7	<1							Ø
7	96	100	7.19	7.25	22.9		18.3	<1							Ø
8	96	118	6.17	7.34	22.9		20	<1							Ø
9			7.14	7.21	223			<1							Ø
10			7.10	7.21	22.3			<1							.01
11			7.02	7.10	22.3			<1							Ø
12	93	133	6.25	7.16	22.3		19.4	<1							Ø
13	98	50	7.09	7.18	22.5		20.4	<1							Ø
14	97	146	7.10	7.23	21.9		22	<1							Ø
15	94	103	7.09	7.23	22.5		26.2	<1							Ø
16			7.10	7.17	21.9			<1							Ø
17			7.02	7.13	22.12			<1							Ø
18			7.00	7.06	21.9			<1							Ø
19	98	86	6.54	7.46	21.9		22.5	<1							Ø
20	78	329	7.01	7.07	22.1		25.1	<1							Ø
21	96	132	6.52	7.16	22.1		26.6	<1							Ø
22	99	85	6.52	7.15	21.7		21.7	<1							Ø
23			7.01	7.10	21.7			<1							Ø
24			7.06	7.10	21.3			<1							Ø
25			7.06	7.12	21.5			<1							Ø
26	99	49	7.06	7.13	21.7		25.5	<1							Ø
27	98	81	7.20	7.20	21.7		22	<1							Ø
28	98	32	6.69	7.19	21.7		25	<1							Ø
29	98	85	7.02	7.15	21.3		25.4	<1							Ø
30			6.93	7.13	21.5			12							2.36
31															
Total															
	AVG 96	AVG 103.5	MIN 6.25			AVG	AVG 21.9	GEM 2	AVG	AVG					2.37
Permit	70	1017	6			7	20	200							
		AVW 158		MAX 7.46	MXD 23.2	MXD	MXD 26.6	GM7 2							
Limits		1525		9		15	41	400							

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month October | Year 2005

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 15360

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE UG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	2.293					6.49	7.17				2.312				
2	2.403					6.52	6.96				2.372				
3	2.345	190	3716	414	8097	6.42	7.19	42.4			2.453	3	98	61	4
4	2.104	92	1614	232	4071	6.42	7.19	43			2.24	4	96	75	5
5	2.071	98	1693	157	2712	6.71	7.19	38.7			2.025	4	96	68	5
6	2.103	106	1859	224	3929	6.64	7.22	43.1			2.076	5	95	87	3
7	1.952					6.38	7.23				1.911				
8	2.084					6.42	7.10				2.021				
9	2.142					5.85	7.21				2.079				
10	2.076	219	3792	510	8830	6.45	6.87	40.6			2.013	10	95	168	3
11	2.033	220	3730	172	2916	6.48	6.90	35.2			1.971	6	97	99	1
12	2.104	108	1895	258	4527	6.45	7.31	50.1			2.049	6	94	103	1
13	2.177	142	2578	216	3922	6.54	7.02	37.7			2.176	7	95	127	1
14	2.076					6.41	6.92				2.072				
15	2.113					6.57	6.94				2.085				
16	2.247					6.57	7.06				2.196				
17	2.175	189	3437	282	5115	6.41	7.14	43.8			2.175	10	94	181	3
18	2.127	159	2821	208	3690	5.92	6.83	42			2.116	4	97	71	5
19	2.173	107	1939	168	3045	5.38	7.11	51.3			2.158	6	97	114	6
20	2.152	202	3623	354	6353	5.38	7.36	41.2			2.163	3	97	54	1
21	1.961					6.28	6.79				1.977				
22	2.009					6.54	6.92				2.014				
23	2.112					6.41	6.91				2.083				
24	2.028	107	1811	188	3180	6.3	6.92	41			2.028	8	93	135	2
25	2.073	102	1763	110	1902	6.5	6.88	37.3			2.046	4	96	68	4
26	2.049	81	1384	150	2563	6.3	6.92	46.9			2.02	7	91	118	3
27	2.174	134	2430	234	4243	6.49	7.08	36.4			2.183	6	96	109	1
28	2.177					6.51	7.10				2.12				
29	2.254					5.93	6.97				2.186				
30	2.469					6.09	6.89				2.414				
31	4.329	81	2924	126	4549	6.26	6.81	22.4			4.547	12	85	455	3
Total															
	AVG 2.212	AVG 137.5	AVG 2530	AVG 235	AVG 4332	MIN 5.38		AVG 40.7	AVG	AVG	AVG 2.202	AVG 6	AVG 95	AVG 123	AVG 3
Permit	6.1		5616		6405							20	70	1017	20
	MAX 4.329	MAX 220	MAX 3792	MAX 510	MAX 8830		MAX 7.36	MAX 51.3			MAX 4.547	AVW 7.3		AVW 128	AVW 4.25
Limits												30		1525	30

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 **Month** October **Year** 2005

Facility Name City of Camas **County** Clark

Receiving Water Columbia River **Plant Operator** J. Dickinson

Plant Type Activated Sludge w/UV Disinfection **Population** 15360

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					5-25
1			6.91	7.02	20.3			<1							.24
2			7.00	7.09	20.3			<1							.31
3	99	82	6.22	7.13	20.5	17.9		<1							.23
4	93	93	7.05	7.11	20.1	22		<1							⊖
5	97	84	7.09	7.18	20.3	24		<1							⊖
6	99	52	7.12	7.18	20.7	27.1		<1							.13
7			7.08	7.14	20.9			<1							0
8			7.06	7.13	20.7			<1							.20
9			7.08	7.15	20.9			<1							.01
10	99	50	7.17	7.37	20.6	25		<1							.01
11	99	16	7.00	7.33	20.8	24		<1							.01
12	99	17	7.00	7.37	20.8	27.4		<1							.24
13	99	18	7.10	7.27	20.4	28.7		<1							.05
14			7.10	7.30	20.4			<1							.14
15			7.03	7.15	20.6			2							.13
16			6.97	7.07	20.6			<1							.01
17	99	54	7.01	7.14	20.8	24.1		<1							⊖
18	97	88	7.10	7.18	20.8	26		<1							.15
19	96	95	7.01	7.18	20.8	25.1		<1							.20
20	99	18	6.52	7.25	20.4	22		<1							.01
21			7.06	7.19	20.4			<1							⊖
22			7.17	7.22	20.6			<1							⊖
23			7.13	7.22	20.6			3							⊖
24	99	34	7.12	7.2	20.6	21		<1							⊖
25	96	68	7.12	7.18	20.6	21.7		<1							.27
26	98	51	7.12	7.2	20.6	22.9		<1							⊖
27	99	18	7.10	7.19	19.8	23.4		<1							.44
28			7.00	7.22	19.8			<1							.09
29			6.83	7.0	19.8			<1							.10
30			7.00	7.04	19.8			<1							.85
31	98	118	6.58	7.41	19.6	16.6		<1							1.2
Total															
	AVG 98	AVG 52	MIN 6.22			AVG 23.5	AVG	GEM 2	AVG	AVG					5.02"
Permit	70	1017	6			7	20	200							
		AVW 78		MAX 7.41	MXD 20.9	MXD 28.7	MXD	GM7 2							
Limits		1525		9		15	41	400							

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month November Year 2005

Facility Name City of Camas | County Clark

eceiving Water Columbia River | Plant Operator J. Dickinson

ant Type Activated Sludge w/UV Disinfection | Population 15360

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE UG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	4.922	78	3202	109	4474	6.22	6.69	17.8			4.893	4	95	163	4
2	2.736	69	1574	108	2464	6.22	6.81	26.3			2.750	2.5	96	57	3
3	3.414	97	2742	126	3587	6.38	6.71	22			3.393	5	95	83	10
4	3.179					6.23	6.65				3.192				
5	3.624					6.30	6.78				3.598				
6	3.212					6.39	6.70				3.197				
7	2.813	76	1791	104	2440	6.41	6.76	24.8			2.714	10	87	226	3
8	2.526	77	1622	114	2401	6.37	6.76	33			2.426	4	95	81	10
9	2.370	111	2194	130	2569	6.45	6.92	47			2.337	7	94	136	11
10	2.313	149	2874	228	4398	6.42	6.88	38			2.278	6	96	114	7
11	2.675					5.26	6.96				2.578				
12	3.095					6.26	6.89				2.994				
13	3.265					6.06	6.77				3.193				
14	2.625	102	2233	161	3525	6.48	7.70	54.2			2.751	7	93	161	3
15	2.384	67	1332	104	2068	6.06	7.70	36.8			2.446	5	96	93	5
16	2.333	108	2101	132	2576	6.48	6.92	44.4			2.340	7	94	137	4
17	2.316	145.5	2810	204	3940	6.56	6.85	63.7			2.258	8.3	94	156.3	6
18	2.142					6.49	7.06				2.062				
19	2.151					6.53	7.01				2.070				
20	2.226					6.57	6.90				2.125				
21	2.223	106.5	1974	220	4079	6.47	7.01	37.5			2.137	8.85	92	158	6
22	2.102	120	2104	200	3506	6.31	6.83	41.1			2.028	5	96	85	6
23	2.146	199	3562	396	7087	6.31	6.87	45.2			2.121	7	96	124	3
24	2.234	145	2702	330	6148	6.42	6.86	43.0			2.174	9	94	163	5
25	2.671					6.42	6.83				2.609				
26	2.546					6.50	7.00				2.495				
27	2.556			115	2367	6.52	6.92	35.4			2.503				
28	2.468	174	3585			6.40	7.02				2.362	5	97	98	5
29	2.435	134	2721	171	3473	6.43	6.87	41.3			2.331	16	88	311	5
30	2.285	167	3183	278	5298	6.49	6.82	39.3			2.237	8	95	149	4
31															
Total															
	AVG 2.666	AVG 118	AVG 2461	AVG 179	AVG 3689	MIN 5.26		AVG 38.4	AVG	AVG	AVG 2.621	AVG 7	AVG 94	AVG 139	5.6
Permit	6.1		5616		6405							20	70	1017	20
	MAX 4.922	MAX 199	MAX 3585	MAX 396	MAX 7087		MAX 7.70	MAX 63.7			MAX 4.893	AVW 7.5		AVW 186	7.75
Limits												30		1525	30

Please Circle ALL Permit Violations Mail to P.O. Box 47775, Olympia WA 98504-7775

VG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

37=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month November Year 2005

Facility Name City of Camas — County Clark

Receiving Water Columbia River — Plant Operator J. Dickinson

Plant Type Activated Sludge w/UV Disinfection — Population 15360

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					R
1	96	163	7.09	7.56	18.4	7.8		<1							.58
2	97	69	6.58	7.56	19.6	12.0		<1							.15
3	92	283	7.24	7.28	18.21	11.5		<1							.50
4			7.15	7.30	18.21			<1							.29
5			7.02	7.20	18.01			<1							.57
6			7.02	7.07	17.8			<1							.41
7	97	68	6.74	7.18	18.01	10.28		<1							.01
8	91	83	7.18	7.28	18.01	15.3		<1							0
9	92	214	7.28	7.38	18.01	20		<1							0
10	96	133	7.29	7.40	18.21	18		<1							.21
11			7.18	7.33	18.21			<1							.40
12			7.09	7.25	18.01			<1							.52
13			6.99	7.09	18.0			<1							0
14	98	69	6.43	7.18	17.8	18.3		<1							0
15	95	102	6.99	7.22	17.8	12.3		<1							0
16	97	78	7.01	7.22	17.8	14.2		<1							0
17	97	113	7.06	7.15	17.8	17.6		<1							0
18			7.06	7.11	17.8			<1							0
19			7.09	7.18	17.61			<1							0
20			7.14	7.21	17.61			<1							0
21	97	107	7.05	7.21	17.6	16.4		<1							0
22	97	101	6.51	7.32	17.5	16.5		<1							0
23	99	53	7.09	7.17	17.2	15.6		<1							0
24	98	91	7.09	7.19	17.2	14.8		<1							.59
25			7.15	7.19	17.2			<1							.47
26			7.13	7.19	17.1			<1							.13
27	96↓	.98↓	7.13	7.17	17	19.4↓		<1							0
28			6.68	7.27	16.8			<1							.12
29	97	97	7.25	7.33	16.61	24.8		12							.14
30	99	75	7.12	7.31	16.6	27.9		3							.01
31															
Total															
	AVG 96	AVG 111	MIN 6.43			AVG 16.3	AVG	GEM 2	AVG	AVG					5.1"
Permit	70	1017	6			7	20	200							
		AVW 125		MAX 7.56	MXD 19.6	MXD 27.9	MXD	GM7 2							
Limits		1525		9		15	41	400							

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AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

GM7=highest 7-day Geometric Mean

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Name and Title — Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month DEC. — Year 2005

lity Name City of Camas — County Clark

ceiving Water Columbia River — Plant Operator J. DICKINSON

Plant Type Activated Sludge w/UV Disinfection — Population 15360

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE UG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	2.845	144	3411	178	4223	6.39	6.81	40.2			2.746	7	95	98	7
2	3.532					6.38	6.78				3.456				
3	3.232					6.48	7.63				3.174				
4	2.851					6.47	6.79				2.879				
5	2.55	183	3882	154	3275	5.83	6.89	43.8			2.518	5	97	105	2
6	2.40	142	2834	196	3923	6.40	7.80	38			2.34	1	99	20	5
7	2.346	81	1585	92	1800	6.21	6.99	47			2.312	6	93	116	7
8	2.305	147	2832	292	5613	6.52	6.81	45.8			2.25	4	97	75	4
9	2.074					6.53	6.88				2.005				
10	2.178			[illegible]		6.57	6.88				2.112				
11	2.202					6.46	7.05				2.152				
12	2.174	162	2937	121	2194	5.36	6.99	46.5			2.138	3	98	53	4.25
13	2.080	116	2012	142	2463	6.63	7.06	45.2			2.082	6	95	104	1
14	2.053	185	3209	132	2266	6.56	7.00	44.5			2.065	8	96	138	12
15	2.105	139	2440	356	6249	6.09	6.94	57.9			2.141	3	98	54	4
16	2028					6.44	6.90				2.054				
17	2.168					6.57	6.93				2.144				
18	2.11					6.63	6.97				2.092				
19	2.3	126	2417	200	3836	6.51	6.92	46.2			2.379	7	94	139	4
20	2.69	130	2921	242	5429	6.31	6.93	37.2			2.694	16	87	359	5
21	3.931	80	2623	176	5770	5.76	6.87	34.6			3.941	16	80	526	14
22	5.41	64.35	2903	106	4783	6.00	6.67	21.2			5.45	18.4	71	836	44
23	3.332					6.00	6.89				3.473				
24	2.899					6.06	6.85				2.995				
25	2.677	95	3571			5.66	6.06				2.771	56	41	2175	
26	3.043	93	2360	62	1573	5.85	6.32	34.1			3.143	4	96	105	6
27	4.507	~~228~~ RS	~~8940~~ RS	74	2781	6.01	7.44	17.5			4.657	~~8~~ RS	~~97~~	~~377~~	57
28	5.023	62	2597	90	3770	6.08	6.49	17.92			5.268	35	44	1538	20
29	4.871	63	2559	104	4225	6.08	6.54	20.8			5.149	26	59	1117	15
30	7.034					6.02	6.47				7.774				
31	4.90					6.18	6.61				5.095				
Total															
	AVG 3.091	AVG 118	AVG 2770	AVG 160	AVG 3669	MIN 5.36		AVG 37.5	AVG	AVG	AVG 3.143	AVG 13	AVG 85	AVG 445	AVG 12.4
Permit	6.1		5616		6405							20	70	1017	20
	MAX 7.034	MAX 185	MAX 3882	MAX 356	MAX 6249		MAX 7.80	MAX 57.9			MAX 7.774	AVW 30		AVW 1234	AVW 24.5
Limits												30		1525	30

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month DEC. — Year 2005
Facility Name City of Camas — County Clark
Receiving Water Columbia River — Plant Operator J. DICKINSON
Plant Type Activated Sludge w/UV Disinfection — Population 15360

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					rain
1	96	160	6.93	7.27	16.6	25.0		<1							.55
2			6.78	6.96	16.4			<1							.56
3			6.72	7.05	15.81			6							.11
4			6.92	7.09	16			<1							Ø
5	99	42	6.41	7.09	16	24.5		<1							Ø
6	97	98	6.99	7.17	16.2	24.7		<1							Ø
7	92	135	7.12	7.23	15.8	26.7		<1							Ø
8	99	75	7.10	7.16	15.4	32.1		<1							Ø
9			7.14	7.23	15.8			<1							Ø
10			7.19	7.25	15.61			<1							Ø
11			7.21	7.27	15.4			<1							Ø
12	96	76	7.24	7.29	15.80	32.3		<1							.01
13	99	17	6.60	7.38	16.0	33.0		<1							Ø
14	91	206	6.60	7.32	15.60	34.2		<1							Ø
15	98	71	7.12	7.51	14.80	35.2		<1							Ø
16			7.21	7.62	14.80			<1							Ø
17			7.09	7.21	14.40			3							Ø
18			7.05	7.14	14.2			<1							.28
19	98	79	6.63	7.3	14.4	33.9		<1							.12
20	98	112	7.08	7.16	14.8	31.5		<1							.72
21	92	460	7.01	7.14	15.0	28.2		<1							1.18
22	58	1999	7.03	7.18	14.4	20		<1							.70
23			7.01	7.29	15.0			<1							.05
24			7.18	7.29	14.81			<1							.03
25			7.18	7.25	15.01			2							.31
26	90	157	7.19	7.23	15.21	24.8		<1							.43
27	23	2213	7.00	7.19	15.21	19.31		<1							1.22
28	78	878	6.95	7.21	14.20	12.62		<1							.24
29	86	644	7.21	7.37	14.2	16.8		<1							1.30
30			6.64	7.37	13.6			<1							.82
31			7.09	7.40	13.6			<1							.25
Total															
	AVG 88	AVG 437	MIN 6.41			AVG 26.7	AVG	GEM 2	AVG	AVG					8.88
Permit	70	1017	6			7	20	200							
		AVW 973		MAX 7.62	MXD 16.6	MXD 35.2	MXD	GM7 2							
Limits		1525		9		15	41	400							

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249

Month JAN. Year 2006

Facility Name City of Camas

County Clark

Receiving Water Columbia River

Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection

Population 15360

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	3.789					6.3	6.64				4.075				
2	3.921	97	3179	130	4251	6.17	6.6	28.1			4.054	17	82	575	7
3	3.546	94	2780	66	1952	6.17	6.63	30.7			3.646	8	91	243	8
4	3.159	80	2108	66	1739	5.99	6.63	21.7			3.311	6	92	166	5
5	2.871	76	1820	140	3352	5.66	6.5	27.7			3.008	6	92	151	2
6	4.238					5.85	6.42				4.343				
7	4.381					5.26	6.16				4.468				
8	3.852					5.07	5.78				3.904				
9	4.982	79	3282	144	5983	5.07	5.9	21.8			5.035	29	63	1218	26
10	6.208	80	4142	80	4142	5.4	6.5	16.9			5.669	14	83	662	7
11	4.758	33	1317	67	2659	6.14	6.5	17.0			4.898	4	88	1163	2
12	5.092	49	2081	78	3312	6.12	6.5	17.3			5.244	13	73	2081	12
13	5.086					6.11	6.8				5.269				
14	4.219					6.20	6.48				4.308				
15	3.508					6.26	6.6				3.531				
16	4.623	66	2545	93	3586	6.07	6.16	21.8			4.699	11	83	431	7
17	5.4	80	3603	182	8197	6.05	6.47	14.2			5.589	7.5	91	350	8
18	4438	81	2998	120	4442	6.10	6.69	15.9			4.545	8	90	303	5
19	3.648	65	1978	90	2738	6.05	6.8	23.4			3.714	5	92	155	6
20	4.059					6.11	6.7				4.148				
21	3.351					6.42	6.98				3.413				
22	3.038					6.42	6.66				3.076				
23	2.832	117	2763	169	3992	6.48	7.46	37.5			2.86	19	84	453	8
24	2.667	91	2024	81	1802	7.08	7.53	33.7			2.708	9	90	203	7
25	2.688	101	2264	154	3452	7.14	7.67	29.6			2.764	16	84	369	11
26	2.63	95	2084	156	3422	7.31	7.71	37.7			2.693	13	86	292	7
27	2.868					7.07	7.71				2.888				
28	3455					7.22	7.57				3.590				
29	5482					6.93	7.49				5.753				
30	5.088	33	1400	70	2970	7.02	7.52	63.3			5.389	10	70	449	8
31	4.676	103	4017	123	4796	6.9	7.62	16.3			4.901	9	91	368	6
Total															
	AVG 4.017	AVG 79	AVG 2573	AVG 112	AVG 3710	MIN 5.07		AVG 26.4	AVG	AVG	AVG 4.113	AVG 11	AVG 85	AVG 476	AVG 7.8
Permit	6.1		5616		6405							20	70	1017	20
	6.208	MAX 117	MAX 4142	MAX 182	MAX 8197		MAX 7.71	MAX 63.3			MAX 5.753	AVW 15		AVW 1031	AVW 11.75
Limits												30		1525	30

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month JAN. | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

ant Type Activated Sludge w/UV Disinfection | Population 15300

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	EFFLUENT CONT TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					Rain
1			7.40	7.53	13.8			<1							.38
2	95	237	7.45	7.58	14	23.2		<1							.10
3	88	243	7.19	7.51	14.2	23.3		<1							.25
4	92	138	7.15	7.23	14.4	16.1		<1							Ø
5	99	50	6.49	7.29	14.6	18.7		<1							.45
6			7.17	7.23	14.8			<1							.57
7			7.10	7.23	14.2			<1							.36
8			7.12	7.19	14.4			<1							.34
9	82	1092	7.06	7.17	14.4	17.3		<1							.67
10	91	331	6.98	7.43	14	10.3		<1							.87
11	97	82	6.96	7.51	13.6	7.0		<1							.25
12	88	524	6.91	7.19	13.7	5.9		<1							.75
13			7.04	7.19	13.7	4.6		<1							.50
14			7.00	7.04	13.77	3.14		6							.11
15			7.02	7.3	14	1.47		<1							.21
16	92	274	7.0	7.5	14.19	2.4		<1							.84
17	96	373	6.36	7.29	14.2	1.8		<1							.74
18	96	190	7.17	7.23	13.8	.82		<1							.07
19	93	186	7.16	7.32	14.2	1.8		<1							.51
20			7.15	7.25	14.8	4.15		<1							.06
21			7.13	7.17	14.18	2.40		12							.14
22			7.17	7.24	14.6	2.5		<1							Ø
23	95	189	6.63	7.64	15.6	5.07		<1							Ø
24	91	158	7.14	7.41	14.8	5.54		4							Ø
25	93	253	7.04	7.61	14.8	5.2		<1							.22
26	96	157	7.18	7.24	14.8	3.28		<1							.15
27			7.20	7.24	14.8			<1							.59
28			7.16	7.22	14.8			<1							.16
29			7.12	7.22	14.2	4.03		<1							1.18
30	89	360	6.92	7.39	13.4	2.84		3							.30
31	95	245	7.14	7.28	13.6	1.33		<1							.58
Total															
	AVG 93	AVG 283	MIN 6.36			AVG 6.96	AVG	GEM 2	AVG	AVG					11.35"
Permit	70	1017	6			7	20	200							
		AVW 507		MAX 7.64	MXD 15.6	MXD 23.3	MXD	GM7 2							
Limits		1526		9		16	41	400							

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month FEB — Year 2006

Facility Name City of Camas — County Clark

Receiving Water Columbia River — Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection — Population 15360

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	3.838	46	1472	70	2240	7.08	7.48	20			3.974	8	83	265	9
2	3.46	79	2280	127	3654	6.87	7.59	24.1			3.598	8	90	240	6
3	3.254					6.82	7.00				3.361				
4	3.343					6.46	6.82				3.427				
5	3.061					6.24	6.46				3.132				
6	2.747	121	2772	116	2733	6.11	6.24	30.1			2.825	12	90	283	14
7	2.618	109	2380	170	3712	6.00	6.11	32.2			2.757	8	93	184	15
8	2.531	93	1963	128	2702	6.12	6.6	25.1			2.66	7	92	155	10
9	2.423	77	1556	192	3880	6.23	7.77	40.2			2.456	5	94	102	9
10	2.306					7.31	7.77				2.377				
11	2.326					6.72	7.76				2.356				
12	2.40					6.71	6.9				2.412				
13	2.349	135	2645	238	4663	6.69	7.52	38.8			2.356	9	93	177	14
14	2.399	98	1961	228	4562	6.43	7.57	37.4			2.428	14	86	283	14
15	2.309	174	3351	260	5007	6.16	6.5	39.6			2.394	7	96	140	12
16	2.245	127	2378	254	4756	6.95	7.53	50.4			2.256	5	96	94	12
17	2.195					7.21	7.74				2.22				
18	2.157					7.36	7.82				2.145				
19	2.205					7.11	7.76				2.198				
20	2.294	112	2142	260	4974	6.92	7.69	49.8			2.258	16.8	85	316	8
21	2.25	108	2027	129	2421	7.01	7.62	48.5			2.255	6	94	113	9
22	2.2	91	1670	142	2605	6.93	7.43	41.4			2.239	7	92	131	12
23	2.35	150	2940	172	3371	6.27	7.51	31.5			2.434	8	95	162	15
24	2.142					5.85	7.51				2.154				
25	2.222					6.98	7.70				2.234				
26	2.331					6.77	7.74				2.333				
27	2.644	129	2848	424	9350	6.77	7.54	38.1			2.643	7	95	154	8
28	3.741	96	2995	124	3869	7.07	7.5	18.5			3.793	7	93	221	17
29															
30															
31															
Total															
	AVG 2.567	AVG 109	AVG 2336	AVG 190	AVG 4031	MIN 5.85		AVG 35	AVG	AVG	AVG 2.631	AVG 8.4	AVG 92	AVG 189	AVG 12
Permit	6.1		5616		6406							20	70	1017	20
	MAX 3.838	MAX 174	MAX 3351	MAX 424	MAX 9350		MAX 7.82	MAX 50.4			MAX 3.974	AVW 9.5		AVW 181	AVW 13
Limits												30		1525	30

Please Circle ALL Permit Violations **Mail to P.O. Box 47775, Olympia WA 98504-7775**

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GM7=highest 7-day Geometric Mean

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 Month FEB Year 2006

Facility Name City of Camas County Clark

Receiving Water Columbia River Plant Operator JIM DICKINSON

ant Type Activated Sludge w/UV Disinfection Population 15360

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					RAIN
1	87	298	7.21	7.29	13.8	0		<1							.12
2	95	180	7.23	7.29	14.2	1.1		<1							.21
3			7.27	7.36	14.4			<1							.37
4			7.36	7.42	14.2			<1							.12
5			7.32	7.40	14.4			<1							Ø
6	88	330	7.32	7.38	14.6	3.6		<1							Ø
7	91	345	7.30	7.34	14.8	5.3		<1							Ø
8	92	222	7.26	7.37	15.2	5.8		<1							Ø
9	95	184	7.27	7.31	15.2	9.8		<1							Ø
10			7.23	7.38	14.6			<1							Ø
11			7.27	7.40	14.6			4							Ø
12			7.19	7.27	15.2			<1							.01
13	94	275	7.15	7.29	15.4	6.6		<1							.20
14	94	283	7.15	7.23	15.4	4.1		<1							.14
15	95	240	7.17	7.22	15	4.1		<1							Ø
16	95	226	6.97	7.75	15	6.2		<1							Ø
17			7.15	7.24	14.3			<1							Ø
18			7.12	7.18	13.7			<1							Ø
19			7.08	7.18	14.1			<1							Ø
20	97	151	7.09	7.18	14.3	4.1		<1							.07
21	93	169	6.31	7.48	14.7	4.6		<1							.08
22	92	224	7.10	7.17	14.9	2.2		<1							.04
23	91	304	7.13	7.19	14.9	2.3		<1							.28
24			7.12	7.20	14.9			<1							.01
25			7.13	7.20	14.7			<1							Ø
26			7.12	7.21	14.5			<1							.09
27	98	176	6.83	7.50	14.9	4.9		<1							.75
28	86	538	7.07	7.16	14.9	4.4		<1							.43
29															
30															
31															
Total															
	AVG 93	AVG 259	MIN 6.31			AVG 4.3	AVG	GEM 2	AVG	AVG					2.92"
Permit	70	1017	6			7	20	200							
		AVW 270		MAX 7.75	MXD 15.4	MXD 9.8	MXD	GM7 2							
Limits		1526		9		15	41	400							

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month MARCH | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 15360

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE MG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	2.912	84	2040	104	2525	6.92	7.77	28			2.97	4	95	99	9
2	2.622	102	2230	124	2712	7.25	7.65	42.4			2.698	7	94	146	5
3	2.399					7.29	7.73				2.420				
4	2.445					7.26	7.66				2.477				
5	2.52					6.49	8.06				2.497				
6	2.403	109	2185	140	2806	6.9	7.72	48.2			2.399	8	93	160	8
7	2.726	102	2319	168	2318	6.6	7.30	30.6			2.726	6	94	136	21
8	3.044	104	2640	148	3757	7.08	7.82	32.2			3.102	9	91	233	10
9	3.398	87	2466	164	4648	7.08	7.75	30.7			3.411	7	92	199	13
10	2.922					7.01	7.55				3.055				
11	2.626					6.49	7.57				2.965				
12	2.813					6.33	6.66	43.9			2.867				
13	2.263	117	2608	99	2207	6.55	6.84	47.2			2.688	15	87	336	8
14	2.483	91	1884	68	1408	6.39	6.88				2.993	8	91	173	6
15	2.466	122	2509	230	4730	6.2	6.88	41.7			2.557	7	94	149	7
16	2.495	146	3038	348	7241	6.13	6.34	45.1			2.641	2	99	44	4
17	2.557					6.01	6.18				2.706				
18	2.514					6.00	6.09				2.687				
19	2.564					5.98	6.15				2.75				
20	2.416	115	2317	125	2519	5.83	8.03	28.2			2.551	7	94	149	2
21	2.411	94	1890	114	2292	7.40	7.74	30.2			2.507	4	96	84	6
22	2.308	122	2348	140	2695	7.32	7.78	22.8			2.46	6	95	123	6
23	2.54	177	3561	160	3218	6.72	7.90	41			2.412	5	97	106	3
24	2.377					7.13	7.24				2.481				
25	2.485					7.38	7.87				2.58				
26	2.419					7.28	7.71				2.525				
27	2.443	145	2955	171	3484	7.2	7.74	53.7			2.538	5	97	106	3
28	2.388	125	2400	181	3484	7.26	7.87	49.6			2.388	6	95	119	8
29	2.468	152	3040	312	6240	6.63	7.90	49.2			2.398	1	99	21	3
30	2.279	164	3117	280	5322	7.36	7.77	53.7			2.392	8	95	160	4
31	2.457					7.30	7.72				2.549				
Total															
	AVG 2.573	AVG 120	AVG 2530	AVG 171	AVG 3534	MIN 5.83		AVG 39.9	AVG	AVG	AVG 2.645	AVG 6.4	AVG 94	AVG 141	AVG 7
Permit	6.1		5816		6405							20	70	1017	20
	MAX 3.398	MAX 177	MAX 3561	MAX 348	MAX 7241		MAX 8.06	MAX 53.7			MAX 3.411	AVW 8		AVW 182	AVW 13
Limits												30		1525	30

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WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 Month MARCH Year 2006

Facility Name City of Camas County Clark

Receiving Water Columbia River Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection Population 15360

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					RAIN
1	91	222	6.58	7.26	14.3	2		<1							.01
2	96	113	7.2	7.32	14.9	2.5		<1							0
3			7.18	7.22	14.9			<1							0
4			7.16	7.22	15.3			<1							.29
5			7.2	7.26	15.1			<1							0
6	94	160	5.8	7.29	15.1	6.8		<1							.09
7	88	477	7.2	7.2	15.3	8.8		<1							.43
8	93	259	7.08	7.82	15.3	7.6		<1							.30
9	92	370	7.22	7.37	14.3	6.1		<1							.23
10			7.33	7.39	14.1			<1							.05
11			7.31	7.44	13.91			<1							.25
12			7.39	7.48	14.1			2							.01
13	92	179	7.37	7.43	14.51	6.3		<1							.02
14	91	130	7.26	7.39	14.71	6.78		<1							.04
15	97	149	7.24	7.43	14.8	4.8		<1							.20
16	99	88	7.24	7.3	14.8	6.8		<1							.02
17			7.18	7.24	15.1			<1							.0.45
18			7.11	7.18	14.81			<1							0
19			7.1	7.14	15.2			<1							0
20	98	43	6.09	7.29	15.4	1.5		<1							.12
21	95	125	7.19	7.24	15.2	1.1		<1							.05
22	96	123	7.21	7.24	15.4	.82		<1							0
23	98	64	7.19	7.24	15.6	2.0		<1							.18
24			7.35	7.84	15.8			<1							.19
25			7.15	7.22	15.6			<1							.21
26			7.15	7.22	15.6			<1							0
27	98	64	7.17	7.22	15.6	3.4		<1							0
28	96	159	7.15	7.26	16	3.6		<1							.02
29	99	62	7.15	7.21	16.01	2.24		<1							.21
30	99	80	7.10	7.15	16.2	2.0		<1							.11
31			7.13	7.19	16.4			<1							.38
Total															
	AVG 95	AVG 159	MIN 5.8			AVG 4.17	AVG	GEM 2	AVG	AVG					3.86
Permit	70	1017	6			7	20	200							
		AVW 317		MAX 7.84	MXD 16.4	MXD 8.8	MXD	GM7 2							
Limits		1526		9		16	41	400							

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Name and Title

Signature

Permit No.	WA0020249	Month	MARCH Year 2006
Facility Name	City of Camas	County	Clark
...iving Water	Columbia River	Plant Operator	JIM DICKINSON
...t Type	Activated Sludge w/UV Disinfection	Population	15360

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					RAIN
1	91	222	6.58	7.26	14.3	2		<1							.01
2	96	113	7.2	7.32	14.9	2.5		<1							Ø
3			7.18	7.22	14.9			<1							Ø
4			7.16	7.22	15.3			<1							.29
5			7.2	7.26	15.1			<1							Ø
6	94	160	5.8	7.29	15.1	6.8		<1							.09
7	88	477	7.2	7.2	15.3	8.8		<1							.43
8	93	259	7.08	7.82	15.3	7.6		<1							.30
9	92	370	7.22	7.37	14.3	6.1		<1							.23
10			7.33	7.39	14.1			<1							.05
11			7.31	7.44	13.91			<1							.25
12			7.39	7.48	14.1			2							.01
13	92	179	7.37	7.43	14.51	6.3		<1							.02
14	91	130	7.26	7.39	14.71	6.78		<1							.04
15	97	149	7.24	7.43	14.8	4.8		<1							.20
16	99	88	7.24	7.3	14.8	6.8		<1							.02
17			7.18	7.24	15.1			<1							.045
18			7.11	7.18	14.81			<1							Ø
19			7.1	7.14	15.2			<1							Ø
20	98	43	6.09	7.29	15.4	1.5		<1							.12
21	95	125	7.19	7.24	15.2	1.1		<1							.05
22	96	123	7.21	7.24	15.4	.82		<1							Ø
23	98	64	7.19	7.24	15.6	2.0		<1							.18
24			7.35	7.84	15.8			<1							.19
25			7.15	7.22	15.6			<1							.21
26			7.15	7.22	15.6			<1							Ø
27	98	64	7.17	7.22	15.6	3.4		<1							Ø
28	96	159	7.15	7.26	16	3.6		<1							.02
29	99	62	7.15	7.21	16.01	2.24		<1							.21
30	99	80	7.10	7.15	16.2	2.0		<1							.11
31			7.13	7.19	16.4			<1							.38
Total															
	AVG 95	AVG 159	MIN 5.8			AVG 4.17	AVG	GEM 2	AVG	AVG					3.86
Permit	70	1017	6			7	20	200							
		AVW 317		MAX 7.84	MXD 16.4	MXD 8.8	MXD	GM7 2							
Limits		1526		9		15	41	400							

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249

Month April Year 2006

Facility Name City of Camas

County Clark

Receiving Water Columbia River

Plant Operator J. Dickinson

Type Activated Sludge w/UV Disinfection

Population 15360

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE MG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	2.545					7.39	7.69				2.638				
2	2.595					7.2	7.76				2.712				
3	2.393	99	1974	72	1427	7.36	7.72	31.6			2.416	15	85	302	3
4	2.216	125	2310	138	2550	7.32	7.76	24.4			2.268	5	96	95	2
5	2.315	70	1351	78	1606	7.34	7.76	38.1			2.408	6	91	120	3
6	2.148			92	1648	7.34	7.73	40.2			2.247				3
7	2.128					6.50	7.73				2.200				
8	2.466					6.3	6.9				2.533				
9	2.575					6.1	6.5				2.666				
10	2.886	129	3105	264	6354	6.78	7.14	33.3			2.993	4	97	~~[illegible]~~ 100	10
11	2.506	77	1609	100	2090	6.58	6.98	33.9			2.632	5	94	110	5
12	2.355	89	1748	143	2809	6.24	6.98	37.2			2.482	3	97	62	2
13	2.393	133	2654	214	4271	6.21	6.73	45.6			2.51	5	96	105	1
14	3.024					6.34	6.73				3.079				
15	3.519					5.99	6.53				3.657				
16	2.973					5.73	6.3				3.101				
17	2.655	103	2281	121	2679	5.67	7.67	49.7			2.714	3.5	97	79	2
18	2.413	96	1932	108	2173	6.78	7.21	50.2			2.5	5	95	104	6
19	2.311	81	1554	108	2071	6.8	7.28	39.5			2.4	11	86	220	3
20	2.312	69	1330	90	1735	6.78	7.30	40.5			2.457	4	94	82	1
21	2.227					6.88	7.21				2.281				
22	2.222					6.12	6.7				2.34				
23	2.285					6.12	7.3				2.496				
24	2.159	142	2657	192	3457	6.84	7.28	54.3			2.316	2	99	39	4
25	2.135	127	2261	166	2956	6.15	7.18	62.3			2.206	6	95	110	10
26	2.155	107	1923	146	2624	7.00	7.35	44.5			2.215	10	91	185	7
27	2.096	113	1975	154	2692	6.03	6.6	43.2			2.198	12	89	220	5
28	2.042					6.03	7.0				2.116				
29	2.103					5.57	5.91				2.135				
30	2.145					5.47	5.77				2.2				
31															
Total															
	AVG 2.410	AVG	AVG	AVG 137	AVG 2690	MIN 5.47		AVG 41.8	AVG	AVG	AVG 2.504	AVG	AVG	AVG	AVG 4.2
Permit	6.1		5616		6405							20	70	1017	20
	MAX 3.519	MAX	MAX	MAX 264	MAX 6354		MAX 7.76	MAX 62.3			MAX 3.657	AVW		AVW	AVW 6.5
Limits												30		1525	30

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month April — Year 2006

Facility Name: City of Camas — County: Clark

Receiving Water: Columbia River — Plant Operator: J. Dickinson

Type: Activated Sludge w/UV Disinfection — Population: 15360

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					RAIN
1			7.13	7.19	16.2			<1							.01
2			7.12	7.17	16.1			<1							.03
3	96	60	7.12	7.21	16.11	1		<1							.10
4	99	38	7.15	7.21	16.5	.85		<1							0
5	96	60	7.15	7.19	16.71	1.60		<1							.27
6	97	76	7.15	7.19	16.71	2.5		<1							0
7		7.14	~~5.00~~	7.17	16.6			<1							.22
8		JD	7.14	7.19	16.6			<1							.23
9			7.14	7.19	16.4			<1							.43
10	96	250	6.86	6.94	16.6	6.7		<1							.02
11	95	110	6.87	6.91	16.3	5.2		<1							.09
12	99	41	6.82	6.87	16.88	4.04		<1							.01
13	99	21	7.0	7.0	16.6	6.7		<1							.22
14			7.0	7.02	16.6			<1							.59
15			6.95	7.00	16.02			<1							.28
16			6.95	7.06	15.4			<1							0
17	98	45	7.04	7.11	15.8	3.8		<1							.07
18	94	125	7.0	7.07	16.4	3.4		<1							0
19	97	60	7.0	7.0	16.4	2.2		<1							0
20	99	20	6.98	7.04	17.2	2.2		<1							.09
21			6.98	7.02	17.2			<1							0
22			7.0	7.02	17.2			<1							0
23			7.0	7.02	17.2			<1							0
24	98	77	7.02	7.07	17.4	1.8		<1							0
25	94	184	6.15	7.18	17.8	2.4		<1							0
26	95	129	7.0	7.18	17.8	4.2		<1							0
27	97	92	7.01	7.09	18.2	2.8		528							0
28			6.99	7.05	18.2			4							0
29			7.08	7.14	18.6			<1							.19
30			7.06	7.14	18.2			<1							0
31															
Total			6.15 JD												
	AVG 97	AVG 868	~~5.06~~			AVG 3.25	AVG	GEM 2	AVG	AVG					2.85
Permit	70	1017	6			7	20	200							
		AVW 106		MAX 7.21	MXD 18.6	MXD 6.7	MXD	GM7 3							
Limits		1625		8		15	41	400							

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249

Month MAY Year 2006

Facility Name City of Camas

County Clark

Receiving Water Columbia River

Plant Operator J. DICKINSON

Type Activated Sludge w/UV Disinfection

Population 15360

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE MG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	2.124	106	1877	134	1256	5.47	7.36	80.8			2.153	5	95	90	10
2	2.058	104	1785	146	2506	6.77	7.36	70			2.131	1	99	18	5
3	2.138	90	1605	70	1248	6.77	7.36	52.5			2.218	4	96	74	2
4	2.178	134	2434	140	2543	6.39	7.32	39.2			2.32	5	96	97	5
5	1.916					5.73	7.25				1.989				
6	2.034					5.73	7.48				2.078				
7	2.462					5.90	7.40				2.484				
8	2.133	95	1689	97	1726	6.76	7.34	34.2			2.187	8	92	146	6
9	2.095	124	2167	318	5556	6.76	7.34	44.2			2.187	7	94	128	2
10	2.040	84	1429	90	1531	6.48	7.34	43.7			2.158	4.5	95	81	4
11	2.065	139	2394	136	2342	6.78	7.38	42.0			2.215	3	98	55	12
12	2.000					6.53	7.38				2.165				
13	1.964					6.48	7.38				2.107				
14	2.115					5.74	6.21				2.295				
15	2.0941	201	3510	288	5030	6.89	7.34	46.7			2.200	5	98	92	3
16	2.141	185	3303	350	6249	6.89	7.32	43.5			1.998	2.5	99	42	3
17	2.068	145	2501	142	2449	6.84	7.37	51.5			2.226	1	99	19	3
18	2.008	123	2060	266	4455	6.68	7.49	52.7			2.185	2	98	36	6
19	1.994					6.68	7.49				2.087				
20	2.028					6.21	7.42				2.183				
21	2.172					6.21	7.38				2.314				
22	2.25	139	2608	174	3265	6.49	7.52	50.3			2.321	4	97	77	3
23	2.364	163	3214	172	3391	6.76	7.41	48.2			2.396	9	94	180	3
24	2.531	101	2132	96	2026	6.75	7.42	36.5			2.622	3	97	66	1
25	2.289	81	1537	136	2596	6.51	7.42	41			2.426	2	98	40	3
26	2.318					6.18	6.93				2.379				
27	2.702					6.00	6.76				2.780				
28	2.420					5.90	6.41				2.544				
29	2.346	118	2309	111	2172	6.44	7.49	48.1			2.456	4.	97	82	5
30	2.266	111	2098	162	3061	6.89	7.49	37.0			2.429	4	96	81	4
31	2.187	168	3064	282	5431	6.86	6.92	40			2.406	3	98	60	5
Total															
	AVG 2.177	AVG 127	AVG 2301	AVG 174	AVG 2939	MIN 5.73		AVG 47.5	AVG	AVG	AVG 2.276	AVG 4	AVG 97	AVG 77	AVG 4.5
Permit	6.1		5615		6405							20	70	1017	20
	MAX 2.702	201	MAX 3510	MAX 350	MAX 6249		MAX 7.52	MAX 80.8			MAX 2.780	AVW 6		AVW 103	AVW 6
Limits												30		1525	30

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 Month MAY Year 2006

Facility Name City of Camas County Clark

Receiving Water Columbia River Plant Operator J. DICKINSON

Type Activated Sludge w/UV Disinfection Population 15360

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	EFFLUENT CONT. pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					RAIN
1	93	180	7.05	7.14	17.8	6.2		26							Ø
2	97	89	6.84	7.25	18.4	4.63	4.63	<1							Ø
3	97	37	7.02	7.17	18.0	1.90	1.90	<1							Ø
4	96	97	6.84	7.25	18.6	1.7		2							Ø
5			6.70	7.25	18.6			4							Ø
6			7.0	7.25	19.0			<1							.06
7			7.04	7.10	18.42			2							.43
8	94	109	7.06	7.13	18.21	.520		<1							Ø
9	99	35	7.06	7.13	18.2	.85		<1							Ø
10	95	72	7.02	7.13	18.6	1.2		<1							Ø
11	91	221	7.00	7.09	18.2	1.5		<1							Ø
12			7.00	7.09	18.2			<1							Ø
13			7.0	7.10	19.0			<1							Ø
14			7.04	7.09	19.42			<1							Ø
15	99	55	7.06	7.11	19.62	1.6		<1							Ø
16	99	50	7.06	7.11	19.6		←2.0	<1							Ø
17	98	56	7.05	7.11	20.61	1.6		<1							Ø
18	98	109	7.02	7.11	19.7	0.5		<1							Ø
19			7.02	7.17	20.61			14							.06
20			7.11	7.22	20.4			<1							.06
21			7.09	7.18	20.2			<1							.35
22	98	58	7.05	7.16	20	1.3		408							.20
23	98	60	7.03	7.13	19.8	.75		<1							.33
24	99	22	6.93	7.03	19.5	.89		<1							.42
25	98	61	6.89	6.97	19.3	.67		<1							.19
26			6.89	6.97	19.3			<1							.23
27			6.91	7.00	18.91			<1							.57
28			6.83	6.95	18.51			2							.02
29	95	102	6.85	6.91	18.9	1.5		<1							O
30	98	81	6.86	6.92	19.5	.68		<1							Ø
31	98	100	6.86	6.92	19.7	.73		<1							.02
Total															
	AVG 97	AVG 84	MIN 6.70			AVG 1.6	AVG	GEM 2	AVG	AVG					2.88"
Permit	70	1017	6			7	20	200							
		AVW 109		MAX 7.25	MAX 20.6	MAX	MAX	GM7 33							
Limits		1526		9		15	41	400							

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Name and Title Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249

Month JUNE Year 2006

Facility Name City of Camas

County Clark

Receiving Water Columbia River

Plant Operator JIM DICKINSON

Type Activated Sludge w/UV Disinfection

Population 15360

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE MG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	2.598	176	3813	272	5894	6.67	6.73	59.7			2.761	4.5	97	103	3
2	2.252					6.17	7.34				2.378				
3	2.203					6.25	7.09				2.385				
4	2.34					6.45	7.31				2.456				
5	2.182	190	3708	240	4367	6.59	7.42	43			2.30	4	98	82	4
6	2.172	140	2536	290	5253	6.42	7.46	39			2.264	5	96	94	5
7	2.106	108	1897	88	1546	6.41	7.16	49			2.252	7	94	131	2
8	2.125	134	2375	125	2215	6.46	7.8	41.3			2.228	1	99	19	3
9	2.027					6.60	7.7				2.063				
10	1.988					6.16	7.26				2.082				
11	2.133					6.24	7.46				2.234				
12	2.16	144	2594	228	4108	6.57	7.53	15.8			2.213	5	97	92	2
13	2.049	136	2324	132	2256	6.30	7.49	1			2.135	1	99	18	3
14	2.207	106	1951	208	3826	6.55	7.31	46.7			2.114	6	94	106	5
15	2.086	134	2331	146	2540	6.48	7.67	81.5			2.191	5	96	91	5
16	2.055					6.76	7.70				2.111				
17	1.985					6.10	7.25				2.087				
18	2.094					6.58	7.41				2.152				
19	2.015	123	2129	164	2838	6.8	7.57	45.5			2.642	3	98	66	14
20	2.004	149	2423	172	2874	6.6	7.7	46.6			2.3	2	99	38	9
21	1.975	114	1878	100	1647	6.6	7.30	40.4			2.120	6	95	106	5
22	2.028	134	2266	124	2097	6.6	7.53	36.2			2.095	4	97	70	2
23	1.959					6.3	7.0				2.061				
24	1.966					5.9	6.83				2.101				
25	2.035					5.73	6.69				2.18				
26	2.096	129	2255	132	2307	5.98	7.94	45.6			2.22	3	98	56	5
27	2.057	88	1510	109	1870	6.63	7.66	45.0			2.175	4	95	73	3
28	1.990	129	2141	246	4082	6.98	6.83	43.4			2.105	3	98	53	4
29	1.938	88	1422	143	2311	6.67	7.48	40.8			2.124	3	~~53~~	53	3
30	1.971					6.56	7.63				2.17		97		
31													TH		
Total															
	AVG 2.095	AVG 130	AVG 2327	AVG 172	AVG 3061	5.73		AVG 42.4	AVG	AVG	AVG 2.22	AVG 3.9	AVG 97	AVG 74	AVG 4.5
Permit	6.1		5616		6405							20	70	1017	20
	MAX 2.598	MAX 190	MAX 3813	MAX 272	MAX 5894		MAX 7.94	MAX 81.5			MAX 2.761	AVW 4.25		82	AVW 7.5
Limits												30		1525	30

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month JUNE | Year 2006

F[illegible] Name City of Camas | County Clark

[illegible]ing Water Columbia River | Plant Operator JIM DICKINSON

Plant Type Activated Sludge w/UV Disinfection | Population 15360

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					RAIN
1	99	69	6.90	6.92	19.9		2.4	3							.59
2			6.86	6.92	19.9			<1							Ø
3			6.84	6.95	19.9			3							.21
4			6.86	6.92	19.9			<1							.05
5	98	77	6.86	6.9	20.3		1.8	<1							Ø
6	98	94	6.88	6.95	20.5		2.7	<1							Ø
7	97	37	6.95	7.01	20.5		5.9	<1							Ø
8	98	56	6.99	7.10	20.1		3.1	<1							Ø
9			7.06	7.10	20.0			<1							Ø
10			7.02	7.08	20.5			8							Ø
11			7.02	7.04	20.7			<1							.04
12	99	37	7.02	7.06	20.5		.82	6							.20
13	98	53	7.02	7.06	20.52		.41	<1							Ø
14	98	88	6.98	7.02	20.3		16.7	<1							.06
15	97	91	6.96	7.0	20.3		19.6	4							.06
16			6.94	7.0	20.5			<1							.03
17			6.85	6.94	20.9			<1							Ø
18			6.81	6.85	20.5			<1							Ø
19	91	308	6.79	7.13	20.5		9.3	<1							Ø
20	95	172	6.97	7.07	20.2		10.9	<1							Ø
21	95	88	6.92	7.03	20.9		8.4	36							Ø
22	98	35	7.01	7.10	20.1		8.2	<1							Ø
23			6.98	7.06	21.3			<1							Ø
24			6.93	7.00	21.7			<1							Ø
25			6.91	6.98	22.1			<1							Ø
26	96	93	6.05	6.95	22.3		14.3	<1							0
27	97	54	6.92	6.99	22.7		6.63	<1							Ø
28	98	70	6.99	7.06	22.1		7.9	<1							Ø
29	98	53	7.08	7.12	21.3		7.9	<1							Ø
30			6.39	7.11	22.1										Ø
31															
Total															
	AVG 97	AVG 86.7	MIN 6.05			AVG	AVG 7.46	GEM 2	AVG	AVG					1.24"
Permit	70	1017	6			7	20	200							
		AVW 150.7		MAX 7.13	MXD 22.7	MXD	MXD 19.6	GM7 3							
Limits		1526		9		15	41	400							

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A[illegible]erage AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum

[illegible]hest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

Permit No. WA0020249

Facility Name City of Camas

Receiving Water Columbia River

Plant Type Activated Sludge w/UV Disinfection

Month July Year 2006

County Clark

Plant Operator J. Dickinson

Population 16670

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE MG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	1.952					6.07	7.28				2.097				
2	1.949					6.48	7.45				2.07				
3	1.978	141	2326	186	3068	6.51	8.55	51.6			2.089	6	96	105	6
4	1.987	72	1242	94	1621	6.44	7.54	43			2.068	6	92	99	6
5	2.035	97	1646	172	2619	7.01	7.66	42.9			2.07	4	96	69	5
6	2.053	121	2071	186	3185	6.69	7.66	39.4			2.141	11	94	191	5
7	1.919					6.69	7.5				2.022				
8	1.958					6.68	7.42				2.07				
9	1.986					6.68	7.33				2.083				
10	2.037	130	2209	200	3398	6.7	7.42	57.2			2.106	10	92	176	12
11	1.993	120	2002	174	2893	6.4	7.0	38			2.086	12	90	210	11
12	2.007	110	1841	136	2276	5.95	7.0	48			2.150	9	92	161	13
13	2.088	104	1811	206	3587	6.51	7.2	68			2.213	4	96	74	9
14	1.969					6.76	7.17				2.054				
15	1.983					6.73	7.23				2.039				
16	2.068					6.36	7.26				2.138				
17	2.04	101	1718	137	2331	6.82	7.26	34.2			2.063	9	91	155	6
18	1.996	111	1848	166	2763	6.75	7.29	12.6			2.032	8	93	136	4
19	2.039	80	1360	112	1904	6.75	7.22	43			2.1	6	93	105	7
20	2.057	137	2350	94	1613	6.87	7.40	39.4			2.124	11	92	195	3
21	2.021					6.68	7.40				2.086				
22	2.104					5.97	7.10				2.123				
23	2.071					6.04	7.13				2.122				
24	2.130	92	1634	116	2061	5.88	7.26	39.6			2.168	11	88	199	4
25	2.104	138	2422	194	3404	6.77	7.19	43			2.111	12	91	211	6
26	2.091	168	2930	201	3505	6.36	7.21	35.5			2.120	8	95	141	4
27	2.06	141	2422	256	4398	6.54	7.36	51.6			2.122	6	96	106	7
28	1.973					6.86	7.33				1.991				
29	1.978					6.18	7.37				2.010				
30	2.054					6.70	7.25				2.065				
31	2.018	145	2440	258	4342	6.4	7.25	52.6			2.049	4	97	68	7
Total															
	AVG 2.023	AVG 118	AVG 2016	AVG 170	AVG 2880	MIN 5.88		AVG 43.5	AVG	AVG	AVG 2.089	AVG 8	AVG 93	AVG 141	AVG 7
Permit	6.1		5616		6405							20	70	1017	20
	2.13	MAX 145	MAX 2930	MAX 258	MAX 4398		MAX 8.55	MAX 68			MAX 2.168	AVW 9		AVW 164	AVW 11
Limits												30		1525	30

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GM7=highest 7-day Geometric Mean

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Name and Title

Signature

Facility Name	City of Camas	Month	July	Year	2006
		County	Clark		
Receiving Water	Columbia River	Plant Operator	J. Dickinson		
Plant Type	Activated Sludge w/UV Disinfection	Population	16670		

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					RAIN
1			7.0	7.07	21.3			<1							Ø
2			7.0	7.0	22.1			<1							Ø
3	97	105	7.0	7.16	22.5		8.6	<1							.51
4	94	99	7.1	7.13	22.5		8.5	<1							Ø
5	97	86	7.08	7.13	21.3		10.9	<1							Ø
6	97	89	7.08	7.16	21.3		14.1	<1							Ø
7			7.01	7.11	22.1			<1							Ø
8			6.95	7.03	22.3			34							Ø
9			6.93	7.0	22.8			18							Ø
10	94	211	6.95	7.1	22.4		10.7	172							Ø
11	94	191	6.84	7.2	22.4		12.7	92							Ø
12	90	233	7.13	7.2	21.7		17.7	60							.14
13	96	166	6.12	7.0	22.4		15.7	164							Ø
14			7.0	7.4	22.3			9							Ø
15			6.98	7.02	22.7			12							Ø
16			6.98	7.15	23.1			4							Ø
17	96	103	7.02	7.21	22.7		1.85	304							Ø
18	98	68	6.97	7.05	22.7		.53	6							Ø
19	94	123	6.95	7.0	22.7		11.4	24							Ø
20	97	53	6.89	6.98	23.1		10.3	<1							Ø
21			6.93	7.0	23.5			<1							Ø
22			6.87	6.96	23.3			6							Ø
23			6.87	7.04	24.1			2							Ø
24	96	72	6.96	7.04	24.19		3.54	6							Ø
25	97	106	6.99	7.09	23.8		5.4	3							Ø
26	98	71	7.06	7.13	23.79		3.30	3							Ø
27	97	124	7.03	7.11	23.6		4.1	3							Ø
28			7.01	7.09	23.1			43							Ø
29			7.02	7.13	23.12			3							.01
30			7.17	7.19	22.7			3							.01
31	97	120	7.07	7.19	22.9		9.3	1							Ø
Total															
	AVG 96	AVG 119	MIN 6.12			AVG	AVG 8.7	GEM 6	AVG	AVG					.67
Permit	70	1017	6			7	20	200							
		AVW 200		MAX 7.4	MXD 24.2	MXD	MXD 17.7	GM7 37							
Limits		1526		9		16	41	400							

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Name and Title

Signature

Permit No. WA0020249

Facility Name City of Camas

Receiving Water Columbia River

Plant Type Activated Sludge w/UV Disinfection

Month August Year 2006

County Clark

Plant Operator Jim Dickinson

Population 16670

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE MG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	2.139	140	2497	270	4817	6.31	7.27	42.5			2.151	10	93	179	8
2	2.092	109	1902	136	2373	6.55	7.20	54.1			2.119	11	90	194	4
3	2.062	108	1857	143	2459	6.09	7.13	39			2.127	19	82	337	5
4	1.959					6.09	7.46				1.984				
5	1.925					5.81	7.05				1.961				
6	2.027					5.78	7.26				2.052				
7	2.038	135	2295	208	3535	6.66	7.18	35.3			2.041	6	96	102	2
8	2.034	86	1459	70	1187	6.39	7.17	40.0			2.001	15	83	250	7
9	2.018	92	1548	106	1784	6.39	7.18	45.2			2.000	22	76	367	9
10	2.041	124	2111	262	4460	6.36	7.2	75			2.065	7	94	121	6
11	2.063					6.20	7.13				1.995				
12	2.019					5.77	7.02				2.039				
13	2.066					6.36	7.22				2.091				
14	2.078	99	1715	200	3466	6.43	7.18	42.5			2.078	6	94	105	8
15	2.079	127	2202	176	3052	6.33	7.18	78			2.062	6	95	103	5
16	2.05	72	1231	190	3248	6.33	7.31	43.8			2.027	7	96	118	8
17	2.081	133	2308	242	4200	6.48	7.25	42.3			2.118	17.7	87	309	8
18	1.940					6.50	7.25				1.959				
19	2.030					5.78	6.84				2.053				
20	2.032					5.69	7.15				2.030	[illegible]			[illegible]
21	2.063	133	2289	195	3355	6.25	7.13	40.8			2.024	8	94	135	6
22	2.041	116	1975	236	4017	6.20	7.13	50.0			1.990	16	86	266	7
23	2.069	119	2053	185	3192	6.30	7.28	36.8			2.029	8	93	135	6
24	2.072	147	2540	157	2713	6.27	7.18	40.5			1.999	19	87	317	4
25	2.017					6.10	7.17				2.008				
26	1.965					5.59	6.88				1.979				
27	2.205					5.32	6.62				2.211				
28	2.068	100	1725	153	2639	5.7	7.0	16.8			2.082	5	95	87	6
29	2.091	68	1186	90	1570	5.74	7.13	.1766			2.059	8	88	17	4
30	2.161	60	1081	78	1405	6.07	7.18	46.5			2.192	4	93	73	3
31	2.021	116	1955	228	3843	6.34	7.39	41.6			2.081	4	97	69	3
Total															
	AVG 2.048	AVG 110	AVG 1891	AVG 175	AVG 3017	MIN 5.32		AVG 42.7	AVG	AVG	AVG 2.05	AVG 10	AVG 90	AVG 173	AVG 6
Permit	6.1		5616		6405							20	70	1017	20
	MAX 2.205	147	MAX 2540	MAX 270	MAX 4817		MAX 7.46	MAX 78			MAX 2.192	AVW 13		AVW 213	AVW 7
Limits												30		1525	30

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Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 | Month August | Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator Jim Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 16670

EFFLUENT CONT.

quency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					RAIN
1	97	142	7.01	7.09	22.7		11.1	3							Ø
2	97	71	6.97	7.01	23		10.9	86							Ø
3	97	89	6.95	7.0	23.1		8.2	<1							Ø
4			6.99	7.06	23.1			56							Ø
5			6.09	7.03	23.3			6							Ø
6			6.99	7.05	23.5			286							Ø
7	99	34	6.99	7.07	23.7		6.5	262							Ø
8	90	117	6.99	7.06	23.3		5.8	600							Ø
9	91	156	7.01	7.09	23.5		8.8	<1							Ø
10	98	103	7.01	7.07	23.1		14	16							Ø
11			6.93	7.01	22.9			220							Ø
12			6.89	6.95	23.1			4							Ø
13			6.92	6.97	23.3			<1							Ø
14	96	140	6.90	6.97	23.3		6.1	4							Ø
15	97	86	6.90	6.97	23.1		9.8	8							Ø
16	96	135	6.92	6.98	22.4		3.2	<1							Ø
17	97	141	6.92	6.97	22.6		3.4	5							Ø
18			6.92	6.98	23.7			18							Ø
19			6.93	6.98	23.2			4							Ø
20			6.86	6.96	23.5			21							Ø
21	97	101	6.84	7.02	23.3		4.4	25							Ø
22	97	116	7.00	7.07	23.1		7.9	2							Ø
23	97	102	7.06	7.10	22.71		4.79	46							.02
24	97	67	7.05	7.12	22.3		4.7	2							Ø
25			7.08	7.13	23.			12							Ø
26			7.03	7.12	23.31			3							Ø
27			7.05	7.12	23.3			186							Ø
28	96	104	7.08	7.12	23.9		.47	29							Ø
29	96	69	7.09	7.20	22.9		.06	10							Ø
30	96	55	7.04	7.11	22.4		17.5	13							Ø
31	99	52	7.01	7.10	22.4		16.6	11							Ø
Total															
	AVG 96	AVG 989	MIN 6.09			AVG	AVG 7.6	GEM 13	AVG	AVG					.02
Permit	70	1017	6			7	20	200							
		AVW 125.5		MAX 7.2	MAX 23.9	MAX	MAX 17.5	GM7 25							
Limits		1525		9		15	41	400							

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Name and Title

Signature

Permit No. WA0020249 | Month September Year 2006

Facility Name City of Camas | County Clark

Receiving Water Columbia River | Plant Operator Jim Dickinson

Plant Type Activated Sludge w/UV Disinfection | Population 16670

Frequency	INFLUENT CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	EFFLUENT CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE MG/L	CYANIDE MG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	1.988					6.43	7.39				1.992				
2	1.958					5.94	7.44				1.944				
3	1.927					5.73	5.94				1.941				
4	2.171	177	3212	276	4997	6.08	7.18	39.6			2.17	4	98	72	7
5	2.075	93	1609	174	3011	6.3	7.34	44.8			2.08	8	93	141	8
6	2.150	193	3461	244	4375	6.31	7.14	47.0			2.175	5	97	91	3
7	2.160	88	1585	220	3963	6.37	7.10	46.5			2.208	2	98	37	3
8	2.004					6.49	7.17				2.011				
9	2.052					6.22	7.43				2.052				
10	2.085					5.66	7.21				2.104				
11	2.080	88	1518	334	5794	6.43	7.21	45.0			2.097	3	97	45	2
12	2.044	105	1790	224	3819	6.38	7.28	47.5			2.061	3	97	52	5
13	2.034	118	2002	190	3223	6.78	7.52	45.4			2.023	2	98	34	8
14	2.217	107	1978	156	2884	6.45	7.30	41.9			2.255	5	95	94	10
15	2.092					6.48	7.36				2.092				
16	2.081					5.99	6.68				2.079				
17	2.12					5.51	7.14				2.125				
18	2.451	92	1881	244	4988	6.57	7.25	37.8			2.401	5	95	100	7
19	2.2	121	2220	128	2348	6.61	7.13	39.5			2.148	4	97	72	9
20	2.5	98	2043	216	4503	6.37	7.11	36.3			2.496	7	93	146	9
21	2.278	106	2014	158	3002	6.49	7.1	41.2			2.293	4	96	76	8
22	2.067					6.53	7.9				2.047				
23	2.045					6.29	7.11				2.052				
24	2.089					5.73	6.73				2.086				
25	2.030	93	1575	195	3301	6.08	7.09	39.1			2.059	5	95	86	7
26	1.984	143	2366	208	3442	6.4	7.17	48.9			2.026	3	98	51	3
27	1.974	78	1284	224	3688	6.25	7.26	44.5			2.041	3	96	51	7
28	1.939	113	1821	156	2523	6.25	7.26	49.8			2.049	5	96	82	5
29	1.897					6.29	7.26				1.955				
30	1.915					6.32	7.37				1.951				
31															
Total															
	AVG 2.087	AVG 113	AVG 2022	AVG 209	AVG 3741	MIN 5.51		AVG 43.4	AVG	AVG	AVG 2.100	AVG 4.25	AVG 96	AVG 77	AVG 6.3
Permit	6.1		5815		6405							20	70	1017	20
	MAX 2.5	MAX 138	MAX 3461	MAX 334	MAX 5794		MAX 7.9	MAX 49.8			MAX 2.496	AVW 5		AVW 99	AVW 8.25
Limits												30		1525	30

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Name and Title

Signature

Permit No. WA0020249 | Month September Year 2006
Facility Name City of Camas | County Clark
Receiving Water Columbia River | Plant Operator Jim Dickinson
Plant Type Activated Sludge w/UV Disinfection | Population 16670

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					R 5-02
1			7.06	7.18	22.2			24							Ø
2			7.11	7.36	22.86			6							Ø
3			7.19	7.38	23.22			22							.02
4	97	127	7.2	7.35	23.2		17.8	1							Ø
5	95	139	7.01	7.24	23.2		18.9	12							Ø
6	99	54	7.06	7.07	23.1		13.3	<1							Ø
7	99	55	6.96	7.07	22.7		15.6	2							Ø
8			6.96	7.00	22.9			2							.08
9			6.93	7.02	22.9			2							.01
10			6.91	7.0	22.7			5							Ø
11	99	35	6.93	7.01	22.9		7.0	58							Ø
12	98	86	6.99	7.04	23.1		10.1	4							Ø
13	96	135	6.99	7.04	22.7		8.3	8							Ø
14	94	188	6.99	7.08	22.1		10.1	4							.50
15			6.99	7.03	22.0			46							.39
16			6.90	6.99	21.9			2							Ø
17			6.49	6.94	22.1			66							.03
18	97	140	6.85	6.94	22.1		4.1	16							.68
19	93	161	6.89	6.99	22.1		6.5	16							.02
20	96	185	6.92	7.0	21.6		5.1	122							.59
21	95	153	6.9	6.99	21.2		4.3	163							.01
22			6.90	6.97	21.6			10							Ø
23			6.90	6.95	21.82			2							Ø
24			6.95	7.01	22			6							Ø
25	96	120	6.98	7.17	21.93		6.04	16							Ø
26	99	51	6.91	6.98	22.4		12.1	2							Ø
27	97	119	6.89	7.01	22.4		7.7	2							Ø
28	97	85	6.89	7.08	22.4		11.2	6							Ø
29			6.99	7.08	22.4			2							Ø
30			6.97	7.05	22.21			4							.02
31															
Total															2.35"
	AVG 97	AVG 115	MIN 6.49			AVG	AVG 9.9	GEM 8	AVG	AVG					
Permit	70	1047	6			7	20	200							
		AVW 160		MAX 7.38	MAX 23.22	MAX	MAX 18.9	GM7 32							
Limits		1526		8		15	41	400							

Please Circle ALL Permit Violations Mail to P.O. Box 47776, Olympia WA 98504-7775
AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum
GM7=highest 7-day Geometric Mean

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Title

Signature

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249 — Month Oct — Year 2006

Facility Name: City of Camas — County: Clark

Receiving Water: Columbia River — Plant Operator: J. Dickinson

P[...] Type: Activated Sludge w/UV Disinfection — Population: 16670

	INFLUENT										EFFLUENT				
Frequency	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK	CONT	CONT	4/WEEK	4/YR	4/YR	CONT	4/WEEK	4/WEEK	4/WEEK	4/WEEK
Date	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY LBS/DAY	TSS MG/L	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	AMMONIA MG/L	OIL & GREASE UG/L	CYANIDE UG/L	FLOW MGD	BOD 5-DAY MG/L	BOD 5-DAY % REMOVAL	BOD 5-DAY LBS/DAY	TSS MG/L
1	2.056					5.74	7.17				2.096				
2	1.976	106	1748	208	3428	6.44	7.34	51			1.84	7	93	109	7
3	1.961	80	1308	178	2911	6.30	7.41	50.3			1.404	8	90	94	6
4	2.002	96	1603	124	2108	6.16	7.05	45.2			2.038	4	96	68	7
5	1.928	105	1688	158	2540	6.25	7.11	48			2.041	6	94	102	2
6	1.883					6.67	7.14				1.915				
7	1.972					6.26	7.33				2.006				
8	2.094					6.3	7.34				2.098				
9	2.025	130	2196	190	3209	6.02	7.53	57.6			2.039	8	94	136	4
10	1.993	148	2460	216	3590	6.5	7.27	76.3			2.024	3	98	51	5
11	1.953	129	2101	348	5668	6.2	7.27	42.7			2.009	5.4	96	90	6
12	1.979	85	1403	188	3102	6.1	7.12	40.1			2.091	12	86	209	5
13	1.924					6.63	7.24				1.978				
14	1.907					6.74	7.35				1.933				
15	2.669					6.08	7.3				2.686				
16	2.259	104	1989	222	4182	6.4	7.2	41			2.269	6	94	114	7
17	2.045	131	2234	252	4298	6.63	7.26	39.6			2.061	6	95	103	10
18	2.374	128	2534	141	2792	6.20	7.19	45			2.396	13	90	260	12
19	2.532	159	3357	280	5913	6.21	7.15	58.2			2.595	6	96	130	7
20	2.137					6.42	7.13				2.142				
21	2.104					6.06	6.96				1.926				
22	2.169					6.0	6.84				2.143				
23	2.112	177	3118	360	6341	6.09	7.17	49.9			2.115	3	98	53	3
24	2.179	131	2381	166	3016	6.19	7.14	50.1			2.164	6	95	108	8
25	2.102	110	1928	338	5925	6.09	7.19	44.6			2.143	1	99	18	6
26	2.103	129	2262	132	2315	6.22	7.04	63.6			2.125	2	98	35	3
27	2.022					6.14	7.09				1.996				
28	2.032					5.48	6.93				2.062				
29	2.173					5.29	7.08				2.11				
30	2.356	101	1985	264	5187	6.32	7.21	34.8			2.287	3	97	57	2
31	2.104	56	983	168	2947	6.49	7.25	49			2.038	3	95	51	4
Total															
	AVG 2.100	AVG 117	AVG 2012	AVG 219	AVG 3704	MIN 5.29		AVG 49.3	AVG	AVG	AVG 2.089	AVG 6	AVG 95	AVG 95	AVG 6
Permit	6.1		5816		6405							20	70	1017	20
	MAX 2.532	MAX 177	MAX 3357	MAX 360	MAX 6341		MAX 7.53	MAX 76.3			MAX 2.686	AVW 7.75		AVW 152	AVW 6
Limits												30		1525	30

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GM7=highest 7-day Geometric Mean

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Jim Dickinson - Op. Supr.

Name and Title

Signature: Jim Dickinson

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No. WA0020249

Month Oct Year 2006

Facility Name City of Camas

County Clark

Receiving Water Columbia River

Plant Operator J. Dickinson

Type Activated Sludge w/UV Disinfection

Population 16670

EFFLUENT CONT.

Frequency	4/WEEK	4/WEEK	CONT	CONT	CONT	4/WEEK	4/WEEK	DAILY	4/YR	4/YR					
Date	TSS % REMOVAL	TSS LBS/DAY	pH (DAILY MIN) STANDARD UNITS	pH (DAILY MAX) STANDARD UNITS	TEMPERATURE DEG C	AMMONIA MG/L (WINTER)	AMMONIA MG/L (SUMMER)	FECAL COLIFORM #/100 ML	OIL & GREASE UG/L	CYANIDE UG/L					Rain
1			6.89	6.99	22			3							0
2	97	107	6.92	7.03	21.8	9.4		4							0
3	97	70	6.91	7.14	21.6	9		4							.01
4	94	117	6.83	6.95	21.4	3.37		536							.06
5	99	34	6.90	7.02	21.6	5.5		110							0
6			6.94	7.03	21.4			26							.02
7			6.92	6.99	21.4			13							.02
8			6.92	7.0	21.2			5							.03
9	98	68	6.93	7.01	21.2	10.5		10							0
10	98	84	6.65	7.24	21.2	11.2		16							0
11	98	101	6.86	6.95	21.2	0.6		18							0
12	97	87	6.88	6.95	21.2	0.0		6							0
13			6.91	7.35	21.4			34							0
14			7.09	7.26	21.21			6							.07
15			6.96	7.11	20.8			3							1.15
16	97	117	6.90	6.96	20.6	.20		8							.05
17	96	354	6.96	7.05	20.6	0.0		0							0
18	91	240	6.97	7.09	20.61	1		214							.58
19	98	151	6.92	7.03	20.6	3.3		96							.06
20			6.57	7.13	20.62			28							.01
21			7.11	7.28	20.41			13							0
22			7.24	7.35	20.2			19							0
23	99	53	7.07	7.26	20.2	0.3		24							0
24	95	144	6.98	7.09	20.1	0.8		8							.26
25	98	107	6.98	7.05	20	0.2		9							.01
26	98	53	6.98	7.07	19.81	0.3		34							0
27			6.22	7.05	19.81			44							0
28			6.93	7.00	19.82			1							.08
29			6.94	7.12	19.8			4							.03
30	99	38	7.08	7.18	19.4	1		16							0
31	98	68	7.01	7.10	19	2.5		1							0
Total															
	AVG 97	AVG 111	MIN 6.22			AVG 3.25	AVG	GEM 13	AVG	AVG					2.44
Permit	70	1017	6			7	20	200							
		AVW 216		MAX 7.35	MAX 21.8	MAX 11.2	MAX	GM7 20							
Limits		1626		9		16	41	400							

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Jim Dickinson - Op. Supr.

Name and Title

Jim Dickinson

Signature

APPENDIX E

WATER CONSUMPTION SUMMARY

	2001-2002	2002-2003	2003-2004	2004-2005		2001-2002	2002-2003	2003-2004	2004-2005
Single Family Residential	848,943	865,842	955,383	982,766		0.849	0.866	0.955	0.983
Multi-family Residential	115,068	107,550	122,111	127,784		0.115	0.108	0.122	0.128
Commercial	93,052	98,356	125,191	114,338		0.093	0.098	0.125	0.114
Industrial	949,574	954,909	1,119,607	1,091,096		0.950	0.955	1.120	1.091
City	27,851	6,152	4,039	9,095		0.028	0.006	0.004	0.009
TOTAL	2,034,486	2,032,808	2,326,330	2,325,078		2.034	2.033	2.326	2.325

	2001-2002	2002-2003	2003-2004	2004-2005
Single Family Residential	848,943	865,842	955,383	982,766
# of Connctns	4,631	5,066	5,407	5,613
	183.3	170.9	176.7	175.1

		Billing	Jan-02	Jan-02	Jan-02	Jan-02	Mar-02	Mar-02	Mar-02	Mar-02	Jan-03	Jan-03	Jan-03	Jan-03	Mar-03	Mar-03	Mar-03	Mar-03
			Nov-16-Jan 15				Jan16-Mar15				Nov-16-Jan 15				Jan16-Mar15			
			# of Connctns	Water Consmptn (100 cu. Ft.)	Water Consmptn (gpd))	Water Consmptn per Connectn	# of Connctns	Water Consmptn (100 cu. Ft.)	Water Consmptn (gpd))	Water Consmptn per Connectn	# of Connctns	Water Consmptn (100 cu. Ft.)	Water Consmptn (gpd))	Water Consmptn per Connectn	# of Connctns	Water Consmptn (100 cu. Ft.)	Water Consmptn (gpd))	Water Consmptn per Connectn
	Single Family Residential	Bi-monthly	4,607	70,476	878,601	191	4,655	65,718	819,284	176	5,026	71,350	889,497	177	5,105	67,555	842,186	165
	Multi-family Residential	Bi-monthly	290	9,375	116,875	403	291	9,085	113,260	389	306	8,850	110,330	361	313	8,404	104,770	335
	Commercial	Bi-monthly	181	6,923	86,307	477	179	8,005	99,796	558	187	7,102	88,538	473	190	8,677	108,173	569
	Industrial	Monthly	30	42,162	1,051,239	17,521	30	34,007	847,908	14,132	29	40,225	1,002,943	17,292	29	36,372	906,875	15,636
	City	Bi-monthly	28	843	10,509	375	29	3625	45,192	1,558	30	461	5,747	192	30	526	6,557	219
1	5/8" Residential		4,141	63,529			4,186	59,143			4,505	63,622			4,581	60,748		
2	1" Residential		161	5,120			162	4,940			173	4,253			178	4,068		
4	1 1/2" Residential		24	1,434			24	1,622			24	1,318			25	1,309		
5	2" Residential		8	1,000			8	939			8	1,455 `			8	1,284		
6	3" Residential		2	433			2	419			2	440			2	426		
10	3/4" Residential		84	1,388			84	1,165			87	1,384			87	1,317		
11	5/8" Commercial		92	1,709			89	2,175			94	1,530			95	1,750		
12	1" Commercial		50	1,519			50	1,755			51	1,978			52	3,168		
14	1 1/2" Commercial		9	777			9	561			10	629			11	998		
15	2" Commercial		12	1,508			12	1,498			13	1,466			13	1,530		
16	3" Commercial		5	386			6	563			6	428			6	496		
17	4" Commercial		4	813			4	1,134			4	736			4	429		
18	3" Resident-No Base														1	0		
20	3/4" Commercial		2	132			2	128			2	97			2	96		
21	5/8" Industrial		3	63			3	118			3	49			3	30		
22	1" Industrial		1	0			1	0			1	0			1	0		
24	1 1/2" Industrial		3	311			3	335			3	259			3	264		
25	2" Industrial		12	9,384			12	6,750			12	7,657			12	6,268		
26	3" Industrial		4	657			4	553			4	384			4	405		
27	4" Industrial		3	9,800			3	8,467			3	10,835			3	11,048		
29	6" Industrial		1	20,314			1	15,317			1	19,797			1	16,824		
31	5/8" City		10	67			10	584			10	6			10	7		
32	1" City		5	13			5	0			5	37			5	123		
33	1 1/4" City		1	0			1	0			1	0			1	0		
34	1 1/2" City										1	0			1	0		
35	2" City		9	763			10	715			10	415			10	370		
47	4" Cemetery		1	0			1	590			1	2			1	123		
57	$99 Allowance																	
58	13 Hcf Allowance																	
59	40 Hcf Water Allowan																	
61	5/8" Irrigation		47	330			48	58			49	89			51	38		
62	1" Irrigation		24	655			24	4			27	29			27	337		
64	1 1/2" Irrigation		9	366			9	67			9	145			9	92		
65	2" Irrigation		11	227			11	121			11	387			11	397		
66	3" Irrigation		5	548			6	0			6	64			6	2		
67	4" Irrigation		1	615			1	36			1	98			1	0		
68	3/4" Irrigation										1	0			1	0		
C01	5/8" Residential - O		466	6,947			469	6,575			521	7,728			524	6,807		
C02	1" Residential - Out		10	130			10	189			11	227			12	205		
C04	1 1/2" Residential -																	
C10	3/4" Residential - O		1	4			1	6			1	3			1	4		
C12	1" Commercial - Outs		3	20			3	35			2	30			2	29		
C14	1 1/2" Commercial -		2	14			2	26			2	30			2	24		
C16	3" Commercial - Outs		2	45			2	130			3	178			2	157		
C27	4" Industrial - Outs		3	1,633			2	1,647			1	755			1	936		
C28	4" Indust Out-No Bas						1	820			1	489			1	597		
C31	5/8" City - Outside		3	0			3	2,326			3	3			3	26		
C41	5/8" Cemetery Outsid										1	42			1	28		
C57	$99 Water Allowance		1	54			1	54			3	28			3	23		

		Jan-04	Jan-04	Jan-04	Jan-04	Mar-04	Mar-04	Mar-04	Mar-04	Jan-05	Consmptn Jan-05		Jan-05	Mar-05	Mar-05		Mar-05
		Nov-16-Jan 15				Jan16-Mar15				Nov-16-Jan 15				Jan16-Mar15			
		# of Connctns	Water Consmptn (100 cu. Ft.)	Water Consmptn (gpd))	Water Consmptn per Connectn	# of Connctns	Water Consmptn (100 cu. Ft.)	Water Consmptn (gpd))	Water Consmptn per Connectn	# of Connctns	Water Consmptn (100 cu. Ft.)	Water Consmptn (gpd))	Water Consmptn per Connectn	# of Connctns	Water Consmptn (100 cu. Ft.)	Water Consmptn (gpd))	Water Consmptn per Connectn
	Single Family Residential	5,383	92,651	1,155,049	215	5,407	60,619	755,717	140	5,594	85,637	1,067,608	191	5,613	72,026	897,924	160
	Multi-family Residential	360	12,479	155,572	432	360	7,111	88,650	246	393	11,459	142,856	364	414	9,041	112,711	272
	Commercial	189	11,755	146,546	775	203	8,329	103,835	512	207	10,048	125,265	605	208	8,295	103,411	497
	Industrial	29	48,072	1,198,595	20,665	31	41,736	1,040,618	16,784	28	41,674	1,039,072	18,555	30	45,847	1,143,119	19,052
	City	32	335	4,176	131	29	313	3,902	135	31	590	7,355	237	31	869	10,834	349
1	5/8" Residential	5,001	85,702		214	5,032	56,760		141	5,209	79,297		190	5,227	67,306		161
2	1" Residential	221	7,268		411	223	3,898		218	246	6,808		346	252	4,892		243
4	1 1/2" Residential	25	1,746		873	23	1,108		602	22	1,291		734	22	1,079		613
5	2" Residential	8	1,325		2,070	7	749		1,338	8	1,139		1,780	7	886		1,582
6	3" Residential	1	467		5,838	1	371		4,638	1	523		6,538	1	648		8,100
10	3/4" Residential	89	1,673		235	90	985		137	100	1,698		212	115	1,536		167
11	5/8" Commercial	93	2,205		296	96	1,447		188	100	2,146		268	101	2,085		258
12	1" Commercial	51	1,734		425	60	1,555		324	57	2,517		552	57	1,810		397
14	1 1/2" Commercial	11	1,321		1,501	13	819		788	14	2,426		2,166	14	1,355		1,210
15	2" Commercial	13	1,416		1,362	15	1,178		982	15	1,336		1,113	15	1,349		1,124
16	3" Commercial	6	354		738	6	354		738	6	533		1,110	6	575		1,198
17	4" Commercial	5	1,507		3,768	5	333		833	5	614		1,535	5	613		1,533
18	3" Resident-No Base	1	0		0	1	0		0	1	0		0	1	0		0
20	3/4" Commercial	3	173		721	3	117		488	4	130		406	4	117		366
21	5/8" Industrial	3	80		333	3	134		558	3	48		200	3	51		213
22	1" Industrial	1	1		13	1	0		0	1	0		0	1	0		0
24	1 1/2" Industrial	3	968		4,033	3	528		2,200	2	566		3,538	3	608		2,533
25	2" Industrial	12	9,280		9,667	12	7,987		8,320	12	6,899		7,186	12	6,794		7,077
26	3" Industrial	4	535		1,672	4	529		1,653	4	535		1,672	4	744		2,325
27	4" Industrial	3	11,298		47,075	3	10,543		43,929	3	12,051		50,213	4	14,167		44,272
29	6" Industrial	1	22,421		280,263	1	21,378		267,225	1	20,098		251,225	1	21,582		269,775
31	5/8" City	12	8		8	11	14		16	11	7		8	11	131		149
32	1" City	5	0		0	5	3		8	5	1		3	5	0		0
33	1 1/4" City	1	0		0	1	0		0	1	0		0	1	0		0
34	1 1/2" City	1	3		38	1	6		75	1	2		25	1	5		63
35	2" City	10	324		405	10	290		363	10	580		725	10	716		895
47	4" Cemetery	2	10		63	1	208		2,600	1	161		2,013	1	142		1,775
57	$99 Allowance	2	76		475	2	58		363	2	114		713	2	116		725
58	13 Hcf Allowance	1	10		125	1	10		125	1	10		125	1	100		1,250
59	40 Hcf Water Allowan	1	10		125	1	10		125	1	10		125	1	100		1,250
61	5/8" Irrigation	60	38		8	60	167		35	65	219		42	64	100		20
62	1" Irrigation	32	10		4	32	263		103	30	65		27	30	217		90
64	1 1/2" Irrigation	8	165		258	8	205		320	7	0		0	7	91		163
65	2" Irrigation	13	479		461	13	631		607	15	413		344	15	291		243
66	3" Irrigation	6	0		0	6	43		90	6	279		581	6	64		133
67	4" Irrigation	1	48		600	1	39		488	1	44		550	1	86		1,075
68	3/4" Irrigation	1	0		0	1	0		0	1	0		0	1	0		0
C01	5/8" Residential - O	382	6,949		227	375	3,859		129	385	6,340		206	386	4,720		153
C02	1" Residential - Out	13	341		328	13	220		212	14	153		137	15	132		110
C04	1 1/2" Residential -	1	18		225	1	0		0	1	20		250	1	10		125
C10	3/4" Residential - O	2	168		1,050	2	78		488	1	31		388	1	433		5,413
C12	1" Commercial - Outs	2	80		500	1	6		75	2	157		981	2	136		850
C14	1 1/2" Commercial -	1	13		163	2	1,359		8,494	1	37		463	1	12		150
C16	3" Commercial - Outs	3	2,952		12,300	1	1,161		14,513	2	152		950	2	243		1,519
C27	4" Industrial - Outs	1	2,963		37,038	1	637		7,963	1	1,014		12,675	1	1,192		14,900
C28	4" Indust Out-No Bas	1	526		6,575	3	0		0	1	463		5,788	1	709		8,863
C31	5/8" City - Outside	3	0		0	1	0		0	3	0		0	3	17		71
C41	5/8" Cemetery Outsid	2	10		63	3	19		79	1	1		13	1	0		0
C57	$99 Water Allowance	3	34		142	1	0		0	1	10		125	1	100		1,250

APPENDIX F

HYDRAULIC MODELING REPORT

APPENDIX F

SEWER SYSTEM HYDRAULIC MODEL

MODEL DEVELOPMENT

The primary goal in the development of the City's hydraulic model was to create a model that realistically represents the physical structure of the main trunk lines of the current wastewater collection system and to determine system deficiencies as the City grows over the next 20 years.

The hydraulic model chosen to accomplish this goal was MOUSE hydraulic modeling software by DHI, Inc. MOUSE modeling software is configured with a graphical user interface. Each model element, including pipes, manholes, force mains, lift stations, catchments, and discharge locations is assigned a unique graphical representation within the program. Each element is also assigned a number of attributes specific to its function and representation. Element attributes include spatial coordinates, rim elevation, invert elevation, diameter, slope, and assigned flows, as well as pump characteristics. Model input is accomplished through the creation and manipulation of these objects and their attributes. The results for a simulation can be given graphically in plan or profile view or in tabular report format to indicate flow, depth of sewer flow, hydraulic grade, and wet well levels for various system elements.

The MOUSE software operates using ESRI's ArcView GIS software program as a platform. GIS files for sewer system manholes, pipes, parcels, basins, etc. are imported into the model and the MOUSE software performs the hydraulic calculations. Microsoft Excel and access are usedto view and display tabular data and for some data manipulation.

The model consists of two layers: the network layer and the catchment layer. The network layer contains all of the information pertaining to the physical structures of the network including manhole location (X,Y coordinates), pipe size, invert elevations, slopes, pipe material, etc. Information to create the network layer was provided by the City in GIS shape files and Autocad as-built files. Known datum inconsistencies were corrected for. Additional information was provided through survey of selected lines. Where specific pipe inverts were not known, elevations were determined through linear interpolation between known upstream and downstream inverts. Additionally, where specific pipe lengths were not given, the length was determined based on the GIS coordinates of the upstream and downstream manholes.

The Camas network is comprised of gravity sewer, STEP (septic tank effluent pump) and force main systems. The model did not include the network components of the STEP systems within the City.

The catchment layer contains all data pertaining to flows within the system. 15 Basins (catchments) were created based on the natural drainage patterns of the City's service area. The basins were further sub-divided into smaller sub-basins. Flows for each sub basin were determined based on the number and zoning of the parcels within the sub-basin. Parcel information was provided in the "camparc" parcels shape file supplied by the City. All developed parcels zoned residential within the basin were considered to be single ERUs and ascribed a flow of 149 gallons per day, the average daily flow per ERU as developed in Chapter 6 of the DRAFT *General Sewer / Wastewater Facility Plan.*

A peaking factor was used to determine the peak hour flow. The peaking factor for residential flows was calculated using an equation provided by the *1998 Department Of Ecology Criteria for Sewage Works Design* (Orange Book). The equation calculates a peaking factor based on population. As population increases, the peaking factor decreases to account for greater attenuation of flows in the presumed larger system.

$$PeakingFactor = \left(18 + \sqrt{Population/1000}\right) / \left(4 + \sqrt{Population/1000}\right)$$

The portions of the network serviced by STEP systems were modeled based on the assumption that the system behaved essentially as a gravity system. This assumption is valid due to the similarity in flow patterns of gravity flow to that from a large number of STEP tanks.

In addition to residentially zoned parcels, flows were also ascribed to parcels zoned commercial, industrial, and other (school/church). Parcels zoned commercial were ascribed a flow rate of 3,000 gallons per acre per day. Industrial flow rates were based on the water consumption of the individual industry as described in Chapter 6 of the *General Sewer / Wastewater Facility Plan*. School and church parcels were ascribed a flow rate based on attending populations. The Department of Ecology ascribes a base flow of 10 gallons per day per student for schools with cafeterias but no showers, and 15 gallons per day per student with for schools with cafeterias and showers, including infiltration. School flows were peaked by a factor of three, assuming an 8-hour school day. This was considered a conservative estimate of the flows as infiltration within the school system is also peaked.

Infiltration and inflow (I&I) was added to the remainder of the basin based on the developed service area. Peak infiltration rates were developed based on adjusted average I&I rates established in the *1998 I/I Study.* Rates from this study were adjusted to account for recent development within the basins, as well as "peaked" to a peak hour I/I rate. To calibrate the model I/I rates were adjusted further to match model results to the known historic peak of 8.8 mgd observed at the treatment plant in December, 2005.

The flow developed for each sub-basin was "dumped" into the network system at the input nodes. The input nodes were generally located at the top of the network system of each sub-basin to provide a level of conservation in the flows within each sub-basin.

Future flows for residential parcels in the basins were developed utilizing the same 149 gallons per ERU. Undeveloped parcels within the basin were ascribed a number of ERU's based on the size and established zone of the parcel. Basins were assumed to grow at the growth rates established in Chapter 6 over the ten and twenty year period.

If a basin reached theoretical build-out prior to accepting the allotted number of ERUs base on the growth rate, these ERUs were transferred to basins with available parcels to handle the growth. The transference of ERUs to other basins was in part based on discussions with the City regarding known developments within the basins.

Commercial flows were similarly "grown" based on available commercial acreage. I&I rates were increased at the rate of increase of additional acreage of service area.

The model looked at flows generated in the years 2005, 2015, and 2025.

Two separate models were created to determine the adequacy of the City's current system. The first model was restricted to the force main running from Brady Rd. to Joy Street. A summary of the basin input information is in Table F-1, and the basins and flow input locations are shown in Figure F-1. The hydraulic grid line resulting from the force main model is shown in Figures F-1 to F-9.

The second system modeled included the main trunk lines of the gravity system. Flows from the force main model were input at the receiving manhole on Joy Street. A summary of the input information is shown in Table F-2, and the basins and flow input locations are shown in Figures G-1 to G-11.

GRAVITY MODEL RESULTS:

The model results show a number of areas with capacity issues within the City's system. The majority of the problems identified were within Basins 1, 2 and 3n. Many of these areas, particularly those identified in Basins 1 and 2 are a result of high inflow and infiltration flows.

Table F-3 shows the results of a model run at 2005 conditions.

A pipe was determined to be under-capacity if the flow through the pipe, as determined by the model, was greater than the theoretical maximum flow the pipe could effectively convey. Pipes were re-sized based on this parameter (Q_{max}/Q_f) through an iterative process, increasing pipe size until all deficiencies were eliminated, as seen in Table F-4. Shaded cells in Table F-4 identify pipes where the Q_{max}/Q_f was greater than 1 for each iteration.

Table F-5 summarizes the results of the final iteration. All deficiencies based on the Q_{max}/Q_f criterion have been eliminated and the resulting pipe sizes are included in the table. Also included in the table is a column showing surcharge. This was developed from the H_{max}/D column of the table. H_{max} represents the maximum peak elevation of the energy grid line. D is the diameter of the pipe. Pipes with an H_{max}/D greater than 1 are surcharged. The amount of surcharge during the peak hour flow in the year of 2025, as measured from the top of the pipe, is quantified in the surcharge column of the table.

TABLE F-1
STEP Main Model Basin Summary

Input #1 (Station 42+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	37	13	11.9	149	1937	1.90	3680.300			256.52	3052.588	0.0067	0.010417
2015	37	13	11.9	149	1937	1.90	3680.300			256.52	3052.588	0.0067	0.010417
2025	37	13	11.9	149	1937	1.90	3680.300			256.52	3052.588	0.0067	0.010417

Input #2 (Station 57+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	733	259	139.4	149	38591	1.90	73322.900	25000	1440	256.52	35758.89	0.1355	0.20967
2015	1092	386	139.4	149	57501	1.90	109251.121	25000	2146	256.52	35758.89	0.1722	0.266347
2025	1202	425	139.4	149	63289	1.90	120249.556	25000	2362	256.52	35758.89	0.1834	0.283697

Input #3 (Station 84+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	184	65	25	149	9685	1.90	18401.500			256.52	6413	0.02	0.038391
2015	274	97	25	149	14430.65	1.90	27418.235			256.52	6413	0.03	0.052341
2025	302	107	25	149	15883.4	1.90	30178.460			256.52	6413	0.04	0.056612

Input #4 (Station 111+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	546	193	82.0	149	28757	1.90	54638.300			256.52	21034.64	0.08	0.117076
2015	814	288	82.0	149	42848	1.90	81411.067			256.52	21034.64	0.10	0.158497
2025	896	317	82.0	149	47161	1.90	89606.812			256.52	21034.64	0.11	0.171177

Input #5 (Station 119+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	23	8	2.6	149	1192	1.90	2264.800			256.52	666.952	0.00	0.004536
2015	34	12	2.6	149	1776.08	1.90	3374.552			256.52	666.952	0.00	0.006253
2025	55	20	2.6	149	2912.771	1.90	5534.265			256.52	666.952	0.01	0.009594

Input #6 (Station 122+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	130	46	12.5	149	6854	1.90	13022.600			256.52	3206.5	0.02	0.025109
2015	194	69	12.5	149	10212.46	1.90	19403.674			256.52	3206.5	0.02	0.034981
2025	213	75	12.5	149	11240.56	1.90	21357.064			256.52	3206.5	0.02	0.038003

TABLE F-1
STEP Main Model Basin Summary

Input #7 (Station 128+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	2168	766	226.9	149	114134	1.90	216854.600			256.52	58204.39	0.28	0.425552
2015	3230	1141	226.9	149	170060	1.90	323113.354			256.52	58204.39	0.38	0.589948
2025	4121	1456	226.9	149	216980	1.90	412261.544			256.52	58204.39	0.47	0.727872

Input #8 & #9 (Station 148+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	119	42	61.7	149	6258	1.90	11890.200	25000	10194	329.12	20306.7	0.07	0.104262
2015	842	298	61.7	149	44339	1.90	84244.898	25000	13128	329.12	20306.7	0.14	0.220744
2025	860	304	61.7	149	45278	1.90	86028.428	25000	18000	329.12	20306.7	0.15	0.231041

Input #10 (Station 176+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	139	49	11.8	149	7301	1.90	13871.900			329.12	3883.616	0.02	0.02747
2015	207	73	11.8	149	10878.49	1.90	20669.131			329.12	3883.616	0.02	0.037986
2025	227	80	11.8	149	11973.64	1.90	22749.916			329.12	3883.616	0.03	0.041206

Input #11, 12, 13 (Station 192+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	181	64	435.3	149	9536	1.90	18118.400	25000	884465	329.12	143265.9	1.07	1.656742
2015	836	295	435.3	149	44009	1.90	83616.416	25000	1282022	329.12	143265.9	1.53	2.373148
2025	297	105	435.3	149	15639	1.90	29714.176	25000	1725000	329.12	143265.9	1.92	2.975099

Input #14, 15 (Station 255+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	1288	455	101.5	149	67795	1.90	128810.500			329.12	33405.68	0.16	0.250969
2015	1919	678	101.5	149	101015	1.90	191927.645		15	329.12	33405.68	0.23	0.348643
2025	2112	746	101.5	149	111184	1.90	211249.220		22.5	329.12	33405.68	0.24	0.378548

Input #16 (Station 272+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	487	172	148.0	149	25628	1.90	48693.200		484700	329.12	48709.76	0.58	0.900589
2015	725	256	148.0	149	38186	1.90	72552.868		923427	329.12	48709.76	1.04	1.61627
2025	798	282	148.0	149	42030	1.90	79856.848		1250400	329.12	48709.76	1.38	2.13344

TABLE F-1
STEP Main Model Basin Summary

Input #17 & #18 (Station 272+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	144	51	17.0	149	7599	1.90	14438.100			256.52	4360.84	0.02	0.029084
2015	215	76	17.0	149	11323	1.90	21512.769			256.52	4360.84	0.03	0.04003
2025	237	84	17.0	149	12462	1.90	23678.484			256.52	4360.84	0.03	0.04338

Input #19 (Station 333+00)

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpad)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	1710	606	275.0	149	90294	1.90	171558.600	18000		256.52	70543	0.26	0.402411
2015	2550	903	275.0	149	134538	1.90	255622.314	18000		256.52	70543	0.34	0.532468
2025	3565	994	275.0	149	148082	1.90	281356.104	18000		256.52	70543	0.37	0.572282

Totals

	Pop	ERU	Inf Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Peak Hr (gpd)	School/Other (gpd)	Com/Indus (gpd)	I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	7,888	2789	1,551		415,561		0.790	0.093	1.381	0.453	2.72	4.202
2015	12,968	4584	1,551		683,052		1.298	0.093	2.221	0.453	4.06	6.288
2025	14,922	5007	1,551		746,053		1.418	0.093	2.996	0.453	4.96	7.672

TABLE F-2
Gravity Model Basin Summary

Basin 1-A **1-2-8**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hr I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	27	81.27	23.77	149	4023	1.90	7643.700	0	0	15029.41	357249	0.365	0.565
2015	40	81.27	23.77	149	5994.27	1.90	11389.113	0	0	15029.41	357249	0.369	0.570
2025	44	81.27	23.77	149	6597.72	1.90	12535.668	0	0	15029.41	357249	0.370	0.572

Basin 1-B **1-1-10**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	27	37.28	29.54	149	4023	1.90	7643.7	0	0	15029.41	443969	0.452	0.699
2015	40	37.28	29.54	149	5994.27	1.90	11389.113	0	0	15029.41	443969	0.455	0.704
2025	44	37.28	29.54	149	6597.72	1.90	12535.668	0	0	15029.41	443969	0.457	0.706

Basin 1-C **1-3-13**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	85	27.43	26.11	149	12665	1.90	24063.5	0	0	15029.41	392418	0.416	0.644
2015	92	27.43	26.11	149	13708	1.90	26045.2	0	0	15029.41	392418	0.418	0.647
2025	92	27.43	26.11	149	13708	1.90	26045.2	0	0	15029.41	392418	0.418	0.647

Basin 1-D **1-2-5**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	96	31.52	26.02	149	14304	1.90	27177.6	0	0	15029.41	391116	0.418	0.647
2015	143	31.52	26.02	149	21312.96	1.90	40494.624	0	0	15029.41	391116	0.432	0.668
2025	157	31.52	26.02	149	23458.56	1.90	44571.264	0	0	15029.41	391116	0.436	0.674

Basin 1-E **10-1-1**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	22	18.04	7.57	149	3278	1.90	6228.2	0	0	15029.41	113844	0.120	0.186
2015	33	18.04	7.57	149	4884.22	1.90	9280.018	0	0	15029.41	113844	0.123	0.190
2025	36	18.04	7.57	149	5375.92	1.90	10214.248	0	0	15029.41	113844	0.124	0.192

Basin 2-A **2-3-1**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)

TABLE F-2
Gravity Model Basin Summary

Current	146	37.70	28.64	149	21754	1.90	41332.6	25000	3270	10074.46	288511	0.358	0.554
2015	213	37.70	28.64	149	31737	1.90	60300.3	25000	3270	10074.46	288511	0.377	0.583
2025	213	37.70	28.64	149	31737	1.90	60300.3	25000	3270	10074.46	288511	0.377	0.583

Basin 2-B **2-1-11**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	120	49.11	38.12	149	17880	1.90	33972	0	0	10074.46	384078	0.418	0.647
2015	179	49.11	38.12	149	26641.2	1.90	50618.28	0	0	10074.46	384078	0.435	0.673
2025	187	49.11	38.12	149	27863	1.90	52939.7	0	0	10074.46	384078	0.437	0.676

Basin 3n-A **3-19A-1**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	39	12.53	9.53	149	5811	1.90	11040.9	0	0	6352.5	60527	0.072	0.111
2015	51	12.53	9.53	149	7599	1.90	14438.1	0	0	6352.5	60527	0.075	0.116
2025	51	12.53	9.53	149	7599	1.90	14438.1	0	0	6352.5	60527	0.075	0.116

Basin 3n-B **3-1-32**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	5	59.23	2.07	149	745	1.90	1415.5	0	0	6352.5	13165	0.015	0.023
2015	7	59.23	2.07	149	1110.05	1.90	2109.095	0	0	6352.5	13165	0.015	0.024
2025	208	59.23	2.07	149	31021.8	1.90	58941.42	0	0	6352.5	13165	0.072	0.112

Basin 3n-C **3-16-6**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	191	66.10	64.24	149	28459	1.90	54072.1	25000	0	6352.5	408101	0.487	0.754
2015	202	66.10	64.24	149	30098	1.90	57186.2	25000	0	6352.5	408101	0.490	0.759
2025	202	66.10	64.24	149	30098	1.90	57186.2	25000	0	6352.5	408101	0.490	0.759

Basin 3n-D **3-1-29**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	8	12.90	9.24	149	1192	1.90	2264.8	0	0	6352.5	58711	0.061	0.094
2015	12	12.90	9.24	149	1776.08	1.90	3374.552	0	0	6352.5	58711	0.062	0.096
2025	13	12.90	9.24	149	1954.88	1.90	3714.272	0	0	6352.5	58711	0.062	0.097

TABLE F-2
Gravity Model Basin Summary

Basin 3n-E **3-1-24**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	97	100.61	31.79	149	14453	1.90	27460.7	0	0	6352.5	201932	0.229	0.355
2015	145	100.61	31.79	149	21534.97	1.90	40916.443	0	0	6352.5	201932	0.243	0.376
2025	159	100.61	31.79	149	23702.92	1.90	45035.548	0	0	6352.5	201932	0.247	0.382

Basin 3n-F **3-1-14**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	56	18.11	10.59	149	8344	1.90	15853.6	0	0	6352.5	67260	0.083	0.129
2015	83	18.11	10.59	149	12432.56	1.90	23621.864	0	0	6352.5	67260	0.091	0.141
2025	92	18.11	10.59	149	13684.16	1.90	25999.904	0	0	6352.5	67260	0.093	0.144

Basin 3n-G **3-1-18**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	28	98.02	51.15	149	4172	1.90	7926.8	0	0	6352.5	324952	0.333	0.515
2015	42	98.02	51.15	149	6216.28	1.90	11810.932	0	0	6352.5	324952	0.337	0.521
2025	46	98.02	51.15	149	6842.08	1.90	12999.952	0	0	6352.5	324952	0.338	0.523

Basin 3n-H **3-1-39**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	256	80.33	76.55	149	38144	1.90	72473.6	0	4650	6352.5	486267	0.563	0.872
2015	275	80.33	76.55	149	40975	1.90	77852.5	0	4650	6352.5	486267	0.569	0.880
2025	275	80.33	76.55	149	40975	1.90	77852.5	0	4650	6352.5	486267	0.569	0.880

Basin 3s-A **3-1-10**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	135	18.12	17.73	149	20115	1.90	38218.5	0	0	4483.05	79502	0.118	0.182
2015	137	18.12	17.73	149	20413	1.90	38784.7	0	0	4483.05	79502	0.118	0.183
2025	137	18.12	17.73	149	20413	1.90	38784.7	0	0	4483.05	79502	0.118	0.183

Basin 3s-B **3-2-2**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)

TABLE F-2
Gravity Model Basin Summary

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	98	14.65	13.41	149	14602	1.90	27743.8	25000	0	4483.05	60121	0.113	0.175
2015	105	14.65	13.41	149	15645	1.90	29725.5	25000	0	4483.05	60121	0.115	0.178
2025	105	14.65	13.41	149	15645	1.90	29725.5	25000	0	4483.05	60121	0.115	0.178

Basin 3s-C **3-1-2**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	122	22.12	18.54	149	18178	1.90	34538.2	0	0	4483.05	83133	0.118	0.182
2015	142	22.12	18.54	149	21158	1.90	40200.2	0	0	4483.05	83133	0.123	0.191
2025	142	22.12	18.54	149	21158	1.90	40200.2	0	0	4483.05	83133	0.123	0.191

Basin 4-A **4-1-8**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	79	26.35	25.98	149	11771	1.90	22364.9	25000	0	10755.69	279387	0.327	0.506
2015	81	26.35	25.98	149	12069	1.90	22931.1	25000	0	10755.69	279387	0.327	0.506
2025	81	26.35	25.98	149	12069	1.90	22931.1	25000	0	10755.69	279387	0.327	0.506

Basin 4-B **4-1-7**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	99	24.37	23.50	149	14751	1.90	28026.9	0	0	10755.69	252742	0.281	0.434
2015	104	24.37	23.50	149	15496	1.90	29442.4	0	0	10755.69	252742	0.282	0.437
2025	104	24.37	23.50	149	15496	1.90	29442.4	0	0	10755.69	252742	0.282	0.437

Basin 4-C **4-1-4**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	68	19.28	18.05	149	10132	1.90	19250.8	25000	1380	10755.69	194152	0.240	0.371
2015	75	19.28	18.05	149	11175	1.90	21232.5	25000	1380	10755.69	194152	0.242	0.374
2025	75	19.28	18.05	149	11175	1.90	21232.5	25000	1380	10755.69	194152	0.242	0.374

Basin 4-D **4-2A-2**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	23	4.58	4.37	149	3427	1.90	6511.3	25000	0	10755.69	47013	0.079	0.121
2015	24	4.58	4.37	149	3576	1.90	6794.4	25000	0	10755.69	47013	0.079	0.122
2025	24	4.58	4.37	149	3576	1.90	6794.4	25000	0	10755.69	47013	0.079	0.122

TABLE F-2
Gravity Model Basin Summary

Basin 5-A — **5-1-22**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	117	30.00	25.90	149	17433	1.90	33122.7	25000	14280	1516.13	39268	0.112	0.173
2015	174	30.00	25.90	149	25975.17	1.90	49352.823	25000	14280	1516.13	39268	0.128	0.198
2025	185	30.00	25.90	149	27565	1.90	52373.5	25000	14280	1516.13	39268	0.131	0.203

Basin 5-B — **5-1-11**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	55	20.95	20.31	149	8195	1.90	15570.5	25000	37860	1516.13	30798	0.109	0.169
2015	59	20.95	20.31	149	8791	1.90	16702.9	25000	37860	1516.13	30798	0.110	0.171
2025	59	20.95	20.31	149	8791	1.90	16702.9	25000	37860	1516.13	30798	0.110	0.171

Basin 6-A — **6-7-8**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	181	49.74	48.46	149	26969	1.90	51241.1	25000	14280	2689.83	130343	0.221	0.342
2015	188	49.74	48.46	149	28012	1.90	53222.8	25000	14280	2689.83	130343	0.223	0.345
2025	188	49.74	48.46	149	28012	1.90	53222.8	25000	14280	2689.83	130343	0.223	0.345

Basin 6-B — **6-1-5**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	97	18.38	18.38	149	14453	1.90	27460.7	25000	21330	2689.83	49431	0.123	0.191
2015	97	18.38	18.38	149	14453	1.90	27460.7	25000	21330	2689.83	49431	0.123	0.191
2025	97	18.38	18.38	149	14453	1.90	27460.7	25000	21330	2689.83	49431	0.123	0.191

Basin 7-A — **7-3-5**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	24	16.58	12.93	149	3576	1.90	6794.4	0	1500	2357.08	30487	0.039	0.060
2015	35	16.58	12.93	149	5215	1.90	9908.5	0	1500	2357.08	30487	0.042	0.065
2025	35	16.58	12.93	149	5215	1.90	9908.5	0	1500	2357.08	30487	0.042	0.065

Basin 7-B — **7-1-6**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)

TABLE F-2
Gravity Model Basin Summary

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	95	159.19	80.71	149	14155	1.90	26894.5	0	126300	2357.08	190245	0.343	0.531
2015	467	159.19	80.71	149	69515.95	1.90	132080.305	0	126300	2357.08	190245	0.449	0.694
2025	606	159.19	80.71	149	90264.2	1.90	171501.98	0	126300	2357.08	190245	0.488	0.755

Basin 7-C **7-2-1**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	48	5.59	4.31	149	7152	1.90	13588.8	25000	750	2357.08	10162	0.050	0.077
2015	72	5.59	4.31	149	10656.48	1.90	20247.312	25000	750	2357.08	10162	0.056	0.087
2025	79	5.59	4.31	149	11729.28	1.90	22285.632	25000	750	2357.08	10162	0.058	0.090

Basin 8-A **8-1-5**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	188	54.74	51.67	149	28012	1.90	53222.8	25000	66390	344.85	17817	0.162	0.251
2015	280	54.74	51.67	149	41737.88	1.90	79301.972	25000	66390	344.85	17817	0.189	0.292
2025	308	54.74	51.67	149	45939.68	1.90	87285.392	25000	66390	344.85	17817	0.196	0.304

Basin 8-B

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	49	76.13	65.77	149	7301	1.90	13871.9	0	126300	344.85	22679	0.163	0.252
2015	73	76.13	65.77	149	10878.49	1.90	20669.131	0	126300	344.85	22679	0.170	0.262
2025	80	76.13	65.77	149	11973.64	1.90	22749.916	0	126300	344.85	22679	0.172	0.266

Basin 9-A **9-1-5**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	181	72.79	71.77	149	26969	1.90	51241.1	0	53370	303.71	21796	0.126	0.196
2015	188	72.79	71.77	149	28012	1.90	53222.8	0	53370	303.71	21796	0.128	0.199
2025	188	72.79	71.77	149	28012	1.90	53222.8	0	53370	303.71	21796	0.128	0.199

Basin 9-B **9-1-2**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	50	14.63	14.63	149	7450	1.90	14155	0	0	303.71	4442	0.019	0.029
2015	50	14.63	14.63	149	7450	1.90	14155	0	0	303.71	4442	0.019	0.029
2025	50	14.63	14.63	149	7450	1.90	14155	0	0	303.71	4442	0.019	0.029

TABLE F-2
Gravity Model Basin Summary

Basin 10-A **10-6-4**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	66	196.57	149.57	149	9834	1.90	18684.6	0	0	3172.62	474515	0.493	0.763
2015	98	196.57	149.57	149	14652.66	1.90	27840.054	0	0	3172.62	474515	0.502	0.777
2025	108	196.57	149.57	149	16127.76	1.90	30642.744	0	0	3172.62	474515	0.505	0.782

Basin 10-B **10-1-20**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	30	31.88	25.32	149	4470	1.90	8493	0	0	3172.62	80333	0.089	0.137
2015	45	31.88	25.32	149	6660.3	1.90	12654.57	0	0	3172.62	80333	0.093	0.144
2025	49	31.88	25.32	149	7330.8	1.90	13928.52	0	0	3172.62	80333	0.094	0.146

Basin 10-C **10-1-23**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	55	36.10	21.56	149	8195	1.90	15570.5	0	0	3172.62	68392	0.084	0.130
2015	82	36.10	21.56	149	12210.55	1.90	23200.045	0	0	3172.62	68392	0.092	0.142
2025	90	36.10	21.56	149	13439.8	1.90	25535.62	0	0	3172.62	68392	0.094	0.145

Basin 10-D **10-10-12**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	29	63.02	40.79	149	4321	1.90	8209.9	0	930	3172.62	129418	0.139	0.214
2015	43	63.02	40.79	149	6438.29	1.90	12232.751	0	930	3172.62	129418	0.143	0.221
2025	48	63.02	40.79	149	7086.44	1.90	13464.236	0	930	3172.62	129418	0.144	0.222

Basin 10-E **10-10B-1**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	70	59.93	31.08	149	10430	1.90	19817	0	30	3172.62	98615	0.118	0.183
2015	104	59.93	31.08	149	15540.7	1.90	29527.33	0	30	3172.62	98615	0.128	0.198
2025	115	59.93	31.08	149	17105.2	1.90	32499.88	0	30	3172.62	98615	0.131	0.203

Basin 10-F **10-1-3**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)

TABLE F-2
Gravity Model Basin Summary

Current	39	47.61	21.52	149	5811	1.90	11040.9	0	0	3172.62	68279	0.079	0.123
2015	58	47.61	21.52	149	8658.39	1.90	16450.941	0	0	3172.62	68279	0.085	0.131
2025	64	47.61	21.52	149	9530.04	1.90	18107.076	0	0	3172.62	68279	0.086	0.134

Basin 10-G **10-1-3**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	144	62.20	50.18	149	21456	1.90	40766.4	0	0	3172.62	159192	0.200	0.309
2015	215	62.20	50.18	149	31969.44	1.90	60741.936	0	0	3172.62	159192	0.220	0.340
2025	231	62.20	50.18	149	34383.24	1.90	65328.156	0	0	3172.62	159192	0.225	0.347

Basin 12-A **10-10-12**

	ERU's	Total Area	Dev Area	Flow/ERU (gpd)	Ave Day (gpd)	Peak Factor	Pk Hour (gpd)	School /Other (gpd)	Com/ Indus (gpd)	I&I (gpad)	Pk Hour I&I (gpd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	414	214.38	165.84	149	61686.00	1.90	117203.4	0	18330	358.16	59395	0.195	0.302
2015	617	214.38	165.84	149	91912.14	1.90	174633.066	0	18330	358.16	59395	0.252	0.390
2025	626	214.38	165.84	149	93274.00	1.90	177220.6	0	18330	358.16	59395	0.255	0.394

Totals	ERU's	Pk Hour (mgd)	School /Other (mgd)	Com/ Indus (mgd)	Total Peak I&I (mgd)	Total Peak Hr (mgd)	Total Peak Hr (cfs)
Current	3503.00	0.992	0.300	0.49	6.187	7.965	12.324
2015	4894.70	1.386	0.300	0.49	6.187	8.359	12.933
2025	5419.16	1.534	0.300	0.49	6.187	8.508	13.163

TABLE F-3
Current Model Results

LinkID	Up Stream MH	Down Stream MH	Up - Invert Level	Down - Invert Level	Length	Slope %	Pipe Diameter	Qmax	Hmax/D	Qmax/Qf	Capacity
2-3-1l1	2-3-1	2-1-6	124.49	114.84	156.08	6.1827	10	0.554	0.785	0.104	
1-3-14l1	1-3-14	1-3-13	330.43	313	152.87	11.4018	8	0	0.58	0	
1-3-13l1	1-3-13	1-3-12	313	289.73	262.09	8.8786	8	0.644	0.29	0.184	
1-3-12l1	1-3-12	1-3-11	289.48	262	201.31	13.6506	8	0.644	0.586	0.148	
1-3-11l1	1-3-11	1-3-10	262	235.54	308.84	8.5675	8	0.644	0.336	0.187	
1-3-10l1	1-3-10	1-3-9	235.34	226	146.25	6.3863	8	0.644	0.669	0.217	
1-3-9l1	1-3-9	1-3-8	226	217.87	157.97	5.1465	8	0.644	0.334	0.241	
1-3-8l1	1-3-8	1-3-7	217.57	206	209.07	5.534	8	0.644	0.696	0.233	
1-3-7l1	1-3-7	1-3-6	206	199.67	141.42	4.476	8	0.644	0.432	0.259	
1-3-6l1	1-3-6	1-3-5	199.52	192	132.65	5.6691	8	0.644	0.667	0.23	
1-3-5l1	1-3-5	1-3-4	192	185.33	123.75	5.3899	8	0.644	0.667	0.236	
1-3-4l1	1-3-4	1-3-3	185.23	182.7	89.04	2.8414	8	0.644	0.935	0.325	
1-3-3l1	1-3-3	1-3-2	182.7	179.47	214.38	1.5067	8	0.644	0.468	0.446	
1-3-2l1	1-3-2	1-3-1	179.22	161.8	221.38	7.8688	8	0.645	2.086	0.195	
1-3-1l1	1-3-1	1-1-10	161.9	161.33	221.38	0.2575	8	0.646	1.819	1.081	NO
1-1-10l1	1-1-10	1-1-9	161.05	154.6	110.72	5.8255	12	3.776	5.555	0.451	
1-1-9l1	1-1-9	1-1-8	154.6	153.35	111.55	1.1206	12	3.234	5.889	0.88	
1-1-8l1	1-1-8	1-1-7	153.35	149.17	88.49	4.7237	12	3.219	9.507	0.427	
1-1-7l1	1-1-7	1-1-6	149.17	148.49	425.2	0.1599	12	2.132	9.373	1.536	NO
1-1-6l1	1-1-6	1-1-5	148.49	148.44	56.87	0.0879	12	2.117	8.237	2.057	NO
1-1-5l1	1-1-5	1-1-4	148.44	147.9	463.05	0.1166	12	2.118	7.846	1.786	NO
1-1-4l1	1-1-4	1-1-3	147.9	147.6	204.27	0.1469	12	2.426	6.524	1.824	NO
1-1-3l1	1-1-3	1-1-2	147.6	147.33	141.95	0.1902	12	2.437	6.124	1.61	NO
1-1-2l1	1-1-2	1-1-1	147.33	147.3	48.85	0.0614	12	2.66	5.827	3.092	NO
1-1-1l1	1-1-1	2-1-11	147	145.77	372.51	0.3302	12	2.661	5.535	1.334	NO
2-1-11l1	2-1-11	2-1-10	145.77	144.56	413.58	0.2926	12	3.165	4.462	1.686	NO
2-1-10l1	2-1-10	2-1-9	144.56	144	178.13	0.3144	12	3.165	1.852	1.626	NO
2-1-9l1	2-1-9	2-1-8	144	128.5	366.34	4.231	12	3.165	1.802	0.443	
2-1-8l1	2-1-8	2-1-7B	128.5	126.5	305.36	0.655	12	3.165	1.455	1.127	NO
2-1-7Bl1	2-1-7B	2-1-7	126.14	124.99	64.67	1.7783	12	3.165	0.803	0.684	
2-1-7l1	2-1-7	2-1-6	124.85	114.84	246.23	4.0653	12	3.165	0.655	0.452	
2-1-6l1	2-1-6	2-1-5	114.64	106.81	92.85	8.433	12	3.718	0.878	0.369	
2-1-5l1	2-1-5	2-1-4	106.61	101.76	131	3.7023	12	3.718	0.72	0.557	

TABLE F-3
Current Model Results

2-1-4I1	2-1-4	2-1-3	101.56	73.34	461.91	6.1094	12	3.718	0.977	0.433	
2-1-3I1	2-1-3	2-1-2B	73.14	66.45	246.84	2.7103	12	3.718	0.958	0.651	
2-1-2BI1	2-1-2B	2-1-2A	66.31	64.36	49	3.9796	12	3.718	0.85	0.537	
2-1-2AI1	2-1-2A	2-1-2	64.2	62.25	32.81	5.9436	12	3.718	1.003	0.439	
2-1-2I1	2-1-2	2-1-1	62.12	60.16	465.18	0.4213	18	3.718	0.535	0.56	
2-1-1I1	2-1-1	5-1-12	56.78	52.47	401	1.0748	12	3.718	1.59	1.033	NO
1-2-8I1	1-2-8	1-2-7	226.12	204.5	303.65	7.12	8	0.565	0.587	0.18	
1-2-7I1	1-2-7	1-2-6	204.5	181.39	354.81	6.5133	8	0.565	0.635	0.188	
1-2-6I1	1-2-6	1-2-5	181.34	175.5	175.43	3.329	8	0.565	0.816	0.263	
1-2-5I1	1-2-5	1-2-4	175.45	170	80.81	6.7442	8	1.212	0.952	0.396	
1-2-4I1	1-2-4	1-2-3	170	166.39	68.18	5.2948	8	1.212	0.758	0.447	
1-2-3I1	1-2-3	1-2-2	166.24	160	130.65	4.7761	8	1.212	1.051	0.471	
1-2-2I1	1-2-2	1-2-1	160	155.3	117.35	4.0051	8	1.212	1.263	0.514	
1-2-1I1	1-2-1	1-1-2	155.2	147.33	152.69	5.1542	8	1.212	9.169	0.453	
5-1-25I1	5-1-25	5-1-24	179.15	175.8	170.03	1.9702	8	0	0.01	0	
5-1-24I1	5-1-24	5-1-23	175.8	158.25	97.27	18.0426	8	0	0.011	0	
5-1-23I1	5-1-23	5-1-22	158.25	146.53	112.21	10.4447	8	0	0.361	0	
5-1-22I1	5-1-22	5-1-21	146.53	135	271.78	4.2424	8	0.173	0.374	0.071	
5-1-21I1	5-1-21	5-1-20	135	125	272.09	3.6753	8	0.173	0.353	0.077	
5-1-20I1	5-1-20	5-1-19	125	112.43	268.1	4.6885	8	0.173	0.197	0.068	
5-1-19I1	5-1-19	5-1-18	112.33	100	246.71	4.9978	8	0.173	0.374	0.066	
5-1-18I1	5-1-18	5-1-17	100	90	271.63	3.6815	8	0.173	0.372	0.077	
5-1-17I1	5-1-17	5-1-16	90	79.7	272.88	3.7746	8	0.173	0.237	0.076	
5-1-16I1	5-1-16	5-1-15	79.6	71	267.08	3.22	8	0.173	0.384	0.082	
5-1-15I1	5-1-15	5-1-14	71	66.21	143.92	3.3282	8	0.173	0.207	0.081	
5-1-14I1	5-1-14	5-1-13	66.11	60.5	122.75	4.5703	8	0.173	0.399	0.069	
5-1-13I1	5-1-13	5-1-12	60.5	52.47	280.67	2.861	8	0.173	1.956	0.087	
5-1-12I1	5-1-12	5-1-11	52.47	43.93	272	3.1397	21	8.049	0.943	0.294	
5-1-11I1	5-1-11	5-1-10	43.93	40.07	274.19	1.4078	21	8.217	0.644	0.449	
5-1-10I1	5-1-10	5-1-9	39.62	37.5	245.69	0.8629	24	8.217	0.841	0.401	
5-1-9I1	5-1-9	5-1-8	37.5	36.52	551.39	0.1777	24	8.217	0.788	0.884	
5-1-8I1	5-1-8	5-1-7	36.52	35	130.28	1.1667	24	8.217	0.853	0.345	
5-1-7I1	5-1-7	5-1-6	35	33	226.78	0.8819	21	8.217	0.758	0.567	
5-1-6I1	5-1-6	5-1-5	33	28	121.91	4.1014	21	8.217	1.123	0.263	
5-1-5I1	5-1-5	5-1-4	28	26.22	240	0.7417	21	8.217	1.406	0.618	

TABLE F-3
Current Model Results

5-1-4I1	5-1-4	5-1-3	26.22	25.93	289.28	0.1002	21	8.217	1.275	1.681	NO
5-1-3I1	5-1-3	5-1-2	25.93	24.9	240	0.4292	21	8.217	0.962	0.812	
5-1-2I1	5-1-2	5-1-1	24.9	24.41	34	1.4412	24	8.217	0.902	0.31	
5-1-1I1	5-1-1	Main_LS	24.41	22	142	1.6972	24	13.619	0.451	0.418	
9-1-5I1	9-1-5	9-1-4	33.75	32.91	226.74	0.3705	8	0.196	0.358	0.273	
9-1-4I1	9-1-4	9-1-3	26.95	25.22	436.41	0.3964	8	0.196	0.571	0.264	
9-1-3I1	9-1-3	9-1-2	25.22	24.95	337.85	0.0799	8	0.196	0.536	0.588	
9-1-2I1	9-1-2	9-1-1	23.85	23.61	65.8	0.3647	8	0.224	0.374	0.316	
9-1-1I1	9-1-1	One Stp LS	23.51	22.5	32.81	3.0785	12	0.224	0.123	0.032	
4-2A-2I1	4-2A-2	4-2A-Q	213.76	209	281.8	1.6891	8	0.121	0.347	0.079	
4-2A-QI1	4-2A-Q	4-2A-1	209	206	115	2.6087	8	0.121	0.397	0.064	
4-2A-1I1	4-2A-1	4-2-3	206	200.12	462.56	1.2712	8	0.121	0.362	0.091	
4-2-3I1	4-2-3	4-2-2	200.12	198.99	374.83	0.3015	8	0.121	0.295	0.188	
4-2-2I1	4-2-2	4-2-1	198.89	190.96	358.22	2.2137	8	0.121	0.416	0.069	
4-2-1I1	4-2-1	4-1-2	190.96	190.15	256.41	0.3159	8	0.122	1.117	0.184	
4-8-2I1	4-8-2	4-8-1	203.25	201.98	172.2	0.7375	10	0	0.008	0	
4-8-1I1	**4-8-1**	4-1-8	201.98	200.95	441.72	0.2332	10	0.002	0.581	0.001	
4-1-8I1	4-1-8	4-1-7	200.95	199.6	468.84	0.2879	10	0.506	0.8	0.442	
4-1-7I1	4-1-7	4-1-6	199.6	199.3	88.8	0.3378	12	0.941	0.711	0.466	
4-1-6I1	4-1-6	4-1-5	199.3	199	70.52	0.4254	12	0.941	0.633	0.415	
4-1-5I1	4-1-5	4-1-4	199	198.2	289.47	0.2764	12	0.941	0.866	0.516	
4-1-4I1	4-1-4	4-1-3	198.2	197.37	315.9	0.2627	12	1.312	0.734	0.737	
4-1-3I1	4-1-3	4-1-2	197.37	190.15	418.58	1.7249	12	1.312	0.745	0.288	
4-1-2I1	4-1-2	4-1-1	190.15	189.6	246.78	0.2229	15	1.433	0.581	0.482	
4-1-1I1	4-1-1	3-2-6	189.6	189.02	158.24	0.3665	15	1.433	0.629	0.376	
3-2-6I1	3-2-6	3-2-5	189.02	188.29	224.99	0.3245	15	1.433	0.633	0.4	
3-2-5I1	3-2-5	3-2-4	188.29	188.06	122.43	0.1879	15	1.433	0.58	0.525	
3-2-4I1	3-2-4	3-2-3	188.06	184	261.61	1.5519	15	1.433	0.58	0.183	
3-2-3I1	3-2-3	3-2-2	184	181.71	123.56	1.8534	15	1.433	0.599	0.167	
3-2-2I1	3-2-2	3-2-1	181.71	175.84	342.51	1.7138	15	1.608	0.362	0.195	
3-2-1I1	3-2-1	3-1-1	175.59	168.9	304.81	2.1948	15	1.608	0.492	0.172	
6-7-9I1	6-7-9	6-1-17	158.05	149.01	334.17	2.7052	8	0	0.007	0	
6-1-17I1	6-1-17	6-1-16	149.01	141.48	280.07	2.6886	8	0	0.008	0	

TABLE F-3
Current Model Results

6-1-16I1	6-1-16	6-1-15	141.48	135.98	144.02	3.8189	8	0	0.009	0
6-1-15I1	6-1-15	6-1-14	135.98	133.05	301.36	0.9723	8	0	0.007	0
6-1-14I1	6-1-14	6-1-13	132.83	131.59	95.32	1.3009	12	0	0.01	0
6-1-13I1	6-1-13	6-1-13B	131.59	127.94	32.81	11.1252	12	0	0.799	0
6-1-13BI1	6-1-13B	6-1-12	127.94	115.03	136.35	9.4683	15	4.203	0.736	0.217
6-1-12I1	6-1-12	6-1-11	115.03	95	256.6	7.8059	12	4.203	0.869	0.433
6-1-11I1	6-1-11	6-1-10	95	71.35	247.14	9.5695	12	4.203	0.957	0.391
6-1-10I1	6-1-10	6-1-9	71.35	59.76	284.88	4.0684	18	4.544	1.058	0.22
6-1-9I1	6-1-9	6-1-8	59.76	57.85	276.65	0.6904	18	4.544	0.758	0.534
6-1-8I1	6-1-8	6-1-7	57.85	52.04	269.02	2.1597	18	4.544	1.032	0.302
6-1-7I1	6-1-7	6-1-6	52.04	49.84	256.12	0.859	18	4.544	1.146	0.479
6-1-6I1	6-1-6	6-1-5	49.84	47.68	279.68	0.7723	18	5.212	1.146	0.579
6-1-5I1	6-1-5	6-1-4	47.68	45.48	278.91	0.7888	18	5.403	0.95	0.594
6-1-4I1	6-1-4	6-1-3	45.48	43.32	265.09	0.8148	18	5.403	1.103	0.585
6-1-3I1	6-1-3	6-1-2	43.32	41.16	268.64	0.8041	18	5.403	0.552	0.589
6-1-2I1	6-1-2	6-1-1	37.5	35.44	251.4	0.8194	18	5.403	0.933	0.583
6-1-1I1	6-1-1	5-2-3	35.44	32.47	265.6	1.1182	21	5.403	0.645	0.331
5-2-3I1	5-2-3	5-2-2	32.47	29.6	75.16	3.8185	18	5.403	0.749	0.27
5-2-2I1	5-2-2	5-2-1	29.5	27.1	79.87	3.0049	18	5.403	0.793	0.304
5-2-1I1	5-2-1	5-1-1	27	24.41	75.8	3.4169	18	5.403	1.203	0.286
6-7-8I1	6-7-8	6-7-7	129.5	120.8	267.66	3.2504	8	0.342	0.455	0.161
6-7-7I1	6-7-7	6-7-6	120.8	100	319	6.5204	8	0.342	0.544	0.114
6-7-6I1	6-7-6	6-7-5	100	90.21	303.36	3.2272	8	0.342	0.601	0.162
6-7-5I1	6-7-5	6-7-4	90.21	82.72	344.71	2.1728	8	0.342	0.527	0.197
6-7-4I1	6-7-4	6-7-3	82.72	80.3	103.15	2.3461	12	0.342	0.39	0.064
6-7-3I1	6-7-3	6-7-2	80.3	77.76	267.1	0.951	12	0.342	0.387	0.101
6-7-2I1	6-7-2	6-7-1	77.76	73.87	417.65	0.9314	12	0.342	0.392	0.102
6-7-1I1	6-7-1	6-1-10	73.87	71.35	189.34	1.3309	12	0.342	0.957	0.085
6-5-2I1	6-5-2	6-5-1	59.47	58.27	380.57	0.3153	8	0	0.007	0
6-5-1I1	6-5-1	6-1-6	58.27	49.84	421.07	2.002	8	0	2.578	0
3-1-39I1	3-1-39	3-1-38	548.87	530	167.36	11.2751	8	0.872	0.319	0.221
3-1-38I1	3-1-38	3-1-37	527.99	521	215.05	3.2504	8	0.872	0.607	0.411
3-1-37I1	3-1-37	Crown LS	521	519	32.81	6.096	12	0.872	0.202	0.09

TABLE F-3
Current Model Results

3-16-6I1	3-16-6	3-16-4	625.42	594.25	396.42	7.8629	8	0.754	0.624	0.228	
3-16-4I1	3-16-4	3-16-3	594.25	581	141.91	9.3369	8	0.754	0.684	0.21	
3-16-3I1	3-16-3	3-16-2	581	563.08	277.87	6.449	8	0.754	0.774	0.252	
3-16-2I1	3-16-2	3-16-1	563.08	554.01	222.76	4.0716	8	0.754	0.81	0.317	
3-16-1I1	3-16-1	3-1-27	554.01	543.48	297.16	3.5435	8	0.754	6.686	0.34	
3-19A-1I1	3-19A-1	3-19B-1	690.67	685	467.84	1.212	8	0.111	0.382	0.085	
3-19B-1I1	3-19B-1	3-19-6	685	678.77	467.84	1.3317	8	0.111	0.193	0.082	
3-19-6I1	3-19-6	3-19-5	678.57	675.28	361.39	0.9104	8	0.111	0.212	0.099	
3-19-5I1	3-19-5	3-19-4	675.16	671.11	334.48	1.2108	8	0.111	0.37	0.085	
3-19-4I1	3-19-4	3-19-3	671.11	667.05	255.81	1.5871	8	0.111	0.271	0.075	
3-19-3I1	3-19-3	3-19-2	667.05	664	51.5	5.9223	8	0.111	0.286	0.039	
3-19-2I1	3-19-2	3-19-1	664	645.19	415.02	4.5323	8	0.111	0.143	0.044	
3-19-1I1	3-19-1	3-1-36	645.09	627.12	269.24	6.6743	8	0.111	0.865	0.036	
3-1-36I1	3-1-36	3-1-35	627.12	620.08	150.2	4.6871	8	0.982	0.59	0.385	
3-1-35I1	3-1-35	3-1-34	619.88	605.44	345.62	4.178	8	0.982	0.508	0.408	
3-1-34I1	3-1-34	3-1-33	605.24	589.5	267	5.8951	8	0.982	0.875	0.344	
3-1-33I1	3-1-33	3-1-32	589.5	573.8	354.48	4.429	8	0.982	0.438	0.397	
3-1-32I1	3-1-32	3-1-31	572.42	561.9	126.18	8.3373	8	1.005	1.112	0.296	
3-1-31I1	3-1-31	3-1-30	561.9	558.52	154.4	2.1891	8	1.005	0.88	0.577	
3-1-30I1	3-1-30	3-1-29	558.52	554.39	83.71	4.9337	8	1.005	0.941	0.384	
3-1-29I1	3-1-29	3-1-28	554.39	548.82	116.48	4.7819	8	1.099	1.337	0.427	
3-1-28I1	3-1-28	3-1-27	548.82	543.48	100.57	5.3097	8	1.1	6.686	0.405	
3-1-27I1	3-1-27	3-1-26	543.48	533.98	143.24	6.6322	8	1.851	14.65	0.61	
3-1-26I1	3-1-26	3-1-25	533.98	530.74	150.68	2.1503	8	1.838	13.949	1.065	NO
3-1-25I1	3-1-25	3-1-24	530.74	527.7	296.49	1.0253	8	1.836	12.602	1.54	NO
3-1-24I1	3-1-24	3-1-23	527.7	517.67	297	3.3771	8	2.182	5.154	1.008	NO
3-1-23I1	3-1-23	3-1-22	517.67	510.51	263.25	2.7198	8	2.182	3.691	1.124	NO
3-1-22I1	3-1-22	3-1-21	510.29	488.8	285.69	7.5221	8	2.182	1.486	0.676	
3-1-21I1	3-1-21	3-1-20B	488.8	480.5	191.92	4.3247	8	2.182	1.048	0.891	
3-1-20BI1	3-1-20B	3-1-20	480.5	464	137.81	11.973	8	2.182	1.03	0.536	
3-1-20I1	3-1-20	3-1-19	464	451	101.75	12.7764	8	2.182	1.031	0.518	
3-1-19I1	3-1-19	3-1-18	451	422	234.31	12.3768	8	2.182	1.435	0.527	
3-1-18I1	3-1-18	3-1-17	422	413.73	117.92	7.0132	8	2.695	0.717	0.865	
3-1-17I1	3-1-17	3-1-16	412.3	395.63	285.81	5.8325	8	2.695	1.306	0.948	
3-1-16I1	3-1-16	3-1-15	395.63	371	272.7	9.0319	8	2.695	0.653	0.762	
3-1-15I1	3-1-15	3-1-14	370	361	109.1	8.2493	8	2.695	1.145	0.797	

TABLE F-3
Current Model Results

3-1-14l1	3-1-14	3-1-13	361	324.63	246.6	14.7486	8	2.824	1.568	0.625	
3-1-13l1	3-1-13	3-1-12	324.63	304.37	323	6.2724	8	2.824	1.345	0.958	
3-1-12l1	3-1-12	3-1-11	304.27	282	244.65	9.1028	8	2.824	10.985	0.795	
3-1-11l1	3-1-11	3-1-10	282	262.19	287.26	6.8962	8	2.791	15.139	0.903	
3-1-10l1	3-1-10	3-1-9	261.79	259.99	230.46	0.781	8	2.374	13.518	2.281	NO
3-1-9l1	3-1-9	3-1-8	259.89	255.71	35.63	11.7317	8	2.373	5.206	0.588	
3-1-8l1	3-1-8	3-1-7	255.71	247.51	206.38	3.9733	8	2.373	3.742	1.011	NO
3-1-7l1	3-1-7	3-1-6	246.66	231.4	242.11	6.3029	8	2.373	10.616	0.803	
3-1-6l1	3-1-6	3-1-5	231.4	226.54	256.56	1.8943	8	2.373	9.33	1.464	NO
3-1-5l1	3-1-5	3-1-4	226.24	210	262.89	6.1775	8	2.373	1.392	0.811	
3-1-4l1	3-1-4	3-1-3	210	194.73	259.92	5.8749	8	2.373	1.092	0.831	
3-1-3l1	3-1-3	3-1-2	194.63	173.42	262.16	8.0905	8	2.373	0.623	0.709	
3-1-2l1	3-1-2	3-1-1	172.82	169.05	276.02	1.3658	15	2.551	0.406	0.347	
3-1-1l1	3-1-1	5-8-1	168.9	83.11	442.05	19.4073	18	4.159	0.213	0.092	
5-8-1l1	5-8-1	5-1-12	82.76	52.47	259.11	11.69	21	4.159	0.745	0.079	
7-3-5l1	7-3-5	7-3-4	71.5	64.31	121.17	5.9338	8	0.06	0.1	0.021	
7-3-4l1	7-3-4	7-3-3	64.26	41.81	193.99	11.5728	8	0.06	0.203	0.015	
7-3-3l1	7-3-3	7-3-2	41.76	39.51	150.63	1.4937	8	0.06	0.139	0.042	
7-3-2l1	7-3-2	7-3-1	39.46	26.94	118.27	10.5859	8	0.06	0.133	0.016	
7-3-1l1	7-3-1	7-1-1	26.89	16.91	190.47	5.2397	8	0.06	0.611	0.022	
7-1-6l1	7-1-6	7-1-5	23.7	22.21	286.97	0.5192	8	0.531	0.82	0.626	
7-1-5l1	7-1-5	7-1-4	22.21	21.45	213.44	0.3561	8	0.531	0.733	0.756	
7-1-4l1	7-1-4	7-1-3	21.45	19.75	57.12	2.9762	8	0.531	0.8	0.262	
7-1-3l1	7-1-3	7-1-2	19.75	17.5	455.94	0.4935	8	0.531	0.814	0.642	
7-1-2l1	7-1-2	7-1-1	17.5	16.86	163.94	0.3904	8	0.531	0.686	0.722	
7-1-1l1	7-1-1	L C LS	16.86	9.62	328.36	2.2049	10	0.591	0.274	0.165	
7-2-1l1	7-2-1	L C LS	12	9.62	101	2.3564	12	0.077	0.084	0.014	
8-1-9l1	8-1-9	8-1-8	30.84	29.83	441.23	0.2289	10	0.225	0.367	0.22	
8-1-8l1	8-1-8	8-1-7	29.83	28.67	335.14	0.3461	10	0.224	0.368	0.179	
8-1-7l1	8-1-7	8-1-6	28.67	27.14	281.54	0.5434	10	0.224	0.378	0.143	
8-1-6l1	8-1-6	8-1-5	27.14	25.16	266.48	0.743	10	0.224	0.516	0.122	
8-1-5l1	8-1-5	8-1-4	25.16	24.22	272.21	0.3453	12	0.476	0.447	0.233	
8-1-4l1	8-1-4	8-1-3	24.22	21.83	304.05	0.7861	12	0.476	0.436	0.155	

TABLE F-3
Current Model Results

8-1-3I1	8-1-3	8-1-2	21.83	21.07	310.28	0.2449	12	0.476	0.467	0.277
8-1-2I1	8-1-2	8-1-1	21.07	20.95	41.2	0.2913	12	0.476	0.322	0.254
8-1-1I1	8-1-1	Oaks LS	20.7	17	250	1.48	12	0.476	0.213	0.099
10-1-23I1	10-1-23	10-1-24	586.24	582.57	246.52	1.4887	8	0.13	0.409	0.09
10-1-24I1	10-1-24	10-1-25	582.57	578.65	271.62	1.4432	8	0.13	0.205	0.092
10-1-25I1	10-1-25	10-1-26	578.46	573.76	73.84	6.3651	8	0.13	0.142	0.044
10-1-26I1	10-1-26	10-10B-1	573.52	565	71.95	11.8416	8	0.13	0.123	0.032
10-1-20I1	10-1-20	10-1-19	560.33	558.74	222.19	0.7156	10	0.137	0.256	0.076
10-1-19I1	10-1-19	10-1-18	558.7	557.34	180	0.7556	10	0.137	0.187	0.065
10-11-8I1	10-1-18	10-1-17	529.03	512.56	172.89	9.5263	8	0.829	0.719	0.228
10-11-7I1	10-1-17	10-1-16	512.51	504.76	172.89	4.4826	8	0.829	0.397	0.333
10-11-6I1	10-1-16	10-1-15	504.29	496.36	122.58	6.4692	8	0.829	0.712	0.277
10-11-5I1	10-1-15	10-1-14	496.36	489.35	99.68	7.0325	8	0.829	0.829	0.266
10-11-4I1	10-1-14	10-1-13	489.35	486.23	79.73	3.9132	8	0.829	0.52	0.356
10-11-3I1	10-1-13	10-1-12	485.94	481.23	202.93	2.321	8	0.829	0.477	0.462
10-11-2I1	10-1-12	10-1-11	480.56	456.89	276.46	8.5618	8	0.829	0.334	0.241
10-11-1I1	10-1-11	10-1-10	456.17	437.78	149.06	12.3373	8	0.829	0.304	0.201
10-6-4I1	10-6-4	10-6-3	475.28	471.48	200.3	1.8972	8	0.763	0.674	0.471
10-6-3I1	10-6-3	10-6-2	471.48	445.39	371.61	7.0208	8	0.763	0.658	0.245
10-6-2I1	10-6-2	10-6-1	445.39	424.43	273.95	7.651	8	0.763	0.848	0.234
10-6-1I1	10-6-1	10-1A-12	424.43	417.32	238.32	2.9834	8	0.763	0.424	0.375
10-1A-12I1	10-1A-12	10-1-12	417.18	411.61	32.81	16.9774	8	0.763	0.268	0.157
10-10-12I1	10-10-12	10-10-11	729.37	719.72	316.82	3.0459	8	0.516	0.687	0.251
10-10-11I1	10-10-11	10-10-10	719.72	713.46	209.66	2.9858	8	0.516	0.347	0.254
10-10-10I1	10-10-10	10-10-9	713.35	700	141.84	9.412	8	0.516	0.491	0.143
10-10-9I1	10-10-9	10-10-9A	700	690.71	83	11.1928	8	0.516	0.474	0.131
10-10-9AI1	10-10-9A	10-10-8	690.71	673.37	136.92	12.6643	8	0.516	0.237	0.123
10-10-8I1	10-10-8	10-10-7	672.92	665.34	144.41	5.2489	8	0.516	0.296	0.191
10-10-7I1	10-10-7	10-10-6	664.94	650.23	168.4	8.7352	8	0.516	0.26	0.148
10-10-6I1	10-10-6	10-10-5	649.67	645.94	62.14	6.0026	8	0.516	0.286	0.179
10-10-5I1	10-10-5	10-10-4	645.64	617	347.43	8.2434	8	0.516	0.264	0.153
10-10-4I1	10-10-4	10-10-3	615.26	611.74	127.96	2.7509	8	0.516	0.351	0.264
10-10-3I1	10-10-3	10-10-2	611.07	595	101.85	15.7781	8	0.516	0.411	0.11

TABLE F-3
Current Model Results

10-10-2I1	10-10-2	10-10-1	595	579.91	67.04	22.5089	8	0.516	0.205	0.092	
10-10-1I1	10-10-1	10-10B-1	579.48	552.57	204.62	13.1512	8	0.516	0.235	0.121	
10-10B-1I1	10-10B-1	10-11-8	552.32	529.58	113.51	20.0335	8	0.829	0.268	0.157	
10-1-18I1	10-11-8	10-11-7	557.34	528.08	178.24	16.4161	8	0.137	0.117	0.029	
10-1-17I1	10-11-7	10-11-6	527.27	510.29	82.16	20.667	8	0.137	0.11	0.026	
10-1-16I1	10-11-6	10-11-5	509.25	487.05	64.52	34.4079	8	0.137	0.098	0.02	
10-1-15I1	10-11-5	10-11-4	486.88	461.89	227.99	10.961	8	0.137	0.427	0.035	
10-1-14I1	10-11-4	10-11-3	461.89	461.44	33	1.3636	8	0.137	0.213	0.1	
10-1-13I1	10-11-3	10-11-2	461.44	411.61	153.23	32.5197	8	0.137	0.099	0.02	
10-1-12I1	10-11-2	10-11-1	410.71	388	158.82	14.2992	8	0.9	0.305	0.202	
10-1-11I1	10-11-1	10-4-4	382.41	380.71	187.51	0.9066	8	0.9	0.677	0.803	
10-4-4I1	10-4-4	10-4-3	437.47	431.39	77.5	7.8452	8	0.829	0.397	0.251	
10-4-3I1	10-4-3	10-4-2	431.2	422.61	105.27	8.16	8	0.829	0.721	0.247	
10-4-2I1	10-4-2	10-4-1	422.31	421.65	63.07	1.0465	8	0.829	0.609	0.688	
10-4-1I1	10-4-1	10-1-10	421.53	377.51	189.32	23.2516	8	0.829	0.258	0.146	
10-1-10I1	10-1-10	10-1-9	375.1	170.58	281.66	72.6124	8	1.73	1.96	0.172	
10-1-9I1	10-1-9	10-1-8	171.3	159.26	89.57	13.442	8	1.73	0.44	0.401	
10-1-8I1	10-1-8	10-1-7	154.04	151.99	186.15	1.1013	8	1.73	3.856	1.4	NO
10-1-7I1	10-1-7	10-1-6	151.69	145.35	182.68	3.4705	8	1.73	1.152	0.789	
10-1-6I1	10-1-6	10-1-5	145.15	138.94	215.3	2.8843	8	1.73	0.995	0.865	
10-1-5I1	10-1-5	S P Hill LS	138.94	137.5	32.81	4.3891	12	1.73	0.332	0.238	
10-1-3I1	10-1-3	10-1-2	146.7	132	255.96	5.7431	8	2.162	1.355	0.766	
10-1-2I1	10-1-2	10-1-1	132	122.59	300	3.1367	10	2.162	0.913	0.572	
10-1-1I1	10-1-1	W C LS	122.59	121	32.81	4.8463	12	2.347	0.38	0.307	

TABLE F-4
2025 Gravity Model Iterations

LinkID	Up Stream MH	Down Stream MH	Up - Invert Level	Down - Invert Level	Length	Slope %	***First Iteration / Original Pipe Sizes***				***Second Iteration***				***Third Iteration***				***Fourth Iteration***			
							Pipe Diameter	**Hmax/D**	**Qmax/Qf**		**Pipe Diameter**	**Hmax/D**	**Qmax/Qf**		**Pipe Diameter**	**Hmax/D**	**Qmax/Qf**		**Pipe Diameter**	**Hmax/D**	**Qmax/Qf**	
2-3-1l1	2-3-1	2-1-6	124.49	114.84	156.08	6.1827	10	0.795	0.11		10	1.061	0.11		10	1.202	0.11		10	1.202	0.11	
1-3-14l1	1-3-14	1-3-13	330.43	313	152.87	11.4018	8	0.582	0		8	0.582	0		8	0.582	0		8	0.582	0	
1-3-13l1	1-3-13	1-3-12	313	289.73	262.09	8.8786	8	0.291	0.185		8	0.291	0.185		8	0.291	0.185		8	0.291	0.185	
1-3-12l1	1-3-12	1-3-11	289.48	262	201.31	13.6506	8	0.587	0.149		8	0.587	0.149		8	0.587	0.149		8	0.587	0.149	
1-3-11l1	1-3-11	1-3-10	262	235.54	308.84	8.5675	8	0.338	0.188		8	0.338	0.188		8	0.338	0.188		8	0.338	0.188	
1-3-10l1	1-3-10	1-3-9	235.34	226	146.25	6.3863	8	0.67	0.218		8	0.67	0.218		8	0.67	0.218		8	0.67	0.218	
1-3-9l1	1-3-9	1-3-8	226	217.87	157.97	5.1465	8	0.335	0.242		8	0.335	0.242		8	0.335	0.242		8	0.335	0.242	
1-3-8l1	1-3-8	1-3-7	217.57	206	209.07	5.534	8	0.697	0.234		8	0.697	0.234		8	0.697	0.234		8	0.697	0.234	
1-3-7l1	1-3-7	1-3-6	206	199.67	141.42	4.476	8	0.434	0.26		8	0.434	0.26		8	0.434	0.26		8	0.434	0.26	
1-3-6l1	1-3-6	1-3-5	199.52	192	132.65	5.6691	8	0.668	0.231		8	0.668	0.231		8	0.668	0.231		8	0.668	0.231	
1-3-5l1	1-3-5	1-3-4	192	185.33	123.75	5.3899	8	0.669	0.237		8	0.669	0.237		8	0.669	0.237		8	0.669	0.237	
1-3-4l1	1-3-4	1-3-3	185.23	182.7	89.04	2.8414	8	0.938	0.326		8	0.938	0.326		8	0.938	0.326		8	0.938	0.326	
1-3-3l1	1-3-3	1-3-2	182.7	179.47	214.38	1.5067	8	0.469	0.448		8	0.469	0.448		8	0.469	0.448		8	0.469	0.448	
1-3-2l1	1-3-2	1-3-1	179.22	161.8	221.38	7.8688	8	2.282	0.196		8	1.246	0.196		8	1.055	0.196		8	1.055	0.196	
1-3-1l1	1-3-1	1-1-10	161.9	161.33	221.38	0.2575	8	2.015	1.084	NO	10	1.306	0.598		10	0.862	0.598		10	0.864	0.598	
1-1-10l1	1-1-10	1-1-9	161.05	154.6	110.72	5.8255	12	5.829	0.477		12	5.045	0.478		12	1.281	0.468		12	1.304	0.468	
1-1-9l1	1-1-9	1-1-8	154.6	153.35	111.55	1.1206	12	6.169	0.891		12	4.617	1.009	NO	15	1.03	0.588		15	0.899	0.588	
1-1-8l1	1-1-8	1-1-7	153.35	149.17	88.49	4.7237	12	9.791	0.431		12	7.473	0.491		12	2.799	0.519		12	1.677	0.519	
1-1-7l1	1-1-7	1-1-6	149.17	148.49	425.2	0.1599	12	9.653	1.565	NO	15	5.866	1.308	NO	18	1.836	0.957		18	1.091	0.957	
1-1-6l1	1-1-6	1-1-5	148.49	148.44	56.87	0.0879	12	8.451	2.095	NO	15	5.295	1.765	NO	18	1.723	1.291	NO	21	0.885	0.856	
1-1-5l1	1-1-5	1-1-4	148.44	147.9	463.05	0.1166	12	8.046	1.82	NO	15	5.02	1.533	NO	18	1.585	1.121	NO	21	0.967	0.743	
1-1-4l1	1-1-4	1-1-3	147.9	147.6	204.27	0.1469	12	6.668	1.841	NO	15	4.338	1.456	NO	18	1.427	0.999		18	1.064	0.999	
1-1-3l1	1-1-3	1-1-2	147.6	147.33	141.95	0.1902	12	6.256	1.627	NO	15	4.049	1.282	NO	18	1.402	0.878		18	1.039	0.878	
1-1-2l1	1-1-2	1-1-1	147.33	147.3	48.85	0.0614	12	5.955	3.114	NO	15	3.689	2.761	NO	18	1.222	2.036	NO	21	0.772	1.35	NO
1-1-1l1	1-1-1	2-1-11	147	145.77	372.51	0.3302	12	5.66	1.344	NO	15	3.425	1.191	NO	18	1.343	0.878		18	0.919	0.878	
2-1-11l1	2-1-11	2-1-10	145.77	144.56	413.58	0.2926	12	4.575	1.703	NO	15	2.768	1.449	NO	18	1.194	1.055	NO	21	0.82	0.699	
2-1-10l1	2-1-10	2-1-9	144.56	144	178.13	0.3144	12	1.888	1.642	NO	15	1.407	1.398	NO	18	0.933	1.018	NO	21	0.787	0.675	
2-1-9l1	2-1-9	2-1-8	144	128.5	366.34	4.231	12	1.87	0.448		12	2.173	0.691		12	2.514	0.818		12	1.467	0.818	
2-1-8l1	2-1-8	2-1-7B	128.5	126.5	305.36	0.655	12	1.516	1.138	NO	15	1.567	0.969		15	1.628	1.147	NO	18	0.937	0.705	
2-1-7Bl1	2-1-7B	2-1-7	126.14	124.99	64.67	1.7783	12	0.809	0.691		12	1.255	1.066	NO	15	1.006	0.696		15	1.006	0.696	
2-1-7l1	2-1-7	2-1-6	124.85	114.84	246.23	4.0653	12	0.663	0.457		12	0.884	0.705		12	1.002	0.835		12	1.002	0.835	
2-1-6l1	2-1-6	2-1-5	114.64	106.81	92.85	8.433	12	0.889	0.375		12	1.214	0.547		12	1.422	0.637		12	1.422	0.637	
2-1-5l1	2-1-5	2-1-4	106.61	101.76	131	3.7023	12	0.729	0.566		12	0.966	0.826		12	1.091	0.962		12	1.09	0.962	
2-1-4l1	2-1-4	2-1-3	101.56	73.34	461.91	6.1094	12	0.99	0.44		12	1.567	0.643		12	5.094	0.749		12	1.24	0.749	
2-1-3l1	2-1-3	2-1-2B	73.14	66.45	246.84	2.7103	12	0.97	0.661		12	1.349	0.965		12	3.848	1.124	NO	15	1.663	0.62	
2-1-2Bl1	2-1-2B	2-1-2A	66.31	64.36	49	3.9796	12	0.861	0.546		12	1.183	0.796		12	1.383	0.928		12	1.383	0.928	
2-1-2Al1	2-1-2A	2-1-2	64.2	62.25	32.81	5.9436	12	1.014	0.447		12	1.3	0.652		12	1.455	0.759		12	1.455	0.759	
2-1-2l1	2-1-2	2-1-1	62.12	60.16	465.18	0.4213	18	0.54	0.569		18	0.694	0.83		18	0.785	0.967		18	0.785	0.967	
2-1-1l1	2-1-1	5-1-12	56.78	52.47	401	1.0748	12	1.753	1.05	NO	15	1.208	0.845		15	1.281	0.985		15	1.281	0.985	
1-2-8l1	1-2-8	1-2-7	226.12	204.5	303.65	7.12	8	0.591	0.182		8	0.591	0.182		8	0.591	0.182		8	0.591	0.182	
1-2-7l1	1-2-7	1-2-6	204.5	181.39	354.81	6.5133	8	0.64	0.19		8	0.64	0.19		8	0.64	0.19		8	0.64	0.19	
1-2-6l1	1-2-6	1-2-5	181.34	175.5	175.43	3.329	8	0.83	0.266		8	0.83	0.266		8	0.83	0.266		8	0.83	0.266	
1-2-5l1	1-2-5	1-2-4	175.45	170	80.81	6.7442	8	0.968	0.408		8	0.968	0.408		8	0.968	0.408		8	0.968	0.408	
1-2-4l1	1-2-4	1-2-3	170	166.39	68.18	5.2948	8	0.774	0.46		8	0.774	0.46		8	0.774	0.46		8	0.774	0.46	
1-2-3l1	1-2-3	1-2-2	166.24	160	130.65	4.7761	8	1.07	0.484		8	1.06	0.484		8	1.05	0.484		8	1.049	0.484	
1-2-2l1	1-2-2	1-2-1	160	155.3	117.35	4.0051	8	1.303	0.529		8	1.104	0.529		8	0.884	0.529		8	0.858	0.529	
1-2-1l1	1-2-1	1-1-2	155.2	147.33	152.69	5.1542	8	9.364	0.466		8	7.478	0.466		8	3.154	0.466		8	2.339	0.466	
5-1-25l1	5-1-25	5-1-24	179.15	175.8	170.03	1.9702	8	0.01	0		8	0.01	0		8	0.01	0		8	0.01	0	
5-1-24l1	5-1-24	5-1-23	175.8	158.25	97.27	18.0426	8	0.011	0		8	0.011	0		8	0.011	0		8	0.011	0	

TABLE F-4
2025 Gravity Model Iterations

5-1-23I1	5-1-23	5-1-22	158.25	146.53	112.21	10.4447	8	0.391	0		8	0.391	0		8	0.391	0	8	0.391	0
5-1-22I1	5-1-22	5-1-21	146.53	135	271.78	4.2424	8	0.405	0.084		8	0.405	0.084		8	0.405	0.084	8	0.405	0.084
5-1-21I1	5-1-21	5-1-20	135	125	272.09	3.6753	8	0.381	0.09		8	0.381	0.09		8	0.381	0.09	8	0.381	0.09
5-1-20I1	5-1-20	5-1-19	125	112.43	268.1	4.6885	8	0.225	0.08		8	0.225	0.08		8	0.225	0.08	8	0.225	0.08
5-1-19I1	5-1-19	5-1-18	112.33	100	246.71	4.9978	8	0.405	0.077		8	0.405	0.077		8	0.405	0.077	8	0.405	0.077
5-1-18I1	5-1-18	5-1-17	100	90	271.63	3.6815	8	0.402	0.09		8	0.402	0.09		8	0.402	0.09	8	0.402	0.09
5-1-17I1	5-1-17	5-1-16	90	79.7	272.88	3.7746	8	0.268	0.089		8	0.268	0.089		8	0.268	0.089	8	0.268	0.089
5-1-16I1	5-1-16	5-1-15	79.6	71	267.08	3.22	8	0.415	0.096		8	0.415	0.096		8	0.415	0.096	8	0.415	0.096
5-1-15I1	5-1-15	5-1-14	71	66.21	143.92	3.3282	8	0.236	0.094		8	0.236	0.094		8	0.236	0.094	8	0.236	0.094
5-1-14I1	5-1-14	5-1-13	66.11	60.5	122.75	4.5703	8	0.431	0.081		8	0.431	0.081		8	0.431	0.081	8	0.431	0.081
5-1-13I1	5-1-13	5-1-12	60.5	52.47	280.67	2.861	8	1.971	0.102		8	2.264	0.102		8	2.402	0.102	8	2.402	0.102
5-1-12I1	5-1-12	5-1-11	52.47	43.93	272	3.1397	21	0.951	0.298		21	1.104	0.383		21	1.181	0.425	21	1.181	0.425
5-1-11I1	5-1-11	5-1-10	43.93	40.07	274.19	1.4078	21	0.65	0.455		21	0.763	0.582		21	0.851	0.644	21	0.851	0.644
5-1-10I1	5-1-10	5-1-9	39.62	37.5	245.69	0.8629	24	0.85	0.407		24	1.167	0.521		24	0.908	0.576	24	0.908	0.576
5-1-9I1	5-1-9	5-1-8	37.5	36.52	551.39	0.1777	24	0.794	0.896		24	1.061	1.147	NO	30	0.761	0.7	30	0.761	0.7
5-1-8I1	5-1-8	5-1-7	36.52	35	130.28	1.1667	24	0.859	0.35		24	0.976	0.448		24	1.042	0.496	24	1.042	0.496
5-1-7I1	5-1-7	5-1-6	35	33	226.78	0.8819	21	0.766	0.574		21	0.974	0.735		21	0.975	0.814	21	0.975	0.814
5-1-6I1	5-1-6	5-1-5	33	28	121.91	4.1014	21	1.15	0.266		21	1.889	0.341		21	1.569	0.377	21	1.569	0.377
5-1-5I1	5-1-5	5-1-4	28	26.22	240	0.7417	21	1.477	0.626		21	1.857	0.802		21	1.299	0.887	21	1.299	0.887
5-1-4I1	5-1-4	5-1-3	26.22	25.93	289.28	0.1002	21	1.342	1.704	NO	24	1.512	1.527	NO	30	0.883	0.932	30	0.883	0.932
5-1-3I1	5-1-3	5-1-2	25.93	24.9	240	0.4292	21	1.06	0.824		21	1.284	1.054	NO	24	1.141	0.817	24	1.141	0.817
5-1-2I1	5-1-2	5-1-1	24.9	24.41	34	1.4412	24	1.042	0.315		24	1.125	0.403		24	1.166	0.446	24	1.166	0.446
5-1-1I1	5-1-1	Main_LS	24.41	22	142	1.6972	24	0.521	0.536		24	0.563	0.607		24	0.583	0.643	24	0.583	0.643
9-1-5I1	9-1-5	9-1-4	33.75	32.91	226.74	0.3705	8	0.361	0.277		8	0.361	0.277		8	0.361	0.277	8	0.361	0.277
9-1-4I1	9-1-4	9-1-3	26.95	25.22	436.41	0.3964	8	0.575	0.268		8	0.575	0.268		8	0.575	0.268	8	0.575	0.268
9-1-3I1	9-1-3	9-1-2	25.22	24.95	337.85	0.0799	8	0.54	0.597		8	0.54	0.597		8	0.54	0.597	8	0.54	0.597
9-1-2I1	9-1-2	9-1-1	23.85	23.61	65.8	0.3647	8	0.377	0.32		8	0.377	0.32		8	0.377	0.32	8	0.377	0.32
9-1-1I1	9-1-1	One Stp LS	23.51	22.5	32.81	3.0785	12	0.124	0.033		12	0.124	0.033		12	0.124	0.033	12	0.124	0.033
4-2A-2I1	4-2A-2	4-2A-Q	213.76	209	281.8	1.6891	8	0.347	0.08		8	0.347	0.08		8	0.347	0.08	8	0.347	0.08
4-2A-QI1	4-2A-Q	4-2A-1	209	206	115	2.6087	8	0.398	0.064		8	0.398	0.064		8	0.398	0.064	8	0.398	0.064
4-2A-1I1	4-2A-1	4-2-3	206	200.12	462.56	1.2712	8	0.363	0.092		8	0.363	0.092		8	0.363	0.092	8	0.363	0.092
4-2-3I1	4-2-3	4-2-2	200.12	198.99	374.83	0.3015	8	0.295	0.189		8	0.295	0.189		8	0.295	0.189	8	0.295	0.189
4-2-2I1	4-2-2	4-2-1	198.89	190.96	358.22	2.2137	8	0.417	0.07		8	0.417	0.07		8	0.417	0.07	8	0.417	0.07
4-2-1I1	4-2-1	4-1-2	190.96	190.15	256.41	0.3159	8	1.12	0.185		8	1.12	0.185		8	1.12	0.185	8	1.12	0.185
4-8-2I1	4-8-2	4-8-1	203.25	201.98	172.2	0.7375	10	0.008	0		10	0.008	0		10	0.008	0	10	0.008	0
4-8-1I1	**4-8-1**	4-1-8	201.98	200.95	441.72	0.2332	10	0.582	0.001		10	0.582	0.001		10	0.582	0.001	10	0.582	0.001
4-1-8I1	4-1-8	4-1-7	200.95	199.6	468.84	0.2879	10	0.801	0.443		10	0.801	0.443		10	0.801	0.443	10	0.801	0.443
4-1-7I1	4-1-7	4-1-6	199.6	199.3	88.8	0.3378	12	0.713	0.468		12	0.713	0.468		12	0.713	0.468	12	0.713	0.468
4-1-6I1	4-1-6	4-1-5	199.3	199	70.52	0.4254	12	0.634	0.417		12	0.634	0.417		12	0.634	0.417	12	0.634	0.417
4-1-5I1	4-1-5	4-1-4	199	198.2	289.47	0.2764	12	0.868	0.517		12	0.868	0.517		12	0.868	0.517	12	0.868	0.517
4-1-4I1	4-1-4	4-1-3	198.2	197.37	315.9	0.2627	12	0.736	0.741		12	0.736	0.741		12	0.736	0.741	12	0.736	0.741
4-1-3I1	4-1-3	4-1-2	197.37	190.15	418.58	1.7249	12	0.747	0.289		12	0.747	0.289		12	0.747	0.289	12	0.747	0.289
4-1-2I1	4-1-2	4-1-1	190.15	189.6	246.78	0.2229	15	0.582	0.484		15	0.582	0.484		15	0.582	0.484	15	0.582	0.484
4-1-1I1	4-1-1	3-2-6	189.6	189.02	158.24	0.3665	15	0.63	0.378		15	0.63	0.378		15	0.63	0.378	15	0.63	0.378
3-2-6I1	3-2-6	3-2-5	189.02	188.29	224.99	0.3245	15	0.634	0.402		15	0.634	0.402		15	0.634	0.402	15	0.634	0.402
3-2-5I1	3-2-5	3-2-4	188.29	188.06	122.43	0.1879	15	0.582	0.528		15	0.582	0.528		15	0.582	0.528	15	0.582	0.528
3-2-4I1	3-2-4	3-2-3	188.06	184	261.61	1.5519	15	0.581	0.184		15	0.581	0.184		15	0.581	0.184	15	0.581	0.184
3-2-3I1	3-2-3	3-2-2	184	181.71	123.56	1.8534	15	0.601	0.168		15	0.601	0.168		15	0.601	0.168	15	0.601	0.168
3-2-2I1	3-2-2	3-2-1	181.71	175.84	342.51	1.7138	15	0.364	0.196		15	0.364	0.196		15	0.364	0.196	15	0.364	0.196
3-2-1I1	3-2-1	3-1-1	175.59	168.9	304.81	2.1948	15	0.493	0.173		15	0.527	0.173		15	0.54	0.173	15	0.54	0.173
6-7-9I1	6-7-9	6-1-17	158.05	149.01	334.17	2.7052	8	0.007	0		8	0.007	0		8	0.007	0	8	0.007	0
6-1-17I1	6-1-17	6-1-16	149.01	141.48	280.07	2.6886	8	0.008	0		8	0.008	0		8	0.008	0	8	0.008	0

TABLE F-4
2025 Gravity Model Iterations

6-1-16l1	6-1-16	6-1-15	141.48	135.98	144.02	3.8189	8	0.009	0		8	0.009	0	8	0.009	0	8	0.009	0
6-1-15l1	6-1-15	6-1-14	135.98	133.05	301.36	0.9723	8	0.007	0		8	0.007	0	8	0.007	0	8	0.007	0
6-1-14l1	6-1-14	6-1-13	132.83	131.59	95.32	1.3009	12	0.01	0		12	0.01	0	12	0.01	0	12	0.01	0
6-1-13l1	6-1-13	6-1-13B	131.59	127.94	32.81	11.1252	12	1.113	0		12	1.113	0	12	1.113	0	12	1.113	0
6-1-13Bl1	6-1-13B	6-1-12	127.94	115.03	136.35	9.4683	15	1.074	0.396		15	1.074	0.396	15	1.074	0.396	15	1.074	0.396
6-1-12l1	6-1-12	6-1-11	115.03	95	256.6	7.8059	12	1.25	0.791		12	1.25	0.791	12	1.25	0.791	12	1.25	0.791
6-1-11l1	6-1-11	6-1-10	95	71.35	247.14	9.5695	12	1.302	0.715		12	1.301	0.715	12	1.301	0.715	12	1.301	0.715
6-1-10l1	6-1-10	6-1-9	71.35	59.76	284.88	4.0684	18	1.616	0.388		18	1.447	0.388	18	1.447	0.388	18	1.447	0.388
6-1-9l1	6-1-9	6-1-8	59.76	57.85	276.65	0.6904	18	1.287	0.943		18	1.081	0.943	18	1.081	0.943	18	1.081	0.943
6-1-8l1	6-1-8	6-1-7	57.85	52.04	269.02	2.1597	18	3.229	0.533		18	2.112	0.533	18	2.112	0.533	18	2.112	0.533
6-1-7l1	6-1-7	6-1-6	52.04	49.84	256.12	0.859	18	3.167	0.845		18	2.043	0.845	18	2.043	0.845	18	2.043	0.845
6-1-6l1	6-1-6	6-1-5	49.84	47.68	279.68	0.7723	18	2.591	0.993		18	1.461	0.992	18	1.461	0.992	18	1.461	0.992
6-1-5l1	6-1-5	6-1-4	47.68	45.48	278.91	0.7888	18	1.959	1.004	NO	21	1.667	0.665	21	1.667	0.665	21	1.667	0.665
6-1-4l1	6-1-4	6-1-3	45.48	43.32	265.09	0.8148	18	1.616	0.988		18	1.615	0.987	18	1.615	0.987	18	1.615	0.987
6-1-3l1	6-1-3	6-1-2	43.32	41.16	268.64	0.8041	18	0.808	0.994		18	0.807	0.993	18	0.807	0.993	18	0.807	0.993
6-1-2l1	6-1-2	6-1-1	37.5	35.44	251.4	0.8194	18	1.276	0.985		18	1.276	0.984	18	1.276	0.984	18	1.276	0.984
6-1-1l1	6-1-1	5-2-3	35.44	32.47	265.6	1.1182	21	0.9	0.559		21	0.902	0.558	21	0.903	0.558	21	0.903	0.558
5-2-3l1	5-2-3	5-2-2	32.47	29.6	75.16	3.8185	18	1.086	0.456		18	1.098	0.456	18	1.105	0.456	18	1.105	0.456
5-2-2l1	5-2-2	5-2-1	29.5	27.1	79.87	3.0049	18	1.116	0.514		18	1.156	0.514	18	1.178	0.514	18	1.178	0.514
5-2-1l1	5-2-1	5-1-1	27	24.41	75.8	3.4169	18	1.39	0.482		18	1.5	0.482	18	1.554	0.482	18	1.554	0.482
6-7-8l1	6-7-8	6-7-7	129.5	120.8	267.66	3.2504	8	0.457	0.162		8	0.457	0.162	8	0.457	0.162	8	0.457	0.162
6-7-7l1	6-7-7	6-7-6	120.8	100	319	6.5204	8	0.546	0.115		8	0.546	0.115	8	0.546	0.115	8	0.546	0.115
6-7-6l1	6-7-6	6-7-5	100	90.21	303.36	3.2272	8	0.604	0.163		8	0.604	0.163	8	0.604	0.163	8	0.604	0.163
6-7-5l1	6-7-5	6-7-4	90.21	82.72	344.71	2.1728	8	0.529	0.198		8	0.529	0.198	8	0.529	0.198	8	0.529	0.198
6-7-4l1	6-7-4	6-7-3	82.72	80.3	103.15	2.3461	12	0.392	0.065		12	0.392	0.065	12	0.392	0.065	12	0.392	0.065
6-7-3l1	6-7-3	6-7-2	80.3	77.76	267.1	0.951	12	0.389	0.102		12	0.389	0.102	12	0.389	0.102	12	0.389	0.102
6-7-2l1	6-7-2	6-7-1	77.76	73.87	417.65	0.9314	12	0.38	0.103		12	0.38	0.103	12	0.38	0.103	12	0.38	0.103
6-7-1l1	6-7-1	6-1-10	73.87	71.35	189.34	1.3309	12	1.302	0.086		12	1.301	0.086	12	1.301	0.086	12	1.301	0.086
6-5-2l1	6-5-2	6-5-1	59.47	58.27	380.57	0.3153	8	0.007	0		8	0.007	0	8	0.007	0	8	0.007	0
6-5-1l1	6-5-1	6-1-6	58.27	49.84	421.07	2.002	8	7.125	0.016		8	4.596	0.009	8	4.596	0.009	8	4.596	0.009
3-1-39l1	3-1-39	3-1-38	548.87	530	167.36	11.2751	8	0.321	0.223		8	0.321	0.223	8	0.321	0.223	8	0.321	0.223
3-1-38l1	3-1-38	3-1-37	527.99	521	215.05	3.2504	8	0.61	0.415		8	0.61	0.415	8	0.61	0.415	8	0.61	0.415
3-1-37l1	3-1-37	Crown LS	521	519	32.81	6.096	12	0.203	0.091		12	0.203	0.091	12	0.203	0.091	12	0.203	0.091
3-16-6l1	3-16-6	3-16-4	625.42	594.25	396.42	7.8629	8	0.626	0.23		8	0.626	0.23	8	0.626	0.23	8	0.626	0.23
3-16-4l1	3-16-4	3-16-3	594.25	581	141.91	9.3369	8	0.687	0.211		8	0.687	0.211	8	0.687	0.211	8	0.687	0.211
3-16-3l1	3-16-3	3-16-2	581	563.08	277.87	6.449	8	0.777	0.254		8	0.777	0.254	8	0.777	0.254	8	0.777	0.254
3-16-2l1	3-16-2	3-16-1	563.08	554.01	222.76	4.0716	8	0.848	0.319		8	0.807	0.319	8	0.807	0.319	8	0.807	0.319
3-16-1l1	3-16-1	3-1-27	554.01	543.48	297.16	3.5435	8	8.766	0.355		8	1.197	0.342	8	1.197	0.342	8	1.197	0.342
3-19A-1l1	3-19A-1	3-19B-1	690.67	685	467.84	1.212	8	0.392	0.089		8	0.392	0.089	8	0.392	0.089	8	0.392	0.089
3-19B-1l1	3-19B-1	3-19-6	685	678.77	467.84	1.3317	8	0.197	0.085		8	0.197	0.085	8	0.197	0.085	8	0.197	0.085
3-19-6l1	3-19-6	3-19-5	678.57	675.28	361.39	0.9104	8	0.217	0.103		8	0.217	0.103	8	0.217	0.103	8	0.217	0.103
3-19-5l1	3-19-5	3-19-4	675.16	671.11	334.48	1.2108	8	0.378	0.09		8	0.378	0.09	8	0.378	0.09	8	0.378	0.09
3-19-4l1	3-19-4	3-19-3	671.11	667.05	255.81	1.5871	8	0.277	0.078		8	0.277	0.078	8	0.277	0.078	8	0.277	0.078
3-19-3l1	3-19-3	3-19-2	667.05	664	51.5	5.9223	8	0.293	0.04		8	0.293	0.04	8	0.293	0.04	8	0.293	0.04
3-19-2l1	3-19-2	3-19-1	664	645.19	415.02	4.5323	8	0.146	0.046		8	0.146	0.046	8	0.146	0.046	8	0.146	0.046
3-19-1l1	3-19-1	3-1-36	645.09	627.12	269.24	6.6743	8	0.872	0.038		8	0.872	0.038	8	0.872	0.038	8	0.872	0.038
3-1-36l1	3-1-36	3-1-35	627.12	620.08	150.2	4.6871	8	0.596	0.391		8	0.596	0.391	8	0.596	0.391	8	0.596	0.391
3-1-35l1	3-1-35	3-1-34	619.88	605.44	345.62	4.178	8	0.515	0.414		8	0.515	0.414	8	0.515	0.414	8	0.515	0.414
3-1-34l1	3-1-34	3-1-33	605.24	589.5	267	5.8951	8	0.882	0.348		8	0.882	0.348	8	0.882	0.348	8	0.882	0.348
3-1-33l1	3-1-33	3-1-32	589.5	573.8	354.48	4.429	8	0.441	0.402		8	0.441	0.402	8	0.441	0.402	8	0.441	0.402
3-1-32l1	3-1-32	3-1-31	572.42	561.9	126.18	8.3373	8	1.184	0.326		8	1.184	0.326	8	1.184	0.326	8	1.184	0.326

TABLE F-4
2025 Gravity Model Iterations

3-1-31I1	3-1-31	3-1-30	561.9	558.52	154.4	2.1891	8	0.934	0.636		8	0.931	0.636		8	0.931	0.636		8	0.931	0.636
3-1-30I1	3-1-30	3-1-29	558.52	554.39	83.71	4.9337	8	1.051	0.424		8	0.978	0.424		8	0.978	0.424		8	0.978	0.424
3-1-29I1	3-1-29	3-1-28	554.39	548.82	116.48	4.7819	8	2.708	0.468		8	0.958	0.468		8	0.958	0.468		8	0.958	0.468
3-1-28I1	3-1-28	3-1-27	548.82	543.48	100.57	5.3097	8	8.766	0.443		8	1.197	0.444		8	1.197	0.444		8	1.197	0.444
3-1-27I1	3-1-27	3-1-26	543.48	533.98	143.24	6.6322	8	16.126	0.646		8	1.525	0.647		8	1.525	0.647		8	1.525	0.647
3-1-26I1	3-1-26	3-1-25	533.98	530.74	150.68	2.1503	8	15.42	1.087	NO	10	1.284	0.627		10	1.284	0.627		10	1.284	0.627
3-1-25I1	3-1-25	3-1-24	530.74	527.7	296.49	1.0253	8	13.868	1.574	NO	10	1.115	0.908		10	1.115	0.908		10	1.115	0.908
3-1-24I1	3-1-24	3-1-23	527.7	517.67	297	3.3771	8	6.173	1.025	NO	10	1.193	0.598		10	1.193	0.598		10	1.193	0.598
3-1-23I1	3-1-23	3-1-22	517.67	510.51	263.25	2.7198	8	4.164	1.142	NO	10	0.747	0.666		10	0.747	0.666		10	0.747	0.666
3-1-22I1	3-1-22	3-1-21	510.29	488.8	285.69	7.5221	8	1.507	0.687		8	1.586	0.726		8	1.586	0.726		8	1.586	0.726
3-1-21I1	3-1-21	3-1-20B	488.8	480.5	191.92	4.3247	8	1.058	0.906		8	1.095	0.958		8	1.095	0.958		8	1.095	0.958
3-1-20BI1	3-1-20B	3-1-20	480.5	464	137.81	11.973	8	1.04	0.544		8	1.076	0.576		8	1.076	0.576		8	1.076	0.576
3-1-20I1	3-1-20	3-1-19	464	451	101.75	12.7764	8	1.041	0.527		8	1.077	0.557		8	1.077	0.557		8	1.077	0.557
3-1-19I1	3-1-19	3-1-18	451	422	234.31	12.3768	8	1.454	0.536		8	1.544	0.566		8	1.511	0.566		8	1.511	0.566
3-1-18I1	3-1-18	3-1-17	422	413.73	117.92	7.0132	8	0.727	0.879		8	1.37	0.92		8	0.755	0.92		8	0.755	0.92
3-1-17I1	3-1-17	3-1-16	412.3	395.63	285.81	5.8325	8	1.321	0.964		8	1.757	1.008	NO	10	1.093	0.556		10	1.093	0.556
3-1-16I1	3-1-16	3-1-15	395.63	371	272.7	9.0319	8	0.661	0.774		8	0.683	0.81		8	0.683	0.811		8	0.683	0.811
3-1-15I1	3-1-15	3-1-14	370	361	109.1	8.2493	8	1.16	0.81		8	1.194	0.848		8	1.193	0.848		8	1.193	0.848
3-1-14I1	3-1-14	3-1-13	361	324.63	246.6	14.7486	8	1.601	0.638		8	6.404	0.666		8	1.342	0.666		8	1.342	0.666
3-1-13I1	3-1-13	3-1-12	324.63	304.37	323	6.2724	8	1.435	0.978		8	4.092	1.02	NO	10	1.011	0.563		10	1.011	0.563
3-1-12I1	3-1-12	3-1-11	304.27	282	244.65	9.1028	8	11.687	0.812		8	11.361	0.845		8	1.609	0.848		8	1.595	0.848
3-1-11I1	3-1-11	3-1-10	282	262.19	287.26	6.8962	8	15.494	0.912		8	12.365	0.952		8	1.847	0.974		8	1.493	0.974
3-1-10I1	3-1-10	3-1-9	261.79	259.99	230.46	0.781	8	13.886	2.284	NO	10	9.105	1.64	NO	12	1	1.041	NO	15	0.68	0.574
3-1-9I1	3-1-9	3-1-8	259.89	255.71	35.63	11.7317	8	5.376	0.589		8	7.072	0.767		8	1.616	0.792		8	1.616	0.792
3-1-8I1	3-1-8	3-1-7	255.71	247.51	206.38	3.9733	8	3.915	1.012	NO	10	9.609	0.727		10	0.646	0.751		10	0.646	0.751
3-1-7I1	3-1-7	3-1-6	246.66	231.4	242.11	6.3029	8	10.654	0.804		8	9.958	1.008	NO	10	1.436	0.596		10	1.436	0.596
3-1-6I1	3-1-6	3-1-5	231.4	226.54	256.56	1.8943	8	9.366	1.466	NO	10	7.005	1.014	NO	12	0.633	0.669		12	0.633	0.669
3-1-5I1	3-1-5	3-1-4	226.24	210	262.89	6.1775	8	1.393	0.812		8	6.496	1.018	NO	10	1.137	0.602		10	1.137	0.602
3-1-4I1	3-1-4	3-1-3	210	194.73	259.92	5.8749	8	1.093	0.832		8	3.331	1.044	NO	10	1.129	0.617		10	1.129	0.617
3-1-3I1	3-1-3	3-1-2	194.63	173.42	262.16	8.0905	8	0.627	0.709		8	0.816	0.889		8	0.886	0.954		8	0.886	0.954
3-1-2I1	3-1-2	3-1-1	172.82	169.05	276.02	1.3658	15	0.407	0.348		15	0.458	0.429		15	0.476	0.46		15	0.476	0.46
3-1-1I1	3-1-1	5-8-1	168.9	83.11	442.05	19.4073	18	0.214	0.093		18	0.245	0.106		18	0.257	0.111		18	0.257	0.111
5-8-1I1	5-8-1	5-1-12	82.76	52.47	259.11	11.69	21	0.751	0.079		21	0.863	0.09		21	0.915	0.095		21	0.915	0.095
7-3-5I1	7-3-5	7-3-4	71.5	64.31	121.17	5.9338	8	0.104	0.023		8	0.104	0.023		8	0.104	0.023		8	0.104	0.023
7-3-4I1	7-3-4	7-3-3	64.26	41.81	193.99	11.5728	8	0.214	0.016		8	0.214	0.016		8	0.214	0.016		8	0.214	0.016
7-3-3I1	7-3-3	7-3-2	41.76	39.51	150.63	1.4937	8	0.145	0.045		8	0.145	0.045		8	0.145	0.045		8	0.145	0.045
7-3-2I1	7-3-2	7-3-1	39.46	26.94	118.27	10.5859	8	0.141	0.017		8	0.141	0.017		8	0.141	0.017		8	0.141	0.017
7-3-1I1	7-3-1	7-1-1	26.89	16.91	190.47	5.2397	8	0.737	0.024		8	0.737	0.024		8	0.737	0.024		8	0.737	0.024
7-1-6I1	7-1-6	7-1-5	23.7	22.21	286.97	0.5192	8	1.231	0.89		8	0.901	0.89		8	0.901	0.89		8	0.901	0.89
7-1-5I1	7-1-5	7-1-4	22.21	21.45	213.44	0.3561	8	1.078	1.075	NO	10	0.722	0.593		10	0.722	0.593		10	0.722	0.593
7-1-4I1	7-1-4	7-1-3	21.45	19.75	57.12	2.9762	8	0.997	0.372		8	0.997	0.372		8	0.997	0.372		8	0.997	0.372
7-1-3I1	7-1-3	7-1-2	19.75	17.5	455.94	0.4935	8	1.052	0.913		8	0.895	0.913		8	0.895	0.913		8	0.895	0.913
7-1-2I1	7-1-2	7-1-1	17.5	16.86	163.94	0.3904	8	0.862	1.026	NO	10	0.65	0.566		10	0.65	0.566		10	0.65	0.566
7-1-1I1	7-1-1	L C LS	16.86	9.62	328.36	2.2049	10	0.325	0.228		10	0.325	0.228		10	0.325	0.228		10	0.325	0.228
7-2-1I1	7-2-1	L C LS	12	9.62	101	2.3564	12	0.09	0.017		12	0.09	0.017		12	0.09	0.017		12	0.09	0.017
8-1-9I1	8-1-9	8-1-8	30.84	29.83	441.23	0.2289	10	0.37	0.223		10	0.37	0.223		10	0.37	0.223		10	0.37	0.223
8-1-8I1	8-1-8	8-1-7	29.83	28.67	335.14	0.3461	10	0.371	0.181		10	0.371	0.181		10	0.371	0.181		10	0.371	0.181
8-1-7I1	8-1-7	8-1-6	28.67	27.14	281.54	0.5434	10	0.38	0.145		10	0.38	0.145		10	0.38	0.145		10	0.38	0.145
8-1-6I1	8-1-6	8-1-5	27.14	25.16	266.48	0.743	10	0.548	0.124		10	0.548	0.124		10	0.548	0.124		10	0.548	0.124
8-1-5I1	8-1-5	8-1-4	25.16	24.22	272.21	0.3453	12	0.474	0.261		12	0.474	0.261		12	0.474	0.261		12	0.474	0.261
8-1-4I1	8-1-4	8-1-3	24.22	21.83	304.05	0.7861	12	0.462	0.173		12	0.462	0.173		12	0.462	0.173		12	0.462	0.173
8-1-3I1	8-1-3	8-1-2	21.83	21.07	310.28	0.2449	12	0.496	0.309		12	0.496	0.309		12	0.496	0.309		12	0.496	0.309

TABLE F-4
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8-1-2I1	8-1-2	8-1-1	21.07	20.95	41.2	0.2913	12	0.341	0.284		12	0.341	0.284	12	0.341	0.284	12	0.341	0.284
8-1-1I1	8-1-1	Oaks LS	20.7	17	250	1.48	12	0.225	0.111		12	0.225	0.111	12	0.225	0.111	12	0.225	0.111
10-1-23I1	10-1-23	10-1-24	586.24	582.57	246.52	1.4887	8	0.433	0.101		8	0.433	0.101	8	0.433	0.101	8	0.433	0.101
10-1-24I1	10-1-24	10-1-25	582.57	578.65	271.62	1.4432	8	0.216	0.103		8	0.216	0.103	8	0.216	0.103	8	0.216	0.103
10-1-25I1	10-1-25	10-1-26	578.46	573.76	73.84	6.3651	8	0.15	0.049		8	0.15	0.049	8	0.15	0.049	8	0.15	0.049
10-1-26I1	10-1-26	10-10B-1	573.52	565	71.95	11.8416	8	0.13	0.036		8	0.13	0.036	8	0.13	0.036	8	0.13	0.036
10-1-20I1	10-1-20	10-1-19	560.33	558.74	222.19	0.7156	10	0.266	0.081		10	0.266	0.081	10	0.266	0.081	10	0.266	0.081
10-1-19I1	10-1-19	10-1-18	558.7	557.34	180	0.7556	10	0.192	0.069		10	0.192	0.069	10	0.192	0.069	10	0.192	0.069
10-11-8I1	10-1-18	10-1-17	529.03	512.56	172.89	9.5263	8	0.789	0.266		8	0.789	0.266	8	0.789	0.266	8	0.789	0.266
10-11-7I1	10-1-17	10-1-16	512.51	504.76	172.89	4.4826	8	0.432	0.387		8	0.432	0.387	8	0.432	0.387	8	0.432	0.387
10-11-6I1	10-1-16	10-1-15	504.29	496.36	122.58	6.4692	8	0.774	0.322		8	0.774	0.322	8	0.774	0.322	8	0.774	0.322
10-11-5I1	10-1-15	10-1-14	496.36	489.35	99.68	7.0325	8	0.906	0.309		8	0.906	0.309	8	0.906	0.309	8	0.906	0.309
10-11-4I1	10-1-14	10-1-13	489.35	486.23	79.73	3.9132	8	0.609	0.414		8	0.609	0.414	8	0.609	0.414	8	0.609	0.414
10-11-3I1	10-1-13	10-1-12	485.94	481.23	202.93	2.321	8	0.522	0.538		8	0.522	0.538	8	0.522	0.538	8	0.522	0.538
10-11-2I1	10-1-12	10-1-11	480.56	456.89	276.46	8.5618	8	0.362	0.28		8	0.362	0.28	8	0.362	0.28	8	0.362	0.28
10-11-1I1	10-1-11	10-1-10	456.17	437.78	149.06	12.3373	8	0.329	0.233		8	0.329	0.233	8	0.329	0.233	8	0.329	0.233
10-6-4I1	10-6-4	10-6-3	475.28	471.48	200.3	1.8972	8	0.682	0.482		8	0.682	0.482	8	0.682	0.482	8	0.682	0.482
10-6-3I1	10-6-3	10-6-2	471.48	445.39	371.61	7.0208	8	0.667	0.251		8	0.667	0.251	8	0.667	0.251	8	0.667	0.251
10-6-2I1	10-6-2	10-6-1	445.39	424.43	273.95	7.651	8	0.859	0.24		8	0.859	0.24	8	0.859	0.24	8	0.859	0.24
10-6-1I1	10-6-1	10-1A-12	424.43	417.32	238.32	2.9834	8	0.43	0.384		8	0.43	0.384	8	0.43	0.384	8	0.43	0.384
10-1A-12I1	10-1A-12	10-1-12	417.18	411.61	32.81	16.9774	8	0.271	0.161		8	0.271	0.161	8	0.271	0.161	8	0.271	0.161
10-10-12I1	10-10-12	10-10-11	729.37	719.72	316.82	3.0459	8	0.756	0.3		8	0.756	0.3	8	0.756	0.3	8	0.756	0.3
10-10-11I1	10-10-11	10-10-10	719.72	713.46	209.66	2.9858	8	0.396	0.303		8	0.396	0.303	8	0.396	0.303	8	0.396	0.303
10-10-10I1	10-10-10	10-10-9	713.35	700	141.84	9.412	8	0.537	0.171		8	0.537	0.171	8	0.537	0.171	8	0.537	0.171
10-10-9I1	10-10-9	10-10-9A	700	690.71	83	11.1928	8	0.518	0.157		8	0.518	0.157	8	0.518	0.157	8	0.518	0.157
10-10-9AI1	10-10-9A	10-10-8	690.71	673.37	136.92	12.6643	8	0.259	0.147		8	0.259	0.147	8	0.259	0.147	8	0.259	0.147
10-10-8I1	10-10-8	10-10-7	672.92	665.34	144.41	5.2489	8	0.325	0.229		8	0.325	0.229	8	0.325	0.229	8	0.325	0.229
10-10-7I1	10-10-7	10-10-6	664.94	650.23	168.4	8.7352	8	0.285	0.177		8	0.285	0.177	8	0.285	0.177	8	0.285	0.177
10-10-6I1	10-10-6	10-10-5	649.67	645.94	62.14	6.0026	8	0.314	0.214		8	0.314	0.214	8	0.314	0.214	8	0.314	0.214
10-10-5I1	10-10-5	10-10-4	645.64	617	347.43	8.2434	8	0.289	0.183		8	0.289	0.183	8	0.289	0.183	8	0.289	0.183
10-10-4I1	10-10-4	10-10-3	615.26	611.74	127.96	2.7509	8	0.386	0.316		8	0.386	0.316	8	0.386	0.316	8	0.386	0.316
10-10-3I1	10-10-3	10-10-2	611.07	595	101.85	15.7781	8	0.449	0.132		8	0.449	0.132	8	0.449	0.132	8	0.449	0.132
10-10-2I1	10-10-2	10-10-1	595	579.91	67.04	22.5089	8	0.224	0.11		8	0.224	0.11	8	0.224	0.11	8	0.224	0.11
10-10-1I1	10-10-1	10-10B-1	579.48	552.57	204.62	13.1512	8	0.257	0.145		8	0.257	0.145	8	0.257	0.145	8	0.257	0.145
10-10B-1I1	10-10B-1	10-11-8	552.32	529.58	113.51	20.0335	8	0.29	0.183		8	0.29	0.183	8	0.29	0.183	8	0.29	0.183
10-1-18I1	10-11-8	10-11-7	557.34	528.08	178.24	16.4161	8	0.12	0.031		8	0.12	0.031	8	0.12	0.031	8	0.12	0.031
10-1-17I1	10-11-7	10-11-6	527.27	510.29	82.16	20.667	8	0.113	0.027		8	0.113	0.027	8	0.113	0.027	8	0.113	0.027
10-1-16I1	10-11-6	10-11-5	509.25	487.05	64.52	34.4079	8	0.101	0.021		8	0.101	0.021	8	0.101	0.021	8	0.101	0.021
10-1-15I1	10-11-5	10-11-4	486.88	461.89	227.99	10.961	8	0.44	0.037		8	0.44	0.037	8	0.44	0.037	8	0.44	0.037
10-1-14I1	10-11-4	10-11-3	461.89	461.44	33	1.3636	8	0.22	0.106		8	0.22	0.106	8	0.22	0.106	8	0.22	0.106
10-1-13I1	10-11-3	10-11-2	461.44	411.61	153.23	32.5197	8	0.102	0.022		8	0.102	0.022	8	0.102	0.022	8	0.102	0.022
10-1-12I1	10-11-2	10-11-1	410.71	388	158.82	14.2992	8	0.31	0.208		8	0.31	0.208	8	0.31	0.208	8	0.31	0.208
10-1-11I1	10-11-1	10-4-4	382.41	380.71	187.51	0.9066	8	0.691	0.827		8	0.691	0.827	8	0.691	0.827	8	0.691	0.827
10-4-4I1	10-4-4	10-4-3	437.47	431.39	77.5	7.8452	8	0.455	0.293		8	0.455	0.293	8	0.455	0.293	8	0.455	0.293
10-4-3I1	10-4-3	10-4-2	431.2	422.61	105.27	8.16	8	0.823	0.287		8	0.823	0.287	8	0.823	0.287	8	0.823	0.287
10-4-2I1	10-4-2	10-4-1	422.31	421.65	63.07	1.0465	8	0.677	0.801		8	0.677	0.801	8	0.677	0.801	8	0.677	0.801
10-4-1I1	10-4-1	10-1-10	421.53	377.51	189.32	23.2516	8	0.279	0.17		8	0.279	0.17	8	0.279	0.17	8	0.279	0.17
10-1-10I1	10-1-10	10-1-9	375.1	170.58	281.66	72.6124	8	2.006	0.189		8	2.006	0.189	8	2.006	0.189	8	2.006	0.189
10-1-9I1	10-1-9	10-1-8	171.3	159.26	89.57	13.442	8	0.463	0.438		8	0.463	0.438	8	0.463	0.438	8	0.463	0.438
10-1-8I1	10-1-8	10-1-7	154.04	151.99	186.15	1.1013	8	5.146	1.532	NO	10	0.813	0.845	10	0.813	0.845	10	0.813	0.845
10-1-7I1	10-1-7	10-1-6	151.69	145.35	182.68	3.4705	8	1.271	0.863		8	1.271	0.863	8	1.271	0.863	8	1.271	0.863
10-1-6I1	10-1-6	10-1-5	145.15	138.94	215.3	2.8843	8	1.044	0.946		8	1.044	0.946	8	1.044	0.946	8	1.044	0.946

TABLE F-4
2025 Gravity Model Iterations

10-1-5I1	10-1-5	S P Hill LS	138.94	137.5	32.81	4.3891	12	0.348	0.26	12	0.348	0.26	12	0.348	0.26	12	0.348	0.26
10-1-3I1	10-1-3	10-1-2	146.7	132	255.96	5.7431	8	1.437	0.841	8	1.437	0.841	8	1.437	0.841	8	1.437	0.841
10-1-2I1	10-1-2	10-1-1	132	122.59	300	3.1367	10	0.958	0.628	10	0.958	0.628	10	0.958	0.628	10	0.958	0.628
10-1-1I1	10-1-1	W C LS	122.59	121	32.81	4.8463	12	0.399	0.336	12	0.399	0.336	12	0.399	0.336	12	0.399	0.336

TABLE F-5
2025 Gravity Model Final Pipe Sizes

LinkID	Up Stream MH	Down Stream MH	Up - Invert Level	Down - Invert Level	Length	Slope %	Pipe Diameter	Qf	Hmax	Qmax (cfs)	Hmax/D	Qmax/Qf
2-3-1l1	2-3-1	2-1-6	124.49	114.84	156.08	6.1827	10	5.308	124.68	0.583	1.202	0.11
1-3-14l1	1-3-14	1-3-13	330.43	313	152.87	11.4018	8	3.975	330.43	0	0.582	0
1-3-13l1	1-3-13	1-3-12	313	289.73	262.09	8.8786	8	3.508	313.19	0.648	0.291	0.185
1-3-12l1	1-3-12	1-3-11	289.48	262	201.31	13.6506	8	4.35	289.65	0.648	0.587	0.149
1-3-11l1	1-3-11	1-3-10	262	235.54	308.84	8.5675	8	3.446	262.2	0.648	0.338	0.188
1-3-10l1	1-3-10	1-3-9	235.34	226	146.25	6.3863	8	2.975	235.55	0.648	0.67	0.218
1-3-9l1	1-3-9	1-3-8	226	217.87	157.97	5.1465	8	2.671	226.22	0.648	0.335	0.242
1-3-8l1	1-3-8	1-3-7	217.57	206	209.07	5.534	8	2.769	217.79	0.648	0.697	0.234
1-3-7l1	1-3-7	1-3-6	206	199.67	141.42	4.476	8	2.491	206.23	0.648	0.434	0.26
1-3-6l1	1-3-6	1-3-5	199.52	192	132.65	5.6691	8	2.803	199.74	0.648	0.668	0.231
1-3-5l1	1-3-5	1-3-4	192	185.33	123.75	5.3899	8	2.733	192.22	0.648	0.669	0.237
1-3-4l1	1-3-4	1-3-3	185.23	182.7	89.04	2.8414	8	1.984	185.5	0.648	0.938	0.326
1-3-3l1	1-3-3	1-3-2	182.7	179.47	214.38	1.5067	8	1.445	183.01	0.648	0.469	0.448
1-3-2l1	1-3-2	1-3-1	179.22	161.8	221.38	7.8688	8	3.302	179.42	0.648	1.055	0.196
1-3-1l1	1-3-1	1-1-10	161.9	161.33	221.38	0.2575	10	1.083	162.43	0.648	0.864	0.598
1-1-10l1	1-1-10	1-1-9	161.05	154.6	110.72	5.8255	12	8.379	161.55	3.919	1.305	0.468
1-1-9l1	1-1-9	1-1-8	154.6	153.35	111.55	1.1206	15	6.663	155.37	3.919	0.895	0.588
1-1-8l1	1-1-8	1-1-7	153.35	149.17	88.49	4.7237	12	7.545	153.91	3.919	1.634	0.519
1-1-7l1	1-1-7	1-1-6	149.17	148.49	425.2	0.1599	18	4.094	150.71	3.919	1.063	0.957
1-1-6l1	1-1-6	1-1-5	148.49	148.44	56.87	0.0879	21	4.579	149.98	3.919	0.857	0.856
1-1-5l1	1-1-5	1-1-4	148.44	147.9	463.05	0.1166	21	5.273	149.81	3.919	0.933	0.743
1-1-4l1	1-1-4	1-1-3	147.9	147.6	204.27	0.1469	18	3.923	149.44	3.919	1.024	0.999
1-1-3l1	1-1-3	1-1-2	147.6	147.33	141.95	0.1902	18	4.464	149.04	3.919	0.998	0.878
1-1-2l1	1-1-2	1-1-1	147.33	147.3	48.85	0.0614	24	5.464	148.67	5.165	0.668	0.945
1-1-1l1	1-1-1	2-1-11	147	145.77	372.51	0.3302	18	5.882	148.13	5.166	0.918	0.878
2-1-11l1	2-1-11	2-1-10	145.77	144.56	413.58	0.2926	21	8.352	146.88	5.841	0.82	0.699
2-1-10l1	2-1-10	2-1-9	144.56	144	178.13	0.3144	21	8.658	145.76	5.841	0.787	0.675
2-1-9l1	2-1-9	2-1-8	144	128.5	366.34	4.231	12	7.14	144.69	5.841	1.467	0.818
2-1-8l1	2-1-8	2-1-7B	128.5	126.5	305.36	0.655	18	8.284	129.45	5.841	0.937	0.705
2-1-7Bl1	2-1-7B	2-1-7	126.14	124.99	64.67	1.7783	15	8.394	127.02	5.841	1.006	0.696
2-1-7l1	2-1-7	2-1-6	124.85	114.84	246.23	4.0653	12	6.999	125.55	5.841	1.002	0.835
2-1-6l1	2-1-6	2-1-5	114.64	106.81	92.85	8.433	12	10.081	115.24	6.425	1.422	0.637
2-1-5l1	2-1-5	2-1-4	106.61	101.76	131	3.7023	12	6.679	107.42	6.425	1.09	0.962
2-1-4l1	2-1-4	2-1-3	101.56	73.34	461.91	6.1094	12	8.58	102.21	6.425	1.24	0.749
2-1-3l1	2-1-3	2-1-2B	73.14	66.45	246.84	2.7103	15	10.363	73.86	6.425	1.663	0.62

TABLE F-5
2025 Gravity Model Final Pipe Sizes

2-1-2BI1	2-1-2B	2-1-2A	66.31	64.36	49	3.9796	12	6.925	67.42	6.425	1.383	0.928
2-1-2AI1	2-1-2A	2-1-2	64.2	62.25	32.81	5.9436	12	8.463	64.97	6.425	1.454	0.759
2-1-2I1	2-1-2	2-1-1	62.12	60.16	465.18	0.4213	18	6.644	63.3	6.425	0.785	0.967
2-1-1I1	2-1-1	5-1-12	56.78	52.47	401	1.0748	15	6.526	58.24	6.424	1.281	0.984
1-2-8I1	1-2-8	1-2-7	226.12	204.5	303.65	7.12	8	3.141	226.31	0.572	0.591	0.182
1-2-7I1	1-2-7	1-2-6	204.5	181.39	354.81	6.5133	8	3.004	204.7	0.572	0.64	0.19
1-2-6I1	1-2-6	1-2-5	181.34	175.5	175.43	3.329	8	2.148	181.58	0.572	0.83	0.266
1-2-5I1	1-2-5	1-2-4	175.45	170	80.81	6.7442	8	3.057	175.75	1.246	0.968	0.408
1-2-4I1	1-2-4	1-2-3	170	166.39	68.18	5.2948	8	2.709	170.32	1.246	0.774	0.46
1-2-3I1	1-2-3	1-2-2	166.24	160	130.65	4.7761	8	2.573	166.57	1.246	1.049	0.484
1-2-2I1	1-2-2	1-2-1	160	155.3	117.35	4.0051	8	2.356	160.35	1.246	0.856	0.529
1-2-1I1	1-2-1	1-1-2	155.2	147.33	152.69	5.1542	8	2.673	155.54	1.246	2.246	0.466
5-1-25I1	5-1-25	5-1-24	179.15	175.8	170.03	1.9702	8	1.652	179.15	0	0.01	0
5-1-24I1	5-1-24	5-1-23	175.8	158.25	97.27	18.0426	8	5.001	175.8	0	0.011	0
5-1-23I1	5-1-23	5-1-22	158.25	146.53	112.21	10.4447	8	3.805	158.25	0	0.391	0
5-1-22I1	5-1-22	5-1-21	146.53	135	271.78	4.2424	8	2.425	146.66	0.203	0.405	0.084
5-1-21I1	5-1-21	5-1-20	135	125	272.09	3.6753	8	2.257	135.13	0.203	0.381	0.09
5-1-20I1	5-1-20	5-1-19	125	112.43	268.1	4.6885	8	2.549	125.13	0.203	0.225	0.08
5-1-19I1	5-1-19	5-1-18	112.33	100	246.71	4.9978	8	2.632	112.46	0.203	0.405	0.077
5-1-18I1	5-1-18	5-1-17	100	90	271.63	3.6815	8	2.259	100.13	0.203	0.402	0.09
5-1-17I1	5-1-17	5-1-16	90	79.7	272.88	3.7746	8	2.287	90.13	0.203	0.268	0.089
5-1-16I1	5-1-16	5-1-15	79.6	71	267.08	3.22	8	2.112	79.74	0.203	0.415	0.096
5-1-15I1	5-1-15	5-1-14	71	66.21	143.92	3.3282	8	2.148	71.14	0.203	0.236	0.094
5-1-14I1	5-1-14	5-1-13	66.11	60.5	122.75	4.5703	8	2.517	66.24	0.203	0.431	0.081
5-1-13I1	5-1-13	5-1-12	60.5	52.47	280.67	2.861	8	1.991	60.64	0.203	2.401	0.102
5-1-12I1	5-1-12	5-1-11	52.47	43.93	272	3.1397	21	27.361	53.27	11.63	1.181	0.425
5-1-11I1	5-1-11	5-1-10	43.93	40.07	274.19	1.4078	21	18.321	44.96	11.801	0.851	0.644
5-1-10I1	5-1-10	5-1-9	39.62	37.5	245.69	0.8629	24	20.48	40.83	11.801	0.908	0.576
5-1-9I1	5-1-9	5-1-8	37.5	36.52	551.39	0.1777	30	16.854	39.11	11.801	0.761	0.7
5-1-8I1	5-1-8	5-1-7	36.52	35	130.28	1.1667	24	23.814	37.79	11.801	1.042	0.496
5-1-7I1	5-1-7	5-1-6	35	33	226.78	0.8819	21	14.501	36.31	11.801	0.975	0.814
5-1-6I1	5-1-6	5-1-5	33	28	121.91	4.1014	21	31.272	33.85	11.801	1.569	0.377
5-1-5I1	5-1-5	5-1-4	28	26.22	240	0.7417	21	13.298	29.89	11.801	1.299	0.887
5-1-4I1	5-1-4	5-1-3	26.22	25.93	289.28	0.1002	30	12.657	28.39	11.801	0.883	0.932
5-1-3I1	5-1-3	5-1-2	25.93	24.9	240	0.4292	24	14.443	27.87	11.802	1.141	0.817
5-1-2I1	5-1-2	5-1-1	24.9	24.41	34	1.4412	24	26.467	26.84	11.802	1.166	0.446
5-1-1I1	5-1-1	Main_LS	24.41	22	142	1.6972	24	32.551	25.58	20.918	0.583	0.643

TABLE F-5
2025 Gravity Model Final Pipe Sizes

9-1-5I1	9-1-5	9-1-4	33.75	32.91	226.74	0.3705	8	0.717	33.99	0.199	0.361	0.277
9-1-4I1	9-1-4	9-1-3	26.95	25.22	436.41	0.3964	8	0.741	27.19	0.199	0.575	0.268
9-1-3I1	9-1-3	9-1-2	25.22	24.95	337.85	0.0799	8	0.333	25.58	0.199	0.54	0.597
9-1-2I1	9-1-2	9-1-1	23.85	23.61	65.8	0.3647	8	0.711	24.1	0.227	0.377	0.32
9-1-1I1	9-1-1	One Stp LS	23.51	22.5	32.81	3.0785	12	6.903	23.63	0.227	0.124	0.033
4-2A-2I1	4-2A-2	4-2A-Q	213.76	209	281.8	1.6891	8	1.53	213.89	0.122	0.347	0.08
4-2A-QI1	4-2A-Q	4-2A-1	209	206	115	2.6087	8	1.904	209.12	0.122	0.398	0.064
4-2A-1I1	4-2A-1	4-2-3	206	200.12	462.56	1.2712	8	1.329	206.14	0.122	0.363	0.092
4-2-3I1	4-2-3	4-2-2	200.12	198.99	374.83	0.3015	8	0.646	200.32	0.122	0.295	0.189
4-2-2I1	4-2-2	4-2-1	198.89	190.96	358.22	2.2137	8	1.752	199.01	0.122	0.417	0.07
4-2-1I1	4-2-1	4-1-2	190.96	190.15	256.41	0.3159	8	0.662	191.14	0.122	1.12	0.185
4-8-2I1	4-8-2	4-8-1	203.25	201.98	172.2	0.7375	10	1.833	203.25	0	0.008	0
4-8-1I1	4-8-1	4-1-8	201.98	200.95	441.72	0.2332	10	1.031	201.99	0.002	0.582	0.001
4-1-8I1	4-1-8	4-1-7	200.95	199.6	468.84	0.2879	10	1.145	201.34	0.507	0.801	0.443
4-1-7I1	4-1-7	4-1-6	199.6	199.3	88.8	0.3378	12	2.018	200.18	0.944	0.713	0.468
4-1-6I1	4-1-6	4-1-5	199.3	199	70.52	0.4254	12	2.264	199.82	0.944	0.634	0.417
4-1-5I1	4-1-5	4-1-4	199	198.2	289.47	0.2764	12	1.825	199.52	0.944	0.868	0.517
4-1-4I1	4-1-4	4-1-3	198.2	197.37	315.9	0.2627	12	1.779	198.85	1.318	0.736	0.741
4-1-3I1	4-1-3	4-1-2	197.37	190.15	418.58	1.7249	12	4.559	197.74	1.318	0.747	0.289
4-1-2I1	4-1-2	4-1-1	190.15	189.6	246.78	0.2229	15	2.972	190.77	1.44	0.582	0.484
4-1-1I1	4-1-1	3-2-6	189.6	189.02	158.24	0.3665	15	3.811	190.2	1.44	0.63	0.378
3-2-6I1	3-2-6	3-2-5	189.02	188.29	224.99	0.3245	15	3.585	189.62	1.44	0.634	0.402
3-2-5I1	3-2-5	3-2-4	188.29	188.06	122.43	0.1879	15	2.728	188.98	1.44	0.582	0.528
3-2-4I1	3-2-4	3-2-3	188.06	184	261.61	1.5519	15	7.841	188.42	1.44	0.581	0.184
3-2-3I1	3-2-3	3-2-2	184	181.71	123.56	1.8534	15	8.569	184.36	1.44	0.601	0.168
3-2-2I1	3-2-2	3-2-1	181.71	175.84	342.51	1.7138	15	8.24	182.09	1.617	0.364	0.196
3-2-1I1	3-2-1	3-1-1	175.59	168.9	304.81	2.1948	15	9.325	175.94	1.617	0.54	0.173
6-7-9I1	6-7-9	6-1-17	158.05	149.01	334.17	2.7052	8	1.936	158.05	0	0.007	0
6-1-17I1	6-1-17	6-1-16	149.01	141.48	280.07	2.6886	8	1.93	149.01	0	0.008	0
6-1-16I1	6-1-16	6-1-15	141.48	135.98	144.02	3.8189	8	2.301	141.48	0	0.009	0
6-1-15I1	6-1-15	6-1-14	135.98	133.05	301.36	0.9723	8	1.161	135.98	0	0.007	0
6-1-14I1	6-1-14	6-1-13	132.83	131.59	95.32	1.3009	12	3.959	132.83	0	0.01	0
6-1-13I1	6-1-13	6-1-13B	131.59	127.94	32.81	11.1252	12	11.579	131.59	0	1.113	0
6-1-13BI1	6-1-13B	6-1-12	127.94	115.03	136.35	9.4683	15	19.369	128.5	7.673	1.074	0.396
6-1-12I1	6-1-12	6-1-11	115.03	95	256.6	7.8059	12	9.699	115.7	7.673	1.25	0.791

TABLE F-5
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6-1-11I1	6-1-11	6-1-10	95	71.35	247.14	9.5695	12	10.739	95.63	7.673	1.301	0.715
6-1-10I1	6-1-10	6-1-9	71.35	59.76	284.88	4.0684	18	20.647	72	8.017	1.447	0.388
6-1-9I1	6-1-9	6-1-8	59.76	57.85	276.65	0.6904	18	8.505	61.15	8.017	1.081	0.943
6-1-8I1	6-1-8	6-1-7	57.85	52.04	269.02	2.1597	18	15.043	58.66	8.017	2.112	0.533
6-1-7I1	6-1-7	6-1-6	52.04	49.84	256.12	0.859	18	9.487	54.47	8.018	2.043	0.845
6-1-6I1	6-1-6	6-1-5	49.84	47.68	279.68	0.7723	18	8.996	52	8.928	1.461	0.992
6-1-5I1	6-1-5	6-1-4	47.68	45.48	278.91	0.7888	21	13.714	49.34	9.118	1.667	0.665
6-1-4I1	6-1-4	6-1-3	45.48	43.32	265.09	0.8148	18	9.24	47.84	9.118	1.615	0.987
6-1-3I1	6-1-3	6-1-2	43.32	41.16	268.64	0.8041	18	9.179	44.53	9.118	0.807	0.993
6-1-2I1	6-1-2	6-1-1	37.5	35.44	251.4	0.8194	18	9.266	39.35	9.118	1.276	0.984
6-1-1I1	6-1-1	5-2-3	35.44	32.47	265.6	1.1182	21	16.329	36.4	9.118	0.903	0.558
5-2-3I1	5-2-3	5-2-2	32.47	29.6	75.16	3.8185	18	20.003	33.26	9.118	1.105	0.456
5-2-2I1	5-2-2	5-2-1	29.5	27.1	79.87	3.0049	18	17.744	30.38	9.118	1.178	0.514
5-2-1I1	5-2-1	5-1-1	27	24.41	75.8	3.4169	18	18.921	27.93	9.118	1.554	0.482
6-7-8I1	6-7-8	6-7-7	129.5	120.8	267.66	3.2504	8	2.122	129.68	0.345	0.457	0.162
6-7-7I1	6-7-7	6-7-6	120.8	100	319	6.5204	8	3.006	120.95	0.345	0.546	0.115
6-7-6I1	6-7-6	6-7-5	100	90.21	303.36	3.2272	8	2.115	100.18	0.345	0.604	0.163
6-7-5I1	6-7-5	6-7-4	90.21	82.72	344.71	2.1728	8	1.738	90.41	0.345	0.529	0.198
6-7-4I1	6-7-4	6-7-3	82.72	80.3	103.15	2.3461	12	5.317	82.9	0.345	0.392	0.065
6-7-3I1	6-7-3	6-7-2	80.3	77.76	267.1	0.951	12	3.385	80.52	0.345	0.389	0.102
6-7-2I1	6-7-2	6-7-1	77.76	73.87	417.65	0.9314	12	3.35	77.98	0.345	0.38	0.103
6-7-1I1	6-7-1	6-1-10	73.87	71.35	189.34	1.3309	12	4.005	74.1	0.345	1.301	0.086
6-5-2I1	6-5-2	6-5-1	59.47	58.27	380.57	0.3153	8	0.661	59.47	0	0.007	0
6-5-1I1	6-5-1	6-1-6	58.27	49.84	421.07	2.002	8	1.666	58.27	0.015	4.596	0.009
3-1-39I1	3-1-39	3-1-38	548.87	530	167.36	11.2751	8	3.953	549.08	0.88	0.321	0.223
3-1-38I1	3-1-38	3-1-37	527.99	521	215.05	3.2504	8	2.122	528.29	0.88	0.61	0.415
3-1-37I1	3-1-37	Crown LS	521	519	32.81	6.096	12	9.714	521.2	0.88	0.203	0.091
3-16-6I1	3-16-6	3-16-4	625.42	594.25	396.42	7.8629	8	3.302	625.64	0.759	0.626	0.23
3-16-4I1	3-16-4	3-16-3	594.25	581	141.91	9.3369	8	3.597	594.46	0.759	0.687	0.211
3-16-3I1	3-16-3	3-16-2	581	563.08	277.87	6.449	8	2.99	581.23	0.759	0.777	0.254
3-16-2I1	3-16-2	3-16-1	563.08	554.01	222.76	4.0716	8	2.375	563.34	0.759	0.807	0.319
3-16-1I1	3-16-1	3-1-27	554.01	543.48	297.16	3.5435	8	2.216	554.28	0.759	1.197	0.342
3-19A-1I1	3-19A-1	3-19B-1	690.67	685	467.84	1.212	8	1.296	690.8	0.116	0.392	0.089
3-19B-1I1	3-19B-1	3-19-6	685	678.77	467.84	1.3317	8	1.359	685.13	0.116	0.197	0.085

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3-19-6I1	3-19-6	3-19-5	678.57	675.28	361.39	0.9104	8	1.123	678.71	0.116	0.217	0.103
3-19-5I1	3-19-5	3-19-4	675.16	671.11	334.48	1.2108	8	1.295	675.29	0.116	0.378	0.09
3-19-4I1	3-19-4	3-19-3	671.11	667.05	255.81	1.5871	8	1.483	671.24	0.116	0.277	0.078
3-19-3I1	3-19-3	3-19-2	667.05	664	51.5	5.9223	8	2.865	667.14	0.116	0.293	0.04
3-19-2I1	3-19-2	3-19-1	664	645.19	415.02	4.5323	8	2.506	664.1	0.116	0.146	0.046
3-19-1I1	3-19-1	3-1-36	645.09	627.12	269.24	6.6743	8	3.041	645.18	0.116	0.872	0.038
3-1-36I1	3-1-36	3-1-35	627.12	620.08	150.2	4.6871	8	2.549	627.41	0.996	0.596	0.391
3-1-35I1	3-1-35	3-1-34	619.88	605.44	345.62	4.178	8	2.406	620.18	0.996	0.515	0.414
3-1-34I1	3-1-34	3-1-33	605.24	589.5	267	5.8951	8	2.858	605.51	0.996	0.882	0.348
3-1-33I1	3-1-33	3-1-32	589.5	573.8	354.48	4.429	8	2.478	589.79	0.996	0.441	0.402
3-1-32I1	3-1-32	3-1-31	572.42	561.9	126.18	8.3373	8	3.399	572.69	1.107	1.184	0.326
3-1-31I1	3-1-31	3-1-30	561.9	558.52	154.4	2.1891	8	1.742	562.29	1.107	0.931	0.636
3-1-30I1	3-1-30	3-1-29	558.52	554.39	83.71	4.9337	8	2.615	558.83	1.107	0.978	0.424
3-1-29I1	3-1-29	3-1-28	554.39	548.82	116.48	4.7819	8	2.574	554.72	1.204	0.958	0.468
3-1-28I1	3-1-28	3-1-27	548.82	543.48	100.57	5.3097	8	2.713	549.14	1.204	1.197	0.444
3-1-27I1	3-1-27	3-1-26	543.48	533.98	143.24	6.6322	8	3.032	543.88	1.963	1.525	0.647
3-1-26I1	3-1-26	3-1-25	533.98	530.74	150.68	2.1503	10	3.13	534.49	1.963	1.284	0.627
3-1-25I1	3-1-25	3-1-24	530.74	527.7	296.49	1.0253	10	2.161	531.37	1.963	1.115	0.908
3-1-24I1	3-1-24	3-1-23	527.7	517.67	297	3.3771	10	3.923	528.16	2.345	1.193	0.598
3-1-23I1	3-1-23	3-1-22	517.67	510.51	263.25	2.7198	10	3.52	518.17	2.345	0.747	0.666
3-1-22I1	3-1-22	3-1-21	510.29	488.8	285.69	7.5221	8	3.229	510.71	2.345	1.586	0.726
3-1-21I1	3-1-21	3-1-20B	488.8	480.5	191.92	4.3247	8	2.448	489.33	2.345	1.095	0.958
3-1-20BI1	3-1-20B	3-1-20	480.5	464	137.81	11.973	8	4.074	480.87	2.345	1.076	0.576
3-1-20I1	3-1-20	3-1-19	464	451	101.75	12.7764	8	4.208	464.36	2.345	1.077	0.557
3-1-19I1	3-1-19	3-1-18	451	422	234.31	12.3768	8	4.142	451.36	2.345	1.511	0.566
3-1-18I1	3-1-18	3-1-17	422	413.73	117.92	7.0132	8	3.118	422.5	2.868	0.755	0.92
3-1-17I1	3-1-17	3-1-16	412.3	395.63	285.81	5.8325	10	5.155	412.74	2.868	1.093	0.556
3-1-16I1	3-1-16	3-1-15	395.63	371	272.7	9.0319	8	3.538	396.09	2.868	0.683	0.811
3-1-15I1	3-1-15	3-1-14	370	361	109.1	8.2493	8	3.381	370.48	2.868	1.193	0.848
3-1-14I1	3-1-14	3-1-13	361	324.63	246.6	14.7486	8	4.521	361.4	3.012	1.342	0.666
3-1-13I1	3-1-13	3-1-12	324.63	304.37	323	6.2724	10	5.346	325.08	3.012	1.011	0.563
3-1-12I1	3-1-12	3-1-11	304.27	282	244.65	9.1028	8	3.552	304.74	3.012	1.595	0.848
3-1-11I1	3-1-11	3-1-10	282	262.19	287.26	6.8962	8	3.092	282.53	3.012	1.493	0.974
3-1-10I1	3-1-10	3-1-9	261.79	259.99	230.46	0.781	15	5.563	262.49	3.195	0.68	0.574
3-1-9I1	3-1-9	3-1-8	259.89	255.71	35.63	11.7317	8	4.032	260.36	3.195	1.616	0.792
3-1-8I1	3-1-8	3-1-7	255.71	247.51	206.38	3.9733	10	4.255	256.25	3.195	0.646	0.751
3-1-7I1	3-1-7	3-1-6	246.66	231.4	242.11	6.3029	10	5.359	247.12	3.195	1.436	0.596
3-1-6I1	3-1-6	3-1-5	231.4	226.54	256.56	1.8943	12	4.778	232	3.195	0.633	0.669
3-1-5I1	3-1-5	3-1-4	226.24	210	262.89	6.1775	10	5.306	226.71	3.195	1.137	0.602

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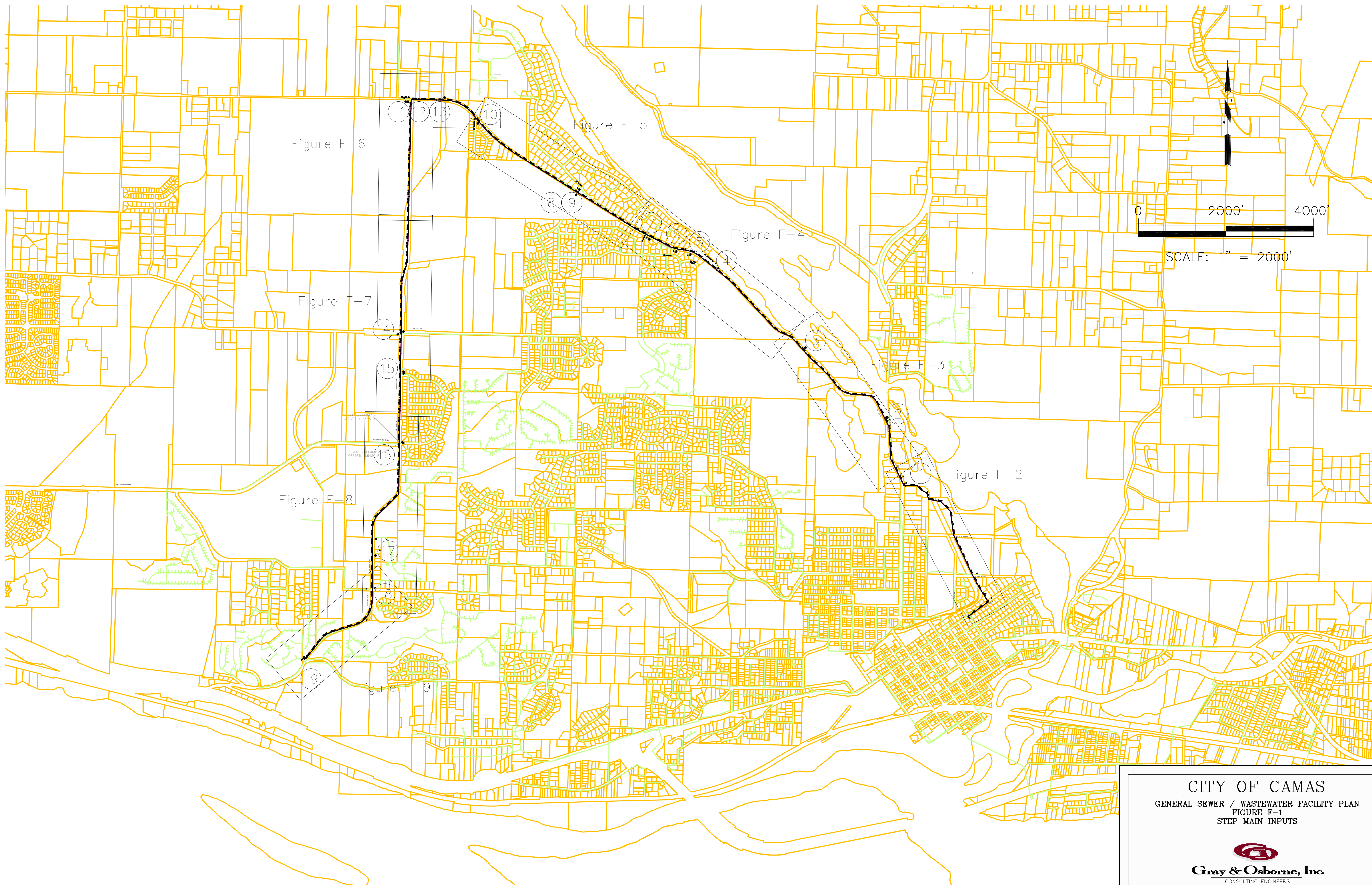
3-1-4l1	3-1-4	3-1-3	210	194.73	259.92	5.8749	10	5.174	210.47	3.195	1.129	0.617
3-1-3l1	3-1-3	3-1-2	194.63	173.42	262.16	8.0905	8	3.349	195.15	3.195	0.886	0.954
3-1-2l1	3-1-2	3-1-1	172.82	169.05	276.02	1.3658	15	7.356	173.42	3.386	0.476	0.46
3-1-1l1	3-1-1	5-8-1	168.9	83.11	442.05	19.4073	18	45.094	169.24	5.003	0.257	0.111
5-8-1l1	5-8-1	5-1-12	82.76	52.47	259.11	11.69	21	52.795	83.13	5.003	0.915	0.095
7-3-5l1	7-3-5	7-3-4	71.5	64.31	121.17	5.9338	8	2.868	71.57	0.065	0.104	0.023
7-3-4l1	7-3-4	7-3-3	64.26	41.81	193.99	11.5728	8	4.005	64.32	0.065	0.214	0.016
7-3-3l1	7-3-3	7-3-2	41.76	39.51	150.63	1.4937	8	1.439	41.86	0.065	0.145	0.045
7-3-2l1	7-3-2	7-3-1	39.46	26.94	118.27	10.5859	8	3.83	39.52	0.065	0.141	0.017
7-3-1l1	7-3-1	7-1-1	26.89	16.91	190.47	5.2397	8	2.695	26.96	0.065	0.737	0.024
7-1-6l1	7-1-6	7-1-5	23.7	22.21	286.97	0.5192	8	0.848	24.19	0.755	0.901	0.89
7-1-5l1	7-1-5	7-1-4	22.21	21.45	213.44	0.3561	10	1.274	22.7	0.755	0.722	0.593
7-1-4l1	7-1-4	7-1-3	21.45	19.75	57.12	2.9762	8	2.031	21.75	0.755	0.997	0.372
7-1-3l1	7-1-3	7-1-2	19.75	17.5	455.94	0.4935	8	0.827	20.25	0.755	0.895	0.913
7-1-2l1	7-1-2	7-1-1	17.5	16.86	163.94	0.3904	10	1.334	17.97	0.755	0.65	0.566
7-1-1l1	7-1-1	L C LS	16.86	9.62	328.36	2.2049	10	3.592	17.13	0.82	0.325	0.228
7-2-1l1	7-2-1	L C LS	12	9.62	101	2.3564	12	5.329	12.09	0.09	0.09	0.017
8-1-9l1	8-1-9	8-1-8	30.84	29.83	441.23	0.2289	10	1.021	31.11	0.228	0.37	0.223
8-1-8l1	8-1-8	8-1-7	29.83	28.67	335.14	0.3461	10	1.256	30.07	0.227	0.371	0.181
8-1-7l1	8-1-7	8-1-6	28.67	27.14	281.54	0.5434	10	1.574	28.88	0.227	0.38	0.145
8-1-6l1	8-1-6	8-1-5	27.14	25.16	266.48	0.743	10	1.84	27.34	0.227	0.548	0.124
8-1-5l1	8-1-5	8-1-4	25.16	24.22	272.21	0.3453	12	2.04	25.51	0.531	0.474	0.261
8-1-4l1	8-1-4	8-1-3	24.22	21.83	304.05	0.7861	12	3.078	24.5	0.531	0.462	0.173
8-1-3l1	8-1-3	8-1-2	21.83	21.07	310.28	0.2449	12	1.718	22.21	0.531	0.496	0.309
8-1-2l1	8-1-2	8-1-1	21.07	20.95	41.2	0.2913	12	1.873	21.41	0.531	0.341	0.284
8-1-1l1	8-1-1	Oaks LS	20.7	17	250	1.48	12	4.786	20.92	0.531	0.225	0.111
10-1-23l1	10-1-23	10-1-24	586.24	582.57	246.52	1.4887	8	1.436	586.38	0.145	0.433	0.101
10-1-24l1	10-1-24	10-1-25	582.57	578.65	271.62	1.4432	8	1.414	582.71	0.145	0.216	0.103
10-1-25l1	10-1-25	10-1-26	578.46	573.76	73.84	6.3651	8	2.97	578.56	0.145	0.15	0.049
10-1-26l1	10-1-26	10-10B-1	573.52	565	71.95	11.8416	8	4.051	573.61	0.145	0.13	0.036
10-1-20l1	10-1-20	10-1-19	560.33	558.74	222.19	0.7156	10	1.806	560.49	0.146	0.266	0.081
10-1-19l1	10-1-19	10-1-18	558.7	557.34	180	0.7556	10	2.103	558.85	0.146	0.192	0.069
10-11-8l1	10-1-18	10-1-17	529.03	512.56	172.89	9.5263	8	3.634	529.27	0.965	0.789	0.266

TABLE F-5
2025 Gravity Model Final Pipe Sizes

10-11-7I1	10-1-17	10-1-16	512.51	504.76	172.89	4.4826	8	2.492	512.8	0.965	0.432	0.387
10-11-6I1	10-1-16	10-1-15	504.29	496.36	122.58	6.4692	8	2.994	504.55	0.965	0.774	0.322
10-11-5I1	10-1-15	10-1-14	496.36	489.35	99.68	7.0325	8	3.122	496.62	0.965	0.906	0.309
10-11-4I1	10-1-14	10-1-13	489.35	486.23	79.73	3.9132	8	2.329	489.65	0.965	0.609	0.414
10-11-3I1	10-1-13	10-1-12	485.94	481.23	202.93	2.321	8	1.794	486.29	0.965	0.522	0.538
10-11-2I1	10-1-12	10-1-11	480.56	456.89	276.46	8.5618	8	3.445	480.8	0.965	0.362	0.28
10-11-1I1	10-1-11	10-1-10	456.17	437.78	149.06	12.3373	8	4.135	456.39	0.965	0.329	0.233
10-6-4I1	10-6-4	10-6-3	475.28	471.48	200.3	1.8972	8	1.622	475.61	0.782	0.682	0.482
10-6-3I1	10-6-3	10-6-2	471.48	445.39	371.61	7.0208	8	3.119	471.71	0.782	0.667	0.251
10-6-2I1	10-6-2	10-6-1	445.39	424.43	273.95	7.651	8	3.261	445.61	0.782	0.859	0.24
10-6-1I1	10-6-1	10-1A-12	424.43	417.32	238.32	2.9834	8	2.036	424.72	0.782	0.43	0.384
10-1A-12I1	10-1A-12	10-1-12	417.18	411.61	32.81	16.9774	8	4.851	417.36	0.782	0.271	0.161
10-10-12I1	10-10-12	10-10-11	729.37	719.72	316.82	3.0459	8	2.055	729.62	0.617	0.756	0.3
10-10-11I1	10-10-11	10-10-10	719.72	713.46	209.66	2.9858	8	2.034	719.97	0.617	0.396	0.303
10-10-10I1	10-10-10	10-10-9	713.35	700	141.84	9.412	8	3.612	713.54	0.617	0.537	0.171
10-10-9I1	10-10-9	10-10-9A	700	690.71	83	11.1928	8	3.939	700.18	0.617	0.518	0.157
10-10-9AI1	10-10-9A	10-10-8	690.71	673.37	136.92	12.6643	8	4.189	690.88	0.617	0.259	0.147
10-10-8I1	10-10-8	10-10-7	672.92	665.34	144.41	5.2489	8	2.697	673.14	0.617	0.325	0.229
10-10-7I1	10-10-7	10-10-6	664.94	650.23	168.4	8.7352	8	3.479	665.13	0.617	0.285	0.177
10-10-6I1	10-10-6	10-10-5	649.67	645.94	62.14	6.0026	8	2.884	649.88	0.617	0.314	0.214
10-10-5I1	10-10-5	10-10-4	645.64	617	347.43	8.2434	8	3.38	645.83	0.617	0.289	0.183
10-10-4I1	10-10-4	10-10-3	615.26	611.74	127.96	2.7509	8	1.953	615.52	0.617	0.386	0.316
10-10-3I1	10-10-3	10-10-2	611.07	595	101.85	15.7781	8	4.676	611.23	0.617	0.449	0.132
10-10-2I1	10-10-2	10-10-1	595	579.91	67.04	22.5089	8	5.585	595.15	0.617	0.224	0.11
10-10-1I1	10-10-1	10-10B-1	579.48	552.57	204.62	13.1512	8	4.269	579.65	0.617	0.257	0.145
10-10B-1I1	10-10B-1	10-11-8	552.32	529.58	113.51	20.0335	8	5.269	552.51	0.965	0.29	0.183
10-1-18I1	10-11-8	10-11-7	557.34	528.08	178.24	16.4161	8	4.77	557.42	0.146	0.12	0.031
10-1-17I1	10-11-7	10-11-6	527.27	510.29	82.16	20.667	8	5.352	527.35	0.146	0.113	0.027
10-1-16I1	10-11-6	10-11-5	509.25	487.05	64.52	34.4079	8	6.906	509.32	0.146	0.101	0.021
10-1-15I1	10-11-5	10-11-4	486.88	461.89	227.99	10.961	8	3.903	486.97	0.146	0.44	0.037
10-1-14I1	10-11-4	10-11-3	461.89	461.44	33	1.3636	8	1.375	462.04	0.146	0.22	0.106
10-1-13I1	10-11-3	10-11-2	461.44	411.61	153.23	32.5197	8	6.713	461.51	0.146	0.102	0.022
10-1-12I1	10-11-2	10-11-1	410.71	388	158.82	14.2992	8	4.452	410.92	0.927	0.31	0.208
10-1-11I1	10-11-1	10-4-4	382.41	380.71	187.51	0.9066	8	1.121	382.87	0.927	0.691	0.827
10-4-4I1	10-4-4	10-4-3	437.47	431.39	77.5	7.8452	8	3.297	437.72	0.965	0.455	0.293
10-4-3I1	10-4-3	10-4-2	431.2	422.61	105.27	8.16	8	3.363	431.45	0.965	0.823	0.287
10-4-2I1	10-4-2	10-4-1	422.31	421.65	63.07	1.0465	8	1.204	422.76	0.965	0.677	0.801

TABLE F-5
2025 Gravity Model Final Pipe Sizes

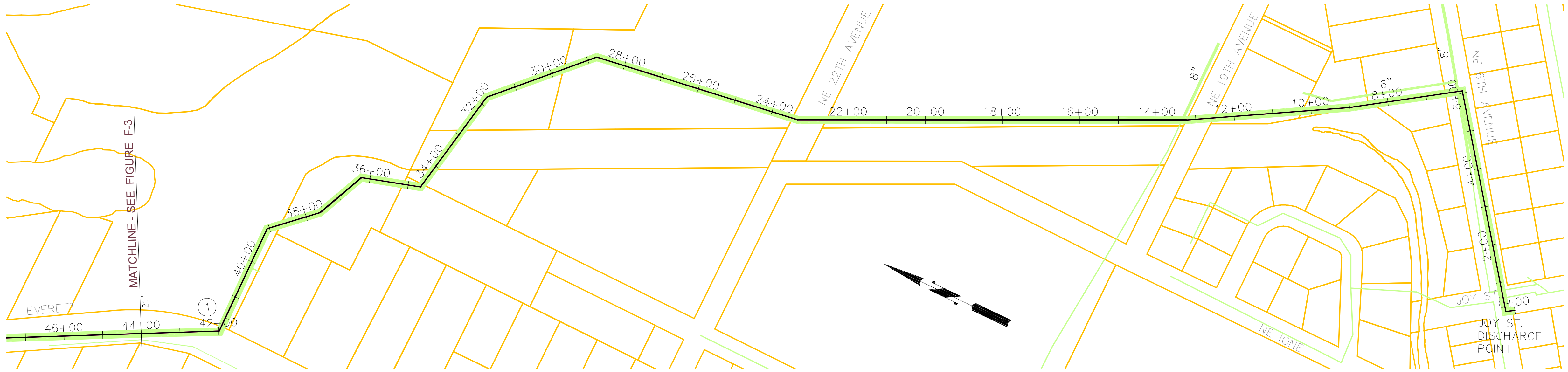
10-4-1I1	10-4-1	10-1-10	421.53	377.51	189.32	23.2516	8	5.677	421.72	0.965	0.279	0.17
10-1-10I1	10-1-10	10-1-9	375.1	170.58	281.66	72.6124	8	10.032	375.3	1.893	2.006	0.189
10-1-9I1	10-1-9	10-1-8	171.3	159.26	89.57	13.442	8	4.316	171.61	1.893	0.463	0.438
10-1-8I1	10-1-8	10-1-7	154.04	151.99	186.15	1.1013	10	2.24	154.64	1.893	0.813	0.845
10-1-7I1	10-1-7	10-1-6	151.69	145.35	182.68	3.4705	8	2.193	152.18	1.893	1.271	0.863
10-1-6I1	10-1-6	10-1-5	145.15	138.94	215.3	2.8843	8	2	145.67	1.893	1.044	0.946
10-1-5I1	10-1-5	S P Hill LS	138.94	137.5	32.81	4.3891	12	7.273	139.29	1.893	0.348	0.26
10-1-3I1	10-1-3	10-1-2	146.7	132	255.96	5.7431	8	2.821	147.17	2.374	1.437	0.841
10-1-2I1	10-1-2	10-1-1	132	122.59	300	3.1367	10	3.78	132.48	2.374	0.958	0.628
10-1-1I1	10-1-1	W C LS	122.59	121	32.81	4.8463	12	7.642	122.99	2.565	0.399	0.336



CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-1
STEP MAIN INPUTS

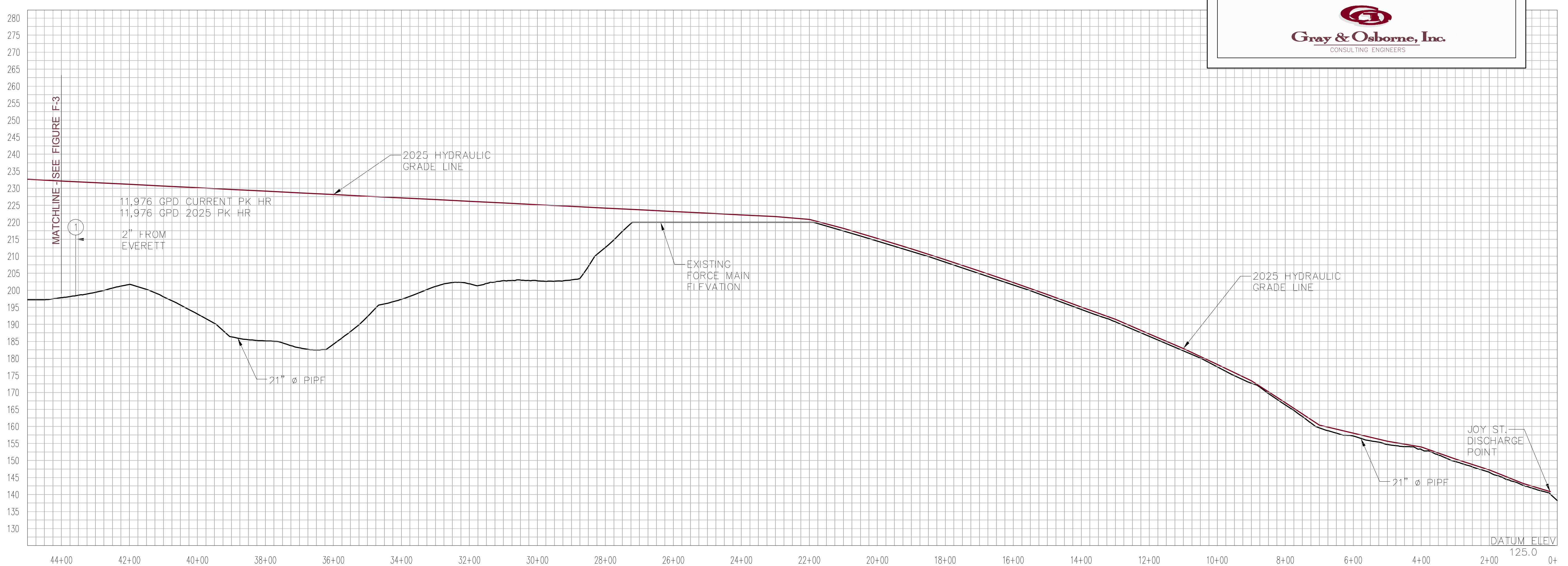
Gray & Osborne, Inc.
CONSULTING ENGINEERS

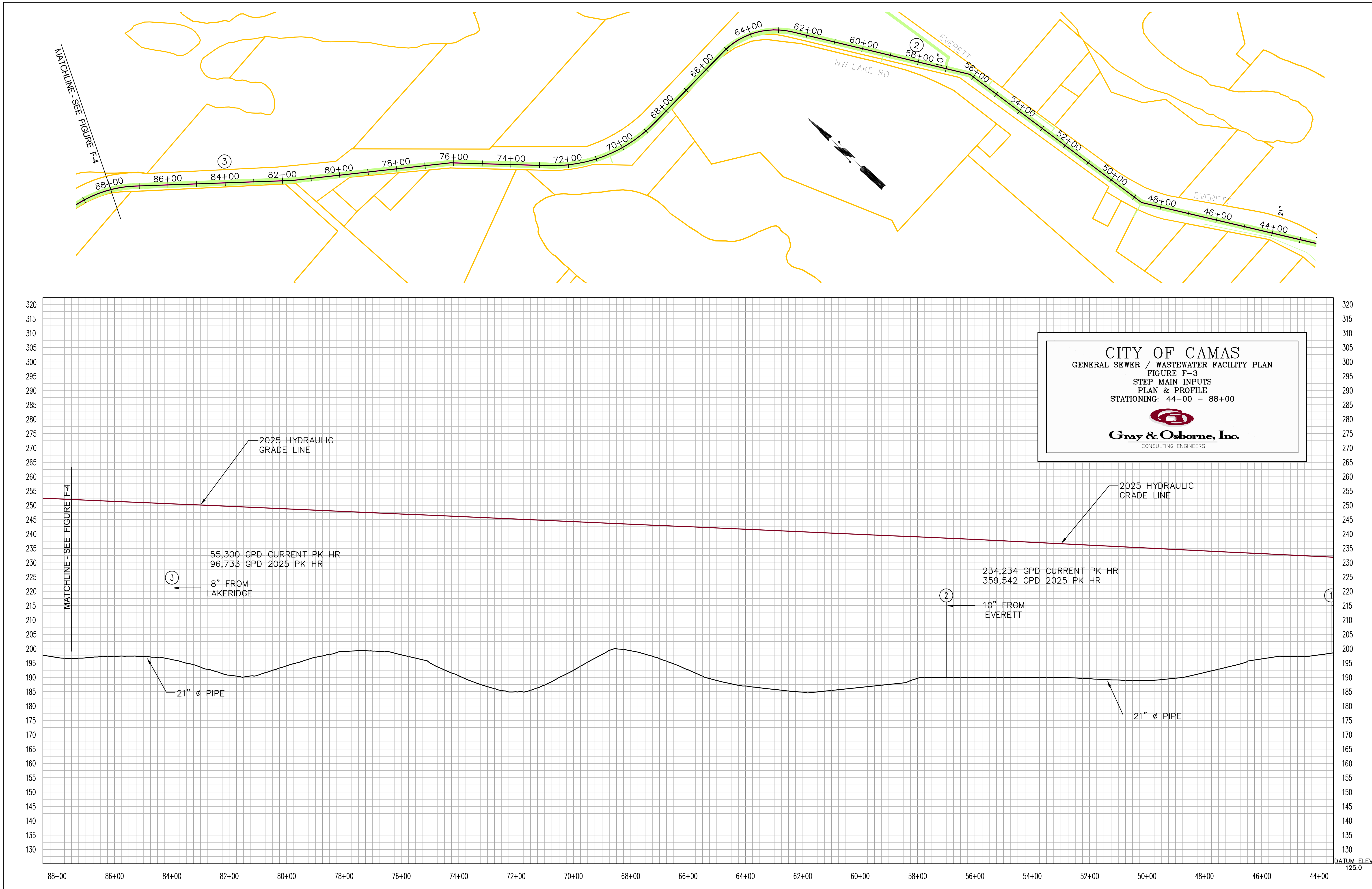


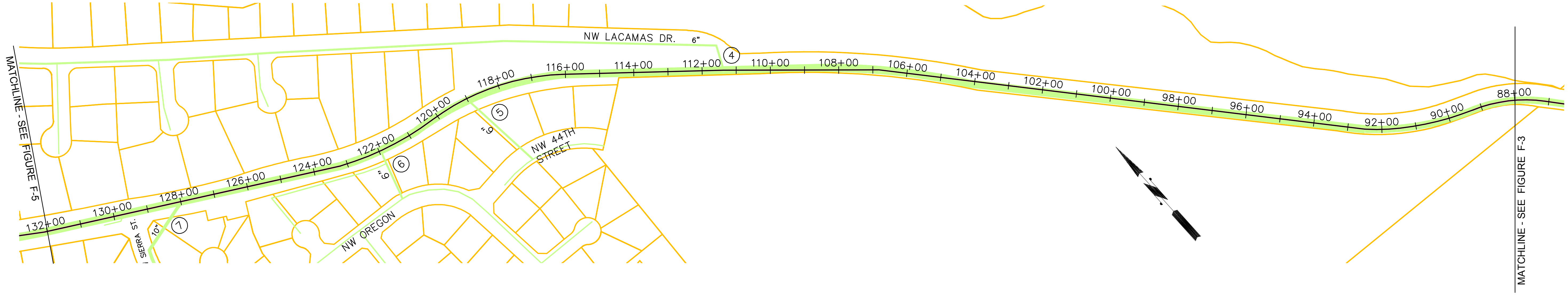
CITY OF CAMAS

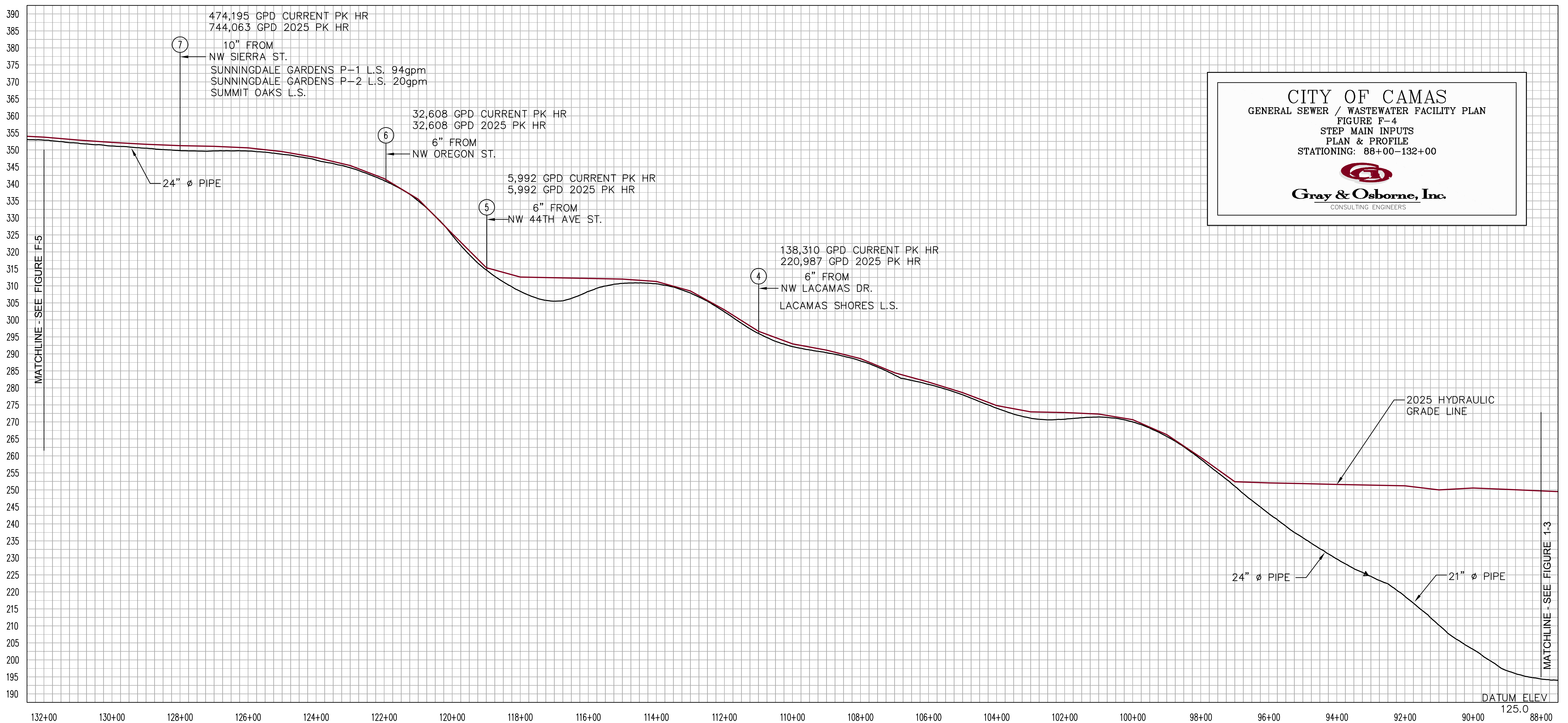
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-2
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 0+00-44+00

Gray & Osborne, Inc.
CONSULTING ENGINEERS




CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-3
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 44+00 – 88+00
Gray & Osborne, Inc.
CONSULTING ENGINEERS
MATCHLINE - SEE FIGURE F-4
NW LAKE RD
EVERETT
2025 HYDRAULIC GRADE LINE
55,300 GPD CURRENT PK HR
96,733 GPD 2025 PK HR
8" FROM LAKERIDGE
234,234 GPD CURRENT PK HR
359,542 GPD 2025 PK HR
10" FROM EVERETT
21" ø PIPE
DATUM ELEV 125.0

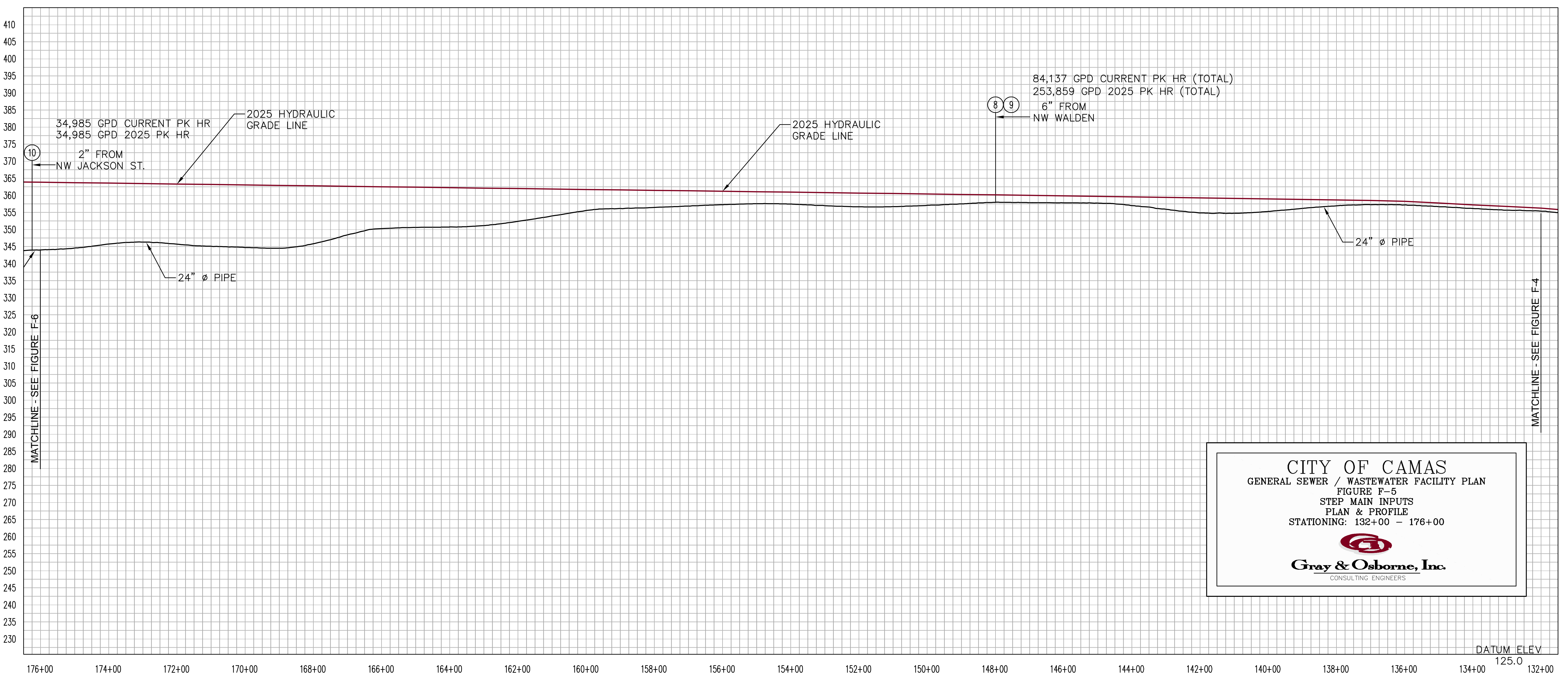




CITY OF CAMAS

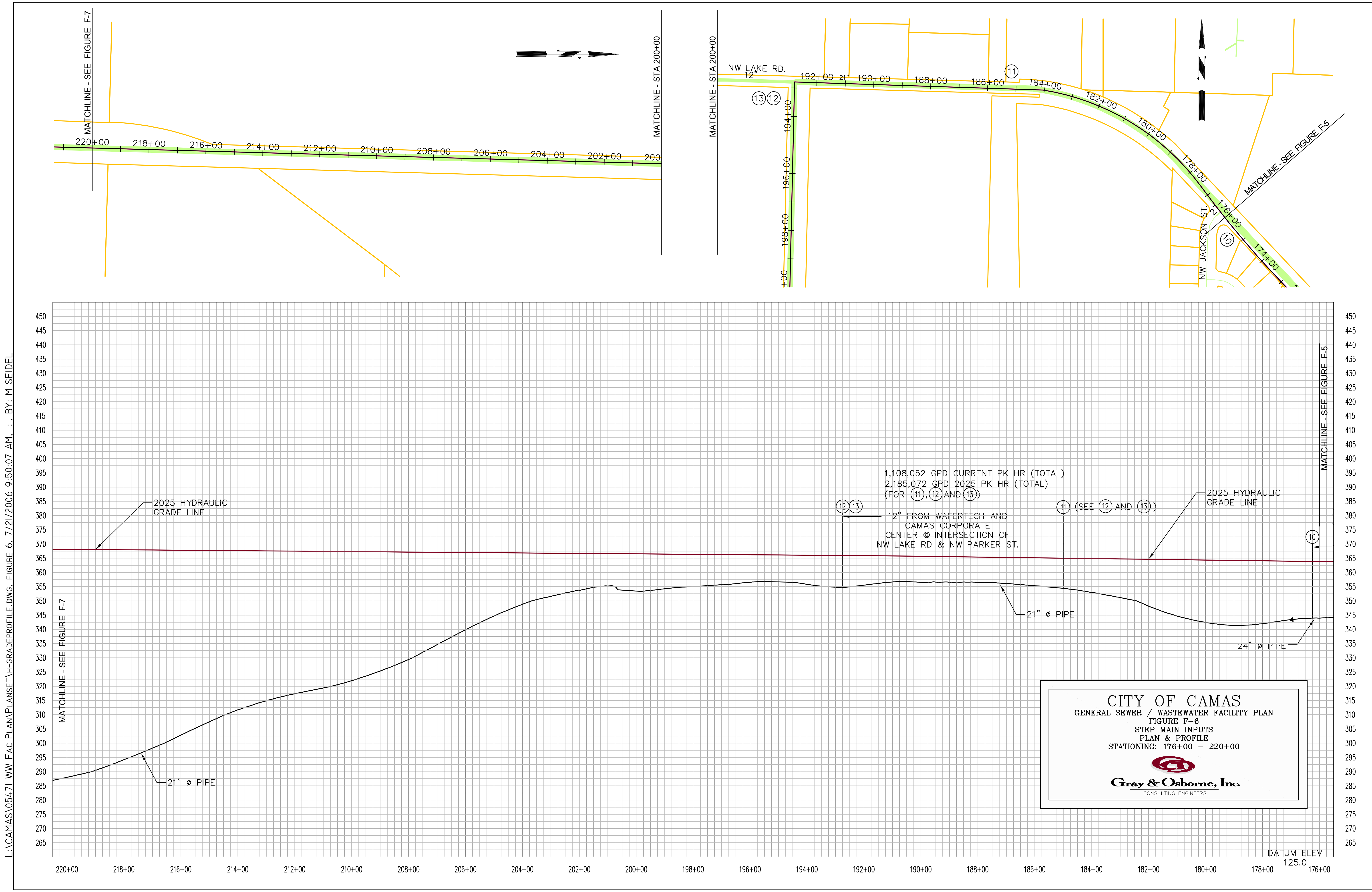
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-4
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 88+00-132+00

Gray & Osborne, Inc.
CONSULTING ENGINEERS



CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-5
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 132+00 – 176+00

Gray & Osborne, Inc.
CONSULTING ENGINEERS



CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN

FIGURE F-6

STEP MAIN INPUTS

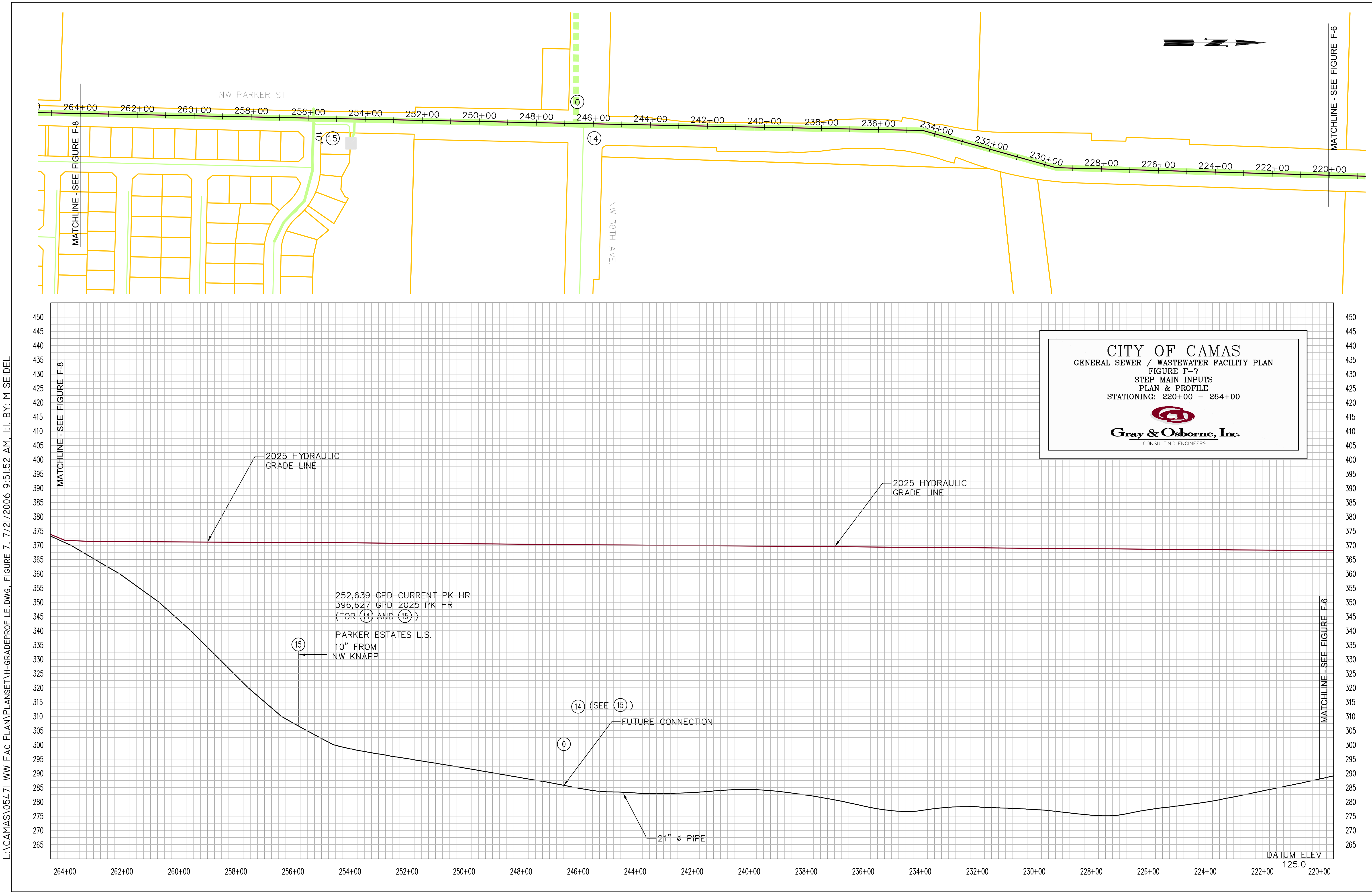
PLAN & PROFILE

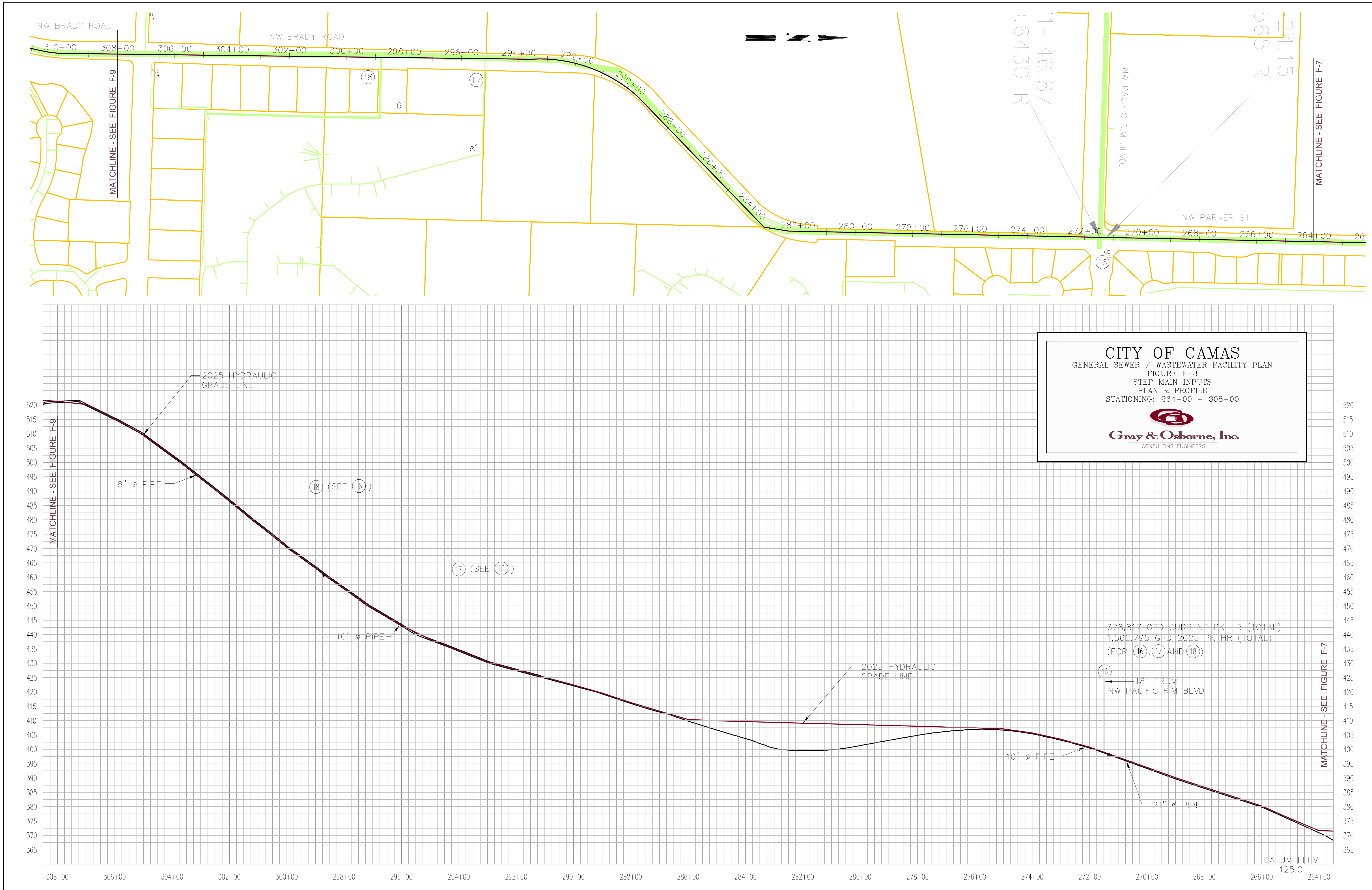
STATIONING: 176+00 – 220+00

Gray & Osborne, Inc.

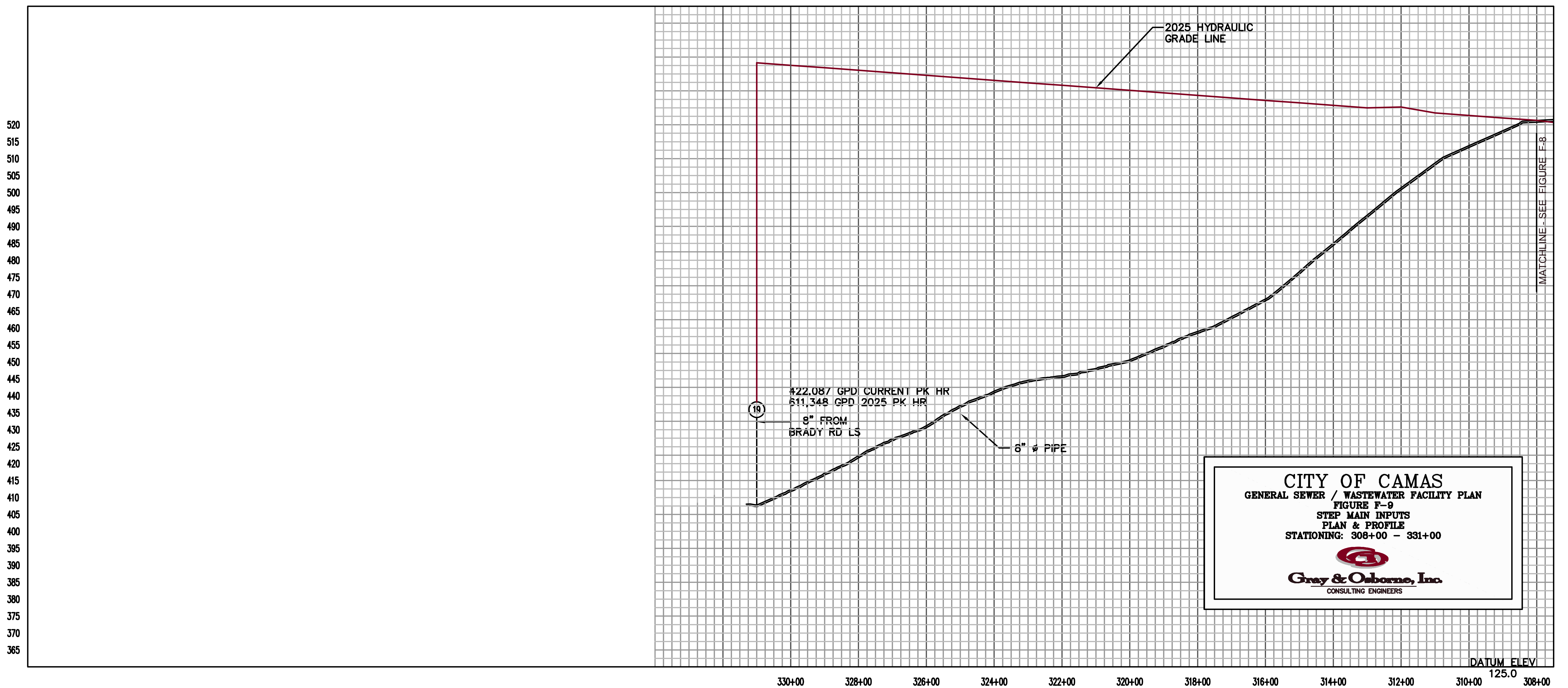
CONSULTING ENGINEERS

L:\CAMAS\05471 WW FAC PLAN\PLANSET\H-GRADEPROFILE.DWG, FIGURE 7, 7/21/2006 9:51:52 AM, 1:1, BY: M SEIDEL





NW BRADY ROAD
NW BRADY ROAD
NW PACIFIC RIM BLVD.
NW PARKER ST
MATCHLINE - SEE FIGURE F-9
MATCHLINE - SEE FIGURE F-7
310+00
308+00
306+00
304+00
302+00
300+00
298+00
296+00
294+00
292+00
290+00
288+00
286+00
284+00
282+00
280+00
278+00
276+00
274+00
272+00
270+00
268+00
266+00
264+00
6"
8"
18"
2025 HYDRAULIC GRADE LINE
8" ø PIPE
18 (SEE 16)
17 (SEE 16)
10" ø PIPE
678,817 GPD CURRENT PK HR (TOTAL)
1,562,795 GPD 2025 PK HR (TOTAL)
(FOR 16, 17 AND 18)
16
18" FROM NW PACIFIC RIM BLVD
21" ø PIPE
DATUM ELEV 125.0
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-8
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 264+00 – 308+00
Gray & Osborne, Inc.
CONSULTING ENGINEERS



CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
FIGURE F-9
STEP MAIN INPUTS
PLAN & PROFILE
STATIONING: 308+00 – 331+00

Gray & Osborne, Inc.
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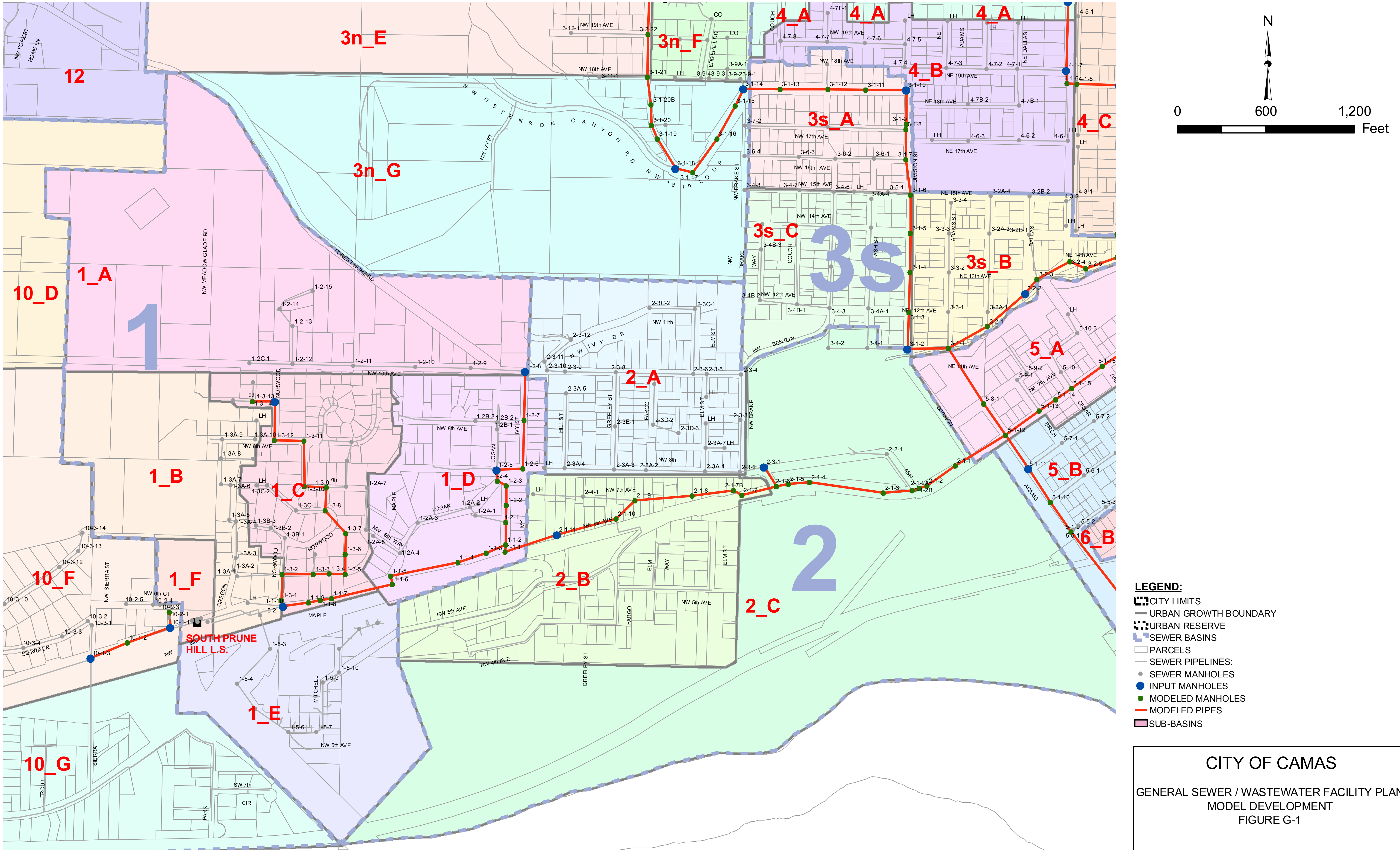
APPENDIX G

SUBBASINS FOR HYDRAULIC MODEL DEVELOPMENT



LEGEND:

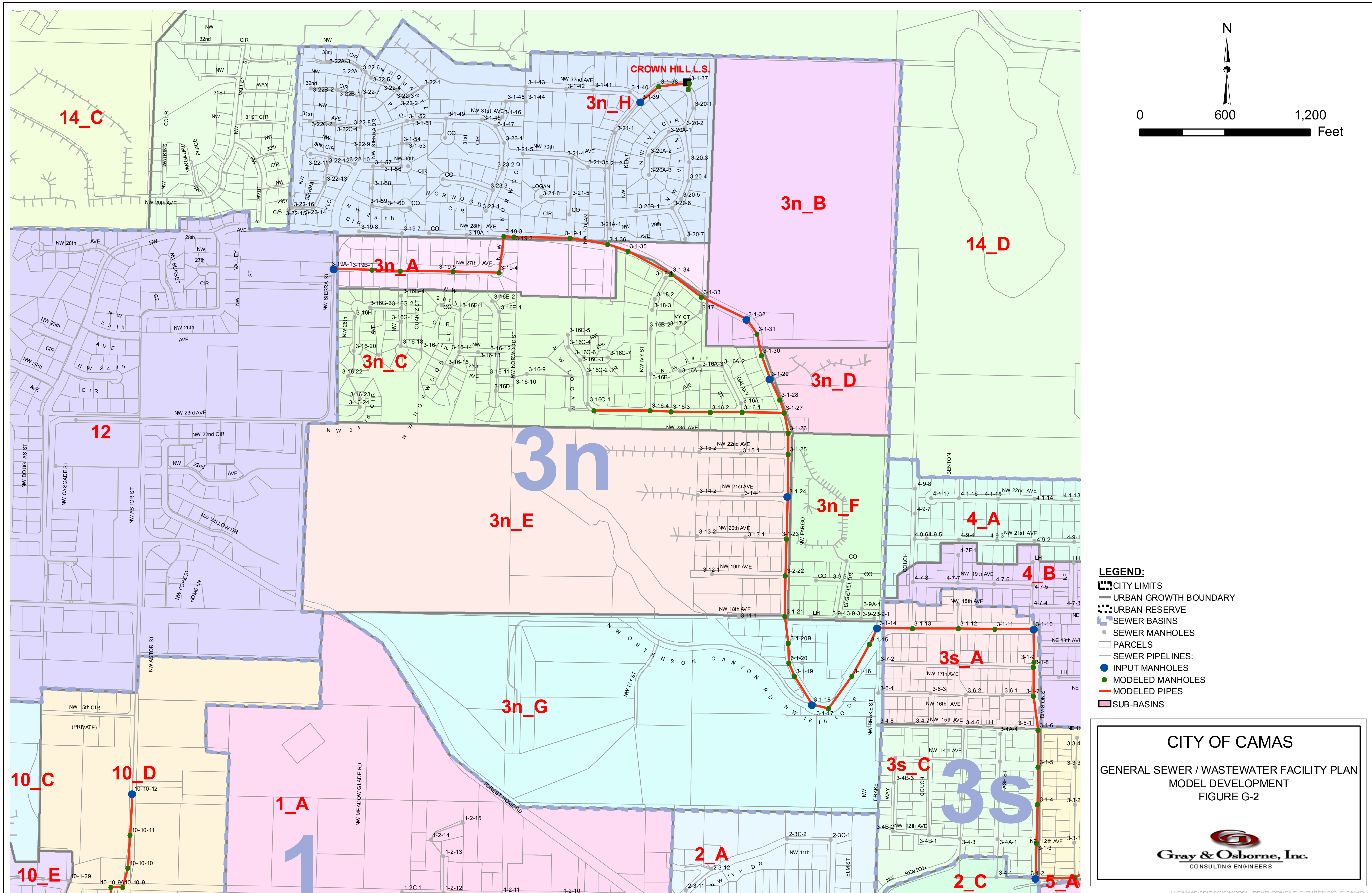
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- PARCELS
- SEWER PIPELINES:
- SEWER MANHOLES
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

CITY OF CAMAS

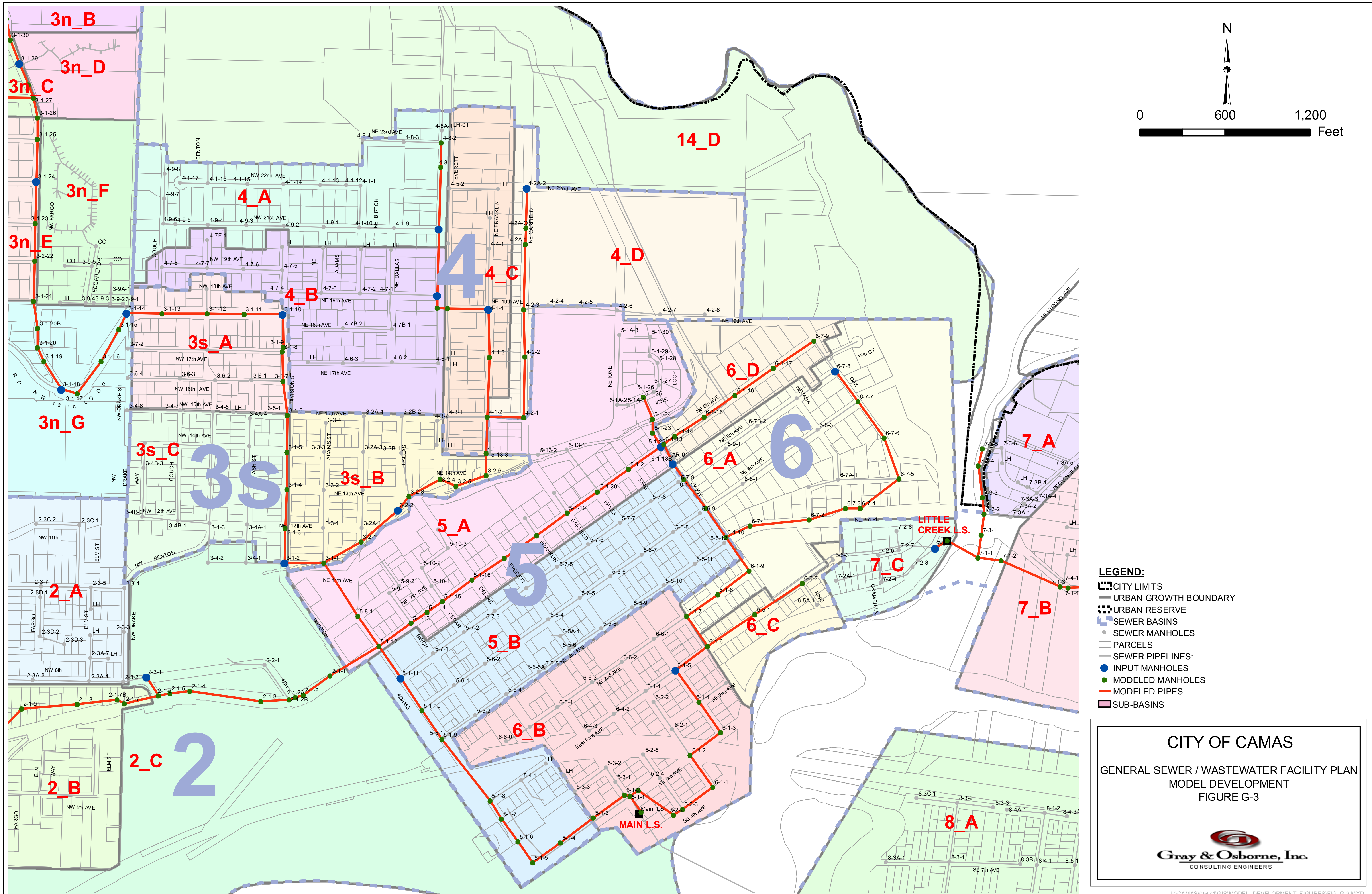
GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-1

Gray & Osborne, Inc.
CONSULTING ENGINEERS

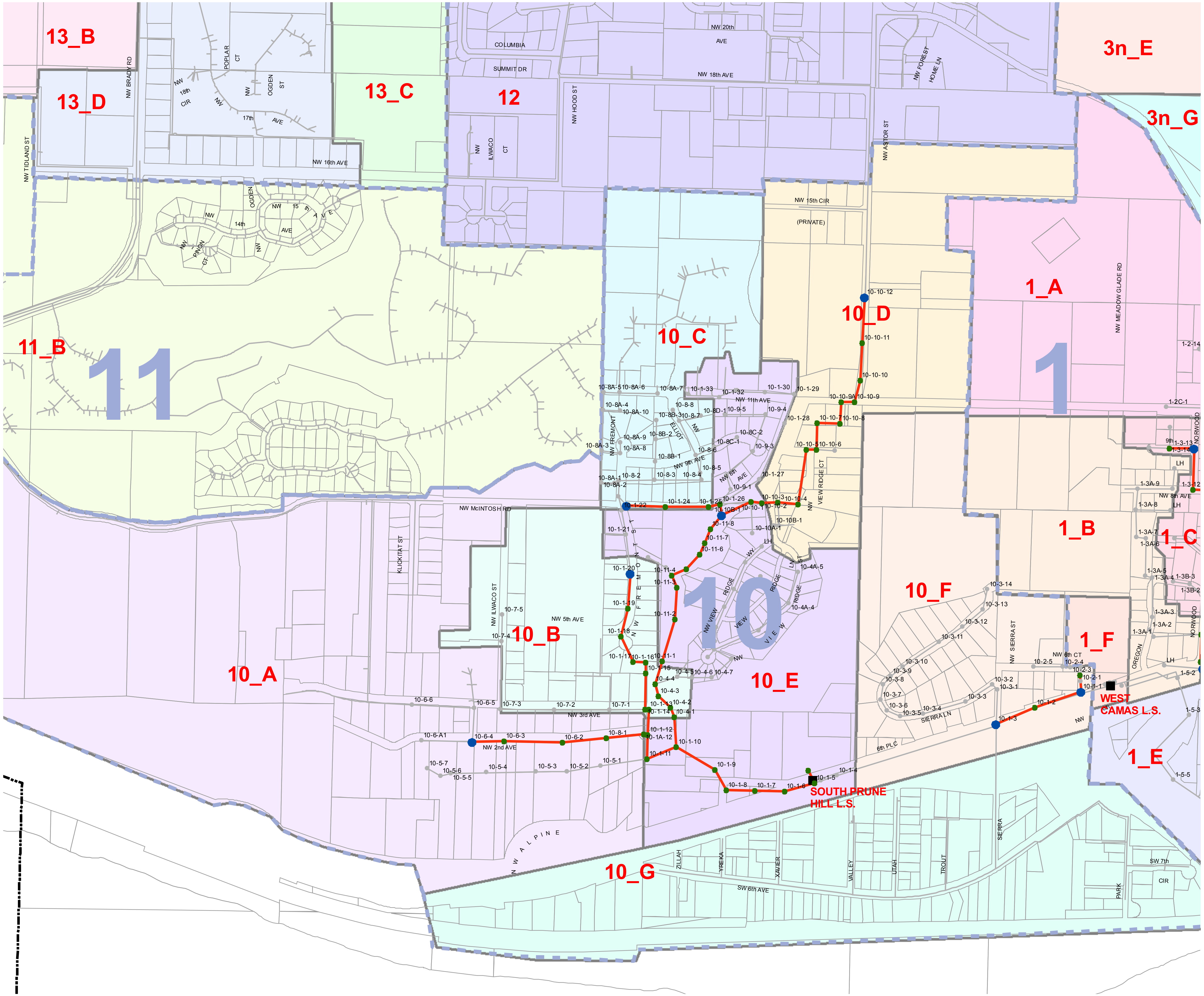
L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-1.MXD



CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-2
Gray & Osborne, Inc.
CONSULTING ENGINEERS
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
SEWER MANHOLES
PARCELS
SEWER PIPELINES:
INPUT MANHOLES
MODELED MANHOLES
MODELED PIPES
SUB-BASINS
N
0
600
1,200
Feet
CROWN HILL L.S.
3n
3s
1
12
14_C
14_D
3n_A
3n_B
3n_C
3n_D
3n_E
3n_F
3n_G
3n_H
3s_A
3s_C
4_A
4_B
10_C
10_D
10_E
1_A
2_A
2_C
5_A
NW 23rd AVE
NW 18th AVE
NW 28th AVE
NW 30th
NW 22nd AVE
NW 21st AVE
NW 20th AVE
NW 19th AVE
NW 17th AVE
NW 16th AVE
NW 15th AVE
NW 14th AVE
NW 12th AVE
NW 11th
NW SIERRA ST
NW LOGAN
NW IVY ST
NW FARGO
NW DRAKE ST
COUCH
DIVISION ST
ASH ST
BENTON
NW ASTOR ST
NW CASCADE ST
NW DOUGLAS ST
NW WILLOW DR
NW MEADOW GLADE RD
FOREST HOME RD
NW OSTENSON CANYON RD
NW 18th LOOP
EDGEHILL DR
L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-2.MXD



N
0
600
1,200
Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
SEWER MANHOLES
PARCELS
SEWER PIPELINES:
INPUT MANHOLES
MODELED MANHOLES
MODELED PIPES
SUB-BASINS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-3
Gray & Osborne, Inc.
CONSULTING ENGINEERS
3n_B
3n_D
3n_C
3n_F
3n_E
3n_G
3s_A
3s_B
3s_C
3s
4_A
4_B
4_C
4_D
4
14_D
5_A
5_B
5
6_A
6_B
6_C
6_D
6
7_A
7_B
7_C
8_A
2_A
2_B
2_C
2
LITTLE CREEK L.S.
MAIN L.S.



LEGEND:

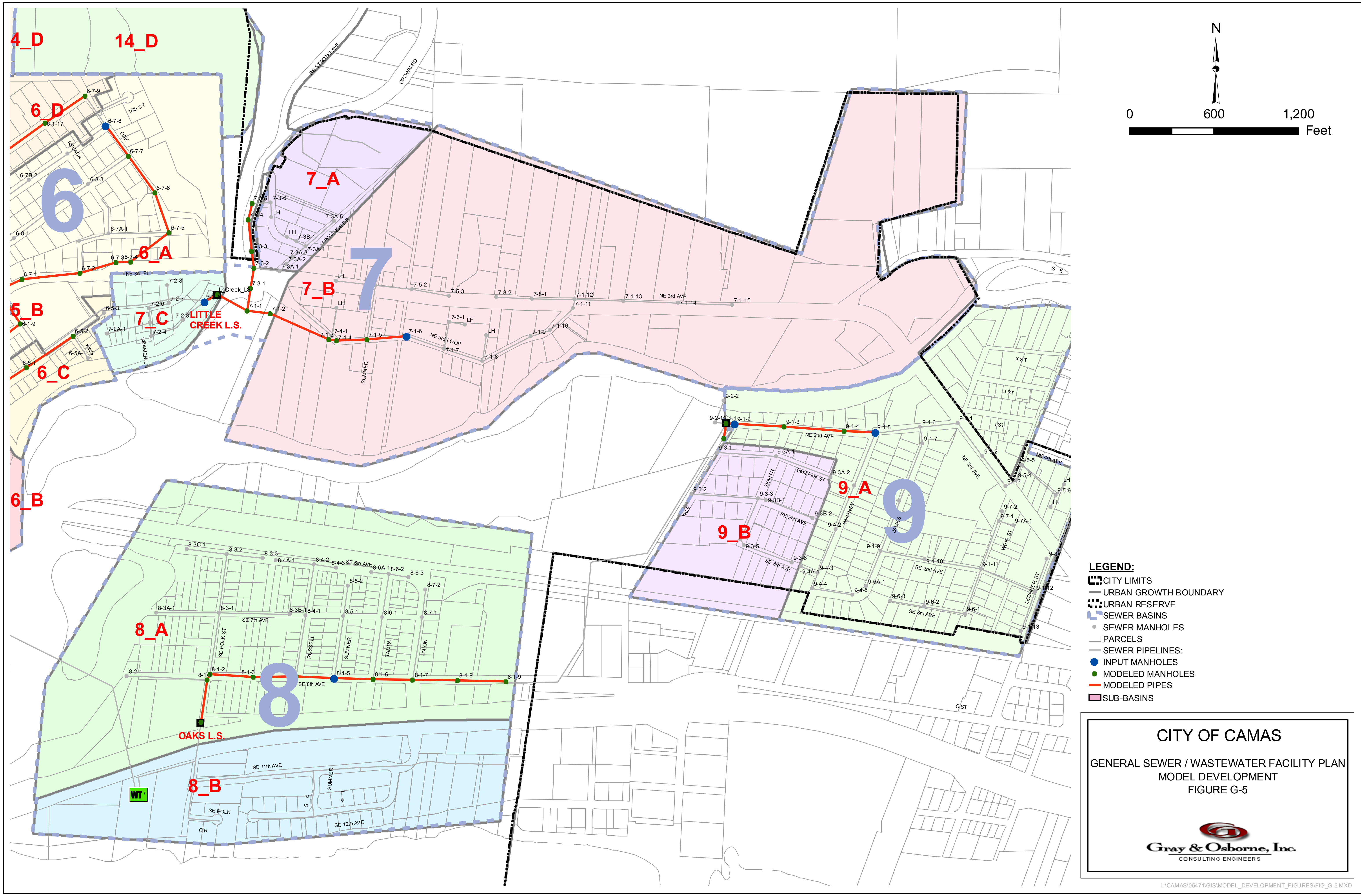
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

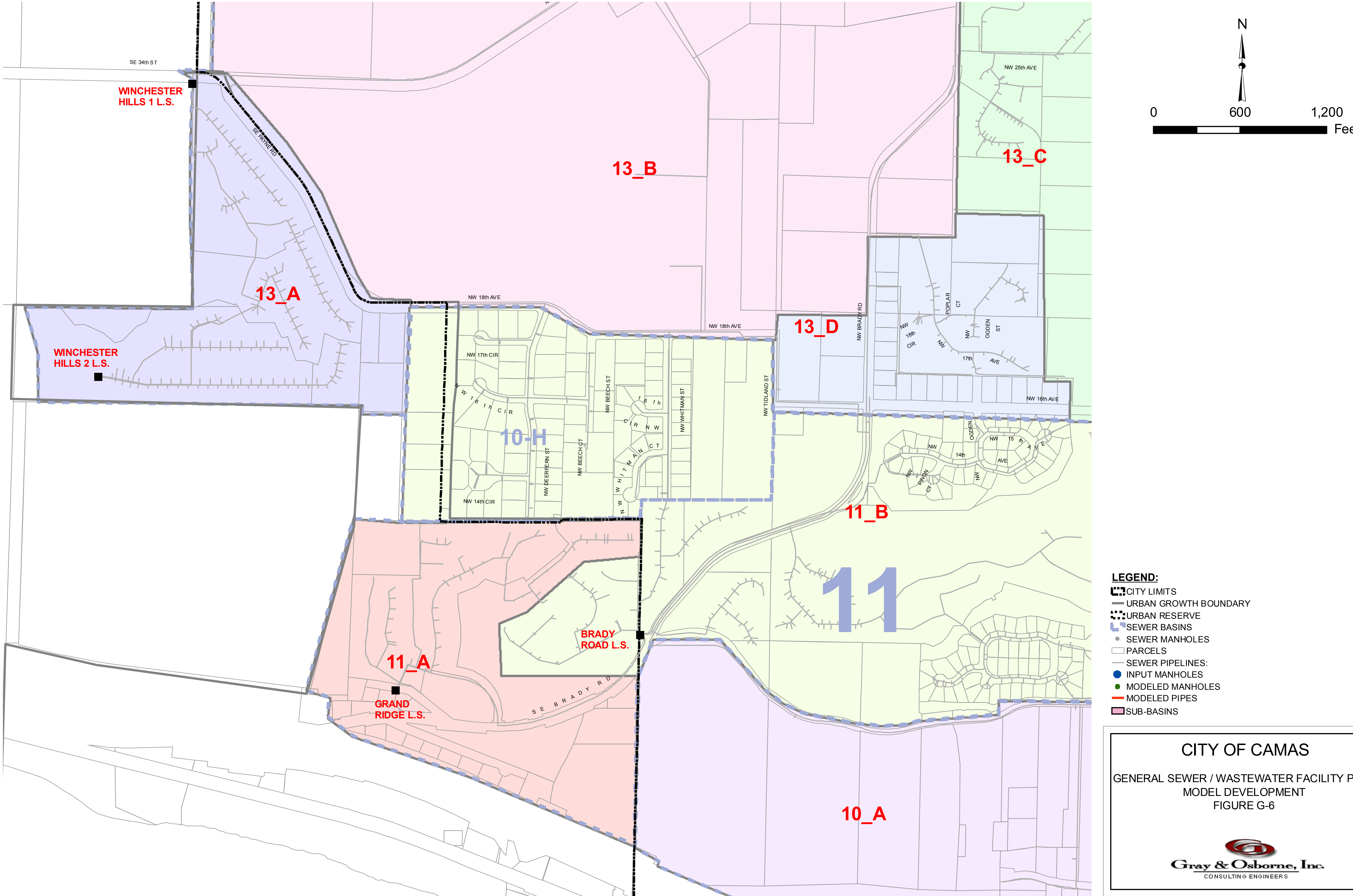
CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-4

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-4.MXD


4_D
14_D
6_D
6
6_A
5_B
7_C
LITTLE CREEK L.S.
6_C
6_B
7_A
7
7_B
9
9_A
9_B
8
8_A
8_B
OAKS L.S.
WT
SE STRONG AVE
CROWN RD
NE 3rd AVE
NE 3rd LOOP
NE 3rd PL
NE 2nd AVE
East First ST
SE 2nd AVE
SE 3rd AVE
SE 6th AVE
SE 7th AVE
SE 8th AVE
SE 11th AVE
SE 12th AVE
SE POLK ST
SE POLK
RUSSELL
SUMNER
TAMPA
UNION
ZENITH
WHITNEY
JAMES
WEIR ST
LECHNER ST
YALE
K ST
J ST
I ST
C ST
NE 4th AVE
PROVINCE DR
CRAMER LN
KING
NEVADA
OAK
15th CT
N
0
600
1,200
Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
SEWER MANHOLES
PARCELS
SEWER PIPELINES:
INPUT MANHOLES
MODELED MANHOLES
MODELED PIPES
SUB-BASINS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-5
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-5.MXD



LEGEND:

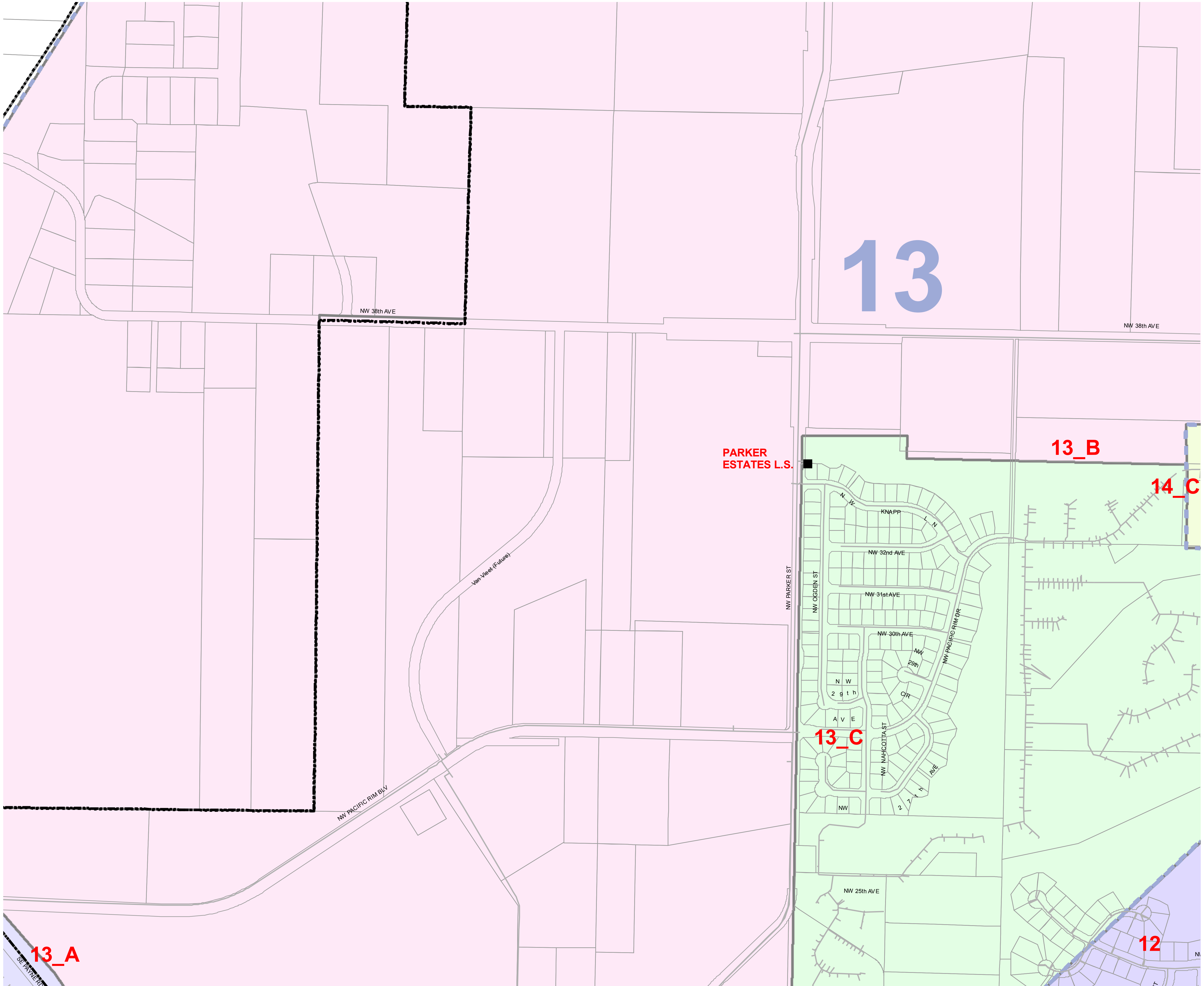
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-6

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-6.MXD



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LEGEND:

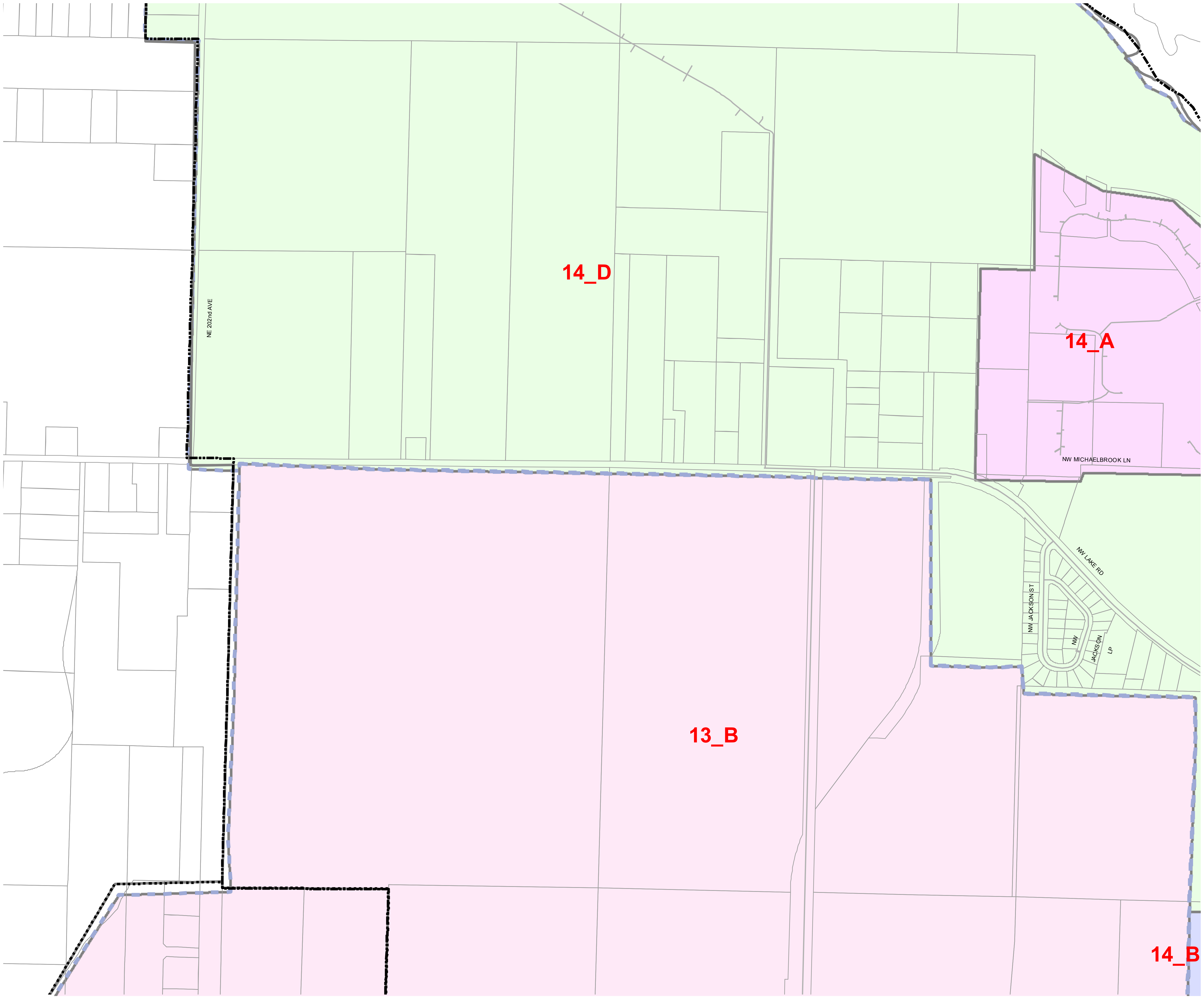
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-7

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-7.MXD



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Feet

LEGEND:

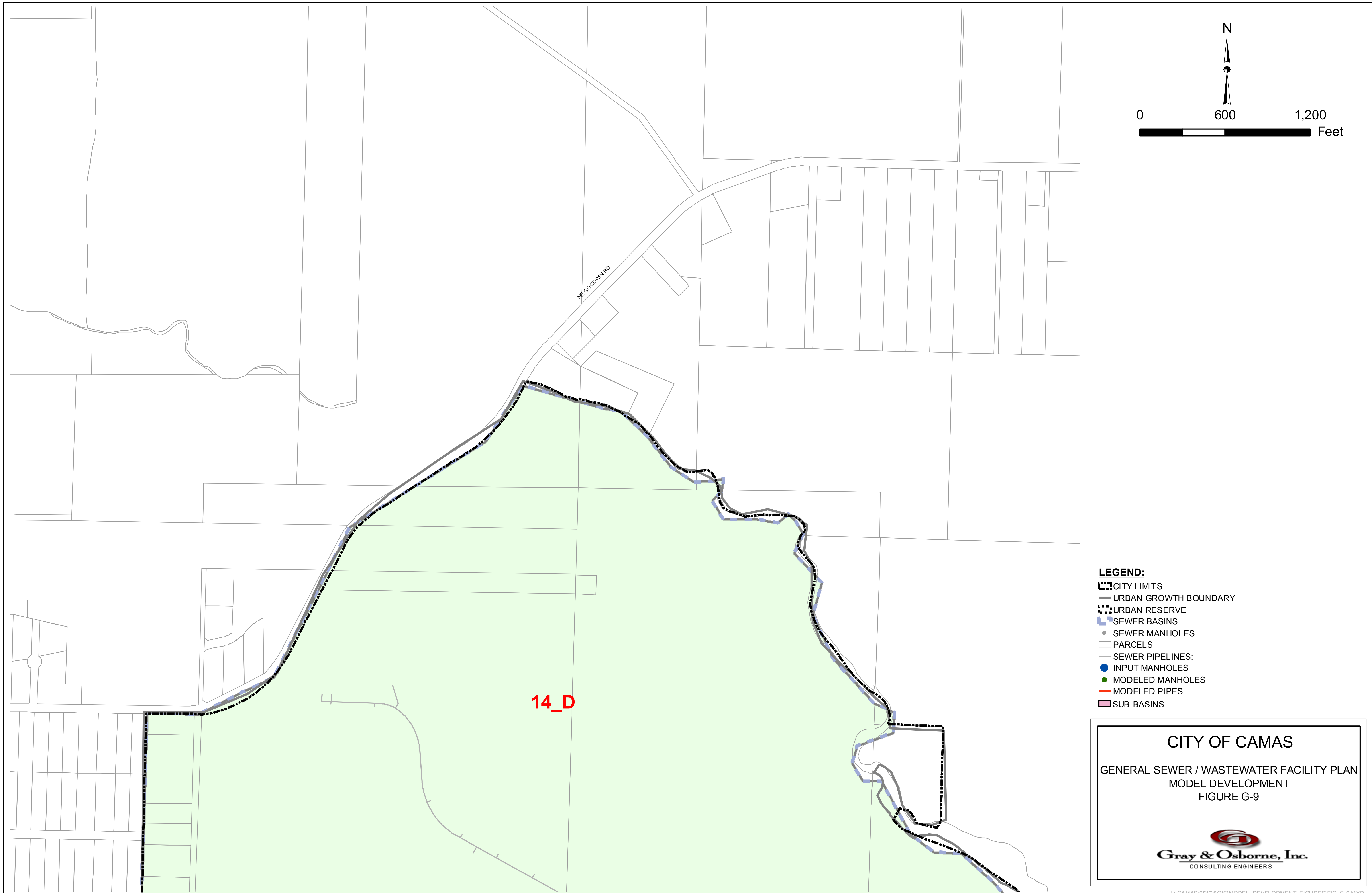
- CITY LIMITS
- URBAN GROWTH BOUNDARY
- URBAN RESERVE
- SEWER BASINS
- SEWER MANHOLES
- PARCELS
- SEWER PIPELINES:
- INPUT MANHOLES
- MODELED MANHOLES
- MODELED PIPES
- SUB-BASINS

CITY OF CAMAS

GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-8

Gray & Osborne, Inc.
CONSULTING ENGINEERS

L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-8.MXD



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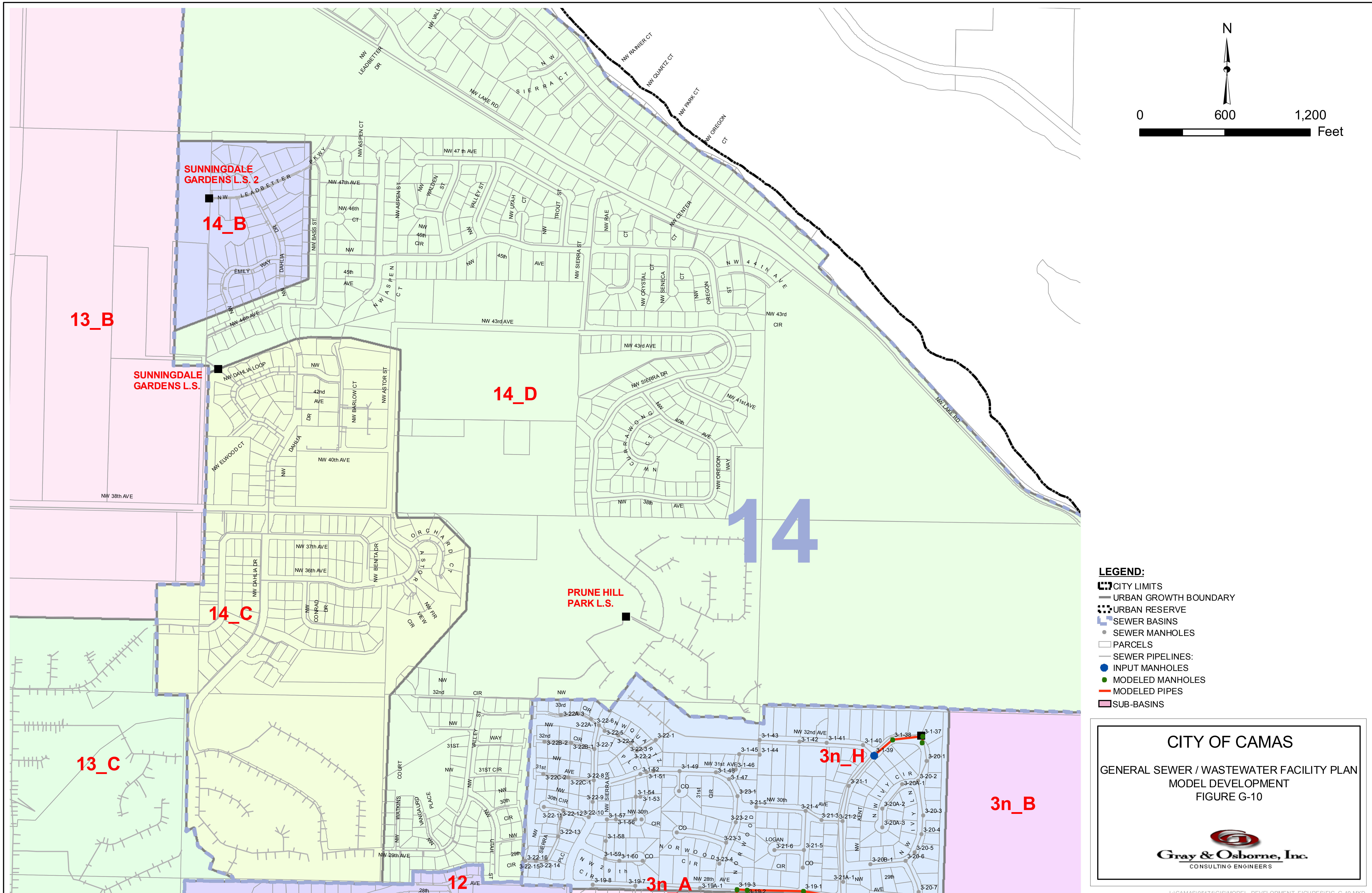
SEWER BASINS
SEWER MANHOLES
PARCELS
SEWER PIPELINES:
INPUT MANHOLES
MODELED MANHOLES
MODELED PIPES
SUB-BASINS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-9
Gray & Osborne, Inc.
CONSULTING ENGINEERS



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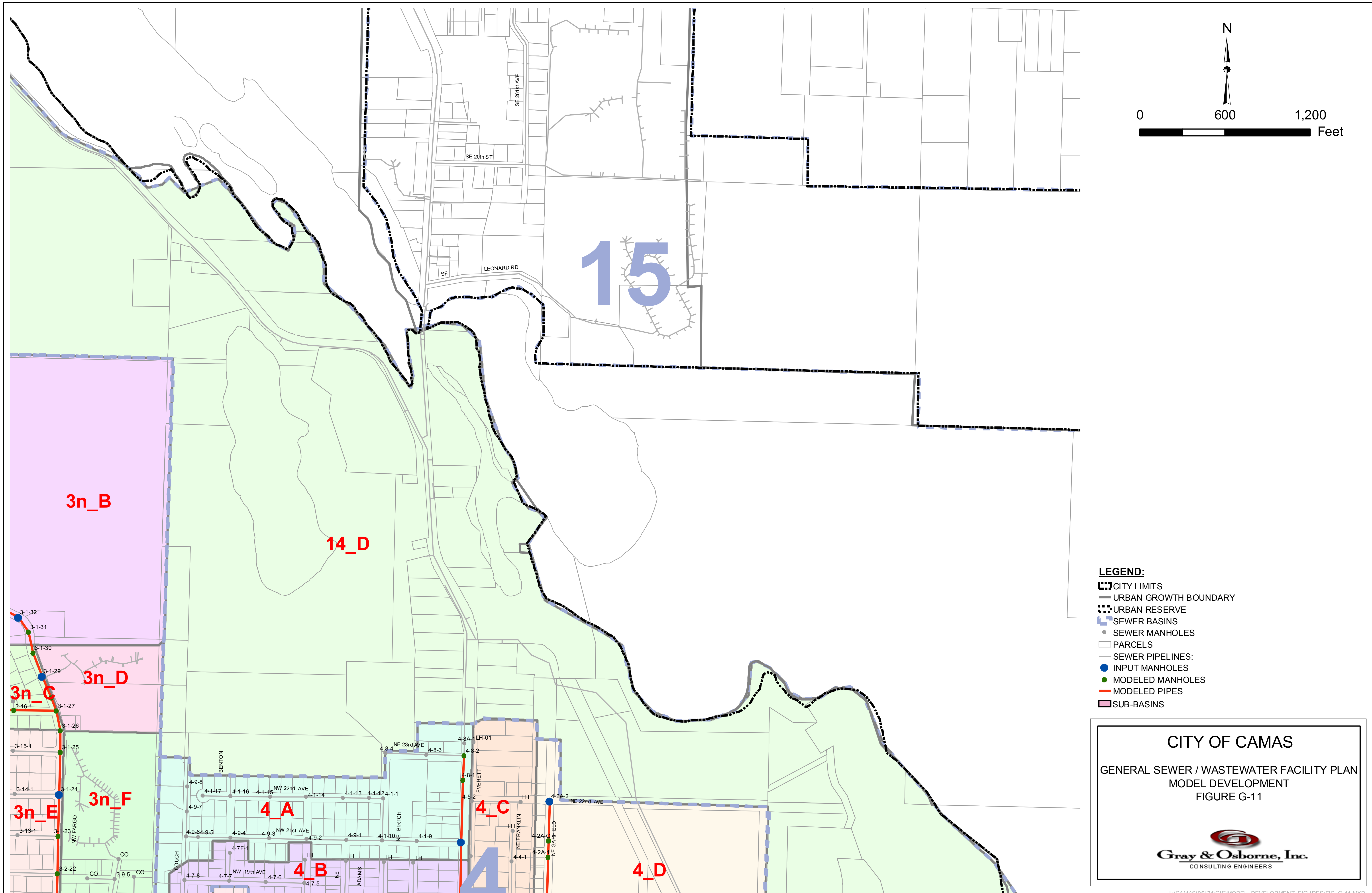
13_C
14_B
14_C
14_D
14
12
3n_A
3n_B
3n_H
SUNNINGDALE GARDENS L.S. 2
SUNNINGDALE GARDENS L.S.
PRUNE HILL PARK L.S.
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
SEWER MANHOLES
PARCELS
SEWER PIPELINES:
INPUT MANHOLES
MODELED MANHOLES
MODELED PIPES
SUB-BASINS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-10
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-10.MXD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600
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3n_E
3n_F
4_A
4_B
4_C
4_D
4
SE 261st AVE
SE 20th ST
LEONARD RD
NE 23rd AVE
NW 22nd AVE
NW 21st AVE
NW 19th AVE
NE 22nd AVE
BENTON
EVERETT
BIRTCH
ADAMS
COUCH
NW FARGO
NE FRANKLIN
NE GARFIELD
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASINS
SEWER MANHOLES
PARCELS
SEWER PIPELINES:
INPUT MANHOLES
MODELED MANHOLES
MODELED PIPES
SUB-BASINS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER FACILITY PLAN
MODEL DEVELOPMENT
FIGURE G-11
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\MODEL_DEVELOPMENT_FIGURES\FIG_G-11.MXD

APPENDIX H

304 STAINLESS STEEL SADDLE FAILURE ANALYSIS REPORT

CITY OF CAMAS

616 Northeast Fourth Avenue
P.O. Box 1055
Camas, Washington 98607
http://www.ci.camas.wa.us

DEPARTMENT OF PUBLIC WORKS

June 25, 2001

Mr. Cline Reese
Romac Industries, Inc.
21919 20th Ave SE, Suite 100
Bothell, WA 98021

SUBJECT: *RMA # 55857*
4" x 1" 304 Stainless Saddle

Dear Mr. Reese:

Please find enclosed (1) Romac 304 Stainless Saddle as described above and per our telephone conversation of Friday, June 22, 2001. The subject saddle was installed in September of 1994 in the Prune Hill Estates Subdivision in Camas by Wubbin Brothers, Inc. of Vancouver, Washington. This type of saddle has been the typical product installed for a 1" diameter Schedule 40 PVC S.T.E.P. sanitary sewer service in the City of Camas for approximately 10 years. The supplier of the saddle was most likely US Filter of Vancouver, Washington.

The City investigated a complaint of a sewer leak on NW Douglas Street in Camas on June 20, 2001. A City maintenance crew excavated and exposed (2) saddles and found both of them to be pitted and leaking around the weld between the threaded nipple and the body of the saddle. The saddles were connected to a 4" diameter Class 200 PVC pressure sewer main which was bedded and backfilled entirely with imported granular material. The saddles were located in an area of the main that was only partially full of liquid. Both saddles were removed and replaced with similar new ones by a City maintenance crew.

We would greatly appreciate your assistance in determining the nature and cause of the corrosion that lead to the failure of these saddles. Please inspect the saddle and advise us in writing of your findings as soon as possible. Please call me if you have any comments or questions. I can be reached at 360-834-3451.

Sincerely,

James M. Hodges

James Hodges
Engineer III

Enclosure

CC: Mark Wubben
US Filter
Jim Anderson
Monte Brachmann

RECD 12/31/01

MDE Engineers, Inc.

December 5, 2001

Mr. Cline Reese
Quality Assurance Manager
Romac Industries
21919 - 20th Avenue S.E., Suite 100
Bothell, WA 98021-4404

Re: 304 Stainless Steel Service Saddle Failure Analysis Report
City of Camas, Jim Hodges
Job: # 12001

Dear Mr. Reese:

In our last conversation, you asked for a report on the investigation of the referenced saddle failure. You indicated the part was returned on a pvc pipe which was removed from a step sewer system in Camas, Washington. The part was returned to you for analysis, where in you sent it to us for a third party investigation of the cause or determination of the source of degradation.

Our investigation included initially evaluating the surfaces for the failure mechanism and process. Then we evaluated the media and manufacturing to determine if they influenced the process in any way. A stereomicroscope and compound microscope were utilized to perform the investigation, while long-term microbiological tests were performed to determine if any microbes were present in the corrosion product/media.

The part was designed and shown to fit a pipe 4.50"-4.80" and was manufactured and QC stamped on 8/6/94. The chemical passivation of the part appeared to be proper as shown by the surface structure at 10X. The GTAW welding of the tapped outlet showed no obvious defects. Testing of the weld microstructure was not performed due to the degradation being outside the HAZ(heat affected zone).

The degradation occurred primarily on the internal surface between the gasket and ½ coupling. Though corrosion of stainless steel can burrough it's way from the outside inward, there was no indication of a corrosion process on the exterior surface, indicating the source of the failure was inside the saddle and piping system. Corrosion product was removed and cultured for one week to determine if microbiologically influenced corrosion (MIC) played any part in the degradation.

The MIC tests were found positive for aerobic bacteria, iron reducing bacteria, and sulfate reducing bacteria (SRB). The short rods, some forming chains along debris from the innoculum or small groups of cells are the growth of the SRB. These are shown in the attached photographs.

700 South Industrial Way Seattle, Washington 98108-5231 206/622-2007 • Fax 206/622-2248

This MIC corrosion mechanism appears to be the cause of this failure. Other mechanisms, such as; work hardening from overbending or overtorque causing anodic regions, crevices producing stagnant conditions and/or stress corrosion cracking may have influenced or accelerated the process, but it appears the MIC was predominate in the degradation mode. The microbes causing MIC can be found is some sewer systems.

If you would like to discuss these results further, please call me anytime.

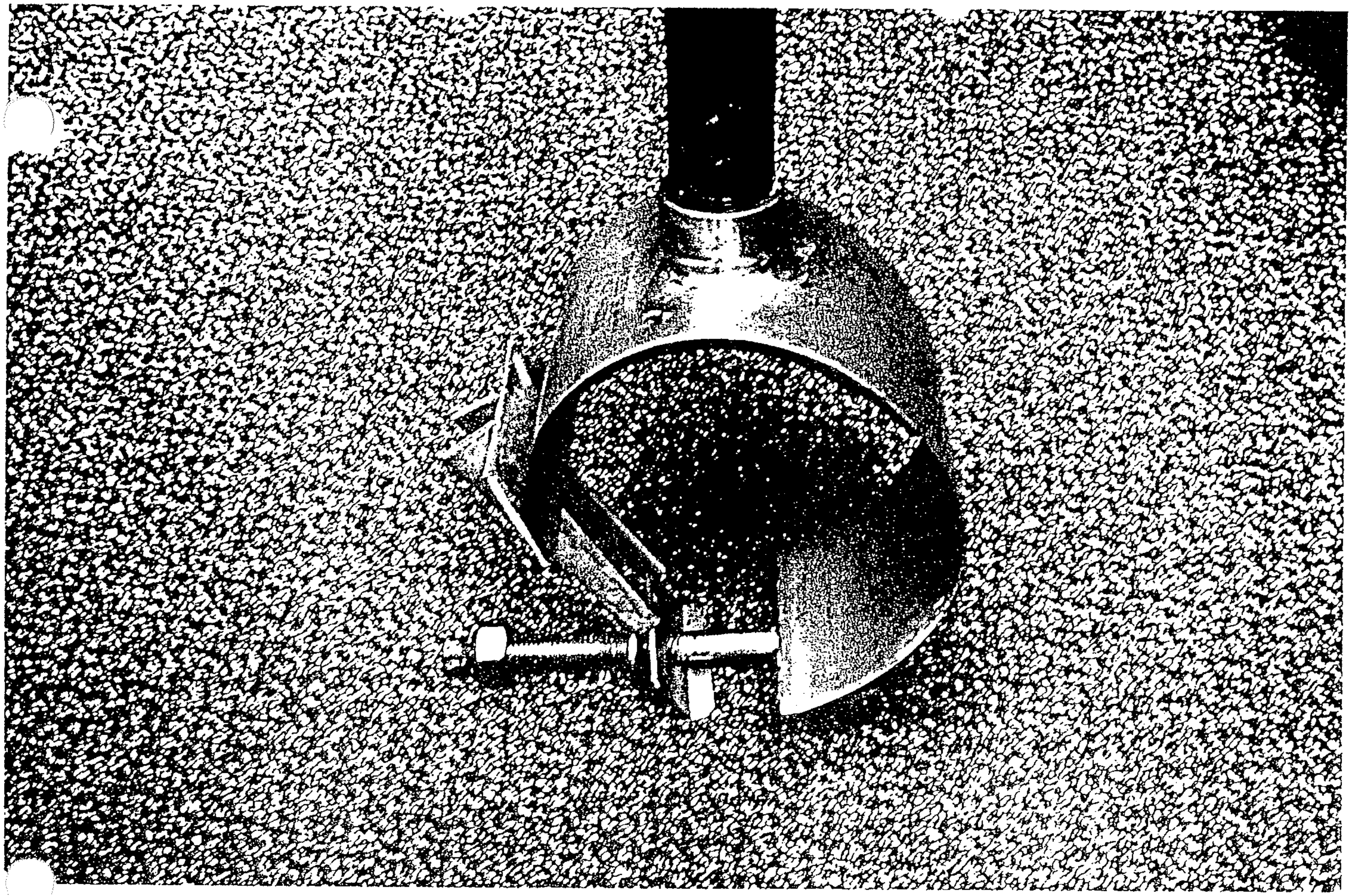
Sincerely,
MDE Engineers, Inc.

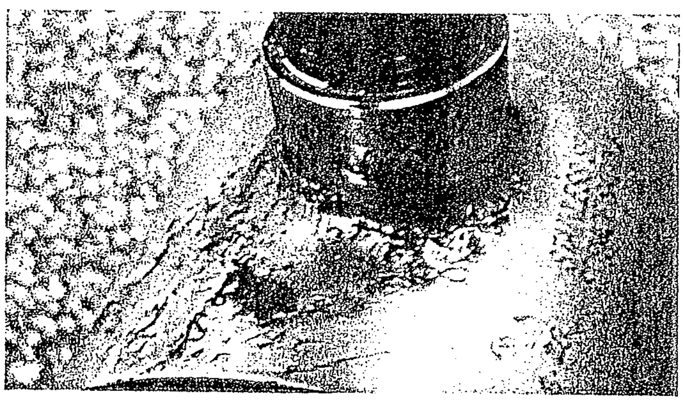
Randy K. Kent, P.E.
Vice-President/Metallurgical Engineer
e-mail: kent@mde.com

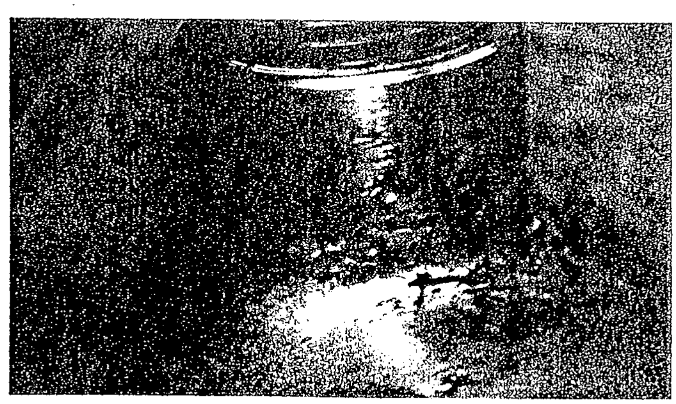
EXPIRES: 11/07/03

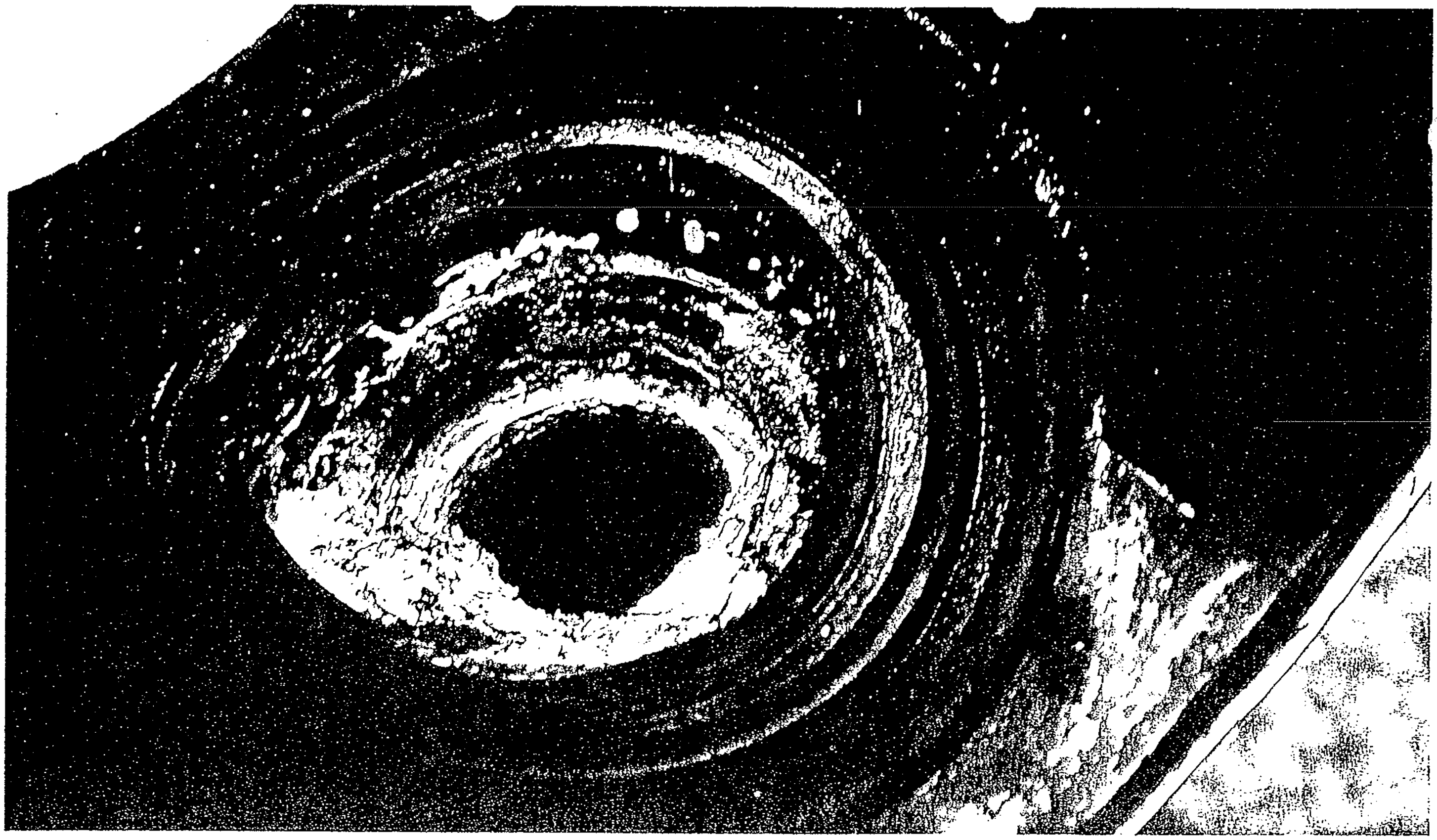
attachments: *Photographs and Photomicrographs (4)*

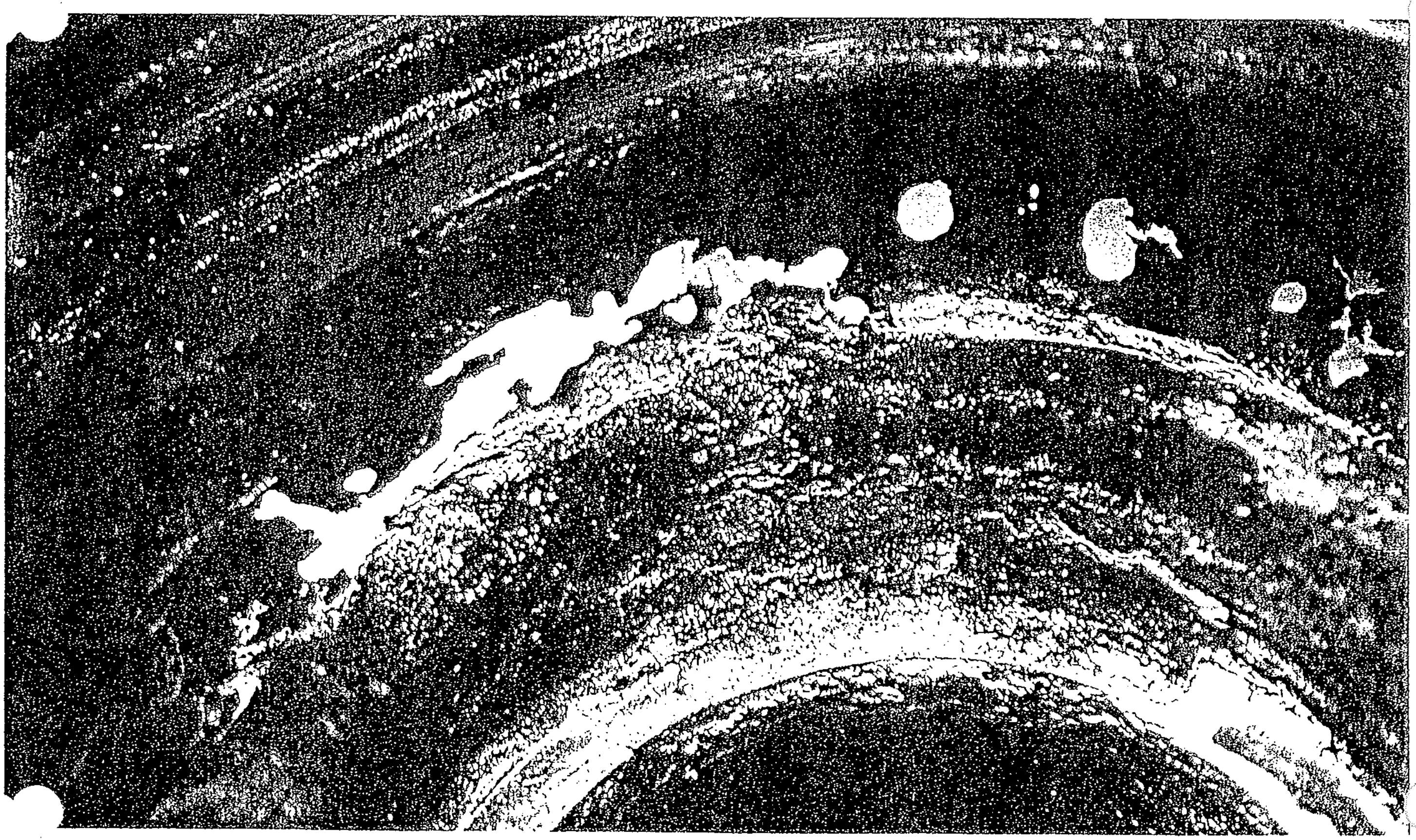
12/6/01
Reviewed by

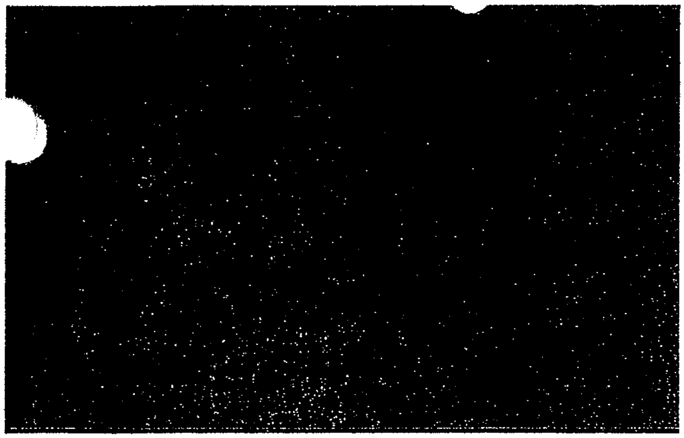
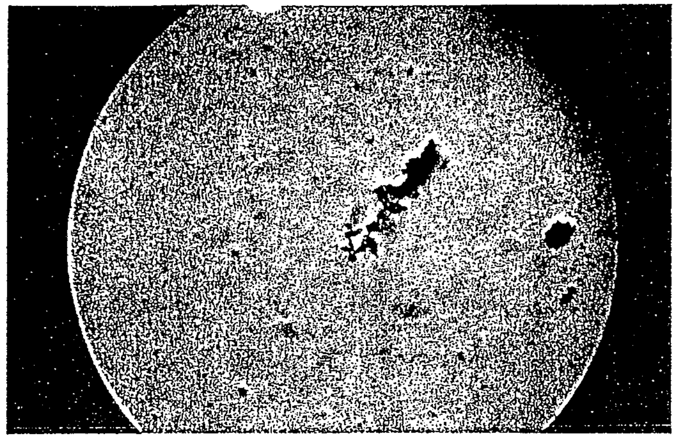
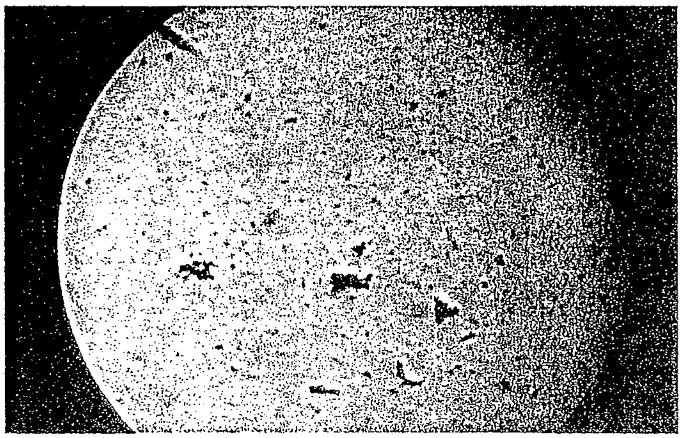
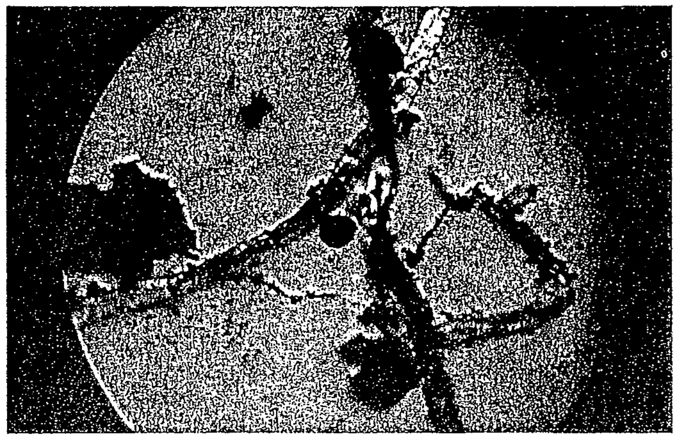
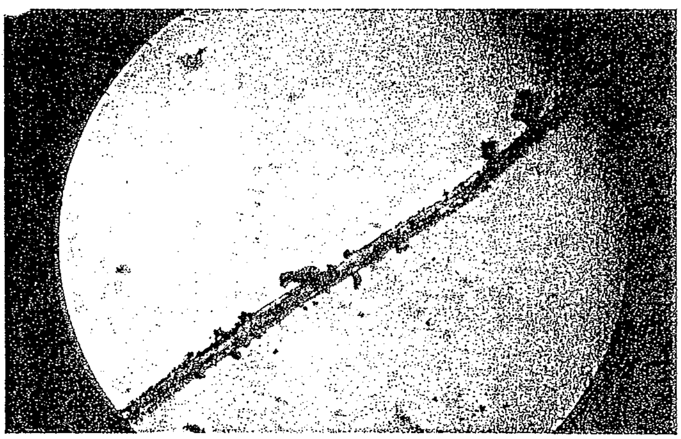
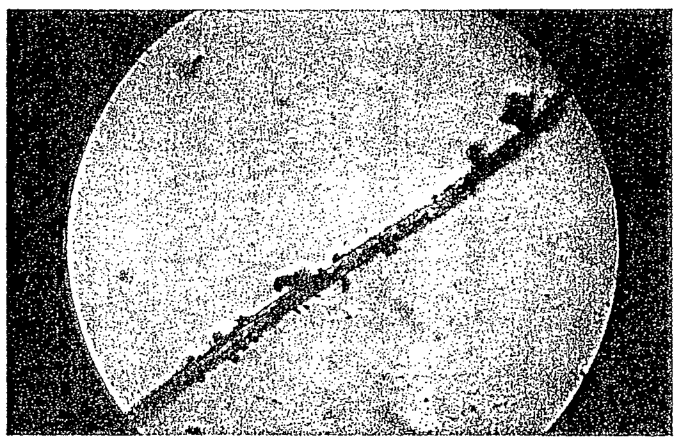
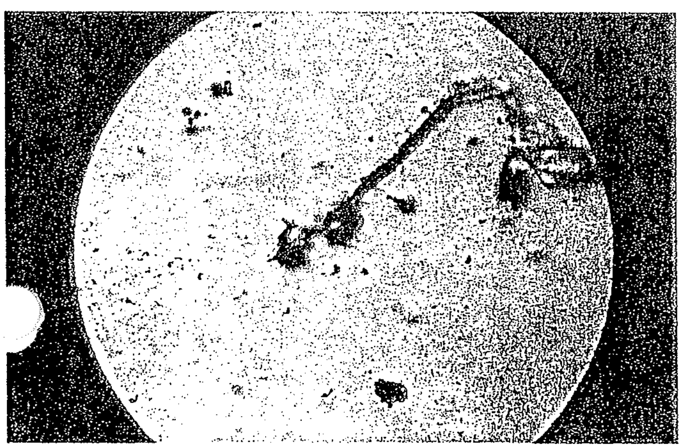
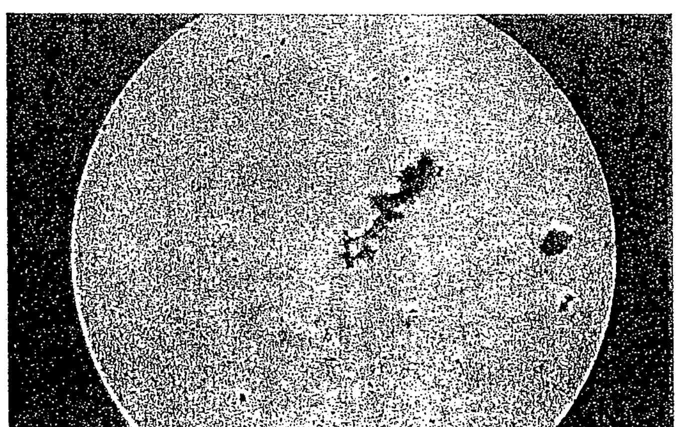


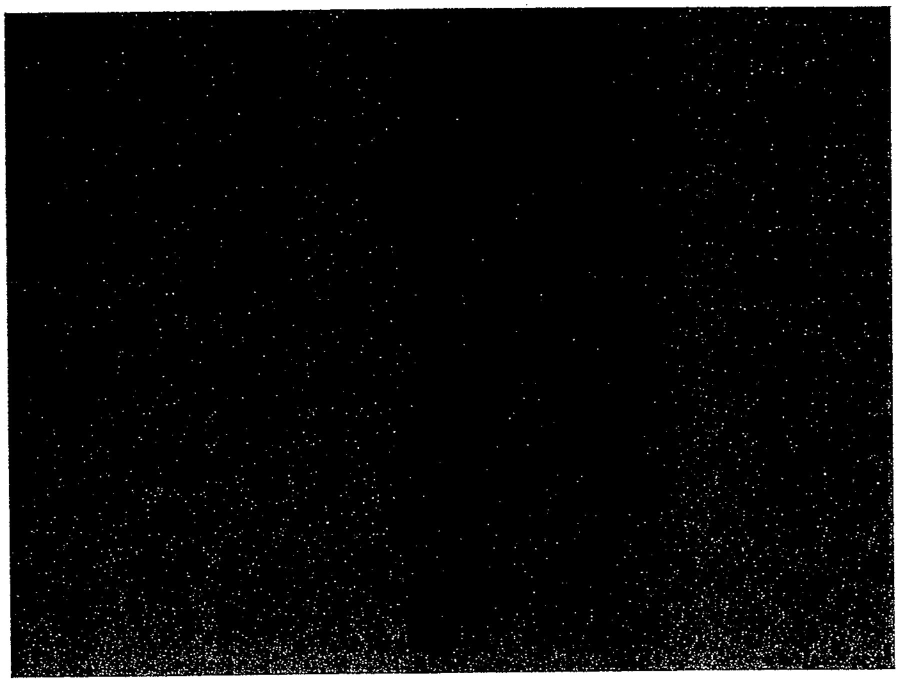
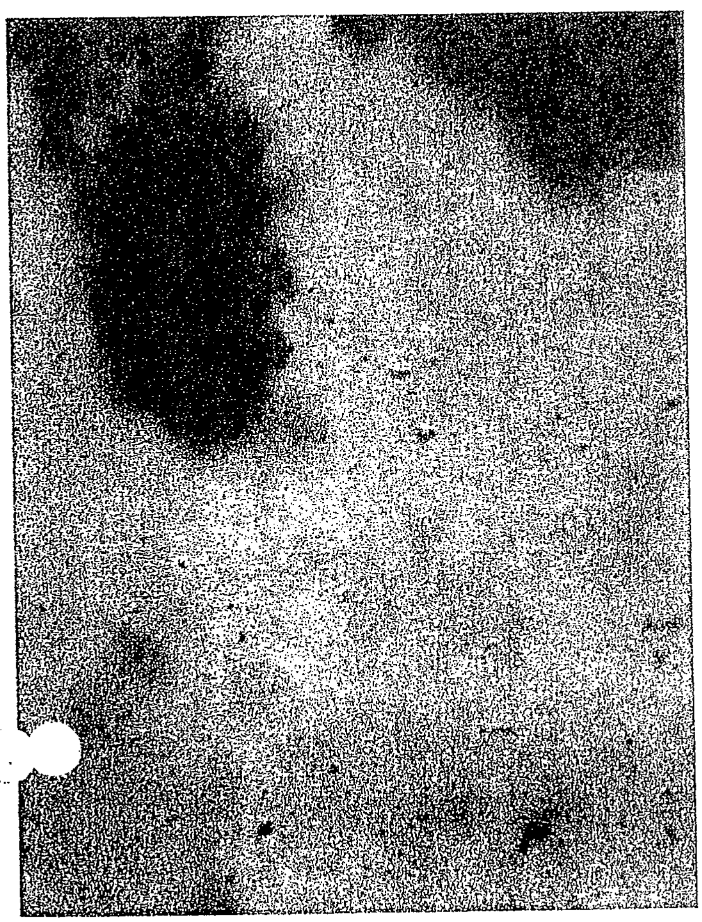
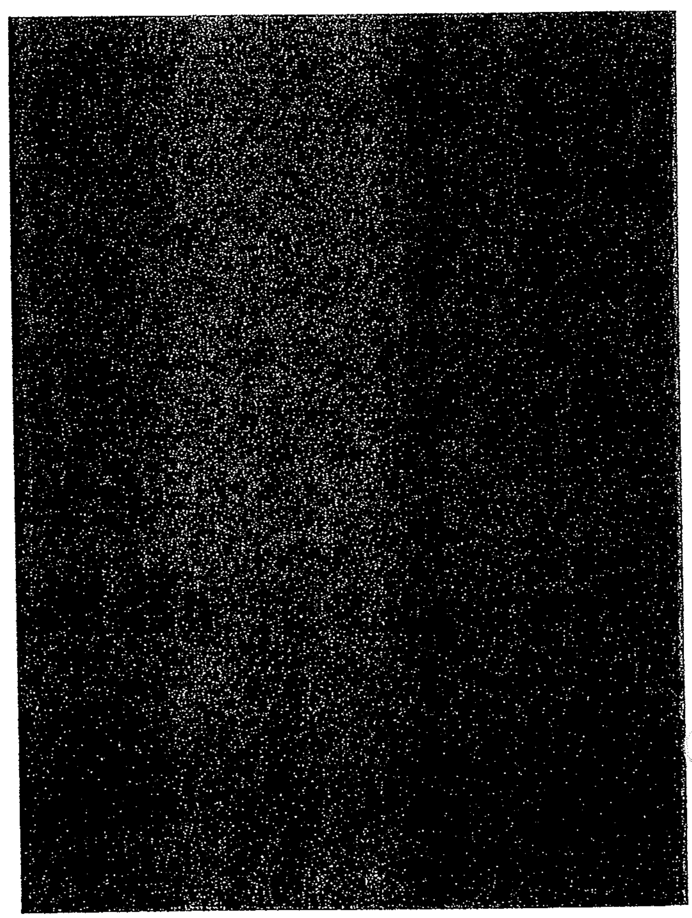








ROMAC
INDUSTRIES,
INC.

21919 20th Ave. SE Suite 100
Bothell, Washington 98021-4404

Hays fluid controls

Transmate
a Division of Romac Industries, Inc.

RMA QA Report

Customer **City of Camus**

Camus , Washington

RMA Number 55857 *QA Number* 710-10

Number PartsReturned 1

Product Descriptions 304 4.80 x 1" IP Saddle

QA Report Analysis

QA Report Conclusion

Please see the attached report from the 3rd party lab analysis.

C. Reese
QA Technician

Cline M. Reese - QA Manager

Wednesday, December 19, 2001

PHONE (425) 951-6200 • TOLL FREE 1-800-426-9341 • FAX NUMBER (425) 951-6201

MDE Engineers, Inc.

December 5, 2001

Mr. Cline Reese
Quality Assurance Manager
Romac Industries
21919 - 20th Avenue S.E., Suite 100
Bothell, WA 98021-4404

Re: 304 Stainless Steel Service Saddle Failure Analysis Report
City of Camas, Jim Hodges
Job: # 12001

Dear Mr. Reese:

In our last conversation, you asked for a report on the investigation of the referenced saddle failure. You indicated the part was returned on a pvc pipe which was removed from a step sewer system in Camas, Washington. The part was returned to you for analysis, where in you sent it to us for a third party investigation of the cause or determination of the source of degradation.

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If you would like to discuss these results further, please call me anytime.

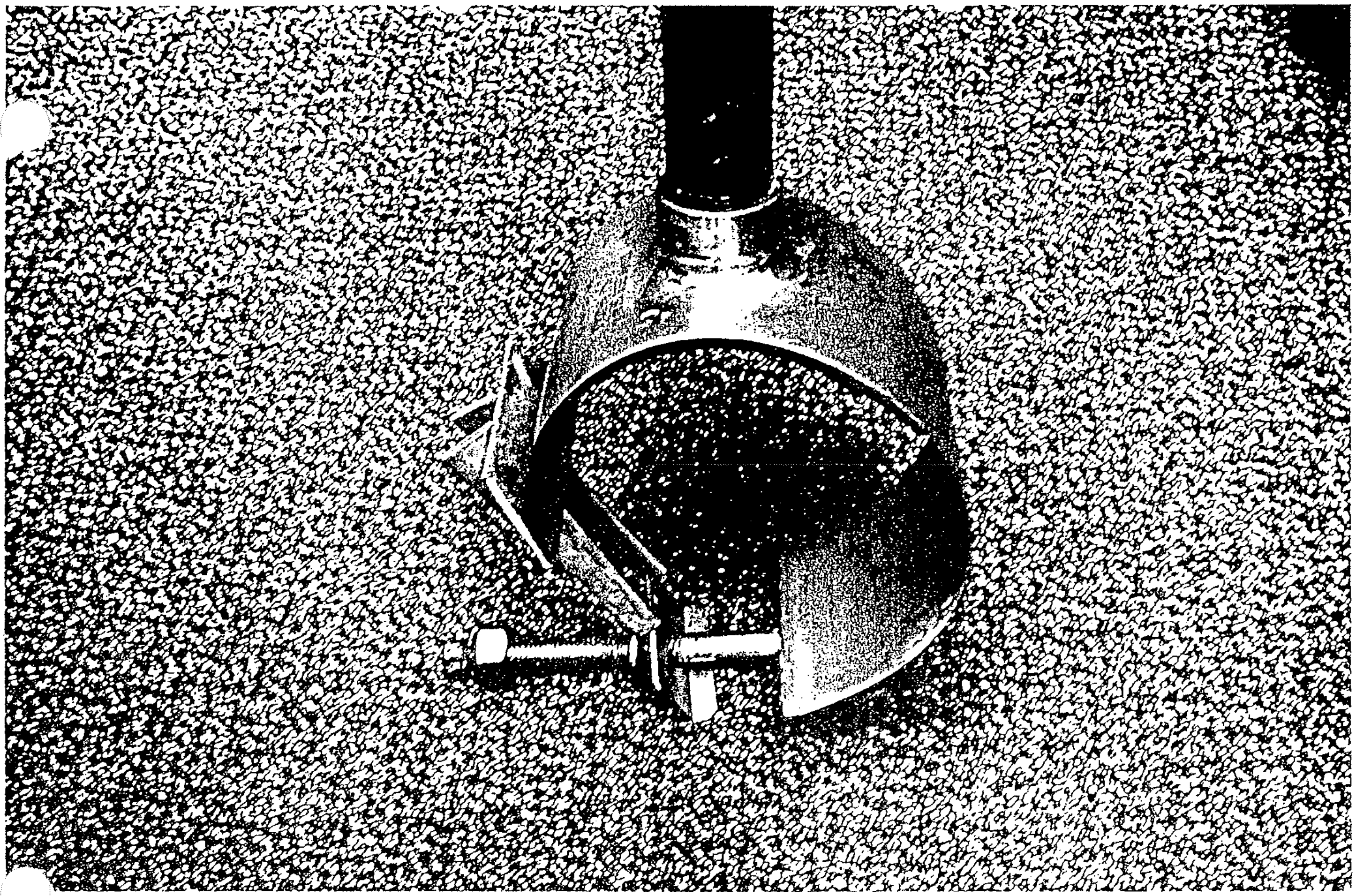
Sincerely,
MDE Engineers, Inc.

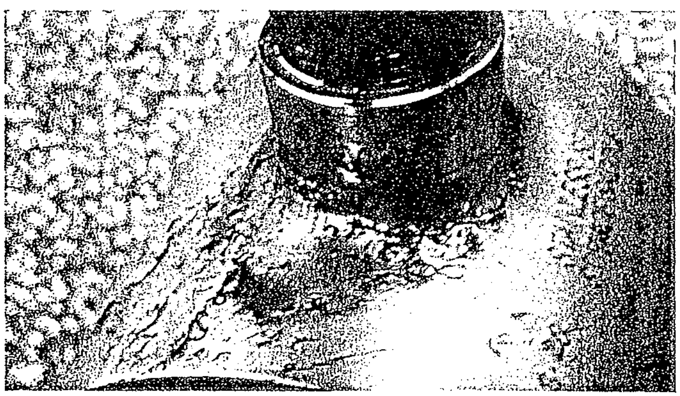
Randy K. Kent, P.E.
Vice-President/Metallurgical Engineer
e-mail: kent@mde.com

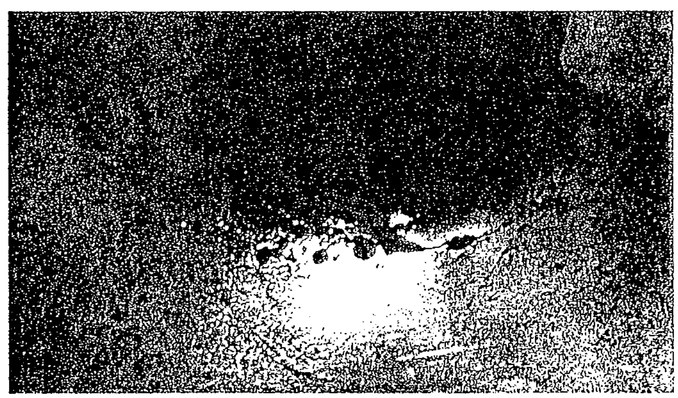
IRES: 11/0[illegible]/03

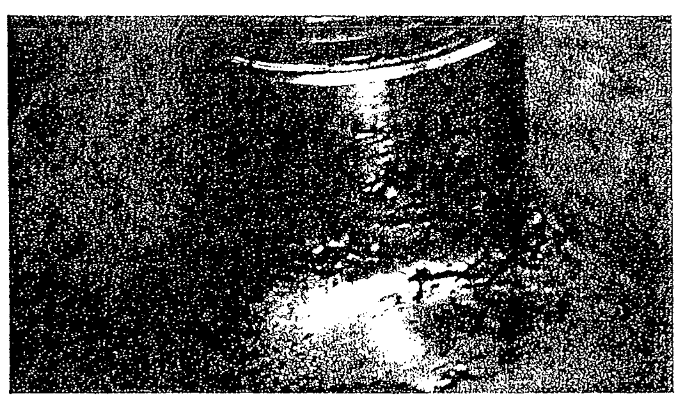
attachments: Photographs and Photomicrographs (4)

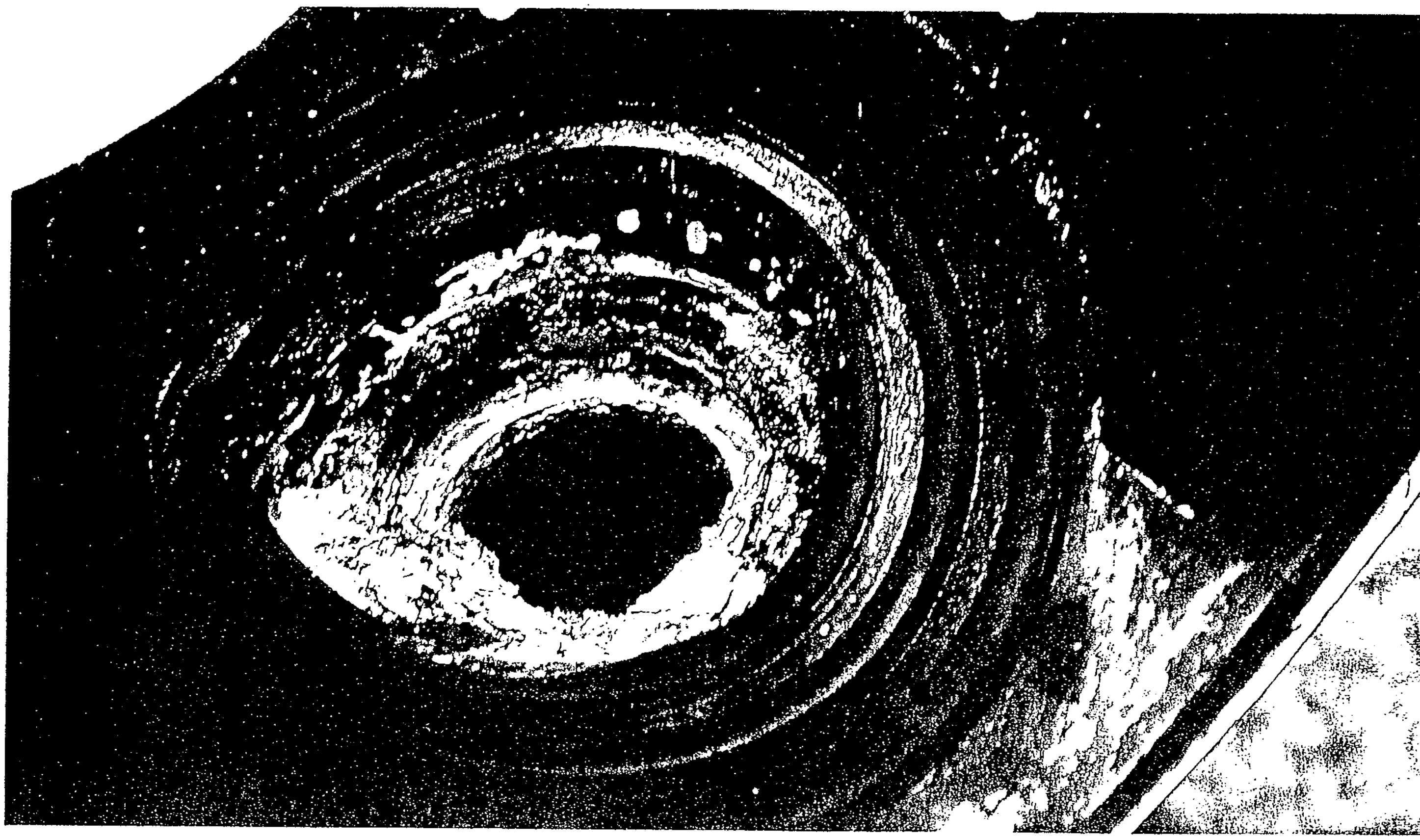
12/6/01
Reviewed by

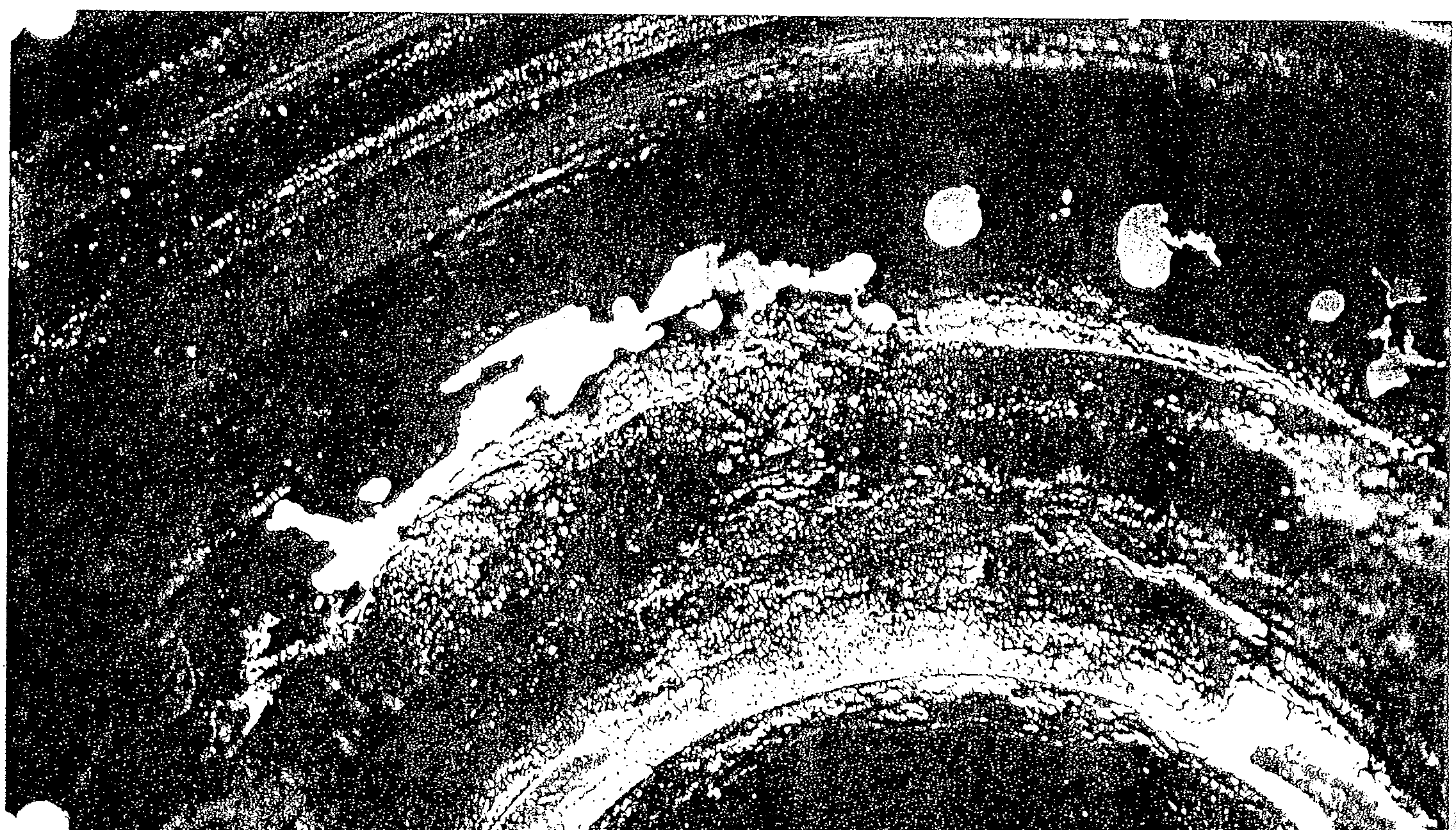


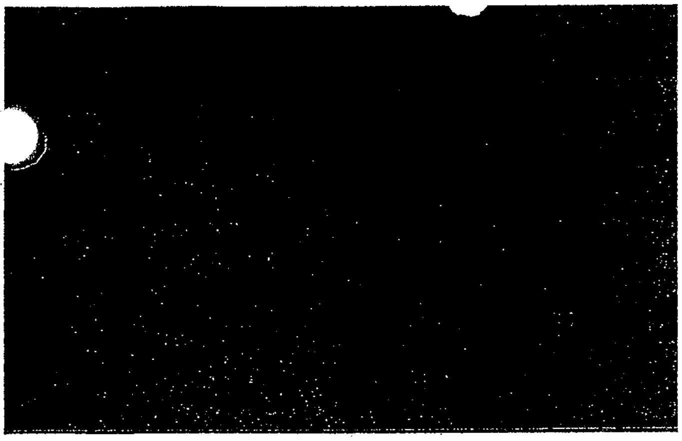
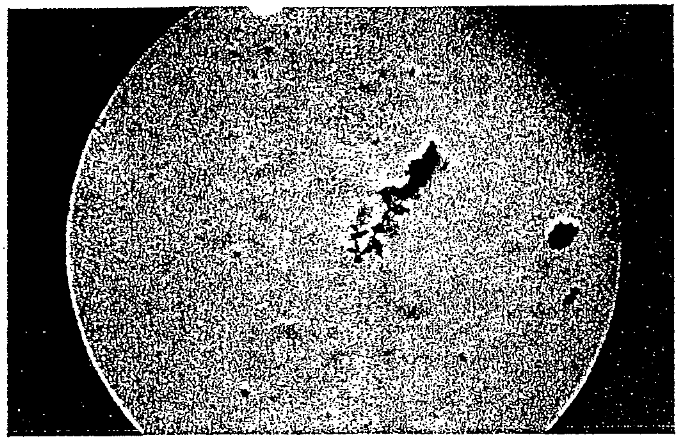
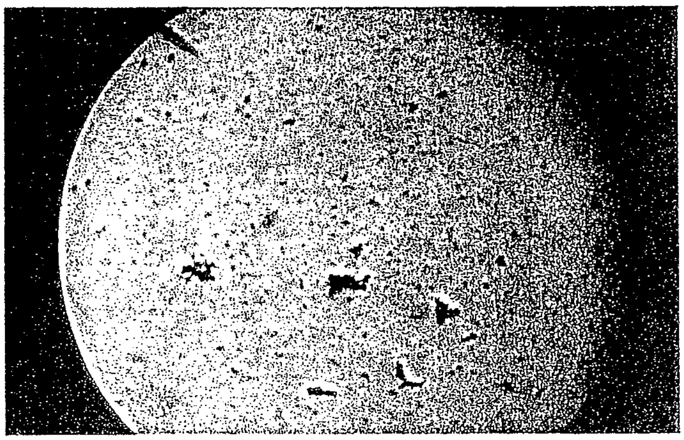


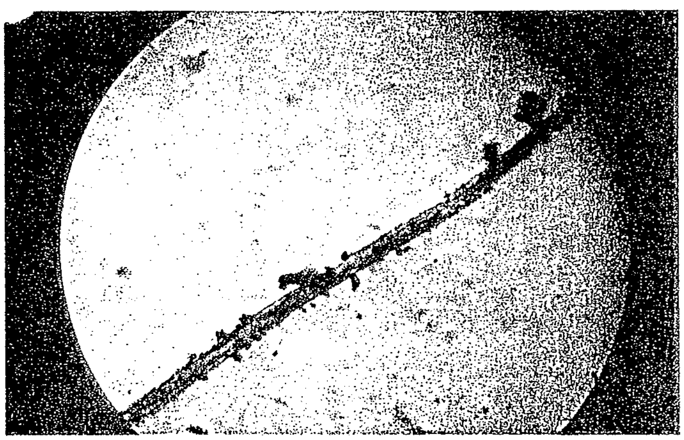
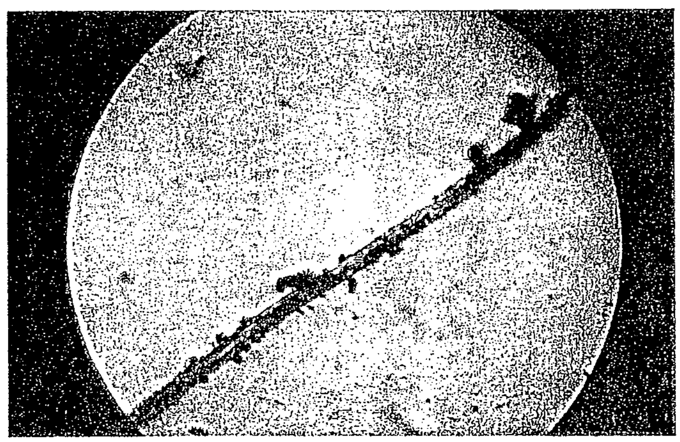
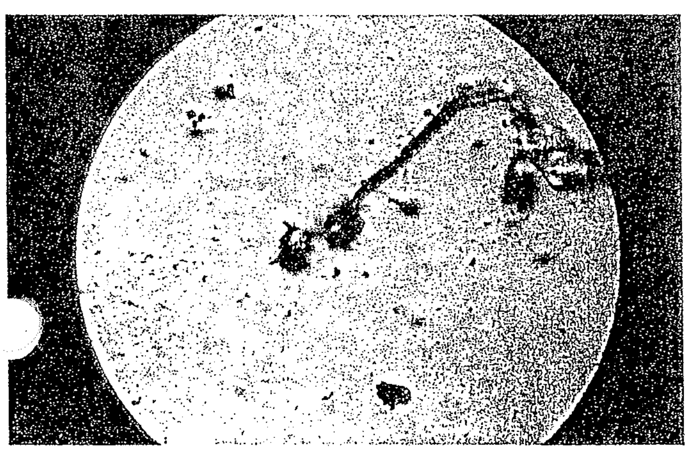
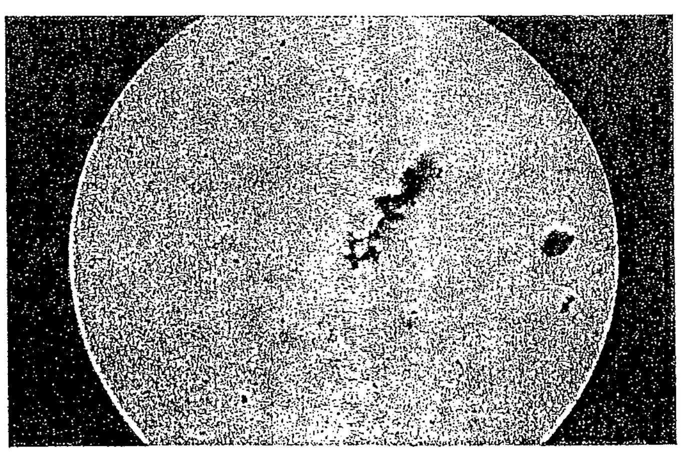


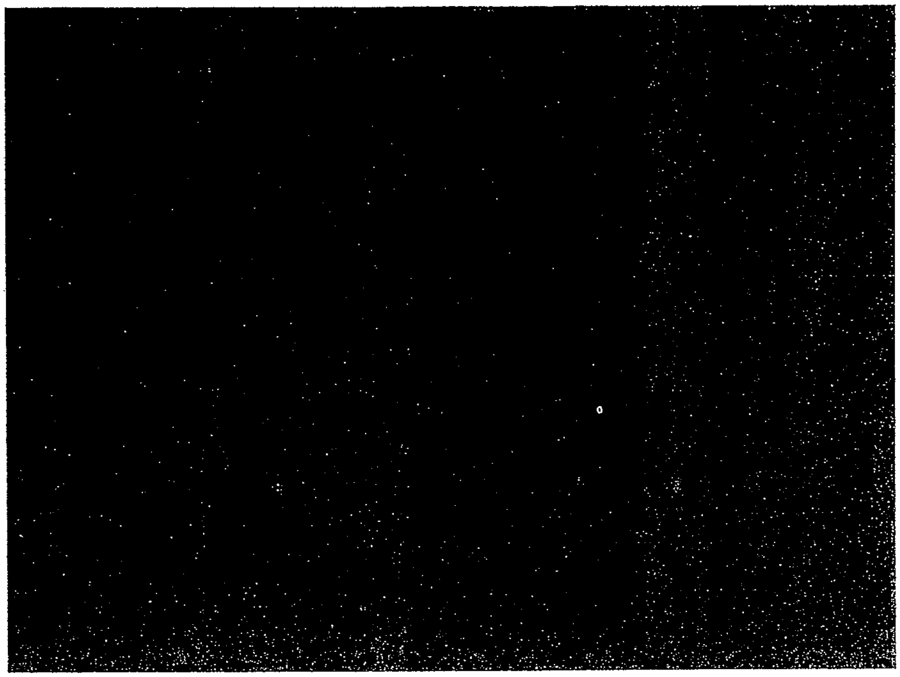


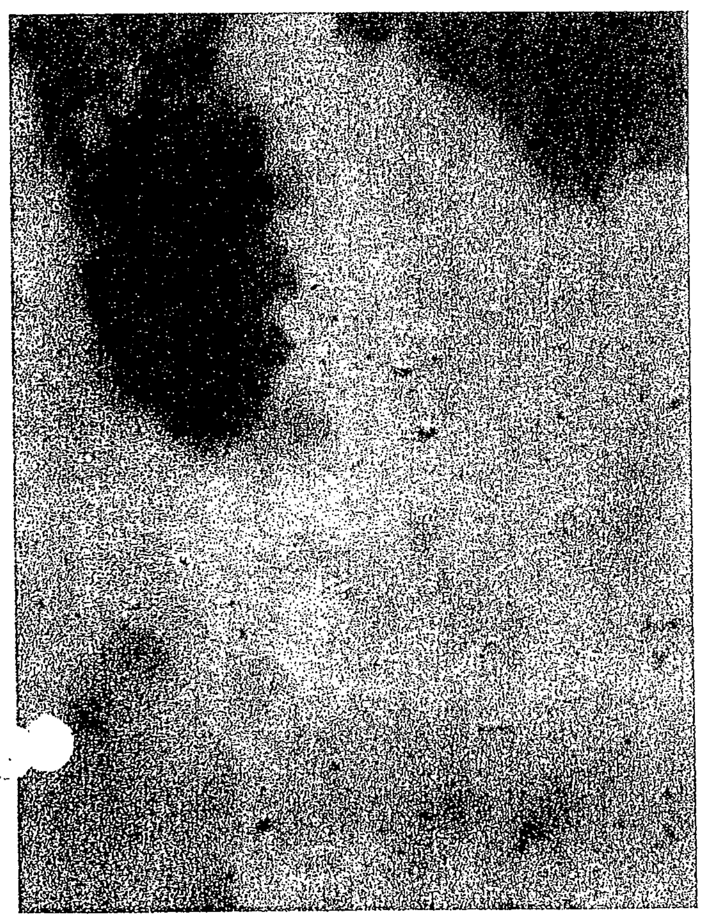


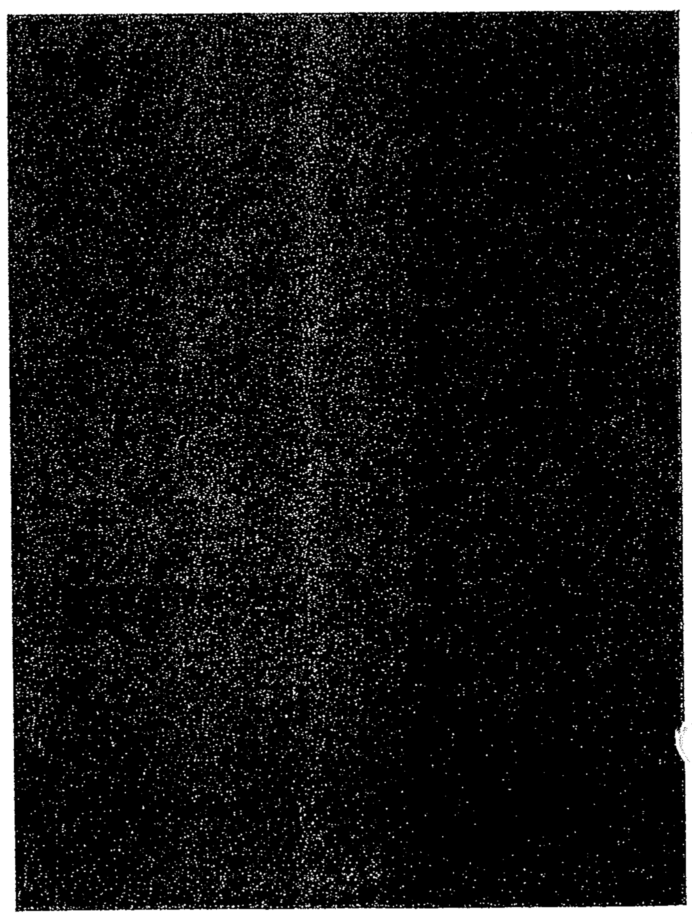








From: Jim Hodges
To: kent@mde.com
Date: 1/2/02 9:50AM
Subject: Job # 12001

To Randy Kent, P.E.

Dear Mr. Kent:

I just received a copy of your company's analysis of a 304 SS saddle that we returned to Romac for evaluation. The City of Camas currently has a few thousand of these saddles in use on our STEP sewer collection system. The saddle that you received for analysis is one of 4 that have failed in recent months. To my knowledge, we have not had this type of failure before All four of the failures have occurred in an isolated area. The HGL of the affected STEP main has recently been increased by some piping changes. Prior to the increased HGL, we believe that the main was only partially full of liquid in the area of the failures. The increased pressure in the main caused leaks to develop, which were investigated, revealing the failed saddles. Based on this scenario, can you answer the following questions?

1) In your report you note the presence of aerobic bacteria, iron reducing bacteria, and sulfate reducing bacteria; and cite this as the corrosion mechanism. Will the presence of trapped air in a system produce conditions favorable for their growth?

2) Can they grow in an anaerobic environment?

3) Do they spread easily? Should we expect similar failures in other parts of our system?

4) How difficult is it to test for these types of conditions in our system?

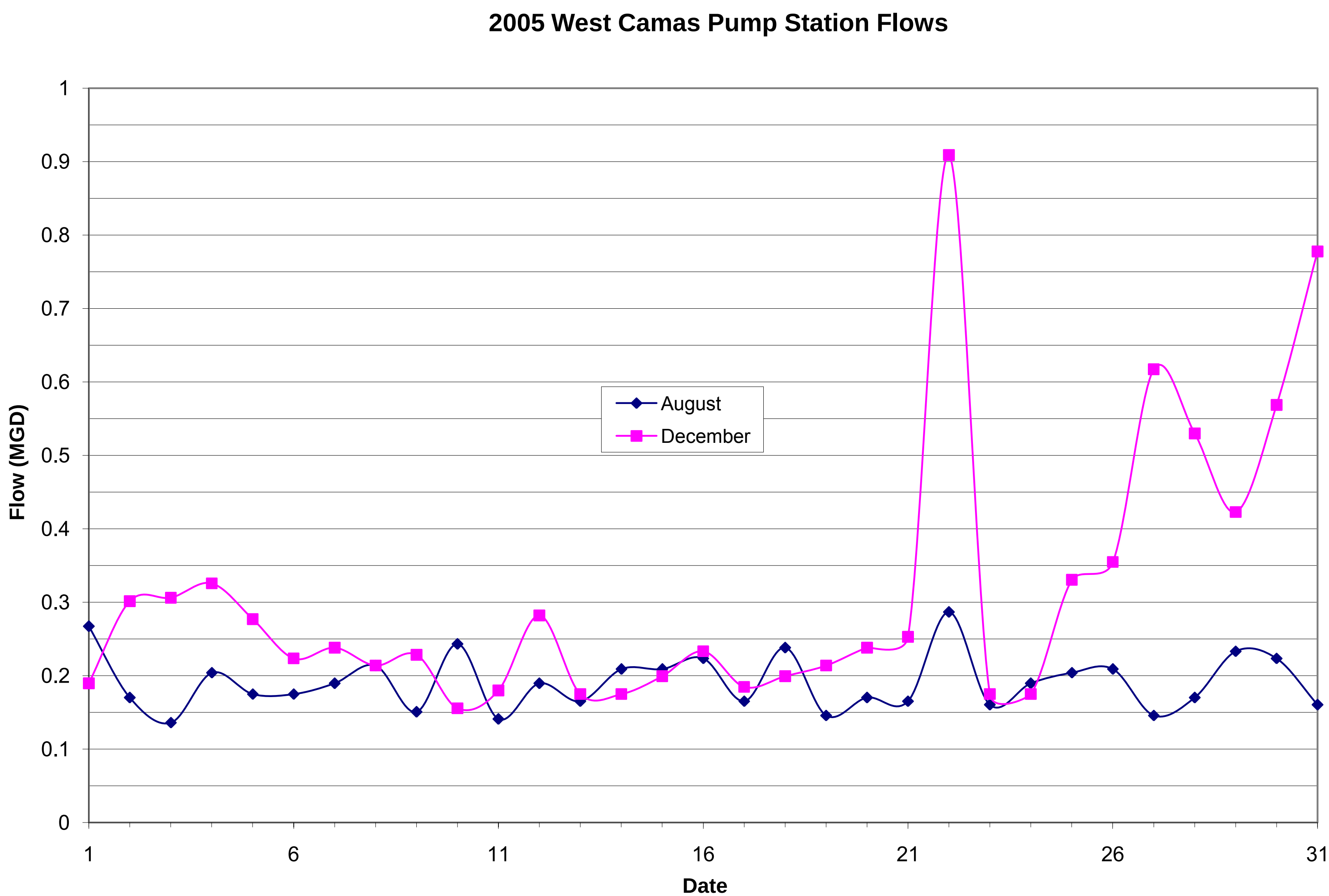
5) Is it feasible for the City staff to collect samples for evaluation, submit them to a company similar to yours, and obtain information useful in predicting potential future problems?

6) Is there an easy solution to restricting the growth of these organisms in a closed sewage collection system?

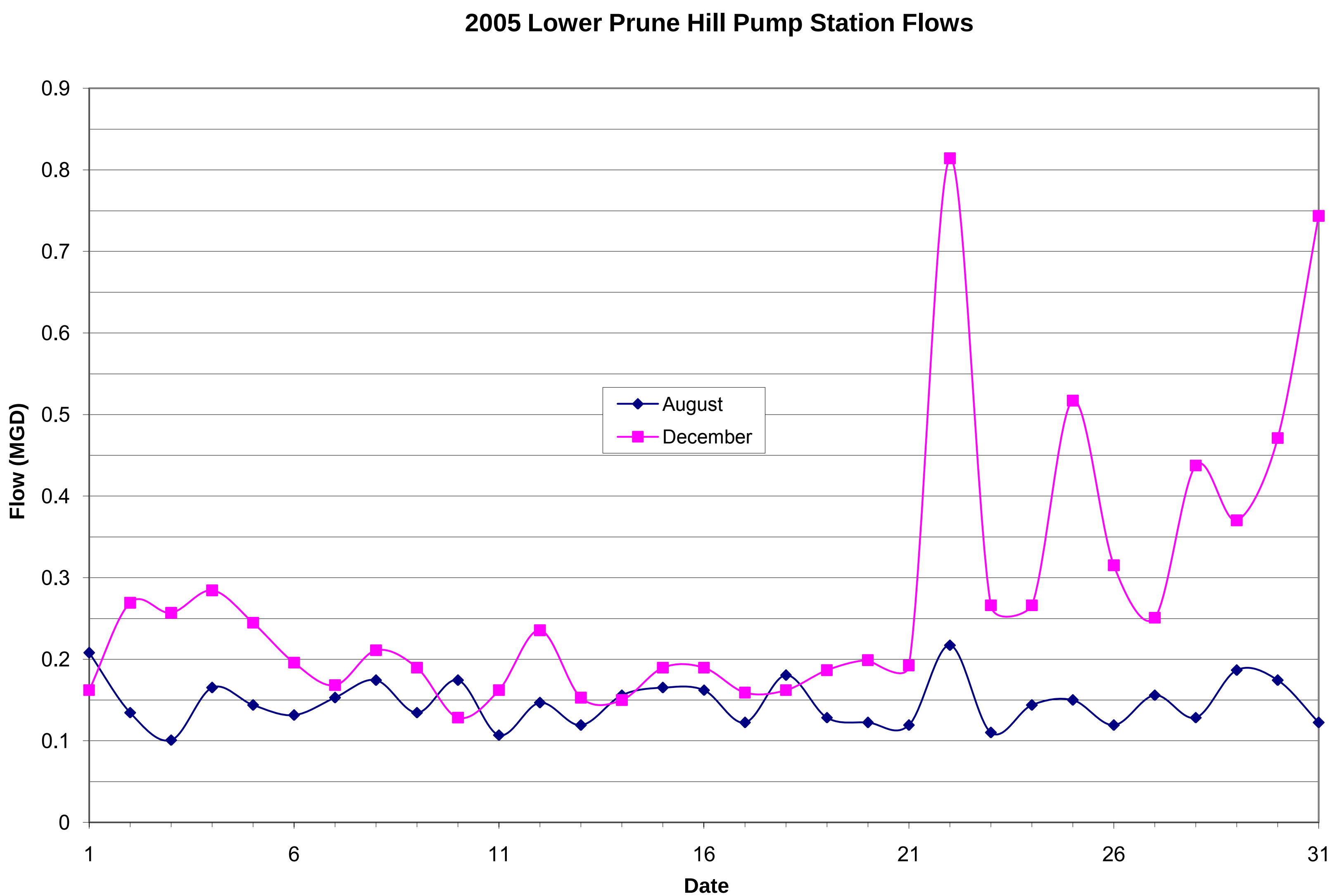
Any information you can give me will be appreciated. Thanks for your time. Please call me if it will aid in your response, or if you have any questions.

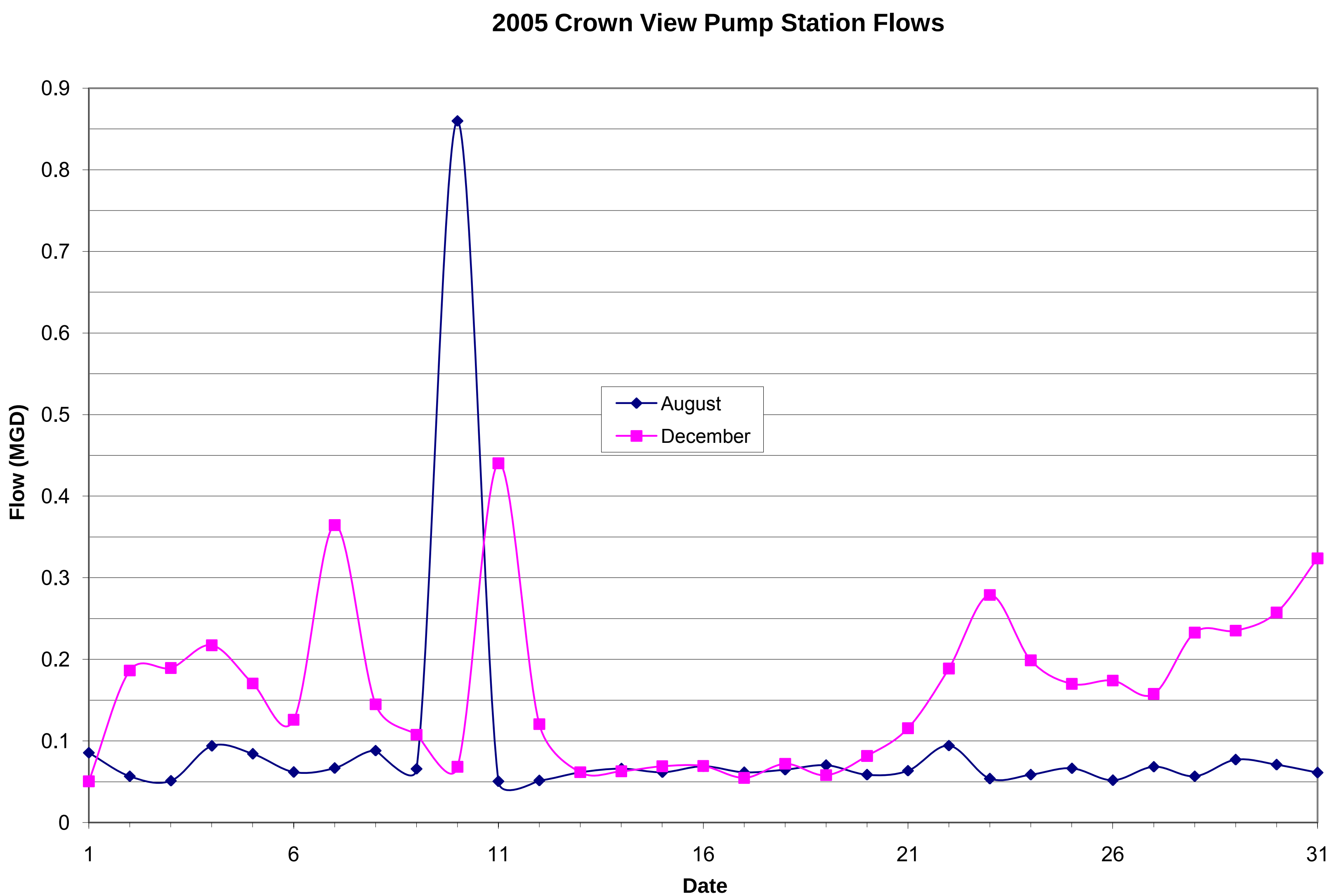
APPENDIX I

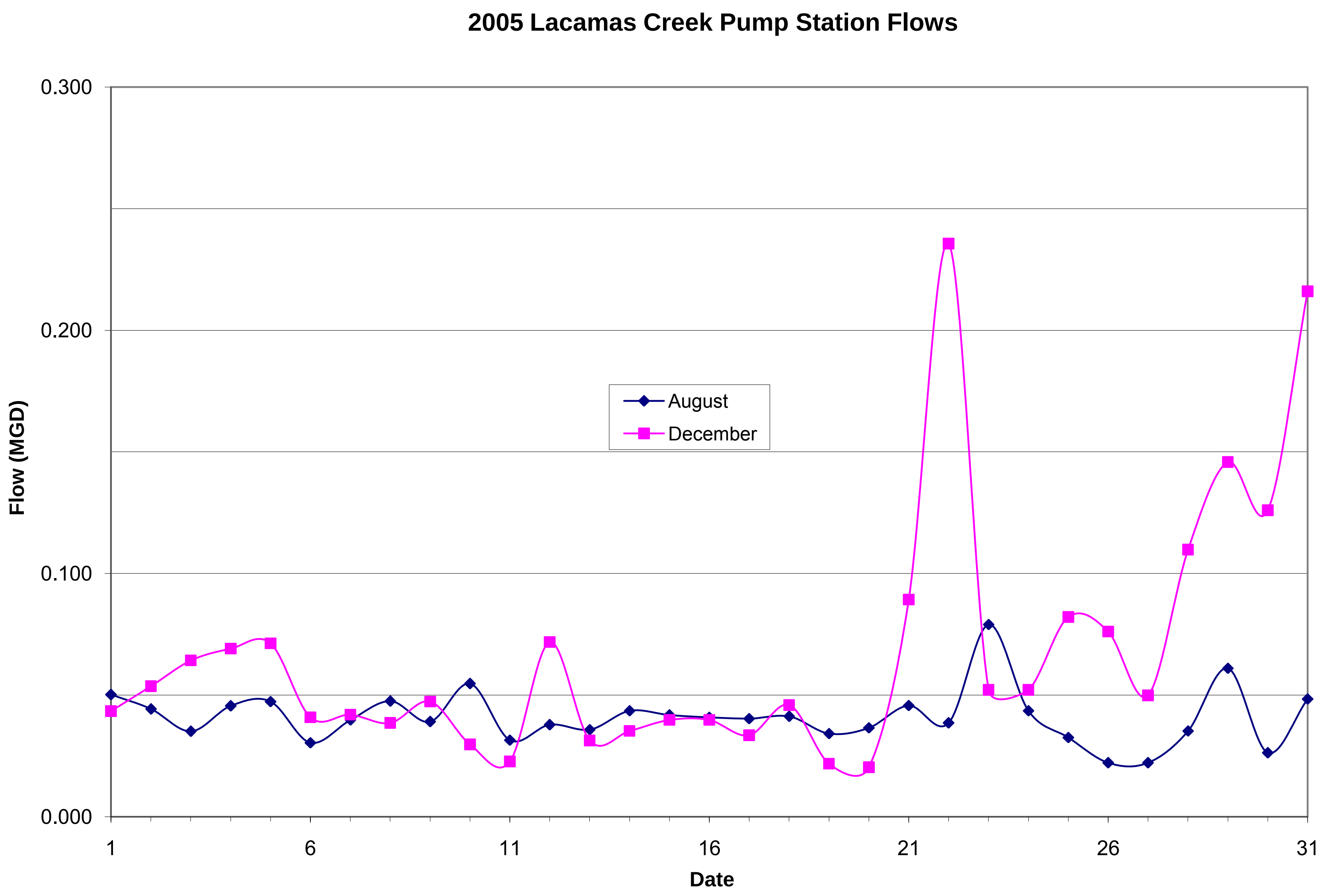
PUMP STATION RUN-TIME DATA

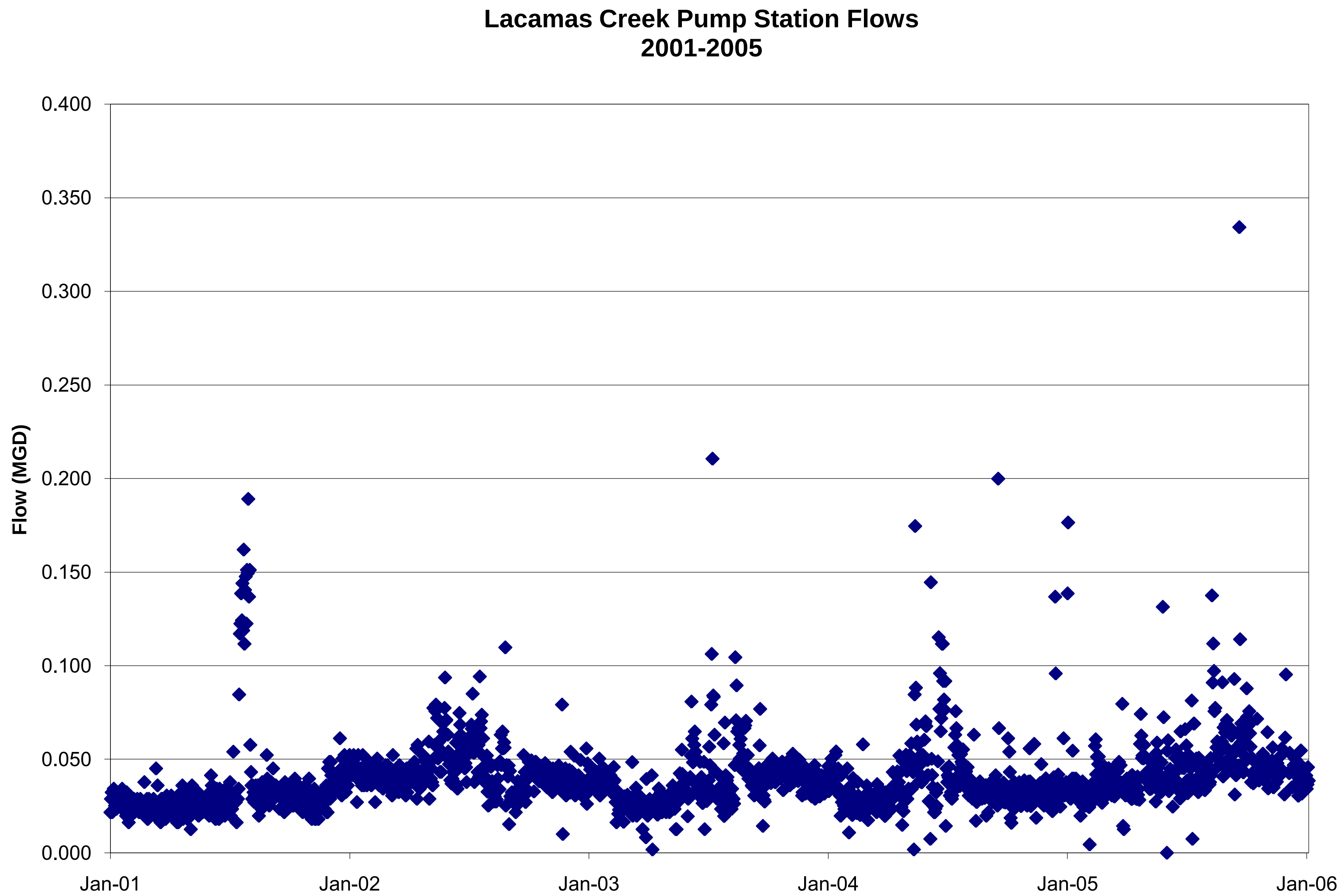


2005 West Camas Pump Station Flows
August
December
Flow (MGD)
Date
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1
6
11
16
21
26
31


2005 Lower Prune Hill Pump Station Flows
Flow (MGD)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
6
11
16
21
26
31
Date
August
December


2005 Crown View Pump Station Flows
Flow (MGD)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
6
11
16
21
26
31
Date
August
December


2005 Lacamas Creek Pump Station Flows
Flow (MGD)
0.300
0.200
0.100
0.000
August
December
1
6
11
16
21
26
31
Date


Lacamas Creek Pump Station Flows
2001-2005
Flow (MGD)
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06

APPENDIX J

BASIN 11 FLOW PROJECTIONS – BRADY ROAD PUMP STATION

TECHNICAL MEMORANDUM

City of Camas
Basin 11 Flow Projections
Brady Road Pump Station

TO:	Monte Brachmann, Jim Hodges & Eric Levison, City of Camas
FROM:	Thomas Zerkel, P.E. & Jay Swift, P.E.
DATE:	June 30, 2006
SUBJECT:	Basin 11 Flow Projections Brady Road Pump Station
G&O #	05471

The Brady Road Pump Station serves Basin 11 in the southwest corner of Camas. The Brady Road Pump Station accepts STEP effluent from the Grand Ridge Pump Station to the southwest and individual STEP systems throughout Basin 11, and pumps the combined flows up Brady Road to NW Parker Street. Basin 11 excludes the area south of NW 18th Avenue and west of NW Beech Street; sewage from this area is conveyed into the Sharp Bypass Line that drains to Basin 10 to the Southeast. Basin 11 consists of approximately 411 acres, of which approximately 127 acres is developed, 73 acres is undeveloped and 211 acres is open space or undevelopable (including right of way). The means of conveyance within Basin 11 consist primarily of STEP, STEF and STEG systems consisting of 2-inch, 6-inch and 8-inch pipe. Although the system is primarily STEP, STEF and STEG, flow rates were developed assuming that the system behaved essentially as a gravity system. This assumption is based on the similarity in flow pattern of gravity flow to that from a large number of STEP tanks. The attached figure shows the basin.

The flows for the 60-acre “New R-10” area in the northwest corner of Basin 10 are projected assuming R-10 zoning, a minimum of 10,000 square feet per lot, resulting in a maximum of 261 lots. Flows from Basin 11 to the Brady Road Pump Station were projected for 2025, with and without the New R-10 area, using the “camparc” parcels shape file supplied by the City. All developed parcels within the basin were considered to be single ERUs and ascribed a flow of 149 gallons per day, the average daily flow per ERU as developed in Chapter 6 of the DRAFT *General Sewer / Wastewater Facility Plan.*

A peaking factor was used to determine the peak hour flow. The peaking factor for residential flows was calculated using an equation provided by the *1998 Department Of Ecology Criteria for Sewage Works Design* (Orange Book). The equation calculates a peaking factor based on population. As population increases, the peaking factor decreases to account for greater attenuation of flows in the presumed larger system.

$$PeakingFactor = \left(18 + \sqrt{Population/1000}\right) / \left(4 + \sqrt{Population/1000}\right)$$

Prune Hill Elementary School is located within the basin. The Department of Ecology ascribes a base flow of 10 gpd per student for schools with cafeterias but no showers, including infiltration. The school has a population of approximately 600 students. Assuming an 8-hour school day the flow was peaked by a factor of three. This is a conservative estimate of the flows as normal infiltration within the school system is also peaked.

Infiltration was added to the remainder of the basin based on the developed service area at a rate of 500 gallons per developed acre per day. This value is a conservative estimate based on the average I/I rate calculated for STEP areas in the *1998 I/I Study* adjusted to establish a peak hour I/I rate.

Future flows in the basin were developed utilizing the same 149 gallons per ERU. Undeveloped parcels within the basin were added to the service area assuming R-10 and R-12 zoning.

Table 1 summarizes the input data for the analysis, the resulting flows to the Brady Road Lift Station with and without the New R-10 area. Infiltration rates remain at 275 gallons per developed acre per day for the future flows.

TABLE 1
Brady Road Pump Station
Basin 11 Flow Projections

	Current	**R-10 Area**	**2025 w/ New R-10 Area**	**2025 w/o New R-10 Area**
Pop	1,388	706	2,982	2,276
Total Area	411[1]	60	461	411[1]
Developed Area (acres)	127	60	254	240
Residential Area (acres)	119	60	252	232
ERUs	514	261	1,104	910
Flow/ERU (gpd)	149	149	149	149
Ave Day Residential Flow (gpd)	77,000	39,000	165,000	126,000
Peak Factor	3.70	NA	3.44	3.54
Peak Hour Residential Flow (gpd)	286,000	NA	569,000	447,000
Peak Hour School (gpd)	18,000	NA	18,000	18,000
Peak Hour I/I (gpad)	500	NA	500	500
Peak Hour I/I (gpd)	63,700	NA	127,200	100,200
Total Peak Hour Flow (gpd)	368,000	NA	715,000	566,000
Total Peak Hour Flow (gpm)	256	NA	497	393
Total Dynamic Head [(2)] (ft)	133	NA	154	144

1. Includes right of ways.
2. Assumes 15 ft of station losses.

The Brady Road Pump Station is located at SE Brady Rd. and NW MacIntosh Rd. The pump station houses two (2) twenty horsepower effluent style pumps. Documentation of existing pump capacity was not available when this memo was prepared. Total dynamic head in the system at 2025, as provided in Table 1, is 154 feet including the “New R-10 area” in the analysis, and 144 feet not including the New R-10 area. It is projected that this basin will be built out prior to 2025.

APPENDIX K

COST ESTIMATES

Basin No.	1					
Proj. No.	1					
Pipe Size		8	10	15	21	24
Segment Length =			221	112	1081	
No of Side Sewers (Parcels) =			0	1	4	1
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 34,200		$ 34,200
2	Trench Safety Systems	LUMP SUM		$ 12,500		$ 12,500
3	Locate Existing Utilities	LUMP SUM		$ 8,200		$ 8,200
4	Erosion Control	LUMP SUM		$ 8,000		$ 8,000
5	Dewatering	LUMP SUM		$ 19,000		$ 19,000
6	Bypass Pumping	LUMP SUM		$ 18,100		$ 18,100
7	Sawcutting	2828	LF	$ 2		$ 5,656
8	Traffic Control	230	HR	$ 30		$ 6,900
9a	8" Gravity Sewer Main	0	LF	$ 70		$ -
9b	10" Gravity Sewer Main	221	LF	$ 80		$ 17,680
9c	15" Gravity Sewer Main	112	LF	$ 120		$ 13,440
9d	21" Gravity Sewer Main	1081	LF	$ 155		$ 167,555
9e	24" Gravity Sewer Main	0	LF	$ 190		$ -
9f	30" Gravity Sewer Main		LF	$ 236		
10	Side Sewer	6	EA	$ 1,000		$ 6,000
11	48" Manhole	6	EA	$ 4,500		$ 27,000
12	Asphalt	400	TN	$ 110		$ 44,000
13a	Gravel Backfill (8")	0	CY	$ 15		
13b	Gravel Backfill (10")	100	CY	$ 15		$ 1,500
13c	Gravel Backfill (15")	60	CY	$ 15		$ 900
13d	Gravel Backfill (21")	650	CY	$ 15		$ 9,750
13e	Gravel Backfill (24")	0	CY	$ 15		$ -
13f	Gravel Backfill (30")	0	CY	$ 15		$ -
14a	CDF (8")	0	CY	$ 75		$ -
14b	CDF (10")	100	CY	$ 75		$ 7,500
14c	CDF (15")	60	CY	$ 75		$ 4,500
14d	CDF (21")	650	CY	$ 75		$ 48,750
14e	CDF (24")	0	CY	$ 75		$ -
14f	CDF (30")	0	CY	$ 75		$ -
	Subtotal					$ 461,131
	Tax @	7.9	%			$ 36,429
	Subtotal					$ 497,560
	Contingency (20%)..					$ 99,512
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 597,072
	Engineering and Administrative Costs (30%):..					$ 179,122
	TOTAL ESTIMATED PROJECT COST:..					$ 776,194

Basin No.	1					
Proj. No.	2					
Pipe Size		6	8	10	12	15
Segment Length =			1062			
No of Side Sewers (Parcels) =			21			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 19,300		$ 19,300
2	Trench Safety Systems	LUMP SUM		$ 7,100		$ 7,100
3	Locate Existing Utilities	LUMP SUM		$ 4,600		$ 4,600
4	Erosion Control	LUMP SUM		$ 4,500		$ 4,500
5	Dewatering	LUMP SUM		$ 10,700		$ 10,700
6	Bypass Pumping	LUMP SUM		$ 10,200		$ 10,200
7	Sawcutting	2124	LF	$ 2		$ 4,248
8	Traffic Control	170	HR	$ 30		$ 5,100
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	1062	LF	$ 70		$ 74,340
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	21	EA	$ 1,000		$ 21,000
11	48" Manhole	5	EA	$ 4,500		$ 22,500
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	480	CY	$ 15		$ 7,200
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	480	CY	$ 75		$ 36,000
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 259,788
	Tax @	7.9	%			$ 20,523
	Subtotal					$ 280,311
	Contingency (20%)…………………………………………………………………					$ 56,062
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 336,373
	Engineering and Administrative Costs (30%):...					$ 100,912
	TOTAL ESTIMATED PROJECT COST:..					$ 437,285

Basin No.	1					
Proj. No.	3					
Pipe Size		6	8	10	12	15
Segment Length =		34	1093			
No of Side Sewers (Parcels) =		0	28			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 20,600		$ 20,600
2	Trench Safety Systems	LUMP SUM		$ 7,500		$ 7,500
3	Locate Existing Utilities	LUMP SUM		$ 4,900		$ 4,900
4	Erosion Control	LUMP SUM		$ 4,800		$ 4,800
5	Dewatering	LUMP SUM		$ 11,400		$ 11,400
6	Bypass Pumping	LUMP SUM		$ 10,900		$ 10,900
7	Sawcutting	2186	LF	$ 2		$ 4,372
8	Traffic Control	190	HR	$ 30		$ 5,700
9a	6" Gravity Sewer Main	34	LF	$ 40		$ 1,360
9b	8" Gravity Sewer Main	1093	LF	$ 70		$ 76,510
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	28	EA	$ 1,000		$ 28,000
11	48" Manhole	5	EA	$ 4,500		$ 22,500
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill (6")	20	CY	$ 15		
13b	Gravel Backfill (8")	490	CY	$ 15		$ 7,350
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	20	CY	$ 75		$ 1,500
14b	CDF (8")	490	CY	$ 75		$ 36,750
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 277,142
	Tax @	7.9	%			$ 21,894
	Subtotal					$ 299,036
	Contingency (20%)……………………………………………………………					$ 59,807
	TOTAL ESTIMATED CONSTRUCTION COST:……………………………………					$ 358,843
	Engineering and Administrative Costs (30%):…………………………………					$ 107,653
	TOTAL ESTIMATED PROJECT COST:………………………………………………					$ 466,496

Basin No.	1					
Proj. No.	4					
Pipe Size		6	8	10	12	15
Segment Length =			845			
No of Side Sewers (Parcels) =			18			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 15,100		$ 15,100
2	Trench Safety Systems	LUMP SUM		$ 5,500		$ 5,500
3	Locate Existing Utilities	LUMP SUM		$ 3,600		$ 3,600
4	Erosion Control	LUMP SUM		$ 3,600		$ 3,600
5	Dewatering	LUMP SUM		$ 8,400		$ 8,400
6	Bypass Pumping	LUMP SUM		$ 8,000		$ 8,000
7	Sawcutting	1690	LF	$ 2		$ 3,380
8	Traffic Control	140	HR	$ 30		$ 4,200
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	845	LF	$ 70		$ 59,150
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	18	EA	$ 1,000		$ 18,000
11	48" Manhole	4	EA	$ 4,500		$ 18,000
12	Asphalt	200	TN	$ 110		$ 22,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	380	CY	$ 15		$ 5,700
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	380	CY	$ 75		$ 28,500
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 203,130
	Tax @	7.9	%			$ 16,047
	Subtotal					$ 219,177
	Contingency (20%)…………………………………………………………………					$ 43,835
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 263,012
	Engineering and Administrative Costs (30%):..					$ 78,904
	TOTAL ESTIMATED PROJECT COST:...					$ 341,916

Basin No.	1					
Proj. No.	5					
Pipe Size		6	8	10	12	15
Segment Length =			891			
No of Side Sewers (Parcels) =			15			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 15,300		$ 15,300
2	Trench Safety Systems	LUMP SUM		$ 5,600		$ 5,600
3	Locate Existing Utilities	LUMP SUM		$ 3,700		$ 3,700
4	Erosion Control	LUMP SUM		$ 3,600		$ 3,600
5	Dewatering	LUMP SUM		$ 8,500		$ 8,500
6	Bypass Pumping	LUMP SUM		$ 8,100		$ 8,100
7	Sawcutting	1782	LF	$ 2		$ 3,564
8	Traffic Control	150	HR	$ 30		$ 4,500
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	891	LF	$ 70		$ 62,370
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	15	EA	$ 1,000		$ 15,000
11	48" Manhole	4	EA	$ 4,500		$ 18,000
12	Asphalt	200	TN	$ 110		$ 22,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	400	CY	$ 15		$ 6,000
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	400	CY	$ 75		$ 30,000
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 206,234
	Tax @	7.9	%			$ 16,292
	Subtotal					$ 222,526
	Contingency (20%)……………………………………………………………					$ 44,505
	TOTAL ESTIMATED CONSTRUCTION COST:...					$ 267,031
	Engineering and Administrative Costs (30%):..					$ 80,109
	TOTAL ESTIMATED PROJECT COST:..					$ 347,140

Basin No.	2					
Proj. No.	1					
Pipe Size		8	12	15	21	30
Segment Length =			388		863	
No of Side Sewers (Parcels) =			0		20	
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 30,500		$ 30,500
2	Trench Safety Systems	LUMP SUM		$ 11,100		$ 11,100
3	Locate Existing Utilities	LUMP SUM		$ 7,300		$ 7,300
4	Erosion Control	LUMP SUM		$ 7,100		$ 7,100
5	Dewatering	LUMP SUM		$ 16,900		$ 16,900
6	Bypass Pumping	LUMP SUM		$ 16,100		$ 16,100
7	Sawcutting	2502	LF	$ 2		$ 5,004
8	Traffic Control	210	HR	$ 30		$ 6,300
9a	8" Gravity Sewer Main	0	LF	$ 80		$ -
9b	12" Gravity Sewer Main	388	LF	$ 100		$ 38,800
9c	15" Gravity Sewer Main	0	LF	$ 120		$ -
9d	21" Gravity Sewer Main	863	LF	$ 155		$ 133,765
9e	xx" Gravity Sewer Main		LF	$ 155		$ -
9f	30" Gravity Sewer Main	0	LF	$ 236		$ -
10	Side Sewer	20	EA	$ 1,000		$ 20,000
11	48" Manhole	6	EA	$ 4,500		$ 27,000
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill (8")	0	CY	$ 15		
13b	Gravel Backfill (12")	180	CY	$ 15		$ 2,700
13c	Gravel Backfill (15")	0	CY	$ 15		$ -
13d	Gravel Backfill (21")	520	CY	$ 15		$ 7,800
13e	Gravel Backfill (xx")	0	CY	$ 15		$ -
13f	Gravel Backfill (30")	0	CY	$ 15		$ -
14a	CDF (8")	0	CY	$ 75		$ -
14b	CDF (12")	180	CY	$ 75		$ 13,500
14c	CDF (15")	0	CY	$ 75		$ -
14d	CDF (21")	450	CY	$ 75		$ 33,750
14e	CDF (xx")	0	CY	$ 75		$ -
14f	CDF (30")	0	CY	$ 75		$ -
	Subtotal					$ 410,619
	Tax @	7.9	%			$ 32,439
	Subtotal					$ 443,058
	Contingency (20%)………..…...….……………………….…..………………………					$ 88,612
	TOTAL ESTIMATED CONSTRUCTION COST:...					$ 531,670
	Engineering and Administrative Costs (30%):...................................…...........					$ 159,501
	TOTAL ESTIMATED PROJECT COST:...					$ 691,171

Basin No.	2					
Proj. No.	2					
Pipe Size		8	12	15	18	21
Segment Length =			354		320	
No of Side Sewers (Parcels) =			12		6	
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 16,700		$ 16,700
2	Trench Safety Systems	LUMP SUM		$ 6,100		$ 6,100
3	Locate Existing Utilities	LUMP SUM		$ 4,000		$ 4,000
4	Erosion Control	LUMP SUM		$ 3,900		$ 3,900
5	Dewatering	LUMP SUM		$ 9,300		$ 9,300
6	Bypass Pumping	LUMP SUM		$ 8,800		$ 8,800
7	Sawcutting	1348	LF	$ 2		$ 2,696
8	Traffic Control	120	HR	$ 30		$ 3,600
9a	8" Gravity Sewer Main	0	LF	$ 80		$ -
9b	12" Gravity Sewer Main	354	LF	$ 100		$ 35,400
9c	15" Gravity Sewer Main	0	LF	$ 120		$ -
9d	18" Gravity Sewer Main	320	LF	$ 145		$ 46,400
9e	21" Gravity Sewer Main	0	LF	$ 155		$ -
9f	24" Gravity Sewer Main		LF	$ -		
10	Side Sewer	18	EA	$ 1,000		$ 18,000
11	48" Manhole	4	EA	$ 4,500		$ 18,000
12	Asphalt	200	TN	$ 110		$ 22,000
13a	Gravel Backfill (8")	0	CY	$ 15		
13b	Gravel Backfill (12")	160	CY	$ 15		$ 2,400
13c	Gravel Backfill (15")	0	CY	$ 15		$ -
13d	Gravel Backfill (18")	170	CY	$ 15		$ 2,550
13e	Gravel Backfill (21")	0	CY	$ 15		$ -
13f	Gravel Backfill (24")	0	CY	$ 15		$ -
14a	CDF (8")	0	CY	$ 75		$ -
14b	CDF (12")	160	CY	$ 75		$ 12,000
14c	CDF (15")	0	CY	$ 75		$ -
14d	CDF (18")	170	CY	$ 75		$ 12,750
14e	CDF (21")	0	CY	$ 75		$ -
14f	CDF (24")	0	CY	$ 75		$ -
	Subtotal					$ 224,596
	Tax @	7.9	%			$ 17,743
	Subtotal					$ 242,339
	Contingency (20%)…………………………………………………………					$ 48,468
	TOTAL ESTIMATED CONSTRUCTION COST:……………………………………					$ 290,807
	Engineering and Administrative Costs (30%):……………………………					$ 87,242
	TOTAL ESTIMATED PROJECT COST:…………………………………………					$ 378,049

Basin No.	3N					
Proj. No.	1					
Pipe Size		6	8	10	12	15
Segment Length =			2300			
No of Side Sewers (Parcels) =			32			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 39,000		$ 39,000
2	Trench Safety Systems	LUMP SUM		$ 14,200		$ 14,200
3	Locate Existing Utilities	LUMP SUM		$ 9,300		$ 9,300
4	Erosion Control	LUMP SUM		$ 9,100		$ 9,100
5	Dewatering	LUMP SUM		$ 21,700		$ 21,700
6	Bypass Pumping	LUMP SUM		$ 20,700		$ 20,700
7	Sawcutting	4600	LF	$ 2		$ 9,200
8	Traffic Control	370	HR	$ 30		$ 11,100
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	2300	LF	$ 70		$ 161,000
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	32	EA	$ 1,000		$ 32,000
11	48" Manhole	9	EA	$ 4,500		$ 40,500
12	Asphalt	600	TN	$ 110		$ 66,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	1030	CY	$ 15		$ 15,450
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	1030	CY	$ 75		$ 77,250
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 526,500
	Tax @	7.9	%			$ 41,594
	Subtotal					$ 568,094
	Contingency (20%)…………………………………………………………					$ 113,619
	TOTAL ESTIMATED CONSTRUCTION COST:...					$ 681,713
	Engineering and Administrative Costs (30%):......................................					$ 204,514
	TOTAL ESTIMATED PROJECT COST:...					$ 886,227

Basin No.	3N					
Proj. No.	2					
Pipe Size		6	8	10	12	15
Segment Length =			1432			
No of Side Sewers (Parcels) =			43			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 27,000		$ 27,000
2	Trench Safety Systems	LUMP SUM		$ 9,800		$ 9,800
3	Locate Existing Utilities	LUMP SUM		$ 6,500		$ 6,500
4	Erosion Control	LUMP SUM		$ 6,300		$ 6,300
5	Dewatering	LUMP SUM		$ 15,000		$ 15,000
6	Bypass Pumping	LUMP SUM		$ 14,300		$ 14,300
7	Sawcutting	2864	LF	$ 2		$ 5,728
8	Traffic Control	230	HR	$ 30		$ 6,900
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	1432	LF	$ 70		$ 100,240
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	43	EA	$ 1,000		$ 43,000
11	48" Manhole	6	EA	$ 4,500		$ 27,000
12	Asphalt	400	TN	$ 110		$ 44,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	640	CY	$ 15		$ 9,600
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	640	CY	$ 75		$ 48,000
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 363,368
	Tax @	7.9	%			$ 28,706
	Subtotal					$ 392,074
	Contingency (20%)…………………………………………………………					$ 78,415
	TOTAL ESTIMATED CONSTRUCTION COST:...					$ 470,489
	Engineering and Administrative Costs (30%):..					$ 141,147
	TOTAL ESTIMATED PROJECT COST:..					$ 611,636

Basin No.	3N					
Proj. No.	3					
Pipe Size		6	8	10	12	15
Segment Length =			1322			
No of Side Sewers (Parcels) =			36			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 24,000		$ 24,000
2	Trench Safety Systems	LUMP SUM		$ 8,800		$ 8,800
3	Locate Existing Utilities	LUMP SUM		$ 5,800		$ 5,800
4	Erosion Control	LUMP SUM		$ 5,600		$ 5,600
5	Dewatering	LUMP SUM		$ 13,400		$ 13,400
6	Bypass Pumping	LUMP SUM		$ 12,700		$ 12,700
7	Sawcutting	2644	LF	$ 2		$ 5,288
8	Traffic Control	220	HR	$ 30		$ 6,600
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	1322	LF	$ 70		$ 92,540
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	36	EA	$ 1,000		$ 36,000
11	48" Manhole	6	EA	$ 4,500		$ 27,000
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	590	CY	$ 15		$ 8,850
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	590	CY	$ 75		$ 44,250
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 323,828
	Tax @	7.9	%			$ 25,582
	Subtotal					$ 349,410
	Contingency (20%)……………………………………………………………					$ 69,882
	TOTAL ESTIMATED CONSTRUCTION COST:...					$ 419,292
	Engineering and Administrative Costs (30%):...					$ 125,788
	TOTAL ESTIMATED PROJECT COST:...					$ 545,080

Basin No.	3N					
Proj. No.	4					
Pipe Size		6	8	10	12	15
Segment Length =			1087			
No of Side Sewers (Parcels) =			34			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 20,800		$ 20,800
2	Trench Safety Systems	LUMP SUM		$ 7,600		$ 7,600
3	Locate Existing Utilities	LUMP SUM		$ 5,000		$ 5,000
4	Erosion Control	LUMP SUM		$ 4,900		$ 4,900
5	Dewatering	LUMP SUM		$ 11,600		$ 11,600
6	Bypass Pumping	LUMP SUM		$ 11,000		$ 11,000
7	Sawcutting	2174	LF	$ 2		$ 4,348
8	Traffic Control	180	HR	$ 30		$ 5,400
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	1087	LF	$ 70		$ 76,090
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	34	EA	$ 1,000		$ 34,000
11	48" Manhole	5	EA	$ 4,500		$ 22,500
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	490	CY	$ 15		$ 7,350
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	490	CY	$ 75		$ 36,750
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 280,338
	Tax @	7.9	%			$ 22,147
	Subtotal					$ 302,485
	Contingency (20%)..					$ 60,497
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 362,982
	Engineering and Administrative Costs (30%):..					$ 108,895
	TOTAL ESTIMATED PROJECT COST:..					$ 471,877

Basin No.	3N					
Proj. No.	5					
Pipe Size		6	8	10	12	15
Segment Length =				1680	296	
No of Side Sewers (Parcels) =				21	5	
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 35,900		$ 35,900
2	Trench Safety Systems	LUMP SUM		$ 13,100		$ 13,100
3	Locate Existing Utilities	LUMP SUM		$ 8,600		$ 8,600
4	Erosion Control	LUMP SUM		$ 8,400		$ 8,400
5	Dewatering	LUMP SUM		$ 19,900		$ 19,900
6	Bypass Pumping	LUMP SUM		$ 19,000		$ 19,000
7	Sawcutting	3952	LF	$ 2		$ 7,904
8	Traffic Control	320	HR	$ 30		$ 9,600
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	0	LF	$ 70		$ -
9c	10" Gravity Sewer Main	1680	LF	$ 80		$ 134,400
9d	12" Gravity Sewer Main	296	LF	$ 100		$ 29,600
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	26	EA	$ 1,000		$ 26,000
11	48" Manhole	8	EA	$ 4,500		$ 36,000
12	Asphalt	500	TN	$ 110		$ 55,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	0	CY	$ 15		$ -
13c	Gravel Backfill (10")	750	CY	$ 15		$ 11,250
13d	Gravel Backfill (12")	140	CY	$ 15		$ 2,100
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	0	CY	$ 75		$ -
14c	CDF (10")	750	CY	$ 75		$ 56,250
14d	CDF (12")	140	CY	$ 75		$ 10,500
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 483,504
	Tax @	7.9	%			$ 38,197
	Subtotal					$ 521,701
	Contingency (20%)……………………………………………………………………					$ 104,340
	TOTAL ESTIMATED CONSTRUCTION COST:………………………………………					$ 626,041
	Engineering and Administrative Costs (30%):………………………………					$ 187,812
	TOTAL ESTIMATED PROJECT COST:…………………………………………………					$ 813,853

Basin No.	3S					
Proj. No.	1					
Pipe Size		6	8	10	12	15
Segment Length =			951			
No of Side Sewers (Parcels) =			51			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 20,900		$ 20,900
2	Trench Safety Systems	LUMP SUM		$ 7,600		$ 7,600
3	Locate Existing Utilities	LUMP SUM		$ 5,000		$ 5,000
4	Erosion Control	LUMP SUM		$ 4,900		$ 4,900
5	Dewatering	LUMP SUM		$ 11,600		$ 11,600
6	Bypass Pumping	LUMP SUM		$ 11,100		$ 11,100
7	Sawcutting	1902	LF	$ 2		$ 3,804
8	Traffic Control	160	HR	$ 30		$ 4,800
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	951	LF	$ 70		$ 66,570
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	51	EA	$ 1,000		$ 51,000
11	48" Manhole	5	EA	$ 4,500		$ 22,500
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	430	CY	$ 15		$ 6,450
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	430	CY	$ 75		$ 32,250
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 281,474
	Tax @	7.9	%			$ 22,236
	Subtotal					$ 303,710
	Contingency (20%)……………………………………………………………					$ 60,742
	TOTAL ESTIMATED CONSTRUCTION COST:………………………………					$ 364,452
	Engineering and Administrative Costs (30%):………………………					$ 109,336
	TOTAL ESTIMATED PROJECT COST:…………………………………………					$ 473,788

Basin No.	3S					
Proj. No.	2					
Pipe Size		6	8	10	12	15
Segment Length =			1020			261
No of Side Sewers (Parcels) =			30			1
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 24,600		$ 24,600
2	Trench Safety Systems	LUMP SUM		$ 9,000		$ 9,000
3	Locate Existing Utilities	LUMP SUM		$ 5,900		$ 5,900
4	Erosion Control	LUMP SUM		$ 5,800		$ 5,800
5	Dewatering	LUMP SUM		$ 13,700		$ 13,700
6	Bypass Pumping	LUMP SUM		$ 13,000		$ 13,000
7	Sawcutting	2562	LF	$ 2		$ 5,124
8	Traffic Control	210	HR	$ 30		$ 6,300
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	1020	LF	$ 70		$ 71,400
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	261	LF	$ 120		$ 31,320
10	Side Sewer	31	EA	$ 1,000		$ 31,000
11	48" Manhole	6	EA	$ 4,500		$ 27,000
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	460	CY	$ 15		$ 6,900
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	140	CY	$ 15		$ 2,100
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	460	CY	$ 75		$ 34,500
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	140	CY	$ 75		$ 10,500
	Subtotal					$ 331,144
	Tax @	7.9	%			$ 26,160
	Subtotal					$ 357,304
	Contingency (20%)……………………………………………………………………					$ 71,461
	TOTAL ESTIMATED CONSTRUCTION COST:……………………………………					$ 428,765
	Engineering and Administrative Costs (30%):…………………………………					$ 128,630
	TOTAL ESTIMATED PROJECT COST:……………………………………………					$ 557,395

Basin No.	3S					
Proj. No.	3					
Pipe Size		6	8	10	12	15
Segment Length =			258	1057	258	261
No of Side Sewers (Parcels) =			7	28	7	2
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 36,700		$ 36,700
2	Trench Safety Systems	LUMP SUM		$ 13,400		$ 13,400
3	Locate Existing Utilities	LUMP SUM		$ 8,800		$ 8,800
4	Erosion Control	LUMP SUM		$ 8,600		$ 8,600
5	Dewatering	LUMP SUM		$ 20,400		$ 20,400
6	Bypass Pumping	LUMP SUM		$ 19,400		$ 19,400
7	Sawcutting	3668	LF	$ 2		$ 7,336
8	Traffic Control	300	HR	$ 30		$ 9,000
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	258	LF	$ 70		$ 18,060
9c	10" Gravity Sewer Main	1057	LF	$ 80		$ 84,560
9d	12" Gravity Sewer Main	258	LF	$ 100		$ 25,800
9e	15" Gravity Sewer Main	261	LF	$ 120		$ 31,320
10	Side Sewer	44	EA	$ 1,000		$ 44,000
11	48" Manhole	8	EA	$ 4,500		$ 36,000
12	Asphalt	500	TN	$ 110		$ 55,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	120	CY	$ 15		$ 1,800
13c	Gravel Backfill (10")	470	CY	$ 15		$ 7,050
13d	Gravel Backfill (12")	120	CY	$ 15		$ 1,800
13e	Gravel Backfill (15")	140	CY	$ 15		$ 2,100
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	120	CY	$ 75		$ 9,000
14c	CDF (10")	470	CY	$ 75		$ 35,250
14d	CDF (12")	120	CY	$ 75		$ 9,000
14e	CDF (15")	140	CY	$ 75		$ 10,500
	Subtotal					$ 494,876
	Tax @	7.9	%			$ 39,095
	Subtotal					$ 533,971
	Contingency (20%)……………………………………………………………					$ 106,794
	TOTAL ESTIMATED CONSTRUCTION COST:...					$ 640,765
	Engineering and Administrative Costs (30%):..					$ 192,230
	TOTAL ESTIMATED PROJECT COST:..					$ 832,995

Basin No.	3S					
Proj. No.	4					
Pipe Size		6	8	10	12	15
Segment Length =			1187			662
No of Side Sewers (Parcels) =			32			4
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 36,500		$ 36,500
2	Trench Safety Systems	LUMP SUM		$ 13,300		$ 13,300
3	Locate Existing Utilities	LUMP SUM		$ 8,700		$ 8,700
4	Erosion Control	LUMP SUM		$ 8,500		$ 8,500
5	Dewatering	LUMP SUM		$ 20,300		$ 20,300
6	Bypass Pumping	LUMP SUM		$ 19,300		$ 19,300
7	Sawcutting	3698	LF	$ 2		$ 7,396
8	Traffic Control	300	HR	$ 30		$ 9,000
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	1187	LF	$ 70		$ 83,090
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	662	LF	$ 120		$ 79,440
10	Side Sewer	36	EA	$ 1,000		$ 36,000
11	48" Manhole	8	EA	$ 4,500		$ 36,000
12	Asphalt	500	TN	$ 110		$ 55,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	530	CY	$ 15		$ 7,950
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	350	CY	$ 15		$ 5,250
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	530	CY	$ 75		$ 39,750
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	350	CY	$ 75		$ 26,250
	Subtotal					$ 491,726
	Tax @	7.9	%			$ 38,846
	Subtotal					$ 530,572
	Contingency (20%)…………………………………………………………					$ 106,114
	TOTAL ESTIMATED CONSTRUCTION COST:………………………………					$ 636,686
	Engineering and Administrative Costs (30%):………………………………					$ 191,006
	TOTAL ESTIMATED PROJECT COST:…………………………………………					$ 827,692

Basin No.	3S					
Proj. No.	5					
Pipe Size		6	8	10	12	15
Segment Length =			533			229
No of Side Sewers (Parcels) =			11			3
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 15,000		$ 15,000
2	Trench Safety Systems	LUMP SUM		$ 5,500		$ 5,500
3	Locate Existing Utilities	LUMP SUM		$ 3,600		$ 3,600
4	Erosion Control	LUMP SUM		$ 3,500		$ 3,500
5	Dewatering	LUMP SUM		$ 8,400		$ 8,400
6	Bypass Pumping	LUMP SUM		$ 8,000		$ 8,000
7	Sawcutting	1524	LF	$ 2		$ 3,048
8	Traffic Control	130	HR	$ 30		$ 3,900
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	533	LF	$ 70		$ 37,310
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	229	LF	$ 120		$ 27,480
10	Side Sewer	14	EA	$ 1,000		$ 14,000
11	48" Manhole	4	EA	$ 4,500		$ 18,000
12	Asphalt	200	TN	$ 110		$ 22,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	240	CY	$ 15		$ 3,600
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	120	CY	$ 15		$ 1,800
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	240	CY	$ 75		$ 18,000
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	120	CY	$ 75		$ 9,000
	Subtotal					$ 202,138
	Tax @	7.9	%			$ 15,969
	Subtotal					$ 218,107
	Contingency (20%)……………………………………………………………					$ 43,621
	TOTAL ESTIMATED CONSTRUCTION COST:...					$ 261,728
	Engineering and Administrative Costs (30%):....................................…..............					$ 78,518
	TOTAL ESTIMATED PROJECT COST:..					$ 340,246

Basin No.	3S					
Proj. No.	6					
Pipe Size		6	8		10	15
Segment Length =			184		866	242
No of Side Sewers (Parcels) =			5		24	7
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 25,900		$ 25,900
2	Trench Safety Systems	LUMP SUM		$ 9,500		$ 9,500
3	Locate Existing Utilities	LUMP SUM		$ 6,200		$ 6,200
4	Erosion Control	LUMP SUM		$ 6,100		$ 6,100
5	Dewatering	LUMP SUM		$ 14,400		$ 14,400
6	Bypass Pumping	LUMP SUM		$ 13,700		$ 13,700
7	Sawcutting	2584	LF	$ 2		$ 5,168
8	Traffic Control	210	HR	$ 30		$ 6,300
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	184	LF	$ 70		$ 12,880
9c	xx" Gravity Sewer Main	0	LF	$ 80		$ -
9d	10" Gravity Sewer Main	866	LF	$ 80		$ 69,280
9e	15" Gravity Sewer Main	242	LF	$ 120		$ 29,040
10	Side Sewer	36	EA	$ 1,000		$ 36,000
11	48" Manhole	6	EA	$ 4,500		$ 27,000
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	90	CY	$ 15		$ 1,350
13c	Gravel Backfill (xx")	0	CY	$ 15		$ -
13d	Gravel Backfill (10")	390	CY	$ 15		$ 5,850
13e	Gravel Backfill (15")	130	CY	$ 15		$ 1,950
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	90	CY	$ 75		$ 6,750
14c	CDF (xx")	0	CY	$ 75		$ -
14d	CDF (10")	390	CY	$ 75		$ 29,250
14e	CDF (15")	130	CY	$ 75		$ 9,750
	Subtotal					$ 349,368
	Tax @	7.9	%			$ 27,600
	Subtotal					$ 376,968
	Contingency (20%)..					$ 75,394
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 452,362
	Engineering and Administrative Costs (30%):..					$ 135,709
	TOTAL ESTIMATED PROJECT COST:..					$ 588,071

Basin No.	4					
Proj. No.	1					
Pipe Size		6	8	10	12	15
Segment Length =			1769			
No of Side Sewers (Parcels) =			46			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 31,500		$ 31,500
2	Trench Safety Systems	LUMP SUM		$ 11,500		$ 11,500
3	Locate Existing Utilities	LUMP SUM		$ 7,500		$ 7,500
4	Erosion Control	LUMP SUM		$ 7,400		$ 7,400
5	Dewatering	LUMP SUM		$ 17,500		$ 17,500
6	Bypass Pumping	LUMP SUM		$ 16,700		$ 16,700
7	Sawcutting	3538	LF	$ 2		$ 7,076
8	Traffic Control	290	HR	$ 30		$ 8,700
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	1769	LF	$ 70		$ 123,830
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	46	EA	$ 1,000		$ 46,000
11	48" Manhole	7	EA	$ 4,500		$ 31,500
12	Asphalt	400	TN	$ 110		$ 44,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	790	CY	$ 15		$ 11,850
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	790	CY	$ 75		$ 59,250
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 424,306
	Tax @	7.9	%			$ 33,520
	Subtotal					$ 457,826
	Contingency (20%)..					$ 91,565
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 549,391
	Engineering and Administrative Costs (30%):.......................................					$ 164,817
	TOTAL ESTIMATED PROJECT COST:..					$ 714,208

Basin No.	4					
Proj. No.	2					
Pipe Size		6	8	10	12	15
Segment Length =			851	550		
No of Side Sewers (Parcels) =			17	6		
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 25,300		$ 25,300
2	Trench Safety Systems	LUMP SUM		$ 9,200		$ 9,200
3	Locate Existing Utilities	LUMP SUM		$ 6,100		$ 6,100
4	Erosion Control	LUMP SUM		$ 5,900		$ 5,900
5	Dewatering	LUMP SUM		$ 14,100		$ 14,100
6	Bypass Pumping	LUMP SUM		$ 13,400		$ 13,400
7	Sawcutting	2802	LF	$ 2		$ 5,604
8	Traffic Control	230	HR	$ 30		$ 6,900
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	851	LF	$ 70		$ 59,570
9c	10" Gravity Sewer Main	550	LF	$ 80		$ 44,000
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	23	EA	$ 1,000		$ 23,000
11	48" Manhole	6	EA	$ 4,500		$ 27,000
12	Asphalt	400	TN	$ 110		$ 44,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	380	CY	$ 15		$ 5,700
13c	Gravel Backfill (10")	250	CY	$ 15		$ 3,750
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	380	CY	$ 75		$ 28,500
14c	CDF (10")	250	CY	$ 75		$ 18,750
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 340,774
	Tax @	7.9	%			$ 26,921
	Subtotal					$ 367,695
	Contingency (20%)…………………………………………………………					$ 73,539
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 441,234
	Engineering and Administrative Costs (30%):....................................					$ 132,370
	TOTAL ESTIMATED PROJECT COST:..					$ 573,604

Basin No.	4					
Proj. No.	3					
Pipe Size		6	8	10	12	15
Segment Length =			1181			
No of Side Sewers (Parcels) =			13			
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 19,900		$ 19,900
2	Trench Safety Systems	LUMP SUM		$ 7,300		$ 7,300
3	Locate Existing Utilities	LUMP SUM		$ 4,800		$ 4,800
4	Erosion Control	LUMP SUM		$ 4,700		$ 4,700
5	Dewatering	LUMP SUM		$ 11,000		$ 11,000
6	Bypass Pumping	LUMP SUM		$ 10,500		$ 10,500
7	Sawcutting	2362	LF	$ 2		$ 4,724
8	Traffic Control	190	HR	$ 30		$ 5,700
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	1181	LF	$ 70		$ 82,670
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	0	LF	$ 100		$ -
9e	15" Gravity Sewer Main	0	LF	$ 120		$ -
10	Side Sewer	13	EA	$ 1,000		$ 13,000
11	48" Manhole	5	EA	$ 4,500		$ 22,500
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	530	CY	$ 15		$ 7,950
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	0	CY	$ 15		$ -
13e	Gravel Backfill (15")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	530	CY	$ 75		$ 39,750
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	0	CY	$ 75		$ -
14e	CDF (15")	0	CY	$ 75		$ -
	Subtotal					$ 267,494
	Tax @	7.9	%			$ 21,132
	Subtotal					$ 288,626
	Contingency (20%)..					$ 57,725
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 346,351
	Engineering and Administrative Costs (30%):..					$ 103,905
	TOTAL ESTIMATED PROJECT COST:..					$ 450,256

Basin No.	4					
Proj. No.	4					
Pipe Size		6	8	10	12	15
Segment Length =			283		1010	140
No of Side Sewers (Parcels) =			6		30	3
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 30,300		$ 30,300
2	Trench Safety Systems	LUMP SUM		$ 11,100		$ 11,100
3	Locate Existing Utilities	LUMP SUM		$ 7,200		$ 7,200
4	Erosion Control	LUMP SUM		$ 7,100		$ 7,100
5	Dewatering	LUMP SUM		$ 16,800		$ 16,800
6	Bypass Pumping	LUMP SUM		$ 16,000		$ 16,000
7	Sawcutting	2866	LF	$ 2		$ 5,732
8	Traffic Control	230	HR	$ 30		$ 6,900
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	283	LF	$ 70		$ 19,810
9c	10" Gravity Sewer Main	0	LF	$ 80		$ -
9d	12" Gravity Sewer Main	1010	LF	$ 100		$ 101,000
9e	15" Gravity Sewer Main	140	LF	$ 120		$ 16,800
10	Side Sewer	39	EA	$ 1,000		$ 39,000
11	48" Manhole	6	EA	$ 4,500		$ 27,000
12	Asphalt	400	TN	$ 110		$ 44,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	130	CY	$ 15		$ 1,950
13c	Gravel Backfill (10")	0	CY	$ 15		$ -
13d	Gravel Backfill (12")	450	CY	$ 15		$ 6,750
13e	Gravel Backfill (15")	80	CY	$ 15		$ 1,200
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	130	CY	$ 75		$ 9,750
14c	CDF (10")	0	CY	$ 75		$ -
14d	CDF (12")	450	CY	$ 75		$ 33,750
14e	CDF (15")	80	CY	$ 75		$ 6,000
	Subtotal					$ 408,142
	Tax @	7.9	%			$ 32,243
	Subtotal					$ 440,385
	Contingency (20%)…………………………………………………………………					$ 88,077
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 528,462
	Engineering and Administrative Costs (30%):..					$ 158,539
	TOTAL ESTIMATED PROJECT COST:...					$ 687,001

Basin No.	5					
Proj. No.	1					
Pipe Size		6	8	21	24	30
Segment Length =						551
No of Side Sewers (Parcels) =						2
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 19,500		$ 19,500
2	Trench Safety Systems	LUMP SUM		$ 7,100		$ 7,100
3	Locate Existing Utilities	LUMP SUM		$ 4,700		$ 4,700
4	Erosion Control	LUMP SUM		$ 4,600		$ 4,600
5	Dewatering	LUMP SUM		$ 10,900		$ 10,900
6	Bypass Pumping	LUMP SUM		$ 10,300		$ 10,300
7	Sawcutting	1102	LF	$ 2		$ 2,204
8	Traffic Control	90	HR	$ 30		$ 2,700
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	0	LF	$ 70		$ -
9c	21" Gravity Sewer Main	0	LF	$ 155		$ -
9d	24" Gravity Sewer Main	0	LF	$ 190		$ -
9e	30" Gravity Sewer Main	551	LF	$ 236		$ 130,036
10	Side Sewer	2	EA	$ 1,000		$ 2,000
11	48" Manhole	3	EA	$ 4,500		$ 13,500
12	Asphalt	200	TN	$ 110		$ 22,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	0	CY	$ 15		$ -
13c	Gravel Backfill (21")	0	CY	$ 15		$ -
13d	Gravel Backfill (24")	0	CY	$ 15		$ -
13e	Gravel Backfill (30")	370	CY	$ 15		$ 5,550
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	0	CY	$ 75		$ -
14c	CDF (21")	0	CY	$ 75		$ -
14d	CDF (24")	0	CY	$ 75		$ -
14e	CDF (30")	370	CY	$ 75		$ 27,750
	Subtotal					$ 262,840
	Tax @	7.9	%			$ 20,764
	Subtotal					$ 283,604
	Contingency (20%)…………………………………………………………………					$ 56,721
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 340,325
	Engineering and Administrative Costs (30%):..					$ 102,098
	TOTAL ESTIMATED PROJECT COST:..					$ 442,423

Basin No.	5					
Proj. No.	2					
Pipe Size		6	8	24	30	36
Segment Length =				707	289	
No of Side Sewers (Parcels) =				1	6	
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 31,200		$ 31,200
2	Trench Safety Systems	LUMP SUM		$ 11,400		$ 11,400
3	Locate Existing Utilities	LUMP SUM		$ 7,500		$ 7,500
4	Erosion Control	LUMP SUM		$ 7,300		$ 7,300
5	Dewatering	LUMP SUM		$ 17,400		$ 17,400
6	Bypass Pumping	LUMP SUM		$ 16,500		$ 16,500
7	Sawcutting	1992	LF	$ 2		$ 3,984
8	Traffic Control	160	HR	$ 30		$ 4,800
9a	6" Gravity Sewer Main	0	LF	$ 40		$ -
9b	8" Gravity Sewer Main	0	LF	$ 70		$ -
9c	24" Gravity Sewer Main	707	LF	$ 190		$ 134,330
9d	30" Gravity Sewer Main	289	LF	$ 236		$ 68,204
9e	36" Gravity Sewer Main	0	LF	$ 285		$ -
10	Side Sewer	7	EA	$ 1,000		$ 7,000
11	48" Manhole	5	EA	$ 4,500		$ 22,500
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill (6")	0	CY	$ 15		
13b	Gravel Backfill (8")	0	CY	$ 15		$ -
13c	Gravel Backfill (24")	420	CY	$ 15		$ 6,300
13d	Gravel Backfill (30")	200	CY	$ 15		$ 3,000
13e	Gravel Backfill (36")	0	CY	$ 15		$ -
14a	CDF (6")	0	CY	$ 75		$ -
14b	CDF (8")	0	CY	$ 75		$ -
14c	CDF (24")	420	CY	$ 75		$ 31,500
14d	CDF (30")	200	CY	$ 75		$ 15,000
14e	CDF (36")	0	CY	$ 75		$ -
	Subtotal					$ 420,918
	Tax @	7.9	%			$ 33,253
	Subtotal					$ 454,171
	Contingency (20%)…………………………………………………………					$ 90,834
	TOTAL ESTIMATED CONSTRUCTION COST:...					$ 545,005
	Engineering and Administrative Costs (30%):..					$ 163,502
	TOTAL ESTIMATED PROJECT COST:...					$ 708,507

Basin No.	6					
Proj. No.	1					
Pipe Size		12	15	21	24	30
Segment Length =				1051		
No of Side Sewers (Parcels) =				16		
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 28,500		$ 28,500
2	Trench Safety Systems	LUMP SUM		$ 10,400		$ 10,400
3	Locate Existing Utilities	LUMP SUM		$ 6,800		$ 6,800
4	Erosion Control	LUMP SUM		$ 6,700		$ 6,700
5	Dewatering	LUMP SUM		$ 15,800		$ 15,800
6	Bypass Pumping	LUMP SUM		$ 15,100		$ 15,100
7	Sawcutting	2102	LF	$ 2		$ 4,204
8	Traffic Control	170	HR	$ 30		$ 5,100
9a	12" Gravity Sewer Main	0	LF	$ 40		$ -
9b	15" Gravity Sewer Main	0	LF	$ 70		$ -
9c	21" Gravity Sewer Main	1051	LF	$ 155		$ 162,905
9d	24" Gravity Sewer Main	0	LF	$ -		$ -
9e	30" Gravity Sewer Main	0	LF	$ -		$ -
10	Side Sewer	16	EA	$ 1,000		$ 16,000
11	48" Manhole	5	EA	$ 4,500		$ 22,500
12	Asphalt	300	TN	$ 110		$ 33,000
13a	Gravel Backfill 12")	0	CY	$ 15		
13b	Gravel Backfill (15")	0	CY	$ 15		$ -
13c	Gravel Backfill (21")	630	CY	$ 15		$ 9,450
13d	Gravel Backfill (24")	0	CY	$ 15		$ -
13e	Gravel Backfill (30")	0	CY	$ 15		$ -
14a	CDF (12")	0	CY	$ 75		$ -
14b	CDF (15")	0	CY	$ 75		$ -
14c	CDF (21")	630	CY	$ 75		$ 47,250
14d	CDF (24")	0	CY	$ 75		$ -
14e	CDF (30")	0	CY	$ 75		$ -
	Subtotal					$ 383,709
	Tax @	7.9	%			$ 30,313
	Subtotal					$ 414,022
	Contingency (20%)………..…...……………………………..…………………………					$ 82,804
	TOTAL ESTIMATED CONSTRUCTION COST:...					$ 496,826
	Engineering and Administrative Costs (30%):.......................................…............					$ 149,048
	TOTAL ESTIMATED PROJECT COST:...					$ 645,874

Basin No.	6					
Proj. No.	2					
Pipe Size		12	15	21	24	30
Segment Length =				815		
No of Side Sewers (Parcels) =				18		
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 22,400		$ 22,400
2	Trench Safety Systems	LUMP SUM		$ 8,200		$ 8,200
3	Locate Existing Utilities	LUMP SUM		$ 5,400		$ 5,400
4	Erosion Control	LUMP SUM		$ 5,300		$ 5,300
5	Dewatering	LUMP SUM		$ 12,400		$ 12,400
6	Bypass Pumping	LUMP SUM		$ 11,800		$ 11,800
7	Sawcutting	1630	LF	$ 2		$ 3,260
8	Traffic Control	140	HR	$ 30		$ 4,200
9a	12" Gravity Sewer Main	0	LF	$ 40		$ -
9b	15" Gravity Sewer Main	0	LF	$ 70		$ -
9c	21" Gravity Sewer Main	815	LF	$ 155		$ 126,325
9d	24" Gravity Sewer Main	0	LF	$ -		$ -
9e	30" Gravity Sewer Main	0	LF	$ -		$ -
10	Side Sewer	18	EA	$ 1,000		$ 18,000
11	48" Manhole	4	EA	$ 4,500		$ 18,000
12	Asphalt	200	TN	$ 110		$ 22,000
13a	Gravel Backfill 12")	0	CY	$ 15		
13b	Gravel Backfill (15")	0	CY	$ 15		$ -
13c	Gravel Backfill (21")	490	CY	$ 15		$ 7,350
13d	Gravel Backfill (24")	0	CY	$ 15		$ -
13e	Gravel Backfill (30")	0	CY	$ 15		$ -
14a	CDF (12")	0	CY	$ 75		$ -
14b	CDF (15")	0	CY	$ 75		$ -
14c	CDF (21")	490	CY	$ 75		$ 36,750
14d	CDF (24")	0	CY	$ 75		$ -
14e	CDF (30")	0	CY	$ 75		$ -
	Subtotal					$ 301,385
	Tax @	7.9	%			$ 23,809
	Subtotal					$ 325,194
	Contingency (20%)…………………………………………………………………………					$ 65,039
	TOTAL ESTIMATED CONSTRUCTION COST:...					$ 390,233
	Engineering and Administrative Costs (30%):..					$ 117,070
	TOTAL ESTIMATED PROJECT COST:..					$ 507,303

Basin No.	6					
Proj. No.	3					
Pipe Size		12	15	21	24	30
Segment Length =			257	0		
No of Side Sewers (Parcels) =			5	0		
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 5,600		$ 5,600
2	Trench Safety Systems	LUMP SUM		$ 2,100		$ 2,100
3	Locate Existing Utilities	LUMP SUM		$ 1,400		$ 1,400
4	Erosion Control	LUMP SUM		$ 1,300		$ 1,300
5	Dewatering	LUMP SUM		$ 3,100		$ 3,100
6	Bypass Pumping	LUMP SUM		$ 3,000		$ 3,000
7	Sawcutting	514	LF	$ 2		$ 1,028
8	Traffic Control	50	HR	$ 30		$ 1,500
9a	12" Gravity Sewer Main	0	LF	$ 40		$ -
9b	15" Gravity Sewer Main	257	LF	$ 70		$ 17,990
9c	21" Gravity Sewer Main	0	LF	$ 155		$ -
9d	24" Gravity Sewer Main	0	LF	$ 110		$ -
9e	30" Gravity Sewer Main	0	LF	$ 30		$ -
10	Side Sewer	5	EA	$ 1,000		$ 5,000
11	48" Manhole	2	EA	$ 4,500		$ 9,000
12	Asphalt	100	TN	$ 110		$ 11,000
13a	Gravel Backfill 12")	0	CY	$ 15		
13b	Gravel Backfill (15")	140	CY	$ 15		$ 2,100
13c	Gravel Backfill (21")	0	CY	$ 15		$ -
13d	Gravel Backfill (24")	0	CY	$ 15		$ -
13e	Gravel Backfill (30")	0	CY	$ 15		$ -
14a	CDF (12")	0	CY	$ 75		$ -
14b	CDF (15")	140	CY	$ 75		$ 10,500
14c	CDF (21")	0	CY	$ 75		$ -
14d	CDF (24")	0	CY	$ 75		$ -
14e	CDF (30")	0	CY	$ 75		$ -
	Subtotal					$ 74,618
	Tax @	7.9	%			$ 5,895
	Subtotal					$ 80,513
	Contingency (20%)……………………………………………………………					$ 16,103
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 96,616
	Engineering and Administrative Costs (30%):..…............					$ 28,985
	TOTAL ESTIMATED PROJECT COST:...					$ 125,601

Basin No.	10					
Proj. No.	1					
Pipe Size		10	12	21	24	30
Segment Length =		1391				
No of Side Sewers (Parcels) =		7				
				UNIT		AMOUNT
NO.	ITEM	QUANTITY		PRICE		
1	Mobilization and Demobilization	LUMP SUM		$ 18,600		$ 18,600
2	Trench Safety Systems	LUMP SUM		$ 6,800		$ 6,800
3	Locate Existing Utilities	LUMP SUM		$ 4,500		$ 4,500
4	Erosion Control	LUMP SUM		$ 4,400		$ 4,400
5	Dewatering	LUMP SUM		$ 10,400		$ 10,400
6	Bypass Pumping	LUMP SUM		$ 9,900		$ 9,900
7	Sawcutting	0	LF	$ 2		$ -
8	Traffic Control	230	HR	$ 30		$ 6,900
9a	10" Gravity Sewer Main	1391	LF	$ 40		$ 55,640
9b	12" Gravity Sewer Main	0	LF	$ 70		$ -
9c	21" Gravity Sewer Main	0	LF	$ 155		$ -
9d	24" Gravity Sewer Main	0	LF	$ -		$ -
9e	30" Gravity Sewer Main	0	LF	$ -		$ -
10	Side Sewer	7	EA	$ 1,000		$ 7,000
11	48" Manhole	6	EA	$ 4,500		$ 27,000
12	Asphalt	400	TN	$ 110		$ 44,000
13a	Gravel Backfill 10")	620	CY	$ 15		$ 9,300
13b	Gravel Backfill (12")	0	CY	$ 15		$ -
13c	Gravel Backfill (21")	0	CY	$ 15		$ -
13d	Gravel Backfill (24")	0	CY	$ 15		$ -
13e	Gravel Backfill (30")	0	CY	$ 15		$ -
14a	CDF (10")	620	CY	$ 75		$ 46,500
14b	CDF (12")	0	CY	$ 75		$ -
14c	CDF (21")	0	CY	$ 75		$ -
14d	CDF (24")	0	CY	$ 75		$ -
14e	CDF (30")	0	CY	$ 75		$ -
	Subtotal					$ 250,940
	Tax @	7.9	%			$ 19,824
	Subtotal					$ 270,764
	Contingency (20%)..					$ 54,153
	TOTAL ESTIMATED CONSTRUCTION COST:..					$ 324,917
	Engineering and Administrative Costs (30%):..					$ 97,475
	TOTAL ESTIMATED PROJECT COST:..					$ 422,392

APPENDIX L

GREGG SERVICE AREA – CROWN ROAD SEWER SERVICE MEMORANDUM

DRAFT TECHNICAL MEMORANDUM

EVALUATION OF SEWER SERVICE
TO THE GREGG RESERVOIR ANNEXATION DEVELOPMENT

TO:	Monte Brachmann & Eric Levison, City of Camas
FROM:	Thomas Zerkel, P.E. & Jay Swift, P.E.
DATE:	October 7, 2005
SUBJECT:	**Sewer System Improvements – Gregg Reservoir Annexation**
G&O #	03689 City of Camas # WS 621

Per discussion between the developer and the City on September 2, 2005, hydraulic model analyses were run to determine the improvements that were necessary to provide the *Gregg Reservoir Annexation* (formerly known as the Loyal Lands Development) with water and sewer service to serve approximately 700 houses. A companion memo has evaluated the improvements necessary for water service. This memo provides an analysis of sewer service requirements and improvements needed to serve the Gregg Reservoir Annexation.

Based on the topography of the Gregg Reservoir Annexation (GRA) area, it is proposed that approximately 50 acres (250 homes) in the northwest portion of the 700 home GRA development will be served by the existing STEP system on Leonard Road in Basin 15 (See Figure 1). The remaining estimated 90 acres (450 homes) are proposed to be served by a new gravity sewer line to the southeast of the GRA area along Crown Road.

PROJECTED FLOWS

Previous studies have investigated the water system storage and pumping requirements to serve anticipated development in the Gregg Zone (*Gregg Service Area Analysis*, 2003) and more specifically to serve the 141-acre Gregg Reservoir Annexation (*Loyal Lands Annexation Analysis,* 2004).

Table 1 provides the projected sewage flows for the proposed 700-house GRA development. The *wastewater* ERU value is calculated based on *winter* water use (in order to exclude irrigation flows). For the City of Camas, it is estimated that 10% of the winter water consumption does not enter the wastewater collection system, so the wastewater ERU value is calculated by dividing the winter water use for single family residential (SFR) units by the number of single family units and multiplying by 0.90. Based on a review of 2004-2005 water use records, average winter single family residential water use is 177 gallons per SFR household. 90% of this value is 159 gallons per SFR household or ERU. Multiplying this by the projected number of GRA homes yields an estimated annual average sewage baseflow of 111,300 gpd.

Calculation of the peaking factor to determine the peak hour flow is performed by multiplying the dry weather flow by a population-based peaking factor (PF), given by the equation:

PF = (18 + square root (P))/(4 + square root (P)) where P = population, in thousands of people (*Department of Ecology Criteria for Sewage Works Design, 1998).* Gregg Annexation Reservoir Area population is estimated by multiplying the number of homes by the persons per household. Based on on OFM estimate of 5,153 housing units in Camas, and a 2002 City population of 13,450, the City has an average population of 2.6 persons per household (pph). This number is consistent with OFM estimates for Clark County at 2.645 pph for year 2005.) Use of the above equation with a GRA population of 1,820 (700 x 2.6 pph) yields a peak hour to annual average peaking factor of 3.62, for the projected 700 homes. Assuming no attenuation in the sewer system, multiplying this peaking factor by the projected residential daily average flows yields a projected peak hour flow of 402,900 gpd.

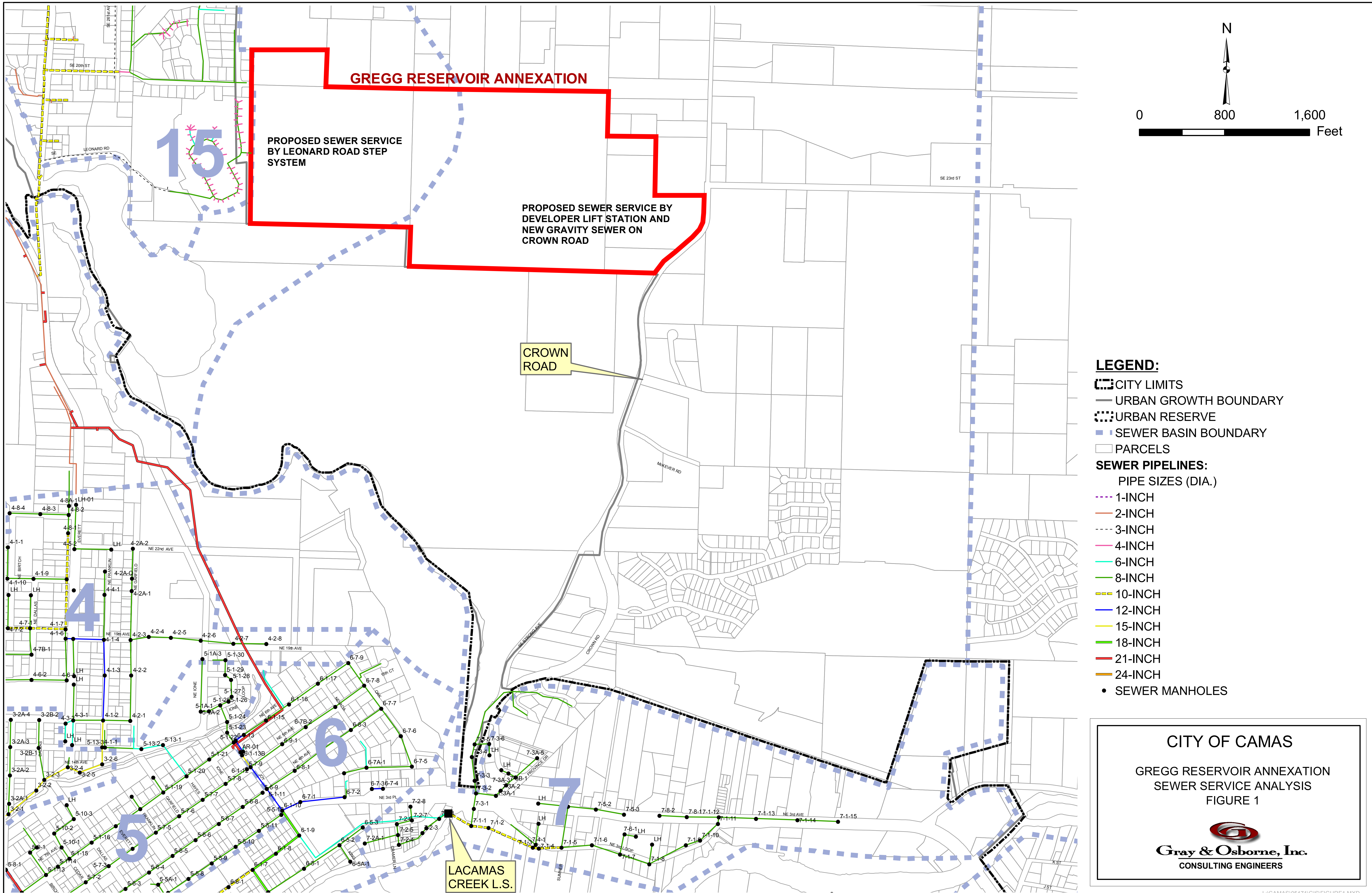
Total peak hour flow from the GRA will include both baseflow from commercial and domestic uses, and infiltration and inflow. In the *1998 City of Camas I/I Study*, I/I was found to range from about 300 to 11,000 gpad within the fifteen collection basins in the City. For *new* gravity sewer systems such as that which will serve the southeast portion of the GRA area, I/I is assumed to be essentially negligible immediately after construction. As the age of the system increases, I/I increases due to system deterioration. Following a standard adopted by a number of communities, peak hour I/I for a newly constructed gravity sewer system such as that serving the GRA area is assumed to increase linearly from zero to 1000 gallons per acre per day (gpad) over 50 years. Hence, for the estimated 90 acres to be served by gravity sewers in the GRA area, the estimated I/I in year 2055 is 90,000 gallons per day (90 acres x 1000 gpad). The northwest portion of the GRA area, since it is proposed to be served by a STEP system, is assumed to have negligible infiltration and inflow, even after 50 years.

TABLE 1
Projected Sewage Flows
Gregg Reservoir Annexation

Criteria	Quantity	Unit
Entire GRA Service Area		
Dwelling Units	700	DU
Equivalent Residential Unit [(1)] -Sewage Flow	159	gpd
Total Average Daily Sewage Baseflow	111,300	gpd
Peaking Factor	3.62	
Peak Hour Baseflow	402,900	gpd
Peak Hour I/I	90,000	gpd
Peak Hour Flow	492,900	gpd
Northwest GRA Service Area (Served by STEP)		
Peak Hour Flow	141,000	gpd
Southeast GRA Service Area (Served by Gravity)		
Peak Hour Flow	351,900	gpd

(1) Calculated based on 90% of single family residential water use in the City of Camas.

As shown in Table 1, the year 2055 peak hour flow for the Northwest GRA Service Area (served by STEP) is projected to be 141,000 gpd, while the peak hour flow for the Southeast GRA Service Area (served by gravity on Crown Road) is projected to be 351,900 gpd.


GREGG RESERVOIR ANNEXATION
PROPOSED SEWER SERVICE BY LEONARD ROAD STEP SYSTEM
PROPOSED SEWER SERVICE BY DEVELOPER LIFT STATION AND NEW GRAVITY SEWER ON CROWN ROAD
CROWN ROAD
LACAMAS CREEK L.S.
N
0 800 1,600 Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASIN BOUNDARY
PARCELS
SEWER PIPELINES:
PIPE SIZES (DIA.)
1-INCH
2-INCH
3-INCH
4-INCH
6-INCH
8-INCH
10-INCH
12-INCH
15-INCH
18-INCH
21-INCH
24-INCH
SEWER MANHOLES
CITY OF CAMAS
GREGG RESERVOIR ANNEXATION
SEWER SERVICE ANALYSIS
FIGURE 1
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\FIGURE1.MXD

The proposed new sewer line on Crown Road should be sized for the build-out population in the entire basin surrounding it. Depending on the projected ultimate annexation of areas within the City, the Crown Hill line should be built for the Southeast Gregg Service Area basin or the Draft Discussion Area shown in the 9/27/05 Comprehensive Growth Management Plan map, both shown in Figure 2. Table 2 indicates the total build-out flows expected from these potential service areas. Peak hour flows of either 4.07 MGD or 0.96 MGD are projected at build-out in the proposed Crown Road Sewer Line, depending on the ultimate annexation decisions.

TABLE 2
Projected Build-out Sewage Flows
Crown Road Sewer Line

Criteria	Quantity	Unit	Quantity	Unit
	Total Southeast Gregg Service Area Basin [2]		**Draft Discussion Area [2]**	
Area	1480	acres	306	acres
Projected Dwelling Units at 4 Units per Acre	5920	DU	1224	DU
Equivalent Residential Unit [(1)] - Sewage Flow	159	gpd	159	gpd
Total Average Daily Sewage Baseflow	0.94	MGD	0.195	MGD
Peaking Factor	2.75		3.42	
Peak Hour Baseflow	2.59	MGD	0.66	MGD
Peak Hour I/I	1.48	MGD	0.30	MGD
Peak Hour Flow	4.07 [1]	MGD	0.96	MGD

1. 4.07 MGD includes the 0.352 MGD coming from the 450 homes in the eastern GRA area.
2. Proposed to be Served by the New Gravity Line on Crown Road.

SEWER SYSTEM CAPACITY ANALYSIS

As previously described, it is proposed that approximately 250 homes in the northwest portion of the GRA development will be served by the existing STEP system on Leonard Road in Basin 15. The remaining estimated 450 homes are proposed to be served by a new gravity sewer line to be constructed along Crown Road to the southeast of the GRA area. In this section, the required Crown Road sewer line capacity is projected, the capacity of existing affected sewer facilities is evaluated, and required improvements are noted, both to serve the GRA development and the ultimate build-out population in the Southeast Gregg Service Area Basin.

Lift station run-time data and the distribution of population throughout the City were used to assist in estimating flows in the various portions of the sewer system. However, comprehensive sewer system flow monitoring has not been conducted since 1998, when it was performed for the *City of Camas Sewer System I/I Study*. Hence, a table from the 1998 I/I study is reprinted as Table 3 in this memo for reference. Table 3 shows a total City peak daily WWTP flow of 4.6 MGD during flow monitoring conducted in 1998.

The storm associated with that flow was estimated to have a 2-year return interval. Figure 3 shows WWTP influent flows for 2000-2004; five daily influent flows have exceeded the 4.6 MGD: 5.632, 5.337, 4.913, 4,796, 4.723 MGD. An analysis of WWTP diurnal flow records indicates that the peak hour flow on February 1, 2003 (when the peak day flow was 5.632 MGD) was 6.5 MGD. As described below, the infiltration rates for the various basins noted in Table 3 were used in constructing a hydraulic model for the Camas sewer system.

Crown Hill Sewer and Downstream Impacts

A new developer-financed lift station sited at the southern end of the east side of the GRA area could serve the entire eastern GRA. The lift station would convey the collected sewage approximately 900 feet to the proposed new Crown Hill Sewer line. The new Crown Hill Sewer line serving the Southeast Gregg Service Area would connect to existing Manhole 7-3-5 at Crown Road in Basin 7. (See Figure 4.) At Manhole 7-1-1, sewage from Crown Road mixes with flow from the rest of Basin 7. This combined flow is then conveyed to the Lacamas Creek Lift Station, where it is pumped to Manhole 6-1-9. At Manhole 6-1-9, the flow from Basin 7 merges with the flow from Basins 6, 11, 13, 14 and 15. At the Main Lift Station, this combined flow is combined with flow from Basins 1, 2, 3, 4, 5,10 and 12.

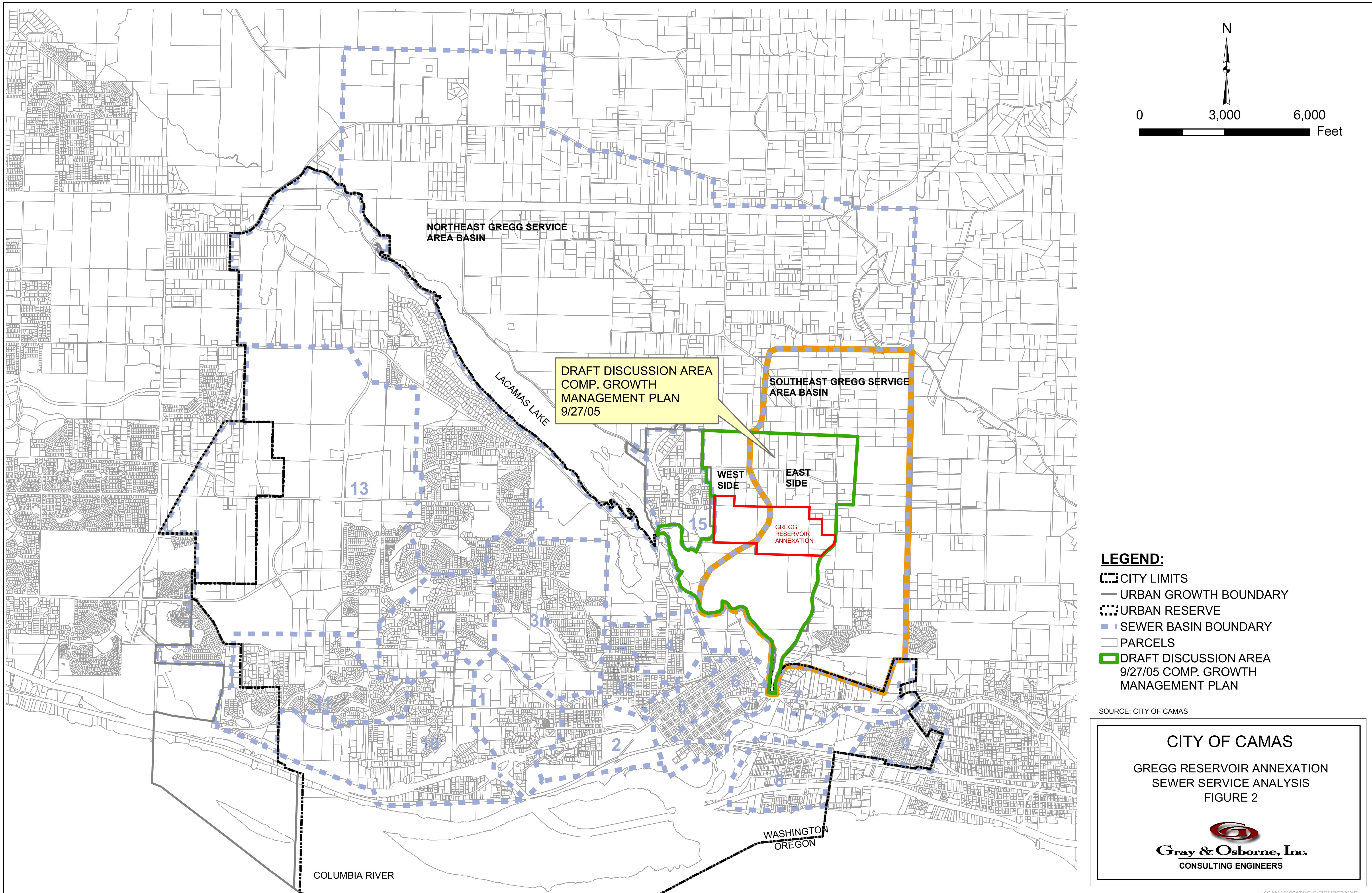
Pipe capacities and downstream impacts from the proposed development were determined using Mouse hydraulic modeling software developed by DHI, Inc. Modeling results are summarized in Appendix A.

To simplify the modeling effort it was assumed that the STEP systems and the basins conveyed to the Parker Estates Lift Station and the Lake Road STEP line drained by gravity to Manhole 6-1-9. The combined flow from the City's multitude of STEP lift stations in this area can be conservatively modeled as a gravity system.

Based on an evaluation of the topography along Crown Road, it was assumed that the minimum slope of the new system connecting the proposed development to the existing system would be 3%.

In order to construct the hydraulic model, the following assumptions were used:

- Basin-wide I/I rates from Table 3
- New estimates of baseflow based on current land use
- Industrial wastewater flows estimated to be 1,701,000 gallons per day (peak hour) based on data provided by the City and summarized in Table 4. It was assumed that all of the NPDES-permitted dischargers were discharging at their permitted capacity, and that the other industrial dischargers were discharging daily volumes equal to their average daily water consumption for 2004. A 10% peaking factor (peak hour to peak day) was applied to the overall total to calculate the 1,701,000 gallons per day peak hour flow.



CITY OF CAMAS

GREGG RESERVOIR ANNEXATION
SEWER SERVICE ANALYSIS
FIGURE 2

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FIGURE 3
City of Camas WWTP
Daily Influent Flows

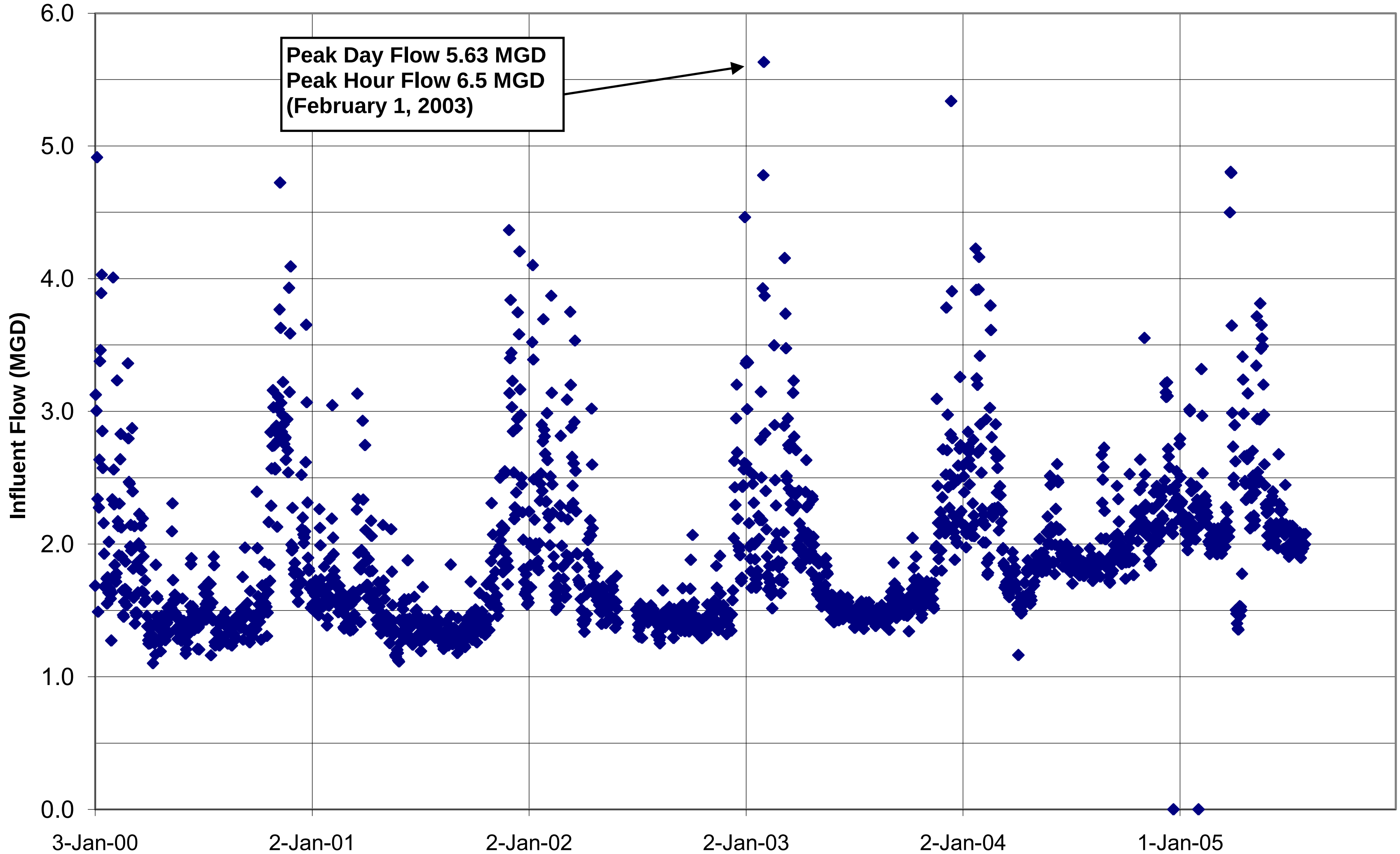


TABLE 3
Estimated Peak Day I/I per Basin
1998 I/I Report

Basin	Developed Area		Est. Pop.		Estimated I/I						Total Flow		
	(acres)	% of Total	Based on	Base Flow	Total I/I		Infiltration		Inflow				
		Dev. Area	Dev. Area	(gpd)	(gpd)	%	(gpd)	%	(gpd)	%	(gpd)	(gpcd)	(gpad)
1	56	3.34	375	40,000	600,000	17.6	60,000	14.9	540,000	18.0	640,000	1,706*	11,467
2	79	4.75	534	70,000	500,000	14.7	50,000	12.4	450,000	15.0	570,000	1,067*	7,170
3 South	71	4.26	479	50,000	200,000	5.9	20,000	5.0	180,000	6.0	250,000	521*	3,505
3 North	213	12.73	1431	150,000	850,000	25.0	110,000	27.4	740,000	24.7	1,000,000	699*	4,699
4	111	6.63	745	90,000	750,000	22.1	70,000	17.4	680,000	22.7	840,000	1,127*	7,578
5	105	6.31	709	100,000	100,000	2.9	10,000	2.5	90,000	3.0	200,000	282*	1,896
6	71	4.27	481	85,000	120,000	3.5	10,000	2.5	110,000	3.7	205,000	427*	2,868
7	54	3.24	364	40,000	80,000	2.4	5,000	1.2	75,000	2.5	120,000	329*	2,213
8	62	3.68	414	45,000	10,000	0.3	1,000	0.2	9,000	0.3	55,000	133	894
9	70	4.19	471	50,000	10,000	0.3	1,000	0.2	9,000	0.3	60,000	127	857
10	91	5.42	609	60,000	70,000	2.1	10,000	2.5	60,000	2.0	130,000	214	1,435
11	81	4.85	545	55,000	5,000	0.1	2,500	0.6	2,500	0.1	60,000	110	740
12	117	7.01	789	70,000	10,000	0.3	5,000	1.2	5,000	0.2	80,000	101	682
13	121	7.23	813	75,000	25,000	0.7	12,500	3.1	12,500	0.4	100,000	123	827
14	308	18.43	1036**	200,000	50,000	1.5	25,000	6.2	25,000	0.8	250,000	241	811
15	61	3.66	206**	20,000	20,000	0.6	10,000	2.5	10,000	0.3	40,000	194	653
Total	1672	100.0	10,000	1,200,000	3,400,000	100.0	400,000	100.0	3,000,000	100.0	4,600,000	460	2,750

New Crown Hill Sewer to Manhole 7-3-5

Modeling results show a pipe size of 8 inches connecting to the existing system would be sufficient to handle the flow generated from the 450 homes proposed from the new development.

The estimated cost for this new gravity line is $1.16 million dollars.

Manhole 7-3-5 to Lacamas Creek Lift Station

The existing system currently has enough excess capacity to convey the additional flows from the new development to the lift station.

Lacamas Creek Lift Station and Force Main to Manhole 6-1-9

Modeling results indicate that the Lacamas Creek Lift Station has insufficient excess capacity to pump the additional flows from the proposed 450 homes associated with the new development. Current excess capacity at the lift station could accommodate additional flows from only approximately 235 new homes based on our analysis. Lift station improvements would require a pump capacity of approximately 0.592 MGD (410 gpm) at the Lacamas Creek Lift Station in order to convey peak hour flows for the entire 450 homes. (Note: lift station capacities are noted with one pump on standby, as required by Department of Ecology criteria.)

The Lacamas Creek Lift Station could be relatively easily expanded to accommodate the peak hour flow of 0.592 MGD (410 gpm) anticipated from the combination of the entire 450 home development and existing flows by simply replacing the existing PACO pumps with larger pumps and providing a new electrical control panel. The estimated cost for this upgrade is $125,000. Cost estimates are attached to the back of the memo. PACO no longer manufactures or sells the pumps that are currently at the lift station. They are manufactured by ABS and marketed as Pumpex pumps by Pumptech in the northwest.

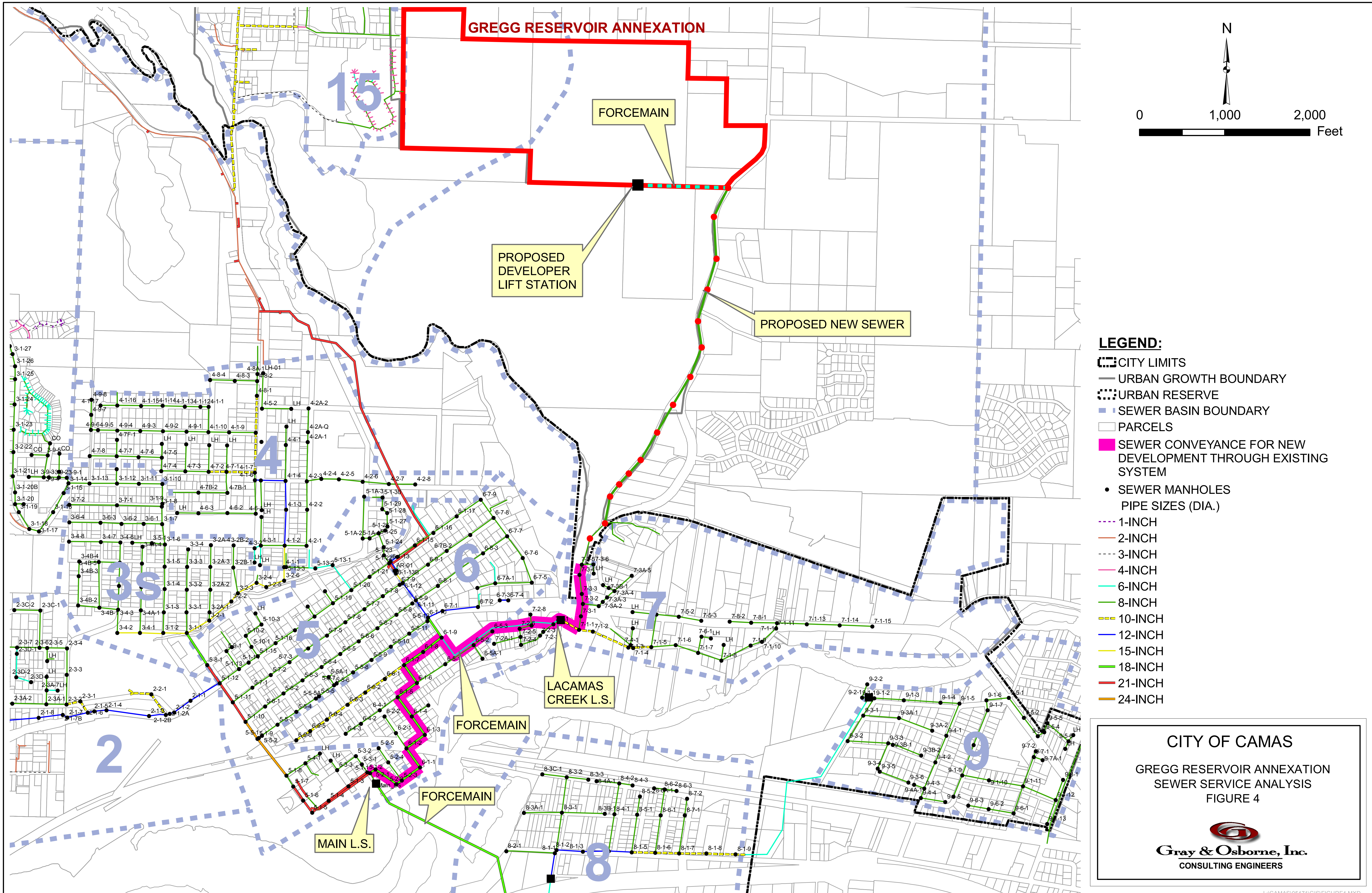
The lift station could be further expanded to as much as 550 gpm by replacing the existing pumps with new pumps; however, this would require major electrical upgrades to the lift station. Expanding beyond 550 gpm would require considerably more expense, including replacing the force main, use of a different pump family, and additional associated mechanical and electrical lift station modifications.

Gravity Sewer from Manhole 6-1-9 to the Main Lift Station

The results of the model indicate that the existing system has sufficient excess capacity to convey the additional flows resulting from the 700 homes in the proposed development.

Table 4
City of Camas
Industrial Wastewater Flows

Industry	Business Type	Modeled Flows	Annual Average Water Consumption (excluding Irrigation)			Wastewater Flow					
			2004	2003	2002	Noted in City's NPDES Permit Application	Industry State Waste Discharge Permit	Industry State Waste Discharge Permit	Industrial User Survey	Hours of Discharge	Maximum Noted
		gpd	gpd	gpd	gpd	gpd	gpd Max Daily	gpd Ave Monthly	gpd		
Wafertech	Semiconductor Manufacturing	**1,150,000**	**561,565**	**502,771**	**437,589**	**1,150,000**	**1,437,500**	**1,150,000**	**450,000**	**Likely 24 h/d**	**1,437,500**
		-									
		-									
		-									
		-									
Linear	Semiconductor Manufacturing	**299,000**	**186,419**	**175,052**	**186,146**	**299,000**	**299,000**	**334,000**		**Likely 24 h/d**	**334,000**
		-									
		-									
Sharp	Semiconductors and LCD R&D	**13,000**	**19,595**	**16,564**	**15,633**	**13,000**	**48,000**	**35,500**	**16,745**	**Likely 24 h/d**	**48,000**
		-									
		-									
		-									
Landa	Manufacturing Industrial Cleaning Systems / Metal Finishing	**43,000**	**5,860**	**5,669**	**7,301**	**43,000**			**9,500**	**16 hours /day**	**43,000**
		-									
Underwriters Lab	Electrical Product Testing	**6,473**	**6,473**	**6,526**	**4,777**						
		-									
Heraeus Shin Etsu	Quartz Glass Manufacturing	**35,000**	**11,733**	**12,166**	**12,871**	**35,000**	**35,000**				**35,000**
		-									
					-						
Total Current Estimated Peak Day Flow		**1,546,473**	**791,645**	**718,749**	**664,317**						**1,897,500**
Peaking Factor		**1.1**	**1.45**								
Total Current Estimated Peak Hour Flow		**1,701,120**	**1,150,000**								


GREGG RESERVOIR ANNEXATION
FORCEMAIN
PROPOSED DEVELOPER LIFT STATION
PROPOSED NEW SEWER
LACAMAS CREEK L.S.
FORCEMAIN
FORCEMAIN
MAIN L.S.
N
0
1,000
2,000
Feet
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASIN BOUNDARY
PARCELS
SEWER CONVEYANCE FOR NEW DEVELOPMENT THROUGH EXISTING SYSTEM
SEWER MANHOLES
PIPE SIZES (DIA.)
1-INCH
2-INCH
3-INCH
4-INCH
6-INCH
8-INCH
10-INCH
12-INCH
15-INCH
18-INCH
21-INCH
24-INCH
CITY OF CAMAS
GREGG RESERVOIR ANNEXATION
SEWER SERVICE ANALYSIS
FIGURE 4
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\FIGURE4.MXD

Main Lift Station to Treatment Plant

Analysis of the Main Lift Station shows an existing excess peak hour capacity of approximately 4.6 MGD based on flow metering data received from the City. Peak hour flows generated from the entire 700 proposed homes is estimated at 0.49 MGD. The Main Lift Station therefore has ample excess capacity to pump the additional flows associated with the development.

Cost Estimates

Table 5 summarized projected City costs to provide service to the GRA area. Actual cost estimates are attached to the back of this memo. Cost estimates are total project costs including tax, engineering and contingency. Developer costs, including the new developer lift station and force main, are not included.

TABLE 5
Capital Costs to Provide Sewer Service to the GRA Area

ITEM	COST ESTIMATE
Crown Hill Sewer (8 " diameter)	$1,160,000
Upgrade Lacamas Creek Lift Station to 410 gpm	$125,000
TOTAL	**$1,285,000**

Future Needs

Simplified models were also developed to determine the sewer facilities required to convey future build-out flows, for two scenarios:

1. the east side of the Draft Discussion Area north of and including the GRA area shown in the 9/27/05 Comprehensive Growth Management Plan map ("east side of Comp Plan Draft Discussion Area").

2. the entire built-out southeast Gregg Service Area Basin, including the GRA area, and

These two respective areas were shown in Figure 2. The areas that could be serviced by a new developer-financed lift station under each of these scenarios is shown in Figure 5.

East Side Of Comp Plan Draft Discussion Area

A summary of sewer system hydraulic modeling results for the East Side of the Draft Discussion Area is provided in Appendix B. To provide sufficient capacity for build-out flows from the Eastside of the Draft Discussion Area, the new Crown Hill sewer line would need to have a diameter of 10 inches, and the sewer line upstream of the Lacamas Creek Lift Station would also need to have a diameter of 10 inches (except the sewer pipe immediately upstream of the Lacamas Creek Lift Station, which would need to have a diameter of 12 inches). The sewer line downstream of the Lacamas Creek Lift Station would not need to be replaced. Improvements required at the Lacamas Creek Lift Station in order to convey peak hour flows from this developed area under build-out conditions would include increasing pump capacity to approximately 1.22 MGD (847 gpm).

Table 6 summarized projected City costs to provide service to the East Side of the Draft Discussion Area, including the GRA. Actual cost estimates are attached to the back of this memo. Cost estimates are total project costs including tax, engineering and contingency. Developer costs, including the new developer lift station and force main, are not included.

TABLE 6
Capital Costs to Provide Sewer Service to the East Side of the Comp Plan Draft Discussion Area

ITEM	COST ESTIMATE
Crown Hill Sewer (10”)	$1,280,000
Replace Sewer Upstream of Lacamas Lift Station	$260,000
Upgrade Lacamas Creek Lift Station to 1.22 MGD (847 gpm)	$700,000
TOTAL	**$2,240,000**

Entire Built-Out Southeast Gregg Service Area Basin

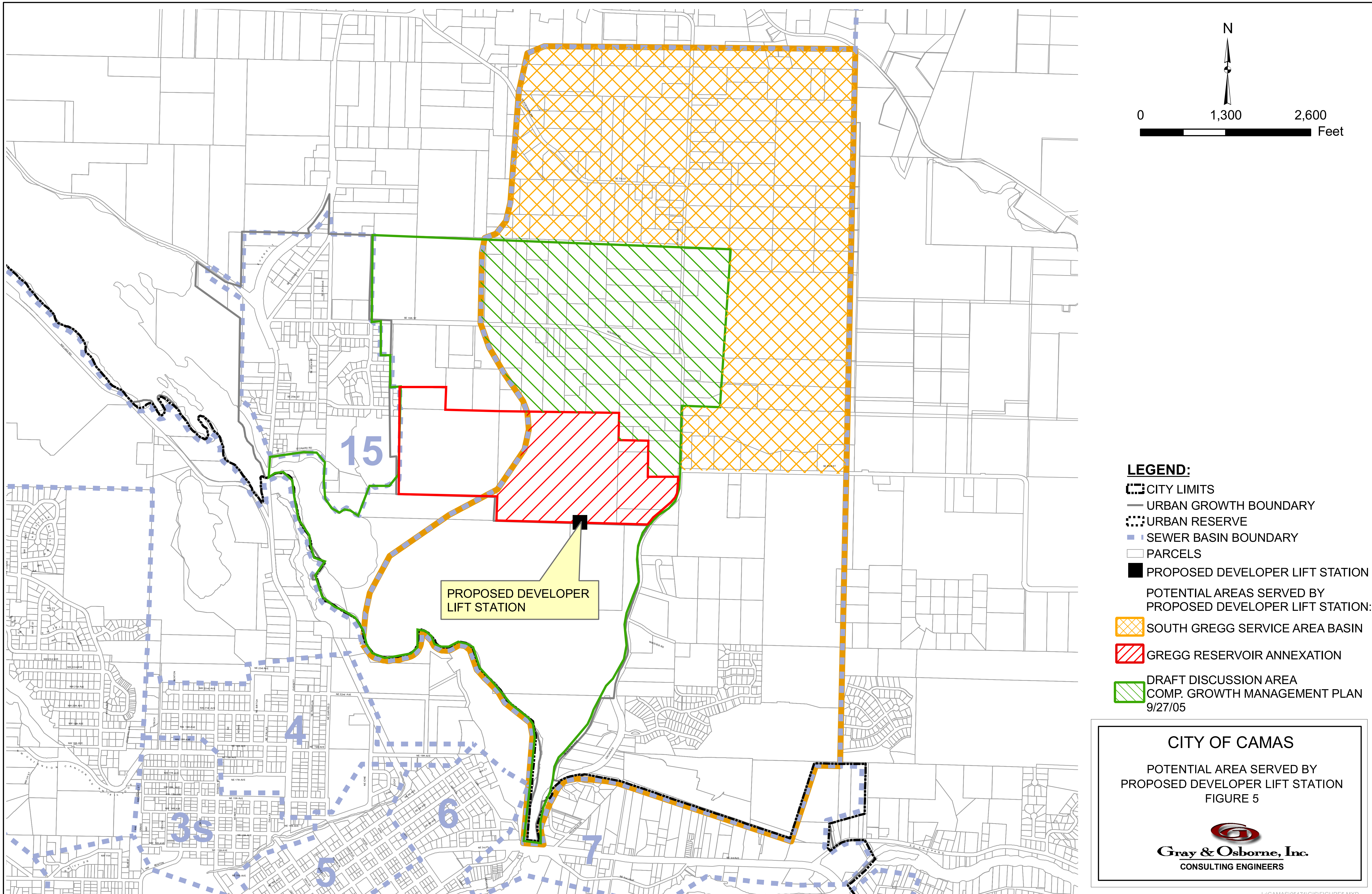
A summary of sewer system hydraulic modeling results for the Entire Built-Out Southeast Gregg Service Area Basin is provided in Appendix C. To provide sufficient capacity for build-out flows from the entire Southeast Gregg Service Area Basin, the new Crown Hill sewer line would need to have a diameter of 15 inches, and the sewer line upstream of the Lacamas Creek Lift Station would need to have a diameter of 15 inches (except the sewer pipe immediately upstream of the Lacamas Creek Lift Station, which would need to have a diameter of 18 inches). The gravity sewer line downstream of the Lacamas Creek Lift Station would need to be replaced with 24-inch diameter pipes.

Improvements required at the Lacamas Creek Lift Station in order to convey peak hour flows from this developed area under build-out conditions would include increasing pump capacity to approximately 5.24 MGD from 0.432 MGD. It is assumed that a new lift station would be built to provide this capacity. Full build-out of the Southwest Gregg Service Area might also require increasing the capacity of the Main Lift Station. The additional 4.8 MGD from the Lacamas Lift Station would increase peak hour flows to 11.3 MGD, just barely exceeding the capacity of the lift station (11.1 MGD). Table 7 summarizes the available connections at the Lacamas Creek and Main lift stations

.

TABLE 7
Summary of Lift Station Analysis

Lift Station	Current Capacity (Peak Hour)	Current Peak Hour Flow	Excess Capacity (Peak Hour)	Connections Available
Lacamas Creek	0.432 MGD	0.250 MGD	0.182 MGD	235
Main	11.1 MGD	6.5 MGD	4.6 MGD	5,900



N
0
1,300
2,600
Feet
15
4
3s
5
6
7
PROPOSED DEVELOPER LIFT STATION
LEGEND:
CITY LIMITS
URBAN GROWTH BOUNDARY
URBAN RESERVE
SEWER BASIN BOUNDARY
PARCELS
PROPOSED DEVELOPER LIFT STATION
POTENTIAL AREAS SERVED BY PROPOSED DEVELOPER LIFT STATION:
SOUTH GREGG SERVICE AREA BASIN
GREGG RESERVOIR ANNEXATION
DRAFT DISCUSSION AREA COMP. GROWTH MANAGEMENT PLAN 9/27/05
CITY OF CAMAS
POTENTIAL AREA SERVED BY PROPOSED DEVELOPER LIFT STATION
FIGURE 5
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471\GIS\FIGURE5.MXD

City of Camas
Evaluation of Sewer Service for the Gregg Reservoir Annexation
Preliminary Cost Estimate
Proposed Crown Road 8" Sewer

	Item	Quantity		Unit Cost	Total
1	Mobilization/Demobilization	1	LS	$ 77,000.00	$ 77,000
2	Clearing and Grubbing	1	LS	$ -	$ -
3	Environmental Controls	1	LS	$ 11,000.00	$ 11,000
4	Trench Excavation Safety Systems	1	LS	$ 13,000.00	$ 13,000
5	Dewatering	1	LS	$ 31,000.00	$ 31,000
6	Locate Existing Utilities	1	LS	$ 8,000.00	$ 8,000
7	Removal of Structures and Obstructions	1	LS	$ 6,000.00	$ 6,000
8	Traffic Control	1	LS	$ 13,000.00	$ 13,000
9	8" PVC Sewer Pipe (Including bedding)	5,150	LF	$ 50.00	$ 257,500
	8" in ROW	5,150			
	8" in unimp easmnt				
10	48" Precast Manhole (Basic to 8')	13	EA	$ 3,000.00	$ 39,000
11	48" Precast Manhole (Height over 8')	0	LF	$ 200.00	$ -
12	Connection to Existing Manhole	1	EA	$ 1,000.00	$ 1,000
13	6" PVC Side Sewer Pipe (including bedding and tee)		EA	$ 900.00	$ -
14	Special Excavation of Unsuitable Material	60	CY	$ 35.00	$ 2,100
15	Foundation Gravel	60	TN	$ 15.00	$ 900
16	Gravel Base	7,790	TN	$ 12.00	$ 93,480
17	Crushed Surfacing Top Course	970	TN	$ 20.00	$ 19,400
18	Cold Mix Asphalt (temp repair)	770	TN	$ 50.00	$ 38,500
19	Asphalt Pavement Repair	3,430	SY	$ 20.00	$ 68,600
20	Hydroseeding		SY	$ 2.00	$ -
21	Saw Cutting	20,600	LF	$ 2.00	$ 41,200
	Subtotal				$ 720,680
	Contingency (20%)				$ 144,136
	Subtotal				$ 864,816
	Sales Tax (7.7%)				$ 66,591
	Total				$ 931,407
	Total Construction Cost (Rounded)				**$ 931,000**
	Engineering and Construction Administration (25%)				$ 233,000
	Total Project Cost (Rounded)				**$ 1,160,000**

City of Camas
Evaluation of Sewer Service for the Gregg Reservoir Annexation
Preliminary Cost Estimate
Lacamas Creek Pump Station - Increase in Capacity to 410 gpm

	Item	Quantity		Unit Cost	Total
1	Mobilization/Demobilization	1	LS	$ 7,000.00	$ 7,000
2	Pumps	2	EA	$ 13,000.00	$ 26,000
3	Control Panel	1	EA	$ 34,000.00	$ 34,000
4	Power Supply Upgrade	1	LS	$ 10,000.00	$ 10,000
	Subtotal				$ 77,000
	Contingency (20%)				$ 15,400
	Subtotal				$ 92,400
	Sales Tax (7.7%)				$ 7,115
	Total				$ 99,515
	Total Construction Cost (Rounded)				**$ 100,000**
	Engineering and Construction Administration (25%)				$ 25,000
	Total Project Cost (Rounded)				**$ 125,000**

City of Camas
Evaluation of Sewer Service for the Gregg Reservoir Annexation
Preliminary Cost Estimate
Proposed Crown Road 10" Sewer

	Item	Quantity		Unit Cost	Total
1	Mobilization/Demobilization	1	LS	$ 85,000.00	$ 85,000
2	Clearing and Grubbing	1	LS	$ -	$ -
3	Environmental Controls	1	LS	$ 11,000.00	$ 11,000
4	Trench Excavation Safety Systems	1	LS	$ 13,000.00	$ 13,000
5	Dewatering	1	LS	$ 31,000.00	$ 31,000
6	Locate Existing Utilities	1	LS	$ 8,000.00	$ 8,000
7	Removal of Structures and Obstructions	1	LS	$ 6,000.00	$ 6,000
8	Traffic Control	1	LS	$ 13,000.00	$ 13,000
9	10" PVC Sewer Pipe (Including bedding)	5,150	LF	$ 62.00	$ 319,300
	10" in ROW	5,150			
	10" in unimp easmnt	0			
10	48" Precast Manhole (Basic to 8')	13	EA	$ 3,000.00	$ 39,000
11	48" Precast Manhole (Height over 8')	0	LF	$ 200.00	$ -
12	Connection to Existing Manhole	1	EA	$ 1,000.00	$ 1,000
13	6" PVC Side Sewer Pipe (including bedding	0	EA	$ 1,000.00	$ -
14	Special Excavation of Unsuitable Material	60	CY	$ 35.00	$ 2,100
15	Foundation Gravel	60	TN	$ 15.00	$ 900
16	Gravel Base	8,040	TN	$ 12.00	$ 96,480
17	Crushed Surfacing Top Course	970	TN	$ 20.00	$ 19,400
18	Cold Mix Asphalt (temp repair)	770	TN	$ 50.00	$ 38,500
19	Asphalt Pavement Repair	3,430	SY	$ 20.00	$ 68,600
20	Hydroseeding		SY	$ 2.00	$ -
21	Saw Cutting	20,600	LF	$ 2.00	$ 41,200

Subtotal	$ 793,480
Contingency (20%)	$ 158,696
Subtotal	$ 952,176
Sales Tax (7.7%)	$ 73,318
Total	$ 1,025,494
Total Construction Cost (Rounded)	**$ 1,025,000**
Engineering and Construction Administration (25%)	$ 256,000
Total Project Cost (Rounded)	**$ 1,280,000**

City of Camas
Evaluation of Sewer Service for the Gregg Reservoir Annexation
Preliminary Cost Estimate
Replace Sewer Upstream of Lacamas Lift Station (w/10" Sewer)

	Item	Quantity			Unit Cost		Total
1	Mobilization/Demobilization	1	LS	$	20,000.00	$	20,000
2	Clearing and Grubbing	1	LS	$	-	$	-
3	Environmental Controls	1	LS	$	2,000.00	$	2,000
4	Trench Excavation Safety Systems	1	LS	$	3,000.00	$	3,000
5	Dewatering	1	LS	$	3,000.00	$	3,000
6	Locate Existing Utilities	1	LS	$	2,000.00	$	2,000
7	Removal of Structures and Obstructions	1	LS	$	1,000.00	$	1,000
8	Traffic Control	1	LS	$	3,000.00	$	3,000
9	10" PVC Sewer Pipe (Including bedding)	950	LF	$	62.00	$	58,900
	10" in ROW	950					
	10" in unimp easmnt	0					
10	48" Precast Manhole (Basic to 8')	6	EA	$	3,000.00	$	18,000
11	48" Precast Manhole (Height over 8')	0	LF	$	200.00	$	-
12	Connection to Existing Manhole	1	EA	$	1,000.00	$	1,000
13	6" PVC Side Sewer Pipe (including bedding	0	EA	$	1,000.00	$	-
14	Special Excavation of Unsuitable Material	10	CY	$	35.00	$	350
15	Foundation Gravel	10	TN	$	15.00	$	150
16	Gravel Base	1,440	TN	$	12.00	$	17,280
17	Crushed Surfacing Top Course	180	TN	$	20.00	$	3,600
18	Cold Mix Asphalt (temp repair)	140	TN	$	50.00	$	7,000
19	Asphalt Pavement Repair	630	SY	$	20.00	$	12,600
20	Hydroseeding		SY	$	2.00	$	-
21	Saw Cutting	3,800	LF	$	2.00	$	7,600
		Subtotal				$	160,480
		Contingency (20%)				$	32,096
		Subtotal				$	192,576
		Sales Tax (7.7%)				$	14,828
		Total				$	207,404
		Total Construction Cost (Rounded)				**$**	**207,000**
		Engineering and Construction Administration (25%)				$	52,000
		Total Project Cost (Rounded)				**$**	**260,000**

City of Camas
Evaluation of Sewer Service for the Gregg Reservoir Annexation
Preliminary Cost Estimate
Lacamas Creek Pump Station and Force Main - Upgrade to 847 gpm

1600 LF 8" DI Force Main

	Item	Quantity		Unit Cost	Total
1	Mobil. & Demobil.	1	LS	$ 37,000.00	$ 37,000
2	8" PVC Force Main	1600	LF	$ 40.00	$ 64,000
3	Locate Existing Utility	1	LS	$ 3,000.00	$ 3,000
4	Trench Safety Systems	1	LS	$ 5,000.00	$ 5,000
5	Trench Excavation, Backfill	1	LS	$ 25,000.00	$ 25,000
6	Traffic Control	1	LS	$ 5,000.00	$ 5,000
7	Erosion Control	1	LS	$ 4,000.00	$ 4,000
8	Foundation Gravel	50	CY	$ 30.00	$ 1,500
9	Gravel Base	300	CY	$ 30.00	$ 9,000
10	Crushed Top Course	200	CY	$ 30.00	$ 6,000
11	Asphalt Pavement Repair	100	TN	$ 100.00	$ 10,000
12	Sawcutting	2000	LF	$ 2.50	$ 5,000
13	Dry Pit Submersible pumps	2	EA	$ 30,000.00	$ 60,000
14	Electrical & Control	1	LS	$ 90,000.00	$ 90,000
15	Generator	1	LS	$ 42,000.00	$ 42,000
16	HVAC	1	LS	$ 20,000.00	$ 20,000
17	Piping at Pump Station	1	LS	$ 15,000.00	$ 15,000
18	Shoring and Dewatering	1	LS	$ 20,000.00	$ 20,000
19	Demolition	1	LS	$ 10,000.00	$ 10,000
	Subtotal				$ 431,500
	Contigency (20%)				$ 86,300
	Subtotal				$ 517,800
	Sales Tax (7.7%)				$ 39,871
	Total Construction Cost				$ 557,671
	Engineering and Administration(25%)				$139,418
	Total Project Cost (Rounded)				$ 698,000

Appendix A
Hydraulic Modeling Results for Sewer Service for the Gregg Reservoir Annexation

LinkID	From Node	To Node	Design Capacity	Qmax	Hmax/D	Qmax/ Capacity	Up - Invert Level	Down - Invert Level	Length	Required Diameter
			(mgd)	(mgd)			[ft]	[ft]	[ft]	(inch)
Fut_8l1	Fut_8	Fut_7	1.408	0.337	0.517	0.24	235.35	218.91	548	8
Fut_7l1	Fut_7	Fut_6	1.408	0.337	0.517	0.24	218.81	207.53	376	8
Fut_6l1	Fut_6	Fut_5	1.408	0.337	0.517	0.24	207.43	190.39	568	8
Fut_5l1	Fut_5	Fut_4	1.408	0.337	0.517	0.24	190.29	171.84	615	8
Fut_4l1	Fut_4	Fut_3	1.408	0.337	0.517	0.24	171.74	157.94	460	8
Fut_3l1	Fut_3	Fut_2	1.408	0.337	0.517	0.24	157.84	116.35	1383	8
Fut_2l1	Fut_2	Fut_1	1.408	0.337	0.517	0.24	116.25	97.68	619	8
Fut_1l1	Fut_1	7-3-5	1.408	0.337	0.429	0.24	97.58	71.6	866	8
7-3-5l1	7-3-5	7-3-4	1.860	0.337	0.489	0.181	71.5	64.26	121.17	8
7-3-4l1	7-3-4	7-3-3	2.592	0.337	0.838	0.13	64.26	41.76	193.99	8
7-3-3l1	7-3-3	7-3-2	0.920	0.337	0.419	0.367	41.76	39.56	150.63	8
7-3-2l1	7-3-2	7-3-1	2.462	0.337	0.301	0.137	39.46	27.09	118.27	8
7-3-1l1	7-3-1	7-1-1	1.738	0.337	0.666	0.194	26.89	16.96	190.47	8
7-1-1l1	7-1-1	L_Creek_LS	2.048	0.476	0.651	0.232	16.86	9.62	328.36	10
6-1-9l1	6-1-9	6-1-8	5.541	3.019	0.843	0.545	59.79	57.85	276.65	18
6-1-8l1	6-1-8	6-1-7	5.134	2.981	0.549	0.581	57.85	56.23	269.02	18
6-1-7l1	6-1-7	6-1-6	6.133	2.931	1.029	0.478	52.04	49.84	256.12	18
6-1-6l1	6-1-6	6-1-5	5.815	2.885	1	0.496	49.84	47.68	279.68	18
6-1-5l1	6-1-5	6-1-4	5.877	2.823	0.839	0.48	47.68	45.48	278.91	18
6-1-4l1	6-1-4	6-1-3	5.973	2.782	0.955	0.466	45.48	43.32	265.09	18
6-1-3l1	6-1-3	6-1-2	5.933	2.749	0.478	0.463	43.32	41.16	268.64	18
6-1-2l1	6-1-2	6-1-1	5.990	2.726	0.871	0.455	37.5	35.44	251.4	18
6-1-1l1	6-1-1	5-2-3	6.997	2.718	0.649	0.388	35.44	32.47	265.6	18
5-2-3l1	5-2-3	5-2-2	12.930	2.707	0.622	0.209	32.47	29.6	75.16	18
5-2-2l1	5-2-2	5-2-1	11.470	2.706	0.573	0.236	29.5	27.1	79.87	18
5-2-1l1	5-2-1	5-1-1	12.231	2.703	0.32	0.221	27	24.41	75.8	18

Appendix B
Hydraulic Modeling Results for Sewer Service for the East Side of the Comp Plan Draft Discussion Area

LinkID	From Node	To Node	Design Capacity	Qmax	Hmax/D	Qmax/ Capacity	Up - Invert Level	Down - Invert Level	Length	Required Diameter
			(mgd)	(mgd)			[ft]	[ft]	[ft]	(inch)
Fut_8l1	Fut_8	Fut_7	2.547	1.043	0.771	0.41	235.35	218.91	548	10
Fut_7l1	Fut_7	Fut_6	2.547	1.043	0.771	0.41	218.81	207.53	376	10
Fut_6l1	Fut_6	Fut_5	2.547	1.043	0.772	0.41	207.43	190.39	568	10
Fut_5l1	Fut_5	Fut_4	2.547	1.044	0.772	0.41	190.29	171.84	615	10
Fut_4l1	Fut_4	Fut_3	2.547	1.044	0.772	0.41	171.74	157.94	460	10
Fut_3l1	Fut_3	Fut_2	2.547	1.045	0.772	0.41	157.84	116.35	1383	10
Fut_2l1	Fut_2	Fut_1	2.547	1.044	0.772	0.41	116.25	97.68	619	10
Fut_1l1	Fut_1	7-3-5	2.547	1.044	0.65	0.41	97.58	71.6	866	10
7-3-5l1	7-3-5	7-3-4	3.369	1.044	0.646	0.31	71.5	64.26	121.17	10
7-3-4l1	7-3-4	7-3-3	4.694	1.044	1.147	0.222	64.26	41.76	193.99	10
7-3-3l1	7-3-3	7-3-2	1.666	1.043	0.574	0.626	41.76	39.56	150.63	10
7-3-2l1	7-3-2	7-3-1	4.458	1.043	0.561	0.234	39.46	27.09	118.27	10
7-3-1l1	7-3-1	7-1-1	3.147	1.043	0.866	0.332	26.89	16.96	190.47	10
7-1-1l1	7-1-1	L_Creek_LS	3.332	1.181	0.91	0.354	16.86	9.62	328.36	12
6-1-9l1	6-1-9	6-1-8	5.541	3.385	0.918	0.611	59.79	57.85	276.65	18
6-1-8l1	6-1-8	6-1-7	5.134	3.385	0.592	0.659	57.85	56.23	269.02	18
6-1-7l1	6-1-7	6-1-6	6.133	3.385	1.147	0.552	52.04	49.84	256.12	18
6-1-6l1	6-1-6	6-1-5	5.815	3.389	1.123	0.583	49.84	47.68	279.68	18
6-1-5l1	6-1-5	6-1-4	5.877	3.402	0.934	0.579	47.68	45.48	278.91	18
6-1-4l1	6-1-4	6-1-3	5.973	3.411	1.09	0.571	45.48	43.32	265.09	18
6-1-3l1	6-1-3	6-1-2	5.933	3.411	0.546	0.575	43.32	41.16	268.64	18
6-1-2l1	6-1-2	6-1-1	5.990	3.408	0.996	0.569	37.5	35.44	251.4	18
6-1-1l1	6-1-1	5-2-3	6.997	3.405	0.739	0.487	35.44	32.47	265.6	18
5-2-3l1	5-2-3	5-2-2	12.930	3.405	0.718	0.263	32.47	29.6	75.16	18
5-2-2l1	5-2-2	5-2-1	11.470	3.403	0.657	0.297	29.5	27.1	79.87	18
5-2-1l1	5-2-1	5-1-1	12.231	3.401	0.362	0.278	27	24.41	75.8	18

Appendix C

Hydraulic Modeling Results for Sewer Service for the Entire Southeast Gregg Service Area

LinkID	From Node	To Node	Design Capacity	Qmax	Hmax/D	Qmax/ Capacity	Up - Invert Level	Down - Invert Level	Length	Required Diameter
			(mgd)	(mgd)			[ft]	[ft]	[ft]	(inch)
Fut_8l1	Fut_8	Fut_7	7.517	5.039	1.12	0.67	235.35	218.91	548	15
Fut_7l1	Fut_7	Fut_6	7.517	5.039	1.118	0.67	218.81	207.53	376	15
Fut_6l1	Fut_6	Fut_5	7.517	5.039	1.118	0.67	207.43	190.39	568	15
Fut_5l1	Fut_5	Fut_4	7.517	5.039	1.118	0.67	190.29	171.84	615	15
Fut_4l1	Fut_4	Fut_3	7.517	5.039	1.118	0.67	171.74	157.94	460	15
Fut_3l1	Fut_3	Fut_2	7.517	5.039	1.118	0.67	157.84	116.35	1383	15
Fut_2l1	Fut_2	Fut_1	7.517	5.039	1.118	0.67	116.25	97.68	619	15
Fut_1l1	Fut_1	7-3-5	7.517	5.039	0.946	0.67	97.58	71.6	866	15
7-3-5l1	7-3-5	7-3-4	9.946	5.039	0.851	0.507	71.5	64.26	121.17	15
7-3-4l1	7-3-4	7-3-3	13.857	5.039	1.694	0.364	64.26	41.76	193.99	15
7-3-3l1	7-3-3	7-3-2	4.917	5.039	0.907	1.025	41.76	39.56	150.63	15
7-3-2l1	7-3-2	7-3-1	13.159	5.039	0.916	0.383	39.46	27.09	118.27	15
7-3-1l1	7-3-1	7-1-1	9.290	5.039	1.157	0.542	26.89	16.96	190.47	15
7-1-1l1	7-1-1	L_Creek_LS	9.825	5.173	0.515	0.527	16.86	9.62	328.36	18

6-1-9l1	6-1-9	6-1-8	11.934	7.362	0.94	0.617	59.79	57.85	276.65	24
6-1-8l1	6-1-8	6-1-7	11.059	7.357	0.596	0.665	57.85	56.23	269.02	24
6-1-7l1	6-1-7	6-1-6	13.208	7.355	1.198	0.557	52.04	49.84	256.12	24
6-1-6l1	6-1-6	6-1-5	12.524	7.354	1.153	0.587	49.84	47.68	279.68	24
6-1-5l1	6-1-5	6-1-4	12.657	7.351	0.923	0.581	47.68	45.48	278.91	24
6-1-4l1	6-1-4	6-1-3	12.864	7.348	1.087	0.571	45.48	43.32	265.09	24
6-1-3l1	6-1-3	6-1-2	12.779	7.347	0.544	0.575	43.32	41.16	268.64	24
6-1-2l1	6-1-2	6-1-1	12.900	7.346	1.038	0.569	37.5	35.44	251.4	24
6-1-1l1	6-1-1	5-2-3	15.070	7.345	0.759	0.487	35.44	32.47	265.6	24
5-2-3l1	5-2-3	5-2-2	27.849	7.345	0.751	0.264	32.47	29.6	75.16	24
5-2-2l1	5-2-2	5-2-1	24.705	7.344	0.672	0.297	29.5	27.1	79.87	24
5-2-1l1	5-2-1	5-1-1	26.343	7.344	0.361	0.279	27	24.41	75.8	24

APPENDIX M

WWTF PERFORMANCE DATA

Figure 1
City of Camas WWTP
Influent and Effluent BOD5 (mg/L)

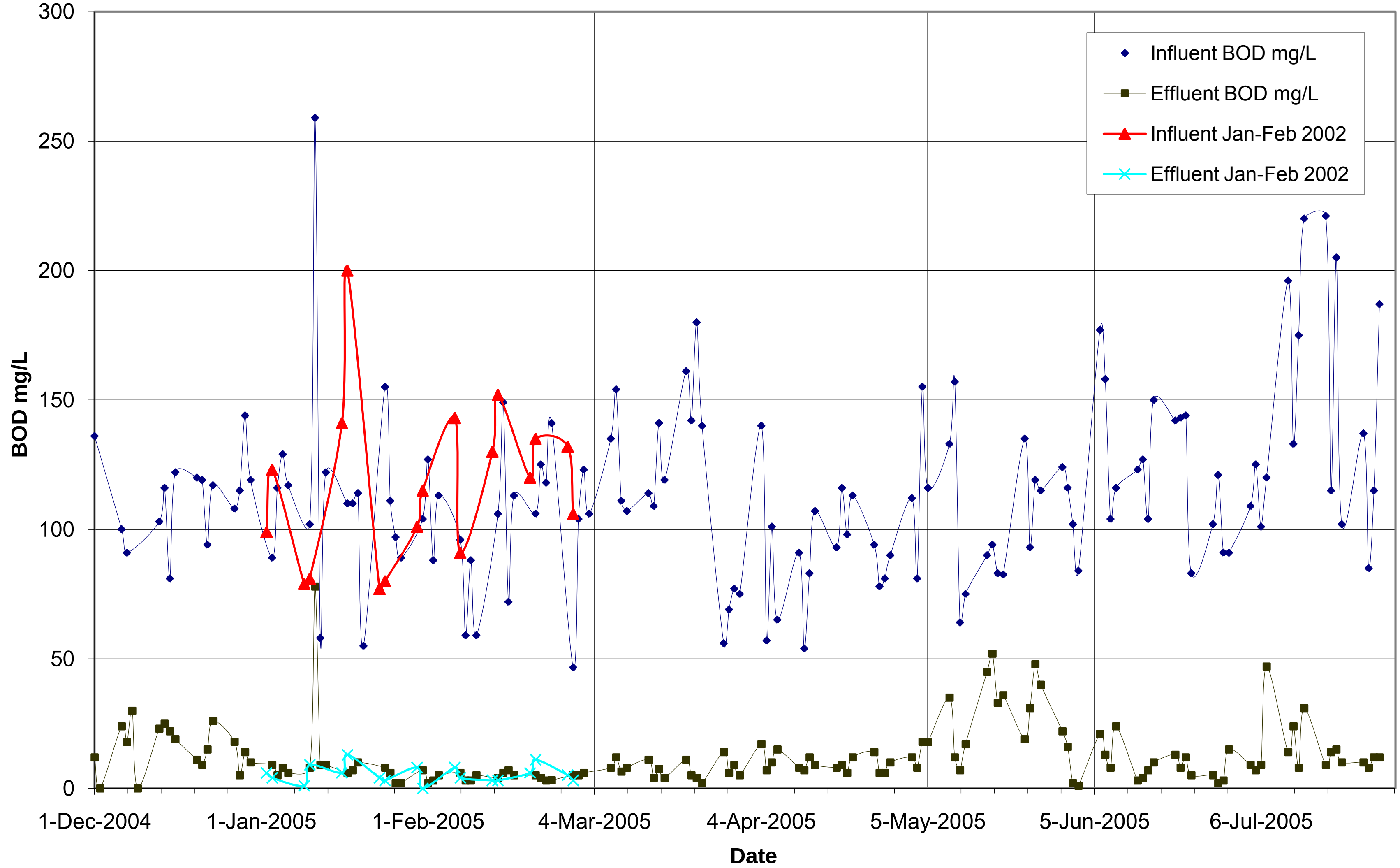


Figure 2
City of Camas WWTP
Influent and Effluent TSS (mg/L)

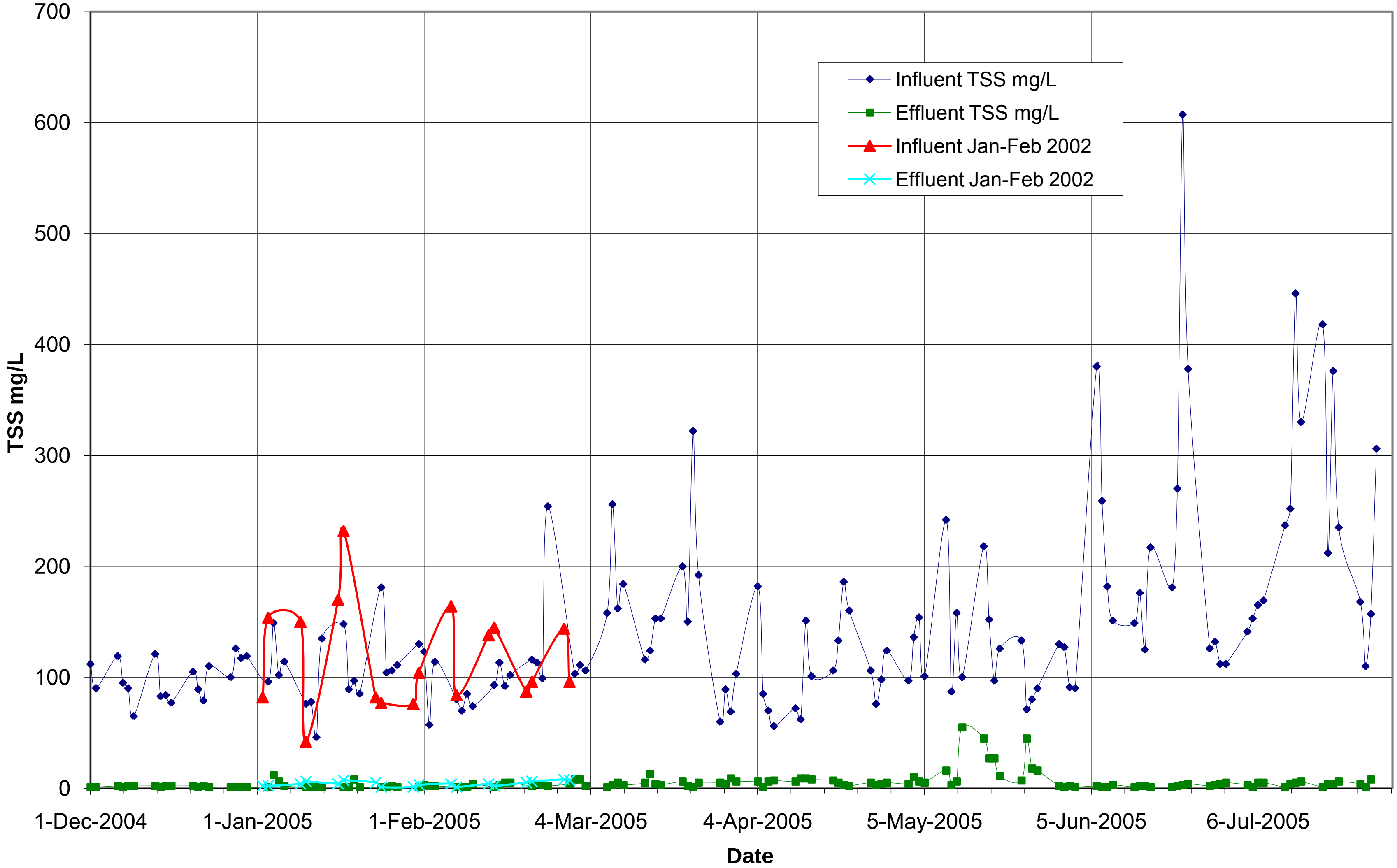


Figure 3
City of Camas WWTP
Influent and Effluent Ammonia (mg/L)

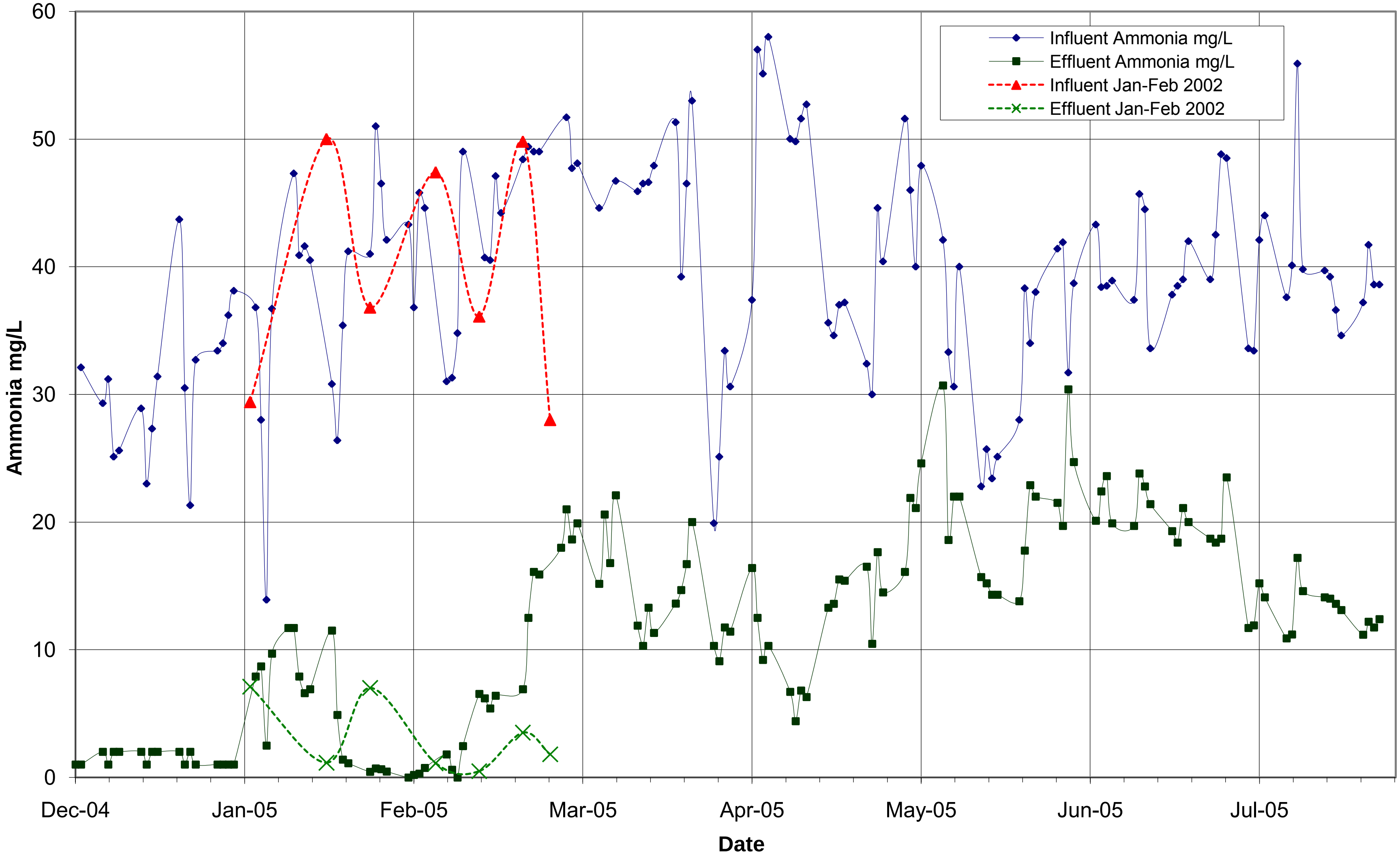


Figure 4
City of Camas WWTP
Influent and Effluent Flow MGD

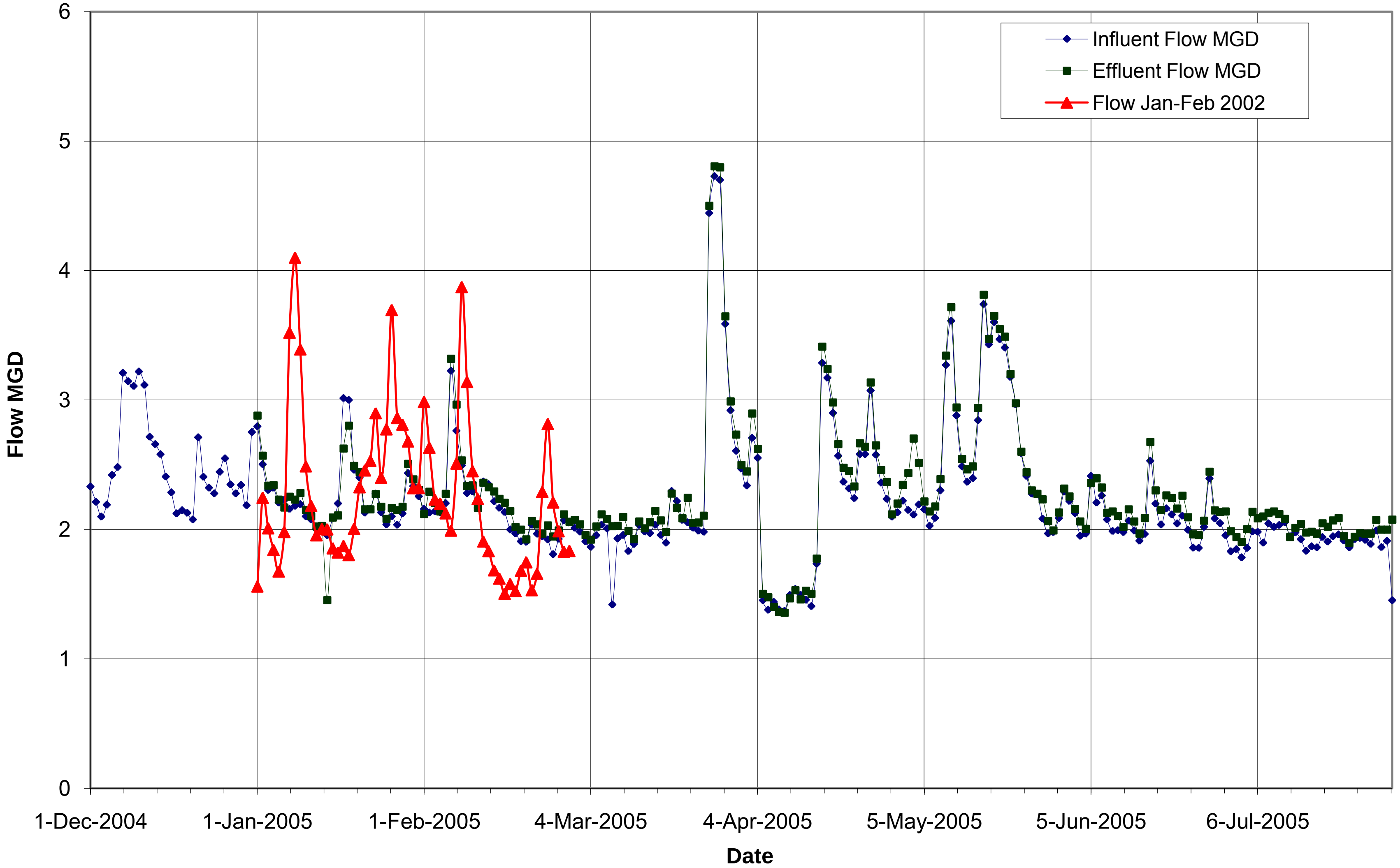
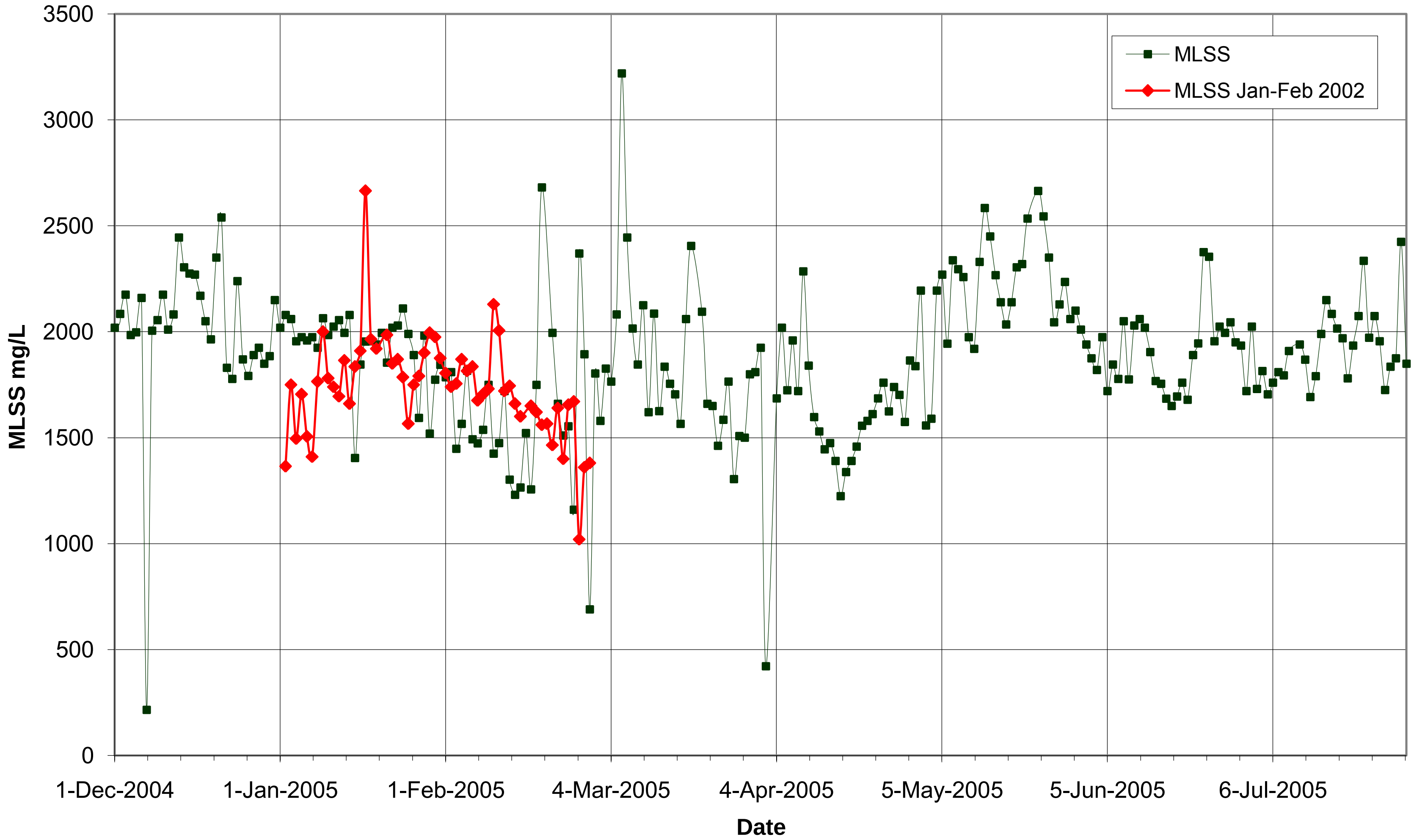


Figure 5
City of Camas WWTP
Aeration Basin MLSS



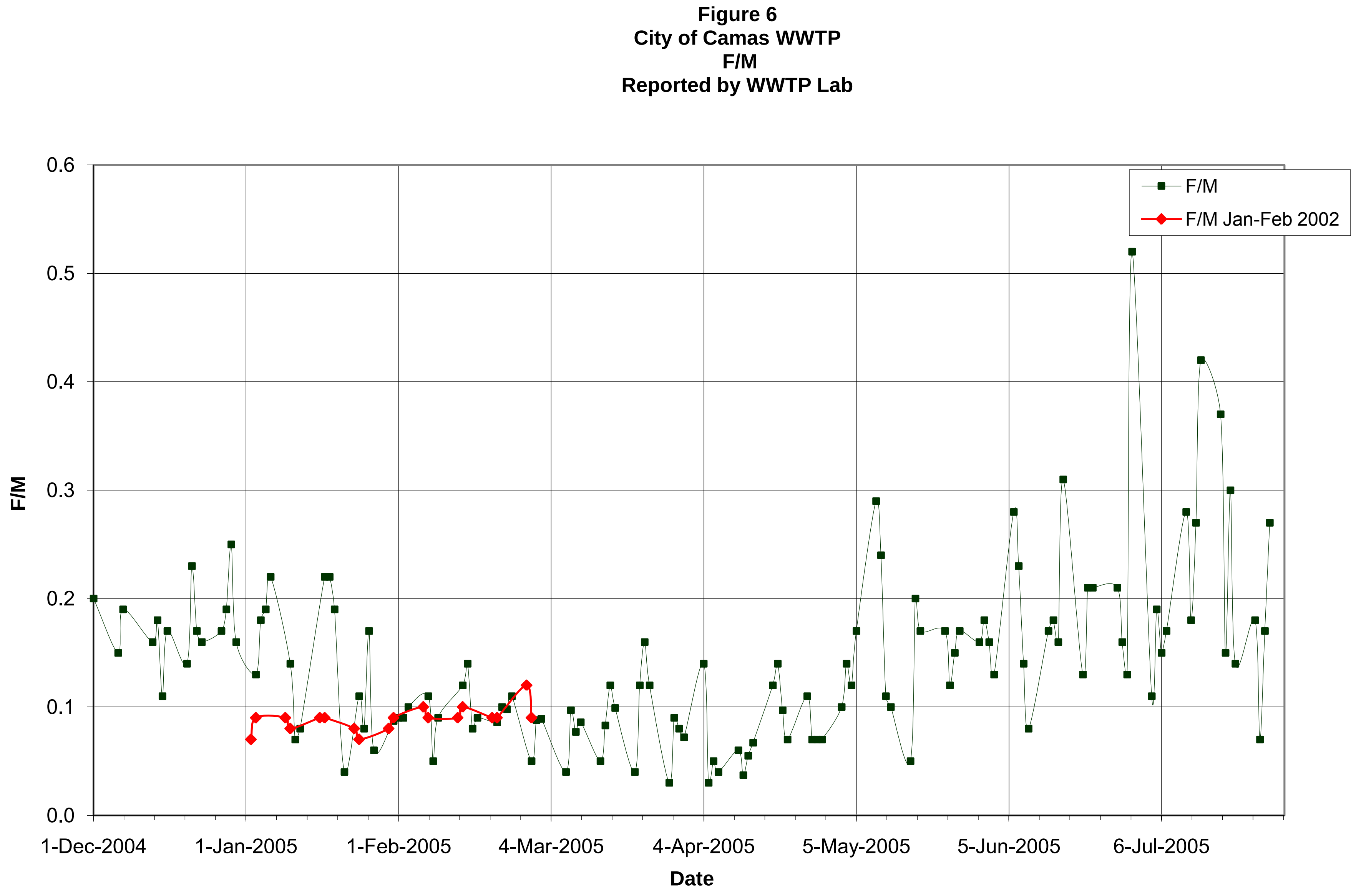


Figure 6
City of Camas WWTP
F/M
Reported by WWTP Lab
F/M
F/M Jan-Feb 2002
0.6
0.5
0.4
0.3
0.2
0.1
0.0
F/M
1-Dec-2004
1-Jan-2005
1-Feb-2005
4-Mar-2005
4-Apr-2005
5-May-2005
5-Jun-2005
6-Jul-2005
Date

Figure 7
City of Camas WWTP
Primary Effluent Suspended Solids mg/L

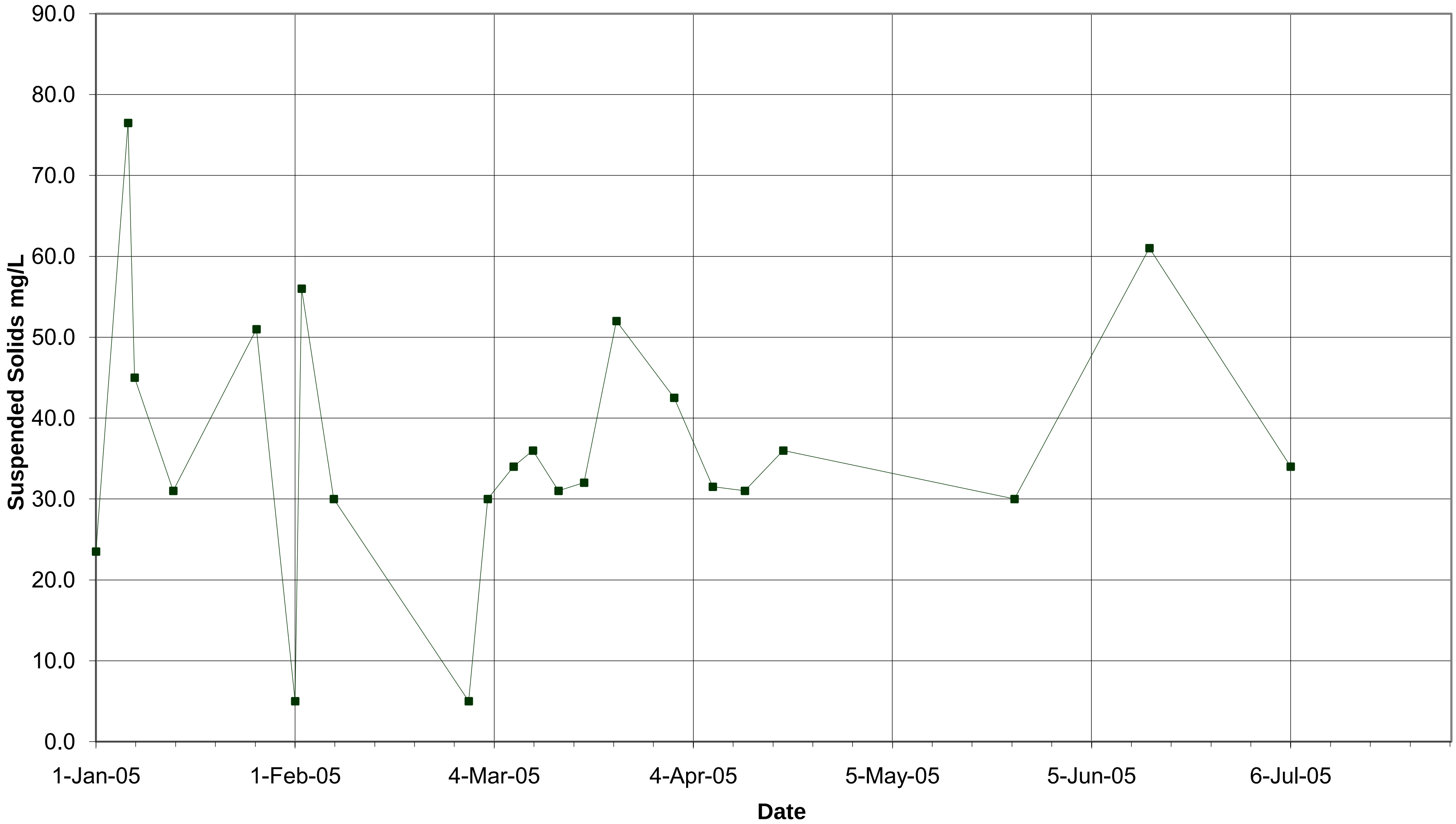


Figure 8
City of Camas WWTP
Influent and Effluent pH

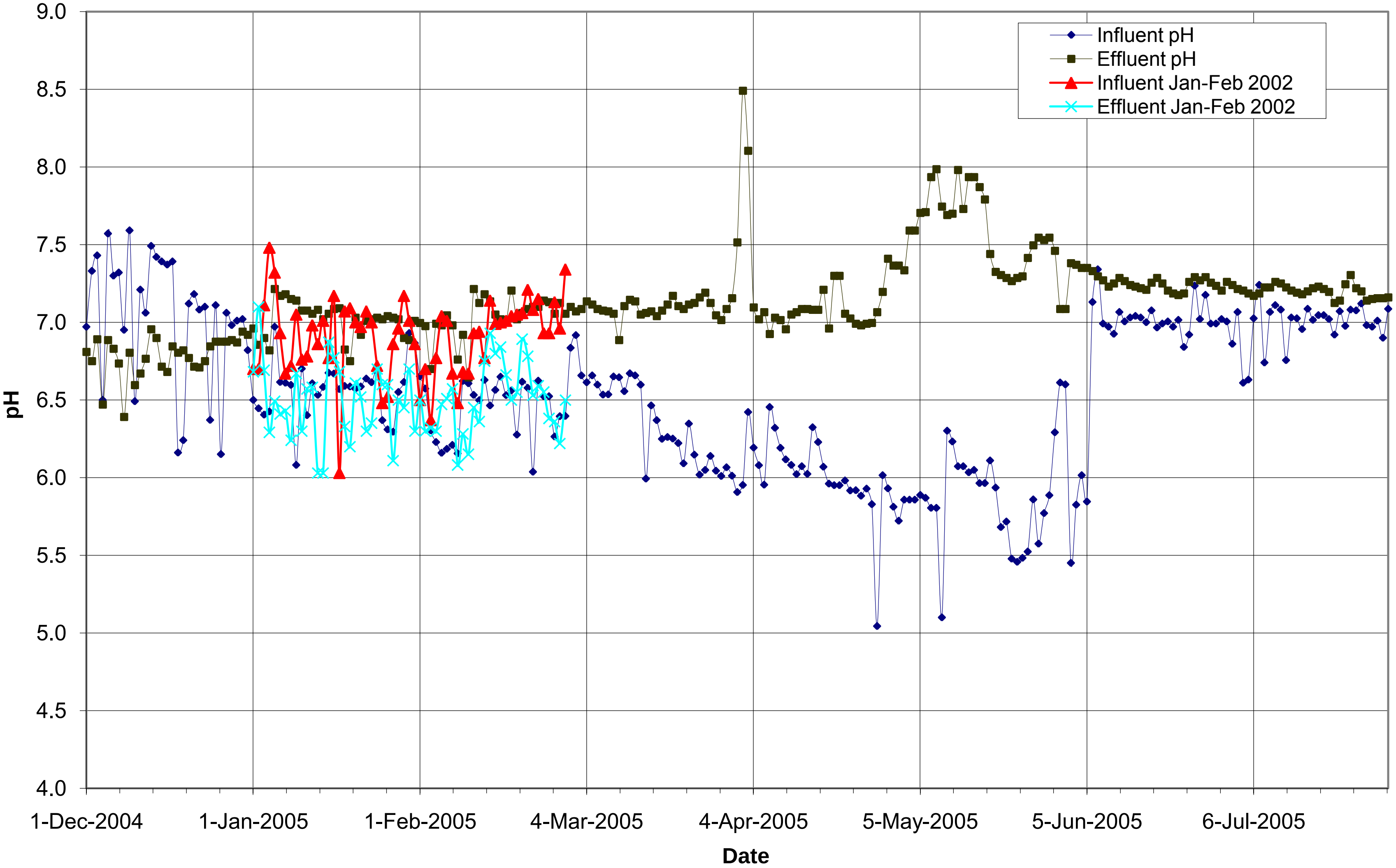


Figure 9
City of Camas WWTP
Aeration Basin Alkalinity

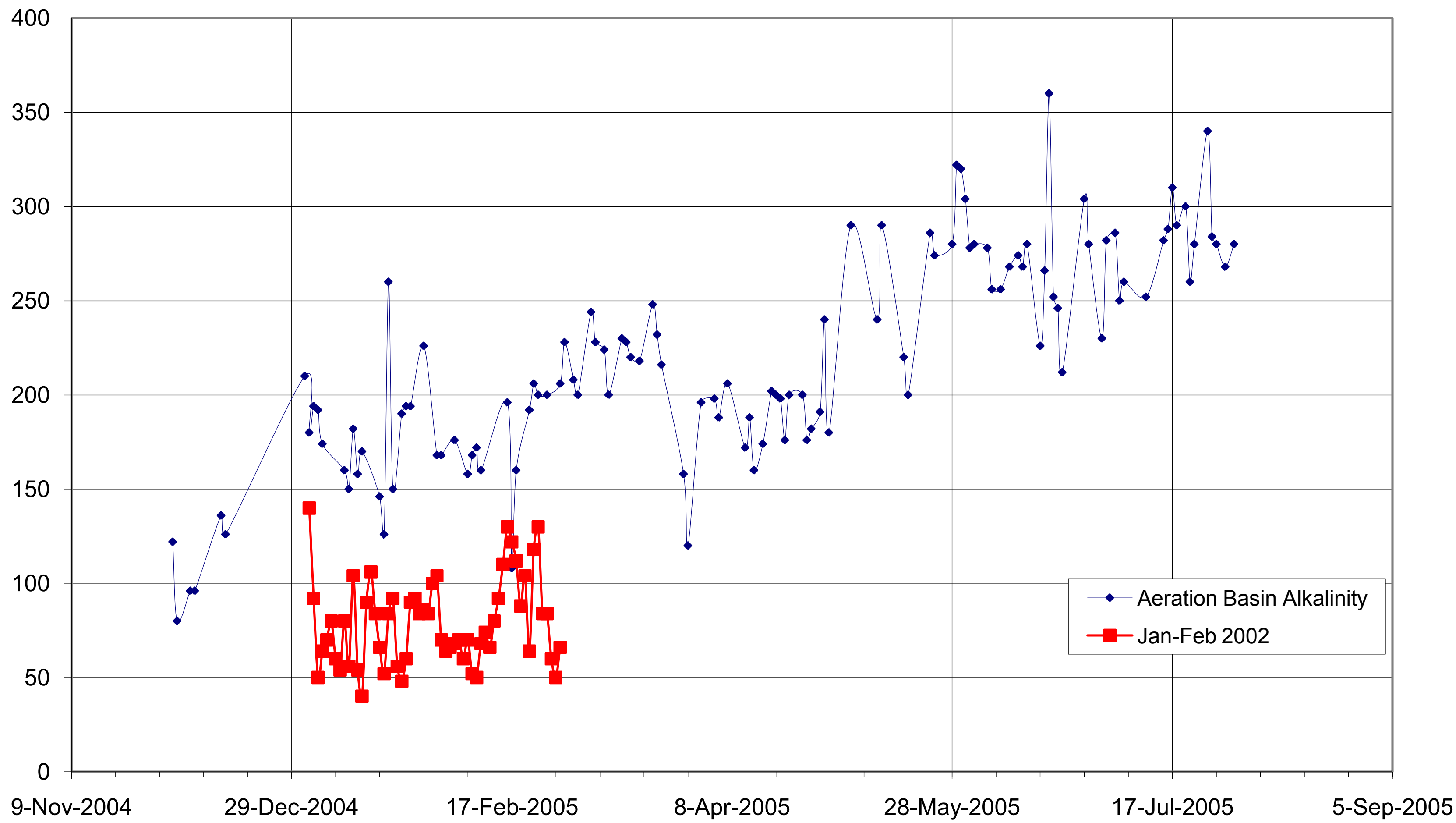
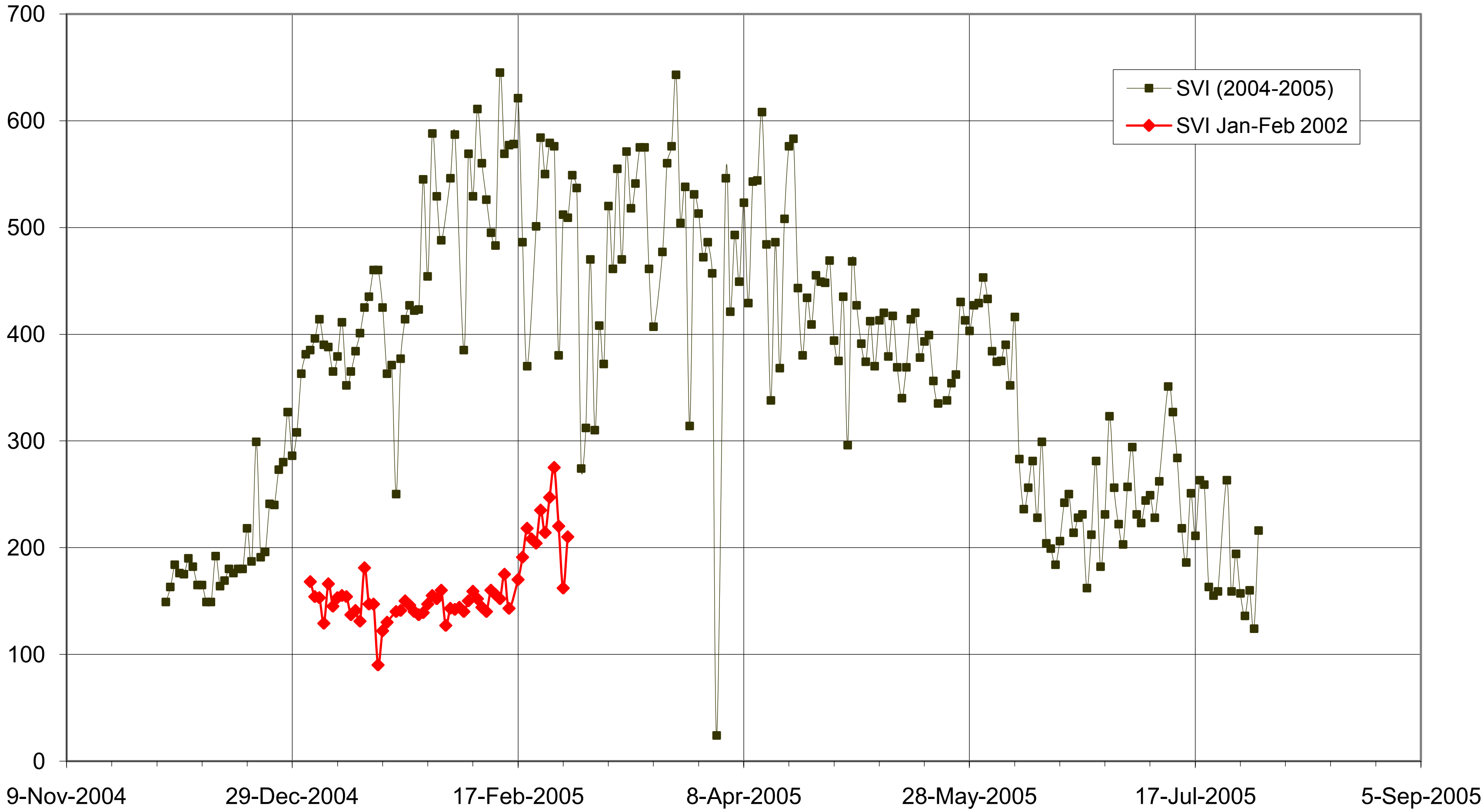


Figure 10
Sludge Volume Index (SVI)
City of Camas WWTP



APPENDIX N

EFFLUENT DYE STUDY AND MIXING ZONE EVALUATION

City of Camas

Final Dye Tracer and Mixing Zone Study

Prepared for:

Gray & Osborne, Inc.
701 Dexter Avenue North
Suite 200
Seattle, Washington 98109

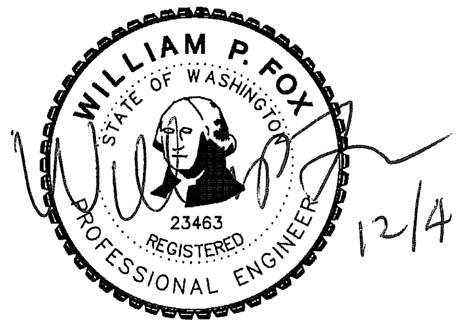
Prepared by:

Cosmopolitan Engineering Group
117 South 8th Street
Tacoma, Washington 98402

December 2006
G&O016

CERTIFICATE OF ENGINEER

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal as a professional engineer licensed to practice as such, is affixed below.



12/4/06

EXPIRES 10-29-07

William P. Fox, P.E.
Cosmopolitan Engineering Group, Inc.

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OVERVIEW

The purpose of this report is to present the results of the dye tracer studies for the City of Camas Wastewater Treatment Plant (WWTP) discharge to the Columbia River. The tracer studies and ancillary field measurements have been conducted to assess and calibrate the most appropriate mixing zone model to use for the City's NPDES permit and development of effluent limitations. This report of the methods and results of the field studies and model calibration is presented in three parts as follows:

PART I

Dye tracer study No. 1 was completed on February 16, 2005. The February field study was selected to represent potential critical conditions for the winter season. Target conditions for the study included maximum potential plume buoyancy (largest difference between ambient river temperature and effluent temperature), relatively low river discharge, adverse tidal conditions (late flood tide) and high effluent flow. Tracer study results and model calibration parameters are presented in this section.

PART II

Dye tracer study No. 2 was conducted on October 4, 2005. The October field study was selected to represent critical conditions for the late summer, early autumn season. Target conditions for the field study included annual low river discharge and adverse tidal conditions (late flood tide). Tracer study results and model calibration parameters from the second dye study are presented in this section.

PART III

This section presents the model selection and calibration parameters that are recommended based on the results of the two dye tracer studies. The revised dilution modeling for the critical conditions established in the NPDES permit are presented in this section along with an assessment of the reasonable potential to exceed water quality standards.

ECOLOGY COMMENTS AND RESPONSES

Ecology provided detailed comments to the January 2006 draft of this report in a letter dated May 5, 2006. This final report incorporates the revisions to the January 2006 report that resulted from the Ecology comments and Cosmopolitan's responses.

PART I:
DYE STUDY NO. 1

PART I:
DYE STUDY NO. 1

The outfall from the City of Camas WWTP is a 36-inch-diameter corrugated metal pipe (CMP) extending approximately 850 feet from the river bank to a depth of approximately 20 to 25 feet during normal river flows. The outfall terminates in a 150-foot diffuser section consisting of 16 6-inch-diameter ports. The ports extend vertically from the diffuser and include 90-degree bends pointing horizontally downstream. The first eight ports are currently capped off, and only the last eight are discharging effluent. Drawings of the outfall and diffuser are shown in Attachment I-1.

WWTP DATA

Dye Injection

Rhodamine WT dye was injected at a constant rate into the Camas WWTP effluent for approximately 4.4 hours on February 16, 2005. The liquid dye (23 percent solution) was injected at a rate of 27 mL/min. The dye solution was injected into the mixing vault at the outlet from the UV chamber. Effluent pumps and plant water recirculation pumps were shut down during the study.

Effluent Monitoring

WWTP staff monitored effluent flow rate and temperature during the tracer study. They also collected effluent grab samples from the outfall manhole across the street from the WWTP. The grab samples were subsequently diluted by a factor of 100:1 in the Cosmopolitan laboratory and measured by the fluorometer. The results of the WWTP effluent monitoring are in Table I-1.

Table III- 1 WWTP Effluent Monitoring During the Tracer Study

Date	Time	Effluent Flow (mgd)	Effluent Temp (C)	Tracer Conc (ppb)
2/16/05	08:30	2.77	14.6	1,220
2/16/05	12:00	2.30	14.8	1,110
2/16/05	13:00	2.00	14.8	790
2/16/05	13:30	2.00	14.9	980
			AVERAGE	1,030

Tracer Concentration

The tracer concentration data in Table I-1 are variable, suggesting that mixing in the outfall was incomplete during the estimated 2-minute travel time between the dye injection point and the effluent manhole. The actual mixed tracer concentration can be more reliably calculated from the known tracer concentration and injection rate. The dye pump was pre-calibrated to an injection rate of 27 mL/min, and at a calibrated concentration of 23 percent. The dye container was weighed before and after the dye injection, which confirmed the 27 mL/min injection rate.

15.5 lbs of 23 percent solution Rhodamine WT dye were discharged over a period of 263 minutes. The corresponding effluent flow during the tracer study field measurements averaged 2.15 mgd. Therefore, the average effluent tracer concentration during the study was the ratio of dye to effluent mass discharge, as shown below:

Tracer Mass Discharge = (0.23) (15.5) / (263) = 0.0135 lbs/min
Effluent Mass Discharge = (2,150,000) (8.34) / (1440) = 12,500 lbs/min
Effluent Tracer Conc = 0.00000108 = 1,080 ppb

RIVER DATA

River Discharge

River discharge data for the Bonneville Dam are available from the following website:

http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=id:BON+record://BON/QR//IR-MONTH/HRXZZAZD/+psy:+psm:+psd:+pey:+pem:+ped:+pk:columbia+river+flow+bonneville

There is a time delay from variations in release at Bonneville to changes observed near Camas. The distance from Bonneville to the Camas WWTP is approximately 10.5 miles. The celerity of a gravity wave generated by an abrupt elevation change of one foot, similar to the flow increase on the morning of February 16, is as follows:

$$V = (2gh)^{½} = 8 \text{ ft/sec}$$

Therefore, abrupt changes in release at the Bonneville Dam takes approximately one to two hours to reach Camas.

River Stage and Tidal Influence

River stage at Camas varies as a function of river discharge, and may be influenced by tides. It is known that tides influence river flow as far upstream as Vancouver, WA. However, no predictions are provided by NOAA upstream of Vancouver. The tracer study was timed to occur during the period predicted to coincide with potential tidal slowing of the river current, which was high slack tide predicted at 12:30 PM in Vancouver.

Bonneville discharge data and predicted tides at Vancouver are plotted in Figure I-1. The duration of the effluent tracer field measurements is also shown as a yellow bar in the figure. The tracer measurements occurred during predicted slack tide at a time when river discharge was in the range of 155 to 160 kcfs.

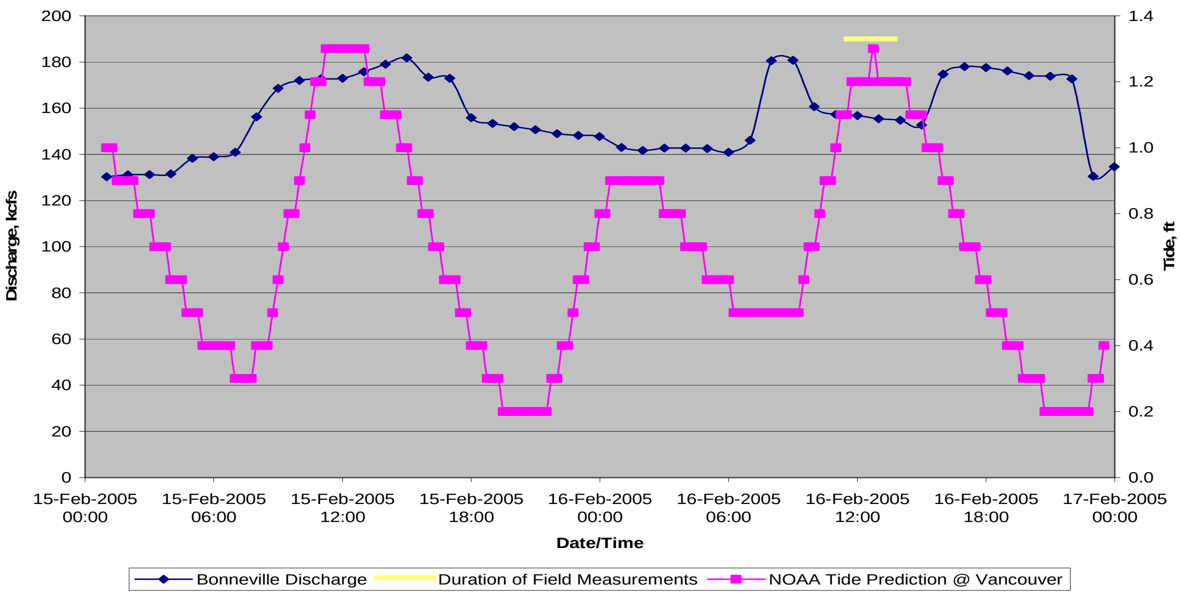


Figure I-1. Bonneville Dam Discharge Data

River Velocity Measurements

Velocity measurements were obtained several times during and prior to the tracer study. These data are listed in Table I-2 with river stage data that were observed at the Port of Washougal. The results lead to no conclusions about tidal influence. The increase in river stage from morning to midday on February 16 could have been caused by either the tide or the unsteady flow caused by the release at Bonneville Dam earlier in the morning. The fact that current velocity rose slightly would suggest that the stage increase was produced by the Bonneville Dam release rather than tidal influence.

Table I-2 River Stage and Velocity Data During the Tracer Study

Date	Time	River Stage (ft)	Current Speed (fps)
2/15/05	13:50	4.5	1.65
2/15/05	15:50	4.5	1.65
2/16/05	07:15	3.0	1.40
2/16/05	11:00	3.8	1.54
2/16/05	13:00	3.9	1.54

CTD Profiles

Conductivity, temperature, and depth profiles were measured three times during the tracer study. The results are presented in Table I-3. Temperature and salinity profiles conclusively show that the receiving water is well mixed, or unstratified.

Table I-3 CTD Profiles During the Tracer Study

Depth (m)	08:34 2/16/05		13:00 2/16/05		14:32 2/16/05	
	Sal (ppt)	Temp (C)	Sal (ppt)	Temp (C)	Sal (ppt)	Temp (C)
1	0.077	4.16	0.077	4.26	0.077	4.34
2	0.077	4.17	0.078	4.26	0.078	4.34
3	0.077	4.17	0.078	4.27	0.078	4.34
4	0.077	4.17	0.079	4.27	0.078	4.35
5	0.077	4.16	0.079	4.28	0.078	4.35
6	0.077	4.16	0.079	4.28	0.078	4.35

TRACER STUDY RESULTS

Overview

Dye injection began at 8:28 on February 16. The fluorometer was placed in the water and towed across the mixing zone boundary 320 feet downstream of the diffuser. The dye plume was quickly found and the research vessel was moored approximately 310 feet downstream. The mooring consisted of an anchor set approximately 50 feet upstream of the diffuser, with a 360-ft anchor line. Traverses across the downstream mixing zone boundary were conducted by swinging in an arc pattern from the main mooring. Lateral anchors were set to aid in cross-channel positioning along the downstream mixing zone boundary.

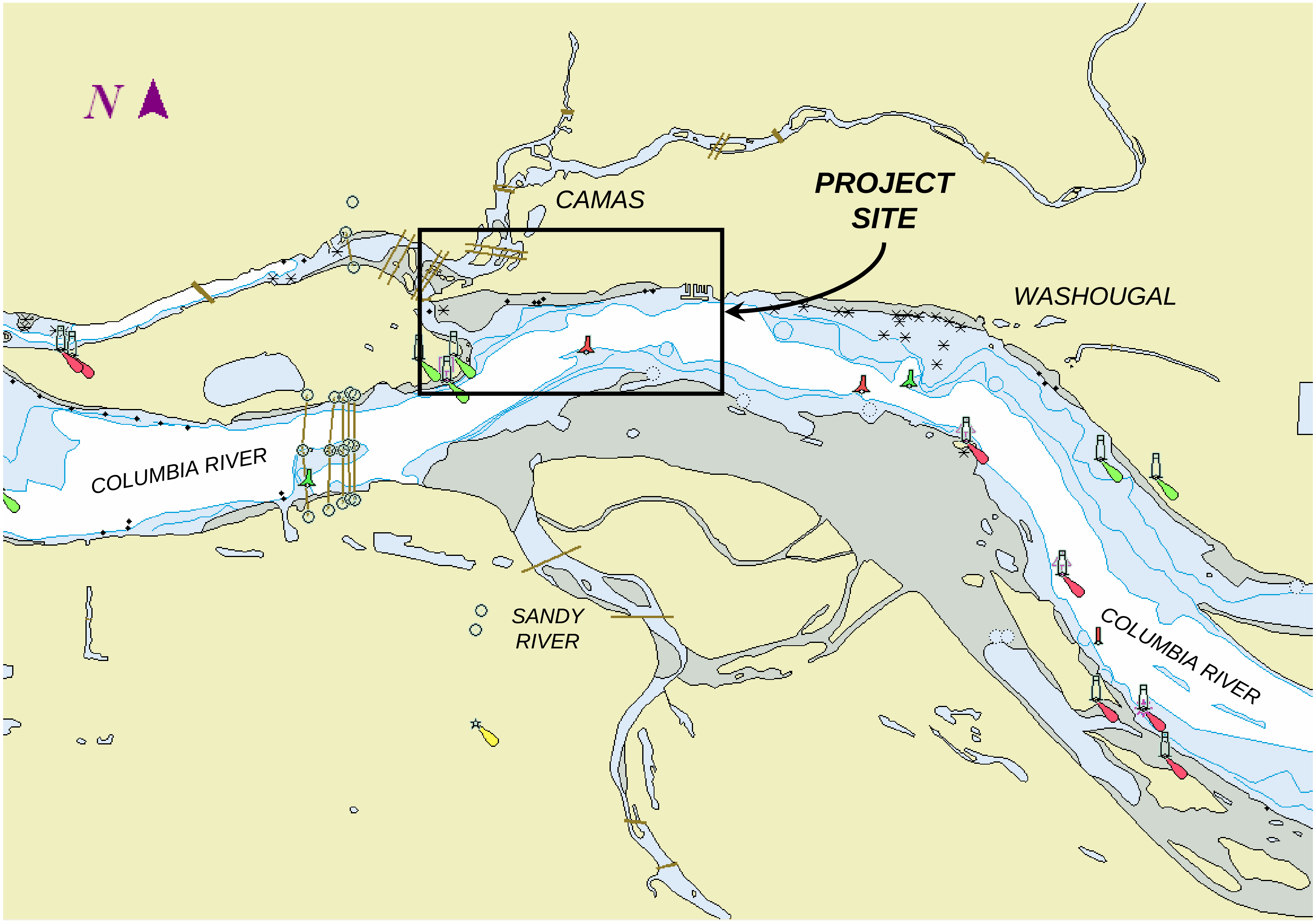
The general configuration of the diffuser, mixing zone boundary, mooring system and cross-channel stationing are illustrated in Figures I-2 through I-4. The river is conveniently oriented east-west, so the vessel's cross-channel positions along the downstream mixing zone boundary were recorded by the latitude reading from a dGPS system. The vessel's cross-channel positioning data were post-processed into a stationing system corresponding to the stationing on the 1971 outfall drawing (sheet 42). That is, the diffuser terminus is at station 12+40 on the drawing. In our reporting of dye study results, our station 12+40 is approximately 310 feet directly downstream of the diffuser terminus. The plume centerline is at approximately station 12+05 or latitude 45° 34.529', corresponding to the midpoint of the diffuser.

Shortly after the mooring system was completed, communications between the SCUFA fluorometer and on-board computer failed. The dye injection was shut off at 9:53. We returned to the Washougal marina and picked up a replacement laptop computer provided the WWTP operators. SCUFA communications were reestablished and the dye injection was restarted at 10:55 and continued through 13:53.

Comprehensive plume tracer concentration data were obtained at the mixing zone boundary between 11:23 and 13:40 on February 16, 2005. Measurements consisted of (1) vertical profiles measured at a fixed location, (2) horizontal transects measured from one edge of the mixing zone to the other at fixed depths, and (3) a final "sawtooth" pattern measured near the centerline of the plume and across depths of maximum plume concentration. The schedule of plume tracer measurements is provided in Table I-4.

Table I-4 Schedule of Plume Tracer Concentration Measurements

Date	Time	Type
2/16/05	11:23 – 11:27	Profile #1 at station 11+80
2/16/05	11:50 – 11:59	Profile #2 at station 12+20
2/16/05	12:10 – 12:17	Transect #1 4 ft above bottom
2/16/05	12:35 – 12:42	Transect #2 8 ft above bottom
2/16/05	12:49 – 13:03	Profile #3 at station 12+05
2/16/05	13:32 – 13:41	Sawtooth pattern

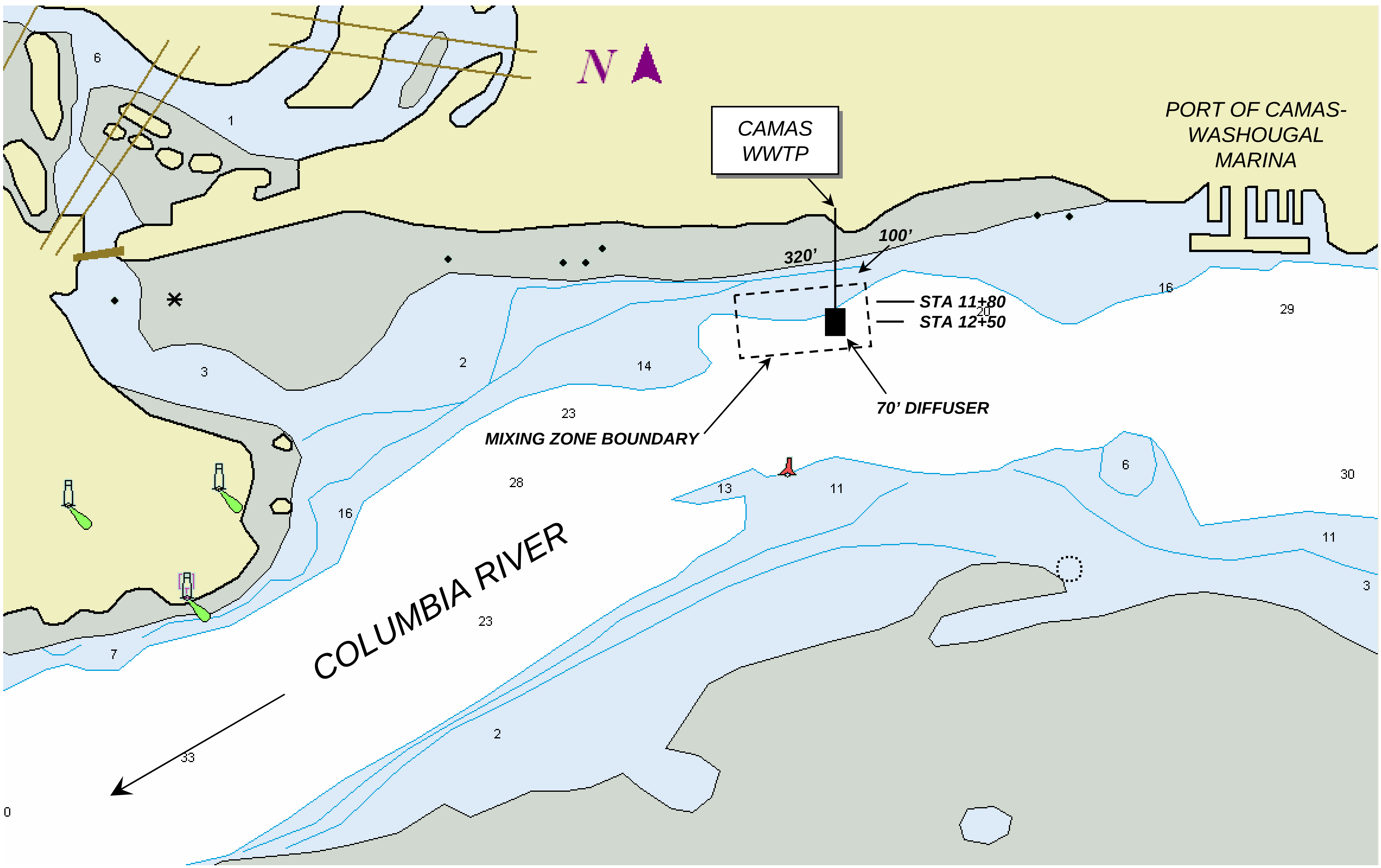


FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

COSMOPOLITAN ENGINEERING GROUP
Civil, Environmental, and Recreational Consulting

NO SCALE

Figure I-2: PROJECT VICINITY MAP



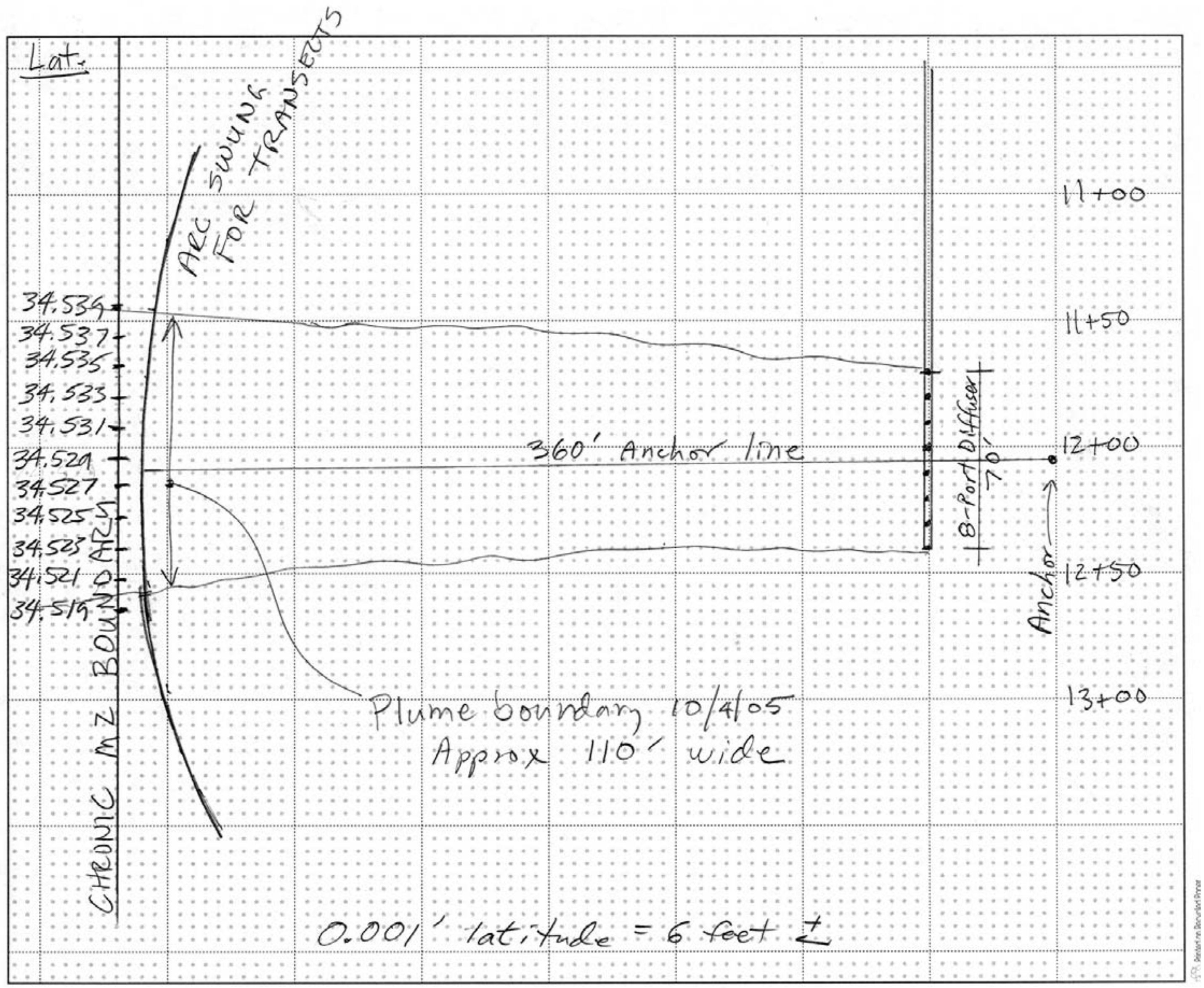
FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

COSMOPOLITAN ENGINEERING GROUP

Civil, Environmental, and Recreational Consulting

NO SCALE

Figure I-3: TRACER STUDY SITE MAP



FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

COSMOPOLITAN ENGINEERING GROUP
Civil, Environmental, and Recreational Consulting

NO SCALE

Figure I-4: MIXING ZONE TRANSECTS

Tabular Results

Effluent tracer concentration data are tabulated and are provided in Attachment I-1. The information on each table includes the date and time of measurement, fluorescence (i.e., the tracer concentration), turbidity (uncalibrated), height of the fluorometer above the river bottom, cross-channel stationing, effluent volume fraction, and dilution. Effluent volume fraction is the proportion of the measured parcel of ambient water consisting of effluent. For example, 0.3% effluent fraction would consist of 3 parts effluent to 997 parts ambient water. Dilution factor is merely the inverse of effluent volume fraction. Only dilution factors less than 1,000:1 are recorded in the tables.

Graphical Results

The tracer concentration measurements are shown graphically for each set of measurements in Figures I-5 through I-10. The data shown are effluent volume fraction. The two principal observations from these graphs are (1) the depth of maximum effluent concentration is about 4 feet above the river bottom, and (2) the concentrations are relatively uniform across the width of the diffuser, with the maximum concentration occurring near the midpoint or a bit shoreward of that point.

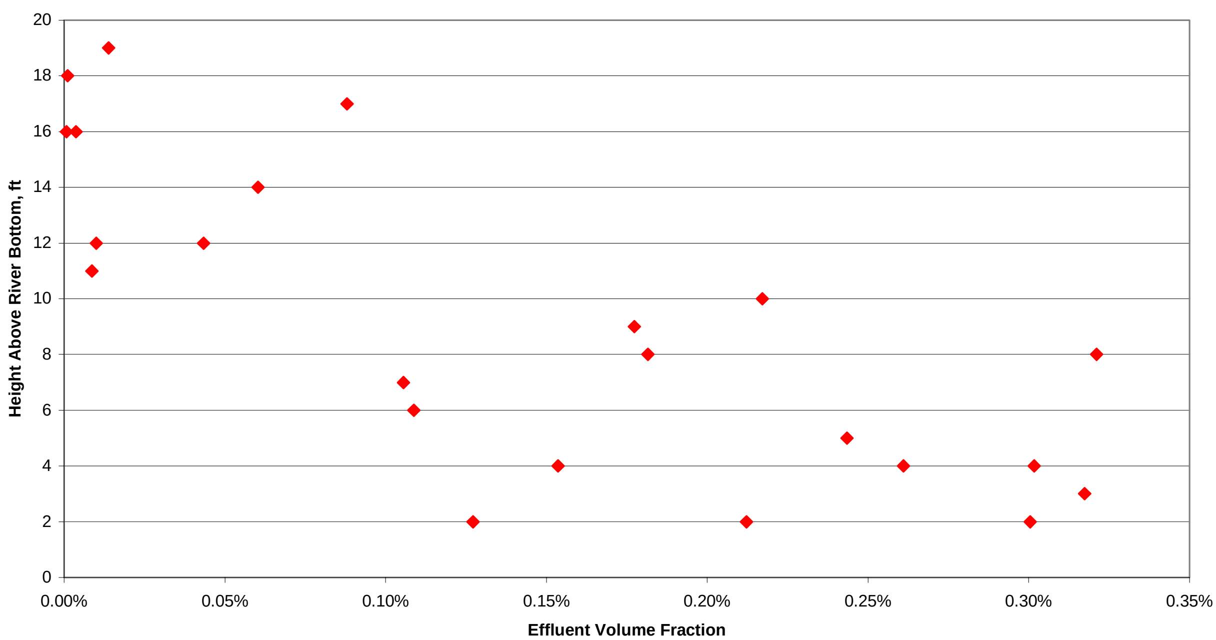


Figure I-5. Profile #1 – Station 11+80

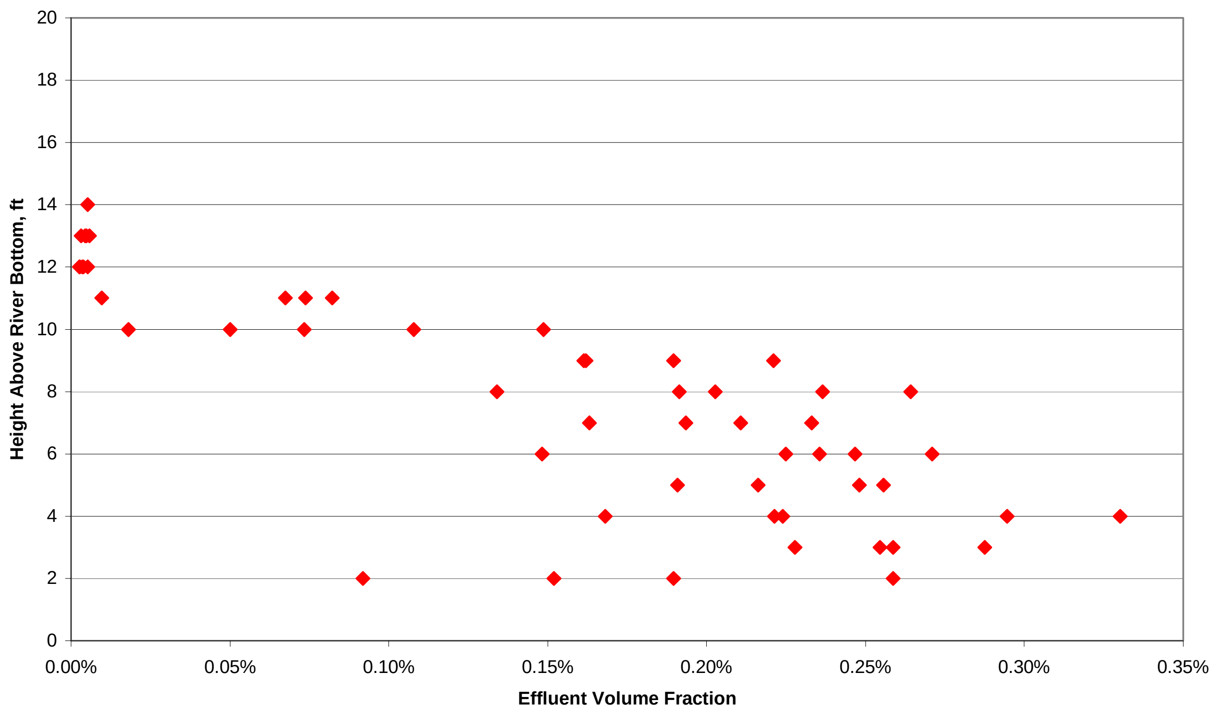


Figure I-6. Profile #2 – Station 12+20

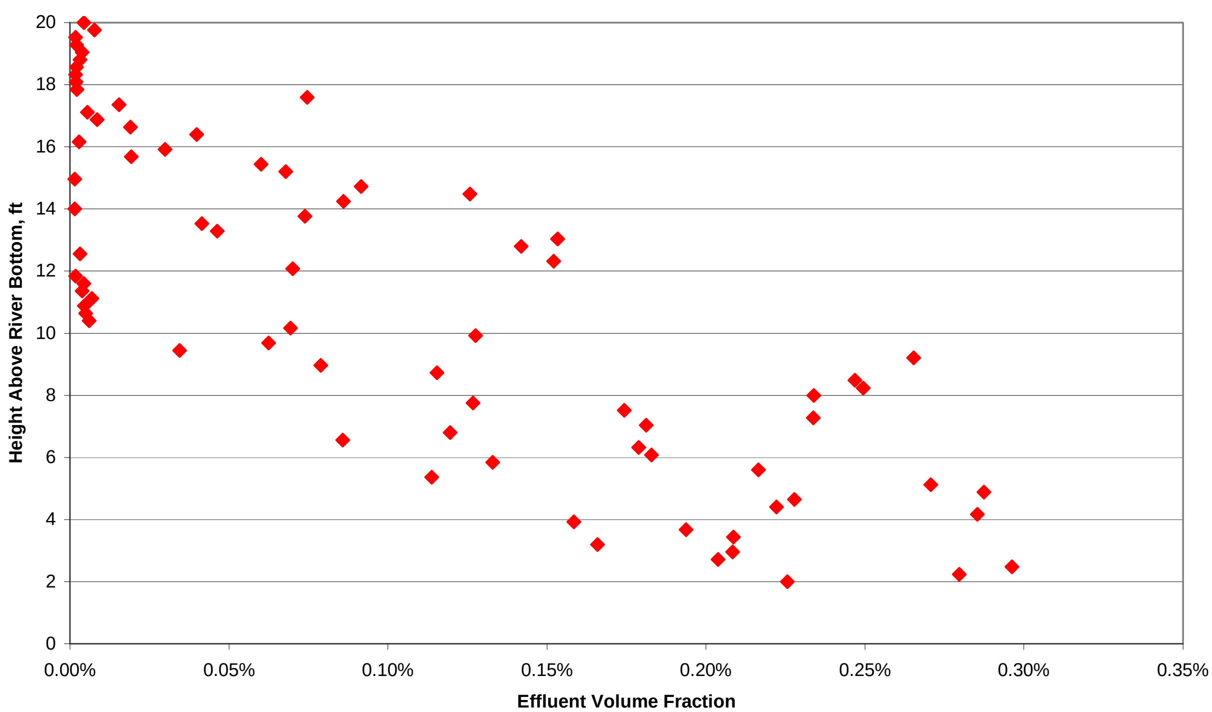


Figure I-7. Profile #3 – Station 12+05

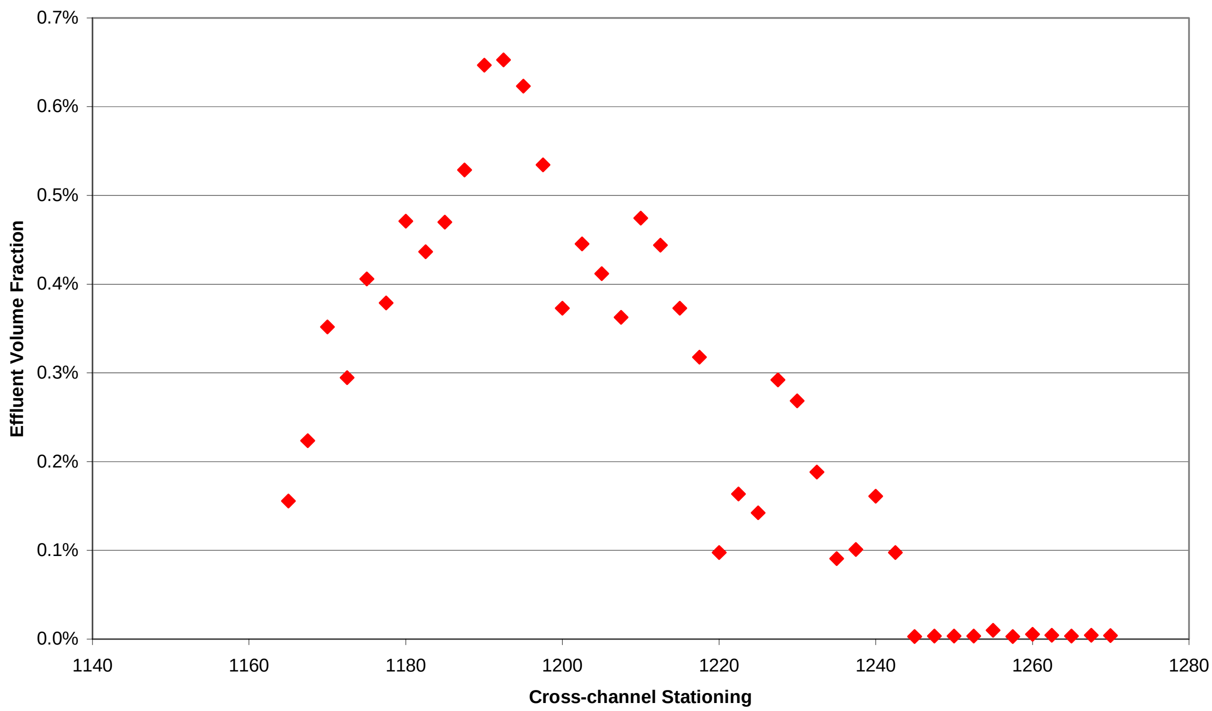


Figure I-8. Transect #1 – 4 ft above bottom

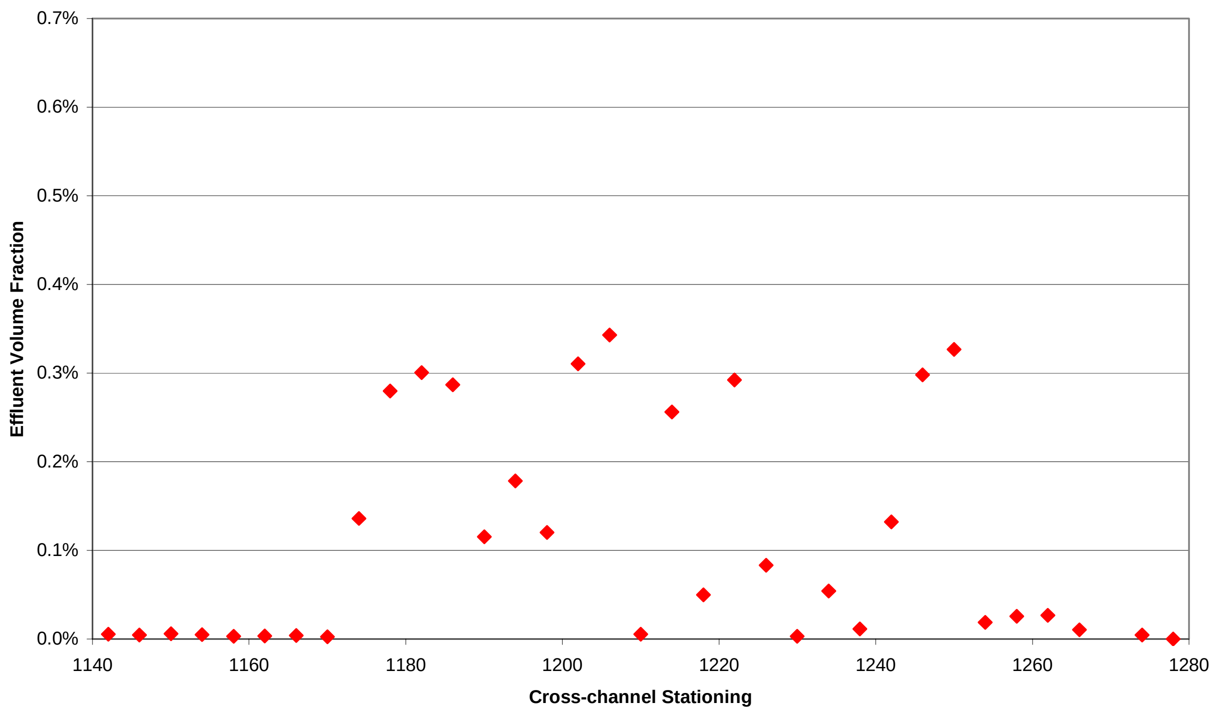


Figure I-9. Transect #2 – 8 ft above bottom

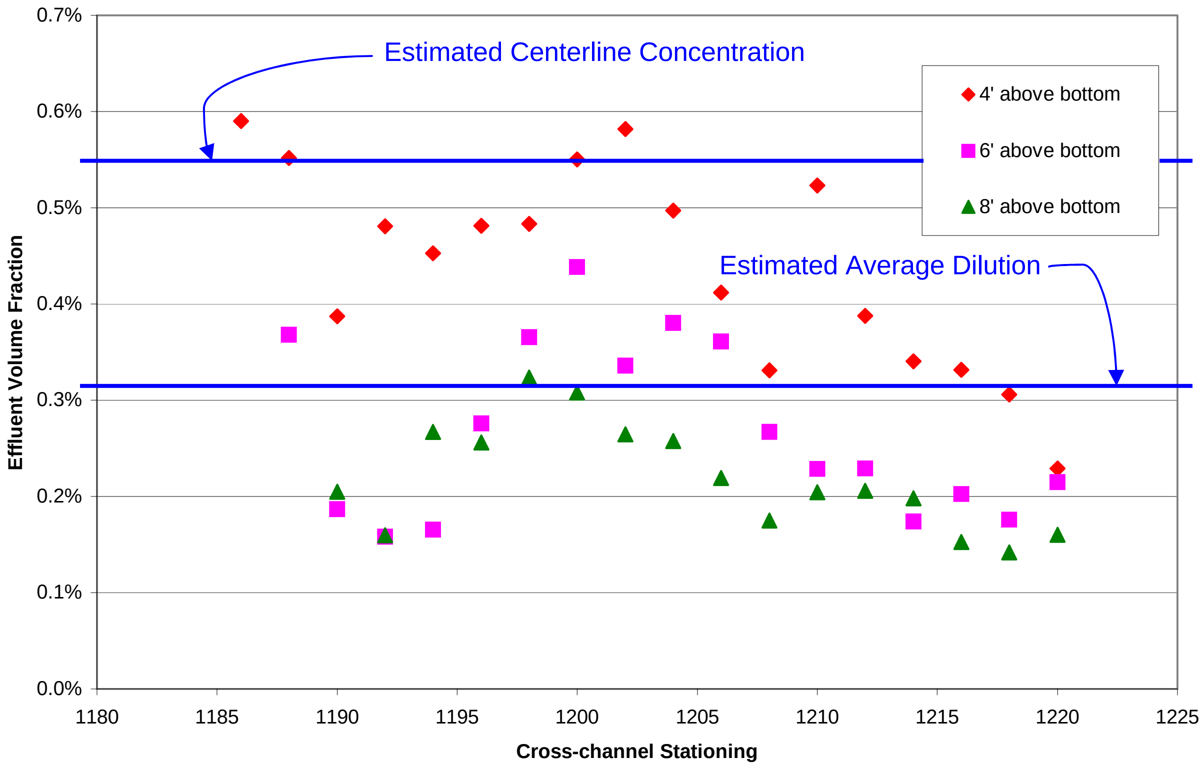


Figure I-10. Sawtooth #1 – near plume midpoint

Observed Dilution Factors

Figures I-5 through I-9 depict effluent concentration sections through the effluent plume, both vertically and horizontally. Figure I-10 provides the best composite depiction of effluent concentrations in the plume, and is consistent with the earlier figures. The average effluent concentration from these data is 0.31% (dilution factor = 320). The 95th percentile effluent concentration is 0.55% (dilution factor = 180). These figures will be used to represent flux-average and centerline plume concentrations, respectively, in the comparison and calibration of dilution models, which follows.

MODEL COMPARISONS

Model runs were made using CORMIX2, UM3 and DKHW for the effluent and ambient conditions measured during the tracer study. The results are provided in Table I-5. The results reveal that CORMIX2 overestimates dilution at the mixing zone boundary, and UM3 underestimates dilution factor. DKHW failed to produce reasonable results and will not be repeated unless the error is discovered.

Table I-5 Summary of Dilution Model Results

Model Run	Flux-average Dilution	Centerline Dilution
CORMIX2	890	N/A
UM3[1]	97	25
DKHW	10,200	N/A
UM3[2]	277	71
Observed (approx)	320	180

(1) Using default aspiration entrainment coefficient = 0.1
(2) Using alternative aspiration entrainment coefficient = 1.3

The UM3 model significantly underestimates both flux-average and centerline dilution factors compared to observed data. The principal calibration parameter to adjust model predictions to observed data is the Aspiration Entrainment Coefficient (AEC). Additional UM3 model runs were made, adjusting the AEC from 0.1 to 2.0. The resulting dilution prediction at an AEC of 1.3 approaches the observed dilution values, suggesting that UM3 may be suitable for this project if properly calibrated.

Model output for the UM3 and DKHW runs, which use the Visual Plumes interface, are provided in Attachment I-2.

CONCLUSIONS AND RECOMMENDATIONS

The dye study was successful at measuring dilution factors at the downstream mixing zone boundary. The observed dilution factors were approximately 320:1 for flux-average, and 180:1 for centerline. Neither CORMIX2, UM3 nor DKHW adequately simulate these dye study results. I expect that we will be able to calibrate UM3 using alternative aspiration entrainment coefficients or dispersion coefficients within the model.

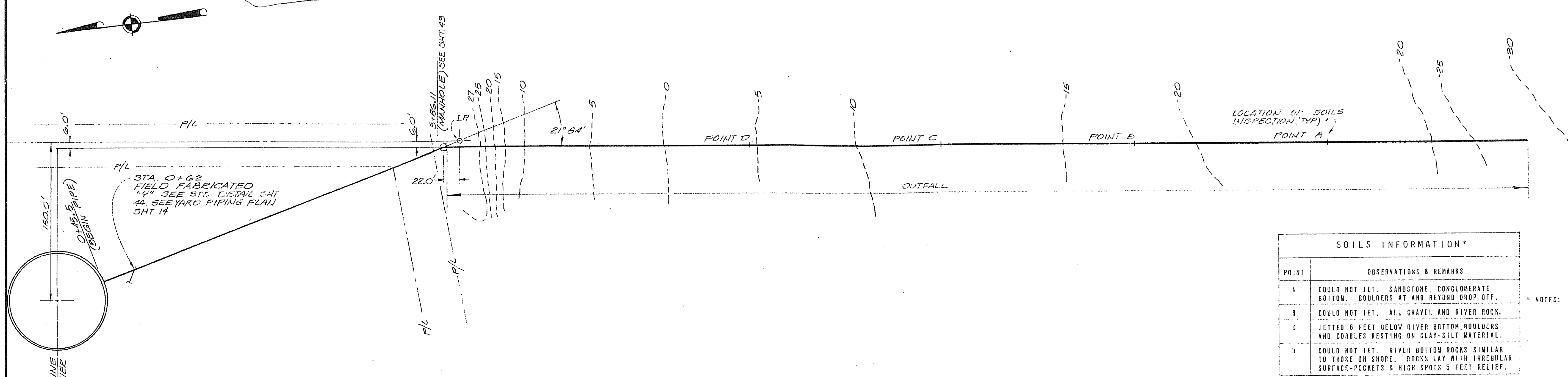
We recommend proceeding with the second dye study as planned for late summer or early autumn 2005. This next period will be more critical in terms of ambient current conditions, and will be designed to calibrate the UM3 model calibration.

In the February field studies, we were not able to precisely measure ambient current profiles or discern tidal effects (which was one of our project goals). We recommend that the second dye study include an ADCP current meter mooring upstream of the diffuser in order to provide precise current speed and water elevation data concurrent with the dye measurements. We will also modify the timing of the field measurements to better correspond to diurnal periods of reduced discharge from the Bonneville Dam.

After the final dye study and model calibration, we recommend analyzing diffuser modifications including opening of the eight nearshore ports and orienting the ports to discharge vertically, which would expose the diffuser jet to a current cross-flow.

ATTACHMENT I-1:
OUTFALL AND DIFFUSER DRAWINGS

BRG 353



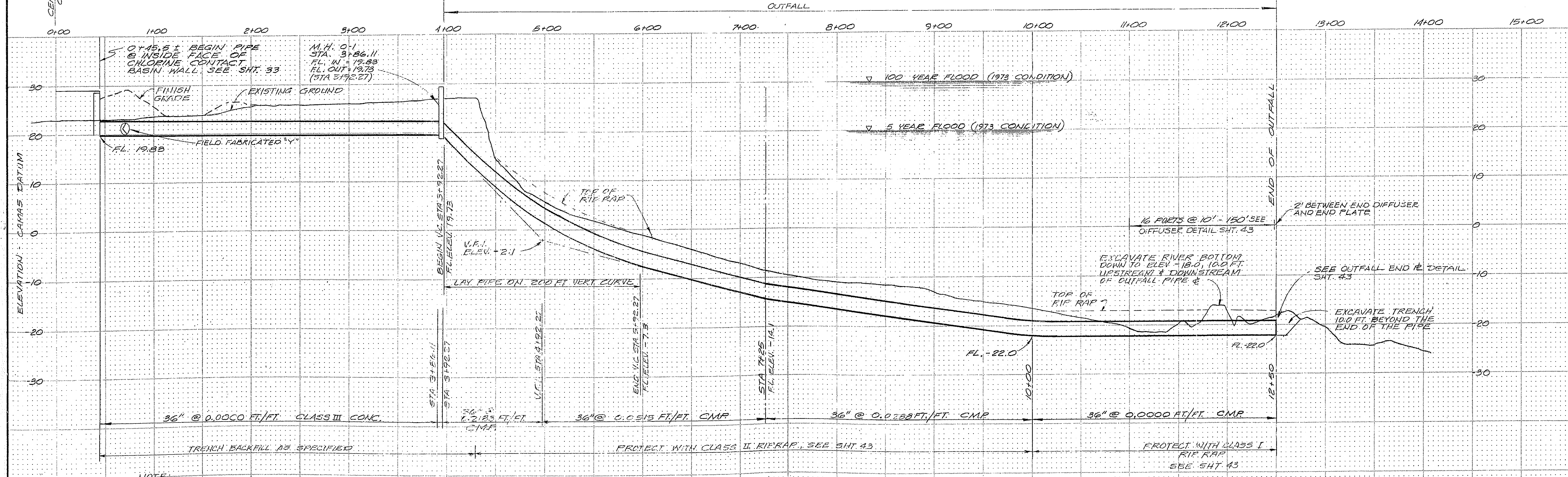
PLAN - OUTFALL

1" = 50'

SOILS INFORMATION*	
POINT	OBSERVATIONS & REMARKS
A	COULD NOT JET. SANDSTONE, CONGLOMERATE BOTTOM. BOULDERS AT AND BEYOND DROP OFF.
B	COULD NOT JET. ALL GRAVEL AND RIVER ROCK.
C	JETTED 8 FEET BELOW RIVER BOTTOM. BOULDERS AND COBBLES RESTING ON CLAY-SILT MATERIAL.
D	COULD NOT JET. RIVER BOTTOM ROCKS SIMILAR TO THOSE ON SHORE. ROCKS LAY WITH IRREGULAR SURFACE-POCKETS & HIGH SPOTS 5 FEET RELIEF.

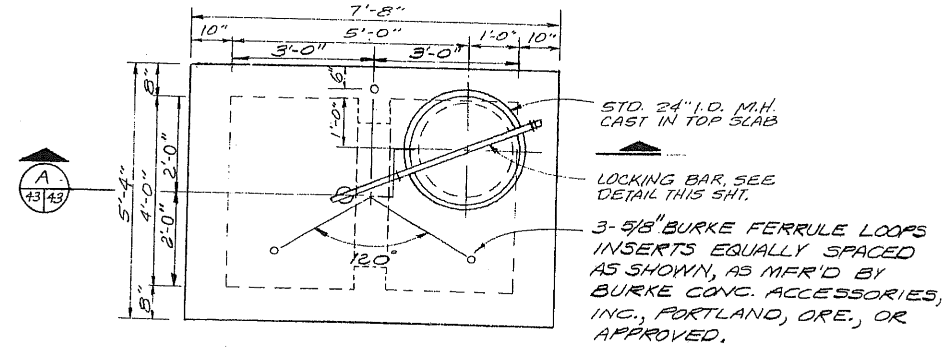
* NOTES:

1. SOILS INFORMATION WAS OBTAINED FROM A DIVER, WHO INSPECTED THE RIVER BOTTOM ON 29 DEC. 1970. A 1½" JET PIPE WAS USED BY THE DIVER TO JET HOLES INTO RIVER BED.
2. SEE NOTE UNDER TEST LOGS SHEET 6

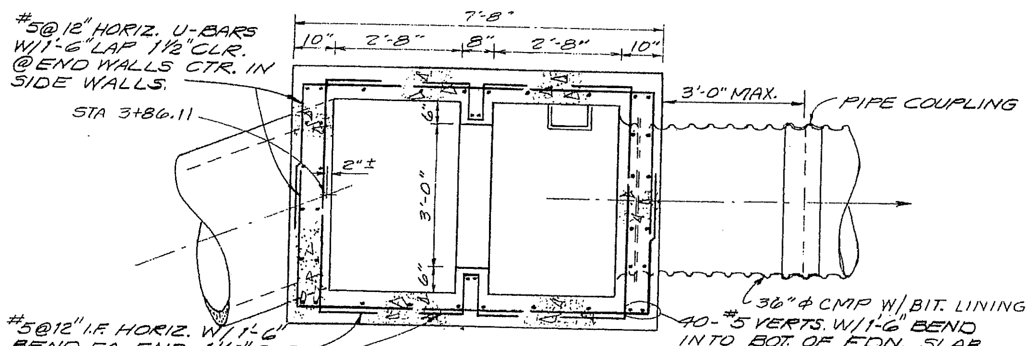


NOTE:
CAMAS DATUM MINUS 1.0 FT. EQUALS COLUMBIA RIVER DATUM ELEVATION

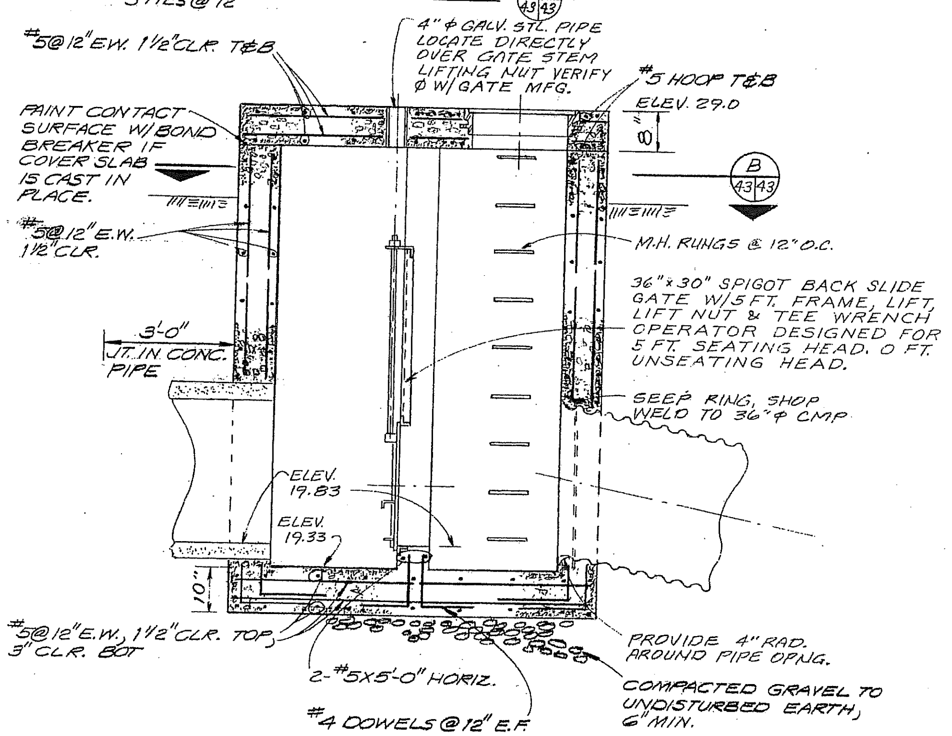
CORNELL, HOWLAND, HAYES & MERRYFIELD ENGINEERS PLANNERS ECONOMISTS CH2M	CITY OF CAMAS, WASHINGTON SEWERAGE SYSTEM ADDITIONS SCHEDULE T OUTFALL - PLAN & PROFILE	DES / DR / CK SHEET 42 OF 53 DATE FEB. 1971 RN P5924.1 P6270.1 SCALE AS SHOWN DWG 5924-1



PLAN

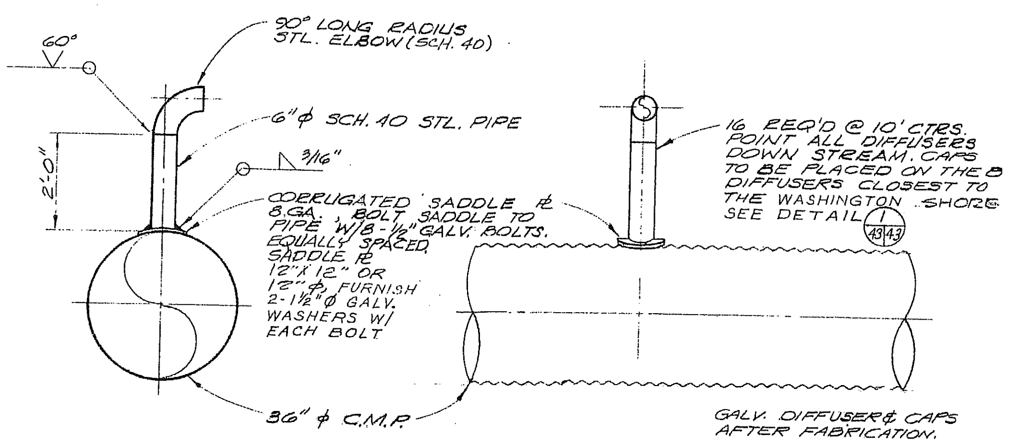


SECTION B 43|43

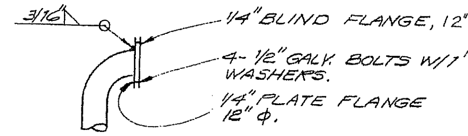


SECTION A 43|43

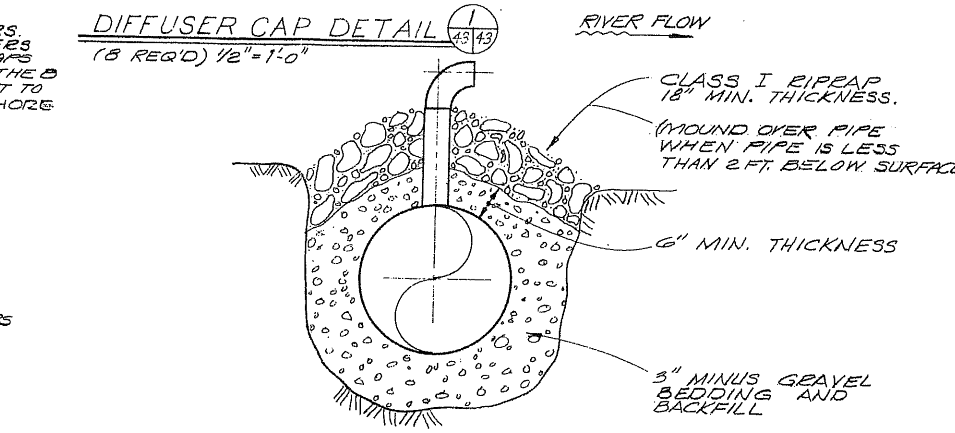
OUTFALL MANHOLE O-1
1/2"=1'-0"



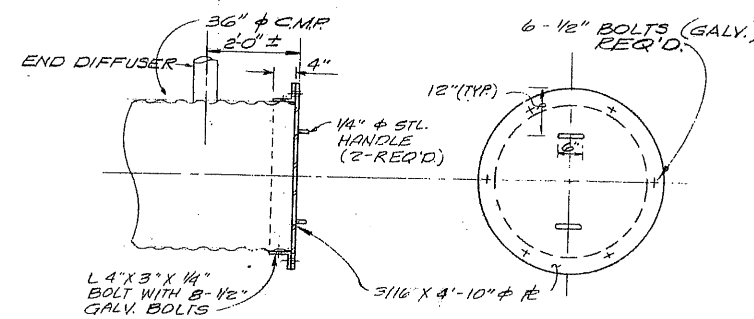
DETAIL OF DIFFUSER
1/2"=1'-0"



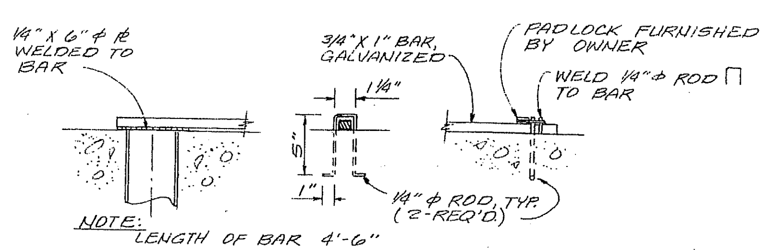
DIFFUSER CAP DETAIL 1 43|43
(8 REQ'D) 1/2"=1'-0"



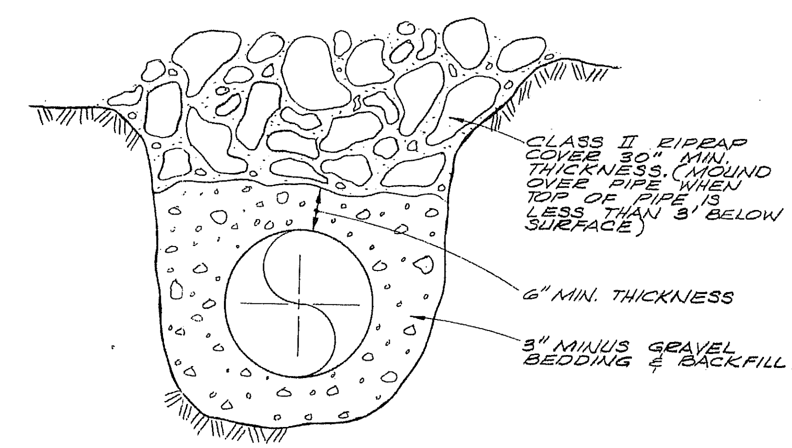
TYPICAL BACKFILL
STA. 10+00 TO 12+50
1/2" = 1'-0"



OUTFALL END PL DETAIL
1/2" = 1'-0"



LOCKING BAR DETAIL
1 1/2" = 1'-0"



TYPICAL BACKFILL
STA. 4+30 TO 10+00
1/2" = 1'-0"

CORNELL, HOWLAND, HAYES & MERRYFIELD ENGINEERS PLANNERS ECONOMISTS CH2M	CITY OF CAMAS, WASHINGTON SEWERAGE SYSTEM ADDITIONS SCHEDULE T OUTFALL - DETAILS	DES RWL DR RJK CK RSR RN P5924.1 P6270.1	SHEET 43 OF 53 DATE FEB. 1971 SCALE AS SHOWN DWG C 5924-1

ATTACHMENT I-2:
TABULAR PLUME DATA FOR DYE STUDY NO. 1

Effluent Concentration = 1080 ppb
Background Concentration = 1.1 ppb

Profile 1	Station 11+80						Effluent	
Entry #	Date	Time	Fluor	Turb	Height	Station	Fraction	Dilution
1	2005:02:16	11:22:50	2.474	1.389	2	1180	0.13%	786
2	2005:02:16	11:23:01	4.528	1.283	3	1180	0.32%	315
3	2005:02:16	11:23:11	2.759	1.284	4	1180	0.15%	651
4	2005:02:16	11:23:21	3.73	1.287	5	1180	0.24%	411
5	2005:02:16	11:23:31	2.274	1.303	6	1180	0.11%	920
6	2005:02:16	11:23:41	2.24	1.313	7	1180	0.11%	947
7	2005:02:16	11:23:51	3.061	1.327	8	1180	0.18%	551
8	2005:02:16	11:24:01	3.015	1.289	9	1180	0.18%	564
9	2005:02:16	11:24:11	3.445	1.254	10	1180	0.22%	461
10	2005:02:16	11:24:21	1.194	1.293	11	1180	0.01%	
11	2005:02:16	11:24:31	1.208	1.286	12	1180	0.01%	
12	2005:02:16	11:24:41	1.096	1.285	13	1180	0.00%	
13	2005:02:16	11:24:51	1.752	1.298	14	1180	0.06%	
14	2005:02:16	11:25:01	1.087	1.245	15	1180	0.00%	
15	2005:02:16	11:25:11	1.14	1.228	16	1180	0.00%	
16	2005:02:16	11:25:21	2.051	1.268	17	1180	0.09%	
17	2005:02:16	11:25:31	1.112	1.275	18	1180	0.00%	
18	2005:02:16	11:25:41	1.25	1.35	19	1180	0.01%	
19	2005:02:16	11:25:51	1.099	1.244	20	1180	0.00%	
20	2005:02:16	11:26:01	1.108	1.28	16	1180	0.00%	
21	2005:02:16	11:26:11	1.569	1.256	12	1180	0.04%	
22	2005:02:16	11:26:21	4.568	1.29	8	1180	0.32%	311
23	2005:02:16	11:26:31	3.919	1.371	4	1180	0.26%	383
24	2005:02:16	11:26:40	4.345	1.39	2	1180	0.30%	333
25	2005:02:16	11:27:00	3.392	1.278	2	1180	0.21%	471
26	2005:02:16	11:27:10	4.358	1.274	4	1180	0.30%	331

Profile 2	Station 12+20						Effluent	
Entry #	Date	Time	Fluor	Turb	Height	Station	Fraction	Dilution
27	2005:02:16	11:50:13	2.741	1.224	2	1220	0.15%	658
28	2005:02:16	11:50:23	3.148	1.27	2	1220	0.19%	527
29	2005:02:16	11:50:33	2.092	1.301	2	1220	0.09%	
30	2005:02:16	11:50:43	3.894	1.265	2	1220	0.26%	387
31	2005:02:16	11:50:53	3.85	1.345	3	1220	0.25%	393
32	2005:02:16	11:51:03	4.205	1.269	3	1220	0.29%	348
33	2005:02:16	11:51:13	3.894	1.244	3	1220	0.26%	387
34	2005:02:16	11:51:23	3.56	1.353	3	1220	0.23%	439
35	2005:02:16	11:51:33	2.916	1.32	4	1220	0.17%	595

36	2005:02:16	11:51:43	3.491	1.318	4	1220	0.22%	452
37	2005:02:16	11:51:53	3.518	1.273	4	1220	0.22%	447
38	2005:02:16	11:52:03	4.281	1.281	4	1220	0.29%	340
39	2005:02:16	11:52:13	4.666	1.274	4	1220	0.33%	303
40	2005:02:16	11:52:23	3.862	1.343	5	1220	0.26%	391
41	2005:02:16	11:52:33	3.435	1.304	5	1220	0.22%	463
42	2005:02:16	11:52:43	3.162	1.378	5	1220	0.19%	524
43	2005:02:16	11:52:53	3.78	1.299	5	1220	0.25%	403
44	2005:02:16	11:53:03	4.027	1.256	6	1220	0.27%	369
45	2005:02:16	11:53:13	3.644	1.305	6	1220	0.24%	425
46	2005:02:16	11:53:23	2.701	1.307	6	1220	0.15%	675
47	2005:02:16	11:53:33	3.529	1.308	6	1220	0.22%	445
48	2005:02:16	11:53:43	3.765	1.303	6	1220	0.25%	405
49	2005:02:16	11:53:53	3.617	1.304	7	1220	0.23%	429
50	2005:02:16	11:54:03	3.19	1.378	7	1220	0.19%	517
51	2005:02:16	11:54:13	3.376	1.234	7	1220	0.21%	475
52	2005:02:16	11:54:23	2.862	1.256	7	1220	0.16%	613
53	2005:02:16	11:54:33	2.548	1.247	8	1220	0.13%	746
54	2005:02:16	11:54:43	3.167	1.28	8	1220	0.19%	522
55	2005:02:16	11:54:53	3.954	1.217	8	1220	0.26%	378
56	2005:02:16	11:55:03	3.654	1.263	8	1220	0.24%	423
57	2005:02:16	11:55:13	3.289	1.238	8	1220	0.20%	493
58	2005:02:16	11:55:23	3.487	1.253	9	1220	0.22%	452
59	2005:02:16	11:55:33	2.85	1.224	9	1220	0.16%	617
60	2005:02:16	11:55:43	3.148	1.269	9	1220	0.19%	527
61	2005:02:16	11:55:53	2.842	1.244	9	1220	0.16%	620
62	2005:02:16	11:56:03	2.706	1.353	10	1220	0.15%	672
63	2005:02:16	11:56:13	2.264	1.313	10	1220	0.11%	928
64	2005:02:16	11:56:23	1.893	1.327	10	1220	0.07%	
65	2005:02:16	11:56:33	1.64	1.289	10	1220	0.05%	
66	2005:02:16	11:56:43	1.295	1.254	10	1220	0.02%	
67	2005:02:16	11:56:53	1.987	1.293	11	1220	0.08%	
68	2005:02:16	11:57:03	1.829	1.286	11	1220	0.07%	
69	2005:02:16	11:57:13	1.897	1.285	11	1220	0.07%	
70	2005:02:16	11:57:23	1.204	1.298	11	1220	0.01%	
71	2005:02:16	11:57:33	1.13	1.245	12	1220	0.00%	
72	2005:02:16	11:57:43	1.157	1.228	12	1220	0.01%	
73	2005:02:16	11:57:53	1.128	1.268	12	1220	0.00%	
74	2005:02:16	11:58:03	1.141	1.275	12	1220	0.00%	
75	2005:02:16	11:58:13	1.139	1.305	12	1220	0.00%	
76	2005:02:16	11:58:23	1.134	1.307	13	1220	0.00%	
77	2005:02:16	11:58:33	1.152	1.308	13	1220	0.00%	
78	2005:02:16	11:58:43	1.162	1.303	13	1220	0.01%	
79	2005:02:16	11:58:53	1.147	1.304	13	1220	0.00%	
80	2005:02:16	11:59:03	1.157	1.378	14	1220	0.01%	

Transect 1	Height = 4' Above Bottom						Effluent	
Entry #	**Date**	**Time**	**Fluor**	**Turb**	**Fraction**	**Dilution**	**Fraction**	**Dilution**
9	2005:02:16	12:10:05	1.142	1.327	4	1270	0.00%	
10	2005:02:16	12:10:15	1.147	1.289	4	1267.5	0.00%	
11	2005:02:16	12:10:25	1.139	1.254	4	1265	0.00%	
12	2005:02:16	12:10:35	1.147	1.293	4	1262.5	0.00%	
13	2005:02:16	12:10:45	1.157	1.289	4	1260	0.01%	
14	2005:02:16	12:10:55	1.13	1.254	4	1257.5	0.00%	
15	2005:02:16	12:11:05	1.204	1.293	4	1255	0.01%	
16	2005:02:16	12:11:15	1.139	1.286	4	1252.5	0.00%	
17	2005:02:16	12:11:25	1.139	1.285	4	1250	0.00%	
18	2005:02:16	12:11:35	1.139	1.298	4	1247.5	0.00%	
19	2005:02:16	12:11:45	1.134	1.245	4	1245	0.00%	
20	2005:02:16	12:11:55	2.152	1.228	4	1242.5	0.10%	
21	2005:02:16	12:12:05	2.841	1.268	4	1240	0.16%	620
22	2005:02:16	12:12:15	2.189	1.275	4	1237.5	0.10%	992
23	2005:02:16	12:12:25	2.08	1.305	4	1235	0.09%	
24	2005:02:16	12:12:35	3.134	1.307	4	1232.5	0.19%	531
25	2005:02:16	12:12:45	3.998	1.308	4	1230	0.27%	373
26	2005:02:16	12:12:55	4.255	1.303	4	1227.5	0.29%	342
27	2005:02:16	12:13:05	2.636	1.285	4	1225	0.14%	703
28	2005:02:16	12:13:15	2.868	1.298	4	1222.5	0.16%	611
29	2005:02:16	12:13:25	2.156	1.245	4	1220	0.10%	
30	2005:02:16	12:13:35	4.531	1.228	4	1217.5	0.32%	315
31	2005:02:16	12:13:45	5.128	1.268	4	1215	0.37%	268
32	2005:02:16	12:13:55	5.891	1.244	4	1212.5	0.44%	225
33	2005:02:16	12:14:05	6.222	1.353	4	1210	0.47%	211
34	2005:02:16	12:14:15	5.018	1.32	4	1207.5	0.36%	276
35	2005:02:16	12:14:25	5.55	1.318	4	1205	0.41%	243
36	2005:02:16	12:14:35	5.912	1.273	4	1202.5	0.45%	224
37	2005:02:16	12:14:45	5.129	1.281	4	1200	0.37%	268
38	2005:02:16	12:14:55	6.87	1.274	4	1197.5	0.53%	187
39	2005:02:16	12:15:05	7.828	1.343	4	1195	0.62%	161
40	2005:02:16	12:15:15	8.15	1.304	4	1192.5	0.65%	153
41	2005:02:16	12:15:25	8.084	1.378	4	1190	0.65%	155
42	2005:02:16	12:15:35	6.81	1.299	4	1187.5	0.53%	189
43	2005:02:16	12:15:45	6.175	1.256	4	1185	0.47%	213
44	2005:02:16	12:15:55	5.813	1.305	4	1182.5	0.44%	229
45	2005:02:16	12:16:05	6.188	1.345	4	1180	0.47%	212
46	2005:02:16	12:16:15	5.189	1.269	4	1177.5	0.38%	264
47	2005:02:16	12:16:25	5.486	1.244	4	1175	0.41%	246
48	2005:02:16	12:16:35	4.28	1.353	4	1172.5	0.29%	340
49	2005:02:16	12:16:45	4.9	1.32	4	1170	0.35%	284
50	2005:02:16	12:16:55	3.514	1.318	4	1167.5	0.22%	447
51	2005:02:16	12:17:05	2.782	1.273	4	1165	0.16%	642

Transect 2	Height = 8' Above Bottom						Effluent	
Entry #	Date	Time	Fluor	Turb	Height	Station	Fraction	Dilution
15	2005:02:16	12:34:50	1.142	1.249	8	1290	0.00%	
16	2005:02:16	12:35:01	1.506	1.306	8	1286	0.04%	
17	2005:02:16	12:35:11	1.184	1.27	8	1282	0.01%	
18	2005:02:16	12:35:21	1.099	1.26	8	1278	0.00%	
19	2005:02:16	12:35:31	1.146	1.234	8	1274	0.00%	
20	2005:02:16	12:35:41	1.069	1.234	8	1270	0.00%	
21	2005:02:16	12:35:51	1.21	1.256	8	1266	0.01%	
22	2005:02:16	12:36:01	1.389	1.247	8	1262	0.03%	
23	2005:02:16	12:36:10	1.375	1.28	8	1258	0.03%	
24	2005:02:16	12:36:21	1.304	1.217	8	1254	0.02%	
25	2005:02:16	12:36:31	4.629	1.263	8	1250	0.33%	306
26	2005:02:16	12:36:41	4.317	1.238	8	1246	0.30%	336
27	2005:02:16	12:36:51	2.524	1.253	8	1242	0.13%	758
28	2005:02:16	12:37:01	1.221	1.224	8	1238	0.01%	
29	2005:02:16	12:37:11	1.684	1.27	8	1234	0.05%	
30	2005:02:16	12:37:21	1.134	1.301	8	1230	0.00%	
31	2005:02:16	12:37:31	1.998	1.265	8	1226	0.08%	
32	2005:02:16	12:37:41	4.255	1.345	8	1222	0.29%	342
33	2005:02:16	12:37:51	1.636	1.269	8	1218	0.05%	
34	2005:02:16	12:38:01	3.868	1.244	8	1214	0.26%	390
35	2005:02:16	12:38:11	1.16	1.353	8	1210	0.01%	
36	2005:02:16	12:38:20	4.802	1.32	8	1206	0.34%	292
37	2005:02:16	12:38:31	4.451	1.318	8	1202	0.31%	322
38	2005:02:16	12:38:41	2.397	1.273	8	1198	0.12%	833
39	2005:02:16	12:38:50	3.025	1.281	8	1194	0.18%	561
40	2005:02:16	12:39:01	2.347	1.274	8	1190	0.12%	866
41	2005:02:16	12:39:11	4.194	1.343	8	1186	0.29%	349
42	2005:02:16	12:39:21	4.343	1.304	8	1182	0.30%	333
43	2005:02:16	12:39:31	4.122	1.378	8	1178	0.28%	357
44	2005:02:16	12:39:41	2.567	1.299	8	1174	0.14%	736
45	2005:02:16	12:39:51	1.128	1.256	8	1170	0.00%	
46	2005:02:16	12:40:01	1.141	1.305	8	1166	0.00%	
47	2005:02:16	12:40:11	1.139	1.307	8	1162	0.00%	
48	2005:02:16	12:40:21	1.134	1.308	8	1158	0.00%	
49	2005:02:16	12:40:31	1.152	1.303	8	1154	0.00%	
50	2005:02:16	12:40:41	1.162	1.4	8	1150	0.01%	
51	2005:02:16	12:40:51	1.147	1.325	8	1146	0.00%	
52	2005:02:16	12:41:01	1.157	1.351	8	1142	0.01%	
53	2005:02:16	12:41:11	1.168	1.418	8	1138	0.01%	
54	2005:02:16	12:41:21	1.159	1.386	8	1134	0.01%	
55	2005:02:16	12:41:30	1.163	1.39	8	1130	0.01%	
56	2005:02:16	12:41:40	1.132	1.399	8	1126	0.00%	
57	2005:02:16	12:41:50	1.13	1.348	8	1122	0.00%	

Profile 3	Station 12+05						Effluent	
Entry #	Date	Time	Fluor	Turb	Height	Station	Fraction	Dilution
59	2005:02:16	12:49:00	3.537	1.232	2	1205	0.23%	443
60	2005:02:16	12:49:11	4.12	1.27	2.24	1205	0.28%	358
61	2005:02:16	12:49:21	4.299	1.32	2.48	1205	0.30%	338
62	2005:02:16	12:49:31	3.302	1.288	2.72	1205	0.20%	490
63	2005:02:16	12:49:41	3.351	1.239	2.96	1205	0.21%	480
64	2005:02:16	12:49:51	2.892	1.346	3.2	1205	0.17%	603
65	2005:02:16	12:50:01	3.353	1.311	3.44	1205	0.21%	479
66	2005:02:16	12:50:11	3.193	1.317	3.68	1205	0.19%	516
67	2005:02:16	12:50:21	2.811	1.367	3.92	1205	0.16%	631
68	2005:02:16	12:50:31	4.181	1.242	4.16	1205	0.29%	351
69	2005:02:16	12:50:41	3.499	1.277	4.4	1205	0.22%	450
70	2005:02:16	12:50:51	3.56	1.338	4.64	1205	0.23%	439
71	2005:02:16	12:51:00	4.204	1.307	4.88	1205	0.29%	348
84	2005:02:16	12:51:11	4.023	1.325	5.12	1205	0.27%	369
85	2005:02:16	12:51:21	2.329	1.301	5.36	1205	0.11%	879
86	2005:02:16	12:51:31	3.438	1.33	5.6	1205	0.22%	462
87	2005:02:16	12:51:41	2.535	1.304	5.84	1205	0.13%	753
88	2005:02:16	12:51:51	3.075	1.36	6.08	1205	0.18%	547
89	2005:02:16	12:52:01	3.031	1.326	6.32	1205	0.18%	559
90	2005:02:16	12:52:11	2.026	1.275	6.56	1205	0.09%	
91	2005:02:16	12:52:21	2.391	1.303	6.8	1205	0.12%	837
92	2005:02:16	12:52:31	3.057	1.326	7.04	1205	0.18%	552
93	2005:02:16	12:52:41	3.624	1.297	7.28	1205	0.23%	428
94	2005:02:16	12:52:51	2.982	1.276	7.52	1205	0.17%	574
95	2005:02:16	12:53:01	2.469	1.328	7.76	1205	0.13%	789
96	2005:02:16	12:53:11	3.626	1.338	8	1205	0.23%	428
97	2005:02:16	12:53:21	3.795	1.291	8.24	1205	0.25%	401
98	2005:02:16	12:53:31	3.766	1.309	8.48	1205	0.25%	405
99	2005:02:16	12:53:41	2.346	1.344	8.72	1205	0.12%	867
100	2005:02:16	12:53:51	1.952	1.328	8.96	1205	0.08%	
101	2005:02:16	12:54:01	3.966	1.379	9.2	1205	0.27%	377
102	2005:02:16	12:54:11	1.472	1.264	9.44	1205	0.03%	
103	2005:02:16	12:54:21	1.774	1.269	9.68	1205	0.06%	
104	2005:02:16	12:54:31	2.478	1.278	9.92	1205	0.13%	784
105	2005:02:16	12:54:41	1.849	1.304	10.16	1205	0.07%	
106	2005:02:16	12:54:51	1.166	1.293	10.4	1205	0.01%	
107	2005:02:16	12:55:01	1.153	1.282	10.64	1205	0.00%	
108	2005:02:16	12:55:11	1.149	1.313	10.88	1205	0.00%	
109	2005:02:16	12:55:21	1.174	1.277	11.12	1205	0.01%	
110	2005:02:16	12:55:31	1.142	1.358	11.36	1205	0.00%	
111	2005:02:16	12:55:40	1.148	1.309	11.6	1205	0.00%	
112	2005:02:16	12:55:51	1.12	1.336	11.84	1205	0.00%	
113	2005:02:16	12:56:01	1.857	1.289	12.08	1205	0.07%	
114	2005:02:16	12:56:11	2.743	1.263	12.32	1205	0.15%	657

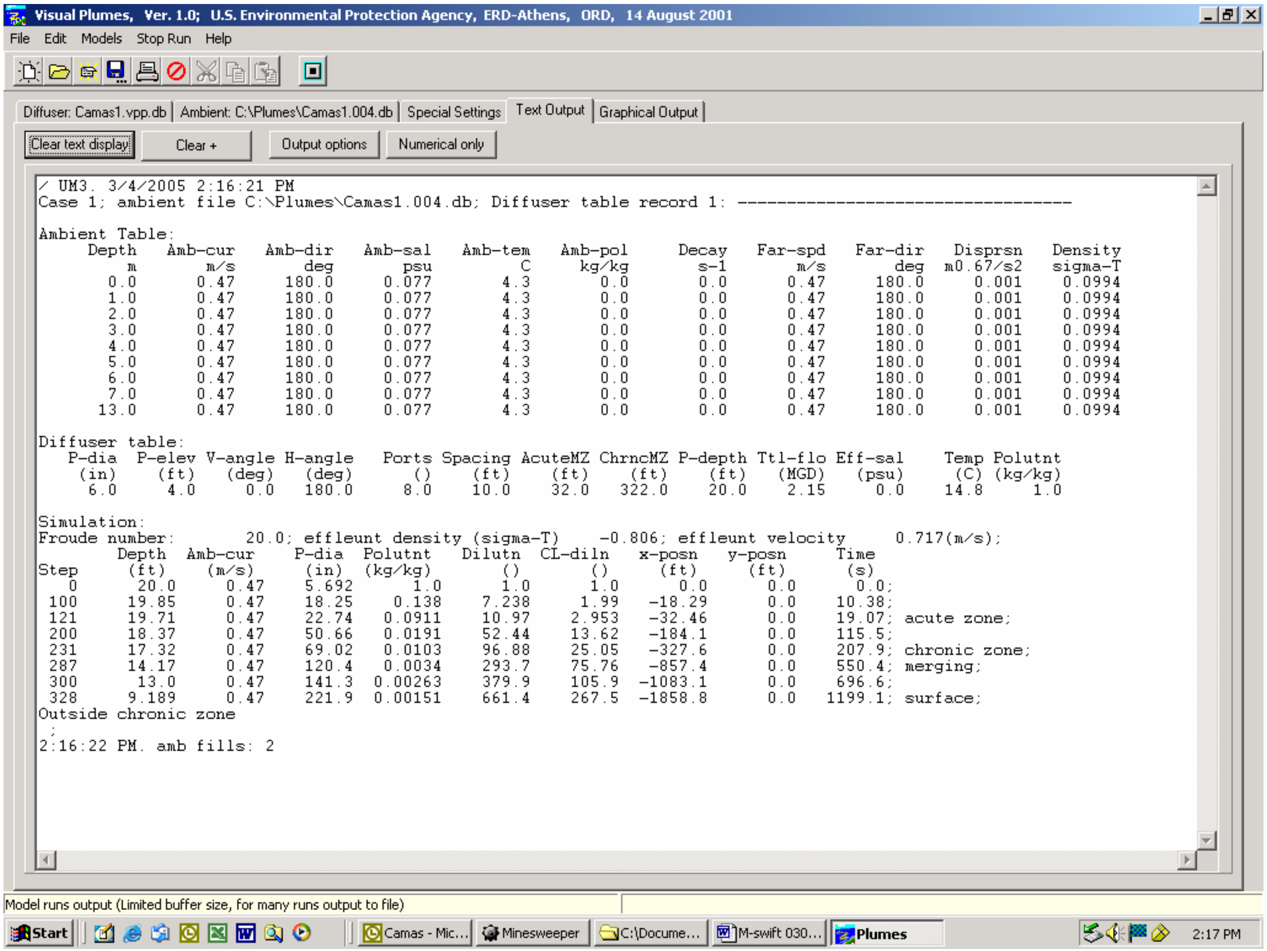
115	2005:02:16	12:56:21	1.134	1.314	12.56	1205	0.00%	
116	2005:02:16	12:56:41	2.632	1.401	12.8	1205	0.14%	705
117	2005:02:16	12:56:51	2.756	1.331	13.04	1205	0.15%	652
118	2005:02:16	12:57:01	1.6	1.315	13.28	1205	0.05%	
119	2005:02:16	12:57:11	1.548	1.372	13.52	1205	0.04%	
120	2005:02:16	12:57:21	1.898	1.399	13.76	1205	0.07%	
121	2005:02:16	12:57:31	1.117	1.275	14	1205	0.00%	
122	2005:02:16	12:57:41	2.03	1.316	14.24	1205	0.09%	
123	2005:02:16	12:57:51	2.458	1.339	14.48	1205	0.13%	795
124	2005:02:16	12:58:01	2.089	1.325	14.72	1205	0.09%	
125	2005:02:16	12:58:11	1.117	1.299	14.96	1205	0.00%	
126	2005:02:16	12:58:21	1.833	1.357	15.2	1205	0.07%	
127	2005:02:16	12:58:31	1.749	1.356	15.44	1205	0.06%	
128	2005:02:16	12:58:41	1.308	1.326	15.68	1205	0.02%	
129	2005:02:16	12:58:51	1.423	1.301	15.92	1205	0.03%	
130	2005:02:16	12:59:01	1.131	1.278	16.16	1205	0.00%	
131	2005:02:16	12:59:11	1.531	1.313	16.4	1205	0.04%	
132	2005:02:16	12:59:21	1.305	1.34	16.64	1205	0.02%	
133	2005:02:16	12:59:31	1.192	1.378	16.88	1205	0.01%	
134	2005:02:16	12:59:41	1.159	1.292	17.12	1205	0.01%	
135	2005:02:16	12:59:51	1.267	1.349	17.36	1205	0.02%	
136	2005:02:16	13:00:01	1.906	1.341	17.6	1205	0.07%	
137	2005:02:16	13:00:11	1.124	1.308	17.84	1205	0.00%	
138	2005:02:16	13:00:21	1.121	1.32	18.08	1205	0.00%	
139	2005:02:16	13:00:31	1.119	1.295	18.32	1205	0.00%	
140	2005:02:16	13:00:41	1.123	1.301	18.56	1205	0.00%	
141	2005:02:16	13:00:51	1.135	1.327	18.8	1205	0.00%	
142	2005:02:16	13:01:01	1.142	1.321	19.04	1205	0.00%	
143	2005:02:16	13:01:11	1.123	6.498	19.28	1205	0.00%	
144	2005:02:16	13:01:21	1.119	1.385	19.52	1205	0.00%	
145	2005:02:16	13:01:31	1.183	1.453	19.76	1205	0.01%	
146	2005:02:16	13:01:41	1.147	1.36	20	1205	0.00%	
147	2005:02:16	13:01:51	1.146	1.344	20.24	1205	0.00%	
148	2005:02:16	13:02:01	1.129	1.384	20.48	1205	0.00%	
149	2005:02:16	13:02:11	1.343	1.327	20.72	1205	0.02%	
150	2005:02:16	13:02:21	1.166	1.338	20.96	1205	0.01%	
151	2005:02:16	13:02:31	1.135	1.331	21.2	1205	0.00%	
152	2005:02:16	13:02:41	1.137	1.337	21.44	1205	0.00%	
153	2005:02:16	13:02:51	1.143	1.346	21.68	1205	0.00%	

Sawtooth 1							**Effluent**	
Entry #	**Date**	**Time**	**Fluor**	**Turb**	**Height**	**Station**	**Fraction**	**Dilution**
159	2005:02:16	13:32:10	3.576	1.16	4	1220	0.23%	436
160	2005:02:16	13:32:20	4.406	1.16	4	1218	0.31%	327
161	2005:02:16	13:33:30	4.678	1.186	4	1216	0.33%	302
162	2005:02:16	13:32:40	4.777	1.18	4	1214	0.34%	294

163	2005:02:16	13:32:50	5.288	1.181	4	1212	0.39%	258
164	2005:02:16	13:33:00	6.751	1.184	4	1210	0.52%	191
165	2005:02:16	13:33:10	4.673	1.181	4	1208	0.33%	302
166	2005:02:16	13:33:20	5.55	1.182	4	1206	0.41%	243
167	2005:02:16	13:33:30	6.47	1.176	4	1204	0.50%	201
168	2005:02:16	13:33:40	7.383	1.172	4	1202	0.58%	172
169	2005:02:16	13:33:50	7.045	1.171	4	1200	0.55%	182
170	2005:02:16	13:34:00	6.319	1.167	4	1198	0.48%	207
171	2005:02:16	13:34:10	6.298	1.16	4	1196	0.48%	208
172	2005:02:16	13:34:20	5.988	1.158	4	1194	0.45%	221
173	2005:02:16	13:34:30	6.295	1.158	4	1192	0.48%	208
174	2005:02:16	13:34:40	5.284	1.156	4	1190	0.39%	258
175	2005:02:16	13:34:50	7.059	1.153	4	1188	0.55%	181
176	2005:02:16	13:35:00	7.471	1.15	4	1186	0.59%	170
177	2005:02:16	13:35:10	5.075	1.146	6	1188	0.37%	272
178	2005:02:16	13:35:20	3.115	1.147	6	1190	0.19%	536
179	2005:02:16	13:35:30	2.806	1.152	6	1192	0.16%	633
180	2005:02:16	13:35:41	2.887	1.152	6	1194	0.17%	604
181	2005:02:16	13:35:51	4.077	1.153	6	1196	0.28%	363
182	2005:02:16	13:36:01	5.049	1.155	6	1198	0.37%	273
183	2005:02:16	13:36:11	5.837	1.162	6	1200	0.44%	228
184	2005:02:16	13:36:21	4.727	1.152	6	1202	0.34%	298
185	2005:02:16	13:36:31	5.209	1.152	6	1204	0.38%	263
186	2005:02:16	13:36:41	5.002	1.154	6	1206	0.36%	277
187	2005:02:16	13:36:51	3.982	1.152	6	1208	0.27%	375
188	2005:02:16	13:37:01	3.571	1.155	6	1210	0.23%	437
189	2005:02:16	13:37:11	3.572	1.151	6	1212	0.23%	437
190	2005:02:16	13:37:21	2.976	1.151	6	1214	0.17%	576
191	2005:02:16	13:37:31	3.288	1.148	6	1216	0.20%	494
192	2005:02:16	13:37:41	2.999	1.131	6	1218	0.18%	569
193	2005:02:16	13:37:51	3.418	1.125	6	1220	0.21%	466
194	2005:02:16	13:38:01	2.83	1.119	8	1218	0.16%	624
195	2005:02:16	13:38:11	2.633	1.12	8	1216	0.14%	705
196	2005:02:16	13:38:21	2.749	1.117	8	1214	0.15%	655
197	2005:02:16	13:38:31	3.241	1.122	8	1212	0.20%	504
198	2005:02:16	13:38:41	3.324	1.122	8	1210	0.21%	486
199	2005:02:16	13:38:51	3.307	1.116	8	1208	0.20%	489
200	2005:02:16	13:39:01	2.99	1.112	8	1206	0.18%	571
201	2005:02:16	13:39:11	3.468	1.112	8	1204	0.22%	456
202	2005:02:16	13:39:21	3.883	1.117	8	1202	0.26%	388
203	2005:02:16	13:39:31	3.957	1.11	8	1200	0.26%	378
204	2005:02:16	13:39:41	4.424	1.106	8	1198	0.31%	325
205	2005:02:16	13:39:51	4.595	1.111	8	1196	0.32%	309
206	2005:02:16	13:40:01	3.866	1.114	8	1194	0.26%	390
207	2005:02:16	13:40:11	3.984	1.115	8	1192	0.27%	374
208	2005:02:16	13:40:21	2.825	1.114	8	1190	0.16%	626

ATTACHMENT I-3:
DILUTION MODEL OUTPUT FOR UM3 AND DKHW

UM3 (default aspiration coefficient = 0.1)



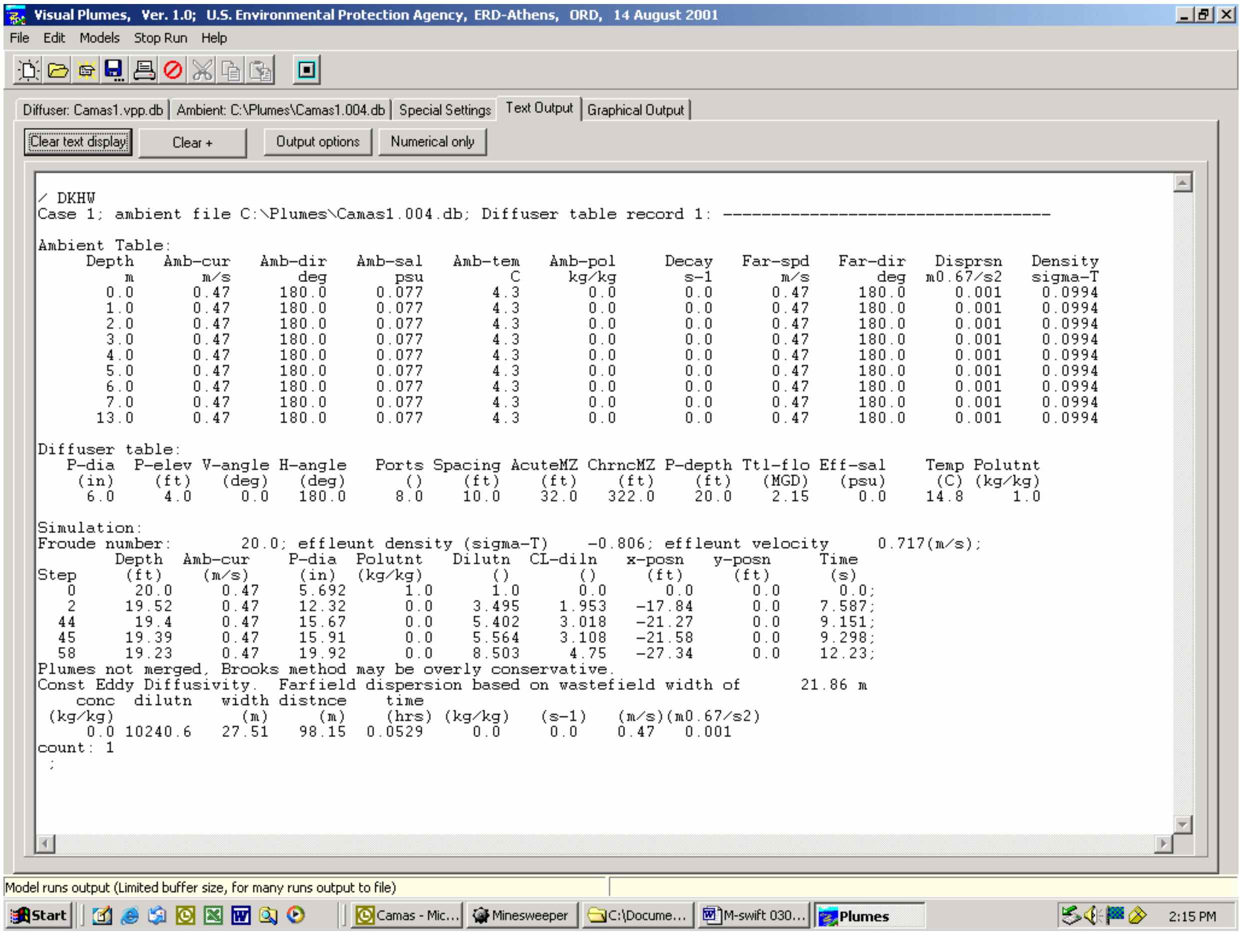

```
/ UM3. 3/4/2005 2:16:21 PM
Case 1; ambient file C:\Plumes\Camas1.004.db; Diffuser table record 1: -----------------------------------

Ambient Table:
      Depth   Amb-cur   Amb-dir   Amb-sal   Amb-tem   Amb-pol     Decay   Far-spd   Far-dir   Disprsn   Density
          m       m/s       deg       psu         C     kg/kg       s-1       m/s       deg  m0.67/s2   sigma-T
        0.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
        1.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
        2.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
        3.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
        4.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
        5.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
        6.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
        7.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       13.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994

Diffuser table:
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     4.0     0.0   180.0     8.0    10.0    32.0   322.0    20.0    2.15     0.0    14.8     1.0

Simulation:
Froude number:       20.0; effleunt density (sigma-T)    -0.806; effleunt velocity     0.717(m/s);
          Depth  Amb-cur     P-dia  Polutnt   Dilutn  CL-diln    x-posn    y-posn      Time
Step       (ft)    (m/s)      (in)  (kg/kg)       ()       ()      (ft)      (ft)       (s)
   0       20.0     0.47     5.692      1.0      1.0      1.0       0.0       0.0       0.0;
 100      19.85     0.47     18.25    0.138    7.238     1.99    -18.29       0.0     10.38;
 121      19.71     0.47     22.74   0.0911    10.97    2.953    -32.46       0.0     19.07; acute zone;
 200      18.37     0.47     50.66   0.0191    52.44    13.62    -184.1       0.0     115.5;
 231      17.32     0.47     69.02   0.0103    96.88    25.05    -327.6       0.0     207.9; chronic zone;
 287      14.17     0.47     120.4   0.0034    293.7    75.76    -857.4       0.0     550.4; merging;
 300       13.0     0.47     141.3  0.00263    379.9    105.9   -1083.1       0.0     696.6;
 328      9.189     0.47     221.9  0.00151    661.4    267.5   -1858.8       0.0    1199.1; surface;
Outside chronic zone
 ;
2:16:22 PM. amb fills: 2
```

DKHW

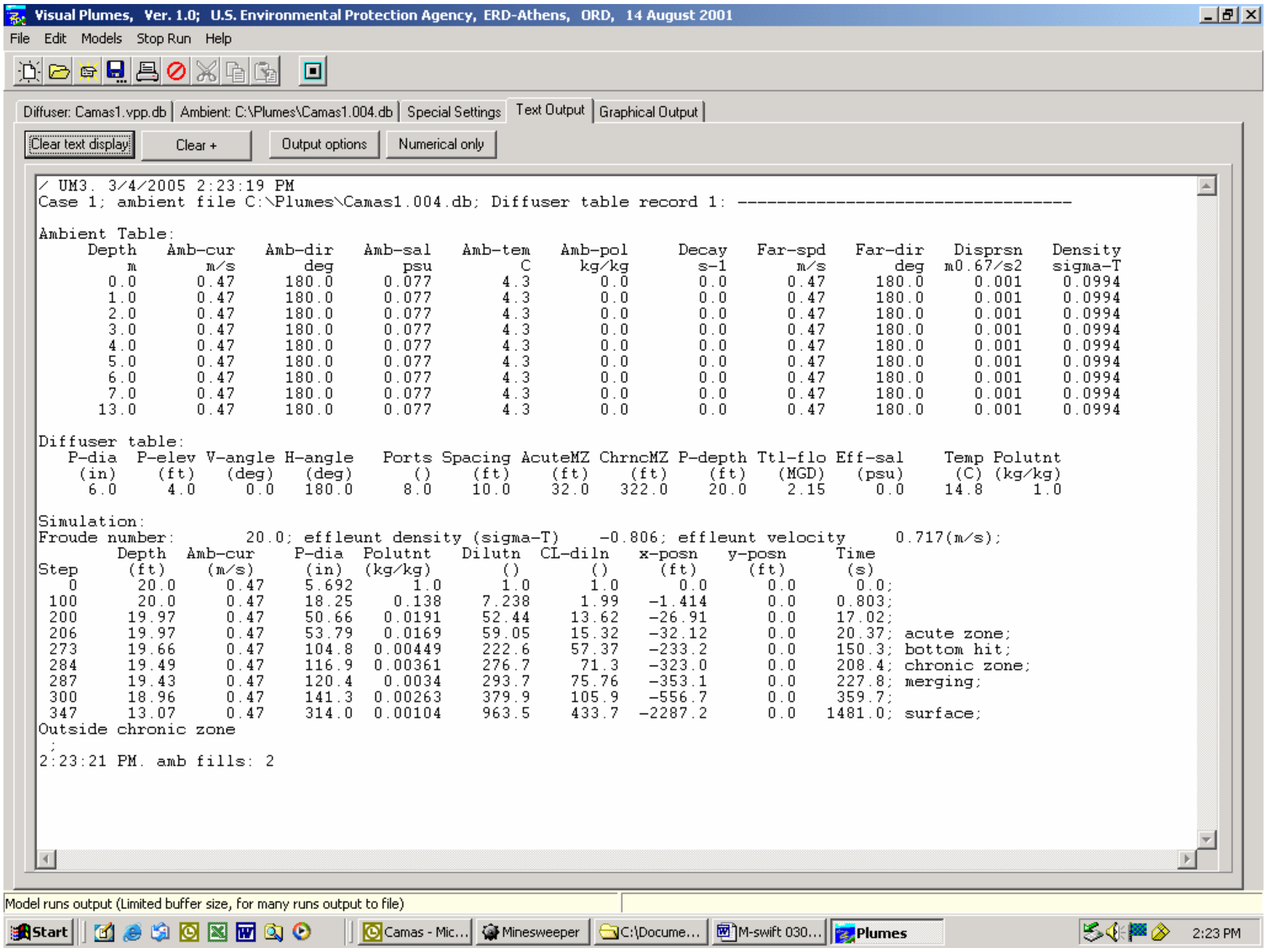

```
/ DKHW
Case 1; ambient file C:\Plumes\Camas1.004.db; Diffuser table record 1: -----------------------------------

Ambient Table:
     Depth   Amb-cur   Amb-dir   Amb-sal   Amb-tem   Amb-pol     Decay   Far-spd   Far-dir   Disprsn   Density
         m       m/s       deg       psu         C     kg/kg       s-1       m/s       deg  m0.67/s2   sigma-T
       0.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       1.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       2.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       3.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       4.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       5.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       6.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       7.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
      13.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994

Diffuser table:
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     4.0     0.0   180.0     8.0    10.0    32.0   322.0    20.0    2.15     0.0    14.8     1.0

Simulation:
Froude number:      20.0; effleunt density (sigma-T)    -0.806; effleunt velocity    0.717(m/s);
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn     Time
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)      (s)
   0     20.0     0.47    5.692      1.0      1.0      0.0      0.0      0.0     0.0;
   2    19.52     0.47    12.32      0.0    3.495    1.953   -17.84      0.0    7.587;
  44     19.4     0.47    15.67      0.0    5.402    3.018   -21.27      0.0    9.151;
  45    19.39     0.47    15.91      0.0    5.564    3.108   -21.58      0.0    9.298;
  58    19.23     0.47    19.92      0.0    8.503     4.75   -27.34      0.0    12.23;
Plumes not merged, Brooks method may be overly conservative.
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      21.86 m
    conc  dilutn   width distnce    time
 (kg/kg)             (m)     (m)   (hrs) (kg/kg)   (s-1)   (m/s)(m0.67/s2)
     0.0 10240.6   27.51   98.15  0.0529     0.0     0.0    0.47   0.001
count: 1
 ;
```

UM3 (with alternate aspiration coefficient = 1.3)



Visual Plumes, Ver. 1.0; U.S. Environmental Protection Agency, ERD-Athens, ORD, 14 August 2001

File Edit Models Stop Run Help

Diffuser: Camas1.vpp.db | Ambient: C:\Plumes\Camas1.004.db | Special Settings | Text Output | Graphical Output

Clear text display | Clear + | Output options | Numerical only

```
/ UM3. 3/4/2005 2:23:19 PM
Case 1; ambient file C:\Plumes\Camas1.004.db; Diffuser table record 1: -----------------------------------

Ambient Table:
     Depth   Amb-cur   Amb-dir   Amb-sal   Amb-tem   Amb-pol     Decay   Far-spd   Far-dir   Disprsn   Density
         m       m/s       deg       psu         C     kg/kg       s-1       m/s       deg   m0.67/s2  sigma-T
       0.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       1.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       2.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       3.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       4.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       5.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       6.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
       7.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994
      13.0      0.47     180.0     0.077       4.3       0.0       0.0      0.47     180.0     0.001    0.0994

Diffuser table:
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     4.0     0.0   180.0     8.0    10.0    32.0   322.0    20.0    2.15     0.0    14.8     1.0

Simulation:
Froude number:       20.0; effleunt density (sigma-T)    -0.806; effleunt velocity    0.717(m/s);
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn     Time
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)      (s)
   0     20.0     0.47    5.692      1.0      1.0      1.0      0.0      0.0      0.0;
 100     20.0     0.47    18.25    0.138    7.238     1.99   -1.414      0.0    0.803;
 200    19.97     0.47    50.66   0.0191    52.44    13.62   -26.91      0.0    17.02;
 206    19.97     0.47    53.79   0.0169    59.05    15.32   -32.12      0.0    20.37; acute zone;
 273    19.66     0.47    104.8  0.00449    222.6    57.37   -233.2      0.0    150.3; bottom hit;
 284    19.49     0.47    116.9  0.00361    276.7     71.3   -323.0      0.0    208.4; chronic zone;
 287    19.43     0.47    120.4   0.0034    293.7    75.76   -353.1      0.0    227.8; merging;
 300    18.96     0.47    141.3  0.00263    379.9    105.9   -556.7      0.0    359.7;
 347    13.07     0.47    314.0  0.00104    963.5    433.7  -2287.2      0.0   1481.0; surface;
Outside chronic zone
 ;
2:23:21 PM. amb fills: 2
```

Model runs output (Limited buffer size, for many runs output to file)

Start | Camas - Mic... | Minesweeper | C:\Docume... | M-swift 030... | Plumes | 2:23 PM

PART II:
DYE STUDY NO. 2

PART II:
DYE STUDY NO. 2

Based on the results of the two dye tracer studies, the recommended mixing zone model for the City of Camas WWTP outfall is UM3, which was the same model used in the NPDES permit. However, the model has been calibrated to the dye studies, revealing that the dilution values cited in the NPDES permit are incorrect. The revised mixing zone modeling and appropriate NPDES permit modifications are presented in this report.

WWTP DATA

Dye Injection

Rhodamine WT dye was injected at a constant rate into the Camas WWTP effluent for 301 minutes (5.0 hours) on October 4, 2005. The liquid dye (23 percent solution) was injected at a rate of 28.4 mL/min. The dye solution was injected into the mixing vault at the outlet from the UV chamber.

Effluent Monitoring

WWTP staff monitored effluent flow rate and temperature during the tracer study. They also collected effluent grab samples from the outfall manhole across the street from the WWTP. The grab samples were subsequently diluted by a factor of 100:1 in the Cosmopolitan laboratory and measured by the same Turner Designs SCUFA fluorometer used in the field study. The results of the WWTP effluent monitoring are in Table II-1.

Table II-1 WWTP Effluent Monitoring During the Tracer Study

Date	Time	Effluent Flow (mgd)	Effluent Temp (C)	Tracer Conc Measured (ppb)	Tracer Conc Calculated (ppb)
10/4/05	6:30	2.01	19.9		1,207
10/4/05	7:00	2.42	19.9	1,180	1,003
10/4/05	7:30	2.78	20.0	1,000	872
10/4/05	8:00	3.85	20.0	680	630
10/4/05	8:30	3.65	20.0	770	665
10/4/05	9:00	3.24	20.0	710	749
10/4/05	9:45	2.93	20.1	730	828
10/4/05	10:30	2.88	20.1	940	842
10/4/05	11:15	2.70	20.2	980	899

Tracer Concentration

The measured tracer concentration data in Table 1 are highly variable, in part due to the wide effluent flow swings typical in the morning. The monitoring during the first dye study in February, when effluent flow was much more stable, also suggested that mixing in the outfall was incomplete during the estimated 2-minute travel time between the dye injection point and the effluent manhole.

The actual mixed tracer concentration can be more reliably calculated from the known effluent flow rate, tracer concentration and injection rate, which are shown in the right-hand column of Table I-1. The dye pump was pre-calibrated to an injection rate of approximately 28 mL/min, and a concentration of 23 percent. The dye container was measured before and after the dye injection, which determined an actual injection rate of 28.4 mL/min.

AMBIENT DATA AND CRITICAL CONDITIONS

The first field study in February revealed that river velocity and water surface elevation vary rapidly near the Camas outfall. The first study was unable to discern whether these changes resulted from abrupt changes in discharge at the Bonneville Dam, or tides, or a combination of both. Therefore, the field studies for the October event were modified and expanded to aid in this determination, as described below:

River Discharge

River discharge data for the Bonneville Dam are available from the following website:

http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=id:BON+record://BON/QR//IR-MONTH/HRXZZAZD/+psy:+psm:+psd:+pey:+pem:+ped:+pk:columbia+river+flow+bonneville

We contacted Mr. Paul Koski, Hydrologist at the Reservoir Control Center of the Corps of Engineers Portland District. Mr. Koski described BPA's planning and operating criteria for releases from the Bonneville Dam. Forecasts are prepared each Thursday and Monday for the following few days. Therefore, scheduling of the second dye study was made flexible to respond to the updated release forecasts at the latest possible opportunity. The field studies were eventually conducted on the morning of Tuesday, October 4, which had been forecasted by the Corps the previous day to be a period of low discharge.

River discharge from the Bonneville Dam during the October field study is shown in Figure II-1. Discharge data during the February study are also shown for comparison. The characteristic rapid variations from Bonneville are revealed in the figure. The durations of the field studies are indicated by horizontal bars. The October 4 field study was successful at capturing the low discharge period. River discharge was at its seasonal, diurnal and weekly minimum (approximately 80 kcfs) for the first two hours of the field measurements (approximately 6:30 to 8:30 Tuesday morning).

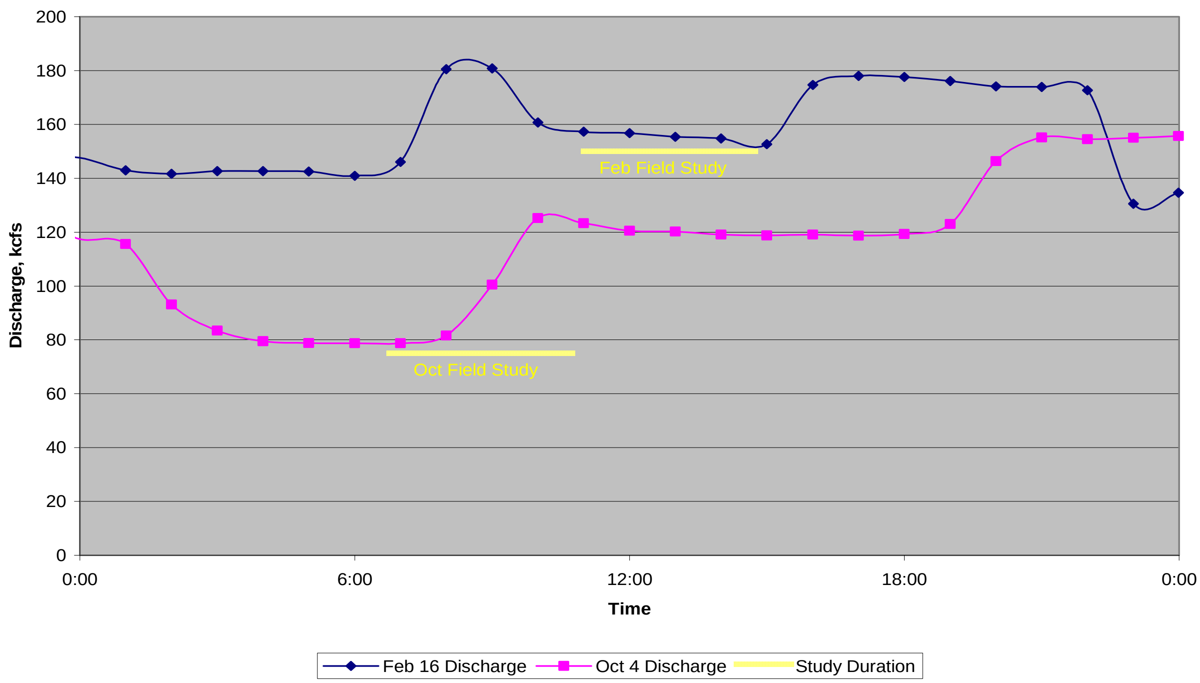


Figure II-1. Bonneville Dam Discharge Data

Tidal Influence

The first dye study in February did not include adequate detail in the measurement of ambient velocity and water surface elevation to determine the separate effects of tide and Bonneville discharge. Therefore, an ADCP current meter was deployed approximately 100 feet upstream of the diffuser to provide continuous and precise measurement of velocity and water surface elevation.

It is known that tides influence river flow as far upstream as Vancouver, WA. However, no predictions are provided by NOAA upstream of Ellsworth, which is approximately 8 miles downstream of Camas. Therefore, the tracer study was timed to occur during the period predicted to coincide with potential tidal slowing of the river current, which was high slack tide predicted at in Vancouver.

The observed water surface elevation data from the ADCP are plotted with the predicted tide data for Ellsworth in Figure II-2. These data clearly confirm that there is a tidal influence at Camas. The observed tide range on October 3 and 4 was approximately 50 to 60 cm.

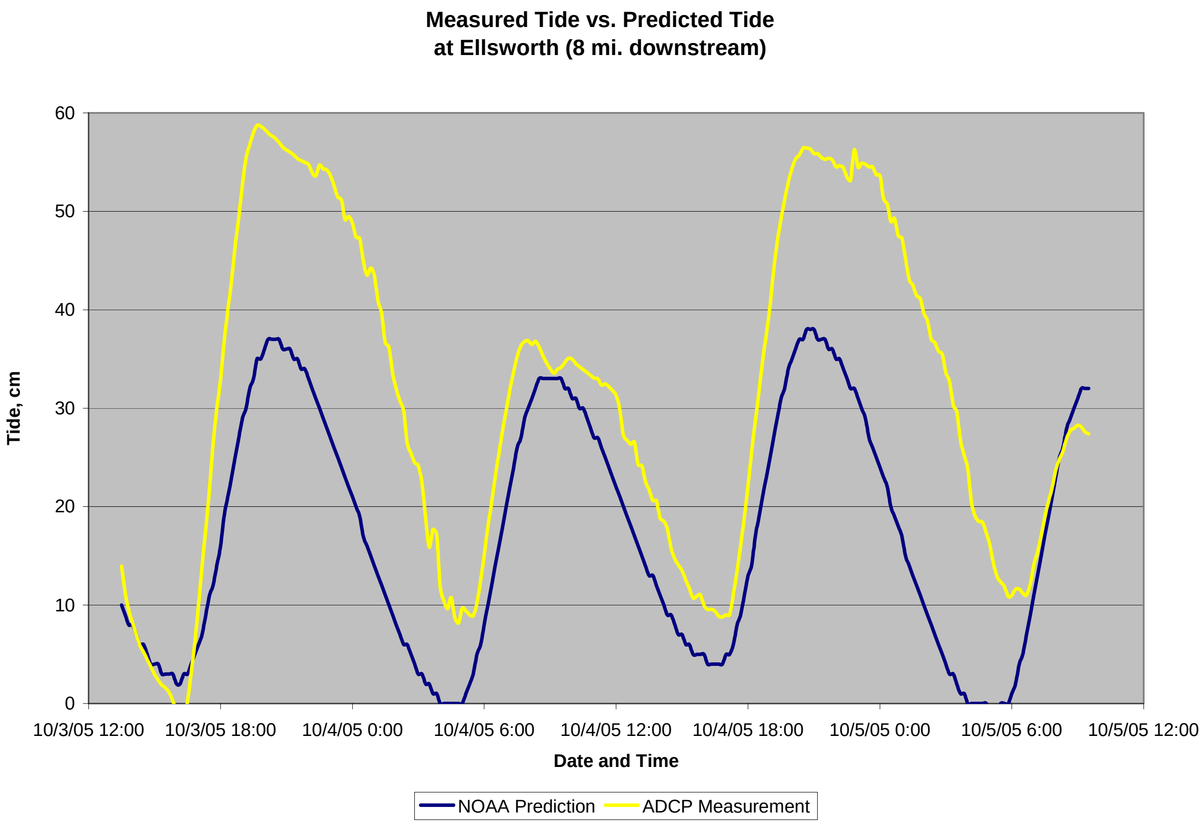


Figure II-2. NOAA Predicted Tide and Observed Water Surface Elevation

River Velocity

The ADCP measured current velocity in 1-meter bins at 10-minute intervals for two days surrounding the dye study. The current speed results for four of the bins are shown in Figure II-3. As expected, current speed decreases from the water surface to the bottom. The direction of all measured currents was between 240 and 250 degrees true. Therefore, there was no reversal of current caused by the tidal influence.

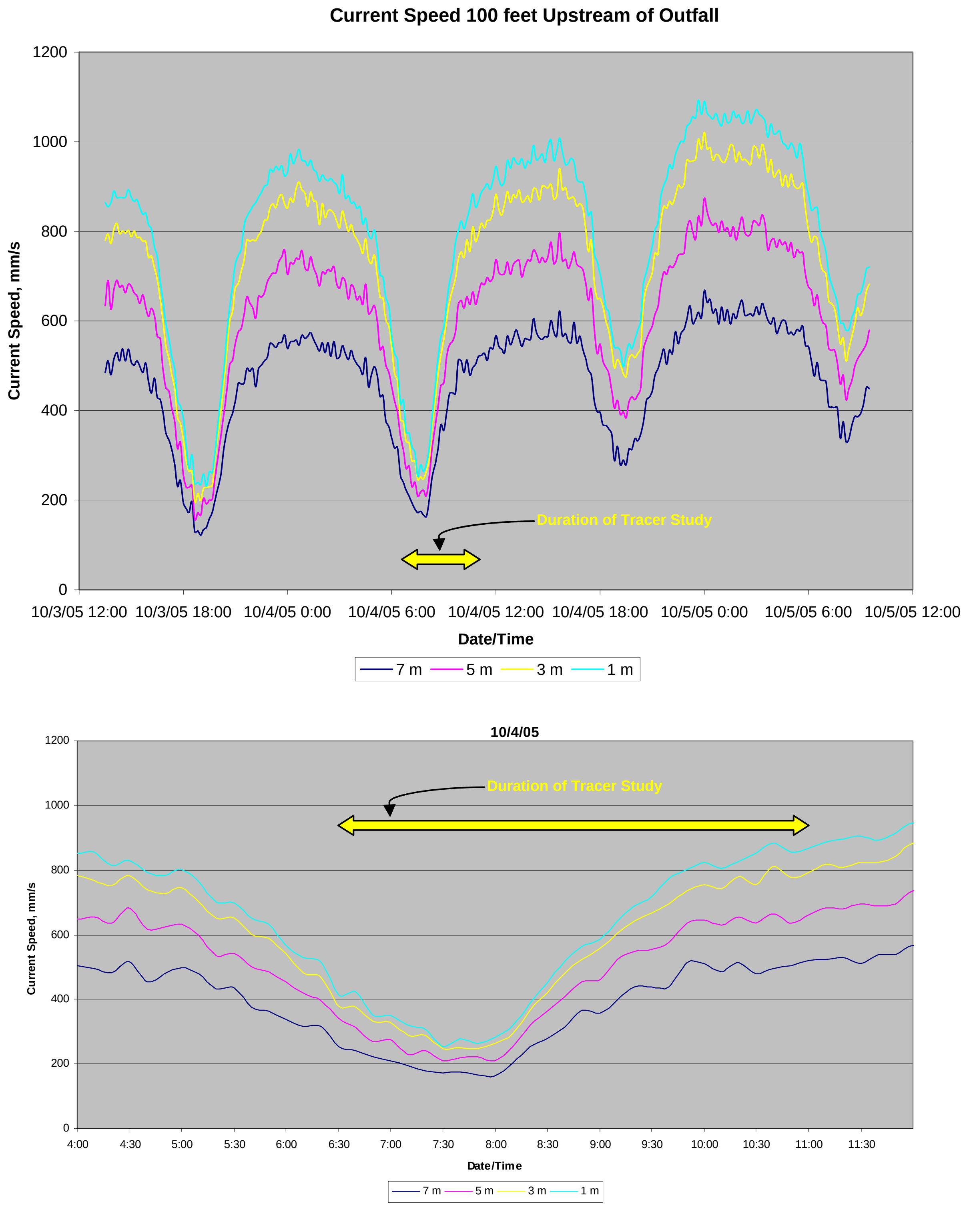


Figure II-3. Current Speed Data Measured During the October Field Studies

Critical Conditions

The data from the Corps and the ADCP mooring combine to reveal that critical (i.e., lowest) current speed is a function of both Bonneville discharge and tidal influence. The average current speed measured during the October event is plotted with the Bonneville discharge and tide data in Figure II-4. The lowest current speed occurs just prior to high slack tide. The first portion of the October 4 tracer study (6:30 to 8:30) captured critical conditions for both tidal and Bonneville influences. The second portion of the tracer study (8:30 to 10:00) was at steadily increasing current speeds. The final portion of the tracer study (10:00 to 11:00) occurred during relatively stable, maximum current speeds.

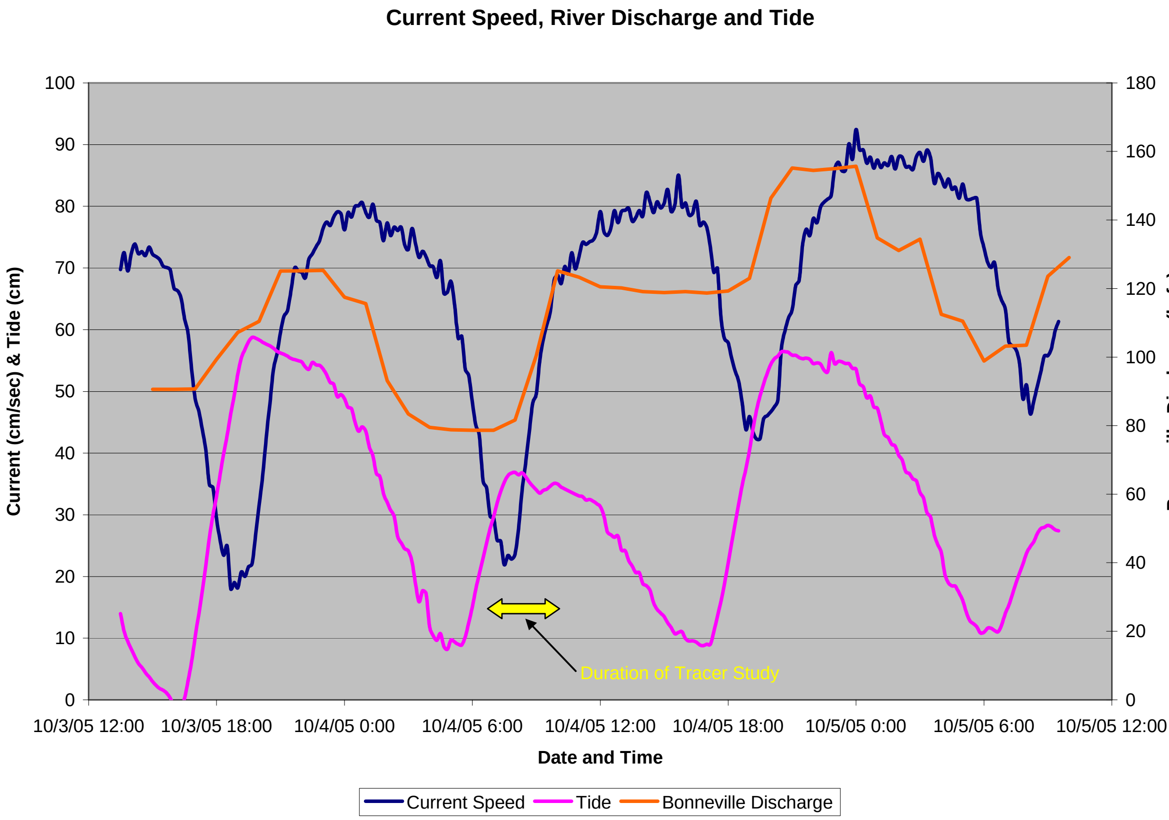


Figure II-4. Critical Ambient Conditions During the October 4 Tracer Study

CTD Profiles

Conductivity, temperature, and depth profiles were measured three times during the October 4 tracer study. The results are presented in Table II-2. Temperature and salinity profiles show that the receiving water is well mixed, or unstratified. This lack of stratification was also observed during the February tracer study.

Table II-2 CTD Profiles During the Tracer Study

Depth (m)	7:23 10/04/05		8:51 10/04/05		11:01 10/04/05	
	Sal (ppt)	Temp (C)	Sal (ppt)	Temp (C)	Sal (ppt)	Temp (C)
1	0.072	17.08	0.072	17.09	0.071	17.12
2	0.073	17.08	0.072	17.09	0.071	17.12
3	0.074	17.08	0.073	17.09	0.071	17.12
4	0.077	17.08	0.075	17.09	0.071	17.11
5	0.077	17.08	0.075	17.09	0.072	17.11
6	0.077	17.08	0.075	17.09	0.072	17.11

TRACER STUDY RESULTS

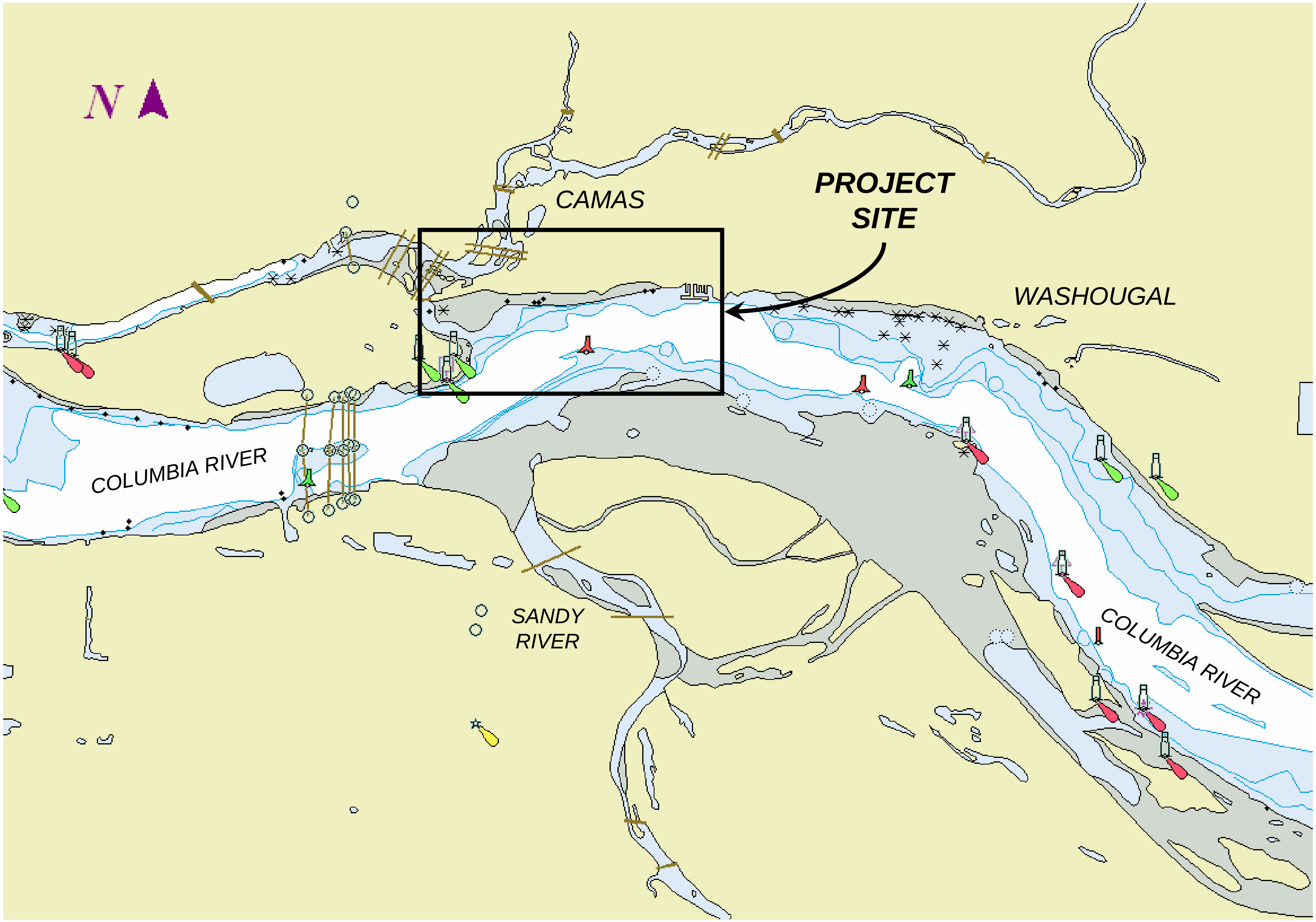
Overview

Dye injection began at 6:19 a.m. on October 4, 2005 and continued until 11:20 a.m. Effluent concentrations were calculated from the known effluent flow rates and dye injection rate, as shown in Table II-1. There is a calculated lag of approximately 30 minutes from the WWTP to the downstream mixing zone, which has been included in the mixing zone plume calculations.

Beginning at approximately 6:45 a.m. and continuing through 11:00 a.m., the fluorometer was placed in the water and placed at various locations along the mixing zone boundary 314 feet downstream of the diffuser (based on dGPS coordinates). One transect was run 206 feet downstream. The mooring consisted of an anchor set approximately 50 feet upstream of the diffuser, with a 400-ft anchor line. Traverses across the downstream mixing zone boundary were conducted by swinging in an arc pattern from the main mooring. Lateral anchors were set to aid in cross-channel positioning along the downstream mixing zone boundary.

The general configuration of the diffuser, mixing zone boundary, mooring system and cross-channel stationing are illustrated in Figures II-5 through II-7. The river is conveniently oriented east-west, so the vessel's cross-channel positions along the downstream mixing zone boundary were recorded by the latitude reading from a dGPS system. The vessel's cross-channel positioning data were post-processed into a stationing system corresponding to the stationing on the 1971 outfall drawing (sheet 42). The diffuser terminus is at approximately station 12+40 on the drawing. In this study, station 12+40 is approximately 310 feet directly downstream of the diffuser terminus. The plume centerline is at approximately station 12+05 or latitude 45° 34.529', corresponding to the midpoint of the diffuser.

Comprehensive plume tracer concentration data were recorded at the mixing zone boundary. Measurements consisted of (1) vertical profiles measured at a fixed location, (2) horizontal transects measured from one edge of the mixing zone to the other at fixed depths, and (3) time series of effluent concentration at a fixed location believed to be centerline of the plume. The schedule of plume tracer measurements is provided in Table II-3.



FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

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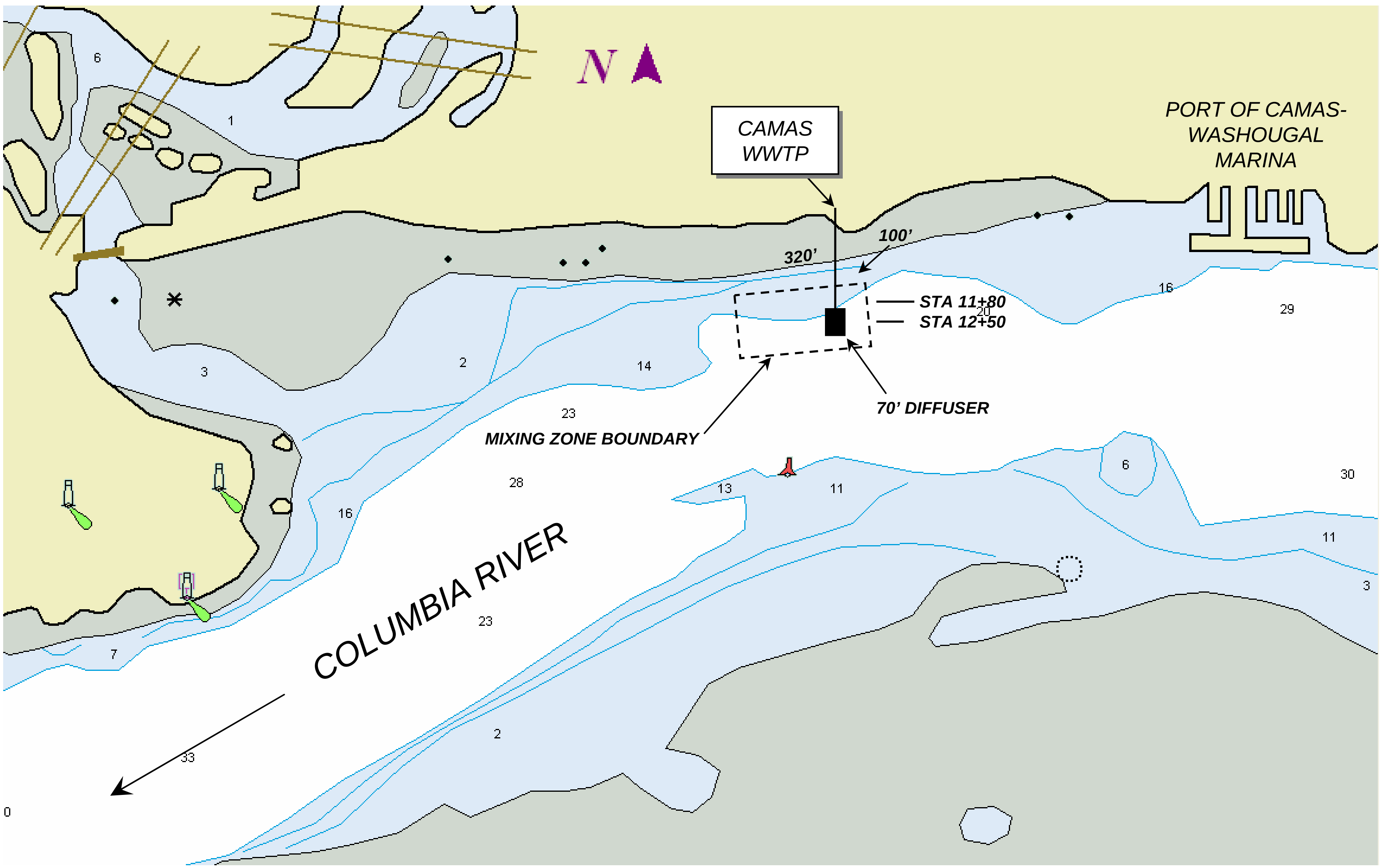
NO SCALE

Figure II-5: PROJECT VICINITY MAP



FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

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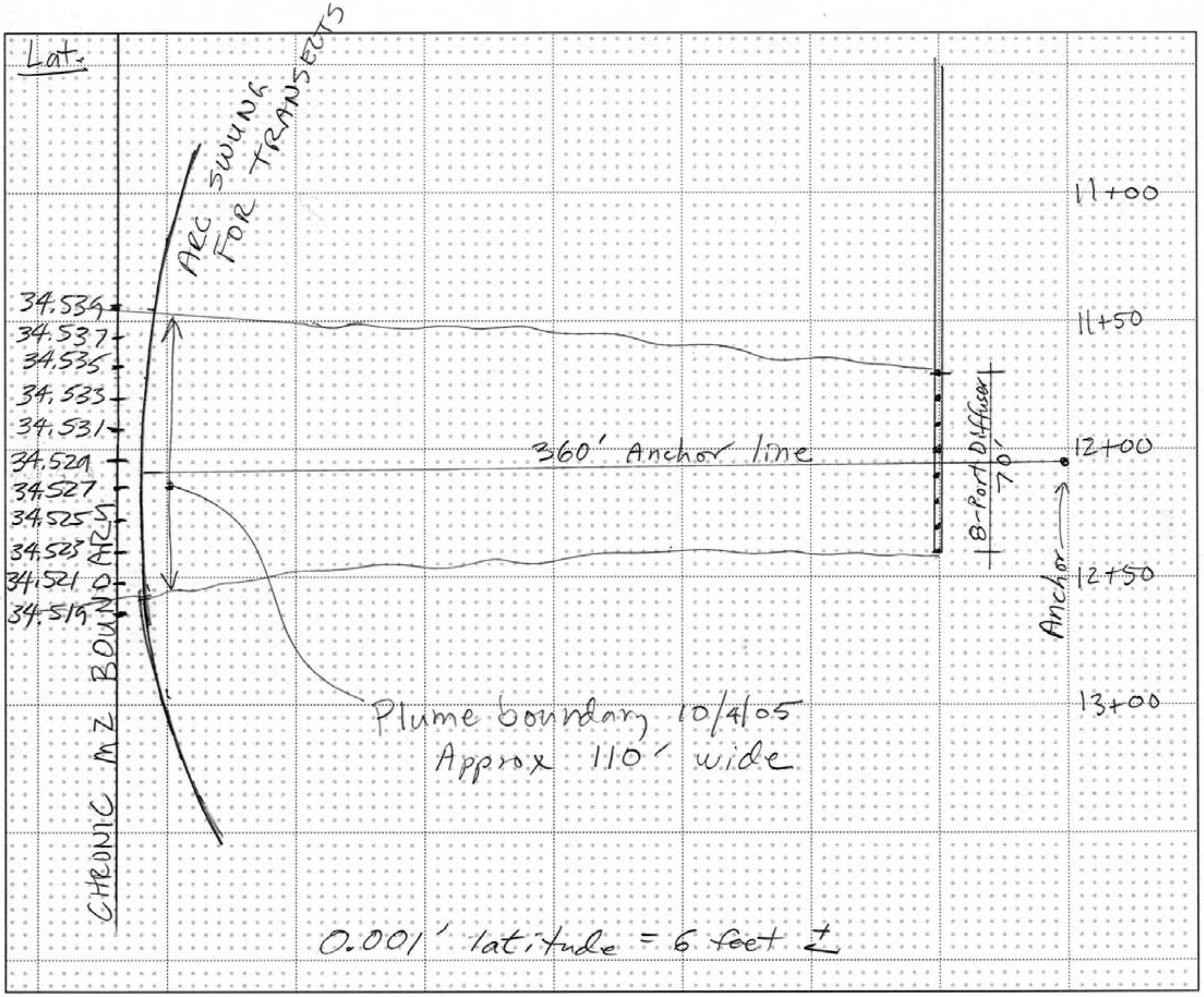
Figure II-6: TRACER STUDY SITE MAP



FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

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Figure II-7: MIXING ZONE TRANSECTS

Table II-3 Schedule of Plume Tracer Concentration Measurements

Date	Time	Type
10/04/05	6:44 – 6:50	Profile #1 at station 12+00
10/04/05	6:52 – 6:59	Transect #1 - 6 ft above bottom
10/04/05	7:18 – 7:29	Time series #1 - 6 ft above bottom at Sta 12+00
10/04/05	8:00 – 8:07	Transect #2 - 5 ft above bottom
10/04/05	8:24 – 8:29	Profile #2 at station 12+05
10/04/05	8:34 – 8:58	General time series – various centerline locations
10/04/05	9:17 – 9:24	Transect 206' downstream from diffuser
10/04/05	10:01 – 10:59	Time series #2 - 4 ft above bottom at Sta 12+00

Tabular Results

Raw fluorometer data and calculated plume concentration data are tabulated and provided in Attachment II-1. The information on each table includes the date and time of measurement, fluorescence (i.e., the tracer concentration), height of the fluorometer above the river bottom, cross-channel stationing, effluent concentration, background concentration, calculated effluent volume fraction, and dilution. Effluent volume fraction is the proportion of the measured parcel of ambient water consisting of effluent. For example, 0.3% effluent fraction would consist of 3 parts effluent to 997 parts ambient water. Dilution factor is merely the inverse of effluent volume fraction.

Graphical Results

The tracer concentration measurements (i.e., effluent volume fraction) are shown graphically in Figures II-8 through II-14. There were three characteristic periods for these measurements, as described below:

- Figures II-8 through II-11 reveal relatively stable plume conditions prior to 8:30 a.m., because ambient current speed was low (approximately 25 cm/sec) and relatively stable during this period. This was the slack tide period representing critical conditions.

- Current speed increased steadily and rapidly between 8:30 and 10:00 a.m., which is revealed in Figures II-12 through II-13. Effluent flows were also greater during this period.

- The time series in Figure II-14 was during relatively stable currents approximately three times higher than the early morning condition. Measurements were at plume centerline.

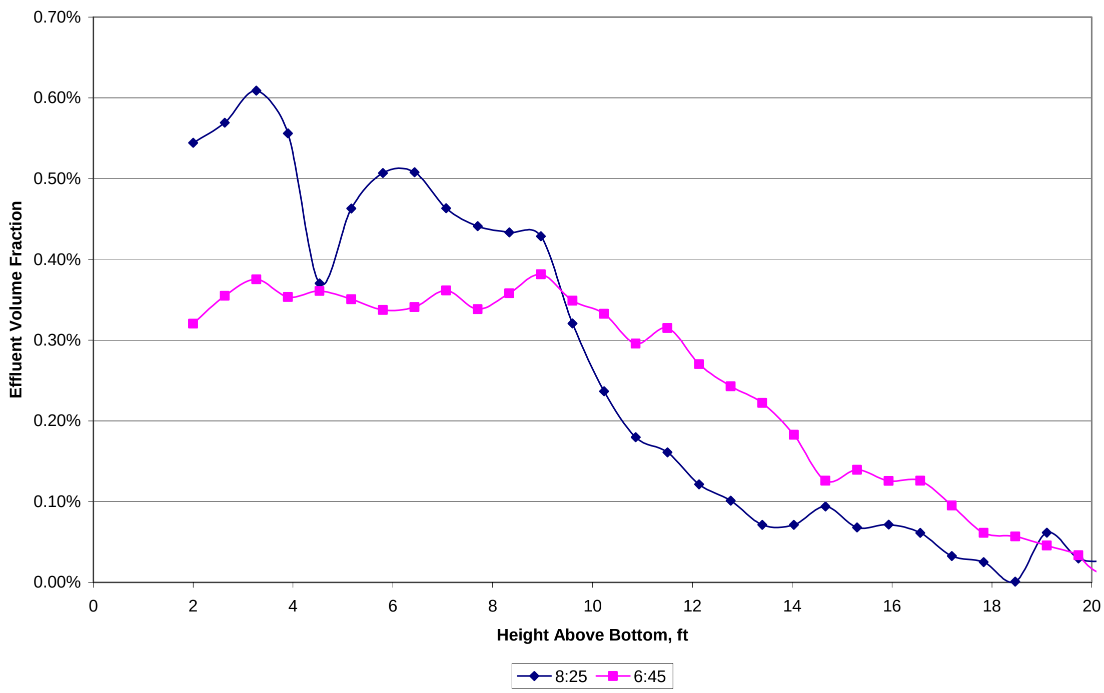

Figure II-8. Slack Tide Profiles

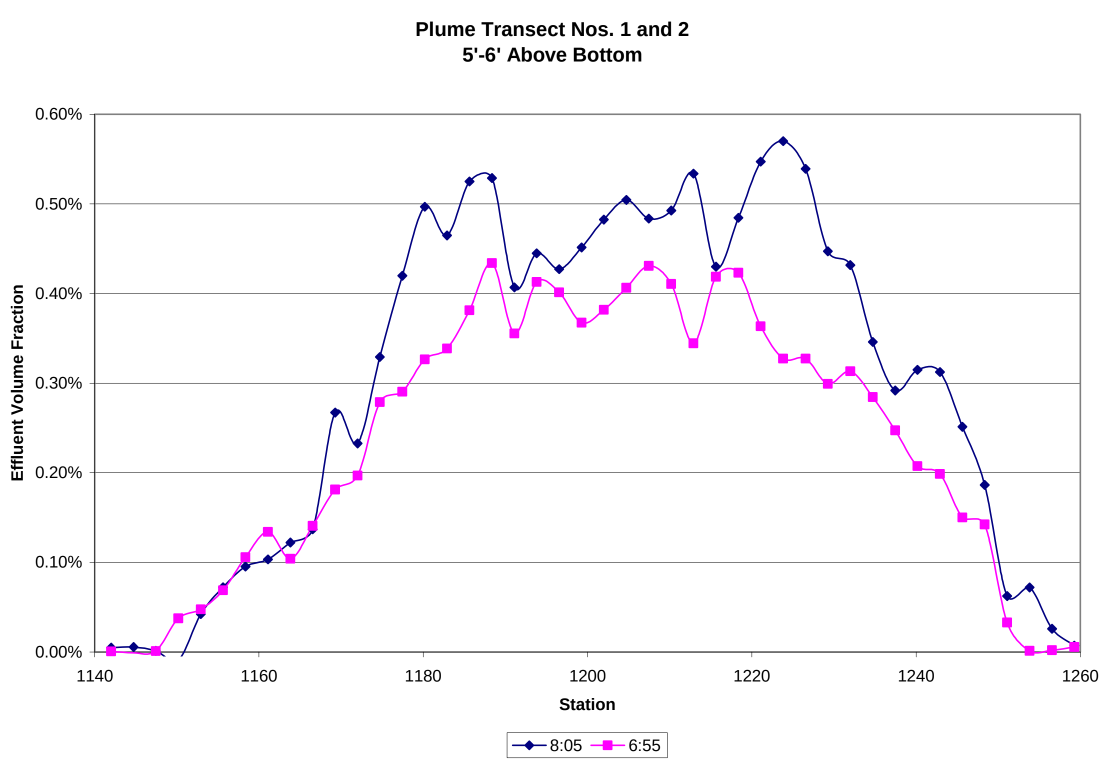

Figure II-9. Slack Tide Transects

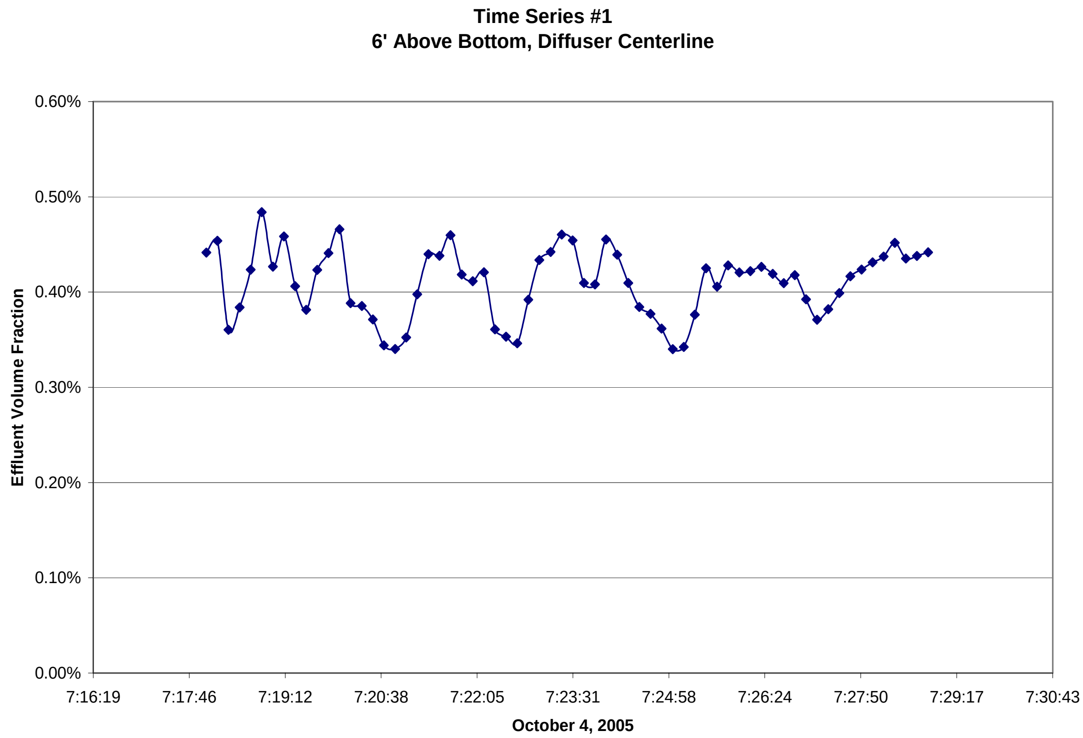

Figure II-10. Slack Tide Time Series

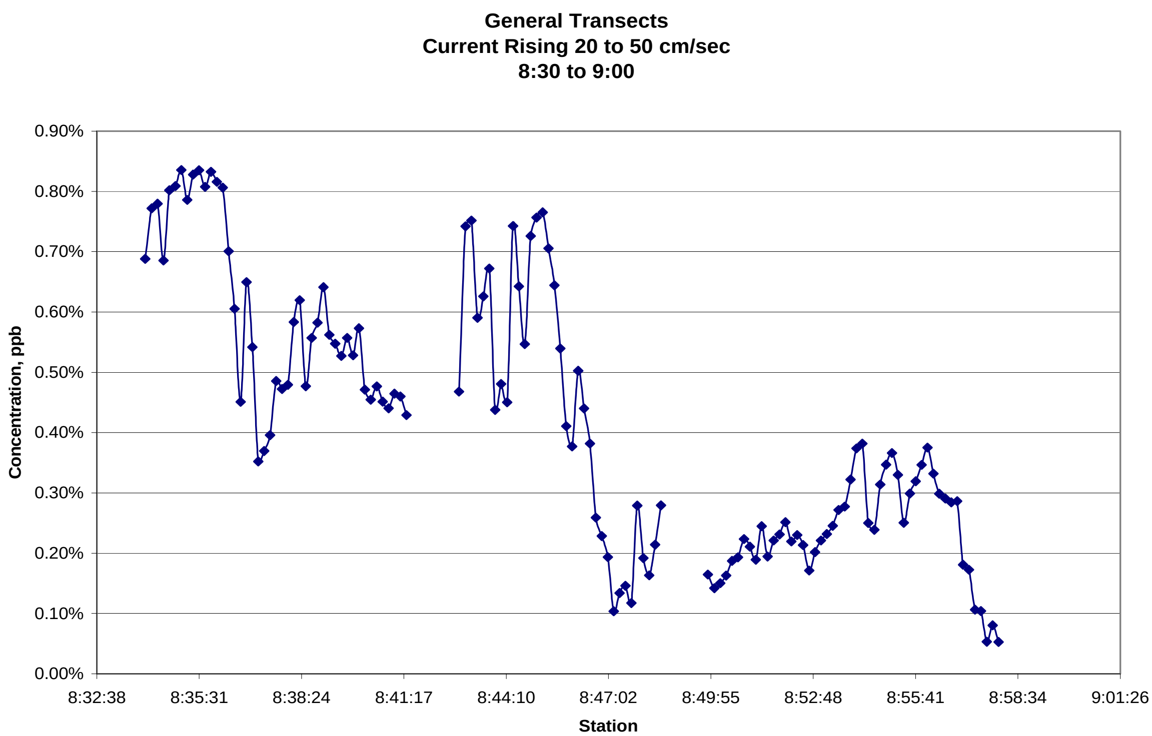

Figure II-11. General Transects During Increasing Currents

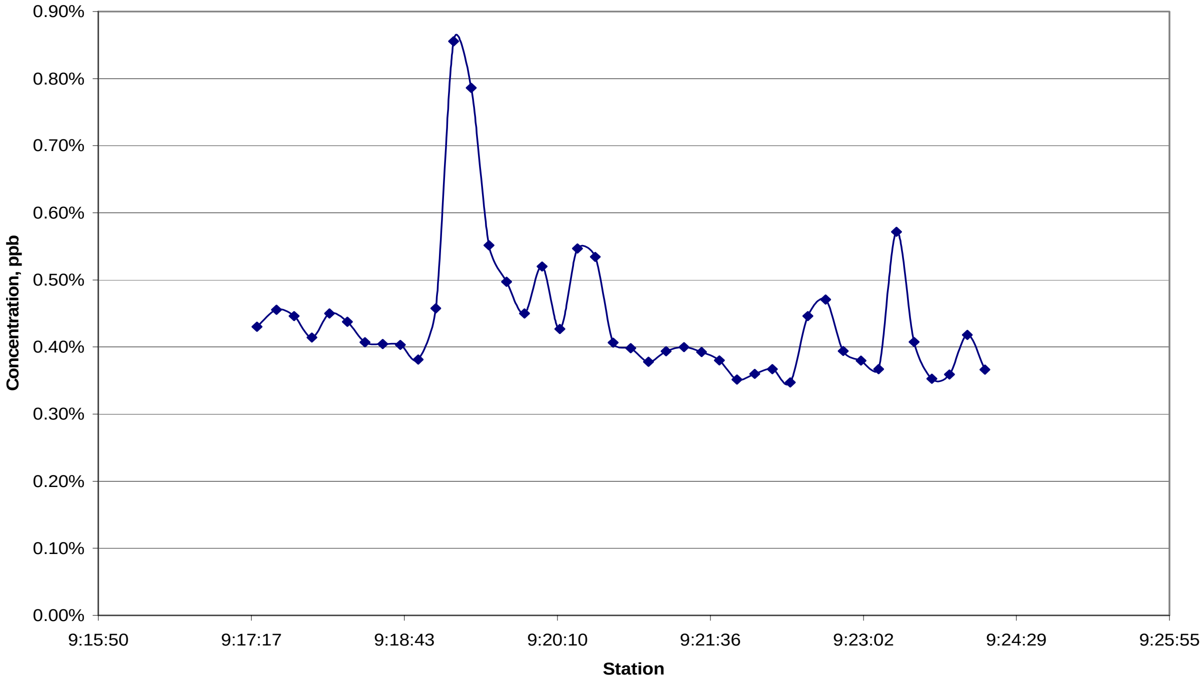

Figure II-12. General Transect 206 Feet Downstream From Diffuser – Increasing Currents

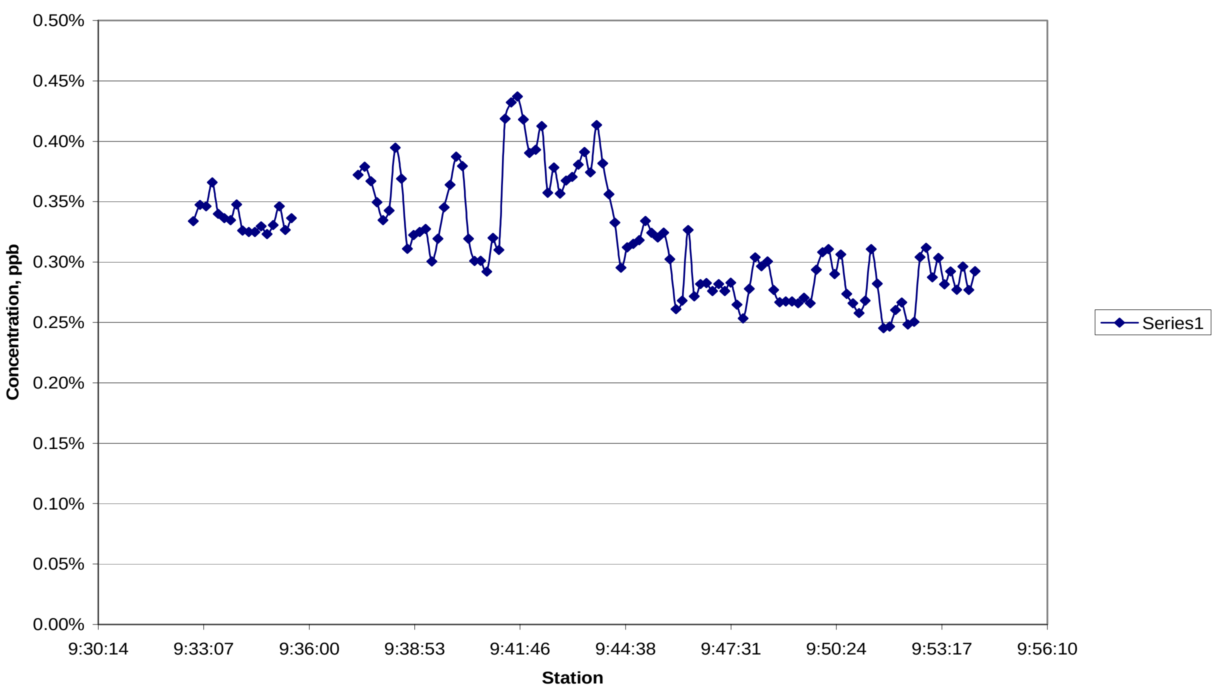

Figure II-13. General Transects 314 Feet Downstream From Diffuser – Increasing Currents

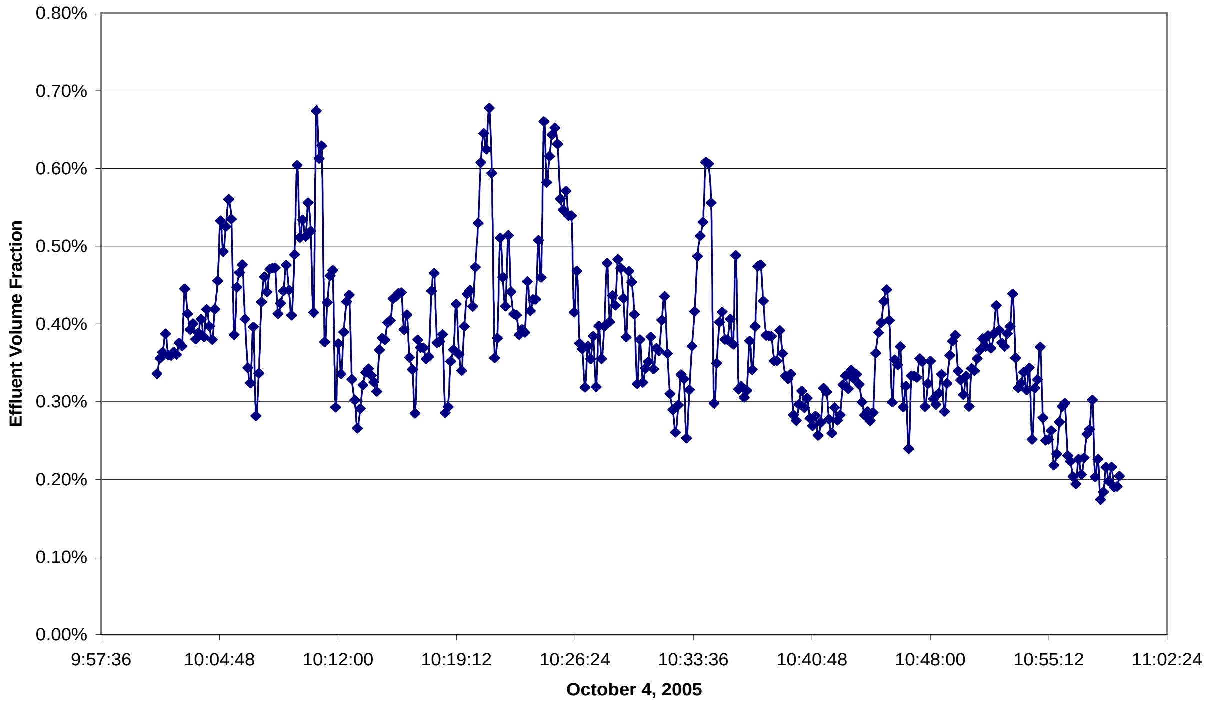

Figure II-14. Maximum Current Time Series – Plume Centerline

Comprehensive Plume Cross-Section

Figures II-8 and II-9 provide the best 3-dimensional data of plume concentration during the critical ambient conditions at slack water (i.e., minimum current speed). These data were combined and extrapolated to simulate the comprehensive distribution of effluent concentration at the downstream mixing zone boundary. Figure II-15 provides a table of effluent volume fraction across the downstream boundary during the low current data (approximately 6:45 through 8:25 a.m.). Each cell is 0.67 ft high by 5.55 ft wide.

Enclosure 2 of Ecology's comments dated May 5, 2006 presented the following equation to quantify peak and average plume concentration:

$$\frac{C_{\max}}{C_{avg}} = \frac{C_{\max} \int_A vdA}{\int_A CvdA}$$

Where: v and C = velocity and concentration of the cross-sectional element dA

The data in Figure II-15 may be used in a finite element solution to the equation above. Elemental concentration data for each cell in the denominator are taken directly from

Figure II-15. The peak concentration (C_{max} in the equation above) is taken as the 95th percentile value. It is critical to not use instantaneous peak concentrations, but to establish a time-averaged concentration at the plume centerline. The 95th percentile of all non-zero concentrations was selected for the peak time-averaged plume concentration.

The tables developed for this calculation are provided in Attachment II-2, and described below:

Table A. This is Table II-15. The data are the effluent concentration, in percent effluent, interpolated from transects and profiles between 6:40 and 7:00 a.m. and again between 8:00 and 8:30 a.m. (Figures II-8 and II-9).

Table B. This table includes the velocity profile for the period from 6:40 to 7:00 a.m. and 8:00 to 8:30 a.m. The data were determined from the ADCP current meter deployed upstream of the diffuser. Note that the current speed varies vertically, but is uniform horizontally at all depths.

Table C. This table is the current flux through each cell (v*dA). It is the product of the cell area and the velocity from Table B.

Table D. This table is the effluent flux through each cell (C*v*dA). It is the product of the cell area and Tables A and B. Note the integral of these cells is the total effluent flow, calculated at 2.32 mgd.

Table E. This table is effluent flux through each cell, with the cells less than 0.001 mgd deleted. The integral of this table of 824 cells is 2.19 mgd. The effluent mass flux through this control area is 95 percent of the total (i.e., 95 percent recovery).

Table F. This table is the current flux through the same 824 cell control area. The flux-average effluent concentration is the integral of Table E divided by the integral of Table F = 0.23 percent, or a dilution factor of 433.

Table G. This table has the same values as Table A for only the 824 cells in the control area. The 95th percentile concentration is 0.48 percent effluent, or a dilution factor of 210. The resulting peak-to-mean ratio is 0.48/0.23 = 2.1.

CROSS-CHANNEL STATIONING, FT

Table A. Effluent fraction cross section from transects and profiles 6:40 to 7:00 and 8:00 to 8:30

HEIGHT ABOVE BOTTOM, FT

	1152.9	1158.4	1163.8	1169.3	1174.7	1180.2	1185.6	1191.1	1196.5	1202.0	1207.5	1212.9	1218.4	1223.8	1229.3	1234.7	1240.2	1245.6	1251.1	1256.5
21.33	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
20.67	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
20.00	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.01%	0.01%	0.01%	0.00%	0.00%
19.33	0.00%	0.01%	0.01%	0.02%	0.02%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%	0.02%	0.00%	0.00%
18.67	0.01%	0.01%	0.01%	0.03%	0.04%	0.05%	0.06%	0.05%	0.05%	0.06%	0.06%	0.06%	0.06%	0.06%	0.05%	0.04%	0.03%	0.03%	0.01%	0.00%
18.00	0.00%	0.01%	0.01%	0.02%	0.02%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%	0.01%	0.00%	0.00%
17.33	0.00%	0.01%	0.01%	0.02%	0.03%	0.04%	0.05%	0.04%	0.04%	0.05%	0.05%	0.05%	0.05%	0.05%	0.04%	0.03%	0.03%	0.02%	0.00%	0.00%
16.67	0.01%	0.02%	0.02%	0.03%	0.05%	0.06%	0.07%	0.06%	0.06%	0.07%	0.07%	0.07%	0.07%	0.07%	0.06%	0.05%	0.04%	0.03%	0.01%	0.00%
16.00	0.01%	0.02%	0.03%	0.05%	0.07%	0.09%	0.10%	0.09%	0.09%	0.10%	0.10%	0.10%	0.10%	0.10%	0.08%	0.07%	0.06%	0.05%	0.01%	0.00%
15.33	0.01%	0.02%	0.03%	0.05%	0.07%	0.10%	0.11%	0.09%	0.10%	0.10%	0.11%	0.10%	0.11%	0.11%	0.09%	0.08%	0.06%	0.05%	0.01%	0.00%
14.67	0.01%	0.03%	0.03%	0.06%	0.08%	0.10%	0.11%	0.10%	0.10%	0.11%	0.11%	0.11%	0.11%	0.11%	0.09%	0.08%	0.07%	0.05%	0.01%	0.00%
14.00	0.01%	0.03%	0.03%	0.06%	0.08%	0.11%	0.12%	0.10%	0.11%	0.11%	0.12%	0.12%	0.12%	0.12%	0.10%	0.08%	0.07%	0.05%	0.01%	0.00%
13.33	0.01%	0.03%	0.03%	0.07%	0.09%	0.13%	0.14%	0.12%	0.13%	0.13%	0.14%	0.13%	0.14%	0.14%	0.11%	0.10%	0.08%	0.06%	0.01%	0.00%
12.67	0.02%	0.04%	0.04%	0.08%	0.11%	0.15%	0.16%	0.13%	0.15%	0.15%	0.16%	0.16%	0.16%	0.16%	0.13%	0.11%	0.09%	0.07%	0.02%	0.00%
12.00	0.02%	0.04%	0.05%	0.09%	0.13%	0.17%	0.19%	0.16%	0.17%	0.18%	0.19%	0.18%	0.19%	0.19%	0.16%	0.13%	0.11%	0.08%	0.02%	0.01%
11.33	0.02%	0.05%	0.05%	0.11%	0.14%	0.19%	0.21%	0.18%	0.20%	0.20%	0.22%	0.21%	0.21%	0.21%	0.18%	0.15%	0.12%	0.09%	0.02%	0.01%
10.67	0.03%	0.06%	0.06%	0.13%	0.17%	0.24%	0.26%	0.22%	0.24%	0.25%	0.26%	0.25%	0.26%	0.26%	0.21%	0.18%	0.15%	0.12%	0.03%	0.01%
10.00	0.03%	0.06%	0.06%	0.13%	0.17%	0.24%	0.26%	0.22%	0.24%	0.25%	0.26%	0.25%	0.26%	0.26%	0.21%	0.18%	0.15%	0.12%	0.03%	0.01%
9.33	0.03%	0.07%	0.08%	0.15%	0.21%	0.28%	0.31%	0.26%	0.28%	0.30%	0.31%	0.30%	0.31%	0.31%	0.26%	0.22%	0.18%	0.14%	0.03%	0.01%
8.67	0.04%	0.08%	0.09%	0.18%	0.25%	0.33%	0.37%	0.31%	0.33%	0.35%	0.37%	0.35%	0.37%	0.36%	0.30%	0.25%	0.21%	0.16%	0.04%	0.01%
8.00	0.04%	0.10%	0.11%	0.22%	0.30%	0.40%	0.44%	0.37%	0.41%	0.42%	0.45%	0.43%	0.44%	0.44%	0.37%	0.31%	0.26%	0.20%	0.05%	0.01%
7.33	0.04%	0.10%	0.11%	0.21%	0.29%	0.39%	0.43%	0.36%	0.40%	0.41%	0.44%	0.42%	0.43%	0.43%	0.36%	0.30%	0.25%	0.19%	0.05%	0.01%
6.67	0.04%	0.09%	0.11%	0.21%	0.29%	0.39%	0.43%	0.36%	0.39%	0.41%	0.43%	0.41%	0.43%	0.42%	0.35%	0.30%	0.25%	0.19%	0.04%	0.01%
6.00	0.04%	0.10%	0.11%	0.22%	0.30%	0.41%	0.45%	0.38%	0.41%	0.43%	0.46%	0.44%	0.45%	0.45%	0.37%	0.32%	0.26%	0.20%	0.05%	0.01%
5.33	0.05%	0.10%	0.12%	0.23%	0.31%	0.42%	0.46%	0.39%	0.42%	0.44%	0.47%	0.45%	0.47%	0.46%	0.38%	0.32%	0.27%	0.21%	0.05%	0.01%
4.67	0.05%	0.10%	0.12%	0.23%	0.31%	0.42%	0.46%	0.39%	0.42%	0.44%	0.47%	0.45%	0.46%	0.46%	0.38%	0.32%	0.27%	0.20%	0.05%	0.01%
4.00	0.04%	0.10%	0.11%	0.22%	0.30%	0.40%	0.45%	0.37%	0.41%	0.42%	0.45%	0.43%	0.45%	0.44%	0.37%	0.31%	0.26%	0.20%	0.05%	0.01%
3.33	0.04%	0.09%	0.10%	0.20%	0.27%	0.36%	0.40%	0.34%	0.37%	0.38%	0.40%	0.39%	0.40%	0.40%	0.33%	0.28%	0.23%	0.18%	0.04%	0.01%
2.67	0.05%	0.11%	0.12%	0.25%	0.33%	0.45%	0.50%	0.42%	0.45%	0.47%	0.50%	0.48%	0.50%	0.49%	0.41%	0.35%	0.29%	0.22%	0.05%	0.02%
2.00	0.05%	0.12%	0.13%	0.27%	0.36%	0.49%	0.54%	0.45%	0.49%	0.51%	0.54%	0.52%	0.54%	0.53%	0.44%	0.37%	0.31%	0.24%	0.06%	0.02%
1.33	0.05%	0.11%	0.13%	0.25%	0.34%	0.46%	0.51%	0.43%	0.46%	0.48%	0.51%	0.49%	0.51%	0.50%	0.42%	0.35%	0.29%	0.22%	0.05%	0.02%
0.67	0.05%	0.11%	0.12%	0.23%	0.32%	0.43%	0.47%	0.40%	0.43%	0.45%	0.48%	0.46%	0.47%	0.47%	0.39%	0.33%	0.27%	0.21%	0.05%	0.01%

95% CONCENTRATION=0.48% (DILUTION=210)
FLUX-AVG CONCENTRATION=0.23% (DILUTION=430)

Notes:

1. **Printed numbers are effluent concentration for each cell (5.5'W x 0.67'H).**

FILE: G&O016/REPORTS/DYE TRACER & MIXING ZONE STUDY/FIG 2-3-4-5-6-7-15.PPT

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Figure II-15: EFFLUENT PLUME SECTION AT CHRONIC MIXING ZONE BOUNDARY 6:45-8:25 – October 4, 2005

MODEL CALIBRATION

Summary of Dye Study No. 1

Data from the first dye study were used in a comparison of CORMIX2, UM3, and DKHW. CORMIX2 and DKHW overestimated dilution at the mixing zone boundary. The UM3 model with default calibration parameters significantly underestimated both flux-average and centerline dilution factors compared to observed data. The principal calibration parameter used in UM3 to adjust model predictions to observed data is the Aspiration Entrainment Coefficient (AEC). Additional UM3 model runs were made, adjusting the AEC from 0.1 to 2.0. The resulting dilution prediction at an AEC of 1.3 approached the observed dilution values, suggesting that UM3 may be suitable for this project if properly calibrated.

Results of Dye Study No. 2 – Low Current Speed

The UM3 model was run at AEC values ranging from 0.2 to 1.0 to best fit the observed concentration data illustrated in Figure II-15. The results are presented in Table II-4. The AEC of 0.6 to 0.8 matched the observed flux-averaged concentration data. None of the predicted centerline dilutions approached the observed peak dilution factor, suggesting that the peak-to-mean algorithm used in UM3 is too conservative (i.e., high). Model output is provided in Attachment II-3.

Table II-4 Summary of UM3 Dilution Model Calibration

Aspiration Entrainment Coefficient	Flux-average Dilution	Centerline Dilution
0.2	344	146
0.4	388	166
0.6	420	180
0.8	437	188
1.0	445	193

Results of Dye Study No. 2 – Peak Current Speed

The sampler was positioned near the plume centerline (Station 12+00) at a depth of 4 feet above the bottom between 10:00 and 11:00 a.m. during the second dye study (Figure II-14). As shown in Figure II-3, this was a period of relatively stable peak current speed after the tidal influence had waned. The purpose of this sampling location was to measure the centerline plume concentration.

Figure II-14 clearly shows high frequency temporal variations ranging from 0.3 to 0.7 percent effluent. The one-hour average of the data in Figure II-14 is 0.38 percent effluent (dilution=260). The sampler was clearly at the plume centerline in a plan view, but was held 4 feet above the bottom, thus not at the vertical centerline. The sampler would have needed to be at above 2 feet above bottom to be at the true plume centerline.

If a Gaussian profile is fitted to the vertical profile data, centered at 2 feet above bottom, the ratio of concentration at 4 feet to concentration at 2 feet would be about 80 to 90 percent. As shown in the data in Figure II-14, the ratio near Station 12+00 between 2 feet and 4 feet above bottom is about 5/6. Thus, we can confidently say that for the time-averaged dilution of 260 at 4 feet above the bottom, the dilution factor 2 feet off the bottom was about 210. THIS IS THE TIME-AVERAGED CENTERLINE DILUTION for a one-hour period of relatively steady ambient conditions between 10:00 and 11:00 a.m.

These conditions were modeled using the calibrated UM3 (Attachment II-2). The results show flux-average dilution of 403 and centerline dilution of 114 at the chronic boundary. Since the observed centerline dilution is estimated at 210, this suggests that the peak-to-mean algorithm in UM3 is too high. The peak-to-mean ratio to fit observed centerline dilution to the model flux-average dilution should be on the order of 2 (210/114).

CONCLUSIONS AND RECOMMENDATIONS

The October dye study successfully captured critical low-flow ambient current conditions, which are a combination of tidal influence and Bonneville Dam release rates. Comprehensive current speed profiles and water surface elevation data were provided by an ADCP mooring deployed for two days.

Extensive tracer concentration data were obtained throughout the plume at the downstream mixing zone boundary, particularly during the critical low current speed period from 6:45 through 8:25 a.m. The observed critical dilution factors were approximately 430:1 for flux-average, and 210:1 for centerline. The UM3 model was run over a range of aspiration entrainment coefficients (AEC). Best fit to the observed data for flux-average dilution was an AEC of 0.6 to 0.8.

ATTACHMENT II-1:
TABULAR PLUME DATA FOR DYE STUDY NO. 2

Profile #1

Entry #	Date	Time	Fluor	Height	Station	Conc Eff ppb	Conc BG ppb	Effluent Fraction	Dilution
1	2005:10:04	6:44:10	5.904	2	1200	1156	2.2	0.32%	312.0662
2	2005:10:04	6:44:20	6.302	2.5625	1200	1156	2.2	0.35%	281.7877
3	2005:10:04	6:44:30	6.538	3.125	1200	1156	2.2	0.38%	266.4576
4	2005:10:04	6:44:40	6.285	3.6875	1200	1156	2.2	0.35%	282.9604
5	2005:10:04	6:44:50	6.372	4.25	1200	1156	2.2	0.36%	277.0597
6	2005:10:04	6:45:00	6.252	4.8125	1200	1156	2.2	0.35%	285.2648
7	2005:10:04	6:45:10	6.099	5.375	1200	1156	2.2	0.34%	296.4589
8	2005:10:04	6:45:20	6.139	5.9375	1200	1156	2.2	0.34%	293.4484
9	2005:10:04	6:45:30	6.381	6.5	1200	1156	2.2	0.36%	276.4633
10	2005:10:04	6:45:40	6.112	7.0625	1200	1156	2.2	0.34%	295.4737
11	2005:10:04	6:45:50	6.34	7.625	1200	1156	2.2	0.36%	279.2012
12	2005:10:04	6:46:00	6.61	8.1875	1200	1156	2.2	0.38%	262.1073
13	2005:10:04	6:46:10	6.234	8.75	1200	1156	2.2	0.35%	286.5377
14	2005:10:04	6:46:20	6.046	9.3125	1200	1156	2.2	0.33%	300.5442
15	2005:10:04	6:46:30	5.618	9.875	1200	1156	2.2	0.30%	338.1782
16	2005:10:04	6:46:40	5.84	10.4375	1200	1156	2.2	0.31%	317.553
17	2005:10:04	6:46:50	5.325	11	1200	1156	2.2	0.27%	369.8858
18	2005:10:04	6:47:00	5.007	11.5625	1200	1156	2.2	0.24%	411.7895
19	2005:10:04	6:47:10	4.767	12.125	1200	1156	2.2	0.22%	450.2895
20	2005:10:04	6:47:20	4.313	12.6875	1200	1156	2.2	0.18%	547.0388
21	2005:10:04	6:47:30	3.656	13.25	1200	1156	2.2	0.13%	793.8826
22	2005:10:04	6:47:40	3.81	13.8125	1200	1156	2.2	0.14%	717.946
23	2005:10:04	6:47:50	3.653	14.375	1200	1156	2.2	0.13%	795.5217
24	2005:10:04	6:48:00	3.657	14.9375	1200	1156	2.2	0.13%	793.3377
25	2005:10:04	6:48:10	3.3	15.5	1200	1156	2.2	0.10%	1050.812
26	2005:10:04	6:48:20	2.908	16.0625	1200	1156	2.2	0.06%	1632.617
27	2005:10:04	6:48:30	2.856	16.625	1200	1156	2.2	0.06%	1762.032
28	2005:10:04	6:48:40	2.728	17.1875	1200	1156	2.2	0.05%	2189.191
29	2005:10:04	6:48:50	2.59	17.75	1200	1156	2.2	0.03%	2963.828
30	2005:10:04	6:49:00	2.298	18.3125	1200	1156	2.2	0.01%	
31	2005:10:04	6:49:10	2.263	18.875	1200	1156	2.2	0.01%	
32	2005:10:04	6:49:20	2.263	19.4375	1200	1156	2.2	0.01%	
33	2005:10:04	6:49:30	2.205	20	1200	1156	2.2	0.00%	

Transect #1

Entry #	Date	Time	Fluor	Height	Station	Conc Eff ppb	Conc BG ppb	Effluent Fraction	Dilution
34	2005:10:04	6:51:40	2.208	6	1142	1103	2.2	0.00%	
35	2005:10:04	6:51:50	2.19	6	1144.727	1103	2.2	0.00%	
36	2005:10:04	6:52:00	2.212	6	1147.455	1103	2.2	0.00%	
37	2005:10:04	6:52:10	2.615	6	1150.182	1103	2.2	0.04%	2658.681
38	2005:10:04	6:52:20	2.725	6	1152.909	1103	2.2	0.05%	2101.624
39	2005:10:04	6:52:30	2.961	6	1155.636	1103	2.2	0.07%	1449.872
40	2005:10:04	6:52:40	3.367	6	1158.364	1103	2.2	0.11%	945.4606
41	2005:10:04	6:52:50	3.679	6	1161.091	1103	2.2	0.13%	746.0125
42	2005:10:04	6:53:00	3.347	6	1163.818	1103	2.2	0.10%	961.9464
43	2005:10:04	6:53:10	3.752	6	1166.545	1103	2.2	0.14%	710.923
44	2005:10:04	6:53:20	4.2	6	1169.273	1103	2.2	0.18%	551.6762
45	2005:10:04	6:53:30	4.372	6	1172	1103	2.2	0.20%	507.9892
46	2005:10:04	6:53:40	5.277	6	1174.727	1103	2.2	0.28%	358.5806
47	2005:10:04	6:53:50	5.404	6	1177.455	1103	2.2	0.29%	344.3672
48	2005:10:04	6:54:00	5.802	6	1180.182	1103	2.2	0.33%	306.3166
49	2005:10:04	6:54:10	5.937	6	1182.909	1103	2.2	0.34%	295.2509
50	2005:10:04	6:54:20	6.408	6	1185.636	1103	2.2	0.38%	262.2035
51	2005:10:04	6:54:30	6.988	6	1188.364	1103	2.2	0.43%	230.4412
52	2005:10:04	6:54:40	6.12	6	1191.091	1103	2.2	0.36%	281.4675
53	2005:10:04	6:54:50	6.755	6	1193.818	1103	2.2	0.41%	242.2289
54	2005:10:04	6:55:00	6.628	6	1196.545	1103	2.2	0.40%	249.1763
55	2005:10:04	6:55:10	6.255	6	1199.273	1103	2.2	0.37%	272.0968
56	2005:10:04	6:55:20	6.413	6	1202	1103	2.2	0.38%	261.8924
57	2005:10:04	6:55:30	6.684	6	1204.727	1103	2.2	0.41%	246.0643
58	2005:10:04	6:55:40	6.954	6	1207.455	1103	2.2	0.43%	232.0893
59	2005:10:04	6:55:50	6.73	6	1210.182	1103	2.2	0.41%	243.5657
60	2005:10:04	6:56:00	5.999	6	1212.909	1103	2.2	0.34%	290.4323
61	2005:10:04	6:56:10	6.821	6	1215.636	1103	2.2	0.42%	238.7692
62	2005:10:04	6:56:20	6.87	6	1218.364	1103	2.2	0.42%	236.2639
63	2005:10:04	6:56:30	6.21	6	1221.091	1103	2.2	0.36%	275.1502
64	2005:10:04	6:56:40	5.812	6	1223.818	1103	2.2	0.33%	305.4686
65	2005:10:04	6:56:50	5.813	6	1226.545	1103	2.2	0.33%	305.384
66	2005:10:04	6:57:00	5.502	6	1229.273	1103	2.2	0.30%	334.1467
67	2005:10:04	6:57:10	5.658	6	1232	1103	2.2	0.31%	319.0724
68	2005:10:04	6:57:20	5.338	6	1234.727	1103	2.2	0.28%	351.6101
69	2005:10:04	6:57:30	4.929	6	1237.455	1103	2.2	0.25%	404.3065
70	2005:10:04	6:57:40	4.488	6	1240.182	1103	2.2	0.21%	482.2345
71	2005:10:04	6:57:50	4.392	6	1242.909	1103	2.2	0.20%	503.3542
72	2005:10:04	6:58:00	3.857	6	1245.636	1103	2.2	0.15%	665.8736
73	2005:10:04	6:58:10	3.77	6	1248.364	1103	2.2	0.14%	702.7723
74	2005:10:04	6:58:20	2.563	6	1251.091	1103	2.2	0.03%	3039.539
75	2005:10:04	6:58:30	2.214	6	1253.818	1103	2.2	0.00%	
76	2005:10:04	6:58:40	2.221	6	1256.545	1103	2.2	0.00%	
77	2005:10:04	6:58:50	2.261	6	1259.273	1103	2.2	0.01%	

Time Series #1

Entry #	**Date**	**Time**	**Fluor**	**Height**	**Station**	**Conc Eff ppb**	**Conc BG ppb**	**Effluent Fraction**	**Dilution**
1	2005:10:04	7:18:01	6.86	6	1200	1055	2.2	0.44%	226.4765
2	2005:10:04	7:18:11	6.99	6	1200	1055	2.2	0.45%	220.33
3	2005:10:04	7:18:21	6.003	6	1200	1055	2.2	0.36%	277.5127
4	2005:10:04	7:18:31	6.251	6	1200	1055	2.2	0.38%	260.5235
5	2005:10:04	7:18:41	6.67	6	1200	1055	2.2	0.42%	236.1031
6	2005:10:04	7:18:51	7.307	6	1200	1055	2.2	0.48%	206.6537
7	2005:10:04	7:19:01	6.704	6	1200	1055	2.2	0.43%	234.3207
8	2005:10:04	7:19:11	7.038	6	1200	1055	2.2	0.46%	218.144
9	2005:10:04	7:19:21	6.486	6	1200	1055	2.2	0.41%	246.2391
10	2005:10:04	7:19:31	6.224	6	1200	1055	2.2	0.38%	262.2715
11	2005:10:04	7:19:41	6.668	6	1200	1055	2.2	0.42%	236.2087
12	2005:10:04	7:19:51	6.852	6	1200	1055	2.2	0.44%	226.866
13	2005:10:04	7:20:01	7.118	6	1200	1055	2.2	0.47%	214.5955
14	2005:10:04	7:20:11	6.298	6	1200	1055	2.2	0.39%	257.5355
15	2005:10:04	7:20:21	6.267	6	1200	1055	2.2	0.39%	259.4986
16	2005:10:04	7:20:31	6.118	6	1200	1055	2.2	0.37%	269.3672
17	2005:10:04	7:20:41	5.832	6	1200	1055	2.2	0.34%	290.5784
18	2005:10:04	7:20:51	5.792	6	1200	1055	2.2	0.34%	293.8142
19	2005:10:04	7:21:01	5.918	6	1200	1055	2.2	0.35%	283.8571
20	2005:10:04	7:21:11	6.397	6	1200	1055	2.2	0.40%	251.4607
21	2005:10:04	7:21:21	6.843	6	1200	1055	2.2	0.44%	227.3058
22	2005:10:04	7:21:31	6.825	6	1200	1055	2.2	0.44%	228.1904
23	2005:10:04	7:21:41	7.053	6	1200	1055	2.2	0.46%	217.4697
24	2005:10:04	7:21:51	6.617	6	1200	1055	2.2	0.42%	238.9361
25	2005:10:04	7:22:01	6.542	6	1200	1055	2.2	0.41%	243.0633
26	2005:10:04	7:22:11	6.641	6	1200	1055	2.2	0.42%	237.6448
27	2005:10:04	7:22:21	6.007	6	1200	1055	2.2	0.36%	277.2211
28	2005:10:04	7:22:31	5.928	6	1200	1055	2.2	0.35%	283.0957
29	2005:10:04	7:22:41	5.853	6	1200	1055	2.2	0.35%	288.9079
30	2005:10:04	7:22:51	6.336	6	1200	1055	2.2	0.39%	255.1694
31	2005:10:04	7:23:01	6.778	6	1200	1055	2.2	0.43%	230.5331
32	2005:10:04	7:23:11	6.867	6	1200	1055	2.2	0.44%	226.1368
33	2005:10:04	7:23:21	7.058	6	1200	1055	2.2	0.46%	217.2459
34	2005:10:04	7:23:31	6.994	6	1200	1055	2.2	0.45%	220.1462
35	2005:10:04	7:23:41	6.523	6	1200	1055	2.2	0.41%	244.1315
36	2005:10:04	7:23:51	6.506	6	1200	1055	2.2	0.41%	245.0954
37	2005:10:04	7:24:01	7.005	6	1200	1055	2.2	0.46%	219.6422
38	2005:10:04	7:24:11	6.835	6	1200	1055	2.2	0.44%	227.6981
39	2005:10:04	7:24:21	6.522	6	1200	1055	2.2	0.41%	244.188
40	2005:10:04	7:24:31	6.255	6	1200	1055	2.2	0.38%	260.2665
41	2005:10:04	7:24:41	6.18	6	1200	1055	2.2	0.38%	265.171
42	2005:10:04	7:24:51	6.016	6	1200	1055	2.2	0.36%	276.5673

43	2005:10:04	7:25:01	5.789	6	1200	1055	2.2	0.34%	294.0598
44	2005:10:04	7:25:11	5.814	6	1200	1055	2.2	0.34%	292.0256
45	2005:10:04	7:25:21	6.17	6	1200	1055	2.2	0.38%	265.839
46	2005:10:04	7:25:31	6.686	6	1200	1055	2.2	0.43%	235.261
47	2005:10:04	7:25:41	6.483	6	1200	1055	2.2	0.41%	246.4115
48	2005:10:04	7:25:51	6.716	6	1200	1055	2.2	0.43%	233.6981
49	2005:10:04	7:26:01	6.638	6	1200	1055	2.2	0.42%	237.8055
50	2005:10:04	7:26:11	6.655	6	1200	1055	2.2	0.42%	236.898
51	2005:10:04	7:26:21	6.7	6	1200	1055	2.2	0.43%	234.529
52	2005:10:04	7:26:31	6.623	6	1200	1055	2.2	0.42%	238.6119
53	2005:10:04	7:26:41	6.519	6	1200	1055	2.2	0.41%	244.3576
54	2005:10:04	7:26:51	6.61	6	1200	1055	2.2	0.42%	239.3153
55	2005:10:04	7:27:01	6.341	6	1200	1055	2.2	0.39%	254.8613
56	2005:10:04	7:27:11	6.115	6	1200	1055	2.2	0.37%	269.5736
57	2005:10:04	7:27:21	6.231	6	1200	1055	2.2	0.38%	261.8161
58	2005:10:04	7:27:31	6.41	6	1200	1055	2.2	0.40%	250.6842
59	2005:10:04	7:27:41	6.595	6	1200	1055	2.2	0.42%	240.1321
60	2005:10:04	7:27:51	6.671	6	1200	1055	2.2	0.42%	236.0502
61	2005:10:04	7:28:01	6.75	6	1200	1055	2.2	0.43%	231.9518
62	2005:10:04	7:28:11	6.816	6	1200	1055	2.2	0.44%	228.6353
63	2005:10:04	7:28:21	6.968	6	1200	1055	2.2	0.45%	221.3466
64	2005:10:04	7:28:31	6.793	6	1200	1055	2.2	0.44%	229.7802
65	2005:10:04	7:28:41	6.821	6	1200	1055	2.2	0.44%	228.3879
66	2005:10:04	7:28:51	6.861	6	1200	1055	2.2	0.44%	226.4279
							avg	**0.41%**	**243.9315**

Transect #2

Entry #	Date	Time	Fluor	Height	Station	Conc Eff ppb	Conc BG ppb	Effluent Fraction	Dilution
67	2005:10:04	8:00:10	2.248	5	1142	971	2.2	0.00%	
68	2005:10:04	8:00:21	2.254	5	1144.727	968	2.2	0.01%	
69	2005:10:04	8:00:31	2.212	5	1147.455	964	2.2	0.00%	
70	2005:10:04	8:00:41	2.113	5	1150.182	961	2.2	-0.01%	
71	2005:10:04	8:00:51	2.606	5	1152.909	958	2.2	0.04%	2359.149
72	2005:10:04	8:01:01	2.89	5	1155.636	955	2.2	0.07%	1383.458
73	2005:10:04	8:01:11	3.108	5	1158.364	951	2.2	0.10%	1047.774
74	2005:10:04	8:01:21	3.181	5	1161.091	948	2.2	0.10%	966.5582
75	2005:10:04	8:01:31	3.355	5	1163.818	945	2.2	0.12%	818.2073
76	2005:10:04	8:01:41	3.489	5	1166.545	942	2.2	0.14%	730.7108
77	2005:10:04	8:01:51	4.709	5	1169.273	939	2.2	0.27%	374.1586
78	2005:10:04	8:02:01	4.378	5	1172	936	2.2	0.23%	429.597
79	2005:10:04	8:02:11	5.27	5	1174.727	933	2.2	0.33%	303.7724
80	2005:10:04	8:02:21	6.103	5	1177.455	930	2.2	0.42%	238.1553
81	2005:10:04	8:02:31	6.802	5	1180.182	926	2.2	0.50%	201.321
82	2005:10:04	8:02:41	6.493	5	1182.909	923	2.2	0.46%	215.1079

83	2005:10:04	8:02:51	7.032	5	1185.636	920	2.2	0.52%	190.4918
84	2005:10:04	8:03:01	7.051	5	1188.364	917	2.2	0.53%	189.131
85	2005:10:04	8:03:11	5.921	5	1191.091	915	2.2	0.41%	245.7704
86	2005:10:04	8:03:21	6.255	5	1193.818	912	2.2	0.44%	224.801
87	2005:10:04	8:03:31	6.081	5	1196.545	909	2.2	0.43%	234.1261
88	2005:10:04	8:03:41	6.288	5	1199.273	906	2.2	0.45%	221.56
89	2005:10:04	8:03:51	6.556	5	1202	903	2.2	0.48%	207.2657
90	2005:10:04	8:04:01	6.739	5	1204.727	900	2.2	0.50%	198.2772
91	2005:10:04	8:04:11	6.538	5	1207.455	897	2.2	0.48%	206.8071
92	2005:10:04	8:04:21	6.605	5	1210.182	894	2.2	0.49%	203.0184
93	2005:10:04	8:04:31	6.958	5	1212.909	891	2.2	0.53%	187.3647
94	2005:10:04	8:04:41	6.021	5	1215.636	889	2.2	0.43%	232.5788
95	2005:10:04	8:04:51	6.492	5	1218.364	886	2.2	0.48%	206.4081
96	2005:10:04	8:05:01	7.032	5	1221.091	883	2.2	0.55%	182.7692
97	2005:10:04	8:05:11	7.218	5	1223.818	880	2.2	0.57%	175.4474
98	2005:10:04	8:05:21	6.931	5	1226.545	878	2.2	0.54%	185.514
99	2005:10:04	8:05:31	6.113	5	1229.273	875	2.2	0.45%	223.6021
100	2005:10:04	8:05:41	5.965	5	1232	872	2.2	0.43%	231.676
101	2005:10:04	8:05:51	5.208	5	1234.727	870	2.2	0.35%	289.0897
102	2005:10:04	8:06:01	4.729	5	1237.455	867	2.2	0.29%	342.7915
103	2005:10:04	8:06:11	4.921	5	1240.182	864	2.2	0.31%	317.631
104	2005:10:04	8:06:21	4.892	5	1242.909	862	2.2	0.31%	320.0759
105	2005:10:04	8:06:31	4.358	5	1245.636	859	2.2	0.25%	398.068
106	2005:10:04	8:06:41	3.797	5	1248.364	856	2.2	0.19%	536.2761
107	2005:10:04	8:06:51	2.733	5	1251.091	854	2.2	0.06%	1601.971
108	2005:10:04	8:07:01	2.814	5	1253.818	851	2.2	0.07%	1386.456
109	2005:10:04	8:07:11	2.421	5	1256.545	849	2.2	0.03%	3840.419
110	2005:10:04	8:07:21	2.261	5	1259.273	846	2.2	0.01%	

Profile #2

Entry #	Date	Time	Fluor	Height	Station	Conc Eff ppb	Conc BG ppb	Effluent Fraction	Dilution
111	2005:10:04	8:24:20	5.677	2	1200	639	2.2	0.54%	183.7167
112	2005:10:04	8:24:31	5.836	2.633333	1200	639	2.2	0.57%	175.6829
113	2005:10:04	8:24:41	6.09	3.266667	1200	639	2.2	0.61%	164.2116
114	2005:10:04	8:24:51	5.752	3.9	1200	639	2.2	0.56%	179.8376
115	2005:10:04	8:25:01	4.566	4.533333	1200	639	2.2	0.37%	269.9844
116	2005:10:04	8:25:11	5.158	5.166667	1200	639	2.2	0.46%	215.951
117	2005:10:04	8:25:21	5.439	5.8	1200	639	2.2	0.51%	197.2161
118	2005:10:04	8:25:31	5.445	6.433333	1200	639	2.2	0.51%	196.8515
119	2005:10:04	8:25:41	5.16	7.066667	1200	639	2.2	0.46%	215.8051
120	2005:10:04	8:25:51	5.018	7.7	1200	639	2.2	0.44%	226.6796
121	2005:10:04	8:26:01	4.969	8.333333	1200	639	2.2	0.43%	230.6909
122	2005:10:04	8:26:11	4.939	8.966667	1200	639	2.2	0.43%	233.2176

123	2005:10:04	8:26:21	4.249	9.6	1200	639	2.2	0.32%	311.7535
124	2005:10:04	8:26:31	3.711	10.23333	1200	639	2.2	0.24%	422.7551
125	2005:10:04	8:26:41	3.349	10.86667	1200	639	2.2	0.18%	555.9469
126	2005:10:04	8:26:51	3.229	11.5	1200	639	2.2	0.16%	620.7804
127	2005:10:04	8:27:01	2.976	12.13333	1200	639	2.2	0.12%	823.174
128	2005:10:04	8:27:11	2.847	12.76667	1200	639	2.2	0.10%	987.2999
129	2005:10:04	8:27:21	2.655	13.4	1200	639	2.2	0.07%	1403.919
130	2005:10:04	8:27:31	2.656	14.03333	1200	639	2.2	0.07%	1400.84
131	2005:10:04	8:27:41	2.8	14.66667	1200	639	2.2	0.09%	1064.638
132	2005:10:04	8:27:51	2.635	15.3	1200	639	2.2	0.07%	1468.467
133	2005:10:04	8:28:01	2.657	15.93333	1200	639	2.2	0.07%	1397.775
134	2005:10:04	8:28:11	2.592	16.56667	1200	639	2.2	0.06%	1629.549
135	2005:10:04	8:28:21	2.408	17.2	1200	639	2.2	0.03%	3071.072
136	2005:10:04	8:28:31	2.361	17.83333	1200	639	2.2	0.03%	3967.596
137	2005:10:04	8:28:41	2.207	18.46667	1200	639	2.2	0.00%	91254.72
138	2005:10:04	8:28:51	2.594	19.1	1200	639	2.2	0.06%	1621.277
139	2005:10:04	8:29:01	2.389	19.73333	1200	639	2.2	0.03%	3379.804
140	2005:10:04	8:29:11	2.365	20.36667	1200	639	2.2	0.03%	3871.412

General Time Series near Plume Centerline

Entry #	Date	Time	Fluor	Height	Station	Conc Eff ppb	Conc BG ppb	Effluent Fraction	Dilution
141	2005:10:04	8:34:00	6.715	3	1200	656	2.2	0.69%	145.304
142	2005:10:04	8:34:11	7.264	3	1200	656	2.2	0.77%	129.5512
143	2005:10:04	8:34:21	7.315	3	1200	656	2.2	0.78%	128.2595
144	2005:10:04	8:34:31	6.697	3	1200	656	2.2	0.69%	145.8856
145	2005:10:04	8:34:41	7.461	3	1200	656	2.2	0.80%	124.7001
146	2005:10:04	8:34:51	7.507	3	1200	656	2.2	0.81%	123.6193
147	2005:10:04	8:35:01	7.681	3	1200	656	2.2	0.84%	119.6948
148	2005:10:04	8:35:11	7.355	3	1200	656	2.2	0.79%	127.2643
149	2005:10:04	8:35:21	7.631	3	1200	656	2.2	0.83%	120.7968
150	2005:10:04	8:35:31	7.679	3	1200	656	2.2	0.84%	119.7385
151	2005:10:04	8:35:41	7.498	3	1200	656	2.2	0.81%	123.8293
152	2005:10:04	8:35:51	7.662	3	1200	656	2.2	0.83%	120.1112
153	2005:10:04	8:36:01	7.552	3	1200	656	2.2	0.82%	122.5799
154	2005:10:04	8:36:11	7.49	3	1200	656	2.2	0.81%	124.0165
155	2005:10:04	8:36:21	6.798	3	1200	656	2.2	0.70%	142.681
156	2005:10:04	8:36:31	6.172	3	1200	656	2.2	0.61%	165.168
157	2005:10:04	8:36:41	5.159	3	1200	656	2.2	0.45%	221.7125
158	2005:10:04	8:36:51	6.461	3	1200	656	2.2	0.65%	153.9656
159	2005:10:04	8:37:01	5.755	3	1200	656	2.2	0.54%	184.5422
160	2005:10:04	8:37:11	4.511	3	1200	656	2.2	0.35%	283.8803
161	2005:10:04	8:37:21	4.624	3	1200	656	2.2	0.37%	270.6466
162	2005:10:04	8:37:31	4.797	3	1200	656	2.2	0.40%	252.6174

163	2005:10:04	8:37:41	5.386	3	1200	656	2.2	0.49%	205.9157
164	2005:10:04	8:37:51	5.298	3	1200	656	2.2	0.47%	211.7648
165	2005:10:04	8:38:01	5.344	3	1200	656	2.2	0.48%	208.6665
166	2005:10:04	8:38:11	6.027	3	1200	656	2.2	0.58%	171.426
167	2005:10:04	8:38:21	6.266	3	1200	656	2.2	0.62%	161.3496
168	2005:10:04	8:38:31	5.33	3	1200	656	2.2	0.48%	209.5998
169	2005:10:04	8:38:41	5.854	3	1200	656	2.2	0.56%	179.5423
170	2005:10:04	8:38:51	6.021	3	1200	656	2.2	0.58%	171.6952
171	2005:10:04	8:39:01	6.407	3	1200	656	2.2	0.64%	155.9419
172	2005:10:04	8:39:11	5.887	3	1200	656	2.2	0.56%	177.9353
173	2005:10:04	8:39:21	5.791	3	1200	656	2.2	0.55%	182.6921
174	2005:10:04	8:39:31	5.659	3	1200	656	2.2	0.53%	189.6639
175	2005:10:04	8:39:41	5.855	3	1200	656	2.2	0.56%	179.4931
176	2005:10:04	8:39:51	5.664	3	1200	656	2.2	0.53%	189.3901
177	2005:10:04	8:40:01	5.959	3	1200	656	2.2	0.57%	174.5271
178	2005:10:04	8:40:11	5.292	3	1200	656	2.2	0.47%	212.1758
179	2005:10:04	8:40:21	5.182	3	1200	656	2.2	0.45%	220.0025
180	2005:10:04	8:40:31	5.326	3	1200	656	2.2	0.48%	209.868
181	2005:10:04	8:40:41	5.162	3	1200	656	2.2	0.45%	221.488
182	2005:10:04	8:40:51	5.09	3	1200	656	2.2	0.44%	227.006
183	2005:10:04	8:41:01	5.248	3	1200	656	2.2	0.46%	215.2387
184	2005:10:04	8:41:11	5.218	3	1200	656	2.2	0.46%	217.3782
185	2005:10:04	8:41:21	5.015	3	1200	656	2.2	0.43%	233.0541
186	2005:10:04	8:42:50	5.27	3	1200	656	2.2	0.47%	213.6962
187	2005:10:04	8:43:01	7.068	3	1200	656	2.2	0.74%	134.7673
188	2005:10:04	8:43:11	7.131	3	1200	656	2.2	0.75%	133.0455
189	2005:10:04	8:43:21	6.072	3	1200	656	2.2	0.59%	169.4337
190	2005:10:04	8:43:31	6.307	3	1200	656	2.2	0.63%	159.7388
191	2005:10:04	8:43:41	6.609	3	1200	656	2.2	0.67%	148.7973
192	2005:10:04	8:43:51	5.072	3	1200	656	2.2	0.44%	228.4288
193	2005:10:04	8:44:01	5.354	3	1200	656	2.2	0.48%	208.0049
194	2005:10:04	8:44:11	5.155	3	1200	656	2.2	0.45%	222.0127
195	2005:10:04	8:44:21	7.072	3	1200	656	2.2	0.74%	134.6567
196	2005:10:04	8:44:31	6.416	3	1200	656	2.2	0.64%	155.609
197	2005:10:04	8:44:41	5.787	3	1200	656	2.2	0.55%	182.8959
198	2005:10:04	8:44:51	6.963	3	1200	656	2.2	0.73%	137.7383
199	2005:10:04	8:45:01	7.163	3	1200	656	2.2	0.76%	132.1877
200	2005:10:04	8:45:11	7.221	3	1200	656	2.2	0.77%	130.6607
201	2005:10:04	8:45:21	6.828	3	1200	656	2.2	0.71%	141.7561
202	2005:10:04	8:45:31	6.427	3	1200	656	2.2	0.64%	155.204
203	2005:10:04	8:45:41	5.74	3	1200	656	2.2	0.54%	185.3241
204	2005:10:04	8:45:51	4.895	3	1200	656	2.2	0.41%	243.4313
205	2005:10:04	8:46:01	4.674	3	1200	656	2.2	0.38%	265.1768
206	2005:10:04	8:46:11	5.497	3	1200	656	2.2	0.50%	198.9831
207	2005:10:04	8:46:21	5.087	3	1200	656	2.2	0.44%	227.2419

208	2005:10:04	8:46:31	4.705	3	1200	656	2.2	0.38%	261.8952
209	2005:10:04	8:46:41	3.899	3	1200	656	2.2	0.26%	386.1374
210	2005:10:04	8:46:51	3.699	3	1200	656	2.2	0.23%	437.6567
211	2005:10:04	8:47:01	3.469	3	1200	656	2.2	0.19%	516.9798
212	2005:10:04	8:47:11	2.88	3	1200	656	2.2	0.10%	964.7756
213	2005:10:04	8:47:21	3.079	3	1200	656	2.2	0.13%	746.3566
214	2005:10:04	8:47:31	3.157	3	1200	656	2.2	0.15%	685.525
215	2005:10:04	8:47:41	2.971	3	1200	656	2.2	0.12%	850.9046
216	2005:10:04	8:47:51	4.03	3	1200	656	2.2	0.28%	358.4959
217	2005:10:04	8:48:01	3.459	3	1200	656	2.2	0.19%	521.0861
218	2005:10:04	8:48:11	3.271	3	1200	656	2.2	0.16%	612.556
219	2005:10:04	8:48:21	3.606	3	1200	656	2.2	0.21%	466.6056
220	2005:10:04	8:48:31	4.033	3	1200	656	2.2	0.28%	357.9091
221	2005:10:04	8:49:50	3.309	3	1200	674	2.2	0.16%	607.9991
222	2005:10:04	8:50:01	3.157	3	1200	674	2.2	0.14%	704.5674
223	2005:10:04	8:50:11	3.213	3	1200	674	2.2	0.15%	665.6179
224	2005:10:04	8:50:21	3.299	3	1200	674	2.2	0.16%	613.5314
225	2005:10:04	8:50:31	3.463	3	1200	674	2.2	0.19%	533.8646
226	2005:10:04	8:50:41	3.504	3	1200	674	2.2	0.19%	517.079
227	2005:10:04	8:50:51	3.707	3	1200	674	2.2	0.22%	447.426
228	2005:10:04	8:51:01	3.621	3	1200	674	2.2	0.21%	474.5046
229	2005:10:04	8:51:11	3.475	3	1200	674	2.2	0.19%	528.84
230	2005:10:04	8:51:21	3.851	3	1200	674	2.2	0.24%	408.4016
231	2005:10:04	8:51:31	3.511	3	1200	674	2.2	0.19%	514.3181
232	2005:10:04	8:51:41	3.691	3	1200	674	2.2	0.22%	452.2273
233	2005:10:04	8:51:51	3.758	3	1200	674	2.2	0.23%	432.7798
234	2005:10:04	8:52:01	3.895	3	1200	674	2.2	0.25%	397.8
235	2005:10:04	8:52:11	3.679	3	1200	674	2.2	0.22%	455.8965
236	2005:10:04	8:52:21	3.752	3	1200	674	2.2	0.23%	434.4529
237	2005:10:04	8:52:31	3.639	3	1200	674	2.2	0.21%	468.5691
238	2005:10:04	8:52:41	3.356	3	1200	674	2.2	0.17%	583.2794
239	2005:10:04	8:52:51	3.561	3	1200	674	2.2	0.20%	495.4232
240	2005:10:04	8:53:01	3.691	3	1200	674	2.2	0.22%	452.2273
241	2005:10:04	8:53:11	3.762	3	1200	674	2.2	0.23%	431.6716
242	2005:10:04	8:53:21	3.854	3	1200	674	2.2	0.25%	407.6608
243	2005:10:04	8:53:31	4.032	3	1200	674	2.2	0.27%	368.0518
244	2005:10:04	8:53:41	4.071	3	1200	674	2.2	0.28%	360.38
245	2005:10:04	8:53:51	4.373	3	1200	674	2.2	0.32%	310.295
246	2005:10:04	8:54:01	4.72	3	1200	674	2.2	0.37%	267.5678
247	2005:10:04	8:54:11	4.775	3	1200	674	2.2	0.38%	261.8528
248	2005:10:04	8:54:21	3.887	3	1200	674	2.2	0.25%	399.6864
249	2005:10:04	8:54:31	3.811	3	1200	674	2.2	0.24%	418.5419
250	2005:10:04	8:54:41	4.316	3	1200	674	2.2	0.31%	318.6536
251	2005:10:04	8:54:51	4.539	3	1200	674	2.2	0.35%	288.2732
252	2005:10:04	8:55:01	4.669	3	1200	674	2.2	0.37%	273.0948

253	2005:10:04	8:55:11	4.425	3	1200	674	2.2	0.33%	303.0431
254	2005:10:04	8:55:21	3.888	3	1200	674	2.2	0.25%	399.4496
255	2005:10:04	8:55:31	4.216	3	1200	674	2.2	0.30%	334.4598
256	2005:10:04	8:55:41	4.354	3	1200	674	2.2	0.32%	313.032
257	2005:10:04	8:55:51	4.537	3	1200	674	2.2	0.35%	288.5199
258	2005:10:04	8:56:01	4.73	3	1200	674	2.2	0.38%	266.5103
259	2005:10:04	8:56:11	4.438	3	1200	674	2.2	0.33%	301.2828
260	2005:10:04	8:56:21	4.214	3	1200	674	2.2	0.30%	334.7919
261	2005:10:04	8:56:31	4.16	3	1200	674	2.2	0.29%	344.0158
262	2005:10:04	8:56:41	4.117	3	1200	674	2.2	0.28%	351.7324
263	2005:10:04	8:56:51	4.13	3	1200	674	2.2	0.29%	349.3632
264	2005:10:04	8:57:01	3.419	3	1200	674	2.2	0.18%	553.1345
265	2005:10:04	8:57:11	3.365	3	1200	674	2.2	0.17%	578.7734
266	2005:10:04	8:57:21	2.917	3	1200	674	2.2	0.11%	940.4058
267	2005:10:04	8:57:31	2.903	3	1200	674	2.2	0.10%	959.1337
268	2005:10:04	8:57:41	2.559	3	1200	674	2.2	0.05%	1878.192
269	2005:10:04	8:57:51	2.742	3	1200	674	2.2	0.08%	1244.042
270	2005:10:04	8:58:01	2.557	3	1200	674	2.2	0.05%	1888.714

Transect 206 ft downstream

Entry #	Date	Time	Fluor	Height	Station	Conc Eff ppb	Conc BG ppb	Effluent Fraction	Dilution
271	2005:10:04	9:17:20	5.365	6	1200	736	2.2	0.43%	232.4071
272	2005:10:04	9:17:31	5.55	6	1200	736	2.2	0.46%	219.5726
273	2005:10:04	9:17:41	5.482	6	1200	736	2.2	0.45%	224.122
274	2005:10:04	9:17:51	5.245	6	1200	736	2.2	0.41%	241.566
275	2005:10:04	9:18:01	5.509	6	1200	736	2.2	0.45%	222.2932
276	2005:10:04	9:18:11	5.418	6	1200	736	2.2	0.44%	228.5793
277	2005:10:04	9:18:21	5.195	6	1200	736	2.2	0.41%	245.5988
278	2005:10:04	9:18:31	5.175	6	1200	736	2.2	0.40%	247.2499
279	2005:10:04	9:18:41	5.165	6	1200	736	2.2	0.40%	248.0838
280	2005:10:04	9:18:51	5.004	6	1200	736	2.2	0.38%	262.3282
281	2005:10:04	9:19:01	5.566	6	1200	736	2.2	0.46%	218.5289
282	2005:10:04	9:19:11	8.494	6	1200	736	2.2	0.86%	116.8682
283	2005:10:04	9:19:21	7.983	6	1200	736	2.2	0.79%	127.1949
284	2005:10:04	9:19:31	6.258	6	1200	736	2.2	0.55%	181.2638
285	2005:10:04	9:19:41	5.857	6	1200	736	2.2	0.50%	201.1398
286	2005:10:04	9:19:51	5.509	6	1200	736	2.2	0.45%	222.2932
287	2005:10:04	9:20:01	6.024	6	1200	736	2.2	0.52%	192.3557
288	2005:10:04	9:20:11	5.339	6	1200	736	2.2	0.43%	234.3321
289	2005:10:04	9:20:21	6.222	6	1200	736	2.2	0.55%	182.8862
290	2005:10:04	9:20:31	6.131	6	1200	736	2.2	0.53%	187.1199
291	2005:10:04	9:20:41	5.189	6	1200	736	2.2	0.41%	246.0918
292	2005:10:04	9:20:51	5.129	6	1200	736	2.2	0.40%	251.1329

293	2005:10:04	9:21:01	4.98	6	1200	736	2.2	0.38%	264.5929
294	2005:10:04	9:21:11	5.096	6	1200	736	2.2	0.39%	253.9946
295	2005:10:04	9:21:21	5.141	6	1200	736	2.2	0.40%	250.1082
296	2005:10:04	9:21:31	5.086	6	1200	736	2.2	0.39%	254.8747
297	2005:10:04	9:21:41	4.996	6	1200	736	2.2	0.38%	263.0788
298	2005:10:04	9:21:51	4.784	6	1200	736	2.2	0.35%	284.6627
299	2005:10:04	9:22:01	4.848	6	1200	736	2.2	0.36%	277.7826
300	2005:10:04	9:22:11	4.898	6	1200	736	2.2	0.37%	272.6347
301	2005:10:04	9:22:21	4.754	6	1200	736	2.2	0.35%	288.0064
302	2005:10:04	9:22:31	5.482	6	1200	736	2.2	0.45%	224.122
303	2005:10:04	9:22:41	5.663	6	1200	736	2.2	0.47%	212.4078
304	2005:10:04	9:22:51	5.098	6	1200	736	2.2	0.39%	253.8193
305	2005:10:04	9:23:01	4.993	6	1200	736	2.2	0.38%	263.3614
306	2005:10:04	9:23:11	4.899	6	1200	736	2.2	0.37%	272.5337
307	2005:10:04	9:23:21	6.406	6	1200	736	2.2	0.57%	174.8855
308	2005:10:04	9:23:31	5.196	6	1200	736	2.2	0.41%	245.5168
309	2005:10:04	9:23:41	4.795	6	1200	736	2.2	0.35%	283.456
310	2005:10:04	9:23:51	4.84	6	1200	736	2.2	0.36%	278.6244
311	2005:10:04	9:24:01	5.274	6	1200	736	2.2	0.42%	239.287
312	2005:10:04	9:24:11	4.895	6	1200	736	2.2	0.37%	272.9382

General Transects

Entry #	**Date**	**Time**	**Fluor**	**Height**	**Station**	**Conc Eff ppb**	**Conc BG ppb**	**Effluent Fraction**	**Dilution**
313	2005:10:04	9:32:50	4.733	4	1200	759	2.2	0.33%	299.4689
314	2005:10:04	9:33:01	4.835	4	1200	759	2.2	0.35%	287.8766
315	2005:10:04	9:33:11	4.826	4	1200	759	2.2	0.35%	288.8632
316	2005:10:04	9:33:21	4.976	4	1200	759	2.2	0.37%	273.2546
317	2005:10:04	9:33:31	4.778	4	1200	759	2.2	0.34%	294.2416
318	2005:10:04	9:33:41	4.752	4	1200	759	2.2	0.34%	297.2394
319	2005:10:04	9:33:51	4.739	4	1200	759	2.2	0.33%	298.7613
320	2005:10:04	9:34:01	4.837	4	1200	759	2.2	0.35%	287.6583
321	2005:10:04	9:34:11	4.674	4	1200	759	2.2	0.33%	306.6107
322	2005:10:04	9:34:21	4.664	4	1200	759	2.2	0.32%	307.855
323	2005:10:04	9:34:31	4.664	4	1200	759	2.2	0.32%	307.855
324	2005:10:04	9:34:41	4.7	4	1200	759	2.2	0.33%	303.4219
325	2005:10:04	9:34:51	4.651	4	1200	759	2.2	0.32%	309.4879
326	2005:10:04	9:35:01	4.708	5	1225	759	2.2	0.33%	302.4541
327	2005:10:04	9:35:11	4.826	5	1225	759	2.2	0.35%	288.8632
328	2005:10:04	9:35:21	4.677	5	1225	759	2.2	0.33%	306.2393
329	2005:10:04	9:35:31	4.752	5	1225	759	2.2	0.34%	297.2394
330	2005:10:04	9:37:20	5.024	5	1225	759	2.2	0.37%	268.6101
331	2005:10:04	9:37:31	5.075	5	1225	759	2.2	0.38%	263.8452
332	2005:10:04	9:37:41	4.984	5	1225	759	2.2	0.37%	272.4694

333	2005:10:04	9:37:51	4.851	5	1225	759	2.2	0.35%	286.1391
334	2005:10:04	9:38:01	4.739	5	1225	759	2.2	0.33%	298.7613
335	2005:10:04	9:38:11	4.799	5	1225	759	2.2	0.34%	291.8641
336	2005:10:04	9:38:21	5.194	5	1225	759	2.2	0.39%	253.3583
337	2005:10:04	9:38:31	4.999	5	1225	759	2.2	0.37%	271.0092
338	2005:10:04	9:38:41	4.559	5	1225	759	2.2	0.31%	321.5578
339	2005:10:04	9:38:51	4.645	5	1225	759	2.2	0.32%	310.2474
340	2005:10:04	9:39:01	4.665	5	1225	759	2.2	0.32%	307.7302
341	2005:10:04	9:39:11	4.684	5	1225	759	2.2	0.33%	305.3763
342	2005:10:04	9:39:21	4.48	5	1225	759	2.2	0.30%	332.6995
343	2005:10:04	9:39:31	4.622	5	1225	759	2.2	0.32%	313.1936
344	2005:10:04	9:39:41	4.82	5	1225	759	2.2	0.35%	289.5247
345	2005:10:04	9:39:51	4.961	5	1225	759	2.2	0.36%	274.7392
346	2005:10:04	9:40:01	5.138	5	1225	759	2.2	0.39%	258.1875
347	2005:10:04	9:40:11	5.078	5	1225	759	2.2	0.38%	263.5701
348	2005:10:04	9:40:21	4.622	5	1225	759	2.2	0.32%	313.1936
349	2005:10:04	9:40:31	4.482	5	1225	759	2.2	0.30%	332.4079
350	2005:10:04	9:40:41	4.484	5	1225	759	2.2	0.30%	332.1168
351	2005:10:04	9:40:51	4.416	5	1225	759	2.2	0.29%	342.3081
352	2005:10:04	9:41:01	4.627	5	1225	759	2.2	0.32%	312.5483
353	2005:10:04	9:41:11	4.552	5	1225	759	2.2	0.31%	322.5148
354	2005:10:04	9:41:21	5.376	5	1225	759	2.2	0.42%	238.8397
355	2005:10:04	9:41:31	5.478	5	1225	759	2.2	0.43%	231.4078
356	2005:10:04	9:41:41	5.516	5	1225	759	2.2	0.44%	228.756
357	2005:10:04	9:41:51	5.371	5	1225	759	2.2	0.42%	239.2163
358	2005:10:04	9:42:01	5.16	5	1225	759	2.2	0.39%	256.2685
359	2005:10:04	9:42:11	5.181	5	1225	759	2.2	0.39%	254.4632
360	2005:10:04	9:42:21	5.33	5	1225	759	2.2	0.41%	242.3498
361	2005:10:04	9:42:31	4.911	5	1225	759	2.2	0.36%	279.8063
362	2005:10:04	9:42:41	5.07	5	1225	759	2.2	0.38%	264.3048
363	2005:10:04	9:42:51	4.905	5	1225	759	2.2	0.36%	280.4269
364	2005:10:04	9:43:01	4.987	5	1225	759	2.2	0.37%	272.1761
365	2005:10:04	9:43:11	5.01	5	1225	759	2.2	0.37%	269.9483
366	2005:10:04	9:43:21	5.087	5	1225	759	2.2	0.38%	262.7485
367	2005:10:04	9:43:31	5.167	5	1225	759	2.2	0.39%	255.6639
368	2005:10:04	9:43:41	5.039	5	1225	759	2.2	0.37%	267.1909
369	2005:10:04	9:43:51	5.336	5	1225	759	2.2	0.41%	241.8861
370	2005:10:04	9:44:01	5.095	5	1225	759	2.2	0.38%	262.0224
371	2005:10:04	9:44:11	4.901	5	1225	759	2.2	0.36%	280.8422
372	2005:10:04	9:44:21	4.724	5	1225	759	2.2	0.33%	300.5368
373	2005:10:04	9:44:31	4.44	5	1225	759	2.2	0.30%	338.6406
374	2005:10:04	9:44:41	4.568	5	1225	759	2.2	0.31%	320.3357
375	2005:10:04	9:44:51	4.59	5	1225	759	2.2	0.32%	317.387
376	2005:10:04	9:45:01	4.613	5	1225	759	2.2	0.32%	314.3617
377	2005:10:04	9:45:11	4.734	5	1225	759	2.2	0.33%	299.3508

378	2005:10:04	9:45:21	4.659	4	1200	759	2.2	0.32%	308.481
379	2005:10:04	9:45:31	4.63	4	1200	759	2.2	0.32%	312.1625
380	2005:10:04	9:45:41	4.66	4	1200	759	2.2	0.32%	308.3556
381	2005:10:04	9:45:51	4.494	4	1200	759	2.2	0.30%	330.6691
382	2005:10:04	9:46:01	4.18	4	1200	759	2.2	0.26%	383.1085
383	2005:10:04	9:46:11	4.233	4	1200	759	2.2	0.27%	373.1209
384	2005:10:04	9:46:21	4.677	4	1200	759	2.2	0.33%	306.2393
385	2005:10:04	9:46:31	4.261	4	1200	759	2.2	0.27%	368.0518
386	2005:10:04	9:46:41	4.338	4	1200	759	2.2	0.28%	354.7965
387	2005:10:04	9:46:51	4.344	4	1200	759	2.2	0.28%	353.8036
388	2005:10:04	9:47:01	4.294	4	1200	759	2.2	0.28%	362.2516
389	2005:10:04	9:47:11	4.338	4	1200	759	2.2	0.28%	354.7965
390	2005:10:04	9:47:21	4.294	4	1200	759	2.2	0.28%	362.2516
391	2005:10:04	9:47:31	4.347	4	1200	759	2.2	0.28%	353.3092
392	2005:10:04	9:47:41	4.208	4	1200	759	2.2	0.26%	377.7664
393	2005:10:04	9:47:51	4.122	4	1200	759	2.2	0.25%	394.6695
394	2005:10:04	9:48:01	4.308	4	1200	759	2.2	0.28%	359.8457
395	2005:10:04	9:48:11	4.506	4	1200	759	2.2	0.30%	328.9483
396	2005:10:04	9:48:21	4.449	4	1200	759	2.2	0.30%	337.2854
397	2005:10:04	9:48:31	4.48	4	1200	759	2.2	0.30%	332.6995
398	2005:10:04	9:48:41	4.3	4	1200	759	2.2	0.28%	361.2166
399	2005:10:04	9:48:51	4.223	4	1200	759	2.2	0.27%	374.9653
400	2005:10:04	9:49:01	4.229	4	1200	759	2.2	0.27%	373.8565
401	2005:10:04	9:49:11	4.229	4	1200	759	2.2	0.27%	373.8565
402	2005:10:04	9:49:21	4.217	4	1200	759	2.2	0.27%	376.0807
403	2005:10:04	9:49:31	4.252	4	1200	759	2.2	0.27%	369.6661
404	2005:10:04	9:49:41	4.217	4	1200	759	2.2	0.27%	376.0807
405	2005:10:04	9:49:51	4.427	4	1200	759	2.2	0.29%	340.6174
406	2005:10:04	9:50:01	4.538	4	1200	759	2.2	0.31%	324.446
407	2005:10:04	9:50:11	4.557	4	1200	759	2.2	0.31%	321.8306
408	2005:10:04	9:50:21	4.4	4	1200	759	2.2	0.29%	344.7977
409	2005:10:04	9:50:31	4.524	4	1200	759	2.2	0.31%	326.4005
410	2005:10:04	9:50:41	4.276	4	1200	759	2.2	0.27%	365.3925
411	2005:10:04	9:50:51	4.217	4	1200	759	2.2	0.27%	376.0807
412	2005:10:04	9:51:01	4.155	4	1200	759	2.2	0.26%	388.0076
413	2005:10:04	9:51:11	4.234	4	1200	759	2.2	0.27%	372.9375
414	2005:10:04	9:51:21	4.557	4	1200	759	2.2	0.31%	321.8306
415	2005:10:04	9:51:31	4.34	4	1200	759	2.2	0.28%	354.4649
416	2005:10:04	9:51:41	4.061	4	1200	759	2.2	0.25%	407.606
417	2005:10:04	9:51:51	4.071	4	1200	759	2.2	0.25%	405.4275
418	2005:10:04	9:52:01	4.174	4	1200	759	2.2	0.26%	384.273
419	2005:10:04	9:52:11	4.222	4	1200	759	2.2	0.27%	375.1508
420	2005:10:04	9:52:21	4.084	4	1200	759	2.2	0.25%	402.63
421	2005:10:04	9:52:31	4.1	4	1200	759	2.2	0.25%	399.2394
422	2005:10:04	9:52:41	4.507	4	1200	759	2.2	0.30%	328.8057

423	2005:10:04	9:52:51	4.566	4	1200	759	2.2	0.31%	320.6064
424	2005:10:04	9:53:01	4.38	4	1200	759	2.2	0.29%	347.9609
425	2005:10:04	9:53:11	4.501	4	1200	759	2.2	0.30%	329.6631
426	2005:10:04	9:53:21	4.336	4	1200	759	2.2	0.28%	355.1287
427	2005:10:04	9:53:31	4.417	4	1200	759	2.2	0.29%	342.1537
428	2005:10:04	9:53:41	4.301	4	1200	759	2.2	0.28%	361.0447
429	2005:10:04	9:53:51	4.448	4	1200	759	2.2	0.30%	337.4354
430	2005:10:04	9:54:01	4.3	4	1200	759	2.2	0.28%	361.2166
431	2005:10:04	9:54:11	4.418	4	1200	759	2.2	0.29%	341.9995

Stationary Time Series #2

Entry #	**Date**	**Time**	**Fluor**	**Height**	**Station**	**Conc Eff ppb**	**Conc BG ppb**	**Effluent Fraction**	**Dilution**
432	2005:10:04	10:01:00	4.83	4	1200	783	2.2	0.34%	297.7279
433	2005:10:04	10:01:11	4.985	4	1200	783	2.2	0.36%	281.1578
434	2005:10:04	10:01:21	5.047	4	1200	783	2.2	0.36%	275.0349
435	2005:10:04	10:01:31	5.233	4	1200	783	2.2	0.39%	258.1683
436	2005:10:04	10:01:41	5.017	4	1200	783	2.2	0.36%	277.9639
437	2005:10:04	10:01:51	5.014	4	1200	783	2.2	0.36%	278.2603
438	2005:10:04	10:02:01	5.048	4	1200	783	2.2	0.36%	274.9383
439	2005:10:04	10:02:11	5.022	4	1200	783	2.2	0.36%	277.4714
440	2005:10:04	10:02:21	5.142	4	1200	783	2.2	0.38%	266.1538
441	2005:10:04	10:02:31	5.108	4	1200	783	2.2	0.37%	269.2656
442	2005:10:04	10:02:41	5.685	4	1200	783	2.2	0.45%	224.6842
443	2005:10:04	10:02:51	5.433	4	1200	783	2.2	0.41%	242.1974
444	2005:10:04	10:03:01	5.275	4	1200	783	2.2	0.39%	254.6421
445	2005:10:04	10:03:11	5.335	4	1200	783	2.2	0.40%	249.7685
446	2005:10:04	10:03:21	5.178	4	1200	783	2.2	0.38%	262.9363
447	2005:10:04	10:03:31	5.241	4	1200	783	2.2	0.39%	257.4891
448	2005:10:04	10:03:41	5.378	4	1200	783	2.2	0.41%	246.389
449	2005:10:04	10:03:51	5.201	4	1200	783	2.2	0.38%	260.9211
450	2005:10:04	10:04:01	5.479	4	1200	783	2.2	0.42%	238.7997
451	2005:10:04	10:04:11	5.309	4	1200	783	2.2	0.40%	251.8573
452	2005:10:04	10:04:21	5.173	4	1200	783	2.2	0.38%	263.3785
453	2005:10:04	10:04:31	5.481	4	1200	783	2.2	0.42%	238.6542
454	2005:10:04	10:04:41	5.767	4	1200	783	2.2	0.46%	219.519
455	2005:10:04	10:04:51	6.371	4	1200	783	2.2	0.53%	187.7306
456	2005:10:04	10:05:01	6.061	4	1200	783	2.2	0.49%	202.8035
457	2005:10:04	10:05:11	6.312	4	1200	783	2.2	0.53%	190.4242
458	2005:10:04	10:05:21	6.587	4	1200	783	2.2	0.56%	178.4874
459	2005:10:04	10:05:31	6.388	4	1200	783	2.2	0.53%	186.9686
460	2005:10:04	10:05:41	5.222	4	1200	783	2.2	0.39%	259.108
461	2005:10:04	10:05:51	5.701	4	1200	783	2.2	0.45%	223.6573
462	2005:10:04	10:06:01	5.848	4	1200	783	2.2	0.47%	214.6448

463	2005:10:04	10:06:11	5.93	4	1200	783	2.2	0.48%	209.9261
464	2005:10:04	10:06:21	5.381	4	1200	783	2.2	0.41%	246.1567
465	2005:10:04	10:06:31	4.89	4	1200	783	2.2	0.34%	291.0871
466	2005:10:04	10:06:41	4.735	4	1200	783	2.2	0.32%	308.8853
467	2005:10:04	10:06:51	5.303	4	1200	783	2.2	0.40%	252.3443
468	2005:10:04	10:07:01	4.405	4	1200	783	2.2	0.28%	355.1131
469	2005:10:04	10:07:11	4.835	4	1200	783	2.2	0.34%	297.1629
470	2005:10:04	10:07:21	5.552	4	1200	783	2.2	0.43%	233.5991
471	2005:10:04	10:07:31	5.807	4	1200	783	2.2	0.46%	217.0847
472	2005:10:04	10:07:41	5.654	4	1200	783	2.2	0.44%	226.7007
473	2005:10:04	10:07:51	5.882	4	1200	783	2.2	0.47%	212.6628
474	2005:10:04	10:08:01	5.894	4	1200	783	2.2	0.47%	211.9719
475	2005:10:04	10:08:11	5.898	4	1200	783	2.2	0.47%	211.7427
476	2005:10:04	10:08:21	5.433	4	1200	783	2.2	0.41%	242.1974
477	2005:10:04	10:08:31	5.539	4	1200	783	2.2	0.43%	234.5086
478	2005:10:04	10:08:41	5.665	4	1200	783	2.2	0.44%	225.9811
479	2005:10:04	10:08:51	5.926	4	1200	783	2.2	0.48%	210.1515
480	2005:10:04	10:09:01	5.672	4	1200	783	2.2	0.44%	225.5254
481	2005:10:04	10:09:11	5.419	4	1200	783	2.2	0.41%	243.2508
482	2005:10:04	10:09:21	6.032	4	1200	783	2.2	0.49%	204.3383
483	2005:10:04	10:09:31	6.932	4	1200	783	2.2	0.60%	165.4743
484	2005:10:04	10:09:41	6.202	4	1200	783	2.2	0.51%	195.6583
485	2005:10:04	10:09:51	6.381	4	1200	783	2.2	0.53%	187.2816
486	2005:10:04	10:10:01	6.211	4	1200	783	2.2	0.51%	195.2192
487	2005:10:04	10:10:11	6.555	4	1200	783	2.2	0.56%	179.7989
488	2005:10:04	10:10:21	6.268	4	1200	783	2.2	0.52%	192.4839
489	2005:10:04	10:10:31	5.447	4	1200	783	2.2	0.41%	241.1532
490	2005:10:04	10:10:41	7.477	4	1200	783	2.2	0.67%	148.3844
491	2005:10:04	10:10:51	6.998	4	1200	783	2.2	0.61%	163.1981
492	2005:10:04	10:11:01	7.127	4	1200	783	2.2	0.63%	158.9252
493	2005:10:04	10:11:11	5.149	4	1200	783	2.2	0.38%	265.522
494	2005:10:04	10:11:21	5.549	4	1200	783	2.2	0.43%	233.8084
495	2005:10:04	10:11:31	5.818	4	1200	783	2.2	0.46%	216.4246
496	2005:10:04	10:11:41	5.872	4	1200	783	2.2	0.47%	213.2419
497	2005:10:04	10:11:51	4.492	4	1200	783	2.2	0.29%	341.6337
498	2005:10:04	10:12:01	5.132	4	1200	783	2.2	0.37%	267.0615
499	2005:10:04	10:12:11	4.828	4	1200	783	2.2	0.34%	297.9545
500	2005:10:04	10:12:21	5.249	4	1200	783	2.2	0.39%	256.8135
501	2005:10:04	10:12:31	5.556	4	1200	783	2.2	0.43%	233.3207
502	2005:10:04	10:12:41	5.625	4	1200	783	2.2	0.44%	228.6202
503	2005:10:04	10:12:51	4.772	4	1200	783	2.2	0.33%	304.4418
504	2005:10:04	10:13:01	4.563	4	1200	783	2.2	0.30%	331.3687
505	2005:10:04	10:13:11	4.28	4	1200	783	2.2	0.27%	376.454
506	2005:10:04	10:13:21	4.478	4	1200	783	2.2	0.29%	343.7333
507	2005:10:04	10:13:31	4.716	4	1200	783	2.2	0.32%	311.2179

508	2005:10:04	10:13:41	4.842	4	1200	783	2.2	0.34%	296.3756
509	2005:10:04	10:13:51	4.882	4	1200	783	2.2	0.34%	291.9554
510	2005:10:04	10:14:01	4.814	4	1200	783	2.2	0.33%	299.5502
511	2005:10:04	10:14:11	4.746	4	1200	783	2.2	0.33%	307.5508
512	2005:10:04	10:14:21	4.65	4	1200	783	2.2	0.31%	319.6018
513	2005:10:04	10:14:31	5.07	4	1200	783	2.2	0.37%	272.8308
514	2005:10:04	10:14:41	5.188	4	1200	783	2.2	0.38%	262.0563
515	2005:10:04	10:14:51	5.172	4	1200	783	2.2	0.38%	263.4671
516	2005:10:04	10:15:01	5.345	4	1200	783	2.2	0.40%	248.9744
517	2005:10:04	10:15:11	5.368	4	1200	783	2.2	0.40%	247.1668
518	2005:10:04	10:15:21	5.587	4	1200	783	2.2	0.43%	231.1852
519	2005:10:04	10:15:31	5.608	4	1200	783	2.2	0.44%	229.7607
520	2005:10:04	10:15:41	5.641	4	1200	783	2.2	0.44%	227.5572
521	2005:10:04	10:15:51	5.647	4	1200	783	2.2	0.44%	227.1611
522	2005:10:04	10:16:01	5.275	4	1200	783	2.2	0.39%	254.6421
523	2005:10:04	10:16:11	5.425	4	1200	783	2.2	0.41%	242.7982
524	2005:10:04	10:16:21	4.994	4	1200	783	2.2	0.36%	280.2521
525	2005:10:04	10:16:31	4.872	4	1200	783	2.2	0.34%	293.048
526	2005:10:04	10:16:41	4.43	4	1200	783	2.2	0.28%	351.132
527	2005:10:04	10:16:51	5.171	4	1200	783	2.2	0.38%	263.5558
528	2005:10:04	10:17:01	5.092	4	1200	783	2.2	0.37%	270.7553
529	2005:10:04	10:17:11	5.09	4	1200	783	2.2	0.37%	270.9427
530	2005:10:04	10:17:21	4.978	4	1200	783	2.2	0.35%	281.8662
531	2005:10:04	10:17:31	5.001	4	1200	783	2.2	0.36%	279.5517
532	2005:10:04	10:17:41	5.665	4	1200	783	2.2	0.44%	225.9811
533	2005:10:04	10:17:51	5.842	4	1200	783	2.2	0.47%	214.9984
534	2005:10:04	10:18:01	5.142	4	1200	783	2.2	0.38%	266.1538
535	2005:10:04	10:18:11	5.155	4	1200	783	2.2	0.38%	264.9829
536	2005:10:04	10:18:21	5.227	4	1200	783	2.2	0.39%	258.68
537	2005:10:04	10:18:31	4.436	4	1200	783	2.2	0.29%	350.1898
538	2005:10:04	10:18:41	4.495	4	1200	783	2.2	0.29%	341.1871
539	2005:10:04	10:18:51	4.955	4	1200	783	2.2	0.35%	284.2194
540	2005:10:04	10:19:01	5.071	4	1200	783	2.2	0.37%	272.7358
541	2005:10:04	10:19:11	5.531	4	1200	783	2.2	0.43%	235.0719
542	2005:10:04	10:19:21	5.024	4	1200	783	2.2	0.36%	277.2749
543	2005:10:04	10:19:31	4.862	4	1200	783	2.2	0.34%	294.1489
544	2005:10:04	10:19:41	5.307	4	1200	783	2.2	0.40%	252.0194
545	2005:10:04	10:19:51	5.632	4	1200	783	2.2	0.44%	228.1539
546	2005:10:04	10:20:01	5.67	4	1200	783	2.2	0.44%	225.6554
547	2005:10:04	10:20:11	5.508	4	1200	783	2.2	0.42%	236.7063
548	2005:10:04	10:20:21	5.903	4	1200	783	2.2	0.47%	211.4568
549	2005:10:04	10:20:31	6.348	4	1200	783	2.2	0.53%	188.7715
550	2005:10:04	10:20:41	6.958	4	1200	783	2.2	0.61%	164.5701
551	2005:10:04	10:20:51	7.253	4	1200	783	2.2	0.65%	154.9623
552	2005:10:04	10:21:01	7.092	4	1200	783	2.2	0.62%	160.0622

553	2005:10:04	10:21:11	7.508	4	1200	783	2.2	0.68%	147.5178
554	2005:10:04	10:21:21	6.851	4	1200	783	2.2	0.59%	168.3561
555	2005:10:04	10:21:31	4.99	4	1200	783	2.2	0.36%	280.6539
556	2005:10:04	10:21:41	5.188	4	1200	783	2.2	0.38%	262.0563
557	2005:10:04	10:21:51	6.198	4	1200	783	2.2	0.51%	195.854
558	2005:10:04	10:22:01	5.802	4	1200	783	2.2	0.46%	217.386
559	2005:10:04	10:22:11	5.511	4	1200	783	2.2	0.42%	236.4918
560	2005:10:04	10:22:21	6.223	4	1200	783	2.2	0.51%	194.6369
561	2005:10:04	10:22:31	5.656	4	1200	783	2.2	0.44%	226.5695
562	2005:10:04	10:22:41	5.432	4	1200	783	2.2	0.41%	242.2724
563	2005:10:04	10:22:51	5.422	4	1200	783	2.2	0.41%	243.0243
564	2005:10:04	10:23:01	5.221	4	1200	783	2.2	0.39%	259.1938
565	2005:10:04	10:23:11	5.278	4	1200	783	2.2	0.39%	254.3939
566	2005:10:04	10:23:21	5.245	4	1200	783	2.2	0.39%	257.1509
567	2005:10:04	10:23:31	5.759	4	1200	783	2.2	0.45%	220.0125
568	2005:10:04	10:23:41	5.463	4	1200	783	2.2	0.42%	239.9707
569	2005:10:04	10:23:51	5.578	4	1200	783	2.2	0.43%	231.8012
570	2005:10:04	10:24:01	5.58	4	1200	783	2.2	0.43%	231.664
571	2005:10:04	10:24:11	6.174	4	1200	783	2.2	0.51%	197.0368
572	2005:10:04	10:24:21	5.801	4	1200	783	2.2	0.46%	217.4464
573	2005:10:04	10:24:31	7.372	4	1200	783	2.2	0.66%	151.3968
574	2005:10:04	10:24:41	6.758	4	1200	783	2.2	0.58%	171.7912
575	2005:10:04	10:24:51	7.023	4	1200	783	2.2	0.62%	162.3521
576	2005:10:04	10:25:01	7.238	4	1200	783	2.2	0.64%	155.4237
577	2005:10:04	10:25:11	7.308	4	1200	783	2.2	0.65%	153.2937
578	2005:10:04	10:25:21	7.145	4	1200	783	2.2	0.63%	158.3467
579	2005:10:04	10:25:31	6.593	4	1200	783	2.2	0.56%	178.2436
580	2005:10:04	10:25:41	6.483	4	1200	783	2.2	0.55%	182.8215
581	2005:10:04	10:25:51	6.673	4	1200	783	2.2	0.57%	175.0557
582	2005:10:04	10:26:01	6.422	4	1200	783	2.2	0.54%	185.4629
583	2005:10:04	10:26:11	6.422	4	1200	783	2.2	0.54%	185.4629
584	2005:10:04	10:26:21	5.449	4	1200	783	2.2	0.41%	241.0047
585	2005:10:04	10:26:31	5.866	4	1200	783	2.2	0.47%	213.5909
586	2005:10:04	10:26:41	5.135	4	1200	783	2.2	0.37%	266.7885
587	2005:10:04	10:26:51	5.08	4	1200	783	2.2	0.37%	271.8835
588	2005:10:04	10:27:01	4.693	4	1200	783	2.2	0.32%	314.0892
589	2005:10:04	10:27:11	5.107	4	1200	783	2.2	0.37%	269.3582
590	2005:10:04	10:27:21	4.979	4	1200	783	2.2	0.35%	281.7648
591	2005:10:04	10:27:31	5.207	4	1200	783	2.2	0.38%	260.4005
592	2005:10:04	10:27:41	4.697	4	1200	783	2.2	0.32%	313.586
593	2005:10:04	10:27:51	5.31	4	1200	783	2.2	0.40%	251.7763
594	2005:10:04	10:28:01	4.98	4	1200	783	2.2	0.36%	281.6634
595	2005:10:04	10:28:11	5.307	4	1200	783	2.2	0.40%	252.0194
596	2005:10:04	10:28:21	5.944	4	1200	783	2.2	0.48%	209.1411
597	2005:10:04	10:28:31	5.354	4	1200	783	2.2	0.40%	248.2639

598	2005:10:04	10:28:41	5.618	4	1200	783	2.2	0.44%	229.0885
599	2005:10:04	10:28:51	5.519	4	1200	783	2.2	0.42%	235.9218
600	2005:10:04	10:29:01	5.983	4	1200	783	2.2	0.48%	206.985
601	2005:10:04	10:29:11	5.893	4	1200	783	2.2	0.47%	212.0293
602	2005:10:04	10:29:21	5.59	4	1200	783	2.2	0.43%	230.9806
603	2005:10:04	10:29:31	5.199	4	1200	783	2.2	0.38%	261.0951
604	2005:10:04	10:29:41	5.863	4	1200	783	2.2	0.47%	213.7659
605	2005:10:04	10:29:51	5.753	4	1200	783	2.2	0.45%	220.384
606	2005:10:04	10:30:01	5.535	4	1200	809	2.2	0.41%	242.6162
607	2005:10:04	10:30:11	4.813	4	1200	809	2.2	0.32%	309.6537
608	2005:10:04	10:30:21	5.273	4	1200	809	2.2	0.38%	263.3014
609	2005:10:04	10:30:31	4.826	4	1200	809	2.2	0.32%	308.1208
610	2005:10:04	10:30:41	4.972	4	1200	809	2.2	0.34%	291.8922
611	2005:10:04	10:30:51	5.043	4	1200	809	2.2	0.35%	284.6026
612	2005:10:04	10:31:01	5.3	4	1200	809	2.2	0.38%	261.0081
613	2005:10:04	10:31:11	4.965	4	1200	809	2.2	0.34%	292.6312
614	2005:10:04	10:31:21	5.182	4	1200	809	2.2	0.37%	271.3364
615	2005:10:04	10:31:31	5.155	4	1200	809	2.2	0.37%	273.8156
616	2005:10:04	10:31:41	5.475	4	1200	809	2.2	0.40%	247.0611
617	2005:10:04	10:31:51	5.723	4	1200	809	2.2	0.44%	229.6694
618	2005:10:04	10:32:01	5.127	4	1200	809	2.2	0.36%	276.435
619	2005:10:04	10:32:11	4.707	4	1200	809	2.2	0.31%	322.7464
620	2005:10:04	10:32:21	4.542	4	1200	809	2.2	0.29%	345.4847
621	2005:10:04	10:32:31	4.307	4	1200	809	2.2	0.26%	384.0176
622	2005:10:04	10:32:41	4.591	4	1200	809	2.2	0.30%	338.4045
623	2005:10:04	10:32:51	4.909	4	1200	809	2.2	0.33%	298.6804
624	2005:10:04	10:33:01	4.863	4	1200	809	2.2	0.33%	303.8397
625	2005:10:04	10:33:11	4.246	4	1200	809	2.2	0.25%	395.4668
626	2005:10:04	10:33:21	4.75	4	1200	809	2.2	0.32%	317.304
627	2005:10:04	10:33:31	5.205	4	1200	809	2.2	0.37%	269.2596
628	2005:10:04	10:33:41	5.565	4	1200	809	2.2	0.42%	240.4532
629	2005:10:04	10:33:51	6.139	4	1200	809	2.2	0.49%	205.4139
630	2005:10:04	10:34:01	6.353	4	1200	809	2.2	0.51%	194.8291
631	2005:10:04	10:34:11	6.498	4	1200	809	2.2	0.53%	188.2562
632	2005:10:04	10:34:21	7.121	4	1200	809	2.2	0.61%	164.4229
633	2005:10:04	10:34:31	7.105	4	1200	809	2.2	0.61%	164.9593
634	2005:10:04	10:34:41	6.698	4	1200	809	2.2	0.56%	179.8855
635	2005:10:04	10:34:51	4.61	4	1200	809	2.2	0.30%	335.7366
636	2005:10:04	10:35:01	5.028	4	1200	809	2.2	0.35%	286.1122
637	2005:10:04	10:35:11	5.453	4	1200	809	2.2	0.40%	248.732
638	2005:10:04	10:35:21	5.561	4	1200	809	2.2	0.42%	240.7394
639	2005:10:04	10:35:31	5.275	4	1200	809	2.2	0.38%	263.1301
640	2005:10:04	10:35:41	5.27	4	1200	809	2.2	0.38%	263.5587
641	2005:10:04	10:35:51	5.486	4	1200	809	2.2	0.41%	246.2341
642	2005:10:04	10:36:01	5.223	4	1200	809	2.2	0.37%	267.6564

643	2005:10:04	10:36:11	6.149	4	1200	809	2.2	0.49%	204.8937
644	2005:10:04	10:36:21	4.757	4	1200	809	2.2	0.32%	316.4353
645	2005:10:04	10:36:31	4.787	4	1200	809	2.2	0.32%	312.7658
646	2005:10:04	10:36:41	4.671	4	1200	809	2.2	0.31%	327.4485
647	2005:10:04	10:36:51	4.743	4	1200	809	2.2	0.31%	318.1774
648	2005:10:04	10:37:01	5.26	4	1200	809	2.2	0.38%	264.42
649	2005:10:04	10:37:11	4.96	4	1200	809	2.2	0.34%	293.1613
650	2005:10:04	10:37:21	5.411	4	1200	809	2.2	0.40%	251.9854
651	2005:10:04	10:37:31	6.037	4	1200	809	2.2	0.47%	210.8744
652	2005:10:04	10:37:41	6.052	4	1200	809	2.2	0.48%	210.0533
653	2005:10:04	10:37:51	5.676	4	1200	809	2.2	0.43%	232.7748
654	2005:10:04	10:38:01	5.316	4	1200	809	2.2	0.39%	259.6679
655	2005:10:04	10:38:11	5.311	4	1200	809	2.2	0.38%	260.0852
656	2005:10:04	10:38:21	5.308	4	1200	809	2.2	0.38%	260.3363
657	2005:10:04	10:38:31	5.051	4	1200	809	2.2	0.35%	283.804
658	2005:10:04	10:38:41	5.051	4	1200	809	2.2	0.35%	283.804
659	2005:10:04	10:38:51	5.369	4	1200	809	2.2	0.39%	255.3251
660	2005:10:04	10:39:01	5.129	4	1200	809	2.2	0.36%	276.2462
661	2005:10:04	10:39:11	4.897	4	1200	809	2.2	0.33%	300.0093
662	2005:10:04	10:39:21	4.866	4	1200	809	2.2	0.33%	303.4978
663	2005:10:04	10:39:31	4.916	4	1200	809	2.2	0.34%	297.9106
664	2005:10:04	10:39:41	4.49	4	1200	809	2.2	0.28%	353.3298
665	2005:10:04	10:39:51	4.429	4	1200	809	2.2	0.28%	362.9992
666	2005:10:04	10:40:01	4.599	4	1200	809	2.2	0.30%	337.276
667	2005:10:04	10:40:11	4.739	4	1200	809	2.2	0.31%	318.6787
668	2005:10:04	10:40:21	4.564	4	1200	809	2.2	0.29%	342.2695
669	2005:10:04	10:40:31	4.665	4	1200	809	2.2	0.30%	328.2455
670	2005:10:04	10:40:41	4.454	4	1200	809	2.2	0.28%	358.973
671	2005:10:04	10:40:51	4.376	4	1200	809	2.2	0.27%	371.8406
672	2005:10:04	10:41:01	4.478	4	1200	809	2.2	0.28%	355.191
673	2005:10:04	10:41:11	4.274	4	1200	809	2.2	0.26%	390.1279
674	2005:10:04	10:41:21	4.41	4	1200	809	2.2	0.27%	366.12
675	2005:10:04	10:41:31	4.766	4	1200	809	2.2	0.32%	315.3255
676	2005:10:04	10:41:41	4.727	4	1200	809	2.2	0.31%	320.192
677	2005:10:04	10:41:51	4.443	4	1200	809	2.2	0.28%	360.7335
678	2005:10:04	10:42:01	4.299	4	1200	809	2.2	0.26%	385.4813
679	2005:10:04	10:42:11	4.565	4	1200	809	2.2	0.29%	342.1248
680	2005:10:04	10:42:21	4.433	4	1200	809	2.2	0.28%	362.3489
681	2005:10:04	10:42:31	4.489	4	1200	809	2.2	0.28%	353.4841
682	2005:10:04	10:42:41	4.802	4	1200	809	2.2	0.32%	310.9628
683	2005:10:04	10:42:51	4.895	4	1200	809	2.2	0.33%	300.232
684	2005:10:04	10:43:01	4.761	4	1200	809	2.2	0.32%	315.9411
685	2005:10:04	10:43:11	4.956	4	1200	809	2.2	0.34%	293.5868
686	2005:10:04	10:43:21	4.867	4	1200	809	2.2	0.33%	303.384
687	2005:10:04	10:43:31	4.911	4	1200	809	2.2	0.34%	298.46

688	2005:10:04	10:43:41	4.806	4	1200	809	2.2	0.32%	310.4855
689	2005:10:04	10:43:51	4.623	4	1200	809	2.2	0.30%	333.9353
690	2005:10:04	10:44:01	4.487	4	1200	809	2.2	0.28%	353.7932
691	2005:10:04	10:44:11	4.525	4	1200	809	2.2	0.29%	348.0108
692	2005:10:04	10:44:21	4.428	4	1200	809	2.2	0.28%	363.1621
693	2005:10:04	10:44:31	4.513	4	1200	809	2.2	0.29%	349.8163
694	2005:10:04	10:44:41	5.133	4	1200	809	2.2	0.36%	275.8695
695	2005:10:04	10:44:51	5.346	4	1200	809	2.2	0.39%	257.1917
696	2005:10:04	10:45:01	5.45	4	1200	809	2.2	0.40%	248.9616
697	2005:10:04	10:45:11	5.67	4	1200	809	2.2	0.43%	233.1773
698	2005:10:04	10:45:21	5.793	4	1200	809	2.2	0.44%	225.1949
699	2005:10:04	10:45:31	5.474	4	1200	809	2.2	0.40%	247.1366
700	2005:10:04	10:45:41	4.621	4	1200	809	2.2	0.30%	334.2111
701	2005:10:04	10:45:51	5.065	4	1200	809	2.2	0.35%	282.4172
702	2005:10:04	10:46:01	5.009	4	1200	809	2.2	0.35%	288.0474
703	2005:10:04	10:46:11	5.201	4	1200	809	2.2	0.37%	269.6185
704	2005:10:04	10:46:21	4.571	4	1200	809	2.2	0.29%	341.259
705	2005:10:04	10:46:31	4.789	4	1200	809	2.2	0.32%	312.5242
706	2005:10:04	10:46:41	4.136	4	1200	809	2.2	0.24%	417.9366
707	2005:10:04	10:46:51	4.895	4	1200	809	2.2	0.33%	300.232
708	2005:10:04	10:47:01	4.893	4	1200	809	2.2	0.33%	300.4549
709	2005:10:04	10:47:11	4.879	4	1200	809	2.2	0.33%	302.0251
710	2005:10:04	10:47:21	5.076	4	1200	809	2.2	0.36%	281.337
711	2005:10:04	10:47:31	5.043	4	1200	809	2.2	0.35%	284.6026
712	2005:10:04	10:47:41	4.575	4	1200	809	2.2	0.29%	340.6843
713	2005:10:04	10:47:51	4.816	4	1200	809	2.2	0.32%	309.2986
714	2005:10:04	10:48:01	5.05	4	1200	809	2.2	0.35%	283.9036
715	2005:10:04	10:48:11	4.658	4	1200	809	2.2	0.30%	329.1803
716	2005:10:04	10:48:21	4.597	4	1200	809	2.2	0.30%	337.5574
717	2005:10:04	10:48:31	4.715	4	1200	809	2.2	0.31%	321.7197
718	2005:10:04	10:48:41	4.912	4	1200	809	2.2	0.34%	298.35
719	2005:10:04	10:48:51	4.523	4	1200	809	2.2	0.29%	348.3104
720	2005:10:04	10:49:01	4.818	4	1200	809	2.2	0.32%	309.0623
721	2005:10:04	10:49:11	5.109	4	1200	809	2.2	0.36%	278.1455
722	2005:10:04	10:49:21	5.256	4	1200	809	2.2	0.38%	264.7661
723	2005:10:04	10:49:31	5.319	4	1200	809	2.2	0.39%	259.4181
724	2005:10:04	10:49:41	4.947	4	1200	809	2.2	0.34%	294.5487
725	2005:10:04	10:49:51	4.853	4	1200	809	2.2	0.33%	304.985
726	2005:10:04	10:50:01	4.7	4	1200	809	2.2	0.31%	323.6501
727	2005:10:04	10:50:11	4.894	4	1200	809	2.2	0.33%	300.3434
728	2005:10:04	10:50:21	4.576	4	1200	809	2.2	0.29%	340.5409
729	2005:10:04	10:50:31	4.972	4	1200	809	2.2	0.34%	291.8922
730	2005:10:04	10:50:41	4.949	4	1200	809	2.2	0.34%	294.3344
731	2005:10:04	10:50:51	5.075	4	1200	809	2.2	0.36%	281.4348
732	2005:10:04	10:51:01	5.165	4	1200	809	2.2	0.37%	272.8921

733	2005:10:04	10:51:11	5.284	4	1200	809	2.2	0.38%	262.3622
734	2005:10:04	10:51:21	5.2	4	1200	809	2.2	0.37%	269.7084
735	2005:10:04	10:51:31	5.315	4	1200	809	2.2	0.38%	259.7513
736	2005:10:04	10:51:41	5.182	4	1200	809	2.2	0.37%	271.3364
737	2005:10:04	10:51:51	5.331	4	1200	809	2.2	0.39%	258.4239
738	2005:10:04	10:52:01	5.626	4	1200	809	2.2	0.42%	236.172
739	2005:10:04	10:52:11	5.37	4	1200	809	2.2	0.39%	255.2445
740	2005:10:04	10:52:21	5.239	4	1200	809	2.2	0.38%	266.2472
741	2005:10:04	10:52:31	5.2	4	1200	809	2.2	0.37%	269.7084
742	2005:10:04	10:52:41	5.336	4	1200	809	2.2	0.39%	258.0118
743	2005:10:04	10:52:51	5.41	4	1200	809	2.2	0.40%	252.0639
744	2005:10:04	10:53:01	5.75	4	1200	809	2.2	0.44%	227.9226
745	2005:10:04	10:53:11	5.083	4	1200	809	2.2	0.36%	280.6539
746	2005:10:04	10:53:21	4.771	4	1200	809	2.2	0.32%	314.7122
747	2005:10:04	10:53:31	4.819	4	1200	809	2.2	0.32%	308.9443
748	2005:10:04	10:53:41	4.934	4	1200	809	2.2	0.34%	295.9492
749	2005:10:04	10:53:51	4.747	4	1200	809	2.2	0.31%	317.6777
750	2005:10:04	10:54:01	4.979	4	1200	809	2.2	0.34%	291.1569
751	2005:10:04	10:54:11	4.232	4	1200	809	2.2	0.25%	398.1915
752	2005:10:04	10:54:21	4.766	4	1200	809	2.2	0.32%	315.3255
753	2005:10:04	10:54:31	4.856	4	1200	809	2.2	0.33%	304.6405
754	2005:10:04	10:54:41	5.196	4	1200	809	2.2	0.37%	270.0685
755	2005:10:04	10:54:51	4.459	4	1200	809	2.2	0.28%	358.1785
756	2005:10:04	10:55:01	4.224	4	1200	809	2.2	0.25%	399.7654
757	2005:10:04	10:55:11	4.234	4	1200	809	2.2	0.25%	397.8
758	2005:10:04	10:55:21	4.324	4	1200	809	2.2	0.26%	380.944
759	2005:10:04	10:55:31	3.964	4	1200	809	2.2	0.22%	458.6877
760	2005:10:04	10:55:41	4.083	4	1200	809	2.2	0.23%	429.7
761	2005:10:04	10:55:51	4.414	4	1200	809	2.2	0.27%	365.4585
762	2005:10:04	10:56:01	4.576	4	1200	809	2.2	0.29%	340.5409
763	2005:10:04	10:56:11	4.612	4	1200	809	2.2	0.30%	335.4582
764	2005:10:04	10:56:21	4.064	4	1200	809	2.2	0.23%	434.08
765	2005:10:04	10:56:31	4.005	4	1200	809	2.2	0.22%	448.2688
766	2005:10:04	10:56:41	3.845	4	1200	809	2.2	0.20%	491.8694
767	2005:10:04	10:56:51	3.768	4	1200	809	2.2	0.19%	516.0237
768	2005:10:04	10:57:01	4.027	4	1200	809	2.2	0.23%	442.8709
769	2005:10:04	10:57:11	3.867	4	1200	809	2.2	0.21%	485.378
770	2005:10:04	10:57:21	4.042	4	1200	809	2.2	0.23%	439.2645
771	2005:10:04	10:57:31	4.289	4	1200	809	2.2	0.26%	387.3265
772	2005:10:04	10:57:41	4.338	4	1200	809	2.2	0.26%	378.4496
773	2005:10:04	10:57:51	4.645	4	1200	809	2.2	0.30%	330.9305
774	2005:10:04	10:58:01	3.841	4	1200	809	2.2	0.20%	493.0683
775	2005:10:04	10:58:11	4.028	4	1200	809	2.2	0.23%	442.6286
776	2005:10:04	10:58:21	3.606	4	1200	809	2.2	0.17%	575.4802
777	2005:10:04	10:58:31	3.686	4	1200	809	2.2	0.18%	544.4988

778	2005:10:04	10:58:41	3.943	4	1200	809	2.2	0.22%	464.2141
779	2005:10:04	10:58:51	3.798	4	1200	809	2.2	0.20%	506.3361
780	2005:10:04	10:59:01	3.946	4	1200	809	2.2	0.22%	463.4165
781	2005:10:04	10:59:11	3.737	4	1200	809	2.2	0.19%	526.4315
782	2005:10:04	10:59:21	3.742	4	1200	809	2.2	0.19%	524.7245
783	2005:10:04	10:59:30	3.853	4	1200	809	2.2	0.20%	489.4889
							avg	**0.38%**	**263.0213**

Upstream Background Check

Entry #	Date	Time	Fluor	Height	Station	Conc Eff ppb	Conc BG ppb	Effluent Fraction	Dilution
784	2005:10:04	11:26:37	2.249			837	2.2	0.01%	17082.16
785	2005:10:04	11:27:30	2.224			837	2.2	0.00%	34876.08
786	2005:10:04	11:27:41	2.189			837	2.2	0.00%	-76093.3
787	2005:10:04	11:27:51	2.207			837	2.2	0.00%	119575.1
788	2005:10:04	11:28:01	2.258			837	2.2	0.01%	14431.48
789	2005:10:04	11:28:11	2.229			837	2.2	0.00%	28862.97

ATTACHMENT II-2:
PEAK-TO-MEAN CALCULATION TABLES

PEAK-TO-MEAN CALCULATION TABLES

Table A. Effluent fraction cross section from transects and profiles 6:40 to 7:00 and 8:00 to 8:30

	1152.9	1155.6	1158.4	1161.1	1163.8	1166.5	1169.3	1172.0	1174.7	1177.5	1180.2	1182.9	1185.6	1188.4	1191.1	1193.8	1196.5
0.67	0.05%	0.07%	0.11%	0.12%	0.12%	0.14%	0.23%	0.22%	0.32%	0.37%	0.43%	0.42%	0.47%	0.49%	0.40%	0.45%	**0.43%**
1.33	0.05%	0.08%	0.11%	0.13%	0.13%	0.15%	0.25%	0.24%	0.34%	0.40%	0.46%	0.45%	0.51%	0.53%	0.43%	0.48%	**0.46%**
2.00	0.05%	0.08%	0.12%	0.14%	0.13%	0.16%	0.27%	0.26%	0.36%	0.42%	0.49%	0.48%	0.54%	0.56%	0.45%	0.51%	**0.49%**
2.67	0.05%	0.08%	0.11%	0.13%	0.12%	0.15%	0.25%	0.24%	0.33%	0.39%	0.45%	0.44%	0.50%	0.52%	0.42%	0.47%	**0.45%**
3.33	0.04%	0.06%	0.09%	0.10%	0.10%	0.12%	0.20%	0.19%	0.27%	0.31%	0.36%	0.35%	0.40%	0.42%	0.34%	0.38%	**0.37%**
4.00	0.04%	0.07%	0.10%	0.12%	0.11%	0.14%	0.22%	0.21%	0.30%	0.35%	0.40%	0.39%	0.45%	0.46%	0.37%	0.42%	**0.41%**
4.67	0.05%	0.07%	0.10%	0.12%	0.12%	0.14%	0.23%	0.22%	0.31%	0.36%	0.42%	0.41%	0.46%	0.48%	0.39%	0.44%	**0.42%**
5.33	0.05%	0.07%	0.10%	0.12%	0.12%	0.14%	0.23%	0.22%	0.31%	0.36%	0.42%	0.41%	0.46%	0.48%	0.39%	0.44%	**0.42%**
6.00	**0.04%**	**0.07%**	**0.10%**	**0.12%**	**0.11%**	**0.14%**	**0.22%**	**0.21%**	**0.30%**	**0.36%**	**0.41%**	**0.40%**	**0.45%**	**0.47%**	**0.38%**	**0.43%**	**0.41%**
6.67	0.04%	0.07%	0.09%	0.11%	0.11%	0.13%	0.21%	0.20%	0.29%	0.33%	0.39%	0.38%	0.43%	0.44%	0.36%	0.40%	**0.39%**
7.33	0.04%	0.07%	0.10%	0.11%	0.11%	0.13%	0.21%	0.21%	0.29%	0.34%	0.39%	0.38%	0.43%	0.45%	0.36%	0.41%	**0.40%**
8.00	0.04%	0.07%	0.10%	0.12%	0.11%	0.14%	0.22%	0.21%	0.30%	0.35%	0.40%	0.39%	0.44%	0.46%	0.37%	0.42%	**0.41%**
8.67	0.04%	0.06%	0.08%	0.10%	0.09%	0.11%	0.18%	0.17%	0.25%	0.29%	0.33%	0.32%	0.37%	0.38%	0.31%	0.35%	**0.33%**
9.33	0.03%	0.05%	0.07%	0.08%	0.08%	0.10%	0.15%	0.15%	0.21%	0.24%	0.28%	0.28%	0.31%	0.32%	0.26%	0.29%	**0.28%**
10.00	0.03%	0.04%	0.06%	0.07%	0.06%	0.08%	0.13%	0.12%	0.17%	0.20%	0.24%	0.23%	0.26%	0.27%	0.22%	0.25%	**0.24%**
10.67	0.03%	0.04%	0.06%	0.07%	0.06%	0.08%	0.13%	0.12%	0.17%	0.20%	0.24%	0.23%	0.26%	0.27%	0.22%	0.25%	**0.24%**
11.33	0.02%	0.03%	0.05%	0.06%	0.05%	0.07%	0.11%	0.10%	0.14%	0.17%	0.19%	0.19%	0.21%	0.22%	0.18%	0.20%	**0.20%**
12.00	0.02%	0.03%	0.04%	0.05%	0.05%	0.06%	0.09%	0.09%	0.13%	0.15%	0.17%	0.17%	0.19%	0.20%	0.16%	0.18%	**0.17%**
12.67	0.02%	0.03%	0.04%	0.04%	0.04%	0.05%	0.08%	0.08%	0.11%	0.13%	0.15%	0.14%	0.16%	0.17%	0.13%	0.15%	**0.15%**
13.33	0.01%	0.02%	0.03%	0.04%	0.03%	0.04%	0.07%	0.07%	0.09%	0.11%	0.13%	0.12%	0.14%	0.14%	0.12%	0.13%	**0.13%**
14.00	0.01%	0.02%	0.03%	0.03%	0.03%	0.04%	0.06%	0.06%	0.08%	0.09%	0.11%	0.11%	0.12%	0.13%	0.10%	0.11%	**0.11%**
14.67	0.01%	0.02%	0.03%	0.03%	0.03%	0.03%	0.06%	0.05%	0.08%	0.09%	0.10%	0.10%	0.11%	0.12%	0.10%	0.11%	**0.10%**
15.33	0.01%	0.02%	0.02%	0.03%	0.03%	0.03%	0.05%	0.05%	0.07%	0.08%	0.10%	0.10%	0.11%	0.11%	0.09%	0.10%	**0.10%**
16.00	0.01%	0.02%	0.02%	0.03%	0.03%	0.03%	0.05%	0.05%	0.07%	0.08%	0.09%	0.09%	0.10%	0.11%	0.09%	0.10%	**0.09%**
16.67	0.01%	0.01%	0.02%	0.02%	0.02%	0.02%	0.03%	0.03%	0.05%	0.05%	0.06%	0.06%	0.07%	0.07%	0.06%	0.07%	**0.06%**
17.33	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.02%	0.03%	0.04%	0.04%	0.04%	0.05%	0.05%	0.04%	0.04%	**0.04%**
18.00	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%	0.02%	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	**0.03%**
18.67	0.01%	0.01%	0.01%	0.02%	0.01%	0.02%	0.03%	0.03%	0.04%	0.05%	0.05%	0.05%	0.06%	0.06%	0.05%	0.06%	**0.05%**
19.33	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%	0.03%	0.04%	0.03%	0.03%	**0.03%**
20.00	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	**0.02%**
20.67	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**
21.33	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**

	1199.3	1202.0	1204.7	1207.5	1210.2	1212.9	1215.6	1218.4	1221.1	1223.8	1226.5	1229.3	1232.0	1234.7	1237.5	1240.2	1242.9	1245.6	1248.4	1251.1	1253.8
0.67	0.43%	0.45%	0.48%	0.48%	0.47%	0.46%	0.44%	0.47%	0.48%	0.47%	0.45%	0.39%	0.39%	0.33%	0.28%	0.27%	0.27%	0.21%	0.17%	0.05%	0.04%
1.33	0.46%	0.48%	0.51%	0.51%	0.50%	0.49%	0.47%	0.51%	0.51%	0.50%	0.48%	0.42%	0.42%	0.35%	0.30%	0.29%	0.29%	0.22%	0.18%	0.05%	0.04%
2.00	0.49%	0.51%	0.54%	0.54%	0.54%	0.52%	0.50%	0.54%	0.54%	0.53%	0.51%	0.44%	0.44%	0.37%	0.32%	0.31%	0.30%	0.24%	0.20%	0.06%	0.04%
2.67	0.45%	0.47%	0.50%	0.50%	0.50%	0.48%	0.47%	0.50%	0.50%	0.49%	0.48%	0.41%	0.41%	0.35%	0.30%	0.29%	0.28%	0.22%	0.18%	0.05%	0.04%
3.33	0.36%	0.38%	0.40%	0.40%	0.40%	0.39%	0.37%	0.40%	0.40%	0.40%	0.38%	0.33%	0.33%	0.28%	0.24%	0.23%	0.23%	0.18%	0.15%	0.04%	0.03%
4.00	0.40%	0.42%	0.45%	0.45%	0.44%	0.43%	0.42%	0.45%	0.45%	0.44%	0.43%	0.37%	0.37%	0.31%	0.26%	0.26%	0.25%	0.20%	0.16%	0.05%	0.04%
4.67	0.42%	0.44%	0.46%	0.47%	0.46%	0.45%	0.43%	0.46%	0.46%	0.46%	0.44%	0.38%	0.38%	0.32%	0.27%	0.27%	0.26%	0.20%	0.17%	0.05%	0.04%
5.33	0.42%	0.44%	0.47%	0.47%	0.46%	0.45%	0.43%	0.47%	0.47%	0.46%	0.44%	0.38%	0.38%	0.32%	0.28%	0.27%	0.26%	0.21%	0.17%	0.05%	0.04%
6.00	**0.41%**	**0.43%**	**0.46%**	**0.46%**	**0.45%**	**0.44%**	**0.42%**	**0.45%**	**0.46%**	**0.45%**	**0.43%**	**0.37%**	**0.37%**	**0.32%**	**0.27%**	**0.26%**	**0.26%**	**0.20%**	**0.16%**	**0.05%**	**0.04%**
6.67	0.39%	0.41%	0.43%	0.43%	0.42%	0.41%	0.40%	0.43%	0.43%	0.42%	0.41%	0.35%	0.35%	0.30%	0.25%	0.25%	0.24%	0.19%	0.15%	0.04%	0.03%
7.33	0.39%	0.41%	0.44%	0.44%	0.43%	0.42%	0.41%	0.43%	0.44%	0.43%	0.41%	0.36%	0.36%	0.30%	0.26%	0.25%	0.24%	0.19%	0.16%	0.05%	0.04%
8.00	0.40%	0.42%	0.45%	0.45%	0.44%	0.43%	0.42%	0.44%	0.45%	0.44%	0.42%	0.37%	0.36%	0.31%	0.26%	0.26%	0.25%	0.20%	0.16%	0.05%	0.04%
8.67	0.33%	0.35%	0.37%	0.37%	0.37%	0.35%	0.34%	0.37%	0.37%	0.36%	0.35%	0.30%	0.30%	0.25%	0.22%	0.21%	0.21%	0.16%	0.13%	0.04%	0.03%
9.33	0.28%	0.30%	0.31%	0.31%	0.31%	0.30%	0.29%	0.31%	0.31%	0.31%	0.30%	0.26%	0.26%	0.22%	0.19%	0.18%	0.18%	0.14%	0.11%	0.03%	0.03%
10.00	0.24%	0.25%	0.26%	0.26%	0.26%	0.25%	0.24%	0.26%	0.26%	0.26%	0.25%	0.21%	0.21%	0.18%	0.15%	0.15%	0.15%	0.12%	0.09%	0.03%	0.02%
10.67	0.24%	0.25%	0.26%	0.26%	0.26%	0.25%	0.24%	0.26%	0.26%	0.26%	0.25%	0.21%	0.21%	0.18%	0.15%	0.15%	0.15%	0.12%	0.09%	0.03%	0.02%
11.33	0.19%	0.20%	0.22%	0.22%	0.21%	0.21%	0.20%	0.21%	0.22%	0.21%	0.20%	0.18%	0.18%	0.15%	0.13%	0.12%	0.12%	0.09%	0.08%	0.02%	0.02%
12.00	0.17%	0.18%	0.19%	0.19%	0.19%	0.18%	0.18%	0.19%	0.19%	0.19%	0.18%	0.16%	0.15%	0.13%	0.11%	0.11%	0.11%	0.08%	0.07%	0.02%	0.02%
12.67	0.14%	0.15%	0.16%	0.16%	0.16%	0.16%	0.15%	0.16%	0.16%	0.16%	0.15%	0.13%	0.13%	0.11%	0.10%	0.09%	0.09%	0.07%	0.06%	0.02%	0.01%
13.33	0.13%	0.13%	0.14%	0.14%	0.14%	0.13%	0.13%	0.14%	0.14%	0.14%	0.13%	0.11%	0.11%	0.10%	0.08%	0.08%	0.08%	0.06%	0.05%	0.01%	0.01%
14.00	0.11%	0.11%	0.12%	0.12%	0.12%	0.12%	0.11%	0.12%	0.12%	0.12%	0.11%	0.10%	0.10%	0.08%	0.07%	0.07%	0.07%	0.05%	0.04%	0.01%	0.01%
14.67	0.10%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.09%	0.09%	0.08%	0.07%	0.07%	0.06%	0.05%	0.04%	0.01%	0.01%
15.33	0.10%	0.10%	0.11%	0.11%	0.11%	0.10%	0.10%	0.11%	0.11%	0.11%	0.10%	0.09%	0.09%	0.08%	0.06%	0.06%	0.06%	0.05%	0.04%	0.01%	0.01%
16.00	0.09%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.08%	0.08%	0.07%	0.06%	0.06%	0.06%	0.05%	0.04%	0.01%	0.01%
16.67	0.06%	0.07%	0.07%	0.07%	0.07%	0.07%	0.07%	0.07%	0.07%	0.07%	0.07%	0.06%	0.06%	0.05%	0.04%	0.04%	0.04%	0.03%	0.03%	0.01%	0.01%
17.33	0.04%	0.05%	0.05%	0.05%	0.05%	0.05%	0.04%	0.05%	0.05%	0.05%	0.05%	0.04%	0.04%	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%	0.00%	0.00%
18.00	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%	0.02%	0.02%	0.01%	0.01%	0.00%	0.00%
18.67	0.05%	0.06%	0.06%	0.06%	0.06%	0.06%	0.05%	0.06%	0.06%	0.06%	0.06%	0.05%	0.05%	0.04%	0.03%	0.03%	0.03%	0.03%	0.02%	0.01%	0.00%
19.33	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.02%	0.02%	0.02%	0.02%	0.02%	0.01%	0.00%	0.00%
20.00	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%
20.67	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
21.33	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table B. Velocity profiles - average of 6:40 to 7:00 and 8:00 to 8:30

	1152.9	1155.6	1158.4	1161.1	1163.8	1166.5	1169.3	1172.0	1174.7	1177.5	1180.2	1182.9	1185.6	1188.4	1191.1	1193.8	1196.5
0.67	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735
1.33	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735
2.00	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735
2.67	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768
3.33	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802
4.00	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830
4.67	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859
5.33	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883
6.00	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907
6.67	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923
7.33	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939
8.00	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964
8.67	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
9.33	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018
10.00	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046
10.67	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075
11.33	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103
12.00	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109
12.67	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114
13.33	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132
14.00	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150
14.67	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166
15.33	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181
16.00	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187
16.67	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192
17.33	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198
18.00	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203
18.67	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208
19.33	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212
20.00	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200
20.67	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188
21.33	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188

	1199.3	1202.0	1204.7	1207.5	1210.2	1212.9	1215.6	1218.4	1221.1	1223.8	1226.5	1229.3	1232.0	1234.7	1237.5	1240.2	1242.9	1245.6	1248.4	1251.1	1253.8
0.67	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735
1.33	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735
2.00	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735	0.735
2.67	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768	0.768
3.33	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802
4.00	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830
4.67	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859
5.33	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883	0.883
6.00	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907	0.907
6.67	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923	0.923
7.33	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939
8.00	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964	0.964
8.67	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
9.33	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018	1.018
10.00	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046	1.046
10.67	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075	1.075
11.33	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103	1.103
12.00	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109
12.67	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114
13.33	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132	1.132
14.00	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150	1.150
14.67	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166
15.33	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181
16.00	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187
16.67	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192
17.33	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198	1.198
18.00	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203	1.203
18.67	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208	1.208
19.33	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212	1.212
20.00	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200
20.67	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188
21.33	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188	1.188

Cell Area 1.827273 sf

PEAK-TO-MEAN CALCULATION TABLES

Table C. vdA - River flow through each cell (cfs) **(Tbl B * Cell Area)**

	1152.9	1155.6	1158.4	1161.1	1163.8	1166.5	1169.3	1172.0	1174.7	1177.5	1180.2	1182.9	1185.6	1188.4	1191.1	1193.8	1196.5	1199.3	1202.0
0.67	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434
1.33	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434
2.00	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434
2.67	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042
3.33	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650
4.00	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172
4.67	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694
5.33	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135
6.00	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576
6.67	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867
7.33	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158
8.00	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621
8.67	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083
9.33	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601
10.00	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119
10.67	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637
11.33	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155
12.00	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258
12.67	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361
13.33	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686
14.00	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011
14.67	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298
15.33	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585
16.00	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683
16.67	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782
17.33	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885
18.00	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987
18.67	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069
19.33	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150
20.00	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931
20.67	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711
21.33	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711

	1204.7	1207.5	1210.2	1212.9	1215.6	1218.4	1221.1	1223.8	1226.5	1229.3	1232.0	1234.7	1237.5	1240.2	1242.9	1245.6	1248.4	1251.1	1253.8
0.67	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434
1.33	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434
2.00	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434
2.67	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042
3.33	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650
4.00	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172
4.67	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694
5.33	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135
6.00	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576
6.67	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867
7.33	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158
8.00	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621
8.67	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083
9.33	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601
10.00	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119
10.67	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637
11.33	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155
12.00	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258
12.67	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361
13.33	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686
14.00	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011
14.67	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298
15.33	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585
16.00	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683
16.67	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782
17.33	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885	2.1885
18.00	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987	2.1987
18.67	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069	2.2069
19.33	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150	2.2150
20.00	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931	2.1931
20.67	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711
21.33	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711	2.1711

Cell Area **1.827273 sf**

Table D. CvdA - Effluent flow through each cell (cfs) **(Tbl A * Tbl B * Cell Area)**

	1152.9	1155.6	1158.4	1161.1	1163.8	1166.5	1169.3	1172.0	1174.7	1177.5	1180.2	1182.9	1185.6	1188.4	1191.1	1193.8	1196.5	1199.3	1202.0
0.67	0.0006	0.0010	0.0014	0.0017	0.0016	0.0019	0.0031	0.0030	0.0043	0.0050	0.0058	0.0056	0.0064	0.0066	0.0053	0.0060	0.0058	0.0057	0.0061
1.33	0.0007	0.0011	0.0015	0.0018	0.0017	0.0021	0.0034	0.0032	0.0046	0.0053	0.0062	0.0060	0.0068	0.0071	0.0057	0.0064	0.0062	0.0061	0.0065
2.00	0.0007	0.0011	0.0016	0.0019	0.0018	0.0022	0.0036	0.0034	0.0049	0.0057	0.0066	0.0064	0.0072	0.0075	0.0061	0.0068	0.0066	0.0065	0.0069
2.67	0.0007	0.0011	0.0016	0.0018	0.0017	0.0021	0.0035	0.0033	0.0047	0.0055	0.0063	0.0062	0.0070	0.0073	0.0059	0.0066	0.0064	0.0063	0.0067
3.33	0.0006	0.0009	0.0013	0.0015	0.0015	0.0018	0.0029	0.0028	0.0039	0.0046	0.0053	0.0052	0.0059	0.0061	0.0049	0.0055	0.0054	0.0053	0.0056
4.00	0.0007	0.0011	0.0015	0.0018	0.0017	0.0021	0.0033	0.0032	0.0045	0.0053	0.0061	0.0060	0.0068	0.0070	0.0057	0.0064	0.0062	0.0061	0.0064
4.67	0.0007	0.0011	0.0016	0.0019	0.0018	0.0022	0.0036	0.0034	0.0049	0.0057	0.0066	0.0064	0.0072	0.0075	0.0061	0.0069	0.0066	0.0065	0.0069
5.33	0.0007	0.0012	0.0017	0.0020	0.0019	0.0023	0.0037	0.0036	0.0050	0.0059	0.0068	0.0066	0.0075	0.0078	0.0063	0.0071	0.0068	0.0068	0.0071
6.00	0.0007	0.0012	0.0017	0.0020	0.0019	0.0023	0.0037	0.0036	0.0050	0.0059	0.0068	0.0067	0.0075	0.0078	0.0063	0.0071	0.0069	0.0068	0.0072
6.67	0.0007	0.0011	0.0016	0.0019	0.0018	0.0022	0.0036	0.0034	0.0048	0.0056	0.0065	0.0064	0.0072	0.0075	0.0060	0.0068	0.0066	0.0065	0.0069
7.33	0.0007	0.0012	0.0016	0.0019	0.0019	0.0023	0.0037	0.0035	0.0050	0.0058	0.0067	0.0066	0.0074	0.0077	0.0062	0.0070	0.0068	0.0067	0.0071
8.00	0.0008	0.0012	0.0017	0.0020	0.0019	0.0024	0.0039	0.0037	0.0052	0.0061	0.0071	0.0069	0.0078	0.0081	0.0066	0.0074	0.0071	0.0071	0.0074
8.67	0.0007	0.0010	0.0015	0.0017	0.0017	0.0020	0.0033	0.0031	0.0044	0.0052	0.0060	0.0059	0.0066	0.0069	0.0056	0.0063	0.0061	0.0060	0.0063
9.33	0.0006	0.0009	0.0013	0.0015	0.0014	0.0018	0.0029	0.0027	0.0039	0.0045	0.0053	0.0051	0.0058	0.0060	0.0049	0.0055	0.0053	0.0052	0.0055
10.00	0.0005	0.0008	0.0011	0.0013	0.0012	0.0015	0.0025	0.0024	0.0033	0.0039	0.0045	0.0044	0.0050	0.0052	0.0042	0.0047	0.0045	0.0045	0.0047
10.67	0.0005	0.0008	0.0011	0.0013	0.0013	0.0016	0.0025	0.0024	0.0034	0.0040	0.0046	0.0045	0.0051	0.0053	0.0043	0.0048	0.0047	0.0046	0.0049
11.33	0.0004	0.0007	0.0010	0.0011	0.0011	0.0013	0.0021	0.0020	0.0029	0.0034	0.0039	0.0038	0.0043	0.0045	0.0036	0.0041	0.0039	0.0039	0.0041
12.00	0.0004	0.0006	0.0008	0.0010	0.0010	0.0012	0.0019	0.0018	0.0026	0.0030	0.0035	0.0034	0.0038	0.0040	0.0032	0.0036	0.0035	0.0034	0.0036
12.67	0.0003	0.0005	0.0007	0.0009	0.0008	0.0010	0.0016	0.0015	0.0022	0.0026	0.0030	0.0029	0.0033	0.0034	0.0027	0.0031	0.0030	0.0030	0.0031
13.33	0.0003	0.0004	0.0006	0.0008	0.0007	0.0009	0.0014	0.0014	0.0019	0.0023	0.0026	0.0026	0.0029	0.0030	0.0024	0.0027	0.0026	0.0026	0.0027
14.00	0.0003	0.0004	0.0006	0.0007	0.0006	0.0008	0.0013	0.0012	0.0017	0.0020	0.0023	0.0022	0.0025	0.0026	0.0021	0.0024	0.0023	0.0023	0.0024
14.67	0.0002	0.0004	0.0005	0.0006	0.0006	0.0007	0.0012	0.0011	0.0016	0.0019	0.0022	0.0021	0.0024	0.0025	0.0020	0.0023	0.0022	0.0022	0.0023
15.33	0.0002	0.0004	0.0005	0.0006	0.0006	0.0007	0.0012	0.0011	0.0016	0.0018	0.0021	0.0021	0.0023	0.0024	0.0020	0.0022	0.0021	0.0021	0.0022
16.00	0.0002	0.0003	0.0005	0.0006	0.0006	0.0007	0.0011	0.0011	0.0015	0.0017	0.0020	0.0020	0.0022	0.0023	0.0019	0.0021	0.0020	0.0020	0.0021
16.67	0.0002	0.0002	0.0003	0.0004	0.0004	0.0005	0.0008	0.0007	0.0010	0.0012	0.0014	0.0013	0.0015	0.0016	0.0013	0.0014	0.0014	0.0014	0.0015
17.33	0.0001	0.0002	0.0002	0.0003	0.0003	0.0003	0.0005	0.0005	0.0007	0.0008	0.0009	0.0009	0.0010	0.0011	0.0009	0.0010	0.0009	0.0009	0.0010
18.00	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0005	0.0005	0.0006	0.0006	0.0007	0.0007	0.0006	0.0007	0.0006	0.0006	0.0007
18.67	0.0001	0.0002	0.0003	0.0003	0.0003	0.0004	0.0006	0.0006	0.0009	0.0010	0.0012	0.0011	0.0013	0.0013	0.0011	0.0012	0.0012	0.0012	0.0012
19.33	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0004	0.0004	0.0005	0.0006	0.0007	0.0007	0.0008	0.0008	0.0006	0.0007	0.0007	0.0007	0.0007
20.00	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0003	0.0004	0.0004	0.0004	0.0004	0.0003	0.0004	0.0004	0.0004	0.0004
20.67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
21.33	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

	1204.7	1207.5	1210.2	1212.9	1215.6	1218.4	1221.1	1223.8	1226.5	1229.3	1232.0	1234.7	1237.5	1240.2	1242.9	1245.6	1248.4	1251.1	1253.8
0.67	0.0064	0.0064	0.0063	0.0062	0.0060	0.0064	0.0064	0.0063	0.0061	0.0052	0.0052	0.0044	0.0038	0.0037	0.0036	0.0028	0.0023	0.0007	0.0005
1.33	0.0068	0.0069	0.0068	0.0066	0.0064	0.0068	0.0068	0.0067	0.0065	0.0056	0.0056	0.0047	0.0040	0.0039	0.0038	0.0030	0.0025	0.0007	0.0005
2.00	0.0073	0.0073	0.0072	0.0070	0.0068	0.0072	0.0073	0.0072	0.0069	0.0060	0.0059	0.0050	0.0043	0.0042	0.0041	0.0032	0.0026	0.0008	0.0006
2.67	0.0070	0.0070	0.0070	0.0068	0.0065	0.0070	0.0070	0.0069	0.0067	0.0058	0.0057	0.0049	0.0042	0.0040	0.0039	0.0031	0.0025	0.0007	0.0006
3.33	0.0059	0.0059	0.0058	0.0057	0.0055	0.0059	0.0059	0.0058	0.0056	0.0048	0.0048	0.0041	0.0035	0.0034	0.0033	0.0026	0.0021	0.0006	0.0005
4.00	0.0068	0.0068	0.0067	0.0065	0.0063	0.0068	0.0068	0.0067	0.0065	0.0056	0.0056	0.0047	0.0040	0.0039	0.0038	0.0030	0.0024	0.0007	0.0005
4.67	0.0073	0.0073	0.0072	0.0070	0.0068	0.0073	0.0073	0.0072	0.0069	0.0060	0.0060	0.0050	0.0043	0.0042	0.0041	0.0032	0.0026	0.0008	0.0006
5.33	0.0075	0.0076	0.0075	0.0073	0.0070	0.0075	0.0075	0.0074	0.0072	0.0062	0.0062	0.0052	0.0045	0.0043	0.0042	0.0033	0.0027	0.0008	0.0006
6.00	0.0075	0.0076	0.0075	0.0073	0.0070	0.0075	0.0075	0.0074	0.0072	0.0062	0.0062	0.0052	0.0045	0.0043	0.0042	0.0033	0.0027	0.0008	0.0006
6.67	0.0072	0.0073	0.0072	0.0070	0.0067	0.0072	0.0072	0.0071	0.0069	0.0059	0.0059	0.0050	0.0043	0.0041	0.0041	0.0032	0.0026	0.0008	0.0006
7.33	0.0075	0.0075	0.0074	0.0072	0.0070	0.0074	0.0075	0.0074	0.0071	0.0061	0.0061	0.0052	0.0044	0.0043	0.0042	0.0033	0.0027	0.0008	0.0006
8.00	0.0078	0.0079	0.0078	0.0076	0.0073	0.0078	0.0078	0.0077	0.0075	0.0064	0.0064	0.0054	0.0046	0.0045	0.0044	0.0035	0.0028	0.0008	0.0006
8.67	0.0067	0.0067	0.0066	0.0064	0.0062	0.0066	0.0067	0.0066	0.0063	0.0055	0.0054	0.0046	0.0039	0.0038	0.0037	0.0029	0.0024	0.0007	0.0005
9.33	0.0058	0.0058	0.0058	0.0056	0.0054	0.0058	0.0058	0.0057	0.0055	0.0048	0.0048	0.0040	0.0034	0.0033	0.0033	0.0026	0.0021	0.0006	0.0005
10.00	0.0050	0.0050	0.0050	0.0048	0.0047	0.0050	0.0050	0.0049	0.0048	0.0041	0.0041	0.0035	0.0030	0.0029	0.0028	0.0022	0.0018	0.0005	0.0004
10.67	0.0051	0.0052	0.0051	0.0050	0.0048	0.0051	0.0051	0.0051	0.0049	0.0042	0.0042	0.0036	0.0030	0.0029	0.0029	0.0023	0.0019	0.0005	0.0004
11.33	0.0043	0.0044	0.0043	0.0042	0.0040	0.0043	0.0043	0.0043	0.0041	0.0036	0.0036	0.0030	0.0026	0.0025	0.0024	0.0019	0.0016	0.0005	0.0003
12.00	0.0038	0.0038	0.0038	0.0037	0.0036	0.0038	0.0038	0.0038	0.0036	0.0031	0.0031	0.0027	0.0023	0.0022	0.0022	0.0017	0.0014	0.0004	0.0003
12.67	0.0033	0.0033	0.0033	0.0032	0.0031	0.0033	0.0033	0.0032	0.0031	0.0027	0.0027	0.0023	0.0019	0.0019	0.0018	0.0014	0.0012	0.0003	0.0003
13.33	0.0029	0.0029	0.0029	0.0028	0.0027	0.0029	0.0029	0.0028	0.0027	0.0024	0.0024	0.0020	0.0017	0.0017	0.0016	0.0013	0.0010	0.0003	0.0002
14.00	0.0025	0.0025	0.0025	0.0024	0.0024	0.0025	0.0025	0.0025	0.0024	0.0021	0.0021	0.0018	0.0015	0.0015	0.0014	0.0011	0.0009	0.0003	0.0002
14.67	0.0024	0.0024	0.0024	0.0023	0.0023	0.0024	0.0024	0.0024	0.0023	0.0020	0.0020	0.0017	0.0014	0.0014	0.0014	0.0011	0.0009	0.0003	0.0002
15.33	0.0023	0.0023	0.0023	0.0023	0.0022	0.0023	0.0023	0.0023	0.0022	0.0019	0.0019	0.0016	0.0014	0.0013	0.0013	0.0010	0.0008	0.0002	0.0002
16.00	0.0022	0.0022	0.0022	0.0022	0.0021	0.0022	0.0022	0.0022	0.0021	0.0018	0.0018	0.0015	0.0013	0.0013	0.0013	0.0010	0.0008	0.0002	0.0002
16.67	0.0015	0.0015	0.0015	0.0015	0.0014	0.0015	0.0015	0.0015	0.0015	0.0013	0.0013	0.0011	0.0009	0.0009	0.0009	0.0007	0.0006	0.0002	0.0001
17.33	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0009	0.0009	0.0007	0.0006	0.0006	0.0006	0.0005	0.0004	0.0001	0.0001
18.00	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0006	0.0006	0.0005	0.0004	0.0004	0.0004	0.0003	0.0003	0.0001	0.0001
18.67	0.0013	0.0013	0.0013	0.0013	0.0012	0.0013	0.0013	0.0013	0.0012	0.0011	0.0011	0.0009	0.0008	0.0007	0.0007	0.0006	0.0005	0.0001	0.0001
19.33	0.0008	0.0008	0.0008	0.0007	0.0007	0.0008	0.0008	0.0008	0.0007	0.0006	0.0006	0.0005	0.0005	0.0004	0.0004	0.0003	0.0003	0.0001	0.0001
20.00	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003	0.0002	0.0002	0.0002	0.0002	0.0001	0.0000	0.0000
20.67	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
21.33	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Total effluent flow **3.5674 cfs**
= **2.316482 mgd**

PEAK-TO-MEAN CALCULATION TABLES

Table E. CvdA for values greater than 0.0010 cfs

	1152.9	1155.6	1158.4	1161.1	1163.8	1166.5	1169.3	1172.0	1174.7	1177.5	1180.2	1182.9	1185.6	1188.4	1191.1	1193.8	1196.5	1199.3	1202.0
0.67		0.0010	0.0014	0.0017	0.0016	0.0019	0.0031	0.0030	0.0043	0.0050	0.0058	0.0056	0.0064	0.0066	0.0053	0.0060	0.0058	0.0057	0.0061
1.33		0.0011	0.0015	0.0018	0.0017	0.0021	0.0034	0.0032	0.0046	0.0053	0.0062	0.0060	0.0068	0.0071	0.0057	0.0064	0.0062	0.0061	0.0065
2.00		0.0011	0.0016	0.0019	0.0018	0.0022	0.0036	0.0034	0.0049	0.0057	0.0066	0.0064	0.0072	0.0075	0.0061	0.0068	0.0066	0.0065	0.0069
2.67		0.0011	0.0016	0.0018	0.0017	0.0021	0.0035	0.0033	0.0047	0.0055	0.0063	0.0062	0.0070	0.0073	0.0059	0.0066	0.0064	0.0063	0.0067
3.33		0.0009	0.0013	0.0015	0.0015	0.0018	0.0029	0.0028	0.0039	0.0046	0.0053	0.0052	0.0059	0.0061	0.0049	0.0055	0.0054	0.0053	0.0056
4.00		0.0011	0.0015	0.0018	0.0017	0.0021	0.0033	0.0032	0.0045	0.0053	0.0061	0.0060	0.0068	0.0070	0.0057	0.0064	0.0062	0.0061	0.0064
4.67		0.0011	0.0016	0.0019	0.0018	0.0022	0.0036	0.0034	0.0049	0.0057	0.0066	0.0064	0.0072	0.0075	0.0061	0.0069	0.0066	0.0065	0.0069
5.33		0.0012	0.0017	0.0020	0.0019	0.0023	0.0037	0.0036	0.0050	0.0059	0.0068	0.0066	0.0075	0.0078	0.0063	0.0071	0.0068	0.0068	0.0071
6.00		0.0012	0.0017	0.0020	0.0019	0.0023	0.0037	0.0036	0.0050	0.0059	0.0068	0.0067	0.0075	0.0078	0.0063	0.0071	0.0069	0.0068	0.0072
6.67		0.0011	0.0016	0.0019	0.0018	0.0022	0.0036	0.0034	0.0048	0.0056	0.0065	0.0064	0.0072	0.0075	0.0060	0.0068	0.0066	0.0065	0.0069
7.33		0.0012	0.0016	0.0019	0.0019	0.0023	0.0037	0.0035	0.0050	0.0058	0.0067	0.0066	0.0074	0.0077	0.0062	0.0070	0.0068	0.0067	0.0071
8.00		0.0012	0.0017	0.0020	0.0019	0.0024	0.0039	0.0037	0.0052	0.0061	0.0071	0.0069	0.0078	0.0081	0.0066	0.0074	0.0071	0.0071	0.0074
8.67		0.0010	0.0015	0.0017	0.0017	0.0020	0.0033	0.0031	0.0044	0.0052	0.0060	0.0059	0.0066	0.0069	0.0056	0.0063	0.0061	0.0060	0.0063
9.33			0.0013	0.0015	0.0014	0.0018	0.0029	0.0027	0.0039	0.0045	0.0053	0.0051	0.0058	0.0060	0.0049	0.0055	0.0053	0.0052	0.0055
10.00			0.0011	0.0013	0.0012	0.0015	0.0025	0.0024	0.0033	0.0039	0.0045	0.0044	0.0050	0.0052	0.0042	0.0047	0.0045	0.0045	0.0047
10.67			0.0011	0.0013	0.0013	0.0016	0.0025	0.0024	0.0034	0.0040	0.0046	0.0045	0.0051	0.0053	0.0043	0.0048	0.0047	0.0046	0.0049
11.33			0.0010	0.0011	0.0011	0.0013	0.0021	0.0020	0.0029	0.0034	0.0039	0.0038	0.0043	0.0045	0.0036	0.0041	0.0039	0.0039	0.0041
12.00				0.0010	0.0010	0.0012	0.0019	0.0018	0.0026	0.0030	0.0035	0.0034	0.0038	0.0040	0.0032	0.0036	0.0035	0.0034	0.0036
12.67						0.0010	0.0016	0.0015	0.0022	0.0026	0.0030	0.0029	0.0033	0.0034	0.0027	0.0031	0.0030	0.0030	0.0031
13.33							0.0014	0.0014	0.0019	0.0023	0.0026	0.0026	0.0029	0.0030	0.0024	0.0027	0.0026	0.0026	0.0027
14.00							0.0013	0.0012	0.0017	0.0020	0.0023	0.0022	0.0025	0.0026	0.0021	0.0024	0.0023	0.0023	0.0024
14.67							0.0012	0.0011	0.0016	0.0019	0.0022	0.0021	0.0024	0.0025	0.0020	0.0023	0.0022	0.0022	0.0023
15.33							0.0012	0.0011	0.0016	0.0018	0.0021	0.0021	0.0023	0.0024	0.0020	0.0022	0.0021	0.0021	0.0022
16.00							0.0011	0.0011	0.0015	0.0017	0.0020	0.0020	0.0022	0.0023	0.0019	0.0021	0.0020	0.0020	0.0021
16.67									0.0010	0.0012	0.0014	0.0013	0.0015	0.0016	0.0013	0.0014	0.0014	0.0014	0.0015
17.33																			

	1204.7	1207.5	1210.2	1212.9	1215.6	1218.4	1221.1	1223.8	1226.5	1229.3	1232.0	1234.7	1237.5	1240.2	1242.9	1245.6	1248.4	1251.1	1253.8
0.67	0.0064	0.0064	0.0063	0.0062	0.0060	0.0064	0.0064	0.0063	0.0061	0.0052	0.0052	0.0044	0.0038	0.0037	0.0036	0.0028	0.0023		
1.33	0.0068	0.0069	0.0068	0.0066	0.0064	0.0068	0.0068	0.0067	0.0065	0.0056	0.0056	0.0047	0.0040	0.0039	0.0038	0.0030	0.0025		
2.00	0.0073	0.0073	0.0072	0.0070	0.0068	0.0072	0.0073	0.0072	0.0069	0.0060	0.0059	0.0050	0.0043	0.0042	0.0041	0.0032	0.0026		
2.67	0.0070	0.0070	0.0070	0.0068	0.0065	0.0070	0.0070	0.0069	0.0067	0.0058	0.0057	0.0049	0.0042	0.0040	0.0039	0.0031	0.0025		
3.33	0.0059	0.0059	0.0058	0.0057	0.0055	0.0059	0.0059	0.0058	0.0056	0.0048	0.0048	0.0041	0.0035	0.0034	0.0033	0.0026	0.0021		
4.00	0.0068	0.0068	0.0067	0.0065	0.0063	0.0068	0.0068	0.0067	0.0065	0.0056	0.0056	0.0047	0.0040	0.0039	0.0038	0.0030	0.0024		
4.67	0.0073	0.0073	0.0072	0.0070	0.0068	0.0073	0.0073	0.0072	0.0069	0.0060	0.0060	0.0050	0.0043	0.0042	0.0041	0.0032	0.0026		
5.33	0.0075	0.0076	0.0075	0.0073	0.0070	0.0075	0.0075	0.0074	0.0072	0.0062	0.0062	0.0052	0.0045	0.0043	0.0042	0.0033	0.0027		
6.00	0.0075	0.0076	0.0075	0.0073	0.0070	0.0075	0.0075	0.0074	0.0072	0.0062	0.0062	0.0052	0.0045	0.0043	0.0042	0.0033	0.0027		
6.67	0.0072	0.0073	0.0072	0.0070	0.0067	0.0072	0.0072	0.0071	0.0069	0.0059	0.0059	0.0050	0.0043	0.0041	0.0041	0.0032	0.0026		
7.33	0.0075	0.0075	0.0074	0.0072	0.0070	0.0074	0.0075	0.0074	0.0071	0.0061	0.0061	0.0052	0.0044	0.0043	0.0042	0.0033	0.0027		
8.00	0.0078	0.0079	0.0078	0.0076	0.0073	0.0078	0.0078	0.0077	0.0075	0.0064	0.0064	0.0054	0.0046	0.0045	0.0044	0.0035	0.0028		
8.67	0.0067	0.0067	0.0066	0.0064	0.0062	0.0066	0.0067	0.0066	0.0063	0.0055	0.0054	0.0046	0.0039	0.0038	0.0037	0.0029	0.0024		
9.33	0.0058	0.0058	0.0058	0.0056	0.0054	0.0058	0.0058	0.0057	0.0055	0.0048	0.0048	0.0040	0.0034	0.0033	0.0033	0.0026	0.0021		
10.00	0.0050	0.0050	0.0050	0.0048	0.0047	0.0050	0.0050	0.0049	0.0048	0.0041	0.0041	0.0035	0.0030	0.0029	0.0028	0.0022	0.0018		
10.67	0.0051	0.0052	0.0051	0.0050	0.0048	0.0051	0.0051	0.0051	0.0049	0.0042	0.0042	0.0036	0.0030	0.0029	0.0029	0.0023	0.0019		
11.33	0.0043	0.0044	0.0043	0.0042	0.0040	0.0043	0.0043	0.0043	0.0041	0.0036	0.0036	0.0030	0.0026	0.0025	0.0024	0.0019	0.0016		
12.00	0.0038	0.0038	0.0038	0.0037	0.0036	0.0038	0.0038	0.0038	0.0036	0.0031	0.0031	0.0027	0.0023	0.0022	0.0022	0.0017	0.0014		
12.67	0.0033	0.0033	0.0033	0.0032	0.0031	0.0033	0.0033	0.0032	0.0031	0.0027	0.0027	0.0023	0.0019	0.0019	0.0018	0.0014	0.0012		
13.33	0.0029	0.0029	0.0029	0.0028	0.0027	0.0029	0.0029	0.0028	0.0027	0.0024	0.0024	0.0020	0.0017	0.0017	0.0016	0.0013	0.0010		
14.00	0.0025	0.0025	0.0025	0.0024	0.0024	0.0025	0.0025	0.0025	0.0024	0.0021	0.0021	0.0018	0.0015	0.0015	0.0014	0.0011			
14.67	0.0024	0.0024	0.0024	0.0023	0.0023	0.0024	0.0024	0.0024	0.0023	0.0020	0.0020	0.0017	0.0014	0.0014	0.0014	0.0011			
15.33	0.0023	0.0023	0.0023	0.0023	0.0022	0.0023	0.0023	0.0023	0.0022	0.0019	0.0019	0.0016	0.0014	0.0013	0.0013	0.0010			
16.00	0.0022	0.0022	0.0022	0.0022	0.0021	0.0022	0.0022	0.0022	0.0021	0.0018	0.0018	0.0015	0.0013	0.0013	0.0013	0.0010			
16.67	0.0015	0.0015	0.0015	0.0015	0.0014	0.0015	0.0015	0.0015	0.0015	0.0013	0.0013	0.0011							
17.33																			

Number cells 824
Total effluent flow 3.3795 cfs
= 2.194512 mgd

Mass Recovery
94.73%

Table F. vdA for values greater than 0.0010 cfs

	1152.9	1155.6	1158.4	1161.1	1163.8	1166.5	1169.3	1172.0	1174.7	1177.5	1180.2	1182.9	1185.6	1188.4	1191.1	1193.8	1196.5	1199.3	1202.0
0.67		1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434
1.33		1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434
2.00		1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434
2.67		1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042
3.33		1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650
4.00		1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172
4.67		1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694
5.33		1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135
6.00		1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576
6.67		1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867
7.33		1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158
8.00		1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621
8.67		1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083
9.33			1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601
10.00			1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119
10.67			1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637
11.33			2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155
12.00				2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258
12.67						2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361
13.33							2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686
14.00							2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011
14.67							2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298
15.33							2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585
16.00							2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683
16.67									2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782
17.33																			

	1204.7	1207.5	1210.2	1212.9	1215.6	1218.4	1221.1	1223.8	1226.5	1229.3	1232.0	1234.7	1237.5	1240.2	1242.9	1245.6	1248.4	1251.1	1253.8
0.67	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434		
1.33	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434		
2.00	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434	1.3434		
2.67	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042	1.4042		
3.33	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650	1.4650		
4.00	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172	1.5172		
4.67	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694	1.5694		
5.33	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135	1.6135		
6.00	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576	1.6576		
6.67	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867	1.6867		
7.33	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158	1.7158		
8.00	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621	1.7621		
8.67	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083	1.8083		
9.33	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601	1.8601		
10.00	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119	1.9119		
10.67	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637	1.9637		
11.33	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155	2.0155		
12.00	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258	2.0258		
12.67	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361	2.0361		
13.33	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686	2.0686		
14.00	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011	2.1011			
14.67	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298	2.1298			
15.33	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585	2.1585			
16.00	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683	2.1683			
16.67	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782	2.1782							
17.33																			

Number cells 824
Total flow 1462 cfs
= 949 mgd

Flux Average Conc 0.23%
Flux Average Dilution 433

PEAK-TO-MEAN CALCULATION TABLES

Table G. Effluent fraction for 95% Mass Recovery

	1152.9	1155.6	1158.4	1161.1	1163.8	1166.5	1169.3	1172.0	1174.7	1177.5	1180.2	1182.9	1185.6	1188.4	1191.1	1193.8	1196.5
0.67		0.07%	0.11%	0.12%	0.12%	0.14%	0.23%	0.22%	0.32%	0.37%	0.43%	0.42%	0.47%	0.49%	0.40%	0.45%	0.43%
1.33		0.08%	0.11%	0.13%	0.13%	0.15%	0.25%	0.24%	0.34%	0.40%	0.46%	0.45%	0.51%	0.53%	0.43%	0.48%	0.46%
2.00		0.08%	0.12%	0.14%	0.13%	0.16%	0.27%	0.26%	0.36%	0.42%	0.49%	0.48%	0.54%	0.56%	0.45%	0.51%	0.49%
2.67		0.08%	0.11%	0.13%	0.12%	0.15%	0.25%	0.24%	0.33%	0.39%	0.45%	0.44%	0.50%	0.52%	0.42%	0.47%	0.45%
3.33		0.06%	0.09%	0.10%	0.10%	0.12%	0.20%	0.19%	0.27%	0.31%	0.36%	0.35%	0.40%	0.42%	0.34%	0.38%	0.37%
4.00		0.07%	0.10%	0.12%	0.11%	0.14%	0.22%	0.21%	0.30%	0.35%	0.40%	0.39%	0.45%	0.46%	0.37%	0.42%	0.41%
4.67		0.07%	0.10%	0.12%	0.12%	0.14%	0.23%	0.22%	0.31%	0.36%	0.42%	0.41%	0.46%	0.48%	0.39%	0.44%	0.42%
5.33		0.07%	0.10%	0.12%	0.12%	0.14%	0.23%	0.22%	0.31%	0.36%	0.42%	0.41%	0.46%	0.48%	0.39%	0.44%	0.42%
6.00		0.07%	0.10%	0.12%	0.11%	0.14%	0.22%	0.21%	0.30%	0.36%	0.41%	0.40%	0.45%	0.47%	0.38%	0.43%	0.41%
6.67		0.07%	0.09%	0.11%	0.11%	0.13%	0.21%	0.20%	0.29%	0.33%	0.39%	0.38%	0.43%	0.44%	0.36%	0.40%	0.39%
7.33		0.07%	0.10%	0.11%	0.11%	0.13%	0.21%	0.21%	0.29%	0.34%	0.39%	0.38%	0.43%	0.45%	0.36%	0.41%	0.40%
8.00		0.07%	0.10%	0.12%	0.11%	0.14%	0.22%	0.21%	0.30%	0.35%	0.40%	0.39%	0.44%	0.46%	0.37%	0.42%	0.41%
8.67		0.06%	0.08%	0.10%	0.09%	0.11%	0.18%	0.17%	0.25%	0.29%	0.33%	0.32%	0.37%	0.38%	0.31%	0.35%	0.33%
9.33			0.07%	0.08%	0.08%	0.10%	0.15%	0.15%	0.21%	0.24%	0.28%	0.28%	0.31%	0.32%	0.26%	0.29%	0.28%
10.00			0.06%	0.07%	0.06%	0.08%	0.13%	0.12%	0.17%	0.20%	0.24%	0.23%	0.26%	0.27%	0.22%	0.25%	0.24%
10.67			0.06%	0.07%	0.06%	0.08%	0.13%	0.12%	0.17%	0.20%	0.24%	0.23%	0.26%	0.27%	0.22%	0.25%	0.24%
11.33			0.05%	0.06%	0.05%	0.07%	0.11%	0.10%	0.14%	0.17%	0.19%	0.19%	0.21%	0.22%	0.18%	0.20%	0.20%
12.00				0.05%	0.05%	0.06%	0.09%	0.09%	0.13%	0.15%	0.17%	0.17%	0.19%	0.20%	0.16%	0.18%	0.17%
12.67						0.05%	0.08%	0.08%	0.11%	0.13%	0.15%	0.14%	0.16%	0.17%	0.13%	0.15%	0.15%
13.33							0.07%	0.07%	0.09%	0.11%	0.13%	0.12%	0.14%	0.14%	0.12%	0.13%	0.13%
14.00							0.06%	0.06%	0.08%	0.09%	0.11%	0.11%	0.12%	0.13%	0.10%	0.11%	0.11%
14.67							0.06%	0.05%	0.08%	0.09%	0.10%	0.10%	0.11%	0.12%	0.10%	0.11%	0.10%
15.33							0.05%	0.05%	0.07%	0.08%	0.10%	0.10%	0.11%	0.11%	0.09%	0.10%	0.10%
16.00							0.05%	0.05%	0.07%	0.08%	0.09%	0.09%	0.10%	0.11%	0.09%	0.10%	0.09%
16.67									0.05%	0.05%	0.06%	0.06%	0.07%	0.07%	0.06%	0.07%	0.06%
17.33																	

	1199.3	1202.0	1204.7	1207.5	1210.2	1212.9	1215.6	1218.4	1221.1	1223.8	1226.5	1229.3	1232.0	1234.7	1237.5	1240.2	1242.9	1245.6	1248.4	1251.1	1253.8
0.67	0.43%	0.45%	0.48%	0.48%	0.47%	0.46%	0.44%	0.47%	0.48%	0.47%	0.45%	0.39%	0.39%	0.33%	0.28%	0.27%	0.27%	0.21%	0.17%		
1.33	0.46%	0.48%	0.51%	0.51%	0.50%	0.49%	0.47%	0.51%	0.51%	0.50%	0.48%	0.42%	0.42%	0.35%	0.30%	0.29%	0.29%	0.22%	0.18%		
2.00	0.49%	0.51%	0.54%	0.54%	0.54%	0.52%	0.50%	0.54%	0.54%	0.53%	0.51%	0.44%	0.44%	0.37%	0.32%	0.31%	0.30%	0.24%	0.20%		
2.67	0.45%	0.47%	0.50%	0.50%	0.50%	0.48%	0.47%	0.50%	0.50%	0.49%	0.48%	0.41%	0.41%	0.35%	0.30%	0.29%	0.28%	0.22%	0.18%		
3.33	0.36%	0.38%	0.40%	0.40%	0.40%	0.39%	0.37%	0.40%	0.40%	0.40%	0.38%	0.33%	0.33%	0.28%	0.24%	0.23%	0.23%	0.18%	0.15%		
4.00	0.40%	0.42%	0.45%	0.45%	0.44%	0.43%	0.42%	0.45%	0.45%	0.44%	0.43%	0.37%	0.37%	0.31%	0.26%	0.26%	0.25%	0.20%	0.16%		
4.67	0.42%	0.44%	0.46%	0.47%	0.46%	0.45%	0.43%	0.46%	0.46%	0.46%	0.44%	0.38%	0.38%	0.32%	0.27%	0.27%	0.26%	0.20%	0.17%		
5.33	0.42%	0.44%	0.47%	0.47%	0.46%	0.45%	0.43%	0.47%	0.47%	0.46%	0.44%	0.38%	0.38%	0.32%	0.28%	0.27%	0.26%	0.21%	0.17%		
6.00	0.41%	0.43%	0.46%	0.46%	0.45%	0.44%	0.42%	0.45%	0.46%	0.45%	0.43%	0.37%	0.37%	0.32%	0.27%	0.26%	0.26%	0.20%	0.16%		
6.67	0.39%	0.41%	0.43%	0.43%	0.42%	0.41%	0.40%	0.43%	0.43%	0.42%	0.41%	0.35%	0.35%	0.30%	0.25%	0.25%	0.24%	0.19%	0.15%		
7.33	0.39%	0.41%	0.44%	0.44%	0.43%	0.42%	0.41%	0.43%	0.44%	0.43%	0.41%	0.36%	0.36%	0.30%	0.26%	0.25%	0.24%	0.19%	0.16%		
8.00	0.40%	0.42%	0.45%	0.45%	0.44%	0.43%	0.42%	0.44%	0.45%	0.44%	0.42%	0.37%	0.36%	0.31%	0.26%	0.26%	0.25%	0.20%	0.16%		
8.67	0.33%	0.35%	0.37%	0.37%	0.37%	0.35%	0.34%	0.37%	0.37%	0.36%	0.35%	0.30%	0.30%	0.25%	0.22%	0.21%	0.21%	0.16%	0.13%		
9.33	0.28%	0.30%	0.31%	0.31%	0.31%	0.30%	0.29%	0.31%	0.31%	0.31%	0.30%	0.26%	0.26%	0.22%	0.19%	0.18%	0.18%	0.14%	0.11%		
10.00	0.24%	0.25%	0.26%	0.26%	0.26%	0.25%	0.24%	0.26%	0.26%	0.26%	0.25%	0.21%	0.21%	0.18%	0.15%	0.15%	0.15%	0.12%	0.09%		
10.67	0.24%	0.25%	0.26%	0.26%	0.26%	0.25%	0.24%	0.26%	0.26%	0.26%	0.25%	0.21%	0.21%	0.18%	0.15%	0.15%	0.15%	0.12%	0.09%		
11.33	0.19%	0.20%	0.22%	0.22%	0.21%	0.21%	0.20%	0.21%	0.22%	0.21%	0.20%	0.18%	0.18%	0.15%	0.13%	0.12%	0.12%	0.09%	0.08%		
12.00	0.17%	0.18%	0.19%	0.19%	0.19%	0.18%	0.18%	0.19%	0.19%	0.19%	0.18%	0.16%	0.15%	0.13%	0.11%	0.11%	0.11%	0.08%	0.07%		
12.67	0.14%	0.15%	0.16%	0.16%	0.16%	0.16%	0.15%	0.16%	0.16%	0.16%	0.15%	0.13%	0.13%	0.11%	0.10%	0.09%	0.09%	0.07%	0.06%		
13.33	0.13%	0.13%	0.14%	0.14%	0.14%	0.13%	0.13%	0.14%	0.14%	0.14%	0.13%	0.11%	0.11%	0.10%	0.08%	0.08%	0.08%	0.06%	0.05%		
14.00	0.11%	0.11%	0.12%	0.12%	0.12%	0.12%	0.11%	0.12%	0.12%	0.12%	0.11%	0.10%	0.10%	0.08%	0.07%	0.07%	0.07%	0.05%			
14.67	0.10%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.09%	0.09%	0.08%	0.07%	0.07%	0.06%	0.05%			
15.33	0.10%	0.10%	0.11%	0.11%	0.11%	0.10%	0.10%	0.11%	0.11%	0.11%	0.10%	0.09%	0.09%	0.08%	0.06%	0.06%	0.06%	0.05%			
16.00	0.09%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.08%	0.08%	0.07%	0.06%	0.06%	0.06%	0.05%			
16.67	0.06%	0.07%	0.07%	0.07%	0.07%	0.07%	0.07%	0.07%	0.07%	0.07%	0.07%	0.06%	0.06%	0.05%							
17.33																					

Number cells **824**

95 Percentile Conc **0.48%**
5 Percentile Dilution **210**

ATTACHMENT II-3:
UM3 MODEL CALIBRATION PRINTOUTS

OCT 4 7:30 AM - LOW CURRENT MODEL CALIBRATION (AEC = 0.2)

Case 1; ambient file C:\Plumes\Camas2.002.001.db; Diffuser table record 1: ----------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.264	180.0	0.071	17.08	0.0	0.0	0.264	180.0	0.001
1.0	0.264	180.0	0.0725	17.08	0.0	0.0	0.264	180.0	0.001
2.0	0.256	180.0	0.074	17.08	0.0	0.0	0.256	180.0	0.001
3.0	0.247	180.0	0.0755	17.08	0.0	0.0	0.247	180.0	0.001
4.0	0.228	180.0	0.077	17.08	0.0	0.0	0.228	180.0	0.001
5.0	0.21	180.0	0.077	17.08	0.0	0.0	0.21	180.0	0.001
6.0	0.187	180.0	0.077	17.08	0.0	0.0	0.187	180.0	0.001
7.0	0.163	180.0	0.077	17.08	0.0	0.0	0.163	180.0	0.001

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
6.0	1.0	0.0	180.0	8.0	10.0	32.0	322.0	21.0	2.53	0.0	20.0	1.0

Froude number: 28.52

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Polutnt (kg/kg)	Dilutn ()	CL-diln ()	x-posn (ft)	y-posn (ft)	
0	21.0	0.177	5.692	1.0	1.0	1.0	0.0	0.0;	
25	21.0	0.177	8.706	0.61	1.64	1.0	-0.386	0.0;	
50	21.0	0.177	13.08	0.372	2.691	1.103	-0.999	0.0;	
75	20.99	0.177	19.09	0.226	4.414	1.667	-2.003	0.0;	
93	20.99	0.177	24.59	0.159	6.304	2.238	-3.139	0.0;	bottom hit,
100	20.98	0.177	27.03	0.138	7.241	2.51	-3.721	0.0;	
125	20.94	0.177	37.22	0.0841	11.88	3.8	-6.819	0.0;	
150	20.84	0.178	50.1	0.0513	19.49	5.82	-12.75	0.0;	
175	20.53	0.18	66.22	0.0313	31.97	9.011	-24.86	0.0;	
185	20.28	0.182	73.72	0.0256	38.97	10.75	-32.51	0.0;	acute zone,
200	19.74	0.186	86.22	0.0191	52.45	14.0	-47.52	0.0;	
225	18.27	0.196	110.7	0.0116	86.05	21.67	-83.08	0.0;	
234	17.71	0.2	120.7	0.00972	102.8	25.54	-96.51	0.0;	merging,
250	16.57	0.208	146.5	0.00708	141.2	37.76	-124.9	0.0;	
275	14.35	0.221	213.2	0.00431	231.6	83.77	-186.5	0.0;	
295	12.07	0.234	296.0	0.0029	344.2	145.7	-258.4	0.0;	surface,

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 28.85 m

conc	dilutn	width	distnce	time				
(kg/kg)		(m)	(m)	(hrs)	(kg/kg)	(s-1)	(m/s)	(m0.67/s2)
2.90E-3	344.8	32.94	98.15	0.033	0.0	0.0	0.163	0.001

OCT 4 7:30 AM - LOW CURRENT MODEL CALIBRATION (AEC = 0.4)

```
Case 2; ambient file C:\Plumes\Camas2.002.001.db; Diffuser table record 1: ---------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0      0.264      180.0      0.071      17.08        0.0        0.0      0.264      180.0      0.001
        1.0      0.264      180.0     0.0725      17.08        0.0        0.0      0.264      180.0      0.001
        2.0      0.256      180.0      0.074      17.08        0.0        0.0      0.256      180.0      0.001
        3.0      0.247      180.0     0.0755      17.08        0.0        0.0      0.247      180.0      0.001
        4.0      0.228      180.0      0.077      17.08        0.0        0.0      0.228      180.0      0.001
        5.0       0.21      180.0      0.077      17.08        0.0        0.0       0.21      180.0      0.001
        6.0      0.187      180.0      0.077      17.08        0.0        0.0      0.187      180.0      0.001
        7.0      0.163      180.0      0.077      17.08        0.0        0.0      0.163      180.0      0.001
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     1.0     0.0   180.0     8.0    10.0    32.0   322.0    21.0    2.53     0.0    20.0     1.0
Froude number:      28.52
        Depth  Amb-cur     P-dia  Polutnt    Dilutn  CL-diln    x-posn    y-posn
Step     (ft)    (m/s)      (in)  (kg/kg)        ()       ()      (ft)      (ft)
   0     21.0    0.177     5.692      1.0       1.0      1.0       0.0       0.0;
  25     21.0    0.177     8.706     0.61      1.64      1.0    -0.193       0.0;
  50     21.0    0.177     13.08    0.372     2.691    1.103    -0.499       0.0;
  75     21.0    0.177     19.09    0.226     4.414    1.667    -1.002       0.0;
  92     21.0    0.177     24.26    0.162      6.18    2.202    -1.531       0.0; bottom hit,
 100     21.0    0.177     27.03    0.138     7.241    2.511     -1.86       0.0;
 125    20.99    0.177     37.23   0.0841     11.88    3.803    -3.407       0.0;
 150    20.96    0.177     50.13   0.0513     19.49    5.834     -6.35       0.0;
 175    20.88    0.178     66.35   0.0313     31.97    9.081    -12.22       0.0;
 200    20.66    0.179     86.71   0.0191     52.45     14.3    -24.72       0.0;
 209    20.49    0.181     95.24   0.0159     62.69    16.84    -32.68       0.0; acute zone,
 225    19.87    0.185     112.1   0.0116     86.05    22.42    -55.48       0.0;
 232     19.4    0.188     120.2   0.0101     98.85    25.31    -70.43       0.0; merging,
 250     18.1    0.197     150.6  0.00708     141.2    39.04    -107.0       0.0;
 275    16.33     0.21     221.5  0.00431     231.6    88.54    -159.5       0.0;
 300    14.29    0.221     337.5  0.00263     380.0    162.3    -230.8       0.0;
 301     14.2    0.222     343.3  0.00258     387.6    165.5    -234.2       0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      30.06 m
    conc  dilutn    width distnce    time
 (kg/kg)              (m)     (m)    (hrs) (kg/kg)   (s-1)   (m/s)(m0.67/s2)
 2.56E-3   390.2    35.66   98.15  0.0456     0.0     0.0   0.163   0.001
```

OCT 4 7:30 AM - LOW CURRENT MODEL CALIBRATION (AEC = 0.6)

```
Case 3; ambient file C:\Plumes\Camas2.002.001.db; Diffuser table record 1: ---------------------------------
      Depth     Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m         m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0       0.264      180.0      0.071      17.08        0.0        0.0      0.264      180.0      0.001
        1.0       0.264      180.0     0.0725      17.08        0.0        0.0      0.264      180.0      0.001
        2.0       0.256      180.0      0.074      17.08        0.0        0.0      0.256      180.0      0.001
        3.0       0.247      180.0     0.0755      17.08        0.0        0.0      0.247      180.0      0.001
        4.0       0.228      180.0      0.077      17.08        0.0        0.0      0.228      180.0      0.001
        5.0        0.21      180.0      0.077      17.08        0.0        0.0       0.21      180.0      0.001
        6.0       0.187      180.0      0.077      17.08        0.0        0.0      0.187      180.0      0.001
        7.0       0.163      180.0      0.077      17.08        0.0        0.0      0.163      180.0      0.001
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     6.0     1.0     0.0   180.0     8.0    10.0    32.0   322.0    21.0    2.53     0.0    20.0     1.0
Froude number:      28.52
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0     21.0    0.177    5.692      1.0      1.0      1.0      0.0      0.0;
  25     21.0    0.177    8.706     0.61     1.64      1.0   -0.129      0.0;
  50     21.0    0.177    13.08    0.372    2.691    1.103   -0.333      0.0;
  75     21.0    0.177    19.09    0.226    4.414    1.667   -0.668      0.0;
  92     21.0    0.177    24.26    0.162     6.18    2.202   -1.021      0.0; bottom hit,
 100     21.0    0.177    27.03    0.138    7.241    2.511    -1.24      0.0;
 125    20.99    0.177    37.23   0.0841    11.88    3.803   -2.271      0.0;
 150    20.98    0.177    50.14   0.0513    19.49    5.836    -4.23      0.0;
 175    20.95    0.177    66.37   0.0313    31.97    9.094   -8.116      0.0;
 200    20.86    0.178     86.8   0.0191    52.45    14.36   -16.16      0.0;
 223    20.59     0.18    110.2   0.0121    82.71    21.99   -32.46      0.0; acute zone,
 225    20.55     0.18    112.5   0.0116    86.05    22.82   -34.74      0.0;
 232    20.34    0.182    120.8   0.0101    98.85     26.0   -44.88      0.0; merging,
 250     19.0    0.191    152.7  0.00708    141.2    39.97   -92.78      0.0;
 275    17.43    0.202    226.4  0.00431    231.6     92.1   -143.0      0.0;
 300    15.88    0.213    347.2  0.00263    380.0    163.4   -201.3      0.0;
 305    15.54    0.214    379.0  0.00238    419.6    180.3   -215.7      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      30.96 m
    conc  dilutn    width distnce    time
 (kg/kg)              (m)     (m)    (hrs) (kg/kg)    (s-1)   (m/s)(m0.67/s2)
 2.35E-3   425.0    37.71   98.15  0.0552     0.0      0.0   0.163   0.001
```

OCT 4 7:30 AM - LOW CURRENT MODEL CALIBRATION (AEC = 0.8)

Case 4; ambient file C:\Plumes\Camas2.002.001.db; Diffuser table record 1: ----------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.264	180.0	0.071	17.08	0.0	0.0	0.264	180.0	0.001
1.0	0.264	180.0	0.0725	17.08	0.0	0.0	0.264	180.0	0.001
2.0	0.256	180.0	0.074	17.08	0.0	0.0	0.256	180.0	0.001
3.0	0.247	180.0	0.0755	17.08	0.0	0.0	0.247	180.0	0.001
4.0	0.228	180.0	0.077	17.08	0.0	0.0	0.228	180.0	0.001
5.0	0.21	180.0	0.077	17.08	0.0	0.0	0.21	180.0	0.001
6.0	0.187	180.0	0.077	17.08	0.0	0.0	0.187	180.0	0.001
7.0	0.163	180.0	0.077	17.08	0.0	0.0	0.163	180.0	0.001

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
6.0	1.0	0.0	180.0	8.0	10.0	32.0	322.0	21.0	2.53	0.0	20.0	1.0

Froude number: 28.52

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Polutnt (kg/kg)	Dilutn ()	CL-diln ()	x-posn (ft)	y-posn (ft)	
0	21.0	0.177	5.692	1.0	1.0	1.0	0.0	0.0;	
25	21.0	0.177	8.706	0.61	1.64	1.0	-0.0965	0.0;	
50	21.0	0.177	13.08	0.372	2.691	1.103	-0.25	0.0;	
75	21.0	0.177	19.09	0.226	4.414	1.667	-0.501	0.0;	
92	21.0	0.177	24.26	0.162	6.18	2.202	-0.766	0.0;	bottom hit,
100	21.0	0.177	27.03	0.138	7.241	2.511	-0.93	0.0;	
125	21.0	0.177	37.23	0.0841	11.88	3.803	-1.703	0.0;	
150	20.99	0.177	50.14	0.0513	19.49	5.837	-3.172	0.0;	
175	20.97	0.177	66.38	0.0313	31.97	9.098	-6.079	0.0;	
200	20.92	0.178	86.84	0.0191	52.45	14.38	-12.04	0.0;	
225	20.76	0.179	112.6	0.0116	86.05	22.94	-25.05	0.0;	
232	20.67	0.179	121.0	0.0101	98.85	26.24	-31.39	0.0;	merging,
233	20.65	0.179	122.3	0.00991	100.8	26.86	-32.55	0.0;	acute zone,
250	19.67	0.186	153.7	0.00708	141.2	40.81	-77.7	0.0;	
275	18.12	0.197	229.4	0.00431	231.6	94.42	-131.3	0.0;	
300	16.79	0.207	353.8	0.00263	380.0	164.2	-184.1	0.0;	
307	16.4	0.21	400.5	0.00229	436.5	188.2	-201.8	0.0;	surface,

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 31.51 m

conc	dilutn	width	distnce	time				
(kg/kg)		(m)	(m)	(hrs)	(kg/kg)	(s-1)	(m/s)	(m0.67/s2)
2.25E-3	444.8	39.11	98.15	0.0624	0.0	0.0	0.163	0.001

OCT 4 7:30 AM - LOW CURRENT MODEL CALIBRATION (AEC = 1.0)

Case 5; ambient file C:\Plumes\Camas2.002.001.db; Diffuser table record 1: ------------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.264	180.0	0.071	17.08	0.0	0.0	0.264	180.0	0.001
1.0	0.264	180.0	0.0725	17.08	0.0	0.0	0.264	180.0	0.001
2.0	0.256	180.0	0.074	17.08	0.0	0.0	0.256	180.0	0.001
3.0	0.247	180.0	0.0755	17.08	0.0	0.0	0.247	180.0	0.001
4.0	0.228	180.0	0.077	17.08	0.0	0.0	0.228	180.0	0.001
5.0	0.21	180.0	0.077	17.08	0.0	0.0	0.21	180.0	0.001
6.0	0.187	180.0	0.077	17.08	0.0	0.0	0.187	180.0	0.001
7.0	0.163	180.0	0.077	17.08	0.0	0.0	0.163	180.0	0.001

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
6.0	1.0	0.0	180.0	8.0	10.0	32.0	322.0	21.0	2.53	0.0	20.0	1.0

Froude number: 28.52

Step	Depth	Amb-cur	P-dia	Polutnt	Dilutn	CL-diln	x-posn	y-posn	
	(ft)	(m/s)	(in)	(kg/kg)	()	()	(ft)	(ft)	
0	21.0	0.177	5.692	1.0	1.0	1.0	0.0	0.0;	
25	21.0	0.177	8.706	0.61	1.64	1.0	-0.0772	0.0;	
50	21.0	0.177	13.08	0.372	2.691	1.103	-0.2	0.0;	
75	21.0	0.177	19.09	0.226	4.414	1.667	-0.401	0.0;	
92	21.0	0.177	24.26	0.162	6.18	2.202	-0.613	0.0;	bottom hit,
100	21.0	0.177	27.03	0.138	7.241	2.511	-0.744	0.0;	
125	21.0	0.177	37.23	0.0841	11.88	3.804	-1.363	0.0;	
150	20.99	0.177	50.14	0.0513	19.49	5.837	-2.537	0.0;	
175	20.98	0.177	66.38	0.0313	31.97	9.1	-4.861	0.0;	
200	20.95	0.177	86.85	0.0191	52.45	14.39	-9.605	0.0;	
225	20.85	0.178	112.7	0.0116	86.05	22.99	-19.73	0.0;	
232	20.8	0.178	121.1	0.0101	98.85	26.34	-24.44	0.0;	merging,
239	20.7	0.179	131.7	0.0088	113.5	31.21	-32.05	0.0;	acute zone,
250	20.28	0.182	154.1	0.00708	141.2	41.59	-56.8	0.0;	
275	18.58	0.194	231.3	0.00431	231.6	96.03	-122.6	0.0;	
300	17.4	0.202	358.3	0.00263	380.0	165.0	-172.0	0.0;	
308	17.01	0.205	413.4	0.00224	445.2	192.9	-190.8	0.0;	surface,

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 31.84 m

conc	dilutn	width	distnce	time				
(kg/kg)		(m)	(m)	(hrs)	(kg/kg)	(s-1)	(m/s)	(m0.67/s2)
2.19E-3	456.1	40.1	98.15	0.0682	0.0	0.0	0.163	0.001

OCT 4 11:00 AM - HIGH CURRENT SPEED MODEL CALIBRATION (AEC = 0.4)

Case 7; ambient file C:\Plumes\Camas2.002.003.db; Diffuser table record 3: ----------------------------------

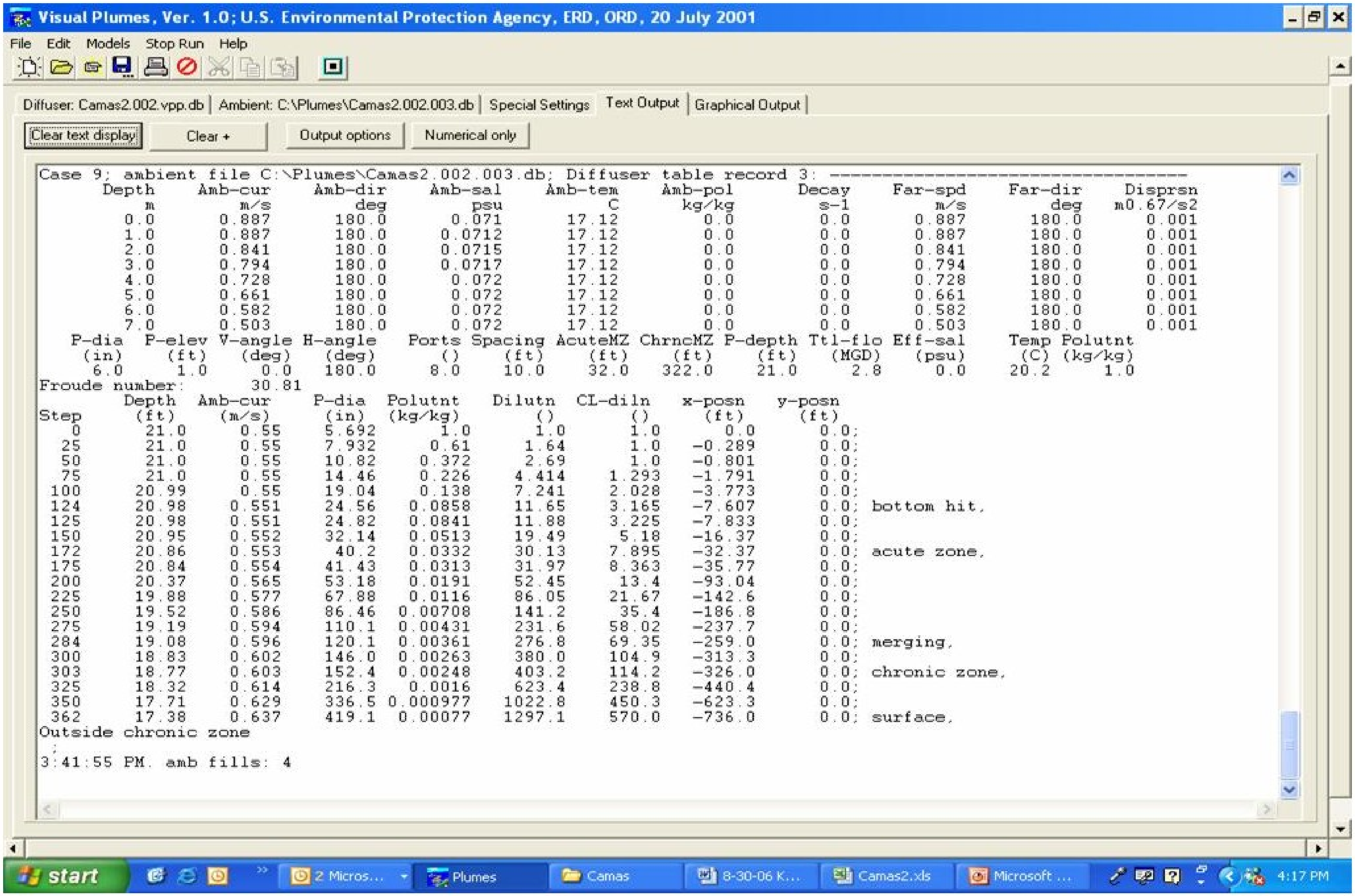
Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.887	180.0	0.071	17.12	0.0	0.0	0.887	180.0	0.001
1.0	0.887	180.0	0.0712	17.12	0.0	0.0	0.887	180.0	0.001
2.0	0.841	180.0	0.0715	17.12	0.0	0.0	0.841	180.0	0.001
3.0	0.794	180.0	0.0717	17.12	0.0	0.0	0.794	180.0	0.001
4.0	0.728	180.0	0.072	17.12	0.0	0.0	0.728	180.0	0.001
5.0	0.661	180.0	0.072	17.12	0.0	0.0	0.661	180.0	0.001
6.0	0.582	180.0	0.072	17.12	0.0	0.0	0.582	180.0	0.001
7.0	0.503	180.0	0.072	17.12	0.0	0.0	0.503	180.0	0.001

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
6.0	1.0	0.0	180.0	8.0	10.0	32.0	322.0	21.0	2.8	0.0	20.2	1.0

Froude number: 27.01

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Polutnt (kg/kg)	Dilutn ()	CL-diln ()	x-posn (ft)	y-posn (ft)	
0	21.0	0.55	6.0	1.0	1.0	1.0	0.0	0.0;	
25	21.0	0.55	8.241	0.61	1.64	1.0	-0.283	0.0;	
50	21.0	0.55	11.1	0.372	2.69	1.0	-0.797	0.0;	
75	21.0	0.55	14.71	0.226	4.414	1.258	-1.812	0.0;	
100	20.99	0.55	19.25	0.138	7.241	1.99	-3.87	0.0;	
123	20.98	0.551	24.48	0.0875	11.42	3.066	-7.661	0.0;	bottom hit,
125	20.98	0.551	25.0	0.0841	11.88	3.185	-8.129	0.0;	
150	20.94	0.552	32.28	0.0513	19.49	5.137	-17.2	0.0;	
170	20.85	0.554	39.5	0.0345	28.96	7.55	-32.65	0.0;	acute zone,
175	20.81	0.555	41.54	0.0313	31.97	8.312	-39.08	0.0;	
200	20.3	0.567	53.22	0.0191	52.45	13.33	-95.93	0.0;	
225	19.92	0.576	67.91	0.0116	86.05	21.69	-134.7	0.0;	
250	19.62	0.583	86.54	0.00708	141.2	35.5	-173.3	0.0;	
275	19.35	0.59	110.2	0.00431	231.6	58.21	-219.6	0.0;	
284	19.26	0.592	120.3	0.00361	276.8	69.64	-239.1	0.0;	merging,
300	19.04	0.597	146.5	0.00263	380.0	105.5	-289.7	0.0;	
308	18.91	0.6	164.9	0.00224	445.2	133.3	-322.4	0.0;	chronic zone,
325	18.6	0.608	217.6	0.0016	623.4	241.2	-407.7	0.0;	
350	18.07	0.62	339.3	0.000977	1022.8	451.5	-577.3	0.0;	
363	17.76	0.628	431.1	0.000755	1323.1	583.0	-691.1	0.0;	surface,

Outside chronic zone



Case 9; ambient file C:\Plumes\Camas2.002.003.db; Diffuser table record 3: -----------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.887	180.0	0.071	17.12	0.0	0.0	0.887	180.0	0.001
1.0	0.887	180.0	0.0712	17.12	0.0	0.0	0.887	180.0	0.001
2.0	0.841	180.0	0.0715	17.12	0.0	0.0	0.841	180.0	0.001
3.0	0.794	180.0	0.0717	17.12	0.0	0.0	0.794	180.0	0.001
4.0	0.728	180.0	0.072	17.12	0.0	0.0	0.728	180.0	0.001
5.0	0.661	180.0	0.072	17.12	0.0	0.0	0.661	180.0	0.001
6.0	0.582	180.0	0.072	17.12	0.0	0.0	0.582	180.0	0.001
7.0	0.503	180.0	0.072	17.12	0.0	0.0	0.503	180.0	0.001

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
6.0	1.0	0.0	180.0	8.0	10.0	32.0	322.0	21.0	2.8	0.0	20.2	1.0

Froude number: 30.81

Step	Depth	Amb-cur	P-dia	Polutnt	Dilutn	CL-diln	x-posn	y-posn	
	(ft)	(m/s)	(in)	(kg/kg)	()	()	(ft)	(ft)	
0	21.0	0.55	5.692	1.0	1.0	1.0	0.0	0.0;	
25	21.0	0.55	7.932	0.61	1.64	1.0	-0.289	0.0;	
50	21.0	0.55	10.82	0.372	2.69	1.0	-0.801	0.0;	
75	21.0	0.55	14.46	0.226	4.414	1.293	-1.791	0.0;	
100	20.99	0.55	19.04	0.138	7.241	2.028	-3.773	0.0;	
124	20.98	0.551	24.56	0.0858	11.65	3.165	-7.607	0.0;	bottom hit,
125	20.98	0.551	24.82	0.0841	11.88	3.225	-7.833	0.0;	
150	20.95	0.552	32.14	0.0513	19.49	5.18	-16.37	0.0;	
172	20.86	0.553	40.2	0.0332	30.13	7.895	-32.37	0.0;	acute zone,
175	20.84	0.554	41.43	0.0313	31.97	8.363	-35.77	0.0;	
200	20.37	0.565	53.18	0.0191	52.45	13.4	-93.04	0.0;	
225	19.88	0.577	67.88	0.0116	86.05	21.67	-142.6	0.0;	
250	19.52	0.586	86.46	0.00708	141.2	35.4	-186.8	0.0;	
275	19.19	0.594	110.1	0.00431	231.6	58.02	-237.7	0.0;	
284	19.08	0.596	120.1	0.00361	276.8	69.35	-259.0	0.0;	merging,
300	18.83	0.602	146.0	0.00263	380.0	104.9	-313.3	0.0;	
303	18.77	0.603	152.4	0.00248	403.2	114.2	-326.0	0.0;	chronic zone,
325	18.32	0.614	216.3	0.0016	623.4	238.8	-440.4	0.0;	
350	17.71	0.629	336.5	0.000977	1022.8	450.3	-623.3	0.0;	
362	17.38	0.637	419.1	0.00077	1297.1	570.0	-736.0	0.0;	surface,

Outside chronic zone

;
3:41:55 PM. amb fills: 4

PART III:
DILUTION MODELING AND WATER QUALITY COMPLIANCE FOR FACILITY PLANNING

PART III:
DILUTION MODELING AND WATER QUALITY COMPLIANCE FOR FACILITY PLANNING

The purpose of this section of the Mixing Zone Study is to establish outfall modifications and mixing zone dilution factors for projected future Camas WWTP flow rates and diffuser options. The mixing zone modeling will be based on the UM3 model calibrated as described in the previous sections of this report. This section will also evaluate reasonable potential to exceed water quality standards, and establish projected effluent limitations for future planning alternatives.

EFFLUENT FLOW RATES

Gray & Osborne provided the effluent flow design criteria for facility planning presented in Table III-1.

Table III-1 Effluent Flow Design Criteria for Facility Planning

	Winter Flow Criteria		Summer Flow Criteria	
	Max. Month (mgd)	Max. Day (mgd)	Max. Month (mgd)	Max. Day (mgd)
2007	3.09	7.03	2.07	3.34
2025	6.10	10.04	5.09	6.36

RECOMMENDED DIFFUSER MODIFICATION

The existing outfall includes a diffuser consisting of eight 6-inch diameter ports discharging horizontally in the same direction as ambient currents. This co-flowing configuration reduces the hydrodynamic mixing potential. Dilution factors would be improved by reorienting the diffuser outlets to a vertical discharge configuration. It is our strong recommendation to proceed with this minor modification to the existing diffuser, and we understand that Gray & Osborne has already proceeded with the permit applications to complete this work.

The new diffuser will consist of eight ports oriented to discharge vertically. Each port will be fitted with a 6-inch Tideflex elastomeric check valve. In addition to aiding in prevention of debris accumulation, the valves will enhance diffuser velocities over the range of operating flow rates. A copy of the performance data for the selected valves is provided in Figure III-1.

TIDEFLEX DIFFUSER (TFD) SYSTEM DATA ANALYSIS

MEDIA: Effluent

Density or ______ lb/ft^3
Spec. Gravity 1

FLOW RANGE:

1.3	MGD	=	903	gpm
5.6	MGD	=	3889	gpm
7.2	MGD	=	5000	gpm

AVAILABLE HEADLOSS@ DIFFUSER:
Minimum ______ feet
Design ______ feet
Maximum ______ feet

MAX. BACKPRESSURE: ______ feet

* DIFFUSER SIZE (IN)	CATALOG * NUMBER
6	**206**

DATE: 14-Nov-2005

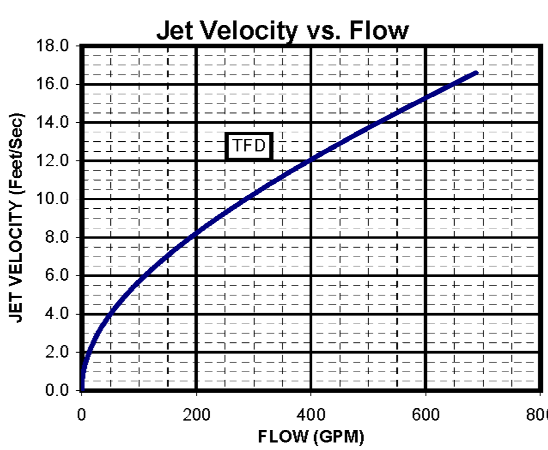
CUSTOMER: City of Camas, WA
CONTACT: Monte Brachmann

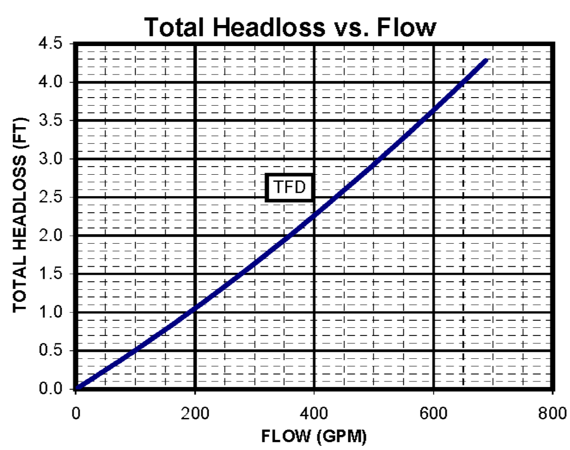
ENGINEER: Gray & Osborne, Inc.
CONTACT: Jay Swift, P.E.

PROJECT: City of Camas, WA - WWTP Outfall

REP: Antec Corporation
CONTACT: Matthew Davidson

		PER TIDEFLEX DIFFUSER			
*** TOTAL QUANTITY**	TOTAL FLOW (gpm)	FLOW (gpm)	**JET VELOCITY (fps)**	**TOTAL HEADLOSS @ DIFFUSER (feet)**	EFFECTIVE DIAMETER (in)
8	903	112.85	6.07	0.57	2.75
	3889	486.11	13.50	2.83	3.83
	5000	625.00	15.66	3.81	4.04





TIDEFLEX TECHNOLOGIES, INC. 300 BILMAR DRIVE, PITTSBURGH, PA 15205 (412) 919-0919 phone (412) 919-0918 fax

Figure III-1. Tideflex Diffuser System Data Analysis

The port velocities corresponding to a range of operating conditions is presented in Table III-2.

Table III-2 Diffuser Port Velocities for Tideflex Diffuser Valves

Design Year	Season	Max Flow Period	Effluent Flow (mgd)	Flow per Port (gpm)	Discharge Velocity (fps)	Port Area (sq. in.)	Port Dia. (in.)
2007	Winter	30-day	3.09	268	9.8	8.8	3.34
2007	Winter	24-hr	7.03	610	15.5	12.6	4.01
2007	Summer	30-day	2.07	180	7.8	7.4	3.07
2007	Summer	24-hr	3.34	290	10.1	9.2	3.42
2025	Winter	30-day	6.1	529	14.1	12.0	3.92
2025	Winter	24-hr	10.04	871	19.5	14.3	4.27
2025	Summer	30-day	5.09	442	12.7	11.2	3.77
2025	Summer	24-hr	6.36	552	14.7	12.0	3.92

DILUTION MODELING

UM3 Model Calibration Parameter

The UM3 model was calibrated to a range of aspiration entrainment coefficients (AEC). The default AEC of 0.1 is rejected because it fits none of the observed data. Best fit to the October tracer study data was an AEC of 0.6 to 0.8. The February dye study found that even higher values for the AEC above 1.0 matched that data. However, the October current data and plume coverage were better than in February, and the observed AEC is more protective. To be protective, a very conservative AEC = 0.4 will be used for future modeling.

AEC = 0.4 is valid for any diffuser port orientation. A tracer study was conducted for the City of Washougal WWTP outfall in October 2006, which was very similar to the tracer studies conducted for the City of Camas. The Washougal outfall has six ports oriented at a vertical angle of 45 degrees. The results of that model produced an AEC = 0.45 (Cosmopolitan Engineering, *City of Washougal Outfall Mixing Zone Study*, prepared for the City of Washougal and Wallis Engineering, January 2007). This value is consistent with the Camas results, and confirms the selection of AEC = 0.4 as a conservative selection for this project.

Peak-to-Mean Ratio

The ratio of flux-average to centerline concentration (also known as peak-to-mean ratio) has been a topic of debated amongst researchers recently. The UM3 model calculates the flux-averaged dilution based on ambient conditions and empirical plume and jet equations.

Centerline dilution is then calculated using algorithms embedded in UM3 that have been demonstrated to be inaccurate.

The acute dilution factor in the current NPDES permit (Run NC24) is based on a peak-to-mean ratio of 3.6. However, the field data from the Camas dye studies and data from other researchers indicates the peak-to-mean ratio should be on the order of 2.0 to 2.3. Several supporting papers provided by Walter Frick of EPA, developer of the UM3 model, are provided in Attachment III-1. The Washougal study revealed a peak-to-mean ratio of 2.37. A peak-to-mean ratio of 2.3 will be used for all future UM3 model runs for the Camas outfall.

Model Results

A series of UM3 model runs from the Visual Plumes interface, with the Brooks farfield algorithm, are provided in Attachment III-2. The basis of the model runs and the results are described below:

2007 Effluent Flows

E-1	This chronic model run is for near-flood ambient conditions modeled by Ecology in the NPDES permit, the 90th percentile river discharge of 522 kcfs. This run is equivalent to Ecology run NC22B except for the maximum month effluent flow rate for 2007.
E-2	This acute model run is for the same near-flood ambient conditions modeled by Ecology, equivalent to Ecology run NC24 except the maximum day effluent flow rate for 2007.
E-3	This chronic model run corresponds to 2007 winter maximum month flow rate and winter effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition.
E-4	This acute model run corresponds to 2007 maximum day winter flow rate and winter effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment, which is caused by the tidal influence that occurs during low to normal Columbia River flows.
E-5	This chronic model run corresponds to 2007 summer maximum month flow rate and summer effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition (same as E-3).
E-6	This acute model run corresponds to 2007 maximum day summer flow rate and summer effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment (same as E-4).

2025 Effluent Flows

Model Runs F-1 through F-6 are the same as E-1 through E-6, except using 2025 effluent flow rates rather than 2007.

The results of the modeling are presented in Table III-3 for 2007 effluent flows, and Table III-4 for 2025 flows. The results demonstrate that critical conditions occur during winter flows at the WWTP. The critical condition for acute dilution occurs during the brief tidally-influenced slowdowns that occur near high tide during low river flow conditions.

REASONABLE POTENTIAL ASSESSMENT

EPA and Ecology use a statistical test to determine a discharge's "reasonable potential" to exceed water quality standards, which is based on effluent and ambient data and acute and chronic dilution factors. If a discharge exhibits a reasonable potential to exceed water quality standards for any parameter, Ecology issues an effluent limitation for that parameter in the NPDES permit. If a parameter does not exhibit a reasonable potential to exceed water quality standards, no NPDES permit limit is required.

EFFLUENT DATA

Water quality-based effluent limits will be assessed for ammonia and selected metals (cadmium, copper, lead, nickel, silver, zinc and mercury). The critical effluent concentrations used in determination of reasonable potential are based on eight effluent metals scans in 2005 and 2006, and over 400 effluent ammonia samples in 2005 and 2006.

The metals data are provided in Table III-5. The values in red are detected concentrations, and the values in black are the detection levels for non-detected results. High concentrations of cadmium and nickel were measured on June 2, 2006. These values may be anomalous, or if realistic should be evaluated in future sampling efforts.

Table III-3 Dilution Model Results for 2007 Effluent Flows

Model Run #	Ambient Condition	Discharge Depth (ft)	Avg Current Speed (m/sec)	Ambient Temp (°C)	Effluent Flow (mgd)	Effluent Temp (°C)	Acute Dilution	Chronic Dilution
E-1	(1)Winter High Flow	26.6	1.0	12.6	3.09	16.0		206
E-2	(1)Winter High Flow	26.6	1.0	12.6	7.03	16.0	40	
E-3	(2)Winter Average	21.0	0.7	12.6	3.09	16.0		257
E-4	(3)Winter 10%	21.0	0.25	12.6	7.03	16.0	35	
E-5	(2)Summer Average	21.0	0.7	21.5	2.07	22.0		271
E-6	(3)Summer 10%	21.0	0.25	21.5	3.34	22.0	61	

(1) Ambient conditions for 522 kcfs river flow (90th percentile) per Ecology NPDES permit (runs NC22 and NC24)
(2) Ambient condition for non-flood river flow based on tidally-averaged current profile from October 2004 current meter deployment.
(3) Ambient condition for acute model runs based on lowest tidally-influenced current profile (duration = 1 hr±) from October 2004 current meter deployment.

Table III-4 Dilution Model Results for 2025 Effluent Flows

Model Run #	Ambient Condition	Discharge Depth (ft)	Avg Current Speed (m/sec)	Ambient Temp (°C)	Effluent Flow (mgd)	Effluent Temp (°C)	Acute Dilution	Chronic Dilution
F-1	(1)Winter High Flow	26.6	1.0	12.6	6.10	16.0		182
F-2	(1)Winter High Flow	26.6	1.0	12.6	10.04	16.0	41	
F-3	(2)Winter Average	21.0	0.7	12.6	6.10	16.0		140
F-4	(3)Winter 10%	21.0	0.25	12.6	10.04	16.0	24	
F-5	(2)Summer Average	21.0	0.7	21.5	5.09	22.0		172
F-6	(3)Summer 10%	21.0	0.25	21.5	6.36	22.0	48	

(1) Ambient conditions for 522 kcfs river flow (90th percentile) per Ecology NPDES permit (runs NC22 and NC24)
(2) Ambient condition for non-flood river flow based on tidally-averaged current profile from October 2004 current meter deployment.
(3) Ambient condition for acute model runs based on lowest tidally-influenced current profile (duration = 1 hr±) from October 2004 current meter deployment.

Table III-5 Camas Effluent Metals Data (µg/L)

Date	Cd	Cu	Pb	Ni	Ag	An	Hg
5/13/2005	3	8	5	20	10	18	0.056
7/21/2005	10	31	5	20	10	19	0.050
9/30/2005	3	5	5	20	10	16	0.056
12/7/2005	3	5	5	20	10	15	0.050
3/31/2006	3	5	5	20	10	25	0.070
6/2/2006	87	12	5	373	70	20	0.050
9/12/2006	3	7	5	20	10	31	
12/18/2006	3	5	5	29	10	30	0.050
Count	8	8	8	8	8	8	7
# Detects	2	4	0	2	0	8	2

Detected Values in Red Detection Limit in Black

AMBIENT DATA AND WATER QUALITY STANDARDS

No ambient sampling has been conducted in this mixing zone study for ammonia or metals or the parameters that affect their water quality standards (pH, temperature, and hardness). The criteria for ambient concentrations, and ambient-depended water quality criteria, are the same as Ecology cited in Appendix C of the NPDES permit.

REASONABLE POTENTIAL RESULTS

The reasonable potential to exceed water quality standards for ammonia and metals is presented in Table III-6 for the recommended diffuser modifications. Ammonia only is considered seasonally due to its dependence on ambient pH and temperature. Only cadmium has a reasonable potential to exceed water quality standards, winter and summer. This result suggests that additional effluent monitoring for cadmium should be conducted, as well as potential source control investigations. However, this finding is based on only two detected values, and thus should be sampled more frequently in the future to determine if the reasonable potential is realistic. The ambient concentration used in the analysis is also relatively high, and may need to be assessed in a sampling program.

If the diffuser is modified to a vertical port orientation using Tideflex valves, there is no reasonable potential to exceed ammonia water quality standards in summer or winter, both in 2007 or 2025. Therefore, water quality-based ammonia limits should be deleted from current and future NPDES permits.

Table III-6 Reasonable Potential Calculation Table

				State Water Quality Standard		Max concentration at edge of...							
	Metal Criteria Translator as decimal	Metal Criteria Translator as decimal	Ambient Concentration (metals as dissolved)	Acute	Chronic	Acute Mixing Zone	Chronic Mixing Zone	LIMIT REQ'D?	Max effluent conc. measured (metals as total recoverable)	# of samples	Multiplier	Acute Dil'n Factor	Chronic Dil'n Factor
Parameter	Acute	Chronic	ug/L	ug/L	ug/L	ug/L	ug/L		ug/L	n			
MODIFIED DIFFUSER (VERTICAL DISCHARGE)													
2007													
Ammonia-N (summer)	1.00	1.00	27	5100	830	431	118	NO	35200	268	0.70	61	271
Ammonia-N (winter)	1.00	1.00	19	2100	470	723	139	NO	35200	268	0.70	35	206
Cadmium	0.940	0.940	0.53	1.70	0.61	4.95	1.28	YES	87.00	8	1.90	35	206
Copper	1.000	1.000	0.86	8.65	6.14	2.52	1.14	NO	31.00	8	1.90	35	206
Lead	0.470	0.470	0.06	29.3	1.14	0.19	0.08	NO	5.0	8	1.90	35	206
Nickel	1.000	1.000	0.56	770.7	85.60	20.77	3.99	NO	373.00	8	1.90	35	206
Silver	0.850	0.850	0.10	1.00	100.00	0.56	0.18	NO	10.00	8	1.90	35	206
Zinc	1.000	1.000	2.00	62.3	56.9	3.62	2.28	NO	31.000	8	1.90	35	206
Mercury	1.000	1.000		2.1	0.012	0.004	0.001	NO	0.070	8	1.90	35	206
2025													
Ammonia-N (summer)	1.00	1.00	27	5100	830	540	170	NO	35200	268	0.70	48	172
Ammonia-N (winter)	1.00	1.00	19	2100	470	1046	195	NO	35200	268	0.70	24	140
Cadmium	0.940	0.940	0.53	1.70	0.61	6.98	1.64	YES	87.00	8	1.90	24	140
Copper	1.000	1.000	0.86	8.65	6.14	3.28	1.27	NO	31.00	8	1.90	24	140
Lead	0.470	0.470	0.06	29.3	1.14	0.24	0.09	NO	5.0	8	1.90	24	140
Nickel	1.000	1.000	0.56	770.7	85.60	30.04	5.61	NO	373.00	8	1.90	24	140
Silver	0.850	0.850	0.10	1.00	100.00	0.77	0.21	NO	10.00	8	1.90	24	140
Zinc	1.000	1.000	2.00	62.3	56.9	4.37	2.41	NO	31.000	8	1.90	24	140
Mercury	1.000	1.000		2.1	0.012	0.006	0.001	NO	0.070	8	1.90	24	140

ATTACHMENT III-1:
EPA PAPERS REGARDING PEAK-TO-MEAN RATIO

Peak-to-mean relationships for round and line plumes assuming a Gaussian Profile

D R A F T

15 November 2001

Walter E. Frick, Don J. Baumgartner, ...

Introduction

Plume models, such as those used in Visual Plumes (Frick et al., 2001), variously predict average and centerline dilutions and concentrations. Also, environmental concerns and user sophistication lead to increased need to define the spatial properties of plumes. Finally, investigations, such as those conducted by Roberts and Tian (2001), cast doubt on the veracity of the three-halves power profile (Kannberg and Davis, 1976) used in UM3 and other models. In particular, the high peak-to-mean concentrations ratios (up to 3.89) in some ambient and plume regimes are in apparent disagreement with laser-induced fluorescence and other experiments. This work revisits the Gaussian profile and develops its peak-to-mean relationships for round and line plumes.

Mathematica software is used to derive peak-to-mean relationships for round and line plumes. The assumptions used are given in Exhibit 1, as well as notes on other issues impinging on the problem.

It is recommended that the peak-to-mean relationships developed herein be used in lieu of the built-in routines used in Visual Plumes to establish centerline properties based on average properties predicted by UM3. As soon as feasible Visual Plumes will be modified to output centerline values based on an assumed Gaussian profile. At this point the recommendations do not extend to UDKHW and NRFIELD as these models are based on independent theory not affected by these considerations.

This modification is considered to be an interim measure. In the long term, it is recommended that further experimental work be conducted to better establish peak-to-mean relationships. The rapid improvement of modern technology, for example, exploiting LIF visualization and processing technology promises to better define these relationships for the main theoretical approaches, such as the Lagrangian and integral flux modeling approaches.

```
(* Round and line plumes
 Definitions:
  sig is the dimensionless radius (or width)
   chi is the concentration at sig (divided by the
     centerline concentration, i.e., =1 at sig=0
    v is the plume velocity at
        sig (similarly =1 at the centerline)
    ca is the ambient concentration (in the plots
          ranging from 0.001 to 2 times centerline
    va is the ambient velocity (in the plots
          ranging from 0.001 to 1 times centerline
    E is the Napierien base value
    Erf is the error function
    p2m is an abbreviation for peak-to-mean ratio
 Notes:
  Definition of radius and
          width consistent with Fan (1976),
    plume radius = √2
    In principle, va can also be greater than
     internal plume velocities (use formulas)
    UM3 should not be fluxed averaged,
    use solutions for avgchi and lineavg
    The UM3 interpretation
     is probably compatible with LIF results
     (unless the latter are mathematically
       manipulated to correspond to flux averages)
    For fully merged line plumes, the same phi
     is assumed (should be investigated further)
    Formulas do not account
     for vertical variations in ambient values
    Other similar limitations apply
     (for example,the effect of angular difference
       ambient and plume velocities is not conside
*)
```

Exhibit 1. Notes from Mathematica file Gaussian.nb. Assumptions used in deriving the subsequent relationships.

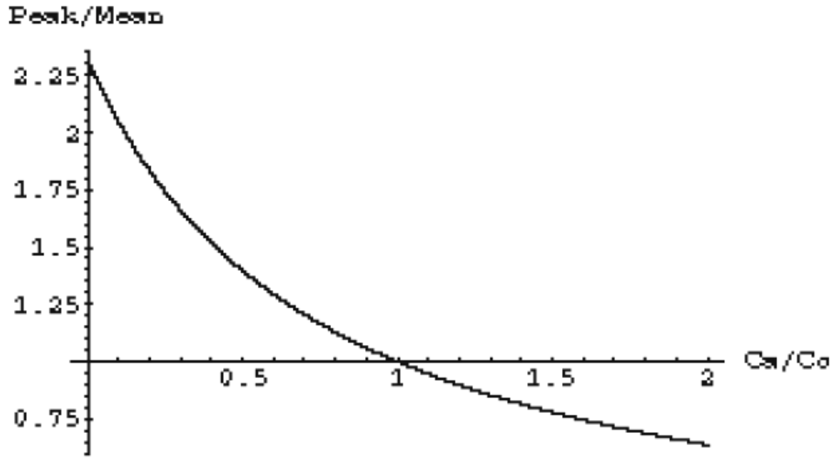


Figure 1. Round plume peak-to-mean ratio as a function of the ratio of the local ambient to centerline plume concentrations. (Inverse of Eqn. 4.)

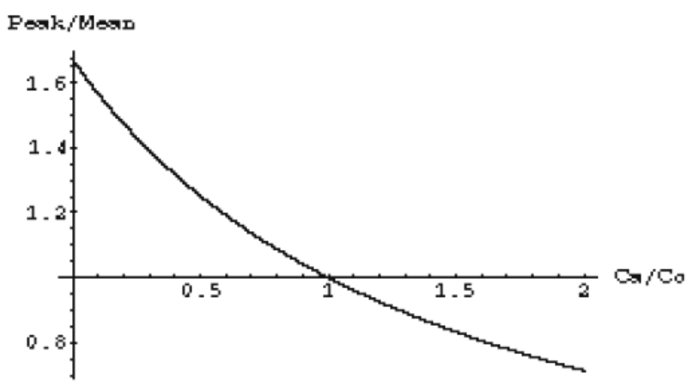


Figure 2. Line plume peak-to-mean ratio as a function of the ratio of the local ambient to

centerline plume concentrations. (Inverse of Eqn. 9.)

Equations

$$\Phi = \exp\left(-\sigma^2\right) \tag{1}$$

$$\chi = \left(1 - C_a\right)\Phi + C_a \tag{2}$$

Round-plume average concentration

$$\overline{\chi} = \frac{\int_0^{\sqrt{2}} \chi 2\pi\sigma d\sigma}{\int_0^{\sqrt{2}} 2\pi\sigma d\sigma} \tag{3}$$

$$\overline{\chi} = \frac{1 + C_a}{2} + \frac{C_a - 1}{2e^2} \tag{4}$$

For the corresponding flux average

$$v = \left(1 - v_a\right)\Phi + v_a \tag{5}$$

$$\overline{\chi}_{flux} = \frac{\int_0^{\sqrt{2}} v\chi 2\pi\sigma d\sigma}{\int_0^{\sqrt{2}} v 2\pi\sigma d\sigma} \tag{6}$$

$$\overline{\chi}_{flux} = \frac{-\frac{\left(-1 + C_a\right)\pi\left(-1 + v_a\right)}{2e^4} + 2C_a\pi v_a + \frac{\pi\left(-v_a + C_a\left(-1 + 2v_a\right)\right)}{e^2} - \frac{\pi}{2}\left(-1 - v_a + C_a\left(-1 + 3v_a\right)\right)}{-\pi\left(-1 + v_a\right) + \frac{\pi\left(-1 + v_a\right)}{e^2} + 2\pi v_a} \tag{7}$$

For line plumes the corresponding equations are

$$\overline{\chi}_{line} = \frac{\int_0^{\sqrt{2}} \chi d\sigma}{\int_0^{\sqrt{2}} d\sigma} \tag{8}$$

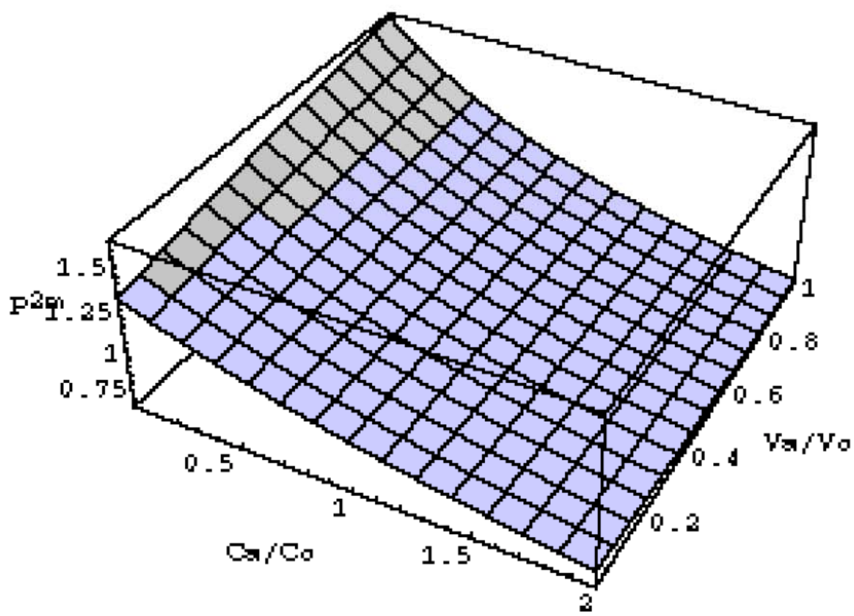
$$\overline{\chi}_{line} = \frac{\sqrt{2}C_a - \frac{\sqrt{\pi}}{2}(C_a - 1)erf\sqrt{2}}{\sqrt{2}} \tag{9}$$

The value of the error function of the square root of two is 0.9545.

$$\overline{\chi}_{line(flux)} = \frac{4\sqrt{2}C_a v_a + (C_a - 1)\sqrt{2\pi}(v_a - 1)erf(2) - 2\sqrt{\pi}(-v_a + C_a(2v_a - 1))erf\sqrt{2}}{4\left(\sqrt{2}v_a - \frac{\sqrt{\pi}}{2}(v_a - 1)erf\sqrt{2}\right)} \tag{10}$$

Corresponding plots of the peak-to-mean flux values are given in Figures 3 and 4.

Figure 3. Round plume flux averaged peak-to-mean ratio as functions of the ratio of the local ambient to centerline plume concentrations and the ratio of the local ambient to centerline velocities. (Inverse of Eqn. 7.)



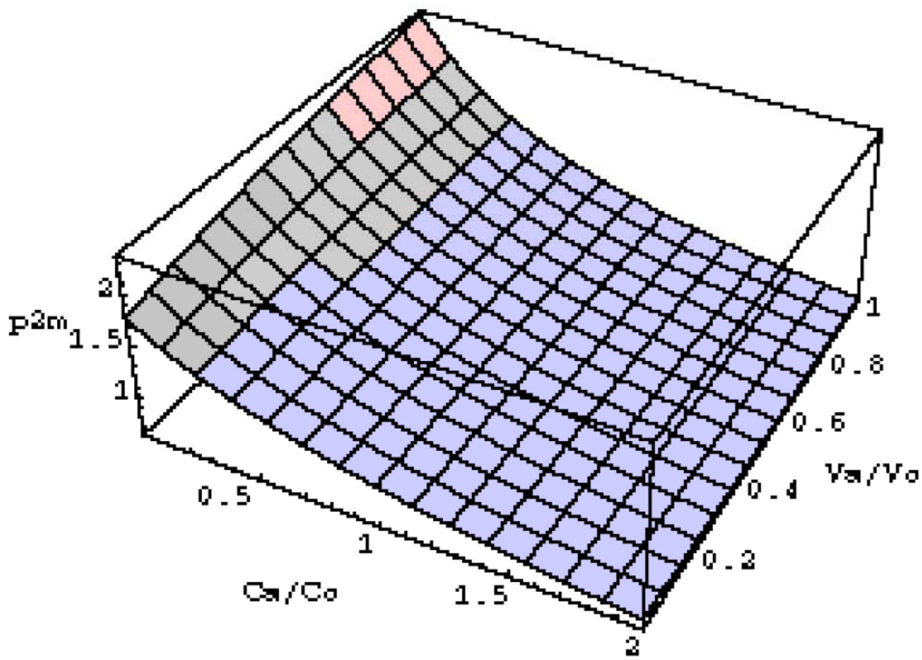


Figure 4. Line plume flux averaged peak-to-mean ratio as functions of the ratio of the local ambient to centerline plume concentrations and the ratio of the local ambient to centerline velocities. (Inverse of Eqn. 10.)

References

Fan, L.N., 1967. Turbulent buoyant jets into stratified or flowing ambient fluids. Report No. KH-R-15, W.M. Keck Lab. of Hydraulics and Water Resources, Cal Tech, Pasadena, CA

Frick, W.E., P.J.W. Roberts, L.R. Davis, J. Keyes, D.J. Baumgartner, and K.P. George, 2001. Dilution models for effluent discharges, 4th Edition (Visual Plumes). USEPA, Athens, Georgia (draft). (Visual Plumes model software. U.S. EPA, ORD, CEAM web page release 13 Sep 2001)

Kannberg, L.D. and L.R. Davis, 1976. An experimental/analytical investigation of deep submerged multiple buoyant jets. ERL, Corvallis, OR. EPA-600/3-76-101, Sep. 1976

Roberts, P.J.W. and X. Tian, 2001. New experimental techniques for validation of marine discharge models. Proceedings of the Fifth International Marine Environmental Modelling Seminar. IMEMS-2001, Sintef Applied Chemistry. New Orleans, LA, USA, 9-11 October 2001

The 3/2 power profile

Users of plume models are frequently interested in estimates of concentrations at the center of or along the centerline plumes. If the model predicts average properties, as the Visual Plumes UM3 model does, profiles, such as the Gaussian distribution, are used to estimate the relationship between these properties. The ratio of the centerline and average plume element concentrations is sometimes called the peak-to-mean ratio.

The three-half power profile found in Kannberg and Davis (19??) can be expressed in terms of the relative radius, *f*,

$$f = r / b \tag{1}$$

where *b* is the radius of the plume. The three-half power profile is

$$g(f) = \left(1 - f^{3/2}\right)^2 \tag{2}$$

and approximates the Gaussian distribution. The simple mean of this distribution given a circular cross-section is 0.257 of centerline value, thus, the peak-to-mean ratio, *k*, is 3.89.

Water carrier mass dilution

If ambient water can serve as a marker then the three-half power profile implies a corresponding distribution of dilution across the plume cross-section. The definition of average dilution of the plume element, S_{avg}, may be expressed in terms of the mass of ambient water, M, mixed with the mass of the material plume element, m,

$$S_{avg} = \frac{M + m}{m} \tag{3}$$

This relationship may be generalized to represent the point-wise dilution, $S(f)$. Allowing dM and dm to represent their respective along f, and, letting C_a and C_e represent the local ambient and effluent concentrations of a tracer

$$C(dM + dm) = dMC_a + dmC_e$$

$$C = \frac{dMC_a}{dM + dm} + \frac{dmC_e}{dM + dm} = \frac{dM}{dm}\frac{C_a}{S} + \frac{C_e}{S} = \frac{dM}{dm}\frac{C_a}{S} + \frac{dm}{dm}\frac{C_a}{S} - \frac{dm}{dm}\frac{C_a}{S} + \frac{C_e}{S} \tag{4}$$

$$C = C_a - \frac{C_a}{S} + \frac{C_e}{S}$$

But

$$S = \frac{S_{avg}}{kg(f)} \tag{5}$$

Finally,

$$C = C_a - \frac{C_a kg(f)}{S_{avg}} + \frac{C_e kg(f)}{S_{avg}} \tag{6}$$

Although C_a is assumed to be uniformly constant, in fact it will in general vary with depth, making the plume distribution approximate.

Flux-averaged concentrations

Measurements of plumes leading to the distribution given by Eqn. 2 generally appear to represent flux measurements. Given that the longitudinal velocity distribution in the plume shares the same profile, the material element the appropriate distribution of properties may be better given by

$$g(f) = 1 - f^{3/2} \tag{7}$$

The corresponding k for this distribution is only 2.33.

Still simpler and giving k values similar to reported values is the distribution

$$g(f) = 1 - f^{2} \tag{8}$$

where $k = 2.0$. For a line source $k = 1.5$.

Significance of distributions on models such as the Visual Plumes UM3 model

The primary predictions of the Visual Plume UM3 model are not affected by the adopted profile. This is due to the fact that UM3, as pointed out above, predicts average dilutions. Centerline dilutions are estimated by superimposing a profile of properties. The results obtained using the 3/2 power profile have been consistently criticized to result in centerline concentrations that are too conservative. This observation agrees with the finding that the zone of established flow is associated with an average dilution of approximately 2:1, more consistent with the distribution given by Eqns. 7 and 8 than by Eqn. 2. In this work Visual Plumes UM3 is modified for the distribution given by Eqn. 8. Thus, earlier versions are considerably more conservative with respect to the prediction of the centerline concentration.

Using Eqns. 6 and 8 and solving for f yields

$$f = \sqrt{1 - \frac{S_{avg}\left(C - C_a\right)}{k\left(C_e - C_a\right)}} \tag{9}$$

Effective dilution

The average mass dilution described by Eqn. 3 only describes the concentration of a pollutant in a plume when the ambient pollutant concentration is zero. At other times it gives a non-conservative estimate of concentrations. Similar statements are true for the centerline and points throughout the plume. A good estimate of actual dilution of pollutants is given by the effective dilution, defined as the ratio of effluent concentration to subsequent plume concentration at any point. The effective dilution, *Seff*, is

$$S_{eff} = \frac{C_e}{C} \tag{10}$$

Visual Plumes allows both S and *Seff* to be reported. The former is most useful for understanding plume dynamics and whenever the ambient concentration is zero. The latter is recommended whenever the the primary concern is pollutant concentration and the ambient concentration is not zero.

The Implications of Concentration Profiles

From Kannberg and Davis (1976) the three-halves power profile may be expressed

$$\Phi = \left(1 - \left(\frac{r}{b}\right)^{\frac{3}{2}}\right)^{2} \qquad \textbf{(1)}$$

where r is the distance from the centerline of the plume and b is the radius of the plume, assumed for the moment to be round.

Similarly, the Gaussian profile may be expressed

$$\Phi_{Gaussian} = \exp\left(-\left(\frac{r}{b_1}\right)^{2}\right) \qquad \textbf{(2)}$$

where

$$b = 1.888 b_1 \qquad \textbf{(3)}$$

Thus, assuming momentarily a Gaussian profile, the ratio of the concentration at b to the centerline concentration is

$$\Phi_{Gaussian} = \exp\left(-(1.888)^{2}\right) = 0.02831 = 2.831\% \qquad \textbf{(4)}$$

The relationship between the two profiles is shown in Figure 1.

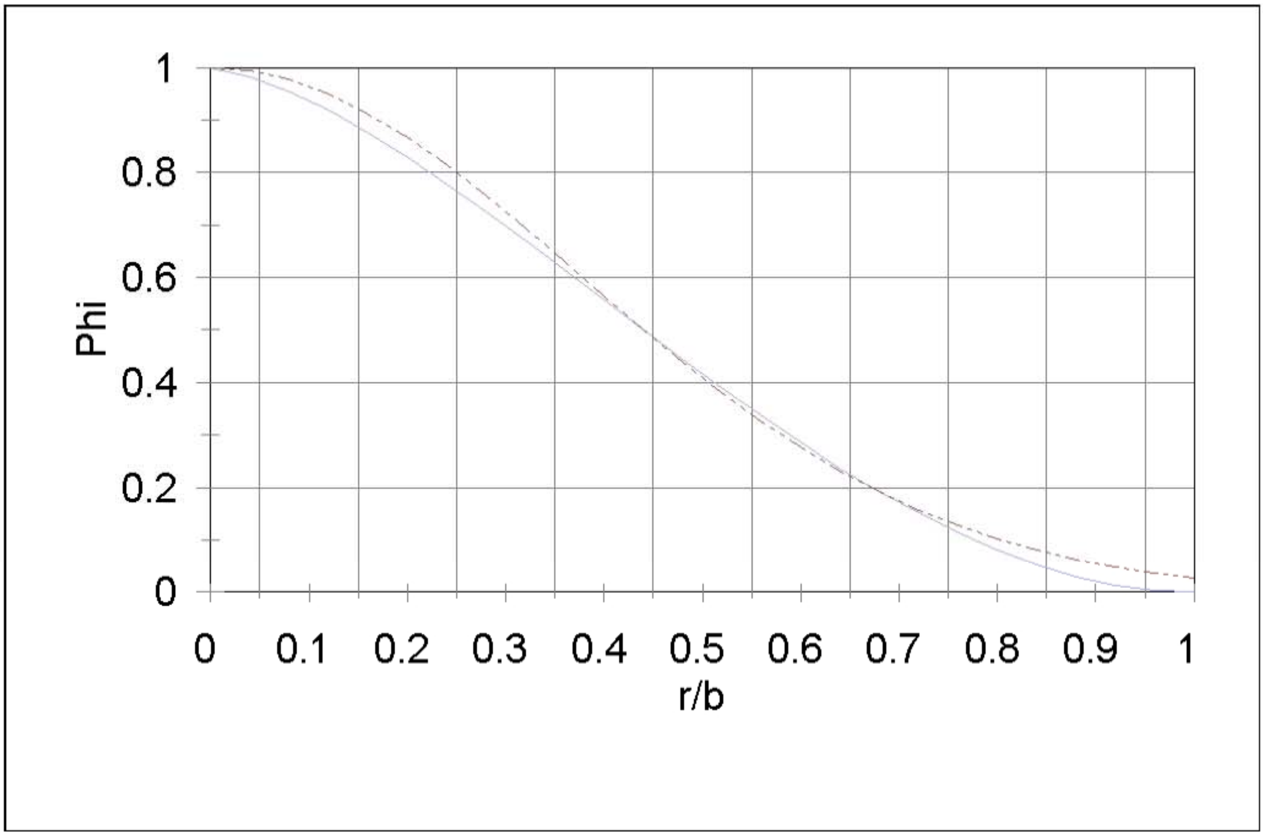


Figure 1 Comparison of Gaussian (broken) and 3/2 power profiles (solid).

Flux averaging ignored, the peak-to-mean ratios of these profiles is 3.67 and 3.89 for the Gaussian and three-halves power profiles respectively (corresponding to averages of 0.273 and 0.257).

Flux Averages

There are at least two common plume model types, Eulerian integral flux and Lagrangian models. While mathematically totally different, the dynamical equivalence of the two approaches has been demonstrated (e.g., Frick, Baumgartner, and Fox, 1994). It is fair to ask whether this equivalence extends to concentration profiles.

Flux averaging considers the fact that more material fluxes through the central portions of the plume cross-section than through comparable areas near the edges of the plume. The flux-averaged concentration may be defined

$$c_{avg} = \frac{\iint cv\,dx\,dy}{\iint v\,dx\,dy} \qquad \textbf{(5)}$$

where c_{avg} and c are the average and point concentrations respectively, v is the velocity at any point in the cross-section, and *dx* and *dy* are the cross-sectional differentials whose product defines the differential area.

ATTACHMENT III-2:
UM3 MODEL RUNS FOR 2007 AND 2025 DESIGN FLOWS

E-1

/ Windows UM3. 6/21/2007 6:02:01 PM
Case 1; ambient file C:\Plumes\Camascritical.001.db; Diffuser table record 1: ----------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	1.03	180.0	0.0	12.6	0.0	0.0	1.03	180.0	0.0003
1.0	1.09	180.0	0.0	12.6	0.0	0.0	1.09	180.0	0.0003
2.0	1.09	180.0	0.0	12.6	0.0	0.0	1.09	180.0	0.0003
3.0	1.07	180.0	0.0	12.6	0.0	0.0	1.07	180.0	0.0003
4.0	1.06	180.0	0.0	12.6	0.0	0.0	1.06	180.0	0.0003
5.0	1.03	180.0	0.0	12.6	0.0	0.0	1.03	180.0	0.0003
6.0	1.0	180.0	0.0	12.6	0.0	0.0	1.0	180.0	0.0003
7.0	0.98	180.0	0.0	12.6	0.0	0.0	0.98	180.0	0.0003
8.0	0.95	180.0	0.0	12.6	0.0	0.0	0.95	180.0	0.0003
9.0	0.92	180.0	0.0	12.6	0.0	0.0	0.92	180.0	0.0003
10.0	0.91	180.0	0.0	12.6	0.0	0.0	0.91	180.0	0.0003
11.0	0.89	180.0	0.0	12.6	0.0	0.0	0.89	180.0	0.0003
12.0	0.85	180.0	0.0	12.6	0.0	0.0	0.85	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
3.34	1.0	90.0	180.0	8.0	10.0	32.0	321.0	26.6	3.09	0.0	16.0	100.0

Froude number: 149.0

Step	Depth	Amb-cur	P-dia	Polutnt	P-speed	Dilutn	x-posn	y-posn	
	(ft)	(m/s)	(in)	(kg/kg)	(m/s)	()	(ft)	(ft)	
0	26.6	0.947	3.34	100.0	2.994	1.0	0.0	0.0;	
65	26.05	0.952	9.518	31.77	1.151	3.146	-0.152	0.0;	begin overlap,
95	25.86	0.954	12.96	20.37	0.972	4.908	-0.338	0.0;	end overlap,
100	25.82	0.954	13.62	18.78	0.956	5.322	-0.385	0.0;	
200	24.45	0.966	36.56	2.664	0.938	37.51	-8.323	0.0;	
245	23.24	0.977	56.5	1.093	0.957	91.45	-32.08	0.0;	acute zone,
300	20.98	0.992	96.46	0.368	0.976	271.8	-154.6	0.0;	
323	19.73	0.999	120.7	0.233	0.983	428.6	-284.9	0.0;	merging,
328	19.41	1.002	127.5	0.211	0.985	473.2	-327.4	0.0;	chronic zone,
385	14.36	1.048	318.1	0.0683	1.013	1462.9	-1457.7	0.0;	bottom hit,
389	13.93	1.052	342.2	0.0631	1.016	1583.5	-1593.2	0.0;	surface,

Outside chronic zone
;
6:02:02 PM. amb fills: 2

$\frac{473}{2.3} = 206$

E-2

```
/ Windows UM3. 6/21/2007 6:03:02 PM
Case 1; ambient file C:\Plumes\Camascritical.001.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0       1.03      180.0        0.0       12.6        0.0        0.0       1.03      180.0     0.0003
        1.0       1.09      180.0        0.0       12.6        0.0        0.0       1.09      180.0     0.0003
        2.0       1.09      180.0        0.0       12.6        0.0        0.0       1.09      180.0     0.0003
        3.0       1.07      180.0        0.0       12.6        0.0        0.0       1.07      180.0     0.0003
        4.0       1.06      180.0        0.0       12.6        0.0        0.0       1.06      180.0     0.0003
        5.0       1.03      180.0        0.0       12.6        0.0        0.0       1.03      180.0     0.0003
        6.0        1.0      180.0        0.0       12.6        0.0        0.0        1.0      180.0     0.0003
        7.0       0.98      180.0        0.0       12.6        0.0        0.0       0.98      180.0     0.0003
        8.0       0.95      180.0        0.0       12.6        0.0        0.0       0.95      180.0     0.0003
        9.0       0.92      180.0        0.0       12.6        0.0        0.0       0.92      180.0     0.0003
       10.0       0.91      180.0        0.0       12.6        0.0        0.0       0.91      180.0     0.0003
       11.0       0.89      180.0        0.0       12.6        0.0        0.0       0.89      180.0     0.0003
       12.0       0.85      180.0        0.0       12.6        0.0        0.0       0.85      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    4.01     1.0    90.0   180.0     8.0    10.0    32.0   321.0    26.6    7.03     0.0    16.0   100.0
Froude number:      214.7
        Depth  Amb-cur     P-dia   Polutnt   P-speed    Dilutn    x-posn    y-posn
Step     (ft)    (m/s)      (in)   (kg/kg)     (m/s)        ()      (ft)      (ft)
   0     26.6    0.947      4.01     100.0     4.725       1.0       0.0       0.0;
 100    25.05    0.961     20.86     15.81     1.098     6.323    -0.605       0.0;
 200    22.77    0.981     58.99     2.287     0.955      43.7    -10.44       0.0;
 238    21.16    0.991     85.27     1.078      0.97     92.74    -32.35       0.0; acute zone,
 274    19.04    1.005     120.9     0.528     0.984     189.2     -92.2       0.0; merging,
 300    16.75    1.026     171.5     0.316     0.996     316.6    -209.4       0.0;
 314    15.12    1.041     215.5     0.239     1.005     417.7    -328.7       0.0; chronic zone,
 333    12.45    1.062     300.2     0.164      1.02     608.6    -591.2       0.0; surface,
Outside chronic zone
 ;
6:03:03 PM. amb fills: 2
```

$$\frac{93}{2.3} = \underline{\underline{40}}$$

E-3

/ Windows UM3. 6/21/2007 6:08:08 PM

Case 1; ambient file C:\Plumes\Camascritical.002.db; Diffuser table record 1: ----------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.79	180.0	0.0	12.6	0.0	0.0	0.79	180.0	0.0003
1.0	0.77	180.0	0.0	12.6	0.0	0.0	0.77	180.0	0.0003
2.0	0.74	180.0	0.0	12.6	0.0	0.0	0.74	180.0	0.0003
3.0	0.7	180.0	0.0	12.6	0.0	0.0	0.7	180.0	0.0003
4.0	0.65	180.0	0.0	12.6	0.0	0.0	0.65	180.0	0.0003
5.0	0.61	180.0	0.0	12.6	0.0	0.0	0.61	180.0	0.0003
6.0	0.54	180.0	0.0	12.6	0.0	0.0	0.54	180.0	0.0003
7.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
8.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
9.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
10.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
11.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
12.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
3.34	1.0	90.0	180.0	8.0	10.0	32.0	321.0	21.0	3.09	0.0	16.0	100.0

Froude number: 149.0

Step	Depth	Amb-cur	P-dia	Polutnt	P-speed	Dilutn	x-posn	y-posn
	(ft)	(m/s)	(in)	(kg/kg)	(m/s)	()	(ft)	(ft)
0	21.0	0.508	3.34	100.0	2.994	1.0	0.0	0.0;
100	19.52	0.543	18.34	15.35	0.643	6.513	-0.52	0.0;
200	17.55	0.585	51.64	2.26	0.554	44.22	-8.208	0.0;
248	15.85	0.616	80.97	0.874	0.583	114.4	-32.61	0.0; acute zone,
290	13.85	0.641	120.1	0.38	0.609	262.8	-102.6	0.0; merging,
300	13.24	0.648	134.3	0.312	0.615	320.4	-136.2	0.0;
331	10.88	0.683	212.0	0.169	0.638	591.9	-329.4	0.0; chronic zone,
340	10.1	0.695	246.0	0.141	0.646	707.4	-417.3	0.0; surface,

Outside chronic zone

;

6:08:09 PM. amb fills: 2

$$\frac{592}{2.3} = 257$$

E-4

```
/ Windows UM3. 6/21/2007 6:09:17 PM
Case 1; ambient file C:\Plumes\Camascritical.003.db; Diffuser table record 1: ---------------------------------
      Depth     Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m         m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0       0.264      180.0        0.0       12.6        0.0        0.0      0.264      180.0     0.0003
        1.0       0.264      180.0        0.0       12.6        0.0        0.0      0.264      180.0     0.0003
        2.0       0.256      180.0        0.0       12.6        0.0        0.0      0.256      180.0     0.0003
        3.0       0.247      180.0        0.0       12.6        0.0        0.0      0.247      180.0     0.0003
        4.0       0.228      180.0        0.0       12.6        0.0        0.0      0.228      180.0     0.0003
        5.0        0.21      180.0        0.0       12.6        0.0        0.0       0.21      180.0     0.0003
        6.0       0.187      180.0        0.0       12.6        0.0        0.0      0.187      180.0     0.0003
        7.0       0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
        8.0       0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
        9.0       0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
       10.0       0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
       11.0       0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
       12.0       0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    4.01     1.0    90.0   180.0     8.0    10.0    32.0   321.0    21.0    7.03     0.0    16.0   100.0
Froude number:      214.7
        Depth  Amb-cur    P-dia  Polutnt  P-speed   Dilutn   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)    (m/s)       ()     (ft)     (ft)
   0     21.0    0.177     4.01    100.0    4.725      1.0      0.0      0.0;
 100    16.56    0.208    28.31     13.8    0.674    7.242   -0.512      0.0;
 199    9.766    0.247    121.1     2.11    0.245    47.38   -6.763      0.0; merging,
 200    9.688    0.247    122.5    2.068    0.245    48.33   -6.941      0.0;
 226    7.031    0.254    178.6    1.236    0.242    80.87   -15.26      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      25.87 m
    conc  dilutn   width distnce    time
 (kg/kg)             (m)     (m)   (hrs)  (kg/kg)    (s-1)    (m/s)(m0.67/s2)
 1.22153   81.83   31.38   97.84   0.159      0.0      0.0    0.163 3.00E-4
count: 1
 ;
6:09:18 PM. amb fills: 2
```

$$\frac{81}{2.3} = \underline{\underline{35}}$$

E-5

/ Windows UM3. 6/21/2007 6:10:25 PM
Case 1; ambient file C:\Plumes\Camascritical.002.db; Diffuser table record 1: ---------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.79	180.0	0.0	21.5	0.0	0.0	0.79	180.0	0.0003
1.0	0.77	180.0	0.0	21.5	0.0	0.0	0.77	180.0	0.0003
2.0	0.74	180.0	0.0	21.5	0.0	0.0	0.74	180.0	0.0003
3.0	0.7	180.0	0.0	21.5	0.0	0.0	0.7	180.0	0.0003
4.0	0.65	180.0	0.0	21.5	0.0	0.0	0.65	180.0	0.0003
5.0	0.61	180.0	0.0	21.5	0.0	0.0	0.61	180.0	0.0003
6.0	0.54	180.0	0.0	21.5	0.0	0.0	0.54	180.0	0.0003
7.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
8.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
9.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
10.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
11.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
12.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
3.07	1.0	90.0	180.0	8.0	10.0	32.0	321.0	21.0	2.07	0.0	22.0	100.0

Froude number: 255.9

Step	Depth	Amb-cur	P-dia	Polutnt	P-speed	Dilutn	x-posn	y-posn	
	(ft)	(m/s)	(in)	(kg/kg)	(m/s)	()	(ft)	(ft)	
0	21.0	0.508	3.07	100.0	2.374	1.0	0.0	0.0;	
100	19.92	0.534	15.24	16.36	0.586	6.114	-0.434	0.0;	
200	18.34	0.568	41.82	2.37	0.54	42.19	-7.721	0.0;	
250	16.91	0.599	66.95	0.88	0.567	113.6	-32.79	0.0;	acute zone,
300	15.02	0.626	107.0	0.327	0.598	305.7	-123.9	0.0;	
313	14.47	0.633	121.0	0.253	0.605	395.4	-171.1	0.0;	merging,
336	13.24	0.648	162.6	0.16	0.618	623.5	-324.4	0.0;	chronic zone,
363	11.57	0.673	251.6	0.0939	0.636	1064.3	-653.0	0.0;	bottom hit,
368	11.27	0.677	274.2	0.0851	0.639	1175.0	-732.9	0.0;	surface,

Outside chronic zone
;
6:10:26 PM. amb fills: 2

$$\frac{623}{2.3} = \underline{\underline{271}}$$

E-6

```
/ Windows UM3. 6/21/2007 6:11:13 PM
Case 1; ambient file C:\Plumes\Camascritical.003.db; Diffuser table record 1: ----------------------------------
     Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
         m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg  m0.67/s2
       0.0      0.264      180.0        0.0       21.5        0.0        0.0      0.264      180.0     0.0003
       1.0      0.264      180.0        0.0       21.5        0.0        0.0      0.264      180.0     0.0003
       2.0      0.256      180.0        0.0       21.5        0.0        0.0      0.256      180.0     0.0003
       3.0      0.247      180.0        0.0       21.5        0.0        0.0      0.247      180.0     0.0003
       4.0      0.228      180.0        0.0       21.5        0.0        0.0      0.228      180.0     0.0003
       5.0       0.21      180.0        0.0       21.5        0.0        0.0       0.21      180.0     0.0003
       6.0      0.187      180.0        0.0       21.5        0.0        0.0      0.187      180.0     0.0003
       7.0      0.163      180.0        0.0       21.5        0.0        0.0      0.163      180.0     0.0003
       8.0      0.163      180.0        0.0       21.5        0.0        0.0      0.163      180.0     0.0003
       9.0      0.163      180.0        0.0       21.5        0.0        0.0      0.163      180.0     0.0003
      10.0      0.163      180.0        0.0       21.5        0.0        0.0      0.163      180.0     0.0003
      11.0      0.163      180.0        0.0       21.5        0.0        0.0      0.163      180.0     0.0003
      12.0      0.163      180.0        0.0       21.5        0.0        0.0      0.163      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    3.42     1.0    90.0   180.0     8.0    10.0    32.0   321.0    21.0    3.34     0.0    22.0   100.0
Froude number:      315.2
        Depth  Amb-cur    P-dia  Polutnt  P-speed   Dilutn   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)    (m/s)       ()     (ft)     (ft)
   0     21.0    0.177     3.42    100.0    3.086      1.0      0.0      0.0;
 100    17.75      0.2    23.73     13.8    0.457    7.244   -0.531      0.0;
 200     13.5    0.226    89.28     2.07    0.219    48.29   -6.572      0.0;
 231     11.6    0.236    120.5    1.121    0.222    89.23   -15.54      0.0; merging,
 254    9.609    0.247    160.7    0.711    0.229    140.7   -32.06      0.0; acute zone,
 267    8.107    0.251    195.4    0.549    0.233    182.0   -49.96      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      26.30 m
    conc  dilutn    width distnce    time
 (kg/kg)              (m)     (m)    (hrs) (kg/kg)   (s-1)    (m/s)(m0.67/s2)
 0.54544   183.3    31.26   97.84    0.141     0.0     0.0    0.163 3.00E-4
count: 1
 ;
6:11:14 PM. amb fills: 2
```

$\frac{141}{2.3} = \underline{\underline{61}}$

F-1

/ Windows UM3. 6/21/2007 6:15:56 PM

Case 1; ambient file C:\Plumes\Camascritical.001.db; Diffuser table record 1: ----------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	1.03	180.0	0.0	12.6	0.0	0.0	1.03	180.0	0.0003
1.0	1.09	180.0	0.0	12.6	0.0	0.0	1.09	180.0	0.0003
2.0	1.09	180.0	0.0	12.6	0.0	0.0	1.09	180.0	0.0003
3.0	1.07	180.0	0.0	12.6	0.0	0.0	1.07	180.0	0.0003
4.0	1.06	180.0	0.0	12.6	0.0	0.0	1.06	180.0	0.0003
5.0	1.03	180.0	0.0	12.6	0.0	0.0	1.03	180.0	0.0003
6.0	1.0	180.0	0.0	12.6	0.0	0.0	1.0	180.0	0.0003
7.0	0.98	180.0	0.0	12.6	0.0	0.0	0.98	180.0	0.0003
8.0	0.95	180.0	0.0	12.6	0.0	0.0	0.95	180.0	0.0003
9.0	0.92	180.0	0.0	12.6	0.0	0.0	0.92	180.0	0.0003
10.0	0.91	180.0	0.0	12.6	0.0	0.0	0.91	180.0	0.0003
11.0	0.89	180.0	0.0	12.6	0.0	0.0	0.89	180.0	0.0003
12.0	0.85	180.0	0.0	12.6	0.0	0.0	0.85	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
3.92	1.0	90.0	180.0	8.0	10.0	32.0	321.0	21.0	6.1	0.0	16.0	100.0

Froude number: 197.2

Step	Depth	Amb-cur	P-dia	Polutnt	P-speed	Dilutn	x-posn	y-posn	
	(ft)	(m/s)	(in)	(kg/kg)	(m/s)	()	(ft)	(ft)	
0	21.0	0.992	3.92	100.0	4.291	1.0	0.0	0.0;	
100	19.69	1.0	19.05	16.52	1.093	6.05	-0.551	0.0;	
200	17.66	1.018	53.0	2.37	0.99	42.17	-10.25	0.0;	
239	16.18	1.032	77.3	1.095	1.008	91.28	-32.72	0.0;	acute zone,
285	13.69	1.054	120.6	0.44	1.029	227.0	-122.1	0.0;	merging,
300	12.55	1.061	145.0	0.327	1.037	305.5	-192.8	0.0;	
316	10.94	1.066	185.1	0.238	1.044	419.3	-325.7	0.0;	chronic zone,
328	9.399	1.072	226.6	0.188	1.049	531.8	-487.6	0.0;	surface,

Outside chronic zone

;

6:15:57 PM. amb fills: 2

$\frac{419}{2.3} = 182$

F-2

```
/ Windows UM3. 6/21/2007 6:15:36 PM
Case 1; ambient file C:\Plumes\Camascritical.001.db; Diffuser table record 1: ----------------------------------
     Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
         m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg  m0.67/s2
       0.0       1.03      180.0        0.0       12.6        0.0        0.0       1.03      180.0     0.0003
       1.0       1.09      180.0        0.0       12.6        0.0        0.0       1.09      180.0     0.0003
       2.0       1.09      180.0        0.0       12.6        0.0        0.0       1.09      180.0     0.0003
       3.0       1.07      180.0        0.0       12.6        0.0        0.0       1.07      180.0     0.0003
       4.0       1.06      180.0        0.0       12.6        0.0        0.0       1.06      180.0     0.0003
       5.0       1.03      180.0        0.0       12.6        0.0        0.0       1.03      180.0     0.0003
       6.0        1.0      180.0        0.0       12.6        0.0        0.0        1.0      180.0     0.0003
       7.0       0.98      180.0        0.0       12.6        0.0        0.0       0.98      180.0     0.0003
       8.0       0.95      180.0        0.0       12.6        0.0        0.0       0.95      180.0     0.0003
       9.0       0.92      180.0        0.0       12.6        0.0        0.0       0.92      180.0     0.0003
      10.0       0.91      180.0        0.0       12.6        0.0        0.0       0.91      180.0     0.0003
      11.0       0.89      180.0        0.0       12.6        0.0        0.0       0.89      180.0     0.0003
      12.0       0.85      180.0        0.0       12.6        0.0        0.0       0.85      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    4.27     1.0    90.0   180.0     8.0    10.0    32.0   321.0    21.0   10.04     0.0    16.0   100.0
Froude number:      262.0
        Depth  Amb-cur     P-dia  Polutnt  P-speed    Dilutn   x-posn    y-posn
Step     (ft)    (m/s)      (in)  (kg/kg)    (m/s)        ()     (ft)      (ft)
   0     21.0    0.992      4.27    100.0    5.952       1.0      0.0      0.0;
 100     19.0    1.006      24.1    15.02    1.234     6.654   -0.698      0.0;
 200    16.27    1.031     70.13    2.197    1.004     45.49   -10.94      0.0;
 237    14.41    1.048     100.4    1.056     1.02     94.65    -32.6      0.0; acute zone,
 256     13.2    1.059     120.5    0.725     1.03     137.9   -56.62      0.0; merging,
 297    8.807    1.075     218.6    0.322     1.05     310.6   -225.5      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      26.89 m
    conc  dilutn   width distnce     time
 (kg/kg)             (m)     (m)    (hrs)  (kg/kg)    (s-1)    (m/s)(m0.67/s2)
  0.3211   311.3   27.25   97.84  0.00951      0.0      0.0     0.85 3.00E-4
count: 1
 ;
6:15:37 PM. amb fills: 2
```

$\frac{95}{2.3} = \underline{\underline{41}}$

F-3

```
/ Windows UM3. 6/21/2007 6:15:05 PM
Case 1; ambient file C:\Plumes\Camascritical.002.db; Diffuser table record 1: -----------------------------------
      Depth     Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m         m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0        0.79      180.0        0.0       12.6        0.0        0.0       0.79      180.0     0.0003
        1.0        0.77      180.0        0.0       12.6        0.0        0.0       0.77      180.0     0.0003
        2.0        0.74      180.0        0.0       12.6        0.0        0.0       0.74      180.0     0.0003
        3.0         0.7      180.0        0.0       12.6        0.0        0.0        0.7      180.0     0.0003
        4.0        0.65      180.0        0.0       12.6        0.0        0.0       0.65      180.0     0.0003
        5.0        0.61      180.0        0.0       12.6        0.0        0.0       0.61      180.0     0.0003
        6.0        0.54      180.0        0.0       12.6        0.0        0.0       0.54      180.0     0.0003
        7.0        0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
        8.0        0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
        9.0        0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
       10.0        0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
       11.0        0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
       12.0        0.46      180.0        0.0       12.6        0.0        0.0       0.46      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    3.92     1.0    90.0   180.0     8.0    10.0    32.0   321.0    21.0     6.1     0.0    16.0   100.0
Froude number:       197.2
        Depth  Amb-cur     P-dia  Polutnt  P-speed   Dilutn   x-posn   y-posn
Step     (ft)    (m/s)      (in)  (kg/kg)    (m/s)       ()     (ft)     (ft)
   0     21.0    0.508      3.92    100.0    4.291      1.0      0.0      0.0;
 100    18.63    0.562     24.34     14.3     0.77    6.988   -0.668      0.0;
 200     15.8    0.617     72.21    2.165    0.584    46.16   -8.979      0.0;
 244    13.59    0.644     109.3    0.906     0.61    110.3   -32.18      0.0; acute zone,
 254    12.98    0.651     120.0    0.743    0.616    134.5   -42.77      0.0; merging,
 298    8.986    0.709     220.8    0.311    0.654    321.5   -170.2      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      26.94 m
    conc  dilutn    width distnce    time
 (kg/kg)              (m)     (m)   (hrs) (kg/kg)    (s-1)    (m/s)(m0.67/s2)
 0.31058   321.8     28.0   97.84  0.0278     0.0      0.0     0.46 3.00E-4
count: 1
 ;
6:15:06 PM. amb fills: 2
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$\frac{322}{2.3} = 140$

F-4

```
/ Windows UM3. 6/21/2007 6:14:36 PM
Case 1; ambient file C:\Plumes\Camascritical.003.db; Diffuser table record 1: ----------------------------------
      Depth     Amb-cur     Amb-dir     Amb-sal     Amb-tem     Amb-pol       Decay     Far-spd     Far-dir     Disprsn
          m         m/s         deg         psu           C       kg/kg         s-1         m/s         deg    m0.67/s2
        0.0       0.264       180.0         0.0        12.6         0.0         0.0       0.264       180.0      0.0003
        1.0       0.264       180.0         0.0        12.6         0.0         0.0       0.264       180.0      0.0003
        2.0       0.256       180.0         0.0        12.6         0.0         0.0       0.256       180.0      0.0003
        3.0       0.247       180.0         0.0        12.6         0.0         0.0       0.247       180.0      0.0003
        4.0       0.228       180.0         0.0        12.6         0.0         0.0       0.228       180.0      0.0003
        5.0        0.21       180.0         0.0        12.6         0.0         0.0        0.21       180.0      0.0003
        6.0       0.187       180.0         0.0        12.6         0.0         0.0       0.187       180.0      0.0003
        7.0       0.163       180.0         0.0        12.6         0.0         0.0       0.163       180.0      0.0003
        8.0       0.163       180.0         0.0        12.6         0.0         0.0       0.163       180.0      0.0003
        9.0       0.163       180.0         0.0        12.6         0.0         0.0       0.163       180.0      0.0003
       10.0       0.163       180.0         0.0        12.6         0.0         0.0       0.163       180.0      0.0003
       11.0       0.163       180.0         0.0        12.6         0.0         0.0       0.163       180.0      0.0003
       12.0       0.163       180.0         0.0        12.6         0.0         0.0       0.163       180.0      0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    4.27     1.0    90.0   180.0     8.0    10.0    32.0   321.0    21.0   10.04     0.0    16.0   100.0
Froude number:       262.0
         Depth  Amb-cur    P-dia  Polutnt  P-speed   Dilutn   x-posn   y-posn
Step      (ft)    (m/s)     (in)  (kg/kg)    (m/s)       ()     (ft)     (ft)
   0      21.0    0.177     4.27    100.0    5.952      1.0      0.0      0.0;
 100     15.99    0.212    30.31     13.8    0.839    7.242   -0.476      0.0;
 187     8.361    0.251    120.9    2.674    0.276    37.38   -5.236      0.0; merging,
 200     7.106    0.254    146.6    2.083    0.263    47.99   -7.297      0.0;
 208     6.171    0.257    168.2    1.778    0.258    56.23    -9.21      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      25.61 m
    conc  dilutn   width distnce     time
 (kg/kg)             (m)     (m)    (hrs)  (kg/kg)    (s-1)    (m/s)(m0.67/s2)
 1.75478   56.96   31.19   97.84    0.162      0.0      0.0    0.163 3.00E-4
count: 1
 ;
6:14:38 PM. amb fills: 2
```

$\frac{56}{2.3} = \underline{\underline{24}}$

F-S

```
/ Windows UM3. 6/21/2007 6:13:37 PM
Case 1; ambient file C:\Plumes\Camascritical.002.db; Diffuser table record 1: -----------------------------------
     Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
         m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
       0.0       0.79      180.0        0.0       21.5        0.0        0.0       0.79      180.0     0.0003
       1.0       0.77      180.0        0.0       21.5        0.0        0.0       0.77      180.0     0.0003
       2.0       0.74      180.0        0.0       21.5        0.0        0.0       0.74      180.0     0.0003
       3.0        0.7      180.0        0.0       21.5        0.0        0.0        0.7      180.0     0.0003
       4.0       0.65      180.0        0.0       21.5        0.0        0.0       0.65      180.0     0.0003
       5.0       0.61      180.0        0.0       21.5        0.0        0.0       0.61      180.0     0.0003
       6.0       0.54      180.0        0.0       21.5        0.0        0.0       0.54      180.0     0.0003
       7.0       0.46      180.0        0.0       21.5        0.0        0.0       0.46      180.0     0.0003
       8.0       0.46      180.0        0.0       21.5        0.0        0.0       0.46      180.0     0.0003
       9.0       0.46      180.0        0.0       21.5        0.0        0.0       0.46      180.0     0.0003
      10.0       0.46      180.0        0.0       21.5        0.0        0.0       0.46      180.0     0.0003
      11.0       0.46      180.0        0.0       21.5        0.0        0.0       0.46      180.0     0.0003
      12.0       0.46      180.0        0.0       21.5        0.0        0.0       0.46      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    3.77     1.0    90.0   180.0     8.0    10.0    32.0   321.0    21.0    5.09     0.0    22.0   100.0
Froude number:      376.5
         Depth  Amb-cur     P-dia  Polutnt  P-speed   Dilutn   x-posn   y-posn
Step      (ft)    (m/s)      (in)  (kg/kg)    (m/s)       ()     (ft)     (ft)
   0      21.0    0.508      3.77    100.0    3.871      1.0      0.0     0.0;
 100      18.9    0.556      22.7    14.55    0.727    6.872   -0.631     0.0;
 200     16.34     0.61     66.16    2.187    0.575    45.72   -8.838     0.0;
 245     14.28    0.635     101.0    0.897    0.602    111.5   -32.73     0.0; acute zone,
 264     13.19    0.648     120.7    0.616    0.614    162.4   -56.16     0.0; merging,
 300     10.23    0.693     196.3    0.302    0.643    331.3   -172.5     0.0;
 309     9.308    0.705     226.9    0.253    0.652    395.9   -227.6     0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      27.10 m
    conc   dilutn    width distnce     time
 (kg/kg)              (m)     (m)     (hrs)  (kg/kg)    (s-1)    (m/s)(m0.67/s2)
 0.25217    396.5    27.76   97.84   0.0172      0.0      0.0     0.46 3.00E-4
count: 1
 ;
6:13:38 PM. amb fills: 2
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$$\frac{396}{2.3} = \underline{\underline{172}}$$

F-6

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/ Windows UM3. 6/21/2007 6:12:34 PM
Case 1; ambient file C:\Plumes\Camascritical.002.db; Diffuser table record 1: ---------------------------------
      Depth     Amb-cur     Amb-dir     Amb-sal     Amb-tem     Amb-pol       Decay     Far-spd     Far-dir     Disprsn
          m         m/s         deg         psu           C       kg/kg         s-1         m/s         deg    m0.67/s2
        0.0        0.79       180.0         0.0        21.5         0.0         0.0        0.79       180.0      0.0003
        1.0        0.77       180.0         0.0        21.5         0.0         0.0        0.77       180.0      0.0003
        2.0        0.74       180.0         0.0        21.5         0.0         0.0        0.74       180.0      0.0003
        3.0         0.7       180.0         0.0        21.5         0.0         0.0         0.7       180.0      0.0003
        4.0        0.65       180.0         0.0        21.5         0.0         0.0        0.65       180.0      0.0003
        5.0        0.61       180.0         0.0        21.5         0.0         0.0        0.61       180.0      0.0003
        6.0        0.54       180.0         0.0        21.5         0.0         0.0        0.54       180.0      0.0003
        7.0        0.46       180.0         0.0        21.5         0.0         0.0        0.46       180.0      0.0003
        8.0        0.46       180.0         0.0        21.5         0.0         0.0        0.46       180.0      0.0003
        9.0        0.46       180.0         0.0        21.5         0.0         0.0        0.46       180.0      0.0003
       10.0        0.46       180.0         0.0        21.5         0.0         0.0        0.46       180.0      0.0003
       11.0        0.46       180.0         0.0        21.5         0.0         0.0        0.46       180.0      0.0003
       12.0        0.46       180.0         0.0        21.5         0.0         0.0        0.46       180.0      0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal     Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)      (C) (kg/kg)
    3.92     1.0    90.0   180.0     8.0    10.0    32.0   321.0    21.0    6.36     0.0     22.0   100.0
Froude number:      426.7
        Depth  Amb-cur    P-dia  Polutnt  P-speed   Dilutn   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)    (m/s)       ()     (ft)     (ft)
   0     21.0    0.508     3.92    100.0    4.473      1.0      0.0      0.0;
 100    18.55    0.564    24.64    14.22    0.788    7.033   -0.672      0.0;
 200    15.65    0.619     73.7    2.158    0.587    46.33    -8.91      0.0;
 244    13.39    0.646    111.6    0.903    0.612    110.7   -32.01      0.0; acute zone,
 252    12.89    0.653    120.3    0.771    0.617    129.7   -40.25      0.0; merging,
 295    8.976    0.709    218.0    0.329    0.654    304.0   -158.6      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      26.87 m
    conc  dilutn   width distnce    time
 (kg/kg)             (m)     (m)   (hrs)  (kg/kg)    (s-1)    (m/s)(m0.67/s2)
 0.32855   304.3   28.01   97.84  0.0299      0.0      0.0    0.46 3.00E-4
count: 1
 ;
6:12:35 PM. amb fills: 2
```

$$\frac{111}{2.3} = \underline{\underline{48}}$$

Gray & Osborne, Inc.
CONSULTING ENGINEERS

March 2, 2009

Mr. David Knight, P.E.
Washington State Department of Ecology
Southwest Regional Office
Water Quality Program
P.O. Box 47775
Olympia, Washington 98504-7775

SUBJECT: SUPPLEMENTAL OUTFALL MIXING ZONE MODELING, WASTEWATER TREATMENT FACILITY CITY OF CAMAS, CLARK COUNTY, WASHINGTON G&O #06518.00

Dear Mr. Knight:

Per our recent discussions regarding effluent dilution modeling and effluent ammonia limitations for the City of Camas Wastewater Treatment Facility, we have asked Cosmopolitan Engineering to model the Camas diffuser using the UM3 model with default parameters and future flows. Attached are two technical memoranda presenting the results of this modeling.

We would appreciate your review and approval of this modeling effort for the determination of dilution values for the Camas diffuser.

Please contact me or John Wilson, P.E., if you need additional information on this supplemental modeling.

Very truly yours,

GRAY & OSBORNE, INC.

Jay L. Swift, P.E.

JLS/hhj
Encl.

cc: Mr. Monte Brachmann, Public Works Director, City of Camas, w/encl.
Mr. Jim Dickinson, Chief Wastewater Treatment Operator, City of Camas, w/encl.
Mr. Eric Levison, Operations Manager, City of Camas, w/encl.
Mr. Greg Zentner, P.E., Washington State Department of Ecology, w/encl.
Mr. Anise Ahmed, P.E., Washington State Department of Ecology, w/encl.
Mr. Bill Fox, P.E., Cosmopolitan Engineering Group

701 Dexter Avenue N., Suite 200 Seattle, Washington 98109 (206) 284-0860 Fax (206) 283-3206

Technical Memorandum

PO Box 1678 • Tacoma, WA 98401-1678
711 Pacific Avenue • Tacoma, WA 98402
Phone (253) 272-7220 • Fax (253) 272-7250
BFox@cosmopolitaneng.com

TM TITLE:	**City of Camas Mixing Zone Study**
DATE:	January 20, 2009
TO:	Jay Swift, Gray & Osborne
PREPARED BY:	Nick Whitaker, Cosmopolitan Engineering Group
REVIEWED BY:	Bill Fox, PE, Cosmopolitan Engineering Group
PROJECT #:	G/O016

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INTRODUCTION

The purpose of this Technical Memorandum (TM) is to update the mixing zone dilution factors and the reasonable potential analysis in *Part III The City of Camas Dye Tracer and Mixing Zone Study* (CEG, June 2007). The mixing zone modeling is based on an updated UM3 model using default values for all calibration parameters. This TM will also evaluate if there is a reasonable potential to exceed water quality standards for the recommended outfall improvements.

EFFLUENT FLOW RATES

Gray & Osborne provided the effluent flow design criteria for facility planning presented in Table 1.

Table 1 Effluent Flow Design Criteria for Facility Planning

Planning Year	Winter Flow Criteria		Summer Flow Criteria	
	Max. Month (mgd)	Max. Day (mgd)	Max. Month (mgd)	Max. Day (mgd)
2025	6.10	10.04	5.09	6.36

RECOMMENDED DIFFUSER MODIFICATION

The existing outfall includes a diffuser consisting of eight, 6-inch-diameter ports discharging horizontally in the same direction as ambient currents. This co-flowing configuration reduces the hydrodynamic mixing potential. Dilution factors would be improved by reorienting the diffuser outlets to a vertical discharge configuration. It is our strong recommendation to proceed with this minor modification to the existing diffuser.

The new diffuser will consist of eight ports oriented to discharge vertically. Each port will be fitted with a 6-inch Tideflex elastomeric check valve. In addition to aiding in the prevention of debris accumulation, the valves will enhance diffuser velocities over the range of operating flow rates. A copy of the performance data for the selected valves is provided in Figure 1.

TIDEFLEX DIFFUSER (TFD) SYSTEM DATA ANALYSIS

MEDIA: Effluent
Density or ______ lb/ft^3
Spec. Gravity 1

FLOW RANGE:

1.3	MGD =	903	gpm
5.6	MGD =	3889	gpm
7.2	MGD =	5000	gpm

AVAILABLE HEADLOSS@ DIFFUSER:
Minimum ______ feet
Design ______ feet
Maximum ______ feet

MAX. BACKPRESSURE: ______ feet

* DIFFUSER SIZE (IN)	CATALOG * NUMBER
6	**206**

DATE: 14-Nov-2005

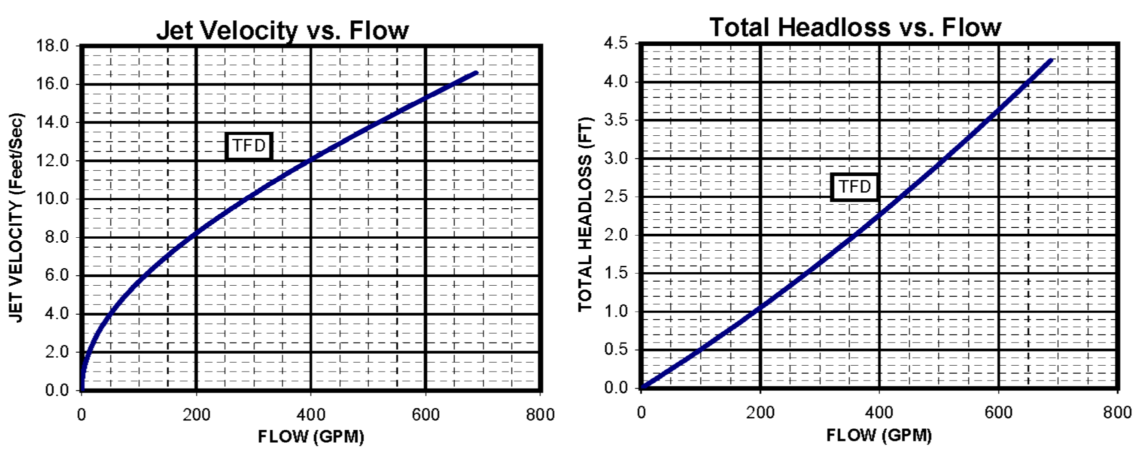
CUSTOMER: City of Camas, WA
CONTACT: Monte Brachmann

ENGINEER: Gray & Osborne, Inc.
CONTACT: Jay Swift, P.E.

PROJECT: City of Camas, WA - WWTP Outfall

REP: Antec Corporation
CONTACT: Matthew Davidson

		PER TIDEFLEX DIFFUSER			
*** TOTAL QUANTITY**	TOTAL FLOW (gpm)	FLOW (gpm)	**JET VELOCITY (fps)**	**TOTAL HEADLOSS @ DIFFUSER (feet)**	EFFECTIVE DIAMETER (in)
8	903	112.85	6.07	0.57	2.75
	3889	486.11	13.50	2.83	3.83
	5000	625.00	15.66	3.81	4.04



TIDEFLEX TECHNOLOGIES, INC. 300 BILMAR DRIVE, PITTSBURGH, PA 15205 (412) 919-0919 phone (412) 919-0918 fax

Figure 1 Tideflex Diffuser System Data Analysis

The port velocities corresponding to a range of operating conditions are presented in Table 2.

Table 2 Diffuser Port Velocities for Tideflex Diffuser Valves

Design Year	Season	Max Flow Period	Effluent Flow (mgd)	Flow per Port (gpm)	Discharge Velocity (fps)	Port Area (sq. in.)	Port Dia. (in.)
2025	Winter	30-day	6.1	529	14.1	12.0	3.92
2025	Winter	24-hr	10.04	871	19.5	14.3	4.27
2025	Summer	30-day	5.09	442	12.7	11.2	3.77
2025	Summer	24-hr	6.36	552	14.7	12.0	3.92

DILUTION MODELING

UM3 MODEL

The UM3 models runs were carried out through the Visual Plumes interface. A default aspiration entrainment coefficient (AEC) of 0.1 was used in all the model runs. Additional default values included the diffuser port contraction coefficient of 1. The model configuration applied the Brooks far-field solution with the default dispersion coefficients. There centerline dilutions were used in the reasonable potential analysis.

The centerline dilution concentration in previous studies (CEG, 2007) was determined by dividing the calculated dilution factor by a peak-to-mean ratio of 2.3. This evaluation used a more conservative centerline dilution factor, which is calculated using the algorithms embedded in UM3.

MODEL RESULTS

A series of UM3 model runs from the Visual Plumes interface, with the Brooks farfield algorithm, are provided in Attachment 1. All model runs are based on the vertical port orientation with Tideflex valves. The basis of the model runs and the results are described below:

F-1	This chronic model run is for near-flood ambient conditions modeled by Ecology in the NPDES permit, the 90th percentile river discharge of 522 kcfs. This run is equivalent to Ecology run NC22B except for the maximum month effluent flow rate for 2025.
F-2	This acute model run is for the same near-flood ambient conditions modeled by Ecology, equivalent to Ecology run NC24 except the maximum day effluent flow rate for 2025.
F-3	This chronic model run corresponds to the 2025 winter maximum month flow rate and winter effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition.

F-4	This acute model run corresponds to 2025 maximum day winter flow rate and winter effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment, which is caused by the tidal influence that occurs during low to normal Columbia River flows.
F-5	This chronic model run corresponds to 2025 summer maximum month flow rate and summer effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition (same as F-3).
F-6	This acute model run corresponds to 2025 maximum day summer flow rate and summer effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment (same as F-4).

The results of the modeling are presented in Table 3. The results demonstrate that critical conditions occur during winter flows at the WWTP. The critical condition for acute dilution occurs during the brief tidally-influenced slowdowns that occur near high tide during low river flow conditions.

Table 3 Dilution Model Results for 2025 Effluent Flows

Model Run #	Ambient Condition	Discharge Depth (ft)	Avg Current Speed (m/sec)	Ambient Temp (°C)	Effluent Flow (mgd)	Effluent Temp (°C)	Acute Dilution	Chronic Dilution
F-1	(1)Winter High Flow	26.6	1.0	12.6	6.10	16.0		138
F-2	(1)Winter High Flow	26.6	1.0	12.6	10.04	16.0	24	
F-3	(2)Winter Average	21.0	0.7	12.6	6.10	16.0		122
F-4	(3)Winter 10%	21.0	0.25	12.6	10.04	16.0	19	
F-5	(2)Summer Average	21.0	0.7	21.5	5.09	22.0		156
F-6	(3)Summer 10%	21.0	0.25	21.5	6.36	22.0	27	

(1) Ambient conditions for 522 kcfs river flow (90th percentile) per Ecology NPDES permit (runs NC22 and NC24)
(2) Ambient condition for non-flood river flow based on tidally-averaged current profile from October 2004 current meter deployment.
(3) Ambient condition for acute model runs based on lowest tidally-influenced current profile (duration = 1 hr±) from October 2004 current meter deployment.

REASONABLE POTENTIAL ASSESSMENT

EPA and Ecology use a statistical test to determine a discharge's "reasonable potential" to exceed water quality standards, which is based on effluent and ambient data and acute and chronic dilution factors. If a discharge exhibits a reasonable potential to exceed water quality standards for any parameter, Ecology issues an effluent limitation for that parameter in the NPDES permit. If a parameter does not exhibit a reasonable potential to exceed water quality standards, no NPDES permit limit is required.

EFFLUENT DATA

Water quality-based effluent limits are assessed for ammonia and selected metals (cadmium, copper, lead, nickel, silver, zinc, and mercury). The critical effluent concentrations used in determination of reasonable potential are based on eight effluent metals scans in 2005 and 2006, and over 400 effluent ammonia samples in 2005 and 2006.

The metals data are provided in Table 4. The values in red are detected concentrations, and the values in black are the detection levels for non-detected results. High concentrations of cadmium and nickel were measured on June 2, 2006. These values may be anomalous, or if realistic should be evaluated in future sampling efforts.

Table 4 Camas Effluent Metals Data (µg/L)

Date	Cd	Cu	Pb	Ni	Ag	An	Hg
5/13/2005	3	8	5	20	10	18	0.056
7/21/2005	10	31	5	20	10	19	0.050
9/30/2005	3	5	5	20	10	16	0.056
12/7/2005	3	5	5	20	10	15	0.050
3/31/2006	3	5	5	20	10	25	0.070
6/2/2006	87	12	5	373	70	20	0.050
9/12/2006	3	7	5	20	10	31	
12/18/2006	3	5	5	29	10	30	0.050
Count	8	8	8	8	8	8	7
# Detects	2	4	0	2	0	8	2

Detected Values in Red   Detection Limit in Black

AMBIENT DATA AND WATER QUALITY STANDARDS

No ambient sampling has been conducted in this mixing zone study for ammonia or metals or the parameters that affect their water quality standards (pH, temperature, and hardness). The criteria for ambient concentrations, and ambient-depended water quality criteria, are the same as Ecology cited in Appendix C of the NPDES permit.

REASONABLE POTENTIAL RESULTS

The reasonable potential to exceed water quality standards for ammonia and metals is presented in Table 5 for the recommended diffuser modifications. Ammonia is the only analyte considered seasonally due to its dependence on ambient pH and temperature. Cadmium was the only analyte with a reasonable potential to exceed water quality standards, both in winter and summer. This result suggests that additional effluent monitoring for cadmium should be conducted, as well as a potential source control investigation. However, this finding is based on only two detected values, and thus should be sampled more frequently in the future to determine if the reasonable potential is realistic. The ambient concentration used in the analysis is also relatively high, and may need to be assessed in a sampling program.

If the diffuser is modified to a vertical port orientation using Tideflex valves, there is no reasonable potential to exceed ammonia water quality standards in summer or winter. The critical condition for ammonia is winter. Comparing the maximum concentration expected at the chronic mixing zone (221 µg/L) to the chronic water quality standard (470 µg/L) reveals a factor of safety greater than two. Therefore, water quality-based ammonia limits should be deleted from current and future NPDES permits.

Table 5   Reasonable Potential Calculation Table

				State Water Quality Standard		Max concentration at edge of...									
	Metal Criteria Translator as decimal	Metal Criteria Translator as decimal	Ambient Concentration (metals as dissolved)	Acute	Chronic	Acute Mixing Zone	Chronic Mixing Zone	LIMIT REQ'D?	Max effluent conc. measured (metals as total recoverable)	Coeff Variation		# of samples	Multiplier	Acute Dil'n Factor	Chronic Dil'n Factor
Parameter	Acute	Chronic	ug/L	ug/L	ug/L	ug/L	ug/L		ug/L	CV	s	n			
Modified Diffuser (Vertical Discharge)															
2025															
Ammonia-N (summer)	1.00	1.00	27.00	5100.00	830.000	939.52	184.94	NO	35200	0.60	0.55	268	0.70	27.0	156.0
Ammonia-N (winter)	1.00	1.00	19.00	2100.00	470.000	1316.16	221.02	NO	35200	0.60	0.55	268	0.70	19.0	122.0
Cadmium	0.940	0.940	0.53	1.70	0.61	8.67	1.80	YES	87.00	0.60	0.55	8	1.90	19.0	122.0
Copper	1.000	1.000	0.86	8.65	6.14	3.91	1.34	NO	31.00	0.60	0.55	8	1.90	19.0	122.0
Lead	0.470	0.470	0.06	29.3	1.14	0.29	0.10	NO	5.0	0.60	0.55	8	1.90	19.0	122.0
Nickel	1.000	1.000	0.56	770.7	85.60	37.79	6.36	NO	373.00	0.60	0.55	8	1.90	19.0	122.0
Silver	0.850	0.850	0.10	1.00	100.00	0.94	0.23	NO	10.00	0.60	0.55	8	1.90	19.0	122.0
Zinc	1.000	1.000	2.00	62.3	56.9	4.99	2.47	NO	31.000	0.60	0.55	8	1.90	19.0	122.0
Mercury	1.000	1.000		2.1	0.012	0.01	0.001	NO	0.070	0.60	0.55	8	1.90	19.0	122.0

Attachment 1

UM3 Model Runs

F-1

/ Windows UM3. 1/19/2009 10:19:30 AM

Case 1; ambient file U:\Nick\Camas\VP plumeF1.002.db; Diffuser table record 1: ----------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	1.03	180.0	0.0	12.6	0.0	0.0	1.03	180.0	0.0003
1.0	1.09	180.0	0.0	12.6	0.0	0.0	1.09	180.0	0.0003
2.0	1.09	180.0	0.0	12.6	0.0	0.0	1.09	180.0	0.0003
3.0	1.07	180.0	0.0	12.6	0.0	0.0	1.07	180.0	0.0003
4.0	1.06	180.0	0.0	12.6	0.0	0.0	1.06	180.0	0.0003
5.0	1.03	180.0	0.0	12.6	0.0	0.0	1.03	180.0	0.0003
6.0	1.0	180.0	0.0	12.6	0.0	0.0	1.0	180.0	0.0003
7.0	0.98	180.0	0.0	12.6	0.0	0.0	0.98	180.0	0.0003
8.0	0.95	180.0	0.0	12.6	0.0	0.0	0.95	180.0	0.0003
9.0	0.92	180.0	0.0	12.6	0.0	0.0	0.92	180.0	0.0003
10.0	0.91	180.0	0.0	12.6	0.0	0.0	0.91	180.0	0.0003
11.0	0.89	180.0	0.0	12.6	0.0	0.0	0.89	180.0	0.0003
12.0	0.85	180.0	0.0	12.6	0.0	0.0	0.85	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
3.92	1.0	90.0	180.0	8.0	10.0	32.0	321.0	21.0	6.1	0.0	16.0	100.0

Froude number: 197.2

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Polutnt (kg/kg)	Dilutn ()	CL-diln ()	x-posn (ft)	y-posn (ft)	
0	21.0	0.992	3.92	100.0	1.0	1.0	0.0	0.0;	
100	19.69	1.0	19.05	16.52	6.05	2.038	-0.551	0.0;	
200	17.66	1.018	53.0	2.37	42.17	10.59	-10.25	0.0;	
239	16.18	1.032	77.3	1.095	91.28	22.93	-32.72	0.0;	acute zone,
285	13.69	1.054	120.6	0.44	227.0	57.04	-122.1	0.0;	merging,
300	12.55	1.061	145.0	0.327	305.5	84.27	-192.8	0.0;	
316	10.94	1.066	185.1	0.238	419.3	138.0	-325.7	0.0;	chronic zone,
328	9.399	1.072	226.6	0.188	531.8	217.7	-487.6	0.0;	surface,

Outside chronic zone

;

10:19:33 AM. amb fills: 2

F-2

/ Windows UM3. 1/19/2009 12:14:44 PM

Case 1; ambient file U:\Nick\Camas\VP plumeF2.003.db; Diffuser table record 1: ---------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	1.03	180.0	0.0	12.6	0.0	0.0	1.03	180.0	0.0003
1.0	1.09	180.0	0.0	12.6	0.0	0.0	1.09	180.0	0.0003
2.0	1.09	180.0	0.0	12.6	0.0	0.0	1.09	180.0	0.0003
3.0	1.07	180.0	0.0	12.6	0.0	0.0	1.07	180.0	0.0003
4.0	1.06	180.0	0.0	12.6	0.0	0.0	1.06	180.0	0.0003
5.0	1.03	180.0	0.0	12.6	0.0	0.0	1.03	180.0	0.0003
6.0	1.0	180.0	0.0	12.6	0.0	0.0	1.0	180.0	0.0003
7.0	0.98	180.0	0.0	12.6	0.0	0.0	0.98	180.0	0.0003
8.0	0.95	180.0	0.0	12.6	0.0	0.0	0.95	180.0	0.0003
9.0	0.92	180.0	0.0	12.6	0.0	0.0	0.92	180.0	0.0003
10.0	0.91	180.0	0.0	12.6	0.0	0.0	0.91	180.0	0.0003
11.0	0.89	180.0	0.0	12.6	0.0	0.0	0.89	180.0	0.0003
12.0	0.85	180.0	0.0	12.6	0.0	0.0	0.85	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
4.27	1.0	90.0	180.0	8.0	10.0	32.0	321.0	21.0	10.04	0.0	16.0	100.0

Froude number: 262.0

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Polutnt (kg/kg)	Dilutn ()	CL-diln ()	x-posn (ft)	y-posn (ft)	
0	21.0	0.992	4.27	100.0	1.0	1.0	0.0	0.0;	
100	19.0	1.006	24.1	15.02	6.654	2.475	-0.698	0.0;	
200	16.27	1.031	70.13	2.197	45.49	11.48	-10.94	0.0;	
237	14.41	1.048	100.4	1.056	94.65	23.72	-32.6	0.0;	acute zone,
256	13.2	1.059	120.5	0.725	137.9	34.56	-56.62	0.0;	merging,
297	8.807	1.075	218.6	0.322	310.6	121.2	-225.5	0.0;	surface,

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 26.89 m

conc	dilutn	width	distnce	time				
(kg/kg)		(m)	(m)	(hrs)	(kg/kg)	(s-1)	(m/s)	(m0.67/s2)
0.3211	311.3	27						

F-3

/ Windows UM3. 1/19/2009 11:58:20 AM

Case 1; ambient file U:\Nick\Camas\VP plumeF3.004.db; Diffuser table record 1: ---------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.79	180.0	0.0	12.6	0.0	0.0	0.79	180.0	0.0003
1.0	0.77	180.0	0.0	12.6	0.0	0.0	0.77	180.0	0.0003
2.0	0.74	180.0	0.0	12.6	0.0	0.0	0.74	180.0	0.0003
3.0	0.7	180.0	0.0	12.6	0.0	0.0	0.7	180.0	0.0003
4.0	0.65	180.0	0.0	12.6	0.0	0.0	0.65	180.0	0.0003
5.0	0.61	180.0	0.0	12.6	0.0	0.0	0.61	180.0	0.0003
6.0	0.54	180.0	0.0	12.6	0.0	0.0	0.54	180.0	0.0003
7.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
8.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
9.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
10.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
11.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
12.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
3.92	1.0	90.0	180.0	8.0	10.0	32.0	321.0	21.0	6.1	0.0	16.0	100.0

Froude number: 197.2

	Depth	Amb-cur	P-dia	Polutnt	Dilutn	CL-diln	x-posn	y-posn	
Step	(ft)	(m/s)	(in)	(kg/kg)	()	()	(ft)	(ft)	
0	21.0	0.508	3.92	100.0	1.0	1.0	0.0	0.0;	
100	18.63	0.562	24.34	14.3	6.988	2.822	-0.668	0.0;	
200	15.8	0.617	72.21	2.165	46.16	11.36	-8.979	0.0;	
244	13.59	0.644	109.3	0.906	110.3	26.82	-32.18	0.0;	acute zone,
254	12.98	0.651	120.0	0.743	134.5	32.63	-42.77	0.0;	merging,
298	8.986	0.709	220.8	0.311	321.5	121.8	-170.2	0.0;	surface,

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 26.94 m

conc	dilutn	width	distnce	time				
(kg/kg)		(m)	(m)	(hrs)	(kg/kg)	(s-1)	(m/s)	(m0.67/s2)
0.31058	321.8	28.0	97.84	0.0278	0.0	0.0	0.46	3.00E-4

count: 1

;

11:58:22 AM. amb fills: 2

F-4

/ Windows UM3. 1/19/2009 12:39:30 PM

Case 1; ambient file U:\Nick\Camas\VP plumeF4.005.db; Diffuser table record 1: -----------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.264	180.0	0.0	12.6	0.0	0.0	0.264	180.0	0.0003
1.0	0.264	180.0	0.0	12.6	0.0	0.0	0.264	180.0	0.0003
2.0	0.256	180.0	0.0	12.6	0.0	0.0	0.256	180.0	0.0003
3.0	0.247	180.0	0.0	12.6	0.0	0.0	0.247	180.0	0.0003
4.0	0.228	180.0	0.0	12.6	0.0	0.0	0.228	180.0	0.0003
5.0	0.21	180.0	0.0	12.6	0.0	0.0	0.21	180.0	0.0003
6.0	0.187	180.0	0.0	12.6	0.0	0.0	0.187	180.0	0.0003
7.0	0.163	180.0	0.0	12.6	0.0	0.0	0.163	180.0	0.0003
8.0	0.163	180.0	0.0	12.6	0.0	0.0	0.163	180.0	0.0003
9.0	0.163	180.0	0.0	12.6	0.0	0.0	0.163	180.0	0.0003
10.0	0.163	180.0	0.0	12.6	0.0	0.0	0.163	180.0	0.0003
11.0	0.163	180.0	0.0	12.6	0.0	0.0	0.163	180.0	0.0003
12.0	0.163	180.0	0.0	12.6	0.0	0.0	0.163	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
4.27	1.0	90.0	180.0	8.0	10.0	32.0	321.0	21.0	10.04	0.0	16.0	100.0

Froude number: 262.0

	Depth	Amb-cur	P-dia	Polutnt	Dilutn	CL-diln	x-posn	y-posn	
Step	(ft)	(m/s)	(in)	(kg/kg)	()	()	(ft)	(ft)	
0	21.0	0.177	4.27	100.0	1.0	1.0	0.0	0.0;	
100	15.99	0.212	30.31	13.8	7.242	3.664	-0.476	0.0;	
187	8.361	0.251	120.9	2.674	37.38	12.19	-5.236	0.0;	merging,
200	7.106	0.254	146.6	2.083	47.99	15.56	-7.297	0.0;	
208	6.171	0.257	168.2	1.778	56.23	18.92	-9.21	0.0;	surface,

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 25.61 m

conc	dilutn	width	distnce	time				
(kg/kg)		(m)	(m)	(hrs)	(kg/kg)	(s-1)	(m/s)	(m0.67/s2)
1.75478	56.96	31.19	97.84	0.162	0.0	0.0	0.163	3.00E-4

count: 1

;

12:39:32 PM. amb fills: 2

F-5

/ Windows UM3. 1/19/2009 12:57:27 PM

Case 1; ambient file U:\Nick\Camas\VP plumeF5.006.db; Diffuser table record 1: -----------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.79	180.0	0.0	21.5	0.0	0.0	0.79	180.0	0.0003
1.0	0.77	180.0	0.0	21.5	0.0	0.0	0.77	180.0	0.0003
2.0	0.74	180.0	0.0	21.5	0.0	0.0	0.74	180.0	0.0003
3.0	0.7	180.0	0.0	21.5	0.0	0.0	0.7	180.0	0.0003
4.0	0.65	180.0	0.0	21.5	0.0	0.0	0.65	180.0	0.0003
5.0	0.61	180.0	0.0	21.5	0.0	0.0	0.61	180.0	0.0003
6.0	0.54	180.0	0.0	21.5	0.0	0.0	0.54	180.0	0.0003
7.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
8.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
9.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
10.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
11.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
12.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
3.77	1.0	90.0	180.0	8.0	10.0	32.0	321.0	21.0	5.09	0.0	22.0	100.0

Froude number: 376.5

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Polutnt (kg/kg)	Dilutn ()	CL-diln ()	x-posn (ft)	y-posn (ft)	
0	21.0	0.508	3.77	100.0	1.0	1.0	0.0	0.0;	
100	18.9	0.556	22.7	14.55	6.872	2.697	-0.631	0.0;	
200	16.34	0.61	66.16	2.187	45.72	11.17	-8.838	0.0;	
245	14.28	0.635	101.0	0.897	111.5	27.11	-32.73	0.0;	acute zone,
264	13.19	0.648	120.7	0.616	162.4	39.52	-56.16	0.0;	merging,
300	10.23	0.693	196.3	0.302	331.3	110.0	-172.5	0.0;	
309	9.308	0.705	226.9	0.253	395.9	156.0	-227.6	0.0;	surface,

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 27.10 m

conc	dilutn	width	distnce	time				
(kg/kg)		(m)	(m)	(hrs)	(kg/kg)	(s-1)	(m/s)	(m0.67/s2)
0.25217	396.5	27.76	97.84	0.0172	0.0	0.0	0.46	3.00

F-6

/ Windows UM3. 1/19/2009 1:42:05 PM

Case 1; ambient file U:\Nick\Camas\VP plumeF6.007.db; Diffuser table record 1: ---------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.79	180.0	0.0	21.5	0.0	0.0	0.79	180.0	0.0003
1.0	0.77	180.0	0.0	21.5	0.0	0.0	0.77	180.0	0.0003
2.0	0.74	180.0	0.0	21.5	0.0	0.0	0.74	180.0	0.0003
3.0	0.7	180.0	0.0	21.5	0.0	0.0	0.7	180.0	0.0003
4.0	0.65	180.0	0.0	21.5	0.0	0.0	0.65	180.0	0.0003
5.0	0.61	180.0	0.0	21.5	0.0	0.0	0.61	180.0	0.0003
6.0	0.54	180.0	0.0	21.5	0.0	0.0	0.54	180.0	0.0003
7.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
8.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
9.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
10.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
11.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003
12.0	0.46	180.0	0.0	21.5	0.0	0.0	0.46	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
3.92	1.0	90.0	180.0	8.0	10.0	32.0	321.0	21.0	6.36	0.0	22.0	100.0

Froude number: 426.7

Step	Depth	Amb-cur	P-dia	Polutnt	Dilutn	CL-diln	x-posn	y-posn	
	(ft)	(m/s)	(in)	(kg/kg)	()	()	(ft)	(ft)	
0	21.0	0.508	3.92	100.0	1.0	1.0	0.0	0.0;	
100	18.55	0.564	24.64	14.22	7.033	2.873	-0.672	0.0;	
200	15.65	0.619	73.7	2.158	46.33	11.43	-8.91	0.0;	
244	13.39	0.646	111.6	0.903	110.7	26.92	-32.01	0.0;	acute zone,
252	12.89	0.653	120.3	0.771	129.7	31.49	-40.25	0.0;	merging,
295	8.976	0.709	218.0	0.329	304.0	113.3	-158.6	0.0;	surface,

Const Eddy Diffusivity. Farfield dispersion based on wastefield width of 26.87 m

conc	dilutn	width	distnce	time				
(kg/kg)		(m)	(m)	(hrs)	(kg/kg)	(s-1)	(m/s)	(m0.67/s2)
0.32855	304.3	28.						

Technical Memorandum

PO Box 1678 • Tacoma, WA 98401-1678
711 Pacific Avenue • Tacoma, WA 98402
Phone (253) 272-7220 • Fax (253) 272-7250
BFox@cosmopolitaneng.com

TM TITLE:	**City of Camas Mixing Zone Study – 16-Port Diffuser**
DATE:	February 19, 2009
TO:	Jay Swift, PE, Gray & Osborne
PREPARED BY:	Nick Whitaker, Cosmopolitan Engineering Group
REVIEWED BY:	Bill Fox, PE, Cosmopolitan Engineering Group
PROJECT #:	G&O016

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LIST OF ATTACHMENTS

INTRODUCTION

Cosmopolitan Engineering Group completed an update to the *Mixing Zone Analysis* for the City of Camas in a Technical Memorandum (TM) dated January 20, 2009. That TM evaluated mixing for a proposed eight-port diffuser modification in which the discharge ports were oriented vertically with the addition of Tideflex elastomeric check valves. The City of Camas is now considering opening up more ports for their existing diffuser. This TM evaluates the dilution and Reasonable Potential Analysis (RPA) for the proposed extended 16-port diffuser with vertical ports and elastomeric check valves.

EFFLUENT FLOW RATES

The effluent flow design criteria is the same as the January 20th TM, presented in Table 1.

Table 1 Effluent Flow Design Criteria for Facility Planning

Planning Year	Winter Flow Criteria		Summer Flow Criteria	
	Max. Month (mgd)	Max. Day (mgd)	Max. Month (mgd)	Max. Day (mgd)
2025	6.10	10.04	5.09	6.36

POTENTIAL DIFFUSER MODIFICATION

The potential diffuser extension would consist of 16 ports oriented to discharge vertically. Each port would be fitted with a 6-inch Tideflex elastomeric check valve. Port spacing would remain at 10 feet, effectively doubling the diffuser length. Revised performance data for the 16-port arrangement are provided in Table 2.

Table 2 Diffuser Port Velocities for Tideflex Diffuser Valves

Design Year	Season	Max Flow Period	Effluent Flow (mgd)	Flow per Port (gpm)	Discharge Velocity (fps)	Effective Area (sq. in.)	Effective Diameter (in.)
2025	Winter	30-day	6.1	265	9.6	8.89	3.36
2025	Winter	24-hr	10.04	436	12.6	11.05	3.75
2025	Summer	30-day	5.09	221	8.7	8.18	3.23
2025	Summer	24-hr	6.36	276	9.8	9.05	3.40

DILUTION MODELING

UM3 MODEL

The UM3 models runs were carried out through the Visual Plumes interface. A default aspiration entrainment coefficient (AEC) of 0.1 was used in all the model runs. Additional default values included the diffuser port contraction coefficient of 1. The model configuration also applied the Brooks farfield solution with the default dispersion coefficients.

The centerline dilution concentration in previous studies (CEG, 2007) was determined by dividing the calculated dilution factor by a peak-to-mean ratio of 2.3. This evaluation used a more conservative centerline dilution factor, which is calculated using the algorithms embedded in UM3.

MODEL RESULTS

A series of UM3 model runs from the Visual Plumes interface, with the Brooks farfield algorithm, are provided in Attachment 1. All model runs are based on the vertical port orientation with Tideflex valves. The basis of the model runs and the results are described below:

G-1	This chronic model run is for near-flood ambient conditions modeled by Ecology in the NPDES permit, the 90th percentile river discharge of 522 kcfs. This run is equivalent to Ecology run NC22B except for the maximum month effluent flow rate for 2025.
G-2	This acute model run is for the same near-flood ambient conditions modeled by Ecology, equivalent to Ecology run NC24 except the maximum day effluent flow rate for 2025.
G-3	This chronic model run corresponds to the 2025 winter maximum month flow rate and winter effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition.
G-4	This acute model run corresponds to 2025 maximum day winter flow rate and winter effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment, which is caused by the tidal influence that occurs during low to normal Columbia River flows.
G-5	This chronic model run corresponds to 2025 summer maximum month flow rate and summer effluent temperature. Ambient current speed is tidally-averaged current profile during the low river flow condition (same as G-3).
G-6	This acute model run corresponds to 2025 maximum day summer flow rate and summer effluent temperature. Ambient current speed is the one-hour minimum velocity profile from the current meter deployment (same as G-4).

The results of the modeling are presented in Table 3. The results demonstrate that critical conditions occur during the 90th percentile high river discharge conditions (Runs G-1 and G-2).

Table 3 Dilution Model Results for 2025 Effluent Flows

Model Run #	Ambient Condition	Discharge Depth (ft)	Avg Current Speed (m/sec)	Ambient Temp (°C)	Effluent Flow (mgd)	Effluent Temp (°C)	Acute Dilution	Chronic Dilution
G-1	(1)Winter High Flow	26.6	1.0	12.6	6.10	16.0		121
G-2	(1)Winter High Flow	26.6	1.0	12.6	10.04	16.0	23	
G-3	(2)Winter Average	21.0	0.7	12.6	6.10	16.0		211
G-4	(3)Winter 10%	21.0	0.25	12.6	10.04	16.0	37	
G-5	(2)Summer Average	21.0	0.7	21.5	5.09	22.0		185
G-6	(3)Summer 10%	21.0	0.25	21.5	6.36	22.0	27	

(1) Ambient conditions for 522 kcfs river flow (90th percentile) per Ecology NPDES permit (runs NC22 and NC24)

(2) Ambient condition for non-flood river flow based on tidally-averaged current profile from October 2004 current meter deployment.

(3) Ambient condition for acute model runs based on lowest tidally-influenced current profile (duration = 1 hr±) from October 2004 current meter deployment.

REASONABLE POTENTIAL ASSESSMENT

EPA and Ecology use a statistical test to determine a discharge's "reasonable potential" to exceed water quality standards, which is based on effluent and ambient data and acute and chronic dilution factors. If a discharge exhibits a reasonable potential to exceed water quality standards for any parameter, Ecology issues an effluent limitation for that parameter in the NPDES permit. If a parameter does not exhibit a reasonable potential to exceed water quality standards, no NPDES permit limit is required.

EFFLUENT DATA

Water quality-based effluent limits are assessed for ammonia and selected metals (cadmium, copper, lead, nickel, silver, zinc, and mercury). The critical effluent concentrations used in determination of reasonable potential are based on 12 effluent metals scans in 2005, 2006, and 2008, and over 400 effluent ammonia samples in 2005 and 2006.

The metals data are provided in Table 4. The values in red are detected concentrations, and the values in black are the detection levels for non-detected results. High concentrations of cadmium and nickel were measured on June 2, 2006. These values may be anomalous, or if realistic should be evaluated in future sampling efforts. The 95th percentile values were used in the RPA.

Table 4 Camas Effluent Metals Data (µg/L)

Date	Cd	Cu	Pb	Ni	Ag	An	Hg
5/13/2005	3	8	5	20	10	18	0.056
7/21/2005	10	31	5	20	10	19	0.05
9/30/2005	3	5	5	20	10	16	0.056
12/7/2005	3	5	5	20	10	15	0.05
3/31/2006	3	5	5	20	10	25	0.07
6/2/2006	87	12	5	373	70	20	0.05
9/12/2006	3	7	5	20	10	31	
12/18/2006	3	5	5	29	10	30	0.05
3/14/2008	5	20	10	50	10	50	
7/2/2008	5	20	5	20	10	50	0.04
9/22/2008	5	20	5	20	10	50	0.16
11/25/2008	5	20	10	20	10	50	0.2
Count	12	12	12	12	12	12	10
# Detects	2	4	0	2	0	8	3
95th percentile	44.65	24.95	10	195.35	10	50	0.182

Detected Values in Red   Detection Limit in Black

AMBIENT DATA AND WATER QUALITY STANDARDS

No ambient sampling has been conducted in this mixing zone study for ammonia or metals or the parameters that affect their water quality standards (pH, temperature, and hardness). The criteria for ambient concentrations, and ambient-depended water quality criteria, are the same as Ecology cited in Appendix C of the NPDES permit.

REASONABLE POTENTIAL RESULTS

The reasonable potential to exceed water quality standards for ammonia and metals is presented in Table 5 for the recommended diffuser modifications. Ammonia is the only analyte considered seasonally due to its dependence on ambient pH and temperature. Cadmium was the only analyte with a reasonable potential to exceed water quality standards.

A comparison of the 8-port and 16-port diffusers RPA results in Table 5 shows a decrease in the maximum concentration at the edge of the acute mixing zone boundaries (except for mercury and lead) and nearly identical values for the chronic mixing zone boundary. Based on the Visual Plumes modeling, the outfall extension would decrease the concentrations of Cadmium at the acute mixing zone boundaries, but will not lower concentrations enough to meet the State Water Quality Standards. However, this finding is based on only one high detected value, and thus should be sampled more frequently in the future to determine if the reasonable potential is realistic.

Table 5 Reasonable Potential Calculation Table

8-PORT DIFFUSER

				State Water Quality Standard		Max concentration at edge of...									
	Metal Criteria Translator as decimal	Metal Criteria Translator as decimal	Ambient Concentration (metals as dissolved)	Acute	Chronic	Acute Mixing Zone	Chronic Mixing Zone	LIMIT REQ'D?	Max effluent conc. measured (metals as total recoverable)	Coeff Variation		# of samples	Multiplier	Acute Dil'n Factor	Chronic Dil'n Factor
Parameter	Acute	Chronic	ug/L	ug/L	ug/L	ug/L	ug/L		ug/L	CV	s	n			
Modified Diffuser (Vertical Discharge)															
2025															
Ammonia-N (summer)	1.00	1.00	27.00	5100.00	830.000	939.52	184.94	NO	35200	0.60	0.55	268	0.70	27.0	156.0
Ammonia-N (winter)	1.00	1.00	19.00	2100.00	470.000	1316.16	221.02	NO	35200	0.60	0.55	268	0.70	19.0	122.0
Cadmium	0.940	0.940	0.53	1.70	0.61	4.12	1.09	YES	45.00	0.60	0.55	12	1.63	19.0	122.0
Copper	1.000	1.000	0.86	8.65	6.14	2.95	1.19	NO	25.00	0.60	0.55	12	1.63	19.0	122.0
Lead	0.470	0.470	0.06	29.3	1.14	0.46	0.12	NO	10.0	0.60	0.55	12	1.63	19.0	122.0
Nickel	1.000	1.000	0.56	770.7	85.60	17.21	3.15	NO	195.00	0.60	0.55	12	1.63	19.0	122.0
Silver	0.850	0.850	0.10	1.00	100.00	0.82	0.21	NO	10.00	0.60	0.55	12	1.63	19.0	122.0
Zinc	1.000	1.000	2.00	62.3	56.9	4.55	2.40	NO	31.000	0.60	0.55	12	1.63	19.0	122.0
Mercury	1.000	1.000		2.1	0.012	0.02	0.003	NO	0.182	0.60	0.55	10	1.74	19.0	122.0

16-PORT DIFFUSER

				State Water Quality Standard		Max concentration at edge of...									
	Metal Criteria Translator as decimal	Metal Criteria Translator as decimal	Ambient Concentration (metals as dissolved)	Acute	Chronic	Acute Mixing Zone	Chronic Mixing Zone	LIMIT REQ'D?	Max effluent conc. measured (metals as total recoverable)	Coeff Variation		# of samples	Multiplier	Acute Dil'n Factor	Chronic Dil'n Factor
Parameter	Acute	Chronic	ug/L	ug/L	ug/L	ug/L	ug/L		ug/L	CV	s	n			
Modified Diffuser (Vertical Discharge)															
2025															
Ammonia-N (summer)	1.00	1.00	27.00	5100.00	830.000	939.52	160.18	NO	35200	0.60	0.55	268	0.70	27.0	185.0
Ammonia-N (winter)	1.00	1.00	19.00	2100.00	470.000	1090.57	222.69	NO	35200	0.60	0.55	268	0.70	23.0	121.0
Cadmium	0.940	0.940	0.53	1.70	0.61	3.50	1.09	YES	45.00	0.60	0.55	12	1.63	23.0	121.0
Copper	1.000	1.000	0.86	8.65	6.14	2.59	1.19	NO	25.00	0.60	0.55	12	1.63	23.0	121.0
Lead	0.470	0.470	0.06	29.3	1.14	0.39	0.12	NO	10.0	0.60	0.55	12	1.63	23.0	121.0
Nickel	1.000	1.000	0.56	770.7	85.60	14.32	3.17	NO	195.00	0.60	0.55	12	1.63	23.0	121.0
Silver	0.850	0.850	0.10	1.00	100.00	0.70	0.21	NO	10.00	0.60	0.55	12	1.63	23.0	121.0
Zinc	1.000	1.000	2.00	62.3	56.9	4.10	2.40	NO	31.000	0.60	0.55	12	1.63	23.0	121.0
Mercury	1.000	1.000		2.1	0.012	0.01	0.003	NO	0.182	0.60	0.55	10	1.74	23.0	121.0

Attachment 1

UM3 Model Runs

G-1

```
/ Windows UM3. 2/12/2009 11:20:51 AM
Case 1; ambient file U:\Nick\Camas\VP plumeF1.002.db; Diffuser table record 1: ----------------------------------
      Depth     Amb-cur     Amb-dir     Amb-sal     Amb-tem     Amb-pol       Decay     Far-spd     Far-dir     Disprsn
          m         m/s         deg         psu           C       kg/kg         s-1         m/s         deg    m0.67/s2
        0.0        1.03       180.0         0.0        12.6         0.0         0.0        1.03       180.0      0.0003
        1.0        1.09       180.0         0.0        12.6         0.0         0.0        1.09       180.0      0.0003
        2.0        1.09       180.0         0.0        12.6         0.0         0.0        1.09       180.0      0.0003
        3.0        1.07       180.0         0.0        12.6         0.0         0.0        1.07       180.0      0.0003
        4.0        1.06       180.0         0.0        12.6         0.0         0.0        1.06       180.0      0.0003
        5.0        1.03       180.0         0.0        12.6         0.0         0.0        1.03       180.0      0.0003
        6.0         1.0       180.0         0.0        12.6         0.0         0.0         1.0       180.0      0.0003
        7.0        0.98       180.0         0.0        12.6         0.0         0.0        0.98       180.0      0.0003
        8.0        0.95       180.0         0.0        12.6         0.0         0.0        0.95       180.0      0.0003
        9.0        0.92       180.0         0.0        12.6         0.0         0.0        0.92       180.0      0.0003
       10.0        0.91       180.0         0.0        12.6         0.0         0.0        0.91       180.0      0.0003
       11.0        0.89       180.0         0.0        12.6         0.0         0.0        0.89       180.0      0.0003
       12.0        0.85       180.0         0.0        12.6         0.0         0.0        0.85       180.0      0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    3.36     1.0    90.0   180.0    16.0    10.0    32.0   321.0    26.6     6.1     0.0    16.0   100.0
Froude number:      144.9
        Depth  Amb-cur     P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)      (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      26.6    0.947      3.36    100.0       1.0      1.0      0.0      0.0;
  62     26.08    0.951     9.154     33.5     2.984    1.203   -0.137      0.0; begin overlap,
  95     25.87    0.953     12.84    20.61      4.85    1.537   -0.335      0.0; end overlap,
 100     25.84    0.954     13.49    19.01     5.258    1.607   -0.381      0.0;
 200     24.48    0.966     36.13    2.695     37.09    9.272   -8.312      0.0;
 245      23.3    0.977     55.83    1.106     90.41    22.76   -32.06      0.0; acute zone,
 300     21.06    0.991     95.31    0.372     268.7    67.94   -154.4      0.0;
 324     19.77    0.999     120.4    0.231     432.1    109.4   -291.8      0.0; merging,
 328     19.52    1.001     125.7    0.214     467.8    120.7   -325.7      0.0; chronic zone,
 386     14.45    1.047     316.8   0.0678    1475.1    651.3  -1478.4      0.0; bottom hit,
 390     14.03    1.051     340.8   0.0626    1596.7    704.6  -1614.9      0.0; surface,
Outside chronic zone
 ;
11:2
```

G-2

```
/ Windows UM3. 2/12/2009 11:25:38 AM
Case 1; ambient file U:\Nick\Camas\VP plumeF2.003.db; Diffuser table record 1: ---------------------------------
      Depth     Amb-cur     Amb-dir     Amb-sal     Amb-tem     Amb-pol       Decay     Far-spd     Far-dir     Disprsn
          m         m/s         deg         psu           C       kg/kg         s-1         m/s         deg    m0.67/s2
        0.0        1.03       180.0         0.0        12.6         0.0         0.0        1.03       180.0      0.0003
        1.0        1.09       180.0         0.0        12.6         0.0         0.0        1.09       180.0      0.0003
        2.0        1.09       180.0         0.0        12.6         0.0         0.0        1.09       180.0      0.0003
        3.0        1.07       180.0         0.0        12.6         0.0         0.0        1.07       180.0      0.0003
        4.0        1.06       180.0         0.0        12.6         0.0         0.0        1.06       180.0      0.0003
        5.0        1.03       180.0         0.0        12.6         0.0         0.0        1.03       180.0      0.0003
        6.0         1.0       180.0         0.0        12.6         0.0         0.0         1.0       180.0      0.0003
        7.0        0.98       180.0         0.0        12.6         0.0         0.0        0.98       180.0      0.0003
        8.0        0.95       180.0         0.0        12.6         0.0         0.0        0.95       180.0      0.0003
        9.0        0.92       180.0         0.0        12.6         0.0         0.0        0.92       180.0      0.0003
       10.0        0.91       180.0         0.0        12.6         0.0         0.0        0.91       180.0      0.0003
       11.0        0.89       180.0         0.0        12.6         0.0         0.0        0.89       180.0      0.0003
       12.0        0.85       180.0         0.0        12.6         0.0         0.0        0.85       180.0      0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal     Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)      (C) (kg/kg)
    3.75     1.0    90.0   180.0    16.0    10.0    32.0   321.0    26.6   10.04     0.0     16.0   100.0
Froude number:      181.3
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0      26.6    0.947     3.75    100.0      1.0      1.0      0.0      0.0;
 100     25.43    0.957    17.64     16.9    5.915    1.955   -0.507      0.0;
 200     23.57    0.974    48.68    2.419    41.32    10.37    -9.75      0.0;
 240     22.18    0.985    71.68    1.096    91.24    22.97   -32.17      0.0; acute zone,
 294     19.32    1.003    121.1    0.376    265.8    67.26   -152.1      0.0; merging,
 300     18.89    1.007    129.6    0.334    299.3    78.04   -181.8      0.0;
 319     17.26    1.021    169.4    0.229    436.1    132.9   -324.5      0.0; chronic zone,
 356     12.95     1.06    318.8     0.11    907.4    399.1   -942.5      0.0; surface,
Outside chronic zone
 ;
11:25:40 AM. amb fills: 2
```

G-3

/ Windows UM3. 2/2/2009 9:24:59 AM

Case 1; ambient file U:\Nick\Camas\VP plumeF3.004.db; Diffuser table record 1: ---------------------------------

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2
0.0	0.79	180.0	0.0	12.6	0.0	0.0	0.79	180.0	0.0003
1.0	0.77	180.0	0.0	12.6	0.0	0.0	0.77	180.0	0.0003
2.0	0.74	180.0	0.0	12.6	0.0	0.0	0.74	180.0	0.0003
3.0	0.7	180.0	0.0	12.6	0.0	0.0	0.7	180.0	0.0003
4.0	0.65	180.0	0.0	12.6	0.0	0.0	0.65	180.0	0.0003
5.0	0.61	180.0	0.0	12.6	0.0	0.0	0.61	180.0	0.0003
6.0	0.54	180.0	0.0	12.6	0.0	0.0	0.54	180.0	0.0003
7.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
8.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
9.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
10.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
11.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003
12.0	0.46	180.0	0.0	12.6	0.0	0.0	0.46	180.0	0.0003

P-dia	P-elev	V-angle	H-angle	Ports	Spacing	AcuteMZ	ChrncMZ	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(ft)	(deg)	(deg)	()	(ft)	(ft)	(ft)	(ft)	(MGD)	(psu)	(C)	(kg/kg)
3.36	1.0	90.0	180.0	16.0	10.0	32.0	321.0	21.0	6.1	0.0	16.0	100.0

Froude number: 144.9

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Polutnt (kg/kg)	Dilutn ()	CL-diln ()	x-posn (ft)	y-posn (ft)	
0	21.0	0.508	3.36	100.0	1.0	1.0	0.0	0.0;	
100	19.55	0.543	18.25	15.45	6.472	2.34	-0.518	0.0;	
200	17.6	0.584	51.23	2.271	44.02	10.77	-8.279	0.0;	
248	15.92	0.615	80.32	0.878	113.9	27.63	-32.88	0.0;	acute zone,
291	13.88	0.64	120.3	0.375	266.8	65.1	-105.9	0.0;	merging,
300	13.35	0.647	132.9	0.313	318.9	81.51	-136.5	0.0;	
331	11.02	0.681	209.2	0.17	589.1	211.0	-329.5	0.0;	chronic zone,
341	10.16								

G-4

```
/ Windows UM3. 2/2/2009 9:27:04 AM
Case 1; ambient file U:\Nick\Camas\VP plumeF4.005.db; Diffuser table record 1: --------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0      0.264      180.0        0.0       12.6        0.0        0.0      0.264      180.0     0.0003
        1.0      0.264      180.0        0.0       12.6        0.0        0.0      0.264      180.0     0.0003
        2.0      0.256      180.0        0.0       12.6        0.0        0.0      0.256      180.0     0.0003
        3.0      0.247      180.0        0.0       12.6        0.0        0.0      0.247      180.0     0.0003
        4.0      0.228      180.0        0.0       12.6        0.0        0.0      0.228      180.0     0.0003
        5.0       0.21      180.0        0.0       12.6        0.0        0.0       0.21      180.0     0.0003
        6.0      0.187      180.0        0.0       12.6        0.0        0.0      0.187      180.0     0.0003
        7.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
        8.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
        9.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
       10.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
       11.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
       12.0      0.163      180.0        0.0       12.6        0.0        0.0      0.163      180.0     0.0003
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
    3.75     1.0    90.0   180.0    16.0    10.0    32.0   321.0    21.0   10.04     0.0    16.0   100.0
Froude number:      181.3
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0     21.0    0.177     3.75    100.0      1.0      1.0      0.0      0.0;
 100    17.11    0.205    26.29     13.8    7.242    3.554   -0.531      0.0;
 200    11.59    0.236    106.7    2.061    48.49    12.98   -6.815      0.0;
 212    10.77    0.241    120.4    1.625    61.49    15.72   -9.361      0.0; merging,
 244    7.602    0.253    186.0    0.862    115.9    37.09    -25.7      0.0; surface,
Const Eddy Diffusivity.  Farfield dispersion based on wastefield width of      50.44 m
    conc  dilutn   width distnce    time
 (kg/kg)             (m)     (m)    (hrs) (kg/kg)   (s-1)   (m/s)(m0.67/s2)
 0.86125   116.1   57.32   97.84   0.153     0.0     0.0   0.163 3.00E-4
count: 1
 ;
9:27:07 AM. amb fills: 2
```

G-5

```
/ Windows UM3. 1/30/2009 4:39:10 PM
Case 1; ambient file U:\Nick\Camas\VP plumeF5.006.db; Diffuser table record 1: ---------------------------------
      Depth     Amb-cur     Amb-dir     Amb-sal     Amb-tem     Amb-pol       Decay     Far-spd     Far-dir     Disprsn
          m         m/s         deg         psu           C       kg/kg         s-1         m/s         deg   m0.67/s2
        0.0        0.79       180.0         0.0        21.5         0.0         0.0        0.79       180.0      0.0003
        1.0        0.77                                                                   0.77
        2.0        0.74                                                                   0.74
        3.0         0.7                                                                    0.7
        4.0        0.65                                                                   0.65
        5.0        0.61                                                                   0.61
        6.0        0.54                                                                   0.54
        7.0        0.46                                                                   0.46
        8.0        0.46                                                                   0.46
        9.0        0.46                                                                   0.46
       10.0        0.46                                                                   0.46
       11.0        0.46                                                                   0.46
       12.0        0.46                                                                   0.46
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal     Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)      (C) (kg/kg)
    3.23     1.0    90.0   180.0    16.0    10.0    32.0   321.0    21.0    5.09     0.0     22.0   100.0
Froude number:      277.0
          Depth  Amb-cur     P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step       (ft)    (m/s)      (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0       21.0    0.508      3.23    100.0      1.0      1.0      0.0      0.0;
 100      19.73    0.539     16.81    15.87    6.302    2.211   -0.478      0.0;
 200      17.97    0.576     46.62    2.316    43.17    10.57   -8.063      0.0;
 248      16.45    0.608     73.16    0.895    111.7    27.03   -32.24      0.0; acute zone,
 300      14.23    0.636     119.2     0.32    312.7     76.4   -131.2      0.0;
 301      14.18    0.637     120.3    0.313    319.0    78.02   -134.6      0.0; merging,
 332      12.28    0.662     181.8     0.17    589.4    185.0   -326.4      0.0; chronic zone,
 354      10.74
```

G-6

```
/ Windows UM3. 1/30/2009 4:40:27 PM
Case 1; ambient file U:\Nick\Camas\VP plumeF6.007.db; Diffuser table record 1: ----------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay    Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1        m/s        deg   m0.67/s2
        0.0       0.79      180.0        0.0       21.5        0.0        0.0       0.79      180.0     0.0003
        1.0       0.77                                                            0.77
        2.0       0.74                                                            0.74
        3.0        0.7                                                             0.7
        4.0       0.65                                                            0.65
        5.0       0.61                                                            0.61
        6.0       0.54                                                            0.54
        7.0       0.46                                                            0.46
        8.0       0.46                                                            0.46
        9.0       0.46                                                            0.46
       10.0       0.46                                                            0.46
       11.0       0.46                                                            0.46
       12.0       0.46                                                            0.46
   P-dia  P-elev V-angle H-angle   Ports Spacing AcuteMZ ChrncMZ P-depth Ttl-flo Eff-sal    Temp Polutnt
    (in)    (ft)   (deg)   (deg)      ()    (ft)    (ft)    (ft)    (ft)   (MGD)   (psu)     (C) (kg/kg)
     3.4     1.0    90.0   180.0    16.0    10.0    32.0   321.0    21.0    6.36     0.0    22.0   100.0
Froude number:      304.5
        Depth  Amb-cur    P-dia  Polutnt   Dilutn  CL-diln   x-posn   y-posn
Step     (ft)    (m/s)     (in)  (kg/kg)       ()       ()     (ft)     (ft)
   0     21.0    0.508      3.4    100.0      1.0      1.0      0.0      0.0;
 100     19.5    0.544    18.61    15.38      6.5    2.363   -0.527      0.0;
 200    17.52    0.586    52.32    2.265    44.14    10.79   -8.368      0.0;
 247    15.84    0.616    81.25    0.893    111.9    27.17    -32.5      0.0; acute zone,
 289    13.84    0.641    120.5    0.389    257.2    62.79   -103.6      0.0; merging,
 300    13.17    0.649    136.6    0.313    319.8     82.9   -142.8      0.0;
 328    11.11    0.679    206.6     0.18    556.7    196.8   -324.6      0.0; chronic zone,
 339    10.22    0.693    247.7    0.144    692.2    298.9   -437.4      0.0; surface,
Outside chronic zone
 ;
4:40:29 PM. amb fills: 2
```

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

October 21, 2009

Mr. Monte Brachmann
Public Works Director
City of Camas
PO Box 1055
Camas, WA 98607

Re: Mixing Zone Analysis APPROVAL

Dear Monte,

On March 2, 2009, the City of Camas through Gray & Osborne, Inc. provided the Department of Ecology (Ecology) a report titled "Supplemental Outfall Mixing Zone Modeling, Wastewater Treatment Facility City of Camas, Clark County, WA G&O #06518.00" The report recommends the City improve mixing by installation of an 8-port "tideflex" diffuser (page 3 of the study). It estimates the mixing zone ratios for flows up to 6.1 MGD (maximum month) and 10.04 MGD (max day) in winter and 5.09 MGD (max summer month) and 6.36 (max summer day). The report terms these "2025 flows".

Ecology has confirmed the mixing zone ratios represent a defensible estimation of the mixing at the edge of appropriately sized mixing zones. Ecology accepts the estimates of mixing at the acute and chronic boundaries at critical conditions from this study as being:

Condition	Acute mixing zone ratio:	Chronic mixing zone ratio:
Winter:	**19:1**	**122:1**
Summer:	**27:1**	**156:1**

Accordingly, if construction of the 8-port diffuser described and recommended is included as part of the next facility upgrade, planning documents (General Sewer Plan, Facility Plans, and Plans and Specifications) may use the above ratios for estimation of the reasonable potential for limits for toxic pollutants not already subject to permit limits (e.g. metals).

For pollutants presently subject to limits in the City's NPDES permit, anti-backsliding provisions of the Clean Water Act and state regulations suggest that the Department must continue these limits at current levels. However, it is within Ecology's discretion to conclude that monthly ammonia limits are appropriately protective since daily limits are based on the effluent's variability and these monthly limits. Accordingly, Ecology will have the basis to remove the daily maximum limits for ammonia from the permit with the completion of this outfall upgrade, and it is our intention is to do so. Monthly average limits for ammonia will continue to be applicable to the discharges – either the limits presently in the permit, or limits similar to those, with some adjustment for seasonality.

Ecology appreciates the City's initiative to provide this study, and patience and help during our review. We worked through some difficult technical issues in modeling this complex and dynamic outfall and receiving environment. We hope that this decision on mixing ratios provides the clarity the City needs to proceed with several projects now in design. We know these projects involve important improvements to the efficiency and reliability of both liquid and residual solids treatment systems. We share your excitement in planning and executing these next phases in the evolution of the city's wastewater treatment plant.

If you have any questions about this approval, please contact me at 360-407-6277.

Sincerely,

David J. Knight P.E.
Environmental Engineer
Southwest Regional Office
Water Quality Program

cc: Mr. Jim Dickinson, Camas WWTP
Mr. Eric Levison, City of Camas
Mr. Jay Swift, Gray & Osborne
Mr. Bill Fox, Cosmopolitan Engineering Group
Mr. Jacek Anuszewski, Ecology
Ms. Pat Bailey, Ecology

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

November 25, 2009

Mr. Monte Brachmann
Public Works Director
City of Camas
PO Box 1055
Camas, WA 98607

Re: Mixing Zone Analysis Approval Follow-up

Dear Mr. Brachmann:

On November 17, 2009, I talked with your consultant, Gray & Osborne about plans we received on November 6, 2009 for "Phase 2 Improvements" at the City's Wastewater Treatment Plant. They made it clear to me that the hydraulics of effluent discharge made it more advantageous to construct the 16-port diffuser outfall than the 8-port diffuser. That was why these new "Plans and Specifications" show the 16-port diffuser.

The 8-port diffuser was previously described as the recommended alternative on page 3 of the report "Supplemental Outfall Mixing Zone Modeling, Wastewater Treatment Facility City of Camas, Clark County, WA G&O #06518.00" Accordingly, I previously sent you a letter approving installation of the 8-port diffuser.

Please now accept this letter as approving the installation of the 16-port diffuser based on the City's Engineering Consultants request. The above modeling report also had an analysis of the 16-port diffuser at "critical conditions" and estimated year 2025 flows. We concur that mixing zone ratios for the 16-port diffuser (when built) will be:

Condition	**Acute mixing zone ratio:**	**Chronic mixing zone ratio:**
Winter:	**23:1**	**121:1**
Summer:	**27:1**	**185:1**

Construction of the 16-port diffuser is part of the next "Phase 2" improvements. Therefore, planning documents (General Sewer Plan, Facility Plans, and Plans and Specifications) can use these ratios to evaluate the need for limits for toxic pollutants. Irrespective of new limits for toxic pollutants, we expect to retain the monthly average limit for ammonia, as we have discussed previously.

We understand that this mixing zone approval will allow the City to finish a revised General Sewer Plan / Facility Plan (GSP/FP). We received the last draft GSP/FP in 2007 but it's taken until now to agree on mixing ratios. Plans for the "Phase 2 Improvements" stem from the draft GSP/FP and describe key liquid and residual solids treatment systems. The drawings anticipate increased flow, TSS, and ammonia capacities on sheet G-5.

We can approve project "Plans and Specifications" that increase the capacity of a POTW after we approve a Facility Plan that describes the engineering basis for that new capacity. We hope to receive your combined GSP/FP and documentation of the environmental review process soon enough to approve it and the "Phase 2" plans before the end of this month.

We share your excitement in planning and executing these next phases in the evolution of the city's wastewater treatment plant. If you have any questions about this outfall approval or the understandings described here, please contact me at 360-407-6277.

Sincerely,

David J. Knight P.E.
Environmental Engineer
Southwest Regional Office
Water Quality Program

cc Mr. Jim Dickinson, Operator in Charge
Mr. Eric Levison; Operations Manager
Mr. Jay Swift, Gray & Osborne
Mr. Bill Fox, Cosmopolitan Engineering Group
Mr. Jacek Anuszewski, Ecology
Ms. Pat Bailey, Ecology

APPENDIX O

WWTF MODELING REPORT

Activated Sludge Modeling

An activated sludge computer modeling program was used to model and evaluate the capacity of the Camas WWTF. The model was created using Hydromantis, Inc. General Purpose Simulator (GPS-X Version 5.0) software and physical design data for the treatment facility. GPS-X uses a series of mathematical algorithms to simulate the activated sludge and secondary clarification processes. By using the computer model it is possible to test the ability of the facility to meet its effluent limits at different influent loadings and conditions. Although a well-developed model can be a powerful tool, the results should be viewed with a certain amount of caution. Mathematical models are by nature only approximations of actual conditions and can provide erroneous output as a result of inaccurate input parameters.

The results of this evaluation indicate that the existing three aeration basin treatment trains and three secondary clarifiers have sufficient capacity to achieve nitrification and to achieve an effluent ammonia concentration of less than 1 mg/L at the maximum month design flow and loads. Additional calculations were performed to confirm the results of the activated sludge model. The results of the additional calculations are provided.

The model was calibrated using actual facility performance data recorded in DMRs from the month of November 2006. November 2006 performance was chosen for the calibration since temperatures were quite low; the growth rate of the microorganisms responsible for treatment is the slowest during the winter when the temperature is lower. The existing conditions of the facility were entered into the model and the effluent quality was evaluated. Primary treatment was not modeled using GPS-X; the wastewater characteristic model inputs assume 50 percent TSS removal and 30 percent BOD_5 removal during primary treatment. The default values for the aeration basin kinetics were adjusted within the suggested range of textbook values (Metcalf and Eddy, 2003). The values were adjusted so that the performance of the model reasonably matched the performance of the facility as reported in the DMRs. The model performance and results from the calibration are included in Tables 1 and 2.

The activated sludge model was then used to evaluate the performance for the 2025 design conditions established in Table 3. The performance of the facility operating with three aeration basins and three secondary clarifiers online was evaluated. Table 3 provides the model inputs and results for the evaluation conditions.

TABLE 1

Model Calibration Inputs
Based on Actual Plant Operating Conditions and Performance for November 2006

Inputs	Units	Nov 2006 Calibration
Primary Effluent TKN	mg/L	46
Primary Effluent Alkalinity	mg/L	196
Primary Effluent $CBOD_5$	mg/L	55(1)
Primary Effluent BOD_5	mg/L	55
Primary Effluent TSS	mg/L	61
Primary Effluent nbsCOD	mg/L	30(2)
Primary Effluent Flow	MGD	3.44
RAS Flow Rate	NA	50%(3)
Aeration Basin Temperature	^{o}C	18
Aerated Volume	Mgal	0.880
Number of Aeration Basins	NA	2
2^{o} Clarifier Area	sf	8836(4)
Settling Behavior (0-1; 1 is good)	NA	0.50 (5)

1. $CBOD_5$ equals BOD_5 to provide a conservative estimate.
2. Influent soluble inert organic material estimated based on experience.
3. Assumption based on design conditions.
4. Two secondary clarifiers in service.
5. Calibrated value.
6. NA: Not applicable.
7. Primary effluent concentrations assume 30% removal and 50% TSS removal.

TABLE 2

Model Calibration Results
Based on Actual Plant Operating Conditions and Performance for November 2006

Results	Units	Actual Performance	Model Performance
MLSS Concentration	mg/L	1,995	1,966
SRT	d	9.32(1)	11.9
SVI	ML/g	303	180
WAS Flow Rate	GPD	0.01884	0.02500
Effluent BOD_5	mg/L	6.3	4.0
Effluent Ammonia-N	mg/L	0.45	0.63
Effluent TSS	mg/L	5.5	8.6

1. Calculated based on the average WAS flow rate and an estimated WAS concentration of 10,000 mg/L.

TABLE 3

Activated Sludge Model Results for New Projected Loading Rates

Inputs	**Units**	**Projected Winter Performance at Design Conditions**
Aeration Basin Temperature	^{o}C	12
Influent TKN	mg/L	51
Primary Effluent Alkalinity	mg/L	350
Primary Effluent $CBOD_5$	mg/L	77
Primary Effluent BOD_5	mg/L	77
Primary Effluent TSS	mg/L	79
Primary Effluent nbsCOD	mg/L	30
Influent Flow	MGD	6.10
RAS Rate	NA	50%
Aeration Basin Temperature	^{o}C	12
Aerated Volume	Mgal	1.32
Number of Aeration Basins	Trains	3
2^{o} Clarifier Area	sf	13,254
Settling Behavior (0-1; 1 is good)	NA	0.50
SVI	NA	200
Results	**Units**	**Value**
WAS Flow Rate	MGD	0.047
MLSS Concentration	mg/L	2,488
SRT	days	9.5
Effluent BOD_5	mg/L	6.4
Effluent Ammonia-N	mg/L	0.56
Effluent TSS	mg/L	11.4
WAS Suspended Solids Concentration	mg TSS/L	7,328
Yield	lb TSS/lb $BOD_{removed}$	0.80

NA: Not applicable

Wastewater Influent

bodbased	**Influent**	
Influent Composition		
Influent Composition		
total carbonaceous BOD5	55	[mgO2/L]
total suspended solids	61	[mg/L]
total TKN	46	[mgN/L]
Organic Variables		
soluble inert organic material	30	[mgCOD/L]
active heterotrophic biomass	0	[mgCOD/L]
active autotrophic biomass	0	[mgCOD/L]
unbiodegradable particulates from cell decay	0	[mgCOD/L]
internal cell storage product	0	[mgCOD/L]
Dissolved Oxygen		
dissolved oxygen	0	[mgO2/L]
Nitrogen Compounds		
nitrate and nitrite	0	[mgN/L]
dinitrogen	0	[mgN/L]
Alkalinity		
alkalinity	196	[mgCaCO3/L]
Influent Stoichiometry		
Local Model Selection		
base composite variables on ...	Mantis	
Influent Fractions		
XCOD/VSS ratio	1.42	[mgCOD/mgVSS]
BOD5/BODultimate ratio	0.66	[-]
Mantis Nutrient Fractions		
N content of active biomass	0.068	[mgN/mgCOD]
N content of endogenous/inert mass	0.068	[mgN/mgCOD]
BODbased Model Coefficients		
soluble substrate/BODultimate	0.3	[-]
ammonium/TKN ratio	0.67	[-]
part. org. N/total org. N ratio	0.9	[-]
VSS/TSS ratio	0.85	[mgVSS/mgTSS]
Load Type Options		
Load Type		
loadtype	3.44	mgd

Plug-Flow Tank

mantis		**Aeration Basin**	
Physical			
Dimensions			
number of reactors		8	
volume setup method		Individual Volumes	
Individual Volumes			
individual volumes		2940	[ft3]
		2940	
		5880	
		36100	
		36100	
		39200	
		39200	
		39200	
Operational			
Aeration Control			
DO setpoint		0	
		0	
		0	
		0	
		0	
		2	
		2	
		2	
Internal Flow Distribution			
internal recycle	8,1	5.08	[Mgal/d(US)]
	8,3	10.2	
Composite Variable Stoichiometry			
Organic Fractions			
XCOD/VSS		1.42	[mgCOD/mgVSS]
BOD5/BODultimate ratio		0.66	[-]
Nutrient Fractions			
N content of active biomass		0.068	[mgN/mgCOD]
N content of endogenous/inert mass		0.068	[mgN/mgCOD]
P content of active biomass		0.021	[mgP/mgCOD]
P content of endogenous/inert mass		0.021	[mgP/mgCOD]
Model Stoichiometry			
Active Heterotrophic Biomass			
heterotrophic yield		0.666	[mgCOD/mgCOD]
heterotrophic endogenous fraction		0.15	[mgCOD/mgCOD]
Active Autotrophic Biomass			
autotrophic yield		0.15	[gCOD/gN]
autotrophic endogenous fraction		0.08	[mgCOD/mgCOD]
Kinetic			
Active Heterotrophic Biomass			
heterotrophic maximum specific growth rate		6	[1/d]
readily biodegradable substrate half saturation coefficient		10	[mgCOD/L]
aerobic oxygen half saturation coefficient		0.2	[mgO2/L]
anoxic oxygen half saturation coefficient		0.2	[mgO2/L]
anoxic growth factor		0.8	[-]

nitrate half saturation coefficient	0.5	[mgN/L]
ammonia (as nutrient) half saturation coefficient	0.05	[mgN/L]
heterotrophic decay rate	0.12	[1/d]
Active Autotrophic Biomass		
autotrophic maximum specific growth rate	0.8	[1/d]
ammonia (as substrate) half saturation coefficient	0.74	[mgN/L]
oxygen half saturation coefficient	0.5	[mgO2/L]
autotrophic decay rate	0.1	[1/d]
Hydrolysis		
maximum specific hydrolysis rate	2.81	[1/d]
slowly biodegradable substrate half saturation coefficient	0.15	[mgCOD/mgCOD]
anoxic hydrolysis factor	0.6	[-]
Ammonification		
ammonification rate	0.016	[L/(mgCOD·d)]
Temperature		
Temperature coefficient for muh	1.07	[-]
Temperature coefficient for bh	1.04	[-]
Temperature coefficient for mua	1.07	[-]
Temperature coefficient for ba	1.04	[-]
Temperature coefficient for kh	1.07	[-]
Temperature coefficient for ka	1.03	[-]

Circular Secondary Clarifier

simple1d	**Secondary Clarifier**	
Physical		
Clarifier Type		
clarifier type	Sloping Bottom	
number of layers	10	
Input Required for All Types of Clarifiers		
feed point from bottom	3.28	[ft]
Sloping Bottom Clarifier Input		
surface	8840	[ft2]
water depth at sidewall	13	[ft]
water depth at center	15	[ft]
Operational		
Underflow		
proportional recycle	On	
stream label to which recycle is proportional	1	
recycle fraction	0.5	[-]
Pumped Flow		
pumped flow	.025	[MGD(US)]
Settling		
Double Exponential Parameters		
use SVI to estimate settling parameters	On	
sludge volume index	200	[mL/g]
clarification (0 - bad, 1 - good)	0.5	[-]
maximum settling velocity	6720	[gal(US)/(ft2·d)]
maximum Vesilind settling velocity	10100	[gal(US)/(ft2·d)]
hindered zone settling parameter	0.0004	[L/mgTSS]
flocculant zone settling parameter	0.0025	[L/mgTSS]
non-settleable fraction	0.001	[-]
maximum non-settleable solids	20	[mgTSS/L]
Flow Distribution		
quiescent zone maximum upflow velocity	2450	[gal(US)/(ft2·d)]
complete mix maximum upflow velocity	7360	[gal(US)/(ft2·d)]

Plug-Flow Tank	mantis		Aeration Basin	
Dimensions				
number of reactors			8	
volume setup method			Individual Volumes	
Individual Volumes				
individual volumes			4410	[ft3]
			4410	
			8820	
			54200	
			54200	
			58800	
			58800	
			58800	
Aeration Control				
DO setpoint			0	
			0	
			0	
			0	
			0	
			2	
			2	
			2	
Internal Flow Distribution				
internal recycle		8,1	5.08	[Mgal/d(US)]
		8,3	10.2	
Stoichiometry				
Organic Fractions				
XCOD/VSS			1.42	[mgCOD/mgVSS]
BOD5/BODultimate ratio			0.66	[-]
Nutrient Fractions				
N content of active biomass			0.068	[mgN/mgCOD]
N content of endogenous/inert mass			0.068	[mgN/mgCOD]
P content of active biomass			0.021	[mgP/mgCOD]
P content of endogenous/inert mass			0.021	[mgP/mgCOD]
Active Heterotrophic Biomass				
heterotrophic yield			0.666	[mgCOD/mgCOD]
heterotrophic endogenous fraction			0.15	[mgCOD/mgCOD]
Active Autotrophic Biomass				
autotrophic yield			0.15	[gCOD/gN]
autotrophic endogenous fraction			0.08	[mgCOD/mgCOD]
Kinetic				
Active Heterotrophic Biomass				
heterotrophic maximum specific growth rate			6	[1/d]
readily biodegradable substrate half saturation coefficient			10	[mgCOD/L]
aerobic oxygen half saturation coefficient			0.2	[mgO2/L]
anoxic oxygen half saturation coefficient			0.2	[mgO2/L]
anoxic growth factor			0.8	[-]
nitrate half saturation coefficient			0.5	[mgN/L]
ammonia (as nutrient) half saturation coefficient			0.05	[mgN/L]
heterotrophic decay rate			0.12	[1/d]
Active Autotrophic Biomass				
autotrophic maximum specific growth rate			0.8	[1/d]
ammonia (as substrate) half saturation coefficient			0.74	[mgN/L]
oxygen half saturation coefficient			0.5	[mgO2/L]
autotrophic decay rate			0.10	[1/d]
Hydrolysis				

maximum specific hydrolysis rate	2.81	[1/d]
slowly biodegradable substrate half saturation coefficient	0.15	[mgCOD/mgCOD]
anoxic hydrolysis factor	0.6	[-]
Ammonification		
ammonification rate	0.016	[L/(mgCOD·d)]
Temperature		
Temperature coefficient for muh	1.07	[-]
Temperature coefficient for bh	1.04	[-]
Temperature coefficient for mua	1.07	[-]
Temperature coefficient for ba	1.04	[-]
Temperature coefficient for kh	1.07	[-]
Temperature coefficient for ka	1.03	[-]

Circular Secondary Clarifier

simple1d — **Secondary Clarifier**

Physical

Clarifier Type

clarifier type	Sloping Bottom	
number of layers	10	

Input Required for All Types of Clarifiers

feed point from bottom	3.28	[ft]

Sloping Bottom Clarifier Input

surface	13300	[ft2]
water depth at sidewall	13	[ft]
water depth at center	15	[ft]

Operational

Underflow

proportional recycle	On	
stream label to which recycle is proportional	1	
recycle fraction	0.5	[-]

Pumped Flow

pumped flow	.047	[MGD(US)]

Settling

Double Exponential Parameters

use SVI to estimate settling parameters	On	
sludge volume index	200	[mL/g]
clarification (0 - bad, 1 - good)	0.5	[-]
maximum settling velocity	6720	[gal(US)/(ft2·d)]
maximum Vesilind settling velocity	10100	[gal(US)/(ft2·d)]
hindered zone settling parameter	0.0004	[L/mgTSS]
flocculant zone settling parameter	0.0025	[L/mgTSS]
non-settleable fraction	0.001	[-]
maximum non-settleable solids	20	[mgTSS/L]

Flow Distribution

quiescent zone maximum upflow velocity	2450	[gal(US)/(ft2·d)]
complete mix maximum upflow velocity	7360	[gal(US)/(ft2·d)]

Camas WWTF

Design Year	**2015**	**2025**
Influent Flows		
Annual Average Flow (MGD)	4.04	5.3
Maximum Month Flow (MGD)	4.84	6.1
Peak Day Flow (MGD)	8.78	10.04
Peak Hour Flow (MGD)	11.47	13.44
Influent Loading		
AA BOD (lb/d)	3,437	4,099
AA BOD (mg/L)	102	93
MM BOD (lb/d)	4,708	5,616
MM BOD (mg/L)	117	110
AA TSS (lb/d)	4,937	5,883
AA TSS (mg/L)	147	133
MM TSS (lb/d)	6,715	8,001
MM TSS (mg/L)	166	157
AA NH4-N (lb/d)	1,149	1,389
AA NH4-N (mg/L)	34	31
MM NH4-N (lb/d)	1,618	1,956
MM NH4-N (mg/L)	40	38
AA TKN (lb/d)	1,588	1,917
AA TKN (mg/L)	47	43
MM TKN (lb/d)	2,130	2,573
MM TKN (mg/L)	53	51

Additional Parameters

COD	10,861	12,943	Assumes COD/BOD_5 Ratio =	2.2	
bCOD (biodegradeable COD)	8,097	9,648	Assumes bCOD/BOD_5 Ratio =	1.64	where bCOD/BOD5 =
nbCOD (non-biodegradeable COD)	2,765	3,294		(ultimate BOD/BOD_5)/(1-1.42(f_d)(Y_H))	
$sBOD_5$ (soluble BOD_5)	1,234	1,471	Assumes $sBOD_5$/BOD_5 Ratio =	0.25	
rbCOD (readily biodegradeable COD)	1,234	1,471	Assumes rbCOD = $sBOD_5$		
sCOD (soluble COD)	2,715	3,236	Assumes sCOD/COD ratio =	0.25	
$sCOD_e$ (effluent soluble COD)	741	882	sCOD - (1.6*$sBOD_5$)		
VSS	1,350	1,629	Assumes VSS/TSS Ratio =	0.85	
nbVSS (non-biodegradeable VSS)	344	415			
*i*TSS (inert TSS)	238	288			
TKN	53	51			
nbTKN (non-biodegradeable TKN)	3	3	Assumes nbTKN/TKN Ratio =	0.05	
bTKN (biodegradeable TKN)	50	48			

Assumptions: (M&E, Fourth Edition p. 704-705)

Y_H (heterotrophic yield)	0.4	lb/lb	lb/lb
Y_n (heterotrophic yield)	0.12	lb/lb	lb/lb
f_d (fraction of cell mass remaining as cell debris)	0.15	lb/lb	lb/lb
$k_{d,20}$ (endogenous heterotrophic decay coefficient)	0.12	d^{-1}	d^{-1}
$k_{dn,20}$ (endogenous nitrogenous decay coefficient)	0.08	d^{-1}	d^{-1}
$\mu_{m, max, 20}$ (heterotrophic growth rate)	6.0	g/g*d	g/g*d
$\mu_{n, max, 20}$ (autotrophic growth rate)	0.8	d-1	d-1
K_s (substrate half-saturation coefficient)	20	g/m^3	g/m^3
$K_{n,20}$ (ammonia half-saturation coefficient)	0.74	g/m^3	g/m^3
K_o (oxygen half-saturation coefficient)	0.5	g/m^3	g/m^3

Kinetic and Stoichiometric Constants

Design Temperature	12	^oC	^oC
$\mu_{m, max, t}$ (heterotrophic growth rate)	3.49	g/g*d	g/g*d
$k_{d,t}$ (endogenous heterotrophic decay coefficient)	0.088	d^{-1}	d^{-1}
$\mu_{n, max, t}$ (autotrophic growth rate)	0.466	g/g*d	g/g*d
$k_{dn,t}$ (endogenous nitrogenous decay coefficient)	0.0585	d^{-1}	d^{-1}
$K_{n,t}$ (ammonia half-saturation coefficient)	0.490	g/m^3	g/m^3

SRT Required

N	12			Effluent Ammonia Nitrogen Concentration (mg/L)
DO	2			Reactor DO Conc. (mg/L)
m_n	0.299			$m_n=m_{n,max}*(N/K_N+N)*(DO/K_o+DO)$
SF	2			Peaking and Safety Factor
$SRT_{ox,reqd}$	6.7	3.3	1.7	Aerobic SRT = SF/m_n (d)
SRT Selected	9.3			

Aeration Basin Sizing (per M&E 2003)

Aerobic Zone:					
VSS/TSS fraction of biomass produced	0.85				
Assumed fraction of TKN consumed	0.7				
No_x	35	34	lb/d, Conc of NH_4-N in influent that is nitrified		
S (effluent bCOD)	1.18	1.18	g/m^3		
S (effluent bCOD)	48	60	lb/d		
$P_{x,bio}$ (biomass production)	1,993	2,374	lb/d		
$P_{x,VSS}$ (VSS production)	2,337	2,788	lb/d	P_{xbio} + nbVss	
$P_{x,TSS}$ (TSS production)	2,927	3,495	lb/d	P_{xbio}/0.85 + nbVss + iTSS	
RAS ratio	0.5	0.5			
WAS:					
assumed bTKN/$P_{x,bio}$ ratio	0.12				
TSS	2,927	3,495	lb/d		
VSS	2,337	2,788	lb/d		
nbVSS	344	415	lb/d		
*i*TSS	590	706	lb/d		
bTKN	239	285	lb/d		
MLSS	3000	3500	mg/L		
V_{ox}	1.088	1.113	MG	$P_{x,TSS}$ * SRT / (MLSS * 8.34)	
Anoxic Zone:					
V_{an} initial approximation	0.22	0.22	$V_{an}=0.2*V_{AB}$ (use 20% for alkalinity recovery)		
HRT_{an}	1.1	0.9	Anoxic Zone HRT (hrs)=V_{an}*24/Q_{mm}		
V_{AB}	1.305	1.336	MG		
AB SWD	21	21			
Existing AB Vol	0.350	0.350	MG		Need to Update
Existing Anoxic Vol	0.048	0.048	MG		
Addn AB Ox Vol Reqd	0.738	0.763	MG		
Assumed AB SWD	21.0	21.0	ft		
Addn AB Ox SF Reqd	4697	4860	SF		

Addn Anoxic Vol Reqd	0.170	0.175	MG
Assumed Anoxic SWD	21.0	21.0	ft
Addn Anoxic SF Reqd	1079	1112	SF
Total Addn AB SF Reqd	5776	5972	SF

Selector Sizing

Selector No.1:			
F/M	8	8	
X	3000	3500	Reactor MLSS (mg/L)
F	4708	5616	Influent BOD (lb/d)
M	589	702	M= Sel Vol (gal)/10^6*(MLSS*8.34)
V_{sx-1}	23521	24049	(gallons) V=M*1E6/MLSS/8.34
Assumed SWD	21	21	ft
S_{x-1} SF	150	153	SF
Selector No.2:			
F/M	4	4	
X	3000	3500	Reactor MLSS (mg/L)
F	4708	5616	Influent BOD (lb/d)
M	113	131	M= Sel Vol (gal)/10^6*(MLSS*8.34)
V_{sx-2}	4500	4500	
Assumed SWD	21	21	ft
S_{x-2} SF	29	29	SF
Selector No.3:			
F/M	2	2	
X	3000	3500	Reactor MLSS (mg/L)
F	4708	5616	Influent BOD (lb/d)
M	113	131	
VSX-3	4500	4500	Sel Vol (gal) = M*10^6/(MLSS*8.34)
Mixing Rate	0.02	0.02	scfm/ft^3
Air Required	12	12	scfm
Assumed SWD	21	21	ft
S_{x-2} SF	29	29	SF

Nitrogen Balance

TKN_{in}	2130	2573	lb/d			
TKN_{ef} Conc	1		mg/L			
TKN_{eff}	40	51	lb/d			
WAS Org-N	239	285	lb/d			
TKNox	1850	2237	lb/d			
$NO\text{-}N_{eff}$ Conc	6	6	mg/L			
$NO\text{-}N_{eff}$	242	305	lb/d			
NO_3-N Denitrified	1608	1932	lb/d			
Alk Consumed	13212	15974	lb/d			
Alk Produced	5742	6897	lb/d			
Residual Alk Reqd to Manintain nuetral pH	80		mg/l			
Residual Alk Reqd to Manintain nuetral pH	3229	4070	lb/d	M&E pg 712		
Reqd Influent Alk	265	258	mg/l			
Actual Influent Alk				User must enter/verify		
Reqd Alk Addition						M&E ref page
				b	0.95	
Anoxic Volume pg 762 M&E Fourth Ed.				$C_{s,T,H}$	11.53 mg/L	

Xb	1733	2019	mg/L
IR	-1.4	-1.4	
Flowrate to Anoxic Tank	-4.1	-5.4	MGD
Nox feed	-207	-272	lb/d
Detention Time	2.5	2.5	h (Adjust this cell)
Vanox	0.50	0.64	MGD Compare with Line 98
F/M	0.6	0.5	
SDNR at 20°C pg 755 lb NO3-N/lb biomass-d	0.225	0.230	
influent rbCOD/influent bCOD	0.15	0.15	
SDNR at 10°C lb NO3-N/lb biomass-d	0.18	0.19	
Check NOr lb/d	1640	2461	Should be greater than Nox feed (Line 168)

$C_{s,20}$	9.1	mg/L	
$C_{s,13}$	10.53	mg/L	1745
a	0.50		
F (fouling f	0.90		
elevation c	35.00	ft	
relative pre	0.9987		
g_T	9.8004		1742
P_{atm}	101.325	kN/m^2	
percent ox	19	%	
$P_{atm,H}$	10.33	m	
$C_{s\_,T,H}$	14.47	mg/L	
height of a	0.1524	m	
$r_{T,P}$			

AB Aeration

Carbonaceous O_2 Demand	5267	6278	lb/d
Nitrogenous O_2 Demand	3413	4162	lb/d
Total O_2 Demand	8679	10440	lb/d
Diurnal PF	1.3	1.3	
Design O_2 Demand	11283	13571	lb/d
SOR	23435	28188	lb/d
Diffuser Efficiency	2.25	2.25	%/ft
Total Efficiency	0.47	0.47	
Air Flow	1991	2395	scfm
Total Air Flow Required	2003	2407	scfm

Secondary Clarifiers

QPH	11.47	13.44	
SF Reqd per DOE	9558	11200	for OFR<1200 gpd/SF
SF Reqd per WEF 8	7169	8400	for OFR < 1600 gpd/SF
Existing 2 x 75 dia SF	8836	8836	
Addn SF Reqd per DOE	722	2364	
Addn SF Reqd per WEF 8	-1667	-436	

Digester

nbVSS (non-biodegradeable VSS)	344	415	
*i*TSS (inert TSS)	238	288	
$P_{x,bio}$ (biomass production)	1993	2374	Biodegradable VSS production, lb/d
$P_{x,TSS}$ (TSS production)	2927	3495	Mass of waste activated sludge per day, lb/d
WAS Conc mg/L	10000	10000	
WAS flowrate gpm	24.4	29.1	
WAS flowrate gpd	35091	41903	
D%, Percent VSS destruction	40	40	
M_w, Mass of solids Wasted	1778	2126	X_{VSS}*D%+X_{iVSS}+X_{iTSS}
Xdig	30000	30000	Digester MLSS, mg/L
SRTdig	60	60	d
Vdig	0.426	0.510	Dig Vol (MG) = SRTdig*Mw/(Xdig*8.34)

APPENDIX P

SEWER SYSTEM BASE MAP

13
14
15
3n
12
11
1
10
2
3s
4
5
6
7
8
9
14_A
14_B
14_C
14_D
13_A
13_B
13_C
13_D
12
11_A
11_B
10_A
10_B
10_C
10_D
10_E
10_F
10_G
1_A
1_B
1_C
1_D
1_E
1_F
2_A
2_B
2_C
3n_A
3n_B
3n_C
3n_D
3n_E
3n_F
3n_G
3n_H
3s_A
3s_B
3s_C
4_A
4_B
4_C
4_D
5_A
5_B
6_A
6_B
6_C
6_D
7_A
7_B
7_C
8_A
8_B
9_A
9_B
10-H
LACAMAS SHORES L.S.
SUNNINGDALE GARDENS L.S.
PARKER ESTATES L.S.
SUMMIT OAKS L.S.
PRUNE HILL PARK L.S.
CROWN VIEW L.S.
STONE LEAF L.S.
WINCHESTER HILLS P-1 L.S.
WINCHESTER HILLS P-2 L.S.
HILLSHIRE L.S.
BRADY ROAD L.S.
GRAND RIDGE L.S.
SOUTH PRUNE HILL L.S.
WEST CAMAS L.S.
LACAMAS CREEK L.S.
MAMI L.S.
OAK PARK L.S.
WWTP
N
0
600
1,200
Feet
LEGEND:
SEWER MANHOLES
PUMP STATION
WTP WASTEWATER TREATMENT PLANT
MODEL INPUT MANHOLES
SEWER MANHOLES
MODELED PIPES (2025 FLOW):
Adequate Capacity
Inadequate Capacity High Priority
Inadequate Capacity Low Priority
SEWER PIPES
SEWER BASINS
CITY LIMITS
URBAN GROWTH BOUNDARY
13_C SUB-BASINS
CITY OF CAMAS
GENERAL SEWER / WASTEWATER
FACILITY PLAN
MODELING RESULTS
Gray & Osborne, Inc.
CONSULTING ENGINEERS
L:\CAMAS\05471 WW FAC PLAN\GIS\SEWER_BASEMAP36x48.MXD

APPENDIX Q

DESIGN CRITERIA FOR DEVELOPMENTS IN THE CAMAS SEWER SERVICE AREA

DESIGN CRITERIA FOR COLLECTION SYSTEM COMPONENTS SERVING DEVELOPMENTS WITHIN THE CAMAS SEWER SERVICE AREA

Required Peak Hour Design Flow for Sizing Collection System Components (Pipes and Pump Stations, etc.) for Residential Flows

EQUATION 1:

Total Design Flow (Peak Hour) = (# of ERUs x *Daily Flow / ERU* x *Orange Book Peaking Factor* x *Camas Site-Specific Adjustment Factor*) + (Acreage x *Areal I/I Rate*)

Where

- Daily Flow / ERU = 149 gpd / ERU
- $\mathit{Orange\ Book\ Peaking\ Factor} = \left(18 + \sqrt{Population/1000}\right) / \left(4 + \sqrt{Population/1000}\right)$
- *Camas Site-Specific Adjustment Factor* = 0.691 (= Ratio of Actual PHF/AAF Peaking Factor Observed within Camas to Theoretical PHF/AAF Peaking Factor, based on Ecology's Orange Book). (PHF = Peak Hour Flow, AAF = Annual Average Flow)
- *Areal I/I Rate* =
  - 500 gpd / developed acre for **new developments** (500 gpd / developed acre is equal to the ~90th percentile I/I per developed acre observed in recently sewered areas within Camas), **or**
  - The Basin-Specific Areal I/I Rates in Table 1, for sizing collection system components for **existing sewered areas**

Substituting these values into Equation 1 yields:

EQUATION 2:

Total Design Flow (Peak Hour) = (# of ERUs x 149 gpd / ERU x *Orange Book Peaking Factor* x 0.691) + (Acreage x *Areal I/I Rate*)

TABLE 1
BASIN-SPECIFIC AREAL I/I RATES

BASIN	BASIN-SPECIFIC AREAL I/I RATES (gal./ dev. acre – day) Peak Hour
1	14,953
2	10,024
3 South	4,461
3 North	6,320
4	10,701
5	1,508
6	2,677
7	2,346
8	500
9	500
10	3,157
11	500
12	500
13	500
14	500
15	519

APPENDIX R

NEPA/SERP/ENVIRONMENTAL REPORT

State Environmental Review Process (SERP) ENVIRONMENTAL REPORT 2007 Wastewater Treatment Facility and Main Sewage Pump Station Improvements (Phase II)

City of Camas

May 25, 2007

Updated

November 2009

TABLE OF CONTENTS

CHAPTER 1

PURPOSE AND NEED

1.0 PURPOSE AND NEED

1.1 Project Description (Proposed Action or Proposed Project)

Main Sewage Pump Station:
The City of Camas proposes to construct a series of major improvements increase reliability and reduce maintenance requirements at its main sewage pump station that pumps nearly all of the City's sewage under the Washougal River to the WWTF. The existing wet well will be enlarged and a grinder facility will be installed to grind debris to prevent clogging of the pumps.

Wastewater Treatment Facility:
Camas will construct a $15-20 million upgrade to the existing Wastewater Treatment Plant to increase capacity and provide redundancy that will ultimately ensure public health and safety and enhance the environmental value of the region's natural resources. The design will include a new primary anaerobic digester, new secondary anaerobic digester, new sludge dryer, new secondary clarifier, additional aeration blower, additional bank of ultraviolet disinfection lamps, aeration basin modifications, enlarged odor control biofilter, new septage storage tank, and operational control systems that will integrate the new systems with the existing plant systems.

1.2 Purpose and Need for the Project

The Department of Ecology issued a Notice of Violation (number 2981) to the City of Camas on January 9, 2006; the WWTF exceeded its ammonia limits December 2004, February 2005, March 2005, April 2005, May 2005, June 2005, September 2005, October 2005, and November 2005. The proposed Wastewater Treatment Facility Improvement Project will address ammonia removal issues and allow the Camas Wastewater Facilities to meet the requirements of the NPDES Permit through the planning period (2025).

Modeling performed on the City of Camas Wastewater Collection System indicates that the Main Pump Station is over capacity at current maximum flows due to Infiltration and Inflow during storm events and the Station will be over capacity due to projected future loadings associated with growth in the City. Increasing the size of the wet well and installing grinder pumps will improve the reliability of this critical pump station. Further, the pumps motors and emergency generator and the electrical and control systems must be upgraded. All proposed work will occur within the fenced boundaries of the existing WWTF and most new infrastructure will be installed over 200 feet from the Columbia River. A Shoreline Substantial Development Permit will be obtained from the City of Camas for this project.

CHAPTER 2

ALTERNATIVES TO THE PROPOSED ACTION

2.0 ALTERNATIVES TO THE PROJECT ACTION

The source of the information for this chapter is the *Draft General Sewer/Wastewater Facility Plan for the City of Camas* prepared by Gray & Osborne, Inc. in November 2006. This report discusses treatment alternatives available to meet the needs of the City for the next 20 years.

Alternative 1: No Action Taking No Action to upgrade the existing Camas WWTF and Main Pump Station would leave the City with a system unable to meet the plant's ammonia limits and other NPDES Permit requirements.

Alternative 2: Satellite Water Reuse Facility: Construction of a 2.1 MGD Membrane BioReactor Water Reuse Facility at the north end of Lacamas Lake near Camp Currie to provide Class A Reuse Water to local clients. This new facility would be a "scalping plant" treating only the liquid portion of the waste stream from Basins 11, 12 and 13 and 2/3 of the flow from Basin 1. Solids would be pumped through City sewers and treated at the existing Wastewater Treatment Facility. Implementation of this alternative would require minor modifications to the STEP line to accommodate the conveyance of solids. The existing WWTF would continue to discharge via the existing outfall, which would also provide a back-up disposal option for the satellite MBR facility as needed.

2.1 Screening Evaluation

Alternative 1: No Action

Taking no action would leave the City of Camas with a wastewater treatment facility unable to meet the requirements of its NPDES Permit. Water quality in the Columbia River could be jeopardized, especially during high flow events. This could lead to violations of the National Pollutant Discharge Elimination System (NPDES) permit for the facility, resulting in fines, compliance orders and hook-up restrictions from the Department of Ecology.

Alternative 2: Satellite Water Reuse Facility:

Advantages of this alternative:

- Construction of a satellite MBR WWTF would reduce the range and scope of improvements required at the existing WWTF to provide service to the growing population of Camas through the planning period.
- The MBR WWTF would provide high quality effluent consistent with Class A Reuse Criteria for potential clients nearby.
- The MBR WWTF would have a small footprint and could easily be upgraded as the population in its service area grows.
- The existing WWTF Outfall could serve the satellite plant during emergencies.

Disadvantages of this alternative include:

- Requires construction of effluent pump station and pipelines.
- Would require an additional WWTF Operator.
- Would require modifications to the STEP line to convey solids to the existing WWTF.
- High cost, compared with the low cost of reclaimed water.
- Would require permitting of a new facility, likely involving work in sensitive areas that would need both federal and local sensitive areas review and concurrence.

Screening evaluation summary:

- **Taking No Action** would leave the City of Camas with a WWTF that is unable to consistently meet the requirements of its NPDES Permit in the next few years, especially considering the growing population and tightened permitting requirements.

- **Alternative 2: Satellite Water Reuse Facility:** Construction of a new Water Reuse Facility would be more expensive that upgrading the existing WWTF, and depending upon the location would likely require significantly more permitting and maintenance. It would also require construction of a new effluent pump station and pipeline. The City would be required to hire additional operations and maintenance staff for the new facilities.

- **Alternative 3: Upgrading the existing WWTF and Main Pump Station:** Implementation of this alternative would provide adequate wastewater treatment and conveyance for the City of Camas through the planning period using current growth projections with minimal permitting requirements.

Findings

Implementation of either of the proposed system upgrade options would provide adequate wastewater treatment for the City of Camas through the 20-year planning period. Upgrading the existing WWTF and Main Pump Station would provide adequate wastewater treatment and conveyance to meet the requirements of the NPDES Permit through the planning period. Time required for funding, permitting, design and construction of the proposed WWTF Upgrade and Main Pump Station Improvements would be significantly less than the time required to permit construction and operation of a new Satellite MBR WWTF near Lacamas Lake.

CHAPTER 3
AFFECTED ENVIRONMENT/ ENVIRONMENTAL CONSEQUENCES

3.0 Affected Environment/Environmental Consequences

3.1 Land Use/Important Farmland/Formally Classified Lands

3.1.1 Affected Environment

City of Camas
The City of Camas is located in southeastern Clark County, approximately 12 miles east of Vancouver at the confluence of the Columbia and Washougal Rivers. The City is bordered by the Columbia River on the south, the City of Washougal and Woodburn Hill on the east, the City of Vancouver and Grass Valley to the west, and Lacamas Lake and Lacamas Park to the north. The City includes approximately 7,400 acres and includes 15,400 residents. A number of light industrial and technical businesses provide much of the employment in the City.

Camas WWTF and Main Pump Station
The City of Camas Wastewater Treatment Facility lies at approximately river mile (RM) 120.8 of the Columbia River, just south of the City. The Main Pump Station is located at the corner of Dallas and Third on the west side of the Washougal River across SR 14 from the WWTF. The outfall extends offshore from the WWTF approximately 850 feet where it discharges in 35 feet of water. The 36-inch corrugated steel metal structure lies under quarry spalls on the bottom of the River.

Wastewater Treatment Facility
The City of Camas WWTF is located near the bank of the Columbia River between the SR 14 ROW and a shoreline access roadway for a barge company. The fence surrounding the Camas WWTF is approximately 100 feet from the bank of the Columbia River, and most of the WWTF infrastructure (with the exception of the Equipment Building nearest the outfall at the east end of the site) appears to be set back from the river, just over 200 feet. The site is located in **Section 12 of Township 1 North, Range 3 East** of Clark County and covers about nine acres. The WWTF site has not been used for agriculture or silviculture in recent years, and there are no formally designated prime farmlands in the project area. Vegetation surrounding the site consists primarily of cottonwoods, maples and alders with a few Douglas fir and spruce trees in the area. Vegetation on the WWTF site is limited to domestic grasses and understory adjacent to the WWTF consists of bushes and forbs characteristic of the Columbia River lowlands.

Main Pump Station
The City of Camas Main Pump Station is located approximately one-half mile northwest of the WWTF on the north side of the Washougal River at the corner of Dallas and Third Avenue SE. A shallow driveway extends approximately 25 feet south from Third Avenue SE to the Lift Station. Vegetation surrounding the Lift Station includes cottonwood, maple and alder trees with a few Oregon ash. Blackberries and nettles dominate the understory. Grasses have been planted in the area across Third Avenue SE from the Pump Station, with some ivy growing, just to the west of the auxiliary generator. A large trucking operation (possibly solid waste disposal) is located west of the Main Pump

Station and large trucks pass the station every few minutes during the afternoon. The area to the north and east of the pump station is largely residential.

3.1.2. Environmental Consequences

Alternative 1: No Action

Taking No Action to improve wastewater treatment facilities in Camas would have no direct impact on existing land use, farmlands or other formally classified lands. The WWTF Site would remain in its present state and facility would eventually become unable to meet the requirements of its National Pollutant Discharge Elimination Permit consistently. This would lead to the imposition of a moratorium on sewer hookups in Camas, which would significantly limit land use options throughout the City/WWTF service area.

Alternative 2: Satellite Water Reuse Facility:

- Construction of a new Satellite Water Reuse Facility on recreational/open space land at the north end of Lacamas Lake near Camp Currie would require conversion of several acres of land to Municipal Zoning. The City of Camas would negotiate with Clark County regarding purchase of a site for the new Satellite WRF and would be required to comply with Clark County permitting requirements associated with critical areas, zoning and construction if the new WRF is located in Camp Curry. If the new facility will be constructed within 200 feet of Lacamas Lake a Shoreline Substantial Development Permit would be required from either the City of Camas or Clark County, depending upon the final location. If the new WRF were located within the City of Camas the following permits would be required.

    - City of Camas Building Permit
    - City of Camas Clearing and Grading Permit
    - City of Camas Land Use Conditional Use Permit
    - City of Camas Shoreline Conditional Use Permit

Alternative 3: Upgrading the existing WWTF and Main Pump Station:

Implementation of this alternative would maintain the existing land uses in the vicinity of the WWTF and at the Main Pump Station. There would be no modification of land use at the north end of Lacamas Lake. Shoreline Substantial Development/Conditional Use Permits would likely be required for improvements at both the WWTF Site and the Main Pump Station Site.

3.1.3 Mitigation

Compliance with the conditions of the Shoreline and/or Land Use Conditional Use Permits, Building Permit and Clearing and Grading Permits would provide adequate mitigation for potential modifications to existing land uses associated with both action alternatives. Implementation of either action alternative would mitigate adverse land use consequences associated with development restrictions that would eventually result from non-compliance with the NPDES permit for the WWTF (No Action Alternative).

The trucking operation west of the Main Pump Station should be contacted regarding potential impacts to traffic associated with construction of the new, larger wet well that would extend northeast into the existing cul-de-sac south of Third Avenue SE.

3.2 Floodplain

3.2.1 Affected Environment

According to the Flood Insurance Rate Map for the City of Camas (FIRM Panel #530026 0002B), most of the WWTF lies within the 100-year flood plain of the Columbia River and the Main Pump Station is located on fill at the edge of the 100-year floodplain of the Washougal River, which lies approximately 600 feet southeast. The fence around the perimeter of the WWTF lies approximately 100 feet from the shoreline of the Columbia River and most of the WWTF components are located approximately 100 feet north of the fence, *with the exception of the Equipment Building and Manhole adjacent to the effluent pipeline to the outfall. The new Anaerobic Digesters and Digester Building the new Sludge Holding Tank may be located within 200 feet of the Columbia River*.

3.2.2 Environmental Consequences

Alternative 1: No Action

Taking no action at the Camas WWTF site would have no impact on the floodplain of the Columbia River. It would, however, eventually leave the City of Camas without an adequate wastewater treatment facility.

Alternative 2: Satellite Water Reuse Facility

Depending upon the final location of the Water Reuse Facility at the north end of Lacamas Lake, mitigation of floodplain impacts may be required. Because the WRF would pump effluent to potential industrial users in the vicinity, a shoreline/floodplain location is not critical for this facility. Construction of the facility outside of the 100-year floodplain of Lacamas Lake would alleviate any floodplain issues associated with this facility.

Any improvements to the existing WWTF associated with this project would occur within the 100-year floodplain of the Columbia River. Any new critical infrastructure would require a Flood Hazard analysis and any new structures in the floodplain should be flood-proofed (elevated) above the 100-year floodplain.

Alternative 3: Upgrading the existing WWTF and Main Pump Station:

Improvements to the existing WWTF will be protected/elevated to at least the 100-year flood elevation plus one foot (two feet, if possible). It appears that the critical infrastructure at the existing pump station is elevated above the 100-year flood elevation. Installation of a new wet well in the cul-de-sac above the Main Pump Station would not adversely impact the 100-year floodplain, as long as construction materials are not placed downhill of the Pump Station.

3.2.3 Mitigation

Construction of proposed improvements to the Camas WWTF within the 100-year floodplain of the Columbia River will not displace enough flood flow to result in an increase in the 100-year flood elevation of more than one foot. The new anaerobic digester and top of the sludge holding tank will be elevated above the 100-year flood elevation. A Flood Hazard Analysis will be required for this project by the City of Camas.

In the event that a new WRF is constructed near the north end of Lacamas Lake, the facility should be sited outside of the 100-year floodplain.

3.3 Wetlands

3.3.1 Affected Environment

Existing WWTF & Main Pump Station

There are no formally classified wetlands within the grounds of the Camas WWTF or on the site of the proposed improvements to the Main Pump Station, which is a paved cul-de-sac. Wetlands may be present around the north end of Lacamas Lake. Soils in the vicinity of the WWTF are Hillsborough Silt Loam, which has very slow surface runoff with no erosion hazard. Soils at the Main Pump Station are Sauvie Association, which are deep, moderately well drained and somewhat poorly drained, nearly level to gently sloping soils on bottomlands along the Columbia River. Soils at the northern end of Lacamas Lake are Lauren and Cove Associations. Lauren series soils consist of deep, somewhat excessively drained, gently sloping soils on terraces above the Columbia River consisting of gravel and volcanic ash. Cove soils consist of deep, very poorly drained with clay sub-soils.

3.3.2 Environmental Consequences

Alternative 1: No Action

Taking no action at either the existing WWTF Site, or the Main Pump Station Site will have no impact on wetlands. Taking no action would eventually leave the City of Camas without an adequate wastewater treatment facility capable of meeting the requirements of its NPDES Permit.

Alternative 2: Satellite Water Reuse Facility

Depending upon the site chosen for construction of a Satellite Water Reuse Facility near the north end of Lacamas Lake, the potential to disturb wetlands exists. Siting the facility outside of wetlands would reduce the amount of critical areas permitting required for a Water Reuse Facility.

Alternative 3: Upgrading the existing WWTF and Main Pump Station

No wetlands would be disturbed associated with construction of proposed improvements to the Camas WWTF or the City of Camas Main Pump Station.

3.3.3 Mitigation

Alternative 1: No Action

No wetland impacts to mitigate.

Alternative 2: Satellite Water Reuse Facility

Siting the WRF and associated pipelines outside of areas known to have wetland soils would minimize potential for impacts to wetlands. No wetlands in the vicinity of the existing WWTF and Main Pump Station would be impacted under this alternative. In the event that significant infrastructure is sited within wetland areas, Clean Water Act, Section 404 permitting and local critical areas review would be required if more than 0.1 acre of wetlands are impacted. Conditions of the 404 Permit would be implemented during construction and wetlands disturbed during trenching for sewer mains and other underground infrastructure. Wetland mitigation could occur on-site (preferred), or be conducted off-site in accordance with the Department of Ecology's latest wetland mitigation ratios.

Alternative 3: Upgrading the existing WWTF and Main Pump Station

No wetlands would be impacted under this alternative, so no wetland mitigation would be required.

3.4 Cultural Resources

3.4.1 Affected Environment

Robert Whitlam of the Washington State Office of Archaeological and Historic Preservation has been contacted (see correspondence in Appendix) regarding the potential for archaeological, historical and culturally significant resources in the project area. Discussions with Dr. Whitlam determined that the area has a high potential for artifacts of archaeological, historic or cultural significance. Dr. Whitlam recommended that a pedestrian survey of the WWTF and Main Pump Station sites be conducted by professional archaeologists prior to soil disturbing activities.

The City of Camas contracted with Archaeological Investigations Northwest to survey the Camas WWTF Site and the Main Pump Station. This survey was conducted in April of 2007 and the *Archaeological Survey for the City of Camas's Pump Station and Wastewater Facility Improvement, Design Phase 2 Project* (May 1, 2007) determined that "no resources were identified within the proposed project areas," Northwest Archaeological Investigations Northwest recommended a finding of "No Historic Properties Affected." Copies of this report were forwarded to the Department of Archaeology & Historic Preservation, and the Cultural Resources Departments of the Yakama Nation and Cowlitz Tribe; there have been no responses to date (May 24, 2007).

3.4.2 Environmental Consequences

Alternative 1: No Action

Taking no action would have no impact on historic, archaeological, or cultural resources in the vicinity of the Camas WWTF, Main Pump Station or near the north end of Lacamas Lake.

Alternative 2: Satellite Water Reuse Facility

Construction of a new Satellite Water Reuse Facility near the north end of Lacamas Lake has the potential to disturb/discover materials of cultural, historic or archaeological significance. In the event that this alternative is implemented, a professional archaeologist should survey the sites chosen for the new WWTF and any associated infrastructure prior to ground disturbing activities.

Alternative 3: Upgrading the existing WWTF and Main Pump Station:

The survey prepared by Archaeological Investigations Northwest indicated that construction of the proposed improvements to the Camas WWTF and the Main Pump Station would have minimal potential for disturbance or discovery of objects of historic, cultural or archaeological significance. However, in the event that significant materials are discovered during construction, mitigation measures outlined below would be conducted to minimize potential for adverse impacts to these resources.

3.4.3 Mitigation

During construction, any excavation by the Contractor that uncovers an archaeological, historical, or culturally significant artifact shall be immediately reported to the Project Engineer, a representative of the Public Works Board, the Department of Archaeology & Historic Preservation and the affected Native American Tribes. Construction shall be temporarily halted pending the notification process and further directions issued by the State Historic Preservation Officer (SHPO) and the Tribal Officials.

3.5 Biological Resources

3.5.1 A. Threatened & Endangered Species Affected Environment

The Camas WWTF is located within 100 feet of the Columbia River and the Main Pump Station is located approximately 600 feet from the Washougal River. The following species/Evolutionarily Significant Units/Distinct Population Segments of salmonids migrate up and down the Columbia River past Camas and are protected under the authority of the Endangered Species Act of 1973:

Species/ESU	Status	Date	FR Notice
Salmonids Under NMFS Jurisdiction:			
Lower Columbia Chinook	Threatened	6-28-05	
	Critical habitat	9-2-05	
Lower Columbia steelhead	Threatened	3-19-98	63 FR 13347
	Critical habitat	9-2-05	65 FR 7764
Columbia River chum	Threatened	6-28-05	
	Critical habitat	9-2-05	
SW Washington & Lower Columbia coho	Threatened	6-28-05	
Upper Columbia spring chinook	Endangered	3-24-99	64 FR 14308
	Critical habitat	9-2-05	
Snake River sockeye	Endangered	11-20-91	56 FR 58619
	Critical habitat	12-28-93	58 FR 53635
Upper Columbia steelhead	Endangered	8-18-97	62 FR 43937
	Critical habitat	2-16-00	65 FR 7764
Snake River fall chinook	Threatened	4-22-92	57 FR 14653
	Critical habitat	12-28-93	58 FR 68543
Snake River spring/summer chinook	Threatened	4-22-92	57 FR 14653
	Critical habitat	12-28-93	58 FR 68543
Mid Columbia steelhead	Threatened	3-25-99	64 FR 14517
	Critical habitat	2-16-00	65 FR 7764
Snake River steelhead	Threatened	8-18-97	62 FR 43937
	Critical habitat	2-16-00	65 FR 7764
Upper Willamette steelhead	Threatened		
	Critical habitat	3-25-99	
USFWS Listed Species		2-16-00	
Columbia River bull trout	Threatened		
	Critical habitat		

LISTED EVOLUTIONARILY SIGNIFICANT UNITS (ESUs) OF CHINOOK SALMON:

Lower Columbia chinook salmon, *Oncorhynchus tshawytscha:* Both spring and fall chinook populations on the lower Columbia River were listed as threatened on March 28, 1998. Critical habitat was updated for this ESU on September 2, 2005.

Spring chinook are present in the Cowlitz, Kalama and Lewis rivers. Spring chinook populations from these rivers are of mixed hatchery and wild origin. Return migration for these stocks occurs from late January to May. Tributary migration occurs from March through July, while spawning extends from late August through early October.

Lower Columbia *fall chinook* consists of 14 stocks. These stocks can be further divided into two general groups; the Tule early spawning stocks with strong hatchery influence of mixed origin, and a Lewis River wild stock that spawns later with little hatchery influence. Return migration through the lower Columbia extends from August through November. Spawning is generally October for early stocks and November for late stocks.

Upper Columbia spring chinook

Upper Columbia spring chinook salmon were listed as endangered on March 24, 1999. Critical habitat was adopted for this ESU on February 15, 2000 and updated on September 2, 2005. Spring chinook destined for areas upstream of Bonneville Dam usually reach peak abundance at the dam between April 20 and April 28 but can be earlier during low flow years or later during high run-off periods. Tributary entry is May-June with spawning in late August to late September.

Snake River fall chinook

Snake River fall chinook salmon were listed as threatened on April 22, 1992, and critical habitat for this ESU was adopted on February 28, 1993.

Snake River spring/summer chinook

Snake River spring/summer chinook were listed as threatened on April 22, 1992 and critical habitat was finalized on December 28, 1993.

COLUMBIA RIVER CHUM SALMON, LISTED THREATENED:

Columbia chum salmon, *O. keta*:

Columbia River chum salmon were once widespread in the lower Columbia River. They were listed as threatened on March 25, 1999, and critical habitat for this ESU was finalized on February 16, 2000 and updated on September 2, 2005. Today chum salmon produced in the lower Columbia are concentrated in the Grays River system near the mouth of the Columbia and near Bonneville Dam in Hardy and Hamilton creeks. A few chum salmon cross Bonneville Dam during some years. These stocks of chum salmon are native. Some non-native chum introductions have been attempted, with no apparent success. Chum enter the Columbia in October and November, and spawn in November and December. The present run size is estimated to range between 3,000 and 10,000 fish annually. According to Joe Hymer of the Washington Department of Fish & Wildlife, hatchery releases of the “threatened” stock of Columbia River chum at the mouth of Grays River occur during June. Juveniles from this release pass through the project area shortly thereafter.

LISTED ESUs OF COLUMBIA RIVER BASIN STEELHEAD:

Lower Columbia steelhead, *O. mykiss*
Lower Columbia River steelhead were listed as threatened on March 19, 1999. Critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005. According to the Columbia River SASSI Appendix, the Lower Columbia River supports five summer steelhead stocks and eighteen winter steelhead stocks. Run timing of the summer steelhead extends from May through October, and run timing of winter steelhead stocks extends from December through April in the Lower Columbia River.

Mid Columbia steelhead

Mid Columbia River steelhead were listed as threatened on March 25, 1999. Critical habitat for this species was adopted on February 2, 2000 and updated on September 2, 2005.

Upper Columbia steelhead

Upper Columbia River steelhead were listed as endangered on August 18, 1997 and critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005.

Snake River steelhead

Snake River steelhead were listed as threatened on August 18, 1997 and critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005.

Upper Willamette River steelhead
The Upper Willamette River steelhead were listed as threatened on March 25, 1999 and critical habitat was finalized for this ESU on February 16, 2000 and updated on September 2, 2005.

SNAKE RIVER SOCKEYE, LISTED AS ENDANGERED

Snake River sockeye salmon, *O. nerka*
Snake River sockeye salmon were listed as endangered on November 20, 1991 and critical habitat for this ESU was adopted on December 28, 1993.

LOWER COLUMBIA RIVER COHO, LISTED AS THREATENED:
Lower Columbia River coho, *O. kisutch*, was listed as threatened by the National Marine Fisheries Service on June 28, 2005. Critical Habitat has not yet been proposed.

COLUMBIA RIVER BULL TROUT, LISTED AS THREATENED:
The US Fish & Wildlife Service listed the **Columbia River bull trout, *Salvelinus confluentus*,** as threatened on June 10, 1998. Critical habitat and ESA Section 4 (d) rules were not adopted at this time. According to Jeff Chan of the Olympia Office of the USFWS, critical habitat for Columbia River bull trout in was adopted on September 26, 2005 and is generally limited to spawning and rearing areas in upper portions of watersheds.

Bald eagle, *Haliaeetus leucocephalus*:
According to Priority Species and Habitat Map prepared for this project by the Washington Department of Fish and Wildlife on January 7, 2005, there are no bald eagles known to nest within approximately two miles of the project site. Wintering bald eagles prey on salmon migrating into and out of the Columbia River and may forage offshore in the vicinity of the project area between November 1 and March 31. The bald eagle was removed from the list of species protected under the authority of the Endangered Species Act in 2007.

Species identified as present in Clark County that are not likely to be present in the project area:

Northern spotted owl, *Strix occidentalis,* Listed Threatened*:*
Northern spotted owls occur in Clark County throughout the year. According to the Priority Habitats & Species Map prepared for the area surrounding Section 12, Township 1 North, Range 3 East on April 23, 2007, there are no northern spotted owl nests or management circles within two miles of the project area.

Gray wolf, *Canis lupus*, Listed Endangered:
Gray wolves have not been sighted in Clark County in many years. Further, the gray wolf population in Washington State is thought to be concentrated in the northeastern corner of the state, and any wolves occurring in the SW corner of the state are likely to be hybrids, which are not eligible for protection under the Endangered Species Act. All work on the proposed Camas WWTF and Main Pump Station Improvement Project will occur on the fenced, developed WWTF site and at the Main Pump Station, which is located adjacent to heavy truck traffic on Third Avenue SE, so it is unlikely that gray wolves would be impacted.

Listed plant species:

- Golden paintbrush, *Castilleja levisecta*, Listed as Threatened in 1990: Historically occurred in the Mill Plain area of Clark County Washington. Typically found in wet prairie areas.

- Water howellia, *Howellia aquatilis,* Listed as Threatened in 1994, occurs in two small populations in the floodplain of the Columbia River in Clark County on the Ridgefield Wildlife Refuge across Lake River from the City of Ridgefield.

- Bradshaw's lomatium, *Lomatium bradshawii*, was listed as Endangered on September 30, 1988. It is thought to be endemic to the area around (within ten miles of) Salem, Oregon. According to Ron Klump of the US Army Corps of Engineers, it was recently discovered along Lacamas Creek near a golf course in Camas, Washington.

3.5.1 B. Fish & Wildlife

Fish
In addition to the populations of listed fishes presented in Section 3.5.1 A., fish species in the Columbia River near the Camas WWTF may include the following: shad, bass, perch, sturgeon (both white and green) and Pacific lamprey. The

Priority Habitats & Species Map provided by WDFW on April 23, 2007 indicated that reticulated sculpins were present in the Columbia River near Camas.

Wildlife
Large game animals present in the vicinity of Camas are likely to include Roosevelt elk, black-tailed deer and black bear. Smaller common mammals include beaver, coyote, raccoons, mountain beaver, snowshoe hare, brush rabbit, purple marten striped skunk, opossum, river otter, mink, weasels and red squirrels. Less common mammals include cougar, bobcat, muskrat, flying squirrel and porcupine. Various species of shrews, rodents and bats are also common.

Waterfowl in the vicinity of the WWTF includes mallards, wood ducks, common merganser, great blue heron, green heron, belted kingfisher and the American dipper. Many species of migrating ducks, geese and swans also migrate past Camas. Birds of prey include the goshawk, Cooper's hawk, sharp shinned hawk, osprey red-tailed hawk, kestrel and northern harrier. Owls that may be present in the vicinity include the great horned owl, western screech owl, northern sawhet and northern pygmy owl. The Camas WWTF lies within the range of the northern spotted owl, but no "northern spotted owl centers" were indicated on the Habitats and Species Map prepared for the vicinity of Township 1 North, Range 3 East, Section 12 (WDFW April 23, 2007).

A wide variety of upland birds may be present in the vicinity of Camas. Species of concern to the US Fish & Wildlife Service include Peregrine falcon *(Falco peregrinus)* and the olive-sided flycatcher *(Contopus cooperi)*. Other common birds present may include Steller's jay, American crows and a variety of woodpeckers, swallows, nuthatches, wrens, sparrows, vireos and finches. The Priority Habitats & Species Maps provided by WDFW on April 23, 2007 indicated that purple martins nest in Washougal and at the Port of Camas/Washougal.

The only snake species common to the project area is the northwestern garter snake. It is unlikely that turtles would be found in the vicinity of the Camas WWTF in the Columbia River or at the Main Pump Station Site above the Washougal River. The lizard most likely to be present is the American alligator lizard. Species of Concern to the USFWS include the long-eared myotis *(Myotis evotis),* long-legged myotis *(Myotis volans),* western toad *(Bufo boreas)* (Mathews 1999).

3.5.1 C. Vegetation

The Camas area was originally forested with tidal wetlands along the Columbia River. Most of the hillsides in the Camas area have been logged at least once. Common species in order of prominence include: Douglas-fir *(Pseudotsuga menziesii),* red alder *(Alnus rubra),* big-leaf maple *Acer macrophyllum),* and black cottonwood *(Populus trichocarpa).* Other species found in the area include Grand fir *(Abies grandis)*, Western red cedar *(Thuja plicata)* and Oregon ash *(Fraxinus latifiola).* Various species of undergrowth include salal, several varieties of berries, innumerable species of brush, sword ferns, honeysuckle, vine maple and others. Grasses consist of bentgrass, brome, cheat and other local grasses. Blue camas may be found growing in open fields.

3.5.2 A. Threatened & Endangered Species Environmental Consequences
Alternative 1: No Action
Taking no action to upgrade the Camas wastewater collection and treatment facilities would have no construction impacts on bald eagles, or the 14 species of salmonids protected or under consideration for listing for protection under the authority of the Endangered Species Act of 1973. If no action is taken to improve the capacity and efficiency of the Camas wastewater collection and treatment system, it will eventually be unable to consistently treat the volume of wastewater generated by growth, or meet the requirements of its NPDES permit. This would result in increased biological oxygen demand (BOD) and bacterial and nutrient contamination in the Columbia River near the outfall, which could adversely affect listed salmonids migrating through the area.

Alternative 2: Satellite Water Reuse Facility
Construction of a new Satellite Water Reuse Facility near the north end of Lacamas Lake would likely require clearing of a forested area. As the WRF would not require an outfall it could be located more than 200 feet from the lake or its significant tributaries. Pipes, pump stations and other infrastructure required to convey treated WRF effluent to client industries to the west may require work in shoreline areas. The Priority Habitats & Species Map prepared for the area surrounding the existing WWTF indicates that there are no known bald eagle nests in this area. Further, the PHS Map indicates that anadromous fish cannot access Lacamas Lake, so direct impacts to listed salmonids are unlikely. Any site proposed for the WRF and associated infrastructure should be surveyed for the potential presence of Bradshaw's lomatium, which was recently discovered in the vicinity of Lacamas Lake (Ron Klump personal communication 2006). This work would have **no effect** on bald eagles nesting approximately five miles to the southwest at the existing WWTF and would not be likely to disturb eagles foraging along Lacamas Lake and the Columbia River during the winter months.

Implementation of this alternative would allow the Camas WWTF to meet the requirements of its NPDES permit over the planning period and would help to maintain water quality in the Columbia River. Implementation of this alternative would not adversely affect the 14 species of salmonids listed or under consideration for protection under the authority of the Endangered Species Act of 1973.

Alternative 3: Upgrading the existing WWTF and Main Pump Station:
Upgrading the Camas WWTF and Main Pump Station on their existing sites would have little, if any, potential to adversely impact listed species of fish and wildlife present in the vicinity. Operation of the upgraded WWTF and Main Pump Station would improve wastewater treatment and conveyance capacity and help to improve and maintain water quality and fisheries habitat in the Columbia and Washougal rivers.

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3.5.2 B. Fish & Wildlife Environmental Consequences

Alternative 1: No Action

Taking no action to upgrade the Camas WWTF will have no direct, or immediate, impact on fish or wildlife populations in the area. However, not upgrading the plant would lead to more frequent discharges of wastewater not meeting NPDES permit requirements and subsequent contamination of the Columbia River in the future, with potential to impact to fish and wildlife present in the vicinity of the outfall.

Alternative 2: Satellite Water Reuse Facility

Construction of a new WRF and associated pipelines and pump station near the north end of Lacamas Lake would have minimal potential for disturbance of listed wildlife species, provided the new facility is located outside of stream and lake buffers and other critical habitat. Operation of the new WRF with conveyance of high quality effluent to industrial clients located to the west would eliminate discharge of wastewater effluent into the environment for the portion of the City of Camas WRF service area. It would also reduce the amount of water withdrawn from streams and groundwater by these industries, which would improve in-stream flows and water quality in the area.

Alternative 3: Upgrading the existing WWTF and Main Pump Station:

Upgrading the Camas WWTF and the Main Pump Station on their respective sites has very limited potential to adversely impact water quality and fisheries habitat in the Columbia River. Construction BMPs for control of sedimentation and erosion will be implemented to minimize potential for adverse impact to adjacent streams and wildlife habitat. Construction noise would not be significantly louder than the existing noise levels associated with operation of the existing aeration basins and blowers. Operational noise generated by the upgraded WWTF and Main Pump Station would not be significantly louder than the current noise levels on these sites. Wastewater treatment and conveyance capacity will be improved initially and maintained through the planning period (2025), which will improve and maintain water quality and fisheries habitat near the existing outfall approximately 1,000 feet south of the WWTF in the Columbia River. It should be noted that minor modifications to the risers on the existing outfall have been made to improve dilution of effluent. Potential impacts to listed species associated with work on the outfall were addressed and reviewed under US Army Corps of Engineers Reference Number 20040120 completed in August 2006.

3.5.2 C. Vegetation Environmental Consequences

Alternative 1: No Action

Taking no action at the Camas WWTF would result in no impacts to vegetation on the site or near the north end of Lacamas Lake. Nutrient levels in the Columbia River near the outfall would increase, which would increase algal productivity and eventually cause low dissolved oxygen levels once the algae start to decompose.

Alternative 2: Satellite Water Reuse Facility
Construction of a new Water Reuse Facility near the north end of Lacamas Lake would require clearing existing vegetation from the site and related mitigation as determined by local Sensitive Areas Regulations and permit conditions from the Clean Water Act, Section 404 Permit and/or Hydraulic Project Approval (if necessary). Reuse of effluent from the WRF by local client industries would reduce the amount of effluent discharged to the Columbia River, which would reduce the amount of aquatic plant life in the vicinity of the outfall slightly. This would reduce the potential for low dissolved oxygen levels near the outfall due to decomposition of excess aquatic plant life, which would improve habitat for listed salmonids and other aquatic life.

Implementation of this alternative would reduce the extent of improvements at the existing WWTF Site required to meet the requirements of the NPDES Permit for the Camas WWTF. This would reduce the potential for disturbance of noise sensitive wildlife during construction in the area.

Alternative 3: Upgrading the existing WWTF and Main Pump Station:
Upgrading the existing WWTF and Main Pump Station will have no effect on vegetation outside of these sites. A small amount of grass will be removed from within the grounds of the WWTF to allow construction of the new Aerobic Digester Building and Sludge Holding Tank. The proposed enlargement of the wet well and installation of the grinder facility will occur in the cul-de-sac south of Third Avenue, which is currently paved. Operation of the upgraded WWTF and Main Pump Station will not change these facilities' impacts to adjacent upland vegetation. Improving wastewater treatment and conveyance capacity will allow the WWTF to meet the requirements of its NPDES Permit through the planning period (2025). Thus, algal productivity near the outfall will remain near current conditions.

3.5.3 Mitigation

- Construction Best Management Practices for the control of sedimentation and erosion shall be implemented to minimize potential short-term water quality impacts.
- Major ground-disturbing construction activities shall be restricted to the drier summer months to minimize the potential for erosion and sedimentation.
- Limiting noise-generating construction activities to the summer months will reduce the potential for noise-related disturbance to foraging bald eagles during the winter.
- Disturbed areas not covered by new structures will be landscaped with grass or native vegetation to minimize the potential for erosion and sedimentation.

3.6 Water Quality

3.6.1 Affected Environment

Surface Water
The Washougal and Columbia Rivers are classified as a Class A freshwater water according to the Washington Administrative Code (WAC) 173-201A-130. The outfall for the Camas WWTF is located approximately 800 feet offshore in the

Columbia River. The Camas WWTF discharged a Maximum Month Flow of 3.09 MGD and a Peak Day Flow of 7.03 MGD in 2005. The Columbia River flows west approximately 100 feet south of the WWTF fence. The Main Pump Station lies approximately 600 feet north of the Washougal River, which flows south to its confluence with the Columbia within a mile downstream. The Pump Station pumps most of the wastewater flow from the City of Camas under the Washougal River to the WWTF.

Surface Water Quality
Portions of the Columbia River upstream of Camas are on the 2004 CWA Section 303 (d) List for temperature. Lacamas Lake is on the 303(d) List for Total PCBs and Total Phosphorus. A portion of the City of Camas receives domestic and industrial water from surface water impoundments on Jones and Boulder creeks, tributaries to the Little Washougal River.

Groundwater:
The City of Camas has a number of wells at sites along the Washougal River and is investing in improvements to existing wells and drilling a number of new wells to replace capacity of failing systems. The City is in the process of transferring existing water rights from Georgia Pacific to the City to meet future water demands. The City does not have a need to develop additional water rights at this time, however, if current water rights transfer efforts are unsuccessful, water reclamation may become a viable option in the future as industrial and residential water demands increase.

3.6.2 Environmental Consequences

Alternative 1: No Action
Surface Water
There would be no construction impacts associated with taking no action to improve the Camas Wastewater Treatment System. If the WWTF were not upgraded, the number of days when the system is unable to meet the requirements of its National Pollutant Discharge Elimination System (NPDES) Permit would increase. BOD coliform and nutrient loading to the Columbia River would increase. This could lead to enforcement actions by the Departments of Health and Ecology and may lead to moratoria on future hookups to the wastewater conveyance and treatment system in Camas. Implementation of this alternative would be likely to preclude expansion of the service area in the future.

Groundwater
Taking no action to improve wastewater treatment and conveyance in Camas would not directly impact groundwater quality or quantity in the area.

Alternative 2: Satellite Water Reuse Facility

Surface Water
Construction of a Water Reuse Facility near the north end of Lacamas Lake to convert a portion of the Camas wastewater flows to Class A Water Reuse Standards would have minimal potential for adverse impacts to surface water, due to the limited size of the facility and the fact that the plant would only use the surface water discharge to the Columbia River under emergency conditions. Construction BMPs for control of sedimentation and erosion would be implemented to minimize release of turbid water into adjacent water bodies and wetlands.

Groundwater
Providing a source of water treated to Class A Water Reuse Standards to industrial clients to the east of Lacamas Lake would reduce industrial demand for process water in Camas. Implementation of this alternative would preserve groundwater quantity and quality in the area for future use.

Alternative 3: Upgrading the existing WWTF and Main Pump Station:

Surface Water
Construction of proposed improvements to the Camas WWTF and the Main Pump Station would have minimal potential for adverse impact to water quality in the Columbia and Washougal Rivers. Ground disturbance associated with WWTF improvements would be limited to the summer construction season, largely within previously disturbed areas more than 200 feet from the Columbia River. Construction BMPs for control of sedimentation and erosion will be implemented to minimize turbid runoff, and disturbed areas not covered with new structures will be reseeded with grass to stabilize soils. Improvements to the Main Pump Station will occur within the existing footprint, or in the paved cul-de-sac immediately north of the building, which lies more than 600 feet from the Washougal River. Construction BMPs similar to those employed for the WWTF improvements will be implemented.

Operation of the improved WWTF and Main Pump Station will provide adequate wastewater treatment and conveyance for the City of Camas through the planning period. The improved facilities should meet the requirements of the NPDES Permit through 2025 under most conditions. BOD, bacterial and nutrient loadings near the outfall should not be significant problems under normal operating conditions.

Groundwater
Construction of proposed improvements to the Camas WWTF and the Main Pump Station have limited potential for adverse impacts to groundwater due to the

limited scope and depth of excavation of the proposed improvements. No construction runoff will be routed to groundwater.

Operation of the upgraded WWTF would not directly impact groundwater, as effluent will be treated to secondary standards and discharged to the Columbia River via the existing outfall. Upgrading the existing WWTF to produce water suitable for groundwater recharge is neither feasible, nor required at this time.

3.6.3 Mitigation

Construction shall take place during the dry season and construction best management practices shall be implemented to minimize the potential for generation of sediment-laden runoff from the construction sites for the new wastewater treatment plant, pump stations and any associated force mains or gravity mains.

Construction BMPs for control of sedimentation and erosion will be implemented during construction to minimize creation and discharge of turbid runoff from constructions sites.

Most construction activities will be limited to the footprint of the existing WWTF and Main Pump Station. The wet well at the pump station will be expanded to the north in a paved cul-de-sac south of Third Avenue SE.

3.7 Coastal Lands

3.7.1 Affected Environment

The proposed project area in Camas is located approximately 120 river miles inland from the Pacific Ocean in Clark County and is not subject to the requirements of the Coastal Zone Management Act. The City of Camas and its WWTF are located adjacent to the Columbia River and are subject to the Shoreline Management Review Regulations of the State of Washington. A Shoreline Substantial Development Permit is required by the City of Camas for proposed improvements to the WWTF, as it is located within 200 feet of the Columbia River. No Shoreline Permit would be required for the improvements to the Main Pump Station as it is located approximately 600 feet from the Washougal River. Work at both facilities will require Conditional Use Permits.

3.8 Socioeconomic/Environmental Justice

3.8.1 Affected Environment

Demographics & Waste Load Projections

The approximate total population in Cathlamet in 2002 was estimated at 13,540 residents. The number of housing units in Camas was 5,153, which includes a total of 278 housing units including single-family homes and apartment units. There were approximately 2.6 persons per residential unit, which is consistent with OFM estimates for Clark County at 2.65 persons per household for 2005. Population projections through 2025 indicate that the population within the City's current boundaries will expand to approximately 22,360 by the end of the planning period. The 2025 population within the City's Urban Growth Boundary is estimated at 24,700 (General Sewer/Wastewater Facility Plan, G&O 2006).

Employment

The economic base in Camas consists of a number of industrial concerns including Georgia Pacific (are they still running the mill?) Bodycote, Columbia Litho, Inc., Brown's Chevrolet, Heraeus Shin-Etsu America, Landa, Linear Technology, Sharp Electronics Corporation, Shell Oil Products and Wafertech. Minor industrial concerns included Fort James Camas, Furuno USA Inc., Lemon Aid Automotive, Post Records and Westlie Motors.

3.8.2 Environmental Consequences

The Camas WWTF provides service to the City residents and industrial facilities. Expansion of the capacity of the WWTF and the Main Pump Station will allow expansion of the population and industrial development.

Failure to provide adequate capacity to serve these areas could lead to a situation where the existing WWTF could not meet the requirements of its NPDES Permit, which would result in a moratorium on new hookups to the system. Placing a moratorium on development could stifle economic activity and future growth in Cathlamet.

3.8.3 Mitigation

Implementation of the proposed WWTP upgrades will mitigate potential water quality impacts associated with expansion of the population and industrial development in the service area over the next 20 years. It would allow the WWTP to meet the requirements of its NPDES permit through the planning period.

3.9 Miscellaneous Issues

3.9.1.1 Air Quality - Affected Environment

Air Quality in the vicinity of Camas is generally good due to winds in the Columbia Gorge influenced by storms off the Pacific Ocean and the general lack of large industrial developments in the immediate vicinity.

3.9.1.2 Air Quality-Environmental Consequences

Emissions to the air associated with the WWTP upgrade would be temporary. Potential sources of emissions would include fugitive dust and exhaust associated with construction activities. Air pollution abatement equipment (biofilters) will be installed as a portion of the proposed system improvements. Once construction is complete, operation of the improved water system will have no impact on air quality.

3.9.1.3 Air Quality - Mitigation

As a routine matter, building permit conditions include watering as the primary dust control measure during ground disturbing construction activities.

3.9.2.1 Transportation-Affected Environment

The Town of Cathlamet is accessed via State Route 13, which provides access to the City of Vancouver and the I-5 corridor to the west and the Columbia Gorge to the east. Construction of the proposed improvements to the WWTF would increase large vehicle traffic to the site for approximately one year. Work at the Main Pump Station would last for several months. Upgrading the pump station may require planning of detour routes for truck traffic from the transfer station to the west. Once construction is complete and the wastewater treatment improvements are in operation, no increase in traffic over existing conditions is anticipated.

3.9.3.1 Noise

Noise associated with construction vehicles and equipment will be present in the project area for approximately six. Once outdoor construction activities are complete, noise levels will return to near normal through the next 14 months of construction activity. Once construction is complete, noise levels will return to preconstruction levels, as new noise-generating equipment (pumps, blowers etc.) will be housed in soundproof enclosures.

4.0 Summary of Mitigation

Mitigation of potential impacts to the human environment as a result of this project will include:

a) Major ground-disturbing construction activities shall take place during the dry season and construction best management practices shall be implemented to minimize the potential for generation of sediment-laden runoff from construction sites associated with wastewater treatment and conveyance system upgrades.

b) Limiting major noise-generating construction activities to the drier summer months reduces the potential for disturbance of bald eagles foraging along the Columbia River.

c) Financial impacts to low income populations shall be mitigated through the acquisition of grants and low-interest loans;

d) Noise impacts shall be addressed by limitation of hours of outdoor construction; and installation of pumps and aerators in soundproof buildings;

e) During construction, any excavation by the contractor that uncovers an historical or archaeological artifact shall be immediately reported to the Project Engineer, a representative of the Public Works Board, and the Cowlitz and Yakama Tribes. Construction shall be temporarily halted pending the notification process and further directions issued by the State Historic Preservation Officer (SHPO) and Tribal Officials.

5.0 Correspondence

6.0 Exhibits

REFERENCES

Gray & Osborne, Inc. 2001. *Biological Evaluation for the First Street, Howerton Way and Waterfront Way Improvements*, prepared for the Washington State Department of Transportation, Vancouver, Washington, July 13.

Gray & Osborne, Inc. 2001. *Wastewater Facility Plan Amendment, prepared for the Town of Cathlamet, November.*

Gray & Osborne, Inc. 2005. *Biological Evaluation for the Camas WWTF Outfall Improvements*, associated with the Rivers & Harbors Act, Section 10 Permit issued by the US Army Corps of Engineers, December 6.

Gray & Osborne, Inc. 2006. *General Sewer/Wastewater Facility Plan for the City of Camas, Draft*, Seattle Office, November.

Hart, J.L. 1973. *Pacific Fishes of Canada,* Fisheries Research Board of Canada, Bulletin 180, Ottawa, Canada.

Holman, Eric 2001. Personal communication regarding the presence of listed salmonids in the project area. WDFW Vancouver Office, July 11.

Hymer, Joe 2001. Personal communication regarding the presence of listed salmonids in the project area. WDFW Vancouver Office, July 12.

Mathews, Daniel 1999. *Cascade-Olympic Natural History, A Trailside Reference,* Second Edition, Raven Editions, Portland Oregon.

US Department of Agriculture, Soil Conservation Service 1972. *Soil Survey of Clark County, Washington,* in cooperation with Washington Agricultural Experiment Station, November 1972.

Washington State Department of Ecology 2000, *2000 Washington State Water Quality Assessment, Section 305 (b) Report*, Olympia, Washington, August.

Washington State Department of Fish and Wildlife 1993. *Salmon and Steelhead Stock Inventory*, Appendix 3 Columbia River Stocks, Olympia, Washington, June.

Washington State Department of Fish & Wildlife 2007. Priority Habitats & Species Maps for Section 12, Township 1 North, Range 3 East, April 23.

Washington State Department of Transportation 2001, *Local Agency Environmental Classification Summary for the First Avenue, Howerton Way and Waterfront Way Improvement Project,* prepared for the Town of Ilwaco by Gray & Osborne, July.

5. Correspondence

CITY OF CAMAS
616 Northeast Fourth Avenue
P.O. Box 1055
Camas, Washington 98607
PH: 360-834-6864 • F: 360-834-1535
http://www.ci.camas.wa.us

NOTICE OF FINAL DECISION
SITE PLAN PERMIT
File# SPRV 09-09 (Wastewater Treatment Facility)

Issued: November 2, 2009

Proposal	The City of Camas proposes to upgrade the main pump station at the Camas Wastewater Treatment Facility to improve sewage conveyance and sludge/biosolids handling.
Location	1129 Polk Street, Camas, WA. Tax Parcel #87360-000
Owner	City of Camas 616 NE 4th Avenue Camas, WA 98607

I. BACKGROUND

- The project area is 3.02 acres.
- The application is subject to Site Plan and SEPA permits. The applicant has submitted an application for a consolidated review process.
- There is a portion of the project that lies within the 200-foot shoreline buffer of a water of state-wide significance, the Columbia River.
- The City of Camas, as lead agency for review of this proposal, made a State Environmental Policy Act (SEPA) determination that this proposal does not have a probable significant adverse impact on the environment. A Determination of Non-Significance (DNS) was issued on October 6, 2009, and the comment period ended on October 20, 2009 with no appeals being filed.

II. DECISION

Site Plan Review (SPRV 09-09) is approved based on the applicant's narrative and drawings contained in the application file dated September 15, 2009. **APPROVAL** OF SPRV 09-09 IS BASED ON THE FOLLOWING FINDINGS OF FACT AND CONCLUSIONS OF LAW:

III. FINDINGS OF FACT – BASED ON SITE PLAN REVIEW CRITERIA OF APPROVAL – CMC 18.18.060 (A-F)

A) Compatibility with the City's Comprehensive Plan;
FINDING: The proposed project is in compliance with the City of Camas Comprehensive Plan, Chapter ten, and page X-2. The benefit of this capitol improvement project is intended to meet the needs of the City until 2025.

B) Compliance with all applicable design and development regulations;
FINDING: The applicant has provided a site plan and building elevations that are in compliance with Site Plan (CMC18.18)

C) Availability and accessibility of adequate public services such as roads, sanitary and storm sewer, and water to serve the site at the time development is to occur, unless otherwise provided for by the applicable regulations;
FINDING: The project is a renovation of the public sanitary service system and therefore is in compliance with this criterion.

D) Adequate provisions are made for other public and private services and utilities, parks and trails;
FINDING: The project is within an existing public facility that has existing public roads and access. No changes to the access is proposed or required.

E) Adequate provisions are made for maintenance of public services; and
FINDING: The Public Works Department has procedures in place to maintain the new buildings and landscaping.

F) *All relevant statutory codes, regulations, ordinances and compliance with the same. The review and decision of the city shall be in accordance with the provisions of CMC Chapter 18.55.*
FINDING: As stated in the responses to criteria A-F, this proposal satisfactorily complies with relevant statutes and codes.

IV. FINDINGS OF FACT –SHORELINE MANAGEMENT(CMC18.88)

CMC18.88.120 Exceptions, "Whenever an applicant claims that, or it appears that, he is exempt from the necessity of a substantial development permit under RCW 90.58.030, the administrator shall decide whether he is in fact exempt, and may refer the matter to SMRC or the city attorney for assistance in resolving such question.

FINDING: The application included a letter dated, October 28, 2009, in which it states that the project is exempt given that it meets the criteria for "normal maintenance or repair of existing structures". The work proposed within the shoreline is to replace and repair 16 risers that will improve the dilution of effluent and protect water quality. The described work is not a new use or new development according to the SMP, rather as repair of an existing development.

V. CONCLUSIONS OF LAW

As conditioned, SPRV 09-09 meets the approval criteria for site plan review contained in Section 18.18.060 CMC.

1. As proposed, SPRV 09-09 is compatible with the City of Camas Comprehensive Plan.
2. As proposed, SPRV 09-09 complies with the applicable design and development standards contained in the Camas Municipal Code and other applicable regulations.
3. The review and decision associated with SPRV 09-09 is in compliance with Chapter 18.55 CMC.

As proposed, SPRV 09-09 meets the exemption criteria for Shoreline Substantial Development permits pursuant to WAC 173-27-040 for "normal repair of existing structures" and pursuant to Camas Shorelines Master Program, Chapter 2-6.

VI. CONDITIONS OF APPROVAL FOR WASTEWATER TREATMENT FACILITY

The application has been approved as proposed in the drawings received September 15, 2009. The following conditions shall be required in addition to what is included in the application materials:

1. The applicant shall install landscaping as proposed on Sheet G-17 within one-year of the issuance of this decision.
2. The applicant shall obtain building permits for all structures.

DATED this 2nd Day of November, 2009

Phil Bourquin,
Community Development Director

APPEALS
This is a Type II Decision and is appealable to the City Council pursuant to CMC18.55.210

GRAY & OSBORNE, INC.
TELEPHONE/MEETING CONVERSATION RECORD

☒☐☒☐**Telephone Conversation**	**Location of Phone Conversation:** GRAY & OSBORNE INC.
☐**Meeting**	**Place of Meeting:**

Date:	10-29-2009~~12-3-2008~~~~5/29/08~~~~5/2/06 – 5/4/06~~	~~**Time:**~~	1030~~11 00~~ ~~a.m.~~	~~p.m.~~
Discussion with:	Danette Guy~~Clint Stanovsky~~ ~~Jim Bay, City of Sequim; Harold Peterson~~			
Firm/City with:	US Army Corps of Engineers, Vancouver Office~~Town of Skykomish~~			
Phone Number:	360 906-7274~~425 649-1649~~			
Gray & Osborne Personnel:	Jim Dougherty~~Jim Dougherty~~~~Eric Delfel~~			
Project:	Camas WWTF Phase 2 Upgrades~~Pipeline crossings of Maloney Creek and Old Maloney Creek culvert & backflow prevention on stormwater outfall at west end of Town~~ ~~Solana Reservoir and Booster Station~~			
Subject:	Rivers & Harbors Act, Section 10 Permit for outfall modifications~~Permitting strategies~~~~Pump Selection, Vent Calculations~~			
G&O Job Number:	07511.00~~07479.000~~~~404915~~			

REMARKS:

~~Jim Bay called on 5/2 and forwarded an e-mail to me regarding the pump selection at the Solana Booster Stations. The e-mail indicated that Harold Peterson and his group could not find horizontal split case pumps for the 225 gpm and 25 gpm pumps. I spoke with Tim Wahlquist at Pump Tech, who was able to provide me with a Peerless Model 2TU1062 for the 225 gpm pump, but said that horizontal split case pumps are not a good fit for the 25 gpm pumps.~~

~~I spoke with Harold Peterson and informed him that horizontal split case pumps are preferred for the 1,000 gpm and 225 gpm pumps due to their low NPSH requirements, which allows the reservoir to be drained lower on the suction side of the pumps, and due to the ease with which operators can work on the pumps. However, a centrifugal pump selection is appropriate for the 25 gpm, or jockey pump. I also requested that care be taken with the selection of the jockey pump to ensure that there is sufficient NPSH to allow operation of the pumps even if the reservoir is nearly empty.~~

I spoke with Danette Guy, ACOE Project Manager for the Camas WWTF Phase 2 Improvement Project, this morning regarding the Rivers & Harbors Act, Section 10 Permit for the proposed improvements to the Camas WWTF outfall diffuser. She said that the JARPA and Informal ESA Consultation Document for the project have been sent to the Corps' Seattle District Office for review and approval. She said that there were a number of more difficult projects included in the pile forwarded to Seattle, and that it is unlikely that the Seattle Office will act on the City of Camas application any time soon.

Danette recommended that we leave the current Rivers & Harbors Act, Section 10 Permit approval letter in the Specifications Package for the project, along with the list of conservation measures from the current ESA document. Her main concerns were compliance with the in-water work window and the conditions of the Hydraulic Project Approval issued by WDFW on October 26, 2006.

14. Conservation measures:

Conservation measures are measures that would reduce or eliminate adverse impacts of the proposed activity (examples: work done during the recommended work window [to avoid times when species are most likely to be in the area], silt curtain, erosion control best management practices, percent grating on a pier to reduce shading impacts).

Mitigation measures designed to minimize potential impacts of the Camas Wastewater Treatment Facility outfall modifications and operation of the facility once the modifications are completed include:

1. Construction equipment and vessels shall be fueled, maintained and stored off-site to minimize the potential for spills of hazardous materials, including fuels, lubricants and coolants.

2. Construction would be limited to the in-water work window established by the Washington Department of Fish & Wildlife, Vancouver Office, which extends from November 1 to February 28 in the Lower Columbia River, or during the summer low flow period between July 15 and September 15 to take advantage of low flows and improved visibility for the proposed under water work.

3. To minimize the potential for accidents resulting in direct effects to listed and candidate fish species, construction vessels and equipment will be fitted with emergency spill kits and construction crews will be trained in their use.

MEMORANDUM

TO: Sarah Fox, City of Camas
FROM: Jim Dougherty
DATE: 10-28-2009
SUBJECT: Justification of Shoreline Exemption for proposed Wastewater Treatment Facility outfall riser repairs/improvements

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The proposed improvements to the City of Camas Wastewater Treatment Facility outfall riser structures include removing 90-degree bends from a total of 16 risers to improve dilution of effluent and installation of Tideflex Valves to eliminate entrapment or impingement of fish species protected under the authority of the Endangered Species Act. The proposed project will open eight (8) risers, which are currently unused, to improve and preserve dilution of wastewater effluent over the next 20 years. This project qualifies for an exemption to the Shoreline Substantial Development permitting process per WAC 173-27-040 for "normal maintenance or repair of existing structures," because it improves the function of the existing riser structures and puts currently unused risers into service to improve effluent dilution and protect water quality as the City of Camas grows.

Implementation of the proposed outfall riser modifications is consistent with the intent of the Shoreline Management Act for the following reasons:

1. It recognizes and protects both state and local interests (clean water).
2. It does not change the nature of the shoreline (or the nature of the WWTF outfall on the benthic surface of the Columbia River).
3. It provides both short-term and long-term improvements to water quality.
4. It protects the ecology of the Columbia River shoreline by improving dilution of wastewater treatment facility effluent.
5. It does not affect public access to the shoreline.
6. Recreational use of the Columbia River will be made safer by more effective dilution of WWTF effluent.

MEMORANDUM

TO: Sarah Fox, Planner, City of Camas
FROM: Jim Dougherty
DATE: September 8, 2009
SUBJECT: Narrative discussion regarding the Camas WWTF Phase 2 Improvements Project compliance with Camas City Code requirements as discussed at the August 29, 2009 Pre-Application Meeting

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This memorandum addresses compliance with Camas City Codes for the City's Wastewater Facilities Phase 2 Improvement Project, per the August 29, 2009 Pre-Application Meeting summary, file PA09-16. Site planning issues will be addressed in the order they were presented in the Pre-Application Meeting Summary.

1. Additions and modifications to the WWTP will require a Site Plan Permit, which is considered a Type II permit, requiring the following information:

- Application form (attached);
- Current mailing list of all owners within 300 feet of the parcel (attached)
- Narrative addressing approval criteria (see following responses)
- Necessary drawings (see site plans & maps from Clark County illustrating critical areas in the vicinity of the Camas WWTP, attached);
- Pre-Application notes (attached);
- SEPA Checklist (attached).

2. The application should address the criteria for Site Plan approval pursuant to CMC18.18.040:

A. Written description addressing project scope:

Main Sewage Pump Station: The City will construct improvements to increase reliability and reduce maintenance requirements at the main sewage pump station, which pumps nearly all of the City's sewage under the Washougal River to the WWTF site. The existing wet well will be enlarged and a grinder facility will be installed to grind debris to prevent clogging of the pumps. These improvements will mostly occur underground and the area of impervious surfaces adjacent to the Main Pump Station will not change.

Wastewater Treatment Facility: Camas will construct an upgrade to the existing Wastewater Treatment Facility to improve sludge/biosolids handling capacity and ensure redundancy that will ensure public health and safety and enhance the environmental value to the region's natural resources. The design will include the following improvements:

- two new primary anaerobic digesters,
- a new sludge storage tank,
- a new digester building and associated sludge handling equipment,
- new sludge dryer,
- additional aeration blower,
- additional bank of UV disinfection lamps,
- aeration basin modifications,
- enlarged odor control biofilter,
- new septage/centrate/WAS storage tank,
- and operational control systems that will integrate the new systems with the existing WWTF systems.
- The existing aerobic digester number 1, a portion of the service roadway and a portion of the aerobic digester number 2 structures will be demolished and removed from the site.

The project will result an 8,500 square foot reduction of impervious surfaces on the WWTF site.

B. Vicinity Map: See Sheet G-1 in drawing package previously submitted.

C. Topographic Map with 1-foot contours: See Sheet G-7.

D. Site Plans: See Site Plan and Area Identification Sheet G-11.

E. Circulation Plan: The access points for the site, driveways, streets and roads serving the Camas WWTF will not change significantly as a result of this project. Further, the project will not generate more than 100 average daily trips.

F. Preliminary drainage and stormwater runoff plan: See Sheet G-15 for the Site Grading and Storm Drain Plan. The majority of the existing stormwater system will remain the same.

G. Site Utility Plan: See Sheet G-16 for the Site Utility Piping Plan.

H. Landscaping Plan: See Sheet G-17 for the Landscape and Irrigation Plan. Note that the existing site is shielded from the view from the east of the residential neighborhood and from the view from the north of commuters travelling on SR 14 by rows of large Leyland Cypress trees located on the wastewater treatment facility property. The view from the south of boat traffic on the Columbia river is currently obstructed by trees which line the river on the south side of the facility. The property to the west of the facility is owned by the City and is densely populated with trees which also serve to shield the view of traffic on SR 14. Once construction is complete, disturbed areas will be hydroseeded. Seven Leyland cypresses will be added to existing landscaping to replace the seven that will have to be removed during construction.

I. Building elevations and architectural style: See the following sheets:

- A-1, Digester Building & Dryer Building Details;
- A15-1, Dryer Building Plans & Schedules;
- A15-2 Dryer Building Exterior Elevations & Building Sections
- A18-1 Digester Building Plans & Schedules;
- A18-2 Digester Building Sections & Elevations.

J. See attached Engineer's Estimate.

3. The proposed WWTF Phase 2 Improvements will upgrade the facility's sludge/biosolids treatment and storage and make significant improvements to the Main Pump Station that will improve performance. The existing aerobic digester will be demolished and two new anaerobic digesters will be constructed adjacent to a new Digester Building. A new Digested Sludge Holding Tank will be constructed east of the Digester Building, and a new biofilter will be installed adjacent to (west of) the existing biofilter. Half of the existing Aerobic Digester No. 2 will be demolished, and the other half will be modified to serve as Septage/Centrate/WAS Storage Tanks. The overall area of impervious surfaces on the WWTF site will be reduced by 8,500 square feet. Disturbed areas will be hydroseeded with grass once construction is complete and seven Leyland cypresses will be added to the existing landscaping on the site.

Improvements to the Main Pump Station will include enlargement of the existing wet well and installation of a grinder facility to grind debris to prevent clogging of the pumps. These improvements will mostly occur underground and the area of impervious surfaces adjacent to the Main Pump Station will not change.

4. Additional Issues:

Building:

- The contractor will obtain a building permit
- An Electrical permit will be obtained and electrical work will be inspected per requirements of the Washington State Department of Labor and Industries

Fire:
A Fire Permit will be obtained for the project.

Engineering:

- Construction plans have been prepared by a licensed Washington State Engineer in accordance with the City of Camas Standards.
- Stormwater Management: The proposed project will reduce impervious surfaces on the WWTF site by 8,500 square feet. No modification to the existing stormwater facility is required.
- A traffic study will not be required.
- Utility Plan is presented in Sheets G-8 through G-16 (previously submitted).
- Erosion Control Bond: The proposed improvements to the Camas WWTF and Main Pump Station will disturb significantly less than one acre. Therefore, an Erosion Control Bond will not be required, per Camas Municipal Code Section 17.21.030.
- NPDES Construction Stormwater Permit: No NPDES Construction Stormwater Permit will be required, as the proposed construction project will disturb less than one acre.

MEMORANDUM

TO: Jim Hodges, Eric Nutting, Jay Swift
FROM: Jim Dougherty
DATE: 8-20-2009
SUBJECT: Permits required for Camas WWTF Outfall Modification Project

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1. Federal Permits
   - Rivers & Harbors Act, Section 10 Permit from US Army Corps of Engineers, Nationwide Permit 7 for outfall modifications (application to Danette Guy USACOE, July 2009)
   - Endangered Species Act compliance, US Fish & Wildlife Service & NOAA Fisheries (forwarded to Dan Guy @ NMFS and ACOE in July 2009).

2. State Permits
   - Hydraulic Project Approval, Washington Department of Fish & Wildlife, HPA issued October 26, 2006, good through February 28, 2011.
   - Aquatic Lands Use Authorization, Washington Department of Natural Resources, application assembled October 2006, status?

3 City Permits
   - Shoreline Substantial Development? Shoreline Exemption?
   - Critical Areas review
   - SEPA DNS (required for HPA & Shoreline permitting).

Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 • (206) 284–0860

MEMORANDUM

TO: Sarah Fox, City of Camas
FROM: Jim Dougherty
DATE: September 3, 2009
SUBJECT: Responses to Site Plan Approval Requirements for the City Camas WWTF

Camas Municipal Code 18.18.040: Submittal and contents of a complete application.
A. The scope of the proposed Camas Wastewater Facilities Upgrade Phase 2 Project includes:

1. Main Sewage Pump Station: Camas will construct a series of major improvements to increase reliability and reduce maintenance requirements at its main pump station, which pumps nearly all of the City's sewage under the Washougal River to the Camas WWTF. The existing wet well will be enlarged and a grinder facility will be installed to grind debris to prevent clogging of the pumps.

2. Wastewater Treatment Facility: Camas will construct a $15-20 million upgrade to the existing Wastewater Treatment Facility to improve sludge/biosolids handling capacity and ensure redundancy that will ultimately ensure public safety and enhance environmental value of the region's natural resources. The design will include to new primary anaerobic digesters, a new sludge storage tank, new sludge dryer, additional aeration blower, enlarged odor control biofilter, new septage centrate/WAS storage centrate/WAS tank, and operational control systems that will integrate the new systems with the existing WWTF systems.

STATE ENVIRONMENTAL POLICY ACT

DETERMINATION OF NON-SIGNIFICANCE

Mail Comments to:
City of Camas
Community Development Director
P.O. Box 1055
Camas, WA 98607

CASE NO:	SEPA09-20 (Camas Wastewater Treatment Facility Renovation, City file #SPRV09-09)
APPLICANT:	City of Camas, Public Works Department
REQUEST:	Equipment upgrades to both the main sewage pump station and the wastewater treatment facility. This project will reduce maintenance issues and improve handling capacity of these facilities to serve the City until 2025.
LOCATION:	1129 SE Polk Street, Camas, WA
Legal Description:	NW & SW ¼, S13, T1N, R35 and Tax parcel #87360-000
SEPA Determination:	Determination of Non-Significance
Comment Deadline:	October 20, 2009, at 5:00 p.m.

As lead agency under the State Environmental Policy Act (SEPA) Rules [Chapter 197-11, Washington Administrative Code (WAC)], the City of Camas must determine if there are possible significant adverse environmental impacts associated with this proposal. The options include the following:

- DS = Determination of Significance (The impacts cannot be mitigated through conditions of approval and, therefore, requiring the preparation of an Environmental Impact Statement (EIS).
- MDNS = Mitigated Determination of Non-Significance (The impacts can be addressed through conditions of approval), or;
- DNS = Determination of Non-Significance (The impacts can be addressed by applying the Camas Municipal Code).

Determination:
Determination of Non-Significance (DNS). The City of Camas, as lead agency for review of this proposal, has determined that this proposal does not have a probable significant adverse impact on the environment. An Environmental Impact Statement (EIS) is not required under RCW 43.21C.030(2)(e). This decision was made after review of a completed environmental checklist and other information on file with the City.

Date of Publication & Comment Period:

Publication date of this DNS is **October 6, 2009**, and is issued under WAC 197-11-340. The lead agency will not act on this proposal until the close of the 14-day comment period which ends on **October 20, 2009**.

SEPA Appeal Process:

An appeal of any aspect of this decision, including the SEPA determination and any required mitigation, must be filed with the City Clerk within fourteen (14) calendar days from the date of the decision notice. The letter of appeal should contain the following information:

1. The case number designated by the City of Camas, and the name of the applicant; and
2. The name and signature of each person or group (petitioners), and a statement showing that each petitioner is entitled to file an appeal as described within the Camas Municipal Code. If multiple parties file a single petition for review, then the petition shall designate one party as the contact representative with the Planning Department. All contact with the Planning Department regarding the petition, including notice, shall be with this contact person

The appeal request is to be submitted to the City Clerk between 8:00 a.m. and 5:00 p.m. Monday through Friday, at the address listed below:

Appeal to the City of Camas SEPA Official
Community Development Department
616 NE Fourth Avenue / P.O. Box 1055
Camas, Washington 98607

Staff Contact Person: Sarah Fox, Planner II (360) 817-1562 ext. 4269
Responsible Official: Phil Bourquin (360) 817-1562

Phil Bourquin, Community Development Director and SEPA Official

10-01-09
Date

STATE OF WASHINGTON

DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION

1063 S. Capitol Way, Suite 106 • Olympia, Washington 98501
Mailing address: PO Box 48343 • Olympia, Washington 98504-8343
(360) 586-3065 • Fax Number (360) 586-3067 • Website: www.dahp.wa.gov

RECEIVED
MAY 30 2007
PUBLIC WORKS BOARD

May 25, 2007

Ms. Kelly Snyder
Public Works Board
PO Box 48319
Olympia, Washington 98504-8319

Log No.: 052507-18-CTED
Re: City of Camas Main Sewage Pump Station Project
Loan # *N.A.*

Dear Ms. Snyder;

Thank you for contacting our department. We have reviewed the professional archaeological survey report by AINW, Inc for the proposed City of Camas Main Sewage Pump Station and Wastewater Treatment Facility Phase II Improvement Project in Clark County, Washington.

We concur with their professional recommendations and your determination of NO Historic Properties Affected.

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Executive Order 05-05 as an agency with technical expertise and permit authority pursuant to RCW 27.44 and RCW 27.53. Should additional information become available, our assessment may be revised.

In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity must stop, the area secured, and the tribes' cultural departments and this department notified. Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: rob.whitlam@dahp.wa.gov

GRAY & OSBORNE, INC.
TELEPHONE/MEETING CONVERSATION RECORD

☒ **Telephone Conversation**

☐ **Meeting**

Location of Phone Conversation: GRAY & OSBORNE INC.	
Place of Meeting:	

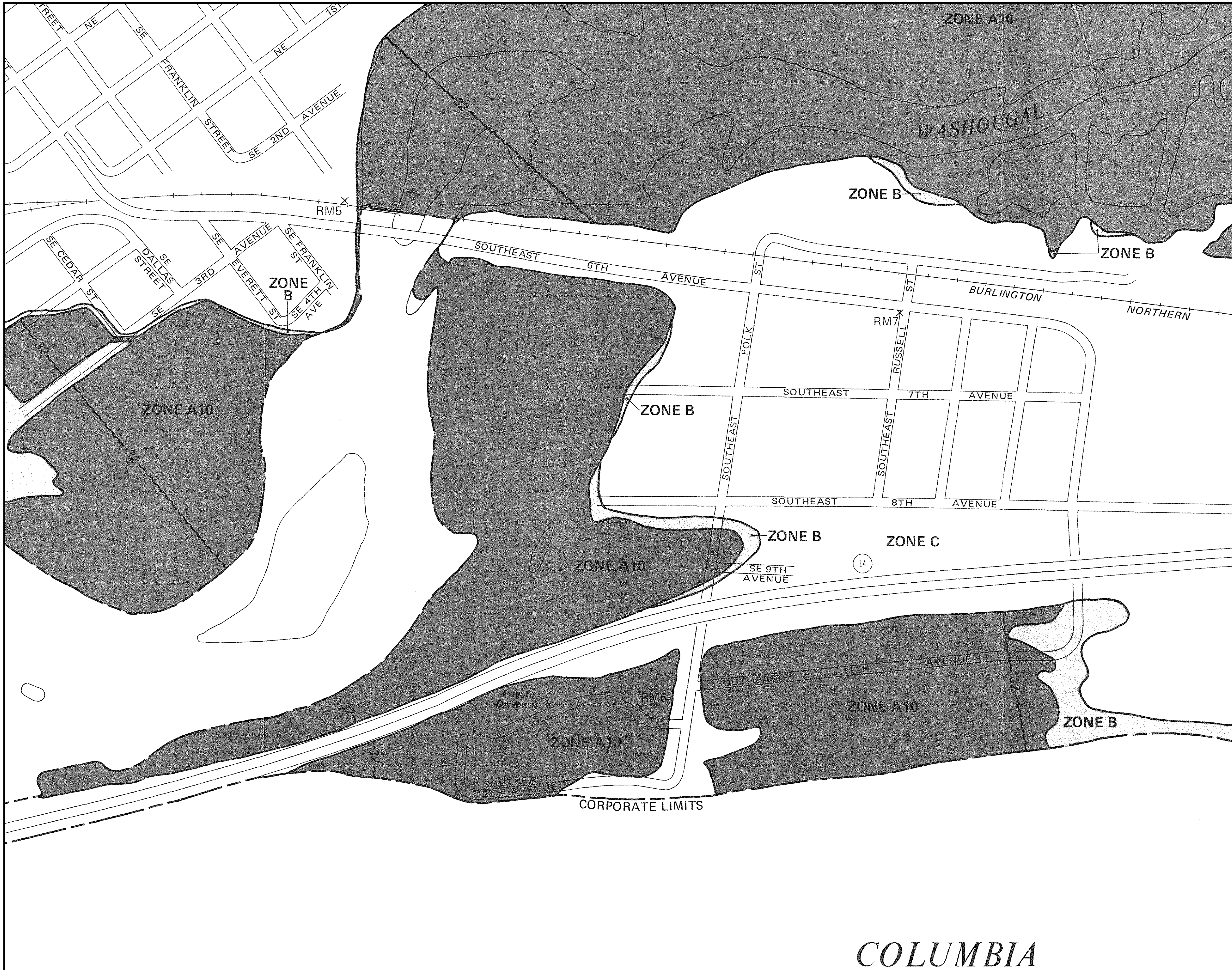
Date:	4-13-07			1315
Discussion with:	Jo Reese			
Firm/City with:	Archaeological Associates Northwest in Portland			
Phone Number:	503 761-6605			
Gray & Osborne Personnel:	Jim Dougherty			
Project:	Camas WWTF Upgrade			
Subject:	Archaeological Survey/Executive Order 0505 Protocols, Tribal coordination			
G&O Job Number:	07511			

REMARKS:

Jo Reese called to update her progress on the archaeological work for the Camas WWTF and the Lift Station at Third & Dallas across the Washougal River. She said that she has signed and returned the contract to Gray & Osborne, and that she is planning on having teams in the field with the Geotech on Monday.

She said that she thought she could get the reports out by the end of the month. She said that she would send copies to the Department of Archaeology and Historic Preservation, the Cowlitz Tribe and the Yakama Tribes. Jo said that she would contact the Cowlitz Tribe to make sure that they received the report and that they are aware of the critical timing associated with the Public Works Trust Fund loan application. I told Jo that I would contact Bill White at the Yakamas to let him know that the report is coming and that we will need a letter from the YIN for the loan application. Hopefully, this will speed tribal consultation up a bit.

6.0 Exhibits



N

APPROXIMATE SCALE

400 0 400 FEE

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
CAMAS, WASHINGTON
CLARK COUNTY

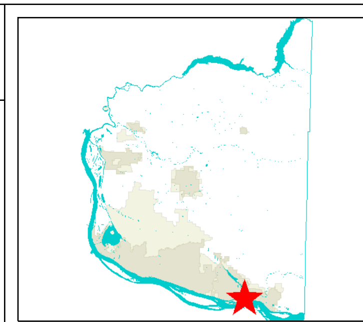
PANEL 2 OF 2
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
530026 0002 B

EFFECTIVE DATE:
FEBRUARY 18, 1981

federal emergency management agency
federal insurance administration

Camas WWTP Aerial



Legend

- Parcels
- Roads
  - Alley
  - Arterial
  - DNR
  - DNR (Private Land)
  - Driveway
  - Interstate
  - Interstate Ramp
  - Primary Arterial
  - Private Roads
  - Private Roads w/o Names
  - Public Roads
  - SR Ramp
  - State Route
- Aerial Photography
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

0 550 1100 1650 ft.

Map center: 45° 34' 47.9" N, 122° 23' 39.7" W

N

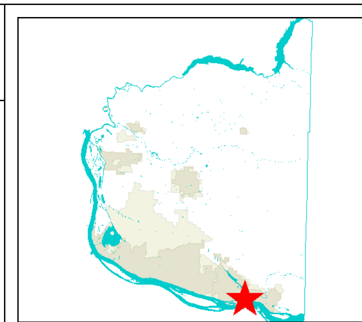
Scale: 1:5,868

Information shown on this map was collected from several sources. Neither Clark County, Washington, nor the producer of this document accept responsibility for any inaccuracies that may be present.

Camas WWTP

0 900 1800 2700 ft.

Map center: 45° 34' 49.5" N, 122° 23' 36.8" W



Legend

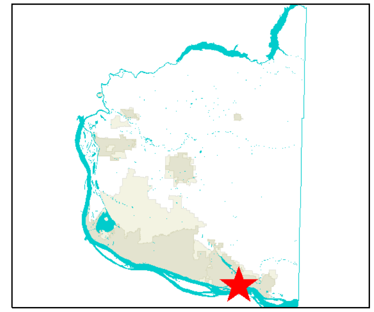
- Parcels
- Roads
  - Alley
  - Arterial
  - DNR
  - DNR (Private Land)
  - Driveway
  - Interstate
  - Interstate Ramp
  - Primary Arterial
  - Private Roads
  - Private Roads w/o Names
  - Public Roads
  - SR Ramp
  - State Route
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

N

Scale: 1:9,413

Information shown on this map was collected from several sources. Neither Clark County, Washington, nor the producer of this document accept responsibility for any inaccuracies that may be present.

County Wetland Inventory



Legend

- Parcels
- Roads
- Alley
- Arterial
- DNR
- DNR (Private Land)
- Driveway
- Interstate
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- State Route
- County Wetland Inventory
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

Scale: 1:9,413

0 900 1800 2700 ft.

Map center: 45° 34' 45.4" N, 122° 23' 37.3" W

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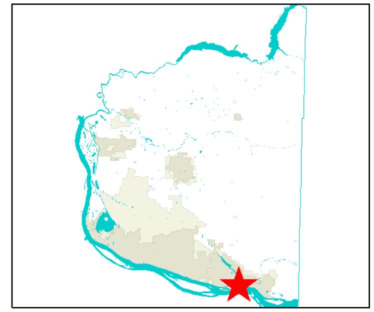
NWI Map



Legend

Parcels

Roads

- Alley
- Arterial
- DNR
- DNR (Private Land)
- Driveway
- Interstate
- Interstate Ramp
- Primary Arterial
- Private Roads
- Private Roads w/o Names
- Public Roads
- SR Ramp
- State Route

NWI Mapped Wetland

- 1

Waterbodies

City Boundaries

Urban Growth Boundaries

County Boundary

County Boundary

0 900 1800 2700 ft.

Map center: 45° 34' 45.4" N, 122° 23' 37.3" W

N

Scale: 1:9,413

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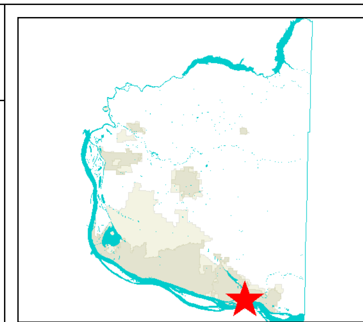
Floodplains & 200 ft Shoreline Buffer



Legend

- Parcels
- **Roads**
  - Alley
  - Arterial
  - DNR
  - DNR (Private Land)
  - Driveway
  - Interstate
  - Interstate Ramp
  - Primary Arterial
  - Private Roads
  - Private Roads w/o Names
  - Public Roads
  - SR Ramp
  - State Route
- 200-foot Shoreline Buffer
- **Floodplains**
  - Floodway Fringe
  - Floodway
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

0 900 1800 2700 ft.

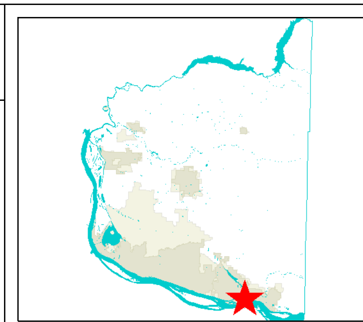
Map center: 45° 34' 45.4" N, 122° 23' 37.3" W

N

Scale: 1:9,413

Information shown on this map was collected from several sources. Neither Clark County, Washington, nor the producer of this document accept responsibility for any inaccuracies that may be present.

Severe Erosion Hazard Area



Legend

- Parcels
- **Roads**
  - Alley
  - Arterial
  - DNR
  - DNR (Private Land)
  - Driveway
  - Interstate
  - Interstate Ramp
  - Primary Arterial
  - Private Roads
  - Private Roads w/o Names
  - Public Roads
  - SR Ramp
  - State Route
- **Severe Erosion Hazard Area**
  - 1
- Waterbodies
- City Boundaries
- Urban Growth Boundaries
- County Boundary
- County Boundary

N

Scale: 1:9,413

0 900 1800 2700 ft.

Map center: 45° 34' 45.4" N, 122° 23' 37.3" W

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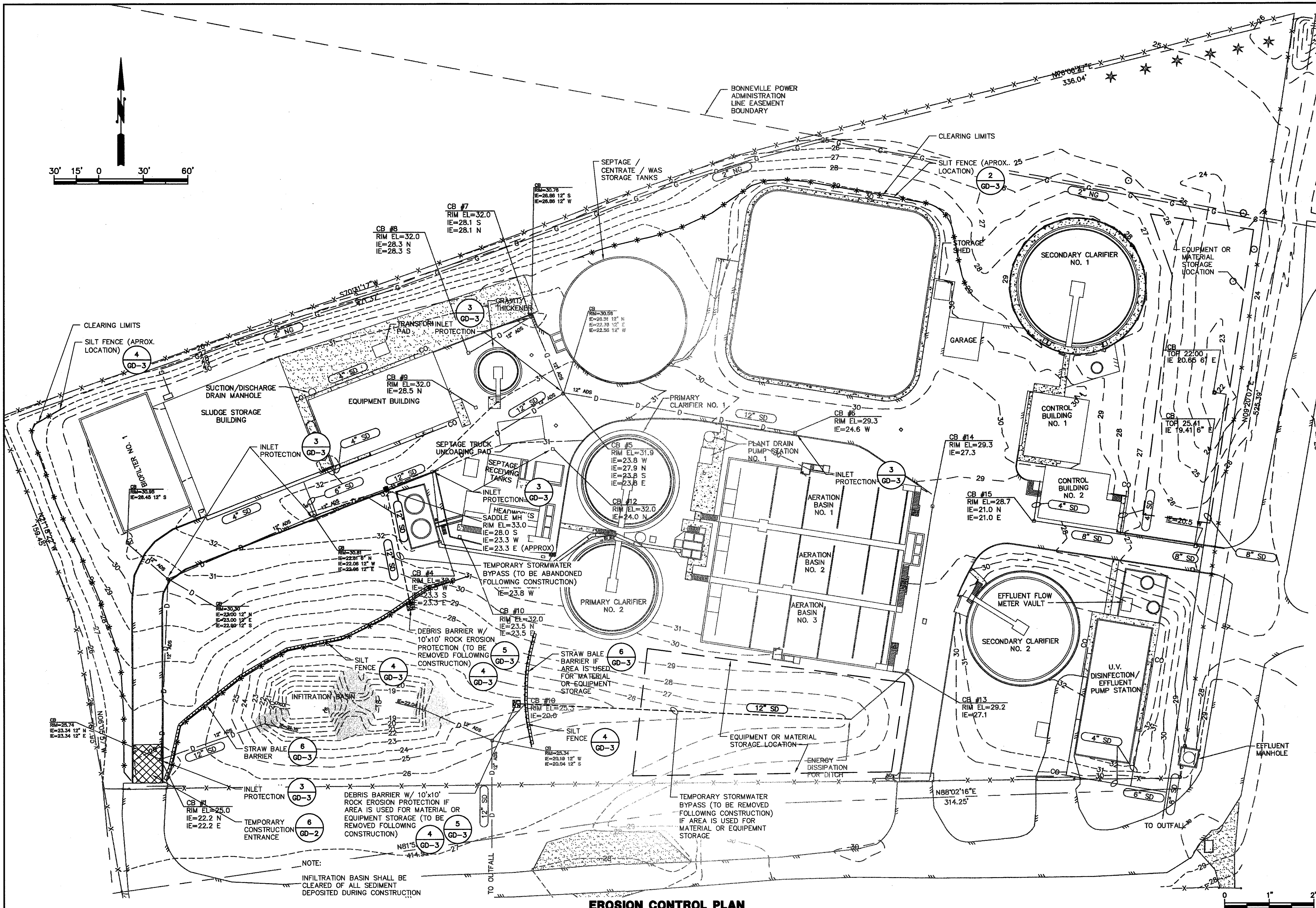


EROSION CONTROL PLAN

SCALE: 1"=30'

TWO INCHES AT FULL SCALE. IF NOT, SCALE ACCORDINGLY

Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 • (206) 284-0860

DATE: OCT. 2009
SCALE: NOTED
DRAWN: M.A.N.
CHECKED: E.F.N.
APPROVED: J.P.W.

NO.	REVISION	DATE	APPD

CITY OF CAMAS
CLARK COUNTY WASHINGTON

WWTF IMPROVEMENTS - PHASE 2

EROSION CONTROL PLAN

SHEET: G-8
OF: 22

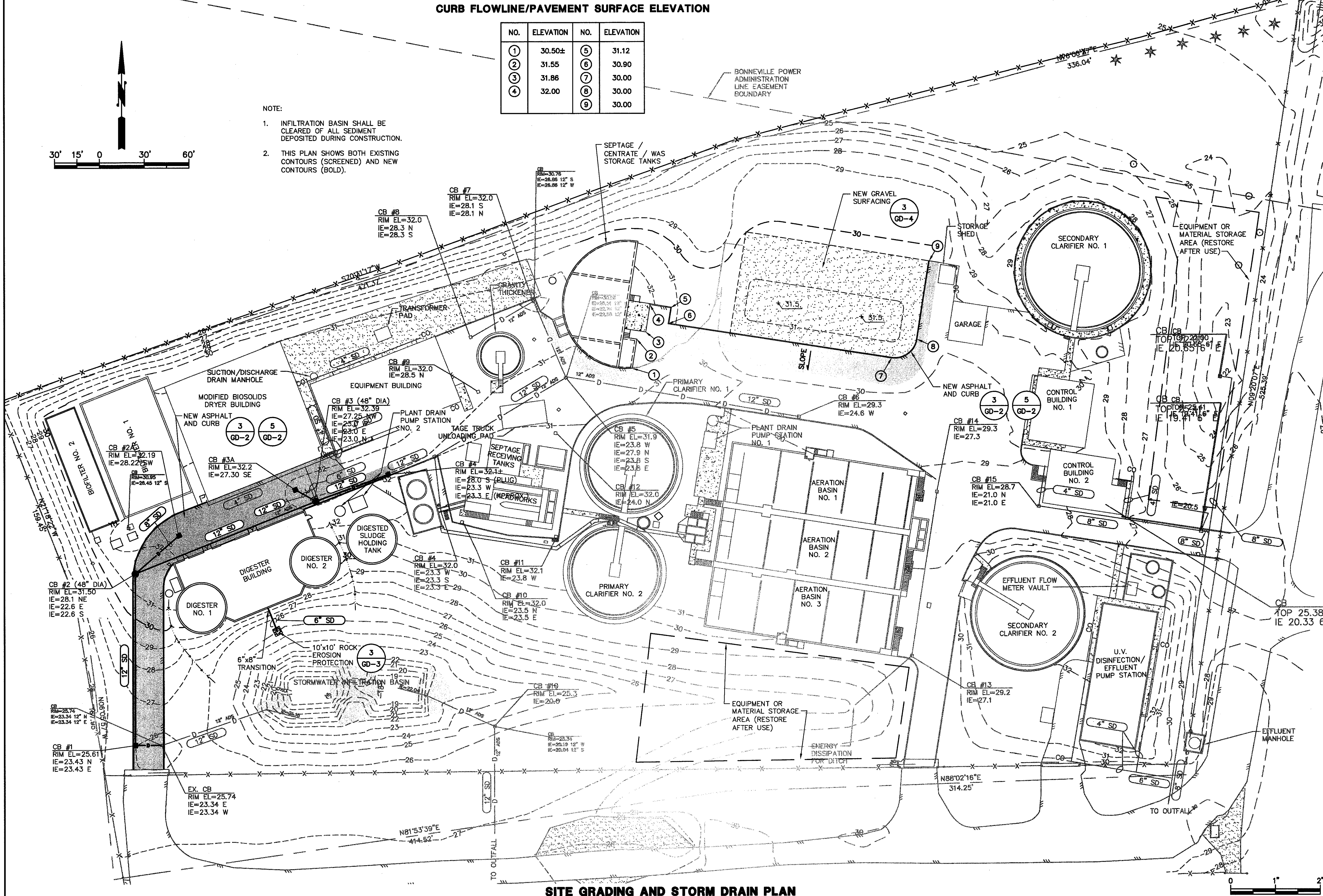
JOB NO.: 07511
DWG: EROSION

CURB FLOWLINE/PAVEMENT SURFACE ELEVATION

NO.	ELEVATION	NO.	ELEVATION
1	30.50±	5	31.12
2	31.55	6	30.90
3	31.86	7	30.00
4	32.00	8	30.00
		9	30.00

NOTE:

1. INFILTRATION BASIN SHALL BE CLEARED OF ALL SEDIMENT DEPOSITED DURING CONSTRUCTION.
2. THIS PLAN SHOWS BOTH EXISTING CONTOURS (SCREENED) AND NEW CONTOURS (BOLD).



SITE GRADING AND STORM DRAIN PLAN

SCALE: 1"=30'

0 1" 2"
TWO INCHES AT FULL SCALE. IF NOT, SCALE ACCORDINGLY

Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 • (206) 284-0860

DATE:	OCT. 2009
SCALE:	NOTED
DRAWN:	B.W.
CHECKED:	E.F.N.
APPROVED:	J.P.W.

No.	REVISION	DATE	APP'D

JOHN P. WILSON — REGISTERED PROFESSIONAL ENGINEER — STATE OF WASHINGTON — 24821

ERIC F. NUTTING — REGISTERED PROFESSIONAL ENGINEER — STATE OF WASHINGTON — 33800

CITY OF CAMAS
CLARK COUNTY WASHINGTON

WWTF IMPROVEMENTS - PHASE 2

SITE GRADING AND STORM DRAIN PLAN

SHEET: G-16
OF: 22

JOB NO.: 07511
DWG: GRADING

BIOLOGICAL EVALUATION

For the

Wastewater Treatment Facility
and
Main Pump Station Improvements

City of Camas

G & O PROJECT NUMBER 07511

Last updated May 30, 2007

1. INTRODUCTION

1.

1.2 Purpose and Need for the Project

The Department of Ecology issued a Notice of Violation (number 2981) to the City of Camas on January 9, 2006; the WWTF exceeded its ammonia limits December 2004, February 2005, March 2005, April 2005, May 2005, June 2005, September 2005, October 2005, and November 2005. The proposed Wastewater Treatment Facility Improvement Project will address ammonia removal issues and allow the Camas Wastewater Facilities to meet the requirements of the NPDES Permit through the planning period (2025).

Modeling performed on the City of Camas Wastewater Collection System indicates that the Main Pump Station is over capacity at current maximum flows due to Infiltration and Inflow during storm events and the Station will be over capacity due to projected future loadings associated with growth in the City. Increasing the size of the wet well and installing grinder pumps will improve the reliability of this critical pump station. Further, the pumps motors and emergency generator and the electrical and control systems must be upgraded. All proposed work will occur within the fenced boundaries of the existing WWTF and most new infrastructure will be installed over 200 feet from the Columbia River. A Shoreline Substantial Development Permit will be obtained from the City of Camas for this project.

Projects utilizing funding from the Washington State Public Works Board must prepared documentation for ESA consultation with the US Fish & Wildlife Service and the National Marine Fisheries Service (NOAA Fisheries) to determine potential impacts to species listed as “threatened” or “endangered” under the authority of the ESA. Further, the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, requires that federally funded or permitted projects that may adversely affect Essential Fish Habitat (EFH) must be reviewed by the

National Marine Fisheries Service. This BE has been prepared to assess the proposed action's likely impact on EFH.

2. PROJECT DESCRIPTION

Overview

Gray and Osborne, Inc. is providing engineering services to the City of Camas for improvements to the City's WWTF to provide adequate wastewater treatment to comply with the conditions of its National Pollutant Discharge Elimination System Permit through the planning period (2025). The purpose of this Biological Evaluation is to analyze potential impacts to species protected under the authority of the Endangered Species Act associated with proposed improvements to the City of Camas WWTF and Main Pump Station. This project will occur in addition to the modifications to the diffusers on the Camas WWTF Outfall, which were permitted in 2006 (Corps Reference Number 200501420).

1 Project Description (Proposed Action or Proposed Project)

Main Sewage Pump Station:

The City of Camas proposes to construct a series of major improvements increase reliability and reduce maintenance requirements at its main sewage pump station that pumps nearly all of the City's sewage under the Washougal River to the WWTF. The existing wet well will be enlarged and a grinder facility will be installed to grind debris to prevent clogging of the pumps.

Wastewater Treatment Facility:

Camas will construct a $15-20 million upgrade to the existing Wastewater Treatment Plant to increase capacity and provide redundancy that will ultimately ensure public health and safety and enhance the environmental value of the region's natural resources. The design will include a new primary anaerobic digester, new secondary anaerobic digester, new sludge dryer, new secondary clarifier, additional aeration blower, additional bank of ultraviolet disinfection lamps, aeration basin modifications, enlarged odor control biofilter, new septage storage tank, and operational control systems that will integrate the new systems with the existing plant systems.

The Camas WWTF and Main Pump Station are located in **Section 12 of Township 1 North, Range 3 East** in Clark County. Proposed WWTF improvements will occur within the footprint of the existing facility and will involve upgrading existing infrastructure by converting the function of a number of structures and upgrading the function of others. New structures to be built on the site include: a new biofilter and sludge dryer in the NE corner of the facility, new anaerobic digesters and a new digester building, and a new sludge holding tank. Work at the Main Pump Station would include internal improvements (i.e. grinder pumps) and construction of a larger wet well in the cul-de-sac immediately north of the Station, south of SE Third Avenue. Construction activities would typically be limited to the hours of 7:00 a.m. to 5:00 p.m. Monday through Friday.

3. DESCRIPTION OF THE PROJECT AREA

The City of Camas Wastewater Treatment Facility lies approximately 100 feet north of the Columbia River at river mile (RM) 120.8, at the corner of SE 12th Avenue and SE Polk Street, across SR 14 from the City. The Main Pump Station is located south of the intersection of SE 3rd Avenue and Dallas Street approximately 600 feet north of the Washougal River.

4. DESCRIPTION OF SPECIES AND HABITAT

Listed Species under the Jurisdiction of the National Marine Fisheries Service, (from the NMFS Northwest Region Webpage, visited May 21, 2007):

The following table presents evolutionarily significant units (ESUs) of salmon that pass Camas during rearing and transport portions of their life cycles

Species/ESU	Status	Date	FR Notice
Salmonids Under NMFS Jurisdiction:			
Lower Columbia Chinook	Threatened	6-28-05	
	Critical habitat	9-2-05	
Lower Columbia steelhead	Threatened	3-19-98	63 FR 13347
	Critical habitat	9-2-05	65 FR 7764
Columbia River chum	Threatened	6-28-05	
	Critical habitat	9-2-05	
SW Washington & Lower Columbia coho	Threatened	6-28-05	
Upper Columbia spring chinook	Endangered	3-24-99	64 FR 14308
	Critical habitat	9-2-05	
Lower Columbia River coho	Threatened	6-28-05	
Snake River sockeye	Endangered	11-20-91	56 FR 58619
	Critical habitat	12-28-93	58 FR 53635
Upper Columbia steelhead	Endangered	8-18-97	62 FR 43937
	Critical habitat	2-16-00	65 FR 7764
Snake River fall chinook	Threatened	4-22-92	57 FR 14653
	Critical habitat	12-28-93	58 FR 68543
Snake River spring/summer chinook	Threatened	4-22-92	57 FR 14653
	Critical habitat	12-28-93	58 FR 68543
Mid Columbia steelhead	Threatened	3-25-99	64 FR 14517
	Critical habitat	2-16-00	65 FR 7764
Snake River steelhead	Threatened	8-18-97	62 FR 43937
	Critical habitat	2-16-00	65 FR 7764
Upper Willamette steelhead	Threatened	3-25-99	
	Critical habitat	2-16-00	

USFWS Listed Species	
Columbia River bull trout	Threatened Critical habitat

LISTED EVOLUTIONARILY SIGNIFICANT UNITS (ESUs) OF CHINOOK SALMON:
Lower Columbia chinook salmon, *Oncorhynchus tshawytscha:* Both spring and fall chinook populations on the lower Columbia River were listed as threatened on March 28, 1998. Critical habitat was updated for this ESU on September 2, 2005.

Spring chinook are present in the Cowlitz, Kalama and Lewis rivers. Spring chinook populations from these rivers are of mixed hatchery and wild origin. Return migration for these stocks occurs from late January to May. Tributary migration occurs from March through July, while spawning extends from late August through early October.

Lower Columbia *fall chinook* consists of 14 stocks. These stocks can be further divided into two general groups; the Tule early spawning stocks with strong hatchery influence of mixed origin, and a Lewis River wild stock that spawns later with little hatchery influence. Return migration through the lower Columbia extends from August through November. Spawning is generally October for early stocks and November for late stocks.

Upper Columbia spring chinook
Upper Columbia spring chinook salmon were listed as endangered on March 24, 1999. Critical habitat was adopted for this ESU on February 15, 2000 and updated on September 2, 2005. Spring chinook destined for areas upstream of Bonneville Dam usually reach peak abundance at the dam between April 20 and April 28 but can be earlier during low flow years or later during high run-off periods. Tributary entry is May-June with spawning in late August to late September.

Snake River fall chinook
Snake River fall chinook salmon were listed as threatened on April 22, 1992, and critical habitat for this ESU was adopted on February 28, 1993.

Snake River spring/summer chinook
Snake River spring/summer chinook were listed as threatened on April 22, 1992 and critical habitat was finalized on December 28, 1993.

LOWER COLUMBIA RIVER COHO, LISTED AS THREATENED:
Lower Columbia River coho, *O. kisutch*, was listed as threatened by the National Marine Fisheries Service on June 28, 2005. Critical Habitat has not yet been proposed.

COLUMBIA RIVER CHUM SALMON, LISTED THREATENED:
Columbia chum salmon*, O. keta*:
Columbia River chum salmon were once widespread in the lower Columbia River. They were listed as threatened on March 25, 1999, and critical habitat for this ESU was finalized on February 16, 2000 and updated on September 2, 2005. Today chum salmon produced in the lower Columbia are concentrated in the Grays River system near the mouth of the Columbia and near Bonneville Dam in Hardy and Hamilton creeks. A few chum salmon cross Bonneville Dam during some years. These stocks of chum salmon are native. Some non-native chum introductions have been attempted, with no apparent success. Chum enter the Columbia in October and November, and spawn in November and December. The present run size is estimated to range between 3,000 and 10,000 fish annually. According to Joe Hymer of the Washington Department of Fish & Wildlife, hatchery releases of the “threatened” stock of Columbia River chum at the mouth of Grays River occur during June. Juveniles from this release pass through the project area shortly thereafter.

LISTED ESUs OF COLUMBIA RIVER BASIN STEELHEAD:

Lower Columbia steelhead, *O. mykiss*
Lower Columbia River steelhead were listed as threatened on March 19, 1999. Critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005. According to the Columbia River SASSI Appendix, the Lower Columbia River supports five summer steelhead stocks and eighteen winter steelhead stocks. Run timing of the summer steelhead extends from May through October, and run timing of winter steelhead stocks extends from December through April in the Lower Columbia River.
Mid Columbia steelhead
Mid Columbia River steelhead were listed as threatened on March 25, 1999. Critical habitat for this species was adopted on February 2, 2000 and updated on September 2, 2005.
Upper Columbia steelhead
Upper Columbia River steelhead were listed as endangered on August 18, 1997 and critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005.
Snake River steelhead
Snake River steelhead were listed as threatened on August 18, 1997 and critical habitat for this ESU was adopted on February 16, 2000 and updated on September 2, 2005.

Upper Willamette River steelhead
The Upper Willamette River steelhead were listed as threatened on March 25, 1999 and critical habitat was finalized for this ESU on February 16, 2000 and updated on September 2, 2005.

SNAKE RIVER SOCKEYE, LISTED AS ENDANGERED
Snake River sockeye salmon, *O. nerka*
Snake River sockeye salmon were listed as endangered on November 20, 1991 and critical habitat for this ESU was adopted on December 28, 1993.

COLUMBIA RIVER BULL TROUT, LISTED AS THREATENED:
The US Fish & Wildlife Service listed the **Columbia River bull trout, *Salvelinus confluentus***, as threatened on June 10, 1998. Critical habitat and ESA Section 4 (d) rules were not adopted at this time. According to Jeff Chan of the Olympia Office of the USFWS, critical habitat for Columbia River bull trout in was adopted on September 26, 2005 and is generally limited to spawning and rearing areas in upper portions of watersheds.

Lower Columbia chinook salmon, *Oncorhynchus tshawytscha:* Both spring and fall chinook populations on the lower Columbia River were listed as threatened on March 28, 1998. Critical habitat was designated for this ESU on September 2, 2005.

Spring chinook are present in the Cowlitz, Camas and Lewis rivers. Spring chinook populations from these rivers are of mixed hatchery and wild origin. Return migration for these stocks occurs from late January to May. Tributary migration occurs from March through July, while spawning extends from late August through early October.

The Lower Columbia *fall chinook* ESU consists of 14 stocks. These stocks can be further divided into two general groups; the Tule early spawning stocks with strong hatchery influence of mixed origin, and a Lewis River wild stock that spawns later with little hatchery influence. Return migration through the lower Columbia extends from August through November. Spawning is generally October for early stocks and November for late stocks.

Upper Columbia spring chinook
Upper Columbia spring chinook were listed as endangered on March 24, 1999. Critical habitat was adopted for this ESU on February 15, 2000. Spring chinook destined for areas upstream of Bonneville Dam usually reach peak abundance at the dam between April 20 and April 28 but can be earlier during low flow years or later during high run-off periods. Tributary entry is May-June with spawning in late August to late September.

Snake River fall chinook
Snake River fall chinook were listed as threatened on April 22, 1992, and critical habitat for this ESU was adopted on February 28, 1993.

Snake River spring/summer chinook

Snake River spring/summer chinook were listed as threatened on April 22, 1992 and critical habitat was finalized on December 28, 1993.

COLUMBIA RIVER CHUM SALMON, LISTED THREATENED:
Columbia chum salmon, *Oncorhynchus keta:*

Columbia River chum salmon were once widespread in the lower Columbia River. They were listed as threatened on March 25, 1999, and critical habitat for this ESU was designated on September 2, 2005. Today chum salmon produced in the lower Columbia are concentrated in the Grays River system near the mouth of the Columbia and near Bonneville Dam in Hardy and Hamilton creeks. These stocks of chum salmon are native. Some non-native chum introductions have been attempted, with no apparent success. Chum enter the Columbia in October and November, and spawn in November and December. The present run size is estimated to range between 3,000 and 10,000 fish annually.

LISTED ESUs OF COLUMBIA RIVER BASIN STEELHEAD:
Lower Columbia steelhead *Oncorhynchus mykiss*

Lower Columbia River steelhead were listed as threatened on March 19, 1999. Critical habitat for this ESU was designated on September 2, 2005. According to the SASSI Columbia River Appendix, the Lower Columbia River supports five summer steelhead stocks and eighteen winter steelhead stocks. Run timing of the summer steelhead extends from May through October, and run timing of winter steelhead stocks extends from December through April in the Lower Columbia River.

Mid Columbia steelhead

Mid Columbia River steelhead were listed as threatened on March 25, 1999. Critical habitat for this species was adopted on September 2, 2005.

Upper Columbia steelhead

Upper Columbia River steelhead were listed as endangered on August 18, 1997 and critical habitat for this ESU was adopted on September 2, 2005.

Snake River steelhead

Snake River steelhead were listed as threatened on August 18, 1997 and critical habitat for this ESU was adopted on September 2, 2005.

Upper Willamette River steelhead

Upper Willamette River steelhead were listed as threatened on March 25, 1999 and critical habitat was finalized for this ESU on September 2, 2005.

SNAKE RIVER SOCKEYE, LISTED AS ENDANGERED
Snake River sockeye salmon, *Oncorhynchus nerka*

Snake River sockeye salmon were listed as endangered on November 20, 1991 and critical habitat for this ESU was adopted on December 28, 1993.

LOWER COLUMBIA RIVER COHO SALMON, Listed as Threatened:
Lower Columbia River coho, *Oncorhynchus kisutch,* has been a candidate for listing for protection under the authority of the Endangered Species Act since July 25, 1995. The National Marine Fisheries Service proposed this species for listing as "threatened" on June 16, 2005.

CRITICAL HABITAT FOR LISTED ANADROMOUS FISHES
The National Marine Fisheries Service designated critical habitat for each of these listed ESUs on September 2, 2005. Critical habitat for these listed salmonids includes all reaches of the Columbia River and its tributary streams below long-standing natural barriers, with the exception of areas covered under Habitat Conservation Plans. The waters of the Columbia River near Camas are considered critical habitat for both out-migrating juveniles and returning adults.

Use of the Waters Adjacent to the Project Area by Listed Salmonids
Joe Hymer of the Washington Department of Fish and Wildlife Vancouver Office indicated that juvenile salmonids from any of the listed species use the waters of the Columbia River for transport, feeding and rearing. Juvenile salmonids school in the shallows along the shore as much as possible and may be present along the shoreline near the Camas WWTF. Outmigrating juvenile salmonids of the various listed ESUs may be present in the Lower Columbia River almost continuously throughout the year (personal communication July 12, 2001) with peak concentrations present from April through June. Abundance of juvenile salmonids is lowest during the mid summer months.

Outmigrating juvenile salmonids generally prefer to remain in shallow areas within the range of light penetration near the edge of the river as much as possible. Near Camas, they may school near the shore of the Camas WWTF near the project area while feeding, rearing and migrating toward the Pacific Ocean.

Factors Affecting Production

Habitat
Habitat degradation for each of these species has occurred due to historical and present-day logging activities and urbanization of the lower drainages.

Hatchery
Many of these stocks have been supplemented by hatchery fish over the past 50 to 100 years with mixed results. Introduction of non-Columbia River stocks from hatcheries has modified some of these stocks significantly. In some cases hatchery fish are thought to compete with the wild stocks that are listed as "threatened" or "endangered" under the

authority of the ESA. In other cases, hatchery enhanced stocks are all that remain of some of the Upper Columbia River and Upper Snake River Stocks.

ESSENTIAL FISHERIES HABITAT
Commercially important salmonid species present in the Lower Columbia include Columbia River chinook salmon, Columbia River coho and a small population of pink salmon.

Species under the jurisdiction of USFWS:

COLUMBIA RIVER BULL TROUT, LISTED AS THREATENED:
The US Fish & Wildlife Service listed the **Columbia River bull trout, *Salvelinus confluentus,*** as threatened on June 10, 1998. Critical Habitat for Columbia River bull trout was designated on September 26, 2005. The designated critical habitat nearest the project area occurs in the lower Lewis River. Most bull trout production in the Lewis River occurs above Merwin Dam. Only a few bull trout have been collected below the dam.

BALD EAGLE
Bald Eagle, *Haliaeetus leucocephalus*
According to Priority Species and Habitat Map prepared for this project by the Washington Department of Fish and Wildlife on April 23, 2007, there are no bald eagles known to nest within approximately two miles of the project site. Wintering bald eagles prey on salmon migrating into and out of the Columbia River and may forage offshore in the vicinity of the project area between November 1 and March 31.

Species identified as present in Clark County that are not likely to be present in the project area:

Northern spotted owl, *Strix occidentalis,* Listed Threatened*:*
Northern spotted owls occur in Clark County throughout the year. According to the Priority Habitats & Species Map prepared for the area surrounding Section 12, Township 1 North, Range East on April 23, 2007, there are no northern spotted owl nests or management circles within two miles of the project area.

Gray wolf, *Canis lupus*, Listed Endangered:
According to the WDFW Wildlife Biologist for Clark County, gray wolves have not been sighted in Clark County in many years. Further, the gray wolf population in Washington State is concentrated in the northeastern corner of the state, and any wolves occurring in the SW corner of the state are likely to be hybrids, which are not eligible for protection under the Endangered Species Act. All work on the proposed outfall improvement project will occur offshore from a boat in the Columbia River, so it is unlikely that gray wolves would be impacted (discussion with C. Dugger 2005).

Listed plant species:

- Golden paintbrush, *Castilleja levisecta*, Listed as Threatened in 1990: Historically occurred in the Mill Plain area of Clark County Washington. Typically found in wet prairie areas.

- Water howellia, *Howellia aquatilis*, Listed as Threatened in 1994, occurs in two small populations in the floodplain of the Columbia River in Clark County on the Ridgefield Wildlife Refuge across Lake River from the City of Ridgefield.

- Bradshaw's lomatium, *Lomatium bradshawii*, was listed as Endangered on September 30, 1988. It is thought to be endemic to the area around (within ten miles of) Salem, Oregon. According to Ron Klump of the US Army Corps of Engineers, it was recently discovered along Lacamas Creek near Camas, Washington.

5. Inventories and Surveys:

The Washington State Salmon and Steelhead Stock Inventory, Appendix 3: Columbia River Stocks was reviewed in the preparation of this document. Habitat biologists from Regions 5 of the Washington Department of Fish and Wildlife were interviewed for information regarding migration timing of the various listed salmonid stocks. Engineers and the biologists from the US Army Corps of Engineers Office in Vancouver, Washington were interviewed regarding permitting requirements for the outfall improvement project

6. Analysis of Effects:

Water Quality & Fisheries Habitat

Construction:

Upgrading the Camas WWTF and Main Pump Station on their existing sites would have little, if any, potential to adversely impact listed species of fish and wildlife present in the vicinity, because work would be restricted to areas more than 100 feet from the Columbia River and more than 600 feet from the Washougal. Further, construction BMPs for control of sedimentation and erosion will be implemented; i.e. major ground disturbing work will occur during the dry season, silt fences will be installed between work areas and adjacent sensitive habitat areas, and disturbed areas will be replanted with grass and native vegetation to minimize runoff.

Operation

Operation of the upgraded WWTF and Main Pump Station would improve wastewater treatment and conveyance capacity and help to improve and maintain water quality and fisheries habitat in the Columbia and Washougal rivers. Implementation of these improvements in conjunction with the outfall modifications permitted in 2006 would improve WWTF effluent quality and dilution through the planning period (2025). . Improving dilution of effluent from the WWTF may reduce impacts associated with pollutants in the effluent, which would improve water quality near the point of discharge and the dilution zone. Water quality in the Columbia River beyond the dilution zone should not be adversely affected regardless of loading over the planning period. Therefore, improving capacity of the Camas WWTF and Main Pump Station will have **no effect** on listed adult salmonids passing through the project area. Juvenile salmonids would be unaffected, as they generally migrate along the shoreline, well landward of the Camas WWTF Outfall.

EFFECTS OF THE PROJECT ON PROPOSED CRITICAL HABITAT

A. DESIGNATED CRITICAL HABITAT FOR CHINOOK SALMON, STEELHEAD AND CHUM SALMON: PRIMARY CONSTITUENT ELEMENTS. (I.e., physical and biological features) essential to the conservation of steelhead and discussion of potential project impacts:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development*:*

According to the WDFW SASSI for Columbia River steelhead (WDF 1992), Lower Columbia chinook salmon, Lower Columbia steelhead, Lower Columbia coho and Columbia River chum salmon migrate past the City of Camas WWTF outfall. These species utilize the area for rearing, foraging and transportation. Chum salmon spawn in lower reaches of streams in the area, including the Washougal River. Substrate quality in the immediate project area is not conducive to salmonid spawning, as benthos are primarily sand that is unsuitable for spawning and larval development. Implementation of the proposed project would result in improved mixing and dilution of effluent from the Camas WWTF through the planning period (2025). This would improve water quality and rearing and transportation habitat. Construction of the proposed WWTF and Main Pump Station improvements will have no effect on water quantity or substrates supporting spawning, incubation and larval development.

2. Freshwater migration corridors free of obstruction, freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions that support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

Work associated with the proposed WWTF and Main Pump Station Improvements will occur more than 100 feet from the north bank of the Columbia River and more than 600 feet from the Washougal. Therefore, there will be no adverse impacts to riparian vegetation and substrate. Once construction of the proposed improvements is complete water quality in the vicinity of the WWTF outfall will be improved. This, coupled with the recently permitted modifications to the outfall diffusers, will improve the migration corridors in the Columbia River. The proposed outfall improvements will improve water quality, and will have no effect on water quantity or floodplain connectivity in the Columbia River.

3. **In-water habitat with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival:**

Proposed improvements to the Camas WWTF in conjunction with outfall improvements permitted in 2006 will improve water quality in the Columbia River by improving and preserving effluent quality through the planning period and enhancing mixing of effluent. This project will have no effect on water quantity, natural cover, aquatic vegetation, large rocks or boulders, side channels, undercut banks etc. as all work will occur more than 100 feet from the north shore of the Columbia River.

4. **Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between freshwater and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation:**

The proposed improvements to the Camas WWTF and Main Pump Station will have no quantifiable effect on the Columbia River estuary approximately 100 miles downstream from Camas.

5. **Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels:**

Proposed improvements to the Camas WWTF and Main Pump Station will improve water in the mixing zone downstream of the facility through the planning period, but it is unlikely that these improvements will be observable or detectable in nearshore marine areas more than 120 miles downstream from Camas.

6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation:

The proposed project will have no effect on nearshore marine areas, as the Camas WWTF is approximately 120 miles upstream from the mouth of the Columbia River, and the level of effluent treatment and dilution will not change enough to be observable 120 miles downstream.

B. BULL TROUT PROPOSED CRITICAL HABITAT PRIMARY CONSTITUENT ELEMENTS. USFWS (2004) identified nine primary constituent elements (PCEs) (i.e., physical and biological features) essential to the conservation of bull trout using the best scientific and commercial data available. These nine PCEs are summarized from the Federal Register below. Most of these elements are focused on freshwater systems and the impacts that may occur there. These PCEs apply to the proposed project, because the Project will take place in the freshwater.

1. Water temperatures ranging from 36 to 59 ºF (2 to 15 ºC), with adequate thermal refugia available for temperatures at the upper end of this range:

The water temperature in the Lower Columbia River is likely adequate for subsistence of bull trout during the late fall, winter and early spring. Late spring through early fall, temperatures in the Columbia River downstream of the project area are likely to be too high for bull trout. The nearest known concentration of bull trout for the project area is in the Lewis River, which is approximately 30 miles downstream of Camas.

Proposed modifications to the Camas WWTF and Main Pump Station in addition to the outfall modifications permitted in 2006 will improve mixing of the higher quality effluent with flow in the main channel of the Columbia River, which would potentially lower in-stream temperatures slightly and improve habitat for foraging or migrating bull trout.

2. Complex stream channels:

The Camas WWTF discharges into the mainstem of the Columbia River. Improving wastewater treatment through the planning period will improve and preserve water quality in the Columbia, but it will have no effect on complex stream channels in this system.

3. **Substrates of sufficient amount, size, and composition to ensure success of egg and juvenile survival.**

Bull trout do not spawn in the lower reaches of the Columbia River, as water temperature, water quality and benthic composition are inadequate. Temperatures are too high, water quality is compromised and benthic substrate is muddy sand, which is not suitable for bull trout spawning. The proposed project will have no impact on the nearest areas appropriate for bull trout spawning, which are upstream of Merwin Dam on the Lewis River. The proposed WWTF and Main Pump Station Improvements will have no effect on substrates in the Columbia or Washougal rivers.

4. **A natural hydrograph, or if regulated, a hydrograph that demonstrates the ability to support bull trout populations.**

The hydrograph of the Lower Columbia River is tidally influenced and controlled by Bonneville Dam. However, the lower reaches may provide transportation, rearing and foraging habitat for bull trout during the cooler months. Improvements to the Camas WWTF and Main Pump Station will not impact the hydrograph of the Columbia and Washougal rivers near Camas, which do not currently support bull trout populations, due to sub-optimal water quality conditions.

5. **Springs, seeps, groundwater sources and subsurface water:**

The proposed improvements to the Camas WWTF and Main Pump Station will have no effect on springs, seeps, groundwater sources or subsurface waters, because all work would be conducted within the confines of the WWTF and the only area to be disturbed outside of the footprint of the existing Main Pump Station will be in the paved cul-de-sac south of Third Avenue SE more than 600 feet from the Washougal River.

6. **Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows:**

Improving and preserving the quality of the effluent from the Camas WWTF will improve water quality and the migratory corridor through the area. Water quality problems associated with the effluent will be mitigated significantly by the proposed treatment and conveyance system improvements to provide adequate migratory corridors in the Columbia River through the planning period.

7. **An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish:**

Implementation of the proposed improvements to the Camas WWTF and Main Pump Station, coupled with the outfall improvements permitted in 2006 will improve mixing and dilution of effluent, but they will have no effect on the food base for bull trout that may occasionally migrate through the project area offshore of the City of Camas. There will be no trench excavation in the Columbia River associated with the proposed WWTF and Pump Station improvements, so benthic macroinvertebrates will not be adversely impacted. Water quality in the Columbia River downstream of the project area will be improved, so there will be no adverse impact on the food base for bull trout that may occasionally pass through the project area.

8. Few or no nonnative predatory, interbreeding, or competitive species present:

Implementation of the proposed WWTF and Pump Station improvements will help to improve and maintain water quality through the planning period (2025). The proposed improvements to the City of Camas WWTF and Main Pump Station will have no effect on non-native predatory**,** interbreeding or competitive species present in the Columbia River.

9. Permanent water of sufficient quantity and quality such that normal reproduction, growth and survival are not inhibited:

Implementation of the proposed improvements to the City of Camas WWTF and Main Pump Station will result in improved/ preserved water quality in the Columbia River in the project vicinity and downstream. Bull trout do not reproduce in the Lower Columbia River, however they rear and forage in the main-stem Columbia and up several tributaries in the area. Implementation of the proposed project will preserve water quality in foraging, rearing and migratory habitat for bull trout.

Based on this analysis, the proposed modifications to the Camas WWTF outfall will result **in no destruction or adverse modification** of proposed critical habitat for bull trout.

Based on this analysis, the proposed installation and operation of the proposed modifications to the Camas WWTF outfall will result in **no destruction or adverse modification** of designated critical habitat for the following listed species present in the Lower Columbia River:

- Upper Columbia River spring chinook salmon;
- Upper Columbia River steelhead;
- Mid Columbia River steelhead;
- Snake River steelhead;
- Snake River spring/summer chinook salmon;
- Snake River fall chinook salmon;
- Snake River sockeye salmon;

- Upper Willamette River steelhead;
- Lower Columbia River chinook salmon;
- Lower Columbia River coho salmon
- Lower Columbia River steelhead;
- Columbia River bull trout.

Potential for Impacts to Bald Eagles

Construction:
Proposed improvements to the City of Camas WWTF will occur within the existing footprint more than 100 feet from the Columbia River. Noise associated with this work is not likely to be louder than the pumps and blowers currently in use on the WWTF site. Modifications to the Main Pump Station will occur in a paved area immediately north of the existing facility. According to the Priority Habitats & Species Maps prepared for the project area on April 23, 2007, these project areas are more than one half mile from the nearest bald eagle nests and out of line-of-sight, so bald eagles will not be impacted by construction activities. Noise generated by construction activities will not be likely to cause wintering bald eagles passing near the WWTF or Pump Station sites to miss feeding opportunities. Therefore, the proposed construction activities will have no effect on bald eagles.

Operation:
Operation of the upgraded WWTF and Main Pump Station will preserve the quality of surface waters in the vicinity of the Camas WWTF Outfall through the planning period. Effluent will be discharged via the newly upgraded outfall, which was permitted in 2006. This will aid in dispersion as flows increase over the next 20 years. Operation of the modified outfall will have **no effect** on wintering bald eagles that may forage in the vicinity of the project.

Indirect Effects
Improvements to the Camas WWTF and Main Pump Station will provide adequate treatment of wastewater and dilution of effluent over the range of volumes anticipated through 2025. This will provide for growth anticipated in Camas over the next 20 years, but will not cause the growth to occur.

Population growth
While the proposed project will help to provide adequate conveyance, treatment and dilution for flows anticipated over the course of the planning period; it will not contribute to population growth or to an increase in tourist activity in the City and Port of Camas-Washougal. It is unlikely that implementation of the proposed WWTF and Pump Station improvements would lead directly to a significant increase in the permanent population of Camas.

Potential for Impacts to Northern Spotted Owls

The potential for adverse impacts to Northern spotted owls associated with implementation of the proposed project is low, because there are no active nests or Spotted Owl Management Circles within two miles of the project area (Priority Habitats & Species Map prepared by WDFW on April 23, 2007).

Potential for Impacts to the Gray Wolf

The potential for adverse impacts to the gray wolf associated with implementation of the proposed improvements to the Camas WWTF and Main Pump Station is very low. Gray wolves have not been sighted in the Camas area for many years, and the majority of the gray wolf population in Washington occurs in the northwest corner of the state approximately 300 miles from the project area in Camas.

Potential for Impacts to Listed Plant Species

Implementation of the proposed improvements to the Camas WWTF outfall will not impact listed plant species occurring in the Camas area, because all work associated with the proposed project will occur either within the existing WWTF and Main Pump Station footprints, or in a paved cul-de-sac immediately north of the pump station. Therefore, the proposed WWTF and Main Pump Station improvements will have **no effect** on golden paintbrush, water howellia or Bradshaw’s lomatium.

Management Actions related to the Species:

Mitigation measures designed to minimize potential impacts of the Camas Wastewater Treatment Facility outfall modifications and operation of the facility once the modifications are completed include:

1. Construction equipment shall be fueled, maintained and stored off-site to minimize the potential for spills of hazardous materials, including fuels, lubricants and coolants into sensitive areas adjacent to the Camas WWTF (Columbia River) and the Main Pump Station (steep slopes).

2. No in-water work is planned associated with the proposed improvements to the Camas WWTF and Main Pump Station. In the event that in-water work is required, construction would be limited to the in-water work window established by the Washington Department of Fish and Wildlife, Vancouver Office, which extends from November 1 to February 28 in the Lower Columbia River.

3. To minimize the potential for accidents resulting in direct effects to listed and candidate fish species, construction equipment will be fitted with emergency spill kits and construction crews will be trained in their use.

4. Construction BMPs for the control of sedimentation and erosion will be implemented during construction; i.e. major ground disturbing activities will occur during the dry summer months, silt fences will be used, as necessary, between excavation areas and adjacent sensitive areas, and straw bales will be used to prevent turbid runoff from leaving the worksite.

5. Limiting noise-generating construction activities to the summer months will reduce the potential for noise-related disturbance to foraging bald eagles during the winter.

6. Disturbed areas not covered by new structures will be landscaped with grass or native vegetation to minimize the potential for erosion and sedimentation.

<u>Conclusions:</u>

1. Potential impacts to listed salmon associated with the construction and operation of the proposed improvements to the Camas WWTF Outfall and the indirect effects associated with the proposed improvements will be minimal or discountable. They will have **no effect** on the listed anadromous salmonids that occur in the Columbia River near the project area. These species/Evolutionarily Significant Units include:
    - Lower Columbia River chinook salmon
    - Lower Columbia River steelhead
    - Lower Columbia River coho salmon
    - Columbia River chum salmon
    - Upper Columbia River spring chinook salmon
    - Upper Columbia River steelhead
    - Mid Columbia River steelhead
    - Snake River steelhead
    - Snake River spring/summer chinook salmon
    - Snake River fall chinook salmon
    - Snake River sockeye salmon
    - Upper Willamette River steelhead
    - Columbia River bull trout

2. All proposed improvements to the Camas WWTF and Main Pump Station will occur within the existing footprints of these structures, except the installation of a new wet well at the pump station, which will be located in an existing paved cul-de-sac off SW Third Avenue Immediately north of the Station. Both of these sites are located more than 0.5-mile from the nearest bald eagle nest. Therefore, the proposed improvements to the Camas WWTF and Main Pump Station will have **no effect** on nesting bald eagles or wintering bald eagles that may forage in the project area.

3. The gray wolf, listed as Endangered, is not likely to be present in the vicinity of Camas. Any wolves that wandered through the vicinity would be likely to avoid the noise generated by the existing WWTF treatment processes and SR 14. Therefore, implementation of the proposed improvements to the Camas WWTF and Main Pump Station will have **no effect** on any gray wolves that may wander through the area

during construction and operation of the proposed improvements to the Camas WWTF and the Main Pump Station.

4. Similarly, because all work will occur offshore in the Columbia River, the proposed outfall improvements will have **no effect** on golden paintbrush, water howellia and Bradshaw's lomatium.

5. Essential Fisheries Habitat: Potential water quality impacts associated with construction of the proposed improvements to the Camas WWTF and the Main Pump Station will not adversely impact water quality in the Columbia River or the Washougal, as Construction BMPs for the control of sedimentation will be implemented. Further, operation of the Camas WWTF with the improved outfall configuration permitted in 2006 will result in significantly improved effluent mixing and dilution, which will improve EFH for migrating chinook, coho and pink salmon. Therefore, the proposed project will have **no effect** on EFH.

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US Army Corps of Engineers ®
Seattle District

INFORMAL ESA CONSULTATION
For Impacts to Aquatic and Terrestrial Listed Species and Designated / Proposed Critical Habitat from Camas WWTP Outfall Modifications

***** This form is for projects that have insignificant or discountable impacts on listed species. It contains all the information required for a biological evaluation, but in abbreviated form and with minimal instructions on how to fill it out. For more detailed instructions, a format for development of a biological assessment or biological evaluation can be found on the Seattle District Corps website (www.nws.usace.army.mil – click on regulatory and then on endangered species, BA Template). You may also contact the Corps at 206-764-3495 for further information.***

1. **Proposed Activity**: Camas WWTP Outfall Modifications: Removal of 90-degree bends on 16 risers along the outer (southern) 150 feet of the 36-inch outfall pipeline discharging to the Columbia River. Tideflex valves will be installed to allow effluent to discharge vertically into the flow of the river.
2. **Drawings -** See attached Drawings.
3. **Date**: June 10. 2009 **Corps Ref No**.: Not yet assigned (UPI **358094-09-01)**
4. **Applicant**: City of Camas Public Works Department: Monte Brachmann
   Address: 616 Fourth Avenue
   City: Camas **State:** WA **Zip**: 98607
5. **Agent:** Jay Swift PE, Gray & Osborne, Inc.
   Address: 701 Dexter Avenue North, Suite 200
   City: Seattle **State:** WA Zip: 98109
6. **Project Name**: Camas WWTP Outfall Modifications
7. **Location(s) of Activity**:
   Section: 12 **Township:** 1 North **Range:** 3 East
   Latitude: 45°34’36” North **Longitude:** 122°23’28” West
   Waterbody: Columbia River **County:** Clark

8. **Description of Work:**

Describe the proposed project.

Divers will cut the eight six-inch risers currently in use on the existing 36-inch outfall pipeline to remove the 90-degree elbow. The inner eight risers will be similarly modified and opened for use associated with the proposed outfall improvements. Divers will then install the Tideflex “duckbill” valves with hose clamps on the vertical riser sections, allowing effluent to discharge vertically into the flow of the Columbia River. Divers will likely be required to temporarily relocate a small number of quarry spalls to modify the risers and install the “duckbill” valves on the risers. These rocks will be replaced in, or near, their original locations once the risers are modified and the Tideflex valves are installed. The footprint of the outfall will not change.

<u>This project received a Nationwide Permit under a SLOPES categorical biological evaluation in 2006. The permit has expired and a new JARPA and this Corps of Engineers Informal ESA Consultation Document are being prepared for this re-permitting effort.</u>

9. Construction Techniques:

Describe methods and timing of construction to be employed in building the project and any associated features. Identify actions that could affect listed / proposed species or designated / proposed critical habitat and describe in sufficient detail to allow an assessment of potential impacts. Consider actions such as vegetation removal, temporary or permanent elevations in noise level, channel modifications, hydrological or hydraulic alterations, access roads, power lines etc. Also discuss construction techniques associated with any interdependent or interrelated projects.

Address the following:

A. Construction sequencing and timing of each stage (duration and dates):
The proposed outfall improvements will be conducted during the in-water work window for the Lower Columbia River, which extends from November 1 through February 28 in accordance with the provisions of the Hydraulic Project Approval from the Washington Department of Fish & Wildlife dated October 26, 2006, or during the summer low flow period extending from July 15 to September 15 to take advantage of low flows and low turbidity levels in the river. The proposed outfall modifications are expected to take a team of divers approximately one week.

B. Site preparation:
Divers may be required to temporarily remove riprap and quarry spalls from around the outfall risers before they can cut the 90-degree bends off and clamp the Tideflex valves in place.

C. Equipment to be used:
Divers will use either surface supplied air or SCUBA to conduct work on the outfall. 90-degree bends will be cut off the risers using either a hacksaw or an underwater cutting torch. Tideflex valves will be installed and held in place by hose clamps.

D. Construction materials to be used:
Tideflex valves, hose clamps, saws or underwater cutting torch

E. Work corridor:
The Camas WWTP Outfall consists of a 36-inch diameter corrugated metal pipe (CMP), which extends from the northern shore of the Columbia River approximately 850 feet south into the Columbia River channel. The diffuser portion of the outfall is located along the outer/southern 150 feet of the pipe at a depth of approximately -35 feet. The existing outfall includes 16 vertical risers, each with a 90-degree bend pointed downstream. The eight diffusers closest to shore are capped off and are not currently in operation. These diffusers will be uncapped, 90-degree bends will be cut off and the risers will be fitted with a Tideflex valve and put into use. The work corridor will extend approximately 20 feet to either side of the diffuser.

F. Staging areas and equipment wash outs:
Staging for the proposed outfall improvement project will likely occur in the parking lot at the boat ramp or marina nearest the outfall.

G. Stockpiling areas:
SCUBA gear, Tideflex valves and hand tools will all be stockpiled on-board the work boat.

H. Running of equipment during construction:
In the event that surface supplied air is used during the proposed outfall modifications, a compressor is likely to be operated on-board the work boat. The workboat may idle on station during construction activities to provide diver support.

I. Soil stabilization needs / techniques:
No soil disturbance is anticipated associated with the proposed outfall modification project. Rocks disturbed during construction will be replaced in or near their original locations. Divers will avoid disturbing benthic sediments as much as possible to minimize turbidity generated and preserve working visibility.

J. Clean-up and re-vegetation:
A small amount of algae growing on the diffuser and adjacent riprap may be disturbed by construction activities. It is anticipated that vegetative cover along the outfall corridor will return to pre-construction conditions within one year.

K. Storm water controls / management:
None required, as all work will be completed under the surface of the Columbia River and no new stormwater will be generated.

L. Source location of any fill used:
Not applicable. No fill material will be installed associated with the proposed project.

M. Location of any spoil disposal:
Not applicable. No dredging or dumping of spoils is anticipated associated with the proposed WWTP outfall improvements.

10. Action Area

Please describe the action area. The action area means all areas to be affected directly (e.g., earth moving, vegetation removal, construction noise, placement of fill, release of environmental contaminants) and indirectly by the proposed action. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. (for example: action area for a new pier could be considered at least one mile. This includes the project area, area where construction and the noise of construction will be heard (direct effects), and the area where increased boating activity is expected to occur (an indirect effect).

The action area for the proposed outfall modification project is limited by the distance that construction activities can be heard underwater in the Lower Columbia River. Noise generated by boat activities and saws and cutting torches may be heard up to a mile in all directions underwater. The project corridor will extend approximately 25 feet on either side of the existing outfall from the point on the pipe 700 feet south of the north bank of the Columbia River to the end of the pipe approximately 850 feet offshore.

11. Species Information:

Listed Species in Clark County under the authority of the US Fish & Wildlife Service from (www.fws.gov/westwafwo/speciesmap/CLARK.html) include:

- Bull trout, *Salvelinus confluentus*
- Gray wolf, *Canis lupus*
- Northern spotted owl, *Strix occidentalis caurina*
- Golden paintbrush, *Castilleja levisecta*
- Water howellia, *Howellia aquatilis*
- Bradshaw's lomatium, *Lomatium bradshawii*

Bull trout occasionally pass through the project area en route to the Pacific Ocean and on their return upstream. None of the other listed species in Clark County are likely to be present in the middle of the Columbia River.

Species identified as present in Clark County that are not likely to be present in the project area:

Northern spotted owl, *Strix occidentalis,* Listed Threatened*:*
Northern spotted owls occur in Clark County throughout the year. According to the Priority Habitats & Species Map prepared for the area surrounding Section 12, Township 1 North, Range 3 East on January 7, 2005, there are no northern spotted owl nests or management circles within two miles of the project area.

Gray wolf, *Canis lupus*, Listed Endangered:
The gray wolf population in Washington State is concentrated in the northeastern corner of the state. Any wolves occurring in the SW corner of the state are likely to be hybrids, which are not eligible for protection under the Endangered Species Act. All work on the proposed outfall improvement project will occur offshore from a boat in the Columbia River, so it is unlikely that gray wolves would be impacted.

Listed plant species:

Golden paintbrush, *Castilleja levisecta,* Listed as Threatened in 1990: Historically occurred in the Mill Plain area of Clark County Washington. Typically found in wet prairie areas.

Water howellia, *Howellia aquatilis,* Listed as Threatened in 1994, occurs in two small populations in the floodplain of the Columbia River in Clark County on the Ridgefield Wildlife Refuge across Lake River from the City of Ridgefield.

Bradshaw's lomatium, *Lomatium bradshawii,* was listed as Endangered on September 30, 1988. It is thought to be endemic to the area around (within ten miles of) Salem, Oregon. According to Ron Klump of the US Army Corps of Engineers, it was recently discovered along Lacamas Creek near Camas, Washington.

Listed Species present in Clark County under the authority of the National Marine Fisheries Service/NOAA Fisheries:

Green sturgeon, *Acipenser medirostris,* Threatened
The green sturgeon was listed as threatened on April 7, 2006. Critical habitat was proposed on September 8, 2008 and included the Columbia River estuary approximately 100 miles downstream of the City of Camas and the project area.

Eulachon, *Thaleichthys pacificus*, Proposed for listing as Threatened
Eulachon were proposed for listing as threatened in March 2009: Eulachon are present in the Columbia River at least as far upstream as Bonneville Dam upstream of Camas. Significant reductions in the number of eulachon returning to the Columbia River since the early 1990s have led to the proposal to list the Distinct Population Segment south of the Canadian Border as Threatened.

Listed Pacific Salmon:
The following table presents the listed ESUs of Pacific Salmon present in the Columbia River. The ESUs most likely to be present include Lower Columbia River chinook, coho, steelhead and Columbia River chum. The remaining ESUs migrate past the Camas WWTP outfall en route to the Pacific Ocean and on their return spawning runs. Returning salmonids utilize transportation habitat in the middle of the river closer to the point of discharge from the Camas WWTP.

Species/ESU	Status	Date	FR Notice
ESUs Under NMFS Jurisdiction			
Lower Columbia chinook	**Threatened** **Critical habitat**	**3-24-98** **9-2-05**	**63 FR14308** **70 FR 52631**
Lower Columbia steelhead	**Threatened** **Critical habitat**	**3-19-98** **9-2-05**	**63 FR 13347** **70 FR 52631**
Columbia River chum	**Threatened** **Critical habitat**	**3-25-99** **9-2-05**	**63 FR 30455** **70 FR 52631**
Lower Columbia coho	**Proposed Threatened**	**6-16-05**	
Upper Columbia spring chinook	**Endangered** **Critical habitat**	**3-24-99** **9-2-05**	**64 FR 14308** **70 FR 52631**
Snake River sockeye	**Endangered** **Critical habitat**	**11-20-91** **12-28-93**	**56 FR 58619** **58 FR 53635**
Upper Columbia steelhead	**Endangered** **Critical habitat**	**8-18-97** **9-2-05**	**62 FR 43937** **70 FR 52631**
Snake River fall chinook	**Threatened** **Critical habitat**	**4-22-92** **12-28-93**	**57 FR 14653** **58 FR 68543**
Snake River spring/summer chinook	**Threatened** **Critical habitat**	**4-22-92** **12-28-93**	**57 FR 14653** **58 FR 68543**
Mid Columbia steelhead	**Threatened** **Critical habitat**	**3-25-99** **9-2-05**	**64 FR 14517** **70 FR 52631**
Snake River steelhead	**Threatened** **Critical habitat**	**8-18-97** **9-2-05**	**62 FR 43937** **70 FR 52631**

Upper Willamette steelhead		**3-25-99** **9-2-05**	
Southwest Washington & Lower Columbia River cutthroat trout	**Proposed** **Removed**	**4-26-99** **7-5-0**	**64 FR 16397**
Columbia River bull trout (USFWS)	**Threatened** **Critical habitat**	**6-10-98** **9-25-05**	

LISTED EVOLUTIONARILY SIGNIFICANT UNITS (ESUs) OF CHINOOK SALMON:

Lower Columbia chinook salmon, *Oncorhynchus tshawytscha:* Both spring and fall chinook populations on the Lower Columbia River were listed as threatened on March 28, 1998. Critical habitat was designated for this ESU on September 2, 2005.

Spring chinook are present in the Cowlitz, Camas and Lewis rivers. Spring chinook populations from these rivers are of mixed hatchery and wild origin. Return migration for these stocks occurs from late January to May. Tributary migration occurs from March through July, while spawning extends from late August through early October.

Lower Columbia fall chinook consist of 14 stocks. These stocks can be further divided into two general groups: the Tule early spawning stocks with strong hatchery influence of mixed origin, and a Lewis River wild stock that spawns later with little hatchery influence. Return migration through the lower Columbia extends from August through November. Spawning is generally October for early stocks and November for late stocks.

Upper Columbia spring chinook
Upper Columbia spring chinook were listed as endangered on March 24, 1999. Critical habitat was adopted for this ESU on February 15, 2000. Spring chinook destined for areas upstream of Bonneville Dam usually reach peak abundance at the dam between April 20 and April 28 but can be earlier during low flow years or later during high run-off periods. Tributary entry is May-June with spawning in late August to late September.

Snake River fall chinook
Snake River fall chinook were listed as threatened on April 22, 1992 and Critical Habitat for this ESU was adopted on February 28, 1993.

Snake River spring/summer chinook
Snake River spring/summer chinook were listed as threatened on April 22, 1992 and Critical Habitat was finalized on December 28, 1993.

COLUMBIA RIVER CHUM SALMON, LISTED THREATENED:

Columbia chum salmon, *Oncorhynchus keta:*
Columbia River chum salmon were once widespread in the Lower Columbia River. They were listed as threatened on March 25, 1999, and critical habitat for this ESU was designated on September 2, 2005. Today chum salmon present in the lower Columbia are concentrated in the Grays River system near the

mouth of the Columbia and near Bonneville Dam in Hardy and Hamilton Creeks. These stocks of chum salmon are native. Some non-native chum introductions have been attempted, with no apparent success. Chum enter the Columbia in October and November, and spawn in November and December. The present run size is estimated to range between 3,000 and 10,000 fish annually.

LISTED ESUs OF COLUMBIA RIVER BASIN STEELHEAD:

Lower Columbia steelhead *Oncorhynchus mykiss*
Lower Columbia River steelhead were listed as threatened on March 19, 1999. Critical habitat for this ESU was designated on September 2, 2005. According to the SASSI Columbia River Appendix, the Lower Columbia River supports five summer steelhead stocks and eighteen winter steelhead stocks. Run timing of the summer steelhead extends from May through October, while run timing of winter steelhead stocks extends from December through April in the Lower Columbia River.

Mid Columbia steelhead
Mid Columbia River steelhead were listed as threatened on March 25, 1999. Critical habitat for this species was adopted on September 2, 2005.

Upper Columbia steelhead
Upper Columbia River steelhead were listed as endangered on August 18, 1997. Critical Habitat for this ESU was adopted on September 2, 2005.

Snake River steelhead
Snake River steelhead were listed as threatened on August 18, 1997. Critical Habitat for this ESU was adopted on September 2, 2005.

Upper Willamette River steelhead
Upper Willamette River steelhead were listed as threatened on March 25, 1999. Critical Habitat was finalized for this ESU on September 2, 2005.

SNAKE RIVER SOCKEY, Listed as Endangered
Snake River sockeye salmon, *Oncorhynchus nerka*
Snake River sockeye salmon were listed as endangered on November 20, 1991. Critical Habitat for this ESU was adopted on December 28, 1993.

LOWER COLUMBIA RIVER COHO SALMON, Listed as Threatened:

Lower Columbia River coho, *Oncorhynchus kisutch:* The National Marine Fisheries Service re-defined the Lower Columbia River ESU and listed this species as "Threatened" on June 28, 2005.

CRITICAL HABITAT FOR LISTED ANADROMOUS FISHES
The National Marine Fisheries Service designated critical habitat for each of these listed ESUs on September 2, 2005. Critical habitat for these listed salmonids includes all reaches of the Columbia River and its tributary streams below long-standing natural barriers, with the exception of areas covered under Habitat Conservation Plans. The waters of the Columbia River near Camas are considered critical habitat for both out-migrating juveniles and returning adults. Critical Habitat for Lower Columbia River coho is under development.

Use of the Waters Adjacent to the Project Area by Listed Salmonids
Joe Hymer of the Washington Department of Fish & Wildlife Vancouver Office indicated that juvenile salmonids from any of the listed species use the waters of the Columbia River for transport, feeding and rearing. Juvenile salmonids school in the shallows along the shore as much as possible and may be present along the shoreline near the Camas WWTP. Out-migrating juvenile salmonids of the various listed ESUs may be present in the Lower Columbia River almost continuously throughout the year (personal communication, July 12, 2001) with peak concentrations present from April through June. Abundance of juvenile salmonids is lowest during the mid summer months.

Out-migrating juvenile salmonids generally prefer to remain in shallow areas within the range of light penetration near the edge of the river as much as possible. Near Camas, they may school near the shore of the Camas WWTP near the project area while feeding, rearing and migrating toward the Pacific Ocean.

12. Existing Environmental Conditions:
Provide color photographs of local area, shoreline conditions and proposed project site.
Describe existing environmental conditions for the following:

A. Shoreline riparian vegetation and habitat features
Shoreline habitat west of the Camas WWTP outfall consists of a mixture of deciduous trees typical of the Columbia River Gorge including alders, cottonwoods, poplars and Oregon ash. There is a commercial pier that extends into the Columbia River directly offshore of the Camas WWTP. East of the outfall, vegetation along the shoreline is limited to grasses and shrubs associated with residential and commercial developments (see attached aerial photo).

B. Aquatic substrate and vegetation
Benthic substrate upstream and downstream of the Camas WWTP Outfall is most likely muddy sand with some gravel. The diffuser is bedded in riprap and quarry spalls for protection from logs, rocks and other debris migrating downstream on the bottom of the Columbia River.

C. Surrounding land/water uses
Land use on the north side of the Columbia River includes the Camas WWTP, SR 14 and commercial and residential developments to the east. There is a commercial dock immediately south of the Camas WWTP. The Columbia River is a major marine transportation corridor. Recreational fishing and wind surfing activities may occur in the area as well. Land use on the south side of the Columbia River is dominated by Interstate 84 and associated commercial and residential developments.

D. Level of development
The immediate project area in the Columbia River is fully developed as the Camas WWTP Outfall, which includes a 36-inch CMP outfall that extends approximately 850 feet south of the north shore of the Columbia River. A narrow, tree-dominated shoreline area extends from the road along the Camas WWTP fence line west to the SR-14 ROW. The area east of the Camas WWTP contains a mixture of residential and industrial developments (see attached aerial photo).

E. Water quality
Water quality in the vicinity of Camas is generally good; this stretch of the Columbia River is on the 2009 CWA 303(d) list for temperature.

F. Distance to nearest bald eagle nest and wintering features (perch trees; roost trees; and important foraging areas such as waterfowl concentration areas and salmon spawning areas).

According to Priority Species and Habitat Map prepared for this project by the Washington Department of Fish and Wildlife on January 7, 2005, there are no bald eagles known to nest within approximately two miles of the project site. Wintering bald eagles prey on salmon migrating into and out of the Columbia River and may forage offshore in the vicinity of the project area between November 1 and March 31.

G. Distance to nearest marbled murrelet nesting and foraging areas.

The Camas WWTP Outfall is located at approximately RM 120.8. The maximum distance from salt water where marbled murrelets are thought to nest is approximately 60 miles. Therefore, the nearest marbled murrelet nesting area is likely to be in old growth forests at least 60 miles downstream of the project area.

H. Distance to nearest bull trout spawning / foraging / overwintering areas. Is the project in or adjacent to bull trout migratory waters?

Anadromous/amphidromous bull trout migrate past the Camas WWTP Outfall in the Columbia River. The nearest bull trout spawning areas are likely in the upper reaches and tributaries of the Washougal River. Bull trout could forage in any of the larger streams along the Columbia River corridor.

I. Is the project located within designated / proposed bull trout critical habitat? If so, please address the proposed projects' potential direct and indirect effect to primary constituent elements (please see the USFWS proposed rule – Federal Register / Vol. 69, No. 122/ Friday, June 25, 2004; Page 35776).

No.

J. Is the project located within designated / proposed Pacific salmon critical habitat? If so, please address the proposed projects' potential direct and indirect effect to primary constituent elements (please see the NOAA-Fisheries proposed rule – Federal Register / Vol. 69, No. 239/ Tuesday, December 14, 2004; Page 74581).

EFFECTS OF THE PROJECT ON PROPOSED CRITICAL HABITAT

A. DESIGNATED CRITICAL HABITAT FOR CHINOOK SALMON, STEELHEAD AND CHUM SALMON: PRIMARY CONSTITUENT ELEMENTS. (i.e., physical and biological features) essential to the conservation of steelhead and discussion of potential project impacts: Yes.

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development*:*

According to the WDFW SASSI for Columbia River steelhead (WDF 1992), Lower Columbia chinook salmon, Lower Columbia steelhead, Lower Columbia coho and Columbia River chum salmon migrate past the City of Camas WWTP outfall. These species utilize the area for rearing, foraging and transportation. Chum salmon spawn in lower reaches of streams in the area, including the Washougal River. Substrate quality in the immediate project area is not conducive to salmonid spawning, as benthos are primarily sand that is unsuitable for spawning and larval development. Implementation of the proposed project would result in improved mixing and dilution of effluent from the Camas WWTP. This would improve water quality and rearing and transportation habitat. This work will be completed either during the WDFW In-Water Work Window established for the Lower Columbia River, which extends from November 1 to February 28; or during the summer low flow period to take advantage of the lightest currents and best visibility for underwater work. Construction of the proposed outfall improvements will have no effect on water quantity or substrates supporting spawning, incubation and larval development.

2. Freshwater migration corridors free of obstruction, freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions that support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

Once the outfall modifications are complete, the proposed project will improve migration corridors in the Columbia River. Effluent discharged via the outfall will receive more complete mixing and dilution than under existing conditions. Riparian vegetation will not be impacted by the proposed outfall improvements, which will be installed in situ beneath the surface of the Columbia River 700 to 850 feet offshore of the WWTP. The proposed outfall improvements will improve water quality, and will have no effect on water quantity or floodplain connectivity in the Columbia River.

3. In-water habitat with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival:

Proposed improvements to the Camas WWTP outfall will improve water quality in the Columbia River by enhancing mixing of effluent. This project will have no effect on water quantity, natural cover, aquatic vegetation, large rocks or boulders, side channels, undercut banks etc. as all work will occur on the existing WWTP outfall in the Columbia River channel.

4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between freshwater and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation:

The proposed improvements to the Camas WWTP outfall will have no quantifiable effect on the Columbia River estuary approximately 100 miles downstream from Camas.

5. Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels:

Proposed improvements to the Camas WWTP outfall will improve water in the mixing zone downstream of the facility, but it is unlikely that these improvements will be observable or detectable in nearshore marine areas more than 120 miles downstream from Camas.

6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation:

The proposed project will have no effect on nearshore marine areas, as the Camas WWTP is approximately 120 miles upstream from the mouth of the Columbia River and the level of effluent treatment and dilution will not change enough to be observable 120 miles downstream.

K. Presence of forage fish (marine areas only).
Not applicable, as the project area is 120 miles upstream from the Pacific Ocean.

13. Effects Analysis:

Describe the direct and indirect effects of the action on the proposed and listed species as well as designated and proposed critical habitat within the action area. Consider the impact to both individuals and the population. Discuss the short-term, construction-related, impacts as well as the long-term and permanent effects.

Water Quality & Fish Habitat

Construction:
Modification of the Camas WWTP outfall to the Columbia River will be accomplished by divers over the course of a few days. It is unlikely that the work will take more than a week to complete. Construction will take place either during the work window established by the Washington Department of Fish and Wildlife, which extends from November 1 to February 28 in the Lower Columbia River, or during low flow summer months, July 15 to September 15, to take advantage of the lowest stream flows and best underwater working visibility. Any salmon, eulachon or green sturgeon present in the vicinity of the outfall during diving operations would be able to avoid noise, turbidity and disturbance generated by divers. Discussion of the proposed project and the limited potential for impacts to listed salmonids, eulachon and green sturgeon with Dan Guy, NMFS Vancouver Office on June 12, 2009, led him to support the idea of conducting the diving operations for the outfall modification during the low flow period on the Columbia between mid July and early September to take advantage of lower current speeds and better visibility for the proposed underwater work.

Operation
According to Mr. Bill Fox of Cosmopolitan Engineering (Memo to Jay Swift P.E. of Gray & Osborne, dated May 6, 2005), diffusing the effluent vertically from the outfall into the Columbia River will help to improve water quality in the dilution zone downstream of the outfall. Improving dilution of effluent from the WWTP may reduce impacts associated with pollutants in the effluent, which would improve water quality near the point of discharge and the dilution zone. Water quality in the Columbia River beyond the dilution zone should not be adversely affected regardless of loadings. Therefore, reorientation of the risers on the Camas WWTP outfall, opening the inshore eight outfall ports, and operation of the Camas WWTP with these improvements will improve and preserve water quality and habitat conditions for listed salmonids passing through the project area through the planning period, 2025, and beyond.

Potential for Impacts to Northern Spotted Owls
The potential for adverse impacts to Northern spotted owls associated with implementation of the proposed project is low, because there are no active nests or Spotted Owl Management Circles within two miles of the project area (Priority Habitats & Species Map prepared by WDFW on January 7, 2005).

Potential for Impacts to the Gray Wolf
The potential for adverse impacts to the gray wolf associated with implementation of the proposed improvements to the Camas WWTP outfall is very low. Gray wolves have not been sighted in the Camas area for many years, and the majority of the gray wolf population in Washington occurs in the northeast corner of the state approximately 300 miles from the project area offshore of Camas.

Potential for Impacts to Listed Plant Species
Implementation of the proposed improvements to the Camas WWTP outfall will not impact listed plant species occurring in the Camas area, because all work associated with the proposed project will occur off shore beneath the surface of the Columbia River. Therefore, the proposed WWTP outfall improvement project will have no effect on golden paintbrush, water howellia or Bradshaw's lomatium.

14. Conservation measures:

Conservation measures are measures that would reduce or eliminate adverse impacts of the proposed activity (examples: work done during the recommended work window [to avoid times when species are most likely to be in the area], silt curtain, erosion control best management practices, percent grating on a pier to reduce shading impacts).

Mitigation measures designed to minimize potential impacts of the Camas Wastewater Treatment Facility outfall modifications and operation of the facility once the modifications are completed include:

1. Construction equipment and vessels shall be fueled, maintained and stored off-site to minimize the potential for spills of hazardous materials, including fuels, lubricants and coolants.

2. Construction would be limited to the in-water work window established by the Washington Department of Fish & Wildlife, Vancouver Office, which extends from November 1 to February 28 in the Lower Columbia River, or during the summer low flow period between July 15 and September 15 to take advantage of low flows and improved visibility for the proposed under water work.

3. To minimize the potential for accidents resulting in direct effects to listed and candidate fish species, construction vessels and equipment will be fitted with emergency spill kits and construction crews will be trained in their use.

15. Determination of Effect:

Provide a summary of impacts concluding with statement(s) of effect, by species. Even projects that are intended to benefit the species might have short-term adverse impacts and those must be addressed. For this template, only the following determinations are valid for listed species or designated critical habitat:

1. Potential impacts to listed salmon associated with the construction and operation of the proposed improvements to the Camas WWTP Outfall and the indirect effects associated with the proposed improvements will be minimal or discountable and long-term impacts on the listed anadromous salmonids that occur in the Columbia River near the project area are likely to be positive. Therefore, the proposed improvements to the Camas WWTP Outfall **may affect, but are unlikely to adversely affect** the following species/ESUs and their critical habitat:
    - Lower Columbia River chinook salmon
    - Lower Columbia River steelhead
    - Lower Columbia River coho
    - Columbia River chum salmon
    - Upper Columbia River spring chinook salmon
    - Upper Columbia River steelhead
    - Mid Columbia River steelhead
    - Snake River steelhead
    - Snake River spring/summer chinook salmon
    - Snake River fall chinook salmon
    - Snake River sockeye salmon
    - Upper Willamette River steelhead
    - Columbia River bull trout
    - Green sturgeon

2. The gray wolf, listed as Endangered, is not likely to be present in the vicinity of Camas. Any wolves that wandered through the vicinity would likely be unaware of the project activity taking place offshore in the Columbia River. Therefore, implementation of the proposed improvements to the Camas WWTP Outfall, which will occur under water, will have **no effect** on any gray wolves that may wander through the area during construction and operation of the Camas WWTP and its upgraded outfall.

3. Similarly, because all work will occur offshore in the Columbia River, the proposed outfall improvements will have **no effect** on golden paintbrush, water howellia and Bradshaw's lomatium.

4. There are no northern spotted owl nesting areas within two miles of the project area; therefore, the project will have **no effect** on northern spotted owls.

5. Eulachon will be able to avoid any noise or disturbance caused by divers during construction and they would benefit from improved water quality in the vicinity of the Camas WWTP Outfall once construction is completed. Therefore, the proposed project **is not likely to jeopardize the continued existence** of eulachon population present in the Columbia River near the Camas WWTP Outfall. In the event that eulachon are eventually listed as threatened, the proposed project **may affect, but is not likely to adversely affect** this species.

6. The proposed improvements to the Camas WWTP **is not likely to jeopardize** proposed Critical Habitat for green sturgeon present in the Columbia River estuary approximately 100 miles downstream of the project area.

16. EFH Analysis

A. Effects of the Proposed Action

i. Effects on EFH (groundfish, coastal pelagic, and salmon EFH should be discussed separately)

Commercially important salmonid species present in the Lower Columbia include Columbia River chinook salmon, Columbia River coho and a small population of pink salmon**.** Proposed modifications to the Camas WWTP Outfall in the middle of the Columbia River are unlikely to affect out-migrating juveniles as they generally remain close to the shoreline while outfall modification will occur near mid-channel. Returning salmonids are mobile enough to avoid any noise or disturbance associated with divers modifying the risers along the outer portion of the outfall.

ii. Effects on Managed Species (unless effects to an individual species are unique, it is not necessary to discuss adverse effects on a species-by species basis)

Construction of the proposed improvements to the Camas WWTP Outfall will be made by a team of divers using hand tools over the course of a few days. Commercially important chinook, coho and pink salmon populations that may migrate through the project area will be able to avoid any disturbance.

iii. Effects on Associated Species, Including Prey Species

Construction impacts associated with minor improvements to the Camas WWTP Outfall by a team of divers using hand tools over a period of one week or less is unlikely to have any significant impact on fish and invertebrate species that are prey for chinook, coho or pink salmon, due to the limited work area and scope of activities. Any prey fish populations, including eulachon will be able to avoid the minimal amount of noise and disturbance caused by divers working on the outfall.

iv. Cumulative Effects

Modeling conducted by Cosmopolitan Engineers indicated that opening the inner eight risers on the diffuser and reorienting discharge from horizontal to vertical directly into the flow of the Columbia River will improve dilution of effluent discharged by the Camas WWTP. This will minimize adverse impacts to water quality and fisheries habitat in the mixing zone in the middle of the Columbia River as the service area population grows and flows increase.

B. Proposed Conservation Measures

- Construction equipment and vessels shall be fueled, maintained and stored off-site to minimize the potential for spills of hazardous materials, including fuels, lubricants and coolants.

- Construction would be limited to the in-water work window established by the Washington Department of Fish & Wildlife, Vancouver Office, which extends from November 1 to February 28 in the Lower Columbia River. Alternatively, work may be conducted during the summer low flow period to facilitate construction activities by allowing divers to work in the least current and lowest turbidity/best visibility.

- To minimize the potential for accidents resulting in direct effects to listed and candidate fish species, construction vessels and equipment will be fitted with emergency spill kits and construction crews will be trained in their use.

C. Conclusions for EFH (taking into account proposed conservation measures)

The proposed project will have no effect on EFH for chinook, coho and pink salmon present in the Columbia River near the Camas WWTP Outfall.

17. References:

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18. Appendices:

A. Maps & Figures

B. Correspondence & Background Information

C. Previously Issued Permits

- Rivers & Harbors Act Section 10 Permit
- Hydraulic Project Approval

____ __________________

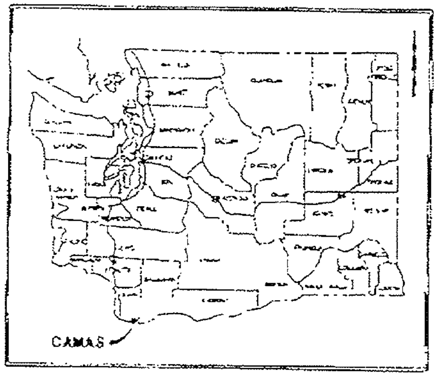
Corps Project Manager Date

____ __________________

Corps Environmental Analyst/ESA Coordinator Date

Appendix A

Maps & Figures



VICINITY MAP
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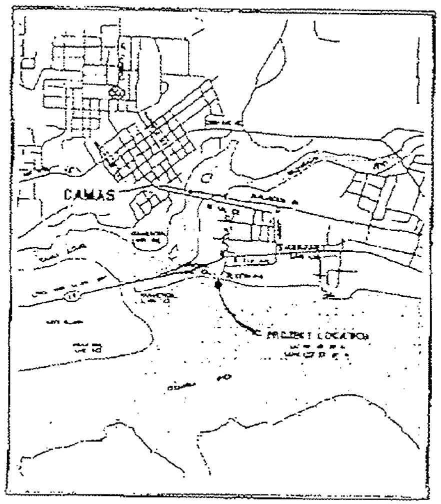


LOCATION MAP
NOT TO SCALE

INDEX

GENERAL

SHEET No.	DESCRIPTION
	CIVIL
G-1	LOCATION MAP, VICINITY MAP, AND SHEET INDEX
G-2	OUTFALL PLAN AND PROFILE
G-3	OUTFALL DETAILS

DIRECTIONS TO CITY OF CAMAS WASTEWATER TREATMENT FACILITY:

FROM I-5 HEADING SOUTHBOUND, MERGE ONTO I-205 S via EXIT 7 TOWARD I-84/SALEM/I-84. GO 10.0 MILES.

MERGE ONTO WA-14 E via EXIT 27 TOWARD CAMAS. GO [illegible] MILES.

TURN RIGHT ONTO SE UNION ST. GO [illegible] MILES.

SE UNION ST BECOMES SE 11TH AVENUE. GO [illegible] MILES.

SE 11TH AVENUE BECOMES POLK STREET. GO [illegible] MILES.

POLK STREET BECOMES SE 11TH AVENUE. GO [illegible] MILES.

TURN RIGHT ONTO THE [illegible] FROM SE 12TH AVENUE.

Gray & Osborne, Inc.
CONSULTING ENGINEERS

CITY OF CAMAS
WASHINGTON

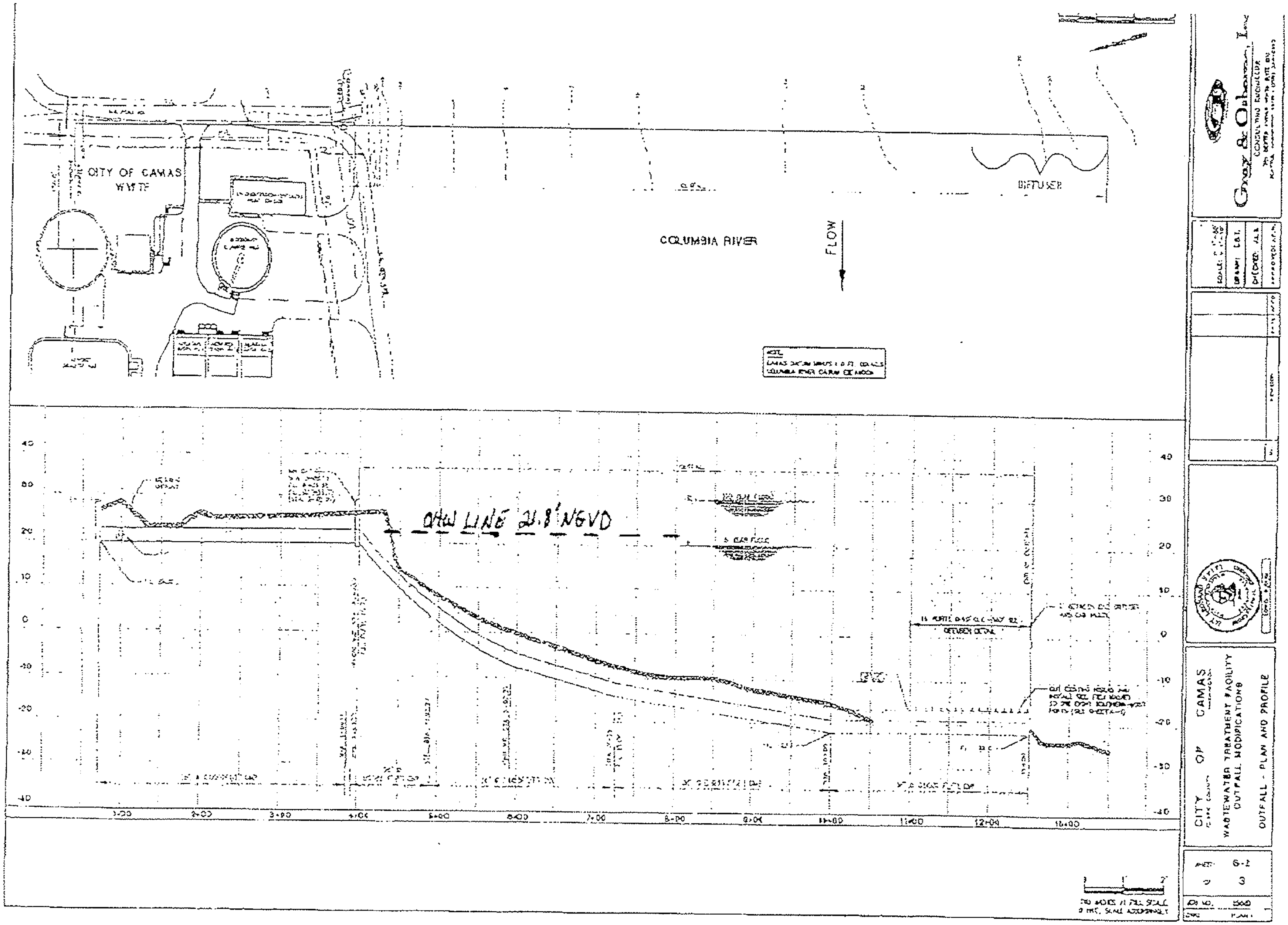
WASTEWATER TREATMENT FACILITY
OUTFALL MODIFICATIONS

LOCATION MAP, VICINITY MAP AND SHEET INDEX

G-1
3

REF: 200501420
CAMAS PUBLIC WORKS
DATE: APRIL 18, 2006

SHEET 1 OF 3

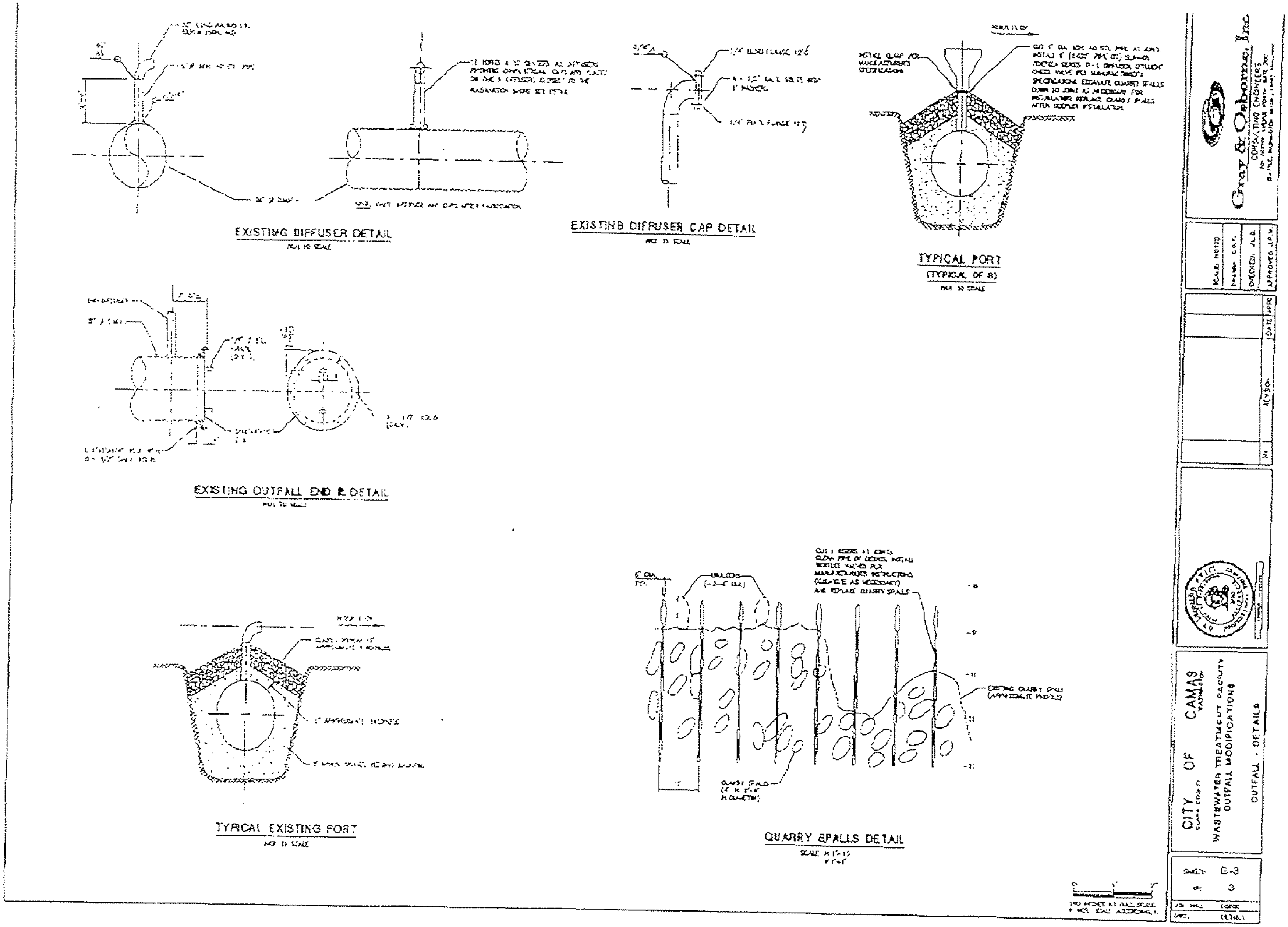


OHW = ORDINARY HIGH WATER

REF: 200501420
CAMAS PUBLIC WORKS

DATE: APRIL 18, 2006

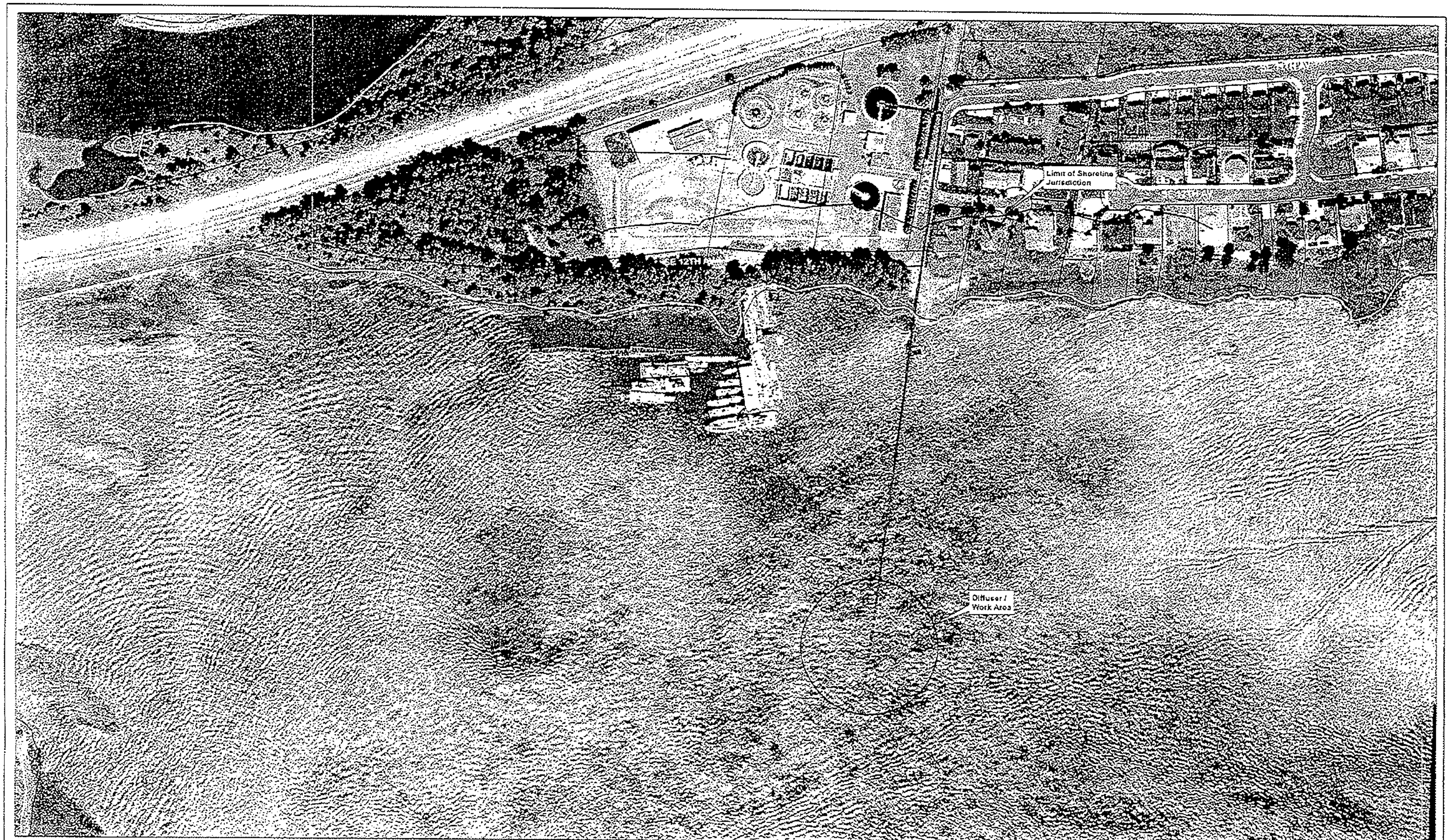
SHEET 2 OF 3



REF: 200501420
CAMAS PUBLIC WORKS

DATE: APRIL 18, 2006

SHEET 3 OF 3



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Feet

CITY OF CAMAS
WASTEWATER TREATMENT FACILITY
OUTFALL MODIFICATIONS

Ordinary High Water
OUTFALL LINE
DIFFUSER

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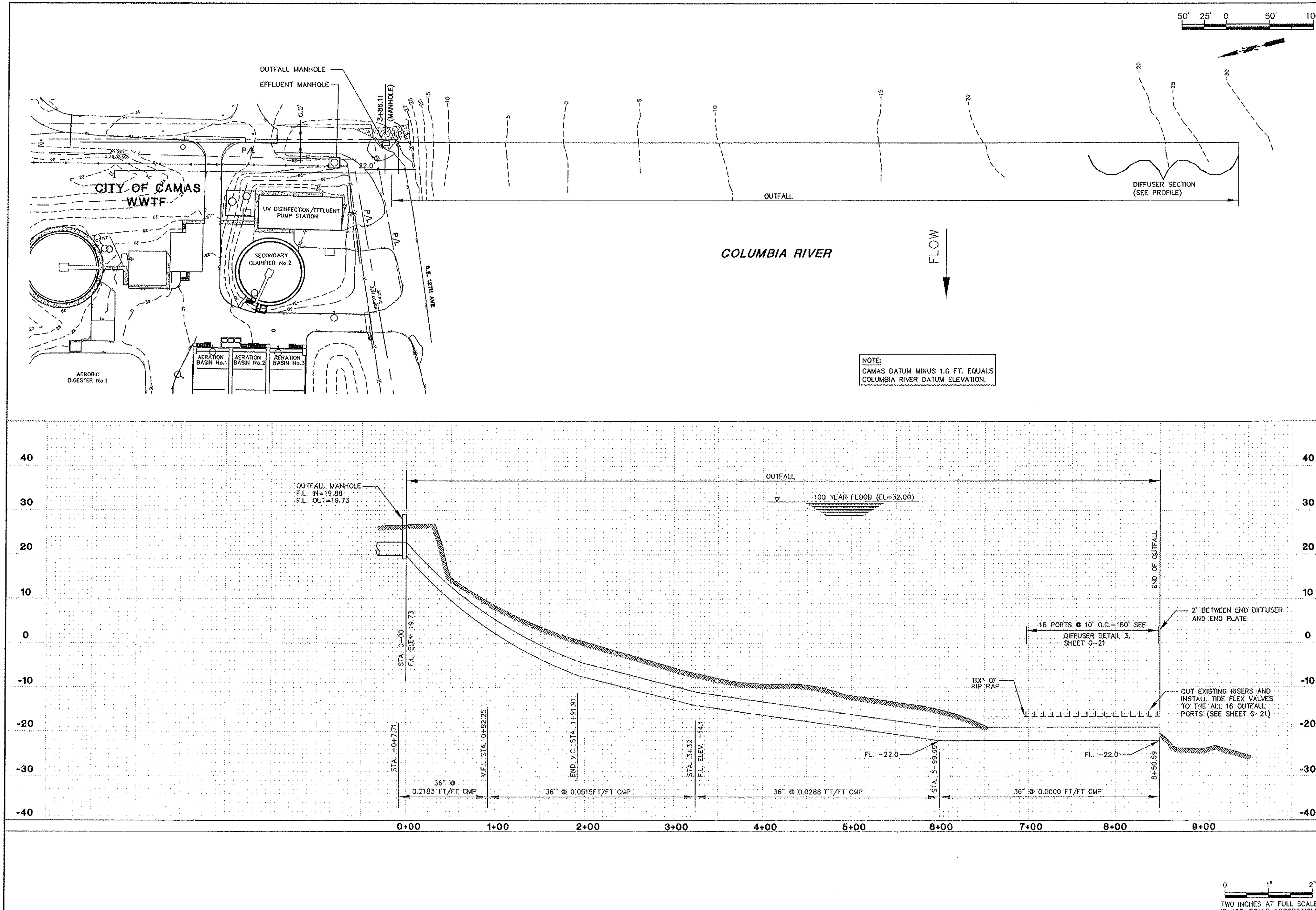


Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 (206) 284-0860

DATE: APR. 2009
SCALE: H 1"=50' V 1"=10'
DRAWN: E.S.T.
CHECKED: E.F.N.
APPROVED: J.P.W.

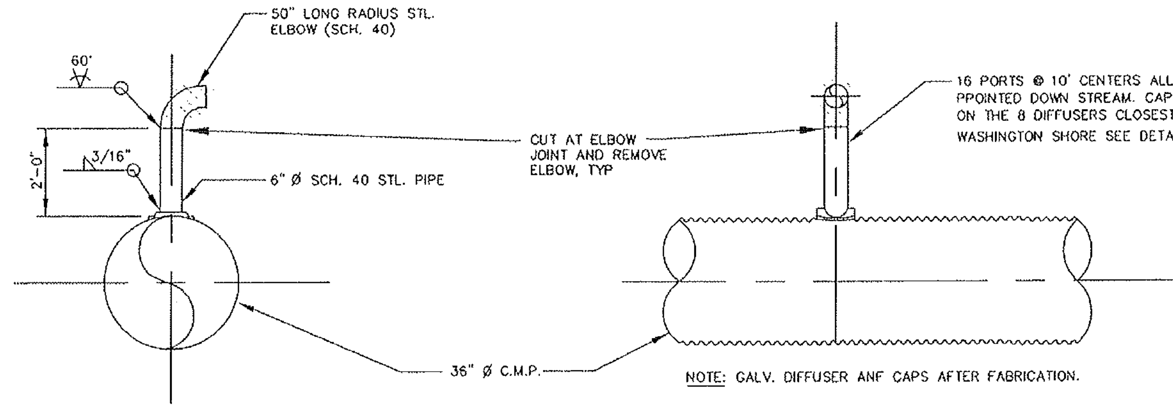
No.	REVISION	DATE	APP'D

JOHN R. WILSON, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER 24211

ERIC F. NUTTING, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER 33900

CITY OF CAMAS
CLARK COUNTY WASHINGTON
WWTF IMPROVEMENTS - PHASE 2
OUTFALL MODIFICATIONS PLAN AND PROFILE

SHEET: G-20
OF: 21
JOB NO.: 07511
DWG: OUTFALL



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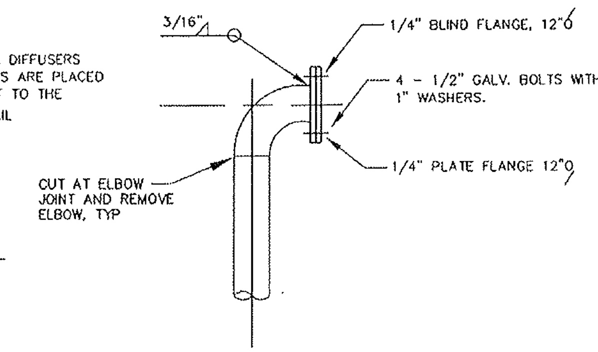

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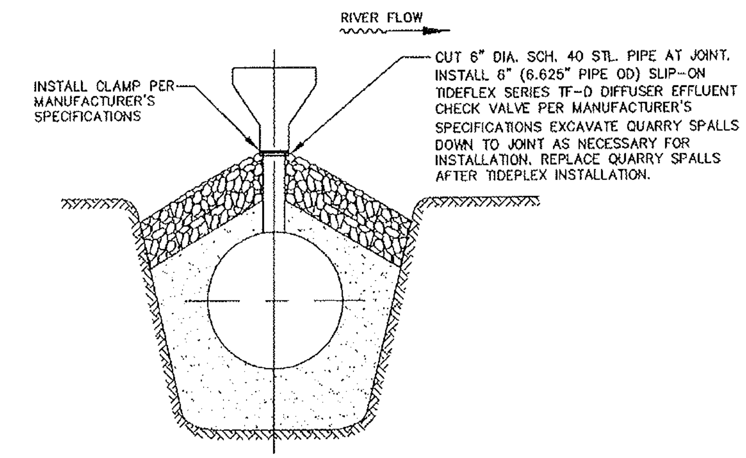

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(TYPICAL OF 16)

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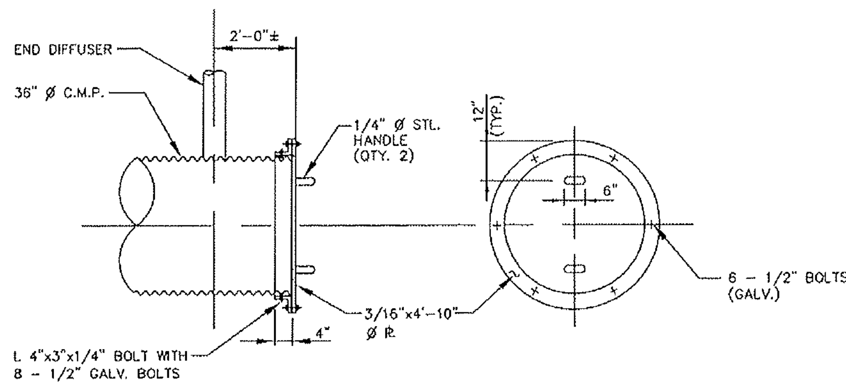

EXISTING OUTFALL END PL DETAIL

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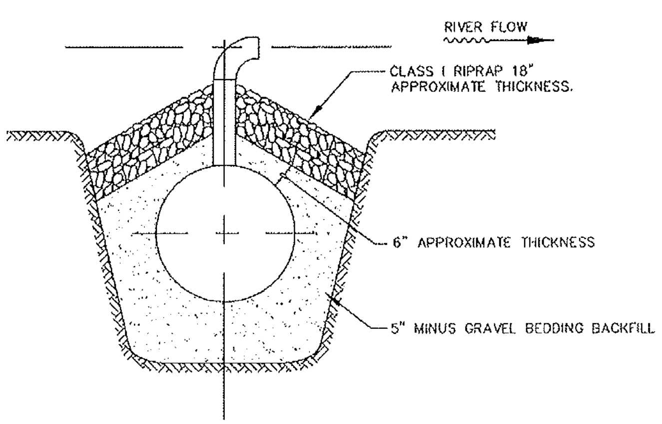

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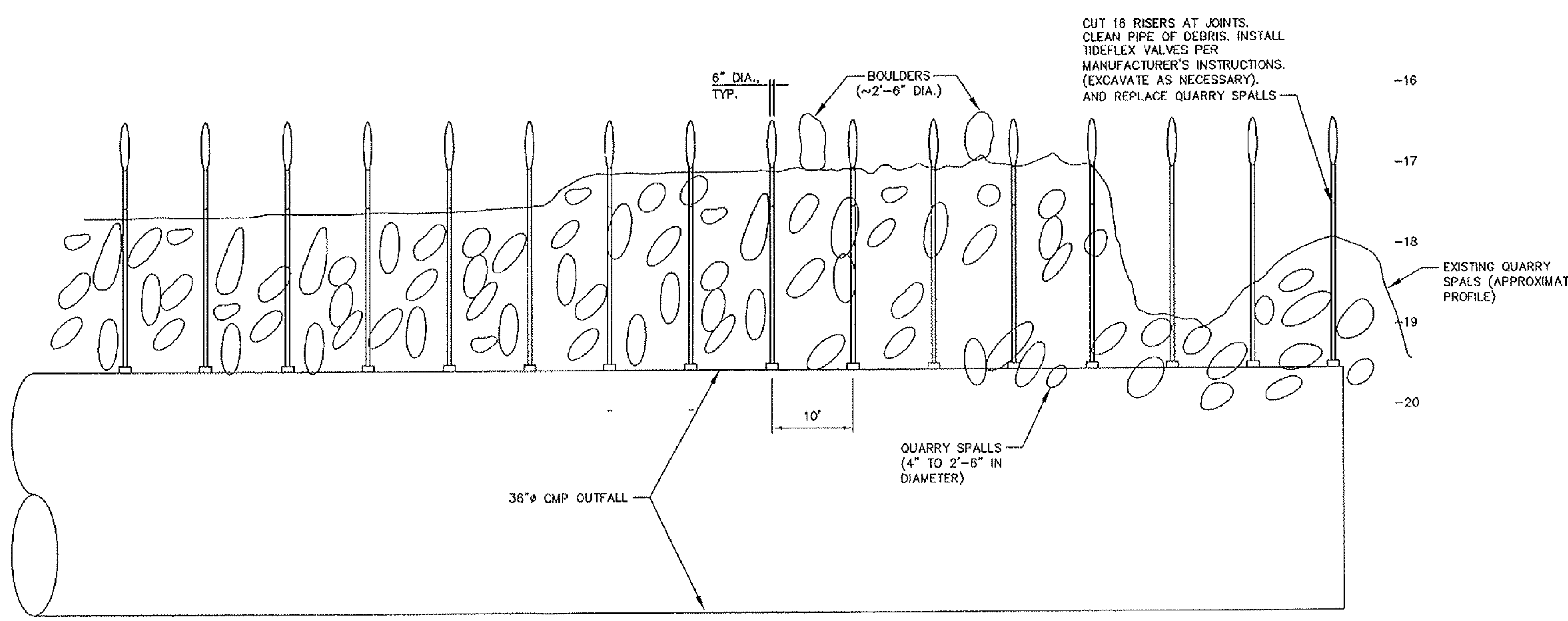

QUARRY SPALLS DETAIL

SCALE: H 1"=10'
V 1"=1'

0 1" 2"
TWO INCHES AT FULL SCALE.
IF NOT, SCALE ACCORDINGLY

L:\CAMAS\07511 WWTF DESIGN PHASE 2\PERMITTING\OUTFALL PERMIT SHEETS\OUTFALL.DWG, DET, 8/17/2009 12:17:00 PM, 0.5:1, BY: R. MEICHO

Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 · (206) 284-0860

DATE: APR. 2009
SCALE: H 1"=50' V 1"=10'
DRAWN: E.S.T.
CHECKED: E.F.N.
APPROVED: J.P.W.

No.	REVISION	DATE	APPD

JOHN P. WILSON · STATE OF WASHINGTON · PROFESSIONAL ENGINEER

ERIC F. NUTTING · STATE OF WASHINGTON · PROFESSIONAL ENGINEER

CITY OF CAMAS
CLARK COUNTY WASHINGTON
WWTF IMPROVEMENTS - PHASE 2
OUTFALL MODIFICATIONS - DETAILS

SHEET: G-21
OF: 21

JOB NO.: 07511
DWG: OUTFALL

Appendix 2

Correspondence

&

Background Information

GRAY & OSBORNE, INC.
TELEPHONE/MEETING CONVERSATION RECORD

☒ **Telephone Conversation**	**Location of Phone Conversation:** GRAY & OSBORNE INC.
☐ **Meeting**	**Place of Meeting:**

Date:	10-29-2009		1030	
Discussion with:	Danette Guy			
Firm/City with:	US Army Corps of Engineers, Vancouver Office			
Phone Number:	360 906-7274			
Gray & Osborne Personnel:	Jim Dougherty			
Project:	Camas WWTF Phase 2 Upgrades			
Subject:	Rivers & Harbors Act, Section 10 Permit for outfall modifications			
G&O Job Number:	07511.00			

REMARKS:

I spoke with Danette Guy, ACOE Project Manager for the Camas WWTF Phase 2 Improvement Project, this morning regarding the Rivers & Harbors Act, Section 10 Permit for the proposed improvements to the Camas WWTF outfall diffuser. She said that the JARPA and Informal ESA Consultation Document for the project have been sent to the Corps' Seattle District Office for review and approval. She said that there were a number of more difficult projects included in the pile forwarded to Seattle, and that it is unlikely that the Seattle Office will act on the City of Camas application any time soon.

Danette recommended that we leave the current Rivers & Harbors Act, Section 10 Permit approval letter in the Specifications Package for the project, along with the list of conservation measures from the current ESA document. Her main concerns were compliance with the in-water work window and the conditions of the Hydraulic Project Approval issued by WDFW on October 26, 2006.

GRAY & OSBORNE, INC.
TELEPHONE/MEETING CONVERSATION RECORD

☒**Telephone Conversation**	**Location of Phone Conversation:** GRAY & OSBORNE INC.
☐**Meeting**	**Place of Meeting:**

Date:	6-12-2009			1200
Discussion with:	Dan Guy			
Firm/City with:	NOAA Fisheries Vancouver			
Phone Number:	360 906-7274			
Gray & Osborne Personnel:	Jim Dougherty			
Project:	Camas WWTP Outfall Improvements			
Subject:	ESA Consultation			
G&O Job Number:	07511.00			

REMARKS:

I received a call from Dan Guy, Division Manager for the NMFS Vancouver Office, regarding the Camas Outfall re-permitting effort. He said to send him an advanced copy of the Biological Evaluation and JARPA form along with the concurrence letter or Corps Permit for the project. He said to forward the same information to Danette at ACOE Vancouver. He asked when the City of Camas was proposing to do the work, and I said that it would likely be within this winter's work window, which extends from November through February. He said that he thought NMFS should be able to work with the Corps to meet this schedule. We'll need to send him a copy of the ACOE Informal ESA Consultation Form, JARPA and the Corps Permit and HPA obtained for the project in 2006 as soon as possible. We also need to add green sturgeon and eulachon to the biological evaluation, which will take a couple more hours.

Dan called back with a few more questions. Specifically, he wanted to know how the diffuser/riser system worked and why we were going to cut off the 90 degree bends. I explained that modeling done by Cosmopolitan Engineers determined that direct, vertical discharge into the flow of the Columbia River would result in approximately four times the mixing as the existing configuration. He said that if all we were doing is having divers cutting the ends of the risers, he would recommend doing the work in the summer during low flow for diver safety and ease of operations. I agreed that this is a good idea and will modify the Informal ESA Consultation document accordingly. Dan said to get the updated forms and drawings to him as soon as possible and he would do what he can to expedite the project with WDFW and USFWS in Vancouver. This means the City will need to get the work done fairly soon after the permit is issued.

WASHINGTON STATE DEPARTMENT OF
Natural Resources

DOUG SUTHERLAND
Commissioner of Public Lands

May 2, 2007

GRAY & OSBORNE, INC.
REC'D - SEATTLE
MAY 07 2007
JOB #

Jim Dougherty
Gray & Osborne Inc
701 Dexter Avenue North
Seattle WA 98109

SUBJECT: City of Camas – Proposed Wastewater Facility and Lift Station Improvements (T01N R03E S11-14)

NOTE: The Washington Natural Heritage Program (WNHP) is expanding our Information Request Service to include a new self-service system. Data users now have the choice of accessing limited tabular information for free, via our website, or licensing and using the WNHP GIS data set. The self-service tabular information now available on the WNHP website (http://www.dnr.wa.gov/nhp/contact/selfservicesys.html) consists of a Township, Range, and Section (TRS) list where Natural Heritage features are reported to occur. Attribute data is not included, however, the data user can refer to the list to determine whether it is necessary to contact WNHP for more information. For-profit organizations will be charged a fee for acquiring the GIS data set and for follow-up consultations with WNHP staff.

We've searched the Natural Heritage Information System for information on rare plants and high quality native wetland and terrestrial ecosystems in the vicinity of your project. A summary of this information is enclosed. In your planning, please consider protection of these significant natural features. Please contact us for consultation on projects that may have an effect on these rare species or high quality ecosystems.

The information provided by the Washington Natural Heritage Program is based solely on existing information in the database. There may be significant natural features in your study area of which we are not aware. These data are being provided to you for informational and planning purposes only - the Natural Heritage Program has no regulatory authority. This information is for your use only for environmental assessment and is not to be redistributed. Others interested in this information should be directed to contact the Natural Heritage Program.

The Washington Natural Heritage Program is responsible for information on the state's rare plants as well as high quality ecosystems. For information on animal species of concern, please contact Priority Habitats and Species, Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia WA 98501-1091, or by phone (360) 902-2543.

Please visit our internet website at http://www.dnr.wa.gov/nhp for more information. Lists of rare plants and their status, rare plant fact sheets, as well as rare plant survey guidelines are available for download from the site. Please call me at (360) 902-1697 if you have any questions.

Sincerely,

Sandy Swope Moody

Sandy Swope Moody, Environmental Review Coordinator
Washington Natural Heritage Program

Enclosures

Asset Management & Protection Division, PO Box 47014, Olympia WA 98504-7014

WASHINGTON NATURAL HERITAGE INFORMATION SYSTEM
ENDANGERED, THREATENED AND SENSITIVE PLANT SPECIES &
HIGH QUALITY WETLAND ECOSYSTEMS AND HIGH QUALITY TERRESTRIAL ECOSYSTEMS
IN THE VICINITY OF CITY OF CAMAS WWTF & LIFT STATION IMPROVEMENTS
REQUESTED BY GRAY & OSBORNE INC

Data Current as of May 2007

TOWNSHIP, RANGE AND SECTION	ELEMENT NAME	STATE STATUS	FEDERAL STATUS
T01N R03E S10 E2ofSW	*Cimicifuga elata* var. *elata* (Tall bugbane)	S	SC
T01N R03E S02 W2ofW2	PSEUDOTSUGA MENZIESII / CORYLUS CORNUTA / POLYSTICHUM MUNITUM FOREST (DOUGLAS-FIR / BEAKED HAZEL / SWORDFERN)		
T01N R03E S02 SE S46 NW	QUERCUS GARRYANA / TOXICODENDRON DIVERSILOBUM / ELYMUS GLAUCUS WOODLAND (OREGON WHITE OAK / PACIFIC POISON-OAK / BLUE WILDRYE)		
T01N R03E S02 S46	North Pacific Herbaceous Bald and Bluff		
T01N R03E S02 S46 NW	*Perideridia oregana* (Oregon yampah)	R1	
T01N R03E S12 NE S48 T01N R04E S07 NW S37	*Trillium parviflorum* (Small-flowered trillium)	S	

WASHINGTON NATURAL HERITAGE INFORMATION SYSTEM
Rare Plant Species

FEDERAL STATUS DEFINITIONS- (Note: Federally listed plant species are subject to the US Endangered Species Act.)

LE = Listed Endangered: Any taxon that is in danger of extinction throughout all or a significant portion of its range and that has been formally listed as such in the Federal Register under the Federal Endangered Species Act.

LT = Listed Threatened: Any taxon that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and that has been formally listed as such in the Federal Register under the Federal Endangered Species Act.

PE = Proposed Endangered: Any taxon that is in danger of extinction throughout all or a significant portion of its range and that has been proposed for listing as such in the Federal Register under the Federal Endangered Species Act.

PT = Proposed Threatened: Any taxon that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range and that has been proposed for listing as such in the Federal Register under the Federal Endangered Species Act.

C = Candidate species: Taxa for which current information indicates the probable appropriateness of listing as Endangered or Threatened and that has been published in the Federal Register as a candidate for listing under the Federal Endangered Species Act.

SC = Species of Concern: Species whose conservation standing is of concern but for which status information is still needed. Species of concern lists are not published in the Federal Register.

STATE STATUS DEFINITIONS- (Note: The state ESA does not include provisions to list or protect rare plant species – the state rare plant list is advisory only.)

E = Endangered: Any taxon in danger of becoming extinct or extirpated from Washington within the foreseeable future if factors contributing to its decline continue. Populations of these taxa are at critically low levels or their habitats have been degraded or depleted to a significant degree.

T = Threatened: Any taxon likely to become Endangered in Washington within the foreseeable future if factors contributing to its population decline or habitat degradation or loss continue.

S = Sensitive: Any taxon that is vulnerable or declining and could become Endangered or Threatened in the state without active management or removal of threats.

X = Possibly Extinct or Extirpated from Washington: Based on recent field searches, a number of plant taxa are considered to be possibly extinct or extirpated from Washington. Taxa in this group are all high priorities for field investigations. If found, they will be assigned one of the above status categories.

R = Review: Taxa of potential concern, but for which no status has yet been assigned.
Group 1 = Taxa in need of additional field work before a status can be assigned.
Group 2 = Taxa with unresolved taxonomic questions.

W = Watch: Taxa more abundant and/or less threatened in Washington than previously assumed.

Non-Vascular Plant:

P = Priority: At this time, there is insufficient information to assign a statewide status to most of the non-vascular taxa. For now, the lichen and macrofungi lists have been divided into two priority groups based on criteria of occurrence pattern, vulnerability, threats, degree of protection, and taxonomy.

WASHINGTON NATURAL HERITAGE PROGRAM

CRITERIA FOR HIGH-QUALITY WETLAND ECOSYSTEMS

The WNHP does not maintain a comprehensive inventory of all wetlands in the state. The database includes information only on those areas that have been surveyed by the program scientists and found to be relatively undisturbed high-quality wetlands. For wetlands included in the database, the physical characteristics, biota, ecosystem functions, processes and settings are essentially natural. For example, to be included in the WNHP database, a freshwater wetland site must meet these six criteria:

1. A native wetland ecosystem type (element) considered important for preservation within the state.

2. Little or no human-caused changes to wetland topography or soils.

3. No human caused changes to hydrology of the wetland, or the wetland appears to have recovered from any changes.

4. Few or no exotic plant species.

5. Little human-caused disturbance of native vegetation, or vegetation has recovered from past disturbance.

6. No major water quality problems.

Criteria 2-6 are weighted based on the amount of disturbance present in all known examples of a given wetland type. Thus a disturbed wetland may be included in the WNHP Information System if it has one of the highest quality examples remaining of a particular wetland type. On the other hand, an equally disturbed site may not be included in the WNHP Information System if it contains a wetland type which has many other undisturbed examples. A severe degree of disturbance would exclude a site from being entered into the WNHP Information System, even if no better examples of that wetland type exist.

CRITERIA FOR HIGH-QUALITY TERRESTRIAL ECOSYSTEMS

Occurrences of terrestrial ecosystem types are determined by the characteristics of each individual ecosystem type. Ecological quality refers to both the ecological condition and the ecological viability of a particular community.

Condition is determined by relative importance of native versus non-native species, extent and nature of human-caused disturbance, and how well the occurrence represents the ecosystem type definition. Viability is determined by size of the area and landscape setting.

Minimum criteria for an occurrence of a terrestrial ecosystem:

1. Native plants dominate the site: tree layers composed of only native species, at least 80 percent of the shrub and herbaceous layers are composed of native plants. Non-native plants are generally insignificant.

2. Little or insignificant disturbance to vegetation by logging, conversion to agriculture, heavy grazing, residential development, or other recent human extractive activities that alter the ecosystem processes.

3. Large enough for minimal viability and ecological function: at least 100 acres for forests in the montane provinces and at least four average tree heights wide at its narrowest width, at least 20 acres for forest in the Puget Lowlands, and at least 10 acres for native grasslands.

The degree to which these criteria are applied to a site depends on characteristics of the particular ecosystem types present. Some ecosystem types are found almost exclusively as small patches, perhaps in areas smaller than in criterion 3. In this case, meeting criteria 1 and 2 would be sufficient. Large but moderately disturbed ecosystems representative of types that have been altered throughout their range because of various land uses may need only meet criteria 1 and 3.

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE - HABITATS AND SPECIES REPORT
IN THE VICINITY OF T01R03E SECTION 11
Report Date: April 23, 2007

Information About Priority Habitats and Species Polygons

Priority Habitats and Species (PHS) polygons are labeled with a unique number and "+" symbol, roughly in the center of the polygon on the map. This PHS Poly number refers to a list of form numbers and species and habitat codes contained in the PHS Polygon Cross Reference Report (listed below). The form numbers refer to the attached PHS Polygon Report. This report details each species or habitat depicted as a polygon on the map. For a complete description of the codes used in this report please refer to the Fish and Wildlife Map Products document. This document may be viewed on our web site at http://www.wdfw.wa.gov/hab/release.htm.

Priority Habitats and Species Polygon - Summary Habitat and Species List:

This report and the accompanying maps may contain some species or habitats that are not considered priority by the agency. YES under the "PHS" column in the table below indicates that the species is considered a priority and is on the Priority Habitats and Species List and/or the Species of Concern List. NO under the "PHS" column indicates the species/habitat is not considered an agency priority.

PHS	State Status	PHS Code	Common Name	Species Use	Species Use Description
YES		OAK	OAK WOODLAND		
YES		RIPAR	RIPARIAN ZONES		
YES		UNOS	URBAN NATURAL OPEN SPACE		

Priority Habitats and Species Polygon Cross Reference Report:

Form number 900000 indicates presence of PHS is unknown or the area was not mapped. Form numbers 909998, 909997, or 909996 indicate compilation errors.

PHS Poly#	Form#	PHS Code*Species Use
2	900000	*-
3	913312	UNOS*-
4	913312	UNOS*-
5	913312	UNOS*-
6	902114-913312	RIPAR*-UNOS*-
7	912981-913312	OAK*-UNOS*-
8	913312	UNOS*-
9	900000	*-
10	912981	OAK*-
11	912981	OAK*-
12	912993	OAK*-
13	912981	OAK*-
14	912981	OAK*-
15	912993	OAK*-
16	912993	OAK*-
17	912981	OAK*-
18	912981	OAK*-
19	913312	UNOS*-
20	912993-913312	OAK*-UNOS*-
21	913311	RIPAR*-
22	913311	RIPAR*-
23	913311	RIPAR*-
24	913311	RIPAR*-
25	913311	RIPAR*-
26	900000	*-

Information About Wildlife Heritage Point Report

Wildlife Heritage points on the map can be referenced to this report by noting the quadpt number where the point occurs on the map, and then looking up the information listed below. This report is sorted by the quadpt number and provides details on each species depicted on the map. For a complete description of the codes used in this report, please refer to the Fish and Wildlife Map Products document. This document may be viewed on our web site at http://www.wdfw.wa.gov/hab/release.htm.

Wildlife Heritage Point - Summary Species List:

This report and the accompanying maps may contain some species or habitats that are not considered priority by the agency. YES under the "PHS" column in the table below indicates that the species is considered a priority and is on the Priority Habitats and Species List and/or the Species of Concern List. NO under the "PHS" column indicates the species/habitat is not considered an agency priority.

PHS	State Status	Species Code	Common Name	Species Use	Species Use Description
YES	ST	HALE	BALD EAGLE	B	BREEDING OCCURRENCE
NO	SM	PAHA	OSPREY	B	BREEDING OCCURRENCE
YES	SC	PRSU	PURPLE MARTIN	B	BREEDING OCCURRENCE

Wildlife Heritage Point Report:

Quadpt#: 4512254011	Species Code: PAHA	Species Use: B	Common Name: OSPREY	
Date: 19890628	Class: SA	Accuracy: C	Scientific Name: PANDION HALIAETUS	
State Status: SM	Federal Status:	Priority: NO	WDFW Region: 5	Verified: V

Township - Range - Section: T02N R03E S35 SWOFSW   Occurrence#: 94   Sequence#: 2
General Description: LACAMAS LAKE TERR: OSPREY NEST IN BROKEN-TOP SNAG ALONG LACAMAS LAKE. NEST ABOUT 0.5MI SE OF NEST #1 WHICH WAS ABANDONED IN 85.

Quadpt#: 4512254015   Species Code: PRSU   Species Use: B   Common Name: PURPLE MARTIN
Date: 19910830   Class: SA   Accuracy: C   Scientific Name: PROGNE SUBIS
State Status: SC   Federal Status: Priority: YES   WDFW Region: 5   Verified: V
Township - Range - Section: T01N R03E S48   Occurrence#: 62   Sequence#: 1
General Description: PURPLE MARTIN NESTING IN 2 PILINGS ON THE UPSTREAM SIDE OF THE BOAT RAMP, PORT OF CAMAS-WASHOUGAL MARINA.

Quadpt#: 4512254026   Species Code: HALE   Species Use: B   Common Name: BALD EAGLE
Date: 20040407   Class: SA   Accuracy: C   Scientific Name: HALIAEETUS LEUCOCEPHALUS
State Status: ST   Federal Status: FT   Priority: YES   WDFW Region: 5   Verified: V
Township - Range - Section: T01N R03E S15 NEOFSW   Occurrence#: 1660   Sequence#: 1
General Description: BALD EAGLE NEST. AIR GPS (NAD 27) 544659 E 5046292 N

Quadpt#: 4512254027   Species Code: HALE   Species Use: B   Common Name: BALD EAGLE
Date: 20050708   Class: SA   Accuracy: C   Scientific Name: HALIAEETUS LEUCOCEPHALUS
State Status: ST   Federal Status: FT   Priority: YES   WDFW Region: 5   Verified: V
Township - Range - Section: T01N R03E S46 SWOFNE   Occurrence#: 1534   Sequence#: 1
General Description: BALD EAGLE NEST IN D. FIR > 35" DBH. TREE TOO TALL AND SITE TOO DENSE TO VIEW JUVENILES FROM GROUND.

Codes Used In Wildlife Heritage Point Report

Quadpt# : A sequential number for a point based on a US Geological Survey 7.5-minute quadrangle.

Species Code : Alphanumeric code which identifies the species. List of codes are available in the documentation.

Species Use : Criteria that identifies how the area is used by the indicated species. List of codes are available in the documentation.

Common Name : Common name of the species.

Date : Date of the observation by year, month, and day (yyyymmdd).

Class : Code that separates animals into general groups.
AA = Artifical animal (e.g., nest platforms not used yet).
EA = Exotic animal.
GA = Game animal.
NA = No animal found after target specific survey completed.
SA = Special animal (e.g., state listed and monitor species).
ST = Split territory.
ZA = Zapped animal. Site no longer supports original occurrence.

Accuracy : Mapping accuracy of the site as determined by the individual doing the mapping.
C = Accurate to within 1/4 mile radius and confirmed by a reliable source.
G = Location known only to a general locality.
N = Accurate to within one mile radius.
U = Accurate to within 1/4 mile radius and unconfirmed by a reliable source.

Scientific Name : Scientific name of the species.

State Status : State listing status of species.
SE = State endangered.   SC = State candidate.
ST = State threatened.   SM = State monitor.
SS = State sensitive.

Federal Status : Federal listing status of species.
FE = Federal endangered.   FC = Federal candidate.
FT = Federal threatened.   FCo = Federal concern.

Priority : Species and habitats that are considered to be priorities for conservation and management by Washington Department of Fish and Wildlife (WDFW). For a copy of the most current Priority Habitats and Species List contact WDFW PHS Section at (360)902-2543, or it is available on our web site at http://www.wdfw.wa.gov/hab/phspage.htm.
YES = Indicates that the species is considered a WDFW priority and is on the Priority Habitat and Species List and/or Species of Concern List.
NO = Indicates that the species is not a WDFW priority.

WDFW Region : This contains the WDFW administrative region number 1 through 6.

Verified : Verification code for an observation.
V = Verified by a reliable source, generally WDFW or other agency biologist.
U = Not verified by a reliable source, or identification of species is uncertain.
1 = Confirmed grizzly bear or wolf observation.
2 = Probable grizzly bear or wolf observation.

Township - Range - Section : The legal description of the species occurrence.

Occurrence# : An ascension catalog number that combined with sequence number identifies a unique record within a species.

Sequence# : Occurrences with multiple locations of a species.

General Description : Description of location of a species.

Form#: 902114 PHS Code: RIPAR Species Use: Common Name: RIPARIAN ZONES
Season: Definition: 5 Accuracy: 1 Scientific Name:
State Status: Federal Status: Priority: YES Site Name: LOWER WASHOUGAL RIVER-LACAMAS CREEK RIPAR
General Description: LOWER WASHOUGAL RIVER-LACAMAS CREEK RIPARIAN CORRIDOR, INCLUDING WETLANDS AND DE CIDUOUS FOREST ALONG WASHOUGAL AND MIXED CONIFEROUS-DECIDUOUS FOREST ALONG LACAM AS CREEK - LOWER AREA USED BY WINTERFOWL AND WADING BIRDS, GREAT HORNED OWLS

Source: DNR ORTHO PHOTO, 1984
Source Date: 84 Source Code: ORTHO
Synopsis:

Source: DUGGER, CARL WDW
Source Date: 032091 Source Code: PROF
Synopsis: OBSERVATIONS DURING PROF DUTIES FORM 1983 TO 1991

Source: ZIMMERMAN, TARA WDW
Source Date: 032191 Source Code: PROF
Synopsis: OBSERVATIONS DURING PROF DUTIES FROM 1983 TO 1991

Form#: 912981 PHS Code: OAK Species Use: Common Name: OAK WOODLAND
Season: Definition: 5 Accuracy: 1 Scientific Name:
State Status: Federal Status: Priority: YES Site Name: CLARK COUNTY OAK WOODLANDS
General Description: OAK WOODLANDS

Source: CHAPPELL, CHRISTOPHER B ET AL WA DEPT OF NATURAL RESOURCES
Source Date: 102999 Source Code: LIT
Synopsis: A GEOGRAPHIC INFORMATION SYSTEM MAP OF EXISTING GRASSLANDS AND OAK WOODLANDS IN THE PUGET LOWLAND AND WILLAMETTE VALLEY ECOREGIONS, WASHINGTON.

Source: MANLOW, STEVE AND ERIC HOLMAN WDFW, DAVE HOWE AND BRENT DAVIS CLARK CO
Source Date: 11 00 Source Code: PROF
Synopsis: OBSERVATIONS OF OAK WOODLANDS DURING FIELD REVIEWS AND SITE INSPECTIONS.

Form#: 912993 PHS Code: OAK Species Use: Common Name: OAK WOODLAND
Season: Definition: 5 Accuracy: 1 Scientific Name:
State Status: Federal Status: Priority: YES Site Name: WASHOUGAL OAKS
General Description: OAK WOODLANDS ADJACENT TO WASHOUGAL RIVER AND SHEPARD HILL.

Source: HOLMAN, ERIC WDFW
Source Date: 11 00 Source Code: PROF
Synopsis: OBSERVATIONS OF OAK WOODLANDS DURING PROJECT REVIEWS AND PHS MAPPING EFFORTS.

Source: MANLOW, STEVE WDFW
Source Date: 11 00 Source Code: PROF
Synopsis: OBSERVATIONS OF OAK WOODLANDS DURING PROJECT REVIEWS AND PHS MAPPING EFFORTS.

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Form#: 913311            PHS Code: RIPAR      Species Use:      Common Name: RIPARIAN ZONES
       Season:           Definition: 5        Accuracy: 1       Scientific Name:
       State Status:     Federal Status:      Priority: YES     Site Name: LADY AND AKERMAN ISLANDS
       General Description: RIPARIAN ZONE ON LADY AND ACKERMAN ISLANDS. COLUMBIA RIVER COTTONWOOD HABITAT.


       Source: DUGGER, CARL  WDFW HABITAT PROGRAM
       Source Date: 09  02     Source Code: PROF
       Synopsis: SITE VISITED ON A REGULAR BASIS.


Form#: 913312            PHS Code: UNOS       Species Use:      Common Name: URBAN NATURAL OPEN SPACE
       Season:           Definition: 5        Accuracy: 1       Scientific Name:
       State Status:     Federal Status:      Priority: YES     Site Name: CAMAS UNOS
       General Description: URBAN NATURAL OPEN SPACE IN THE VICINITY OF CAMAS AND WASHOUGAL. AREA SUPPORTS
                            MATURE TIMBER. FREQUENT OBSERVATIONS OF VAUX SWIFTS SURROUNDING DEAD LAKE.


       Source: DUGGER, CARL  AND STEVE MANLOW  WDFW HABITAT PROGRAM
       Source Date: 10  02     Source Code: PROF
       Synopsis: OBSERVATIONS OF URBAN NATURAL OPEN SPACE HABITAT IN THE VICINITY OF CAMAS FROM
                 1991 TO THE PRESENT.
```

Codes Used In Priority Habitat and Species Polygon Report

Form# : Unique number that links the information in the reports to features on the map.

PHS Code : This contains a code that identifies the fish and wildlife species found in the area or the habitat that occurs there. List of codes are available in the documentation.

Species Use : Criteria that identifies how the area is used by the indicated species. List of codes are available in the documentation. This field is not used if a habitat is described.

Common Name : Common name of the species or habitat.

Season : Season of species use. Use is indicated by the presence of a non-blank character in one or more positions or sub-strings of the field position.
Position 1: W = Winter use. Position 2: S = Spring use.
Position 3: U = Summer use. Position 4: F = Fall use.
Position 5: S = Severe winter use.

Definition : Identifies the definitions or criteria used to classify the area as a priority. List of codes are available in the documentation.

Accuracy : Mapping accuracy of the line delineation as determined by the mapper.
1 = Accurate within a 1/4 mile. 3 = Location known to within one mile.
2 = Accurate within a 1/2 mile. 4 = Location known to general locality only.

Scientific Name : Scientific name of the species.

State Status : State listing status of species.
SE = State endangered. SC = State candidate.
ST = State threatened. SM = State monitor.
SS = State sensitive.

Federal Status : Federal listing status of species.
FE = Federal endangered. FC = Federal candidate.
FT = Federal threatened. FCo = Federal concern.

Priority : Species and habitats that are considered to be priorities for conservation and management by Washington Department of Fish and Wildlife (WDFW). For a copy of the most current Priority Habitats and Species List contact WDFW PHS Section at (360)902-2543, or it is available on our web site at http://www.wdfw.wa.gov/hab/phspage.htm.
YES = Indicates that the species is considered a WDFW priority and is on the Priority Habitat and Species List and/or Species of Concern List.
NO = Indicates that the species is not a WDFW priority.

Site Name : Name assigned to the area based generally on a local place name.

General Description : Description about the area, including how it is used and why it is important.

Source : Identifies and describes the source responsible for the information described on the form or drawn on the map. Single or multiple sources may be cited.

Source Date : Date of source of information.

Source Code : Code identifying the source of information.

Synopsis : Brief narrative describing content of source of information.

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
PRIORITY FISH REPORT FROM THE WASHINGTON LAKES AND RIVERS INFORMATION SYSTEM (WLRIS) DATABASE
FOR TOWNSHIP T01R03E, SECTION 11
Report Date: April 23, 2007

Information About The Fish Presence Report

The fish information in this report only includes information that Washington Department of Fish and Wildlife (WDFW) maintains in a central computer database. This information only documents the location of important fish resources to the best of our knowledge. It is not a complete inventory of the fish species in the state. Fish are identified as priority by WDFW if they meet one of three criterion as listed in the Priority Habitats and Species List. The list is available by contacting WDFW Priority Habitats and Species section at (360)902-2543, or it is available on our web site at http://www.wdfw.wa.gov/hab/phspage.htm. To insure appropriate use of this information users are encouraged to consult with WDFW biologists.

Streams with presence of priority anadromous and resident fish species from the WLRIS database are highlighted on the accompanying map. Due to the complexity of displaying linear features individual species that utilize each river reach are not distinguishable. If more species specific information is needed, users should request individual species maps, digital data, or contact the WLRIS database manager.

State status information is not available in the WLRIS database for these species. Please see WDFW Species of Concern List for current status. For a copy of this list, contact WDFW Endangered Species Section at (360)902-2515, or it is available on our web site at http://www.wdfw.wa.gov/wlm/diversty/soc/soc.htm.

Priority Anadromous Fish Presence:

Code	Common Name	Stream Name	Stream LLID	Record Date
CHFA	Fall Chinook	Columbia River	1240483462464	05-03-14
CHMF	Fall Chum	Columbia River	1240483462464	05-03-14
CHSP	Spring Chinook	Columbia River	1240483462464	05-03-14
CHSU	Summer Chinook	Columbia River	1240483462464	04-03-26
COHO	Coho Salmon	Columbia River	1240483462464	05-03-14
DBT	Dolly Varden/Bull Trout	Columbia River	1240483462464	05-03-14
PINK	Pink Salmon	Columbia River	1240483462464	05-03-14
SOCK	Sockeye Salmon	Columbia River	1240483462464	05-03-14
STSU	Summer Steelhead	Columbia River	1240483462464	05-03-14
STWI	Winter Steelhead	Columbia River	1240483462464	05-03-14
CHMF	Fall Chum	Lacamas Creek	1223935455865	05-03-14
COHO	Coho Salmon	Lacamas Creek	1223935455865	05-03-14
CHFA	Fall Chinook	Stream name(s) not in database	1223700455885	05-03-14
CHFA	Fall Chinook	Stream name(s) not in database	1223955455836	05-03-14
CHFA	Fall Chinook	Stream name(s) not in database	1223964455727	05-03-14
CHMF	Fall Chum	Stream name(s) not in database	1223700455885	05-03-14
CHMF	Fall Chum	Stream name(s) not in database	1223955455836	05-03-14
CHMF	Fall Chum	Stream name(s) not in database	1223964455727	05-03-14
COHO	Coho Salmon	Stream name(s) not in database	1223700455885	05-03-14
COHO	Coho Salmon	Stream name(s) not in database	1223955455836	05-03-14
COHO	Coho Salmon	Stream name(s) not in database	1223964455727	05-03-14
DBT	Dolly Varden/Bull Trout	Stream name(s) not in database	1223964455727	05-03-14
STSU	Summer Steelhead	Stream name(s) not in database	1223700455885	05-03-14
STSU	Summer Steelhead	Stream name(s) not in database	1223955455836	05-03-14
STSU	Summer Steelhead	Stream name(s) not in database	1223964455727	05-03-14
STWI	Winter Steelhead	Stream name(s) not in database	1223700455885	05-03-14
STWI	Winter Steelhead	Stream name(s) not in database	1223955455836	05-03-14
STWI	Winter Steelhead	Stream name(s) not in database	1223964455727	05-03-14
CHFA	Fall Chinook	Washougal River	1223962455734	05-03-14
CHMF	Fall Chum	Washougal River	1223962455734	05-03-14
COHO	Coho Salmon	Washougal River	1223962455734	05-03-14
STSU	Summer Steelhead	Washougal River	1223962455734	05-03-14
STWI	Winter Steelhead	Washougal River	1223962455734	05-03-14

Priority Resident Fish Presence:

Code	Common Name	Stream Name	Stream LLID	Record Date
CCT	Resident Cutthroat	Stream name(s) not in database	1223700455885	05-03-14
CCT	Resident Cutthroat	Stream name(s) not in database	1223955455836	05-03-14
CCT	Resident Cutthroat	Stream name(s) not in database	1223963455976	05-03-14
CCT	Resident Cutthroat	Stream name(s) not in database	1223964455727	05-03-14
CCT	Resident Cutthroat	Columbia River	1240483462464	05-03-14
CCT	Resident Cutthroat	Lacamas Creek	1223935455865	05-03-14
RBT	Rainbow Trout	Lacamas Creek	1223935455865	04-10-19
CCT	Resident Cutthroat	Washougal River	1223962455734	05-03-14

Codes Used In The Fish Presence Report

Code : WDFW alphanumeric code that identifies the fish species.

Common Name : Common name of the fish species.

Stream Name : Stream name based on the US Geological Survey, Geographic Names Information System database.

Stream LLID : Unique stream identifier (ID) generated from the node latitude and longitude located at a stream's mouth. This ID is to be construed only as an ID, and not necessarily as a reference to a stream's location.

Record Date : Date the information was entered into the database.

Appendix 3

Previously Issued Permits

JD
TZ
JW
outfall
Camas File 05680

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

GRAY & OSBORNE, INC.
REC'D - SEATTLE
AUG 14 2006
JOB #

August 11, 2006

Monte Brachmann
City of Camas
616 Fourth Avenue
Camas, WA 98607

RE: U.S. Army Corps of Engineers Reference #200501420
Nationwide Permit #3 for Diffuser Cap Maintenance, Columbia River, Clark County, Washington

Dear Mr. Brachmann:

This letter is to confirm that the above-referenced project will not require an individual water quality certification or Coastal Zone Management consistency determination from the Department of Ecology. Your project does not meet our criteria for requiring an individual certification under Nationwide Permit #3.

Please note that this letter does not exempt the applicant from compliance with other requirements of federal, state, and local agencies.

Please contact me if you have any questions regarding this letter at (360) 407-7391 or e-mail rcol461@ecy.wa.gov.

Sincerely,

Loree Ochoa
for

Randi Redick
Federal Permit Manager
Shorelands and Environmental Assistance Program

RR:dn

cc: Ron Klump, U.S. Army Corps of Engineers
Jay Swift, Gray & Osborne, Inc.

Washington Department of FISH and WILDLIFE

H. .DRAULIC PROJECT APPROVAL

RCW 77.55.021 - Appeal pursuant to Chapter 34.05 RCW

Southwest
2108 Grand Boulevard
Vancouver, WA 98661
(360) 696-6211

Issue Date: October 26, 2006
Project Expiration Date: February 28, 2011

Control Number: 105882-1
FPA/Public Notice #: N/A

PERMITTEE	AUTHORIZED AGENT OR CONTRACTOR
City of Camas Public Works	Gray & Osborne, Inc.
ATTENTION: Monte Brachmann	ATTENTION: Jay Swift
616 Fourth Avenue	701 Dexter Avenue North
Camas, WA 98607	Seattle, WA 98109
360-817-1560	206-284-0860
Fax: 360-834-1535	Fax: 206-283-3206

Project Name: WS-635 WWTF Outfall Modifications

Project Description: Re-orient the eight diffuser risers currently in use on the City of Camas outfall, and install Tideflex Valves on the ends of the risers to minimize entrainment of debris in the diffuser pipe.

PROVISIONS

1. Work below the ordinary high water line shall only occur between November 1 and February 28 in the years 2006, 2007, 2008, 2009, 2010, 2011.

2. NOTIFICATION REQUIREMENT: The Area Habitat Biologist (AHB) listed below shall receive written notification (email, phone, FAX or mail) from the person to whom this Hydraulic Project Approval (HPA) is issued (permittee) or the agent/contractor no less than three working days prior to the start of construction activities. The notification shall include the permittee's name, project location, starting date for work, and the control number for this HPA.

3. Work shall be accomplished per plans and specifications approved by the Washington Department of Fish and Wildlife entitled JARPA and dated 12/14/05, except as modified by this Hydraulic Project Approval. A copy of these plans shall be available on site during construction.

4. The outfall facility shall be maintained by the owner(s) per RCW 77.57.030 to ensure continued, unimpeded fish passage. If the structure becomes a hindrance to fish passage, the owner(s) shall be responsible for obtaining an Hydraulic Project Approval and providing prompt repair. Financial responsibility for maintenance and repairs shall be that of the owner(s).

5. The outfall structure shall be constructed to prevent the entry of fish.

6. The outfall structure shall be constructed and maintained to ensure the unimpeded passage of fish.

7. If at any time, as a result of project activities, fish are observed in distress, a fish kill occurs, or water quality problems develop (including equipment leaks or spills), immediate notification shall be made to the Washington Department of Ecology at 1-800-258-5990, and to the Area Habitat Biologist listed below.

Washington
Department of
FISH and
WILDLIFE

H, ,DRAULIC PROJECT APPROVAL

RCW 77.55.021 - Appeal pursuant to Chapter 34.05 RCW

Southwest
2108 Grand Boulevard
Vancouver, WA 98661
(360) 696-6211

Issue Date: October 26, 2006
Project Expiration Date: February 28, 2011

Control Number: 105882-1
FPA/Public Notice #: N/A

PROJECT LOCATIONS

Location #1

WORK START: November 01, 2006				WORK END: February 28, 2011		
WRIA: 27.0001		Waterbody: Columbia River			Tributary to: Pacific Ocean	
1/4 SEC:	Section:	Township:	Range:	Latitude:	Longitude:	County:
NW 1/4	13	01 N	03 E	N 45.5767	W 122.3911	Clark
Location #1 Driving Directions						

NOTES

APPLY TO ALL HYDRAULIC PROJECT APPROVALS

This Hydraulic Project Approval pertains only to those requirements of the Washington State Hydraulic Code, specifically Chapter 77.55 RCW (formerly RCW 77.20). Additional authorization from other public agencies may be necessary for this project. The person(s) to whom this Hydraulic Project Approval is issued is responsible for applying for and obtaining any additional authorization from other public agencies (local, state and/or federal) that may be necessary for this project.

This Hydraulic Project Approval shall be available on the job site at all times and all its provisions followed by the person(s) to whom this Hydraulic Project Approval is issued and operator(s) performing the work.

This Hydraulic Project Approval does not authorize trespass.

The person(s) to whom this Hydraulic Project Approval is issued and operator(s) performing the work may be held liable for any loss or damage to fish life or fish habitat that results from failure to comply with the provisions of this Hydraulic Project Approval.

Failure to comply with the provisions of this Hydraulic Project Approval could result in a civil penalty of up to one hundred dollars per day and/or a gross misdemeanor charge, possibly punishable by fine and/or imprisonment.

All Hydraulic Project Approvals issued pursuant to RCW 77.55.021 (EXCEPT agricultural irrigation, stock watering or bank stabilization projects) or 77.55.141 are subject to additional restrictions, conditions or revocation if the Department of Fish and Wildlife determines that new biological or physical information indicates the need for such action. The person(s) to whom this Hydraulic Project Approval is issued has the right pursuant to Chapter 34.04 RCW to appeal such decisions. All agricultural irrigation, stock watering or bank stabilization Hydraulic Project Approvals issued pursuant to RCW 77.55.021 may be modified by the Department of Fish and Wildlife due to changed conditions after consultation with the person(s) to whom this Hydraulic Project Approval is issued: PROVIDED HOWEVER, that such modifications shall be subject to appeal to the Hydraulic Appeals Board established in RCW 77.55.301.

APPEALS INFORMATION

If you wish to appeal the issuance or denial of, or conditions provided in a Hydraulic Project Approval, there are informal and formal appeal processes available.

A. INFORMAL APPEALS (WAC 220-110-340) OF DEPARTMENT ACTIONS TAKEN PURSUANT TO RCW 77.55.021, 77.55.141, 77.55.181, and 77.55.291: A person who is aggrieved or adversely affected by the following Department actions may request an informal review of:

(A) The denial or issuance of a Hydraulic Project Approval, or the conditions or provisions made part of a Hydraulic Project Approval; or

(B) An order imposing civil penalties. A request for an INFORMAL REVIEW shall be in WRITING to the Department of Fish and Wildlife HPA Appeals Coordinator, 600 Capitol Way North, Olympia, Washington 98501-1091 and shall be RECEIVED by the Department within 30 days of the denial or issuance of a Hydraulic Project Approval or receipt of an order imposing civil penalties. If agreed to by the aggrieved party, and the aggrieved party is the Hydraulic Project Approval applicant, resolution of the concerns will be facilitated through discussions with the Area Habitat Biologist and his/her supervisor. If resolution is not reached, or the aggrieved party is not the Hydraulic Project Approval applicant, the Habitat Technical Services Division Manager or his/her designee shall conduct a review and recommend a decision to the Director or his/her designee. If you are not satisfied with the results of this informal appeal, a formal appeal may be filed.

B. FORMAL APPEALS (WAC 220-110-350) OF DEPARTMENT ACTIONS TAKEN PURSUANT TO RCW 77.55.021 (EXCEPT agricultural irrigation, stock watering or bank stabilization projects) or 77.55.291:
A person who is aggrieved or adversely affected by the following Department actions may request a formal review of:

(A) The denial or issuance of a Hydraulic Project Approval, or the conditions or provisions made part of a Hydraulic Project Approval;

(B) An order imposing civil penalties; or

(C) Any other 'agency action' for which an adjudicative proceeding is required under the Administrative Procedure Act, Chapter 34.05 RCW.

A request for a FORMAL APPEAL shall be in WRITING to the Department of Fish and Wildlife HPA Appeals Coordinator, shall be plainly labeled as 'REQUEST FOR FORMAL APPEAL' and shall be RECEIVED DURING OFFICE HOURS by the Department at 600 Capitol Way North, Olympia, Washington 98501-1091, within 30-days of the Department action that is being challenged. The time period for requesting a formal appeal is suspended during consideration of a timely informal appeal. If there has been an informal appeal, the deadline for requesting a formal appeal shall be within 30-days of the date of the Department's written decision in response to the informal appeal.

C. FORMAL APPEALS OF DEPARTMENT ACTIONS TAKEN PURSUANT TO RCW 77.55.021 (agricultural irrigation, stock watering or bank stabilization only), 77.55.141, 77.55.181, or 77.55.241: A person who is aggrieved or adversely affected by the denial or issuance of a Hydraulic Project Approval, or the conditions or provisions made part of a Hydraulic Project Approval may request a formal appeal. The request for FORMAL APPEAL shall be in WRITING to the Hydraulic Appeals Board per WAC 259-04 at Environmental Hearings Office, 4224 Sixth Avenue SE, Building Two - Rowe Six, Lacey, Washington 98504; telephone 360/459-6327.

D. FORMAL APPEALS OF DEPARTMENT ACTIONS TAKEN PURSUANT TO CHAPTER 43.21L RCW: A person who is aggrieved or adversely affected by the denial or issuance of a Hydraulic Project Approval, or the conditions or provisions made part of a Hydraulic Project Approval may request a formal appeal. The FORMAL APPEAL shall be in accordance with the provisions of Chapter 43.21L RCW and Chapter 199-08 WAC. The request for FORMAL APPEAL shall be in WRITING to the Environmental and Land Use Hearings Board at Environmental Hearings Office, Environmental and Land Use Hearings Board, 4224 Sixth Avenue SE, Building Two - Rowe Six, P.O. Box 40903, Lacey, Washington 98504; telephone 360/459-6327.

E. FAILURE TO APPEAL WITHIN THE REQUIRED TIME PERIODS results in forfeiture of all appeal rights. If there is no timely request for an appeal, the department action shall be final and unappealable.

Washington
Department of
FISH and
WILDLIFE

H, DRAULIC PROJECT APPROVAL

RCW 77.55.021 - Appeal pursuant to Chapter 34.05 RCW

Southwest
2108 Grand Boulevard
Vancouver, WA 98661
(360) 696-6211

Issue Date: October 26, 2006 | Control Number: 105882-1

Project Expiration Date: February 28, 2011 | FPA/Public Notice #: N/A

ENFORCEMENT: Sergeant Webb (38) P3

Habitat Biologist Anne Friesz	friesarf@dfw.wa.gov 360-906-6764	Anne R Friesz	for Director WDFW

CC: WRIA file, Olympia
Todd Welker, DNR PC Region

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CRITICAL HABITAT; CANDIDATE SPECIES; AND SPECIES OF CONCERN
IN CLARK COUNTY
AS PREPARED BY
THE U.S. FISH AND WILDLIFE SERVICE
WESTERN WASHINGTON FISH AND WILDLIFE OFFICE

(Revised November 1, 2007)

LISTED

Bull trout (*Salvelinus confluentus*)

Gray wolf (*Canis lupus*)

Northern spotted owl (*Strix occidentalis caurina*)

Major concerns that should be addressed in your Biological Assessment of project impacts to listed species include:

1. Level of use of the project area by listed species.

2. Effect of the project on listed species' primary food stocks, prey species, and foraging areas in all areas influenced by the project.

3. Impacts from project activities and implementation (e.g., increased noise levels, increased human activity and/or access, loss or degradation of habitat) that may result in disturbance to listed species and/or their avoidance of the project area.

Castilleja levisecta (golden paintbrush) [historic]

Howellia aquatilis (water howellia)

Lomatium bradshawii (Bradshaw's lomatium)

Major concerns that should be addressed in your Biological Assessment of project impacts to listed plant species include:

1. Distribution of taxon in project vicinity.

2. Disturbance (trampling, uprooting, collecting, etc.) of individual plants and loss of habitat.

3. Changes in hydrology where taxon is found.

DESIGNATED

Critical habitat for bull trout

PROPOSED

None

CANDIDATE

(Brush Prairie) Mazama pocket gopher (*Thomomys mazama* ssp. *oregonus*)
Oregon spotted frog (*Rana pretiosa*)

SPECIES OF CONCERN

Aleutian Canada goose (*Branta canadensis leucopareia*)
Bald eagle (*Haliaeetus leucocephalus*)
California wolverine (*Gulo gulo luteus*)
Cascades frog (*Rana ascadae*)
Coastal cutthroat trout (*Oncorhynchus clarki clarki*) [southwest Washington DPS]
Larch Mountain salamander (*Plethodon larselli*)
Long-eared myotis (*Myotis evotis*)
Long-legged myotis (*Myotis volans*)
Northern goshawk (*Accipiter gentilis*)
Northwestern pond turtle (*Emys* (= *Clemmys*) *marmorata marmorata*)
Olive-sided flycatcher (*Contopus cooperi*)
Pacific lamprey (*Lampetra tridentata*)
Pacific Townsend=s big-eared bat (Corynorhinus townsendii townsendii)
Peregrine falcon (*Falco peregrinus*)
River lamprey (*Lampetra ayresi*)
Slender-billed white-breasted nuthatch (*Sitta carolinensis aculeata*)
Tailed frog (*Ascaphus truei*)
Van Dyke=s salamander (*Plethodon vandykei*)
Western gray squirrel (*Sciurus griseus griseus*)

Western toad (*Bufo boreas*)
Cimicifuga elata (tall bugbane)
Corydalis aquae-gelidae (Clackamas corydalis)
Lathyrus torreyi (Torrey's peavine) [historic]

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

REPLY TO
ATTENTION OF

APR 28 2006

Regulatory Branch

Mr. Monte Brachmann
City of Camas Public Works
616 Fourth Avenue
Camas, Washington 98607

Reference: 200501420
Camas Public Works

Dear Mr. Brachmann:

Our regulatory program utilizes a series of nationwide permits (NWPs) to authorize specific categories of work that have minimal impact on the aquatic environment when conducted in accordance with the permit conditions (*Federal Register*, January 15, 2002, Vol. 67, No. 10). Based on the information you provided to us, NWP 3, Maintenance, authorizes your proposal to replace/modify 8 diffuser caps on the waste water line, as depicted on the enclosed drawings dated April 18, 2006. The project would occur in the Columbia River near Camas, Clark County, Washington.

In order for this NWP authorization to be valid, you must ensure that the work is performed in accordance with the enclosed *Nationwide Permit 3, Terms and Conditions* and the following special conditions that we have added to ensure that this project would have no more than a minimal adverse impact on the aquatic environment:

a. If future operations by the United States require the removal, relocation, or other alteration of the work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, you will be required, upon due notice from the U.S. Army Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

b. In order to meet the requirements of the Endangered Species Act (ESA) SLOPES III Programmatic Consultation, you must comply with the enclosed *Terms and Conditions of the SLOPES III Programmatic Consultation for* "Overwater and in-water structures ". If you cannot comply with the terms and conditions of this programmatic consultation, you must, prior to commencing construction, contact the U.S. Army Corps of Engineers, Seattle District, Regulatory Branch for an individual consultation in accordance with the requirements of the ESA.

We have reviewed your project pursuant to the requirements of the Endangered Species Act (ESA). The U.S. Army Corps of Engineers has consulted on a programmatic basis with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service for certain actions and determined that this project meets the requirements of NWP National General Condition 11 provided you comply with special condition "b" listed above. We have also reviewed your project pursuant to the requirements of the Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 in regards to Essential Fish Habitat (EFH). We have determined that the proposed action will not adversely affect EFH for federally managed fisheries in Washington.

Our verification of this NWP is valid for 2 years from the date of this letter unless the NWP is modified, reissued or revoked. All of the existing NWPs are scheduled to be modified, reissued, or revoked prior to March 18, 2007. It is incumbent upon you to remain informed of changes to the NWPs. We will issue a public notice when the NWPs are reissued. Furthermore, if you commence or are under contract to commence this activity before the date that the relevant nationwide permit is modified or revoked, you will have twelve (12) months from the date of the modification or revocation of the NWP to complete the activity under the present terms and conditions of this nationwide permit. This verification includes a preliminary jurisdictional determination that is not appealable.

If this project complies with all terms and conditions of this NWP, you will need no further authorization from us. However, you must still obtain all State and local permits that apply to your project. Also, we remind you that failure to comply with all terms and conditions of this NWP verification invalidates your authorization and could result in a violation of Section 10 of the 1899 Rivers and Harbors Act.

Upon completing the authorized work, please fill out and return the enclosed *Certificate of Compliance with Department of the Army Permit* form to the address indicated on the form. Your signature on this form is our assurance that the completed work and any required mitigation was conducted in accordance with the terms and conditions of this NWP.

Thank you for your cooperation during the permit process. Your efforts help us protect our nation's aquatic resources, including wetlands. We are interested in your thoughts and opinions concerning your experience with our Regulatory Program and encourage you to complete a customer service survey form. This form and information about our program is available on our website at: www.nws.usace.army.mil click on Regulatory – Regulatory/Permits.

A copy of this letter with enclosures will be furnished to Mr. Jay Swift, Gray and Osborne, Inc., 701 Dexter Avenue North, Suite 200, Seattle, Washington 98109. If you have any questions about this letter or our regulatory program, please contact me at (360) 750-9046 or via email at Ron.Klump@usace.army.mil.

Sincerely,

Kristin G. Tong
for
Ron Klump, Project Manager
Enforcement Section

Enclosures

US Army Corps
of Engineers
Seattle District

NATIONWIDE PERMIT 3
Terms and Conditions

Effective Date: March 18, 2002

In addition to any special condition that may be required on a case-by-case basis by the District Engineer, the following terms and conditions must be met, as applicable, for a Nationwide Permit 3 authorization to be valid in Washington State.

A. DESCRIPTION OF AUTHORIZED ACTIVITIES

Maintenance. Activities related to:

(i) The repair, rehabilitation, or replacement of any previously authorized, currently serviceable, structure, or fill, or of any currently serviceable structure or fill authorized by 33 CFR 330.3, provided that the structure or fill is not to be put to uses differing from those uses specified or contemplated for it in the original permit or the most recently authorized modification. Minor deviations in the structure's configuration or filled area including those due to changes in materials, construction techniques, or current construction codes or safety standards which are necessary to make repair, rehabilitation, or replacement, are permitted, provided the adverse environmental effects resulting from such repair, rehabilitation, or replacement are minimal. Currently serviceable means useable as is or with some maintenance, but not so degraded as to essentially require reconstruction. This NWP authorizes the repair, rehabilitation, or replacement of those structures or fills destroyed or damaged by storms, floods, fire, or other discrete events, provided the repair, rehabilitation, or replacement is commenced, or is under contract to commence, within two years of the date of their destruction or damage. In cases of catastrophic events, such as hurricanes or tornadoes, this two-year limit may be waived by the District Engineer, provided the permittee can demonstrate funding, contract, or other similar delays.

(ii) Discharges of dredged or fill material, including excavation, into all waters of the US to remove accumulated sediments and debris in the vicinity of, and within, existing structures (e.g., bridges, culverted road crossings, water intake structures, etc.) and the placement of new or additional riprap to protect the structure, provided the permittee notifies the District Engineer in accordance with General Condition 13. The removal of sediment is limited to the minimum necessary to restore the waterway in the immediate vicinity of the structure to the approximate dimensions that existed when the structure was built, but cannot extend further than 200 feet in any direction from the structure. The placement of riprap must be the minimum necessary to protect the structure or to ensure the safety of the structure. All excavated materials must be deposited and retained in an upland area unless otherwise specifically approved by the District Engineer under separate authorization. Any bank stabilization measures not directly associated with the structure will require a separate authorization from the District Engineer. (Sections 10 and 404)

(iii) **REVOKED**

This permit does not authorize maintenance dredging for the primary purpose of navigation and beach restoration. This permit does not authorize new stream channelization or stream relocation projects. Any work authorized by this permit must not cause more than minimal degradation of water quality, more than minimal changes to the flow characteristics of the stream, or increase flooding (See General Conditions 9 and 21). (Sections 10 and 404)

NOTE: This NWP authorizes the repair, rehabilitation, or replacement of any previously authorized structure or fill that does not qualify for the Section 404(f) exemption for maintenance.

B. CORPS REGIONAL CONDITIONS FOR THIS NWP

Regional Condition for NWP 3(i) – Maintenance, Repair
The repair or replacement of existing permitted bank protection must incorporate the least environmentally damaging practicable methods. These methods include but are not limited to the use of bioengineering, biotechnical design, root wads, large woody debris, native plantings, and fish friendly riprap designs.

Regional Condition for NWP 3(ii) – Sediment Removal, Riprap Placement

The permittee must avoid and minimize discharges into waters of the United States at the project site to the maximum extent practicable, and the "Notification" must include a written justification to the District Engineer detailing compliance with this condition. To enable the Corps in making this determination, the notification must include the following assessments:

a. Why the discharge must occur in waters of the United States and why avoidance or additional minimization cannot be achieved.

b. How the proposed project incorporates least environmentally damaging practicable bank protection methods. These methods include but are not limited to the use of bioengineering, biotechnical design, root wads, large woody debris, native plantings, and fish friendly riprap designs.

C. EPA, Puyallup Tribe and Chehalis Tribe WQC CONDITIONS FOR THIS NWP

EPA, Puyallup Tribe and Chehalis Tribe water quality certification (WQC) has been denied without prejudice. An individual WQC is required for all Section 404 activities.

D. STATE WQC CONDITIONS FOR THIS NWP

State WQC has been partially denied without prejudice for this permit. An individual 401 Certification is required for projects or activities authorized under this NWP if the project/activity will likely result in any of the following adverse effects:

1. The project or activity will likely cause or contribute to an exceedance of a State water quality standard (WAC 173-201A) or sediment quality standard (WAC 173-204). The requirement to obtain an individual 401 certification shall not apply to projects or activities that are carried out in accordance with the following permits, approvals, or management practices. These projects are presumed to comply with state water quality standards including state sediment management standards:

   a. Projects or activities where the discharges authorized under this NWP are explicitly authorized or covered by a National Pollutant Discharge Elimination System permit.

   b. Projects, activities or portions of projects or activities designed, constructed and maintained in accordance with the stormwater standards and practices contained in the most current version of Ecology's Stormwater Manual or an Ecology approved equivalent.

   c. For WSDOT in-water or over-water construction and maintenance activities, an individual 401 certification is not required for those projects carried out in compliance with 2 through 4 below and the Ecology approved Implementing Agreement regarding compliance with the state of Washington Surface Water Quality Standards.

   Compliance with this condition will be determined through receipt of a signed statement by the WSDOT project engineer or maintenance supervisor, guaranteeing that the project will meet the latest Ecology approved Water Quality Implementing Agreement for work In-Water. This statement shall be sent to the Corps of Engineers along with the JARPA application.

2. For projects/activities not designed in accordance with either Ecology's stormwater manual or an Ecology approved equivalent, or for projects where there is credible site specific information which indicates that the permits, approvals, or management practices identified above will not be sufficient to meet state water quality standards, the applicant may provide documentation with the application that the project/activity will otherwise comply with state water quality standards. An individual 401 Certification is required for projects which are unable to provide documentation that the project/activity will otherwise comply with state water quality standards.

3. Projects or activities that cause or contribute to a discharge to a waterbody on the state's list of impaired waterbodies [i.e., the 303(d) list] and the discharge may result in further exceedances of a specific parameter the waterbody is listed for. The current list of 303(d)-listed waterbodies is available on Ecology's web site at http:*//www.ecy.wa.gov/programs/wq/303d/1998/wrias/1998_water_segs.pdf* or by contacting Ecology's Federal Permits staff.

NOTE: An individual 401 Certification will <u>not</u> be required if the applicant provides documentation showing that the project or activity will either <u>not</u> result in a discharge containing the listed parameter or, if present, the parameter will <u>not</u> contribute to an increased impairment of the waterbody.

4. Projects that do not incorporate structures and/or modifications beneficial for fish or wildlife habitat (e.g., soil bioengineering, biotechnical design, rock barbs, etc.).

NOTE: An individual 401 certification will not be required if the project/activity is designed and constructed in accordance to guidelines developed by the Washington State Department of Fish and Wildlife.

E. STATE CZM CONSISTENCY DETERMINATION CONDITIONS FOR THIS NWP

The Coastal Zone Management (CZM) Consistency Determination has been partially denied without prejudice for this NWP. An individual CZM Consistency Response must be obtained for projects requiring individual 401 Certification and located within counties in the coastal zone.

F. CORPS NATIONAL GENERAL CONDITIONS FOR ALL NWPs

1. **Navigation**. No activity may cause more than a minimal adverse effect on navigation.

2. **Proper Maintenance**. Any structure or fill authorized shall be properly maintained, including maintenance to ensure public safety.

3. **Soil Erosion and Sediment Controls**. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

4. **Aquatic Life Movements**. No activity may substantially disrupt the necessary life-cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. Culverts placed in streams must be installed to maintain low flow conditions.

5. **Equipment.** Heavy equipment working in wetlands must be placed on mats, or other measures must be taken to minimize soil disturbance.

6. **Regional and Case-By-Case Conditions**. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state or tribe in its Section 401 Water Quality Certification and Coastal Zone Management Act consistency determination.

7. **Wild and Scenic Rivers**. No activity may occur in a component of the National Wild and Scenic River System; or in a river officially designated by Congress as a "study river" for possible inclusion in the system, while the river is in an official study status; unless the appropriate Federal agency, with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation, or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency in the area (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

8. **Tribal Rights**. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

9. **Water Quality**.

(a) In certain states and tribal lands an individual 401 Water Quality Certification must be obtained or waived (See 33 CFR 330.4(c)).

(b) For NWPs 12, 14, 17, 18, 32, 39, 40, 42, 43, and 44, where the state or tribal 401 certification (either generically or individually) does not require or approve water quality management measures, the permittee must provide water quality management measures that will ensure that the authorized work does not result in more than minimal degradation of water quality (or the Corps determines that compliance with state or local standards, where applicable, will ensure no more than minimal adverse effect on water quality). An important component of water quality management includes stormwater management that minimizes degradation of the downstream aquatic system, including water quality (refer to General Condition 21 for stormwater management requirements). Another important component of water quality management is the establishment and maintenance of vegetated buffers next to open waters, including streams (refer to General Condition 19 for vegetated buffer requirements for the NWPs). This condition is only applicable to projects that have the potential to affect water quality. While appropriate measures must be taken, in most cases it is not necessary to conduct detailed studies to identify such measures or to require monitoring.

10. **Coastal Zone Management**. In certain states, an individual state coastal zone management consistency concurrence must be obtained or waived (see 33 CFR 330.4(d)).

11. **Endangered Species.**

(a) No activity is authorized under any NWP which is likely to jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will destroy or adversely modify the critical habitat of such species. Non-federal permittees shall notify the District Engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or is located in the designated critical habitat and shall not begin work on the activity until notified by the District Engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that may affect Federally-listed endangered or threatened species or designated critical habitat, the notification must include the name(s) of the endangered or threatened species that may be affected by the proposed work or that utilize the designated critical habitat that may be affected by the proposed work. As a result of formal or informal consultation with the FWS or NMFS the District Engineer may add species-specific regional endangered species conditions to the NWPs.

(b) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the USFWS or the NMFS, both lethal and non-lethal "takes" of protected species are in violation of the ESA. Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the USFWS and NMFS or their world wide web pages at *http://www.fws.gov/r9endspp/endspp.html* and *http://www.nmfs.noaa.gov/prot_res/overview/es.html* respectively.

12. **Historic Properties**. No activity which may affect historic properties listed, or eligible for listing, in the National Register of Historic Places is authorized, until the District Engineer has complied with the provisions of 33 CFR part 325, Appendix C. The prospective permittee must notify the District Engineer if the authorized activity may affect any historic properties listed, determined to be eligible, or which the prospective permittee has reason to believe may be eligible for listing on the National Register of Historic Places, and shall not begin the activity until notified by the District Engineer that the requirements of the National Historic Preservation Act have been satisfied and that the activity is authorized. Information on the location and existence of historic resources can be obtained from the State Historic Preservation Office and the National Register of Historic Places (see 33 CFR 330.4(g)). For activities that may affect historic properties listed in, or eligible for listing in, the National Register of Historic Places, the notification must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property.

13. **Notification.**

(a) **Timing**: Where required by the terms of the NWP, the prospective permittee must notify the District Engineer with a preconstruction notification (PCN) as early as possible. The District Engineer must determine if the notification is complete within 30 days of the date of receipt and can request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the District Engineer will notify the prospective permittee that the notification is still incomplete and the PCN review process will not commence until all of the requested information has been received by the District Engineer. The prospective permittee shall not begin the activity:

(1) Until notified in writing by the District Engineer that the activity may proceed under the NWP with any special conditions imposed by the District or Division Engineer; or

(2) If notified in writing by the District or Division Engineer that an Individual Permit is required; or

(3) Unless 45 days have passed from the District Engineer's receipt of the complete notification and the prospective permittee has not received written notice from the District or Division Engineer. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) **Contents of Notification**: The notification must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) Brief description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), Regional General Permit(s), or Individual Permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP (Sketches usually clarify the project and when provided result in a quicker decision.);

(4) For NWPs 7, 12, 14, 18, 21, 34, 38, 39, 40, 41, 42, and 43, the PCN must also include a delineation of affected special aquatic sites, including wetlands, vegetated shallows (e.g., submerged aquatic vegetation, seagrass beds), and riffle and pool complexes (see paragraph 13(f));

(5) For NWP 7 (Outfall Structures and Maintenance), the PCN must include information regarding the original design capacities and configurations of those areas of the facility where maintenance dredging or excavation is proposed;

(6) For NWP 14 (Linear Transportation Projects), the PCN must include a compensatory mitigation proposal to offset permanent losses of waters of the US and a statement describing how temporary losses of waters of the US will be minimized to the maximum extent practicable;

(7) For NWP 21 (Surface Coal Mining Activities), the PCN must include an Office of Surface Mining (OSM) or state-approved mitigation plan, if applicable. To be authorized by this NWP, the District Engineer must determine that the activity complies with the terms and conditions of the NWP and that the adverse environmental effects are minimal both individually and cumulatively and must notify the project sponsor of this determination in writing;

(8) For NWP 27 (Stream and Wetland Restoration Activities), the PCN must include documentation of the prior condition of the site that will be reverted by the permittee;

(9) For NWP 29 (Single-Family Housing), the PCN must also include:

(i) Any past use of this NWP by the Individual Permittee and/or the permittee's spouse;

(ii) A statement that the single-family housing activity is for a personal residence of the permittee;

(iii) A description of the entire parcel, including its size, and a delineation of wetlands. For the purpose of this NWP, parcels of land measuring 1/4-acre or less will not require a formal on-site delineation. However, the applicant shall provide an indication of where the wetlands are and the amount of wetlands that exists on the property. For parcels greater than 1/4-acre in size, formal wetland delineation must be prepared in accordance with the current method required by the Corps. (See paragraph 13(f));

(iv) A written description of all land (including, if available, legal descriptions) owned by the prospective permittee and/or the prospective permittee's spouse, within a one mile radius of the parcel, in any form of ownership (including any land owned as a partner, corporation, joint tenant, co-tenant, or as a tenant-by-the-entirety) and any land on which a purchase and sale agreement or other contract for sale or purchase has been executed;

(10) For NWP 31 (Maintenance of Existing Flood Control Facilities), the prospective permittee must either notify the District Engineer with a PCN prior to each maintenance activity or submit a five year (or less) maintenance plan. In addition, the PCN must include all of the following:

(i) Sufficient baseline information identifying the approved channel depths and configurations and existing facilities. Minor deviations are authorized, provided the approved flood control protection or drainage is not increased;

(ii) A delineation of any affected special aquatic sites, including wetlands; and,

(iii) Location of the dredged material disposal site;

(11) For NWP 33 (Temporary Construction, Access, and Dewatering), the PCN must also include a restoration plan of reasonable measures to avoid and minimize adverse effects to aquatic resources;

(12) For NWPs 39, 43 and 44, the PCN must also include a written statement to the District Engineer explaining how avoidance and minimization for losses of waters of the US were achieved on the project site;

(13) For NWP 39 and NWP 42, the PCN must include a compensatory mitigation proposal to offset losses of waters of the US or justification explaining why compensatory mitigation should not be required. For discharges that cause the loss of greater than 300 linear feet of an intermittent stream bed, to be authorized, the District Engineer must determine that the activity complies with the other terms and conditions of the NWP, determine adverse environmental effects are minimal both individually and cumulatively, and waive the limitation on stream impacts in writing before the permittee may proceed;

(14) For NWP 40 (Agricultural Activities), the PCN must include a compensatory mitigation proposal to offset losses of waters of the US. This NWP does not authorize the relocation of greater than 300 linear-feet of existing serviceable drainage ditches constructed in non-tidal streams unless, for drainage ditches constructed in intermittent non-tidal streams, the District Engineer waives this criterion in writing, and the District Engineer has determined that the project complies with all terms and conditions of this NWP, and that any adverse impacts of the project on the aquatic environment are minimal, both individually and cumulatively;

(15) For NWP 43 (Stormwater Management Facilities), the PCN must include, for the construction of new stormwater management facilities, a maintenance plan (in accordance with state and local requirements, if applicable) and a compensatory mitigation proposal to offset losses of waters of the US. For discharges that cause the loss of greater than 300 linear feet of an intermittent stream bed, to be authorized, the District Engineer must determine that the activity complies with the other terms and conditions of the NWP, determine adverse environmental effects are minimal both individually and cumulatively, and waive the limitation on stream impacts in writing before the permittee may proceed;

(16) For NWP 44 (Mining Activities), the PCN must include a description of all waters of the US adversely affected by the project, a description of measures taken to minimize adverse effects to waters of the US, a description of measures taken to comply with the criteria of the NWP, and a reclamation plan (for all aggregate mining activities in isolated waters and non-tidal wetlands adjacent to headwaters and any hard rock/mineral mining activities);

(17) For activities that may adversely affect Federally-listed endangered or threatened species, the PCN must include the name(s) of those endangered or threatened species that may be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work; and

(18) For activities that may affect historic properties listed in, or eligible for listing in, the National Register of Historic Places, the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property.

(c) **Form of Notification**: The standard Individual Permit application form (Form ENG 4345) may be used as the notification but must clearly indicate that it is a PCN and must include all of the information required in (b) (1)-(18) of General Condition 13. A letter containing the requisite information may also be used.

(d) **District Engineer's Decision**: In reviewing the PCN for the proposed activity, the District Engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. The prospective permittee may submit a proposed mitigation plan with the PCN to expedite the process. The District Engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed work are minimal. If the District Engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the District Engineer will notify the permittee and include any conditions the District Engineer deems necessary. The District Engineer must approve any compensatory mitigation proposal before the permittee commences work. If the prospective permittee is required to submit a compensatory mitigation proposal with the PCN, the proposal may be either conceptual or detailed. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the District Engineer will expeditiously review the proposed compensatory mitigation plan. The District Engineer must review the plan within 45 days of receiving a complete PCN and determine whether the conceptual or specific proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the District Engineer to be minimal, the District Engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP. If the District Engineer determines that the adverse effects of the proposed work are more than minimal, then the District Engineer will notify the applicant either: (1) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an Individual Permit; (2) that the project is authorized under the NWP subject to the applicant's submission of a mitigation proposal that would reduce the adverse effects on the aquatic environment to the minimal level; or (3) that the project is authorized under the NWP with specific modifications or conditions. Where the District Engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period. The authorization will include the necessary conceptual or specific mitigation or a requirement that the applicant submit a mitigation proposal that would reduce the adverse effects on the aquatic environment to the minimal level. When conceptual mitigation is included, or a mitigation plan is required under item (2) above, no work in waters of the US will occur until the District Engineer has approved a specific mitigation plan.

(e) **Agency Coordination**: The District Engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level. For activities requiring notification to the District Engineer that result in the loss of greater than 1/2-acre of waters of the US, the District Engineer will provide immediately (e.g., via facsimile transmission, overnight mail, or other expeditious manner) a copy to the appropriate Federal or state offices (USFWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will then have 10 calendar days from the date the material is transmitted to telephone or fax the District Engineer notice that they intend to provide substantive, site-specific comments. If so contacted by an agency, the District Engineer will wait an additional 15 calendar days before making a decision on the notification. The District Engineer will fully consider agency comments received within the specified time frame, but will provide no response to the resource agency, except as provided below. The District Engineer will indicate in the administrative record associated with each notification that the resource agencies' concerns were considered. As required by section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act, the District Engineer will provide a response to NMFS within 30 days of receipt of any Essential Fish Habitat conservation recommendations. Applicants are encouraged to provide the Corps multiple copies of notifications to expedite agency notification.

(f) **Wetland Delineations**: Wetland delineations must be prepared in accordance with the current method required by the Corps (For NWP 29 see paragraph (b)(9)(iii) for parcels less than (1/4-acre in size). The permittee may ask the Corps to delineate the special aquatic site. There may be some delay if the Corps does the delineation. Furthermore, the 45-day period will not start until the wetland delineation has been completed and submitted to the Corps, where appropriate.

14. **Compliance Certification**. Every permittee who has received NWP verification from the Corps will submit a signed certification regarding the completed work and any required mitigation. The certification will be forwarded by the Corps with the authorization letter and will include:

(a) A statement that the authorized work was done in accordance with the Corps authorization, including any general or specific conditions;

(b) A statement that any required mitigation was completed in accordance with the permit conditions; and

(c) The signature of the permittee certifying the completion of the work and mitigation.

15. **Use of Multiple Nationwide Permits**. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the US authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit (e.g. if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the US for the total project cannot exceed 1/3-acre).

16. **Water Supply Intakes**. No activity, including structures and work in navigable waters of the US or discharges of dredged or fill material, may occur in the proximity of a public water supply intake except where the activity is for repair of the public water supply intake structures or adjacent bank stabilization.

17. **Shellfish Beds**. No activity, including structures and work in navigable waters of the US or discharges of dredged or fill material, may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWP 4.

18. **Suitable Material.** No activity, including structures and work in navigable waters of the US or discharges of dredged or fill material, may consist of unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.) and material used for construction or discharged must be free from toxic pollutants in toxic amounts (see section 307 of the CWA).

19. **Mitigation**. The District Engineer will consider the factors discussed below when determining the acceptability of appropriate and practicable mitigation necessary to offset adverse effects on the aquatic environment that are more than minimal.

(a) The project must be designed and constructed to avoid and minimize adverse effects to waters of the US to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing or compensating) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland impacts requiring a PCN, unless the District Engineer determines in writing that some other form of mitigation would be more environmentally appropriate and provides a project-specific waiver of this requirement. Consistent with National policy, the District Engineer will establish a preference for restoration of wetlands as compensatory mitigation, with preservation used only in exceptional circumstances.

(d) Compensatory mitigation (i.e., replacement or substitution of aquatic resources for those impacted) will not be used to increase the acreage losses allowed by the acreage limits of some of the NWPs. For example, 1/4-acre of wetlands cannot be created to change a 3/4-acre loss of wetlands to a 1/2-acre loss associated with NWP 39 verification. However, 1/2-acre of created wetlands can be used to reduce the impacts of a 1/2-acre loss of wetlands to the minimum impact level in order to meet the minimal impact requirement associated with NWPs.

(e) To be practicable, the mitigation must be available and capable of being done considering costs, existing technology, and logistics in light of the overall project purposes. Examples of mitigation that may be appropriate and practicable include, but are not limited to: reducing the size of the project; establishing and maintaining wetland or upland vegetated buffers to protect open waters such as streams; and replacing losses of aquatic resource functions and values by creating, restoring, enhancing, or preserving similar functions and values, preferably in the same watershed.

(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the establishment, maintenance, and legal protection (e.g., easements, deed restrictions) of vegetated buffers to open waters. In many cases, vegetated buffers will be the only compensatory mitigation required. Vegetated buffers should consist of native species. The width of the vegetated buffers required will address documented water quality or aquatic habitat loss concerns. Normally, the vegetated buffer will be 25 to 50 feet wide on each side of the stream, but the District Engineers may require slightly wider vegetated buffers to address documented water quality or habitat loss concerns. Where both wetlands and open waters exist on the project site, the Corps will determine the appropriate compensatory mitigation (e.g., stream buffers or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where vegetated buffers are determined to be the most appropriate form of compensatory mitigation, the District Engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland impacts.

(g) Compensatory mitigation proposals submitted with the "notification" may be either conceptual or detailed. If conceptual plans are approved under the verification, then the Corps will condition the verification to require detailed plans be submitted and approved by the Corps prior to construction of the authorized activity in waters of the US.

(h) Permittees may propose the use of mitigation banks, in-lieu fee arrangements or separate activity-specific compensatory mitigation. In all cases that require compensatory mitigation, the mitigation provisions will specify the party responsible for accomplishing and/or complying with the mitigation plan.

20. **Spawning Areas**. Activities, including structures and work in navigable waters of the US or discharges of dredged or fill material, in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., excavate, fill, or smother downstream by substantial turbidity) of an important spawning area are not authorized.

21. **Management of Water Flows**. To the maximum extent practicable, the activity must be designed to maintain preconstruction downstream flow conditions (e.g., location, capacity, and flow rates). Furthermore, the activity must not permanently restrict or impede the passage of normal or expected high flows (unless the primary purpose of the fill is to impound waters) and the structure or discharge of dredged or fill material must withstand expected high flows. The activity must, to the maximum extent practicable, provide for retaining excess flows from the site, provide for maintaining surface flow rates from the site similar to preconstruction conditions, and provide for not increasing water flows from the project site, relocating water, or redirecting water flow beyond preconstruction conditions. Stream channelizing will be reduced to the minimal amount necessary, and the activity must, to the maximum extent practicable, reduce adverse effects such as flooding or erosion downstream and upstream of the project site, unless the activity is part of a larger system designed to manage water flows. In most cases, it will not be a requirement to conduct detailed studies and monitoring of water flow. This condition is only applicable to projects that have the potential to affect waterflows. While appropriate measures must be taken, it is not necessary to conduct detailed studies to identify such measures or require monitoring to ensure their effectiveness. Normally, the Corps will defer to state and local authorities regarding management of water flow.

22. **Adverse Effects From Impoundments**. If the activity creates an impoundment of water, adverse effects to the aquatic system due to the acceleration of the passage of water, and/or the restricting its flow shall be minimized to the maximum extent practicable. This includes structures and work in navigable waters of the US, or discharges of dredged or fill material.

23. **Waterfowl Breeding Areas**. Activities, including structures and work in navigable waters of the US or discharges of dredged or fill material, into breeding areas for migratory waterfowl must be avoided to the maximum extent practicable.

24. **Removal of Temporary Fills**. Any temporary fills must be removed in their entirety and the affected areas returned to their preexisting elevation.

25. **Designated Critical Resource Waters**. Critical resource waters include, NOAA-designated marine sanctuaries, National Estuarine Research Reserves, National Wild and Scenic Rivers, critical habitat for Federally listed threatened and endangered species, coral reefs, state natural heritage sites, and outstanding national resource waters or other waters officially designated by a state as having particular environmental or ecological significance and identified by the District Engineer after notice and opportunity for public comment. The District Engineer may also designate additional critical resource waters after notice and opportunity for comment.

(a) Except as noted below, discharges of dredged or fill material into waters of the US are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, and 44 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters. Discharges of dredged or fill materials into waters of the US may be authorized by the above NWPs in National Wild and Scenic Rivers if the activity complies with General Condition 7. Further, such discharges may be authorized in designated critical habitat for Federally listed threatened or endangered species if the activity complies with General Condition 11 and the USFWS or the NMFS has concurred in a determination of compliance with this condition.

(b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with General Condition 13, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The District Engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

26. **Fills Within 100-Year Floodplains**. For purposes of this General Condition, 100-year floodplains will be identified through the existing Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps or FEMA-approved local floodplain maps.

(a) Discharges in Floodplain; Below Headwaters. Discharges of dredged or fill material into waters of the US within the mapped 100-year floodplain, below headwaters (i.e., 5 cfs), resulting in permanent above-grade fills, are not authorized by NWPs 39, 40, 42, 43, and 44.

(b) Discharges in Floodway; Above Headwaters. Discharges of dredged or fill material into waters of the US within the FEMA or locally mapped floodway, resulting in permanent above-grade fills, are not authorized by NWPs 39, 40, 42, and 44.

(c) The permittee must comply with any applicable FEMA-approved state or local floodplain management requirements.

27. **Construction Period**. For activities that have not been verified by the Corps and the project was commenced or under contract to commence by the expiration date of the NWP (or modification or revocation date), the work must be completed within 12-months after such date (including any modification that affects the project). For activities that have been verified and the project was commenced or under contract to commence within the verification period, the work must be completed by the date determined by the Corps. For projects that have been verified by the Corps, an extension of a Corps approved completion date maybe requested. This request must be submitted at least one month before the previously approved completion date.

G. CORPS REGIONAL GENERAL CONDITIONS FOR ALL NWPs

1. **Mature Forested and Bog and Bog-like Wetlands**. The use of NWPs is specifically prohibited in mature forested wetlands or bog and bog-like wetlands or just these components of a wetland system (as defined in the Definition section of this Public Notice), except for projects provided coverage under the following NWPs:

NWP 3(i,ii)	–	Maintenance
NWP 20	–	Oil Spill Cleanup
NWP 32	–	Completed Enforcement Actions
NWP 38	–	Cleanup of Hazardous and Toxic Waste
NWP 40(a)	–	USDA program participant

NOTE: NWP regulations do not allow the regional conditioning of NWP 40(a).

2. **Access**. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being, or has been, accomplished in accordance with the terms and conditions of your permit.

3. **Commencement Bay**. An individual permit is required in the Commencement Bay Study Area (CBSA) for activities which would have qualified for the following NWPs:

NWP 12 – Utility Line Activities (substations and access roads)
NWP 13 – Bank Stabilization
NWP 14 – Linear Transportation Crossings
NWP 23 – Approved Categorical Exclusions
NWP 29 – Single-Family Housing
NWP 39 – Residential, Commercial, and Institutional Developments
NWP 40 – Agricultural Activities
NWP 41 – Reshaping Existing Drainage Ditches
NWP 42 – Recreational Facilities
NWP 43 – Stormwater Management Facilities

The CBSA is located near the southern end of Puget Sound's main basin at Tacoma, Pierce County, Washington. The CBSA extends from Brown's Point around the bay to Point Defiance and includes the commercial waterways, wetlands, and any other jurisdictional waters. From Point Defiance, the line runs southeast to State Route 7 (Pacific Avenue), then south to the centerline of I-5; then east (northbound lanes) along I-5 to the Puyallup River. The boundary extends 200 feet on either side of the Puyallup River southeast to the Clark Creek Road (Melroy) Bridge. From the Puyallup River, the boundary extends east along I-5 to 70th Avenue E. The line then returns to Brown's Point to the northwest, following the 100-foot contour elevation above sea level located east of Hylebos Creek and Marine View Drive.

4. **Mill Creek Special Area Management Plan (SAMP)**. Within the boundaries of the (SAMP), the following NWPs can be used only in those areas designated as "Developable Wetlands":

NWP 14 – Linear Transportation Crossings
NWP 23 – Approved Categorical Exclusions
NWP 29 – Single-Family Housing
NWP 33 – Temporary Construction, Access and Dewatering
NWP 39 – Residential, Commercial, and Institutional Developments
NWP 40 – Agricultural Activities
NWP 41 – Reshaping Existing Drainage Ditches
NWP 42 – Recreational Facilities
NWP 43 – Stormwater Management Facilities

Until the SAMP is approved, the users of these NWPs listed above (except NWP 40a.) must notify the District Engineer in accordance with General Condition 13 for any acreage or volume proposed. Once the SAMP is approved, the "Notification" limits will be as specified in the individual NWPs.

Mitigation requirements for these projects must either be onsite or within the areas designated as "Preferred Mitigation Sites". Mitigation plans must comply with the requirements found within the Mill Creek Special Area Management Plan, King County, Washington, dated April 2000.

An individual permit is required for all proposals in "Developable Wetlands" that would have qualified for NWPs other than those listed above.

NWP 27, Stream Restoration and Enhancement Activities, can be used within the SAMP, but, must comply with the requirements found within the Mill Creek Special Area Management Plan, King County, Washington.

The Mill Creek SAMP applies to all areas and tributaries drained by Mill Creek (Auburn), Mullen Slough, Midway Creek, Auburn Creek, and the area bounded by 4th Street Northeast in Auburn on the south, and the Ordinary High Water mark of the Green River on the east and north.

5. **Prohibited Work Times for Bald Eagle Protection.** For compliance with National General Condition 11, the following construction activity prohibitions apply to protect bald eagles, listed as threatened under the Endangered Species Act:

(a) No construction activity authorized under a NWP shall occur within 1/4 mile of an occupied bald eagle nest, nocturnal roost site, or wintering concentration area, within the following seasonal work prohibition times.

(b) No construction activity authorized under a NWP shall occur within 1/2 mile BY LINE OF SIGHT of an occupied bald eagle nest or nocturnal roost site, within the following seasonal work prohibition times:

Work prohibition times:

(1) Nesting between January 1 and August 15 each year.
(2) Wintering areas between November 1 and March 31 each year.

Exceptions to these prohibited work times can be made by request to the Corps and approved by the U.S. Fish and Wildlife Service (USFWS).

Contact the USFWS to determine if a bald eagle nest, nocturnal roost, or wintering concentration occurs near your proposed project:

West of Cascades: Olympia Office – (360) 753-9440
East of Cascades: Ephrata – (509) 754-8580 or Spokane – (509) 893-8002
Mainstem of the Columbia River downstream from McNary Dam: Portland – (503) 231-6179

H. ADDITIONAL LIMITATIONS ON THE USE OF NWPs

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.

2. NWPs do not obviate the need to obtain other Federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.

4. NWPs do not authorize any injury to the property or rights of others.

5. NWPs do not authorize interference with any existing or proposed Federal project.

6. If future operations by the United States require the removal, relocation, or other alteration of the work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, you will be required, upon due notice from the U. S Army Corps of Engineers, to remove, relocate, or alter the

structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

I. FURTHER INFORMATION

Further information about the U.S. Army Corps of Engineers regulatory program, including nationwide permits, may also be accessed on our Internet page: ***http://www.nws.usace.army.mil*** (select "Regulatory/Permits").

US Army Corps of Engineers
Seattle District

Terms and Conditions of the SLOPES III Programmatic Consultation for "Over-water and In-Water Structures"

Applicability: These conditions are applicable to activities involving over-water and in-water structures that were included in a programmatic consultation between the U.S. Army Corps of Engineers (Corps) and the National Marine Fisheries Service (NMFS) that addressed certain activities in the Lower Columbia River within the State of Washington. For additional information, please refer to "Endangered Species Act – Section 7 Consultation Programmatic Biological Opinion and Conference Opinion & Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation: Revised Standard Local Operating Procedures for Endangered Species (SLOPES III) to Administer Certain Activities Authorized or Carried Out by the Department of the Army in the State of Oregon and on the North Shore of the Columbia River," dated November 30, 2004.

Location: Within Washington State, the Lower Columbia programmatic consultation addressed activities that would occur in the mainstem Columbia River, including certain sloughs and adjacent wetlands, downstream of McNary Dam. Washington State tributaries of the Columbia River, the mainstem Columbia River upstream of Dam, and all other portions of the Seattle District were excluded from the action area of this programmatic consultation.

Description of Activity: Over-water and in-water structures include recreational boating facilities and dock and wharf facilities operated by ports and other commercial entities. Recreational boating requires construction and maintenance of a variety of types and sizes of structures. Some are water dependent, and will be placed in riparian, nearshore, and over-water areas. Others are "related facilities" (e.g., parking lots, picnic areas) that are not water dependent. For purposes of this consultation, actions proposed to support recreational boating facilities are construction of boat ramps; maintenance, repair, and relocation of structures within an existing marina; structures in fleeting and anchorage areas; installation of small temporary floats; and repair of navigational aids. Commercial dock and wharf facilities also entail many different types and sizes of structures, often installed and operated over large areas. For purposes of this consultation, however, the proposed action includes the following work: (1) Replacement of existing pilings, fender piles, group pilings, walers, and fender pads; (2) installation of new mooring dolphins and structural pilings; (3) height extension of existing pilings; and (4) recycling of large wood obstructions that limit the usefulness of dock and wharf facilities.

Terms and Conditions: To comply with the requirements of the Endangered Species Act (ESA) and Magnuson-Stevens Fishery Conservation and Management Act, a Department of the Army permittee for this activity must comply with the applicable terms and conditions listed below. These terms and conditions, specified in the above-referenced programmatic biological opinion, are necessary to implement the reasonable and prudent measures described in the biological opinion. These terms and conditions are non-discretionary, and compliance with these terms and conditions is necessary to exempt the permittee from the prohibitions of Section 9 of the ESA.

Conditions of Standard Local Operating Procedures for Endangered Species

a. Salvage notice. If a sick, injured, or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NOAA Fisheries Law Enforcement at (360) 418-4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

b. Project Completion Report or Memo to File. Each permit issued by the Corps under this Opinion must require the applicant to submit a project completion report to the Corps within 60 days of finishing work below ordinary high water; for each project carried by the Corps, the project supervisor must prepare a project completion memo to file. Each report or memo must contain the following information and be available for inspection on request by NOAA Fisheries.

i. Applicant's name and permit number (if any).

ii. Corps contact person.

iii. Project name.

iv. Type of activity.

v. Project site including any compensatory mitigation site by 5th field HUC.

vi. Start and end dates for work completed.

vii. Photos of habitat conditions at the project site including any compensatory mitigation site, before, during, and after project completion.[1]

viii. Projects with the following work elements must include these data.

(1) Work Cessation—Dates work ceased due to high flows.[2]

(2) Fish Screen—Proof of compliance with NOAA Fisheries fish screen criteria.[3]

(3) Pollution Control—A summary of pollution and erosion control inspections, including any erosion control failure, contaminant release, and correction effort.

(4) Drilling—Describe the drilling method and steps taken to isolate drilling operations, fluids, slurry and spoils from flowing water.

(5) Pilings. The number, type, and diameter of pilings removed, broken during removal, and installed; and any sound attenuation measures used.

(6) Site Preparation—Riparian area cleared within 150 feet of ordinary high water; upland area cleared; new impervious area created.

(7) Streambank Stabilization—Type and amount of materials used; project size (one bank or two, width and linear feet).

(8) Road Construction, Repairs, and Improvements—Rationale for any new permanent road crossing design.

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[1] Relevant habitat conditions may include characteristics of channels, eroding, and stable streambanks in the project area, riparian vegetation, water quality, flows at base, bankfull and over-bankfull stages, and other visually discernable environmental conditions at the project area, and upstream and downstream from the project. Include general views and close-ups of the project and project area, including pre- and post-construction. Label each photo with date, time, project name, photographer's name, and a comment about the subject.

[2] "High flows" means any flow likely to rise above the top of an work isolation area or otherwise inundate a work area that would normally be dry.

[3] National Marine Fisheries Service, Juvenile Fish Screen Criteria (revised February 16, 1995) and Addendum; Juvenile Fish Screen Criteria for Pump Intakes (May 9, 1996) (guidelines and criteria for migrant fish passage facilities, and new pump intakes and existing inadequate pump intake screens) or as amended (http://www.nwr.noaa.gov/1hydrop/hydroweb/ferc.htm).

(9) In-water and Over-water Structures—Area of new in-water or over-water structure.

c. Site Restoration and/or Compensatory Mitigation Report. Each applicant must submit a site restoration and/or compensatory mitigation report by December 31 each year after the project is completed until the Corps approves that the site restoration and/or compensatory mitigation performance standards have been met. This report must describe the date and purpose of each visit to a restoration and/or compensatory mitigation site, site conditions observed during that visit, and any corrective action planned or taken.

General Conditions for Surveying, Exploration, Construction, Operation, and Maintenance

a. Exclusions. Any exploration or construction activity, including surface water diversion and release of construction discharge water within 300 feet upstream from any occupied redd until fry emerge or within 300 feet of native submerged aquatic vegetation is not authorized by this Opinion, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form. Permits for the following types of exploration, construction, and mitigation actions are not authorized by this Opinion.

   i. Use of pesticides.

   ii. Use of short pieces of plastic ribbon to determine flow patterns.

   iii. Temporary roads or drilling pads built on steep slopes where grade, soil types, or other features suggest a likelihood of excessive erosion or failure.

   iv. Exploratory drilling in estuaries that cannot be conducted from a work barge or an existing bridge, dock, or wharf.

   v. Installation of a fish screen on any permanent water diversion or intake that is not already screened.

   vi. Any projects that require in-water installation of hollow steel piling greater than 24-inches in diameter or use of H-pile larger than designation HP24.

   vii. Drilling or sampling in an EPA-designated Superfund Site, a state-designated cleanup area, or the likely impact zone of a significant contaminant source, as identified by historical information or the Corps' best professional judgment.

   viii. Compensatory mitigation actions that require construction of permanent structures, maintenance beyond the establishment period or after the performance standards have been met, or creation of habitat functions where they did not historically exist, or that simply preserve existing functions.

b. Pollution and Erosion Control Plan. A pollution and erosion control plan must be prepared and carried out to prevent pollution caused by surveying or construction operations. The pollution and erosion control plan must be commensurate with the scale of the project, contain pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

   i. Goal. The goal is to avoid or minimize the adverse effects of pollution and erosion by limiting soil disturbance, scheduling work when the fewest number of fish are likely to be present, managing likely pollutants, and limiting the harm that may be caused by accidental discharges of pollutants and sediment.

   ii. Responsible Party. The name, address, and telephone number of the person responsible for accomplishment of the pollution and erosion control plan.

   iii. Minimum Area. Practices to confine vegetation removal and soil disturbance to the minimum area necessary to complete the project and otherwise prevent erosion and sedimentation associated with access roads, stream crossings, drilling sites, construction sites, borrow pit operations, haul roads, equipment and material storage sites, fueling operations, staging areas, and roads being decommissioned.

iv. In-water Work Timing. Develop a schedule to complete all work below ordinary high water, except hydraulic and topographic measurements within the wetted channel,[4] inside the most recent Oregon Department of Fish & Wildlife (ODFW) or the Corps Seattle District preferred in-water work period,[5] as appropriate for the project area unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

v. Cease Work During High Flows. Project operations must cease under high flow conditions that may inundate the project area except for efforts to avoid or minimize resource damage.

vi. Concrete, Cement, and Grout. Practices to confine, remove, and dispose of excess concrete, cement, grout, and other mortars or bonding agents, including measures for washout facilities.

vii. Construction Debris. Practices to prevent construction debris from dropping into any stream or waterbody and to remove any material that does drop with a minimum disturbance to the streambed and water quality.

viii. Hazardous Materials. A description of any regulated or hazardous products or materials that will be used for the project including procedures for inventory, storage, handling, and monitoring.

ix. Spill Containment. A spill containment and control plan with notification procedures, specific cleanup and disposal instructions for different products, a description of quick response containment and cleanup supplies that will be available on the site, including a supply of sediment control materials (*e.g.*, a silt fence, straw bales,[6] an oil absorbing, floating boom whenever surface water is present), proposed methods for disposal of spilled materials, and employee training for spill containment.

c. Work Area Isolation Plan. Except for piling installation[7] completed in compliance with all other relevant terms and conditions, a work area isolation plan must be prepared and carried out for any project that requires work below ordinary high water where adult or juvenile fish are reasonably certain to be present or 300 feet or less upstream from spawning habitats, unless otherwise approved in writing by NOAA Fisheries. The work area isolation plan must be commensurate with the scale of the project, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal to minimize the adverse effects of erosion and other types of pollution by removing from flowing water and fish from the work area.

ii. Responsible Party. The name and address of the person responsible for meeting each component of the work area isolation plan including a fishery biologist experienced with work area isolation and competent to ensure the safe handling of all ESA-listed fish that will be responsible for the capture and release operation.

iii. Flow Conditions. An estimate of the range of flows likely to occur during isolation.

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[4] Hydraulic and topographic measurements within the wetted channel may be completed anytime except during the spawning period, unless a fisheries biologist verifies that no redds are occupied within 300 feet downstream from the measurement site.

[5] ODFW, Oregon Guidelines for Timing of In-water Work to Protect Fish and Wildlife Resources (June 2000) at http://www.dfw.state.or.us/lands/0600_inwtrguide.pdf and U.S. Army Corps of Engineers, Seattle District Regulatory Branch, Allowable Work Windows at http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=work_windows as amended.

[6] When available, certified weed-free straw or hay bales must be used to prevent introduction of noxious weeds.

[7] Pilings may be installed without work isolation provided all other relevant terms and conditions are met.

iv. Plan View. A plan view of all isolation elements and fish release areas.

v. Equipment and Materials List. A list of equipment and materials that are necessary to complete work area isolation including fish screen for any pump used to dewater the isolation area, and that will be available onsite to provide appropriate redundancy of key plan functions (*e.g.,* operational, properly-sized, back-up pumps and generators).

vi. Sequence and Schedule. The sequence and schedule of dewatering and rewatering activities.

d. Capture and Release. Before and intermittently during isolation of an in-water work area, fish trapped in the area must be captured using a trap, seine, electrofishing, or other methods as are prudent to minimize risk of injury, then released at a safe release site.

i. Do not use electrofishing if water temperatures exceed 18°C or are expected to rise above 18°C, unless no other method of capture available.

ii. If electrofishing equipment is used to capture fish, comply with NOAA Fisheries' electrofishing guidelines.[8]

iii. Handle ESA-listed fish with extreme care keeping fish in water to the maximum extent possible during seining and transfer procedures to prevent the added stress of out-of-water handling.

vi. Ensure water quality conditions are adequate in buckets or tanks used to transport fish by providing circulation of clean, cold water using aerators to provide dissolved oxygen and minimizing holding times.

v. Release fish into a safe release site as quickly as possible and as near as possible to capture sites.

vi. Do not transfer the ESA-listed fish to anyone except NOAA Fisheries personnel unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

vii. Obtain all other Federal, state, and local permits necessary to conduct the capture and release activity.

viii. Allow NOAA Fisheries or its designated representative to accompany the capture team during the capture and release activity and to inspect the team's capture and release records and facilities.

ix. Submit an electronic copy of the Salvage Report Form (Appendix B) to NOAA Fisheries at slopes.nwr@noaa.gov within 10 calendar days of completion of the salvage operation.

e. Fish Passage. Safe passage around or through the project area must be provided for any adult and juvenile salmon or steelhead species present during construction unless passage did not previously exist or as otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

i. Fish ladders (*e.g.*, pools and weirs, vertical slots, Denil fishways) and fish trapping systems are not authorized by this Opinion.

ii. After project completion, adult and juvenile passage upstream and downstream must not be impaired for the life of the project.

f. Stormwater Management Plan. A stormwater management plan must be prepared and carried out for any project that will produce any new impervious surface or a land cover that will slow the entry of water into the

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8 National Marine Fisheries Service Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act (June 2000) (http://www.nwr.noaa.gov/1salmon/salmesa/final4d.htm).

soil. The stormwater management plan must be commensurate with the scale of the projects, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal is to minimize adverse effects due to the quantity and quality of stormwater runoff for the life of the project by maintaining or restoring natural runoff conditions.

ii. Responsible Party. The name, address, and telephone number of the person responsible for accomplishment of the stormwater management plan.

iii. Management Practices and Facilities. A system of management practices and if necessary, structural facilities designed to complete the following functions.

(1) Minimize, disperse, and infiltrate stormwater runoff onsite using sheet flow across permeable vegetated areas to the maximum extent possible without causing flooding, erosion impacts, or long-term adverse effects to groundwater.

(2) Pre-treat stormwater from pollution generating surfaces including bridge decks before infiltration or discharge into a freshwater system, as necessary to minimize any nonpoint source pollutant (*e.g.*, debris, sediment, nutrients, petroleum hydrocarbons, metals) likely to be present in the volume of runoff predicted from a six-month, 24-hour storm.[9]

(3) Ensure that the duration of post project discharge matches the predeveloped discharge rates from 50 percent of the two-year peak flow up to the 50-year peak flow.

iv. Continuous Rainfall/Runoff. For projects that require engineered water quality or detention facilities to meet stormwater requirements, use a continuous rainfall/runoff model if available for the project area to calculate stormwater facility water quality and flow control rates.

v. Permeable Pavements. Use permeable pavements for load-bearing surfaces including multiple-use trails to the maximum extent feasible based on soil, slope, and traffic conditions.

vi. Facilities Inside the Riparian Management Area. Install structural facilities outside wetlands or the riparian management area[10] whenever feasible, otherwise provide compensatory mitigation to offset any long-term adverse effects. Identify the location of all stormwater facilities relative to the riparian management area.

vii. Recordkeeping. Document completion of the following activities according to a regular schedule for the operation, inspection, and maintenance of all structural facilities and conveyance systems in a log available for inspection on request by the Corps and NOAA Fisheries.

(1) Inspect and clean each facility as necessary to ensure that the design capacity is not exceeded, heavy sediment discharges are prevented, and whether improvements in operation and maintenance are needed.

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9 A six-month, 24-hour storm may be assumed to be 72 percent of the two-year, 24-hour amount. See, Washington State Department of Ecology (2001), Appendix I-B-1.

10 "Riparian management area" means land: (1) within 150 feet of any natural water occupied by listed salmonids during any part of the year or designated as critical habitat; (2) within 100 feet of any natural water within one-fourth mile upstream from areas occupied by listed salmonids or designated as critical habitat and that is physically connected by an above-ground channel system such that water, sediment, or woody material delivered to such waters will eventually be delivered to water occupied by listed salmon or designated as critical habitat; and (3) within 50 feet of any natural water upstream from areas occupied by listed salmonids or designated as critical habitat and that is physically connected by an above-ground channel system such that water, sediment, or woody material delivered to such waters will eventually be delivered to water occupied by listed salmon or designated as critical habitat. "Natural water" means all perennial or seasonal waters except water conveyance systems that are artificially constructed and actively maintained for irrigation.

(2) Promptly repair any deterioration threatening the effectiveness of any facility.

(3) Post and maintain a warning sign on or next to any storm drain inlet as appropriate for the receiving water that says, "Dump No Waste – Drains to Groundwater, Streams, or Lakes."

(4) Only dispose of sediment and liquid from any catch basin in an approved facility.

viii. Runoff/Discharge into a Freshwater System. When stormwater runoff will be discharged directly into surface water or a wetland, or indirectly through a conveyance system, the following requirements apply.

(1) Maintain natural drainage patterns and whenever possible ensure that discharges from the project site occur at the natural location.

(2) Use a conveyance system comprised entirely of manufactured elements (*e.g.*, pipes, ditches, outfall protection) that extends to the ordinary high water line of the receiving water unless existing topography and vegetative site conditions will provide adequate biofiltration to remove likely sediment and other pollutants.

(3) Stabilize any erodible elements of this system as necessary to prevent erosion.

(4) Do not divert surface water from or increase discharge to an existing wetland if that will cause a measurable or detectable adverse effect to wetland hydrology, soils, or vegetation.

(5) The velocity of discharge water released from an outfall or diffuser port may not exceed four feet per second, and the maximum size of any aperture may not exceed one inch.

g. Site Restoration Plan. A site restoration plan must be prepared and carried out to ensure that all streambanks, soils, and vegetation disturbed by the project are cleaned up and restored as follows. The site restoration plan must be commensurate with the scale of the project, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal is to reestablish habitat access, water quality, production of habitat elements (*e.g.*, large wood), channel conditions, flows, watershed conditions, and other aquatic habitat forming processes that were harmed during project completion.

ii. Responsible Party. The name, address, and telephone number of the person responsible for accomplishment of the site restoration plan including providing and managing any financial assurances and monitoring necessary to ensure restoration success.

iii. Baseline Information. This information may be obtained from existing sources (*e.g.*, land use plans, watershed analyses, subbasin plans), where available.

(1) A functional assessment of adverse effect, *i.e.*, the location, extent and function of the riparian and aquatic resources that will be adversely affected by construction and operation of the project.

(2) The location and extent of resources surrounding the restoration site including historic and existing conditions.

iv. Objectives. Restoration objectives that describe the extent and methods of site restoration necessary to offset adverse effects of the project by aquatic resource type.

(1) Restore damaged streambanks to a natural slope, pattern, and profile suitable for establishment of permanent wood vegetation unless precluded by pre-project conditions (*e.g.*, a natural rock wall).

(2) Replant each area requiring revegetation before the first April 15 following construction. Use a diverse assemblage of species native to the project area or region including grasses, forbs, shrubs, and trees. Noxious or invasive species may not be used.

(3) Use as much as possible of the large wood, native trees, native vegetation, topsoil, and native channel material that was stockpiled during site preparation.

(4) Do not apply surface fertilizer within 50 feet of any stream channel.

(5) Install fencing as necessary to prevent access to revegetated sites by livestock or unauthorized persons.

v. Performance Standards. Use the following standards to help design the plan and assess whether the restoration goal is met. While no single criterion is sufficient to measure success, the intent is that these features should be present within reasonable limits of natural and management variation.

(1) Human and livestock disturbance if any is confined to small areas necessary for access or other special management situations.

(2) Areas with signs of significant past erosion are completely stabilized and healed; bare soil spaces are small and well dispersed.

(3) Soil movement such as active rills and soil deposition around plants or in small basins is absent or slight and local.

(4) Native woody and herbaceous vegetation, and germination microsites are present and well distributed across the site.

(5) Plants have normal, vigorous growth form and a high probability of remaining vigorous, healthy, and dominant over undesired competing vegetation.

(6) Vegetation structure is resulting in rooting throughout the available soil profile.

(7) Plant litter is well distributed and effective in protecting the soil with little or no litter accumulated against vegetation as a result of active sheet erosion ("litter dams").

(8) A continuous corridor of shrubs and trees appropriate to the site are present to provide shade and other habitat functions for the entire streambank.

(9) Streambanks are stable, well vegetated, and protected at margins by roots that extend below baseflow elevation or by coarse-grained alluvial debris.

vi. Work Plan. Develop a work plan with sufficient detail to include a description of the following elements as applicable:

(1) Water supply source if necessary.

(2) Boundaries for the restoration area.

(3) Restoration methods, timing, and sequence.

(4) Geomorphology and habitat features of stream or other open water.

(5) Site management and maintenance requirements including a plan to control exotic invasive vegetation.

(6) Elevation and slope of the restoration area to ensure they conform to required elevation and hydrologic requirements of target plant species.

(7) Woody native vegetation appropriate to the restoration site.[11] This must be a diverse assemblage of species that are native to the project area or region including grasses, forbs, shrubs, and trees. This may include allowances for natural regeneration from an existing bank or planting.

vii. Five-Year Monitoring and Maintenance Plan. Develop a five-year monitoring and maintenance plan with the following elements as applicable:

(1) A schedule to visit the restoration site annually for five years or longer as necessary to confirm that the performance standards are achieved. Despite the initial five-year planning period, site visits and monitoring must continue from year to year until the Corps certifies that site restoration performance standards have been met.

(2) During each visit, inspect for and correct any factors that may prevent attainment of performance standards (*e.g.*, low plant survival, invasive species, wildlife damage, drought).

(3) Keep a written record to document the date of each visit, site conditions, and any corrective actions taken.

h. Compensatory Mitigation Plan. A compensatory mitigation plan must be prepared and carried as necessary to ensure the project does not cause a long-term loss of riparian or aquatic functions. The compensatory mitigation plan must be commensurate with the scale of the project, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Actions of Concern. The following actions require a Compensatory Mitigation Plan to offset long-term adverse effects:

(1) Riparian and aquatic habitats displaced by construction of structural stormwater facilities, a new or enlarged boat ramp, or scour protection.

(2) Riparian and benthic habitat displaced by new or enlarged over-water structures.

(3) Other activities that prevent development of properly functioning riparian and aquatic habitat processes.

ii. Goal. The goal is to ensure that completion of the project does not cause a net loss of riparian and aquatic habitat functions.

iii. Responsible Party. The name, address, and telephone number of the person responsible for accomplishment of the compensatory mitigation plan including providing and managing any financial assurances and monitoring necessary to ensure compensatory mitigation success.

iv. Objectives. Compensatory mitigation objectives related to the extent and type of compensatory mitigation necessary to offset unavoidable losses to riparian and aquatic habitat at the project site.

(1) Elements of a site restoration plan outline above.

(2) Watershed-level considerations related to specific aquatic resource needs of the affected area.

(3) Existing technology and logistical concerns.

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[11] Use reference sites to select vegetation for the mitigation site whenever feasible. Historic reconstruction, vegetation models, or other ecologically-based methods may also be used as appropriate.

iv. Drilling Waste Containment. All drilling equipment, drill recovery, recycling pits, and any waste or spoil produced must be contained as necessary to prevent any drilling fluids or other wastes from entering the stream.

(1) All drilling fluids and waste must be completely recovered then recycled or disposed to prevent entry into flowing water.

(2) Drilling fluids must be recycled using a tank instead of drill recovery/recycling pits whenever feasible.

(3) When drilling is completed, try to remove the remaining drilling fluid from the sleeve (*e.g.*, by pumping) to reduce turbidity when the sleeve is removed.

k. Heavy Equipment. Use of heavy equipment is restricted as follows:

i. Choice of Equipment. When heavy equipment will be used, the equipment selected must have the least adverse effects on the environment (*e.g.*, minimally sized, low ground pressure equipment).

ii. Vehicle and Material Staging. Store construction materials and fuel and operate, maintain, and store vehicles as follows:

(1) To reduce the staging area and likelihood of contamination, ensure that only enough supplies and equipment to complete a specific job will be stored onsite.

(2) Complete vehicle staging, cleaning, maintenance, refueling, and fuel storage in a vehicle staging area placed 150 feet or more from any stream, waterbody, or wetland unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

(3) Inspect all vehicles operated within 150 feet of any stream, waterbody, or wetland daily for fluid leaks before leaving the vehicle staging area. Repair any leaks detected in the vehicle staging area before the vehicle resumes operation. Document inspections in a record that is available for review on request by the Corps or NOAA Fisheries.

(4) Before operations begin and as often as necessary during operation, steam clean all equipment that will be used below ordinary high water until all visible external oil, grease, mud, and other visible contaminates are removed. Complete all cleaning in the staging area.

(5) Diaper all stationary power equipment (*e.g.*, generators, cranes, and stationary drilling equipment) operated within 150 feet of any steam, waterbody, or wetland to prevent leaks unless suitable containment is provided to prevent likely spills from entering any stream or waterbody.

l. Pre-construction Activity. The following actions must be completed before significant[12] alteration of the project area.

i. Marking. Flag the boundaries of clearing limits associated with site access and construction to prevent ground disturbance of critical riparian vegetation, wetlands, areas below ordinary high water, and other sensitive sites beyond the flagged boundary.

ii. Temporary Erosion Controls. All temporary erosion controls must be in place and appropriately installed downslope of project activity until site restoration is complete.

m. Site Preparation. Native materials including large wood, native vegetation, weed-free topsoil, and native channel materials (gravel, cobble, and boulders) disturbed during site preparation must be conserved onsite for site restoration.

[12] "Significant" means an effect can be meaningfully measured, detected, or evaluated.

i. If possible, leave native materials where they are found. In areas to be cleared, clip vegetation at ground level to retain root mass and encourage reestablishment of native vegetation.

ii. If native materials are moved, damaged, or destroyed, replace them with a functional equivalent during site restoration.

iii. Stockpile all large wood[13] taken from below ordinary high water and from within 150 feet of a stream, waterbody, or wetland, native vegetation, weed-free topsoil, and native channel material displaced by construction for use during site restoration.

iv. As part of the site restoration, all large wood taken from the riparian zone or stream during construction must be returned to those areas and placed in a natural configuration that may be expected to function naturally.

n. Temporary Access Roads and Drilling Pads. All temporary access roads and drilling pads must be constructed as follows.

i. Existing Ways. Use existing roadways, travel paths, and drilling pads whenever possible unless construction of a new way or drilling pad would result in less habitat take. When feasible, eliminate the need for an access road by walking a tracked drill or spider hoe to a survey site or lower drilling equipment to a survey site using a crane.

ii. Soil Disturbance and Compaction. Minimize soil disturbance and compaction whenever a new temporary road or drill pad is necessary within wetlands or the riparian management area by clearing vegetation to ground level and placing clean gravel or geotexile fabric unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

iii. Temporary Stream Crossings.

(1) Minimize the number of temporary stream crossings.

(2) Design temporary road crossings as follows.

(a) A qualified fish biologist will survey and map spawning habitat, any occupied spawning redds, and native submerged aquatic vegetation within 300 feet upstream downstream and 100 feet upstream from a proposed crossing.

(b) Do not place a stream crossing within 300 feet downstream or 100 feet upstream from any occupied redd until fry emerge or within 300 feet of native submerged aquatic vegetation.

(c) Design the crossing to provide for foreseeable risks (*e.g.*, flooding and associated bedload and debris to prevent the diversion of streamflow out of the channel and down the road if the crossing fails).

(d) Vehicles and machinery must cross riparian areas and stream at right angles to the main channel wherever possible.

iv. Obliteration. When the project is complete, obliterate all temporary access roads that will not be in footprint of a new bridge or other permanent structure, stabilize the soil, and revegetate the site.

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[13] "Large wood" means a tree, log, or redwood big enough to dissipate stream energy associated with high flows, capture bedload, stabilize streambanks, influence channel characteristics, and otherwise support aquatic habitat function, given the slope and bankfull channel width of the stream in which the wood occurs. See Oregon Department of Forestry and ODFW, "A Guide to Placing Large Wood in Streams, May 1995, http://www.nwr.noaa.gov/1salmon/salmesa/4ddocs/lrgwood.pdf

o. Earthwork. Earthwork including drilling, excavation, dredging, filling, and compacting must be completed as quickly as possible.

   i. Site Stabilization. Stabilize all disturbed areas including obliteration of temporary roads following any break in work unless construction will resume within four days.

   ii. Inspection of Erosion Controls. Monitor instream turbidity and inspect all erosion controls daily during the rainy season, weekly during the dry season, or more often as necessary to ensure the erosion controls are working adequately.[14]

      (1) If monitoring or inspection shows that the erosion controls are in effective, immediately mobilize work crews to repair, replace, or reinforce controls as necessary.

      (2) Remove sediment from erosion controls before it reaches one-third of the exposed height of the control.

   iii. Drilling, Boring, Jacking. If drilling, boring, or jacking is used, the following conditions apply.

      (1) Isolate drilling operations in wetted stream channels using a steel pile, sleeve, or other appropriate isolation method to prevent drilling fluids from contacting water.

      (2) If it is necessary to drill through a bridge deck, use containment measures to prevent drilling debris from entering the channel.

      (3) Sampling and directional drill recovery/recycling pits and any associated waste or spoils must be completely isolated from surface waters, off-channel habitats, and wetlands. All waste or spoils must be covered if precipitation is falling or imminent. All drilling fluids and waste must be recovered and recycled or disposed to prevent entry into flowing water.

      (4) If a drill boring conductor breaks and drilling fluid or waste is visible in a water or a wetland, all drilling activity must cease pending written approval from NOAA Fisheries to resume drilling.

p. Treated Wood. Use of lumber, pilings, or other wood products that are treated or preserved with pesticidal compounds (including but not limited to alkaline, copper quaternary, ammoniacal copper arsenate, ammoniacal copper zinc arsenate, copper boron azole, chromated copper arsenate, copper naphthenate, creosote, and pentachlorophenol) may not be used below ordinary high water or as part of an in-water or over-water structure except as described below.

   i. Onsite Storage. Treated wood shipped to the project area must be stored out of contact with standing water and wet soil and protected from precipitation.

   ii. Visual Inspection. Each load and piece of treated wood must be visually inspected and rejected for use in or above aquatic environments if visible residues, bleeding of preservative, preservative-saturated sawdust, contaminated soil, or other matter is present.

   iii. Pilings. Pilings treated with ammoniacal copper zinc arsenate, chromated copper arsenate, or creosote may be installed below ordinary high water according to NOAA Fisheries' guidelines,[15] provided that no more

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[14] "Working adequately" means that upland work is not contributing visible sediment to water, and in-water work does not increase ambient stream turbidity by more than ten percent above background 100 feet below the discharge, when measured relative to a control point immediately upstream from the turbidity causing activity.

[15] Letter from Steve Morris, National Marine Fisheries Service to W.B. Paynter, Portland District, U.S. Army Corps of Engineers (December 9, 1998) (transmitting a document titled "Position Document for the Use of Treated Wood in Areas within Oregon Occupied by Endangered Species Act Proposed and Listed Anadromous Fish Species," National Marine Fisheries Service, December 1998).

than 50 piles are used. Also note that these guidelines do not apply to pilings treated with any other preservative and do not authorize use of treated wood for any other purpose.

iv. Prefabrication and Field Preservative Treatment. Use prefabrication to the extent feasible to ensure that cutting, drilling, and field preservative treatment is minimized. When field fabrication is necessary, all cutting and drilling of treated wood and field preservative treatment of wood exposed by cutting and drilling, will occur above ordinary high water to minimize discharge of sawdust, drill shavings, excess preservative and other debris in riparian, or aquatic habitats. Use tarps, plastic tubs, or similar devices to contain the bulk of any fabrication debris and wipe off any excess field preservative.

v. Abrasion Prevention. All treated wood structures including pilings must have design features to avoid or minimize impacts and abrasion by livestock, pedestrians, vehicles, vessels, floats, *etc.,* to prevent the deposition of treated wood debris and dust in riparian or aquatic habitats.

vi. Waterproof Coating. Treated wood may be used to construct a bridge, over-water structure, or an in-water structure provided that all surfaces exposed to leaching by precipitation, overtopping waves, or submersion are coated with a waterproof seal or barrier that will be maintained for the life of the project. Coatings and any paint-on field treatment must be carefully applied and contained to reduce contamination. Surfaces that are not exposed to precipitation or wave attack, such as parts of a timber bridge completely covered by the roadway wearing surface of the bridge deck are exempt from this requirement.

vii. Debris Removal. Projects that require removal of treated wood must use the following precautions.

(1) Ensure that to the extent feasible, no treated wood debris falls into the water. If treated wood debris does fall into the water, remove it immediately.

(2) After removal, place treated wood debris in an appropriate dry storage site until it can be removed from the project area. Do not leave treated wood construction debris in the water or stacked on the streambank at or below the ordinary high water.

(3) Evaluate treated wood construction debris removed during a project including treated wood pilings to ensure proper disposal of debris.

q. Piling Installation. Hollow steel piling 24 inches in diameter or smaller and H-pile designated as HP24 or smaller may be installed below ordinary high water as follows.

i. Minimize the number and diameter of pilings as feasible.

ii. Repairs, upgrades, and replacement of existing pilings consistent with these terms and conditions are allowed. In addition, up to five single pilings or one dolphin consisting of three to five pilings may be added to an existing facility per in-water construction period.

iii. Whenever feasible, use vibratory hammer for piling installation. Otherwise, use the smallest drop or hydraulic impact hammer necessary to complete the job and set the drop height to the minimum necessary to drive the piling.

iv. When using an impact hammer to drive or proof steel piles, one of the following sound attenuation devices must be used to reduce sound pressure levels by 20 dB.

(1) Place a block of wood or other sound dampening material between the hammer and the piling being drive.

(9) Non-water-related facilities (*e.g.*, parking lots, picnic areas, restrooms) inside the riparian management area.

(10) Any other over-water structure more than six feet wide unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

ii. Excluded Locations for New or Expanded Structures.

(1) Estuarine or saltwater.[17]

(2) Insufficient flow to dissipate fuels and other pollutants from vessels.

(3) Within 0.5 miles downstream from the confluence of a spawning tributary.

(4) An area where a floating dock is likely to ground out or where moored boats will prop wash the bottom.

(5) Requires pre-construction excavation, routine maintenance dredging (*e.g.*, alcoves, backwater sloughs, side channels, other shallow-water areas), or construction of a breakwater, jetty, or groin.

b. New Structures, Maintenance, and Replacement Authorized by this Opinion. New structures may be built and existing structures may be repaired or replaced as follows:

i. Applicable Terms and Conditions. Any new over-water or in-water structure, or replacement or upgrade of an existing structure authorized by this Opinion must be consistent with all applicable terms and conditions of this Incidental Take Statement including, but not limited to those that are relevant to monitoring and construction (*e.g.*, project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, piling installation and removal, treated wood, work area isolation, site restoration, compensatory mitigation).

ii. Educational Signs. Because the best way to minimize adverse effects caused by boating is to educate the public about pollution and its prevention, the following information must be posted and maintained on a permanent sign at all public facilities authorized by this Opinion.

(1) A description of the ESA-listed salmonids, which are or may be present in the project area.

(2) Notice that the adults and juveniles of these species and their habitats are to be protected so that they can successfully migrate, spawn, rear, and complete other behaviors necessary for their recovery.

(3) Lack of necessary habitat conditions may result in a variety of adverse effects including direct mortality, migration delay, reduced spawning, loss of food sources, reduced growth, reduced populations, and decreased productivity.

(4) All users of the facility are required or encouraged to: (1) follow procedures and rules governing use of sewage pump-out facilities; (2) minimize the fuel and oil released into surface waters during fuelings and from bilges and gas tanks; (3) avoid cleaning boat hulls in the water to prevent the release of cleaner, paint, and solvent; (4) practice sound fish cleaning and waste management, including proper disposal of fish waste; and (5) dispose of all solid and liquid waste produced while boating in a proper facility away from surface waters.

iii. Flotation.

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[17] "Estuary or other saltwater area" means an area with maximum intrusion of more than 0.5 ppt measured at depth; in the Columbia River, this includes all areas downstream from Jim Crow Sands (river mile 27).

(1) Permanently encapsulate all synthetic flotation material to prevent breakup into small pieces and dispersal in water.

(2) Install small temporary floats less than seven days before a scheduled event, remove them five days after a scheduled event is concluded, and do not leave them in place longer than 21 days total.

(3) Install mooring buoys and temporary floats (*e.g.*, shellfish traps) more than 300 feet from native submerged aquatic vegetation, more than 50 feet from the shoreline, and in water deeper than 20 feet at all times, or as necessary that gear does not ground out unnecessarily, and boats do not prop wash the bottom.

iv. Access Maintenance. Sediment or other debris including large wood that obstructs or interferes with normal use of an over-water or in-water structure may be removed or excavated as follows provided that the materials are all naturally—occurring; and sediment consists of more than 80 percent sand, gravel, or other naturally—occurring; any sediment consists of more than 80 percent sand, gravel or other naturally—occurring bottom material; and the area to be excavated is not within an EPA-designated Superfund Site, state-designated cleanup area, or the likely impact zone of a significant contaminant source, as identified by historical information on the Corps' best professional judgment.

(1) Only the minimum amount of sediment and debris necessary to restore normal use may be removed or excavated.

(2) All sediment and debris must be side cast or returned to the water downstream from the structure where it will continue to provide aquatic habitat function, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

v. Boat Ramps. Concrete boat ramps must consist of pre-cast concrete slabs below the ordinary high water, and upland portions of the ramp must be completed in the dry so that no wet concrete that has cured less than 24 hours is allowed to contact any wetland or channel below ordinary high water. Rock may be used to construct a footing or other protection necessary to prevent scouring, downcutting, or failure at the boat ramp provided that the rock does not extend further than four feet from the edge of the ramp in any direction.

vi. Covered Moorages and Boathouses. Any replacement roof, wall, or garage door for covered moorages and boathouses must be made of translucent materials. In addition, each side (except the door) of the boathouse must have windows at least four feet wide installed the length of the boathouse subject to breaks only for structural support. Skylights (at least two 4-feet by 4-feet) may be installed in the roof in lieu of translucent panels.

vii. Marinas. An existing marina may be modified within the existing footprint of the moorage or in water more than 50 feet from the shoreline and more than 20 feet deep except that structures may not be placed in areas that support aquatic vegetation or areas where boat operations may damage aquatic vegetation.

viii. Piscivorus Bird Deterrence. Fill all pilings, mooring buoys, and navigational aids (*e.g.*, channel markers) with devices to prevent perching by piscivorus birds.

APPENDIX S

EFFLUENT FILTRATION EVALUATION

Gray & Osborne, Inc.
CONSULTING ENGINEERS

MEMORANDUM

TO:	ERIC LEVISON, PUBLIC WORKS DIRECTOR
COPIES TO:	JIM HODGES, PROJECT MANAGER JIM DICKINSON, WWTF OPERATOR JOHN P. WILSON, P.E., SEATTLE ERIC NUTTING, P.E., SEATTLE JAY SWIFT, P.E., SEATTLE
FROM:	KEN ALEXANDER, P.E.
DATE:	DECEMBER 1, 2010
SUBJECT:	EFFLUENT FILTER EVALUATION, WASTEWATER TREATMENT FACILITY CITY OF CAMAS, CLARK COUNTY, WASHINGTON G&O #07511.00

PURPOSE AND BACKGROUND

The City of Camas requested Gray & Osborne to evaluate potential alternatives to either rehabilitating or replacing the existing effluent filter at the City's wastewater treatment facility (WWTF). The existing effluent filter was installed as part of the Phase 1 upgrade in 2000, when the plant capacity was increased to 6.1 mgd (maximum month) capacity. The filters were installed to ensure the WWTF could meet suspended solids removal standards at all times, particularly during high winter flows.

The existing filtration system, manufactured by Aqua Aerobic Systems, is located in the UV/Effluent Pump Station Building and consists of two parallel trains of fabric disk filters, each train with 12 disks, to filter effluent from the secondary clarifiers. Each filter train has a capacity of 3 mgd for a total filtering capacity of 6 mgd with both filter trains in operation.

The filtration system is designed for a maximum head loss of 1.06 feet at 6 mgd (3 mgd per filter train). When head loss exceeds 1.06 feet, the secondary effluent flows over a weir and bypasses the filters through channels around each filter basin. Thus with both filter trains in operation, flows in excess of 6 mgd go directly to the UV disinfection system. To provide better flow control through the UV system, the overflow weirs that allow flow to bypass the filters are being removed and replaced with serpentine weirs, one in each bypass channel, as part of the Phase 2 upgrade now underway.

The two existing concrete basins that house the filters are 16 feet long by 8.5 feet wide by 12.25 feet deep. The basins are entirely below the building floor level. An open-channel horizontal lamp UV system is downstream; secondary clarifiers are upstream.

The WWTF operator has reported a number of problems with operating the Aqua Aerobic filters. The most prominent issue is the buildup of biological growth on the interior of the filter fabric, which occurs because the backwash system consists only of intermittent flow reversal through the fabric and does not include spray washing. Other reported issues include inoperative valves and an inability to replace outdated parts. Because of these problems, the filter has not been operated in a number of years.

FILTER ALTERNATIVES EVALUATED

Gray & Osborne contacted five different equipment representatives that represent six different filter manufacturers:

1. Aqua Aerobic filter represented by Goble Sampson (existing filter)
2. Sanitaire filter represented by Beaver Equipment
3. Ashbrook-Simon-Hartley Iso-Disk filter represented by Treatment Equipment Company
4. Nova Ultrascreen filter represented by Treatment Equipment Company
5. Parkson filter represented by Pedroni & Company
6. Kruger Hydrotech filter represented by Wm. H. Reilly & Company

Sanitaire's product will not fit within the existing basin. At the time this memorandum was written, Parkson was not willing to participate in the evaluation. Because the Ashbrook-Simon-Hartley product is so similar to the existing Aqua Aerobic filter in its design and operation, it was decided to not include the Ashbrook-Simon-Hartley filter in the evaluation. The alternatives evaluated in more detail include:

1. Rehabilitating the existing Aqua Aerobic filter,
2. Replacing the existing filter with a Kruger Hydrotech filter, and
3. Replacing the existing filter with a Nova Ultrascreen filter.

Alternative No. 1 – Rehabilitate Existing Aqua Aerobic Fabric Disk Filter

Aqua Aerobic sent a field technician to evaluate the existing filtration system on September 28, 2010. A summary of the findings and recommendations is provided below.

<u>Aqua Aerobic Field Technician Findings</u>

- The filters are currently out of service and have been for quite some time. According to the operator, Jim Dickinson, they have no plans to use them in their current condition.
- Both filters are in need of repair.
- Both units have several of the hook and loop tabs showing. Jim Dickinson stated that these cloths were not sized properly and when installed the technician had to use contact cement to get the tabs to stick together properly.
- The valves were all cycled and all of them work. Several of the solenoids are leaking and/or sticking. The sticking solenoids do operate after cycling the solenoid a few times. Several of the gaskets between the solenoids are in need of replacement.
- Filter 1 has one frame that appears to be damaged. The threads have pulled out of the frame.
- Filter 2 is missing its V seal.
- Filter 2 also has a faulting PLC. An attempt to discern the fault was made. However, communications could not be established.

<u>Recommendations</u>

- Replace all pneumatic actuators with electric.
- Replace the UniOp displays with Panel Views.
- Replace the 5/04 PLC for Filter 2. (Ethernet ports have been added to the control cabinet by the plant. The ports are currently unused and the reason

for them was not available. It would be assumed that the idea would be SCADA communication. If this is the case, an SLC 5/05 may be a better choice.)

- Install an analog card and a level transducer. (Currently, the filters use air pressure and a differential switch.)
- Replace the "rod style" high-level indicator with a float ball.
- Replace the orifice plate with a throttling valve. (WWTF operators stated that they were unable to get backwash pumps to achieve proper pressure/vacuum readings.)
- Replace the air weir with a slide gate or another positive closing device.
- Replace and/or install chain guards.
- Replace all the cloths with a current version.
- Use chlorine as needed to control slime growth.

The estimated cost for this alternative is $396,000, including sales tax, contingency, design engineering, construction administration, and HMI programming. A cost breakdown is included in Table A-1 of Appendix A. The proposed cloth for the rehabilitation of the Aqua Aerobic filter is intended to be less prone to biological fouling and require less cleaning, but maintenance will still need to include periodic use of chlorine to keep the filter fabric clean. Gray & Osborne contacted a number of existing wastewater treatment plants and determined that regular cleaning using a bleach solution was a normal part of the filter operation and maintenance. Appendix B-1 provides a summary of information regarding filter operation and maintenance obtained from other treatment facilities using the Aqua Aerobic filter.

Alternative No. 2 – Replace Existing Filter with Kruger Hydrotech Disk Filter

With this alternative, the existing filters would be removed and replaced with two new cloth media (woven polyester screen) disk filters (10 microns). Preliminary installation drawings are shown on Figures 1 and 2.

A summary of the design criteria for the Kruger filter is listed below:

Number of Units:	2
Number of Disks per Unit:	12
Filter Area per Unit:	723 ft^2
Submerged Filter Area per Unit:	470 ft^2
Peak Hydraulic Loading:	4.43 gpm/ft^2

Kruger indicates their filter can operate within the 1.06 feet of available head across the filter system and achieve treatment of at least 3 mgd per filter train. Any flow through the filter that exceeds available head will be bypassed through the existing bypass channels.

The operation of the Kruger Hydrotech filter is described below:

- Influent flows by gravity into the partially submerged filter disks from the center drum. Flow is continuous, even during backwash cycles.

- Filter disks consist of modular panels that are pulled out and reinstalled by hand as needed for replacement. Removal of filter panels is not a part of routine cleaning.

- Disks are normally static and the flow is from the inside of the disks to the outside into a collection tank from which the filtered water is discharged.

- Backwash occurs when a level sensor indicates high head loss across the filter.

- Filtered effluent is used to backwash the disks using a spray header that pushes filtered water back to the inside of the disks. The disk assembly is rotated during backwash to allow the stationary spray header to wash the entire cloth surface. A collection trough inside the center drum collects backwash water for disposal via the plant drain system. Estimated backwash rate is 3 percent of throughput flow.

- An automated chemical cleaning system (ACS) is available. This can either be skid mounted or portable. The ACS uses dilute acid (hydrochloric, muriatic, citric) or hypochlorite as a cleaning solution. A separate header/spray system at the top of the filter is used to deliver the cleaning solution to the disk surface.

Gray & Osborne contacted several facilities with Kruger filters installed and operational. No significant problems were reported from this survey and all respondents to the survey were satisfied with the Kruger filter. Appendix B-2 provides a summary of information gathered in the survey. There are two Kruger filter installations in the State of Oregon, but none in Washington.

The estimated cost for this alternative is $890,000, including sales tax, contingency, design engineering, construction administration, and HMI programming. Appendix A, Table A-2, provides a breakdown of the estimated project cost. It will be necessary to modify the existing UV/Effluent Pump Station Building to install the filter because the existing doorway is not large enough to get the skid-mounted filter inside. The empty weight of the Kruger filter is 5,610 pounds per filter (12-disk model). A new double door with a minimum clear space of 8'-4" high by 8'-4" wide would be installed to replace the existing 7-foot-high by 6-foot-wide double door. Additionally, it will be necessary to fill both of the existing filter basins with concrete to raise the level of basins to provide the proper hydraulic profile for the filtration system. Building modifications are included in the cost estimate.

Alternative No. 3 – Replace Existing Filter with Nova Ultrascreen Disk Filter

With this alternative, the existing filters would be removed and replaced with two new disk filters that use an AISI 316 stainless steel mesh media (15 to 25 microns). Preliminary installation drawings are attached as Figures 3 and 4.

A summary of the design criteria for this filter is listed below:

Number of Units:	2
Number of Disks per Unit:	12
Filter Area per Unit:	264 ft^2
Peak Hydraulic Loading:	16 gpm/ft^2

Nova indicates their filter can operate within the 1.06 feet of available head across the filter system and treat at least 3 mgd per filter train. Any flow through the filter that exceeds available head will be bypassed through the existing bypass channels.

The operation of the Nova Ultrascreen filter is described below:

- Influent flows continuously by gravity into the spaces between partially submerged filter disks that are in a constant state of slow rotation. Each disk is sealed to the walls of the tank by EPDM rubber seals to prevent short-circuiting.

- Filter disks consist of stainless steel mesh with openings between 15 and 25 microns.

- Flow is from the inside of the disks to the outside into a collection tank from which the filtered water is discharged. The feed passes through the filter mesh and freely falls into the filtrate zone below, then flows out through the effluent outlet.

- Backwash is initiated when a level sensor indicates high head loss across the filter. Backwash occurs by turning on the wash water pump and the back of the screen mesh is sprayed by low-pressure water for about 1 minute. Once the mesh is cleaned, the level in the feed zone recedes to another preset level where a second level sensor deactivates the wash water pump. All of the solids cleaned from the fine filtration mesh are collected in a simple trough between the disks and leave the filter under gravity flow. The reject troughs are connected to a common outlet and the concentrated wash water is sent back to the plant drain pump station by gravity.

- Filtered effluent is used to backwash the disks using a spray header that pushes filtered water back to the inside of the disks. A collection trough inside the center drum collects backwash water for disposal via the plant drain system. Estimated backwash rate is 3 percent of throughput flow.

- The level sensor is also used for turning the filter itself on and off. At low level, the filter is de-energized and allowed to remain in a "filter ready" idle mode. Once flow resumes, the idle filter is energized and the normal filtration and wash cycles resume. A level sensor will send a signal to the control panel when a high-level condition or overflow situation occurs, which may occur during a plant upset or a power outage.

Gray & Osborne contacted several facilities with Nova filters installed and operational. No significant problems were reported from this survey and all respondents to the survey were satisfied with the Nova filter. Appendix B-3 provides a summary of contacts made for the survey. There are no Nova filter installations on the west coast; all installations are in the eastern United States and Europe.

The estimated cost for this alternative is $1,075,000, including sales tax, contingency, design engineering, construction administration, and HMI programming. Appendix A, Table A-3, provides a breakdown of the estimated project cost. It will be necessary to modify the existing UV/Effluent Pump Station Building to install the filter because the existing doorway is not large enough to get the skid-mounted filter inside. The empty weight of the Nova filter is 8,500 pounds. A new double door with a minimum clear space of 8'-4" high by 8'-4" wide would be installed to replace the existing 7-foot-high by 6-foot-wide double door. Additionally, it will be necessary to fill both of the existing filter basins with concrete to raise the level of basins to provide the proper hydraulic profile for the filtration system. Building modifications are included in the cost estimate.

SUMMARY

Costs for the three alternatives are listed below.

- Alternative No. 1 – Rehabilitate existing Aqua Aerobic Filter: $396,000
- Alternative No. 2 – Replace existing filter with Kruger Hydrotech Filter: $890,000
- Alternative No. 3 – Replace existing filter with Nova Ultrascreen Filter: $1,075,000

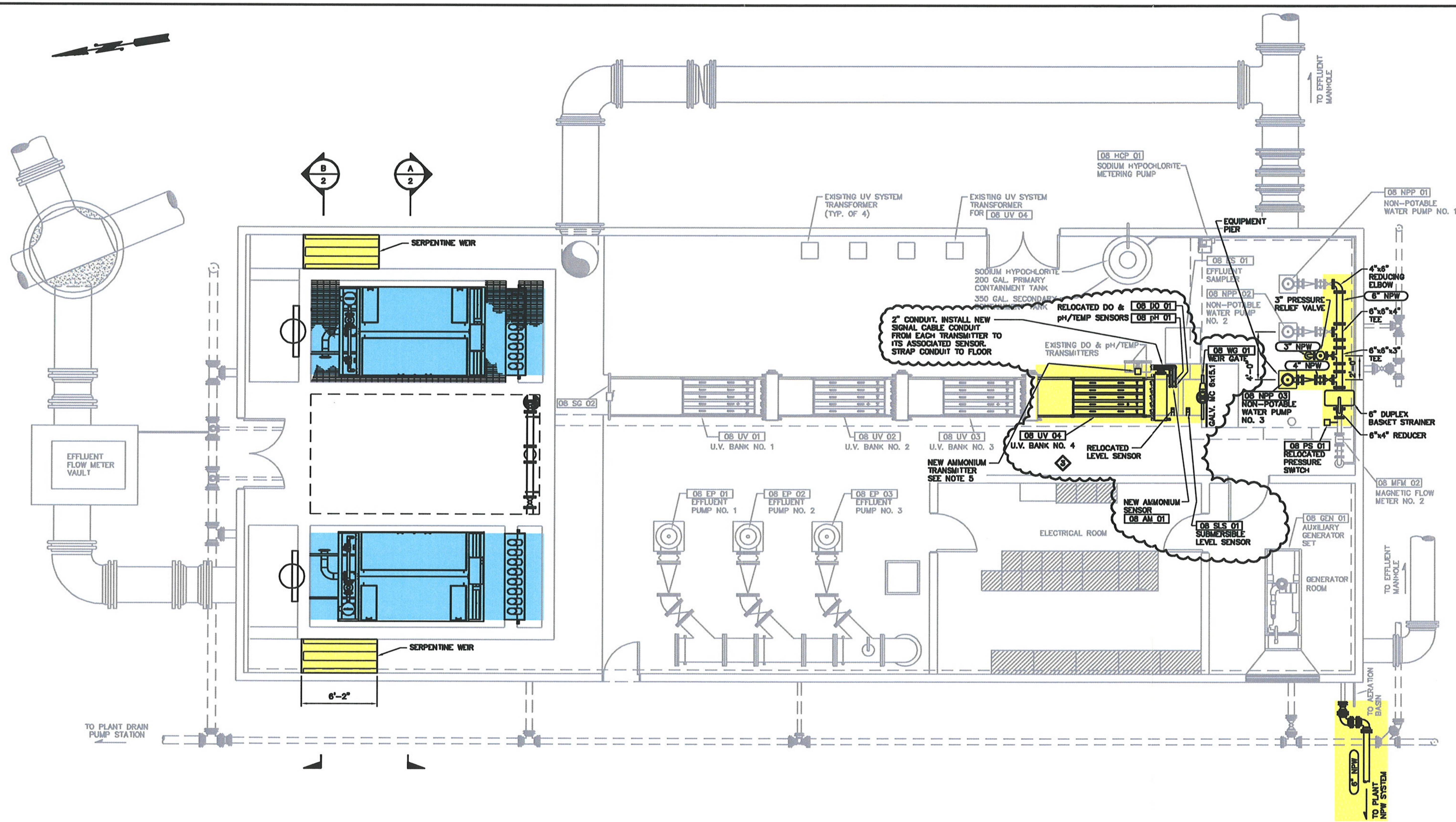
Rehabilitating the Aqua Aerobic filter is the least expensive alternative. Because the WWTF operator has had problems with this filter in the past, the major concern with this alternative is operation and maintenance. Although this concern is being mitigated by the proposed use of a different filter fabric, it is expected that routine periodic use of chlorine will still be needed for this filter. This is required with any filtration system for filtering municipal secondary effluent because BOD and nutrient levels are high enough to support biological growth on the filter media. It should be noted that regular cleaning of drinking water filtration systems that have much lower BOD and nutrient concentrations are also subject to periodic maintenance using chlorine.

The Kruger Hydrotech filter preliminary estimate is $890,000 and is $500,000 higher in estimated cost compared with rehabilitating the existing filter. The overall design is expected to result in less operation and maintenance than the existing filter because the filter units will be more accessible for cleaning and the media and backwashing system are expected to be less vulnerable to biofouling, but routine periodic cleaning with chemical solutions (weak acid or dilute sodium hypochlorite) will still be part of the recommended operation and maintenance regime. There are two Kruger filters in Oregon that are relatively accessible for a site visit and should the City be interested in investigating this option further, both are within a 1-day drive of Camas.

The Nova Ultrascreen filter is the most expensive of the three alternatives evaluated. At an estimated cost of $1,075,000, it is estimated to be $685,000 more than the Aqua Aerobic option.

Gray & Osborne recommends the City of Camas rehabilitate the existing Aqua Aerobic filter. The cost of replacing the filter with either the Kruger or Nova filter is estimated to be more than double the cost of the Aqua Aerobic rehabilitation. Gray & Osborne has experience with Aqua Aerobic filters at other wastewater treatment plants, some in operation for more than 10 years, and we believe the maintenance issues experienced at Camas can be addressed through operator training and a rigorous operation and maintenance program. Appendix B-1 has additional information on filter fabric cleaning procedures that have been used successfully at other WWTFs using the Aqua Aerobic filter.

KCA/hhj



U.V. DISINFECTION/EFFLUENT PUMP STATION - UPPER MODIFICATIONS PLAN

SCALE: 1/8"=1'-0"

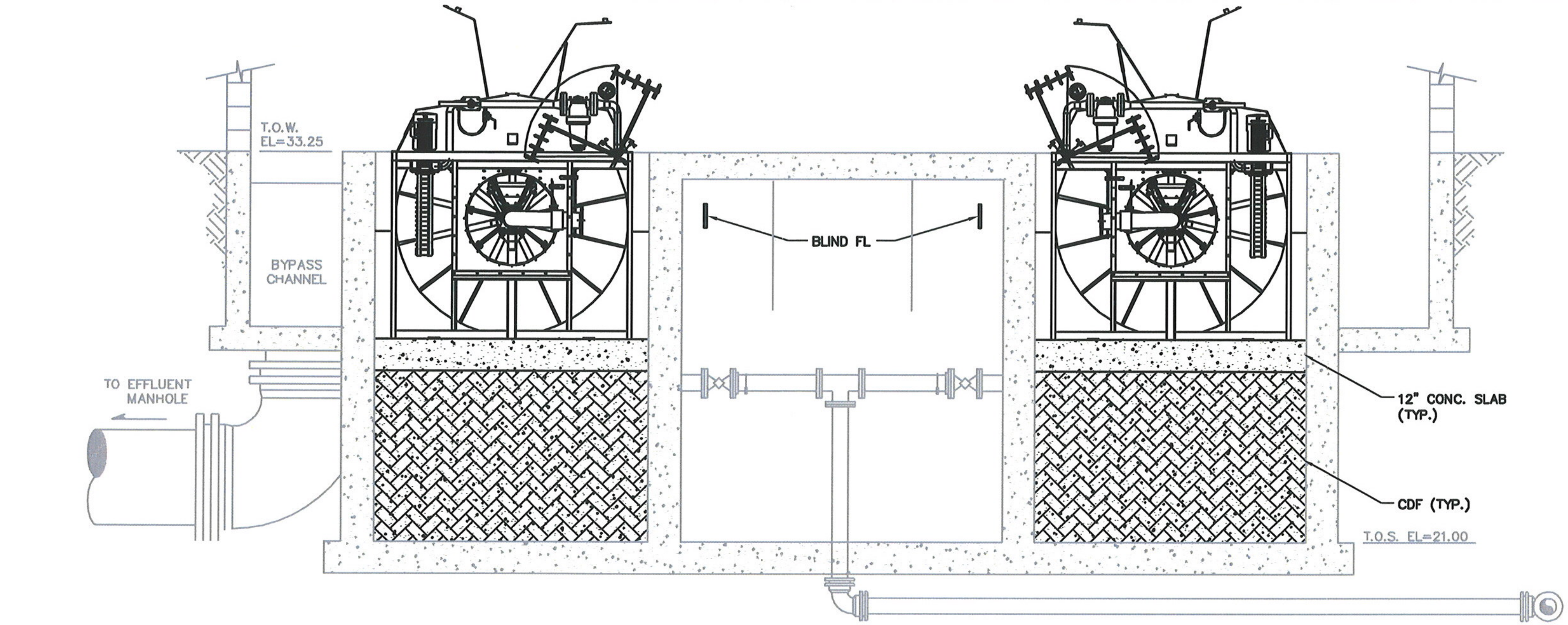
(SOURCE: SHEET M8-1, CITY OF CAMAS WWTF IMPROVEMENTS, PHASE 2)

PHASE 2 UPGRADES

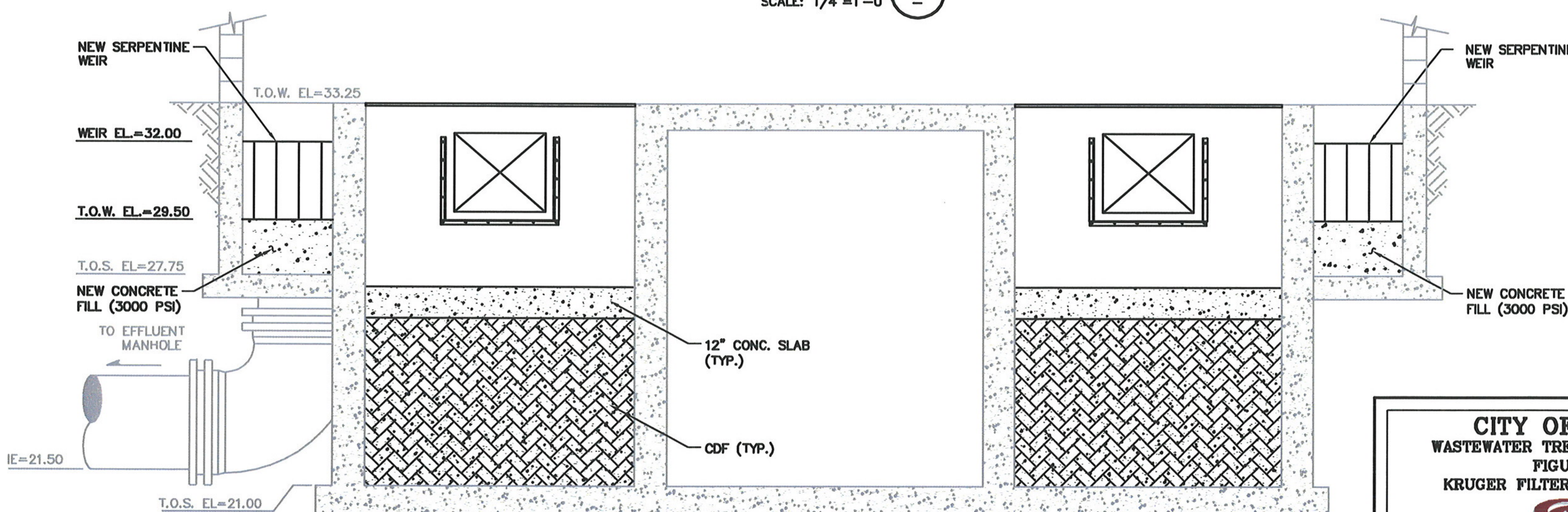
FILTER INSTALLATION

CITY OF CAMAS
WASTEWATER TREATMENT FACILITY
FIGURE 1
KRUGER FILTER PLAN VIEW

Gray & Osborne, Inc.
CONSULTING ENGINEERS



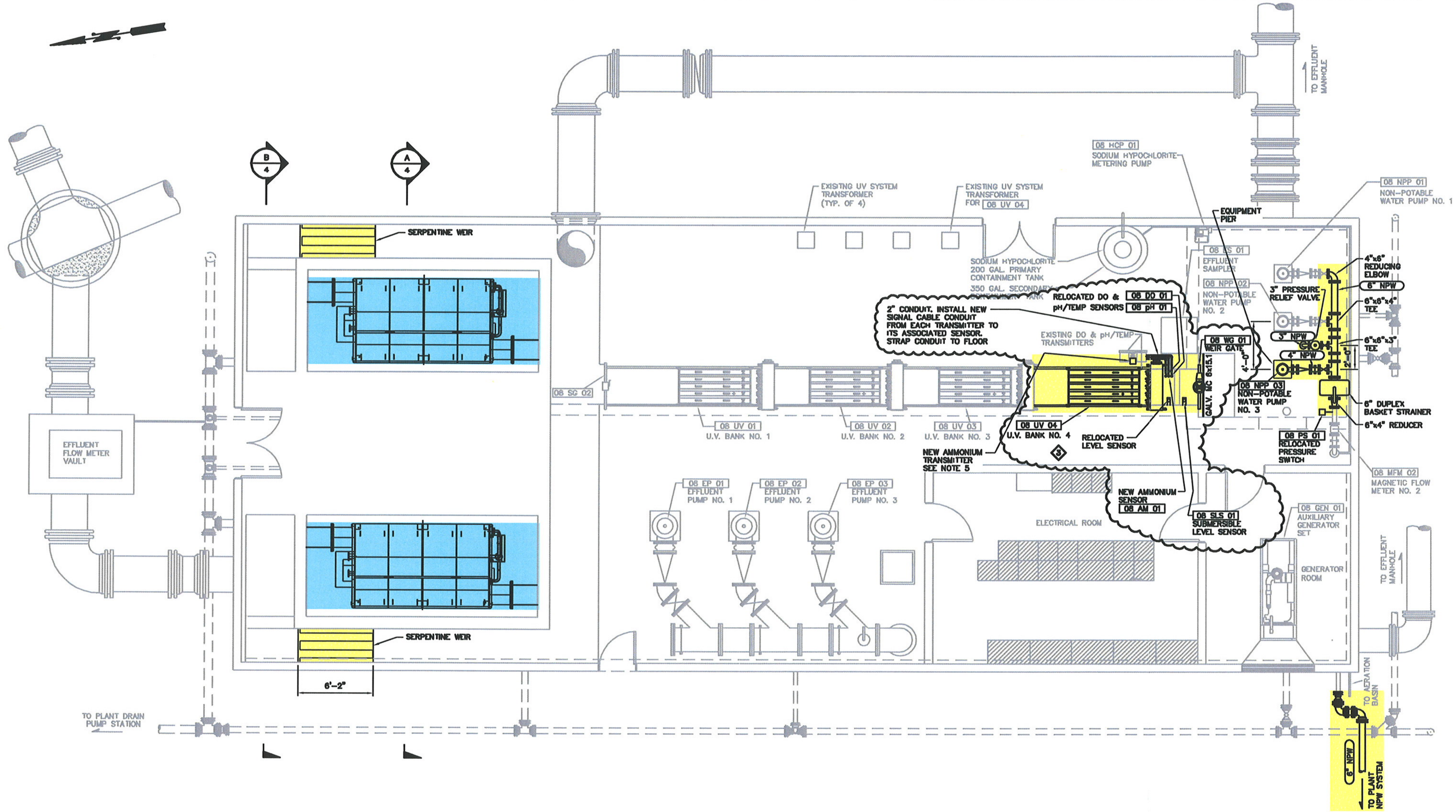
SECTION A
SCALE: 1/4"=1'-0"



SECTION B
SCALE: 1/4"=1'-0"

CITY OF CAMAS
WASTEWATER TREATMENT FACILITY
FIGURE 2
KRUGER FILTER SECTION VIEWS

Gray & Osborne, Inc.
CONSULTING ENGINEERS



U.V. DISINFECTION/EFFLUENT PUMP STATION - UPPER MODIFICATIONS PLAN

SCALE: 1/8"=1'-0"

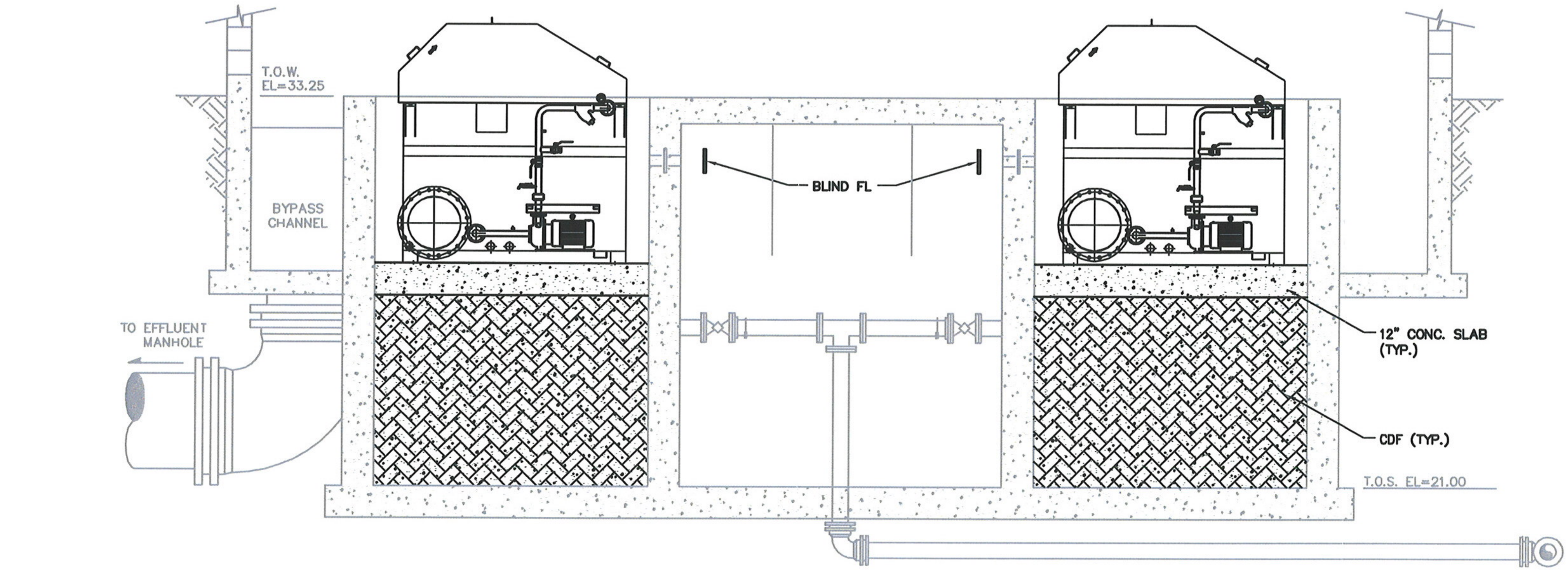
(SOURCE: SHEET M8-1, CITY OF CAMAS WWTF IMPROVEMENTS, PHASE 2)

PHASE 2 UPGRADES

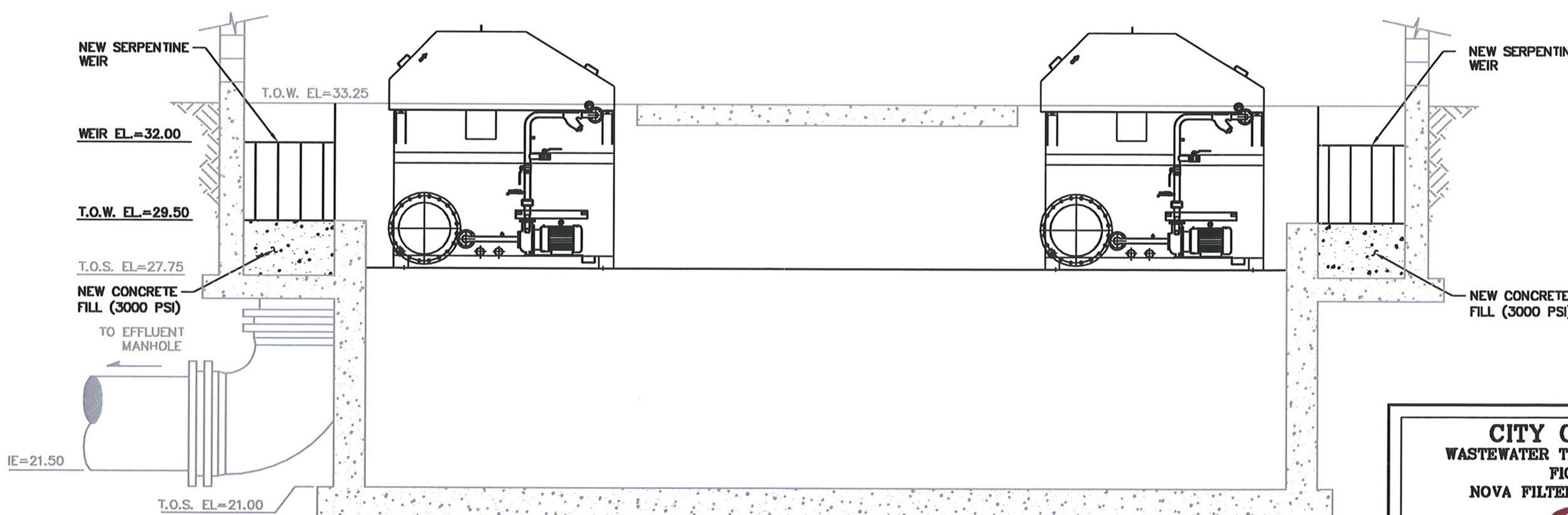
FILTER INSTALLATION

CITY OF CAMAS
WASTEWATER TREATMENT FACILITY
FIGURE 3
NOVA FILTER PLAN VIEW

Gray & Osborne, Inc.
CONSULTING ENGINEERS



SECTION A/—
SCALE: 1/4"=1'-0"



SECTION B/—
SCALE: 1/4"=1'-0"

CITY OF CAMAS
WASTEWATER TREATMENT FACILITY
FIGURE 4
NOVA FILTER SECTION VIEWS

Gray & Osborne, Inc.
CONSULTING ENGINEERS

TABLE A-1

Aqua Aerobic Filter Rehabilitation

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Aqua Aerobic Material & Labor - (includes 10% markup) (see attached proposal from Aqua Aerobics)	1	LS	$ 239,840	$ 239,840
2	Mechanical Labor Costs	1	LS	$ 40,000	$ 40,000
3	Electrical & Controls	1	LS	$ 20,000	$ 20,000
4	Building Modifications	1	LS	$ -	$ -
	Subtotal:………………………………………………………………				$ 299,840
	Sales Tax (8.2%):…………………………………………………………				$ 24,587
	Contingency (5%)				$ 16,221
	TOTAL ESTIMATED CONSTRUCTION COST:……………………				$ 341,000
	Engineering Design & Construction Administration				$ 50,000
	HMI Programming (Conley Engineering)				$ 5,000
	TOTAL ESTIMATED PROJECT COST				**$ 396,000**

AQUA-AEROBIC SYSTEMS, INC.
Partnering for Solutions

Proposal#: 42407

TO:	GRAY AND OSBORNE, INC. 8513 NE HAZEL DELL AVENUE, SUITE 106 VANCOUVER, WASHINGTON 98665 USA	PROJECT: CAMAS WWTP PROPOSAL DATE: November 11, 2010
ATTN:	KEN ALEXANDER	
CC:	Goble Sampson Associates, Inc / ph#: 425/392-0491 / fx#: 425/392-9615 Douglas Allie	

The following Notes apply to Aqua-Aerobic Systems' proposal:

Aqua-Aerobic Systems is pleased to offer the following proposal for your acceptance within thirty (30) days.

Two AquaDisk® Model #ADFC-54x12E-PC refurbishments consisting of:

144 Each New OptiFiberPA2-13® Cloth Media Filter cloths with new non-corrosive support frame assemblies.
The OptiFiber® is the state of the art cloth media. The unique OptiFiber® Pile Cloth Media provides depth for storage of removed solids, resulting in longer filter run time between backwashes. It also allows for higher solids loading and ease of cleaning, reducing the amount of back wash waste.

2 Each Centertube refurbishments consisting of new Viton V-ring effluent port/center tube seals, new Neoprene media seating gaskets, new OptiFiberPA2-13® cloth media and non-corrosive support frame assemblies.

2 Each New chain guard weldments

22 Each New style stainless steel backwash springs

2 Lots AquaDisk® Instrumentation consisting of:
1 Each Level sensing pressure transducers with 304 stainless steel probe mounting brackets and new float switches.

2 Lots AquaDisk® Valves consisting of:
1 Each Backwash pump valves - Throttling gate valves
1 Set of (6) Backwash valves - 3" full port, two piece ASTM A351 Grade CF8M stainless steel body ball valves, flanged end connections with single phase electronic actuators. Valve actuator combination shall be manufactured by TCI/RCI.
1 Each Sludge Valves - 3" full port, two piece ASTM A351 Grade CF8M stainless steel body ball valves, flanged end connections with single phase electronic actuators. Valve actuator combination shall be manufactured by TCI/RCI.

2 Lots AquaDisk® Controls with Starters
1 Each Allen Bradley SLC5/05 central processing units with 16K emmory and Ethernet connection.
1 Each Analog input cards
1 Each Allen Bradley Panelview 600 touch screen displays
1 Each Ethernet switches
1 Lot Aqua-Aerobics Systems control software. This includes lifetime use of our proprietary software and updated programming for the new PLC and HMI screens.

1 Lot AquaDisk® Service consisting of
4 Day Installation supervision (1 Trip)
4 Days Mechanical supervision (1 Trip)
Unlimited 24/7 phone support to our Customer Response Center Hotline.

1 Lot Freight to the jobsite. FOB Aqua-Aerobic Systems factory with full freight allowed to the jobsite. Unloading shall be by others.

The Following Notes apply to Aqua-Aerobic Systems' Proposal:

- We expect record set drawings to be completed and in transit to you approximately 4 - 8 weeks after receipt of order with acceptable terms and conditions and guarantee of payment. We expect shipment of equipment (transit time excluded) will be approximately 12 - 14 weeks from transmittal of record set drawings and release for manufacture. Any changes to the record set drawings may result in price adder(s). *Schedules may be adjusted at time of order placement, depending upon existing order backlog. Weeks quoted are actual working weeks.
- Materials and Services not specifically described/itemized in this proposal are not included in the quoted total price, and are to be supplied by the installing contractor/purchaser.
- All piping, supports, gaskets, and hardware beyond Aqua-Aerobic Systems' equipment terminations are to be supplied by the installing contractor/purchaser.

Ball valves per filter ship loose. Interconnecting piping, wiring, and installation is to be supplied by the installing contractor/purchaser.

- Electrical wiring and supply power is to be supplied by the installing contractor/purchaser.
- Installation and field wiring of the control panel is to be supplied by the installing contractor/purchaser.
- Electrical wiring, interconnecting wiring, conduit, supply power, and appurtenances are to be supplied by the installing contractor/purchaser.
- Freeze protection may be required for outdoor installation in cold weather climates. All such protection, including but not limited to, heat tracing and insulation of pumps and piping, as well as protection against internal tank freezing, shall be provided and installed by the installing contractor.
- Aqua-Aerobic Systems, Inc. reserves the right to re-evaluate the pricing quoted prior to order acceptance if a purchase order is received after the validity date stated in this proposal, OR if the lead times stated in this proposal are exceeded. Any pricing adjustments required shall be based on a published materials cost index specific to the materials proposed.
- Supervision services included in Aqua-Aerobic Systems' proposal are based upon supply of the quantity of trips and days stated. Additional supervision services can be provided for an additional charge of $1100/day plus travel and living expenses.

GOODS QUOTED ABOVE WILL BE SOLD SUBJECT ONLY TO THE TERMS AND CONDITIONS OF SALE SET FORTH HEREIN. ANY DIFFERENT OR ADDITIONAL TERMS ARE HEREBY OBJECTED TO.

Total Price: **$218,036.00**

TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC.

Page 1 of 2

This offer and all of the goods and sales of Aqua-Aerobic Systems, Inc. are subject only to the following terms and conditions. The acceptance of any order resulting from this proposal is based on the express condition that the Buyer agrees to all the terms and conditions herein contained. Any terms and conditions in any order, which are in addition to or inconsistent with the following, shall not be binding upon Aqua-Aerobic Systems, Inc. This proposal and any contract resulting therefrom, shall be governed by and construed in accordance with the laws of the State of Illinois, without regard to conflicts of laws principles.

PAYMENT

Unless specifically stated otherwise, quoted terms are Net 30 Days from shipping date. Past-due charges are 1.5% per month and will apply only on any past-due balance. Aqua-Aerobic Systems, Inc. does not allow retainage of any invoice amount, unless authorized in writing by an authorized representative of our Loves Park, Illinois office.

DURATION OF QUOTATION

This proposal of Aqua-Aerobic Systems, Inc. shall in no event be effective more than 30 days from date thereof, unless specifically stated otherwise, and is subject to change at any time prior to acceptance.

SHIPMENT

Shipping dates are not a guarantee of a particular day of shipment and are approximate, being based upon present production information, and are subject to change per the production schedules existing at time of receipt of purchase order. Aqua-Aerobic Systems, Inc. shall not be responsible for any delay in shipment for causes beyond its control including, but not limited to, war, riots, strikes, labor trouble causing interruption of work, fires, other casualties, transportation delays, modification of order, any act of governmental authorities or acts of God. Quoted shipment dates in this proposal are approximate dates goods will be shipped and, unless agreed to in writing by Aqua-Aerobic Systems, Inc., Buyer may not postpone or delay the dates of shipment of goods from our plant or from our supplier's plants beyond the dates set forth in this proposal.

TITLE AND RISK OF LOSS

All prices and all shipments of goods are F.O.B. Aqua-Aerobic Systems, Inc.'s plant at Loves Park, Illinois unless specifically stated otherwise. Delivery of the goods sold hereunder to the carrier shall be deemed delivery to the Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

TAXES

Prices quoted do not include any taxes, customs duties, or import fees. Buyer shall pay any and all use, sales, privilege or other tax or customs duties or import fees levied by any governmental authority with respect to the sale or transportation of any goods covered hereby. If Aqua-Aerobic Systems, Inc. is required by any taxing authority to collect or to pay any such tax, duty or fee, the Buyer shall be separately billed at such time for the amounts Aqua-Aerobic Systems, Inc. is required to pay.

INSURANCE

Unless the goods are sold on a CIF basis, the Buyer shall provide marine insurance for all risks, including war and general coverage.

SECURITY

If at any time the financial responsibility of the Buyer becomes unsatisfactory to Aqua-Aerobic Systems, Inc., or Aqua-Aerobic Systems, Inc. otherwise deems itself insecure as to receipt of full payment of the purchase price from Buyer hereunder, Aqua-Aerobic Systems, Inc. reserves the right to require payment in advance or security or guarantee satisfactory to Aqua-Aerobic Systems, Inc. of payment in full of the purchase price.

LIMITATION OF ACTION

No action shall be brought against Aqua-Aerobic Systems, Inc. for any breach of its contract of sale more than two years after the accrual of the cause of action thereof, and, in no event, unless the Buyer shall first have given written notice to Aqua-Aerobic Systems, Inc., of any claim of breach of contract within 30 days after the discovery thereof.

CANCELLATION CLAUSE

No acceptance of this proposal, by purchase order or otherwise, may be modified except by written consent of Aqua-Aerobic Systems, Inc. nor may it be cancelled except by prior payment to Aqua-Aerobic Systems, Inc. the following sums as liquidated damages therefor: 1) If cancellation is prior to commencement of production and prior to the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to 15% of the total purchase price; 2) If cancellation is after the commencement of production or after the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to the total of the direct, out-of-pocket expenses incurred to the date of cancellation for labor, machine time, materials and any charges made to us by suppliers for cancellation, plus 30% of the total purchase price. All charges and expenses shall be as determined by Aqua-Aerobic Systems, Inc. In the event any items are used by Aqua-Aerobic Systems, Inc. to fill a subsequent order, then upon receipt of payment for such order, Aqua-Aerobic Systems, Inc. shall pay the Buyer a sum equal to the direct out-of-pocket expenses previously charged and received from Buyer.

PROPRIETARY INFORMATION

This proposal, including all descriptive data, drawings, material, information and know-how disclosed by Aqua-Aerobic Systems, Inc. to Buyer in relation hereto is confidential information intended solely for the confidential use of Buyer, shall remain the property of Aqua-Aerobic Systems, Inc. and shall not be disclosed or otherwise used to the disadvantage or detriment of Aqua-Aerobic Systems, Inc. in any manner.

TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC.

QUALIFIED ACCEPTANCE AND INDEMNITY
In the event the acceptance of this proposal by Buyer either is contingent upon or subject to the approval by any third party such as, but not limited to, a consulting engineer, with respect to goods, parts, materials, descriptive data, drawings, calculations, or any other matter, then upon such approval by any third party, Aqua-Aerobic Systems, Inc. shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal. In the event any such third party requires modifications in the proposal prior to the approval thereof, Aqua-Aerobic Systems, Inc. may at its sole option and without liability to any party elect to cancel this proposal or return the purchase order to Buyer. In the event Aqua-Aerobic Systems, Inc. elects to modify this proposal to conform to the requirements for approval by any third party, Aqua-Aerobic Systems, Inc. in such event shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal as modified.

Buyer agrees to indemnify and save harmless Aqua-Aerobic Systems, Inc. from and against all costs and expenses and liability of any kind whatsoever arising out of or in connection with claims by third parties so long as the goods sold hereunder conform to the requirements of this proposal as approved by any third party.

WARRANTY; LIMITATION OF LIABILITY; AND DISCLAIMER
In return for purchase and full payment for Aqua-Aerobic Systems, Inc. goods, we warrant new goods provided by us to be free from defects in materials and workmanship under normal conditions and use for a period of one year from the date the goods are put into service, or eighteen months from date of shipment (whichever first occurs). If the goods include an "Endura Series" motor, the complete Endura Series unit shall be warranted by Aqua to be free from defects in materials and workmanship under normal conditions and use for three years from the date the product is put into service or 42 months from the date of shipment (whichever occurs first).

OUR OBLIGATION UNDER THIS WARRANTY IS EXPRESSLY AND EXCLUSIVELY LIMITED to replacing or repairing (at our factory at Loves Park, Illinois) any part or parts returned to our factory with transportation charges prepaid, and which our examination shall show to have been defective. Prior to return of any goods or its parts to our factory, Buyer shall notify Aqua-Aerobic Systems, Inc. of claimed defect, and Aqua-Aerobic Systems, Inc. shall have the privilege of examining the goods at Buyer's place of business at or where the goods have otherwise been placed in service. In the event this examination discloses no defect, Buyer shall have no authority to return the goods or parts to our factory for the further examination or repair. All goods or parts shall be returned to Buyer, F.O.B. Loves Park, Illinois. This warranty shall not apply to any goods or part which has been repaired or altered outside our factory, or applied, operated or installed contrary to our instruction, or subjected to misuse, chemical attack/degradation, negligence or accident. This warranty and any warranty and guaranty of process or performance shall no longer be applicable or valid if any product, including any software program, supplied by Aqua-Aerobic Systems, Inc., is modified or altered without the written approval of Aqua-Aerobic Systems, Inc. Our warranty on accessories and component parts not manufactured by us is expressly limited to that of the manufacturer thereof.

THE FOREGOING WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND OF ALL OTHER LIABILITIES AND OBLIGATIONS ON OUR PART, INCLUDING ANY LIABILITY FOR NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE; AND ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY DISCLAIMED; AND WE EXPRESSLY DENY THE RIGHT OF ANY OTHER PERSON TO INCUR OR ASSUME FOR US ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF ANY GOODS PROVIDED BY US. THERE ARE NO WARRANTIES OR GUARANTEES OF PERFORMANCE UNLESS SPECIFICALLY STATED OTHERWISE.

UNDER NO CIRCUMSTANCES, INCLUDING ANY CLAIM OF NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE, SHALL AQUA-AEROBIC SYSTEMS, INC. BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, COSTS OF CONNECTING, DISCONNECTING, OR ANY LOSS OR DAMAGE RESULTING FROM A DEFECT IN THE GOODS. LIMIT OF LIABILITY: AQUA-AEROBIC SYSTEMS, INC.'S TOTAL LIABILITY UNDER THE ABOVE WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT OF ANY DEFECTIVE PART. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE, AND OUR LIABILITY WITH RESPECT TO ANY CONTRACT OR SALE, OR ANYTHING DONE IN CONNECTION THEREWITH, WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT, IN ANY CASE, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

Final acceptance of this proposal must be given to Aqua-Aerobic Systems, Inc. at their office in Loves Park, Illinois. Please acknowledge acceptance by signing the proposal and returning it to Aqua-Aerobic Systems, Inc.

Accepted by: ______________________

By: __________ **Date:** __________

Offer Respectfully Submitted,

Sherry Pike

Sherry Pike, Customer Service Representative
Aqua-Aerobic Systems, Inc.

TABLE A-2

Kruger Filter Installation

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Remove & Wastehaul Existing Filter	1	LS	$ 10,000	$ 10,000
2	Filter Equipment (includes 10% markup) - includes automated cleaning system	1	LS	$ 624,800	$ 624,800
3	Mechanical Installation	1	LS	$ 50,000	$ 50,000
4	Electrical and Controls	1	LS	$ 25,000	$ 25,000
5	Building Modifications				
a	New Doorway	1	LS	$ 10,000	$ 10,000
b	Fill in Basin	1	LS	$ 9,000	$ 9,000
	Subtotal:				$ 728,800
	Sales Tax (8.2%):				$ 59,762
	Contingency (5%)				$ 39,428
	TOTAL ESTIMATED CONSTRUCTION COST:				$ 828,000
	Engineering Design & Construction Administration				$ 52,000
	HMI Programming (Conley Engineering)				$ 10,000
	TOTAL ESTIMATED PROJECT COST				**$ 890,000**

TABLE A-3

Nova Filter Installation

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	Remove & Wastehaul Existing Filter	1	LS	$ 10,000	$ 10,000
2	Filter Equipment (includes 10% markup)	1	LS	$ 825,000	$ 825,000
3	Mechanical Installation	1	LS	$ 50,000	$ 50,000
4	Electrical and Controls	1	LS	$ 25,000	$ 25,000
5	Building Modifications				
a	New Doorway	1	LS	$ 10,000	$ 10,000
b	Fill in Basin	1	LS	$ 10,000	$ 10,000
	Subtotal:……				$ 930,000
	Sales Tax (8.2%):……				$ 76,260
	Contingency (5%)				$ 50,313
	TOTAL ESTIMATED CONSTRUCTION COST:……				$ 1,007,000
	Engineering Design & Construction Administration				$ 58,000
	HMI Programming (Conley Engineering)				$ 10,000
	TOTAL ESTIMATED PROJECT COST				**$ 1,075,000**

APPENDIX T

EFFLUENT FILTRATION OPERATION AND MAINTENANCE SUMMARY

SURVEYS OF WWTFS WITH AQUA AEROBIC FILTER

Mason County
Tom Moore
360-427-9670
11/30/2010, msg
Bill
360-275-7067
12/1/2010, msg

1. Is biological growth on the filter media an issue?	a bit on the inside of disks
2. Where does the growth build-up occur (inside of disks, outside of disks, both sides)?	didn't see any until they changed it out
3. What chemicals and what strength of chemicals are used for removing biological growth?	doesn't use chlorine bc doesn't like it
4. How is the cleaning done?	a dirty filter works better', doesn't clean it, garden hose on top edges
5. What is the frequency of cleaning?	as needed, once every 2 weeks
6. Have filter fabric media been replaced since the filter was installed and why were the fabric media replaced?	yes, after about 5 years
Other:	prefers not to clean it
	add polymer before filter
	don't use high pressure spray bars
	only use backwash and sludge waste cycle

Royal City
John Lasen
509-346-2263 (office) / 3326 (cell)
11/30/2010, msg
509-346-3326
3-Dec

1. Is biological growth on the filter media an issue?	NO
2. Where does the growth build-up occur (inside of disks, outside of disks, both sides)?	N/A
3. What chemicals and what strength of chemicals are used for removing biological growth?	Dishwashing detergent
4. How is the cleaning done?	High pressure sprayer
5. What is the frequency of cleaning?	Infrequent - they rarely have to clean the media
6. Have filter fabric media been replaced since the filter was installed and why were the fabric media replaced?	Yes, this was done around 2007 They replaced the original media with OptiFiber PA213

Other:
Polymer is added upstream for filter
Very happy with new media, rarely needs cleaning, but they still clean occasaionally

Warden
Steve Maddox
509-760-2189
11/30/2010

1. Is biological growth on the filter media an issue?	No. See some on inside of tank
2. Where does the growth build-up occur (inside of disks, outside of disks, both sides)?	Film inside of tank
3. What chemicals and what strength of chemicals are used for removing biological growth?	Bleach solution, 1/3 cup bleach to 3 gallons water (not O&M recommended strength)
4. How is the cleaning done?	Tank: scrub w/broom and spray w/bleach solution. Filter: backwash, drain, hose wash, spray w/bleach solution
5. What is the frequency of cleaning?	Every 2 months
6. Have filter fabric media been replaced since the filter was installed and why were the fabric media replaced?	No. In operation for 1.5 years

Other:
Have not done a full fledged cleaning w/bleach as recommended by manufacturer in O&M manual
Very bottom of the filter can be a problem bc it doesn't drain all the way. They leave the hose running at the bottom to dilute the 4-5 inches for about 30 mins
Total down time for cleaning of filter and tank is about 2 hrs total.

AquaDisk® Filter Cloth Part # 2609819

Nylon Pile Cloth Sock
Aqua Type OptiFiber PA2-13® Pile Cloth Media

Effective Surface Area: 8.97 sq. ft. per segment
Segments per Disk: 6
Total Disk Area: 53.8 sq. ft.

Specification:

- Nylon pile construction on a polyester support backing.
- Active Filter Depth: 3 to 5 mm
- Nominal Filtration Rating: 10 microns
- Nominal weight: 880 gm/square meter
- Stitching: Polyester white thread
- Polyester Velcro® closure strips provided to retain cloth in position during clamping bar compression.

Physical and Chemical Resistance:

Physical:

- The user shall expose the media only to influent temperatures below 100°F (38°C); temperatures exceeding 100°F are not recommended.
- The user shall protect the media from prolonged, intense direct sunlight using a loose-fitting opaque cover that is vented to prevent heat build-up. Media submerged in water does not require covering.
- The user shall ensure that the media is properly installed and aligned to prevent contact with hardware that will cause rips, holes, seam separations, damaged fibers or worn/bare spots.

NOTE: These are the specifications and cleaning procedures for the fabric media proposed for the City of Camas wastewater treatment facility effluent filter rehabilitation. This is the same media used at the City of Warden, WA, Water Reclamation Facility that went into service in 2009.

Nylon Pile Cloth Sock
Aqua Type OptiFiber PA2-13® Pile Cloth Media

Chemical:

- The cloth media may be exposed only to influent streams that are essentially free of aggressive chemicals that may damage or blind the media. The user shall contact AAS technical staff anytime their influent contains such aggressive chemicals; AAS will respond with appropriate recommendations. Examples of potentially-destructive/blinding chemicals include, but are not limited to mineral acids, organic acids, organic solvents, strong bases, strong oxidizing agents, and fats/oils/greases.
- Exposure to free chlorine will embrittle the nylon fibers of the pile cloth. The cloth should not be exposed to free chlorine. Chlorine in a chloramine solution can be used at concentrations up to 50 mg/l residual chloramines.
- The user shall expose the media only to environments having pH values between 4.0 and 9.0; pH values below 4.0 and above 9.0 are not recommended.
- The user shall not employ any of the chemicals or out-of-spec pH and temperature values listed above while cleaning their filter media; they shall employ only those chemicals and procedures approved by AAS and outlined in the O & M manual.
- The user shall select any required filter aid chemicals (ie., precipitants, coagulants, and flocculants) through systematic screening tests conducted by experienced technicians. The user shall insure that the selected chemicals are consistently dosed in proper concentrations, dispersed rapidly and completely, and allowed adequate flocculation times prior to filtration to form settleable/filterable solids. The user shall also insure that any chemical conditioning protocol may be adjusted to accommodate changing influent conditions.

Nylon Pile Cloth Sock
Aqua Type OptiFiber PA2-13® Pile Cloth Media

Cloth Cleaning:

Due to its unique structure, the PA2-13 Pile Cloth minimizes the frequency of special cleaning (cleaning in addition to standard backwash events) under normal operating conditions. At design flow, the water in the tank returns to the normal operating level of 2" to 4" above the top of the filter media after back washing. This visual check provides a quick point of reference to confirm that the cloth has been restored after backwash and that no special attention is required.

The cloth will not return to the original bright white color after backwash. This is normal and has no effect on performance.

Large, sudden quantities of grease or oil can blind the cloth temporarily. While it is unusual to have significant amounts of grease or oil entering the filter, it may be removed by manually initiating two or three backwashes in rapid succession through the control panel.

If the cloth cannot be restored through manually initiated backwashes, confirm the backwash system is operating properly (i.e., verify pumping rate, make sure backwash shoes make full contact with the filter media, determine no blockages exist that would prevent proper suction of the media). After confirmation that the backwash system is operating properly and the cloth still has not been restored, proceed with chemical cleaning.

DO NOT use high pressure water to clean the cloth. This can cause irreversible damage to the cloth that is not covered by warranty and once damaged the cloth must be replaced. Spraying the area around the cloth is acceptable and reflective spray and misting striking the cloth should not cause any damage. Care should be taken to avoid direct spray impact on the cloth itself.

DO NOT use any chemicals to clean the cloth other than those listed in this document without first consulting the Aqua-Aerobic Service Department.

AquaDisk® Filter Cloth

Nylon Pile Cloth Sock
Aqua Type OptiFiber PA2-13® Pile Cloth Media

Cleaning Procedure

1. Execute two backwash cycles to clean the cloth as well as possible. Discontinue flow to the filter by manually closing the Influent Valve. Open the Filter Tank Drain Valve, and hose off the tank walls as the tank drains. Drain the tank completely and close the Tank Drain Valve.

2. Fill the tank with clean water (preferred) or with clarifier effluent until the water level is approximately 1 inch above the top of the disks or until the water level reaches the top of the effluent weir.

3. Reference the following table for filter-tank volumes and recommended cleaning solution dosages. This method will support soaking periods of 3 to 24 hours. The target concentration is 50 mg/L chloramine residual. Mixing can be accomplished by the rotation of the disk and shaft. Once the chemicals have been added and mixed, turn the filter unit off and to ensure the complete formation of chloramines, check the mixture with test strips. The test strips measure both free and *total chlorine.* If free *chlorine* is detected, add more ammonia and mix for an additional 15 minutes before re-testing.

Unit size	Unit Volume	Ammonia[b]				Bleach[c]	
Number of Disks	Gallons	Liters		Gallons		Liters	Gallons
		5%	10%	5%	10%		
1 or 2	2500	3.2	1.6	0.8	0.4	11.4	3.0
4	3400	4.4	2.2	1.2	0.6	5.5	4.1
6	4300	5.5	2.8	1.5	0.7	19.6	5.2
8	5700	7.3	3.7	1.9	1.0	26.0	6.9
10	6600	8.4	4.3	2.2	1.1	30.1	8.0
12	7500	9.6	4.9	2.5	1.3	34.3	9.1

Notes:

a) This volume is based on the filter unit being off-line and the water level at the effluent weir crest.

b) This dosage is based on typical 5 to 10% household ammonia (NH_3). The store label may not indicate the strength of the contents. If unsure of the ammonia concentration, assume it is 10% and add the appropriate volume listed in the table. After mixing, check with test strips. Additional ammonia can be added if free chlorine is detected.

c) This dosage is based on typical 6% household chlorine bleach (NaOCl).

WARNING:

Do not combine ammonia and chlorine bleach or use the same container for preparation. An extremely hazardous gas will result; therefore, care in handling should be taken. Each chemical should be stored in separate containers. When added to the filter tank, add the ammonia first. Allow the tank contents to mix for 15 minutes following the addition of each chemical.

4. Continuously rotate the disks through the solution. Overnight soaking is recommended. The backwash recycle feature can be used to draw the chemical through the cloth. Open the valves that connect the backwash pump to the filter tank and close the valves to the normal discharge point. Note that it is critical to reverse these valve positions before placing the filter back on line. Periodically during the soak period, manually initiate a backwash to draw chemical through the cloth.

5. Open the Tank Drain Valve and allow the tank to drain completely, close the Tank Drain Valve.

6. If the backwash recirculation feature was used, close the valves that connect the backwash pump to the filter tank and open the valves to the normal discharge point. Note that it is critical to re-set these valve positions before placing the filter back on line.

7. Open the Influent Valve, and put the filter back into automatic operation.

8. Once the filter is cleaned and back on-line, assess the effectiveness of the cleaning process by observing the recovery after backwash. At design flow, the water in the tank should return to the normal operating level of 2″ to 4″ above the top of the filter media after back washing.

SURVEYS OF WWTFS WITH KRUGER FILTER

1. How long has the filter been in operation?	2006
2. Verify the filter capacity given by the manufacturer.	16.8 MGD, 6.83 MGD average
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	gravity
4. What kind of biological treatment process is upstream of the filter?	
5. Do they employ any kind of chemical coagulation system up stream of the filter?	will be adding alum soon, nothing now
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	No
7. What kind of disinfection system is used downstream of the filter?	Hypochlorite
8. Do they have any maintenance issues with the filter?	4 hrs a month on filters cleaning and nozzel jets, not replaced yet
9. If they have maintenance issues describe them.	
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	
11. What kind of effluent TSS concentrations do they see in the filter effluent?	Influent 5, Effluent <1
12. How is the filter cleaned?	Backwash cycle several times per day, 1.5-3 hrs per day, 0.5% of what is coming in
13. Do they have to shut down the filter during cleaning?	No, continues to filter during backwash
14. Have they noticed build up of biological growth on the filter?	Yes, do monthly cleaning
15. Where is the biological growth occurring?	On the filters, algae growth, since installed Kruger has developed a chemical cleaning system for the filters
16. Did they get good start up services and training?	Really good, went 'all out'
17. Have they experienced good service since start up?	Haven't needed to call since installation, other Kruger equip and always responsive and resonable with response

Palm Coast, FL
Pat Henderson 386-986-2343, 386-986-2346
Kruger Hydrotech Filtration

Really low maintenance
Small maintenace crew
Happy with it and would recommend

1. How long has the filter been in operation?	2008
2. Verify the filter capacity given by the manufacturer.	Wildcat- 2 filters for total of 13.4 MGD, Rio De Flag - 3 filters for total of 8 MGD
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	gravity for both
4. What kind of biological treatment process is upstream of the filter?	both - activated sludge, nitrogen removal
5. Do they employ any kind of chemical coagulation system up stream of the filter?	no
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	
7. What kind of disinfection system is used downstream of the filter?	no
8. Do they have any maintenance issues with the filter?	one backwash pump failure out of warranty (out of 5 units that he operates)
9. If they have maintenance issues describe them.	every 2-3 months, isolate filter, backwash with bleach
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	
11. What kind of effluent TSS concentrations do they see in the filter effluent?	Rio De Flag: 3-5 ppm in and 0.5ppm out, Wildcat: 5-10 ppm in and less than 2 ppm out
12. How is the filter cleaned?	backwash cycle, flush w/bleach every 2-3 months
13. Do they have to shut down the filter during cleaning?	no for backwash, yes for bleach cleaning
14. Have they noticed build up of biological growth on the filter?	yes
15. Where is the biological growth occurring?	mostly on concrete walls, small amount on filter, media remains pretty clean
16. Did they get good start up services and training?	phone calls returned, good training, problems resolved, no problem sending supplemental training materials out
17. Have they experienced good service since start up?	responsive

Flagstaff, AZ - 2 plants
Wildcat Hill
Rio De Flag

retrofits in both plants, much lower maintenance than dual media
reduction in backwash flow compared to dual media filters, 10,000 gpd at wildcat, significant reduction

Larry Lemke
928-699-6006

1. How long has the filter been in operation?	2006
2. Verify the filter capacity given by the manufacturer.	12 4 filters, averaging 2.25 MGD
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	yes
4. What kind of biological treatment process is upstream of the filter?	oxidation ditch, extended aeration, clarifiers
5. Do they employ any kind of chemical coagulation system up stream of the filter?	no
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	no
7. What kind of disinfection system is used downstream of the filter?	uv disinfection
8. Do they have any maintenance issues with the filter?	track backwash hours, clean every 75 days w/liquid hypochlorite
9. If they have maintenance issues describe them.	isolate filters, rotate drums, let soak, backwash. Grease bearings. Check backwash nozzels every week.
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	
11. What kind of effluent TSS concentrations do they see in the filter effluent?	8-20 mg/L in and less than detectable (5 mg/L)
12. How is the filter cleaned?	backwash
13. Do they have to shut down the filter during cleaning?	no backwash, yes hypochlorite cleaning
14. Have they noticed build up of biological growth on the filter?	little bit, mostly hardness and iron
15. Where is the biological growth occurring?	on media (10 micron)
16. Did they get good start up services and training?	Very good
17. Have they experienced good service since start up?	Yes

Springboro, OH
Bob Vance
937-748-9453

key is tracking backwash hours
replaced 15 membrane panels in 5 years, thought would have to do more, have many many more
maintenance friendly, easy to change
Now Kruger offers a chemical feed, would recommend looking into this option for reduced maintenance
Looked at many different filters, works great for them, very pleased (did not look at Nova filter)

1. How long has the filter been in operation?	2002
2. Verify the filter capacity given by the manufacturer.	1.25
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	gravity
4. What kind of biological treatment process is upstream of the filter?	reuse plant
5. Do they employ any kind of chemical coagulation system up stream of the filter?	no, reuse plant
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	no, reuse plant
7. What kind of disinfection system is used downstream of the filter?	uv
8. Do they have any maintenance issues with the filter?	grease fittings and bearings 1/month, clean strainer, check nozzles, 'iron out' powder backwash every couple months
9. If they have maintenance issues describe them.	nope
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	
11. What kind of effluent TSS concentrations do they see in the filter effluent?	less than 10 mg/L in and less than 5 mg/L out
12. How is the filter cleaned?	backwash, 'iron out' in isolated drum
13. Do they have to shut down the filter during cleaning?	backwas, isolate to backwash 'iron out'
14. Have they noticed build up of biological growth on the filter?	no, located inside, only a litte bit of iron
15. Where is the biological growth occurring?	
16. Did they get good start up services and training?	Yes
17. Have they experienced good service since start up?	very good, simple, no issues

Bob Sheldon - contract operator and engineer

Reliable and simple
Cedar Creek - most recent plant, 3 filters there, add alum there
Have designed and operate 5 different reuse plants with Kruger filters
Recommends getting an extra cartridge for strainer
Only had to replace media disc once of all plants and that was self inflicted replacement
Doesn't use very much backwash water

1. How long has the filter been in operation?	2006
2. Verify the filter capacity given by the manufacturer.	80000 gpd designed 1.75 MGD
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	gravity
4. What kind of biological treatment process is upstream of the filter?	secondary, no clarifier, oxidation ditch
5. Do they employ any kind of chemical coagulation system up stream of the filter?	no
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	no
7. What kind of disinfection system is used downstream of the filter?	no
8. Do they have any maintenance issues with the filter?	good, filter panels are expensive, good pumps
9. If they have maintenance issues describe them.	even if you clean w/hypochlorite, have had to take apart and clean 2x since 2006, hypo backwash monthly
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	
11. What kind of effluent TSS concentrations do they see in the filter effluent?	5 and 10 mg/L seasonal limits
12. How is the filter cleaned?	backwash, hypo 1/month
13. Do they have to shut down the filter during cleaning?	no, yes for hypo wash
14. Have they noticed build up of biological growth on the filter?	yeah, slime layer
15. Where is the biological growth occurring?	on filter media and concrete
16. Did they get good start up services and training?	Can't say enough positive
17. Have they experienced good service since start up?	Fantastic, came out 2 yrs after installed to help since electrical was botched

Wayne County (Red Creek), NY
Seth Gilick
315-754-5054

Mike Baker (computer programer) great guy

1. How long has the filter been in operation?	2005/2009	2 installed in 05, 2 more in 09
2. Verify the filter capacity given by the manufacturer.	15 MGD	1.1 MGD typically
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	gravity	
4. What kind of biological treatment process is upstream of the filter?	clarifiers	
5. Do they employ any kind of chemical coagulation system up stream of the filter?	no	
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.		
7. What kind of disinfection system is used downstream of the filter?	hypo	
8. Do they have any maintenance issues with the filter?	every 4-6 take down and spray, keep backwash pressure at 110	
9. If they have maintenance issues describe them.	have had one belt break on old one, no issues with others	
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	no, have some in stock in case	
11. What kind of effluent TSS concentrations do they see in the filter effluent?	less than 2 mg/l	
12. How is the filter cleaned?	backwash, spray	
13. Do they have to shut down the filter during cleaning?	no backwash, yes for cleaning	
14. Have they noticed build up of biological growth on the filter?	algae on filters mainly in summer	
15. Where is the biological growth occurring?	between filter panels	
16. Did they get good start up services and training?	very attentive, follow up	
17. Have they experienced good service since start up?	yes,	

West Brunswick County, NC
Ron Worthington
910-612-2079

really enjoy them, very nice
initially had prob w/glue on filter panels, replaced with discount on next order
replace nozzel tips 1 or 2 per year, pretty cheap though

1. How long has the filter been in operation?
2. Verify the filter capacity given by the manufacturer.
3. Does it operate by gravity flow or is wastewater being pumped to the filter?
4. What kind of biological treatment process is upstream of the filter?
5. Do they employ any kind of chemical coagulation system up stream of the filter?
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.
7. What kind of disinfection system is used downstream of the filter?
8. Do they have any maintenance issues with the filter?
9. If they have maintenance issues describe them.
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?
11. What kind of effluent TSS concentrations do they see in the filter effluent?
12. How is the filter cleaned?
13. Do they have to shut down the filter during cleaning?
14. Have they noticed build up of biological growth on the filter?
15. Where is the biological growth occurring?
16. Did they get good start up services and training?
17. Have they experienced good service since start up?

Oconomowoc, WI
Tom Steinbach
262-569-2192

end of 2008
12 MGD   2.3 - 11.5 MGD max, avg 2.6 MGD
gravity
conventional activated sludge
metal salts for phosphorous removal fed to primary clarifiers
chlorination typically - 25 lbs/day, 1.25 mg/L
chlorination ahead of the filters
replaced pvc fittings on backwash system, everything is good, chlorine soak units when take off line
no cleaning backwash nozzles, soak when offline every 6 months

0.5 - 1.5 mg/L typically no detects
backwash, and chlorine soak
no and yes
no, staining on media panels

excellent, very good luck, were there for a week
yes, haven't really needed them much

very satisfied

1. How long has the filter been in operation?	2002
2. Verify the filter capacity given by the manufacturer.	4 MGD
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	gravity
4. What kind of biological treatment process is upstream of the filter?	clarifiers
5. Do they employ any kind of chemical coagulation system up stream of the filter?	hypochlorination
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	
7. What kind of disinfection system is used downstream of the filter?	uv
8. Do they have any maintenance issues with the filter?	media break (factory),
9. If they have maintenance issues describe them.	bearing break
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	change out every other year on sprays
11. What kind of effluent TSS concentrations do they see in the filter effluent?	0.3 mg/L
12. How is the filter cleaned?	hypochlorite in spray bottles every other week
13. Do they have to shut down the filter during cleaning?	no, they'll add hypo to clarifiers so don't have to shut down
14. Have they noticed build up of biological growth on the filter?	algae on clarifers, not on filters
15. Where is the biological growth occurring?	
16. Did they get good start up services and training?	good, good personel
17. Have they experienced good service since start up?	yes
	grease bearings, maintenance free
	are doing an upgrade and installing another

Mesquite, NV
Randy Woods
702-232-5001

1. How long has the filter been in operation?	2008
2. Verify the filter capacity given by the manufacturer.	1 MGD,
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	gravity
4. What kind of biological treatment process is upstream of the filter?	SBR facility
5. Do they employ any kind of chemical coagulation system up stream of the filter?	EQ basin
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	
7. What kind of disinfection system is used downstream of the filter?	
8. Do they have any maintenance issues with the filter?	chlorinate injection on the inlet discs, dump hypo in feeder bay every 4-6 weeks
9. If they have maintenance issues describe them.	no major issues, grease drive chains, typical o and m
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	no
11. What kind of effluent TSS concentrations do they see in the filter effluent?	0 non detect
12. How is the filter cleaned?	backwash, hypo in feeder bay
13. Do they have to shut down the filter during cleaning?	not during backwash, yes for hypo flush (about 1 hr)
14. Have they noticed build up of biological growth on the filter?	iron build up on disc filters
15. Where is the biological growth occurring?	goes away when clean
16. Did they get good start up services and training?	operator training
17. Have they experienced good service since start up?	good, had issue with backwash pump and were able to correct

Pala, CA –
Charles Smith
(760) 801-4805

1. How long has the filter been in operation?	2002
2. Verify the filter capacity given by the manufacturer.	6 MGD
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	gravity
4. What kind of biological treatment process is upstream of the filter?	aeration basin, clarifier, contact chamber
5. Do they employ any kind of chemical coagulation system up stream of the filter?	hypochlorite
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	
7. What kind of disinfection system is used downstream of the filter?	no, land application
8. Do they have any maintenance issues with the filter?	keep nozzels clean, when panels tear get plugged nozzels, change filters every 5 years which is a significant cost
9. If they have maintenance issues describe them.	take one down during low flow and bleach it to clean every 3 months
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	
11. What kind of effluent TSS concentrations do they see in the filter effluent?	less than 2 mg/L
12. How is the filter cleaned?	backwash and bleach
13. Do they have to shut down the filter during cleaning?	no and yes
14. Have they noticed build up of biological growth on the filter?	no mostly mineral deposits
15. Where is the biological growth occurring?	
16. Did they get good start up services and training?	good, nice o&m manual
17. Have they experienced good service since start up?	yes
	filter was open at start, had to build a blg around it
	really like the newer version

SURVEYS OF WWTFS WITH NOVA FILTER

1. How long has the filter been in operation?	3 years
2. Verify the filter capacity given by the manufacturer.	600,000 gpd peak, have 2 filters
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	gravity flow and pump if EQ basin isn't high enough
4. What kind of biological treatment process is upstream of the filter?	fine drum screen, degrit, spr, eq basin (10 TDS in, less than 1 TDS out, reuse quality out of nova screen)
5. Do they employ any kind of chemical coagulation system up stream of the filter?	No
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	1ppm chlorine upstream, limit for this concentration
7. What kind of disinfection system is used downstream of the filter?	None
8. Do they have any maintenance issues with the filter?	No
9. If they have maintenance issues describe them.	None
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	Seals out in sun when first got them, had problem once installed. Nova came out and replaced seals.
11. What kind of effluent TSS concentrations do they see in the filter effluent?	
12. How is the filter cleaned?	High pressure water, 4 bars (60 psi minimum) with 2-inch feed line
13. Do they have to shut down the filter during cleaning?	No, automatic self cleaning backwash cycle
14. Have they noticed build up of biological growth on the filter?	No, has chemical injection point if want to do chemical wash on the screen
15. Where is the biological growth occurring?	None
16. Did they get good start up services and training?	Yes
17. Have they experienced good service since start up?	Yes

Big Cypress Seminole Indian Reservation Hendry County, 30,000 Rabbit Run Clewiston, FL 33440	3.6	Mr. Ronald Payne	863-228-2013	2008

1. How long has the filter been in operation?	May-09
2. Verify the filter capacity given by the manufacturer.	3.25 MGD, flow at 1.0 MGD
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	Gravity
4. What kind of biological treatment process is upstream of the filter?	Extended Air, Bar Stage
5. Do they employ any kind of chemical coagulation system up stream of the filter?	No
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	Add less than 1pmm to keep
7. What kind of disinfection system is used downstream of the filter?	sodium hypochlorite
8. Do they have any maintenance issues with the filter?	company knew had a batch of bad seals out on the market, came out to replace seals, proactive
9. If they have maintenance issues describe them.	no issues since got it, low maintence.
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	No
11. What kind of effluent TSS concentrations do they see in the filter effluent?	NTUs less than 2, 0 TSS, undected,
12. How is the filter cleaned?	18 seconds cycle, automated
13. Do they have to shut down the filter during cleaning?	Less than
14. Have they noticed build up of biological growth on the filter?	Initially yes bc 140 degrees, backwashed w/chlorine now don't, installed awning in 2nd stage with another filter to reduce heat (filter is outside)
15. Where is the biological growth occurring?	None
16. Did they get good start up services and training?	Very good.
17. Have they experienced good service since start up?	Yes.
	New model has 8 segments instead of 2. Easier replacement of screens.

Town of Orange Park, Florida 700 Ash Street Orange Park, FL 32073	3.0	Mr. Bob Brace	904-545-1343	2009

Nova Ultrascreen Disk Filter

Other Comments:
Have silver and copper issues. Majority of effluent can be caught in 25 micron filter, difference btwn 25 and 10 micron negligible.
Removing all of particles they were removing with a paper filter.
NTU wo filtration 4-5, with filtration 1.4 and 1.5
Incoming TSS during rainy season was 600 and still discharged less than 2, filter moved quicker, didn't have to manually speed up
Everyone who has come out and seen has been amazed. Simple design.

1. How long has the filter been in operation?	2 months, pilot tested it, have 1 and will bid more, not sole source, bid with kruger
2. Verify the filter capacity given by the manufacturer.	2.0 MGD,fully loaded
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	pumped
4. What kind of biological treatment process is upstream of the filter?	secondary clarifiers
5. Do they employ any kind of chemical coagulation system up stream of the filter?	no
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	
7. What kind of disinfection system is used downstream of the filter?	chlorine, soon uv
8. Do they have any maintenance issues with the filter?	not yet, orange park (next plant over) no issue
9. If they have maintenance issues describe them.	
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	
11. What kind of effluent TSS concentrations do they see in the filter effluent?	five and 13 coming in, required maintain TSS of 5 and get avg 2.2 TSS and 1.3 NTU
12. How is the filter cleaned?	Pressurized bars, automatic
13. Do they have to shut down the filter during cleaning?	No
14. Have they noticed build up of biological growth on the filter?	Did at start up, out in the sun, have hypochlorite feed when pump comes on use about 1 gallon/6 month
15. Where is the biological growth occurring?	Didn't see it, typical in FL
16. Did they get good start up services and training?	Good, one of better companies they have worked with
17. Have they experienced good service since start up?	Responsive

JEA Arlington, Florida 1555 Milcoe Road Jacksonville, FL 32225	2.0	Mr. Colin Groff	904-665-6736	2009

Nova Ultrascreen Disk Filter

Other Comments:
Recommend over aqua aerobic filter (not good)
Would enclose or cover
Responsive company

1. How long has the filter been in operation?
2. Verify the filter capacity given by the manufacturer.
3. Does it operate by gravity flow or is wastewater being pumped to the filter?
4. What kind of biological treatment process is upstream of the filter?
5. Do they employ any kind of chemical coagulation system up stream of the filter?
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.
7. What kind of disinfection system is used downstream of the filter?
8. Do they have any maintenance issues with the filter?
9. If they have maintenance issues describe them.
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?
11. What kind of effluent TSS concentrations do they see in the filter effluent?
12. How is the filter cleaned?
13. Do they have to shut down the filter during cleaning?
14. Have they noticed build up of biological growth on the filter?
15. Where is the biological growth occurring?
16. Did they get good start up services and training?
17. Have they experienced good service since start up?

Ardmore, Alabama 29529 Jones Avenue Ardmore, AL 35739	2.0	Mr. Wayne Miller	256-423-6161	2009

Nova Ultrascreen Disk Filter

Other Comments:

Left message 11/4/2010 10 AM

1. How long has the filter been in operation?
2. Verify the filter capacity given by the manufacturer.
3. Does it operate by gravity flow or is wastewater being pumped to the filter?
4. What kind of biological treatment process is upstream of the filter?
5. Do they employ any kind of chemical coagulation system up stream of the filter?
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.
7. What kind of disinfection system is used downstream of the filter?
8. Do they have any maintenance issues with the filter?
9. If they have maintenance issues describe them.
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?
11. What kind of effluent TSS concentrations do they see in the filter effluent?
12. How is the filter cleaned?
13. Do they have to shut down the filter during cleaning?
14. Have they noticed build up of biological growth on the filter?
15. Where is the biological growth occurring?
16. Did they get good start up services and training?
17. Have they experienced good service since start up?

Hopedale, Massachusetts
154 Meldon Street
Hopedale, MA 01747

Nova Ultrascreen Disk Filter	1.5	Mr. Ken Webb	508-634-2210	2009

Other Comments:
WILL NOT COMMENT ON THE PRODUCT
"NOT SUPPOSED TO ENDORSE ANY PRODUCTS"

1. How long has the filter been in operation?		May-10
2. Verify the filter capacity given by the manufacturer.	400,000 total, 200,000 gpd each filter	
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	pumped EQ tanks	
4. What kind of biological treatment process is upstream of the filter?	no	
5. Do they employ any kind of chemical coagulation system up stream of the filter?	no	
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	no	
7. What kind of disinfection system is used downstream of the filter?	uv	
8. Do they have any maintenance issues with the filter?	no,	
9. If they have maintenance issues describe them.		
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	no	
11. What kind of effluent TSS concentrations do they see in the filter effluent?	below 10, usually about 5 (coming out of SBR tanks)	
12. How is the filter cleaned?		
13. Do they have to shut down the filter during cleaning?		
14. Have they noticed build up of biological growth on the filter?	not while he was operating	
15. Where is the biological growth occurring?		
16. Did they get good start up services and training?	very good	
17. Have they experienced good service since start up?	yes	

		John Chudzik - CDM (engr & operator for 3-4 months)	860-808-2252	
New Hartford, Conneticut 238 Main Street New Hartford, CN 06057	2.3	Mr. Dan Radaski	860-489-0455	2010
		Dan is Contractor who installed		

Nova Ultrascreen Disk Filter

Other Comments:

Dan- one of the pump motors was bad at startup, got new one in 1 wk

John- ran well, low maintance

1. How long has the filter been in operation?	8 months
2. Verify the filter capacity given by the manufacturer.	120000 gpd MDD, running at 80,000 gpd
3. Does it operate by gravity flow or is wastewater being pumped to the filter?	gravity from clarifiers
4. What kind of biological treatment process is upstream of the filter?	no, aeration, clarifiers
5. Do they employ any kind of chemical coagulation system up stream of the filter?	no
6. If they employ chemicals upstream of the filter what is the chemical and the typical dose used.	
7. What kind of disinfection system is used downstream of the filter?	no, good readings
8. Do they have any maintenance issues with the filter?	mainly from clarifiers bc didn't have scum box too many solids, had to do chlorine wash over 4th of july due to grease
9. If they have maintenance issues describe them.	backwash bars got clogged
10. Do the EPDM rubber seals between the disk and walls showing any signs of wear or leakage?	No problems
11. What kind of effluent TSS concentrations do they see in the filter effluent?	
12. How is the filter cleaned?	
13. Do they have to shut down the filter during cleaning?	
14. Have they noticed build up of biological growth on the filter?	
15. Where is the biological growth occurring?	
16. Did they get good start up services and training?	yes
17. Have they experienced good service since start up?	Really really good with customer service

Port Austin, Michigan 8747 N. Hellums Road Port Austin, MI 48467	0.7	Jeff Mr. Glen Gibbons	989-780-3923	2010	Installed the filter not operator

Nova Ultrascreen Disk Filter

Other Comments:
Recommend backwash with separate water, not filtered wwater
don't use grayfor or palcol pumps

APPENDIX U

DIGESTER GAS TREATMENT INFORMATION

Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 • (206) 284-0860

TO: Eric Nutting
cc John Wilson
Doug Welch
Project File (G&O 07511)
FROM: Jay Swift
DATE: October 24, 2010
SUBJECT: Pre-design Memo for Sulfide Removal from Digester Gas at the Camas WWTF

Solids handling improvements are currently being constructed at the City of Camas Wastewater Treatment Facility (WWTF) as part of the Phase II WWTF improvements. The improvements include including new anaerobic digesters, digested sludge storage tank and sludge dryer to generate Class A biosolids. The anaerobic digestion system will consist primarily of two primary anaerobic digesters and one sludge holding tank. The volume of the primary digesters would provide sufficient capacity to produce Class B biosolids for the year 2025. Digested sludge from the primary digesters will be routed to the new digested sludge holding tank. The new primary digesters will each have a working volume of 24,500 cubic feet (180,000 gallons). A fixed cover will be installed on each of the new primary digesters and the sludge holding tank. A new digester control building will be constructed between the digesters to house the heat exchangers, gas boiler, sludge thickening system, recirculation pumps, digested sludge pumps and associated piping, and control equipment.

Design hydraulic retention time and volatile solids loading in the primary digesters for the year 2025 are projected to be 20 days and 6,760 lb VSS/day, respectively, under monthly maximum flow conditions in the year 2025. The primary digesters will be heated to a temperature of approximately 35°C using energy derived from the methane gas produced during digestion. The design hydraulic retention time and operating temperatures will allow the process to meet the Class B pathogen reduction criteria in the WAC 173-308 regulations, as well as the criteria for vector attraction reduction (38 percent VSS reduction or greater).

Because the concentration of sulfate in Camas influent is higher than in typical domestic wastewater, higher levels of hydrogen sulfide are likely to be present in the digester gas. As measured during the *Neutralized Sulfuric Acid Disposal Study, (Disposal Study),* Camas influent was 4 to 5 times stronger with respect to sulfate (140 – 150 mg/L vs. 30 mg/L) and about 50% stronger with respect to TDS (700 - 800 mg/L vs. 500 mg/L), relative to medium-strength domestic wastewater. WaferTech's discharge accounted for 22 - 24 % of Camas WWTF influent daily flow and between 26% and 79% of Camas

WWTF influent loadings for the major constituents evaluated, including 64% of the sulfate and 57% of TDS.

The addition of the maximum amount of a proposed neutralized sulfuric acid stream from WaferTech will nearly double the amount of sulfate currently entering the plant. However, based on the information in the *Disposal Study*, it is projected that the increase in total sulfur entering the anaerobic digester will increase by a lesser amount (<20%) because most of the sulfur entering the digester appears to be in the biomass, and the additional proposed amount does not appear to concentrate significantly in the biomass. As shown in Table 1, it is projected that hydrogen sulfide concentrations as high as 0.9% may be present in the untreated digester gas. As discussed below, this concentration is high enough to cause problems with the boiler and biosolids dryer, as well as requiring additional treatment to meet Southwest Clean Air Agency (SWCAA) requirements.

Based on discussions with the sludge dryer manufacturer, it is recommended that the volumetric concentration of hydrogen sulfide in the digester gas not exceed 1% (10,000 ppm) to minimize corrosion and other impacts detrimental to equipment. As shown in Table 1, concentrations in the digester gas are expected to approach 1%. Because of this, a hydrogen sulfide removal system is being designed to be incorporated as a change order during the digester system construction currently underway

Per discussion with Clint Lamoreaux, P.E., at SWCAA, the higher hydrogen sulfide concentrations will likely result in the following requirements:

1. The City will need to submit a SWCAA permit modification application, reflecting the higher projected digester gas concentration.

2. SWCAA will likely require reduction of the hydrogen sulfide concentrations in the digester gas, if the actual concentration approaches or exceeds 1%. The permit can be written such that this requirement goes into effect only if the concentrations are, in fact, as high (or nearly so) as projected, since there is some uncertainty about the concentrations.

3. The requirement to reduce concentrations in digester gas, if imposed, would likely be based on a revised BACT evaluation. Per Mr. Lamoreaux, it is not expected that a human health evaluation (and ambient impact analysis) will drive the permit modification. However, if the concentrations are as high or higher than 1%, SWCAA will have some safety concerns and will want to verify that all air release valves, etc., have adequate safeguards and all gas is combusted.

4. **Based on additional discussion with Mr. Lamoreaux (phone conversation, August 2010), the digester gas will need to be treated to remove hydrogen sulfide to 0.1% (1,000 ppm). Based on this requirement, the target treated hydrogen sulfide concentration is 0.05% (500 ppm).**

Several technologies are available to control hydrogen sulfide in digester gas. Potential liquid phase controls include iron precipitation and pH control. Precipitation of iron sulfide has relatively low capital costs but typically has relatively high chemical costs and increased sludge production. In other plants that use iron compounds, the iron has precipitated on the sleeves housing ultraviolet disinfection lamps, leading to significant increases in the glass sleeve cleaning frequency. The pH control option has been shown to have relatively high chemical costs. Although increasing the pH will reduce hydrogen sulfide generation in the digester, digester performance may be affected and the biosolids produced may have more odors, especially when mixed with other materials (topsoil, compost, etc.) when the pH is closer to neutral.

Gas phase treatment alternatives are available, each with its own advantages and disadvantages, including catalytic oxidation, wet chemical scrubbers, iron sponge scrubbers and biological oxidation. Based on discussions with staff at the Fox Metro Water Reclamation District in Illinois, who successfully remove sulfide from digester gas with an iron filter, use of an iron filter is a promising alternative. Per Katehis et al, iron sponge filter systems are cost effective for the removal of up to 100 lbs sulfur a day, and dry iron oxide scrubbers have economic treatment capacities of up to 200 lbs sulfur per day (the range at Camas), rivaling the cost efficiency of much more complex catalytic or alkylamine systems. As noted in the *Disposal Study*, it is conservatively projected that an iron scrubber would remove 80% of the hydrogen sulfide from the gas stream at Camas. However, the desired percent removal for the Camas system is 94-95%, as shown in Table 1.

TABLE 1

Projected Flows and Concentrations of Solids and Sulfur Entering the Digester at Startup and Projected 2025 Operating Conditions

	Units	**2012 (Startup) Average Annual**	**2012 (Startup) Maximum Month**	**2025 Average Annual**	**2025 Maximum Month**
Digester Gas Production	ft^3/d	25,045	34,131	36,258	49,368
Ratio of Dig. Gas to Liquid Feed	v/v	20.6	20.6	20.6	20.5
Estimated Max. Hydrogen Sulfide Concentration in Digester Gas	% (mg/kg)	0.88% (8800)	0.86% (8600)	0.84% (8400)	0.83% (8300)
Minimum Removal Requirements					
SWCAA Required Treated Hydrogen Sulfide Concentration in Digester Gas	% (mg/kg)	0.10% (1000)	0.10% (1000)	0.10% (1000)	0.10% (1000)
Required Percent Removal		88.6%	88.4%	88.0%	87.9%
Removal Requirements with Safety Factor					
Target Treated Hydrogen Sulfide Concentration in Digester Gas	% (mg/kg)	0.05% (500)	0.05% (500)	0.05% (500)	0.05% (500)

Desired Percent Removal	%	94.3%	94.2%	94.0%	94.0%
Pressure	psi	2.2	2.2	2.2	2.2

One alternative under consideration for Camas is the Varec 234/235 Series Gas Purifier which uses iron sponge technology. The 234/235 Series Purifier is designed to remove most of the H_2S from the gas stream. It is usually installed immediately downstream of the digester, after the condensate and sediment trap or condensate accumulator. This vessel is also recommended upstream of a gas engine generator or a boiler. The following parameters should be measured for proper operation: Inlet biogas flow rate, inlet and outlet biogas pressures, inlet and outlet H_2S concentrations, condensation (drip water), and pH of drip water. Isolation valves (supplied by others) are recommended for field installation in the inlet and outlet piping of each compartment. Drip traps are recommended for installation the drain connection to provide for safe condensate removal.

ATTACHMENT A

CONTROL EQUIPMENT DESCRIPTION FOR CAMAS WASTEWATER TREATMENT FACILITIES IMPROVEMENTS – PHASE 2

ATTACHMENT A

SOUTHWEST CLEAN AIR AGENCY PERMIT APPLICATION FOR CAMAS WASTEWATER TREATMENT FACILITIES IMPROVEMENTS – PHASE 2

Equipment to scrub hydrogen sulfide from the digester gas has been added to the Camas Wastewater Treatment Facilities Improvements – Phase 2 project. The project was permitted under Southwest Clean Air Agency Air Discharge Permit (SWCAA 09-2904) with Technical Support Document (SWCCA 2076). The hydrogen sulfide scrubbing equipment was necessitated by a potential increase in sulfate loading to the plant resulting to a potential increase in hydrogen sulfide in the digester gas. The previous permit was based on a sulfate loading contribution from WaferTech of 2,820 pounds per day. WaferTech has since requested approval for a sulfate loading of 4,230 pounds per day, an increase of 1,410 pounds of sulfate a day. The following provides a description and design criteria of the proposed Hydrogen Sulfide scrubbing system.

Digester Gas

With the exception of the increase in hydrogen sulfide concentration, the biogas production is assumed to remain the same as per the previous permit. Biogas produced during biological digestion in the anaerobic digesters will be used as an energy source to heat the digester contents using a boiler and heat exchangers and the biogas will also be used to dry the digester biosolids using a biosolids dryer.

Digester gas typically contains methane concentrations of 60 to 70% and carbon dioxide concentrations of 30 to 35% by volume, along with trace amounts of nitrogen, hydrogen, and hydrogen sulfide, and has a heat content between 500 and 700 Btu/ft^3, with an average value of 640 Btu/ft^3 typically used for design (*Design of Municipal Wastewater Treatment Plants*, Fourth Edition, Water Environment Federation, Page 22-25). In order to provide a conservative estimate of gas emissions, a value of 600 Btu/ft^3 is used herein.

The yearly average digester gas production, based on 50% influent volatile suspended solids (VSS) reduction and a gas production of 15 cubic feet per pound of VSS removed, is 27,500 ft^3/d. With an assumed digester gas heat value of 600 Btu/ft^3, the annual average digester gas heat available is 16,500,000 Btu/d or 688,000 Btu/hr.

Table 1 shows new design sulfur loading to the digesters resulting from the increased sulfate loading to the plant.

	Influent Flow (mgd)	Sludge to Digesters(1) (gpd)	Sulfur Loading to Digesters(2) (lb/d)	H_2S Concentration in Digester gas(3)
2025 Annual Average	5.3	13,184	30	8,400 ppm
2025 Maximum Month	6.1	17,984	41	8,300 ppm

1. Includes both waste activated sludge and waste primary sludge.
2. Based on a combined concentration of 0.38% sulfur in waste activated sludge and waste primary sludge.
3. Assumes 90% of sulfur ends up as digester gas.

Hydrogen Sulfide Scrubber

Hydrogen sulfide will be scrubbed from the digester gas using an iron sponge scrubber. The iron sponge uses iron oxide impregnated wood chips as a scrubbing media. Digester gas is passed though a permeable bed containing the iron oxide chips. The hydrogen sulfide reacts with iron oxide to solid ferric sulfide and water according to following equation:

$$Fe_2O_3 + H_2O + 3H_2S \rightarrow Fe_2S_3 + 4H_2O$$

The iron sponge requires periodic media regeneration. Regeneration is accomplished with the injection of air to the system resulting in the removal of the sulfur and the re-oxidation of the iron to form iron oxide in accordance with the following reaction:

$$Fe_2S_3 + 3O_2 + 2H_2O \rightarrow Fe_2O_3 + H_2O + 6S$$

The scrubber model design basis is a Marcab Model 1207-756 Gas Scrubber. The unit is 12 feet in diameter with an overall height of approximately 11 feet. The unit is equipped with an in vessel regeneration system and contains 756 cubic feet of Iron Sponge media. The system will be installed immediately downstream of the digester, after the condensate and sediment traps (See Attached Site Plan). The system is designed to remove 94% of the hydrogen sulfide resulting in a concentration of 500 ppm exiting the scrubber. At the 2025 average annual flow of digester gas to the scrubber (36, 258 cubic feet per day) the media would last approximately 6 months prior to requiring regeneration, and approximately 1 year prior to requiring replacement at . Table 2 provides influent and effluent concentrations of hydrogen sulfide to the scrubber.

	H_2S to Scrubber	Required SWCCA Max H_2S	Required SWCCA % Removal	Target Max H_2S	Target % Removal
2025 Annual Average	8,400 ppm	1,000 ppm	88%	500 ppm	94%
2025 Maximum Month	8,300 ppm	1,000 ppm	88%	500 ppm	94%

Regeneration requires in-vessel flooding of the media, with water, and subsequent introduction of air bubbled through the flooded bed. The bubbled air starts the reaction of oxygen with the ferric sulfide while the heat of the exothermic reaction is harmlessly absorbed by the water.

After 24 hours of aqueous regeneration, the bed is drained. Airflow continues while water vapor dispels any lingering warmth. Within 24 hours the temperature of the escaping vapor reaches ambient, Marcab Regeneration is complete, and the purifier may be returned to service.

APPENDIX V

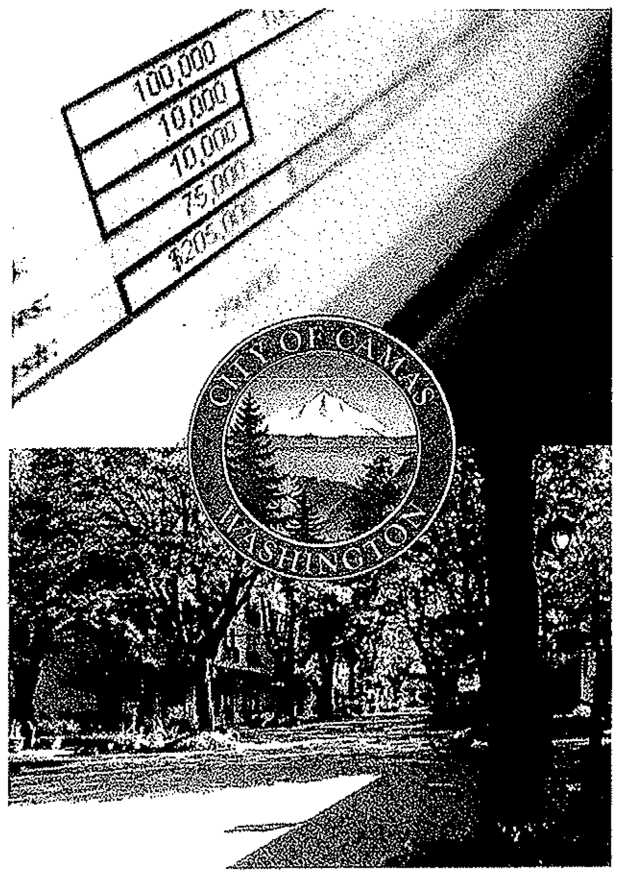
JANUARY 2010 CITY OF CAMAS UTILITIES RATE STUDY

City of Camas, Washington

Final Report for

UTILITIES RATE STUDY

January 2010



CONSULTING SERVICES PROVIDED BY:

FCS GROUP
Solutions-Oriented Consulting

Redmond Town Center
7525 166th Avenue NE, Suite D-215
Redmond, WA 98052
T: 425.867.1802
F: 425-867-1937

ANGIE 230

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REPORT CONTENTS

SECTION 1: INTRODUCTION

INTRODUCTION

In 2008, the City of Camas authorized FCS GROUP to complete a utilities rate study for the water, sewer, storm and sanitation utilities. Included as part of the rate study was an update of the System Development Charges (SDC) for water and sewer and establishing a new SDC for the storm utility. The results of the study aim to establishing a blueprint for achieving strong financial performance in the future and sustaining efficient and effective services to the City's customers. The scope of the project included the following elements:

- Assess revenue needs for a multi-year period that include adequate funding for operations and maintenance, capital projects, debt service, and other program activities.
- Project long-term capital needs and incorporate these needs into a long-term funding forecast that includes rates, debt, system development charges and existing reserves.
- Develop and recommend rate structures that:
  - ✓ Generate sufficient revenue to meet each utility's financial obligations on a stand along basis;
  - ✓ Promote water conservation;
- Update system development charges imposed on new development to mitigate the impact of such development on the capital facilities of the water, sewer and storm systems.

The methodology, key factors, conclusions and recommendations for each of the key task areas of the study are summarized in this executive level report.

A. NORTH ANNEXATION AREA

In 2008, the City annexed 1,100 acres of land located in the North Urban Growth Area (NUGA) located north of Lacamas Lake. This area is mostly undeveloped with minimal utility infrastructure. The City is in discussions with major land owners on development agreements and is preparing facility plans to address future growth.

The revenue requirement portion of this study does not address the additional operating and maintenance or capital costs associated with this area since that these costs are assumed to go into effect after the study period. The system development charge section takes a look at capital expenditures for a 20-year period, and therefore, does incorporate capital costs associated to the annexed area. The proposed charges in the following sections have developed system development charges for both the existing and annexed area.

SECTION 2: RATE STUDY METHODOLOGY

A. UTILITY RATE SETTING PRINCIPLES AND METHODOLOGY

The methods used to establish utility rates are based on principles that are generally accepted and widely followed throughout the industry. These principles are designed to produce rates that equitably recover costs from each class of customer by setting the appropriate level of revenue to be collected from ratepayers, and establishing a rate structure to equitably collect those revenues.

The primary tasks of the rate study are listed below:

- Revenue Requirements Analysis. This analysis identified the total revenue requirement to fully fund each utility on a standalone basis, considering operating and maintenance expenditures, capital funding needs, debt requirements and policy objectives.
- Rate Design Analysis. This analysis includes the development of rates that generate sufficient revenue to meet each system's revenue requirement forecast and continue to address the City's pricing objectives (e.g. conservation).

B. REVENUE REQUIREMENT ANALYSIS

A revenue requirement analysis forms the basis for a long-range financial plan and multi-year rate management strategy for each utility. It also enables the City to set utility rate structures, which fully recover the total costs of operating each utility: capital improvement and replacement, operations, maintenance, general administration, fiscal policy attainment, cash reserve management, and debt repayment. Linking utility rate levels to a financial plan such as this helps to enable not only sound financial performance for the City's utility enterprise funds, but also a clear and reasonable relationship between the costs imposed on utility customers and the costs incurred to provide them the service.

When FCS GROUP conducts a revenue requirements analysis, it includes the following core elements to form a complete portrayal of the utility's financial obligations:

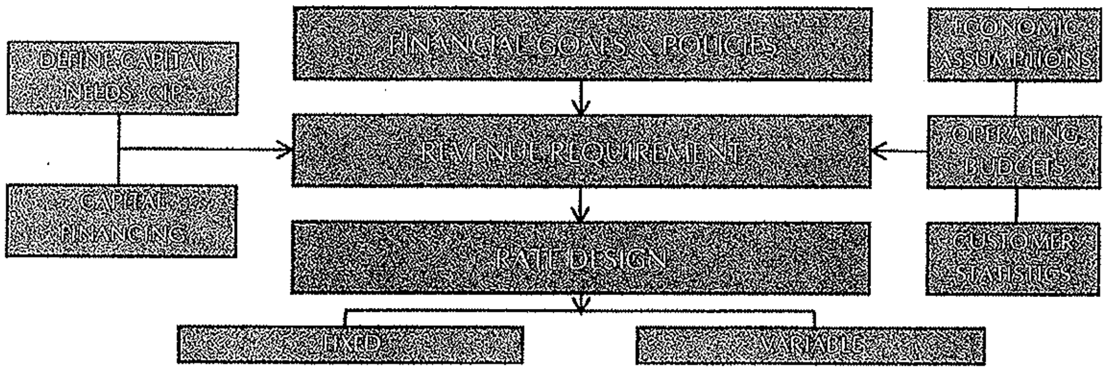
- ***Fiscal Policy Analysis*** – Identifies formal and informal fiscal policies of the City to ensure that current policies are maintained, including reserve levels, capital/system replacement funding and debt service coverage targets.
- ***Capital Funding Plan*** – Defines a strategy for funding the City's capital improvement/equipment program, including an analysis of available resources from rate revenues, system development charges, debt financing, and any special resources that may be readily available (e.g., grants, developer participation, etc.).
- ***Operating Forecast*** – Identifies future annual non-capital costs associated with the operation, maintenance, and administration of the utility systems.
- ***Reserve Analysis*** – Forecasts cash flow and fund balance activity in the City's utility reserves. Tests for satisfaction of actual or recommended minimum fund balance policies, including working capital/operating reserves and capital contingency/emergency reserves.
- ***Sufficiency Testing*** – Evaluates the sufficiency of utility revenues in meeting all obligations, including cash uses such as operating expenses, debt service, capital outlays, and reserve contributions, as well as any coverage requirements associated with long-term debt.
- ***Strategy Development*** – Designs a forward-looking strategy for adjusting utility resources to fully fund all utility obligations on a periodic or annual basis over the projection period.

From this foundation, utility rate structures can be adjusted to meet the defined annual and long-term funding targets as well the City's pricing objectives.

C. RATE DESIGN

The focus of rate design is the design of the pricing structures and is largely dictated by the objectives of the utility. The principal consideration is for the rate structure to generate sufficient revenues for the system which are reasonably commensurate with the cost of providing service. Most rate designs consist of fixed and variable charges. Fixed costs typically attempt to cover costs of the system that do not vary while variable costs vary with a change in user demand. Although majority of costs are fixed in nature, in general customers prefer more costs tied to the variable charge since changes in behavior have a direct correlation with a change in their bill. **Exhibit 2.1** provides an overview of the rate study process.

Exhibit 2.1: Overview of Rate Study Process



SECTION 3: WATER UTILITY

INTRODUCTION

The Camas Water Utility provides water to its customers for domestic, irrigation, commercial, industrial process and fire protection use. The Camas water utility has approximately 6,500 customers both within and outside the current City Limits. The system has 9,330 acre/feet of annual water rights from both surface and groundwater sources. The Jones/Boulder surface source is limited to winter time use to help protect stream flows for endangered fish. The infrastructure includes 9 wells, water filtration plant, 6 reservoir sites, 8 booster stations and over 110 miles of water main. In 2008 the average daily consumption was 3.7 million gallons per day (MGD) with a peak day of 7.8 MGD. In 2009 the Utility will complete the Water Facility Plan update that will provide guidance for system improvements needed for the next twenty years. The main capital focus of the next 6 years will be improving distribution and planning for the annexed area north of the lake.

A. REVENUE REQUIREMENT

A revenue requirement analysis forms the basis for a long-range financial plan and multi-year rate management strategy. The analysis is developed by completion of an operating forecast that identifies future annual non-operating costs and a capital funding plan that defines a strategy for funding the capital improvement needs of the City.

A.1 REVENUE REQUIREMENTS ANALYSIS

The purpose of the operating forecast is to determine whether the existing rates and charges are sufficient to recover the costs the City incurs to operate and maintain the water system. A combination of 2008 budget revenues and expenses and 2008 actual information formed the baseline for this forecast. The operating income forecast was developed for the 2009 through 2013 time period. The following list highlights some of the key assumptions used in the development of the water utility revenue requirement:

Reserves

- Operating Reserves: minimum 90 days of O&M expenses (per discussion with City staff).
- Capital Contingency Reserves: $200 thousand (per discussion with City staff).

Operating Revenue

- Customer Growth Rate Revenue: 1.5 percent (per discussion with City staff).
- Interest Earnings Rate: 3.13 percent per year (per discussion with City staff using the five-year average for the Washington State Local Government Investment Pool).

Operating & Maintenance (O&M) Expenses

- General Cost Inflation: 3.15 percent per year (based on analysis of historical Consumer Price Index data and discussion with City staff).
- Construction Cost Inflation: 6.0 percent per year (to date of anticipated construction, based on the discussion with City staff).
- Labor Cost Inflation: 5.0 percent per year (based on discussion with City staff).
- Local/State Excise Taxes: Public utility excise tax rate is 5.029 percent on all water rate revenues.
- State B&O Tax: 1.50 percent on all non-rate revenues.

Debt Service

- Three (3) existing debt obligations totaling $401 to $403 thousand: a revenue bond loan, a community economic revitalization board loan (CERB) and a public works trust fund loan (PWTF) starting in 2009.
  - ✓ The revenue bond loan is a Water and Sewer loan with 74 percent of it allocated to the water utility.
  - ✓ The CERB loan is paid off in 2016, outside the time frame covered in this study.
  - ✓ The PWTF loan is a five year loan, which starts in 2009 and is paid off in 2013.
- Two (2) new debt service obligations totaling $23 - $172 thousand per year: The first debt issue is anticipated in 2009 for an amount $240 thousand and the second in 2010 for an amount of $1.6 million. Both issues assume a 20-year term and a 5.6 percent interest rate. These debt issues will help fund numerous main installation/replacement projects.

System Reinvestment

- System reinvestment funding is to ensure system integrity through reinvestment in the system. Ideally, the minimum funding would be an amount equal to or greater than depreciation expense. If the annual depreciation expense is not available, it can be estimated based on the current water utility asset listing. The City's water utility depreciation expense is currently approximately $839 thousand (water's portion of the combined water and sewer plant).
- Historically, this rate funded component has had minimal dedicated funding; instead it depends on the availability of funds.
- This study assumes no annual funding in 2009. To avoid adding additional pressure on the rate payers, system reinvestment will not be funded through 2010 and will be incorporated at $200 thousand per year starting in 2011 through 2013.

A.2 CAPITAL FUNDING PLAN

The water utility is anticipating $7.6 million in capital costs in 2009 through 2013 (2008 dollars), $8.9 million inflated at 6 percent per year to date of construction. The annual average capital funding need is approximately $1.8 million inflated, with 2010 being the highest capital outlay year at $4.0 million inflated. **Exhibit 3.1** provides a summary of the water utility capital funding.

Exhibit 3.1: Water Utility Capital Funding Summary

Summary of Expenditures	2009	2010	2011	2012	2013	Total
CAPITAL PROJECTS						
Improvement Upgrade & Expansions	$ 1,433,650	$ 3,957,881	$ 467,871	$ 28,406	$ 2,706,561	$ 8,594,369
Repairs and Replacements	55,650	58,989	62,528	66,280	70,257	313,704
TOTAL CAPITAL EXPENDITURES	$ 1,489,300	$ 4,016,870	$ 530,399	$ 94,686	$ 2,776,818	$ 8,908,073
FUNDING SOURCES						
Grants / Developer Donations	$ 1,249,300	$ 2,232,968	$ 363,657	$ -	$ 2,676,451	$ 6,522,376
System Reinvestment	-	-	166,742	94,686	100,367	361,795
System Development Charge Revenue	-	189,104				189,104
New Debt Proceeds	240,000	1,581,200	-	-	-	1,821,200
Capital Fund Balance	-	13,598	-	-	-	13,598
TOTAL CAPITAL RESOURCES	$ 1,489,300	$ 4,016,870	$ 530,399	$ 94,686	$ 2,776,818	$ 8,908,073

Notes: Does not include Capital Fund reserve funding.

Approximately 75 percent of the capital projects will be funded through grants or developer donations and the remaining 25 percent will be funded through a combination of system development charges, annual rate funded system reinvestment, existing capital fund balances and new revenue bond debt issues.

A.3 SUMMARY OF REVENUE REQUIREMENT

The operating forecast components of O&M expenses, debt service and system reinvestment funding come together to form the multi-year revenue requirement. The revenue requirement compares the overall revenue available to the water utility to the expenses to evaluate the sufficiency of rates. **Exhibit 3.2** provides a summary of the water utility revenue requirement findings.

Exhibit 3.2: Water Utility Revenue Requirement Summary

Revenue Requirement	2009	2010	2011	2012	2013
Revenues					
Rate Revenues Under Existing Rates	$ 2,751,397	$ 2,792,668	$ 2,834,558	$ 2,877,076	$ 2,920,233
Non-Rate Revenue	222,103	238,466	254,297	264,885	280,629
Total Revenue	**$ 2,973,500**	**$ 3,031,134**	**$ 3,088,855**	**$ 3,141,961**	**$ 3,200,861**
Expenses					
Cash O&M Expenses	$ 2,502,332	$ 2,600,866	$ 2,703,549	$ 2,810,491	$ 2,922,049
Existing Debt Service	402,641	403,908	401,061	401,757	400,917
New Debt Service	22,610	171,571	171,571	171,571	171,571
Rate Funded System Reinvestment	-	-	200,000	200,000	200,000
Total Expenses	**$ 2,927,583**	**$ 3,176,346**	**$ 3,476,181**	**$ 3,583,819**	**$ 3,694,538**
Surplus (Deficiency)	$ 45,917	$ (145,211)	$ (387,326)	$ (441,858)	$ (493,676)
Additions to Meet Coverage	$ (80,813)	$ (111,885)	$ -	$ -	$ -
Total Surplus (Deficiency)	$ (34,896)	$ (257,097)	$ (387,326)	$ (441,858)	$ (493,676)
% of Rate Revenue	1.27%	9.21%	13.66%	15.36%	16.91%
Annual Rate Adjustment	**5.00%**	**5.00%**	**4.25%**	**4.00%**	**4.00%**
Rate Revenues After Rate Increase	$ 2,854,574	$ 3,078,916	$ 3,257,917	$ 3,439,057	$ 3,630,269
Net Cash Flow After Rate Increase	**$ 143,906**	**$ 126,642**	**$ 14,742**	**$ 91,861**	**$ 180,652**
Coverage After Rate Increase	1.41	1.28	1.44	1.59	1.77

Notes: 2009 Rate increase assumes partial year implementation.

Summary of Revenue Requirements:

- The revenue requirement analysis indicates a rate deficiency in each year of the study ranging from 1.27 percent in 2009 increasing to 16.91 percent by 2013.
- In order to fund the upcoming capital projects and to meet annual operating and maintenance requirements we recommend a 5.00 percent rate increase in 2009 and 2010 followed by a 4.25 percent increase in 2011 and 4.00 percent increases in 2012 and 2013.
- Operating fund target of 90 days is met by the end of the study period.

- Emergency construction fund of $200 thousand is met or exceeded every year of the study period.
- Debt service coverage of 1.25 minimum requirements is met after increases.
- Implementation of the new rate increases took effect March 30, 2009.

Since the City decided to adopt rates on an annual basis, we recommend that the City revisit and update economic and capital assumptions on an annual basis to make sure assumptions used have not changed significantly.

B. RATE DESIGN

The principal objective of the rate design stage of this rate study was to implement water rate structures that collect the appropriate level of revenue.

Establishing rates is a blend of "Art" and "Science" and especially so when it comes to the rate levels and structures. Several variables must be balanced to arrive at optimal rates. A cost-of-service analysis, which evaluates the rate equity by customer class, was not performed during the current study. The new rate increases were passed through to each class with a uniform across the board approach as requested by the City. In essence, each rate component (fixed and variable charge) will be increased by the same percentage. There was no greater weight put on either charge.

B.1 EXISTING WATER RATES

The existing water rates are composed of a fixed monthly charge by meter size and a variable charge per hundred cubic feet (ccf) for all water use. There are currently two separate fixed charge structures (including fire and cemetery classes) and five variable charge structures. The monthly fixed charges increase by meter size for all classes. There is a 1.5 multiplier on both the fixed and variable charges for all customers outside the City limits. **Exhibit 3.3** provides a summary of the current water utility rate structure.

Exhibit 3.3 – Current Water Rates

Existing Rates		
Meter	Monthly Fixed	Fire Line Monthly Fixed
5/8"	$ 6.43	
3/4"	6.97	
1"	8.60	
1.25"	9.68	
1.5"	10.77	
2"	16.73	
3"	60.65	
4"	76.92	$ 16.76
6"	114.88	23.53
8"		30.27
10"		44.00
Variable Charge (ccf)		
Residential	Commercial	City
$ 1.24	$ 1.50	$ 1.50
Industrial	Irrigation	Cemetery
$ 1.25	$ 1.40	$ 0.56

Notes: Outside City customers have a 1.5 multiplier on the fixed and variable charges.

B.2 PROPOSED WATER RATES

As previously mentioned the rate increases were passed along across-the-board to each individual class. **Exhibit** 3.4 provides a summary of the proposed rates for 2009.

Exhibit 3.4: 2009 Proposed Water Rates

Proposed Rates		
Meter	Monthly Fixed	Fire Line Monthly Fixed
5/8"	$ 6.75	
3/4"	7.32	
1"	9.03	
1.25"	10.16	
1.5"	11.31	
2"	17.57	
3"	63.68	
4"	80.77	$ 17.60
6"	120.62	24.71
8"		31.79
10"		46.20
Variable Charge (ccf)		
Residential	Commercial	City
$ 1.30	$ 1.58	$ 1.58
Industrial	Irrigation	Cemetery
$ 1.31	$ 1.47	$ 0.59

Notes: Outside City customers have a 1.5 multiplier on the fixed and variable charges.

C. CONSERVATION RATE STRUCTURE

C.1 INTRODUCTION TO CONSERVATION

Part of the rate study scope of services was the development of a conservation based inverted block rate structure.

The conservation rate structure was developed in part based on the regulatory requirements of the 2003 Municipal Water Supply Efficiency Requirement Act (Municipal Water Law), which applies to municipal water suppliers to use water more efficiently in exchange for certainty and flexibility in exercising in water rights. House Bill 1338 Section 7 outlines several requirements pertaining to financials and rates. The requirements outlined are as follows:

- Ensure the efficient use of water while maintaining water system financial viability;
- Improve affordability of supplies;
- Evaluate the feasibility of adopting and implementing water delivery rate structures that encourage water conservation; and
- Identify water use patterns among utility customer classes.

An inverted block water rate structure for the residential customer class can help the City meet regulatory requirements, and achieve its conservation goals, all intended to save its precious water resources.

C.2 CONSERVATION RATE

When developing a conservation rate structure a detailed customer statistics analysis is completed separating customer usage by class and month. Understanding the class' usage profile provides useful information regarding at what level to establish usage block sizes.

The residential class was chosen for the conservation rate structure since this class is generally the largest class on the system. In addition, it tends to have the most discretionary use with the greatest peak usage during the most constrained time of the year when water supply is at the lowest.

Since the City has not had a conservation rate structure for the residential class before, a basic 3-block inverted block structure was developed. The block sizes and charges were based on residential annual, winter, summer and peak statistics. Block one was based on an expanded winter average month usage, block two was based on double the winter usage, and block three was based on any usage above block two threshold. The block two price was based on the summer to winter average month ratio and block three was based on peak to winter average month ratio; total revenue generated from the blocks had to meet the annual revenue requirement. To account for the fact that the inverted block structure would induce water conservation and to preserve revenue stability, a 5 percent consumption reduction factor was applied to the third block. **Exhibit** 3.5 provides a summary of the proposed conservation rates for 2009 for the residential class.

Exhibit 3.5: 2009 Proposed Residential Conservation Water Rates

Proposed Conservation Rates	
Meter	Monthly Fixed
5/8"	$ 6.75
3/4"	7.32
1"	9.03
1.25"	10.16
1.5"	11.31
2"	17.57
Variable Charge (ccf)	
Block 1 (0-10)	$1.04
Block 2 (11-20)	$1.66
Block 3 (21+)	$2.43

Notes: Outside City customers have a 1.5 multiplier on the fixed and variable charges.

Under the proposed block structure approximately 65 percent of customers fall into block one, 22 percent into block two and the remaining 13 percent into block three. Approximately 62 percent of the usage is in block one, 20 percent is in block two and 18 percent is in block three.

The City did not implement the proposed rate provided for the residential class.

D. FIRE COST ALLOCATION

In Lane v. Seattle, 164 Wn.2d 875 (2008), the Washington Supreme Court ruled that municipalities may not charge utility customers a monthly fire hydrant fee, and that the cost of fire hydrants must be borne by the general fund. Camas should consult with its attorney to insure that it is in compliance with Lane v. Seattle.

E. SUMMARY

The analysis described above concludes the rate study for the water utility. After performing a rate revenue analysis, it was shown that the revenues at current level are not sufficient to fund ongoing water system obligations. As a result a 5.0 percent increase is proposed in 2009 effective March 30th, 2009. Although the rate study has provided a financial forecast and rate transition plan through 2013, the City is not proposing a multi-year rate increase at this time. Staff will review rates annually and bring recommendations back for council consideration.

Furthermore, we recommend that the City update the cost-of-service rate study (last performed in 2003) to update the rate structure for changes in utility customer class demands. A cost-of-service analysis will also identify the fire related costs and help the City comply with the requirements stemming from the Lane versus Seattle court case.

The detailed technical exhibits developed as part of the water rate study can be found at the end of this report in the Technical Appendices.

SECTION 4: SEWER UTILITY

INTRODUCTION

The Camas Sewer system provides sewer service for 6,300 residential, commercial and industrial customers in areas within the Urban Growth Boundary (UGB). The system is comprised of a main sewer treatment plant rated at 6.1 MGD average daily flow, and a collection system that includes gravity main lines, pump stations, force mains and a large number of Septic Tank Effluent Systems (STE). The utility has submitted a General Sewer Wastewater Facility Plan in 2009 to the Department of Ecology (DOE) for approval that will guide system improvements for the next twenty years. The Utility has also submitted to DOE an amendment to the above mentioned plan that will specifically address the annexation area north of the lake. The main capital focus over the next six years is a major improvement to the Waste Water Treatment Plant that will convert to anaerobic digestion and produce class A solids, and planning for the annexed area north of the lake.

A. REVENUE REQUIREMENTS

Similar to the water utility a revenue requirement was completed for the sewer utility and forms the basis for a long-range financial plan and multi-year rate management strategy.

A.1 OPERATING FORECAST

The purpose of the operating forecast is to determine whether the currently adopted rates and charges are sufficient to recover the costs the City incurs to operate and maintain the sewer system. A combination of 2008 budget revenues and expenses and 2008 actual figures form the baseline for this forecast. The operating income forecast was developed for the 2009 through 2013 time period. The following list highlights some of the key assumptions used in the development of the sewer utility revenue requirement:

Reserves

- Operating Reserves: minimum 60 days of O&M expenses (per discussion with City staff).
- Capital Contingency Reserves: $200 thousand (per discussion with City staff).

Operating Revenue

- Customer Growth Rate Revenue: 1.50 percent per year (per discussion with City staff).
- Interest Earnings Rate: 3.13 percent per year (per discussion with City staff using the five-year average for the Washington State Local Government Investment Pool).

Operating & Maintenance (O&M) Expenses

- General Cost Inflation: 3.15 percent per year (based on analysis of historical Consumer Price Index data and discussion with City staff).
- Construction Cost Inflation: 6.00 percent per year (to year of anticipated construction, based on the discussion with City staff).
- Labor Cost Inflation: 5.00 percent per year (based on discussion with City staff).
- Local/State Excise Taxes: Public utility excise tax rate is 3.852 percent on collection revenue and 1.50 percent on the treatment revenue. According to City's tax records, collection makes up 29 percent of rate revenue and treatment makes up 71 percent of rate revenue.
- State B&O Tax: 1.50 percent on all non-rate revenues.

Debt Service

- Seven (7) existing debt service obligations totaling approximately $1.57 million: two (2) revenue bond loans, three (3) public works trust fund loans (PWTF) and two (2) Department of Ecology loans (DOE).
  - ✓ One of the revenue bond loans is a Water and Sewer loan with 26 percent of it allocated to the sewer utility. The other revenue bond loan is a refunding of the 1998 bonds.
  - ✓ The PWTF loans consist of; a five year loan, which starts in 2009 and gets paid off in 2013, a 5-year pre construction loan for the WWF Improvements Phase II which is going to be converted into a 20-year loan starting in 2009 and a Sewer Treatment Plant Upgrade loan.
  - ✓ Two DOE loans one of which is related to the Sewer Treatment Plant (STP) Clarifier.
- Four (4) new debt service obligations totaling $10,000 to $1.7 million per year: the City has acquired $10 million in PWTF money to help pay for upcoming (STP) Upgrade related projects, which will be completed between 2009 and 2012. The PWTF money will be used for projects in 2009 and 2010. The second debt issue is anticipated in 2011 for an amount of $7.55 million, which will also be used to help pay for the STP Upgrade projects. The third debt issues is anticipated in 2012 for an amount of $4.72 million and will also be used to help finish the STP related projects and a main improvement/replacement project. The last debt issues is anticipated in 2013 for an amount of $520 thousand to help pay for pump station upgrades and STP update.

System Reinvestment

- The purpose of system reinvestment funding is to ensure system integrity through reinvestment in the system. Ideally, the minimum funding would be an amount equal to or greater than depreciation expense. If the annual depreciation expense is not available, it can be estimated based on the current sewer system asset listing. The City's sewer utility depreciation expense is currently approximately $970 thousand (sewer's portion of the combined water and sewer plant).
- Historically, this rate funded component has had minimal dedicated funding, instead funding depends on availability.
- Currently, the City is not assuming any funding for system reinvestment due to the significant level of capital which the City is undertaking during the planning period. This will avoid adding additional pressure on rate payers.

A.2 CAPITAL FUNDING PLAN

The sewer utility is anticipating $23.2 million in capital costs in 2009 through 2013 (2008 dollars) and $24.2 million inflated (6 percent per year to date of construction). The annual average capital funding need is approximately $4.84 million inflated, with 2010 being the highest capital outlay year at $8.12 million inflated. **Exhibit** 4.1 below provides a summary of the sewer utility capital funding.

Exhibit 4.1: Sewer Utility Capital Fund Summary

Summary of Expenditures	2009	2010	2011	2012	2013	Total
CAPITAL PROJECTS						
Improvement Upgrade & Expansions	$ 421,200	$ 4,370,790	$ 3,029,775	$ 2,464,048	$ 301,101	$ 10,586,914
Repairs and Replacements	1,790,800	3,752,810	5,054,503	2,464,048	568,746	13,630,907
TOTAL CAPITAL EXPENDITURES	$ 2,212,000	$ 8,123,600	$ 8,084,278	$ 4,928,096	$ 869,847	$ 24,217,821
FUNDING SOURCES						
Public Works Trust Fund Loans	$ 2,020,000	$ 7,980,000				$ 10,000,000
System Development Charge Revenue	186,163	143,600	186,163	186,163	186,163	888,253
New Debt Proceeds	-	-	7,550,000	4,720,000	520,000	12,790,000
Capital Fund Balance	5,837	-	348,115	21,933	163,683	539,568
TOTAL CAPITAL RESOURCES	$ 2,212,000	$ 8,123,600	$ 8,084,278	$ 4,928,096	$ 869,847	$ 24,217,821

Notes: Does not include Capital Fund reserve funding.

The projects will be funded through a combination of system development charges 4 percent, PWTF loans 41percent, revenue bond loans 53 percent and the remainder from existing fund balances 2 percent.

A.3 SUMMARY OF REVENUE REQUIREMENT

The operating forecast components of O&M expenses, debt service and system reinvestment funding come together to form the multi-year revenue requirement. The revenue requirement compares the overall revenue available to the utility to the expenses to evaluate the sufficiency of rates. **Exhibit 4.2** below provides a summary of the sewer utility revenue requirement findings.

Exhibit 4.2: Sewer Utility Revenue Requirement Summary

Revenue Requirement	2009	2010	2011	2012	2013
Revenues					
Rate Revenues Under Existing Rates	$ 3,431,364	$ 3,482,834	$ 3,535,077	$ 3,588,103	$ 3,641,924
Non-Rate Revenue	136,992	141,419	154,924	180,689	199,286
Total Revenue	**$ 3,568,356**	**$ 3,624,253**	**$ 3,690,001**	**$ 3,768,792**	**$ 3,841,211**
Expenses					
Cash O&M Expenses	$ 2,808,285	$ 2,914,495	$ 3,025,097	$ 3,140,399	$ 3,260,227
Existing Debt Service	1,582,175	1,581,721	1,579,057	1,576,928	1,573,447
New Debt Service	10,100	156,316	1,249,112	1,667,422	1,711,165
Total Expenses	**$ 4,400,561**	**$ 4,652,532**	**$ 5,853,266**	**$ 6,384,749**	**$ 6,544,840**
Surplus (Deficiency)	**$ (832,204)**	**$ (1,028,279)**	**$ (2,163,265)**	**$ (2,615,957)**	**$ (2,703,629)**
% of Rate Revenue	24.25%	29.52%	61.19%	72.91%	74.24%
Annual Rate Adjustment	**34.00%**	**10.60%**	**10.60%**	**8.00%**	**3.00%**
Rate Revenues After Rate Increase	$ 4,306,362	$ 5,161,700	$ 5,794,472	$ 6,351,901	$ 6,640,595
Net Cash Flow After Rate Increase	$ 9,088	$ 585,917	$ 9,099	$ 41,379	$ 179,532
Coverage After Rate Increase	2.80	4.05	2.29	1.97	2.02

Notes: 2009 Rate increase assumes partial year implementation.

Summary of Revenue Requirement:

- The revenue requirement analysis indicates a rate deficiency starting in 2009 and ranging from 24.25 percent in 2009 increasing to 74.24 percent by 2013.
- In order to fund the ongoing operating needs we recommend a 34 percent rate increases in 2009 followed by two 10.60 percent increases in 2010 and 2011, an 8.00 percent increase in 2012 and a 3.00 percent in 2013.
- Operating fund target of 60 days is met every year except 2009 and 2011 with 2011 being off only by 1 day. In order to meet operating targets of 60 days in 2009 a higher increase would be required.
- Emergency construction fund of $200 thousand is met every year.
- Implementation of the new rate increases took effect March 30th, 2009.
- Debt service coverage is above the 1.25 minimum requirement after rate increases.
- No system reinvestment funding due to debt burden.

Similar to the water utility, the City Council decided to adopt rate increases on an annual basis. The City should revisit economic and capital assumptions used in the study and make sure these assumptions have not changed significantly to ensure rates remain sufficient and the fund level is adequate to meet cash flow needs and target fund balances.

B. RATE DESIGN

As discussed in the water utility section, the principal objective of the rate design stage is to implement sewer rate structures that collect the appropriate level of revenue as outlined by the revenue requirement. Since a cost-of-service analysis was not performed, the increase is passed through to each class with an across the board approach as requested by the City.

B.1 EXISTING SEWER RATES

The existing sewer rates are composed of two separate structures. The residential structure consists of a fixed monthly charge, while the commercial/industrial structure consists of a fixed monthly charge and an additional volume charge per 100 cubic feet of use. There is a 1.5 multiplier on both the fixed and variable charges for all customers outside the City limits.

Exhibit 4.3 below provides a summary of the current sewer rate structure.

Exhibit 4.3: Existing Sewer Rates

Existing Rates		
Class	Monthly Fixed	Varialbe Charge (ccf)
Residential	$ 24.05	
Commercial / Industrial	5.75	$ 2.45

Notes: Outside City customers have a 1.5 multiplier on the fixed and variable charges.

B.2 PROPOSED SEWER RATES

The proposed Sewer rate schedule contains no structural changes and applies the rate increase across the board (or equally to each rate component). **Exhibit** 4.4 on the following page provides a summary of the proposed 2009 sewer rate schedule.

Exhibit 4.4: Proposed Sewer

Proposed Rates		
Class	Monthly Fixed	Varaibe Charge (ccf)
Residential	$ 32.23	
Commercial / Industrial	7.71	$ 3.28

Notes: Outside City customers have a 1.5 multiplier on the fixed and variable charges.

C. SUMMARY

The analysis described above concludes the rate study for the sewer utility. After performing a rate revenue analysis, it was shown that the revenues at current level are not sufficient to fund ongoing sewer system obligations. As a result a 34.00 percent increase is proposed in 2009 for sewer rates effective March 30th, 2009. Although the rate study has provided a financial forecast and rate transition plan through 2013, the City is not proposing a multi-year rate increase at this time. Staff will review rates annually and bring recommendations back for council consideration.

Similar with the water analysis, we recommend that the City update the cost-of-service rate study (last performed in 2003) to update the rate structure for changes in customer class demands.

The detailed technical exhibits developed as part of the sewer rate study can be found at the end of this report in the Technical Appendices.

SECTION 5: STORM WATER UTILITY

INTRODUCTION

The Camas Storm utility was formed to provide a funding source to comply with the National Pollution Discharge Elimination System (NPDES) Phase 2 permit issued by the Department of Ecology on January 17th, 2007. The utility maintains the public storm system that includes gravity main lines, manholes, catch basins and storm treatment/detention ponds. The utility is also responsible for street sweeping to reduce sediment entering streams. Some treatment facilities and private storm collection systems are the responsibility of private business and homeowner associations (HOAs).

A. REVENUE REQUIREMENT

The stormwater utility revenue requirement was established similar to the other utilities; it is developed by completion of an operating forecast that identifies future annual operating costs and a capital funding plan that defines a strategy for funding capital improvement needs of the stormwater system on a standalone basis.

A.1 OPERATING FORECAST

The purpose of the operating forecast is to determine whether the currently adopted rates and charges are sufficient to recover the costs the City incurs to operate and maintain the stormwater utility. The City provided a 6-year stormwater plan that was used as the basis for this forecast. The forecast was developed for the 2009 through 2013 time period. The following list highlights some of the key assumptions used in the development of the stormwater utility revenue requirement:

Key Assumptions

- Operating Reserves: minimum 30 days of O&M expenses (per discussion with City staff).
- Capital Contingency Reserves: currently not funded.
- Fisher Basin Reserve/Cash Balance: Used for Fisher Basin capital projects only until it is depleted.

Operating Revenue

- Customer Growth Rate Revenue: 2.00 percent per year (per discussion with City staff and stormwater 6-year plan).
- Interest Earnings Rate: 3.13 percent per year (per discussion with City staff using the five-year average for the Washington State Local Government Investment Pool).

Operating & Maintenance (O&M) Expenses

- All expenses were provided by the City from the stormwater 6-year plan.
- State B&O Tax: 1.50 percent.

Debt Service

- The stormwater utility currently does not hold any debt.
- New Debt Service: There are no new debt issues assumed for the study period.

System Reinvestment

- As with the water and sewer utilities it is important to fund annual system reinvestment to ensure system integrity. Ideally, the minimum funding would be an amount equal to or greater than depreciation expense. If the annual depreciation expense is not available, it can be estimated based on the current stormwater system asset listing. The City's stormwater utility depreciation expense is currently approximately $397 thousand.

- Historically, the City has been funding all of its capital expenses through reserves and direct rate funding, thereby capturing depreciation funding through rates. The City's current annual average CIP for the storm utility is $327,000 inflated.

A.2 CAPITAL FUNDING PLAN

The stormwater utility is anticipating $1.32 million (2008 dollars) in total capital costs in 2009 through 2013, $1.64 million inflated (6 percent per year to year of construction). Approximately $996 thousand inflated of the total costs are related to Fisher Basin projects and the remaining $640 thousand inflated are for the Non Fisher Basin projects. The annual average total capital funding need is approximately $327 thousand inflated, with 2013 being the highest capital outlay year at $596 thousand inflated. **Exhibit 5.1** below provides a summary of the stormwater utility capital funding.

Exhibit 5.1: Stormwater Utility Capital Funding Summary

Summary of Expenditures	2009	2010	2011	2012	2013	Total
CAPITAL PROJECTS						
Improvement Upgrade & Expansions	$ 37,100	$ 103,933	$ 199,495	$ 211,465	$ 297,755	$ 849,748
Repairs and Replacements	37,100	103,933	199,495	148,341	297,755	786,624
TOTAL CAPITAL EXPENDITURES	$ 74,200	$ 207,866	$ 398,990	$ 359,806	$ 595,510	$ 1,636,373
FUNDING SOURCES						
Fisher Basin Capital Fund Transfers	$ 68,900	$ 95,506	$ 279,889	$ 170,434	$ 247,961	$ 862,690
Non Fisher Basin Capital Fund Balance	5,300	112,360	119,102	189,372	347,550	773,683
TOTAL CAPITAL RESOURCES	$ 74,200	$ 207,866	$ 398,990	$ 359,806	$ 595,510	$ 1,636,373

Notes: Does not include Capital Fund reserve funding.

The projects related to Fisher Basin will be funded through Fisher Basin funds only until the fund is depleted; once the fund is depleted (in 2013) the projects will be funded through rate revenue. The Non Fisher Basin projects are currently funded through rates.

A.3 SUMMARY OF REVENUE REQUIREMENT

The operating forecast components of O&M expenses and capital funded through rates join together to form the multi-year revenue requirement. The revenue requirement compares the overall available utility revenue to the expenses to evaluate the sufficiency of rates. **Exhibit 5.2** below provides a summary of the stormwater utility revenue requirement findings.

Exhibit 5.2: Stormwater Utility Revenue Requirement Summary

Revenue Requirement	2009	2010	2011	2012	2013
Revenues					
Rate Revenues Under Existing Rates	$ 527,485	$ 538,034	$ 548,795	$ 559,771	$ 570,966
Non-Rate Revenue	-	-	-	1,057	2,237
Total Revenue	$ 527,485	$ 538,034	$ 548,795	$ 560,828	$ 573,203
Expenses					
Cash Operating Expenses	$ 473,761	$ 571,805	$ 586,028	$ 600,678	$ 615,767
Street Cleaning	138,831	138,391	142,338	146,405	150,593
Administration / Taxes	97,754	136,407	119,519	122,583	125,739
Rate Funded System Reinvestment	30,300	112,360	119,102	189,372	347,550
Total Expenses	$ 740,646	$ 958,963	$ 966,987	$ 1,059,038	$ 1,239,649
Surplus (Deficiency)	$ (213,161)	$ (420,928)	$ (418,192)	$ (498,209)	$ (666,446)
% of Rate Revenue	40.41%	78.23%	76.20%	89.00%	116.72%
Annual Rate Adjustment	55.00%	20.00%	20.00%	3.00%	3.00%
Rate Revenues After Rate Increase	$ 745,072	$ 1,000,744	$ 1,224,911	$ 1,286,891	$ 1,352,008
Net Cash Flow After Rate Increase	$ 1,162	$ 34,841	$ 247,782	$ 218,004	$ 102,880

Notes: 2009 Rate increase assumes partial year implementation.

Summary of Revenue Requirement:

- The revenue requirement analysis indicates a rate deficiency starting in 2009 and ranging from 40.41 percent in 2009 increasing to 116.72 percent by 2013.
- In order to fund the ongoing operating needs and upcoming capital projects we recommend a 55.00 percent increase in 2009 followed by two 20.00 percent increases in 2010 and 2011 and 3.00 percent increases in 2012 and 2013.
- Operating fund target of 30 days is not met until 2012 with the current rate increases. In order to reach the 30 day reserve target larger rate increases are required.
- From an independent utility stand point, the stormwater utility had negative fund balances in the beginning of the study (not taking into account Fisher Basin funds). With the proposed increase the stormwater utility starts to carry positive balances in 2011.
- Implementation of the new rate increases took effect March 30, 2009.

Similar to the recommended approach for the water and sewer utilities, the City should revisit economic and capital assumptions on an annual basis to make sure significant changes have not occurred and that rates remain sufficient to meet cash flow needs and target fund balances.

B. RATE DESIGN

As discussed in the previous sections, the principal objective of the rate design stage is to implement stormwater rate structures that collect the appropriate level of revenue as outlined by the revenue requirement.

B.1 EXISTING STORMWATER RATES

The existing stormwater rate is made up of two components an O&M component and a capital component. The current residential O&M component is $3.76 per month and the capital component is $0.95 per month.

Existing Fisher Basin customers are paying for the O&M component only since Fisher Basin related capital is being paid for from the Fisher Basin fund, while the Non Fisher Basin customers are paying both the O&M and Capital components of the charge for a total of $4.71 per month. The charges are based on equivalent dwelling unit (EDU) which is defined as 3,218 square feet per dwelling unit. Each residential customer is considered to have one EDU, while all other classes are calculated based on their impervious surface area and are charged for each EDU. **Exhibit 5.3** below provides a summary of the current stormwater rate structure.

Exhibit 5.3: Existing Stormwater Rates

Existing Rates		
Monthly Charge per EDU		
O&M	Capital	Total
$3.76	$0.95	$4.71

Notes: Fisher Basin pays the O&M fee only

B.2 PROPOSED STORMWATER RATES

Under the existing rate structure Fisher Basin customers only pay the O&M component of the total charge due to the fact that Fisher Basin capital gets paid out of the Fisher Basin fund balance. Once the fund balance is depleted, Fisher Basin customers will have to pay for capital out of rates. Since there are significantly less Fisher Basin customers than Non Fisher Basin customers the Fisher Basin capital portion of the charge could be substantial. We propose changing the existing charge into a uniform charge, which covers the entire rate revenue requirement for Fisher Basin and Non Fisher Basin customers. The proposed charge contains no other structural changes and applies the rate increases across the board. **Exhibit 5.4** provides a summary of the proposed 2009 stormwater rate schedule.

Exhibit 5.4: Proposed Stormwater Rates

Proposed Rates
Total Monthly Charge per EDU
$6.89

Notes: Includes both O&M and Capital

C. SUMMARY

The analysis described above concludes the rate study for the stormwater utility. After performing a rate revenue analysis, it was shown that the revenues at current level are not sufficient to fund ongoing stormwater obligation. As a result a 55.00 percent increase is proposed in 2009 for stormwater rates effective March 30th, 2009. Although the rate study has provided a financial forecast and rate transition plan through 2013, the City is not proposing a multi-year rate increase at this time. Staff will review rates annually and bring recommendations back for council consideration.

The detailed technical exhibits developed as part of the stormwater rate study can be found at the end of this report in the Technical Appendices.

SECTION 6: SANITATION UTILITY

INTRODUCTION

The Sanitation Utility collects solid waste from all residential, commercial, and industrial accounts using containers 2 yards and smaller. The City has entered into a non-exclusive franchise agreement with Waste Connects Inc. for solid waste collection for containers larger than 2 yards. Solid waste collection is mandatory in Camas. The utility owns four refuse trucks and has four FTE. The utility also collects mandatory recycle fees from the residential customers and has entered into a contract with Waste Connections Inc. to collect and dispose of residential recycle material. Commercial recycling is provided by a variety of purveyors. The City begins servicing newly annexed areas seven years after the annexation occurs in accordance with State law.

A. REVENUE REQUIREMENTS

The sanitation utility revenue requirement was established similar to the other utilities; it is developed by completion of an operating forecast that identifies future annual operating costs and a capital funding plan that defines a strategy for funding capital improvement needs of the sanitation system on a standalone basis.

A.1 OPERATING FORECAST

The purpose of the operating forecast is to determine whether the currently adopted rates and charges are sufficient to recover the costs the City incurs to operate and maintain the sanitation utility. The City provided a 6-year sanitation plan that was used as the basis for this forecast. The forecast was developed for the 2009 through 2013 time period. The following list highlights some of the key assumptions used in the development of the sanitation utility revenue requirement:

Key Assumptions

- Operating Reserve: minimum 30 days of O&M expenses (per discussion with City staff).

Operating Revenue

- Customer Growth Rate Revenue: 2.00 percent per year (per discussion with City staff and sanitation 6-year plan).
- Interest Earnings Rate: 3.13 percent per year (per discussion with City staff using the five-year average for the Washington State Local Government Investment Pool).

Operating & Maintenance (O&M) Expenses

- All expenses were provided by the City from the sanitation 6-year plan,

Equipment Reinvestment

- The City currently funds equipment replacement (consisting of truck rental and operations center lease) in the amount of approximately $320-$380 thousand annually.

A.2 SUMMARY OF REVENUE REQUIREMENT

The detailed operating forecast joins the anticipated O&M expenses with any equipment replacement costs to form the multi-year revenue requirement. The revenue requirement compares the overall available utility revenue to the expenses to evaluate the sufficiency of rates. **Exhibit 6.1** below provides a summary of the sanitation utility revenue requirement findings.

Exhibit 6.1: Sanitation Revenue Requirement Summary

Revenue Requirement	2009	2010	2011	2012	2013
Revenues					
Rate Revenues Under Existing Rates	$ 1,851,300	$ 1,888,326	$ 1,926,093	$ 2,014,174	$ 2,054,457
Non-Rate Revenue	35,401	26,492	27,390	28,402	29,301
Total Revenue	**$ 1,886,701**	**$ 1,914,818**	**$ 1,953,483**	**$ 2,042,576**	**$ 2,083,758**
Expenses					
Disposal	$ 565,020	$ 595,219	$ 643,205	$ 677,621	$ 713,836
Recycling	314,647	345,329	372,799	389,727	407,583
Collection	701,461	721,536	757,213	763,510	785,447
Customer Accounts / A&G / Taxes	238,217	239,574	246,268	253,902	261,006
Total Expenses	**$ 1,819,345**	**$ 1,901,657**	**$ 2,019,486**	**$ 2,084,760**	**$ 2,167,872**
Surplus (Deficiency)	**$ 67,356**	**$ 13,160**	**$ (66,003)**	**$ (42,185)**	**$ (84,114)**
% of Rate Revenue	0.00%	0.00%	3.43%	2.09%	4.09%
Annual Rate Adjustment	**0.00%**	**2.00%**	**2.00%**	**2.00%**	**2.00%**
Rate Revenues After Rate Increase	$ 1,851,300	$ 1,926,093	$ 2,003,907	$ 2,135,415	$ 2,221,686
Net Cash Flow After Rate Increase	$ 67,356	$ 50,360	$ 10,644	$ 77,238	$ 80,606

Notes: Includes revenue assumptions for additional connections at Lacamas Heights in 2012.

Summary of Revenue Requirement:

- The analysis assumes that there will be new connections coming online at Lacamas Heights starting in 2011/2012 generating additional rate revenue starting in 2012 (approximately $50 thousand). New connections are made up of 268 residential customers, ranging in sizes of can pickup, and 6 commercial customers.
- The revenue requirement analysis indicates a rate deficiency of 3.43 percent beginning in 2011 increasing to 4.09 percent by 2013.
- In order to fund the ongoing operating needs we recommend a 2.00 percent rate increase beginning in 2010 through 2013. The increases begin in 2010 instead of 2011 in order to minimize customer impacts by phasing in the adjustments over time.
- Operating fund target of 30 days of working capital met throughout the 2009 – 2013 time period. Revenue in excess of 30 days of working capital is assumed to be transferred to the equipment fund.

B. RATE DESIGN

The sanitation rate design is fairly straightforward. Unlike other operations that charge a combination of fixed and variable charges, all charges are recovered by container size and frequency of pickup.

B.1 EXISTING SANITATION RATES

As previously mentioned the existing sanitation rate structure is composed of a charge by container size and frequency of pickup. **Exhibit 6.2** provides a summary of the existing sanitation rates.

Exhibit 6.2: Existing Sanitation Rates

Existing Rates	
Regular Monthly Service	
Service	Monthly Charge
35 gallon (EOW)	$ 9.25
35 gallon weekly	14.12
65 gallon weekly	18.95
95 gallon weekly	25.70

Existing Rates				
# of Empties	Regular Dumpster		Compacted	
	1.5 Yards	2 Yards	1.5 Yards	2 Yards
1	$ 64.35	$ 89.27	$ 135.31	$ 178.54
2	135.31	178.54	282.89	357.08
3	209.10	267.81	430.46	535.62
4	282.89	357.08	578.04	714.16
5	356.67	446.35	725.62	892.70

B.2 PROPOSED SANITATION RATES

The proposed sanitation rate schedule contains no structural changes and applies the rate increase across the board (or equal to each rate component). Since the first rate increase is proposed for 2010 for the sanitation utility, **Exhibit 6.3** below provides a summary of the proposed 2010 sanitation rate schedule.

Exhibit 6.3: Proposed 2010 Sanitation Rates

Proposed Rates 2010	
Regular Monthly Service	
Service	Monthly Charge
35 gallon (EOW)	$ 9.44
35 gallon weekly	14.40
65 gallon weekly	19.33
95 gallon weekly	26.21

Proposed Rates 2010				
# of Empties	Regular Dumpster		Compacted	
	1.5 Yards	2 Yards	1.5 Yards	2 Yards
1	$ 65.64	$ 91.06	$ 138.02	$ 182.11
2	138.02	182.11	288.55	364.22
3	213.28	273.17	439.07	546.33
4	288.55	364.22	589.60	728.44
5	363.80	455.28	740.13	910.55

C. SUMMARY

The analysis described above concludes the rate study for the sanitation utility. After performing a rate revenue analysis, it was shown that the revenues at current level are not sufficient to fund ongoing sanitation system obligations starting in 2011. As a result a 2.00 percent increase is proposed in 2010 for sanitation rates effective January 1st, 2010. Although the rate study has provided a financial forecast and rate transition plan through 2013, the City is not proposing a multi-year rate increase at this time. Staff will review rates annually and bring recommendations back for council consideration.

We recommend that the City update the cost-of-service rate study (last performed in 2003) to update the rate structure for changes in utility costs and customer class demands.

The detailed technical exhibits developed as part of the sanitation rate study can be found at the end of this report in the Technical Appendix.

SECTION 7: SYSTEM DEVELOPMENT CHARGES

INTRODUCTION

As part of the utility rate study the City of Camas requested the study include an update to the water and sewer system development charges (SDCs) and to create a new SDC for the storm drainage utility. This section will provide a general overview of SDCs, summarize the methodology used, outline key factors and present the recommended charges.

A. OVERVIEW

"System Development Charge (or connection) charge" is a generic term referring to charges imposed as a condition of connecting to the utility system. SDCs differ from installation fees in that they are intended as a means of ensuring that new customers bear their equitable share of the cost of the system assets that serve all customers, and are not direct reimbursement for out-of-pocket costs to physically connect the new customer to the system. It is assumed that SDCs are imposed in addition to meter charges, labor and material charges, tap fees, inspection fees, or other non-capital charges related to the immediate expense of connecting a new service.

B. METHODOLOGY

The purpose of the SDC is two-fold: 1) to provide a source for capital financing and 2) to equitably recover the proportionate share of utility plant-in-service from new customers. In the absence of SDCs, growth-related costs would be borne in large part by existing customers. The cost of the system to be recovered by SDCs can be defined in two parts: an existing cost basis portion, which recover existing costs, and a future cost basis portion, which recover future costs.

Revenues generated from the SDCs can be used to fund capital projects or to pay debt service incurred to finance capital projects, but cannot be used to pay operating and maintenance costs.

There are several documented approaches used in the industry to establish a SDC that is legally defensible if designed properly. Within the range of legally defensible approaches, the choice of the costs the City targets is a matter of policy. It is important that the City follow a methodical and rational approach to consistently determine and implement cost-based SDCs.

Since the calculated charges represent the maximum allowable charge, the City may choose to implement a charge at any level up to the calculated charge. Revenues generated from the charge will vary depending upon whether or not the full charge is implemented (e.g., phase-in strategies). The lower the charge and longer the phase-in period, the less revenue will be collected and available to help pay the cost of these facilities. This loss in revenue could result in delays in completing the capital improvement program and/or result in increased costs to the City's existing ratepayers through rates for service.

B.1 EXISTING COST BASIS

The existing cost basis portion of the charge developed in this study is based on facilities of general benefit, such as storage reservoirs, transmission mains, interceptor trunk lines, etc. It is intended to recognize the current ratepayers' net investment in estimated original cost of the non-donated system assets and the accumulated interest on that investment. For Washington cities and towns, State statute (RCW 35.92.025) and subsequent legal interpretations provide a guideline for connection charges which suggest that such charges should reflect the actual original cost of the utility system, and can include interest on that cost at the rate applicable at the time of construction. Interest can be accumulate for a maximum of ten years from the date of construction, and cannot exceed the original cost of the asset. In addition, outstanding debt principal (less any cash available to buy down debt) is deducted from plant-in-service because new customers will pay their share of debt service through user rates. For this study, the existing cost basis for each utility is based on the City's record of system assets as of December 31, 2007, incorporating the adjustments noted above.

B.2 FUTURE COST BASIS

The statue enabling connection charges for cities and towns does not specifically address a charge based on planned future improvements. Common practice and legal opinion suggest that future facilities needed to serve growth, as well as to provide for regulatory system improvement, can be included in the connection charge. It is common practice for Cities and Towns to include up to twenty (20) years of future costs consistent with the planning period used in the City's comprehensive planning process. The future cost basis can include utility capital projects planned for construction and identified in comprehensive system planning documents.

It is important to note that current-year dollars are used when calculating the SDC and not inflated dollars. This approach assumes that the SDC will be updated annually to track construction cost inflation. Projects directly funded by developers, grants, or special property assessments are not included in the calculation. Replacement projects are most often excluded from the calculation unless they are needed to increase the size of the system. The capital improvement program has been allocated between existing and future customers based on engineering and planning criteria.

A separate future cost basis charge is calculated for the non-NUGAE customers and NUGAE customers. The NUGAE customers require an extensive amount of capital to allow the City to incorporate them into the water, sewer and stormwater utilities. The analysis has developed separate SDC rates for both NUGAE and non-NUGAE areas. The resulting rate differential of the NUGAE only costs being spread over a much smaller customer base.

C. WATER SYSTEM DEVELOPMENT CHARGE

The City currently uses a cost of service allocation basis approach when calculating the SDC and establishes an individual charge for each customer class based on the results of the cost-of-service functional allocation which includes assignment of costs based on individual customer flow statistics, meter equivalents and number of accounts.

After assessing the current structure and individual class charges it seemed that most class specific SDCs resulted in similar charges with the exception of the industrial class, which demonstrated a significantly higher disproportionate demand on the system based on its size and usage.

From these observations a "general" approach is proposed, which changes the class specific SDC and instead calculates the value of one meter customer equivalent (MCE) and assesses all new system connections based on this equivalent unit buy-in value. This recommended approach is applicable to all customer classes with the exception of the industrial class due to the disproportionate demand placed on the system by these customers. A separate charge is recommended specifically for the industrial class.

DETERMINATION OF THE WATER SYSTEM DEVELOPMENT CHARGE

C.1 EXISTING COST BASIS

As of 2007, water utility total fixed assets equal $37.75 million. Of this amount, approximately $4.83 million was contributed and, therefore, excluded from the cost basis. Calculating 10 years of interest on each allocable asset adds $15.62 million to the total asset value. The water utility's existing cash reserves were less than outstanding debt, and thus a reduction of $5.72 million was made to account for principal outstanding. After adjusting the utility's total assets for capital contributions and principal outstanding, the total existing cost basis is approximately $42.82 million.

C.2 FUTURE COST BASIS

According to the 2008 Draft Water System Plan the City has planned for approximately $69.80 million of capital projects in the water utility between 2008 and 2027. Recognizing the fact that some of the projects will provide capacity beyond the 20-year period, with the help of the City and the consulting engineer working on the Water System Plan, the project costs were reduced based on the capacity they will provide by the end of the 20-year period (this reduction in costs only applies to the non-NUGAE customers since NUGAE customers build out by 2025). The resulting 20-year project capital total was $66.12 million.

From the $66.12 million, $34.12 million are considered to be contributed/donated, reducing the future cost basis portion for NUGAE and non-NUGAE customers. In addition to the contributions/donations any project or portion of the project designated as repair and replacement (R&R) ($1.10 million) was also deducted. The resulting allocable future cost basis was $30.90 million, which was made up of $20.72 million project costs related to NUGAE, $6.10 million of project costs related to non-NUGAE and $4.08 million of project costs related to both customer bases.

C.3 CUSTOMER BASE

Using the detailed customer statistics provided by the City, the water utility had approximately 9,446 Non NUGAE meter customer equivalents (MCEs) in 2008 – MCEs relate to flow factor assumptions that vary by meter size and are established by the American Water Works Association. The consulting engineer working on the Water System Plan provided a growth forecast, by class, for the 20-year study period using flow based equivalent residential units (ERUs). Since a different unit of measure was used in estimating the future demand ERUs than in the calculation of the charge (MCEs), a growth rate was calculated from the demand projection ERUs (percentage growth from current ERUs to 20-year future ERUs) and applied to the MCEs to calculate the 20-year MCEs. Using this approach the City will add 6,780 non-NUGAE MCEs over the next twenty-year period – reaching a total non-NUGAE customer base of 16,226 MCEs.

NUGAE customers are new and in addition to the current customer base. The method used to estimate the 20-year NUGAE customer base in MCEs consisted of using the flow based demand ERUs provided by class and developing a ratio between the 20-year non-NUGAE ERUs and MCEs. These ratios were then applied to the NUGAE flow based demand ERUs and converted to MCEs for the 20-year period; 5,581 MCEs. The total customer base, NUGAE and non-NUGAE, for the 20-year period is calculated to be 21,807 MCEs.

C.4 CALCULATION OF THE GENERAL WATER SYSTEM DEVELOPMENT CHARGE

Exhibit 6.1 shows the calculation of the water system development charge by calculating the existing and the future cost bases.

Exhibit 6.1: Calculation of Water System Development Charge

Water System Development Charge Calculation					
	Non-NUGAE		NUGAE		Notes
Existing Allocable Cost	$	42,818,181	$	42,818,181	
Allocable Customer Base		21,807		21,807	Total customer base (existing & future)
Existing Portion	**$**	**1,964**	**$**	**1,964**	
Future Cumulative Cost*	$	4,082,100	$	4,082,100	Capital allocable to NUGAE & non-NUGAE
Allocable Customer Base		12,361		12,361	Total future customers
Future Cumulative Portion	**$**	**330**	**$**	**330**	
Future Cost	$	6,095,575	$	20,720,667	Capital allocable to NUGAE & non-NUGAE
Allocable Customer Base		6,780		5,581	Total future customers
Future Portion	**$**	**899**	**$**	**3,713**	
TOTAL SDC	**$**	**3,193**	**$**	**6,007**	per MCE

*Notes: Cumulative costs apply to both NUGAE & non-NUGAE, the remaining future costs apply to each area on an individual basis.

Exhibit 6.2 shows the proposed non-NUGAE and the NUGAE system development charges by meter size using the MCEs to differentiate the demands each meter size place on the system.

Exhibit 6.2: Proposed Non-NUGAE and NUGAE System Development Charges

Meter	MCEs	Proposed Non-NUGAE	Proposed NUGAE
5/8"	1	$ 3,193	$ 6,007
3/4"	1.5	4,790	9,011
1"	2.5	7,983	15,018
1.5"	5	15,965	30,035
2"	8	25,544	48,056
3"	16	51,088	96,112
4"	25	79,825	150,175
6"	50	159,650	300,350
8"	80	255,440	480,560

As previously mentioned the proposed charges are a calculated ceiling, the City can implement a charge of any level up to the indicated amount.

D. SEPARATE INDUSTRIAL WATER SYSTEM DEVELOPMENT CHARGE ALTERNATIVES

As previously mentioned the industrial class exhibited high disproportionate demands on the system based on its size and usage compared to other classes. To avoid the remaining classes subsidizing the industrial class a separate industrial system development charge is proposed.

A charge based on MCEs represents the peaking (maximum instantaneous) requirements placed on the system by a customer. The increase in the charge from one meter to the next represents the maximum peaking requirement for that meter size and the relationship between each different size meter to the base 5/8" meter. If every customer class uses water on an equitable basis (usage per MCE) the peaking approach is appropriate.

If there are customers who use disproportionate amounts of water on an average daily basis whereby the average usage exceeds the standard MCE factor, the peaking methodology alone may not be appropriate. This is because the system is sized not only based on peak demand of the individual customer, but is sized based on the total system requirements of "all" individual customer demands. A large user places a disproportionate demand on other parts of the system such as storage requirements and source of supply and should be charged commensurate with these increased demands. The SDC options proposed address this issue.

Two options are proposed to the City for the Industrial SDC. The first option keeps the City's current methodology and simply updates the industrial charge based on the functional allocation of updated costs. The second approach uses a similar functional allocation approach as the existing methodology, but spreads the "base" costs by ERUs instead of MCEs.

D.1 INDUSTRIAL OPTION 1 – CURRENT METHODOLOGY

The water system costs were spread based on a functional allocation (base, peak, fire, etc.). The previous study was used since a cost-of-service analysis was not performed during the 2008 update. Similar to the general approach existing and future infrastructure costs were calculated, however instead of dividing through by the applicable total customer base, the costs were spread through by the industrial customer class statistics representing accounts, meter customer equivalents (MCEs) and meter service equivalents (MSEs – related to actual cost of the meter/hardware) depending on the function.

Exhibit 6.3 summarizes the Industrial charge for the base 5/8" meter.

Exhibit 6.3: Industrial Charge for 5/8" Base Meter

Industrial Option 1						
Industrial	Customer / Account	Meters & Services/MSE	Base/MCE	Peak/MCE	Fire/Account	SDC
Non-NUGAE	$ -	$ 393	$ 14,725	$ 2,134	$ 2,567	$ 19,819
NUGAE	$ -	$ 393	$ 29,551	$ 4,326	$ 4,206	$ 38,476

Exhibit 6.4 escalates the SDC based on each function and an appropriate factor by meter size.

Exhibit 6.4: SDC Escalation Based on Function and Meter Size

Meter	MCEs	MSEs	Proposed	
			Non-NUGAE	NUGAE
5/8"	1	1	$ 19,819	$ 38,476
3/4"	1.5	1.1	28,288	55,454
1"	2.5	1.4	45,265	89,449
1.5"	5	1.8	87,569	174,298
2"	8	2.9	138,579	276,362
3"	16	11	276,634	550,561
4"	25	14	429,544	856,633
6"	50	21	853,770	1,706,309
8"	80	29	1,362,684	2,725,763

D.2 INDUSTRIAL OPTION 2 – SYSTEM UNIT COST

Similar to the first option the costs were spread based on a functional allocation. In this scenario the costs were based on the customer statistics for the system as a whole to determine unit costs instead of allocating costs based on individual customer statistics first. This approach also spreads "base" costs or total average water flow based on the ERU for the system (283.6 gpd/ERU) instead of MCEs.

Exhibit 6.5 summarizes the Industrial charge for the base 5/8" meter and one (1) ERU. When comparing the two options it is important to remember that each industrial class will be multiple ERUs.

Exhibit 6.5: Industrial Charge for 5/8" Base Meter

Industrial Option 2						
Industrial	Customer / Account	Meters & Services/MSE	Base/ERU	Peak/MCE	Fire/Account	SDC
Non-NUGAE	$ -	$ 393	$ 988	$ 1,147	$ 518	$ 3,046
NUGAE	$ -	$ 393	$ 2,704	$ 2,324	$ 845	$ 6,266

The calculation of system development charges by meter size will depend on the size of meter factors associated with that meters size (as with option 1). In addition, the projected demand will be needed to estimate the number of ERUs.

As an example, two existing accounts are used to calculate an SDC using both options and compare the outcomes:

- The first account (6346) is on a two inch meter and its usage for 2008 was 2,076 ccf.
- The second account (6344) is on a six inch meter and its usage for 2008 was 296,967 ccf

OPTION 1 CALCULATION: 2" METER, NON-NUGAE CUSTOMER

Step 1: $0 is added for the customer/account portion of the charge.

Step 2: $393 per MSE representing the Meters & Services portion is multiplied by 2.9 to represent the fact that the meter size is two inches = [$393*2.9 = $1,139.70].

Step 3: $14,725/MCE representing the "Base" portion is escalated by 8 to represent the meter size = [8 * $14,752 = $117,800]

Step 4: $2,134/MCE representing the "Peak" portion is escalated by 8 to represent the meter size = [8 * $2,134 = $17,072]

Step 5: $2,567/account is added representing the Fire portion

Total charge = $138,579 [$0 + $1,139.70 + $117,800 + $17,072 + 2,567]

Similarly, the calculation for the six inch meter would be as follows: Customer ($0) + Meters & Services ($393*21= $8,253) + Base ($14,725*50 = $736,250) + Peak ($2,134*50 = $106,700) + Fire ($2,567) for a combined charge of $853,770.

OPTION 2 CALCULATION: 2" METER, NON-NUGAE CUSTOMER

Step 1: $0 is added for the customer/account portion of the charge.

Step 2: \$393 per MSE representing the Meters & Services portion is multiplied by 2.9 to represent the fact that the meter size is two inches = [\$393*2.9 = \$1,139.70].

Step 3: \$988/ERU (this is the change between the options). Determine the number of ERUs for the customer by dividing the projected annual use of 2,076 ccf by 283.6 gpd (represents 1 ERU). First you must convert ccf to gallons per day (2,076 ccf *748(g/ccf)/365(days/year) = 4,254 gpd. Calculate ERUs = 4,254 gpd/283.6(gpd/ERU) = 15. Calculate base allocation \$988 * 15 = \$14,821

Step 4: \$1,147/MCE representing the "Peak" portion is escalated by 8 to represent the meter size = [8 * \$1,147 = \$9,176]

Step 5: \$518/account is added representing the Fire portion

Total charge = \$25,655 [\$0 + \$1,139.70 + \$14,821 + \$9,176 + 518]

Similarly, the calculation for the six inch meter would be as follows: Customer (\$0) + Meters & Services (\$393*21= \$8,253) + Base (296,967ccf*748(g/ccf)/365(days/year) = 608,579 gpd, 608,579 gpd/283.6(gpd/ERU) = 2,146 ERUs), 2,146 ERUs * \$988 = \$2,120,248) + Peak (\$1,147*50 = \$57,350) + Fire (\$518), results in a charge of \$2,186,369.

Comparing the resulting charges for the two and six inch meters side by side shows that option two results in lower charges if consumption is lower (two inch meter option one: \$138,579; two inch meter option two: \$25,655), while the opposite is true if the customers consumption is on the higher side (six inch meter option one: \$853,770; six inch meter option two: \$2,186,369).

E. SEWER SYSTEM DEVELOPMENT CHARGE

The sewer utility follows the same methodology currently in place where Residential and Commercial I customers are charged a fixed system development charge for the base meter size of 5/8" (Commercial I customers charge increases based on meter size by AWWA flow factors). Commercial II charge is calculated based on functionally allocated costs and established unit costs for flow and strength (Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS).

DETERMINATION OF THE SEWER SYSTEM DEVELOPMENT CHARGE

E.1 EXISTING COST BASIS

As of 2007, sewer utility total fixed assets equal \$43.60 million. Of this amount approximately \$6.24 million was contributed and, therefore, excluded from the cost basis. Calculating 10 years of interest on each allocable asset adds \$15.62 million. The sewer utility's existing cash reserves were less than outstanding debt, and thus a reduction of \$16.48 million was made to account for principal outstanding. After adjusting the utility's total assets for capital contributions and principal outstanding, the total existing cost basis is approximately \$39.77 million.

E.2 FUTURE COST BASIS

According to the 2008 Draft Sewer System Plan the City has planned for approximately \$102.62 million of capital projects in the sewer utility between 2008 and 2027. Similar to the water utility, recognizing the fact that some of the projects will provide capacity beyond the 20-year period, with the help of the City and the consulting Engineer working on the Sewer System Plan, the project costs were reduced based on the capacity they will provide by the end of the 20-year period (this reduction in costs only applies to the non-NUGAE customers since NUGAE customers build out by 2025). The resulting 20-year project capital total was \$79.31 million.

From the $79.31 million $13.70 million are considered to be contributed/donated, reducing the future cost basis portion for NUGAE and non-NUGAE customers. In addition to the contributions/donations any project or portion of the project designated as repair and replacement (R&R) was deducted as well; total R&R deduction was $24.37 million. The resulting allocable future cost basis was $41.27 million, which was made up of $22.06 million project costs related to NUGAE, $18.36 million of project costs related to non-NUGAE and $850 thousand of project costs related to both customer bases.

E.3 CUSTOMER BASE

The consulting Engineer working on the Sewer System Plan provided a growth forecast, which listed 2005 actual ERUs and estimates for 2015 and 2025. An annual compounding interest rate was calculated based on the 2005 and 2015 ERUs and applied to the 2005 ERU counts for three years to estimate the number of existing ERUs in 2008, which is 15,086. Since the non-NUGAE city build out is outside the 20-year study period an annual compounding growth rate was calculated from 2015 to 2025 and applied to the 2025 year for two years to estimate the total ERUs in the 20-year study period. The total non-NUGAE ERUs assumed in 2027 was 24,959. From the information provided by the consulting Engineer NUGAE customers reached build out by 2025 at 5,228 ERUs.

E.4 CALCULATION OF THE SEWER SYSTEM DEVELOPMENT CHARGE RESIDENTIAL/COMMERCIAL I

Exhibit 6.6 shows the calculation of the sewer system development charge by calculating the existing and future cost bases.

Exhibit 6.6: Sewer System Development Charge Calculation – Existing and Future Cost Bases

Sewer System Development Charge Calculation					
		Non-NUGAE		NUGAE	Notes
Existing Allocable Cost	$	39,767,590	$	39,767,590	
Allocable Customer Base		30,187		30,187	Total customer base (existing & future)
Existing Portion	$	1,317	$	1,317	
Future Cumulative Cost*	$	850,000	$	850,000	Capital allocable to NUGAE & non-NUGAE
Allocable Customer Base		15,101		15,101	Total future customers
Future Cumulative Portion	$	56	$	56	
Future Cost	$	7,724,178	$	22,060,325	Capital allocable to NUGAE & non-NUGAE
Allocable Customer Base		9,873		5,228	Total future customers
Future Portion	$	782	$	4,220	
Future Cost - non NUGAE**	$	10,634,955			Capital allocable to non-NUGAE Phase III portion
Allocable Customer Base		9,026			Future through 2025 (Phase III capacity)
Future Portion	$	1,178			
TOTAL SDC	$	3,334	$	5,593	per ERU

Notes:

*Cumulative costs apply to both NUGAE & non-NUGAE, the remaining future costs apply to each area on an individual basis.

**Phase III treatment plant upgrade will only provide enough capacity for ERUs through 2025

NUGAEs portion is included in the NUGAE Future Cost section since all NUGAE builds out in 2025.

Exhibit 6.7 shows the non-NUGAE and the NUGAE system development charges and how they vary by meter size for Commercial I customers.

Exhibit 6.7: Non-NUGAE and NUGAE System Development Charges for Commercial I Customers

Flow Factors	Meter	Proposed	
		Non-NUGAE	NUGAE
1	5/8"	$ 3,334	$ 5,593
1.5	3/4"	5,001	8,390
2.5	1"	8,335	13,983
5	1.5"	16,670	27,965
8	2"	26,672	44,744
16	3"	53,344	89,488
25	4"	83,350	139,825
50	6"	166,700	279,650
80	8"	266,720	447,440

COMMERCIAL II

For Commercial II customers the costs were spread based on a functional allocation from the previous study since a cost-of-service analysis was not performed during the 2008 update. Once the costs were functionalized, unit costs were developed for each function for each portion of the charge (existing and future). **Exhibit 6.8** summarizes the Commercial II charge.

Exhibit 6.8: Non-NUGAE and NUGAE System Development Charges for Commercial II Customers

Commercial II	Proposed	
	Non-NUGAE	NUGAE
Flow (gallons)	$ 16.94	$ 28.78
BOD (lbs / day)	$ 3,149	$ 5,071
TSS (lbs / day)	$ 1,192	$ 1,921

As with the water system development charge, the proposed charges are a calculated ceiling, the City can implement a charge of any level up to the indicated amount.

F. STORM SYSTEM DEVELOPMENT CHARGE

Currently the City does not have a system development charge for its storm water utility. To stay consistent with the water and sewer utilities the same methodology was used in the development of the stormwater utility's system development charges.

DETERMINATION OF THE STORM SYSTEM DEVELOPMENT CHARGE

F.1 EXISTING COST BASIS

As of 2007, storm water utility total fixed assets equal $10.77 million. Of this amount approximately $8.08 million was contributed and, therefore, excluded from the cost basis. Calculating 10 years of interest on each allocable asset adds $489 thousand. Currently the storm water utility holds no debt. After adjusting the utility's total assets for capital contributions the total existing cost basis is approximately $3.18 million.

F.2 FUTURE COST BASIS

According to the City's six year Capital Improvement Program (CIP) the City has planned for approximately $1.89 million in projects. In addition to the six year CIP 20 percent of all street fund 20-year projects are assumed to be allocated to the storm water utility with 15 percent of the storm water utility's portion being contributed/donated. The total combined 20-year plan is $41.03 million. The City split projects between non-NUGAE, NUGAE and projects which benefit both customer groups. The NUGAE portion of total projects was $30.67 million, non-NUGAE portion was $10.25 million and the cumulative portion was $104 thousand.

From the $41.03 million $5.78 million are considered to be contributed/donated, reducing the future cost basis portion for NUGAE and non-NUGAE customers. In addition to the contributions/donations any project or portion of the project designated as repair and replacement was also deducted. The resulting allocable future cost basis was $34.36 million, which is made up of $26.07 million related to NUGAE, $8.18 million related to non-NUGAE and $104 thousand of project costs related to both customer bases.

F.3 CUSTOMER BASE

According to the City's billing records, in 2008 there were approximately 9,692 non-NUGAE Equivalent Domestic Units (EDUs). After a discussion with City staff the same growth rate was assumed for the storm water utility 20-year period as for the sewer utility. Using the appropriate growth rate the total non-NUGAE 20-year period EDUs are 16,023. The NUGAE EDUs assume to tie sewer utility's ERUs directly at 5,225.

F.4 CALCULATION OF THE STORM SYSTEM DEVELOPMENT CHARGE

Exhibit 6.9 shows the calculation of the sewer system development charge by calculating the existing and future cost bases.

Storm

Exhibit 6.9: Sewer System Development Charge by Existing and Future Cost Bases

Storm Water System Development Charge Calculation					
		Non-NUGAE		NUGAE	Notes
Existing Allocable Cost	$	3,178,410	$	3,178,410	
Allocable Customer Base		21,251		21,251	Total customer base (existing & future)
Existing Portion	$	150	$	150	
Future Cumulative Cost*	$	104,375	$	104,375	Capital allocable to NUGAE & non-NUGAE
Allocable Customer Base		11,559		11,559	Total future customers
Future Cumulative Portion	$	9	$	9	
Future Cost	$	8,181,558	$	26,071,200	Capital allocable to NUGAE & non-NUGAE
Allocable Customer Base		6,331		5,228	Total future customers
Future Portion	$	1,292	$	4,987	
TOTAL SDC	$	1,451	$	5,145	per EDU

*Notes: Cumulative costs apply to both NUGAE & non-NUGAE, the remaining future costs apply to each area on an individual basis

As with water and sewer system development charges, the proposed charges are a calculated maximum, the City can implement a charge of any level up to the indicated amount.

TECHNICAL APPENDICES

SEWER SYSTEM

City of Camas
Sewer Utility Rate Study
Summary

Revenue Requirements	2008	2009	2010	2011	2012	201[illegible]
Revenues						
Rate Revenues Under Existing Rates	$ 3,380,654	$ 3,431,364	$ 3,482,834	$ 3,535,077	$ 3,588,103	$ 3,641,92[illegible]
Non-Rate Revenues	252,500	136,992	141,419	154,924	180,689	199,286
Total Revenues	**$ 3,633,154**	**$ 3,568,356**	**$ 3,624,253**	**$ 3,690,001**	**$ 3,768,792**	**$ 3,841,21[illegible]**
Expenses						
Cash Operating Expenses	$ 2,685,081	$ 2,808,285	$ 2,914,495	$ 3,025,097	$ 3,140,399	$ 3,260,2[illegible]
Existing Debt Service	1,453,353	1,582,175	1,581,721	1,579,057	1,576,928	1,573,4[illegible]
New Debt Service	-	10,100	156,316	1,249,112	1,667,422	1,711,165
Rate Funded System Reinvestment	-	-	-	-	-	
Total Expenses	**$ 4,138,434**	**$ 4,400,561**	**$ 4,652,532**	**$ 5,853,266**	**$ 6,384,749**	**$ 6,544,8[illegible]**
Net Surplus (Deficiency)	**$ (505,280)**	**$ (832,204)**	**$ (1,028,279)**	**$ (2,163,265)**	**$ (2,615,957)**	**$ (2,703,629)**
% of Rate Revenue	14.95%	24.25%	29.52%	61.19%	72.91%	74.24[illegible]
Additions to Meet Coverage	$ -	$ -	$ -	$ -	$ -	$ -
Total Surplus (Deficit)	**$ (505,280)**	**$ (832,204)**	**$ (1,028,279)**	**$ (2,163,265)**	**$ (2,615,957)**	**$ (2,703,629)**
% of Rate Revenue	14.95%	24.25%	29.52%	61.19%	72.91%	74.24[illegible]
Annual Rate Adjustment	**0.00%**	**34.00%**	**10.60%**	**10.60%**	**8.00%**	**3.00[illegible]**
Rate Revenues After Rate Increase	$ 3,380,654	$ 4,306,362	$ 5,161,700	$ 5,794,472	$ 6,351,901	$ 6,640,595
Additional Taxes from Rate Increase	$ -	$ 33,705	$ 64,670	$ 87,032	$ 106,461	$ 115,50[illegible]
Net Cash Flow After Rate Increase	**(505,280)**	**9,088**	**585,917**	**9,099**	**41,379**	**179,5[illegible]**
Coverage After Rate Increases	1.84	2.80	4.05	2.29	1.97	2.[illegible]
Sample Monthly Bill (SF Fixed)	$ 24.05	$ 32.23	$ 35.64	$ 39.42	$ 42.57	$ 43.[illegible]
Monthly Increase	$ -	$ 8.18	$ 3.42	$ 3.78	$ 3.15	$ 1.[illegible]

Notes:

No revenue from NUGAE growth is assumed in the study period

2009 increase is in effect for 9 month (effective April)

City of Camas
Sewer Utility Rate Study
Summary

Fund Balance	2008	2009	2010	2011	2012	201
Operating:						
Beginning Balance	$ **479,154**	$ **175,000**	$ **184,088**	$ **479,095**	$ **488,194**	$ **516,2**
Net Cash Flow after Rate Increase	(505,280)	9,088	585,917	9,099	41,379	179,532
Transfer of Surplus to Capital Fund	-	-	(290,910)	-	(13,343)	(159,8
Ending Balance	$ (26,127)	$ 184,088	$ 479,095	$ 488,194	$ 516,230	$ 535,92
	$ 441,383	*$ 461,636*	*$ 479,095*	*$ 497,276*	*$ 516,230*	*$ 535,9*
60 Day Target	(4)	24	60	59	60	
Capital						
Beginning Balance	$ **1,052,178**	$ **200,000**	$ **200,423**	$ **540,169**	$ **208,959**	$ **206,909**
plus: Rate Funded System Reinvestment	-	-	-	-	-	-
plus: Grants / Developer Donations / Other Outside Sources	250,000	-	-	-	-	-
plus: Existing PWTF / Bond Proceeds	1,435,200	2,020,000	7,980,000	-	-	-
plus: System Development Charges	186,163	186,163	186,163	186,163	186,163	186,16
plus: Net Debt Proceeds Available for Projects	-	-	-	7,550,000	4,720,000	520,000
plus: Interest Earnings	32,930	6,259	6,273	16,905	6,540	6,47
plus: Transfer of Surplus from Operating Fund	-	-	290,910	-	13,343	159,83
Total Capital Funding Sources	2,956,471	2,412,423	8,663,769	8,293,237	5,135,006	1,079,38
less: Capital Expenditures	(1,950,000)	(2,212,000)	(8,123,600)	(8,084,278)	(4,928,096)	(869,84
Ending Balance	**1,006,471**	**200,423**	**540,169**	**208,959**	**206,909**	**209,536**
Minimum Capital Contingency Target	*$ 200,000*	*$ 200,000*	*$ 200,000*	*$ 200,000*	*$ 200,000*	*$ 200,00*

City of Camas
Sewer Utility Rate Study
Assumptions

Economic & Financial Factors

		2008	2009	2010	2011	2012	2013
1	General Cost Inflation	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%
2	Construction Cost Inflation	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
3	Labor Cost Inflation	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
4	Customer Growth (Historical Ann.from Budget)	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
5	General Inflation plus Growth	4.70%	4.70%	4.70%	4.70%	4.70%	4.70%
6	Connection Charge Tax	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
8	No Escalation	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Fund Earnings (5-year average of the LWGSIP)	3.13%	3.13%	3.13%	3.13%	3.13%	3.13%
	Local / State Excise Tax	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%
	State B&O Tax	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
	Collection	29.00%	29.00%	29.00%	29.00%	29.00%	29.00%
	Treatment	71.00%	71.00%	71.00%	71.00%	71.00%	71.00%

Accounting Assumptions

FISCAL POLICY RESTRICTIONS

	2008	2009	2010	2011	2012	2013
Min. Op. Fund Balance Target (days of O&M expense)	60	60	60	60	60	60
Max. Op. Fund Balance (days of O&M expense)	60	60	60	60	60	60

Minimum Capital Fund Balance Target

Select Minimum Capital Fund Balance Target	2	**User Input**

1 - Defined as % of Plant

Plant-in-Service in 2007: $ 43,604,604

	2008	2009	2010	2011	2012	2013
Minimum Capital Fund Balance - % of plant assets	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
2 - Amount at Right ==>	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000

RATE FUNDED SYSTEM REINVESTMENT

Select Reinvestment Funding Strategy	3	**User Input**

Amount of Annual Cash Funding from Rates

1 - Equal to Annual Depreciation Expense

2 - Equal to Annual Depreciation Expense less Annual Debt Principal Payments

	2008	2009	2010	2011	2012	2013
3 - Equal to Amount at Right ==>	$ -	$ -	$ -	$ -	$ -	$ -

4 - Do Not Fund System Reinvestment

City of Camas
Sewer Utility Rate Study
Assumptions

Capital Financing Assumptions

		2008	2009	2010	2011	2012	2013
System Development Charges							
Select SDC Alternative	1	**Current Charge is in use**					
1 - User Input (Current Charge)	$						
2 - Calculated Charge	$ -						
Total Customer Equivalents							
SDC Revenue		$ 186,163	$ 186,163	$ 186,163	$ 186,163	$ 186,163	$ 186,163
REVENUE BONDS							
Term (years)		20	20	20	20	20	20
Interest Cost		5.00%	5.60%	5.60%	5.00%	5.00%	5.00%
Issuance Cost		2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Revenue Bond Coverage Requirement	1.25						
PWTF LOAN							
Term (years; 10 year minimum and no more than 20 years)		20	20	20	20	20	20
Interest Cost		0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
OTHER LOANS & REVENUE-SUPPORTED GENERAL OBLIGATION BONDS [a]							
Term (years)		20	20	20	20	20	20
Interest Cost		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Issuance Cost		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

[a] Tax-supported general obligation bonds are assumed to be accounted for in the General Fund; terms and annual obligations of such bonds are not factors in this analysis.

City of Camas
Sewer Utility Rate Study
Operating Revenue and Expenditure Forecast

Revenues		FORECAST BASIS	Budget 2008	Projection 2009	Projection 2010	Projection 2011	Projection 2012	Projection 2013
Rate revenues								
Residential	4	Customer Growth (Historical Ann.from Budget)	$ 2,003,351	2,033,401	2,063,902	2,094,860	2,126,283	2,158,177
Swr Comm/Industrial	4	Customer Growth (Historical Ann.from Budget)	751,256	762,525	773,963	785,573	797,356	809,317
Swr Ind/Wafer Tech	4	Customer Growth (Historical Ann.from Budget)	626,047	635,438	644,969	654,644	664,464	674,430
Total Rate revenue			**$ 3,380,654**	**$ 3,431,364**	**$ 3,482,834**	**$ 3,535,077**	**$ 3,588,103**	**$ 3,641,924**
Non-rate revenues								
Sewer Hook-up Fees	1	General Cost Inflation	$ 10,000	$ 10,315	$ 10,640	$ 10,975	$ 11,321	$ 11,677
Inspection Fees-Step Syst (100% Sewer)	1	General Cost Inflation	10,000	10,315	10,640	10,975	11,321	11,677
Space & Facilities Leases (50% Sewer)	1	General Cost Inflation	10,000	10,315	10,640	10,975	11,321	11,677
Interest Income (50% sewer)		Calculated	125,000	5,477	5,761	14,994	36,352	50,403
Wtr-Swr Turn off Fees By Owner (100% Water)	1	General Cost Inflation	-	-	-	-	-	-
Penalties	1	General Cost Inflation	60,000	61,890	63,839	65,849	67,923	70,063
Other Rents & Use Charges	1	General Cost Inflation	37,500	38,681	39,899	41,156	42,452	43,789
Total Non-rate revenues			**$ 130,396**	**$ 70,746**	**$ 73,592**	**$ 79,770**	**$ 93,706**	**$ 103,473**
TOTAL REVENUES			**$ 3,511,050**	**$ 3,502,109**	**$ 3,556,426**	**$ 3,614,847**	**$ 3,681,809**	**$ 3,745,398**

City of Camas
Sewer Utility Rate Study
Operating Revenue and Expenditure Forecast

Expenditures		FORECAST BASIS	Budget 2008	Projection 2009	Projection 2010	Projection 2011	Projection 2012	Projection 2013
Excise Tax State Tax		*Excise and B&O Tax Rate*	$ 66,000	$ 78,729	$ 79,895	$ 81,127	$ 82,493	$ 83,814
810 **SWR Collection**								
Reg Salar	3	Labor Cost Inflation	$ 21,241	$ 22,303	$ 23,418	$ 24,589	$ 25,819	$ 27,109
Overtime	3	Labor Cost Inflation	1,000	1,050	1,103	1,158	1,216	1,276
Personnel Benefits	3	Labor Cost Inflation	7,737	8,124	8,530	8,957	9,404	9,875
Office and Operating Supplies	1	General Cost Inflation	2,500	2,579	2,660	2,744	2,830	2,919
Small Tools and Minor Equip	1	General Cost Inflation	500	516	532	549	566	584
Supplies - Chemicals	1	General Cost Inflation	-	-	-	-	-	-
Professional Ser	3	Labor Cost Inflation	-	-	-	-	-	-
Communication	1	General Cost Inflation	-	-	-	-	-	-
Travel	1	General Cost Inflation	-	-	-	-	-	-
Operating Rentals and Leases	1	General Cost Inflation	-	-	-	-	-	-
Repairs & Maintenance	3	Labor Cost Inflation	40,000	42,000	44,100	46,305	48,620	51,051
Miscellaneous	1	General Cost Inflation	500	516	532	549	566	584
Intfund Oper. Rentals & Lease	1	General Cost Inflation	5,000	5,157	5,320	5,487	5,660	5,839
Total SWR Collection			**$ 78,478**	**$ 82,245**	**$ 86,195**	**$ 90,337**	**$ 94,681**	**$ 99,237**
811 **Swr Pressurce Coll**								
Reg	3	Labor Cost Inflation	$ 96,305	$ 101,120	$ 106,176	$ 111,485	$ 117,059	$ 122,912
Overtime	3	Labor Cost Inflation	10,000	10,500	11,025	11,576	12,155	12,763
Personnel Benefits	3	Labor Cost Inflation	35,570	37,349	39,216	41,177	43,236	45,397
Office and Operating Supplies	1	General Cost Inflation	30,000	30,945	31,919	32,925	33,962	35,031
Fuel consumed	1	General Cost Inflation	-	-	-	-	-	-
Small Tools and Minor Equip	1	General Cost Inflation	3,000	3,094	3,192	3,292	3,396	3,503
Chemicals	1	General Cost Inflation	128,000	132,031	136,190	140,479	144,903	149,467
Professional Services	3	Labor Cost Inflation	2,000	2,100	2,205	2,315	2,431	2,553
Travel	1	General Cost Inflation	-	-	-	-	-	-
Operating rentals and Leases	1	General Cost Inflation	200	206	213	219	226	234
Repairs & Maintenance	3	Labor Cost Inflation	50,000	52,500	55,125	57,881	60,775	63,814
Miscellaneous	1	General Cost Inflation	-	-	-	-	-	-
Intfund Oper. Rentals & Lease	1	General Cost Inflation	7,000	7,220	7,448	7,682	7,924	8,174
Intfund Repairs & Maint	1	General Cost Inflation	-	-	-	-	-	-
Total Swr Pressurce Coll			**$ 362,075**	**$ 377,066**	**$ 392,709**	**$ 409,033**	**$ 426,068**	**$ 443,848**

City of Camas
Sewer Utility Rate Study
Operating Revenue and Expenditure Forecast

			Budget 2008	Projection 2009	Projection 2010	Projection 2011	Projection 2012	Projection 2013
830 **SWR Pumping**								
Reg Salaries	3	Labor Cost Inflation	$ 127,409	$ 133,779	$ 140,468	$ 147,492	$ 154,866	$ 162,610
Overtime	3	Labor Cost Inflation	6,000	6,300	6,615	6,946	7,293	7,658
Personnel Benefits	3	Labor Cost Inflation	46,407	48,727	51,164	53,722	56,408	59,228
Uniforms and Clothing	1	General Cost Inflation	-	-	-	-	-	-
Office and Operating Supplies	1	General Cost Inflation	10,000	10,315	10,640	10,975	11,321	11,677
Fuel Consumed	1	General Cost Inflation	-	-	-	-	-	-
Small Tools and Minor Equip	1	General Cost Inflation	1,000	1,031	1,064	1,097	1,132	1,168
Professional Ser	1	General Cost Inflation	7,500	7,736	7,980	8,231	8,490	8,758
Communication	1	General Cost Inflation	2,000	2,063	2,128	2,195	2,264	2,335
Travel	1	General Cost Inflation	-	-	-	-	-	-
Operating Rentals and Leases	1	General Cost Inflation	3,000	3,094	3,192	3,292	3,396	3,503
Public Utility	1	General Cost Inflation	90,000	92,835	95,758	98,774	101,885	105,094
repairs & Maintenance	1	General Cost Inflation	30,000	30,945	31,919	32,925	33,962	35,031
Miscellaneous	1	General Cost Inflation	500	516	532	549	566	584
Intfund Oper. Rentals & Lease	1	General Cost Inflation	15,000	15,472	15,960	16,462	16,981	17,516
Public Utility	1	General Cost Inflation	-	-	-	-	-	-
Total SWR Pumping			**$ 338,816**	**$ 352,814**	**$ 367,420**	**$ 382,661**	**$ 398,564**	**$ 415,162**
850 **SWR Treatment**								
Reg Salary	3	Labor Cost Inflation	$ 174,627	183,358	192,526	202,153	212,260	222,873
Overtime	3	Labor Cost Inflation	5,000	5,250	5,513	5,788	6,078	6,381
Personnel Benefits	3	Labor Cost Inflation	60,984	64,033	67,235	70,597	74,126	77,833
Uniforms & Clothing	1	General Cost Inflation	-	-	-	-	-	-
Office and Operating Supplies	1	General Cost Inflation	20,000	20,630	21,280	21,950	22,641	23,354
Fuel Consumed	1	General Cost Inflation	-	-	-	-	-	-
Small Tools and Minor Equip	1	General Cost Inflation	20,000	20,630	21,280	21,950	22,641	23,354
Supplies - Chemicals	1	General Cost Inflation	240,000	255,000	263,031	271,315	279,860	288,674
Professional Ser	1	General Cost Inflation	147,500	152,145	156,937	161,880	166,978	172,237
Communication	1	General Cost Inflation	2,500	2,579	2,660	2,744	2,830	2,919
Travel	1	General Cost Inflation	1,000	1,031	1,064	1,097	1,132	1,168
Operating rentals and leases	1	General Cost Inflation	12,000	12,378	12,768	13,170	13,585	14,013
Insurance	1	General Cost Inflation	80,000	82,520	85,119	87,799	90,565	93,417
Public Utility	1	General Cost Inflation	130,000	134,094	138,318	142,674	147,167	151,802
Repairs & Maintenance	3	Labor Cost Inflation	36,600	38,430	40,352	42,369	44,488	46,712
Miscellaneous	1	General Cost Inflation	25,000	25,787	26,600	27,437	28,301	29,193
Intfund Oper. Rentals & Lease	1	General Cost Inflation	5,000	5,157	5,320	5,487	5,660	5,839
Total SWR Treatment			**$ 960,211**	**$ 1,003,024**	**$ 1,040,000**	**$ 1,078,410**	**$ 1,118,313**	**$ 1,159,769**

City of Camas
Sewer Utility Rate Study
Operating Revenue and Expenditure Forecast

			Budget 2008	Projection 2009	Projection 2010	Projection 2011	Projection 2012	Projection 2013
860 **SWR Services**								
Reg Salaries	3	Labor Cost Inflation	-	-	-	-	-	-
Overtime	3	Labor Cost Inflation	500	525	551	579	608	638
Personnel Benefits	3	Labor Cost Inflation	45	47	50	52	55	57
Repairs & Maintenance	3	Labor Cost Inflation	500	525	551	579	608	638
Miscellaneous	1	General Cost Inflation	1,000	1,031	1,064	1,097	1,132	1,168
Intfund Oper. Rentals & Lease	1	General Cost Inflation	-	-	-	-	-	-
Total SWR Services			**2,045**	**2,129**	**2,216**	**2,307**	**2,402**	**2,501**
100 **Admin/Gen**		50% to water 50% to Sewer						
Regular Salaries	3	Labor Cost Inflation	78,369	82,287	86,402	90,722	95,258	100,021
Overtime	3	Labor Cost Inflation	-	-	-	-	-	-
Personnel Benefits	3	Labor Cost Inflation	27,284	28,648	30,080	31,584	33,163	34,821
Uniforms & Clothing	1	General Cost Inflation	-	-	-	-	-	-
OPEB Expense	1	General Cost Inflation	-	-	-	-	-	-
Office and Operating Supplies	1	General Cost Inflation	2,500	2,579	2,660	2,744	2,830	2,919
Fuel Consumed	1	General Cost Inflation	-	-	-	-	-	-
Small Tools and Minor Equip	1	General Cost Inflation	4,750	4,900	5,054	5,213	5,377	5,547
Professional Ser	3	Labor Cost Inflation	76,500	80,325	84,341	88,558	92,986	97,636
Communication	1	General Cost Inflation	4,500	4,642	4,788	4,939	5,094	5,255
Travel	1	General Cost Inflation	250	258	266	274	283	292
Operating Rentals and Leases	1	General Cost Inflation	-	-	-	-	-	-
Insurance	3	Labor Cost Inflation	-	-	-	-	-	-
Public Utility	1	General Cost Inflation	-	-	-	-	-	-
Repairs & Maintenance	3	Labor Cost Inflation	-	-	-	-	-	-
Miscellaneous	1	General Cost Inflation	10,750	11,089	11,438	11,798	12,170	12,553
Interfund Profess. Serv.	1	General Cost Inflation	274,981	283,641	292,574	301,789	311,293	321,098
Intfund Oper. Rentals & Lease	1	General Cost Inflation	43,165	44,524	45,927	47,373	48,865	50,404
Total Admin/Gen			**523,048**	**542,892**	**563,530**	**584,994**	**607,320**	**630,545**

City of Camas
Sewer Utility Rate Study
Operating Revenue and Expenditure Forecast

			Budget 2008	Projection 2009	Projection 2010	Projection 2011	Projection 2012	Projection 2013
170 **Customer Services**								
Regular Salaries	3	Labor Cost Inflation	-	-	-	-	-	-
Overtime	3	Labor Cost Inflation	-	-	-	-	-	-
Personnel Benefits	3	Labor Cost Inflation	-	-	-	-	-	-
Office and Operating Supplies	1	General Cost Inflation	3,000	3,094	3,192	3,292	3,396	3,503
Small Tools and Minor Equip	1	General Cost Inflation	-	-	-	-	-	-
Professional Ser	3	Labor Cost Inflation	12,500	13,125	13,781	14,470	15,194	15,954
Communication	1	General Cost Inflation	375	387	399	412	425	438
Travel	1	General Cost Inflation	-	-	-	-	-	-
Operating Rentals and Leases	1	General Cost Inflation	-	-	-	-	-	-
Repairs & Maintenance	3	Labor Cost Inflation	1,000	1,050	1,103	1,158	1,216	1,276
Miscellaneous	1	General Cost Inflation	-	-	-	-	-	-
Interfund Profess. Serv.	1	General Cost Inflation	-	-	-	-	-	-
Intfund Oper. Rentals & Lease	1	General Cost Inflation	-	-	-	-	-	-
Total Customer Services			**16,875**	**17,656**	**18,475**	**19,332**	**20,230**	**21,171**
Other Additions								
Step Tank Pumping	1	General Cost Inflation	150,000	154,724	159,597	164,624	169,808	175,157
Total Other Additions			**150,000**	**154,724**	**159,597**	**164,624**	**169,808**	**175,157**
Add'l O&M from CIP		*From CIP*	-	-	-	-	-	-
Total Cash O&M Expenditures			**$ 2,685,081**	**$ 2,808,286**	**$ 2,914,495**	**$ 3,025,097**	**$ 3,140,399**	**$ 3,260,227**
Depreciation Expense in	2007 $	970,219						
Depreciation Expense		*Last year's plus annual additions from CIP*	$ 1,012,219	$ 1,056,459	$ 1,218,931	$ 1,380,617	$ 1,479,179	$ 1,496,576
TOTAL EXPENSES			**$ 3,697,300**	**$ 3,864,745**	**$ 4,133,427**	**$ 4,405,714**	**$ 4,619,578**	**$ 4,756,803**

City of Camas
Sewer Utility Rate Study
Capital Improvement Program

Project Costs and O&M Impacts in Year:	2008

(Project costs are escalated using Construction Cost Inflation assumptions)

No	Description	Current Cost	Year	Life In Years	For CFC Calculation: % Upgrade / Expansion	For CFC Calculation: % R&R	Specific Funding Source 1- Enterprise Fund, 2-Grants & Developer Donations		Upgrade / Expansion	R&R	TOTAL ESCALATED COSTS
1	BIOSOLIDS LAND APPLICATION	$ 100,000	2008	20	2%	98%	1	Enterprise Fund	$ 2,000	$ 98,000	$ 100,000
2	"	-	2009	20	2%	98%	1	Enterprise Fund	-	-	-
3	"	-	2010	20	2%	98%	1	Enterprise Fund	-	-	-
4	LACAMAS CREEK LAND ACQUISITION	50,000	2014	50	100%	0%	1	Enterprise Fund	50,000	-	70,926
5	JOY TO MAIN STATION DESIGN	150,000	2014	50	0%	100%	1	Enterprise Fund	-	150,000	212,778
6	STP ROTARY SCREEN REPLACE	150,000	2008	50	0%	100%	1	Enterprise Fund	-	150,000	150,000
7	SEWER MAIN REPLACE (NW 6th, et. al.)	1,400,000	2008	50	0%	100%	1	Enterprise Fund	-	1,400,000	1,400,000
8	STP Upgrade	2,000,000	2009	50	20%	80%	1	Enterprise Fund	400,000	1,600,000	2,000,000
9	SANITARY PS UPGRADES	200,000	2008	50	10%	90%	1	Enterprise Fund	20,000	180,000	200,000
10	SEWER FACILITY PLAN UPDATE	100,000	2008	50	50%	50%	1	Enterprise Fund	50,000	50,000	100,000
11	STP UPGRADE START	7,000,000	2010	50	50%	50%	1	Enterprise Fund	3,500,000	3,500,000	7,000,000
12	"	6,000,000	2011	50	50%	50%	1	Enterprise Fund	3,000,000	3,000,000	6,000,000
13	" Dryer	2,500,000	2012	50	50%	50%	1	Enterprise Fund	1,250,000	1,250,000	2,500,000
14	ANNUAL PS UPGRADES	200,000	2009	50	10%	90%	1	Enterprise Fund	20,000	180,000	212,000
15	LACAMAS CREEK PS UPGRADE(FORCEMAIN)	1,500,000	2015	50	100%	0%	2	Grants/Developer Donation	1,500,000	-	2,255,445
16	JOY TO MAIN STATION CONSTRUCTION	1,000,000	2015	50	100%	0%	1	Enterprise Fund	1,000,000	-	1,503,630
17	G&O NUEA SANITARY (total 18,300,000) 10% (2/3) Developer	1,220,000	2014	50	100%	0%	2	Grants/Developer Donation	1,220,000	-	1,730,593
18	G&O NUEA SANITARY (total 18,300,000) 10% (1/3) City	610,000	2014	50	100%	0%	1	Enterprise Fund			
19	G&O NUEA SANITARY (total 18,300,000) 10% (2/3) Developer	1,220,000	2015	50	100%	0%	2	Grants/Developer Donation	1,220,000	-	1,834,429

City of Camas
Sewer Utility Rate Study
Capital Improvement Program

Project Costs and O&M Impacts in Year: **2008** (Project costs are escalated using Construction Cost Inflation assumptions)

No	Description	Current Cost	Year	Life in Years	For CFC Calculation: % Upgrade / Expansion	For CFC Calculation: % R&R	Specific Funding Source 1- Enterprise Fund, 2-Grants & Developer Donations		Upgrade / Expansion	R&R	TOTAL ESCALATED COSTS
20	G&O NUEA SANITARY (total 18,300,000) 10% (1/3) City	610,000	2015	50	100%	0%	1	Enterprise Fund			
21	G&O NUEA SANITARY (total 18,300,000) 10% (2/3) Developer	1,220,000	2016	50	100%	0%	2	Grants/Developer Donation	1,220,000	-	1,944,495
22	G&O NUEA SANITARY (total 18,300,000) 10% (1/3) City	610,000	2016	50	100%	0%	1	Enterprise Fund			
23	G&O NUEA SANITARY (total 18,300,000) 10% (2/3) Developer	1,220,000	2017	50	100%	0%	2	Grants/Developer Donation	1,220,000	-	1,736,440
24	G&O NUEA SANITARY (total 18,300,000) 10% (1/3) City	610,000	2017	50	100%	0%	1	Enterprise Fund			
25	G&O NUEA SANITARY (total 18,300,000) 10% (2/3) Developer	1,220,000	2018	50	100%	0%	2	Grants/Developer Donation	1,220,000	-	1,805,898
26	G&O NUEA SANITARY (total 18,300,000) 10% (1/3) City	610,000	2018	50	100%	0%	1	Enterprise Fund			
27	G&O NUEA SANITARY (total 18,300,000) 10% (2/3) Developer	1,220,000	2019	50	100%	0%	2	Grants/Developer Donation	1,220,000	-	1,878,134
28	G&O NUEA SANITARY (total 18,300,000) 10% (1/3) City	610,000	2019	50	100%	0%	1	Enterprise Fund			
29	G&O NUEA SANITARY (total 18,300,000) 10% (2/3) Developer	1,220,000	2020	50	100%	0%	2	Grants/Developer Donation	1,220,000	-	1,953,259
30	G&O NUEA SANITARY (total 18,300,000) 10% (1/3) City	610,000	2020	50	100%	0%	1	Enterprise Fund			
31	G&O NUEA SANITARY (total 18,300,000) 10% (2/3) Developer	1,220,000	2021	50	100%	0%	2	Grants/Developer Donation	1,220,000	-	2,031,390
32	G&O NUEA SANITARY (total 18,300,000) 10% (1/3) City	610,000	2021	50	100%	0%	1	Enterprise Fund			
33	G&O NUEA SANITARY (total 18,300,000) 10% (2/3) Developer	1,220,000	2022	50	100%	0%	2	Grants/Developer Donation	1,220,000	-	2,112,645
34	G&O NUEA SANITARY (total 18,300,000) 10% (1/3) City	610,000	2022	50	100%	0%	1	Enterprise Fund			
35	G&O NUEA SANITARY (total 18,300,000) 10% (2/3) Developer	1,220,000	2023	50	100%	0%	2	Grants/Developer Donation	1,220,000	-	2,197,151
36	G&O NUEA SANITARY (total 18,300,000) 10% (1/3) City	610,000	2023	50	100%	0%	1	Enterprise Fund			
37	WEST CAMAS FORCE MAIN-SOUTH PH	1,000,000	2012	50	60%	40%	1	Enterprise Fund	600,000	400,000	1,262,477
38	COLLECTION SYSTEM UPGRADES	1,500,000	2014	50	20%	80%	1	Enterprise Fund	300,000	1,200,000	2,127,779
39		2,000,000	2015	50	20%	80%	1	Enterprise Fund	400,000	1,600,000	3,007,261
40		2,000,000	2016	50	20%	80%	1	Enterprise Fund	400,000	1,600,000	3,187,696
41		2,500,000	2017	50	20%	80%	1	Enterprise Fund	500,000	2,000,000	3,558,280
42		1,428,571	2018	50	20%	80%	1	Enterprise Fund	285,714	1,142,857	2,114,635
43		1,428,571	2019	50	20%	80%	1	Enterprise Fund	285,714	1,142,857	2,199,220
44		1,428,571	2020	50	20%	80%	1	Enterprise Fund	285,714	1,142,857	2,287,169
45		1,428,571	2021	50	20%	80%	1	Enterprise Fund	285,714	1,142,857	2,378,676

City of Camas
Sewer Utility Rate Study
Capital Improvement Program

Project Costs and O&M Impacts in Year:	2008

(Project costs are escalated using Construction Cost Inflation assumptions)

No	Description	Current Cost	Year	Life in Years	For CFC Calculation: % Upgrade / Expansion	For CFC Calculation: % R&R	Specific Funding Source 1-Enterprise Fund, 2-Grants & Developer Donations		Upgrade / Expansion	R&R	TOTAL ESCALATED COSTS
46	"	1,428,571	2022	50	20%	80%	1	Enterprise Fund	285,714	1,142,857	2,473,823
47	"	1,428,571	2023	50	20%	80%	1	Enterprise Fund	285,714	1,142,857	2,572,776
48	"	1,428,571	2024	50	20%	80%	1	Enterprise Fund	285,714	1,142,857	2,675,687
49	"	1,714,286	2025	50	20%	80%	1	Enterprise Fund	342,857	1,371,429	3,339,258
50	"	1,714,286	2026	50	20%	80%	1	Enterprise Fund	342,857	1,371,429	3,472,828
51	"	1,714,286	2027	50	20%	80%	1	Enterprise Fund	342,857	1,371,429	3,611,741
52	"	1,714,286	2028	50	20%	80%	1	Enterprise Fund	342,857	1,371,429	-
53	"	1,714,286	2029	50	20%	80%	1	Enterprise Fund	342,857	1,371,429	-
54	"	1,714,286	2030	50	20%	80%	1	Enterprise Fund	342,857	1,371,429	-
55	"	1,714,286	2031	50	20%	80%	1	Enterprise Fund	342,857	1,371,429	-
56	PUMP STATION UPGRADES	250,000	2010	50	10%	90%	1	Enterprise Fund	25,000	225,000	280,900
57	"	250,000	2011	50	10%	90%	1	Enterprise Fund	25,000	225,000	297,754
58	"	250,000	2012	50	10%	90%	1	Enterprise Fund	25,000	225,000	315,619
59	"	250,000	2013	50	10%	90%	1	Enterprise Fund	25,000	225,000	334,556
60	"	250,000	2014	50	10%	90%	1	Enterprise Fund	25,000	225,000	354,630
61	"	250,000	2015	50	10%	90%	1	Enterprise Fund	25,000	225,000	375,908
62	"	250,000	2016	50	10%	90%	1	Enterprise Fund	25,000	225,000	398,462
63	"	250,000	2017	50	10%	90%	1	Enterprise Fund	25,000	225,000	355,828
64	"	250,000	2018	50	10%	90%	1	Enterprise Fund	25,000	225,000	370,061
65	"	250,000	2019	50	10%	90%	1	Enterprise Fund	25,000	225,000	384,864
66	"	250,000	2020	50	10%	90%	1	Enterprise Fund	25,000	225,000	400,258

City of Camas
Sewer Utility Rate Study
Capital Improvement Program

Project Costs and O&M Impacts in Year: 2008 (Project costs are escalated using Construction Cost Inflation assumptions)

No	Description	Current Cost	Year	Life in Years	For CFC Calculation: % Upgrade / Expansion	For CFC Calculation: % R&R	Specific Funding Source 1- Enterprise Fund, 2-Grants & Developer Donations		Upgrade / Expansion	R&R	TOTAL ESCALATED COSTS
67	STP UPGRADE CLOSE-OUT (15%)	850,000	2012	50	50%	50%	1	Enterprise Fund	425,000	425,000	850,000
68	STEP BYPASS LINE, PH. I NUGAE	1,500,000	2014	50	100%	0%	1	Enterprise Fund	1,500,000	-	2,127,779
69	STEP BYPASS LINE, PH. II (SR-14?) NUGAE	1,700,000	2015	50	100%	0%	1	Enterprise Fund	1,700,000	-	2,556,171
70	"	250,000	2016	50	100%	0%	1	Enterprise Fund	250,000	-	398,462
71	TRANSMISSION TRUNK (WEST) TO MAIN STATION	1,500,000	2011	50	0%	100%	1	Enterprise Fund	-	1,500,000	1,786,524
72	PARKER PUMP STATION REPLACEMENT	1,500,000	2014	50	30%	70%	1	Enterprise Fund	450,000	1,050,000	2,127,779
73	WWTF PLAN UPDATE	400,000	2013	50	50%	50%	1	Enterprise Fund	200,000	200,000	535,290
74	"	400,000	2021	50	50%	50%	1	Enterprise Fund	200,000	200,000	666,029
75	38th AVENUE SEWER LINE	750,000	2010	50	100%	0%	1	Enterprise Fund	750,000	-	842,700
76	STP UPGRADE: EQUIPMENT REPLACE	5,000,000	2015	50	0%	100%	1	Enterprise Fund	-	5,000,000	7,518,151
77	STP UPGRADE: DEMO G.P. CONNECTIONS RELAY ADAMS (UPS	1,000,000	2021	50	0%	100%	1	Enterprise Fund	-	1,000,000	1,665,074
78	TREATMENT PLAN EXPANSION (new plnt)	20,026,000	2021	50	100%	0%	1	Enterprise Fund	20,026,000	-	33,344,762
79					100%	0%	1	Enterprise Fund	-	-	-
	Total Capital Projects	**$ 108,276,000**			**56%**	**44%**			**$ 55,368,000**	**$ 47,808,000**	**$ 141,486,102**
	Total Upgrade/Expansion Projects										81,177,244
	Total R&R Projects										60,308,858
	Projects by Grants / Developer Donations								13,700,000	-	21,479,880
	Projects by Enterprise Fund								41,668,000	47,808,000	120,006,222

Year	2008 $	Inflated
2008	1,950,000	1,950,000
2009	2,200,000	2,212,000
2010	8,000,000	8,123,600
2011	7,750,000	8,084,278
2012	4,600,000	4,928,096
2013	650,000	869,847
Total	25,150,000	26,167,821

City of Camas
Sewer Utility Rate Study
Existing Debt Input

Existing Debt Service - Revenue Bonds		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Water & Sewer Revenue Bonds	26.00%										
Annual Interest Payment		$ 64,999	$ 62,955	$ 60,800	$ 58,535	$ 56,215	$ 53,355	$ 50,365	$ 47,245	$ 43,930	$ 40,485
Annual Principal Payment		48,100	50,700	53,300	54,600	57,200	59,800	62,400	66,300	68,900	72,800
Total Annual Payment		$ 113,099	$ 113,655	$ 114,100	$ 113,135	$ 113,415	$ 113,155	$ 112,765	$ 113,545	$ 112,830	$ 113,285
Use of Debt reserve for Debt Service		-	-	-	-	-	-	-		-	-
Water and Sewer Revenue and Refunding Bonds 1998		100% Sewer									
Annual Interest Payment		$ 137,514	$ 125,456	$ 111,498	$ 96,840	$ 81,473	$ 65,293	$ 47,971	$ 29,485	$ 10,013	$
Annual Principal Payment		265,000	335,000	350,000	365,000	380,000	395,000	415,000	430,000	450,000	
Total Annual Payment		$ 402,514	$ 460,456	$ 461,498	$ 461,840	$ 461,473	$ 460,293	$ 462,971	$ 459,485	$ 460,013	$ -
Use of Debt reserve for Debt Service		-	-	-	-	-	-	-	-	-	-
REVENUE BOND 3											
Annual Interest Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment											
Total Annual Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Use of Debt reserve for Debt Service		-	-	-	-	-	-	-	-	-	-
REVENUE BOND 4											
Annual Interest Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment											
Total Annual Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Use of Debt reserve for Debt Service		-	-	-	-	-	-	-	-	-	-
REVENUE BOND 5											
Annual Interest Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment											
Total Annual Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Use of Debt Reserve for Debt Service		-	-	-	-	-	-	-	-	-	-
TOTAL REVENUE BONDS											
Annual Interest Payment		$ 202,513	$ 188,411	$ 172,298	$ 155,375	$ 137,687	$ 118,647	$ 98,336	$ 76,730	$ 53,942	$ 40,485
Annual Principal Payment		313,100	385,700	403,300	419,600	437,200	454,800	477,400	496,300	518,900	72,800
Total Annual Payment		$ 515,613	$ 574,111	$ 575,598	$ 574,975	$ 574,887	$ 573,447	$ 575,736	$ 573,030	$ 572,842	$ 113,285
Use of Debt reserve for Debt Service		-	-	-	-	-	-	-	-	-	-
Annual Debt Reserve Target on Existing Revenue Bonds		575,736	575,736	575,736	575,736	575,736	575,736	575,736	573,030	572,842	113,610

City of Camas
Sewer Utility Rate Study
Existing Debt Input

Existing Debt Service - PWTF Loans		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
PW-07-862-PRE-104	5-Year Loan was converted into a 20 Year										
Annual Interest Payment		$ 3,385	$ 5,000	$ 4,750	$ 4,500	$ 4,250	$ 4,000	$ 3,750	$ 3,500	$ 3,250	$ 3,000
Annual Principal Payment			50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Total Annual Payment		$ 3,385	$ 55,000	$ 54,750	$ 54,500	$ 54,250	$ 54,000	$ 53,750	$ 53,500	$ 53,250	$ 53,000
			$1,000,000	$950,000	$900,000	$850,000	$800,000	$750,000	$700,000	$650,000	$600,000
PW-99-791-006											
Annual Interest Payment		$ 20,291	$ 18,600	$ 16,909	$ 15,218	$ 13,527	$ 11,836	$ 10,146	$ 8,455	$ 6,764	$ 5,073
Annual Principal Payment		169,092	169,092	169,092	169,092	169,092	169,092	169,092	169,092	169,092	169,092
Total Annual Payment		$ 189,383	$ 187,692	$ 186,001	$ 184,310	$ 182,619	$ 180,929	$ 179,238	$ 177,547	$ 175,856	$ 174,165
DOE Loan											
Annual Interest Payment		$ 265,088	$ 248,886	$ 232,012	$ 214,440	$ 196,140	$ 177,082	$ 157,234	$ 136,564	$ 115,039	$ 92,621
Annual Principal Payment		391,170	407,372	424,245	441,818	460,118	479,176	499,024	519,693	541,219	563,637
Total Annual Payment		$ 656,258	$ 656,258	$ 656,258	$ 656,258	$ 656,258	$ 656,258	$ 656,258	$ 656,258	$ 656,258	$ 656,258
STP Clarifier (DOE Loan)											
Annual Interest Payment		$ 28,858	$ 26,257	$ 23,542	$ 20,710	$ 17,754	$ 14,670	$ 11,452	$ 8,094	$ 4,590	$ 934
Annual Principal Payment		59,856	62,457	65,172	68,004	70,960	74,044	77,262	80,620	84,124	43,423
Total Annual Payment		$ 88,714	$ 88,714	$ 88,714	$ 88,714	$ 88,714	$ 88,714	$ 88,714	$ 88,714	$ 88,714	$ 44,357
Public Works Trust Fund Loan											
Annual Interest Payment	50%	$ -	$ 400	$ 400	$ 300	$ 200	$ 100	$ -	$ -	$ -	$ -
Annual Principal Payment			20,000	20,000	20,000	20,000	20,000				
Total Annual Payment		$ -	$ 20,400	$ 20,400	$ 20,300	$ 20,200	$ 20,100	$ -	$ -	$ -	$ -
Public Works Trust Fund Loan - WWTP Pre-Construction											
Annual Interest Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment											
Total Annual Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Public Works Trust Fund Loan - WWTP Construction											
Annual Interest Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment											
Total Annual Payment		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL PWTF LOANS											
Annual Interest Payment		$ 317,623	$ 299,143	$ 277,614	$ 255,168	$ 231,871	$ 207,688	$ 182,581	$ 156,613	$ 129,642	$ 101,627
Annual Principal Payment		620,118	708,921	728,509	748,914	770,170	792,312	795,378	819,406	844,436	826,152
Total Annual Payment		$ 937,740	$ 1,008,064	$ 1,006,123	$ 1,004,082	$ 1,002,041	$ 1,000,000	$ 977,959	$ 976,018	$ 974,078	$ 927,780

City of Camas
Sewer Utility Rate Study
Capital Funding Analysis

Summary of Expenditures	2008	2009	2010	2011	2012	2013	2008 - 2015 TOTAL
CAPITAL PROJECTS							
Improvement Upgrades & Expansions	$ 72,000	$ 421,200	$ 4,370,790	$ 3,029,775	$ 2,464,048	$ 301,101	$ 10,658,914
Repairs and Replacements	1,878,000	1,790,800	3,752,810	5,054,503	2,464,048	568,746	15,508,90
TOTAL CAPITAL EXPENDITURES	**$ 1,950,000**	**$ 2,212,000**	**$ 8,123,600**	**$ 8,084,278**	**$ 4,928,096**	**$ 869,847**	**$ 26,167,82**

Capital Financing Plan	2008	2009	2010	2011	2012	2013	TOTAL
Existing PWTF/ Bond Proceeds	$ 1,435,200	$ -	$ -	$ -	$ -	$ -	$ 1,435,200
Project Specific Grants / Developer Donations	250,000	-	-	-	-	-	250,00
Project to be Funded	264,800	2,212,000	8,123,600	8,084,278	4,928,096	869,847	24,482,62
OTHER FUNDING SOURCES [NOTE A]							
Other Outside Sources							$ -
PWTF Loan Proceeds		2,020,000	7,980,000				10,000,000
Other Loan Proceeds							-
Connection Charges	186,163	186,163	186,163	186,163	186,163	186,163	1,116,97
Rate Funded System Reinvestment	-	-	-	-	-	-	-
Capital Fund Balance Deficiency	(78,637)	(5,837)	-	(7,898,115)	(4,741,933)	(683,683)	(13,408,20
Capital Fund Balance	78,637	5,837	-	540,169	222,303	366,744	1,213,68
Capital Fund Balance Deficiency	-	-	-	(7,357,946)	(4,519,630)	(316,940)	(12,194,51
Revenue Bond Proceeds [Note B]	-	-	-	7,550,000	4,720,000	520,000	12,790,00
Rates							
Total							

City of Camas
Sewer Utility Rate Study
Revenue Requirements Analysis

Cash Flow Sufficiency Test	2008	2009	2010	2011	2012	2013
EXPENSES						
Cash Operating Expenses	$ 2,685,081	$ 2,808,285	$ 2,914,495	$ 3,025,097	$ 3,140,399	$ 3,260,227
Existing Debt Service	1,453,353	1,582,175	1,581,721	1,579,057	1,576,928	1,573,447
New Debt Service	-	10,100	156,316	1,249,112	1,667,422	1,711,165
Rate-Funded CIP	-	-	-	-	-	-
Rate Funded System Reinvestment	-	-	-	-	-	-
Additions Required to Meet Minimum Op. Fund Balance	-	-	-	-	-	-
Total Expenses	$ 4,138,434	$ 4,400,561	$ 4,652,532	$ 5,853,266	$ 6,384,749	$ 6,544,840
REVENUES						
Rate Revenue	$ 3,380,654	$ 3,431,364	$ 3,482,834	$ 3,535,077	$ 3,588,103	$ 3,641,924
Other Revenue	127,500	131,516	135,658	139,930	144,337	148,883
Operating Fund & Debt Reserve Fund Interest Earnings	125,000	5,477	5,761	14,994	36,352	50,403
Total Revenue	$ 3,633,154	$ 3,568,356	$ 3,624,253	$ 3,690,001	$ 3,768,792	$ 3,841,211
NET CASH FLOW (DEFICIENCY)	**$ (505,280)**	**$ (832,204)**	**$ (1,028,279)**	**$ (2,163,265)**	**$ (2,615,957)**	**$ (2,703,629)**
		80,243				

Coverage Sufficiency Test	2008	2009	2010	2011	2012	2013
EXPENSES						
Cash Operating Expenses	$ 2,685,081	$ 2,808,285	$ 2,914,495	$ 3,025,097	$ 3,140,399	$ 3,260,227
Revenue Bond Debt Service	515,613	574,111	575,598	1,248,303	1,669,156	1,714,091
Revenue Bond Coverage Requirement at 1.25	128,903	143,528	143,899	312,076	417,289	428,523
Total Expenses	$ 3,329,597	$ 3,525,925	$ 3,633,992	$ 4,585,475	$ 5,226,844	$ 5,402,841
ALLOWABLE REVENUES						
Rate Revenue	$ 3,380,654	$ 3,431,364	$ 3,482,834	$ 3,535,077	$ 3,588,103	$ 3,641,924
Other Revenue	127,500	131,516	135,658	139,930	144,337	148,883
Interest Earnings - All Funds	125,000	11,736	12,034	31,899	42,891	56,879
Total Revenue	$ 3,633,154	$ 3,574,616	$ 3,630,526	$ 3,706,906	$ 3,775,332	$ 3,847,686
Coverage Realized	1.84	1.33	1.24	0.55	0.38	0.34
COVERAGE SURPLUS (DEFICIENCY)	**$ 303,557**	**$ 48,691**	**$ (3,467)**	**$ (878,569)**	**$ (1,451,513)**	**$ (1,555,155)**

City of Camas
Sewer Utility Rate Study
Revenue Requirements Analysis

Maximum Revenue Deficiency	2008	2009	2010	2011	2012	2013
Sufficiency Test Driving the Deficiency	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*
Maximum Deficiency From Tests	$ 505,280	$ 832,204	$ 1,028,279	$ 2,163,265	$ 2,615,957	$ 2,703,629
less: Net Revenue From Prior Rate Increases		-	(1,138,550)	(1,638,408)	(2,204,949)	(2,697,196)
Revenue Deficiency	$ 505,280	$ 832,204	$ -	$ 524,856	$ 411,008	$ 6,433
Plus: Adjustment for State Excise Tax	20,243	33,341	-	21,027	16,466	258
Total Revenue Deficiency	**$ 525,523**	**$ 865,545**	**$ -**	**$ 545,884**	**$ 427,474**	**$ 6,690**

Rate Increases	2008	2009	2010	2011	2012	2013
Rate Revenue with no increase	$ 3,380,654	$ 3,431,364	$ 3,482,834	$ 3,535,077	$ 3,588,103	$ 3,641,924
Revenues from Prior Rate Increases	-	-	1,184,164	1,704,048	2,293,287	2,805,255
Rate Revenue Before Rate Increase (Incl. previous increases)	3,380,654	3,431,364	4,666,998	5,239,125	5,881,390	6,447,179
Required Annual Rate Increase	15.55%	25.22%	0.00%	10.42%	7.27%	0.10%
Number of Months New Rates Will Be In Effect	12	9	12	12	12	12
Info: Percentage Increase to Generate Required Revenue	*15.55%*	*33.63%*	*0.00%*	*10.42%*	*7.27%*	*0.10%*
Policy Induced Rate Increases	0.00%	34.00%	10.60%	10.60%	8.00%	3.00%
ANNUAL RATE INCREASE	**0.00%**	**34.00%**	**10.60%**	**10.60%**	**8.00%**	**3.00%**
CUMULATIVE RATE INCREASE	**0.00%**	**34.00%**	**48.20%**	**63.91%**	**77.03%**	**82.34%**
						4.78%

Impacts of Rate Increases	2008	2009	2010	2011	2012	2013
Rate Revenues After Rate Increase	$ 3,380,654	$ 4,306,362	$ 5,161,700	$ 5,794,472	$ 6,351,901	$ 6,640,595
Full Year Rate Revenues After Rate Increase	*3,380,654*	*4,598,028*	*5,161,700*	*5,794,472*	*6,351,901*	*6,640,595*
Additional State Taxes Due to Rate Increases	-	33,705	64,670	87,032	106,461	115,509
Net Cash Flow After Rate Increase	(505,280)	9,088	585,917	9,099	41,379	179,532
Coverage After Rate Increase	1.84	2.80	4.05	2.29	1.97	2.02

City of Camas
Sewer Utility Rate Study
Fund Activity

Funds	2008	2009	2010	2011	2012	2013
OPERATING FUND						
Beginning Balance	$ 479,154	$ 175,000	$ 184,088	$ 479,095	$ 488,194	$ 516,230
plus: Net Cash Flow after Rate Increase	(505,280)	9,088	585,917	9,099	41,379	179,532
less: Transfer of Surplus to Capital Fund	-	-	(290,910)	-	(13,343)	(159,835)
Ending Balance	$ (26,127)	$ 184,088	$ 479,095	$ 488,194	$ 516,230	$ 535,928
Minimum Target Balance	*441,383*	*461,636*	*479,095*	*497,276*	*516,230*	*535,928*
Maximum Funds to be Kept as Operating Reserves	*441,383*	*461,636*	*479,095*	*497,276*	*516,230*	*535,928*
Info: No of Days of Cash Operating Expenses	*(4)*	*24*	*60*	*59*	*60*	*60*
CAPITAL FUND						
Beginning Balance	$ 1,052,178	$ 200,000	$ 200,423	$ 540,169	$ 208,959	$ 206,909
plus: Rate Funded System Reinvestment	-	-	-	-	-	-
plus: Grants / Developer Donations / Other Outside Sources	250,000	-	-	-	-	-
plus: Existing / New PWTF / Existing Bond Proceeds	1,435,200	2,020,000	7,980,000	-	-	-
plus: System Development Charges	186,163	186,163	186,163	186,163	186,163	186,163
plus: Net Debt Proceeds Available for Projects	-	-	-	7,550,000	4,720,000	520,000
plus: Interest Earnings	32,930	6,259	6,273	16,905	6,540	6,476
plus: Transfer of Surplus from Operating Fund	-	-	290,910	-	13,343	159,835
plus: Direct Rate Funding	-	-	-	-	-	-
Total Capital Funding Sources	**2,956,471**	**2,412,423**	**8,663,769**	**8,293,237**	**5,135,006**	**1,079,383**
less: Capital Expenditures	(1,950,000)	(2,212,000)	(8,123,600)	(8,084,278)	(4,928,096)	(869,847)
Ending Balance	**$ 1,006,471**	**$ 200,423**	**$ 540,169**	**$ 208,959**	**$ 206,909**	**$ 209,536**
Minimum Target Balance	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000
DEBT RESERVE						
Beginning Balance		$ -	$ -	$ -	$ 673,328	$ 1,094,269
plus: Reserve Funding from New Debt	-	-	-	673,328	420,941	46,375
less: Use of Reserves for Debt Service	-	-	-	-	-	-
Ending Balance	$ -	$ -	$ -	$ 673,328	$ 1,094,269	$ 1,140,644
Minimum Target Balance	*575,736*	*575,736*	*575,736*	*1,249,063*	*1,670,005*	*1,716,380*

City of Camas

Sewer Utility Rate Study

System Development Charge

EXISTING COST BASIS:	2008		NOTES:
Plant in Service			
Utility Capital Assets		$ 43,604,604	Original cost of plant-in-service as of 12/31/2007
less: Contributed Capital		(6,238,872)	CIAC, Grants, and other contributed capital
plus: Interest on Non-Contributed Plant		18,879,806	Interest on assets up to a maximum 10-year period
Existing Cash Balances	1,006,471		Available Construction Cash and Debt Fund Cash
less: Debt Principal Outstanding	(17,484,419)		Total principal outstanding for the existing debt
less: Net Debt Principal Outstanding		(16,477,948)	Debt principal outstanding, net of cash reserves
TOTAL EXISTING COST BASIS		**$ 39,767,590**	
FUTURE COST BASIS:			**NOTES:**
Capital Improvement Plan			
Total Future Projects (2008$)			Total projects identified in the 20-year CIP
Cumulative		$ 4,152,500	Projects which apply to both Non NUGAE & NUGAE (cost reflect 20-year capacity)
Non NUGAE		25,260,622	Projects which apply to only Non NUGAE
Phase III		10,634,955	
NUGAE		39,259,124	Projects which apply to only NUGAE (100% build out within 20-years)
less: Identified Repair & Replacement Projects			R&R projects are not eligible for GFC
Cumulative		(3,302,500)	R&R projects which apply to both Non NUGAE & NUGAE
Non NUGAE		(17,536,444)	R&R projects which apply only to Non NUGAE
Phase III		-	
NUGAE		(3,498,800)	R&R projects which apply only to NUGAE
less: Contributed Future Upgrade and Expansion Projects			Not eligible for recovery through GFC
Cumulative		-	Contributions which apply to both Non NUGAE & NUGAE
Non NUGAE		-	Contributions which apply only to Non NUGAE
Phase III		-	
NUGAE		(13,700,000)	Contributions which apply only to NUGAE
TOTAL FUTURE COST BAISIS		$ 41,269,458	
CUSTOMER BASE			**NOTES:**
Existing Residential Equivalent Domestic Units			Existing residential customer equivalents 2008
Non NUGAE		15,086	From G&O
NUGAE		-	From G&O
Future Residential Equivalent Domestic Units (Incremental)			Estimated growth in Customer Equivalents 20-year growth 2008-2027
Non NUGAE		9,873	From G&O
NUGAE		5,228	From G&O
Phase III Capacity	9,026		
TOTAL CUSTOMER BASE		30,187	Estimated growth in Customer Equivalents 20-year growth 2008-2027
RESULTING CHARGE			
Existing Cost Basis Portion			
Allocable Existing Portion		$ 39,767,590	
Allocable Customer Base		30,187	
Existing Cost Basis Charge Non NUGAE		**$ 1,317**	Applies To Both Non NUGAE and NUGAE
Future Cost Basis Portion			
Allocable Future Portion to Both		$ 850,000	
Allocable Customer Base		15,101	
Future Cost Basis Charge Cumulative		**$ 56**	Applies To Both Non NUGAE and NUGAE
Allocable Future Portion Non NUGAE		$ 7,724,178	
Allocable Customer Base		9,873	
Future Cost Basis Charge Non NUGAE		**$ 782**	Applies Only to Non NUGAE
Allocable Future Portion Non NUGAE Phase III		$ 10,634,955	
Allocable Customer Base		9,026	
Future Cost Basis Charge Non NUGAE Phase III		**$ 1,178**	
Allocable Future Portion NUGAE		$ 22,060,325	
Allocable Customer Base		5,228	
NUGAE Future Cost Basis Charge		**$ 4,220**	Applies Only to NUGAE
Non NUGAE		**3,334**	Applies Only to Non NUGAE
NUGAE		**5,593**	Applies Only to NUGAE

City of Camas
Sewer Utility Rate Study
SDC

Meter Size	Existing Rates	Proposed Non NUGAE	Difference	Proposed NUGAE	Difference
Residential	$ 2,349	$ 3,334	$ 985	$ 5,593	$ 3,244
Commercial I					
5/8"	$ 2,349	$ 3,334	$ 985	$ 5,593	$ 3,244
3/4"	3,523	5,001	1,478	8,390	4,867
1"	5,872	8,336	2,463	13,983	8,111
1.5"	11,745	16,671	4,926	27,967	16,222
2"	18,792	26,674	7,882	44,747	25,955
3"	37,584	53,348	15,764	89,493	51,909
4"	58,725	83,357	24,632	139,833	81,108
6"	117,449	166,713	49,264	279,666	162,217
8"	187,919	266,741	78,822	447,466	259,547
Commercial II					
Flow (gallons)	$ 8.55	$ 16.94	$ 8.39	$ 28.78	$ 20.23
BOD (lbs / day)	1,364	3,149	1,785	5,071	3,708
TSS (lbs / day)	1,006	1,192	186	1,921	914

City of Camas
Storm Utility Rate Study
System Development Charge

EXISTING COST BASIS:	2008	NOTES:
Plant in Service		
Utility Capital Assets	$ 10,770,683	Original cost of plant-in-service as of 12/31/2007
less: Contributed Capital	(8,081,647)	CIAC, Grants, and other contributed capital
plus: Interest on Non-Contributed Plant	489,374	Interest on assets up to a maximum 10-year period
Existing Cash Balances -		Available Construction Cash and Debt Fund Cash
less: Debt Principal Outstanding -		Total principal outstanding for the existing debt
less: Net Debt Principal Outstanding	-	Debt principal outstanding, net of cash reserves
TOTAL EXISTING COST BASIS	**$ 3,178,410**	

FUTURE COST BASIS:		NOTES:
Capital Improvement Plan		
Total Future Projects (2008$)		Total projects identified in the 20-year CIP
Cumulative	$ 104,375	
Non NUGAE CIP	10,249,380	
NUGAE CIP	30,672,000	
less: Identified Repair & Replacement Projects		R&R projects are not eligible for GFC
Cumulative	-	
Non NUGAE CIP	(892,500)	
NUGAE CIP	-	
less: Contributed Future Upgrade and Expansion Projects		Not eligible for recovery through GFC
Cumulative	-	
Non NUGAE CIP	(1,175,322)	
NUGAE CIP	(4,600,800)	
TOTAL FUTURE COST BAISIS	$ 34,357,133	

CUSTOMER BASE		NOTES:
Existing Residential Equivalent Domestic Units		Existing residential customer equivalents 2008
Cumulative	9,692	
Non NUGAE	9,692	Assumed annualized sewer growth rates
NUGAE	-	Assumed annualized sewer growth rates
Future Residential Equivalent Domestic Units (Incremental)		Estimated growth in Customer Equivalents 20-year growth 2008-2027
Cumulative	11,559	
Non NUGAE	6,331	Assumed annualized sewer growth rates
NUGAE	5,228	Assumed annualized sewer growth rates based on Sewer to Storm Proporti...
TOTAL CUSTOMER BASE	21,251	Estimated growth in Customer Equivalents 20-year growth 2008-2027

RESULTING GENERGAL CHARGE		
Existing Cost Basin Portion		
Allocable Existing Portion	$ 3,178,410	
Allocable Customer Base	21,251	
Existing Cost Basis Charge	**$ 150**	
Future Cost Basin Portion		
Cumulative		
Allocable Future Portion	$ 104,375	
Allocable Customer Base	11,559	Growth portion is allocable to future customers only
Future Cost Basis Cumulative Charge	**$ 9**	
Non NUGAE Only		
Allocable Future Portion	$ 8,181,558	
Allocable Customer Base	6,331	Growth portion is allocable to future customers only
Future Cost Basis Non NUGAE Charge	**$ 1,292**	
NUGAE Only		
Allocable Future Portion	$ 26,071,200	
Allocable Customer Base	5,228	Growth portion is allocable to future customers only
Future Cost Basis Charge	**$ 4,987**	
Non NUGAE	**$ 1,451**	
NUGAE	**$ 5,145**	

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TASK 5 – POTHOLING

Objective: Obtain information regarding locations of existing side sewers connecting to the Central Avenue sewer line.

A. Pothole and/or use a metal detector to identify existing side sewers connecting to the Central Avenue sewer.