Sewer Facilities Plan

Prepared for
City of Yelm

June 2016

Prepared by
Parametrix
and
FCS GROUP
Solutions-Oriented Consulting

Sewer Facilities Plan

Prepared for

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June 2016 | 216-1781-033

CITATION

Parametrix. 2016. Sewer Facilities Plan. Prepared by Parametrix, Puyallup, Washington. June 2016.

CERTIFICATION

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.

6-22-16

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APPENDICES

KEY TERMS

µg/L	microgram per liter
µmhos/cm	micromhos/centimeter
2013 Annual I/I Report	2013 *Annual Infiltration/Inflow Report: Yelm Water Reclamation Facility*
A	ampere
ATS	automatic transfer switch
BOD	Biochemical Oxygen Demand
CCC	cross-connection control
ccf	charge per hundred cubic feet
cfm	cubic feet per minute
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIP	Capital Improvements Plan
City	City of Yelm
DAHP	Washington State Department of Archaeology and Historic Preservation
DMR	Daily Monitoring Report
DO	dissolved oxygen
DOH	Washington State Department of Health
DPS	distinct population segment
DWF	dry weather flow
DWSRF	Drinking Water State Revolving Funds
Ecology	Washington State Department of Ecology
EI&C	electrical, instrumentation and control
ENR	Engineering News-Record
EPA	U.S. Environmental Protection Agency
EPDM	Ethylene propylene diene monomer
ERU	equivalent residential unit
ESU	evolutionarily significant unit
F	Fahrenheit
FPPA	Farmland Protection and Policy Act
FRP	fiberglass reinforced plastic
ft^2	square foot
FVNR	full voltage nonreversing
GBT	Gravity Belt Thickener

KEY TERMS (CONTINUED)

GMA	Growth Management Act
gpcd	gallons per capita per day
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
HDPE	High-density polyethylene
hp	horsepower
HVAC	Heating, Ventilation, and Air Conditioning
I/I	inflow and infiltration
IPS	Intermediate Pump Station
kA	kiloampere
kVA	kilovolt-ampere
kW	kilowatt
lb/d	pounds per day
LFC	local facilities charge
LID	Local Improvement District
LUD	Local Utility District
M	Millions
MBR	membrane bioreactor
MCC-Exist	existing motor control center
MCCs	Motor Control Centers
mg/L	milligrams per liter
mgd	million gallons per day
mJ/cm^2	millijoules per $centimeter^2$
mL	milliliter
MLSS	mixed liquor suspended solids
MPC	Master Planned Community
msl	mean sea level
ND	Non Detect
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity units
NWRI	National Water Research Institute
O&M	Operation and Maintenance
OFM	Washington State Office of Financial Management

KEY TERMS (CONTINUED)

ORCAA	Olympic Region Clean Air Agency
ORP	oxidation-reduction potential
Plan	Sewer Facilities Plan
PLCs	programmable logic controllers
PSE	Puget Sound Energy
psi	pounds per square inch
PWTF	Public Works Trust Fund
RCW	Revised Code of Washington
RIBs	Rapid Infiltration Basins
RM	river mile
RO	reverse osmosis
RV	Recreational Vehicle
SBRs	sequencing batch reactors
SCADA	Supervisory Control and Data Acquisition System
scfm	cubic feet per minute at standard conditions
SCS	U.S. Department of Agriculture, Soil Conservation Service
SDC	System Development Charge
SFP	Sewer Facilities Plan
SEPA	Washington State Environmental Policy Act
SR	State Route
STEP	Septic Tank Effluent Pump
SWD	side water depth
TCPHSSD	Thurston County Public Health and Social Services Department
TDH	total dynamic head
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TRPC Buildable Lands Report	2007 *Thurston Regional Planning Council Buildable Lands Report*
TRPC	Thurston Regional Planning Council
TSS	Total Suspended Solids
UGA	Urban Growth Area
ULID	Utility Local Improvement District
UPS	Uninterruptible Power Supply

KEY TERMS (CONTINUED)

USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
UV	ultraviolet
V	volt
VFD	variable frequency drive
WAC	Washington Administrative Code
WAS	waste activated sludge
WRF	Water Reclamation Facility
WUE	water use efficiency
WWTP	Wastewater Treatment Plant
Yelm Comprehensive Plan	2009 *City of Yelm Comprehensive Plan and Joint Plan with Thurston County*
Yelm GSP	2013 *City of Yelm General Sewer Plan*
Yelm WSP	2010 *City of Yelm Water System Plan*
YMC	Yelm Municipal Code

EXECUTIVE SUMMARY

INTRODUCTION

As documented in the approved 2013 City of Yelm General Sewer Plan (Yelm GSP), the need to review critical upgrade requirements for the City of Yelm (City) Water Reclamation Facility (WRF) was identified. This Sewer Facilities Plan (Plan) describes the development and evaluation of alternatives for liquid and solids stream treatment upgrades at the City's WRF. This Plan has been prepared in accordance with Washington Administrative Code (WAC) 173-240.

Completing the projects recommended in this Plan will allow the City to provide continued reliable reclaimed water production, wastewater treatment, and waste solids handling while protecting and preserving the surrounding environment.

The Plan is organized as follows:

1. Introduction
2. Planning Area Characteristics
3. Flows and Loads from Existing Collection System
4. Regulatory Requirements
5. Condition and Capacity Assessment
6. Liquid Stream Treatment Alternatives
7. Solids Stream Treatment Alternatives
8. Preferred Alternatives
9. Financial Plan
10. Public Involvement

Key objectives of this Sewer Facilities Plan for the City of Yelm are:

- *Producing an uninterrupted, year-round supply of Class A reclaimed water.*
- *Planning for the expected 2030 growth flows and the projected 1.22-mgd design flow capacity of the WRF.*

Key objectives of this Sewer Facilities Plan for the City of Yelm are:

- **Producing an uninterrupted, year-round supply of Class A reclaimed water.** This objective is a high priority for the City. It is necessary in order to meet existing water rights mitigation commitments, as well as to fulfill the obligations currently committed to the City's reclaimed water customers.

  In addition, in the Yelm Comprehensive Plan (Section V, Public Facilities and Utilities included as Appendix B of this Plan), the City is committed to providing treatment of wastewater to a reusable level and then recycling the water throughout the city.

  Meeting these commitments has been challenging with the WRF experiencing periodic exceedances of the total nitrogen reclaimed water permit discharge limit, total coliform reclaimed water permit discharge limit, and of the National Pollutant Discharge Elimination System (NPDES) permit ammonia discharge limit. These exceedances occurred for an extended period in late 2010, much of 2011, and into early 2012. A few nitrogen-based permit exceedances have also occurred in the winter periods of 2013, 2014, and 2015. Operational, short-term modifications to address this issue are being employed; however, a long-term, reliable solution to this challenge is necessary and a new Facilities Plan will provide long-range alternatives to address this challenge.

- **Planning for the expected 2030 growth flows and the projected 1.22-mgd design flow capacity of the WRF.** As stated in the Yelm GSP, over the last decade, Yelm has been the fastest growing city in Thurston County and one of the fastest growing cities in the state. As such, the City's sewered population is projected to more than double by 2020 and more than triple by 2030 with a similar rate of growth for commercial development. Planning for this growth in a manner that is consistent with meeting the requirements set forth in the Growth Management Act is important.

In addition to achieving the above key objectives and providing reliable reclaimed wastewater treatment and supply capability while recognizing the current economic challenges faced by rate payers of the City to fund the improvements, this Plan also specifically addresses the following:

- Providing reliable wastewater treatment service to continuously produce reclaimed water with Total Nitrogen levels less than 10 milligrams per liter (mg/L) year round;
- Meeting high standards for water quality;
- Maximizing use of existing WRF facilities;
- Implementing treatment technologies that reduce the operation and maintenance requirements for the WRF such as reducing the chemical addition requirements for facility operation; and
- Delivering construction and operation of an upgraded water reclamation facility, over phases, by 2030 in a cost-effective manner.

PLANNING AREA CHARACTERISTICS

Planning area characteristics provide important information to be used in applications for funding the WRF improvements identified in this Plan.

Key planning area characteristics for the City of Yelm include:

- The City of Yelm is located about 17 miles southeast of Olympia, Washington, near the eastern boundary of Thurston County, as shown in Figure ES-1, City of Yelm Vicinity Map (Reference Figure 1-2, Yelm GSP). The City covers approximately 3,635 acres (5.7 square miles), which includes the Thurston Highlands Master Planned Community (MPC) (1,240 acres, 1.9 square miles) and the Tahoma Terra MPC (220 acres, 0.34 square miles). An additional 2,390 acres (3.7 square miles) lie outside city limits but within the City's Urban Growth Area (UGA). The UGA represents all of the Yelm vicinity likely to be needed to accommodate urban growth over the next 20 years. Relative locations of the MPCs above are shown in Figure ES-2, City of Yelm Master Planned Community (Reference Figure 2-1, Yelm GSP).
- Per the Yelm GSP, the City of Yelm intends to provide sewer service within its entire UGA except for the Thurston Highlands MPC area. The Tahoma Terra MPC area is included in the City's current and future wastewater service areas. Therefore, wastewater collection and treatment service for the Thurston Highlands MPC area will be developed under another separate, distinct facilities plan. The City's existing wastewater service area is serviced by a septic tank effluent pumping (STEP) collection system. The STEP collection system consists of either individual STEP tanks located at buildings or common STEP tanks serving multiple residences or commercial structures. Solids in the wastewater settle in the STEP tank, and the effluent is pumped through smaller-diameter pressure mains to the WRF.

> - *The City's existing wastewater service area is serviced by a septic tank effluent pumping (STEP) collection system.*
> - *Per the Yelm GSP, the City of Yelm intends to provide sewer service within its entire UGA except for the Thurston Highlands MPC area.*

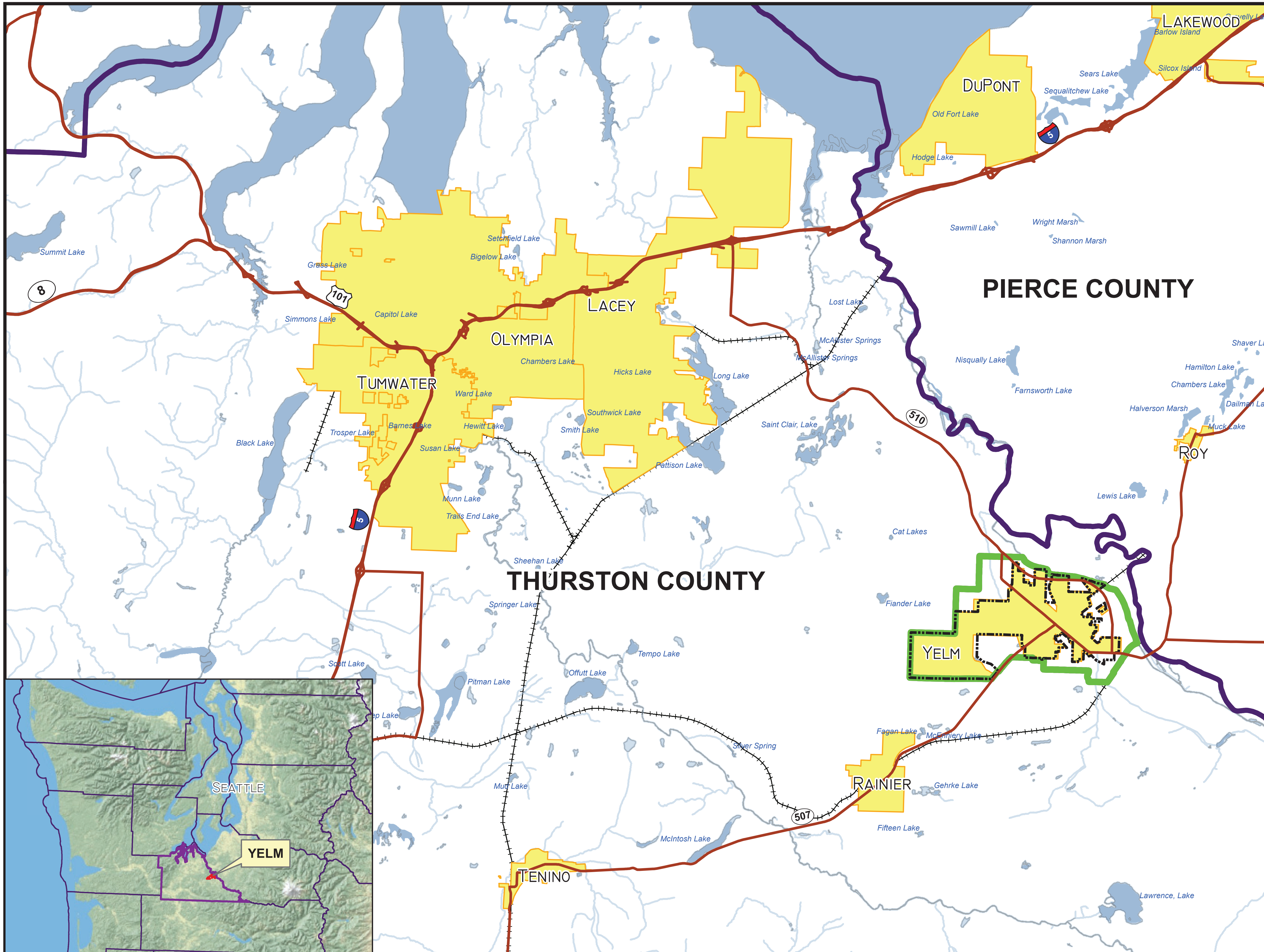


Figure ES-1
City of Yelm
Vicinity Map

Source:
City of Yelm
General Sewer Plan,
Figure 1-1

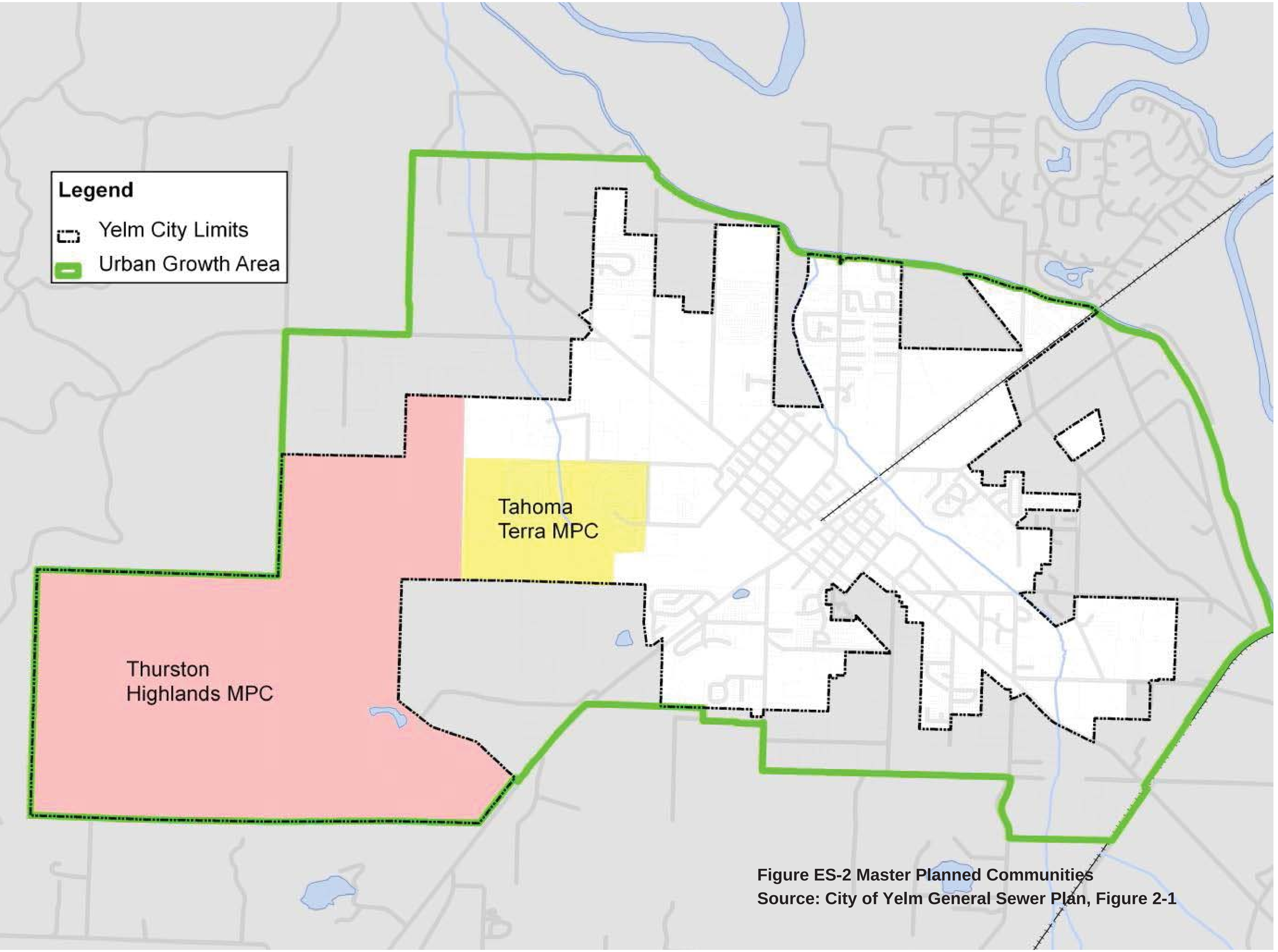


Figure ES-2 Master Planned Communities
Source: City of Yelm General Sewer Plan, Figure 2-1

- The City of Yelm provides potable water service for the majority of the City's current and future wastewater service areas.
- Approximately 34 percent of reclaimed water produced by the WRF is distributed for beneficial uses, such as irrigation or groundwater recharge through rapid infiltration basins (RIBs).
- Stormwater infiltration and inflow into the City's sewer collection system has been very limited because the STEP collection system is pressure based.

- *Stormwater infiltration and inflow into the City's sewer collection system has been very limited because the STEP collection system is pressure based.*

- The WRF site lies in an area known as the Yelm Prairie. This area was occupied by glacial meltwaters during the receding stages of the Vashon Glacier and generally has little change in elevation.
- Work elements proposed for this Sewer Facilities Plan are limited to within the current fence line of the WRF. This may limit planning needs with regards to archeological and historical sites, prime or unique farmland, water or air sensitive areas, and wildlife habitat (threatened or endangered species).
- Key demographics for the City of Yelm include:

➢ Per capita money income (2013 dollars)	$19,003
➢ City of Yelm Median household income, 2009-2013	$49,191
➢ Washington State Median household income, 2009-2013	$59,478
➢ Percentage of persons below poverty level in the City of Yelm, 2009-2013	21.2%

- City land use consists of a mix of commercial, residential, and industrial zoned land. The majority of the land is residential. There are approximately 584 acres of commercially zoned land, 1,176 acres of residential land, and 190 acres of industrial land within the city limits. This approximation does not include the two MPCs, Thurston Highlands and Tahoma Terra in the southwest part of the City, which will contain an additional 1,550 acres of primarily residential land.
- The 2007 *Thurston Regional Planning Council (TRPC) Buildable Lands Report* (TRPC Buildable Lands Report) estimates that 217 acres of land are available for commercial development within city limits, and 6 acres are available for commercial development within the UGA. The 2007 TRPC also states that the land supply for industrial purposes within city limits and the UGA is 108 acres and 80 acres, respectively. These numbers include vacant or partially used lots, as well as re-developable land.
- Various park areas exist within the service area and are reliant on the WRF reclaimed water supply for turf irrigation and landscape irrigation. There are 56.45 acres of park and trail land area within the city limits and UGA.
- Air and public health planning for the City of Yelm area is managed by Thurston County, the Olympic Region Clean Air Agency (ORCAA), and Thurston County Public Health and Social Services Department (TCPHSSD). TCPHSSD delegates all large wastewater and potable water system project reviews to the Washington State Departments of Health and Ecology.

Photograph ES-1. Yelm Cochrane Pond

Photograph ES-2. Yelm Longmire Park Ball Fields

FLOWS AND LOADS FROM THE EXISTING COLLECTION SYSTEM

WRF influent wastewater flow and load information is vital to provide proper sizing of WRF treatment components and projecting future flows and loads. The historic and existing WRF flows are as follows:

Table ES-1. Existing WRF Wastewater Flow Characterization

Year	Average annual flow (mgd)	Maximum month flow (mgd)	Maximum day flow (mgd)	Peak hour flow (mgd)
2006	0.284	0.314	0.427	NA
2007	0.317	0.329	0.398	0.708
2008	0.329	0.353	0.411	0.756
2009	0.349	0.359	0.436	0.784
2010	0.354	0.366	0.449	0.843
2011	0.356	0.370	0.440	0.807
2012	0.354	0.363	0.479	2.167
2013	0.369	0.399	0.473	0.858
2014	0.382	0.408	0.487	0.990 [a, b]
2015	0.405	0.440	0.502	0.940

[a] On 12/12/14 from 04:00 to 11:00, flow rates ranged from as low as 0.16 mgd to as high as 2.25 mgd and were discarded due to the irregular pattern.

[b] On 09/21/14 from 21:00 to 23:00, flow rates ranged from 0.90 mgd to 1.08 mgd and were discarded due to the irregular pattern.

The annual average flow for 2014 was 0.382 mgd and 0.405 mgd in 2015. Average day and maximum day flow plots in the 2011 to 2015 period appear to be following a more seasonal pattern with highest flows occurring in winter months and lower flows occurring in summer months.

The elevated peak hour flow recorded for 2013 coincided with an extended power outage event across the City of Yelm which cause the majority of City full STEP Tank pumps to come on line all at once when power was restored.

Based on recent flow and load monitoring, the GSP projected flows and loads have been modified as follows:

Table ES-2. Revised Flow and Load for WRF Facility Plan Basis of Design

Year	Average Daily Flows	Max Month Flow (mgd)	Max Day Flow (mgd)	Peak Hour Flow (mgd)	Average Annual BOD5 (lb/d)	Average Annual TSS (lb/d)	Average Annual TKN (lb/d)	Max Month BOD5 (lb/d)	Min Month BOD5 (lb/d)	Max Month TSS (lb/d)	Max Month TKN (lb/d)	Max Day BOD5 (lb/d)	Max Day TSS (lb/d)	Max Day TKN (lb/d)
2010	0.35	0.37	0.45	0.81	608	164	184	682	308	205	233	763	297	231
2020	0.80	0.83	1.00	1.84	1,405	378	417	1,470	692	471	534	1,764	683	524
2036	1.16	1.22	1.46	2.69	2,077	557	611	2,172	1,017	694	814	2,608	1,005	767

Notes: Total Kjeldahl Nitrogen (TKN) loads are based on 80 mg/L as N in influent, rather than the 63 mg/L as N TKN concentration that was used by the Yelm GSP as its basis to compute TKN loads. The 80 mg/L as N TKN value was selected to recalculate Yelm GSP TKN loads so as to address the noted upward trend in the WRF influent TKN concentration that has consistently occurred from 2011 through 2014.

The 2036 flows and loads will be the basis of design for all upgrades and improvements identified in this plan. The 2036 flows and loads in this plan are identical to the 2030 general sewer plan flows and loads because:

- Once the GSP 2030 projected flows and loads are achieved any additional flows and loads will processed by wastewater treatment facilities separate from the WRF.
- Sewer flows and loads from a significant portion within the City UGA (the Thurston County MPC), will be processed under a separate facilities plan and wastewater treatment facility.

The WRF influent Total Kjeldahl Nitrogen (TKN) concentration has been trending upwards in 2011 to 2015. The WRF influent TKN concentrations have been consistently above 70 mg/L for a majority of the 2011 to 2015 period.

The Biochemical Oxygen Demand (BOD) load trend in the WRF has been steadily decreasing from 2009 to 2014. The influent BOD load trend has appeared to stabilize in 2015. Also, the WRF influent BOD load data is showing a definitive seasonal trend, with highest BOD loads occurring during the winter months (December, January, and February) and the lowest BOD loads occurring during the summer months (July and August).

If influent BOD is not entering the WRF at sufficient quantities, then supplemental carbon will need to be added to ensure that sufficient denitrification is occurring. Therefore, this Plan will also include a minimum month BOD load condition to address the need for periodic carbon supplementation at the WRF to support effective biological denitrification. The minimum BOD load condition listed will be based on an influent BOD concentration of 100 mg/L.

- *The WRF influent Total Kjeldahl Nitrogen (TKN) concentration has been trending upwards in 2011 to 2015.*
- *The Biochemical Oxygen Demand (BOD) load trend in the WRF has been steadily decreasing from 2009 to 2014. The influent BOD load trend has appeared to stabilize in 2015.*
- *If influent BOD is not entering the WRF at sufficient quantities, then supplemental carbon will need to be added to ensure that sufficient denitrification is occurring.*

REGULATORY REQUIREMENTS

An analysis was conducted in the Yelm GSP with regards to projected future NPDES and reclaimed water permit limits. The Yelm GSP NPDES permitting analysis indicated that little change in NPDES requirements is expected. The Yelm GSP recommended that the total residual chlorine limits be relaxed with regards to discharge to Outfall 2 at the Centralia Power Canal.

Based on the information provided by the Yelm GSP regulatory analysis, it is not expected that future reclaimed water regulations (Total Nitrogen effluent discharge limit to remain at 10 mg/L even with updated rule) would directly impact WRF treatment alternative analysis approaches of this Plan. This conclusion would change if the City was to move away from surface percolation of reclaimed water (application of reclaimed water to Rapid Infiltration Basins) to direct groundwater recharge. Direct recharge to groundwater would necessitate more advanced levels of treatment such as reverse osmosis (RO).

CONDITION AND CAPACITY ASSESSMENT

Condition and capacity assessments of the following WRF process areas were conducted:

- Influent Facilities.
- Secondary Treatment – Sequencing Batch Reactor.
- Tertiary Treatment.
- Disinfection and Dechlorination.
- Sludge Storage, Pumping, and Processing.
- Reclaimed Water Pumping and Storage.
- Flow Measurement and Sampling.
- Support Systems (Power Supply and Distribution, Controls and Alarm Equipment, and Heating, Ventilation, and Air Conditioning Equipment).

Photograph ES-3. Outfall Pipe to Centralia Power Canal

Key findings of the condition assessment include:

- Major mechanical equipment (pumps, blowers) and electrical equipment (generators) across process areas are now at or approaching the end of useful service life.
- Only a single, fixed air diffuser grid is installed in each SBR basin. If there is a failure in the grid (e.g., popped diffuser membrane or cracked diffuser distribution pipe), then process air feed into a SBR basin could be completely compromised (causing blower trip-outs or over-pressure conditions in the air distribution piping resulting in pressure relief air blow-offs at the blower). This forces Yelm Operations staff to take the SBR basin with the failed grid completely off-line and requires a complete dewatering of the off-line basin to allow maintenance of the damaged grid. In addition, repairs for damaged grids or membrane replacement in the SBRs is hampered by personnel entry into deep, hard-to-access confined space areas.

- The complete dewatering of a SBR basin is a very tedious operation due to the fact the Yelm Operations staff has to rely on the limited dewatering flow capability provided by the Drain and Sludge Pump Station and the Waste Activated Sludge (WAS) Pump Station pumps. The Drain and Sludge Pump Station pumps can only be activated to dewater a SBR basin when the basin water levels reach a low enough level. Otherwise, the drain and sludge pumps can be overwhelmed by the SBR basin drain inflows causing an overflow of the Drain and Sludge Pump Station Wet Well. Generally, it takes at least a 1-day period to fully dewater a SBR basin which can cause significant operation disruptions.
- Based on May 2013 Ecology comments on the GSP, there is a possible and significant flow discrepancy between the influent and effluent flow measurements. Ecology reviewed monthly flow data (influent flow, reclaimed water use, discharge to Power Canal, and discharge to Nisqually River) that the City reported on monthly discharge monitoring reports. The data indicate a difference of 30,000 to 60,000 gallons per day between the influent flow and combined discharges. Prior to approximately March 2007, the City reported more effluent than influent flow. From that date to the present, the reported influent flow exceeds the total effluent flows.
- Per the Ecology Orange Book, the existing WRF chlorine contact tanks with a 4-foot operating flow depth are too shallow. The Orange Book recommends a flow depth of 6 to 15 feet be provided in chlorine contact tanks and does not recommend the use of shallower tanks.
- Potential leaks from the Chlorine Cylinder Storage and Chlorinator Rooms are discharged by the existing emergency ventilation air system directly into the surrounding atmosphere without any pre-treatment.

Photograph ES-5. Worn Reject Water Pump Station Pump

Photograph ES-6. Corrosion Damage on Reclaimed Water Pump Station Pump Skid

Photograph ES-7. Single Aeration Diffuser Grid in Deep SBR Tank

- Potential leaks from the Chlorine Cylinder Storage and Chlorinator Rooms are discharged by the existing emergency ventilation air system directly into the surrounding atmosphere without any pre-treatment.
- Windows XP operating software on the Supervisory Control and Data Acquisition System (SCADA) computers is out-of-date and no longer supported by Microsoft.
- SCADA computers use out-of-date software where the software vendors are no longer in business and, therefore, software packages (e.g., for computer backup) are no longer supported.
- A single board computer that is used in the SBR PLC is obsolete and is no longer supported by the manufacturer for spare parts.

- *Only a single, fixed air diffuser grid is installed in each SBR basin. If there is a failure in the grid, then process air feed into a SBR basin could be completely compromised.*
- *Repairs for damaged grids or membrane replacement in the SBRs is hampered by personnel entry into deep, hard-to-access confined space areas.*
- *Per the Ecology Orange Book, the existing WRF chlorine contact tanks with a 4-foot operating flow depth are too shallow.*
- *Potential leaks from the Chlorine Cylinder Storage and Chlorinator Rooms are discharged by the existing emergency ventilation air system directly into the surrounding atmosphere without any pre-treatment.*
- *Windows XP operating software on the Supervisory Control and Data Acquisition System (SCADA) computers is out-of-date and no longer supported by Microsoft.*
- *A single board computer that is used in the SBR PLC is obsolete and is no longer supported by the manufacturer for spare parts.*

The two primary elements for evaluating WRF treatment and hydraulic capacity included:

1. Treatment process related elements (ability to meet treatment requirements of the current NPDES and reclaimed water permits), and
2. Hydraulic flow elements which involve conveying flow physically through the facility.

Both of these elements are addressed in the capacity analysis with process capacity reported in terms of maximum month flow and load, and hydraulic capacity reported in terms of peak hour flow. The solids stream treatment system is primarily a hydraulic flow scheme and is generally expressed only in terms of sludge flow processing capacity.

Key findings of the treatment and hydraulic capacity assessment include:

- Nitrogen removal controls the WRF biological treatment capacity.
- Based on a Parametrix capacity assessment, SBR biological treatment capacity is based on two of three SBR basins in service: 0.55 mgd flow in the winter and 0.65 mgd in the summer. These values are lower than the stated apparent design criteria design flow of 1.06 mgd expected for the SBR treatment system. Primary reasons for this difference in apparent treatment capacity are:
  - Lower than expected influent COD/TKN and BOD/TKN ratios have been continuously encountered in the 2011 to 2015 time frame compared to those ratios proposed in the SBR basis of design.
  - Lower than expected influent temperatures (as low as 6 degrees) as compared to 20-degree design temperatures listed in previous SBR basis of design documents.
  - Original designers had assumed that a three-SBR-basin operation was necessary to achieve the 1.06-mgd design flow.
- The assumption that a three-SBR-basin operation is necessary is supported by a recent letter issued by the SBR manufacturer which indicates the stated design nitrogen treatment capacity estimation of two operating SBR tanks is 0.71 mgd and the SBR system treatment capacity is 1.06 mgd with three SBR tanks in operation.
- Currently, the Reclaimed Water Pump Station can pump up to 265 gpm which corresponds to 381,600 gpd.

- *Based on a Parametrix capacity assessment, SBR biological treatment capacity is based on two of three SBR basins in service: 0.55 mgd flow in the winter and 0.65 mgd in the summer.*
- *The assumption is that a three-SBR-basin operation is necessary to achieve the 1.06 mgd stated design flow is supported by a recent letter issued by the SBR manufacturer. This letter indicates the stated design nitrogen treatment capacity estimation of two operating SBR tanks is 0.71 mgd and the SBR system treatment capacity is 1.06 mgd with three SBR tanks in operation. The manufacture design calculations indicated that TKN design load is 500 lbs per day at the 1.06 mgd design flow and that the minimum BOD:NH3 load ratio should be 4:1 and the BOD:TKN ratio should be 3.3:1.*
- *Currently, the Reclaimed Water Pump Station can pump up to 265 gpm which corresponds to 381,600 gpd.*

LIQUID STREAM TREATMENT ALTERNATIVES DEVELOPMENT AND EVALUATION

A basic summary of the Liquid Stream Treatment Alternatives analyzed for the Sewer Facilities Plan includes:

- **Alternative 1 – Optimization of Existing Facilities with Minor Enhancements and Upgrades**
  - Replace chlorine gas-based disinfection and dechlorination with liquid-based disinfection and dechlorination, complete existing tertiary filter upgrades and expansion, and construct a new influent equalization tank.
- **Alternative 2 – Optimization of Existing Facilities with Major Enhancements and Upgrades**
  - Option A (Alternative 2A): Conversion from gravity-based SBR settling to ballasted SBR settling, replace chlorine gas-based disinfection and dechlorination with ultraviolet (UV) light disinfection, and complete existing tertiary filter upgrades and expansion.
  - Option B (Alternative 2B): Conversion from existing tertiary filters to new alternative denitrification filter process, replace chlorine gas-based disinfection and dechlorination with UV light disinfection, and construct a new influent equalization tank.
  - Option C (Alternative 2C): Add another SBR tank, replace chlorine gas-based disinfection and dechlorination with UV light disinfection, complete existing tertiary filter upgrades and expansion, and construct a new influent equalization tank.
- **Alternative 3 – Complete Process Renovation – MBR**
  - Convert from SBR secondary treatment and tertiary filtration processes to an MBR system and replace chlorine gas-based disinfection and dechlorination with UV light disinfection.
- **Do Nothing Alternative**
  - Operate facility without any significant improvements. Feed chemicals, organic carbon materials, and bioaugmentation products into the WRF process units to enhance operation and treatment.
  - Specifically feed carbon supplementation material to the existing filtration system (filter denitrification) in an attempt to extend WRF nitrogen removal treatment capacity. Parametrix and the City conducted a successful pilot study to confirm this mode of operation could be employed at the WRF. The study report is located in Appendix F.

The Do Nothing Alternative is not considered viable in the long term because:

- *The WRF controls system is obsolete and running on outdated Windows XP software.*
- *Replacement of aged WRF gas-based disinfection and dechlorination systems are warranted to better protect plant workers and the nearby public.*
- *Worker safety issues need to be addressed with regards to worker entry into deep SBR tanks and improving chemical handling and storage.*
- *WRF critical support facilities are in need of major upgrades and enhancements.*

The Do Nothing Alternative is not considered viable in the long term and was not evaluated further due to the following reasons:

- The WRF controls system is obsolete and running on outdated Windows XP software. Various plant control components have also been found to be obsolete with no replacement parts available.
- Replacement of aged WRF gas-based disinfection and dechlorination systems are warranted to better protect plant workers and the nearby public. Currently, the gas

systems have no emergency release treatment systems in place. In addition, the existing chlorine contact tanks do not meet Orange Book requirements.

- Worker safety issues need to be addressed with regards to worker entry into deep SBR tanks and improving chemical handling and storage.
- WRF critical support facilities (e.g., in-plant pumping stations including the Intermediate, Reject, and Plant Drain/Sludge Pump Stations) are in need of major upgrades and enhancements.
- Based on a recent WRF capacity assessment, all three existing SBRs would need to be operational in order for the facility to provide sufficient nitrification to meet total nitrogen permit limits at Winter Maximum Month Daily Flows above 0.65 mgd. With all three SBRs operating, a standby SBR tank with associated equipment would not be available to facilitate maintenance and repairs while still meeting discharge permit limits.
- Current process air blower configuration does not meet Ecology Orange Book design guidelines for equipment redundancy when three SBRs are in operation.
- To address future growth, the WRF will need to be expanded from 1-mgd design flow capacity to approximately 1.24-mgd design flow capacity.

Alternatives 1 through 3, reflect a set of diversified WRF upgrades and expansion options for the City to consider. For example Alternatives 1 and 2 serve to maximize the use of existing facilities while Alternative 3 considers a complete overhaul of the WRF to employ a new liquid stream technology such as the MBR technology.

The evaluation of liquid stream treatment alternatives is summarized in Table ES-3. The preferred liquid stream treatment alternative to process up to the 2036 design flows and loads (see Table ES-2) is recommended to be Alternative 2, Option A. The reasoning for this recommendation is as follows:

- Alternative 2, Option A, had the highest criterion ranking among all alternatives evaluated with a score of 189. This alternative scored the highest due to its specific ability to:
  - Maintain plant operations as currently practiced; operation of two SBR basins with one SBR reserved as a spare.
  - Provide the lowest present worth of all alternatives presented.
  - Reduce chemical usage and costs compared to other alternatives.
  - Increase reliability in meeting the reclaimed water treatment requirements for cold weather nitrogen removal by implementing ballasted sedimentation in the SBR tanks which would allow higher levels of solids to be present in the SBR tanks.
  - Improve sludge settleability to reduce chemical addition requirements (e.g., magnesium hydroxide and aluminum based coagulants).
  - Provide an immediate opportunity to increase nitrogen removal treatment reliability and sludge settleability through full-scale pilot installation of ballasted sedimentation equipment into the existing SBRs as design and construction efforts proceed.

SOLIDS STREAM TREATMENT ALTERNATIVES DEVELOPMENT AND EVALUATION

A summary of the solids stream treatment alternatives analyzed for the Sewer Facilities Plan include:

- **Alternative 1 – Refurbishment or Replacement of Gravity Belt Thickener Operation with Minor Enhancements**
  - Gravity Belt Thickener Refurbishment or Replacement with New Drum Thickener – Continue hauling thickened, unclassified WAS only to the Tacoma Central Plant. The City's Septic Tank Effluent Pump (STEP) tank sludge pumping, hauling, and disposal will continued to be handled by a private septage pumping company.
- **Alternative 2 – Optimization of Existing Facilities with Major Enhancements**
  - Replacing sludge thickening with a screw press dewatering system. Unclassified, dewatered solids would be hauled to a licensed private biosolids processing company by a contracted hauler. The screw press would be designed to allow for Class A or Class B operation in the future.
- **Alternative 3 – Complete Process Renovation to Provide Class A Biosolids**
  - Convert WRF to an advanced Alkaline Stabilization Process (Lystek process) to Achieve Class A Biosolids. This process would include the sludge thickening and screw press dewatering system proposed in Alternative 2. The Lystek process uses an innovative process consisting of high shear mixing, steam addition, and potassium hydroxide addition to economically create an agricultural high value Class A biosolids product. An evaluation of the solids stream treatment alternatives is summarized in Table ES-4.

The preferred solids stream treatment alternative is recommended to be Alternative 3. The reasoning for this recommendation is as follows:

- Alternative 3 had the highest overall criterion ranking among all the alternatives evaluated with a score of 147. This alternative scored the highest due to its specific ability to:
  - Allow for phasing of construction where the thickening and dewatering equipment could be installed in an initial phase and the Class A specific equipment installed in a future phase.
  - Provide a beneficial side stream return to the liquid stream process by potentially reducing liquid stream pH chemical and supplemental carbon feed costs. This is accomplished by recovering carbon from the STEP collection system septage solids and through addition of potassium hydroxide which raises the pH of the side stream flow returned to the liquid stream WRF processes.
  - Significantly reduce hauling and disposal costs not only for WAS sludge but also for septage sludge obtained from maintenance pumping of the City's STEP collection system. In addition, the septage sludge is potentially positively used in the WRF liquid stream process to enhance nitrogen removal.
  - Use existing equipment and building space. The existing sodium hydroxide storage and feed system can be easily retrofitted to feed potassium hydroxide. In addition, the solids handling building would be in part used to house the new dewatering equipment.
  - Facilitate addressing the future possibility that biosolids disposal requirements may become more stringent.

Table ES-3. Liquid Stream Alternatives Evaluation Matrix

Alternative Number and Description	Options	Specific Advantages of Alternative Implementation	Specific Disadvantages and Challenges of Alternative Implementation	Initial Project Cost (Millions [M])	O&M PW Cost (M)	Total Present Worth Cost (M)	Minimize City Capital Financial Impact	Maximize Safety	Increases Reliability of Meeting Current and Future Permit Limits	Minimizes WRF Operation Disruptions During Construction	Maximizes Use of Existing Facilities	Simplifies Operations to Reduce O&M Costs	Total Ranking Score
							Values of Importance						
							10	10	10	9	8	7	
							Individual Criterion Scoring						
1 Optimization of Existing Facilities with Minor Enhancements and Upgrades	Not Applicable	• Use of existing facilities is maximized. • Capital costs to construct will be lower than other alternatives. • Improves ability to provide Total Nitrogen removal for current and future flows and under all seasonal conditions.	• All three SBR tanks will be required for operation as flows approach design capacity, thereby increasing operational staff efforts for maintenance and laboratory work. • This alternative will not employ any new tools to ensure good gravity sludge settleability in the SBRs. • Because of mixed liquor suspended solids (MLSS) operating constraints, the SBR system will encounter nitrification challenges in the winter. • High operating costs due to the need to feed chemicals to ensure good SBR gravity sludge settleability is maintained.	$16.875	$14.836	$31.711	4	3	2	2	4	2	**154**
2 Optimization of Existing Facilities with Major Enhancements and Upgrades (All Options Include UV Disinfection)	A – Ballasted SBR Settling	• Use of existing facilities is maximized. • Capital costs to construct will be lower than other alternatives, except for Alternatives 1 and 2B. • The ballasted settling process could be introduced as full-scale temporary pilot process into SBRs before construction of permanent facilities can be completed. This would allow for more immediate benefits to meet reclaimed water nitrogen limits and allow reduced operations requirements by maintaining only two operating SBRs. • Allows for one SBR tank out of service as WRF design flow capacity is approached.	• The use of ballasted sedimentation for SBRs is relatively new in North America with only a handful of systems along the U.S. East Coast in operation. Pilot testing before implementation is highly recommended. • The sand filtration step would still be needed to comply with reclaimed water regulations.	$20.458	$10.325	$30.783	3	3	4	4	4	3	**189**
	B – New Denitrification Filters	• The new filters could be constructed without causing major disruptions to ongoing WRF operations by maintaining operation of the existing filters. • The Tetra Denite deep bed down flow filters have over 400 established filter cell installations across the U.S. and are also certified California Title 22 for both filtration and denitrification.	• Existing filters would be abandoned, • Increased Capital Costs compared to Alternatives 1, 2A, and 2C. • High operating costs due to the need to feed chemicals to ensure good SBR gravity sludge settleability is maintained. • All three SBR tanks will be required for operation to provide proper nitrification during cold weather operation.	$20.589	$12.000	$32.589	3	3	3.5	4	3	2	**169**
	C – Add SBR Tank	• Includes upgrades to existing facilities to replace aged equipment.	• Three SBR tanks will be required for operation thereby increasing operational staff efforts for maintenance and laboratory work. • This alternative will not employ any new tools to ensure good gravity sludge settleability in the SBRs. • Because of MLSS operating constraints, the SBR system may still encounter nitrification challenges in the winter. • High operating costs due to the need to feed chemicals to ensure good SBR gravity sludge settleability is maintained.	$21.438	$13.768	$35.206	3	2	2	2	2	2	**118**
3 Complete Process Renovation – MBR	Not Applicable	• Simple to operate since all sludge is completely retained by membranes. • Allows for high MLSS concentrations to better ensure cold weather Total Nitrogen removal.	• Significant maintenance of plant operations planning required during construction in order to integrate MBR construction. • Highest capital cost to implement the alternatives. • Additional fine screening system will need to be maintained.	$23.598	$10.763	$34.361	2.5	3	4	2	3	3	**158**

Table ES-4. Solids Stream Alternatives Evaluation Matrix

	Alternative Number and Description	Specific Advantages of Alternative Implementation	Specific Disadvantages and Challenges of Alternative Implementation	Initial Project Cost (M)	O&M PW Cost (M)	Total Present Worth Cost (M)	Minimize City Financial Impact	Maximizes Ease of Biosolids Distribution	Maximizes Utilization of Existing Facilities	Reduces Impact of Side Stream Flows on Liquid Stream Processes	Simplifies Operations to Reduce O&M Costs	Total Ranking Score
						Values of Importance	10	10	10	9	7	
						Individual Criterion Scoring						
1	Refurbishment or Replacement of Gravity Belt Thickener Operation with Minor Enhancements (Refurbish gravity belt thickener or provide new drum screen thickener, continue hauling unclassified thickened sludge to Tacoma)	• Capital costs to construct will be lower than other alternatives. • Reduced maintenance requirements compared to other alternatives.	• Is dependent on the Tacoma Central Plant continuing to accept thickened, unclassified sludge over the long-term planning period of 20 years. • Higher hauling and disposal costs compared to other alternatives. • Side stream flow from this alternative provides no benefit to the liquid stream processes to which it is returned.	$1.972	$7.993	$9.965	2	2	2	2	2	**92**
2	Optimization of Existing Facilities with Major Enhancements (Provide new drum screen and screw press to produce dewatered, unclassified sludge; haul dewatered material to a private sludge processing company that can accept waste municipal sludge)	• Provides ability to reduce hauling and disposal costs compared to Alternative 1. • Least present worth cost of the alternatives presented.	• Side stream flow from this alternative provides no benefit to the liquid stream processes to which it is returned. • A licensed private sludge treatment company would need to be contracted to convert the unclassified solids to either Class A and/or Class B Biosolids for ultimate disposal.	$3.155	$6.462	$9.617	2	2	4	2	2	**112**
3	Complete Process Renovation to Provide Class A Biosolids (Provide new screw press and Lystek process to generate Class A Biosolids, distribute biosolids to local area sites and users)	• Provides a side stream flow that is rich in carbon source for return back to the liquid stream process. This carbon could help reduce the amount of synthetic carbon required for effective nitrogen removal for any of the liquid stream treatment alternatives discussed in Chapter 6. • The side stream return back to the liquid stream would also have an elevated pH. The elevated pH could help to reduce the amount of magnesium hydroxide added for pH control under all liquid stream treatment alternatives discussed in Chapter 6. • The produced biosolids material may actually become in demand and the solids could be sold or customers may completely pay their own costs to collect biosolids for use. • Reduced O&M.	• Highest capital cost of alternatives presented. • Requires potential effort to develop a robust area market that will accept the Class A biosolids produced.	$7.438	$2.445	$9.883	2	3	4	4	3	**147**

PREFERRED ALTERNATIVES

Description of Preferred Alternatives

The preferred liquid stream treatment alternative involves the upgrade and improvements of the following process units:

- Secondary Treatment:
  - Adding ballasted sedimentation to the SBR biological treatment process.
  - Replacing the existing SBR process air positive displacement blowers with newer, more energy efficient units.
  - Replacing the existing SBR in-tank membrane diffuser systems and floating mixer systems with a jet aeration-based system. This will remove the need and reduce worker safety challenges of maintaining aeration and mixing equipment in deep tanks. Jet aeration motive pumps will be installed at-grade outside of the SBR process tanks to facilitate ease of maintenance.
- Tertiary Treatment:
  - Refurbishment of existing filter cells.
  - Construction of three new filter cells.
- Disinfection Treatment:
  - Convert one of two existing chlorine contact tanks to house two separate UV disinfection treatment trains. The remaining chlorine contact tank would provide emergency disinfection capability if the UV disinfection system was not operable.
  - Provide new on-site sodium hypochlorite generation system to chlorinate reclaimed water.

The preferred liquid stream treatment alternative process schematic is shown in Figure ES-3.

The preferred solids stream treatment alternative includes upgrade and improvements to the following process units:

- Solids Thickening:
  - Replacement of the existing SBR waste activated sludge gravity belt thickener with a new drum thickener.
- Solids Dewatering:
  - Installation of new dewatering screw press after thickener unit.
- Chemical Feed:
  - Upgrades to polymer preparation and feed systems.
- Sludge Treatment Process to convert dewatered sludge to a Class A Biosolids product. The Class A Sludge Treatment Process is expected to be implemented in a future phase that would occur beyond 2030.

The preferred solids stream treatment alternative process schematic is shown in Figure ES-4.

The preferred alternatives site plan is shown in Figure ES-5, and the preferred alternatives hydraulic profile is shown in Figure ES-6.

Three primary phases of upgrade have been identified as follows:

- *Immediate Upgrades – Immediate upgrades are critical work elements identified to prevent major plant operation disruptions.*
- *2020 Upgrades – These work elements are focused on upgrading key plant design components that are at design capacity*
- *2025 Upgrades – These work elements are focused on upgrading existing 1-mgd flow capacity process components to the new 1.22-mgd design flow capacity.*

Elements of the preferred liquid and solids stream treatment alternatives will be implemented in phases to help provide a logical upgrade path to the existing facilities and allow for distributed costs across the planning period. In addition, the phased approach will help to defer upgrades until plant flow rate increases are actually realized. Three primary phases of upgrade have been identified as follows:

- Immediate Upgrades – Immediate upgrades are critical work elements identified to prevent major plant operation disruptions.
- 2020 Upgrades – These work elements are focused on upgrading key plant design components that are at design capacity (e.g., SBR with regards to nitrogen removal) or in need of replacement because of the new design flow capacity of 1.22 mgd (Maximum Month Average Daily Influent Flow).
- 2025 Upgrades – These work elements are focused on upgrading existing 1-mgd flow capacity process components to the new 1.22-mgd design flow capacity.

The immediate upgrades will include the following specific work elements:

- Reclaimed Water Pump Station electrical, mechanical, and structural upgrades.

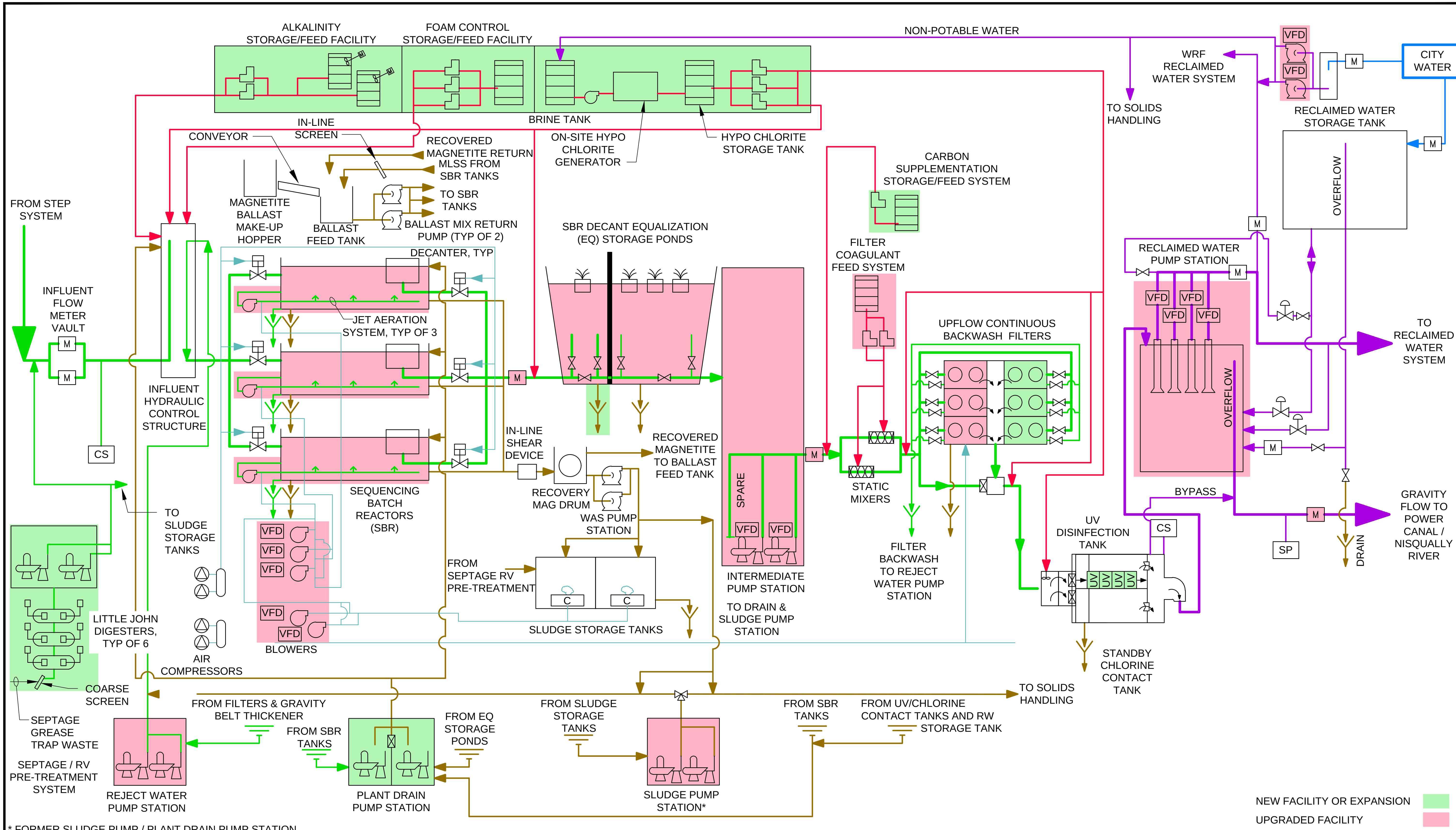
Photograph ES-8. Existing WRF Reclaimed Water Pump Station

- Critical upgrades to SCADA and controls such as:
  - Upgrading all plant SCADA-related computers.
  - Installing new SCADA software on the SCADA computers.
  - Ensuring that existing controls can communicate with new SCADA software.
  - Setting up the new fiber optic communication network backbone to build on in the 2020 and 2025 upgrades.
  - Replacement of Reclaimed Water Pump Station programmable logic controller.
- New electrical conduit and control wiring trenching and conduit lay down.

The 2020 upgrades will include the following specific work elements:

- Adding ballasted sedimentation to SBR process.
- Constructing new Ballasted Sedimentation Process Building.
- Completing Reject Water Pump Station improvements.
- Completing Drain and Sludge Pump Station improvements.
- Completing first phase electrical improvements (consolidate motor control centers for solids handling equipment, Intermediate Pump Station, and Reject Water Pump Station; and install new central generator, transformers, and switchgear).
- Completing Control Improvements – Installing new fiber optic communications network and replacing all existing programmable logic controllers/single-board computers, including the units for the SBR and in-plant pump stations.
- Completing Control Building expansion.
- Adding UV disinfection.
- Modifying Chlorine Contact Basin for UV disinfection.
- Adding Secondary Liquid Hypo Chlorination.

Photograph ES-9. Gravity SBR Sludge Settling (Left) versus Ballasted Sedimentation Assisted Settling (Right)



Parametrix DATE: June 21, 2016 FILE: PS1781033FES-3

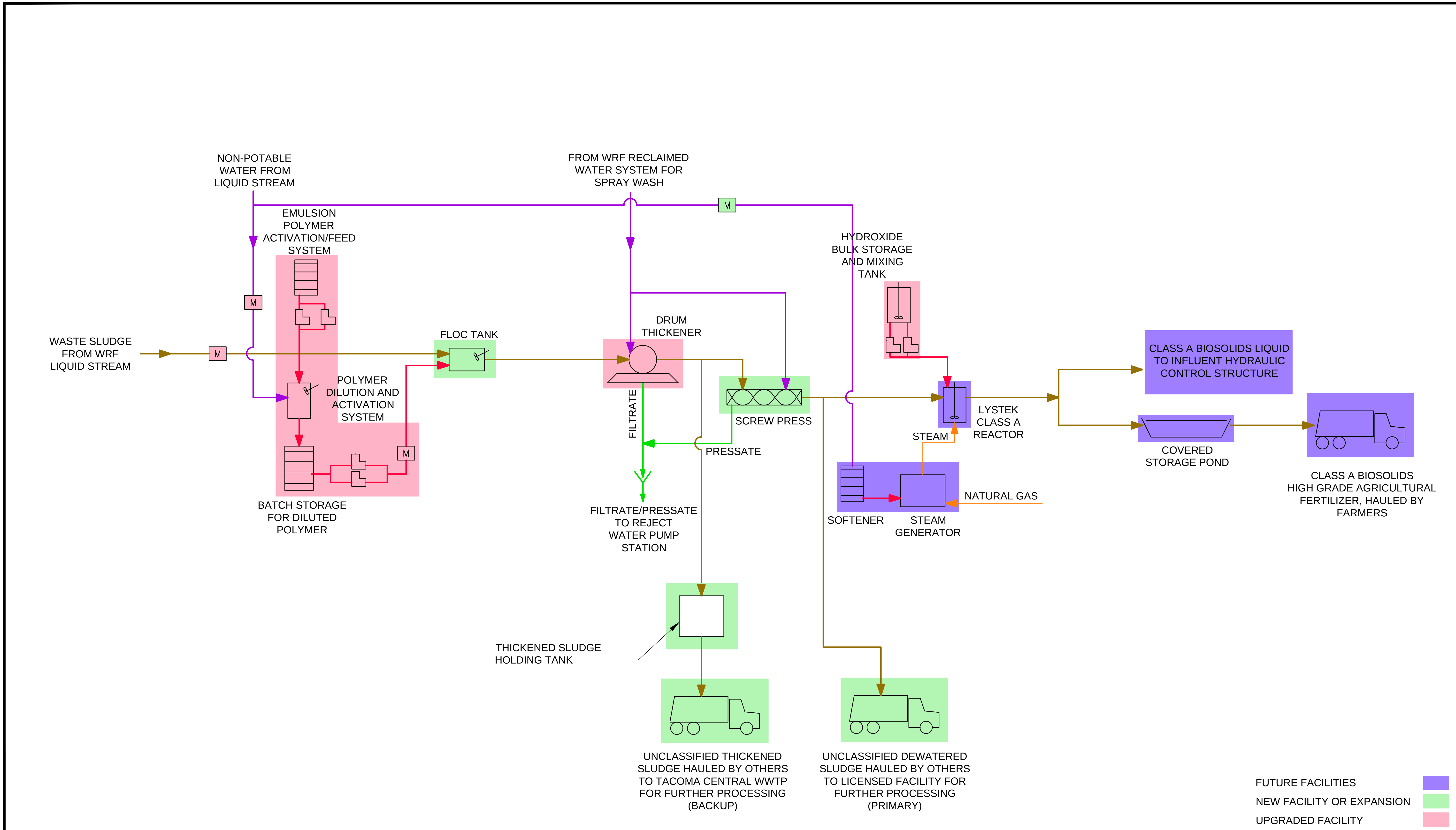
LEGEND

CENTRIFUGAL PUMP	VERTICAL PUMP	PNEUMATIC CONTROL VALVE	FLOATING MIXER	CS COMPOSITE SAMPLER	ISOLATION GATE
RAIL MOUNTED SUBMERSIBLE PUMP	STATIC MIXER	SCADA FLOW CONTROL VALVE	F/C FINE OR COARSE BUBBLE DIFFUSER	SP SAMPLE PORT	EFFLUENT FLOW WEIR
SUBMERSIBLE PUMP	INJECTOR	ISOLATION VALVE	SURFACE AERATOR	FIXED MIXER	AIR
POSITIVE DISPLACEMENT PUMP	M FLOW METER	THREE WAY VALVE	VFD VARIABLE FREQUENCY DRIVE	TOTE OR STORAGE TANK	CHEMICAL

INFLUENT FLOW STREAM MAJOR/MINOR
RECLAIMED WATER FLOW STREAM MAJOR/MINOR
SOLID OR DRAINAGE

Figure ES-3
Preferred Liquid Stream Alternative Process Schematic

Sewer Facilities Plan
Yelm, Washington

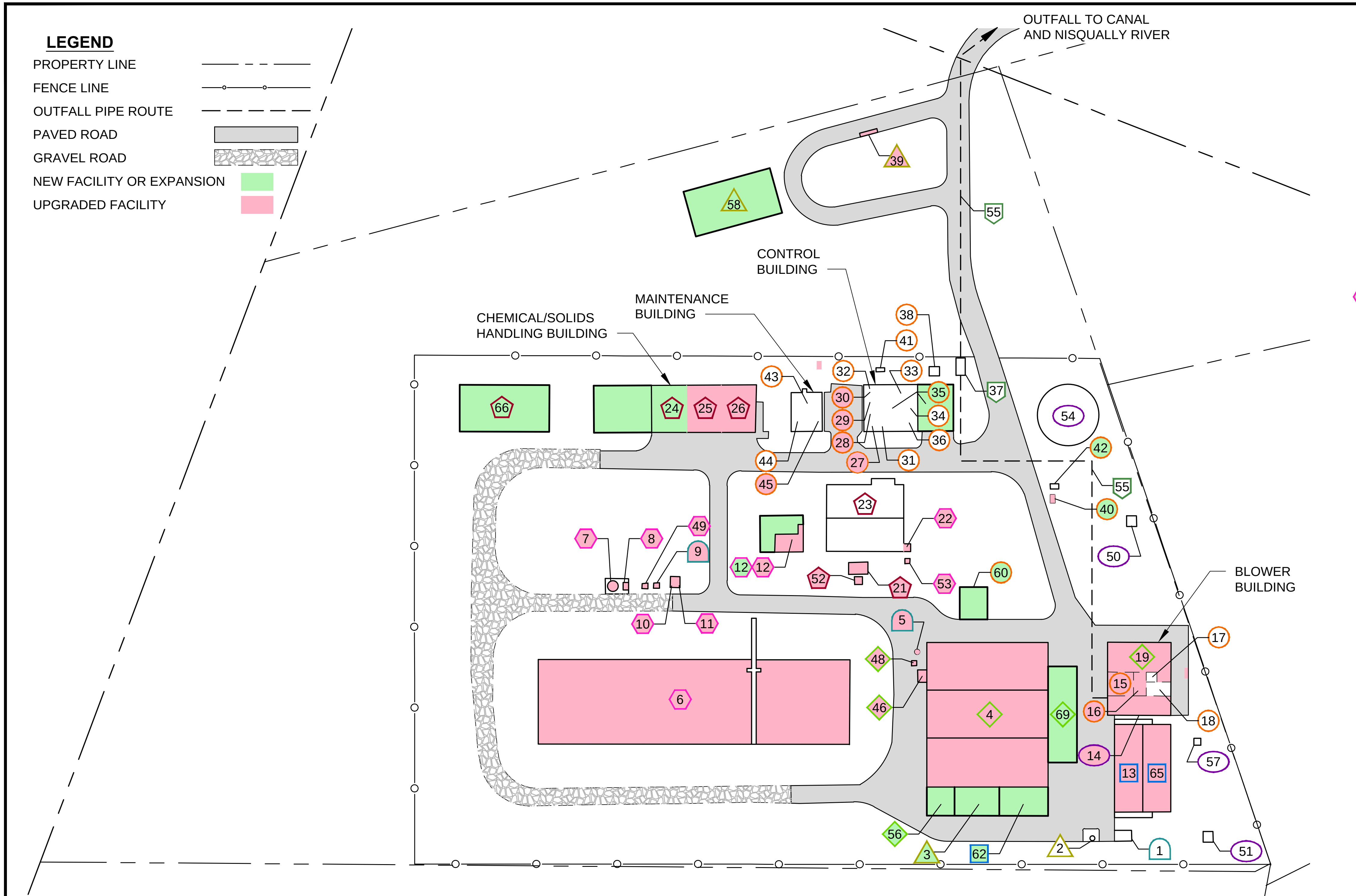


Parametrix DATE: June 9, 2016 FILE: PS1781033FES-4

LEGEND

CENTRIFUGAL PUMP
RAIL MOUNTED SUBMERSIBLE PUMP
SUBMERSIBLE PUMP
POSITIVE DISPLACEMENT PUMP
VERTICAL PUMP
STATIC MIXER
INJECTOR
M FLOW METER
PNEUMATIC CONTROL VALVE
SCADA FLOW CONTROL VALVE
ISOLATION VALVE
THREE WAY VALVE
FLOATING MIXER
F/C FINE OR COARSE BUBBLE DIFFUSER
SURFACE AERATOR
VFD VARIABLE FREQUENCY DRIVE
CS COMPOSITE SAMPLER
SP SAMPLE PORT
FIXED MIXER
TOTE OR STORAGE TANK
ISOLATION GATE
EFFLUENT FLOW WEIR
AIR
CHEMICAL
INFLUENT FLOW STREAM MAJOR/MINOR
RECLAIMED WATER FLOW STREAM MAJOR/MINOR
SOLID OR DRAINAGE

Figure ES-4
Preferred Solids Stream Alternative Process Schematic
Sewer Facilities Plan
Yelm, Washington



SCHEDULE OF SUB PROCESS AREAS

1 INFLUENT METERING VAULT
2 INFLUENT HYDRAULIC CONTROL STRUCTURE
3 INFLUENT CHEMICAL STORAGE/FEED FACILITY
4 SEQUENCING BATCH REACTOR TANKS W/ AERATION UPGRADES
5 SBR DECANT FLOW METER MANHOLE UPGRADE
6 SBR DECANT EQUALIZATION STORAGE PONDS UPGRADE
7 INTERMEDIATE PUMP STATION (IPS) UPGRADE
8 VALVE BOX UPGRADE
9 IPS FLOWMETER VAULT UPGRADE
10 STATIC MIXER 'A' UPGRADE
11 STATIC MIXER 'B' UPGRADE
12 12 EFFLUENT FILTERS EXPANSION AND UPGRADE
13 UV DISINFECTION UPGRADE
14 RECLAIMED WATER PUMP STATION AND WETWELL UPGRADE
15 MCC ROOM UPGRADE
16 CONTROL ROOM (BLOWER BUILDING) UPGRADE
17 RESTROOM
18 STORAGE ROOM
19 BLOWER ROOM - REPLACE EXISTING BLOWER
21 SLUDGE PUMP STATION UPGRADE
22 REJECT WATER PUMP STATION UPGRADE
23 SLUDGE STORAGE TANKS
24 NEW LYSTEK CLASS A BIOSOLIDS SYSTEM
25 SOLIDS HANDLING ROOM UPGRADE
26 CHEMICAL FEED AND STORAGE ROOM UPGRADE
27 PROCESS MAKE-UP WATER SUPPLY ROOM UPGRADE
28 ELECTRICAL ROOM
29 ELECTRICAL ROOM
30 ELECTRICAL ROOM
31 RESTROOM
32 MCC ROOM UPGRADE
33 LABORATORY
34 BREAKROOM
35 OFFICE EXPANSION
36 PROCESS CONTROL ROOM
37 OUTFALL LINE PIG PORT
38 SEPTIC TANK
39 RV/SEPTAGE PUMP STATION UPGRADE
40 STANDBY GENERATOR
41 HVAC HEAT PUMP
42 POWER TRANSFORMER
43 MAINTENANCE GARAGE
44 STEP SYSTEM SUPPLY ROOM
46 WAS PUMP STATION UPGRADE
48 WAS PINCH VALVE VAULT UPGRADE
49 CHECK VALVE VAULT UPGRADE
50 OVERFLOW AIR RELEASE ASSEMBLY
51 PLANT REUSE CHECK VALVE VAULT
52 SLUDGE PS CHECK VALVE VAULT UPGRADE
53 REJECT WATER CHECK VALVE VAULT UPGRADE
54 RECLAIMED WATER (RW) STORAGE TANK
55 OUTFALL PIPE (TO CANAL OR RIVER)
56 FOAM CONTROL STORAGE/FEED FACILITY
57 RW STORAGE TANK DRAIN AIR GAP SLAB
58 NEW RV/SEPTAGE PRE-TREATMENT SYSTEM
60 PLANT DRAIN PUMP STATION
62 LIQUID HYPOCHLORITE STORAGE/FEED FACILITY
65 STAND BY CHLORINE CONTACT TANK
66 CLASS A BIOSOLIDS COVERED LAGOON
69 BIOMAG PROCESS BUILDING

Parametrix DATE: June 9, 2016 FILE: PS1781033FES-5

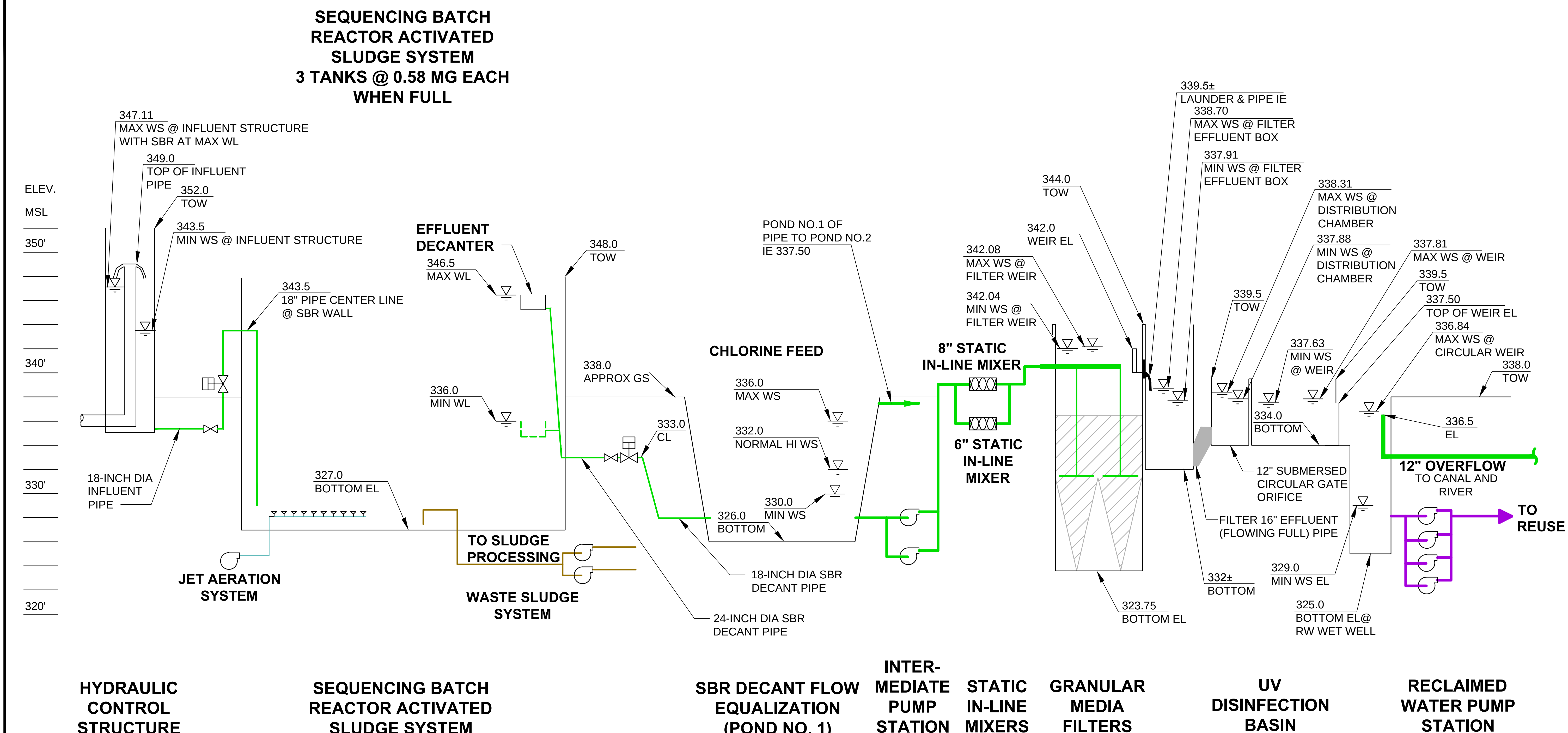
N

0 100
SCALE IN FEET

PRIMARY PROCESS AREAS

INFLUENT FACILITIES
SECONDARY TREATMENT - SBR
TERTIARY TREATMENT
DISINFECTION & DECHLORINATION
SLUDGE STORAGE, PUMPING & PROCESSING
RECLAIMED WATER PUMPING & STORAGE
SUPPORT SYSTEMS
OUTFALL
FLOW MEASUREMENT & SAMPLING

Figure ES-5
Preferred Alternative
WRF Site Plan
Sewer Facilities Plan
Yelm, Washington



ABBREVIATIONS

EL - ELEVATION		TOW - TOP OF WALL	
EX - EXISTING		WL - WATER LEVEL	
GS - GRADE SURFACE		WSE - WATER SURFACE ELEVATION	
IE - INVERT ELEVATION		▽ - WATER SURFACE LEVEL INDICATION	
OF - OVERFLOW			

INFLUENT

FLOW CONDITIONS USED AT SBR TANKS
MAX FLOW BASED ON DESIGN PEAK HOUR FLOW - 2.69 MGD
MIN FLOW BASED ON 2015 MIN HOUR FLOW - 0.01 MGD

AT FILTERS AND DISINFECTION
MAX FLOW BASED ON DESIGN MAX DAY FLOW - 1.46 MGD
MIN FLOW BASED ON 2015 AVERAGE DAY FLOW - 0.405 MGD

Parametrix DATE: June 21, 2016 FILE: PS1781033FES-6

LEGEND

- CENTRIFUGAL PUMP
- RAIL MOUNTED SUBMERSIBLE PUMP
- SUBMERSIBLE PUMP
- CHEMICAL METERING PUMP
- VERTICAL PUMP
- STATIC MIXER
- INJECTOR
- M FLOW METER
- PNEUMATIC CONTROL VALVE
- SCADA FLOW CONTROL VALVE
- ISOLATION VALVE
- THREE WAY VALVE
- FLOATING MIXER
- FINE OR COARSE BUBBLE DIFFUSER
- F/C SURFACE AERATOR
- VFD VARIABLE FREQUENCY DRIVE
- CS COMPOSITE SAMPLER
- SP SAMPLE PORT
- FIXED MIXER
- TOTE OR STORAGE TANK
- ISOLATION GATE
- EFFLUENT FLOW WEIR
- AIR
- CHEMICAL
- INFLUENT FLOW STREAM MAJOR/MINOR
- RECLAIMED WATER FLOW STREAM MAJOR/MINOR
- SOLID OR DRAINAGE

Figure ES-6
HYDRAULIC PROFILE
Sewer Facilities Plan
Yelm, Washington

2025 upgrades will include the following work elements:

- Liquid Stream:
  - General upgrades of SBR tank (miscellaneous tank work including coatings, existing decanter repairs, and structural).
  - Installing SBR process air blowers.
  - Installing SBR jet aeration system to replace tank anoxic mixers and air diffusers.
  - Completing second phase electrical improvements (focus on electrical gear upgrades for SBR related equipment).
  - Upgrading the RV Dump Station.
  - Upgrading the Intermediate Pump Station (mechanical and structural).
  - Constructing a new Chemical Feed Building located near the influent hydraulic control structure.
  - Making improvements to the existing tertiary filter with backwash upgrades.
  - Installing new tertiary filters with backwash upgrades.
  - Constructing a new Plant Drain Pump Station (Drain and Sludge Pump Station would then only serve as a dedicated Sludge Pump Station).
- Solids Stream:
  - Installing new sludge thickening and dewatering equipment.
  - Upgrade thickening and dewatering polymer make up and feed systems.
  - At this time, the Class A biosolids treatment effort will be delayed to beyond the current facility planning window.

A summary of phased project costs is provide in Table ES-5.

Table ES-5. Project Costs by Phase

Project Phase	Anticipated Project Cost (millions of dollars)
1 – Immediate Upgrades	$1.916
2 – 2020 Upgrades	$9.556
3 – 2025 Upgrades	$12.141
Grand Total Project Costs without Class A Biosolids:	**$25.530**
Grand Total Project Costs with Class A Biosolids:	**$29.812**

The proposed schedule of the recommended alternative phases is as follows:

- Immediate Upgrades:
  - Design in 2016.
  - Construction occurs in 2017.
- 2020 Upgrades:
  - Design for the 2020 upgrades is slated for 2017 to 2018.
  - Construction would occur from 2019 through 2020.
  - Upon completion of the construction, actual project costs (factoring in any grants obtained) will be evaluated and a second rate study will be conducted in 2021 to update the proposed rate structure for 2025 planned upgrades.
- 2025 Upgrades:
  - Design for the 2025 upgrades is planned from 2022 to 2023.
  - Construction would occur in 2024 through 2025.

FINANCIAL PLAN

Current Rates

The City's current rate structure consists of two rate components, a fixed monthly charge based on rate class, which is charged to all customers, and a monthly usage charge per hundred cubic feet (ccf) that is charged to nonresidential customers. Table ES-6 shows the existing rate structure.

Table ES-6. 2016 Existing Rate Structure

Monthly Rates	2016
City-Owned Electrical Meter/No Meter	
1 SF on 1 tank	$57.37
2 SF on 1 tank	$57.37
3 SF on 1 tank	$57.37
Duplex	$57.37
Triplex	$51.63
Fourplex	$45.90
Residential with 4+ units	$43.02
Nonresidential – base	$57.37
Nonresidential – usage (per ccf)	$6.37
Private Electrical Meter	
1 SF on 1 tank	$56.85
2 SF on 1 tank	$56.32
3 SF on 1 tank	$55.79
Duplex	$56.32
Triplex	$51.11
Fourplex	$45.37
Residential with 4+ units	$43.02
Nonresidential – base	$57.37
Nonresidential – usage (per ccf)	$6.37

Senior customers receive a discount and pay 75 percent of the rate for a fourplex or smaller.

Projected Rates

The analysis for implementation of the SFP preferred alternative shows a need for increases of 8.10 percent per year from 2017 through 2021 for implementation of the preferred liquid and solid stream alternatives presented in this SFP (with Class A Biosolids improvements deferred). Table ES-7 shows the proposed rates for the 6-year planning period.

Table ES-7. 6-Year Proposed Rates

Monthly Rates	2016	2017	2018	2019	2020	2021
City-Owned Electrical Meter/No Meter						
1 SF on 1 tank	$57.37	$62.02	$67.04	$72.47	$78.34	$84.69
2 SF on 1 tank	$57.37	$62.02	$67.04	$72.47	$78.34	$84.69
3 SF on 1 tank	$57.37	$62.02	$67.04	$72.47	$78.34	$84.69
Duplex	$57.37	$62.02	$67.04	$72.47	$78.34	$84.69
Triplex	$51.63	$55.81	$60.33	$65.22	$70.50	$76.21
Fourplex	$45.90	$49.62	$53.64	$57.98	$62.68	$67.75
Residential with 4+ units	$43.02	$46.50	$50.27	$54.34	$58.75	$63.50
Nonresidential – base	$57.37	$62.02	$67.04	$72.47	$78.34	$84.69
Nonresidential – usage (per ccf)	$6.37	$6.89	$7.44	$8.05	$8.70	$9.40
Private Electrical Meter						
1 SF on 1 tank	$56.85	$61.45	$66.43	$71.81	$77.63	$83.92
2 SF on 1 tank	$56.32	$60.88	$65.81	$71.14	$76.91	$83.14
3 SF on 1 tank	$55.79	$60.31	$65.19	$70.47	$76.18	$82.35
Duplex	$56.32	$60.88	$65.81	$71.14	$76.91	$83.14
Triplex	$51.11	$55.25	$59.73	$64.56	$69.79	$75.45
Fourplex	$45.37	$49.04	$53.02	$57.31	$61.95	$66.97
Residential with 4+ units	$43.02	$46.50	$50.27	$54.34	$58.75	$63.50
Nonresidential – base	$57.37	$62.02	$67.04	$72.47	$78.34	$84.69
Nonresidential – usage (per ccf)	$6.37	$6.89	$7.44	$8.05	$8.70	$9.40

Table ES-8 shows residential monthly bill comparisons for the proposed annual increases.

Table ES-8. Monthly Bill Comparisons

Residential	2016	2017	2018	2019	2020	2021
Monthly Bill	$57.37	$62.02	$67.04	$72.47	$78.34	$84.69
$ Difference		$4.65	$5.02	$5.43	$5.87	$6.35
Rate Increase		8.10%	8.10%	8.10%	8.10%	8.10%

Note: Assumes single family residential on one tank with City-owned meter

Affordability

The Department of Health and the Department of Commerce Public Works Board use an affordability index to prioritize low-cost loan awards depending on whether rates exceed 2.0 percent of the median household income for the service area. The median household income for the City of Yelm was $53,482 in 2010-2014 according to the U.S. Census Bureau. The 2015 figures are escalated based on 0.12 percent general cost inflation in 2015 followed by the 10-year average general cost inflation of 2.29 percent for years 2016-2021, to show the median household income in future years. Table ES-9 presents the City's rates with the projected rate increases for the forecast period, tested against the 2.0 percent monthly affordability threshold.

Table ES-9. Affordability Test

Year	Inflation	Median Household Income	2% Monthly Threshold	Projected Monthly Bill	% of Median HH Income
2014	–	$53,482	$89.14	–	–
2015	0.12%	$53,546	$89.24	–	–
2016	2.29%	$54,772	$91.29	$57.37	1.26%
2017	2.29%	$56,027	$93.38	$62.02	1.33%
2018	2.29%	$57,310	$95.52	$67.04	1.40%
2019	2.29%	$58,622	$97.70	$72.47	1.48%
2020	2.29%	$59,965	$99.94	$78.34	1.57%
2021	2.29%	$61,338	$102.23	$84.69	1.66%

Applying the 2.0 percent test, the City's rates are forecasted to remain within the indicated affordability range through 2021.

Conclusion

The results of this analysis indicate that rate increases are necessary to support future debt service to fund the capital program while aiming to meet target balances in the operating and capital funds. Implementation of the proposed rate increases should provide for continued financial viability while maintaining generally affordable rates.

The City has chosen not to update their system development charge at this time. All SDC revenue has been forecast at the current SDC rate. It may be worthwhile to review this charge in the future to assure it is representative of the existing and future sewer system costs.

It is important to remember that the analysis performed in this SFP assumes a growth rate of 1.80 percent based on the City's recent experience. If the future growth rates change, the proposed annual rate increases may need to be updated and revised.

The analysis presented in this SFP also assumes a total of $4.0 million in grant funding for capital projects in 2020 and 2024. It is important to recognize that if these grants do not come to fruition, the City will likely be required to issue more debt to fund the capital program and rate increases will need to be revised or capital projects may need to be delayed.

It is recommended that the City regularly review and update the key underlying assumptions that compose the multi-year financial plan to ensure that adequate revenues are collected to meet the City's total financial obligations.

PUBLIC INVOLVEMENT

The City of Yelm Sewer Facilities Plan contents and analyses were formally presented to the City Council at the initial stage of development and later following detailed analysis. The City Council presentations were open to the public. The dates and topics for City Council meetings were:

- Meeting (Wednesday, July 29, 2015) – Facility Plan Condition Assessment Presentation.
- Meeting (Wednesday, February 24, 2016) – Sewer Facilities Plan Alternatives Analysis and Recommended Alternative.

The date, time, location, and purpose of City Council and public meetings were advertised on the City's website and at the City Hall Reader Board. Agendas for the meetings were also posted on the City website.

In addition to the City Council meetings, an overview of the contents and results of the Sewer Facilities Plan will be presented to the Yelm Planning Commission once the plan has been approved by the Department of Ecology.

The City has provided copies of the Sewer Facilities Plan to the following agencies concurrently with Ecology:

- Department of Health.
- Nisqually Indian Tribe.
- Thurston County.

The Sewer Facilities Plan will be posted on the City website for review by the public and other interested stakeholders.