6. LIQUID STREAM TREATMENT ALTERNATIVES EVALUATION

6.1 INTRODUCTION

This chapter summarizes the alternatives to enhance liquid stream treatment processes at the WRF in order to:

- Allow the WRF to better comply with mandated Ecology reclaimed water permit reliability and nitrogen removal requirements.
- Address key issues and challenges identified in the WRF condition assessment.
- Accommodate future influent flows and loads.

The sizing of the alternatives identified below are based on the flows and loads information provided in Chapter 3, Table 3-4.

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.

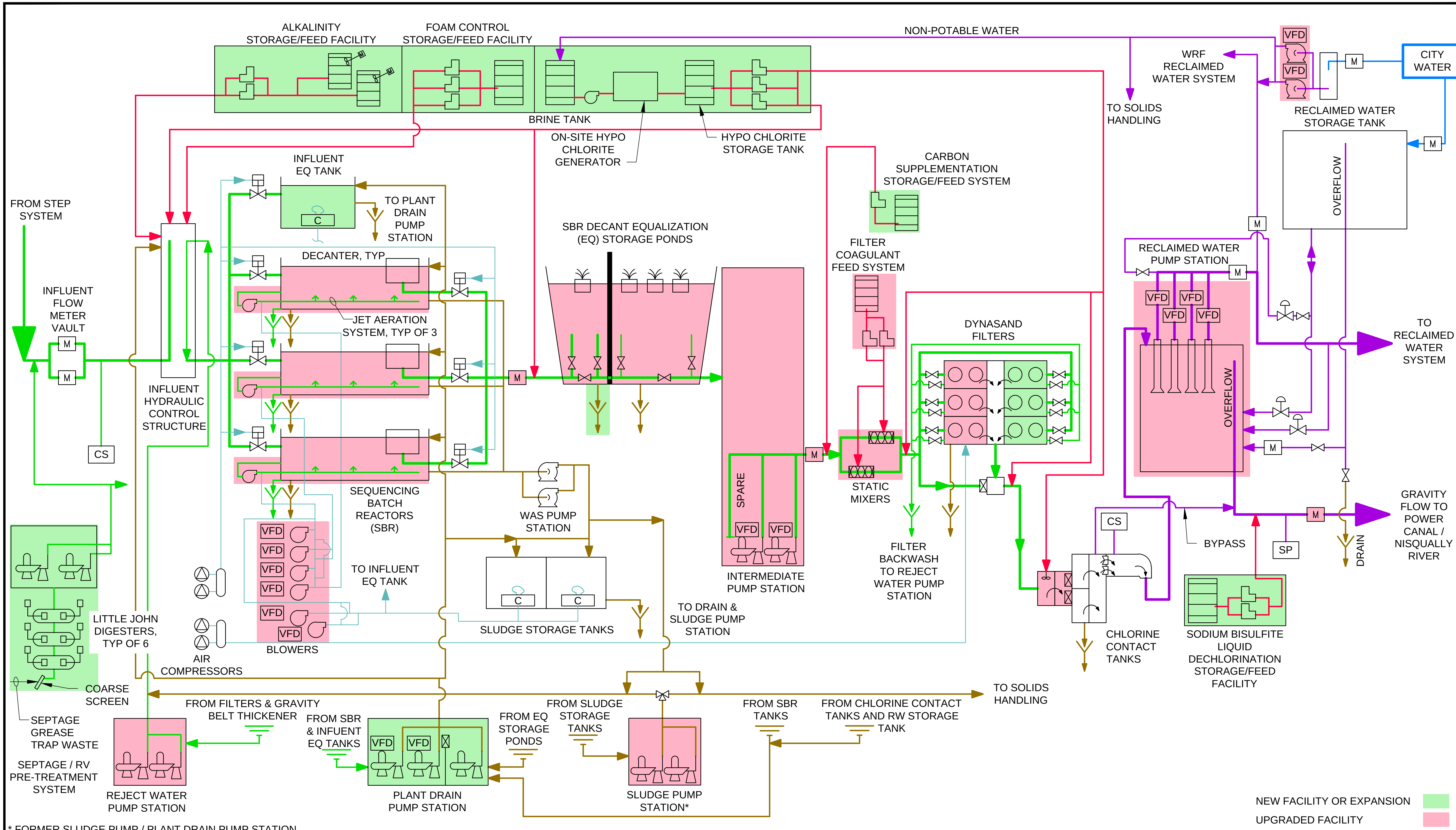
Parametrix and the City conducted a successful pilot study to confirm this mode of operation could be employed at the WRF. The study report is included in Appendix F.

- 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.
  - Meet Ecology Orange Book design guidelines for equipment redundancy (e.g., Process Air Blowers).
  - 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.

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.*

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. Process Flow Diagrams and Conceptual Site Plans for each alternative are presented in Figure 6-1 through Figure 6-10.



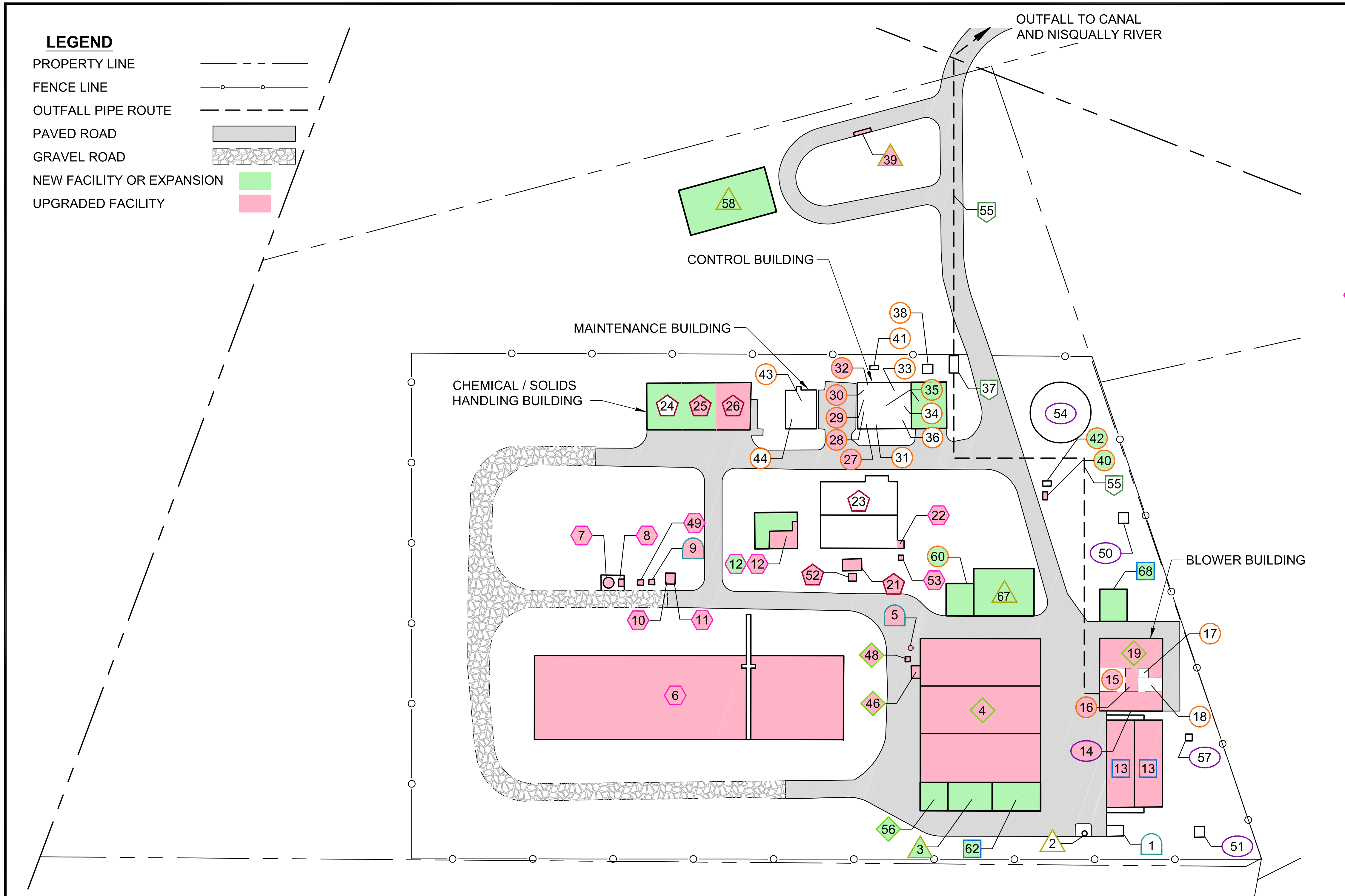
Parametrix DATE: June 21, 2016 FILE: PS1781033F6-1

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 6-1
Liquid Stream Alternative 1 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 CHLORINE CONTACT TANKS
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 TRUCK LOADING BAY
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 CHLORINE STORAGE/FEED FACILITY
67 INFLUENT EQUALIZATION TANK
68 LIQUID DECHLORINATION STORAGE/FEED FACILITY

Parametrix DATE: May 12, 2016 FILE: PS1781033F6-2

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

N

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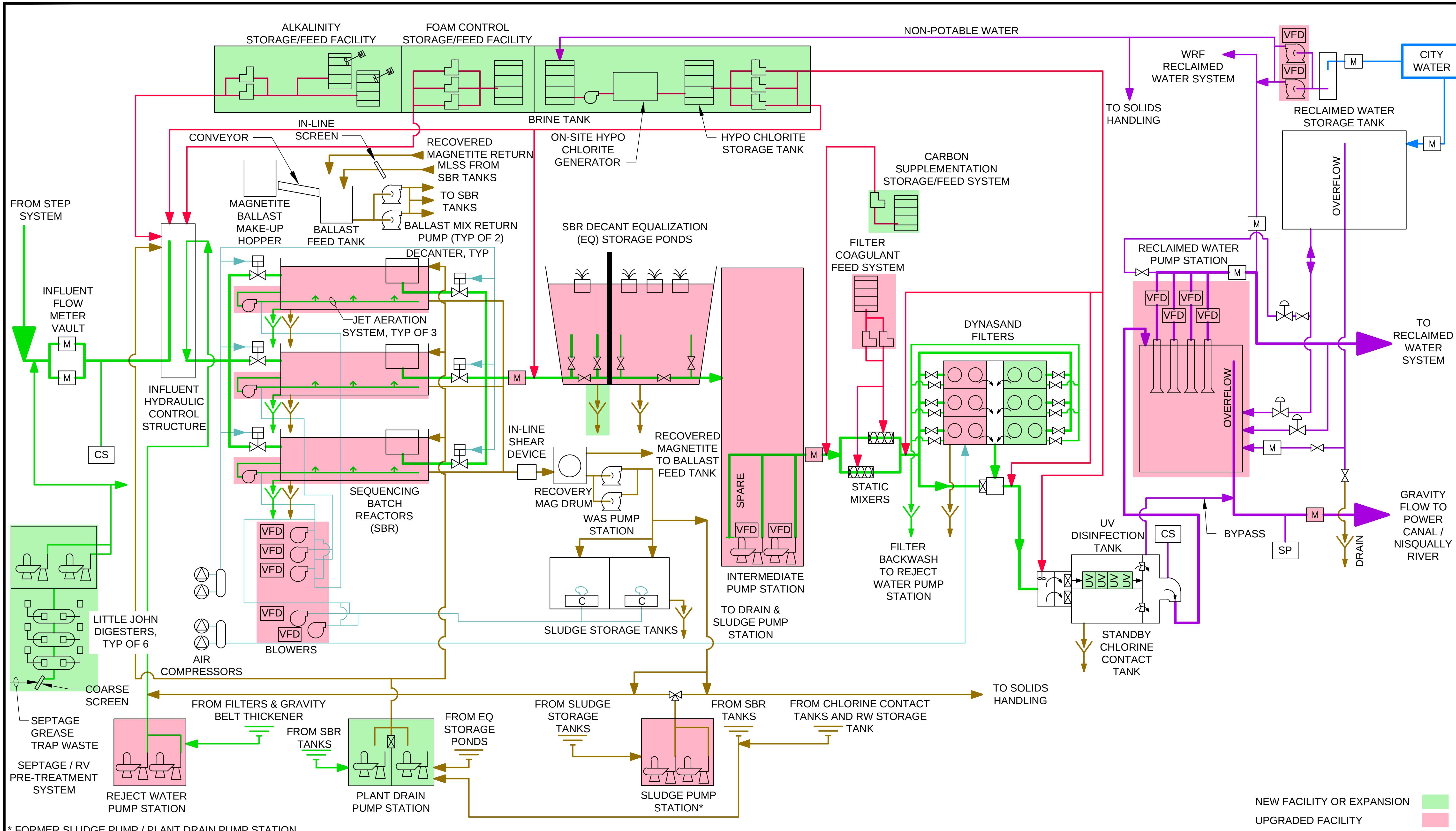
SCALE IN FEET

Figure 6-2
Liquid Stream Alternative 1
WRF Site Plan
Sewer Facilities Plan
Yelm, Washington

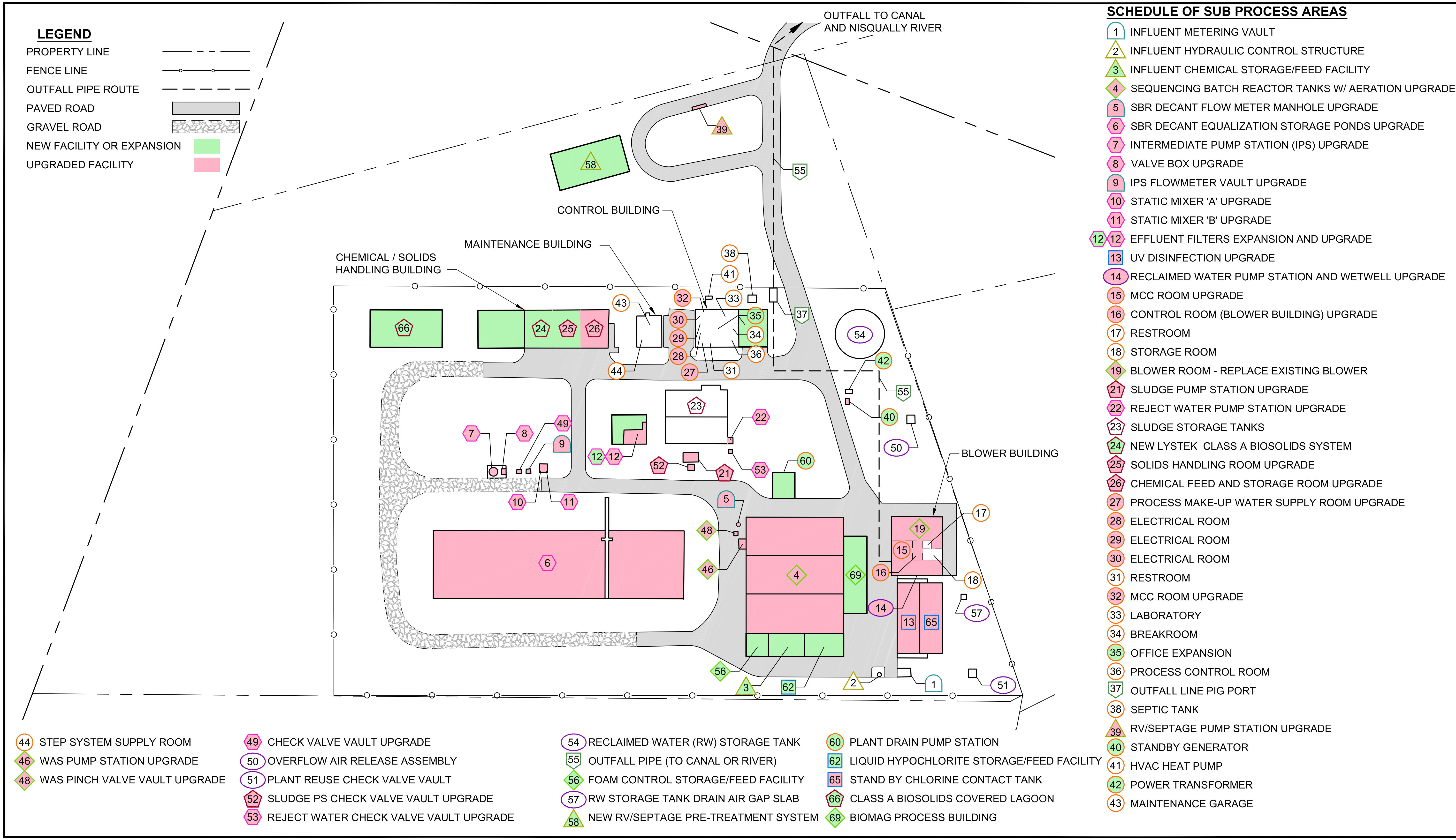


Parametrix DATE: June 21, 2016 FILE: PS1781033F6-3

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 6-3
Liquid Stream Alternative 2 Option A Process Schematic
Sewer Facilities Plan
Yelm, Washington



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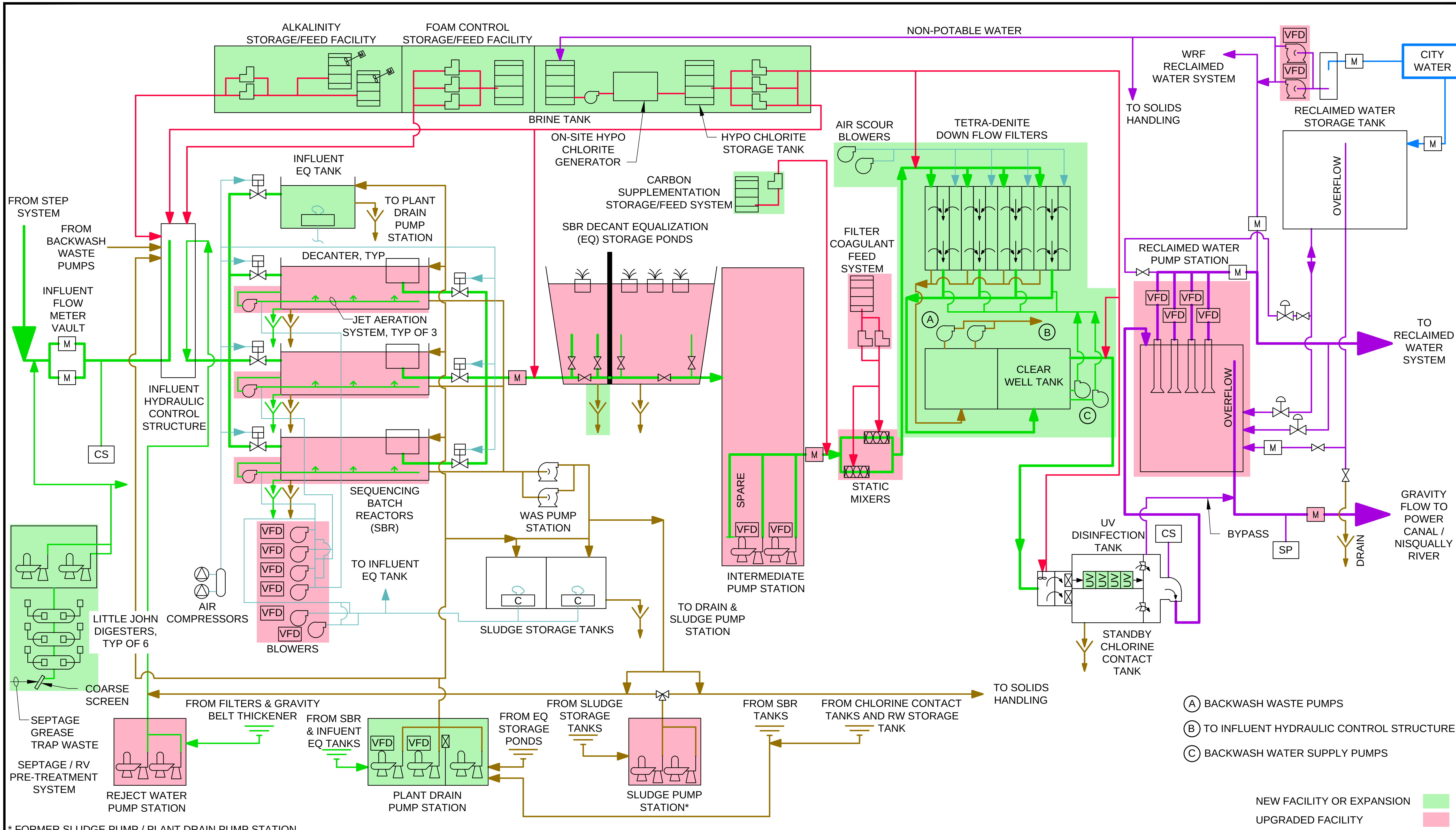
SCALE IN FEET

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 6-4
Liquid Stream Alternative 2 Option A
WRF Site Plan
Sewer Facilities Plan
Yelm, Washington

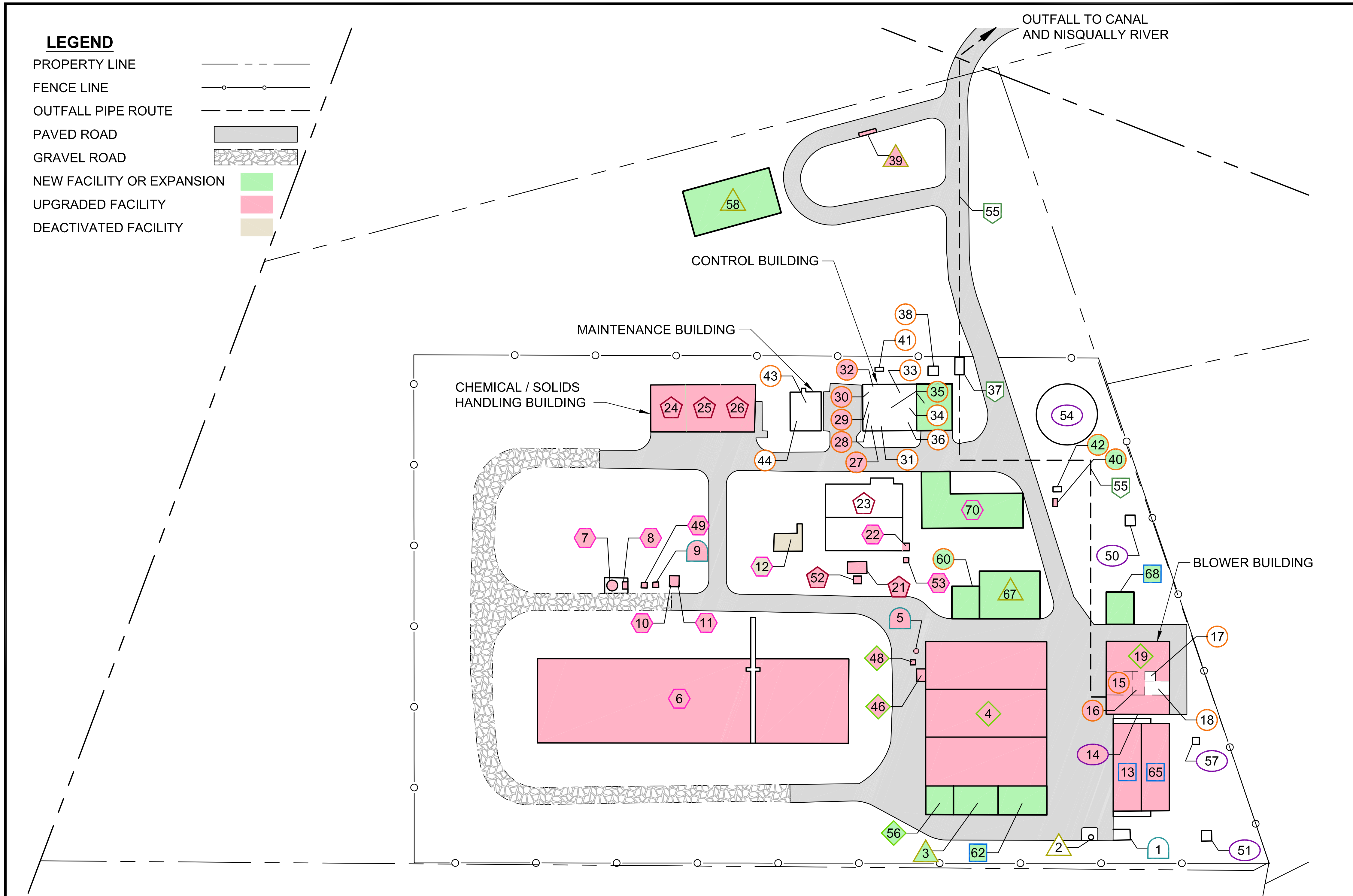


Parametrix DATE: June 21, 2016 FILE: PS1781033F6-5

LEGEND

CENTRIFUGAL PUMP	VERTICAL PUMP	PNEUMATIC CONTROL VALVE	FLOATING MIXER	CS COMPOSITE SAMPLER	ISOLATION GATE	INFLUENT FLOW STREAM MAJOR/MINOR	
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	RECLAIMED WATER FLOW STREAM MAJOR/MINOR	
POSITIVE DISPLACEMENT PUMP	M FLOW METER	THREE WAY VALVE	VFD VARIABLE FREQUENCY DRIVE	TOTE OR STORAGE TANK	CHEMICAL	SOLID OR DRAINAGE	

Figure 6-5
Liquid Stream Alternative 2 Option B 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 EFFLUENT FILTERS - DEACTIVATED
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 STORAGE STATION UPGRADE
22 REJECT WATER PUMP STATION UPGRADE
23 SLUDGE STORAGE TANKS
24 TRUCK LOADING BAY
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 CHLORINE STORAGE/FEED FACILITY
65 STAND BY CHLORINE CONTACT TANK
67 INFLUENT EQUALIZATION TANK
70 EFFLUENT FILTER FACILITY

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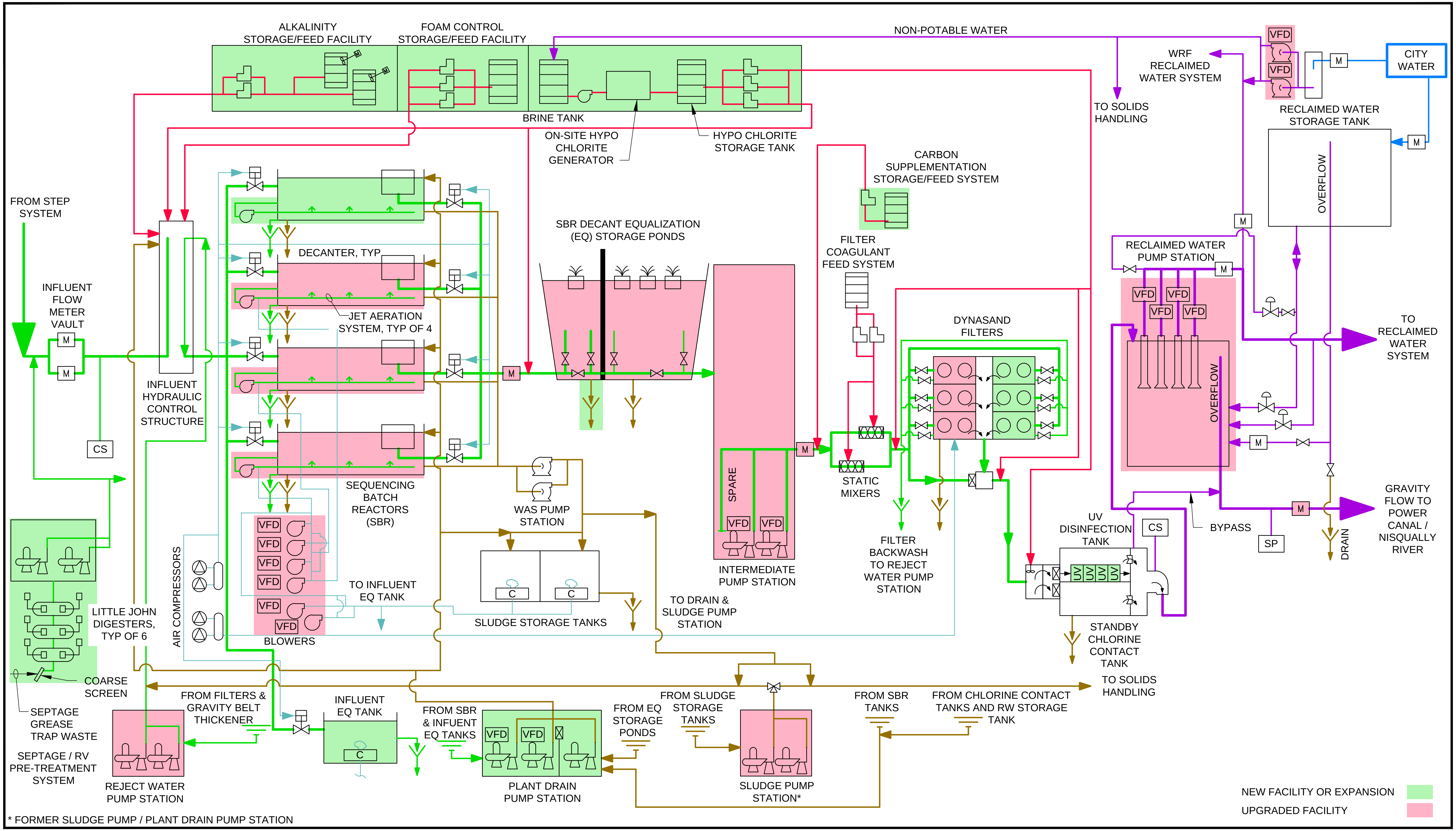
N

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 6-6
Liquid Stream Alternative 2 Option B
WRF Site Plan
Sewer Facilities Plan
Yelm, Washington



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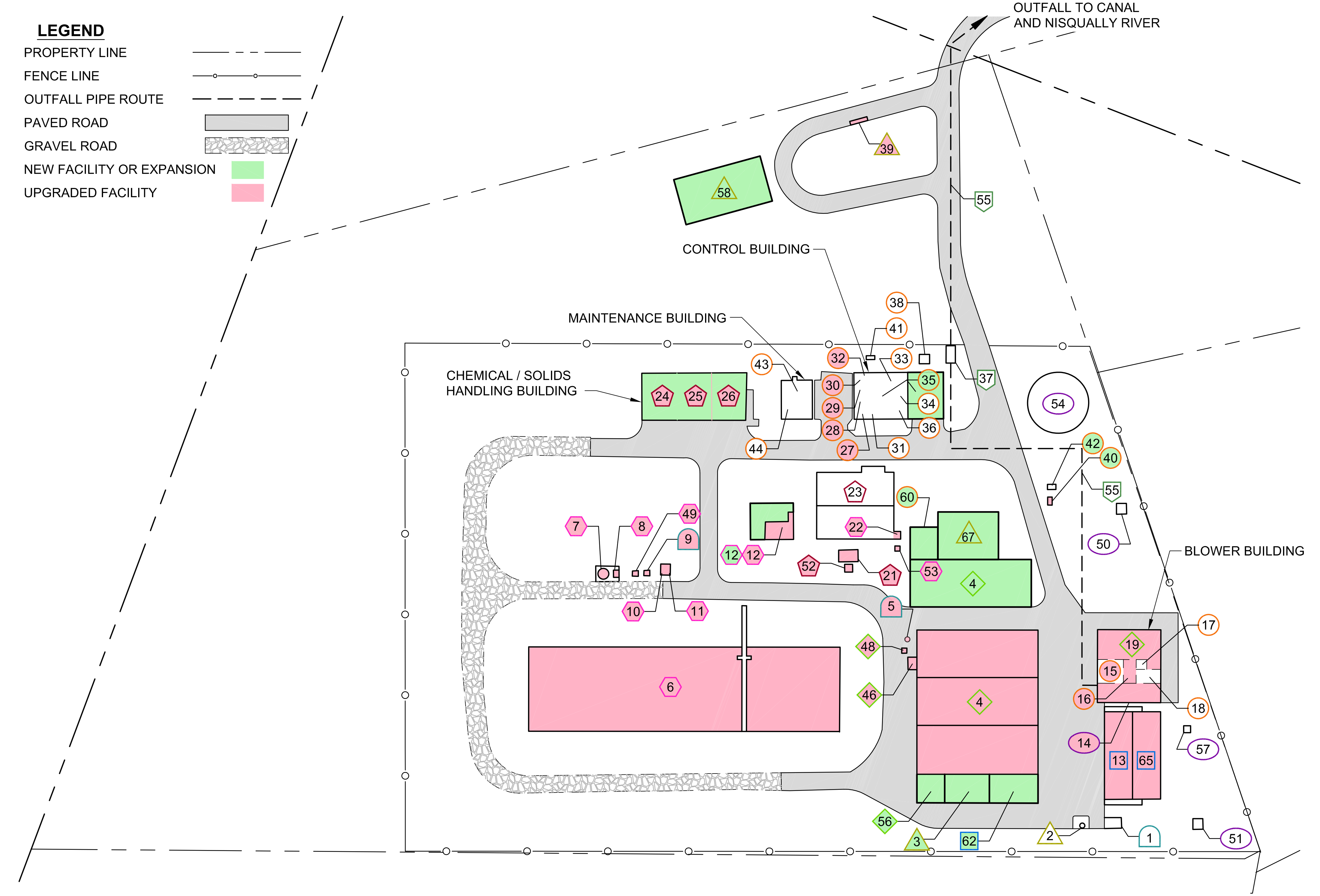
LEGEND

CENTRIFUGAL PUMP	VERTICAL PUMP	PNEUMATIC CONTROL VALVE	FLOATING MIXER	CS COMPOSITE SAMPLER	ISOLATION GATE	INFLUENT FLOW STREAM MAJOR/MINOR
RAIL MOUNTED SUBMERSIBLE PUMP	STATIC MIXER	SCADA FLOW CONTROL VALVE	F/C FINE OR COARSE BUBBLE DIFFUSER	SP SAMPLE PORT	EFFLUENT FLOW WEIR	RECLAIMED WATER FLOW STREAM MAJOR/MINOR
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	SOLID OR DRAINAGE

Figure 6-7
Liquid Stream Alternative 2 Option C Process Schematic
Sewer Facilities Plan
Yelm, Washington



LEGEND

- PROPERTY LINE
- FENCE LINE
- OUTFALL PIPE ROUTE
- PAVED ROAD
- GRAVEL ROAD
- NEW FACILITY OR EXPANSION
- UPGRADED FACILITY

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 EFFLUENT FILTERS EXPANSION AND UPGRADE
13 CHLORINE CONTACT TANKS
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 TRUCK LOADING BAY
25 SOLIDS HANDLING ROOM UPGRADE
26 CHEMICAL FEED AND STORAGE ROOM UPGRADE
27 PROCESS MAKE-UP WATER SUPPLY ROOM UPGRADE
28 STORAGE ROOM
29 STORAGE ROOM
30 STORAGE 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 CHLORINE STORAGE/FEED FACILITY
65 STAND BY CHLORINE CONTACT TANK
67 INFLUENT EQUALIZATION TANK

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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 6-8
Liquid Stream Alternative 2 Option C
WRF Site Plan
Sewer Facilities Plan
Yelm, Washington

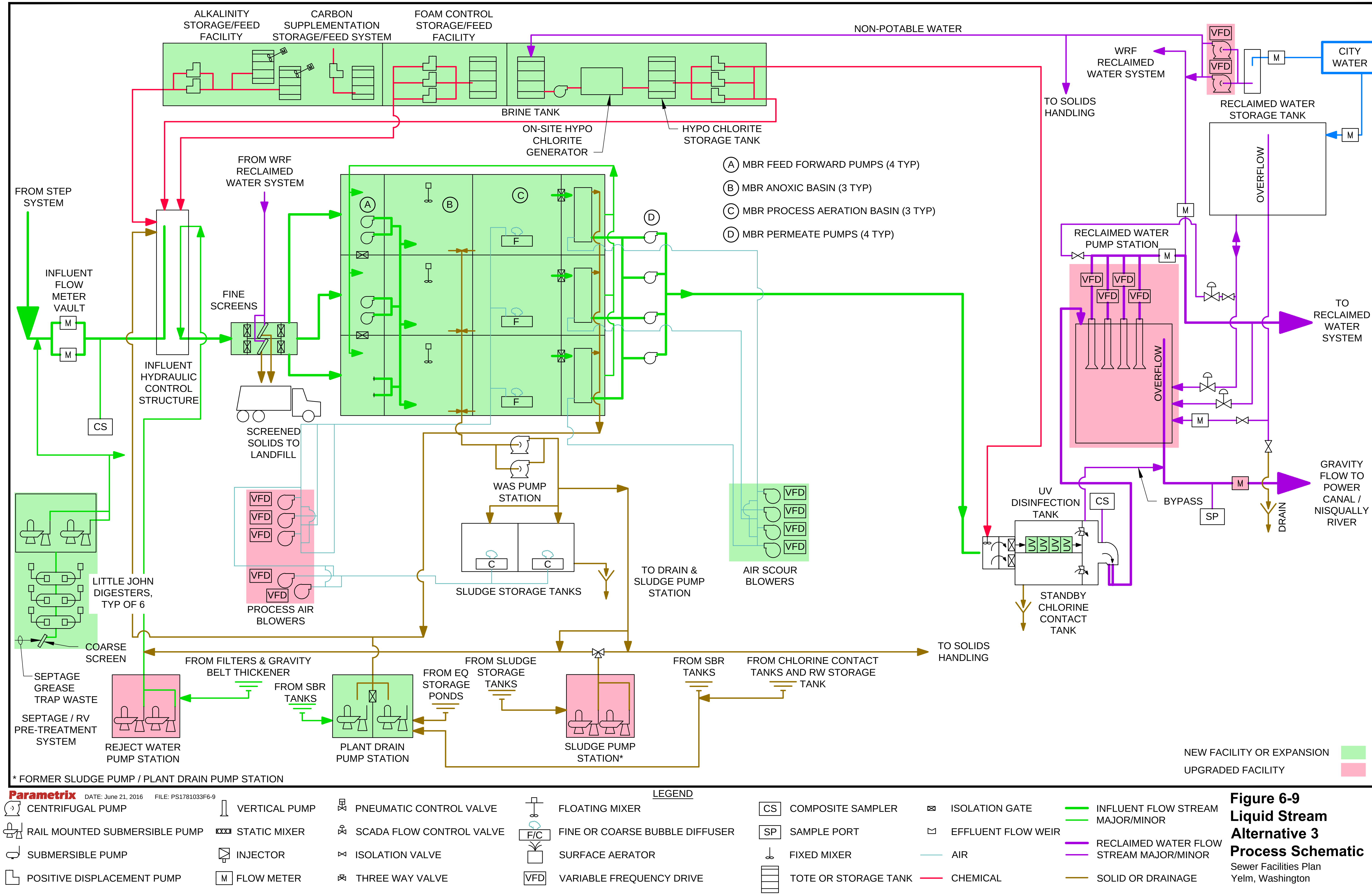
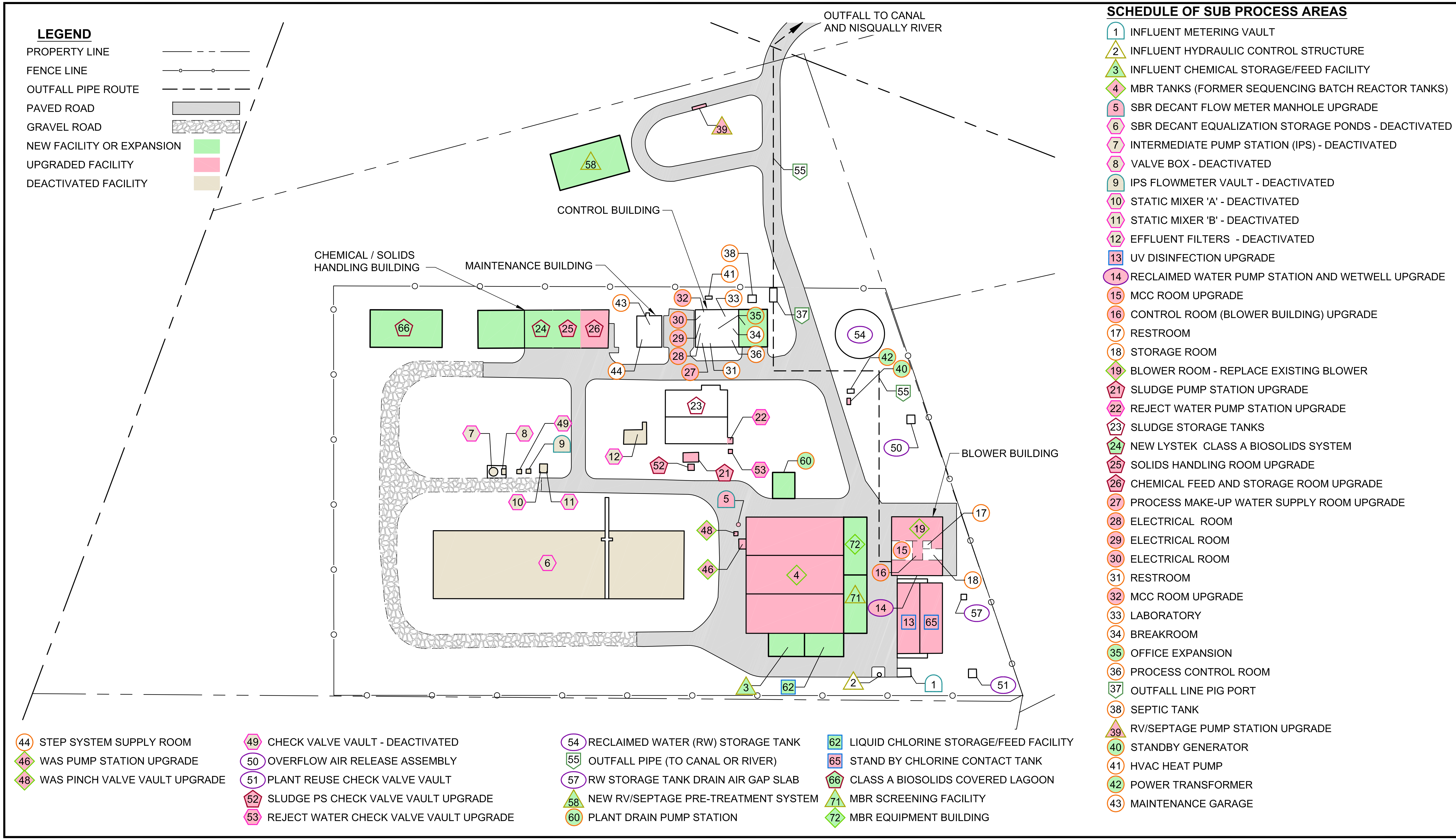


Figure 6-9
Liquid Stream Alternative 3 Process Schematic
Sewer Facilities Plan
Yelm, Washington



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N
0 100
SCALE IN FEET

PRIMARY PROCESS AREAS

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

Figure 6-10
Liquid Stream Alternative 3
WRF Site Plan
Sewer Facilities Plan
Yelm, Washington

6.2 ALTERNATIVES WORK ELEMENT DESCRIPTIONS

Work elements that pertain to all or some of the above WRF liquid stream improvement alternatives are outlined for each alternative in Table 6-1, on page 6-25, and described in more detail in the following sections:

Section 6.2.1	New Influent Equalization Tank
Section 6.2.2	New Influent Chemical Feed Building
Section 6.2.3	Existing Control Building Expansion
Section 6.2.4	RV Dump Station Upgrades
Section 6.2.5	Existing Sequencing Batch Reactor Tanks General Rehabilitation
Section 6.2.6	Existing Secondary Treatment Process Air Blower Replacement
Section 6.2.7	SBR Tank Aeration Systems Replacement
Section 6.2.8	Conversion From SBR Using Gravity Settling to SBR Using Ballasted Settling
Section 6.2.9	Conversion of Existing SBR Process to MBR Process
Section 6.2.10	Construct One Additional SBR Tank to Match Existing Tanks
Section 6.2.11	Existing Tertiary Filter Upgrades and Expansion
Section 6.2.12	Replace Existing Filters with New Alternative Technology Denitrification Filters
Section 6.2.13	Convert from Gas-Based Disinfection and Dechlorination to Liquid-Based Systems
Section 6.2.14	New UV Disinfection System with New Liquid Hypochlorite-Based Residual Maintenance System (Convert from Gas-Based Disinfection and Dechlorination to UV Light Disinfection. Provide small liquid-based chlorination system for general plant uses, e.g., reclaimed water chlorination, pre-chlorination of influent)
Section 6.2.15	Refurbish or Replace All Existing In-Plant Pump Stations
Section 6.2.16	Refurbish or Replace Selected In-Plant Pump Stations (Plant Drain/Sludge Pump Station Only)
Section 6.2.17	Replace Existing Reclaimed Water Pump Station
Section 6.2.18	Outfall Rehabilitation
Section 6.2.19	Electrical and Controls – Existing Systems Upgrades and New Systems Expansion

6.2.1 New Influent Equalization Tank

For this work element, a new influent equalization tank would be integrated into Liquid Stream Alternatives 1, 2B, and 2C. The tank would be built adjacent to and share a common wall with the existing SBR tankage and be connected into the existing stub-out located on the influent piping. This pipe stub-out was provided to serve for a future SBR.

The alternative process flow diagrams reflect the new piping and layout arrangement for the proposed equalization tank. Stored equalization flows would be metered back into operating SBRs during overnight low-flow periods.

A significant advantage of the Equalization Tank is that pre-aeration of a portion of the influent flows could be accomplished to help reduce sulfide levels and reduce wastewater septicity.

The proposed equalization tank size is approximately half the size of an existing SBR tank, with an approximate liquid holding capacity of 250,000 gallons and the tank would not be covered.

The equalization tank pumping system would be integrated with the new Plant Drain Pump Station.

The influent equalization tank was not included in Alternative 2A or Alternative 3 because the ballasted sedimentation and MBR treatment systems used in these alternatives are less sensitive to flow fluctuations and septicity when compared to the gravity-settling-based SBR systems employed for Alternatives 1, 2B, and 2C.

6.2.2 New Influent Chemical Feed Building

This building would contain the following rooms to house bulk storage tanks and feed equipment for the following chemicals that would be continuously or periodically fed into the WRF raw influent:

- Magnesium Hydroxide – To control pH of the raw influent in order to maintain pH for optimum biological activity in the secondary treatment process (MBR or SBR).
- Chemical Coagulant – A polymer chemical would be used as a filter aid for the MBR process, while aluminum chlorohydrate coagulant would be used as a sludge settling aid and foam control chemical for the SBR process.
- Optional Chemical or Additive – An additional room would be provided to allow the placement of another chemical tote and feed equipment as needed for feed into influent. Other chemicals or additives could include supplemental carbon and bioaugmentation materials.

This work element would be incorporated into all liquid stream treatment alternatives.

6.2.3 Existing Control Building Expansion

The existing Control Building would be modified to convert the old Chlorine Disinfection Rooms and Gas Dechlorination Rooms into storage areas. In addition, the Control Building would be expanded to allow for a dedicated conference/meeting room separate from kitchen facilities and individual operator office rooms. A 1,000-square-foot expansion of the Control Building would occur as part of this work item.

This work element would be incorporated into all liquid stream treatment alternatives.

Table 6-1. Liquid Stream Alternatives Work Elements Matrix

			Alternative Work Elements – See corresponding section number in Chapter 6 for full descriptions of each Work Element																		
Alternative Number and Description		Alternative Options	6.2.1 New Influent Equalization Tank	6.2.2 New Influent Chemical Feed Building	6.2.3 Existing Control Building Expansion	6.2.4 RV Dump Station Upgrades	6.2.5 Existing Sequencing Batch Reactor Tanks General Rehabilitation	6.2.6 Existing Secondary Treatment Process Air Blower Replacement	6.2.7 SBR Tank Aeration Systems Replacement	6.2.8 Conversion From SBR Using Gravity Settling to SBR Using Ballasted Settling	6.2.9 Conversion of Existing SBR Process to MBR Process	6.2.10 Construct One Additional SBR Tank to Match Existing Tanks	6.2.11 Existing Tertiary Filter Upgrades and Expansion	6.2.12 Replace Existing Filters with New Alternative Technology Denitrification Filters	6.2.13 Convert from Gas-Based Disinfection and Dechlorination to Liquid-Based Systems	6.2.14 New UV Disinfection System with New Liquid Hypochlorite-Based Residual Maintenance System	6.2.15 Refurbish or Replace All Existing In-Plant Pump Stations	6.2.16 Refurbish or Replace Selected In-Plant Pump Stations (Plant Drain/Sludge Pump Station Only)	6.2.17 Replace Existing Reclaimed Water Pump Station	6.2.18 Outfall Rehabilitation	6.2.19 Electrical and Controls – Existing Systems Upgrades and New Systems Expansion
1	Optimization of Existing Facilities with Minor Enhancements and Upgrades	Not Applicable	X	X	X	X	X	X	X	–	–	–	X	–	X	–	X	–	X	X	X
2	Optimization of Existing Facilities with Major Enhancements and Upgrades	A	–	X	X	X	X	X	X	X	–	–	X	–	–	X	X	–	X	X	X
		B	X	X	X	X	X	X	X	–	–	–	X	X	–	X	X	–	X	X	X
		C	X	X	X	X	X	X	X	–	–	X	X	–	–	X	X	–	–	X	X
3	Complete Process Renovation – MBR	Not Applicable	–	X	X	X	X	X	–	–	X	–	–	–	–	X	–	X	X	X	X

6.2.4 RV Dump Station Upgrades

The RV Dump Station is currently shut down due to previous operational issues with regards to the sludge feeding of RV waste without pre-treatment into the secondary treatment process. Under this work element, the RV Dump Station would be upgraded to provide a basic pre-treatment and flow equalizations system. The RV Dump Station would become capable of handling commercial/residential septic tanker dumps, as well RV waste dumps. Main upgrade components include:

- Mechanical screening system to remove inert materials. Provide a screenings washing and dewatering system to process waste inert materials collected.
- Three below-grade, 10,000-gallon fiber reinforced fiberglass tanks to hold RV, restaurant grease tank, and septic tank wastes.
- Ozonation/aeration pre-treatment system to break down toxic waste components within the storage tanks into biologically degradable waste components within the below-grade holding tanks.
- Pre-treatment System Discharge Pump Station. Processed septage would be metered at a controlled flow either into the secondary treatment system or into the solids handling system.

A renovated RV Dump Station would allow the City of Yelm to utilize a potentially low-cost carbon source to enhance denitrification at the WRF secondary treatment process. This carbon source is in the form of City septic tank sludge that is currently not reaching the WRF. Septic haulers currently remove sludge solids from the City's collection system septic tanks and convey it to sludge processors located outside of city limits.

This work element would be incorporated into all liquid stream treatment alternatives.

6.2.5 Existing Sequencing Batch Reactor Tanks General Rehabilitation

The following would be completed as part of this work element:

- Addition of handrails to improve all around access into the SBR tanks.
- Rehabilitation of existing handrail.
- Improved fall protection for existing tank access ladders.
- Rehabilitation and re-coating of existing electrical conduits and junction boxes.
- Reclaimed water piping valve replacement and piping replacement in the tank areas.
- General patching and repair of tank walkways, walls, and floor concrete.
- Regrouting of tank bottoms to facilitate drainage during cleaning.

This work element would be incorporated into all liquid stream treatment alternatives.

6.2.6 Existing Secondary Treatment Process Air Blower Replacement

An aeration system is a highly critical system in maintaining the biology of the WRF secondary treatment process. The existing process blowers are now approaching 15 years of continuous operating duty, maybe oversized for current service, and are in need of planned replacement. Key items for this work element include:

- Newer direct-driver, energy efficient hybrid positive displacement blowers which are able to better handle SBR water level and load fluctuations effectively.
- Total of four new process blowers would be installed to facilitate redundancy.

- Replacement as needed of electrical gear such as VFDs.
- Additional interconnecting air piping and isolation valves to allow any blower to provide air to any operating SBR.

This work element would be incorporated into all liquid stream treatment alternatives.

6.2.7 SBR Tank Aeration Systems Replacement

This work involves completely replacing the existing PVC fine bubble diffuser membrane holder system, fine bubble diffuser EPDM-based membranes, and associated supports in each existing SBR tank with a jet aeration system.

Key items for the work element include:

- A fiberglass jet aeration header would be mounted onto the floor of each existing SBR tank.
- Installation of new jet-motive, dry-pit centrifugal pumps at grade to facilitate ease of maintenance.
- Piping connections to SBR process air blowers and the new jet-motive pumps from the fiberglass jet aeration headers.

Providing a jet-aeration-based system would remove the periodic need to replace fine bubble membrane diffusers or the need to conduct PVC diffuser header repairs. Air to the new jet aeration system would be supplied by the new energy efficient blowers described in the Section 6.2.6 work element. In addition, the existing floating mixers in each SBR would no longer be required, further simplifying operation and maintenance requirements.

This work element would only be incorporated into Alternatives 1, 2A, 2B, and 2C.

6.2.8 Conversion From SBR Using Gravity Settling to SBR Using Ballasted Settling

As part of this work element, the sequencing batch reactor secondary treatment system would remain in operation. The main change for the SBR process would be that the gravity settling step would be converted to a ballasted settling step. A ballast settling material, magnetite, would be blended in with the WRF mixed liquor to ballast or help weigh down existing mixed liquor sludge flocs. This would allow the sludge flocs to settle in a much more rapid time frame than the currently provided gravity settling process. The ballasted sedimentation process has been demonstrated to help combat sludge settleability problems brought about by filament formation, zoolgeal formation, pin flocs, and straggler floc formation.

In addition, higher concentrations of mixed liquor would be allowed over a conventional gravity-settling-based SBR operation. Providing higher mixed liquor concentrations would allow for the existing SBR tankage to: 1) effectively process current and future Sewer Facilities Plan flows and loads with only two of the three SBR tanks in service, and 2) to provide enhanced nitrification operation during cold weather operating conditions.

The ballasted sedimentation process has already been applied to eleven WWTPs along the U.S. East Coast and specifically for two SBR-based plants of similar operating flows to the Yelm WRF. The oldest ballasted sedimentation process has been operating since 2009.

In addition, the benefits of the ballasted sedimentation process could be accomplished before full-scale facilities are constructed. This is because ballasted sedimentation system manufacturers have portable equipment trailers that could be brought on-site to provide temporary operation while full-scale facilities are being constructed. Operating with temporary ballasted sedimentation would allow for pilot testing of the process in full-scale and potentially provide immediate benefits in providing better settling sludge and more reliable nitrogen removal during winter conditions.

Key components of this work element include:

- New building which contains a magnetite shear mill separator and waste sludge in-line screen to remove inert materials to prevent fouling of the shear mill. Also contains a storage bin for makeup magnetite located adjacent to the new building.
- Purchase of bulk magnetite to incorporate into the existing SBR-activated sludge.
- Temporary magnetite equipment trailer that could be rented during piloting and construction of permanent magnetite facilities.
- New foam control system which would incorporate surface wasting.

This work element would only be incorporated into Alternative 2A.

6.2.9 Conversion of Existing SBR Process to MBR Process

In this work item, the SBR secondary treatment process would be converted to the MBR process. To prevent membrane damage and fouling from debris, the WRF influent flow would then require fine screening. Also, the MBR process would use continuous and recirculating flows rather than flow batching to accomplish treatment, requiring new pumping systems. This work element includes the following:

- A major modification of the influent hydraulic control structure and associated influent piping system to allow flow transition into the following fine screen system.
- The addition of a covered, influent fine screening facility to screen influent before it enters the MBR process tankage.
- Converting two of the existing three SBR tanks into MBR continuous flow process trains. Each MBR train would process 50 percent of the Sewer Facilities Plan design flows and loads. The third process tank would be converted to an influent equalization storage tank.
- Construction of a new MBR Process Building to house internal recycle and permeate pump systems.
- Installation of a gantry crane system at the existing SBR tankage to provide a membrane module and equipment removal system to allow ease of maintenance.

This work element would only be incorporated into Alternative 3.

6.2.10 Construct One Additional SBR Tank to Match Existing Tanks

For this work element, a fourth SBR tank would be constructed to match the existing tanks. The existing piping system would be utilized to connect influent and effluent piping to the new tank. The new tank would not share a common wall with the existing three tanks in order to preserve an existing buried piping corridor. Construction of the fourth tank would allow the facility to effectively process future flows with all four SBR tanks in service.

This work element would only be incorporated into Alternative 2C.

6.2.11 Existing Tertiary Filter Upgrades and Expansion

Under this work element, the existing filters would be provided with the following upgrades:

- Backwashing system equipment and instrumentation upgrades to reduce backwash water requirements.
- Additional instrumentation to monitor filter carbon supplementation.
- Installation of permanent carbon supplementation feed and storage equipment in the existing Solids Handling Building. Information on successful pilot denitrification filter testing is provided in Appendix F.
- Filter media and internals replacement.
- Existing coagulant feed pumps, pump controls, and piping in the existing Chemical Feed Building would be upgraded.
- Backwash water would be obtained from existing reclaimed water storage tank.
- Expansion or replacement of existing static mixer vault to allow installation of additional fittings and facilitate easier removal of static mixers for maintenance.

The expansion would involve adding three more additional filter cells and would provide a total of six filter cells that would be available to process flows discharged from the SBRs. The new filters would also be fitted with the same internal filter, instrumentation, and backwashing improvements provided for the existing units.

This work element would be incorporated into all alternatives except Alternative 3.

6.2.12 Replace Existing Filters with New Alternative Technology Denitrification Filters

For this work element, the existing filters would be completely replaced with alternative technology that employs deep bed down flow sand filters and is marketed as the brand name Tetra-Denite by Severn Trent Services. Such filters typically employ deeper sand beds than the existing WRF continuous backwash upflow filters, as well as possess Title 22 certification for simultaneous denitrification and contact filtration. This denitrification filtration process has become an established treatment process for wastewater treatment facilities across the U.S. with over 400 Tetra-Denite filter cells now currently in operation. New filter elements to be constructed near the existing chlorine contact basin include:

- Reinforced concrete deep bed sand filter cells with mud well.
- Filter equipment including carbon supplementation storage tank, carbon feed pumps, backwash pumps, air scour blowers, and controls, housed in a small building adjacent to the new filter cells.

The new filter system would be constructed closer to the existing chlorine contact basins to eliminate the long, stagnant gravity flow situation that currently occurs from the existing filter discharge channel into the chlorine contact basins.

This work element would only be incorporated into Alternative 2B.

6.2.13 Convert from Gas-Based Disinfection and Dechlorination to Liquid-Based Systems

For this work element, the liquid hypochlorite (on-site generated or commercially produced 12.5-percent hypochlorite solution) would replace chlorine gas for disinfection and general oxidation uses. Liquid, commercially produced liquid 38 percent sodium bisulfite solution, would replace sulfur dioxide gas as the dechlorinating agent. These liquid-based systems would be sized per Orange Book design guidelines which include:

- An 8-mg/L maximum chlorine dose for activated sludge effluent at the maximum day design flow of 1.46 mgd, along with a miscellaneous 5-mg/L dose requirement at the maximum day design flow for other plant oxidation uses (influent conditioning, biological filament control). This equates to a system being able to provide up to approximately 160 lb/d (160 gallons per day of 12.5 percent hypochlorite or approximately 2,300 gallons of on-site generated 0.8 percent hypochlorite solution of chlorine) for disinfection purposes. Note that one pound of chlorine gas is equivalent to 1 gallon of 12.5 percent commercially-produced hypochlorite solution or 15 gallons of 0.8 percent on-site generated hypochlorite solution.
- Based on a maximum 8-mg/L chlorine residual in a liquid chlorine disinfected effluent and a maximum daily river discharge of 1.46 mgd, the liquid sodium bisulfide dechlorination system would be sized to provide 320 lb/d or 150 gpd of solution (bisulfite feed rate assumes 2.17 lb of sulfur dioxide equivalent per gallon of 38-percent bisulfite solution, solution specific gravity of 1.3, and 1 pound of sulfur dioxide is required to dechlorinate 1 pound of chlorine residual).

The liquid hypochlorite chlorine on-site generation equipment (if implemented over bulk delivery), bulk storage tanks, and feed equipment would be placed in a new structure adjacent to or as part of the new structure housing influent chemical storage and feed equipment. This would allow liquid hypochlorite generation, storage, and feed equipment to be located as close as possible to the chlorine contact chamber or reclaimed water feed points. The liquid dechlorination bulk storage tanks and feed equipment would be placed in a new structure to the east of the existing Blower Room. These structures would be provided with heating and ventilation controls in order to maintain proper stored chemical temperatures.

Other items related to this work element include:

- New total chlorine analyzers to replace existing units.
- New liquid chemical dosing and mixing equipment.
- New ORP sensor.

This work element would only be incorporated into Alternative 1.

6.2.14 New UV Disinfection System with New Liquid Hypochlorite-Based Residual Maintenance System

New UV disinfection equipment would be installed into one of the existing chlorine contact tanks. A focus will be made on potentially employing "non-contact" based UV systems in order to reduce cleaning maintenance requirements. Non-contact UV systems employ highly scale-resistant flow tubes that convey effluent flow to be disinfected past dry-mounted UV lamps.

Because the reclaimed water system flows will still need to be provided with chlorine residual, a smaller liquid hypochlorite chlorine-based system will be installed to feed liquid hypochlorite into the WRF Reclaimed Water Pump Station discharge piping after UV disinfection is accomplished.

The following key items that will be included in this work element are:

- A four-bank UV system, where three of the four banks will operate at the maximum day design flow of 1.46 mgd. At lower flows, only one to two of the four banks would need to operate. The fourth bank serves as a redundant bank to meet National Water Research Institute (NWRI) guidelines for ultraviolet disinfection for water reuse.
- Liquid hypochlorite on-site generation equipment (if implemented over bulk delivery), hypochlorite bulk storage, and feed system.
- Hypochlorite mixing system incorporated into pressurized reclaimed water discharge piping.

This work element would be incorporated into all alternatives except Alternative 1.

6.2.15 Refurbish or Replace All Existing In-Plant Pump Stations

Under this work element, the following pump stations would be refurbished:

- Intermediate Pump Station.
- Reject Water Pump Station.
- Sludge Pump Station formerly called the Plant Drain and Sludge Pump Station (Plant Drain capability to be provided in a separate new pump station).

Refurbishment work would include:

- Pump replacement.
- Replacement or expansion of existing valve vaults to improve valve access, removal, and repair.
- Replacement of valves and gates.
- Replacement of flow meters and adding flow meter for Reject Water Pump Station.
- Wet well cover replacement with new access hatches with safety features (safety grating) and proper positioning to better facilitate pump removal.
- VFD replacement for Intermediate Pump Station.
- Electrical improvements for Reject Water Pump Station (e.g., seal and high temperature detection, alarms, and interrupts).

Under this work element, the following new pump stations would be provided:

- Dedicated Plant Drain Pump Station (separated from existing Sludge Pump Station).

New pump station work would include:

- Completely new Plant Drain Pump Station to be incorporated with new Influent Equalization Tank and Pump Station.
- Plant Drain Pump Station would have a minimum design flow capacity of 750 gpm. Pumps would be VFD-controlled to allow changes in dewatering rates.
- New plant drain piping. Dedicated, valve-isolated drains would be provided for each SBR decant equalization pond.

This work element would be incorporated into all alternatives except Alternative 3.

6.2.16 Refurbish or Replace Selected In-Plant Pump Stations

Under this work element, the following pump station would be demolished or abandoned because it is not required for the operation of an MBR-based system:

- Intermediate Pump Station.

Under this work element, the following pump stations would be refurbished:

- Reject Water Pump Station.
- Sludge Pump Station formerly called the Plant Drain and Sludge Pump Station (Plant Drain pumping to be provided in a separate new pump station).

Refurbishment work would include:

- Pump replacement.
- Replacement or expansion of existing valve vaults to improve valve access, removal, and repair.
- Replacement of valves and gates.
- Replacement of flow meters and adding flow meter for Reject Water Pump Station.
- Electrical improvements for Reject Water Pump Station (e.g., seal and high temperature detection, alarms, and disconnects).
- Electrical improvements for Sludge Pump Station.

The following new pump station would be provided:

- Dedicated Plant Drain Pump Station.

New pump station work would include:

- Completely new Plant Drain Pump Station to be incorporated with new Influent Equalization Tank and Pump Station.
- Plant Drain Pump Station would have a minimum design flow capacity of 750 gpm. Pumps would be provided with VFDs to allow changes in dewatering rates.
- New plant drain piping. A new valve isolated drain would be provided for the smaller effluent emergency storage pond (under the MBR process, the existing SBR effluent decant equalization ponds would be converted to emergency storage).

This work element would only be incorporated into Alternative 3.

6.2.17 Replace Existing Reclaimed Water Pump Station

Under this work element, the following would be completed:

- Demolition of existing, corroded package pump skid.
- Installation of new vertical turbine pumps with new mounting bases. Station pumping capacity would be increased to 900 gpm, and the minimum sized pump would be 150 gpm.
- Electrical and controls improvements.
- New dedicated VFDs for each pump.
- Replace reclaimed water discharge flow meter and valves.

This work element would be incorporated into all alternatives except Alternative 2C.

6.2.18 Outfall Rehabilitation

Under this work element, the following tasks would be completed:

- Installation of manholes to facilitate inspection and repairs.
- Inspection of complete outfall length.
- Refurbish existing air-vacuum valves and vaults.
- Slip line repairs as needed.
- Provide a dedicated flow meter for flows discharged into the Outfall.

This work element would be incorporated into all liquid stream treatment alternatives.

6.2.19 Electrical and Controls – Existing Systems Upgrades and New Systems Expansion

The following efforts would be included under this work element:

- Conversion of existing plant SCADA to Wonderware.
- Replacement of control system Ethernet.
- Replacement of PLCs and plant computers with newer technology.
- Emergency power generator rehabilitation.
- Provide new flow monitoring instrumentation for the effluent flow discharged from the UV system or chlorine contact basin.

This work element would be incorporated into all liquid stream treatment alternatives.

6.3 LIQUID STREAM ALTERNATIVES EVALUATION APPROACH

The liquid stream treatment alternatives were evaluated and ranked based on a ranking methodology where weighting and scoring of key criteria is employed. In addition, other tools such as process modelling, pilot testing, cost evaluations, and public involvement were used to help confirm weighted criteria scoring and technical feasibility of alternatives selected for evaluation.

6.3.1 Liquid Stream Alternatives Ranking Methodology Analysis

The liquid stream treatment alternative analysis uses a ranking methodology employing key ranking criteria. Each ranking criterion is assigned a value of importance. The maximum value of importance is 10 and reflects a criterion that is highly critical to be achieved by the City. Whereas the minimum value of importance set at 1 reflects a criterion of minor importance or concern to the City. Liquid stream alternatives key ranking criteria and assigned values of importance for each criterion are presented in Table 6-2:

Table 6-2. Liquid Stream Key Ranking Criterion

Criterion	Value of Importance
Minimizes City Financial Impact (Capital and Operation Costs)	10
Maximizes Employee and City Resident Safety	10
Increases Reliability of Meeting Current and Future Permit Limits	10
Minimizes Plant Operation Disruptions During Construction	10
Maximizes Utilization of Existing Facilities	8
Minimizes O&M Costs	7

The above values of importance were based on input from various City staff. Input from the public was also solicited to obtain feedback on the assigned values of importance.

The alternatives ranking methodology analysis then involves assigning a ranking value of 0 to 4 for each criterion. An alternative which completely fulfilled a criterion in question was assigned a ranking value of 4. The ranking value is then multiplied by the value of importance number to get a weighted score. All criterion weighted scores are then added together to get a total ranking score for a specific alternative.

6.3.2 Computer Process Modelling

Computer process modelling, conducted either by vendors or by Parametrix, has been employed to verify technical feasibility of alternatives as warranted. The primary model used to demonstrate technical feasibility for the liquid stream treatment alternatives was BioWin.

6.3.3 Pilot Testing

Pilot testing has also been employed to demonstrate technical feasibility for tertiary filter denitrification to be employed in the Alternative 1 option. Details of the WRF pilot filtration testing results are found in Appendix F.

6.3.4 Cost Estimating

Specific procedures for estimating O&M and capital costs were also developed as part of the alternative analysis approach. O&M and capital costs were used in a life-cycle cost analysis to allow financial comparisons of the various alternatives and to help set the scoring for the criteria Minimizes City Financial Impacts.

6.3.4.1 Capital Costs

Capital cost included construction costs (e.g., materials, labor, equipment involved in the installation, subcontractor costs, and indirect costs such as contractor mobilization, demobilization, temporary contractor facilities, testing commissioning, and cleanup), plus indirect costs that would not be a physical element of the project (e.g., engineering, legal, and administrative costs, taxes, and fees).

Cost estimates are based on preliminary design information using flow diagrams for main process systems, plant schematic layouts, and preliminary equipment lists. Costs were developed using vendor budgeting quotes, equipment factors, parametric models, and engineering judgment or analogy (i.e., reference to similar, recent past projects).

The expected level of accuracy of these estimates follows the Recommended Practice 18R-97 *Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries* (AACE 1998) designation as a “Class 4” estimate with an expected level of accuracy of +30 percent to -15 percent. This means that bids can be expected to fall within a range of 30 percent over the estimate to 15 percent under the estimate. Estimated project costs are presented in April 2016 dollars consistent with the 20 cities Engineering News-Record (ENR) value of 10,128.32. Costs have not been adjusted to the mid-point of construction for this comparison analysis. The following assumptions and markups were used to develop construction and total project costs:

- Project Contingency (includes as needed pilot testing) 30 percent
- General Conditions 13 percent
- Contractor Overhead and Profit 10 percent
- City of Yelm Sales Tax 8.7 percent
- Engineering, Permitting, and Construction Management 20 percent
- Administration and Legal 10 percent

6.3.4.2 O&M Costs

O&M costs included labor, supplies, and utility costs for operations, preventive and corrective maintenance, inspections, and repair and replacement of parts. O&M costs were based on:

- Historical costs from recent projects.
- Vendor-supplied costs.
- Costs supplied by City WRF staff (power, labor, and chemicals).
- Calculations, as necessary, to supplement other sources.
- Escalation of unit costs will generally be 2 percent unless specifically noted.
- A 5 percent contingency was applied to each alternative annual cost computation.

The cost estimates are generally based on applying the above information to changing operating conditions (e.g., increasing flows to be treated) anticipated over the planning period.

6.3.4.3 Life-Cycle Costs

Life-cycle costs were used to distinguish the best alternative from an overall economic standpoint. The life-cycle cost calculations converted the capital costs and annual O&M costs for each alternative into net present worth values. Factors considered in the life-cycle period are as follows:

- Discount rate of 4.5 percent for computing present worth values.
- Life-cycle period of 20 years.

6.4 ALTERNATIVES EVALUATION

The alternatives evaluation results is summarized in Table 6-2. The table includes the following key evaluation information:

- Outline of specific advantages and challenges for each alternative. General advantages offered by all alternatives presented are:
  - Enhance operation and maintenance activity by providing more rapid dewatering of WRF process tankage and ponds.
  - Reliability of system will be greatly enhanced by replacing old equipment and updating the electrical/controls infrastructure.
  - Safety for plant staff and public will be improved by switching away from gas-based disinfection and dechlorination and removing the need to access inside the SBR tanks for equipment maintenance.
- Individual criterion ratings for each alternative.
- Criterion ranking scores for each alternative.
- The net present worth analysis for each alternative which includes:
  - Initial project implementation costs.
  - Present worth of O&M costs over a 20-year period.

More detailed alternative cost break-down information is provided in Appendix G.

Table 6-3. 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**

6.5 RECOMMENDATION OF PREFERRED LIQUID STREAM ALTERNATIVE

The preferred liquid stream treatment alternative to process up to the 2036 design flows and loads (see Table 3-4) 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.

6.5.1 Summary Discussion of Non-Preferred Liquid Stream Alternatives

Basic commentary on why the other alternatives are not being recommended is as follows:

- Alternative 1 Commentary: Although this alternative provided a low capital cost solution it was not recommended primarily for the following reasons:
  - High operation and maintenance requirements primarily due to chemical feed requirements to maintain SBR sludge settleability.
  - Alternative would require all three SBR tanks to be in operation as influent flows approached design build-out.
  - The existing filters do not have Title 22 certification to operate simultaneously in denitrification and contact filtration mode.
  - The existing chlorine contact tanks do not comply with current Ecology Orange Book requirements.
- Alternative 2, Option B Commentary: This alternative offered the ability to provide new enhanced denitrification filters and provided similar capital and present worth costs as Alternative 2, Option A, but was not selected primarily for the following reasons:
  - High operation and maintenance requirements primarily due to chemical feed requirements to maintain SBR sludge settleability.
  - Increased operations complexity as the need to operate three basins as flows approached design flow would be required.

- Alternative 2, Option C Commentary:
  - High operation and maintenance requirements primarily due to chemical feed requirements to maintain SBR sludge settleability.
  - The existing filters do not have Title 22 certification to operate simultaneously in denitrification and contact filtration mode.
  - Increased operations complexity as the need to operate three basins as flows approached design flow would be required.
- Alternative 3 Commentary: Alternative 3, which would employ the MBR process in place of the SBR system, offered the ability to completely remove sludge settleability issues with the membranes providing a complete barrier to solids release from the process. However, Alternative 3 was not recommended as the preferred liquid stream treatment alternative for upgrade of the WRF for the following reasons:
  - Significantly higher capital cost compared to other alternatives.
  - Concerns for increased operations and maintenance brought about by maintaining the MBR fine screens and potential cleaning requirements for membrane cassettes.
  - Significant maintenance of plant operations planning would be required to take down existing SBR tanks and reconfigure the tanks as MBR process tanks.

7. SOLIDS STREAM TREATMENT ALTERNATIVES EVALUATION

7.1 INTRODUCTION

This chapter summarizes the evaluation of alternatives to enhance the solids stream treatment approach at the WRF in order to:

- Address key issues identified in the WRF condition assessment.
- Accommodate future influent flows and loads.

The sizing of the alternatives identified below are based on the Flows and Loads information provided in Chapter 3, Table 3-4.

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. City STEP tank sludge pumping, hauling, and disposal will continue to be handled by a private septage pumping company.
- Thickening polymer system upgrades including polymer drum unloading and new polymer feed pumps.
- Piping and valve upgrades to existing sludge holding tanks.
- Add redundant sludge tank mixing blower.
- Replacement and/or refurbishment of existing gravity belt thickener support facilities (includes air compressor, valves, feed piping, flow meters).
- Coating and painting repairs for Solids Handling Building.

Alternative 2 – Optimization of Existing Facilities with Major Enhancements

- Replacing sludge thickening with screw press dewatering system:
  - Piping and valve upgrades to existing sludge holding tanks.
  - Add redundant sludge tank mixing blower.
  - Replace gravity belt thickener with drum thickener and screw press dewatering system.
  - Upgrade existing thickening polymer feed system for dewatering capability.
  - Unclassified, dewatered solids would be hauled to a licensed private biosolids processing company by a contracted hauler. 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. The Lystek process uses an innovative process consisting of high shear mixing, steam addition, and potassium hydroxide addition to economically create an agriculturally high value Class A biosolids product. This alternative has the following key elements:

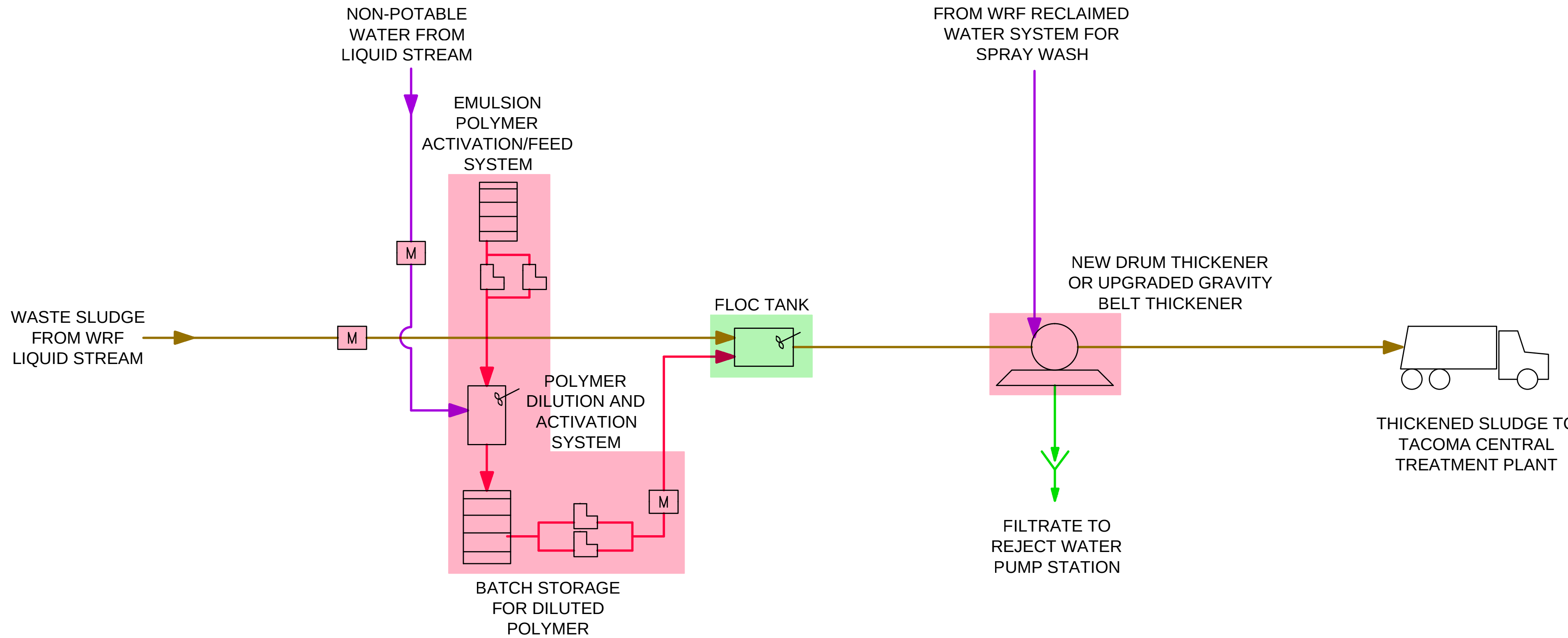
- Conducting as needed pilot testing with WAS only and with WAS/Screened Septage combined sludge.
- Refurbishment of caustic feed system in Solids Handling Building to provide potassium hydroxide feed to the Lystek process.
- Replace GBT unit with a drum thickener and screw press to provide dewatered solids to the Lystek process.
- Provide septage handling facility to screen incoming septage from City sources to be processed by the Lystek process.
- The Lystek process offers the following key advantages:
    - Provides a high carbon side stream flow that could be used to enhance the SBR denitrification process. Also, the side stream flow would have an elevated pH that could help reduce magnesium hydroxide addition needs to the plant influent. Magnesium hydroxide addition is currently a costly requirement for proper WRF operation.
    - Provides ability to process raw septage from City STEP tanks and reduce septage disposal costs while recovering carbon for use in the liquid stream biological nitrogen removal process.

Technologies that provide organic solids destruction capability such as anaerobic digestion and aerobic digestion were not considered due to the significant requirement of additional tankage and potential generation of significant nitrogen return flow streams that will negatively impact the City's nitrogen removal capability in the WRF liquid stream secondary treatment process. Because the City is committed to providing a reclaimed water flow stream with low nitrogen, only solids stream treatment alternatives that provided possible benefits in assisting to provide low nitrogen levels in the WRF effluent were considered.

Solids stream process schematics for each alternative are provided in Figure 7-1 through Figure 7-3.

Site plans layouts for each solids stream treatment alternative are located in the following Chapter 6 site plan figures:

- Solids Stream Alternative 1 – Refurbishment or Replacement of Gravity Belt Thickener Operation with Minor Enhancements: Gravity Belt Thickener Refurbishment or Replacement with New Drum Thickener. Site Plan located in Figure 6-2.
- Solids Stream Alternative 2 – Optimization of Existing Facilities with Major Enhancements: Provide Drum Thickening and Screw Press Dewatering of Unclassified Sludge. Site Plan located in Figure 6-4.
- Solids Stream Alternative 3 – Complete Process Renovation to Provide Class A Biosolids: Provide Class A Lystek Biosolids Processing. Site Plan located in Figure 6-10.



NEW FACILITY OR EXPANSION

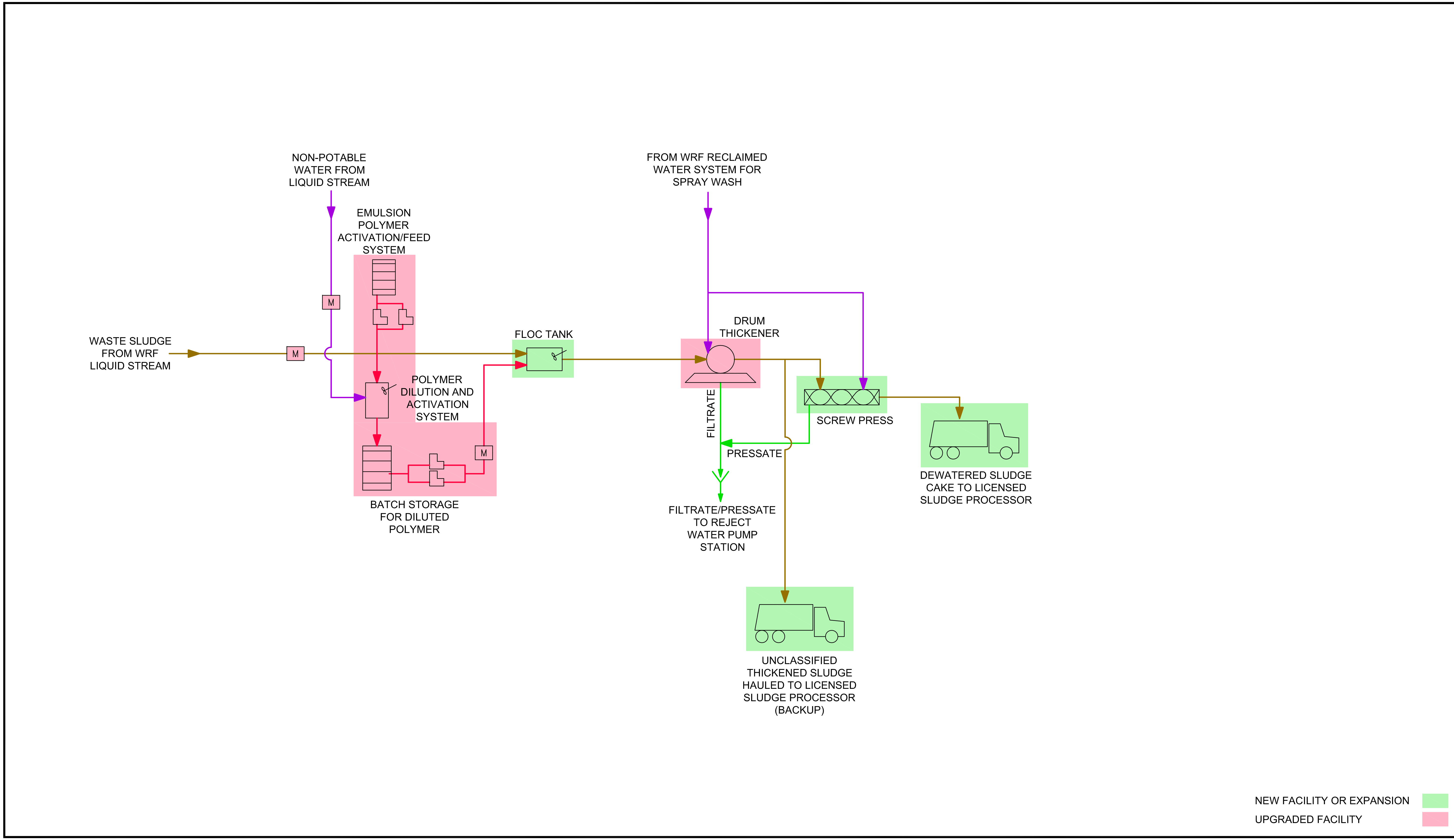
UPGRADED FACILITY

Parametrix DATE: May 12, 2016 FILE: PS1781033F7-1

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 7-1
Solids Stream Alternative 1 Process Schematic
Sewer Facilities Plan
Yelm, Washington

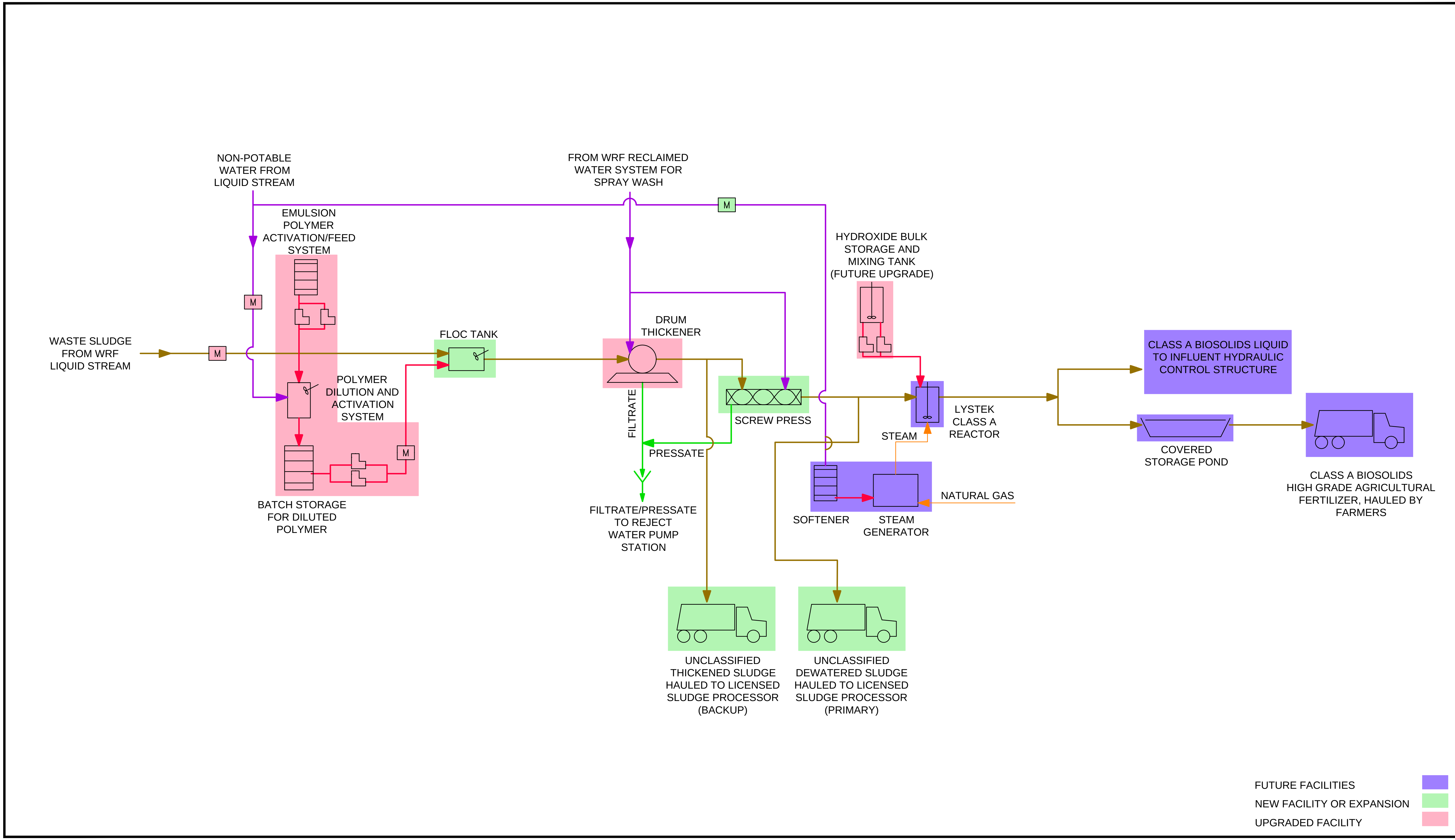


Parametrix DATE: May 12, 2016 FILE: PS1781033F7-2

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 7-2
Solids Stream Alternative 2 Process Schematic
Sewer Facilities Plan
Yelm, Washington



Parametrix DATE: June 8, 2016 FILE: PS1781033F7-3

LEGEND

CENTRIFUGAL PUMP	VERTICAL PUMP	PNEUMATIC CONTROL VALVE	FLOATING MIXER	CS COMPOSITE SAMPLER	ISOLATION GATE	INFLUENT FLOW STREAM MAJOR/MINOR
RAIL MOUNTED SUBMERSIBLE PUMP	STATIC MIXER	SCADA FLOW CONTROL VALVE	F/C FINE OR COARSE BUBBLE DIFFUSER	SP SAMPLE PORT	EFFLUENT FLOW WEIR	RECLAIMED WATER FLOW STREAM MAJOR/MINOR
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	SOLID OR DRAINAGE

Figure 7-3
Solids Stream
Alternative 3
Process Schematic
Sewer Facilities Plan
Yelm, Washington

7.2 SOLIDS STREAM TREATMENT ALTERNATIVES EVALUATION APPROACH

The selected solids stream treatment alternatives listed in Section 7.1 were evaluated and ranked based on a ranking methodology where weighting and scoring of key criteria is employed. In addition, other tools such as a process model and public involvement were used to help confirm weighted criterion scores and technical feasibility of the alternatives.

7.2.1 Solids Stream Treatment Alternatives Ranking Analysis

The solids stream treatment alternatives analysis employs the same ranking methodology described in Chapter 6 for the liquid stream treatment alternatives analysis. The key ranking criteria and assigned values of importance for each criterion are presented in Table 7-1.

Table 7-1. Solids Stream Treatment Alternatives Key Ranking Criteria

Ranking Criterion	Value of Importance
Minimizes City Financial Impacts (Capital and Operation Costs)	10
Maximizes Ease of Distribution for Processed Solids	9
Maximizes Utilization of Existing Facilities	8
Reduces Impact of Side Stream Flows on Liquid Stream Processes	8
Simplicity of Operation to Reduce O&M Labor	7

The above values of importance were based on input from various City staff. Input from the public was also solicited to obtain feedback on the assigned values.

7.2.2 Computer Process Modelling

Computer process modeling, conducted by Parametrix, has been employed to verify technical feasibility of alternatives as warranted, especially in terms of evaluating the solids stream side stream flow impacts on liquid stream processes. The primary model used to demonstrate technical feasibility support for the solids stream treatment alternatives was BioWin.

7.2.3 Cost Estimating

Specific procedures for estimating O&M and capital costs were also developed as part of the alternative analysis approach. O&M and capital costs were used in a life-cycle cost analysis to allow financial comparisons of the various alternatives and to help scoring of financial and maintenance-related criteria. Capital, O&M, and life cycle cost approaches are identical to those used in the Chapter 6 analysis.

7.3 ALTERNATIVE EVALUATION

The solids stream treatment alternatives evaluation results are summarized in Table 7-2. The table includes the following key evaluation information:

- Outline of specific advantages and challenges for each alternative. General advantages offered by all alternatives presented are:
  - Reduce operation and maintenance activity and increasing solids stream treatment reliability by replacing aged equipment with new equipment.
- Individual criterion ratings for each alternative.
- Criterion ranking scores for each alternative.
- The net present worth analysis for each alternative which includes:
  - Initial project implementation costs.
  - Present worth of O&M costs over a 20-year period.

More detailed alternative cost break-down information is provided in Appendix G.

7.4 RECOMMENDATION OF PREFERRED SOLIDS STREAM TREATMENT ALTERNATIVE

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.

7.4.1 Summary Discussion of Non-Preferred Solids Stream Alternatives

Although Alternatives 1 and 2 had significantly lower capital costs than the preferred Alternative 3, these alternatives were categorized as non-preferred primarily due to the following concerns:

- The uncertainty of available vendors to accept increasing amounts of raw septage or unclassified sludge in the future. At this time, many waste septage processing and unclassified sludge vendors are having to limit the amount of septage or sludge received due to regulatory or equipment constraints.
- The current contract with the City of Tacoma to accept raw WAS runs the risk of future termination. However, if the City of Yelm could receive a written guarantee of long-term service (20-year), this concern would be removed.
- The side stream flows from these alternatives would have potentially negative rather than positive impacts on WRF liquid stream nitrogen removal.
- Landfilling of untreated municipal sludge, although currently possible by state regulations, is strongly discouraged by Ecology for long-term planning.
- At this time, there are highly limited number of sludge processors available to take on the City of Yelm's untreated WAS sludge load. Currently, the City of Tacoma is deemed the only viable sludge processor willing to take Yelm's raw WAS sludge. However, Tacoma will only accept the sludge in low solids content form (less than 5 percent solids) which greatly increases hauling costs. These costs will rise dramatically in the future as fuel costs continue to rise and WRF sludge generation levels increase.

Table 7-2. 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**

8. PREFERRED ALTERNATIVES

8.1 INTRODUCTION

The objective of this chapter is to present the recommended plan for upgrading the Yelm WRF to address flows and loads through the 2015 to 2035 planning period. The preferred alternative improvements are phased to allow the City to:

- Address the immediate improvements needed at the existing facility.
- Provide reliable capacity to support the GMA projections adopted in the Comprehensive Planning process.
- Provide flexibility to meet current regulations and adapt to future regulatory requirements.

8.2 WASTEWATER RECLAMATION FACILITY TREATMENT PROCESSES

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. Only three process blowers would be required for the preferred alternative compared against other alternatives since one of the three SBR basins is a standby basin.
  - 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 8-1.

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 8-2.

The preferred alternatives site plan is shown in Figure 8-3, and the preferred alternatives hydraulic profile is shown in Figure 8-4.

8.2.1 Liquid Stream Refinement

The following detailed preferred liquid stream treatment alternative information is provided for the WRF process areas.

8.2.1.1 Secondary Treatment Refinement

A propriety biological treatment technology called BioMag will be incorporated into the existing SBR process. This will allow SBRs to use the existing process tankage volume to process increased flow rates with one SBR tank out of service for standby or for scheduled maintenance.

Secondary treatment upgrades will also include enhancements that will aid in operator safety (removing the need to enter deep process tanks) and offer additional opportunities to reduce operations and maintenance requirements over what is required to maintain existing tank equipment. For example, the existing anoxic floating mixers and fine bubble diffuser grids will be replaced with jet aeration systems. Primary pumping equipment for the jet aeration systems will be situated at grade and outside the tanks to facilitate ease of maintenance.

8.2.1.2 Tertiary Treatment Refinement

For this upgrade, three additional continuous backwash up-flow filter cells will be constructed. The three existing filter cells will be outfitted with new flow distributors, new sand media, and new controls to reduce backwash wastewater flows. The new filter cells will also be outfitted with the same backwash wastewater controls being installed on the existing filters.

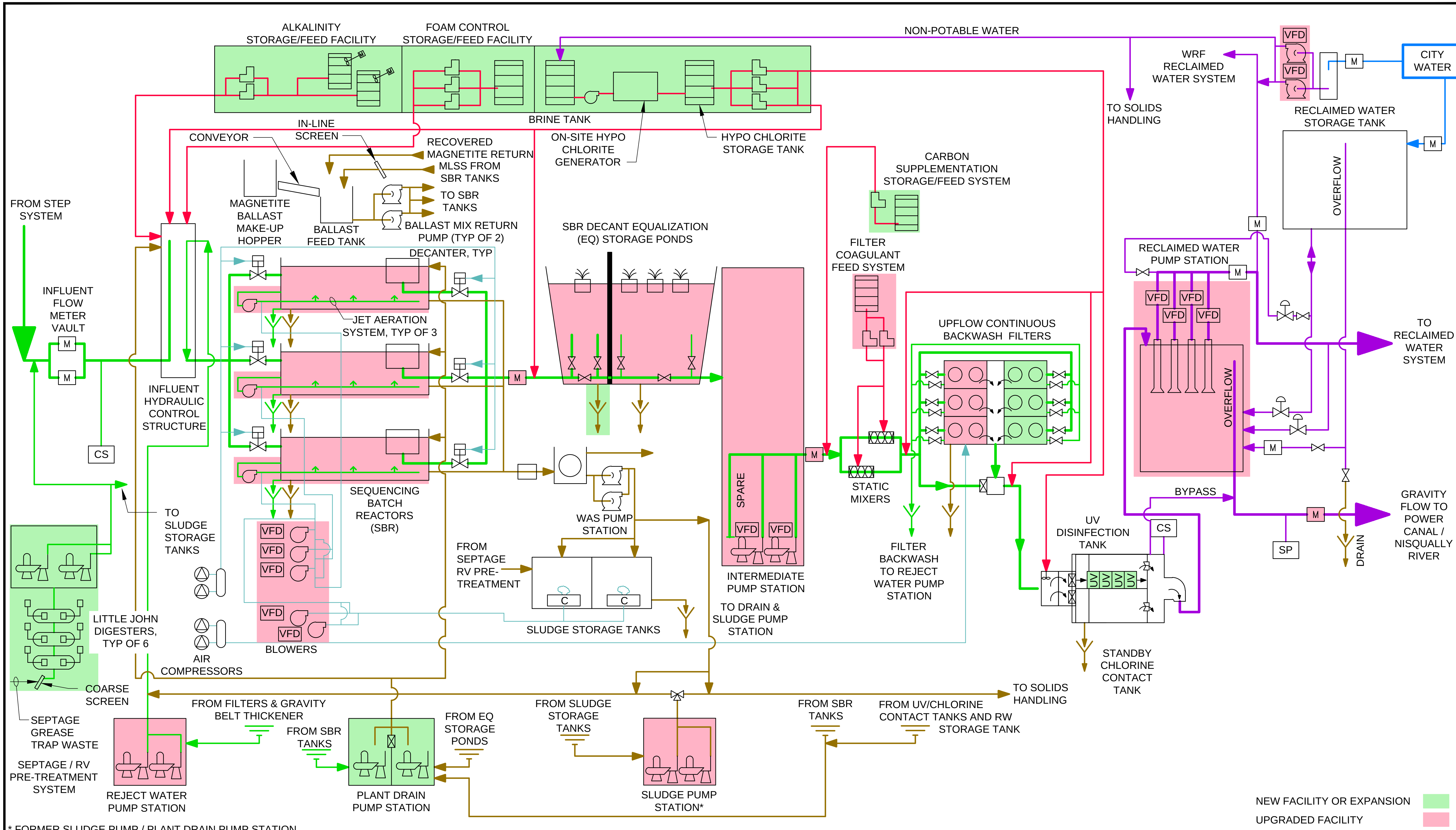
8.2.1.3 Disinfection Treatment

The existing chlorine gas based disinfection and sulfur dioxide de-chlorination systems are to be replaced with a non-contact UV disinfection process. The non-contact process differs from traditional UV systems in that the UV lamps are suspended outside a transparent conduit, which carries the wastewater to be disinfected. Such a system is being selected since operation and maintenance requirements are greatly reduced over traditional systems. There are two known major manufacturers of non-contact UV disinfection systems.

A secondary on-site liquid hypochlorite generation system will be provided to chlorinate reclaimed water sent into the City's reclaimed water distribution system.

8.2.1.4 Solids Handling Refinement

The existing gravity belt thickener will be replaced with a drum thickener and sludge dewatering screw press. No aerobic or anaerobic treatment of the sludge for volatile solids reduction will occur on site. Dewatered, untreated sludge will be hauled to local beneficial use facilities such as composters who will convert the untreated sludge to either a Class A or Class B biosolids. Alternative 3 is the recommended alternative with the Class A treatment component being postponed beyond 2030.



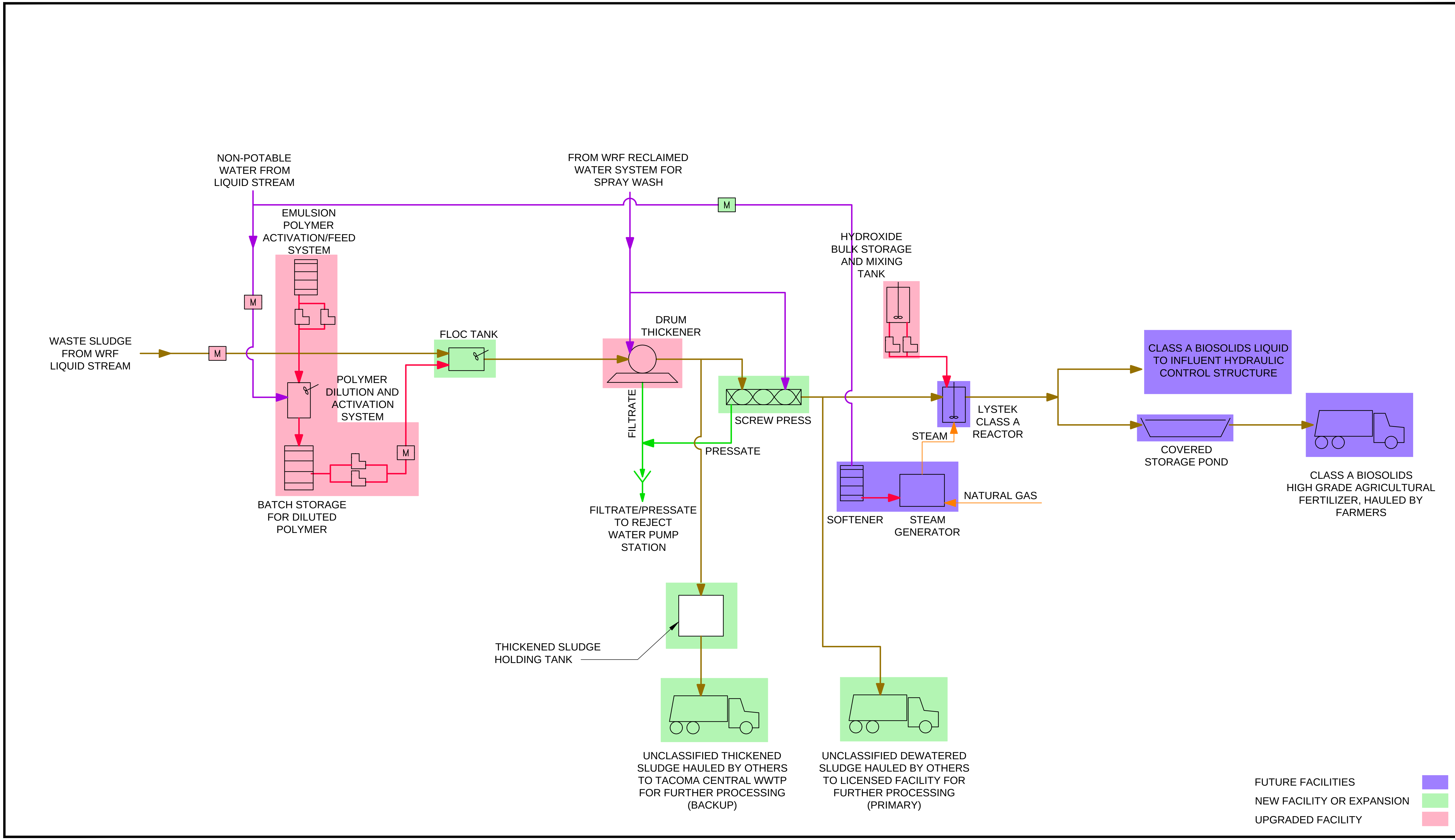
Parametrix DATE: June 21, 2016 FILE: PS1781033F8-1

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 8-1
Preferred Liquid Stream Alternative Process Schematic

Sewer Facilities Plan
Yelm, Washington

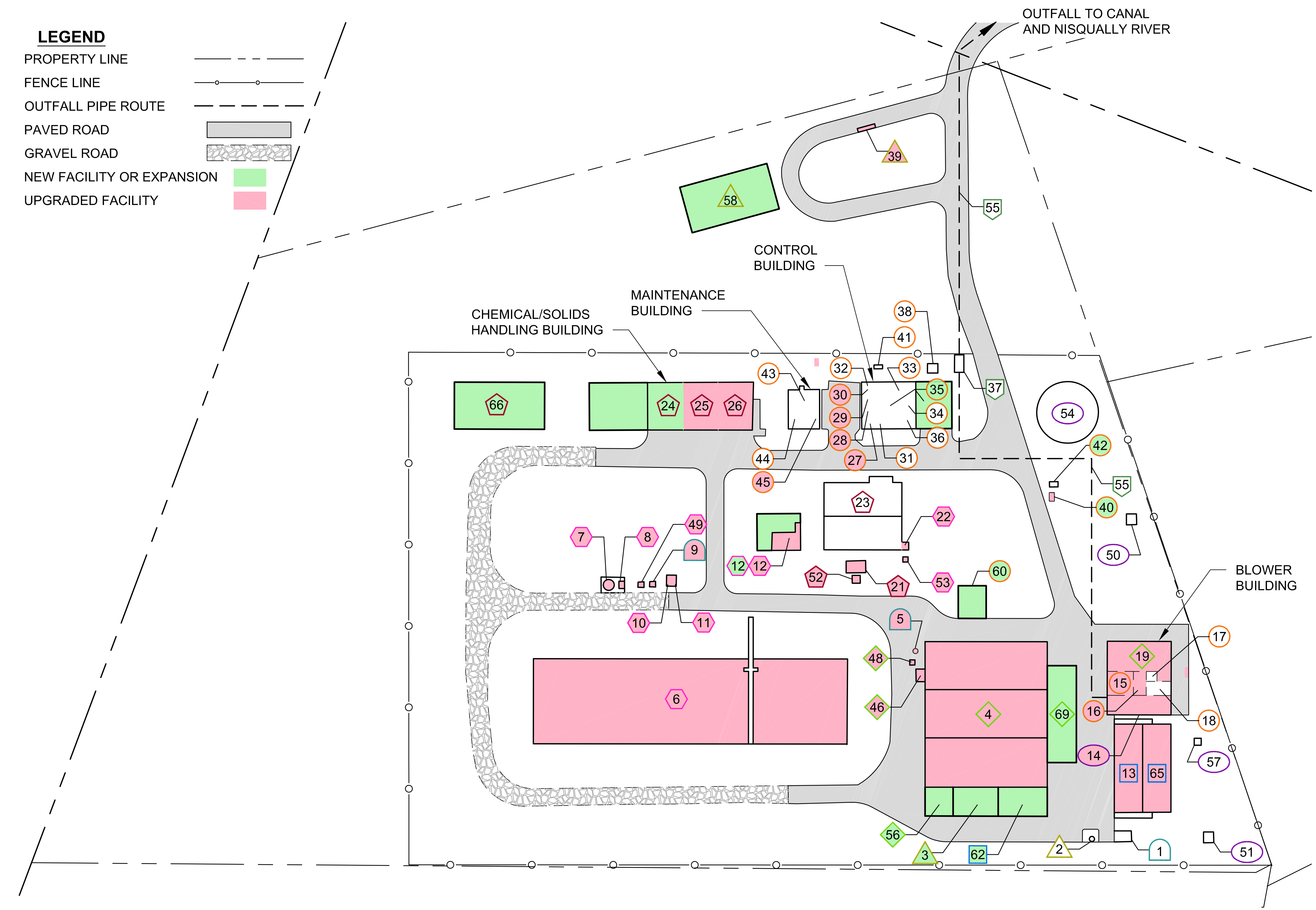


Parametrix DATE: June 8, 2016 FILE: PS1781033F8-2

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
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 8-2
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

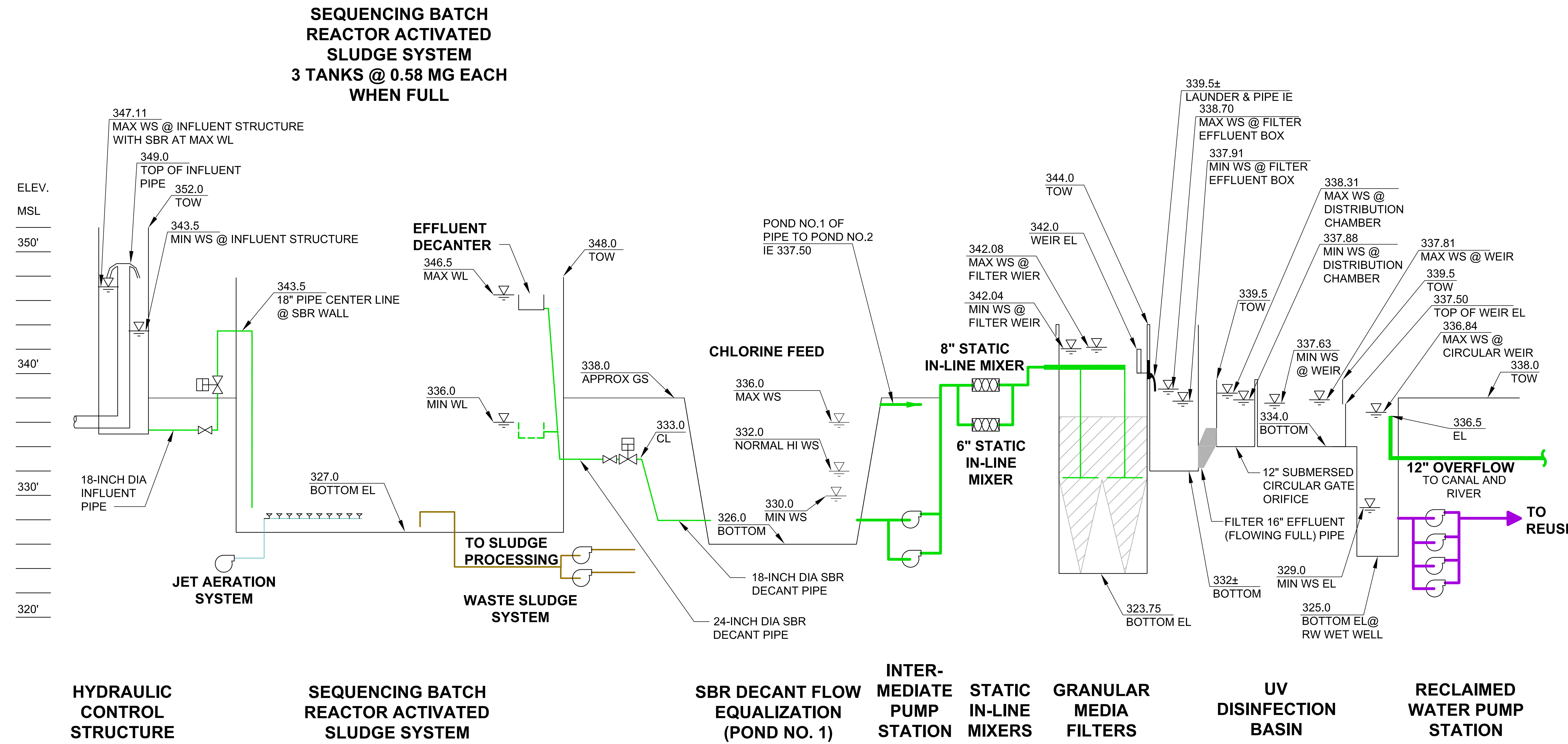
Parametrix DATE: May 12, 2016 FILE: PS1781033F8-3

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

N
0 100
SCALE IN FEET

Figure 8-3
Preferred Alternative
WRF Site Plan
Sewer Facilities Plan
Yelm, Washington



ABBREVIATIONS

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

INFLUENT

FLOW CONDITIONS USED AT SBR'S

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: May 12, 2016 FILE: PS1781033F8-4

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
- 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 8-4
HYDRAULIC PROFILE
Sewer Facilities Plan
Yelm, Washington

8.3 WRF SUPPORT FACILITIES

8.3.1 Odor Control

No additional odor control facilities are planned at the WRF. The existing facility has operated without complaints with no odor control systems in place.

8.3.2 In-Plant Pump Stations

All existing plant pump stations will be upgraded, which include:

- Intermediate Pump Station.
- Reject Pump Station.
- Drain and Sludge Pump Station.

Existing pump station upgrades will include the following:

- Controls upgrades and replacement.
- Piping and valves replacement.
- Pump replacement.
- Access improvements to top hatches to facilitate pump removal.

8.3.3 Standby Generator

The two existing generators will be replaced with a newer, single generator to handle all plant loads. The generator will be centrally located on the plant site to distribute backup power to all WRF facilities.

8.3.4 Electrical and Controls

The two existing separate WRF electrical services will be consolidated into a single electrical service that incorporates a new single backup generator discussed above. In addition, motor control centers for the solids handling and storage equipment, Intermediate Pump Station, Reject Water Pump Station, and Drain and Sludge Pump Station will be consolidated into a single Electrical Room area. It is planned that the Sulfur Dioxide and Chlorine Feed Rooms can be refurbished to serve as a new Electrical Room upon completion of the UV disinfection upgrades.

In addition, key instrumentation upgrades include:

- SBR on-line nitrogen and ORP monitoring with SCADA trending data general flow meter replacements plant wide with particular focus on effluent flow metering system improvements to remove flow discrepancies as outlined in Chapter 5.

8.3.5 Reclaimed Water System

The reclaimed water system pumps and piping will be fully replaced. Also, significant controls and electrical upgrades will be performed and include new PLC controllers and individual VFDs for each pump.

8.3.6 Staffing Requirements

Improvements discussed in this plan are tailored to at least maintain current operator staffing requirements without increasing staff operation and maintenance workload requirements.

8.4 SITE PLANNING

All plant improvements will occur within the existing plant fence line. No new and extensive site planning is anticipated at this time.

8.5 DESIGN CRITERIA

Table 8-1. Yelm WRF Preferred Alternatives Summary Design Data

Process Unit	Value
Influent Facilities (Sub Process Areas – 2, 3, 39, 56)	
Influent Hydraulic Control Structure	
Number	One
Volume	2,141 gallons
Dimensions	54-inch diameter
Material of construction	High-density polyethylene (HDPE)
Influent riser elevation	349.0 feet
Indoor Mag Hydroxide Feed System	
Storage Tank No. 1 volume	2,500 gallons
Storage Tank No. 2 volume	2,500 gallons
Feed Pumps:	
Number	Two
Type	Diaphragm
Capacity	150 gpd
Indoor Influent Alternate Chemical Feed System	
Tote volume and number	270 gallons using one tote
Feed Pumps:	
Number	Two
Type	Diaphragm
Capacity	100 gpd
RV Dump Station Pump (Inactive)	
Secondary Treatment – Sequencing Batch Reactor (SBR) (Sub Process Areas – 4, 19, 46, 48, 56)	
SBR Tanks	
Material of construction	Cast-In-Place Concrete
Number of tanks	Three
Interior tank dimensions	100 feet long, 40 feet wide, by 21 feet high
Maximum operating side water depth (SWD)	19.5 feet
Volume at maximum SWD	583,400 gallons per tank
Minimum Operating SWD	9 feet
Cycle times	6 hour (two-tank operation) at Design Flow of 1.22 mgd
Decanter type	Floating Fiberglass Decanter, Submerged Decant Orifices
Decanter average flow rate	5,000 gallons per minute (gpm)
(Table Continues)	

Table 8-1. Yelm WRF Preferred Alternatives Summary Design Data (Continued)

Process Unit	Value
SBR Jet Diffuser Header	
Number and Material	One fiberglass reinforced plastic (FRP) Header per Tank
Design specific oxygen transfer	550 pounds per hour per tank
SBR Jet Aeration Pumps	
Number	One dedicated pump per SBR tank, one swing standby unit to serve any SBR, Total of 4 pumps
Type	Centrifugal
Motor size and type	50 horsepower (hp) for dedicated pumps, 60 hp for swing pump. All motors variable frequency drive controlled
SBR Tank Decanters	
Number	One per SBR Tank, total of three, refurbish existing.
Type	Floating
Material of construction	Fiberglass
SBR Process Air Blowers, New Units Replacing Existing Units	
Number	Three, Two Duty
Type	Hybrid Positive Displacement
Motor size and type	150 hp, variable frequency drive (VFD)-controlled motors
Capacity	3,000 cubic feet per minute (cfm) at 10 pounds per square inch (psi) discharge pressure
Ballasted Sedimentation Pneumatic Conveyance System Air Compressors	
Number	One
Type	Duplex Unit
Motor size and type	Two 20 hp
Ballasted Sedimentation Ballast Tank Mixer	
Number	One
Type	Vertical Shaft
Motor size	3 hp
Ballasted Sedimentation Feed And Storage Tank	
Number	One
Type	Outdoor Silo
Capacity	25 ton
Ballasted Sedimentation Shear Mill Pumps	
Number	Three
Type	Positive Displacement
Motor size and type	One 7.5 hp feed pump, one 5 hp WAS pump and one 7.5 hp discharge pump
Capacity	Feed and WAS pumps at 150 gpm and discharge pump at 300 gpm
SBR Ballasted Sedimentation Shear Mill	
Number of Units	One
Motor size and type	30 hp
(Table Continues)	

Table 8-1. Yelm WRF Preferred Alternatives Summary Design Data (Continued)

Process Unit	Value
SBR Waste Activated (WAS) Pumps, Existing	
Number of pumps	Two, One Duty
Type of pump	Self-Priming, Centrifugal, 3-inch discharge
Pump manufacturer	Gorman Rupp
Pump model	T3AB-3
Motor size and type	7.5 hp, 460 volt (V), 3-phase, constant speed
Capacity	150 gpm at 25 feet total dynamic head (TDH)
New Indoor, SBR Foam Control Chemical Feed System	
Chemical used	Polyaluminum Chloride or Proprietary Chemical
Chemical tote storage volume	270 gallons
Feed pumps	
Number	Two
Type	Diaphragm
Capacity	150 gpd
Air Compressor for Instrument Air and Pneumatic Valve Air Supply	
Type	Reciprocating Air Compressor, Single Air Tank
Number of compressors	Two, New units replacing existing units
Compressor motor size	10 hp
Tertiary Treatment (Sub Process Areas 6, 7, 8, 10, 11, 12)	
SBR Effluent Decant Equalization Basins, Existing	
Number	Two
Basin No. 1 volume (in operation)	157,000 gallons at Minimum SWD – 4 feet 546,000 gallons at Maximum SWD – 10 feet
Basin No. 2 volume (off line)	548,000 gallons at Minimum SWD – 4 feet 1,743,000 gallons at Maximum SWD – 10 feet
Intermediate Pump Station	
Number of pumps	Two, Existing pumps replaced with New Units
Type of pump	Submersible, Sewage
Wet well materials of construction	96-inch-diameter concrete manhole
Pump capacity	1,800 gpm
Pump motor size	30 HP, VFD Controlled
Effluent Filters	
Type	Continuous Backwash, Up-flow
Mode of operation	Contact Filtration with Option to Denitrify
Number	Six Cells, Two modules per cell, Three cells are new
Maximum flow capacity	800 gpm or 1.152 mgd
Loading rate, all cells in service at maximum flow capacity	2.7 gpm per square foot at Maximum Flow Capacity
Loading rate, one cell out of service, at maximum flow capacity	4.0 gpm per square foot at Maximum Flow Capacity
Media Depth	2 meters
(Table Continues)	

Table 8-1. Yelm WRF Preferred Alternatives Summary Design Data (Continued)

Process Unit	Value
Air Compressors to Supply Air to Filter Airlift Pumps (New Units replacing Existing)	
Type	Reciprocating Air Compressor, Single Air Tank
Number of compressors	Two
Compressor motor size	10 hp
Coagulant Feed Pumps (Existing)	
Type	Peristaltic
Number	Two
Coagulant type	Poly Aluminum Chloride
Chemical Static Mixers, Existing	
Number	Two
Type	In-Pipe, Static
Manufacturer	United Equipment Technologies Corp.
Sizes	6-inch diameter and 10-inch diameter, Use 6-inch-diameter mixer for flows under 1 mgd, 10-inch-diameter mixer for flows greater than 1 mgd
Reject Water Pumps (Processes Filter Waste Backwash flow, Drum Thickener Filtrate and Screw Press Pressate), Existing Pumps Replaced with New Units	
Number	Two
Type	Submersible, Non-Clog
Motor	7.5 HP, VFD controlled
Flow capacity per pump	350 gpm
Disinfection (Sub Process Areas – 13, 62, 65)	
New UV Disinfection System	
Type	Non-Contact System
Number of Reactors	Four, One Standby
Design Flow	1.46 mgd
Number of Reactors to Process Design Flow	Three
Projected Power Use at Design Flow	31 kW
Design Dose	100 millijoules per centimeter^2 (mJ/cm^2)
Reclaimed Water Residual and Backup Disinfection On-Site Hypochlorite Generation System	
Type	On-site Generation – Mixed Oxidant
Number of Generators	One
Generator Free Available Chlorine Production Rate	60 lb/d
Solution Storage Tank Size	2,000 gallons
Backup Storage Tank Size	2,000 gallons
Brine Saturator Tank Size	500 gallons
Chlorine Solution Rapid Mixer Type	In-line on pipe
Chlorine Solution Rapid Mixer motor size	1 hp
Chlorine Solution Feed Pump Type	Peristaltic
Chlorine Solution Feed Pump Capacity	100 gph
Number of Chlorine Solution Pumps	Three

(Table Continues)

Table 8-1. Yelm WRF Preferred Alternatives Summary Design Data (Continued)

Process Unit	Value
Standby Chlorine Contact Tank, Existing	
Number	One
Tank volume	34,000 gallons at 4.5 foot SWD
Length	75 feet
Width	4.5 feet
Length to width ratio	50:1
Detention time at 1.36 mgd flow, one tank out of service	37 minutes
Operating Side Water Depth	4.5 feet
New Chlorine Solution Rapid Mixer Type	Submerged, induction
Number of New Chlorine Solution Rapid Mixers	One
New Chlorine Solution Rapid Mixer Motor Size	1 hp
Sludge Storage, Pumping and Processing (Sub Process Areas – 21, 22, 23, 24, 25, 26)	
Sludge Storage Tanks, Existing	
Materials of construction	Cast-in-Place Concrete with Concrete Hollow Core Roof Slab
Number	Two
Dimensions per tank	18 feet deep
Storage volume at maximum SWD of 15 feet	160,000 gallons per tank
Tank sludge air mixing system	Coarse Bubble Diffusers, 78 Diffusers per tank
Tank Sludge Mixing System, Existing System to Be Replaced with New	
Mixing system type	Coarse Bubble Air Mixing
Diffuser style	24-inch Open Bottom Stainless Steel Diffusers
Number of diffusers	78 per Tank
Mixing air design range	20 to 40 cubic feet per minute at standard conditions (scfm) per 1,000 cubic feet of tank volume, depends on depth of sludge in tanks
Tank Sludge Air Mixing System Air Supply Blower, Existing Unit Replaced With New Units	
Type	Hybrid PD Blowers
Number	Two
Blower horsepower	30 hp with VFD Speed Control
Drum Thickener Unit	
Number	One
Design feed solids concentration	1 percent dry solids
Solids processing capacity	115 dry pounds per hour
Thickened sludge dry solids content	5 to 7 percent range, 6 percent design
Dewatering Screw Press	
Number	One
Design feed solids concentration	5 to 7 percent dry solids
Solids processing capacity	115 dry pounds per hour
Thickened sludge dry solids content	18 to 20 percent range, 19 percent design
(Table Continues)	

Table 8-1. Yelm WRF Preferred Alternatives Summary Design Data (Continued)

Process Unit	Value
Sludge Pump Station (Stored Sludge Pumping)	
Number of Pumps	Two
Type	Submersible, Non Clog
Flow capacity	500 gpm per pump
New Polymer Feed Pumps	
Number	Two
Type	Progressing Cavity
Reclaimed Water Pumping and Storage (Sub Process Areas – 14 and 54)	
New High Flow Pumps	
Pump type	Vertical turbine, skid or based mounted
Number	Two
Flow capacity	900 gpm
Motor size	50 hp, VFD controlled
New Low Flow Pumps	
Pump type	Vertical turbine mounted with high flow pumps on skid or new pump bases
Number	Two, VFD controlled
Flow capacity	150 gpm
Motor size	10 hp
Storage Tank, Existing	
Material of construction	Bolted Steel
Number	One
Diameter	53 feet
Storage capacity at maximum SWD of 30 feet	495,000 gallons
Flow Measurement and Sampling (Sub Process Areas – 1, 5, 9, 14, 46)	
Influent Flow Meter, Low Flows, Existing Unit	
Type	Magnetic flow meter
Size	6-inch diameter
Recommended flow range	0.0173 mgd to 0.864 mgd
Influent Flow, High Flows, Existing Unit	
Type	Magnetic flow meter
Size	8-inch diameter
Recommended flow range	0.0216 to 1.728 mgd
SBR Decant Flow Meter, Existing Unit Replaced with New	
Type	Insertion Turbine
Size	24-inch
Recommended Flow Range	0 to 10,000 gpm
Intermediate Pump Station Flow Meter (Feed flow into Tertiary Treatment), Existing Unit	
Type	Magnetic flow meter
Size	8-inch diameter
Recommended flow range	0.0216 to 1.728 mgd

(Table Continues)

Table 8-1. Yelm WRF Preferred Alternatives Summary Design Data (Continued)

Process Unit	Value
WAS Flow Meter, Existing Unit Replaced with New Unit	
Type	Magnetic flow meter
Size	3-inch diameter
Recommended range	24 to 800 gpm
Drum Thickener Influent Flow (in Solids Handling Area) Existing Unit Replaced with New	
Type	Magnetic flow meter
Size	3-inch diameter
Recommended range	24 to 800 gpm
Effluent Flow (After UV disinfection)	
Type	Sharp Crested Weir with Ultrasonic Level Detector
Flow range	0 to 4 mgd
Reclaimed Water Distribution Flow, Existing Unit replaced with New Unit	
Type	Magnetic flow meter, 8-inch diameter
Flow range	0.0216 to 1.728 mgd
Reclaimed Water Storage Flow, Existing Unit replaced with New Unit	
Type	Propeller, 6-inch diameter
Flow range	90 to 1,200 gpm
Effluent Discharge to Canal or River Flow	Differential between effluent flow meter and the sum of RW distribution, RW storage, and RW plant use flow meters
Influent Flow Automatic Sampler, Existing	
Type	Outdoor, refrigerated automatic composite sampler unit
Location	Influent pipe, just upstream of Influent Hydraulic Control Structure and downstream of influent flow meters
Effluent Flow Automatic Sampler, Existing	
Type	Outdoor, refrigerated automatic composite sampler unit
Location	In UV Disinfection discharge flow channel to Reclaimed Water Pump Station wet well
Support Systems – (Sub Process Areas 15, 16, 17, 18, 20, 31, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, 47, 73, 74)	
Standby Generator No. 1 (Sub Process Area 73) New unit to replace two existing units	
Size	750 kilowatt (kW)
Fuel type	Diesel
Fuel tank size	3,000 gallons
Process Water Pumps, New system to replace existing	
Number	Two
Type	Centrifugal
Motor size	7.5 hp
Flow capacity per pump	150 gpm
Effluent Outfall – (Process Sub Areas 37, 55)	
Existing Outfall Pipe	
Pipe material	PVC
Size	12-inch diameter
Length to canal side discharge	Approximately 5,000 feet
Length to river side discharge	Approximately 8,000 feet

8.6 IMPLEMENTATION

Elements of the preferred liquid and solids stream treatment alternatives will be implemented in phases to help to provide a logical upgrade path to 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 have been identified and will be discussed in detail below.

8.6.1 Proposed Phasing Option

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.

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.*

The immediate upgrades will include the following specific work elements:

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

Photograph 8-1. Existing WRF Reclaimed Water Pump Station

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 8-2. Gravity SBR Sludge Settling (Left) versus Ballasted Sedimentation Assisted Settling (Right)

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 8-2.

Table 8-2. 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**

8.7 PROJECT SCHEDULE

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

- Immediate Needs 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.

The phased recommended alternative project costs are summarized as follows:

- A detailed breakdown of the phased recommended alternative project costs is provided in Appendix H.
- FCS has conducted a rate study in Chapter 9 to determine impacts of the recommended alternative on the City rate payers.

8.8 ENVIRONMENTAL COMPLIANCE

The State Environmental Review Process (SERP) checklist, with updated SEPA, for the project is included in Appendix I.

9. FINANCIAL PLAN

9.1 INTRODUCTION

This chapter was prepared by FCS GROUP to provide a financial program that allows the sewer utility to remain financially viable during the planning period. This financial viability analysis considers the historical financial condition, current and identified future financial and policy obligations, operation and maintenance needs, and the ability to support the financial impact related to the completion of the capital projects identified in this Sewer Facilities Plan (SFP). Furthermore, this chapter provides a review of the City's current rate structure with respect to rate adequacy and customer affordability. Current Financial Structure

This section summarizes the current financial structure used as the baseline for the capital financing strategy and financial forecast developed for this GSP.

9.2 CURRENT FINANCIAL STRUCTURE

9.2.1 Financial Plan

The City is responsible for funding all of its costs. The primary source of funding is derived from ongoing monthly charges for service, with additional revenues coming from annual permits, the sale of reclaimed water, and other miscellaneous revenue. The City controls the level of user charges and, subject to statutory authority, can adjust user charges as needed to meet financial objectives.

The financial plan can only provide a qualified assurance of financial feasibility if it considers the total system costs of providing sewer services, both operating and capital. To meet these objectives, the following elements have been completed:

1. **Capital Funding Plan**. Identifies the total Capital Improvement Plan (CIP) obligations of the planning period. The plan defines a strategy for funding the CIP including an analysis of available resources from rate revenues, existing reserves, connection charges, debt financing, and any special resources that may be readily available (e.g., grants, developer contributions, etc.). The capital funding plan impacts the financial plan through the use of debt financing (resulting in annual debt service) and the assumed rate revenue available for capital funding.
2. **Financial Forecast**. Identifies future annual non-capital costs associated with the operating, maintenance, and administration of the sewer system. Included in the financial plan is a reserve analysis that forecasts cash flow and fund balance activity along with testing for satisfaction of actual or recommended minimum fund balance policies. The financial plan ultimately 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. The plan also identifies the future adjustments required to fully fund all utility obligations in the projection period.

9.2.2 Capital Funding Plan

The CIP developed for this SFP identifies $13.3 million in project costs over the 6-year planning horizon and $26.5 million in the 20-year period. This CIP consists of 12 projects, including collection system upgrades, water valve replacements, STEP tank pump repair and replacement, and liquid stream upgrades. Costs are stated in 2015 dollars and are escalated by 2.65 percent annually to the year of planned spending for financing projections.

A summary of the 6-year and 20-year CIP is shown in Table 9-1. As shown, each year has varied capital cost obligations depending on construction schedules and infrastructure planning needs. Approximately 50.10 percent (2015 dollars) of the capital costs are included in the 6-year planning period. The liquid stream Alternative 2A project consists of 86.6 percent of the 6-year CIP. Table 9-2 provides more detail for the 6-year CIP.

Table 9-1. 6- and 20-year CIP

Year	2015 Dollars	Inflated
2016	$1,915,794	$1,966,559
2017	$246,000	$259,210
2018	$997,000	$1,078,375
2019	$1,794,220	$1,992,089
2020	$8,242,470	$9,393,960
2021	$55,000	$64,345
6-year total:	**$13,250,484**	**$14,754,538**
2022-2035	$13,201,171	$17,182,294
20-year total:	**$26,451,654**	**$31,936,832**

Table 9-2. 6-Year Detailed CIP (2015 Dollars)

Project	2016	2017	2018	2019	2020	2021
Liquid Stream Alternative 2A – Ballasted SBR Settling	$1,915,794	–	–	$1,470,220	$8,086,210	–
COM-1 – STEP tank pump repair and replacement	–	$35,000	$125,000	$125,000	$120,000	$45,000
COM-2 – Reserve fund for STEP tank replacement	–	$10,000	$10,000	$10,000	$10,000	$10,000
COM-3 – Convert shared STEP tanks to individual STEP tanks	–	$7,000	$7,000	$7,000	$7,000	–
COM-4 – Replace ARVs	–	$11,760	$11,760	$11,760	$11,760	–
RWOM-1 – Reclaimed water valve replacement	–	$12,000	$12,000	–	–	–
ADMIN-1 – Utility administration improvements	–	$7,500	$7,500	$7,500	$7,500	–
C-1 – Collection system upgrades	–	$162,740	$162,740	$162,740	–	–
RW-1 – Expand Cochrane Park RIBs	–	–	$661,000	–	–	–
Total:	**$1,915,794**	**$246,000**	**$997,000**	**$1,794,220**	**$8,242,470**	**$55,000**

9.2.3 Capital Financing Strategy

An ideal capital financing strategy would include the use of grants and low-cost loans when debt issuance is required. However, these resources are very limited and competitive in nature and do not provide a reliable source of funding for planning purposes. It is recommended that the City pursue these funding avenues but assume bond financing to meet needs for which the City's available cash resources are insufficient. Revenue bonds have been used as the debt funding instrument for the majority of the capital financing needs in this analysis. Based on the engineer's input, grants are assumed to fund $4 million of the overall funding needs associated with projects in 2020 and 2024.The capital financing strategy developed to fund the CIP identified in this SFP assumes the following funding resources:

- Accumulated cash reserves.
- Transfers of excess cash (over minimum balance targets) from the Operating Fund.
- A portion of annual revenue collections from System Development Charges.
- Interest earned on Capital Fund balances and other miscellaneous capital resources.
- Grant financing for $2 million in 2020 and $2 million in 2024.
- Revenue bond financing.

Based on information provided by the City, the sewer utility began 2016 with $1.46 million in the Operating Fund and $2.7 million in the Capital Fund. Additional funds beyond the Operating Fund maximum target of sixty days of cash operating expenses are transferred to the Capital Fund, ranging from a high of $881,000 in 2023 to a low of $155,000 in 2020.System development charge (SDC) revenue collections are assumed at an annual amount of $331,000 in 2016, increasing to $465,000 by 2035, and accounting for 52-73 new connections per year. The City uses 50 percent of annual SDC revenue to pay down debt, leaving approximately $166,000 to $233,000 in annual revenues available for capital projects.

The cash resources described above are forecasted to fund 100 percent of the 20-year CIP. Table 9-3 presents the corresponding 20-year capital financing strategy.

Table 9-3. 20-Year Capital Funding Strategy

Year	Capital Expenditures (2015 Dollars)	Capital Expenditures Escalated	Revenue Bond Financing	Grant	Cash Funding	Total Financial Resources
2016	$1,915,794	$1,966,559	–	–	$1,966,559	$1,966,559
2017	5246,000	$259,210	–	–	$259,210	$259,210
2018	5997,000	51,078,375	–	–	$1,078,375	$1,078,375
2019	51,794,220	51,992,089	–	–	$1,992,089	$1,992,089
2020	58,242,470	59,393,960	6,650,000	2,000,000	$743,960	$9,393,960
2021	$555,000	$564,345	–	–	$64,345	$64,345
Subtotal:	**$13,250,484**	**$14,754,538**	**$6,650,000**	**$2,000,000**	**$6,104,538**	**$14,754,538**
2022-2035	$13,201,171	$17,182,294	$10,500,000	$2,000,000	$4,682,294	$17,182,294
Total:	**$26,451,654**	**$31,936,832**	**$17,150,000**	**$4,000,000**	**$10,786,832**	**$31,936,832**

The 20-year capital funding plan identifies 33.78 percent cash funding for capital projects. The remaining capital costs are projected to be covered by revenue bond financing (53.70 percent) and grant funding (12.52 percent). This type of planning looks at average growth over the 20-year period, assumed to be 1.80 percent for the City. If growth is not occurring at the planned rate, the timing of capital projects will need to be adjusted accordingly.

9.3 AVAILABLE FUNDING ASSISTANCE AND FINANCING RESOURCES

Feasible long-term capital funding strategies must be defined to ensure that adequate resources are available to fund the CIP identified in this SFP. In addition to the City's resources such as accumulated cash reserves, capital revenues, and rate revenues designated for capital purposes, capital needs can be met from outside sources such as grants, low-interest loans, and bond financing. The following sections summarize the City's internal and external resources.

9.3.1 City Resources

Resources appropriate for funding capital needs include accumulated cash in the major capital fund, rate revenues designated for capital spending purposes, and capital-related charges such as the System Development Charge (SDC). The first two resources will be discussed in the Fiscal Policies section (9.4.2) of the Financial Forecast. Capital-related charges are discussed below.

9.3.1.1 Capital Connection Charges

A connection charge such as the SDC refers to a one-time charge imposed on new customers as a condition of connecting to the sewer system. Connection charges are separate from meter installation fees or similar charges for the labor and materials used to make a physical connection. The purpose of the connection charge is two-fold: to promote equity between new and existing customers and to provide a source of revenue to fund capital projects. Revenue can only be used to fund utility capital projects or to pay debt service incurred to finance those projects. The City currently charges all new customers a System Development Charge (SDC) of $6,394 per equivalent residential unit (ERU), which is defined as 875 cubic feet or less per month, based on water meter in-flow, or sewer effluent meter when installed by owner with approval of the City sewer department. In the absence of a connection charge, growth-related capital costs would be borne in large part by existing customers. In addition, the net investment in the utility already collected from existing customers would be diluted by the addition of new customers, effectively subsidizing new customers with prior customers' payments.

9.3.1.2 Local Facilities Charges

While a connection charge is the manner in which new customers pay their share of general facilities costs, local facilities funding is used to pay the costs of local facilities that connect each property to the system infrastructure. Local facilities funding is often overlooked in rate forecasting because it is funded up-front by either connecting customers, developers, or through an assessment to properties, but never from rates. Although these funding mechanisms do not provide a capital resource toward funding CIP costs, a discussion of these charges is included in this chapter because of the impact on new customers.

A number of mechanisms can be considered toward funding local facilities. One of the following scenarios typically occurs: (a) the utility charges a connection fee based on the cost of the local facilities (under the same authority as the SDC); (b) a developer funds extension of the system to its development and turns those facilities over to the utility (contributed capital); or (c) a local assessment is set up called a Utility Local Improvement District (ULID/LID) or a Local Utility District (LUD) which collects tax revenue from benefited properties.

A local facilities charge (LFC) is a variation of the connection charge authorized through RCW 35.92.025. It is a City-imposed charge to recover the cost related to service extension to local properties. Often called a front-footage charge and imposed on the basis of footage of the main "fronting" of a particular property, it is usually implemented as a reimbursement mechanism to a city for the cost of a local facility that directly serves a property. It is a form of connection charge and thus can accumulate up to 10 years of interest. It typically applies in instances when no developer-installed facilities are needed through developer extension due to the prior existence of available mains already serving the developing property.

The developer extension is a requirement that a developer install on-site and sometimes off-site improvements as a condition of extending service. These are in addition to the connection charge required and must be built to City standards. Part of the agreement between the City and the developer planning to extend service might include a late-comer agreement, resulting in a late-comer charge to new connections to the developer extension.

Latecomer charges are a variation of developer extensions whereby new customers connecting to a developer-installed improvement make a payment to the City based on their share of the developer's cost (RCW 35.91.020). The City passes this charge on to the developer who installed the facilities. As part of the developer extension process, this defines the allocation of costs and records latecomer obligations on the title of affected properties. No interest is allowed, and the reimbursement agreement cannot exceed 20 years in duration, unless a longer duration is approved by the City.

LID/ULID is another mechanism for funding infrastructure that assesses benefited properties based on the special benefit received by the construction of specific facilities (RCW 35.43.042). Most often used for local facilities, some ULIDs also recover related general facilities costs. Substantial legal and procedural requirements can make this a relatively expensive process, and there are mechanisms by which a ULID can be rejected.

9.3.2 Outside Resources

This section outlines various grant, loan, and bond opportunities available to the City through federal and state agencies to fund the CIP identified in the SFP.

9.3.2.1 Grants and Low Cost Loans

Historically, federal and state grant programs were available to local utilities for capital funding assistance. However, these assistance programs have been mostly eliminated, substantially reduced in scope and amount, or replaced by loan programs. Remaining miscellaneous grant programs are generally lightly funded and heavily subscribed. Nonetheless, the benefit of low-interest loans makes the effort of applying worthwhile. Grants and low-cost loans for Washington State utilities are available from the Department of Commerce including several assistance programs for which the City may be eligible:

- Public Works Trust Fund (PWTF) – Cities, counties, special purpose districts, public utility districts, and quasi-municipal governments are eligible to receive loans from the PWTF. Eligible projects include repair, replacement, and construction of infrastructure for domestic water, sanitary wastewater, stormwater, solid waste, road, and bridge projects that improve public health and safety, respond to environmental issues, promote economic development, or upgrade system performance. Currently, the Public Works Board has suspended the non-Construction Programs and significantly reduced funding to the construction loan program. The Public Works Board website notes that the next funding cycle is to be determined by funding levels in early 2016-17.

  In addition to lack of PWTF funding over the last few years, the Board must implement policies and procedures designed to maximize local government use of federal funds to finance local infrastructure including, but not limited to, Drinking Water State Revolving Funds (DWSRF) operated by the state departments of health and ecology. Projects that are eligible for drinking water state revolving funds are not eligible for

Public Works Board construction loans. Under this requirement, there are three ways in which a project can be considered eligible for a DWSRF loan:

1) Projects that have applied to the state revolving funds and are awaiting a funding decision.
2) Projects that have been rejected for funding solely due to not meeting readiness requirements.
3) Projects that have not applied, but would likely be eligible if the project applied and met the project readiness requirements.

When the program is funded and available, PWTF loans are available at interest rates ranging from 1.28 percent to 2.55 percent depending on the repayment term, with reduced interest rates available for all projects located in "distressed" communities. The standard loan offer is 2.55 percent interest repaid over a 5- to 20-year term. All loan terms are subject to negotiation and Board approval. Currently no local match is required and the maximum loan amount is $7 million per jurisdiction per biennium.

Information regarding the application process as well as rates and terms are posted on the PWTF website in early spring. The next application cycle is planned for the spring of 2016.

Further detail is available at http://www.pwb.wa.gov.

- State Water Pollution Control Revolving Fund (WAC 173-98): Managed by the Department of Ecology (Ecology), this program provides loan assistance to utilities for high-priority water quality projects consistent with the Clean Water Act. It is funded through federal capitalization grants, state matching funds, and principal and interest repayments. The program funds projects with a quantifiable water quality benefit, such as transitioning customers from septic to sewer.
- Infrastructure Assistance Coordinating Council: The Infrastructure Assistance Coordinating Council (Council) is comprised of state and local agencies whose function is to provide funding for infrastructure repair and development. Its purpose is to assist local governments in coordinating funding efforts for infrastructure improvements, and can be a valuable resource to provide awareness of any new funding opportunities.

9.3.2.2 Bond Financing

General Obligation Bonds – General Obligation (G.O.) bonds are bonds secured by the full faith and credit of the issuing agency, committing all available tax and revenue resources to debt repayment. With this high level of commitment, G.O. bonds have relatively low interest rates and few financial restrictions. However, the authority to issue G.O. bonds is restricted in terms of the amount and use of the funds, as defined by Washington constitution and statute. Specifically, the amount of debt that can be issued is linked to assessed valuation.

RCW 39.36.020 states:

(2)(a)(ii) Counties, cities, and towns are limited to an indebtedness amount not exceeding one and one-half percent of the value of the taxable property in such counties, cities, or towns without the assent of three-fifths of the voters therein voting at an election held for that purpose.

(2)(b) In cases requiring such assent counties, cities, towns, and public hospital districts are limited to a total indebtedness of two and one-half percent of the value of the taxable property therein.

While bonding capacity can limit availability of G.O. bonds for utility purposes, these can sometimes play a valuable role in project financing. A rate savings may be realized through two avenues: the lower interest rate and related bond costs; and the extension of repayment obligation to all tax-paying properties (not just developed properties) through the authorization of an ad valorem property tax levy.

Revenue Bonds – Revenue bonds are commonly used to fund utility capital improvements. The debt is secured by the revenues of the issuing utility. With this limited commitment, revenue bonds typically bear higher interest rates than G.O. bonds and also require security conditions related to the maintenance of dedicated reserves (a bond reserve) and financial performance (added bond debt service coverage). The City agrees to satisfy these requirements by resolution as a condition of bond sale.

Revenue bonds can be issued in Washington without a public vote. There is no bonding limit, except perhaps the practical limit of the utility's ability to generate sufficient revenue to repay the debt and provide coverage. In some cases, poor credit might make issuing bonds problematic.

9.4 FINANCIAL FORECAST

The financial forecast, or revenue requirement analysis, forecasts the amount of annual revenue that needs to be generated by user rates. The analysis incorporates operating revenues, O&M expenses, debt service payments, rate-funded capital needs, and any other identified revenues or expenses related to operations. The objective of the financial forecast is to evaluate the sufficiency of the current level of rates. In addition to annual operating costs, the revenue needs also include debt covenant requirements and specific fiscal policies and financial goals of the City.

The analysis determines the amount of revenue needed in a given year to meet that year's expected financial obligations. For this analysis, two revenue sufficiency tests have been developed to reflect the financial goals and constraints of the City: cash needs must be met and debt coverage requirements must be realized. In order to operate successfully with respect to these goals, both tests of revenue sufficiency must be met.

Cash Test – The cash flow test identifies all known cash requirements for the City in each year of the planning period. Typically these include O&M expenses, debt service payments, depreciation funding or directly funded capital outlays, and any additions to specified reserve balances. The total annual cash needs of the City are then compared to projected cash revenues using the current rate structure. Any projected revenue shortfalls are identified and the rate increases necessary to make up the shortfalls are established.

Coverage Test – The coverage test is based on a commitment made by the City when issuing revenue bonds and some other forms of long-term debt. For purposes of this analysis, revenue bond debt is assumed for any needed debt issuance. As a security condition of issuance, the City would be required per covenant to agree that the revenue bond debt would have a higher priority for payment (a senior lien) compared to most other expenditures; the only outlays with a higher lien are O&M expenses. Debt service coverage is expressed as a multiplier of the annual revenue bond debt service payment. For example, a 1.0 coverage factor would imply that no additional cushion is required. A 1.25 coverage factor means revenue must be sufficient to pay O&M expenses and annual revenue bond debt service payments, plus an additional 25 percent of annual revenue bond debt service payments. The excess cash flow derived from the added coverage, if any, can be used for either rate-funded capital expenditures or to build reserves. Targeting a higher coverage factor can help the City achieve a better credit rating and provide lower interest rates for future debt issues.

In determining the annual revenue requirement, both the cash and coverage sufficiency test must be met and the test with the greatest deficiency drives the level of needed rate increase in any given year.

9.4.1 Current Financial Structure

The City maintains a fund structure and implements financial policies that target management of a financially viable and fiscally responsible sewer system.

9.4.2 Fiscal Policies

A brief summary of the key financial policies employed by the City, as well as those recommended and incorporated in the financial program are discussed below.

Operating Fund – An operating reserve is designed to provide a liquidity cushion; it protects a utility from the risk of short-term variation in the timing of revenue collection or payment of expenses. Like other types of reserves, operating reserves also serve another purpose: operating reserves help smooth rate increases over time. Target funding levels for an operating reserve are generally expressed as a certain number of days of operating and maintenance (O&M) expenses, with the minimum requirement varying with the expected revenue volatility. Industry practice for utility operating reserves ranges from 30 days (8 percent) to 120 days (33 percent) of O&M expenses, with the lower end more appropriate for utilities with stable revenue streams and the higher end of the range more appropriate for utilities with significant seasonal or consumption-based fluctuations. The analysis assumes the City is to maintain a minimum balance in the operating fund equal to 60 days of O&M expenses.

Capital Fund – A capital contingency reserve is the minimum fund balance in a capital fund, set aside for capital needs that are large, urgent, and unexpected. These needs could result from a sudden asset failure, or could come from capital project cost overruns. There is more than one way to determine an appropriate level for this reserve. For instance, a utility could choose a certain percentage of the total cost of its assets, or it could base the minimum reserve on the cost of replacing a highly critical asset, or it could set the capital contingency as a percentage of average capital spending per year. The final target level should balance industry practice with the risk level of the City. The most common method is to set a minimum capital fund balance equal to 1 to 2 percent of the original cost of the WRF in service. Although the City does not have a formal policy regarding a minimum capital fund balance, discussions with City staff and consideration of industry standards established an internal target of 1 percent of fixed assets in the capital fund.

System Reinvestment – System reinvestment funding promotes system integrity through reinvestment in the system. Target system reinvestment funding levels are commonly linked to annual depreciation expense as a measure of the decline in asset value associated with routine use of the system. Particularly for utilities that do not already have an explicit system reinvestment policy in place, implementing a funding level based on full depreciation expense could significantly impact rates. This impact could be mitigated by phasing the funding in over a multi-year period, or by establishing a lower upfront funding target. A common alternative benchmark is annual depreciation expense net of debt principal payments on outstanding debt. This approach recognizes that customers are still paying for certain assets through the debt component of their rate, and intends to avoid simultaneously charging customers for an asset and its future replacement. The specific benchmark used to set system reinvestment funding targets is a matter of policy that must balance various objectives including managing rate impacts, keeping long-term costs down, and promoting “generational equity” (i.e., not excessively burdening current customers with paying for facilities that will serve a larger group of customers in the future). The City does not currently fund system reinvestment and it has not been included in this forecast.

Debt Management – It is prudent to consider policies related to debt management as part of broader utility financial policy structure. Debt management policies should be evaluated and formalized including the level of acceptable outstanding debt, debt repayment, bond coverage and total debt coverage targets. The sewer utility does not currently hold any revenue bonds; however, revenue bonds are forecasted in the future to fund the capital improvement program. Once revenue bonds are issued, the City will aim to meet a debt service coverage ratio of 1.50 and is forecasted to remain at or above this ratio throughout the study period.

9.4.2.1 Financial Forecast

The financial forecast is developed from 2016 budget documents along with other key factors and assumptions to develop a complete portrayal of the City's annual financial obligations. The following is a list of the key revenue and expense factors and assumptions used to develop the financial forecast:

- **Revenue** – The City has two general revenue sources: revenue from charges for service (rate revenue) and miscellaneous (non-rate) revenue. In the event of a forecasted annual shortfall, rate revenue can be increased to meet the annual revenue requirement. Non-rate revenues are forecast to escalate based on general cost inflation.
- **System Development Charge** – The current system development charge (SDC) is $6,394 and is forecast to remain at that level throughout the study period. The SDC is expected to generate between $331,000 in 2016 and $465,000 in 2035 collected from 52 to 73 new connections. This money is used to fund growth related capital projects.
- **Growth** – Rate revenue is escalated based on the growth rate of 1.80 percent per year established in discussions with the City and is in-line with the City's recent experience.
- **Expenses** – O&M expense projections are based on the 2016 budget and are forecasted to increase with construction cost inflation of 2.65 percent, labor cost inflation of 2.87 percent, medical cost inflation of 10.00 percent, and a weighted inflation factor averaging 3.31 percent throughout the study period. The weighted inflation factor was developed in conjunction with the engineers to represent the changes to the treatment O&M expenses as additional capital improvements are made. This weighted factor represents the combination of the inflationary increases discussed above and the increase to the treatment related expenses. Budget 2016 figures were used for 2016 taxes; future taxes are calculated based on forecasted revenues and prevailing tax rates.
- **Existing Debt** – The City currently has a total of three outstanding sewer debt issues, including two Ecology loans and one United States Department of Agriculture (USDA) loan. Annual payments range from $363,000 decreasing to $163,000 and expire between 2017 and 2039.
- **Future Debt** – The capital financing strategy developed for this SFP forecasts the need to issue $17.15 million in new debt in two separate issuances. The first issuance will occur in 2020 for $6.65 million and the second will occur in 2024 for $10.50 million. The addition of this new debt adds $603,000 in annual debt service in 2020, increasing to $1.6 million in 2024 when the second bond is issued. The analysis performed assumes all revenue bond financing.
- **Grant Assumptions** – In addition to future debt assumptions, per the request of the consultant engineer, the capital financing strategy also assumes grant proceeds in years 2020 and 2024 to cover approximately 19 percent of the overall capital financing needs; a combined total of $4.0 million.

- **Revenue Bond Assumptions** – The forecast assumes a revenue bond interest rate of 5.25 percent, an issuance cost of 1.5 percent, and a term of 20 years.
- **Transfer to Capital Fund** – Any Operating Fund balance above the maximum target is assumed to be available to fund capital projects and is projected to be transferred to the Capital Fund each year. The 2016 Operating Fund balance is expected to end the year at 60 days of O&M expenses, which is the maximum target for that year. The 2016 Capital Fund balance is expected to end the year at approximately $2.23 million, which is about $1.8 million over the minimum target. The Operating Fund Balance is expected to meet the targeted 60 days of O&M expenses in all years of the study period. The Capital Fund Balance is expected to meet the targeted 1 percent of assets for all years except 2025 when large capital spends are recognized.

Although the financial plan is completed for the 20-year time horizon of this SFP, the rate strategy focuses on the shorter term planning period of 2016 through 2021. It is imperative that the City revisit the proposed rates every 2 to 3 years to ensure that the rate projections developed remain adequate. Any significant changes should be incorporated into the financial plan and future rates should be adjusted as needed.

Table 9-4 summarizes the annual revenue requirements based on the forecast of revenues, expenditures, fund balances, and fiscal policies.

The financial forecast indicates the need for rate increases of 8.10 percent in years 2017 through 2021. While the utility is currently covering existing O&M expenses, the rate increases beginning in 2017 are necessary to support new future debt service to fund the capital program while aiming to meet target balances in the operating and capital funds. Initializing rate increases in 2017 allows for level rate increases throughout the study period, helping to build up fund balances in preparation for new debt service and large capital spending. The level rate increases avoid the need for a much larger increase in 2020 when the first debt issuance occurs. As mentioned previously, this forecast assumes grant funding of $2.0 million in 2020 followed by another $2.0 million in 2024. If this level of grant funding is not recognized in the future, rate increases will need to be on the order of 10.25 percent annually and an additional $2.2 million in revenue bonds will need to be issued to fund the capital program.

9.4.3 City Funds and Reserves

Table 9-5 shows a summary of the projected Operating Fund and Capital Fund ending balances through 2021 based on the rate forecasts presented above. The combined minimum target balance is based on 60 days of O&M expenses plus one percent of fixed assets. Ending balances stay above the minimum balances for all years in the forecast period with the exception of 2025 when large capital expenses are recognized. The utility is able to meet the minimum target balance the year following the deficient year, as well as all other years in the forecast period.

Table 9-4. 6-Year Financial Forecast

Revenue Requirement	2016	2017	2018	2019	2020	2021
Revenues						
Rate Revenues Under Existing Rates	$2,000,000	$2,036,000	$2,072,648	$2,109,956	$2,147,935	$2,186,598
SDC Revenue Towards Debt	$165,597	$168,578	$171,612	$174,701	$177,846	$181,047
Non-Rate Revenues	$36,985	$35,404	$36,200	$39,563	$40,422	$44,319
Total Revenues:	**$2,202,582**	**$2,239,982**	**$2,280,460**	**$2,324,219**	**$2,366,202**	**$2,411,963**
Expenses						
Cash Operating Expenses	$1,774,802	$1,844,397	$1,903,026	$1,964,128	$2,027,442	$2,120,334
Existing Debt Service	$363,382	$363,382	$270,127	$270,127	$270,127	5270,127
New Debt Service	–	–	–	–	$603,493	$603,493
Rate Funded System Reinvestment	–	–	–	–	–	–
Total Expenses:	**$2,138,184**	**$2,207,778**	**$2,173,153**	**$2,234,255**	**$2,901,061**	**$2,993,953**
Net Surplus (Deficiency)	$64,398	$32,203	$107,307	$89,965	$(534,859)	$(581,990)
Additions to Meet Coverage	–	–	–	–	–	–
Total Surplus (Deficiency):	**$64,398**	**$32,203**	**$107,307**	**$89,965**	**$(534,859)**	**$(581,990)**
Annual Rate Adjustment		**8.10%**	**8.10%**	**8.10%**	**8.10%**	**8.10%**
Cumulative Annual Rate Adjustment		**8.10%**	**16.86%**	**26.32%**	**36.55%**	**47.61%**
Rate Revenues After Rate Increase	$2,000,000	$2,187,173	$2,406,892	$2,648,684	$2,914,765	$3,207,577
Additional Taxes from Rate Increase	-	$13,009	$28,763	$46,360	$65,989	$87,860
Net Cash Flow After Rate Increase:	**$64,398**	**$170,367**	**$412,788**	**$582,333**	**$165,982**	**$351,129**

Table 9-5. Ending Cash Balance Summary

Ending Fund Balances	2016	2017	2018	2019	2020	2021
Operating Fund	$291,748	$303,189	$312,826	$322,870	$333,278	$348,548
Capital Fund	$2,233,915	$2,403,505	$2,001,527	$863,262	$553,867	$1,009,198
Total:	**$2,525,663**	**$2,706,694**	**$2,314,353**	**$1,186,133**	**$887,145**	**$1,357,746**
Combined Minimum Target Balance	*$713,936*	*$727,968*	*$748,390*	*$778,355*	*$882,702*	*$898,615*

9.5 CURRENT AND PROJECTED RATES

9.5.1 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 9-6 shows the existing rate structure.

Table 9-6. 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.

9.5.2 Projected Rates

The analysis for this SFP shows a need for increases of 8.10 percent per year from 2017 through 2021. Table 9-7 shows the proposed rates for the 6-year planning period.

Table 9-7. 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 9-8 shows residential monthly bill comparisons for the proposed annual increases.

Table 9-8. 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

9.6 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 9-9 presents the City's rates with the projected rate increases for the forecast period, tested against the 2.0 percent monthly affordability threshold.

Table 9-9. 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.

9.7 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 chapter 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 chapter 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.

10. PUBLIC INVOLVEMENT

This chapter summarizes the opportunities for public involvement in the preparation of this Sewer Facilities Plan, both during the development process as well as through review and comment of the draft Sewer Facilities Plan. This chapter also identifies comments received from public, regulatory agency, and tribal stakeholders upon review of the draft Sewer Facilities Plan, and documents how these comments were addressed in the final Sewer Facilities Plan.

10.1 PUBLIC INVOLVEMENT PROCESS

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, February 25, 2015) – Facility Plan Status Update.
- Meeting (Wednesday, August 26, 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 and have been included in Appendix I.

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.

10.2 COMMENTS FROM AGENCIES, TRIBAL, AND PUBLIC STAKEHOLDERS

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.

11. REFERENCES

AACE (Association for the Advancement of Cost Engineering). 2005. Cost estimate classification system – as applied in engineering, procurement, and construction for the process industries. AACE International Recommended Practice No. 18R-97.

Ecology (Washington State Department of Ecology). 2008. Criteria for sewage works design: water quality program. Publication No. 98-37 WQ. Washington State Department of Ecology, Olympia, Washington.

EPA (U.S. Environmental Protection Agency). 1974. Design criteria for mechanical, electric, and fluid systems and component reliability. EPA-430-99-74-01. EPA Office of Water Program Operations, Municipal Construction Division. Washington, D.C.