1. INTRODUCTION

1.1 PURPOSE AND SCOPE

As documented in the approved 2013 *City of Yelm General Sewer Plan* (Yelm GSP), the City of Yelm (City) will review critical upgrade requirements for their existing Water Reclamation Facility (WRF). This Sewer Facilities Plan (Plan) describes the development and evaluation of alternatives for liquid and solids waste stream treatment upgrades at the City's WRF. This Plan has been prepared in accordance with Washington Administrative Code (WAC) 173-240. Completing the projects recommended in this Plan will allow the City to provide continued reliable reclaimed water production, wastewater treatment, and waste solids handling to the City of Yelm while protecting and preserving the surrounding environment.

1.2 BACKGROUND

1.2.1 History of Wastewater Treatment in Yelm

As of 2011, the City's wastewater system was estimated to serve approximately 6,340 people (Source: Yelm GSP Table 2-4). It was also reported in the Yelm GSP that as of 2011, 8,201 people lived within the City's Urban Growth Area (UGA). For additional reference, the latest United States Census Bureau (as of July 1, 2013) estimates the City of Yelm population living within city limits at 7,639. The Washington State Office of Financial Management (OFM) estimates the City of Yelm population, as of April 1, 2015, at 7,915.

Due to groundwater contamination with high levels of nitrate from individual business and home septic fields, Washington State Department of Health (DOH) cited the public water supply of Yelm as a potential health hazard in 1988. Yelm was required to install a sanitary sewer system and treatment plant to correct this problem. In 1994, a Septic Tank Effluent Pump (STEP) sewer system and 0.3-million-gallons-per-day (mgd) Lagoon Wastewater Treatment Plant were constructed. In 1999, a Water Reclamation Facility (WRF) was constructed at the original lagoon treatment plant site in order to provide Class A reclaimed water production. The WRF construction was performed in response to a Shoreline Permit stipulation for the Lagoon Wastewater Treatment Plant (WWTP) that mandated the City of Yelm to transition from stream discharge to a new method and location to discharge its treated wastewater.

Historically, effluent from the WRF has either been discharged via a Side Channel Outfall into the Centralia Power Canal (which drains into the Nisqually River) or delivered into the City's reclaimed water supply system. The current reclaimed water supply system delivers reuse water for city-wide landscape irrigation, maintenance of the City's Cochrane Park wetland water features, or for surface percolation in the City's Cochrane Park Rapid Infiltration Basins (RIBs) in support of the City's Water Right Mitigation Plan. In addition, an emergency Side Channel Outfall discharge is maintained directly to the Nisqually River, but it is only used when the Centralia Power Canal is taken out of service for inspection and maintenance.

The City currently does not have the ability to achieve 100 percent reuse year round so the Shoreline Permit was renegotiated in 2002 to allow the City to maintain the Nisqually River outfall as an emergency outfall only and the Centralia Power Canal outfall as a standby outfall.

1.2.2 Sewer Facilities Plan Objectives

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

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

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

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

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

> *Key objectives of this Sewer Facilities Plan for the City of Yelm are:*
>
> - *Producing an uninterrupted, year-round supply of Class A reclaimed water.*
> - *Planning for the expected 2030 growth flows and the projected 1.22-mgd design flow capacity of the WRF.*

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

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

1.3 PLAN REQUIREMENTS

This Plan was prepared for submittal to the Department of Ecology (Ecology) in accordance with WAC 173-240, and the guidance of the State of Washington *Criteria for Sewage Works Design* (the "Orange Book"; Ecology, 2008). The Plan also meets the requirements of a Facilities Plan as defined by 40 Code of Federal Regulations (CFR) 35.719-1.

The owner and operator of the existing WRF is the City of Yelm. The City Project Representative is:

Ryan Johnstone, P.E.
Public Works Director
901 Rhoton Road
Yelm, WA 98597
Phone: 360-458-8499
Fax: 360-458-8417
Email: ryanj@ci.yelm.wa.us

This plan document has been prepared by:

Parametrix, Inc.
1019 39th Avenue SE, Suite 100
Puyallup, WA 98374
Phone: 253-604-6600
Fax: 1-855-542-6353
Website: www.parametrix.com

1.4 AUTHORITY AND MANAGEMENT

The City of Yelm owns, operates, and maintains the WRF site and facilities within the WRF site located just to the north of the City Center. The City owns, operates, and maintains the wastewater STEP-based wastewater collection system which is described in Chapter 2 of this Plan.

1.5 RELATED WASTEWATER PLANNING STUDIES

The following previous studies and planning documents were used in the preparation of this Plan:

- 2013 *City of Yelm General Sewer Plan* (Yelm GSP), Brown and Caldwell, 2013.
- 2010 *City of Yelm Water System Plan* (Yelm WSP), Brown and Caldwell, 2010.
- 2009 *City of Yelm Comprehensive Plan and Joint Plan with Thurston County* (Yelm Comprehensive Plan), City of Yelm, 2009.
- *Infiltration/Inflow: I/I Analysis and Project Certification*. Publication No. 97-03. Environmental Protection Agency. May 1985.
- *Water Reclamation and Reuse Standards*. Publication No. 97-23. Washington State Departments of Health and Ecology. September 1997.
- Fact Sheet and Fact Sheet Addendums for National Pollutant Discharge Elimination System (NPDES) Permit No. WA0040762; Yelm Water Reclamation Facility. Washington State Department of Ecology. 2011. (Appendix C)
- *City of Yelm Water Right Mitigation Plan*. Mitigation for City of Yelm Water Right Application: G2-29085 Priority Date January 10, 1994. February 2011.

- *City of Yelm Water Reclamation Facility and Unit Process Capacity Analysis Technical Memorandum*, Parametrix, 2013. (Appendix D)
- *Yelm WRF Existing Sequencing Batch Reactor BioWin Model Memorandum*, Evoqua JetTech, 2014. (Appendix E)
- *City of Yelm Test Report for Pilot Denitrifying Filter Unit Technical Memorandum*, Parametrix, 2015. (Appendix F)

2. PLANNING AREA CHARACTERISTICS

2.1 WASTEWATER SERVICE AREA

2.1.1 Existing Service Area

The City of Yelm is located about 17 miles southeast of Olympia, Washington, near the eastern boundary of Thurston County, as shown in Figure 2-1, City of Yelm Vicinity Map (Reference Figure 1-1, Yelm GSP). The City covers approximately 3,635 acres (5.7 square miles), which includes the Thurston Highlands Master Planned Community (MPC) (1,240 acres, 1.9 square miles) and the Tahoma Terra MPC (220 acres, 0.34 square miles). An additional 2,390 acres (3.7 square miles) lie outside city limits but within the City's UGA. The UGA represents all of the Yelm vicinity likely to be needed to accommodate urban growth over the next 20 years. Relative locations of the MPCs above are shown in Figure 2-2, City of Yelm Master Planned Communities (Reference Figure 2-1, Yelm GSP).

The City-owned and operated wastewater collection and treatment system currently serves a portion of the area within Yelm city limits and UGA. The City's existing wastewater service area is shown in Figure 2-2, City of Yelm Existing Sanitary Sewer Service Area (Reference Figure 1-2, Yelm GSP).

No other sewer agencies are located directly adjacent to the Yelm city limits or UGA. The nearest municipally sewered area is in Lacey, Washington (approximately 10 miles to the northwest). The Nisqually Indian Tribe, which is in the process of constructing a membrane bioreactor (MBR) treatment facility for its sewer service area, is located approximately 5 miles northwest of Yelm on State Route (SR) 510.

The City's existing wastewater service area is sewered by a septic tank effluent pumping (STEP) collection system. The STEP collection system consists of either individual STEP tanks located at buildings or common STEP tanks serving multiple residences or commercial structures. Solids in the wastewater settle in the STEP tank, and the effluent is pumped through smaller-diameter pressure mains to the WRF. These pipelines are generally located in the public right-of-way and serve most, but not all, of the buildings within the city limits.

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

As of 2011, the existing service area collection system consisted of approximately 2,125 STEP tanks, 759 valves, and 40 miles of STEP collection line. City mapping data from 2011 shows that three STEP tanks were in service outside city limits and within the UGA. These include a residential home, a duplex, and a church. Locations of the City's existing STEP tanks are shown in Figure 2-3, City of Yelm Existing Sewer System (Reference Figure 3-2, Yelm GSP).

2.1.2 Unsewered Areas

Other areas within city limits are still served by private on-site septic systems and are termed unsewered areas. Several pockets of unsewered areas exist within the city limits. Land within these areas is subject to the Yelm Municipal Code (YMC), ordinances, resolutions, and policies.

Per the Yelm GSP, it was estimated that 157 parcels within city limits were determined to contain septic tanks not yet connected to the City's STEP wastewater collection system.

In addition, numerous other parcels with unsewered private septic systems exist outside the city limits and are located within the UGA.

Specific unsewered parcel areas can be identified in Figure 2-3, City of Yelm Existing Sewer System (Reference Figure 3-2, Yelm GSP).

2.1.3 Future Service Area

The future sewer service area, as shown in Figure 2-4, City of Yelm Future Sanitary Sewer Service Area "Without MPC Scenario" (Reference Figure 2-2, Yelm GSP), is consistent with the Growth Management Act (GMA). Per the Yelm GSP, the City of Yelm intends to provide sewer service within its entire UGA except for the Thurston Highlands MPC area (identified as the "Without MPC" scenario in the Yelm GSP). The Tahoma Terra MPC area is included in the City's current and future wastewater service areas. Therefore, wastewater collection and treatment service for the Thurston Highlands MPC area will be developed under another separate, distinct wastewater facilities plan and treatment facility.

2.2 POTABLE WATER FACILITIES

2.2.1 Purveyors

The City of Yelm provides potable water service for the majority of the City's current and future wastewater service area. Figure 2-5, City of Yelm Existing Water System Map (Reference Figure 1-3, Yelm WSP) illustrates the City's existing water system facilities. There are a number of other non-City water purveyors within or adjacent to the City sewer service area. Figure 2-6, City of Yelm Neighboring Water Purveyors (Reference Figure 1-2, Yelm WSP) provides the information on the relative locations of neighboring water purveyors.

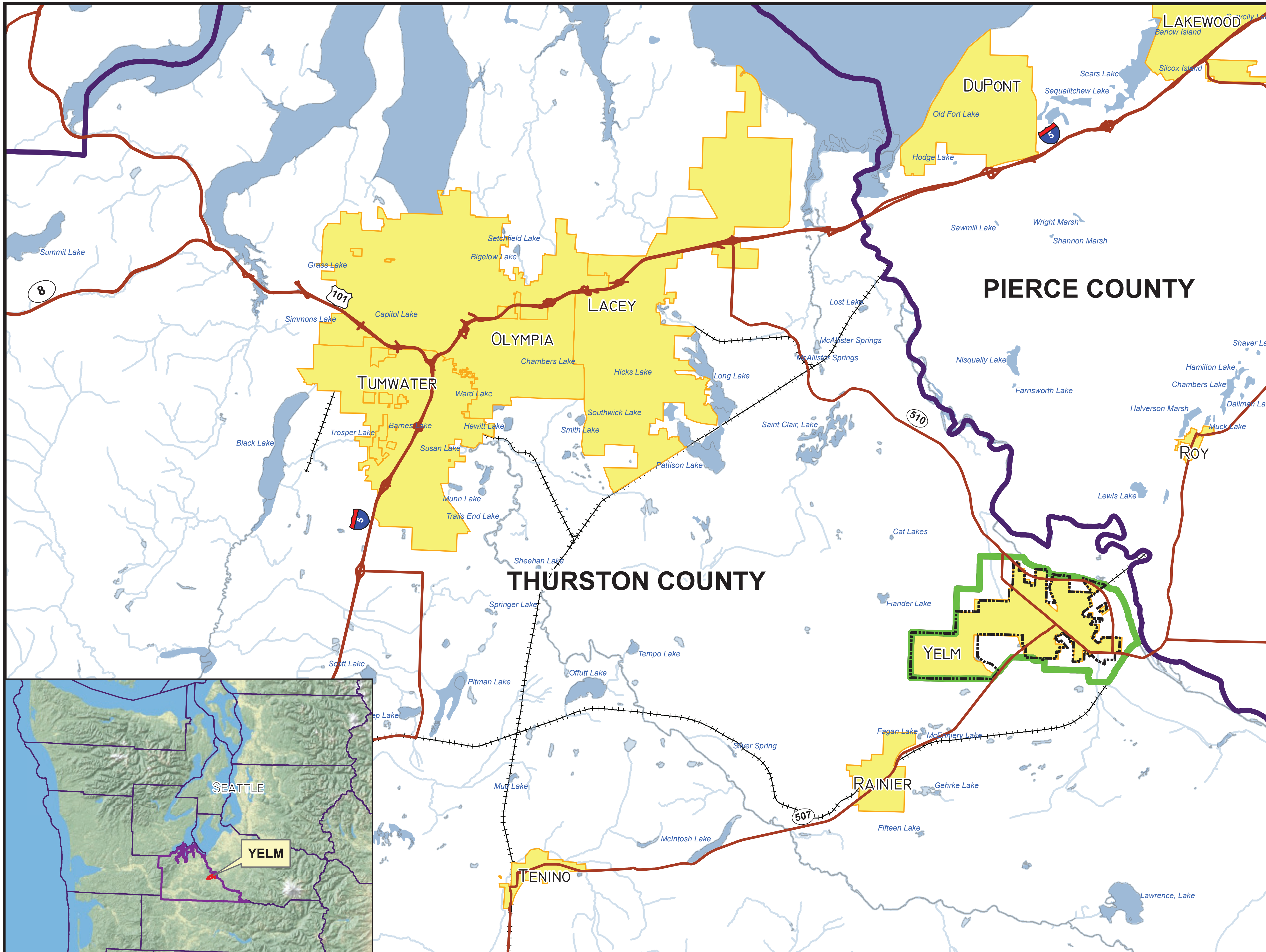
As described in the Yelm WSP, the existing potable water system consists of one well field comprising two active wells, a chlorine treatment system located at the well site, two 500,000-gallon storage reservoirs, and approximately 53 miles of distribution pipe. The entire water system is currently located in a single pressure zone. The City is currently in the process of constructing a new potable water well and storage facilities in the Thurston Highlands MPC area.

The water utilities or sources of supply are not impacted by the City's WRF current and planned modes of effluent discharge per the Washington State Environmental Policy Act (SEPA) Environmental Checklist (see Appendix I).

2.2.2 Water Use Efficiency

The City established a water conservation program in 2003 (Resolution 433, see Appendix 4F of the Yelm WSP). Previous DOH planning guidelines required that the City develop a conservation program consistent with DOH's Conservation Planning Requirements. The 2002 *City of Yelm Water System Plan* showed how the City was complying with those guidelines. Since that time, the Water Use Efficiency Guidebook has replaced the Conservation Planning Requirements. The City is already in compliance with DOH requirements related to water use efficiency (WUE) as described in Chapter 4 of the Yelm WSP. Key water use efficiency goals as spelled out in the Yelm WSP include:

- Increase Reclaimed Water Usage.
- Reduce Distribution System Leakage.
- Reduce Annual Residential Consumption.



Legend

- Yelm City Limits
- Urban Growth Area
- Roads
- Cities
- County Line

N

0 10,000 Feet

Figure 2-1
City of Yelm Vicinity Map

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

YELM WASHINGTON
PRIDE OF THE PRAIRIE

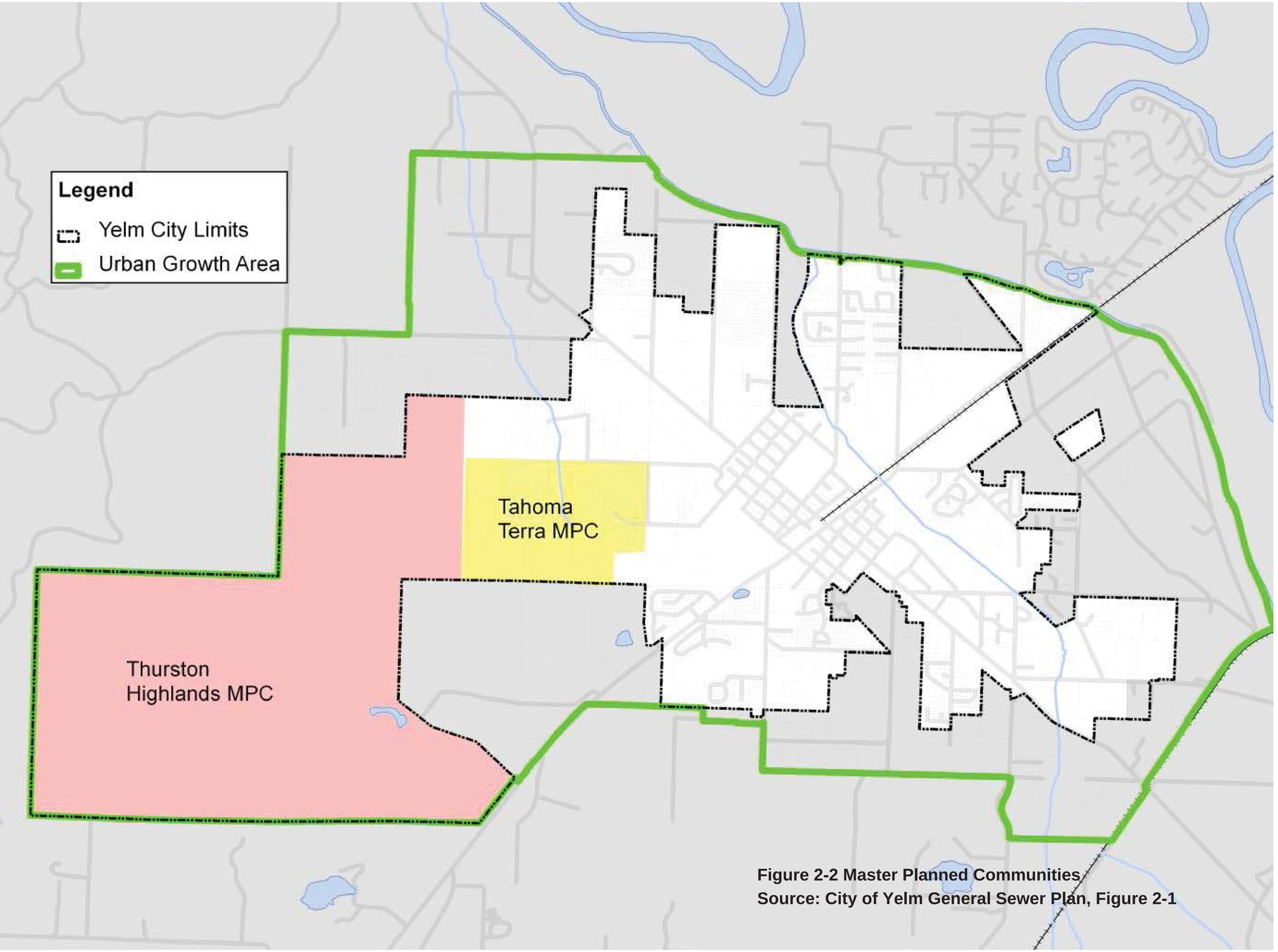
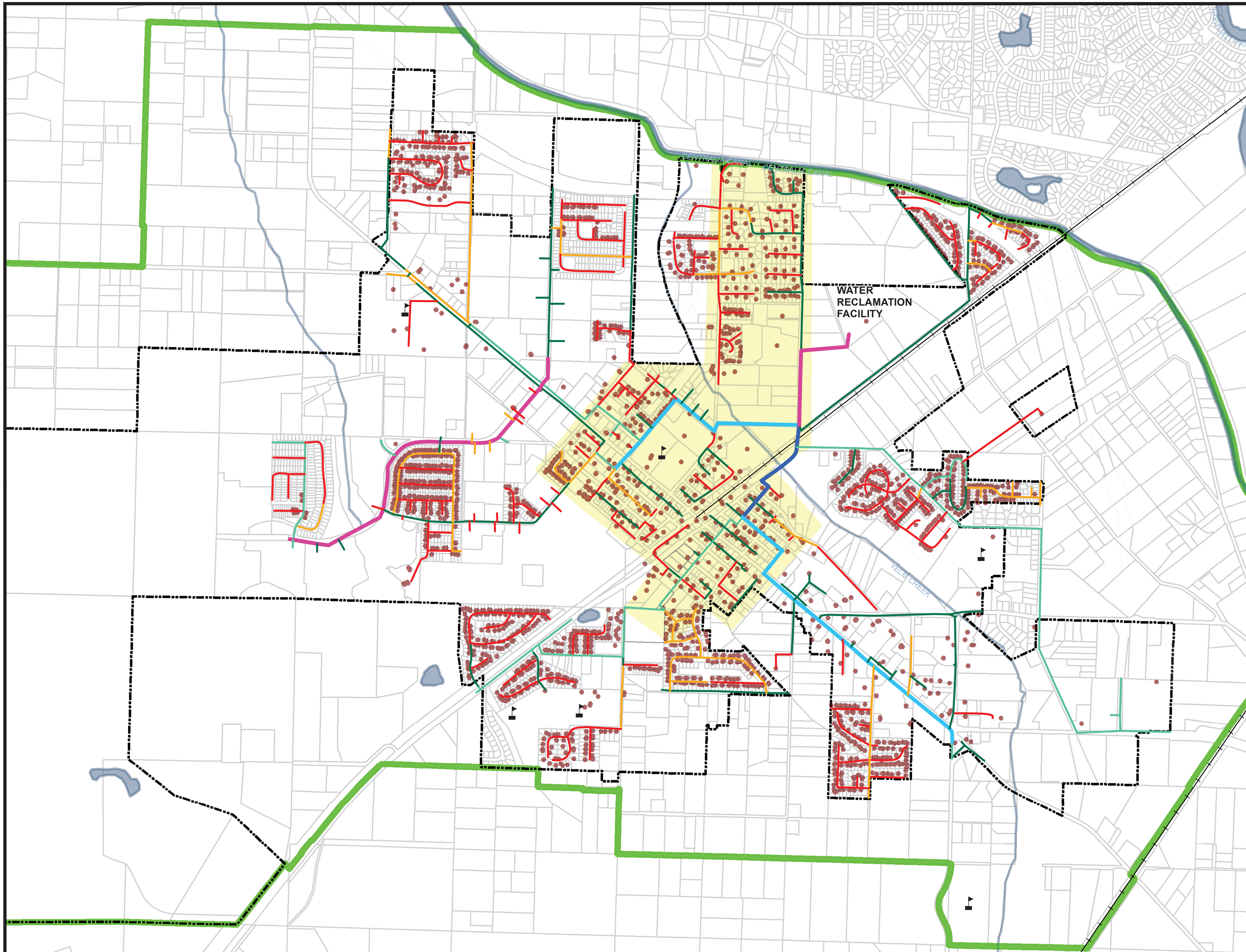


Figure 2-2 Master Planned Communities
Source: City of Yelm General Sewer Plan, Figure 2-1



Legend

- Yelm City Limits
- Urban Growth Area
- School
- STEP Tank

City Owned STEP Pipes

Pipe Diameter

- 2 Inch
- 3 Inch
- 4 Inch
- 6 Inch
- 8 Inch
- 10 Inch
- 12 Inch
- Approx. 1994 STEP System Limits

STEP Tank Data provided by City Sewer Department August, 2011.

N

0 1,500 Feet

1 inch = 1,500 feet

Figure 2-3
City of Yelm
Existing Sewer System

Source: City of Yelm General Sewer Plan, Figure 3-2

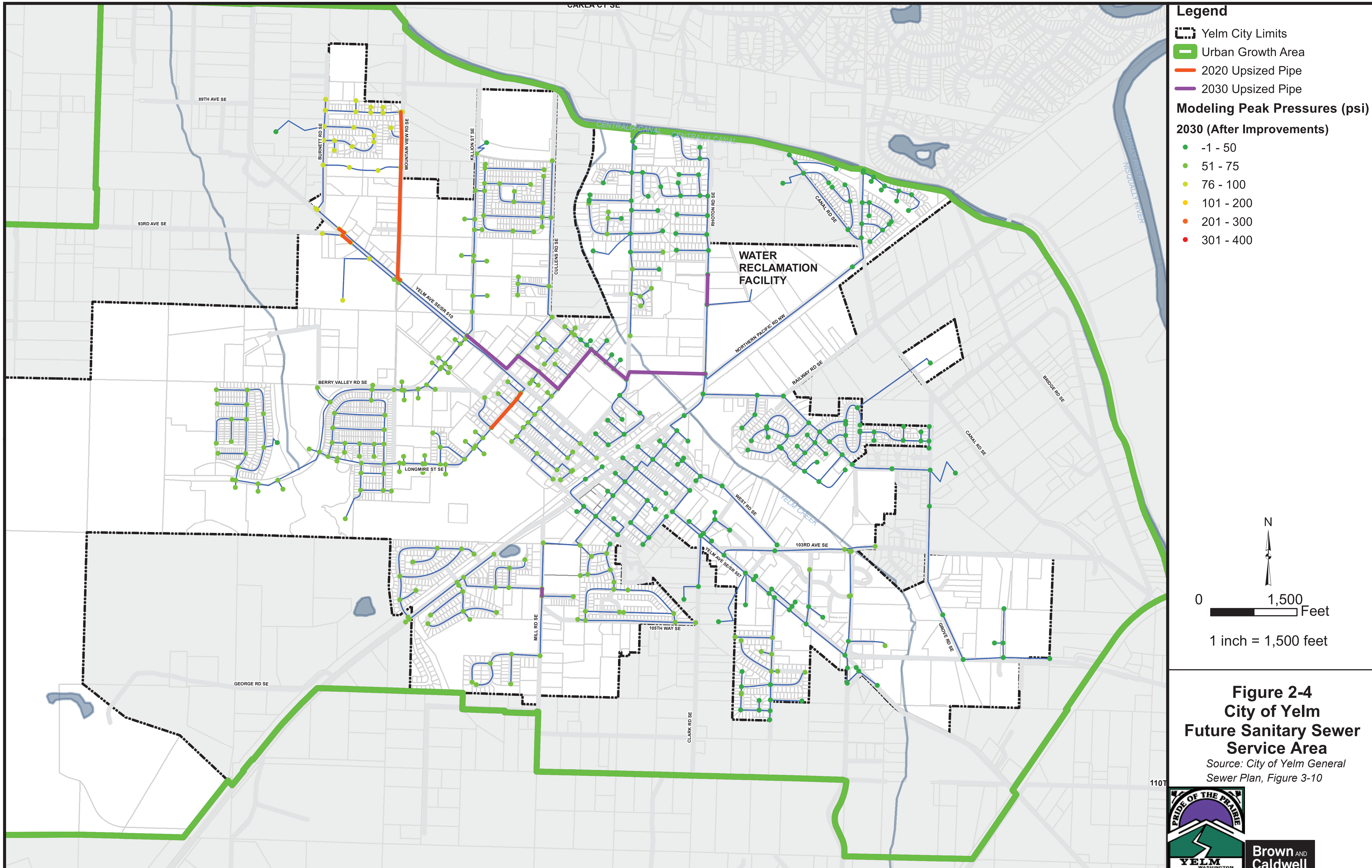


Figure 2-4
City of Yelm
Future Sanitary Sewer Service Area

Source: City of Yelm General Sewer Plan, Figure 3-10

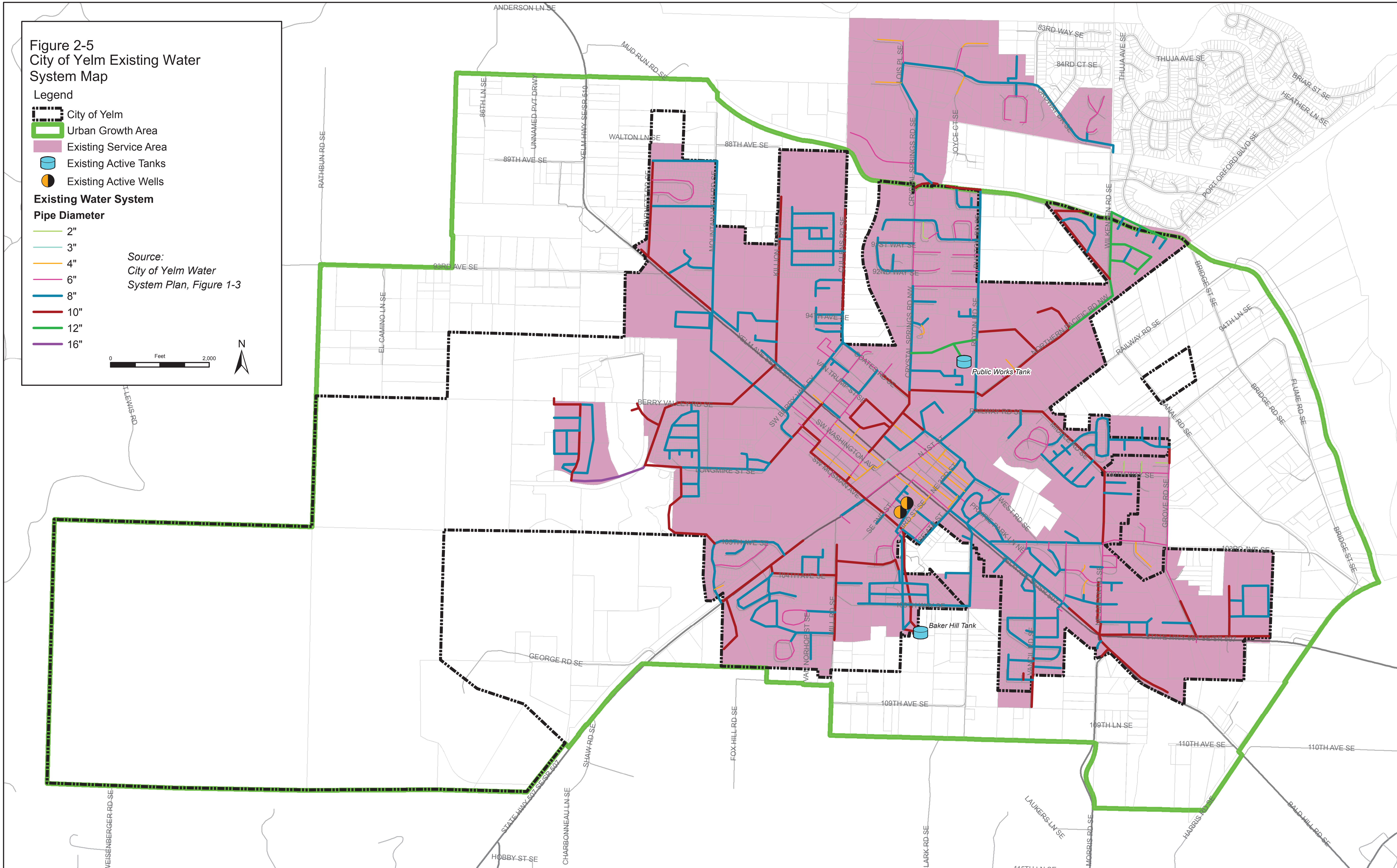


Figure 2-5
City of Yelm Existing Water System Map
Legend
City of Yelm
Urban Growth Area
Existing Service Area
Existing Active Tanks
Existing Active Wells
Existing Water System
Pipe Diameter
2"
3"
4"
6"
8"
10"
12"
16"
Source:
City of Yelm Water System Plan, Figure 1-3
0
Feet
2,000
N
Public Works Tank
Baker Hill Tank
ANDERSON LN SE
MUD RUN RD SE
WALTON LN SE
88TH AVE SE
89TH AVE SE
93RD AVE SE
RATHBUN RD SE
EL CAMINO LN SE
BERRY VALLEY RD SE
LONGMIRE ST SE
GEORGE RD SE
SHAW RD SE
FOX HILL RD SE
109TH AVE SE
109TH LN SE
110TH AVE SE
HOBBY ST SE
CHARBONNEAU LN SE
WEISENBERGER RD SE
CLARK RD SE
115TH LN SE
LAUKERS LN SE
MORRIS RD SE
HARRIS RD SE
BALD HILL RD SE
BRIDGE ST SE
BRIDGE RD SE
FLUME RD SE
CANAL RD SE
RAILWAY RD SE
94TH LN SE
THUJA AVE SE
83RD WAY SE
84RD CT SE
BRIAR ST SE
HEATHER LN SE
PORT ORFORD BLVD SE
WILKENSEN RD SE
CRYSTAL SPRINGS RD NW
JOYCE CT SE
91ST WAY SE
92ND WAY SE
94TH AVE SE
SW WASHINGTON AVE
SW MOSMAN AVE
VAN TRUMP ST SE
PRAIRIE PARK LN NE
WEST RD SE
GROVE RD SE
103RD AVE SE
MILL RD SE
VANCIL RD SE
STATE HWY 507 SE/SR 507
YELM HWY SE/SR 510
86TH LN SE
UNNAMED PVT DRWY

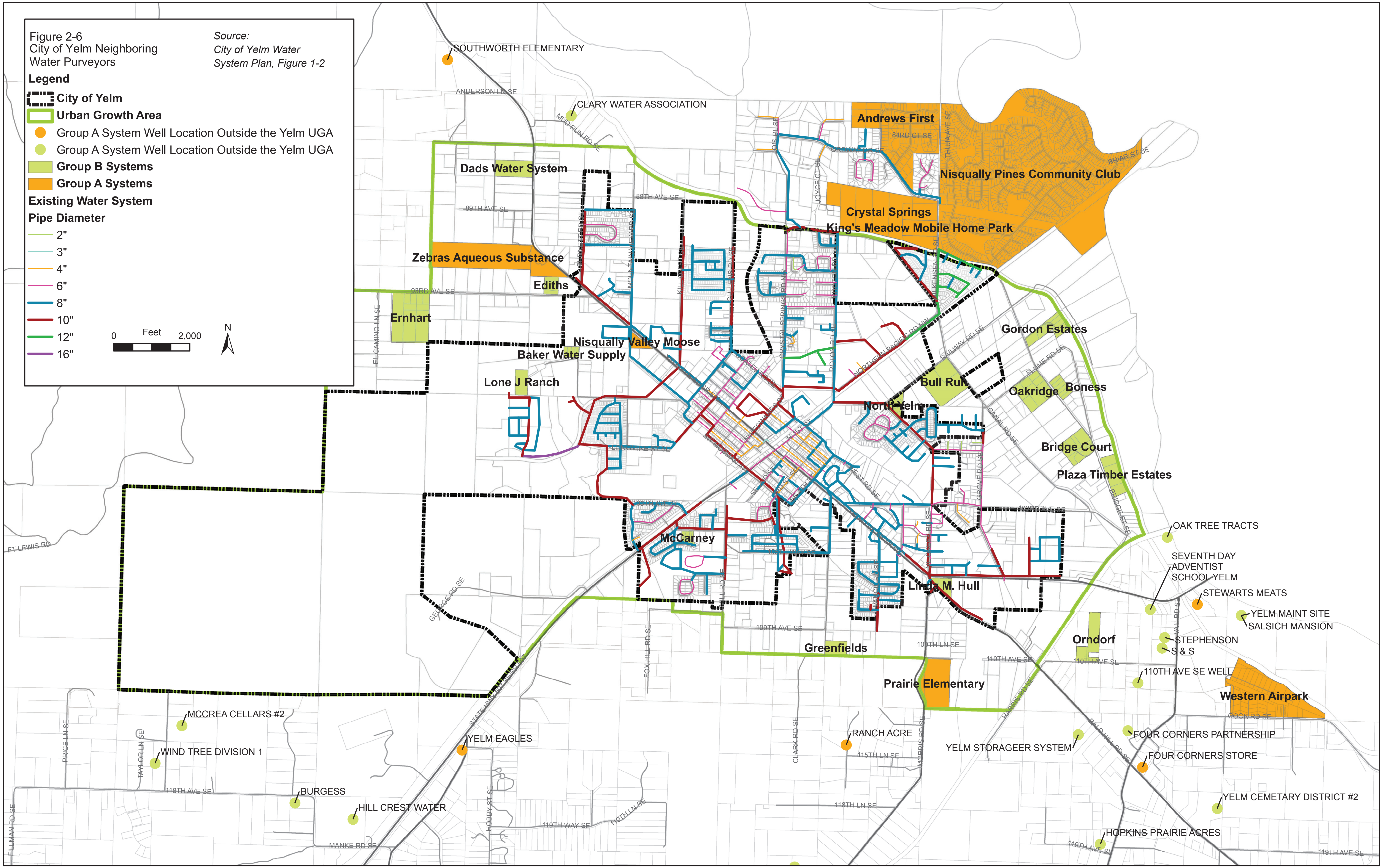


Figure 2-6
City of Yelm Neighboring Water Purveyors

Source:
City of Yelm Water System Plan, Figure 1-2

2.3 WATER RECLAMATION

The City of Yelm's WRF was one of the first facilities in Washington capable of treating 100 percent of its influent raw wastewater to Class A reclaimed water standards.

After treatment, approximately 34 percent of the reclaimed water that is produced is distributed for beneficial uses, such as irrigation or groundwater recharge through RIBs. The City discharges reclaimed water to the Centralia Power Canal during periods when demand for reclaimed water is low or when treated effluent cannot be treated to Class A standards. The outfall in the Nisqually River is maintained for emergency use only. The reclaimed water produced at the WRF is distributed to customers throughout the service area, including irrigation customers at schools, commercial landscaping, parks, and City streetscapes; commercial applications such as a school bus washing facility; and groundwater recharge at the City's Cochrane Park.

The City's reclaimed water system is currently part of the wastewater utility and is primarily operated by Wastewater Department staff. Wastewater Department staff also operate components of the reclaimed water distribution system, including meter readings and cross-connection control (CCC).

The existing reclaimed water system components are shown in Figure 2-7, City of Yelm Existing Reclaimed Water System (Reference Figure 5-1, Yelm GSP).

In 2009, the City prepared a Draft *Reclaimed Water Plan* (Skillings and Connolly 2009), which was never finalized or adopted. An updated Reclaimed Water Plan with information on recommended improvements is provided in the Yelm GSP.

The Yelm GSP recommended the following improvements that are now included in the City's Capital Improvements Plan (CIP):

- Expansion of the Cochrane Park Rapid Infiltration Basins.
- System Operation and Maintenance improvements including:
  - Installing a radio read meter at Cochrane Park RIBs (completed in 2012).
  - Preparing a schedule of maintenance activities at Cochrane Park.
  - Replacing damaged reclaimed water valves in the reclaimed water distribution system and installing new valve at the WRF.
  - Inspecting the existing reclaimed water tank storage.

The Yelm GSP also recommended improvements for consideration that have not yet been included in the City's CIP. These improvements include the following items:

- Update the level of service goals and reclaimed water production forecast for the reclaimed water utility.
- Improve the capacity of the WRF Reclaimed Water Pump Station.
- Construct a second reclaimed water storage tank.

2.4 STORMWATER MANAGEMENT

Stormwater collection and treatment is regulated through Chapters 13.10, 13.16, and 13.20 of the YMC. Additionally, the City has adopted by reference (YMC 13.16.060) the latest version of Washington State Department of Ecology's (Ecology's) *Stormwater Management Manual for Western Washington* (SWMMWW). Peak stormwater are not captured within the City's STEP wastewater collection system due to its pressurized sewer main operation. Also data shown in Section 2.5 indicates that influent flow is unaffected by area precipitation events. The City controls stormwater quality and erosion through requiring a sediment control plan or permanent stormwater quality control plan for all new construction projects (YMC Chapter 13.16).

2.5 INFLOW AND INFILTRATION MANAGEMENT

The U.S. Environmental Protection Agency (EPA) defines inflow and infiltration (I/I) as "excessive" in accordance with the following definitions (EPA 1985):

- Excessive infiltration occurs when dry weather flow (DWF), during a period of seasonal high groundwater, is in excess of 120 gallons per capita per day (gpcd). Dry weather flow is defined as the highest average daily flow recorded over a 7- to 14-day period during a period of high groundwater but no rainfall.
- Excessive inflow occurs when the total daily flow, during periods of significant rainfall, exceeds 275 gpcd (excluding major industrial and commercial flows).

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

To demonstrate that the Yelm STEP wastewater collection system is not influenced by excessive infiltration or inflow, Table 2-1, taken from the 2013 *Annual Infiltration/Inflow Report: Yelm Water Reclamation Facility* (Annual I/I Report), is provided below.

Table 2-1. 2013 WRF Annual Infiltration/Inflow Data

Month	Average Monthly Flow (MGD)		Total Monthly Rainfall (Inches)		Estimated Population Served	
	1995	2013	1995	2013	1995	2013
January	0.139	0.364	4.5	2.75	1,131	6,848
February	0.144	0.360	4.58	2.24	1,263	6,848
March	0.146	0.368	3.95	3.01	1,355	6,848
April	0.140	0.365	2.81	4.9	1,355	6,848
May	0.139	0.373	1.42	4.35	1,358	6,848
June	0.138	0.367	1.57	1.98	1,358	6,848
July	0.132	0.360	1.84	0.00	1,358	6,848
August	0.146	0.350	1.41	1.77	1,383	7,500
September	0.147	0.366	1.76	8.90	1,442	7,500
October	0.146	0.377	3.57	2.34	1,501	7,500
November	0.146	0.381	8.51	3.55	1,540	7,500
December	0.150	0.399	7.24	1.59	1,560	7,500
Low Month:	0.132	0.350				
High Month:	0.150	0.399	1995 High Month Average Daily Flow/Capita = 96 gpcd 2013 High Month Average Daily Flow/Capita = 53.2 gpcd			
Yearly Average:	0.143	0.369				

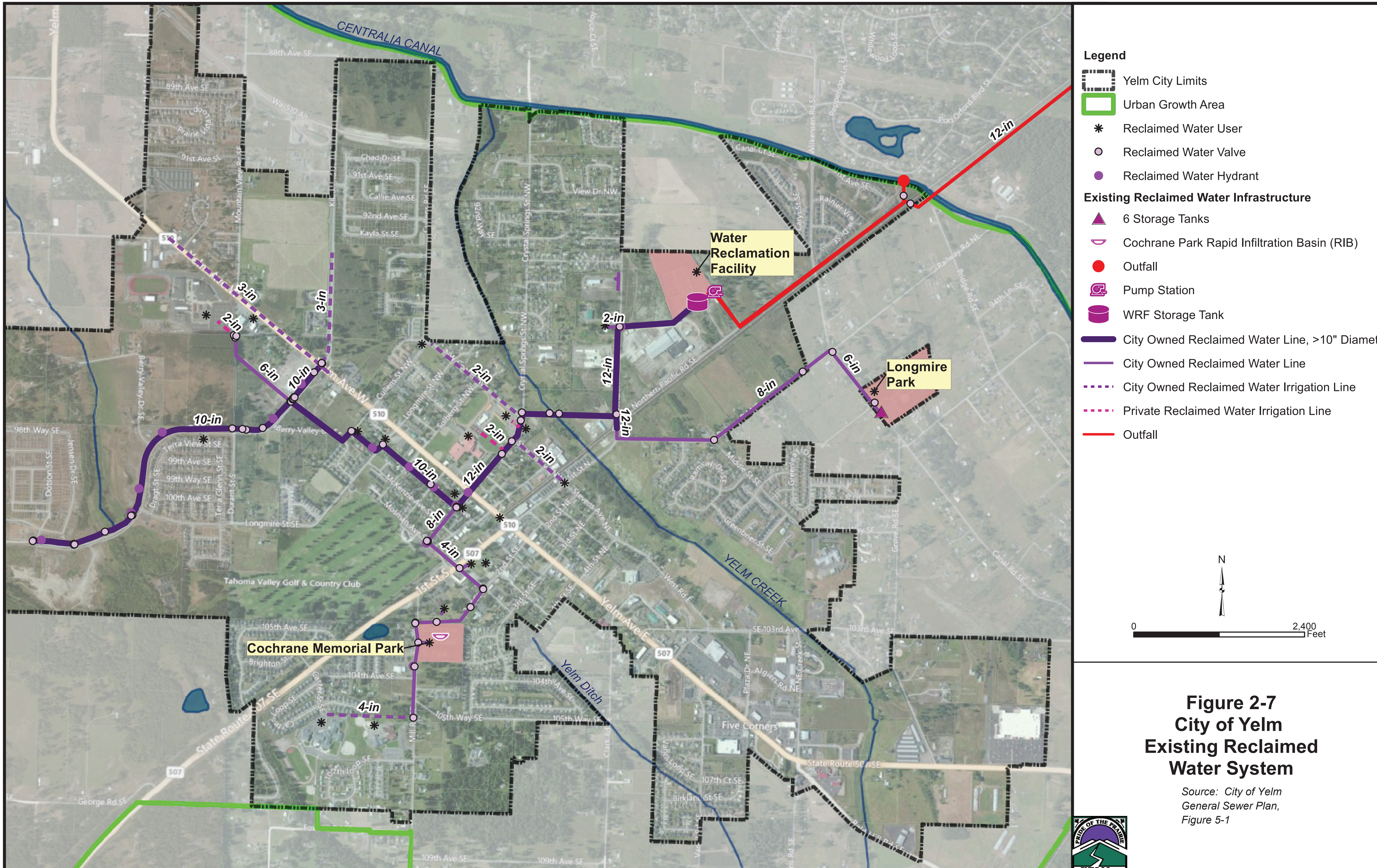


Figure 2-7
City of Yelm
Existing Reclaimed Water System

Source: City of Yelm General Sewer Plan, Figure 5-1

Generally, Table 2-1 data indicates that the highest daily flows have no direct correlation to total monthly rainfall or daily precipitation events. The higher month flows are thought to primarily occur due to the large influx of grade school students attending school from outside the City of Yelm wastewater service area rather than from precipitation related infiltration or inflow. The increase in the high month to low month difference from 1995 to current can be partially explained by noting only two schools were connected to the Yelm sewer collection system in 1995, while currently six schools are now connected to the system. The full Annual I/I Report, which contains month-by-month plots of Daily Rainfall versus Influent, is provided in Appendix A.

2.6 FEATURES OF THE WASTEWATER SERVICE AREA

2.6.1 Topography

The City lies in an area known as the Yelm Prairie. This area was occupied by glacial meltwaters during the receding stages of the Vashon Glacier and generally has little change in elevation. Topography is depicted on the area topographic map (created from contour data provided by the Thurston County Geodata Department) as shown in Figure 2-8, City of Yelm Topography (Reference Figure 1-5, Yelm GSP).

The central portion of the existing city limits lies approximately 340 feet above mean sea level (msl). The land slopes upward to the south and west with the highest portion of the study area located at an elevation of 512 feet above msl at the western extreme of the Thurston Highlands MPC. The area within the Thurston Highlands MPC generally exhibits greater variation in topography than the rest of the service area.

2.6.2 Soils

The soils of Thurston County have been mapped and classified into 133 soil units by the U.S. Department of Agriculture, Soil Conservation Service (SCS). The majority of soils in the City of Yelm area are classified as either (1) Spanaway gravelly sandy or stony loam or (2) Everett very gravelly sandy loam. The characteristics of the soils have been grouped by the SCS as undulating and rolling, coarse, and moderately coarse textured soils underlain by loose glacial outwash materials.

2.6.3 Water and Air Sensitive Areas

The GMA (Revised Code of Washington [RCW] Chapter 36.70a) contains specific requirements for the designation and protection of “critical areas,” defined by the GMA as wetlands, areas with recharging effect on aquifers used for potable water, fish and wildlife habitat conservation areas, frequently flooded areas, and geologically hazardous areas. Maps from the Yelm Comprehensive Plan identifying critical areas within city limits and the UGA are provided in Figure 2-9 City of Yelm Critical Areas – Streams, Wildlife, Wetlands (Reference Yelm Comprehensive Plan Map No. 4). Relevant critical area information is summarized as follows:

- Shorelines and abutting floodplains in or adjacent to the UGA include Black Lake, Black Lake Ditch, Trosper Lake, and along the Deschutes River. Additionally, floodplains adjacent to the north of Yelm Creek, northeast of the Water Reclamation Facility, Mill Pond, and west of Cochrane Park exist within Yelm city limits.
- Wetland areas are present at the headwaters of Black Lake. Small wetlands are also present within the UGA to the west of Trosper Lake and along Black Lake Ditch.
- Freshwater emergent and forested wetlands remain present along the north side of the Centralia Power Canal extending about 8 miles from Mountain View Road SE to Wilkensen Road SE. Freshwater wetlands also exist surrounding Mill Pond, to the west of Cochrane Park.

- Aquifer-sensitive area underlies most of the west UGA, surrounding Black Lake. The City's wells and many private wells do not use the aquifer for water supply.
- The few areas identified as steep slopes and volcanic hazards occur along portions of the Centralia Power Canal and Yelm Creek.
- There are no identified priority habitats or species within or in very close proximity to the UGA. For example, a threatened species recently listed in 2014, the Mazama Pocket Gopher (which has four sub-species including the Yelm, Olympia, Roy Prairie, and Tenino pocket gophers) does not have a critical habitat area in or in very close proximity to the UGA. The designated critical habitat areas for the Mazama Pocket Gopher are found closer to the City of Olympia, the Cities of Rainier and Tenino, and in the area of Joint Base Fort Lewis McChord.

The City's future zoning designations include an environmentally sensitive area in the southwest corner of the UGA. This area includes wetlands and areas of high groundwater. Development will not occur in this zone of the UGA.

2.6.4 Prime or Unique Farmland

The Farmland Protection and Policy Act (FPPA), 7 U.S.C. 4201, was enacted in 1981 in order to minimize the loss of prime farmland and unique farmland as a result of federal actions by converting these lands to nonagricultural uses. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for uses such as cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water. Unique farmland is land other than prime farmland that is used for the production of specific high value food and fiber crops. Compliance with the FPPA is required for federal agencies that authorized actions resulting in the conversion of prime or unique farmland not already committed to urban development or water storage. Compliance is to be coordinated with the U.S. Department of Agriculture (USDA). The Washington State Department of Ecology *Farm Soils Map* published in May of 2010 notes the majority of Yelm and the area occupied by the WRF exist as prime farmland if it were to be irrigated.

Website information for the Soils Map can be accessed at the following locations:

http://www.ecy.wa.gov/services/gis/maps/county/soils/soils.htm

http://ceq.hss.doe.gov/nepa/regs/exec81180.html

2.6.5 Archeological and Historical Sites

The Washington State Department of Archaeology and Historic Preservation (DAHP) advocates for the preservation of Washington's irreplaceable historic and cultural resources—significant buildings, structures, sites, objects, and districts—as assets for the future. Both federal and local laws require agencies to assess the effects of their proposed projects on significant archeological and historic properties. When development activity is proposed within the location of a known archaeological or historic site, the City will require the project proponent to engage a professional archaeologist to investigate and report to the City and the DAHP on the location, condition, and the extent of the site, impacts associated with the proposal, and any recommended mitigation. The City will consult with concerned tribes and DAHP to solicit comments on proposed development and related mitigation for cultural resources. The City will condition project approval to avoid impacts and require necessary mitigation.

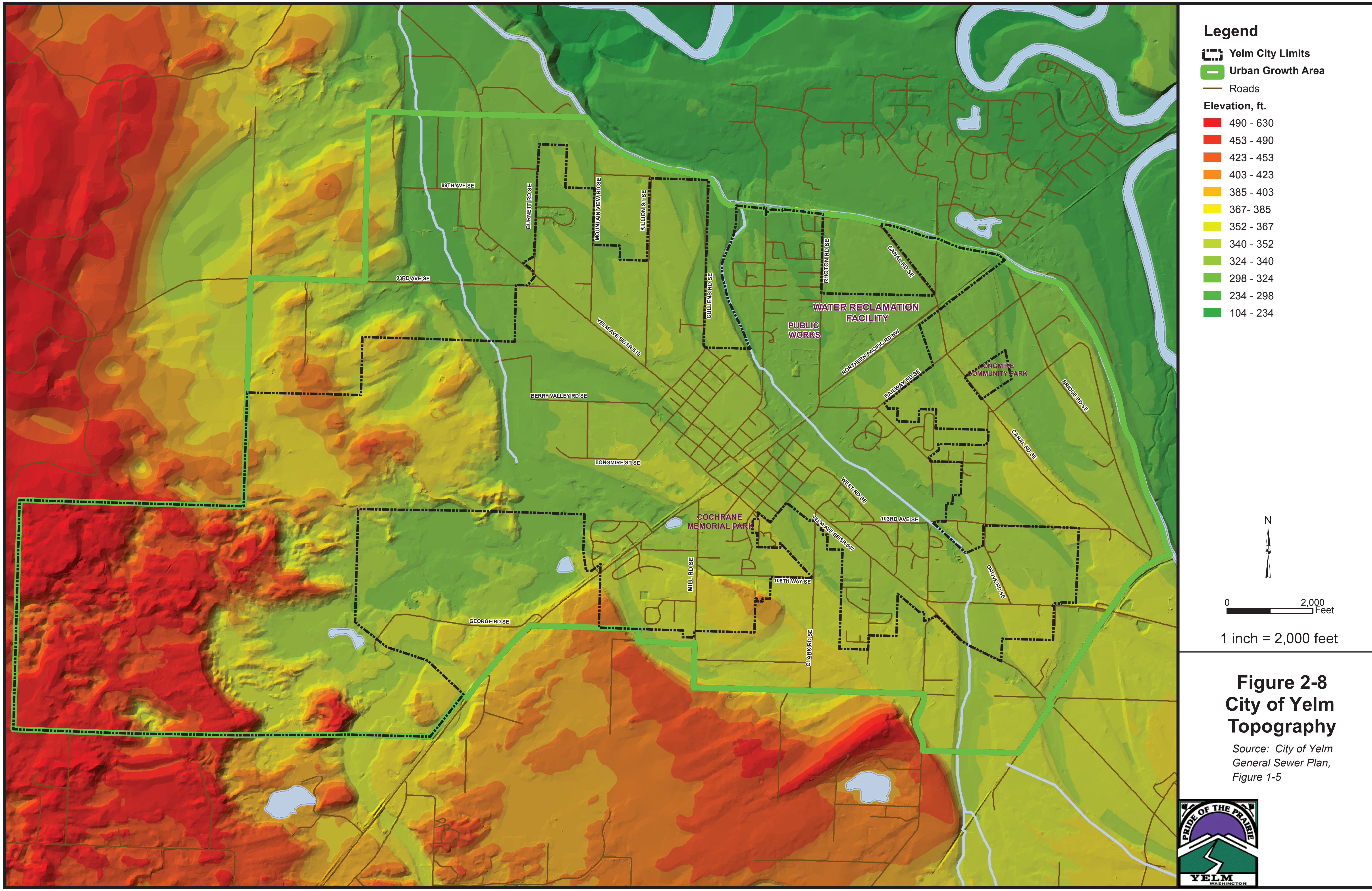
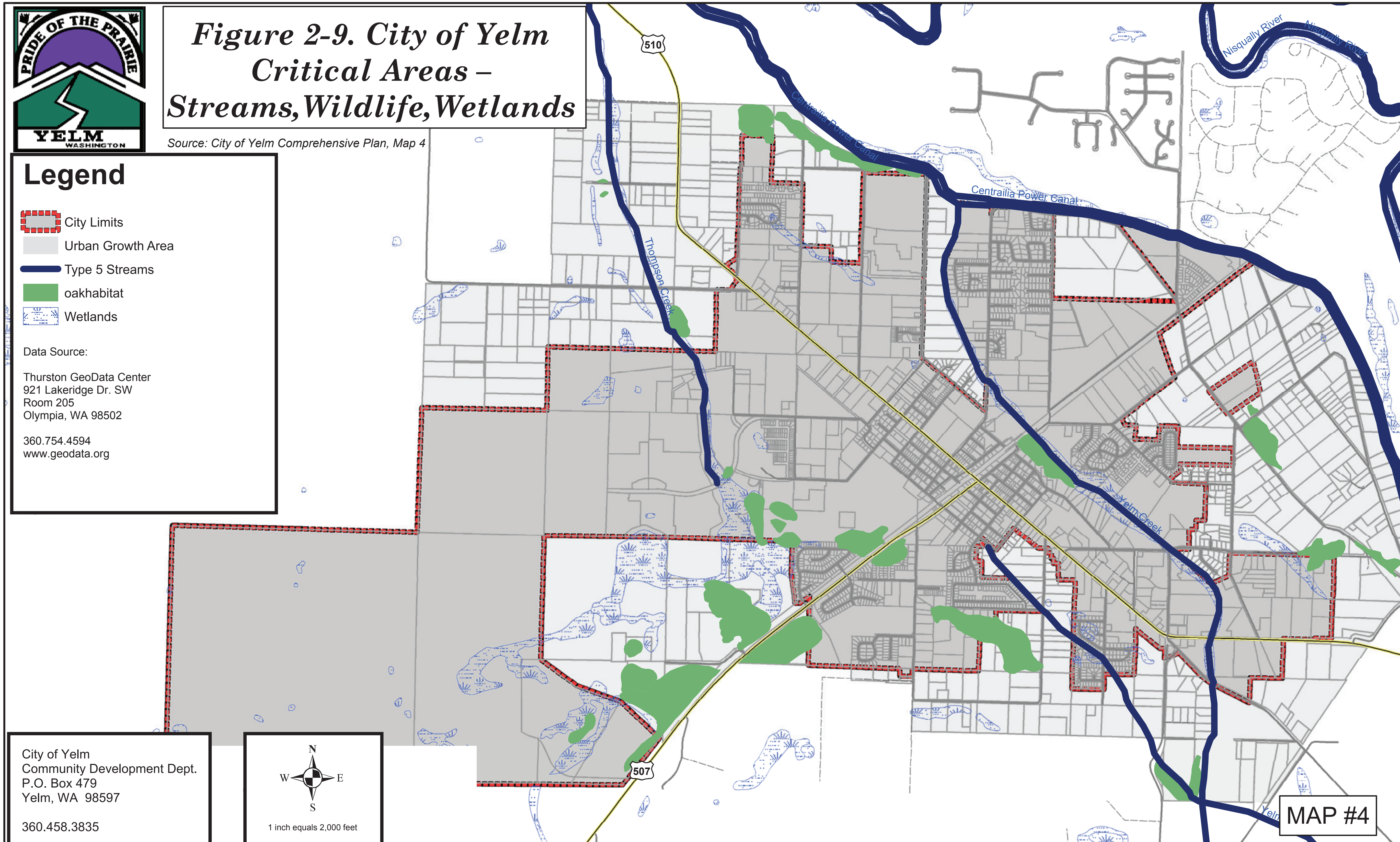


Figure 2-8
City of Yelm Topography

Source: City of Yelm General Sewer Plan, Figure 1-5

Figure 2-9. City of Yelm Critical Areas – Streams,Wildlife,Wetlands

Source: City of Yelm Comprehensive Plan, Map 4



Local tribal authorities must be contacted if human remains or historical or archaeological resources are encountered. Tribal addresses and telephone numbers include the following:

Nisqually Indian Tribe
Department of Natural Resources
12501 Yelm Highway SE
Olympia, Washington 98513
360.438.8687
360.438.8742
www.nisqually-nsn.gov

According to the DAHP analysis, 257 archaeological sites, districts, and cemeteries have been identified in Thurston County. Of these 257 sites documented within the DAHP inventory, 59 sites exist within Yelm city limits and are all recorded as single family dwellings.

DAHP inventory information can be accessed at the following location:

http://www.dahp.wa.gov/ https://fortress.wa.gov/dahp/wisaard/

2.6.6 Wild and Scenic Rivers

No Federally recognized wild and scenic rivers exist within the service area boundary, nor do either of the WRF outfalls discharge to any of these federally recognized rivers.

2.6.7 Wildlife Habitat – Threatened or Endangered Species

Threatened Species and Critical Habitat were evaluated during completion of the City of Yelm Community Development Department Environmental Checklist, which was prepared for the Yelm GSP. The Yelm GSP Environmental Checklist included the following:

> As part of the Thurston Highlands EIS effort, a comprehensive query of the U.S. Fish and Wildlife Service (USFWS) website was conducted for documentation of any Listed or Proposed Endangered and Candidate Species and Species of Concern occurring within a 1.5-mile radius of the project area. In addition, a thorough search was conducted of the National Marine Fisheries Service, Northwest Regional Office, Office of Protected Resources web pages. Both of these websites were accessed October 4, 2006. No Federally-listed species or critical habitat records were found for the Thurston Highlands property. The prevalence of low-diversity, replanted, mostly young Douglas fir forest does not afford preferred habitat conditions for listed species that could potentially occur, such as Northern spotted owl (*Strix occidentalis*). Furthermore, the absence of prairie habitat conditions within Thurston Highlands eliminates the potential for listed plant and animal species associated with this habitat type to occur. The only potential Federally-listed species that might occur within Thurston Highlands is an aquatic plant, water howellia (*Howellia aquatilis*), that could occur within the sphagnum bog habitat associated with the Wetland A complex.
>
> The Draft Biological Assessment prepared for the SR 510/Yelm Loop Highway Corridor (WSDOT, May 2007) investigated the presence of threatened and endangered species within the same general project area as the Yelm sewer system service area. Within the project area, it was determined that listed fish species included Puget Sound Chinook salmon and bull trout. Designated critical habitat for the Puget Sound Chinook salmon evolutionarily significant unit (ESU) occurs in portions of the mainstream Nisqually River and the lowest reaches of Yelm Creek (river mile [RM] 0.0 to 0.7). The closest

designated critical habitat for the Coastal-Puget Sound bull trout distinct population segment (DPS) is in the Nisqually River. Puget Sound steelhead, proposed for listing as a threatened species, may also occur in the project vicinity. There are no known listed plant species identified in the project.

As noted in Section 2.6.3, a threatened species, the Mazama Pocket Gopher, listed as of 2014, does not have any critical habitats located within or near the Yelm wastewater service area.

2.7 DEMOGRAPHICS AND LAND USE

2.7.1 Demographics

The following key City demographics were summarized from the US Census Bureau State and County People Quickfacts Webpage:

Table 2-2. City of Yelm Selected Demographic Information

Demographic Parameter	Value
Population, 2010 (April 1) estimate base	6,848
Persons under 5 years, percent, 2010	10.0%
Persons under 18 years, percent, 2010	36.0%
Persons 65 years and over, percent, 2010	7.6%
Population, 2013 estimate	7,639
Population, percent change – April 1, 2010 to July 1, 2013	11.6%
Housing units, 2010	2,523
Housing units in multi-unit structures, percent, 2009-2013	17.8%
Media value of owner-occupied housing units, 2009-2013	$197,600
Households, 2009-2013	2,373
Persons per Household, 2009-2013	2.96
Per capita money income in 12-month period (2013 dollars), 2009-2013	$19,003
Median household income, 2009-2013	$49,191
Washington state media household income, 2009-2013	$59,478
Persons below poverty level, percent, 2009-2013	21.2%

Source: US Census Bureau State and County People Quickfacts Webpage.

Note: Parameters listed above are specific to the City of Yelm unless noted as a state-wide parameter.

2.7.2 Existing Land Use

The City's current land use and zoning designations are shown in Figure 2-10, City of Yelm Current Land Use and Zoning Designations (Reference Figure 1-3, Yelm GSP). Based on the Yelm GSP evaluation of City zoning information, the City consists of a mix of commercial, residential, and industrial zoned land. The majority of the land is residential. There are approximately 584 acres of commercially zoned land, 1,176 acres of residential land, and 190 acres of industrial land within the city limits. This approximation does not include the two MPCs, Thurston Highlands and Tahoma Terra in the southwest part of the City, which will contain an additional 1,550 acres of primarily residential land.

Based on analysis of the City zoning designations within the current city limits, the City's WRF currently exists on industrial land surrounded by primarily residentially zoned land with some commercially zoned land to the south of the WRF.

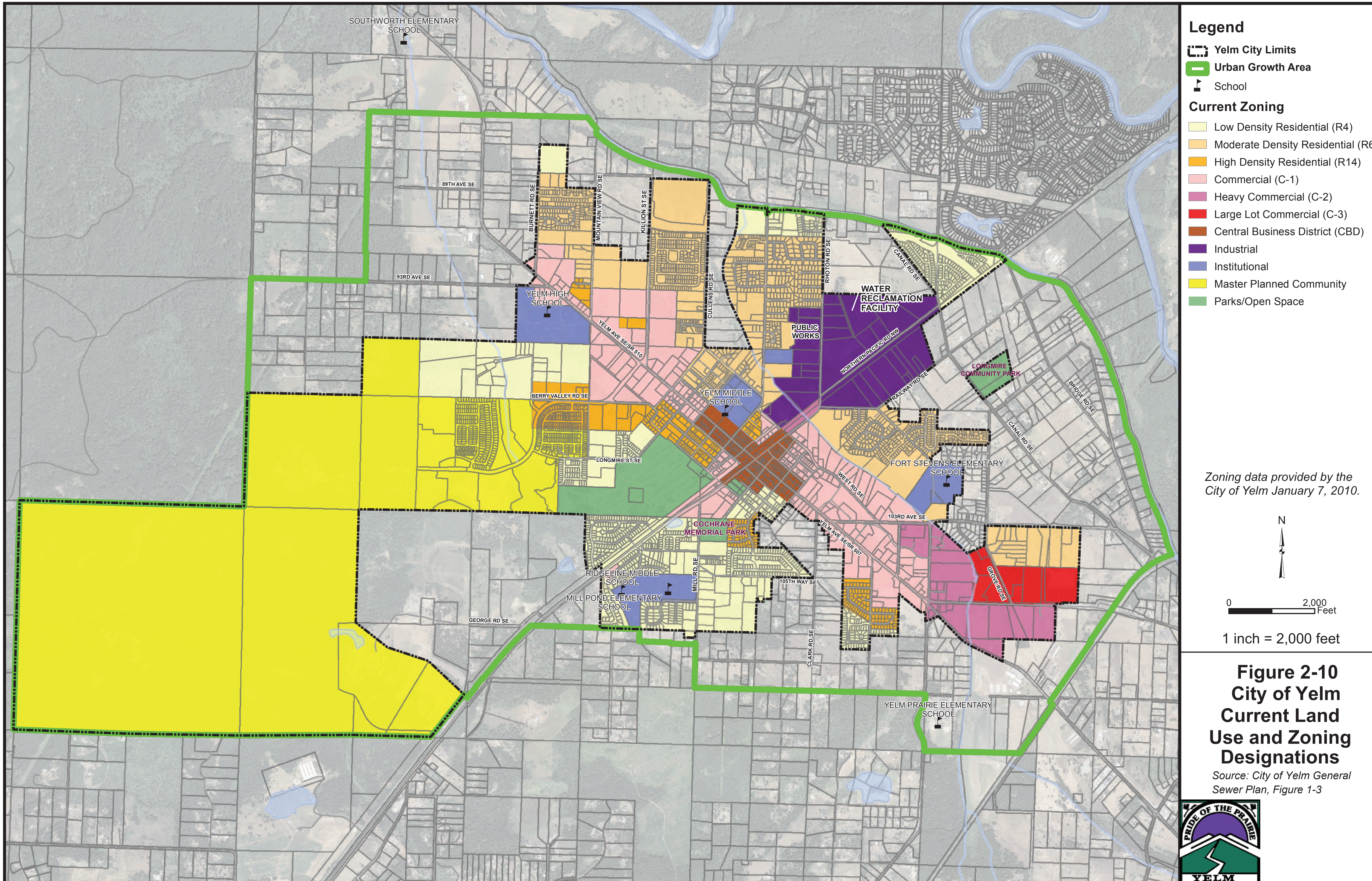


Figure 2-10
City of Yelm Current Land Use and Zoning Designations

Source: City of Yelm General Sewer Plan, Figure 1-3

2.7.3 Future Land Use

The Yelm Comprehensive Plan also addresses future land use and development trends within the Yelm UGA. Figure 2-11, City of Yelm Future Zoning Map (July 2006), provides information on future land use (Reference Figure No. 3 from Yelm Comprehensive Plan).

The 2007 *Thurston Regional Planning Council* (TRPC) *Buildable Lands Report* (TRPC Buildable Lands Report) estimates that 217 acres of land are available for commercial development within city limits and 6 acres are available for commercial development within the UGA. The 2007 TRPC also states that the land supply for industrial purposes within city limits and the UGA is 108 acres and 80 acres, respectively. These numbers include vacant or partially used lots as well as re-developable land.

2.7.4 Recreation and Open Space Alternatives

Various park areas exist within the service area and are reliant on the WRF reclaimed water supply for turf irrigation and landscape irrigation. There are 56.45 acres of park and trail land area within the City and UGA. City recreation and open space related areas include:

- Cochrane Memorial Park.
- Longmire Community Park.
- Yelm City Park.
- Yelm Sidewalk and Bikeways Program.
- 2007 Thurston County Regional Trails Plan (includes the Yelm to Tenino and the Yelm Prairie Line Trails).

Per the Yelm Comprehensive Plan, the levels of service for park and recreation facilities shall be 6.5 acres of land per 1,000 population. The level of service for regional parks and open space programs shall be identified by Thurston County.

2.8 AIR QUALITY AND PUBLIC HEALTH

The Federal Clean Air Act of 1992 requires that all federally-funded projects be in compliance with state and regional air quality plans. The local air-quality authority for Thurston County is the Olympic Region Clean Air Agency (ORCAA). ORCAA regulates construction and modification of potential air contaminant sources in Clallam, Grays Harbor, Jefferson, Mason, Pacific, and Thurston Counties. The ORCAA must be notified of construction projects so that it may review whether a permit is required; review requirements are outlined in Section 300 of the ORCAA regulations. Activities exempt from review include the following wastewater-related activities:

- Septic sewer systems, not including active wastewater treatment facilities;
- NPDES permitted ponds and lagoons used solely for the purpose of settling suspended solids and skimming of oil and grease; and
- Sewer manholes, junction boxes, sumps, and lift stations associated with wastewater treatment systems.

The local public health authority is the Thurston County Public Health and Social Services Department (TCPHSSD). TCPHSSD project reviews are limited to private septic systems and small private potable water systems. Larger wastewater and potable water system project reviews are delegated to the Washington State Departments of Health and Ecology.

Figure 2-11. City of Yelm Future Zoning Map (July 2006)

Source: City of Yelm Comprehensive Plan, Map 3

Legend

City Limits

Yelm Future Zoning

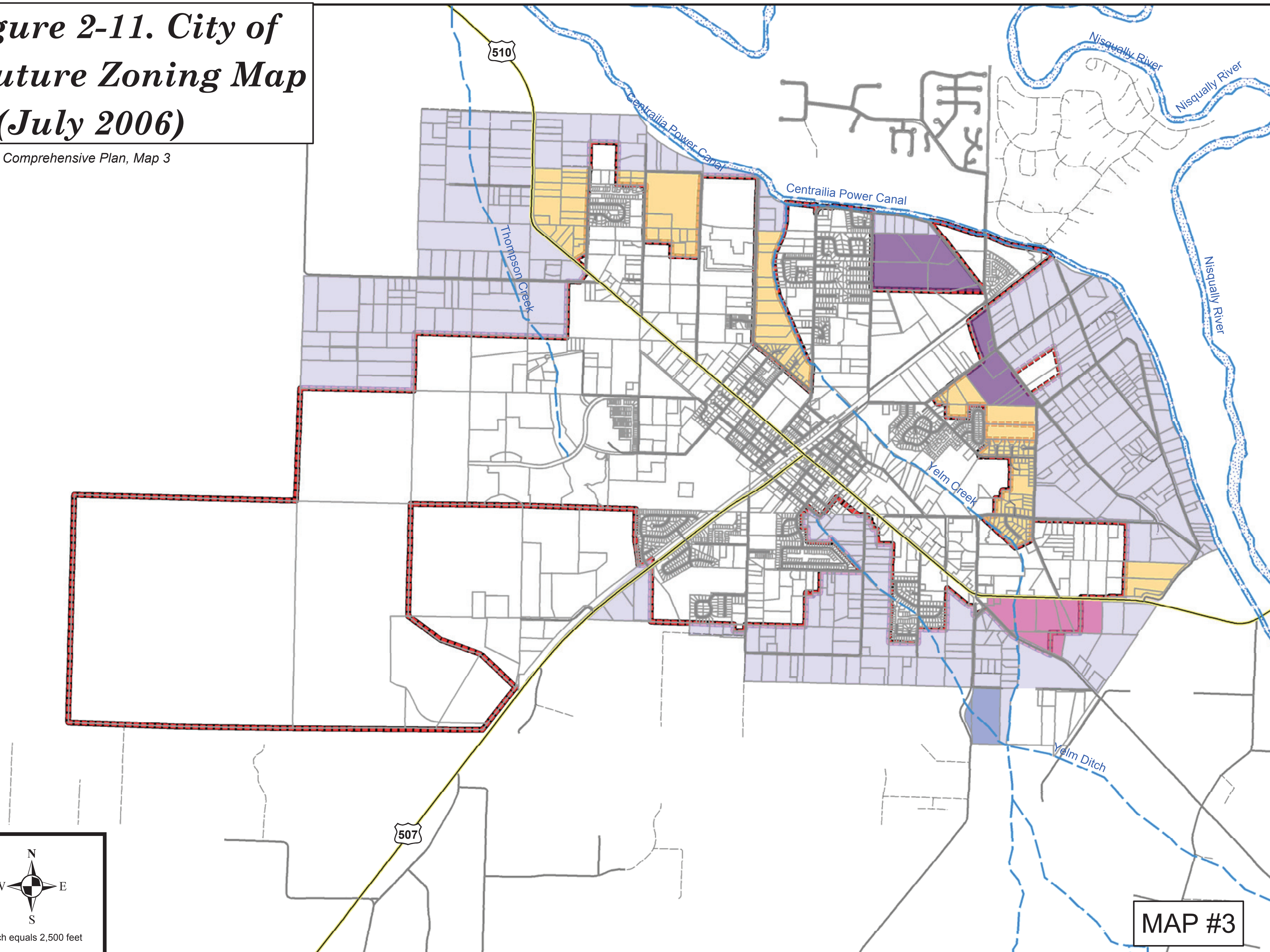
Zoning Designation

- C-1 Commercial
- C-2 Heavy Commercial
- C-3 Large Lot Commercial
- CBD Central Business District
- I Industrial
- ID Insitutional District
- MPC Master Planned Community
- P/OS Parks/Open Space
- R-4 Low Density Residential
- R-6 Moderate Density Residential
- R-14 High Density Residential

Data Source:

Thurston GeoData Center
921 Lakeridge Dr. SW
Room 205
Olympia, WA 98502

360.754.4594
www.geodata.org



City of Yelm
Community Development Dept.
P.O. Box 479
Yelm, WA 98597

360.458.3835

N
W E
S

1 inch equals 2,500 feet

3. FLOWS AND LOADS FROM EXISTING COLLECTION SYSTEM

3.1 INTRODUCTION

This chapter presents the projection of future flows and loads generated by the City's existing wastewater collection system. This information will be used as a basis-of-design in development of the WRF facility planning alternatives analyses.

3.1.1 Planning Basis

An evaluation of the historical WRF wastewater flow and loads (9-year period from January 2006 to December 2015) and the City's planning documents was conducted in the Yelm GSP. The Yelm GSP evaluation was used to establish flow and load projections for future scenarios associated with anticipated growth based on population and land use through the 2034 planning year. The projections summarized here are generally consistent with the direction provided in the Yelm GSP and have been further refined based on recent influent monitoring trends.

3.1.2 Coding of Raw Sewage Flows and Loads

The influent flow has several distinct sources based on the contributors in the UGA and city limits service area. The sources are coded as follows:

1. Residential flow.
2. Commercial, industrial, and education system (non-residential flow).
3. Wet weather I/I.

The flows from these sources have been grouped into these categories based on typical analysis procedures and the availability of information for each source.

3.1.2.1 Residential Flows

Residential flows include contribution from single family units, as well as multifamily units. In order to estimate the amount of residential flow treated at the WRF, the Yelm GSP analyzed average winter water use records for the 2008 to 2010 period. The Yelm GSP analysis indicated that residential use accounted for approximately 75 percent of water demand during the winters of 2008 to 2010; residential flows at the WRF were therefore estimated to be 75 percent of the average influent flow. Projected forward to 2014, this equates to an average flow of 0.29 mgd and approximately 43 gallons per day (gpd) per person. An equivalent residential unit (ERU) is defined as the flow produced by one average occupied single-family housing unit. Based on U.S. Census data for 2010, there were approximately 2.98 people per each residential housing unit within city limits. Compared to the sewered population of 6,348 in 2010, this equates to 2,131 ERUs connected and 127.41 gpd/ERU.

3.1.2.2 Non-Residential Flows

Commercial, industrial, and education system flow are grouped together and defined as "non-residential flow." Based on the 2013 Yelm GSP analysis of winter water use records, commercial wastewater flows were determined to comprise 22 percent of the WRF average influent flow. When compared to commercial development analysis, this flow rate is equivalent to approximately 0.13 gallons per day per square foot (gpd/ft^2) of commercial development (5,660 gpd/acre). As indicated in the Yelm WSP, three industries were identified as consuming potable water supply and were identified as Lasco (bath fixture manufacturer), CalPortland (formerly Glacier Northwest providing ready mix concrete products), and Amtech (composite products manufacturer). Ecology does not list any of the industries as requiring an Industrial

State Waste Discharge Permit to Discharge Industrial Wastewater to a Publicly Owned-Treatment Works, so it appears that the water is incorporated into product consumption or disposed of by alternate means rather than discharged to the City of Yelm sewer system.

Wastewater flows from schools were determined by the Yelm GSP to comprise 3 percent of the average influent flow at the WRF in 2010. The Yelm WSP estimates a 2010 student population of 3,889 within city limits. This equates to approximately 2.6 gpd per student.

3.1.2.3 Infiltration and Inflow

Wet weather I/I flow is caused by rainfall events and includes contribution from connected impervious areas such as roof drains and catch basins (inflow) and groundwater (infiltration) leaking into the collection system. The total flow through a system is therefore the sum of the base wastewater flow plus the I/I. Infiltration and inflow in the Northwest typically follows a seasonal pattern, with high levels of I/I during the wet winter season and low levels of I/I during the summer.

The City's collection system consists entirely of STEP tanks, which pump flow from individual connections to the WRF. Because the entire system is pressurized, it is considered highly resistant to I/I impacts. The City's 2013 *Annual Infiltration/Inflow Report: Yelm Water Reclamation Facility*, prepared in January 2014, does not report any significant I/I in the system. The 2013 Annual I/I Report is included in Appendix A.

In 2013, the difference between the maximum month influent flow and minimum month flow was only 0.031 mgd, indicating that wet weather does not have a strong impact on flows at the WRF. Appendix A contains data plot information on wet weather month comparisons of daily influent flow to rainfall. As shown in the data plots, there is no correlation between daily rainfall and influent flow. For this reason, additional flow due to I/I is not included in the Yelm GSP flow characterization or flow projections.

3.1.3 Population

Service area population, employment, education forecasts, and determination methodology are detailed in the Yelm GSP. WRF improvements will be based on population in the service area for the "without Master Planned Community (MPC)" scenario. Because the planned Thurston Highlands MPC represents such a significant percentage of the total population growth projected for Yelm, the City has elected to develop WRF improvements based on the "without MPC" population projection scenario. The City made this decision to better allow the City to:

- Create a reliable WRF improvement plan, independent of the timing for the Thurston Highlands development and other future developments. Final planning and permitting for Thurston Highlands are not finalized. The level of uncertainty with this potentially large portion of the City's population makes developing accurate projections difficult.
- Determine which improvements are necessary to serve existing customers and which are necessary solely to serve the future MPCs. This will allow the Sewer Facilities Plan to develop improvement plans and rate structures in accordance with the City's "growth pays for growth" philosophy and that accounts for specific growth within city limits that is not associated with future MPCs.

For clarification purposes, the "without MPC" population projection scenario includes the already active Tahoma Terra MPC development but does not include the planned Thurston Highlands MPC or other future MPCs. Table 3-1 shows the Yelm GSP projected "without MPC" service population for 2020 and 2030. For these reasons, the Thurston Highlands MPC may contain its own dedicated wastewater sewer collection system and treatment facilities when it is eventually developed.

Table 3-1. Yelm Sewered Population Growth in Yelm GSP: "Without MPC" scenario

Column No.:	(1)	(2)	(3) = (1) + (2)	(4)	(5) = (3) – (4)	(6)	(7)	(8) = (5) + (7)
Year	Population Within City Limits, Not Including Tahoma Terra	Population within Tahoma Terra Development[a]	Total Population Within City Limits[b]	Population Within City Limits Not Served by City Sewer[c]	Total Population Within City Limits Served by City Sewer	Total UGA Population	UGA Population Served by City Sewer[d]	Total Population Served by City Sewer
2010	6,192	656	6,848	508	6,340	1,353	8	6,348
2020	10,883	1,785	12,668	0	12,668	1,981	1,308	13,976
2030	14,298	2,575	16,874		16,874	3,220	3,220	20,094

a Tahoma Terra population is estimated based on a population of 656 in 2010 and a complete build-out by 2027.

b 2010 population data based on 2010 U.S. Census information.

c Assumes that all existing customers served by septic tanks will be served by City sewer by 2020. All development within Tahoma Terra will be served by City sewer.

d Assumes that the entire existing population within the UGA will be connected to City sewer by 2030 as the city expands into the UGA and that eight residential customers are currently served.

The population projections show that, compared to the 2010 sewered population, the sewered population will more than double by 2020 (120 percent increase) and more than triple by 2030 (217 percent increase).

3.2 HISTORIC AND EXISTING WRF INFLUENT FLOWS

The historic and existing influent flows for the WRF between 2006 and 2010 were originally analyzed in the Yelm GSP. The GSP data has been updated to also include flow information from 2011 through 2015.

WRF wastewater influent flow information from 2006–2015 is plotted in Figure 3-1 (page 3-5) and key design flow parameters have also been characterized in Table 3-2 for the same period.

Table 3-2. Existing WRF Wastewater Flow Characterization

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

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

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

c Under development.

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

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

3.3 HISTORIC AND EXISTING WASTEWATER LOADS

Wastewater loading data are important for sizing several critical treatment processes. The wastewater loading components of principal interest are the Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), and Total Kjeldahl Nitrogen (TKN). TKN is a measure which tracks ammonia and organic nitrogen components in wastewater. TKN does not measure inorganic forms of nitrogen in wastewater such as nitrate. WRF staff measures influent TSS daily and influent BOD an average of five times per week. Since 2011, TKN has been measured at least once a month using a WRF wastewater influent daily composite sample.

3.3.1 Biochemical Oxygen Demand (BOD)

The Yelm GSP daily and monthly average influent BOD load data has been updated with 2011 to 2015 data and is presented in Figure 3-2 (page 3-7). Influent BOD concentration data is also provided in Figure 3-3 (page 3-9).

3.3.2 Total Suspended Solids (TSS)

Recent daily and monthly average influent TSS loads are presented in Figure 3-4 (page 3-11). Influent TSS concentration data is provided in Figure 3-5 (page 3-13).

3.3.3 Total Kjeldahl Nitrogen (TKN)

The historical average monthly influent TKN loads are presented in Figure 3-6 (page 3-15). Influent TKN concentration data is provided in Figure 3-7 (page 3-17).

3.4 FLOW AND LOAD PROJECTIONS

As directed in the Yelm GSP, the flow and load projections for the WRF facility planning are based on the Yelm GSP decision to exclude the future flows and loads from Thurston Highlands MPC ("without MPC" scenario as identified in the Yelm GSP). A summary of the Yelm GSP planning-related flow and load projections are presented as follows:

Table 3-3. Previous Yelm GSP Projected Flow and Load Basis of Design

Year	Average Daily Flows	Max Month Flow (mgd)	Max Day Flow (mgd)	Peak Hour Flow (mgd)	Average Annual BOD5 (lb/d)[a]	Average Annual TSS (lb/d)	Average Annual TKN (lb/d)	Max Month BOD5 (lb/d)	Max Month TSS (lb/d)	Max Month TKN (lb/d)	Max Day BOD5 (lb/d)	Max Day TSS (lb/d)	Max Day TKN (lb/d)
2010	0.35	0.37	0.45	0.81	608	164	184	682	205	192	763	297	231
2020	0.80	0.83	1.00	1.84	1,405	378	417	1,470	471	436	1,764	683	524
2030	1.16	1.22	1.46	2.69	2,077	557	611	2,172	694	639	2,608	1,005	767

[a] lb/d = pounds per day

However, based on recently detected changes in TKN and BOD load patterns, Parametrix is recommending that the maximum month TKN design loads be raised from those values currently shown in the Yelm GSP. The reasoning for the increase is based on observations from 2011 to 2015 influent test data sets which indicate significantly higher influent TKN concentrations and loads compared to those values used for the Yelm GSP (62 mg/L and 192 pounds/day). Figure 3-7 indicates that influent TKN concentration has been trending upwards in 2011 to 2015. Also this figure shows that WRF influent TKN concentrations have been consistently above 70 mg/L for a majority of the 2011 to 2015 period.

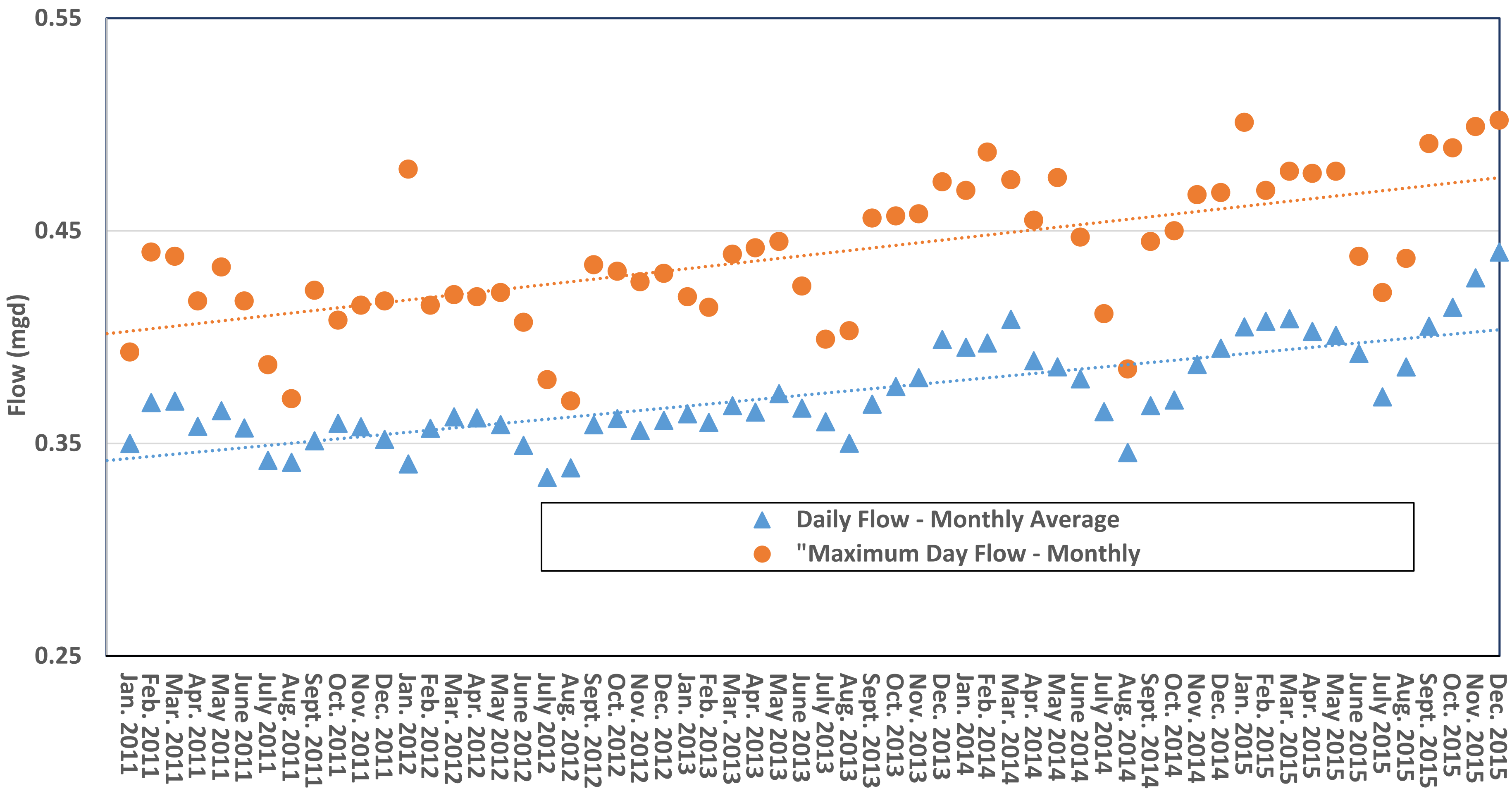


Figure 3-1. WRF Influent Average Daily and Maximum Day Flows by Month, 2011 to 2015

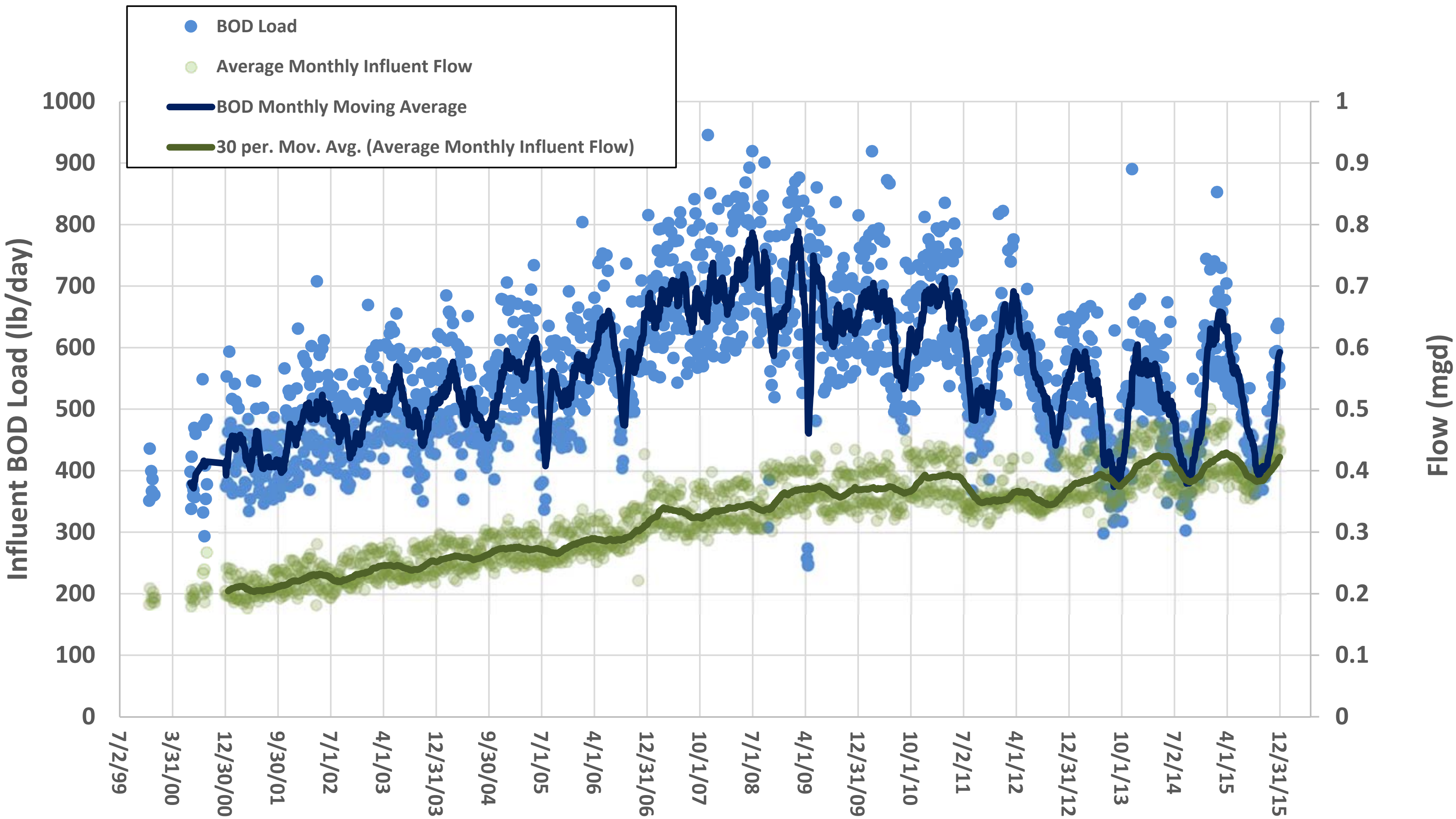


Figure 3-2. WRF Influent BOD Load and Daily Flows, 1999 to 2015

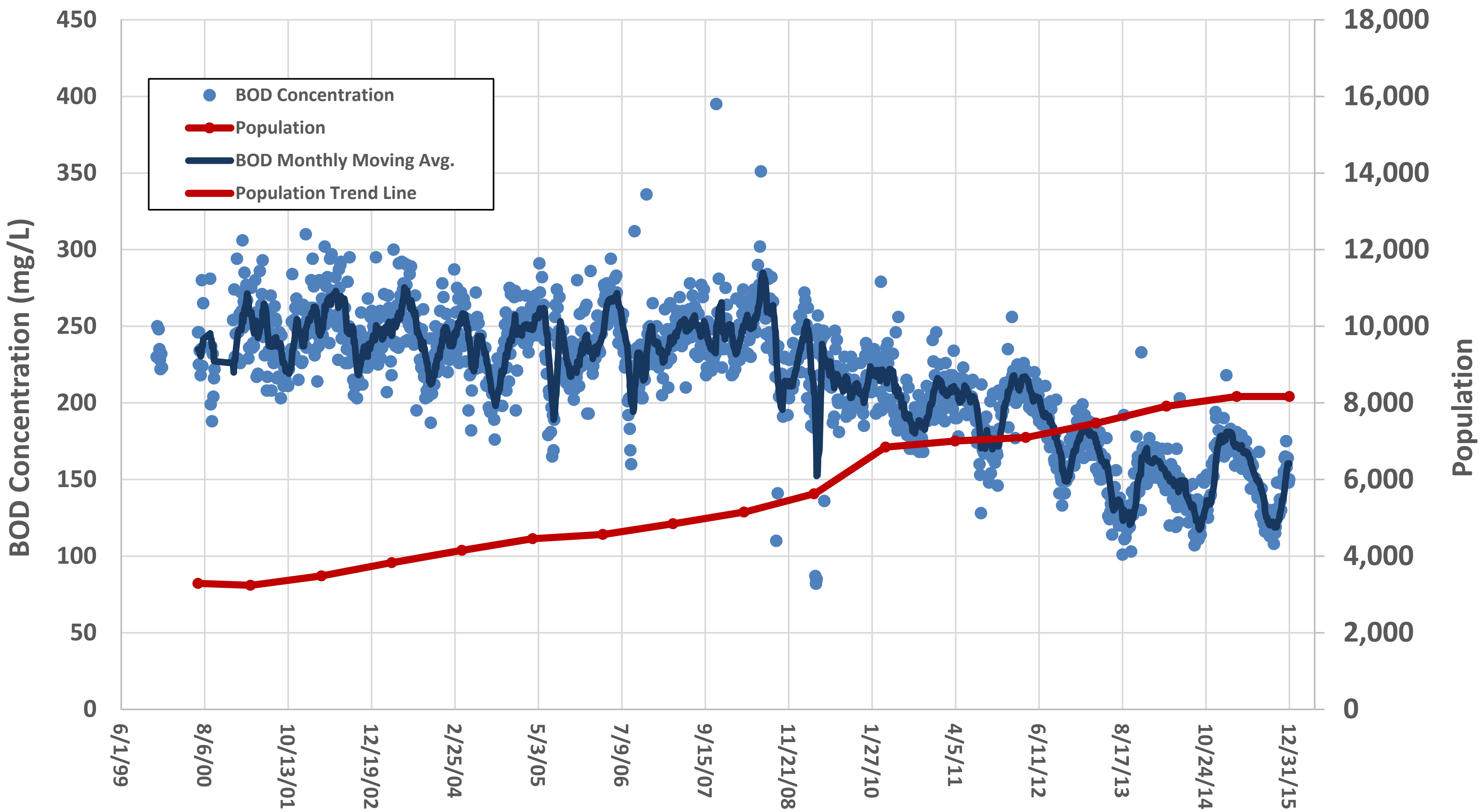


Figure 3-3. WRF Influent BOD Concentrations, 1999 to 2015

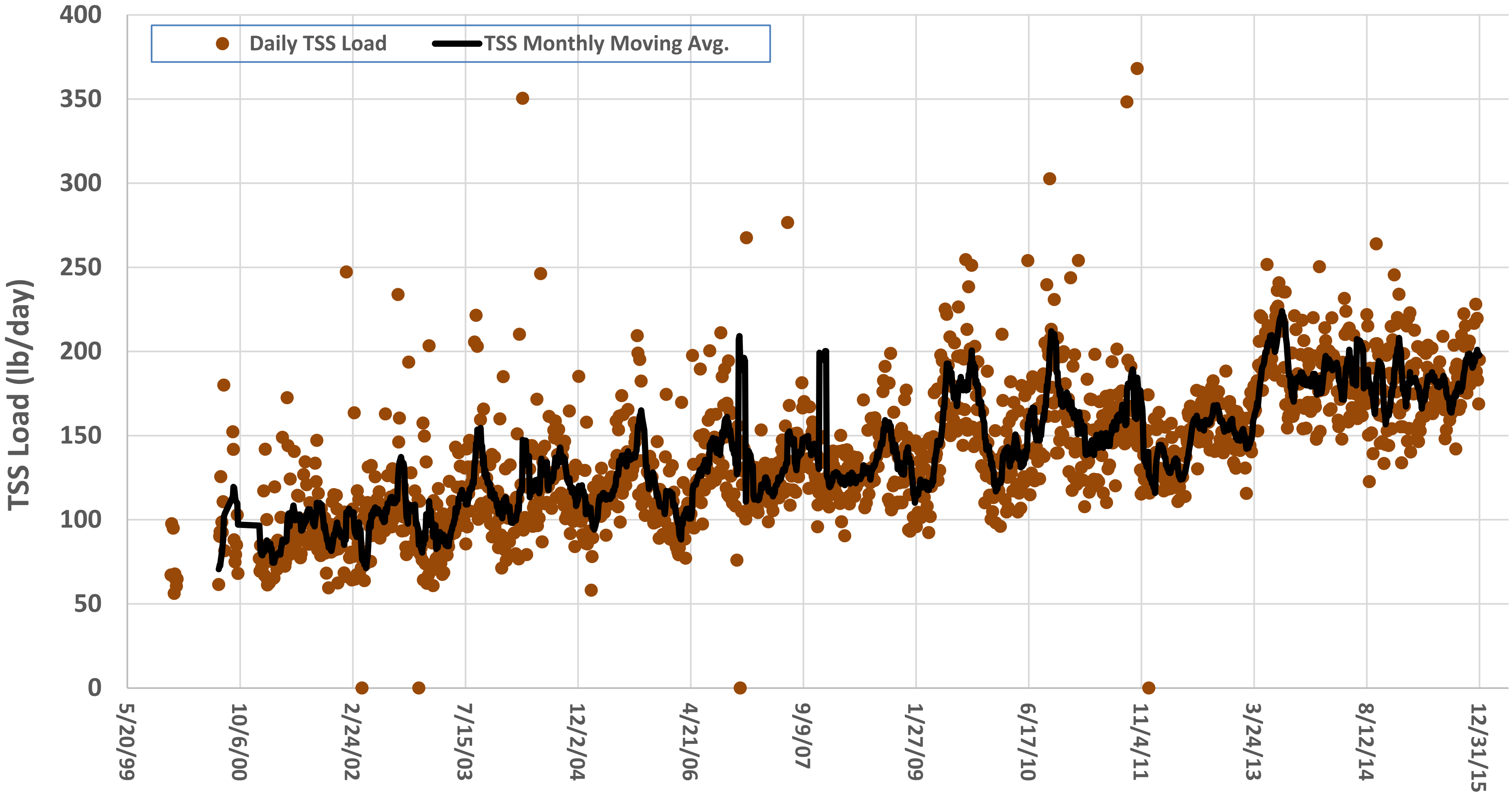


Figure 3-4. WRF Influent TSS Loads, 1999 to 2015

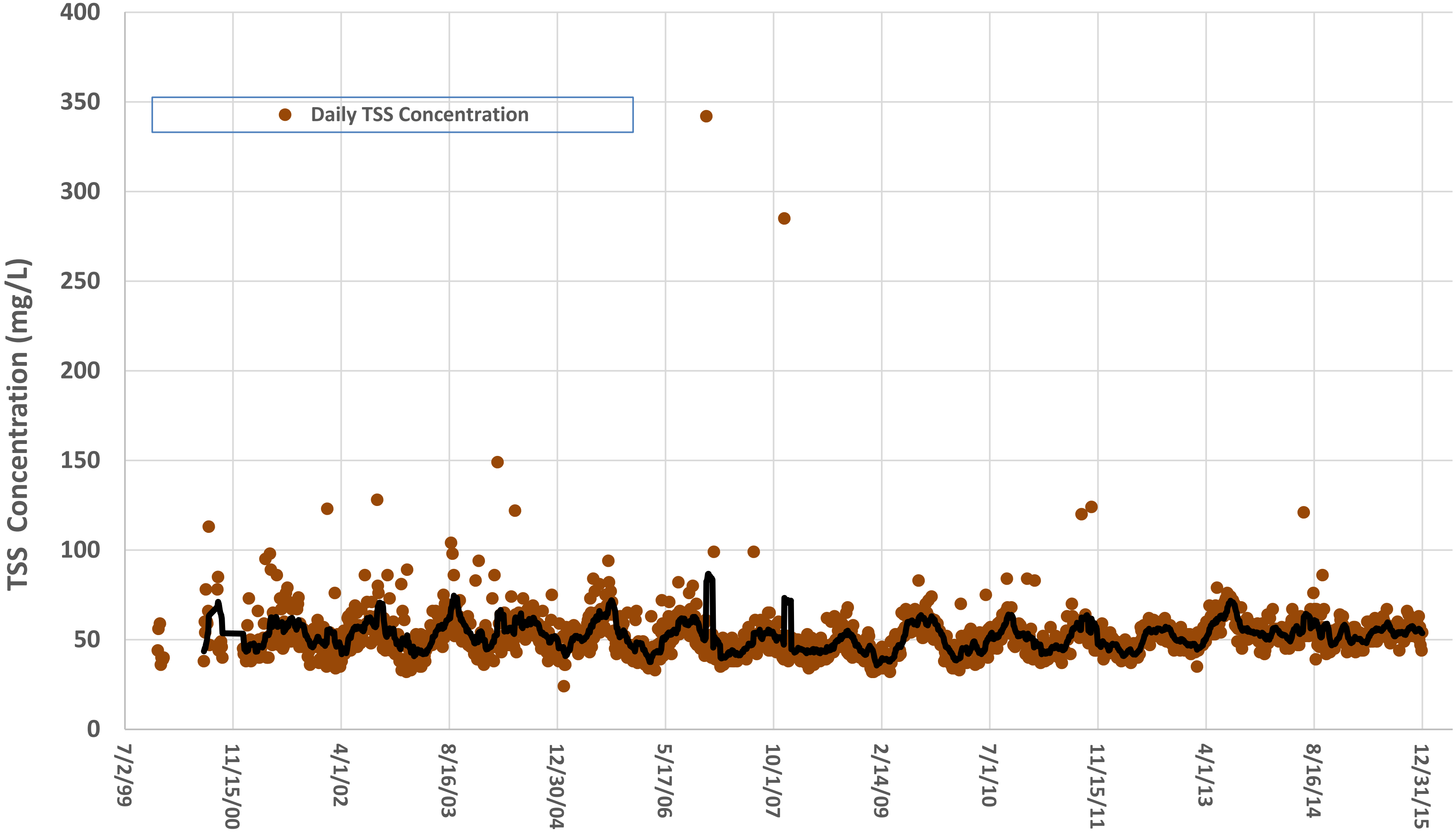


Figure 3-5. WRF Influent TSS Concentrations, 1999 to 2015

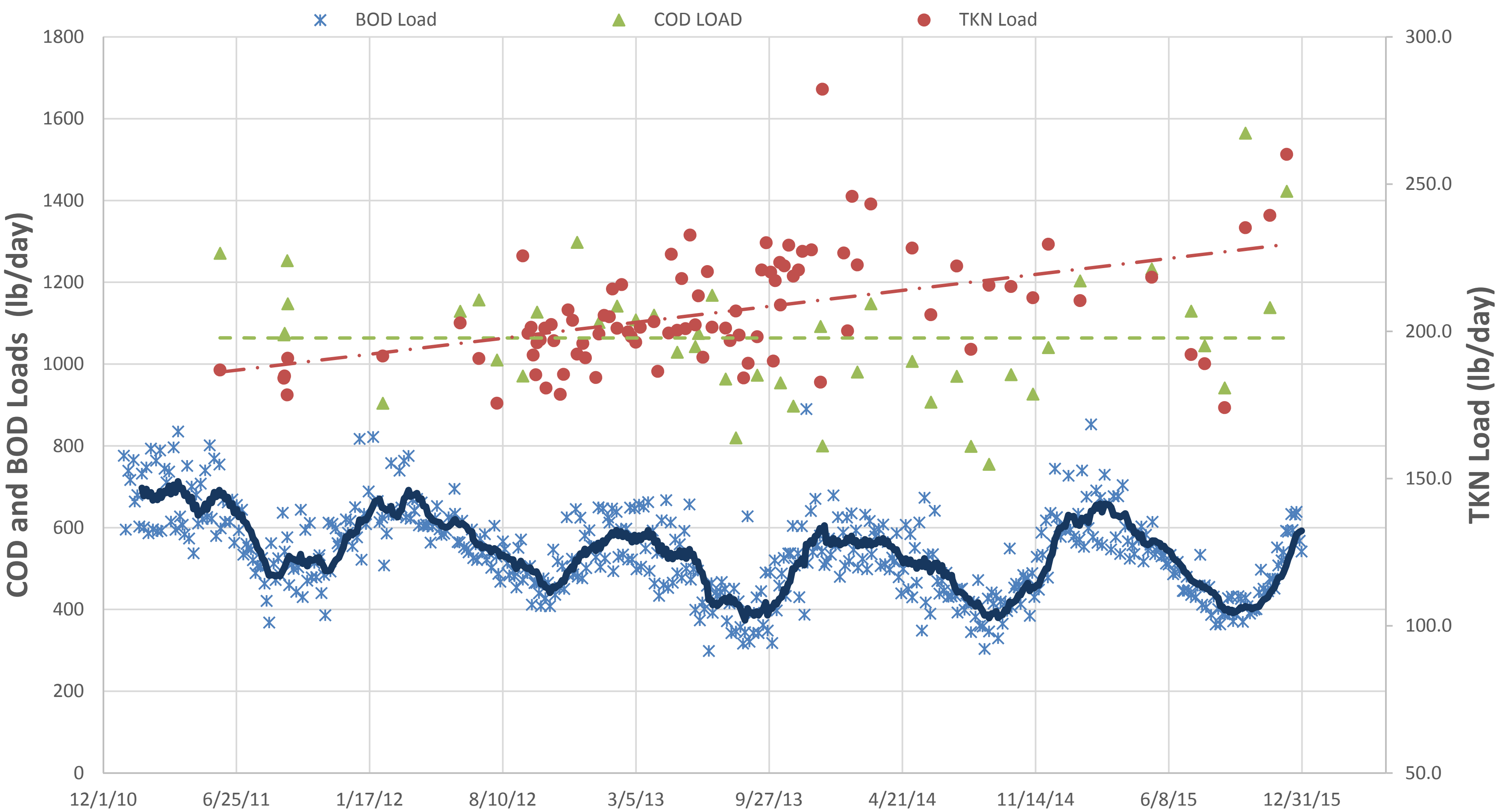


Figure 3-6. WRF Influent BOD, COD, and TKN Loads, 2011 to 2015

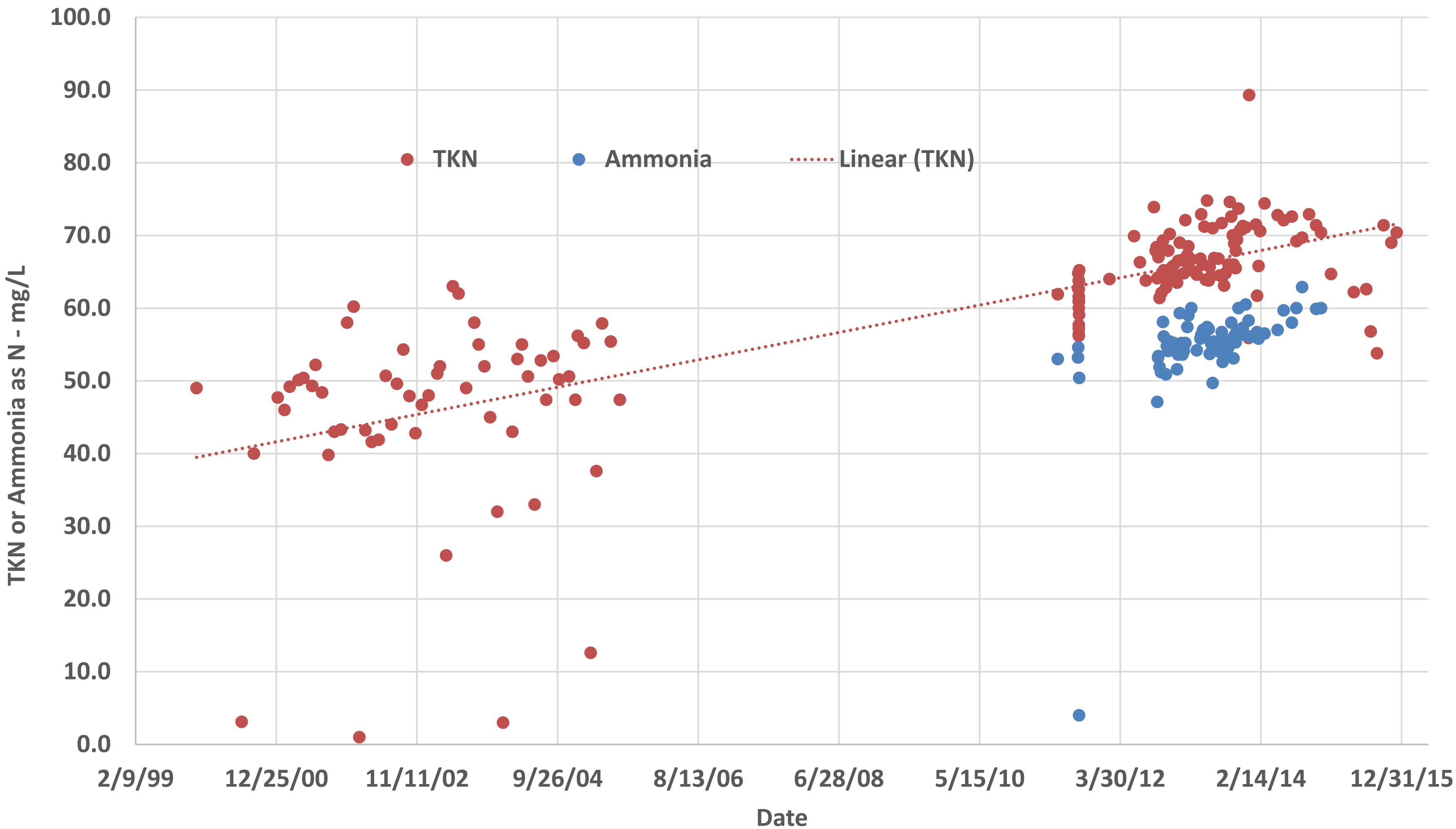


Figure 3-7. WRF Influent TKN and Ammonia Concentrations, 1999 to 2015

Also, a minimum month BOD load is being documented for the WRF flow and load. Available BOD in the influent is a vital component to remove nitrogen biologically at the WRF. As shown in Figure 3-2, the BOD load trend into the WRF has been steadily decreasing from 2009 to 2014. The influent BOD load trend has appeared to stabilize in 2015. Also, the WRF influent BOD influent load data is showing a definitive seasonal trend, with highest BOD loads occurring during the winter months (December, January, and February) and the lowest BOD loads occurring during the summer months (July and August).

If influent BOD is not entering the WRF at sufficient quantities, then supplemental carbon will need to be added at either the SBRs or the tertiary filters to ensure that sufficient denitrification is occurring. Therefore, this Plan will also include a minimum month BOD load condition to address the need for periodic carbon supplementation at the WRF to support effective biological denitrification. The minimum BOD load condition listed will be based on an influent BOD concentration of 100 mg/L. This 100 mg/L value was derived primarily based on BOD concentration data plotted in Figure 3-3.

A summary of the WRF facility planning related flow and load projections based on the load modifications listed above are shown as follows in Table 3-4.

Table 3-4. Revised GSP Projected Flows and Loads for WRF Facilities Plan Basis of Design

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

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

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

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

4. REGULATORY REQUIREMENTS

4.1 INTRODUCTION

This chapter summarizes the current and potential future regulatory requirements associated with making WRF improvements as defined in the Yelm GSP. The regulatory requirements discussed herein are primarily based on the City's existing NPDES and State Reclaimed Water Discharge Permit (No. WA0040762) issued July 7, 2011, and Permit Fact Sheet (Updated July 2011) attached as Appendix C, WRF NPDES and Reclaimed Water Discharge Permit. The technical details and operational requirements for WRF outfalls and receiving waters are described below.

4.2 BACKGROUND

Initially, the City's wastewater treatment system was constructed to provide secondary treatment and discharge into the Centralia Power Canal, with emergency discharge into the Nisqually River. However, due to water quality concerns in the Nisqually River, the shoreline substantial development permit for the secondary effluent was challenged. A temporary discharge permit was issued after the City agreed to pursue water reuse with 100 percent upland discharge and to eliminate discharge directly into the Nisqually River.

In 1999, the City replaced the initial aerated lagoon treatment system at the WRF with sequencing batch reactors (SBRs). The SBRs provide secondary biological wastewater treatment. Additionally, the City made changes to add coagulation, filtration, and additional disinfection to meet the reclaimed water standards for tertiary treatment processes. The final shoreline permit, which was completed in 2002, specifies that while the reclaimed water distribution system is the primary and preferred discharge location, the Centralia Power Canal can be used as a standby outfall when there is insufficient demand for reclaimed water or the reclaimed water system is unavailable. The permit also allows emergency discharge to the Nisqually River if the primary and standby outfalls are unavailable.

In 1992, the Washington State Legislature approved the Reclaimed Water Act (RCW 90.46), which encourages the use of reclaimed water for beneficial purposes, such as irrigation and commercial and industrial uses. In order to promote the development of water reclamation facilities, Ecology and DOH established a Pilot Project program for treatment facilities that pioneered water reclamation. The City of Yelm received Pilot Project status and began developing plans for beneficial reuse. Initial plans were focused primarily on using reclaimed water for irrigation. However, because irrigation demands vary seasonally, establishing plans for year-round upland discharge were difficult. Modifications to the Reclaimed Water Act in 1995 included provisions for non-consumptive uses of reclaimed water, including surface percolation (infiltration), wetland enhancement, and streamflow augmentation. The City incorporated these provisions into its plan for reuse and completed construction on a groundwater recharge facility at Cochrane Park in 1999. The RIBs located at Cochrane Park provide a year-round demand for reclaimed water.

The City currently uses reclaimed water for beneficial purposes continuously through the year, although use varies seasonally according to irrigation demands. The Centralia Power Canal remains a backup discharge location with the Nisqually River outfall serving as an emergency backup.

The permit allows up to 1.0 mgd (maximum month flow) of discharge to one of three locations: the reclaimed water system, the Centralia Power Canal, or the Nisqually River. Section 4.2.1 describes conditions under which each of the discharge locations is used.

4.2.1 Outfalls

The WRF is permitted to discharge effluent to two surface water bodies (the Centralia Power Canal and the Nisqually River), as well as to distribute Class A reclaimed water for irrigation and/or surface percolation at Rapid Infiltration Basins.

Discharge to the Centralia Power Canal is considered a "standby" disposal alternative for periods when Class A reclaimed water standards cannot be achieved when there is insufficient demand for reclaimed water. Discharge to the Nisqually River is an "emergency" disposal alternative, to be used only when the canal must be shut down for maintenance or anytime flow in the canal drops below 200 cubic feet per second (cfs). Due to the ambient water quality and designated uses of the Nisqually River, regulatory requirements are more restrictive for the River than for discharges to the Canal.

4.2.2 Receiving Waters

The Nisqually River, either through direct outfall discharge or indirect outfall, discharges into the Centralia Power Canal (Canal draws flow from and drains back into the Nisqually River). The emergency Nisqually River discharge location is in a stream receiving water area for the main stem of the Nisqually River from the mouth of the river to Alder Dam. Per Table 602 of WAC 173-201A, the stream waters in this location have the following designated uses (WAC 173-201A-600):

- Aquatic Life Uses – Core Summer Habitat.
- Recreation Uses – Primary Contact Recreation.
- Water Supply Uses – Domestic, Industrial, Agricultural, and Stock Water.
- Miscellaneous Uses – Wildlife Habitat, Harvesting, Commerce/Navigation, Boating, and Aesthetics.

4.3 NPDES PERMITTING REQUIREMENTS

4.3.1 Basis for Effluent Limitations

The WRF effluent must meet the requirements of the NPDES discharge permit, which are established by Ecology as necessary to comply with both federal and state regulations established to protect water quality and designated beneficial uses.

4.3.1.1 Technology-Based Limitations

Discharges from municipal WWTPs to surface water must comply with federal and state standards codified in 40 CFR part 133 and Chapter 173-221 WAC, respectively. These standards, also referred to as "secondary treatment standards," limit the discharge of conventional pollutants including BOD, TSS, and pH. The Washington State regulations also include a standard for fecal coliform bacteria. These upper bounds allow for establishment of both concentration and mass based discharge limitations in the permit based on the WRF design flows.

4.3.1.2 Water Quality-Based Limitations

In addition to secondary treatment standards, Washington State establishes water quality standards for all surface waters in the State. These standards include established beneficial uses and water quality criteria that must be met to protect the established beneficial uses. These water quality standards are codified in Chapter 173-201A WAC. In addition, the Washington State Antidegradation Policy may result in more restrictive limitations than would be dictated by the water quality standards in order to prevent further degradation of high-quality water. Mixing zones can be permitted by Ecology to take advantage of natural dilution in the receiving waters provided dilution does not harm sensitive habitats. Mixing zones typically allow for some exceedance of acute and chronic toxicity criteria within the mixing zone. In all cases, established water quality criteria must be met at the edge of the mixing zone.

4.3.1.3 TMDL-Based Limitations

In many cases, technology-based limitations require sufficient treatment to result in compliance with water quality standards. If a water body fails to meet any water quality standards after application of technology-based controls, the federal Clean Water Act requires a water body be placed on its 303(d) list of impaired water bodies. The Clean Water Act then requires development of a Total Maximum Daily Load (TMDL) analysis to bring impaired water bodies into compliance with water quality standards. The TMDL evaluation must establish the allowable load to protect water quality and then allocate the load to all sources of pollution.

4.3.1.4 Human Health-Based Effluent Limits

Washington State water quality standards include numeric human health-based criteria promulgated for the state by the U.S. Environmental Protection Agency (USEPA) in its National Toxics Rule (Federal Register, Vol. 57, No. 246, 1992). The existing NPDES permit Fact Sheet (see Appendix C) states that the WRF discharge is unlikely to contain chemicals regulated for human health, and thus the discharge is not currently regulated for human health-based criteria. The discharge will be reevaluated for impacts to human health during each permit renewal cycle. Wastewater system growth is not anticipated to change the nature of the effluent discharge with respect to pollutants regulated for human health as the industrial wastewater flow contribution is anticipated to be minor.

4.4 RECLAIMED WATER PERMITTING REQUIREMENTS

4.4.1 Basis for Effluent Limitations

The WRF effluent must also meet State Reclaimed Water Discharge permit limits if applied to designated reclaimed water uses such as surface percolation or turf irrigation. Reclaimed water effluent limits and requirements are established by Ecology as necessary to comply with both federal and state regulations established to protect groundwater quality and designated beneficial users of the reclaimed water.

4.4.1.1 Technology-Based Limitations

All reclaimed water permits must ensure that the effluent has been adequately and reliably treated so that as a result of that treatment, it is suitable for a beneficial use or controlled use that would not otherwise occur and is no longer considered a wastewater [RCW 90.46.010(40)]. The authority and duties for reclaimed water use are in addition to those already provided in law with regard to sewage and wastewater collection, treatment, and disposal for the protection of public health and the safety of the state’s waters.

All waste discharge permits issued by Ecology must specify conditions requiring all known available and reasonable methods of prevention, control, and treatment of discharges to waters of the state (WAC 173-216-110).

The Water Reclamation and Reuse Standards, 1997, outline the requirements for the additional level of treatment technology, as well as water quality limits necessary for public health protection during the use of reclaimed water. The standards provide four classes of reclaimed water, Classes A, B, C, and D. The Yelm WRF currently is permitted to produce Class A reclaimed water.

Class A reclaimed water requires the most stringent treatment and water quality limitations. As defined by the Water Reclamation and Reuse Standards of 1997, the technology and water quality requirements for the production of Class A reclaimed water are as follows:

> "Class A Reclaimed Water" is reclaimed water that had been adequately and reliably treated and, at a minimum is, at all times, an oxidized, coagulated, filtered and disinfected wastewater.
>
> 1. Oxidized is defined as wastewater in which the organic matter has been stabilized such that the BOD5 does not exceed 30 mg/L and TSS does not exceed 30 mg/L, is nonputrescible and contains dissolved oxygen (DO), at the end of the secondary process. After the tertiary process or nitrogen removal, BOD5 should not exceed 20 mg/L.
> 2. Coagulated wastewater is defined as an oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated prior to filtration by the addition of chemicals or by an equally effective method. MBRs do not require coagulation to be an equally effective method.
> 3. Filtered wastewater is defined as an oxidized, coagulated wastewater which has been passed through natural undisturbed soils or filter media, such as sand or anthracite, so that the turbidity as determined by an approved laboratory method does not exceed an average operating turbidity of 2 nephelometric turbidity units (NTU), determined monthly, and does not exceed 5 NTU at any time. For MBRs, an average of 0.2 NTU and maximum of 0.5 NTU is used instead of coagulation and to demonstrate membrane integrity. Experience and testing has shown that MBRs should be able to meet 0.2 and 0.5 NTU, if they are not leaking.
> 4. Adequate disinfection is defined as the median number of total coliform organisms in the wastewater after disinfection does not exceed 2.2 per 100 milliliters, as determined from the bacteriological results of the last seven days for which analyses have been completed, and the number of total coliform organisms does not exceed 23 per 100 milliliters in any sample.
> 5. For uses that include public contact with the reclaimed water, a 0.5 mg/L free chlorine residual shall be maintained in the reclaimed water during conveyance from the reclamation facility to the use areas. For surface percolation or forest irrigation, ultraviolet light is the preferred method of disinfection.

4.4.1.2 Groundwater Quality-Based Effluent Limitations

RCW 90.46.080 states that reclaimed water may be beneficially used for groundwater recharge via surface percolation provided that it meets the groundwater recharge criteria as measured in the groundwater beneath or down gradient of the recharge project site. The groundwater recharge criteria are defined in 90.46.010 as the contaminant criteria found in the drinking water quality standards adopted by the Washington State Board of Health pursuant to Chapter 43.20 RCW and the Department of Health pursuant to Chapter 70.119A RCW. The primary drinking water standards are listed in Table 4-1. Drinking water is the beneficial use generally requiring the highest quality of groundwater. Providing protection to the level of drinking water standards will protect a great variety of existing and future beneficial uses.

Table 4-1. Primary Drinking Water Standards

Parameter	Concentration
Nitrate as N	10 mg/L
Nitrite as N	1 mg/L
Arsenic	10 microgram per liter (µg/L)
Cadmium	5 µg/L
Chromium	100 µg/L
Fluoride	4 mg/L
Mercury	2 µg/L
Nickel	100 µg/L
Fecal Coliform Bacteria	Non Detect (ND)
Total Trihalomethanes (TTHM)	80 µg/L

RCW 90.46.080 further states that if the groundwater recharge criteria do not contain a standard for a constituent or a contaminant, Ecology shall establish a discharge limit consistent with the goals of the Reclaimed Water Act. In order to protect existing water quality and preserve the designated beneficial uses of Washington's groundwater, including the protection of human health, WAC 173-200-100 states that waste discharge permits shall be conditioned in such a manner as to authorize only activities that will not cause violations of the Groundwater Quality Standards. Additional groundwater criteria as defined in Chapter 173-200 WAC and in RCW 90.48.520 for this discharge include the criteria shown in Table 4-2.

Table 4-2. Additional Groundwater Criteria

Parameter	Concentration
Conductivity	700 µmhos/cm[a]
Total Dissolved Solids	500 mg/L
Chloride	250 mg/L
Sulfate	250 mg/L
Copper	1,300 µg/L
Lead	15 µg/L
Manganese	50 µg/L
Silver	50 µg/L
Zinc	5,000 µg/L
pH	6.5 to 8.5 standard units

[a] µmhos/cm = micromhos/centimeter

4.5 CURRENT NPDES AND RECLAIMED WATER PERMIT LIMITS

NPDES or reclaimed water quality permit existing and projected limits for each of the WRF discharge locations are summarized in Table 4-3.

Table 4-3. Yelm WRF Existing and Projected NPDES Permit Limits

Parameter	Existing Permit Limit	Projected Permit Limit
Effluent Limit at Outfall No. 001: Yelm Reclaimed Water System		
BOD [a]	30 mg/L monthly average	No change
TSS [a]	30 mg/L monthly average	No change
Total coliform bacteria [a]	2.2 count per 100 mL 7-day limit; 23 per 100 mL sample maximum	No change
pH [a]	Shall be between 6.0 and 9.0 on a daily basis	No change
Turbidity [a]	2 NTU monthly average; 5 NTU sample maximum	If moving to membrane-based treatment: 0.2 NTU monthly average 0.5 NTU sample maximum
Residual chlorine (mg/L) [a]	Minimum Chlorine Residual of 0.5 mg/L	0.5 mg/L as Free Chlorine
Total Nitrogen (mg/L) [b]	10 mg/L monthly average; 15 mg/L daily maximum	No change
Effluent Limit at Outfall No. 002: Centralia Power Canal		
BOD [a]	30 mg/L monthly average (250 lb/d); 45 mg/L weekly average (375 lb/d) Minimum 85% removal	No change
TSS [a]	30 mg/L monthly average (250 lb/d); 4 mg/L weekly average (375 lb/d) Minimum 85% removal	No change
Fecal coliform bacteria [c]	100 per 100 mL monthly average; 200 per 100 mL weekly average	No change
pH [a]	Shall be between 6.0 and 9.0 on a daily basis	No change
Total residual chlorine (mg/L) [a]	0.5 mg/L monthly average; 0.75 mg/L weekly average	No change
Total ammonia (mg/L) [d]	3 mg/L monthly average; 4.5 mg/L weekly average	No change
Effluent Limit at Outfall No. 003: Nisqually River		
BOD [a]	30 mg/L monthly average 250 lb/d) ; 45 mg/L weekly average (375 lb/d) Minimum 85% removal	No change
TSS [a]	30 mg/L monthly average 250 lb/d); 45 mg/L weekly average (375 lb/d) Minimum 85% removal	No change
Fecal coliform bacteria [c]	100 per 100 milliliter (mL) monthly average; 200 per 100 mL weekly average	No change
pH [a,c]	Shall be between 6.5 and 9.0 on a daily basis	No change
Total ammonia (mg/L) [d]	3 mg/L monthly average; 4.5 mg/L weekly average	No change
Total residual chlorine (mg/L) [a]	0.047 mg/L monthly average; 0.124 mg/L maximum day	0.5 mg/L monthly average; 0.75 mg/L weekly average
Total lead (µg/L) [c]	10 µg/L monthly average; 15 µg/L maximum day	–

[a] Technology-based limit.

[b] Groundwater quality-based limit.

[c] Water quality-based limit.

[d] Limit based upon expected WRF performance.

The most restrictive permit limits are the effluent limits pertaining to nitrogen. Nitrogen is a principal component of amino acids and proteins, and enters the City's STEP system through organic matter, such as human waste and food remnants. The nitrogen in the organic matter is partially broken down into ammonia in individual STEP tanks. When discharged from the STEP tanks and conveyed to the WRF in influent, nitrogen is primarily in the form of ammonia, ammonium, and organic nitrogen.

At the WRF, nitrogen is removed from sewage in a two-step process in the SBRs. During the first stage of the process, called nitrification, bacteria convert the ammonia in plant influent to nitrite and nitrate. When the WRF is discharging to the Centralia Power Canal or the Nisqually River, this is the only required step in the nitrogen removal process. However, the City treats all influent water flow to Class A reclaimed water standards regardless if discharge occurs to the Power Canal or not. The current NPDES permit requires that the ammonia be reduced to at least 3 mg/L (monthly average) when discharging to the Power Canal or Nisqually River. Effluent being discharged to the Power Canal or Nisqually River is required to be tested for ammonia at least monthly.

The current Reclaimed Water permit requires that total nitrogen be less than 10 mg/L year round, average monthly effluent turbidity less than 2 nephelometric turbidity units (NTU), and effluent turbidity no greater than 5 NTU at any time. To accomplish the total nitrogen limit, almost full nitrification of the influent must occur in the WRF SBR biological treatment process. Nitrification requires the addition of air and suitable dissolved oxygen levels in the SBRs to occur. Also, in the second step of nitrogen removal, denitrification is required where nitrate is converted to nitrogen gas in the SBR biological treatment process. Biological denitrification requires anoxic conditions where dissolved oxygen in the wastewater being treated needs to be low and a sufficient amount of carbon source is present. If insufficient, carbon will hamper the denitrification process. The Yelm WRF currently uses continuous backwash upflow sand filters with coagulant addition to meet reclaimed water turbidity effluent limits.

The reclaimed water produced by the WRF must comply with Department of Ecology permit requirements. The permit governs the limits shown in Table 4-3 (on page 4-6): reclaimed water, river, and canal water quality parameter limits.

4.6 PROJECTED NPDES AND RECLAIMED WATER PERMIT LIMITS

An analysis was conducted in the Yelm GSP with regards to projected future NPDES and reclaimed water permit limits. That analysis is summarized in Table 4-3.

The Yelm GSP permitting analysis indicated that little change in NPDES requirements is expected. The Yelm GSP recommended that the total residual chlorine limits be relaxed with regards to discharge to Outfall 2 at the Centralia Power Canal. Items added to the GSP future regulations listed under facility planning include:

1. Tightened turbidity limits if membrane technology is selected as a preferred alternative.
2. The general chlorine residual requirement for reclaimed water could be clarified by Ecology to mean free chlorine in future permit cycles.

4.7 PROJECTED RECLAIMED WATER PERMIT REQUIREMENTS

Note: The following information is directly excerpted from the Yelm GSP and inserted in this Plan for general reference.

In 2010, Ecology began drafting an update to the state's reclaimed water rules. Although the Draft Rules were originally scheduled for adoption by the end of 2010, the final revisions and adoption have been delayed and work towards adoption has only re-started in earnest as of 2014.

The Yelm GSP analyzed the impact if reclaimed water regulation updates were adopted in their current form and the analysis indicated:

- Implementation Costs for Groundwater Monitoring: Potential requirements to monitor for additional constituents and/or lower detection limits may result in increased analytical testing and personnel requirements. There are 171 constituents for which groundwater recharge projects may become subject to monitoring. By comparison, the City is currently required to monitor for 28 constituents at its existing RIB.
- Potential to Increase Treatments Costs: An expanded list of constituents and lower concentration thresholds may result in additional required treatment or modifications to the City's treatment system. Additional treatment technology, such as reverse osmosis (RO) membranes, may be used to generate reclaimed water that meets the proposed point of compliance water quality criteria for groundwater recharge projects; however, RO treatment imposes a considerable cost.
- Potential to Increase the Required Area of Land for Infiltration Sites: The areas identified for the City's potential RIBs at the WRF or at the Public Works Facility are relatively compact (approximately 2.5 acres or less). This does not provide for a wide buffer between the RIB and the point of compliance, which must be within the property boundary. In order to increase this buffer, the City would need to acquire additional land, which would increase the project cost considerably.
- Increased Budget and Timeline for Planning and Engineering Studies: To provide evidence that proposed projects do not impact the environment (anti-degradation, water quality, etc.) or other water rights, costs for planning and engineering studies may increase significantly. Increased studies and agency review time required by the Draft Rule would likely result in:
  - Additional groundwater impairment analysis and fate and transport modeling, potentially doubling planning costs.
  - Additional permitting time and time to negotiate approval with DOH/Ecology, with the potential to increase from one year to many years.

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

5. CONDITION AND CAPACITY ASSESSMENT

5.1 INTRODUCTION

This chapter summarizes capacity and current conditions of unit processes currently installed at the Yelm WRF. Current capacity is also compared to current and future build-out flows and loads.

5.2 CAPACITY ASSESSMENT GENERAL APPROACH

The two primary elements for evaluating WRF capacity include:

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

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

5.3 FACILITY DESCRIPTION

The Yelm WRF provides secondary and tertiary treatment of wastewater prior to discharge for reclaimed water use or stream discharge into the Centralia Power Canal or the Nisqually River. In 1999, the original aerated lagoon facility at the current WRF site was upgraded to provide nutrient-removal-based secondary treatment, tertiary treatment, and expanded capacity. The upgrade included the following major components:

- Expansion of Administrative Building.
- Additional Storage and Generator Building.
- New influent flow meters.
- New sequencing batch reactors.
- New process air blowers.
- New WAS pumping system.
- Existing Aerated Pond System converted to SBR effluent equalization and emergency storage volume.
- New Intermediate Pump Station (IPS).
- New Tertiary Filtration System.
- New Reject Water Pump Station.
- New chemical feed facilities.
- New gravity belt waste activated sludge (WAS) thickener system.
- New chlorine contact basins.

- Repurposing existing lagoon polishing tank to aerated waste activated sludge storage tanks.
- Repurposing existing aerated pond drain pump station as a Drain and Sludge Pump Station.

A flow schematic of the current treatment process units is presented in Figure 5-1 and the site layout is presented in Figure 5-2.

5.4 WRF CURRENT STATED DESIGN CRITERIA

Stated WRF design criteria from the Yelm GSP is summarized in Table 5-1.

Table 5-1. WRF Stated Design Criteria

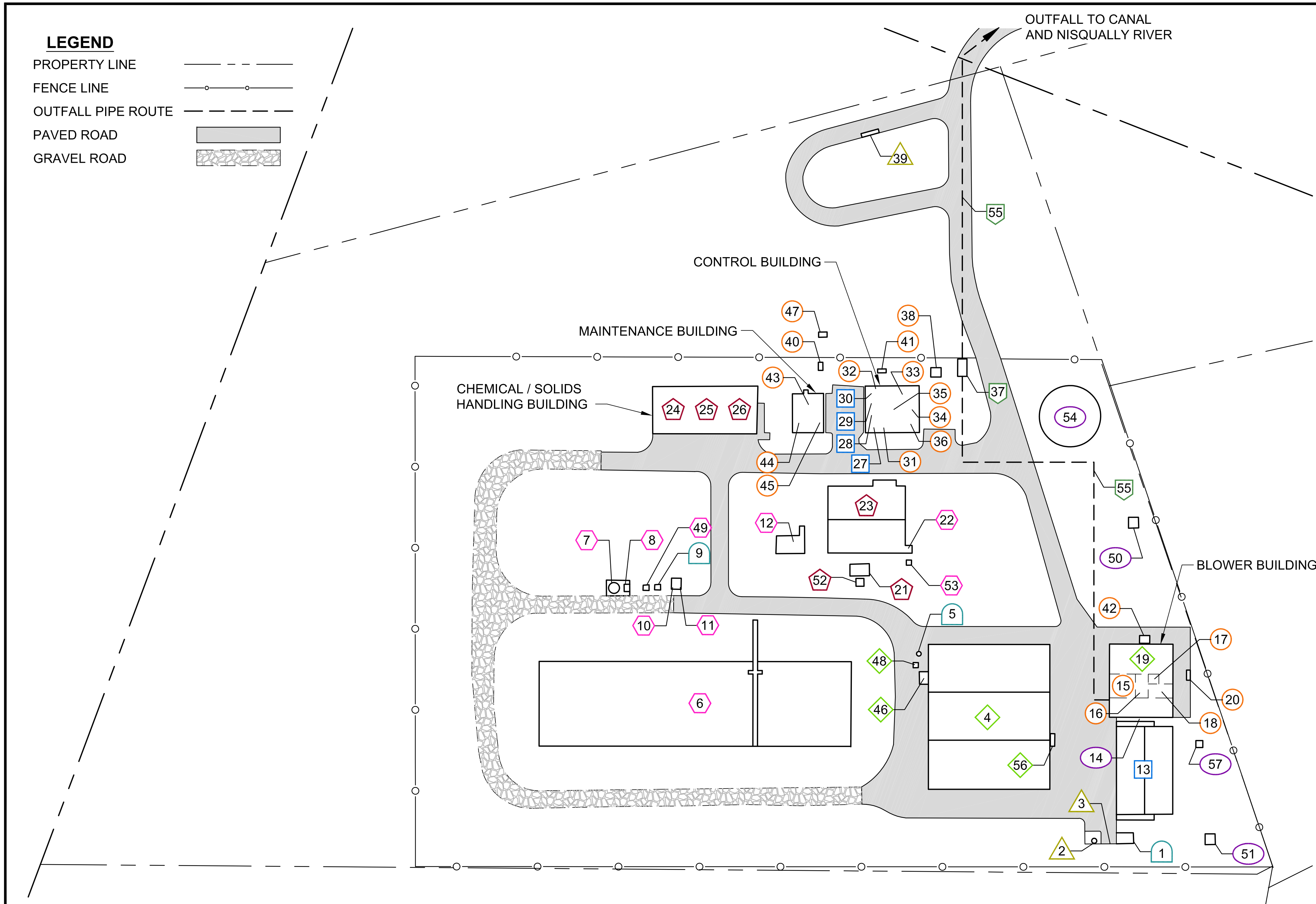
Parameter	Stated Design Criteria
Maximum Month	1.06 mgd
Flow	1,486 pounds/day
BOD	248 pounds/day
TSS	372 pounds/day
Ammonia	No value specified
Maximum Day	
Flow	1.36 mgd
BOD	1,750 pounds/day
TSS	370 pounds/day
Ammonia	435 pounds/day

Note: SBR design calculations show a maximum loading of 485 pounds/day.

The design criteria listed above are based on stated design criteria compiled by Brown and Caldwell in the Yelm GSP. Parametrix recently conducted a WRF capacity assessment based on current load conditions experienced by the WRF in 2013. Information on the Parametrix WRF capacity assessment is contained in Sections 5.5 and 5.6.

Current stated design capacity data is also provided for individual major process areas in Table 5-2. Major WRF process areas include:

- Influent Facilities (Hydraulic Control, Chemical Feed).
- Secondary Treatment (Sequencing Batch Reactor).
- Tertiary Treatment (Flow Equalization, Pumping, Chemical Feed, and Filtration).
- Disinfection and (Gaseous Chlorine Disinfection) Dechlorination (Sulfur Dioxide Gas).
- Sludge Storage, Pumping, and Processing.
- Reclaimed Water Pumping and Storage.
- Flow Measurement and Sampling.
- Support Facilities (Laboratory, Supervisory Control and Data Acquisition System [SCADA], Electrical Distribution).
- Outfall.



SCHEDULE OF SUB PROCESS AREAS

1 INFLUENT METERING VAULT
2 INFLUENT HYDRAULIC CONTROL STRUCTURE
3 TEMP INFLUENT CHEMICAL STORAGE/FEED FACILITY
4 SEQUENCING BATCH REACTOR TANKS
5 SBR DECANT FLOW METER MANHOLE
6 SBR DECANT EQUALIZATION STORAGE PONDS
7 INTERMEDIATE PUMP STATION (IPS)
8 VALVE BOX
9 IPS FLOWMETER VAULT
10 STATIC MIXER 'A'
11 STATIC MIXER 'B'
12 EFFLUENT FILTERS
13 CHLORINE CONTACT TANKS
14 RECLAIMED WATER PUMP STATION AND WETWELL
15 MCC ROOM
16 CONTROL ROOM (BLOWER BUILDING)
17 RESTROOM
18 STORAGE ROOM
19 BLOWER ROOM
20 STANDBY GENERATOR (SOUTH HALF)
21 DRAIN AND SLUDGE PUMP STATION
22 REJECT WATER PUMP STATION
23 SLUDGE STORAGE TANKS
24 TRUCK LOADING BAY
25 SOLIDS HANDLING ROOM
26 CHEMICAL FEED AND STORAGE ROOM
27 PROCESS MAKE-UP WATER SUPPLY ROOM
28 SO_2 FEED ROOM
29 CHLORINE FEED ROOM
30 CHLORINE STORAGE ROOM
31 RESTROOM
32 MCC ROOM
33 LABORATORY
34 BREAKROOM
35 OFFICE
36 PROCESS CONTROL ROOM
37 OUTFALL LINE PIG PORT
38 SEPTIC TANK
39 RV PUMP STATION (NOT IN USE)
40 PRIMARY POWER XFMR (NORTH HALF)
41 HVAC HEAT PUMP
42 PRIMARY POWER XFMR (SOUTH HALF)
43 MAINTENANCE GARAGE
44 STEP SYSTEM SUPPLY ROOM
45 STANDBY GENERATOR (NORTH HALF)
46 WAS PUMP STATION
47 POWER VAULT
48 WAS PINCH VALVE VAULT
49 CHECK VALVE VAULT
50 OVERFLOW AIR RELEASE ASSEMBLY
51 PLANT REUSE CHECK VALVE VAULT
52 DRAIN & SLUDGE PUMP STATION CHECK VALVE VAULT
53 REJECT WATER CHECK VALVE VAULT
54 RECLAIMED WATER (RW) STORAGE TANK
55 OUTFALL PIPE (TO CANAL OR RIVER)
56 TEMP OUTDOOR FOAM CONTROL STORAGE/FEED FACILITY
57 RW STORAGE TANK DRAIN AIR GAP SLAB

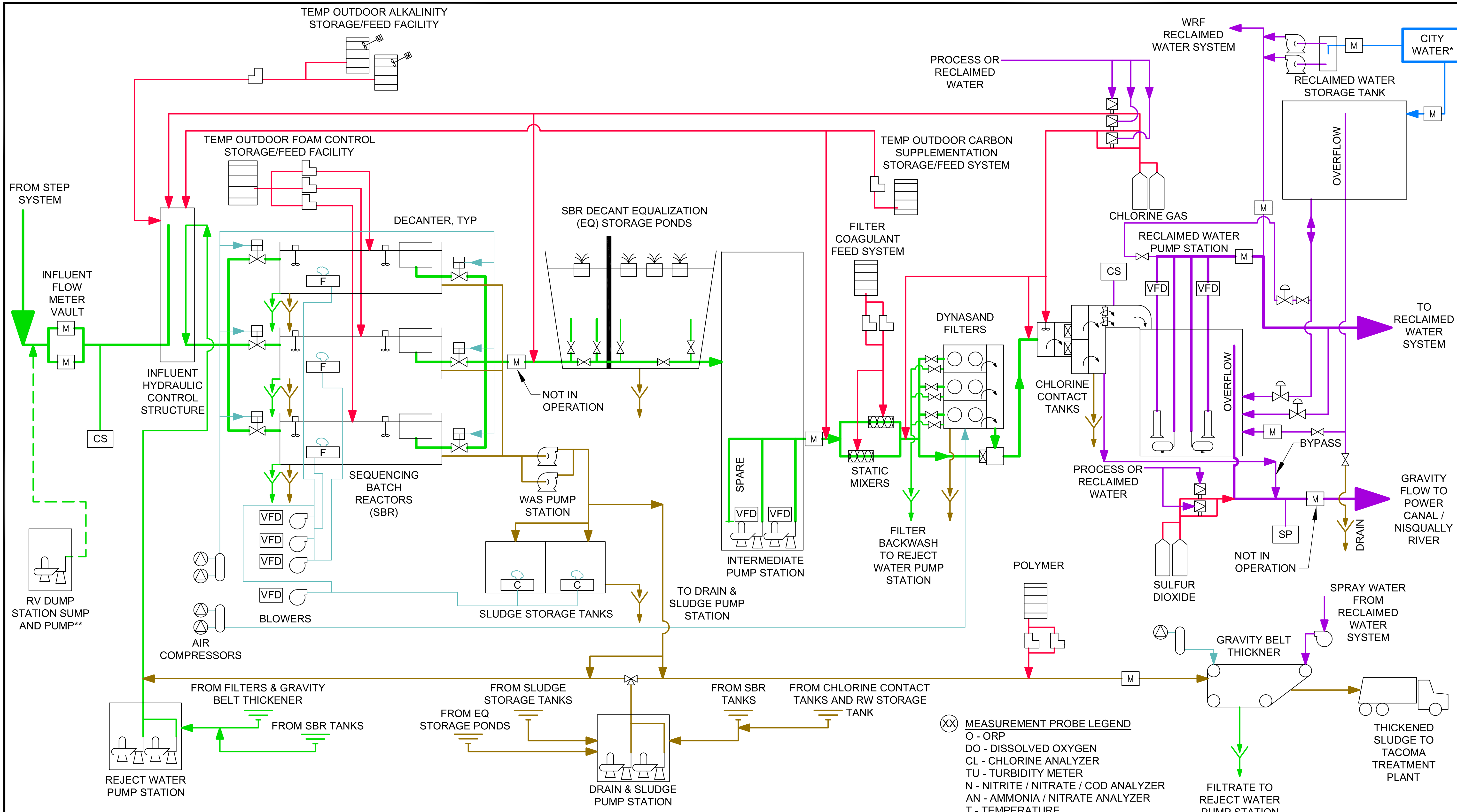
Parametrix DATE: May 12, 2016 FILE: PS1781033F5-1

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 5-1
Existing WRF Site Plan
Sewer Facilities Plan
Yelm, Washington



* THE USE OF CITY WATER TO AUGMENT THE RECLAIMED WATER SYSTEM HAS BEEN DISCONTINUED.

** THE RV DUMP STATION HAS BEEN CLOSED.

Parametrix DATE: May 12, 2016 FILE: PS1781033F5-2

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	
CHEMICAL METERING PUMP	M FLOW METER	THREE WAY VALVE	VFD VARIABLE FREQUENCY DRIVE	TOTE OR STORAGE TANK	CHEMICAL	SOLID OR DRAINAGE

Figure 5-2
Existing WRF Process Schematic
Sewer Facilities Plan
Yelm, Washington

Table 5-2. Yelm WRF Summary Design Data

Process Unit	Value
Influent Facilities (Sub Process Areas – 2, 3, 39)	
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
Outdoor, Temporary Mag Hydroxide Feed System	
Storage Tank No. 1 volume	1,000 gallons
Storage Tank No. 2 volume	1,000 gallons
Feed Pumps:	
Number	One
Type	Diaphragm
Capacity	150 gpd
Outdoor, Temporary Carbon Supplementation Feed System	
Tote volume	270 gallons
Feed Pumps:	
Number	One
Type	Diaphragm
Capacity	100 gpd
RV Dump Station Pump (Inactive)	
Dilute Caustic Solution Feed Pumps (Inactive)	
50% Caustic Solution Transfer Pump (Inactive)	
Dilute Caustic Storage Tank (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 feet
Volume at maximum SWD	583,440 gallons per tank
Minimum Operating SWD	9 feet
Cycle times	6 hour (two-tank operation) 10 hour (three-tank operation)
Decanter type	Floating Fiberglass Decanter, Submerged Decant Orifices
Decanter average flow rate	5,000 gallons per minute (gpm)
SBR Process Aeration Diffusers	
Type	Ethylene propylene diene monomer (EPDM) fine bubble 9-inch-diameter membrane disks
Number	1,256 per SBR Tank
Manufacturer and model	Evoqua, previously known as Siemens
Design specific oxygen transfer	550 pounds per hour per tank
(Table Continues)	

Table 5-2. Yelm WRF Summary Design Data (Continued)

Process Unit	Value
SBR Tank Mixers	
Number	Two per tank, total of six
Type	Floating Direct Drive
Motor size and type	15 horsepower (hp), constant speed
SBR Tank Decanters	
Number	One per SBR Tank, total of three
Type	Floating
Material of construction	Fiberglass
SBR Process Air Blowers	
Number	Three, Two Duty
Type	Rotary Lobe, Positive Displacement
Manufacturer	Gardner Denver
Model	Sutorbilt – GFJCJEA
Motor size and type	150 hp, variable frequency drive (VFD)-controlled motors
Capacity	2,600 cubic feet per minute (cfm) at 10 pounds per square inch (psi) discharge pressure
SBR Waste Activated (WAS) Pumps	
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)
Outdoor Temporary, SBR Foam Control Chemical Feed System	
Chemical used	Polyaluminum Chloride
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
Manufacturer	Quincy
Model	310
Number of compressors	Two
Compressor motor size	10 hp
Tertiary Treatment (Sub Process Areas 6, 7, 8, 10, 11, 12)	
SBR Effluent Decant Equalization Basins	
Number	Two
Basin No. 1 volume (in operation)	157,000 gallons at Minimum SWD – 4 feet 546,000 gallons at Maximum SWD – 10 feet

(Table Continues)

Table 5-2. Yelm WRF Summary Design Data (Continued)

Process Unit	Value
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
Type of pump	Submersible, Sewage
Wet well materials of construction	96-inch-diameter concrete manhole
Pump manufacturer	ABS
Pump model	AFP 1547.3
Motor size and type	20.3 hp, 460 V, 3-phase, VFD-Controlled Motors
Pump capacity	1,680 gpm at 82 feet Head
Effluent Filters	
Type	Continuous Backwash, Up-flow
Mode of operation	Contact Filtration Only
Manufacturer and model	Parkson Dynasand
Number	Three Cells, Two modules per cell
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
Air Compressors to Supply Air to Filter Airlift Pumps	
Type	Reciprocating Air Compressor, Single Air Tank
Manufacturer	Quincy
Model	140T15DT10HP (Confirm)
Number of compressors	Two
Compressor motor size	10 hp
Coagulant Feed Pumps	
Type	Peristaltic
Number	One
Coagulant type	Poly Aluminum Chloride
Chemical Static Mixers	
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

(Table Continues)

Table 5-2. Yelm WRF Summary Design Data (Continued)

Process Unit	Value
Reject Water Pumps (Filter Backwash Waste and GBT Filtrate)	
Number	Two
Type	Submersible, Non-Clog
Manufacturer and model	Flygt C-3085
Motor	3 hp
Flow capacity per pump	180 gpm at 28.5 feet TDH
Disinfection and Dechlorination (Sub Process Areas – 13, 27, 28, 29, 30)	
Chorine Gas Storage for Disinfection	
Type of storage	150-pound cylinders
Number of active cylinders for contact basin chlorine gas feed	Two
Number of active cylinders for influent chlorine gas feed	One
Cylinders held in storage	Six
Total cylinders in Feed Room	Nine
Maximum daily feed rate from single operating cylinder	40 pounds per day
Raw Influent and Filter Chlorinators	
Number of chlorinators	One, No. 3
Chlorinator model	V500, Wallace and Tiernan – Evoqua
Chlorinator size	250 pounds/day
Feed control mode	Manual
Contact Basin Chlorinators	
Number	Two, No. 1 and No .2
Model	V2000, Wallace and Tiernan – Evoqua
Size	2,000 pounds/day
Feed control mode	Flow paced with optional residual trim and two cylinder system automatic switch over
Chlorine Gas Detector	
Number	One
Model	Wallace and Tiernan – Evoqua Series 50
Chlorine Contact Tanks	
Number	Two
Tank volume	34,000 gallons each at 4.5 foot SWD
Length	75 feet
Width	4.5 feet
Length to width ratio	50:1
Detention time at 1 mgd flow, both tanks in service	97 minutes
Detention time at 1.36 mgd flow, one tank out of service	37 minutes
Operating Side Water Depth	4.5 feet
Chlorine Solution Rapid Mixer Type	Vertical with Submerged Impeller
Number of Chlorine Solution Rapid Mixers	One
Chlorine Rapid Solution Mixer motor size	1 hp, constant speed
(Table Continues)	

Table 5-2. Yelm WRF Summary Design Data (Continued)

Process Unit	Value
Sulfur Dioxide Gas Storage for Dechlorination	
Type of storage	150-pound Cylinders
Number of active cylinders for effluent dechlorination	Two
Cylinders held in storage	Three
Total cylinders in Feed Room	Five
Maximum daily feed rate from single operating cylinder	48 pounds/day
Effluent Dechlorination Sulfonators	
Number of sulfonators	Two
Sulfonator model	V500, Wallace and Tiernan – Evoqua
Sulfonator size	250 pounds/day
Feed Control Mode	Flow Paced
Sulfur Dioxide Gas Detector	
Number	One
Model	Wallace and Tiernan – Evoqua Acutec 35
Process Water Pumps	
Number	Two
Type	Centrifugal
Motor size	5 hp
Sludge Storage, Pumping and Processing (Sub Process Areas – 21, 22, 23, 24, 25, 26)	
Sludge Storage Tanks	
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	
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	
Type	Positive displacement
Number	One
Blower horsepower	40 hp with VFD Speed Control
Gravity Belt Thickener (GBT) Unit	
Number	One
Size	1 meter
Manufacturer	BDP
Belt drive motor size	2 hp

(Table Continues)

Table 5-2. Yelm WRF Summary Design Data (Continued)

Process Unit	Value
Design feed solids concentration	1 percent dry solids
Solids processing capacity	900 pounds per hour
Hydraulic capacity	180 gpm
Thickened sludge dry solids content	3 to 7 percent range, 5 percent design
Wash Pump for GBT Belt	
Number	One
Capacity	20 gpm at 60 psi
Motor size	1.5 hp
GBT Air Compressor:	
Number	One
Compressor motor size	3 hp
Capacity	11 cfm
Solids and Drain Pumps (Stored Sludge and Plant Drains Pumping)	
Number	Two
Type	Submersible, Non Clog
Manufacturer and model	Flygt C-3102
Pump motor horsepower	6 hp, VFD controlled
Wet well construction	Cast-in-place concrete
Wet well dimensions	14.5 feet by 9.5 feet by 24.5 feet
Flow capacity	390 gpm per pump
GBT Polymer Feed Pumps:	
Number	Two
Type	Progressing Cavity
Manufacturer and model	Seepex MD
Reclaimed Water Pumping and Storage (Sub Process Areas – 14 and 54)	
High Flow Pumps	
Pump type	Vertical turbine, skid-mounted
Number	Two
Manufacturer and model	Peerless Pump Model 8MA
Flow capacity	265 gpm at 168 feet head
Motor size	15 hp, Shared VFD control with other pump
Low Flow Pumps	
Pump type	Submersible, can-mounted on high flow pump skid
Number	Two
Manufacturer and model	Grundfos Model 80S
Flow capacity	48 to 110 gpm
Motor size	7.5 hp
(Table Continues)	

Table 5-2. Yelm WRF Summary Design Data (Continued)

Process Unit	Value
Storage Tank	
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	
Type	Magnetic flow meter
Size	6-inch diameter
Recommended flow range	0.0173 mgd to 0.864 mgd
Influent Flow, High Flows	
Type	Magnetic flow meter
Size	8-inch diameter
Recommended flow range	0.0216 to 1.728 mgd
SBR Decant Flow Meter	
Type	Averaging Pitot Tube, Insertion into Pipe
Size	24-inch
Recommended Flow Range	Not Available
Intermediate Pump Station Flow Meter (Feed flow into Tertiary Treatment)	
Type	Magnetic flow meter
Size	8-inch diameter
Recommended flow range	0.0216 to 1.728 mgd
WAS Flow Meter	
Type	Magnetic flow meter
Size	3-inch diameter
Recommended range	24 to 800 gpm
Belt Filter Press Influent Flow (in Solids Handling Room)	
Type	Magnetic flow meter
Size	3-inch diameter
Recommended range	24 to 800 gpm
Effluent Flow (Chlorine Contact Tank)	
Type	Sharp Crested Weir with Ultrasonic Level Detector
Flow range	0 to 4 mgd
Reclaimed Water Distribution Flow	
Type	Magnetic flow meter, 8-inch diameter
Flow range	0.0216 to 1.728 mgd
Reclaimed Water Storage Flow	
Type	Propeller, 6-inch diameter
Flow range	90 to 1,200 gpm
(Table Continues)	

Table 5-2. Yelm WRF Summary Design Data (Continued)

Process Unit	Value
Effluent Discharge to Canal or River Flow	
Type	Differential between effluent flow meter and the sum of RW distribution, RW storage and RW plant use flow meters
Flow Range	Not Available
Influent Flow Automatic Sampler	
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	
Type	Outdoor, refrigerated automatic composite sampler unit
Location	In chlorine contact 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)	
Standby Generator No. 1 (Sub Process Area 45)	
Size	100 kilowatt (kW)
Fuel type	Diesel
Fuel tank size	150 gallons
Standby Generator No. 2 (Sub Process Area)	
Size	500 kW
Fuel type	Diesel
Fuel tank size	800 gallons
Process Control Building Heat Pump	
Motor horsepower and voltage	1/2 hp and 208 V, one-phase
Air flow capacity	1,350 cfm
Chlorine Feed Room Exhaust Fan	
Motor size and voltage/phase	1/4 hp and 115 V, one-phase
Air flow capacity	150 cfm
Chlorine Storage Room Exhaust Fan	
Motor size and voltage/phase	1/60 hp and 115V, one-phase
Air flow capacity	150 cfm
Process Control Building Restroom Exhaust Fan	
Motor size and voltage/phase	37 Watts and 115V, one-phase
Air flow capacity	85 cfm
Chlorine Feed Room Electric Unit Heater	
Motor size and voltage/phase	300 Watts and 480V, three-phase
Air flow capacity	300 cfm
Chlorine Storage Room Electric Unit Heater	
Motor size and voltage/phase	300 Watts and 480V, three-phase
Air flow capacity	300 cfm
(Table Continues)	

Table 5-2. Yelm WRF Summary Design Data (Continued)

Process Unit	Value
Sulfur Dioxide Feed Room Electric Unit Heater	
Motor size and voltage/phase	150 Watts and 208V, one-phase
Air flow capacity	300 cfm
Maintenance Garage Shop Exhaust Fan	
Motor size and voltage/phase	1/4 hp and 480 V, three-phase
Air flow capacity	720 cfm
Maintenance Garage Shop Electric Unit Heaters	
Motor size and voltage/phase	5,000 Watts and 480 V, three-phase
Air flow capacity	300 cfm
Number of Units	Two
Maintenance Garage STEP System Supply Room Unit Heater	
Motor size and voltage/phase	1,500 Watts and 208 V, one-phase
Air flow capacity	300 cfm
Standby Generator No. 1 Unit Heater	
Motor size and voltage/phase	1,500 Watts and 208 V, one-phase
Air flow capacity	300 cfm
Blower Building RWPS Room Supply Fan	
Motor size and voltage/phase	1 hp and 480 V, three-phase
Air flow capacity	2,300 cfm
Blower Building RWPS Room Duct Heater	
Motor size and voltage/phase	5,000 Watts and 480V, three-phase
Blower Building Control Room Supply Fan	
Motor size and voltage/phase	3/4 hp and 480V, three-phase
Air flow capacity	1,000 cfm
Blower Building Control Room Electric Duct Heater	
Motor size and voltage/phase	2,500 Watts and 480 V, three-phase
Blower Building Bathroom Exhaust Fan	
Motor size and voltage/phase	35 Watts and 115 V, one-phase
Air flow capacity	74 cfm
Blower Building Electrical Room Electric Unit Heaters	
Motor size and voltage/phase	5 Watts and 208 V, one-phase
Air flow capacity	270 cfm
Number of Units	Two
Blower Building Electrical Room Exhaust Fan	
Motor size and voltage/phase	5 hp and 480 V, three-phase
Air flow capacity	4,200 cfm
Blower Building Electrical Room Exhaust Fan	
Motor size and voltage/phase	1/30 hp and 115 V, one-phase
Air flow capacity	400 cfm
Blower Building Blower Room Exhaust Fan	
Motor size and voltage/phase	1.5 hp and 480 V, three-phase
Air flow capacity	7,734 cfm
(Table Continues)	

Table 5-2. Yelm WRF Summary Design Data (Continued)

Process Unit	Value
Blower Building Blower Room Electric Duct Heater	
Motor size and voltage/phase	2,000 Watts and 480V, three-phase
Blower Building Blower Room Supply Fan	
Motor size and voltage/phase	1 hp and 480 V, three-phase
Air flow capacity	2,500 cfm
Solids Handling Building Chemical Feed Room Electric Duct Heater	
Motor size and voltage/phase	1,100 Watts and 480 V, three-phase
Solids Handling Building Chemical Feed Room Supply Fan	
Motor size and voltage/phase	1 hp and 480 V, three-phase
Air flow capacity	2,750 cfm
Solids Handling Building GBT Room Electric Unit Heater	
Motor size and voltage/phase	3,000 Watts and 208 V, three-phase
Air flow capacity	270 cfm
Effluent Outfall – (Process Sub Areas 37, 55)	
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

5.5 WRF CURRENT PERFORMANCE

Plots of permit-related concentration parameters are provided for the recent period of 2011 to 2015 in Figure 5-3 through Figure 5-8.

In the recent period of 2011 to 2015, the WRF has been generally producing an effluent that that meets reclaimed water and NPDES permit limits. However the facility has had recent challenges meeting reclaimed water permit limits especially in regards to meeting the total nitrogen limit during cold weather periods. Also, two recent incidences for either exceeding the monthly maximum permit limit or the maximum weekly mean limit for total coliform occurred in 2014.

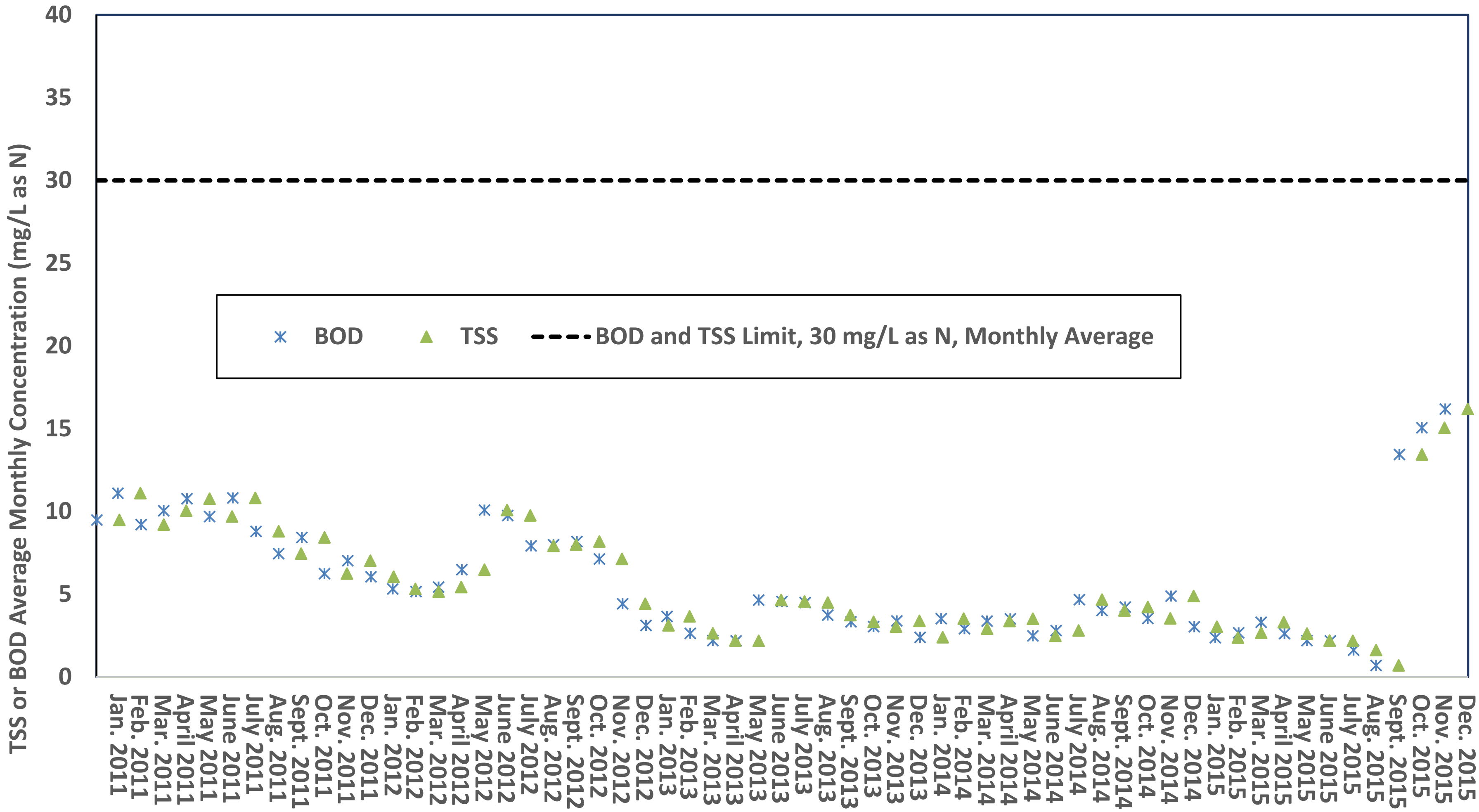


Figure 5-3. Yelm WRF Monthly Average Effluent BOD and TSS Concentrations, 2011 to 2015

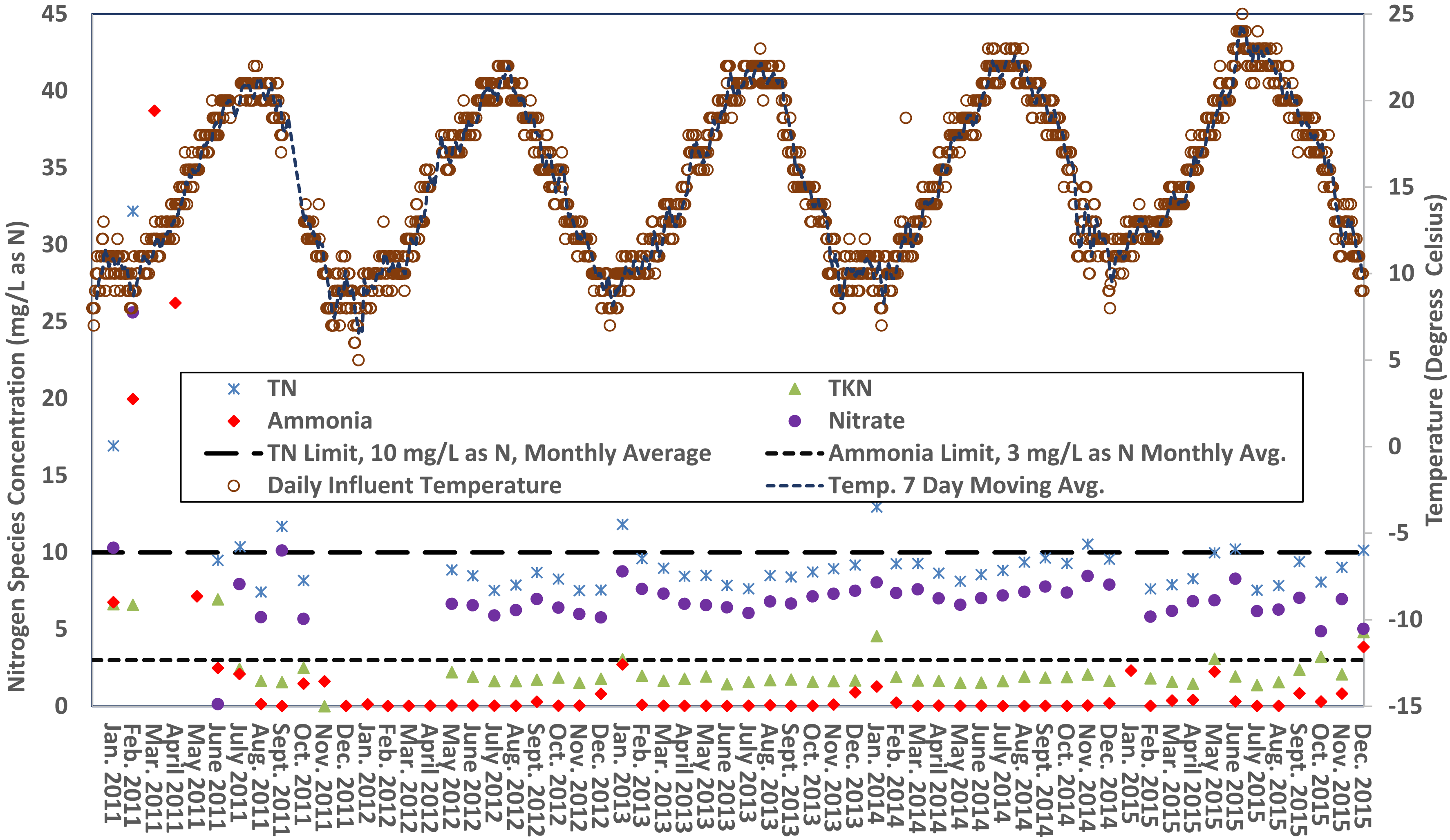


Figure 5-4. Yelm WRF Monthly Average Effluent Nitrogen Species Concentrations, 2011 to 2015

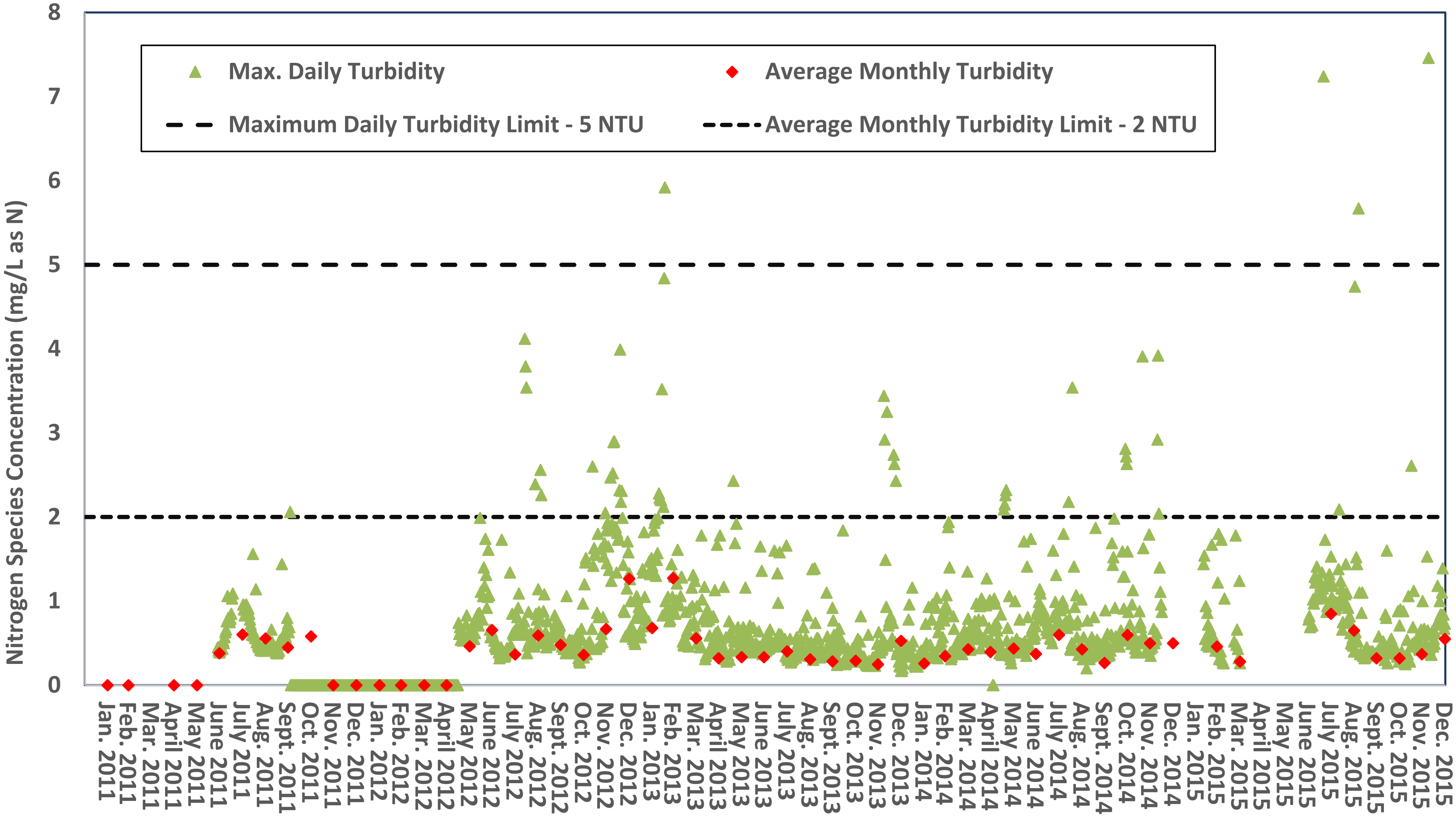


Figure 5-5. Reclaimed Water Daily Average, Maximum Daily, and Average Monthly Turbidity

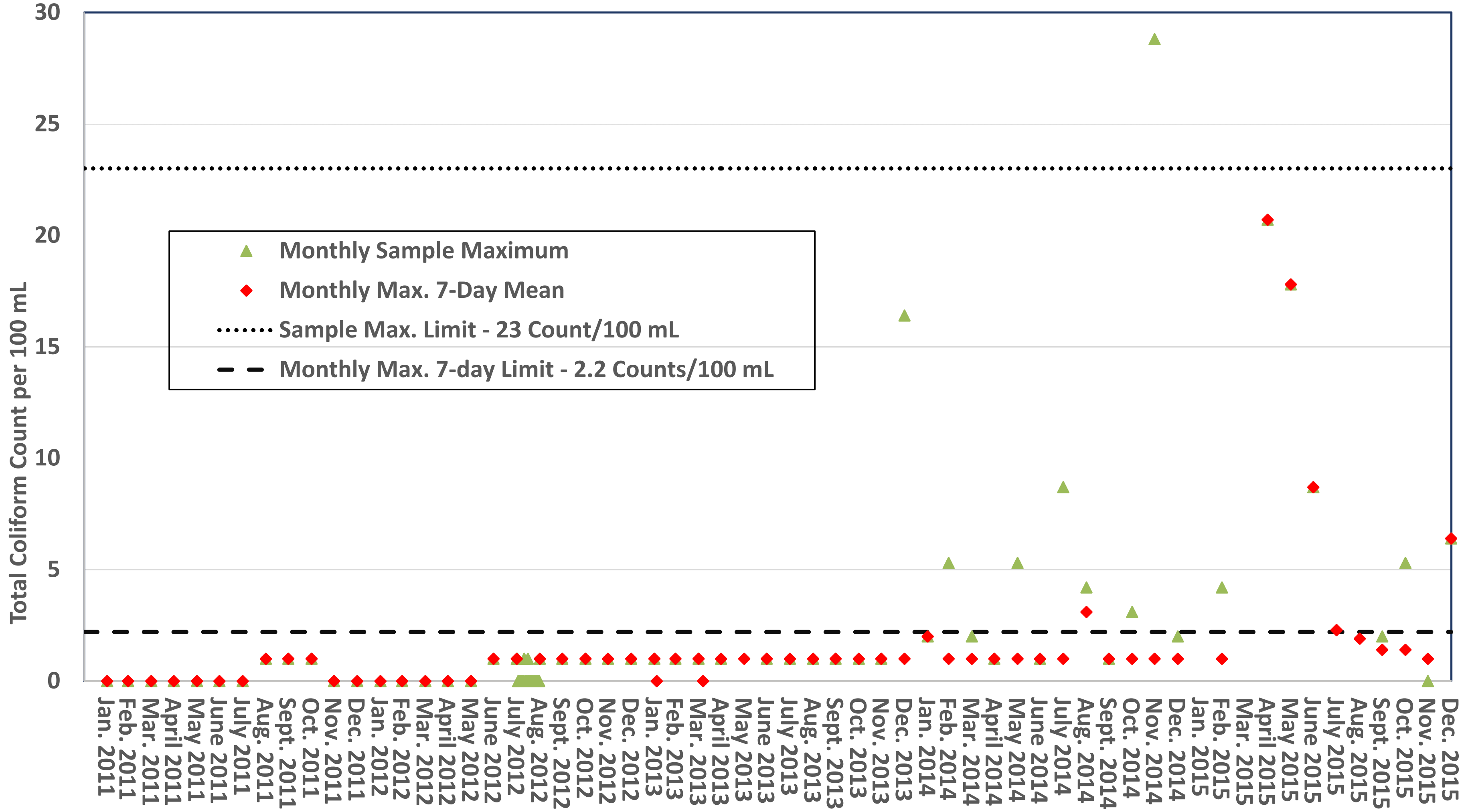


Figure 5-6. Daily, Monthly Average, Monthly Maximum Weekly Fecal Coliform Counts

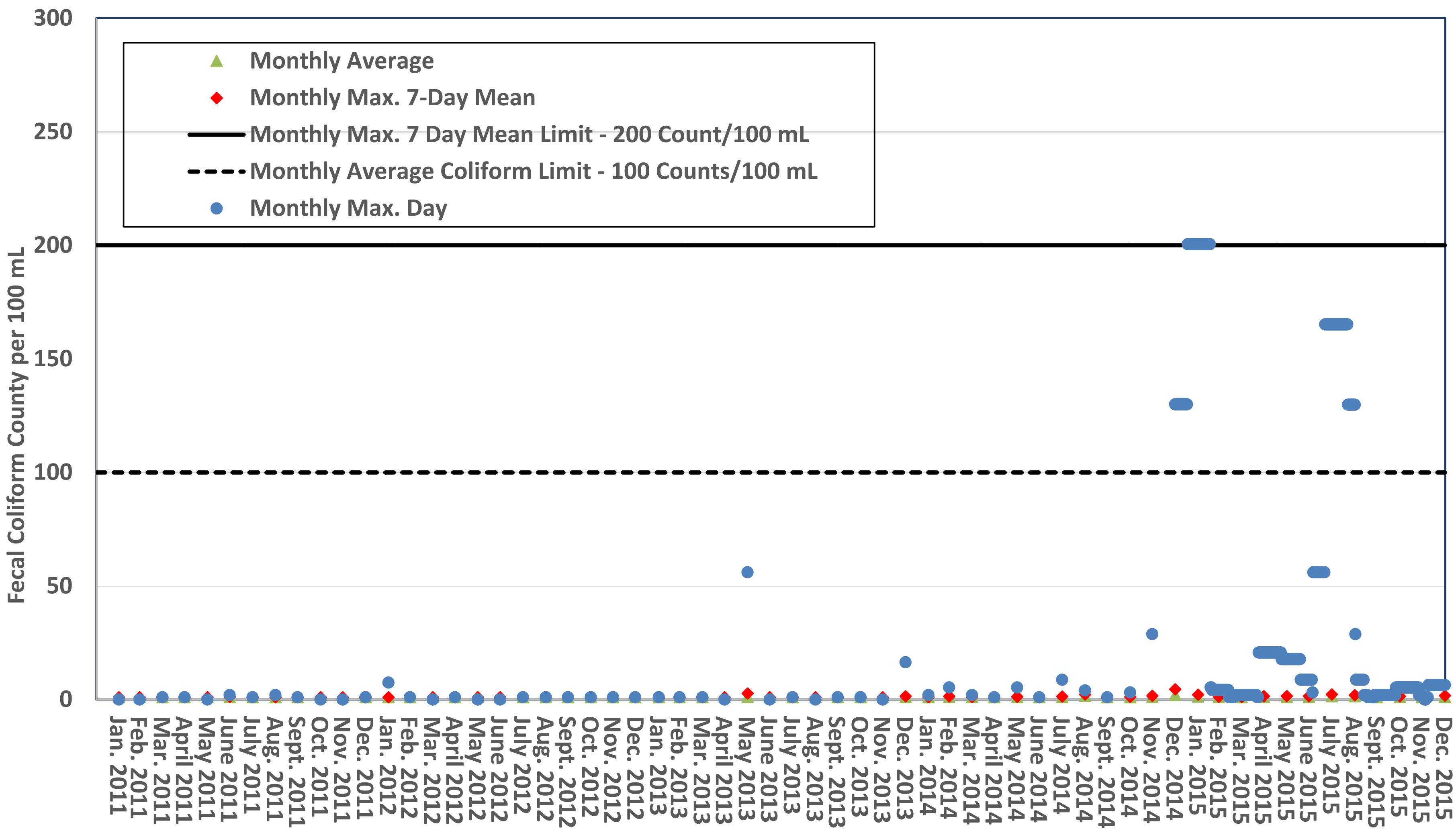


Figure 5-7. Daily, Monthly Sample Maximum, and Monthly 7 Day Mean Reclaimed Water Total Coliform Counts

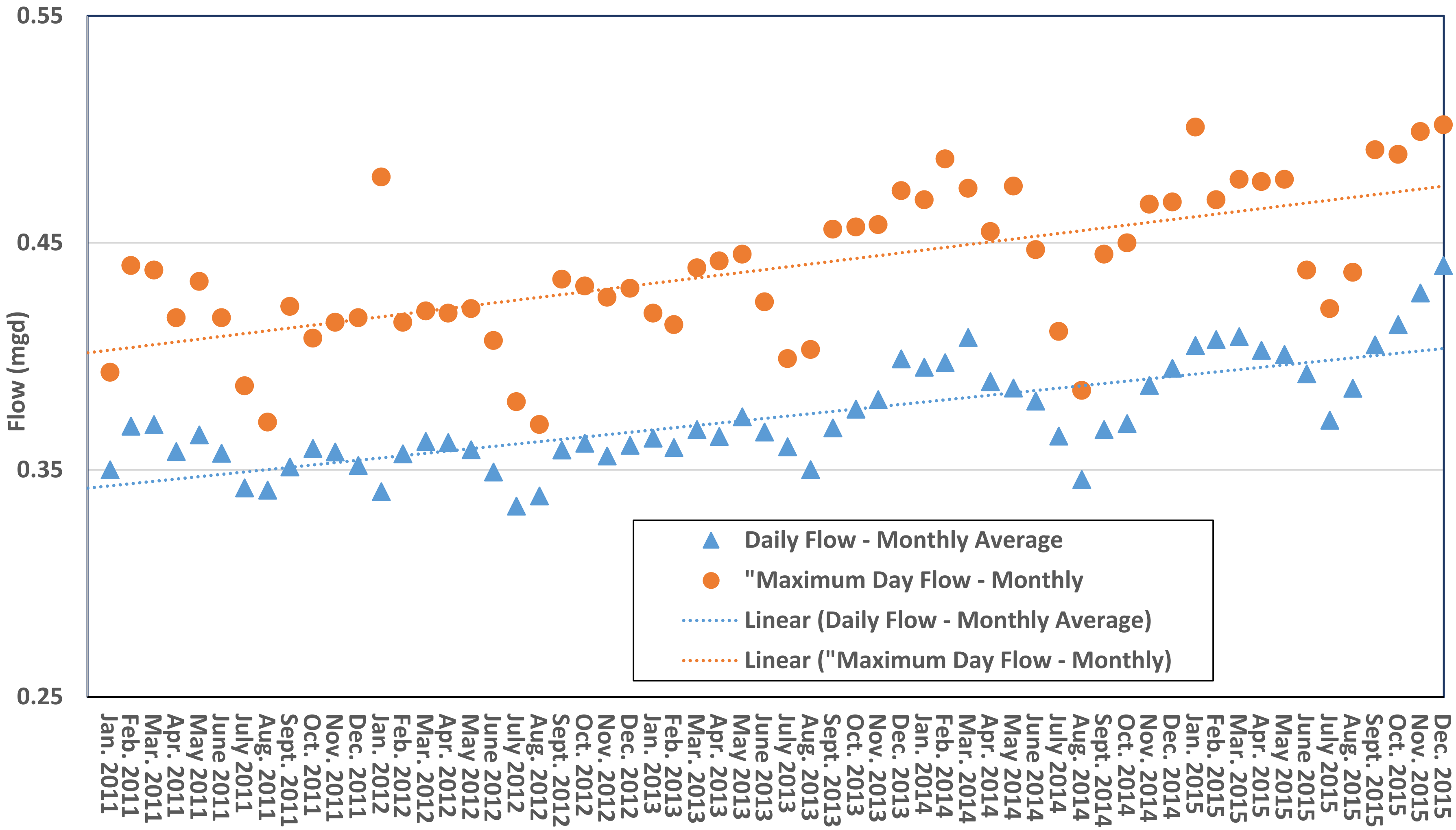


Figure 5-8. WRF Influent and Effluent Average Daily Flows by Month

5.6 WRF TREATMENT, HYDRAULIC CAPACITY, AND REDUNDANCY ASSESSMENTS

5.6.1 Treatment Capacity Assessments

A WRF treatment capacity assessment was performed and presented initially in the GSP. Follow-up WRF treatment and hydraulic capacity work was conducted by Parametrix in 2013. A full copy of the Parametrix capacity assessment is contained in Appendix D and a summary of the Parametrix assessment work is described below.

In order to determine the biological treatment capacity remaining in the WRF, three scenarios were modeled by Parametrix utilizing the BioWin software. The model used to evaluate these scenarios was originally assembled for the GSP work and updated by Parametrix to reflect current WRF performance. Basic findings of the Parametrix treatment capacity assessment indicated the following:

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

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

5.6.2 Hydraulic Capacity Assessments

The following key hydraulic capacity element was assessed in the 2013 Parametrix WRF Capacity Assessment Report:

- **Reclaimed Water Pumping**

  Currently, the Reclaimed Water Pump Station can pump up to 265 gpm which corresponds to 381,600 gpd. As the WRF influent flow increases, it will be necessary to upgrade the pumps to accommodate the increased production of reclaimed water. It was also noted that during past summer month periods, reclaimed water production is as high as 350,000 gpd. WRF staff has noticed that at these times the Reclaimed Water Pump Station has trouble keeping up with this level of flow demand.

  As a result of this review, it appears that the Reclaimed Water Pump Station is sized adequately to handle the current flow of reclaimed water. However, as part of the City's plan to mitigate for additional groundwater withdrawals, an additional 50,000 gpd of reclaimed water will be conveyed to Cochrane Park between the months of October and May each year. This additional volume may necessitate hydraulic capacity upgrades to the Reclaimed Water Pump Station.

  The hydraulic capacity of a pump station is usually presented in terms of "firm capacity." Ecology defines firm capacity as the pumping capacity of the pump station with the largest pump out of service. The capacity of the various existing pump stations at the WRF will be measured with this in mind.

Additional hydraulic capacity examined in this Sewer Facilities Plan include the following:

- **Influent Facilities**

  There are no significant hydraulic capacity issues with regards to utilizing existing flow metering equipment to measure peak flows as described for the GSP 2030 build-out condition.

- **SBR Tanks**

  SBR Tanks – The current WRF Operation and Maintenance (O&M) Manual states that two-basin operation can be practiced if diurnal instantaneous peak flow is below 1.43 mgd. Once the diurnal instantaneous peak flow rises above 1.43 mgd, then it is recommended that all three SBR basins be operated using 10-hour duration cycles. A current inspection of the influent flow data indicates instantaneous diurnal peak hour flows were as high as 0.9 mgd.

- **Filter**

  The filters are designed to effectively provide reclaimed water turbidities up to a maximum loading rate of 4 gpm per square foot of filter. The filters are also designed to process an influent flow that has a total suspended solids as high as 30 mg/L, which roughly translates to an influent turbidity of 12 to 15 NTU per the existing WRF O&M Manual. However, the current manual also states that 10-mg/L influent TSS is the more desirable solids load on the filters, especially if the filters are operated at the higher 4 gpm per square foot of filter loading rate.

  With two cells in service and with the IPS currently operating at a 0.5 mgd continuous flow, this translates to a current loading rate of 1.7 gpm per square foot. If only one filter is in service, then the loading rate would be at 3.4 gpm per square foot for a 0.5 mgd IPS flow rate.

  Note that under three-cell operation (all filter cells in operation, two modules per cell, three cells total, 50 square feet per module), the filter O&M Manual predicted

70,000 gpd of waste backwash water will be produced. Currently with one-cell operation, backwash waste flow rates have been estimated to be as high as 70,000 gpd, and it has been observed the backwash flow rates can exceed 100,000 gpd when two filter cells are in operation.

- **Intermediate Pump Station (IPS)**

  The IPS conveys SBR decants stored in the equalization storage pond through the static mixers and to the sand filters. This pump station is currently composed of two, 20.3-hp VFD-controlled pumps that each have a pumping capacity of 872 gpm. This equates to a firm capacity of 872 gpm for the Intermediate Pump Station. The current volume being treated by the sand filters is approximately 500,000 gpd. This is approximately 350 gpm or 40 percent of the total IPS firm capacity. Looking forward, if the WRF operates at the maximum design influent flow rate of 1.3 mgd, the IPS will be required to pump approximately 700 gpm from the equalization basin to the sand filters. This is approximately 80 percent of the IPS firm capacity.

  Based on the above calculations, the existing IPS has adequate capacity to serve the WRF up to the maximum design flow rate of 1 mgd.

- **Influent Flow Meters**

  The smaller 6-inch flow meter is used for average flows up to 0.4 mgd and for peak flow up to 1.0 mgd. The larger 8-inch magnetic flow meter is used when average flows range between 0.35 to 0.7 mgd with peak flows as high as 1.8 mgd. Both flow meters are used when average flow ranges between 0.6 to 1.1 mgd and to peak flows of up to 2.8 mgd.

5.6.3 Redundancy and Reliability Assessment

The current WRF NPDES and State Reclaimed Water Discharge permit contains stated reliability requirements.

Reliability classes are described in EPA's technical bulletin, *Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability*, EPA 430-99-74-001, and are summarized in Table 5-3 below:

Table 5-3. Guidelines for Classifying Sewerage Works

Reliability Class	Guideline
I	These are works whose discharge, or potential discharge, (1) is into public water supply, shellfish, or primary contact recreation waters, or (2) as a result of its volume and/or character, could permanently or unacceptably damage or affect the receiving waters or public health if normal operations were interrupted. Examples of Reliability Class I works are those with a discharge or potential discharge near drinking water intakes, into shellfish waters, near areas used for water contact sports, or in dense residential areas.
II	These are works whose discharge, or potential discharge, as a result of its volume and/or character, would not permanently or unacceptably damage or affect the receiving waters or public health during periods of short-term operations interruptions, but could be damaging if continued interruption of normal operations were to occur (on the order of several days). Examples of a Reliability Class II works are works with a discharge or potential discharge moderately distant from shellfish areas, drinking water intakes, areas used for water contact sports, and residential areas.
III	These are works not otherwise classified as Reliability Class I or Class II.

Part S5.D Operation and Maintenance section of the WRF permit states that the WRF shall maintain Reliability Class II sewerage at the wastewater treatment plant which requires a backup power source to operate all vital WRF components and critical lighting and ventilation during peak wastewater flow conditions. The exception is that vital components used to support secondary processes (e.g., SBR process blowers) need not be operable to full levels of treatment but be sufficient to maintain biota in the SBR process tanks.

Additionally, Part S9.D of the WRF permit states that the WRF shall maintain the highest reliability class as described in the State Water and Reclamation and Reuse Standards which require one of the following features for each of the critical reclamation treatment unit processes of oxidation, coagulation, filtration, and disinfection:

1. Alarm and standby power source.
2. Alarms and automatically actuated short-term (24-hour) storage or disposal provisions.
3. Automatically actuated long-term storage or disposal provisions for treating wastewater.

The WRF meets the Part S9.D requirements of the permit primarily by providing equipment, piping, and controls to achieve all the reliability features above. For achieving Feature No. 1, the WRF has standby generators. For Feature 2, the WRF has interlocks or the ability to interrupt the IPS and provide 24-hour storage of SBR-treated effluent based on the current WRF design flow within the SBR effluent equalization basins. And finally, the WRF has the ability to meet Feature 3, where the Reclaimed Water Pump Station can be automatically halted based on high turbidity or other measured parameter to allow long-term and automatic gravity flow diversion of off-specification reclaimed water flows into either the Centralia Power Canal or the Nisqually River via the 12-inch-diameter outfall pipe at the WRF.

Table 5-4 summarizes general process design reliability guidelines for various WRF treatment components based on Ecology Orange Book requirements, EPA requirements, and Parametrix recommendations.

Table 5-4. General Process Design Reliability Guidelines

WRF Component	Requirement or Recommended Reliability Design Criteria
SBRs, Process Aeration Basins	• At least two equal basins must be provided. All units in service for peak flow and loading conditions.[a,b]
Process Aeration System	• A sufficient number of blowers are to be provided to enable the design oxygen transfer to be maintained with the largest unit out of service.[a,b] • Provide separated, multiple air diffuser grids in each SBR basin to allow for isolation of failed aeration grid while keeping SBR basin on-line. Consider removable diffuser grid systems to allow diffuser grid maintenance while an SBR basin is in service.[a,c]
Intermediate Pump Station Pumps	• A back-up pump must be provided for each set of pumps performing the same function.[c,b]
Reject Water Pump Station Pumps	• A back-up pump must be provided for each set of pumps performing the same function.[a,b]
Solids and Drain Pump Station Pumps	• A back-up pump must be provided for each set of pumps performing the same function.[a,b]
Reclaimed Water Pump Station Pumps	• A back-up pump shall be provided for each set of pumps performing the same function. This is only recommended since the standby Outfall discharge serves in continuous duty to discharge excess Reclaimed Water Wet Well overflows to the Nisqually River or Centralia Power Canal when pump power fails or pump maintenance is required.[c]

(Table Continues)

Table 5-4. General Process Design Reliability Guidelines (Continued)

WRF Component	Requirement or Recommended Reliability Design Criteria
Disinfection and Dechlorination Feed Systems	• Adequate flexibility to allow equipment used for non-disinfection purposes to function as standby units. Dosing equipment sized to provide maximum daily dose with single largest unit out of service.[a,b]
Disinfection Contact Basins	• Units must be sufficient in number and size so that even with the largest-flow-capacity unit out of service, the remaining units will have a design flow capacity of at least 50 percent of the design basin flow. All units in service for peak flow conditions.[a,b]
Effluent Filtration	• Filtration process shall be provided with one of the following reliability features[a]: ➢ Alarm and multiple filter units capable of treating entire flow with at least one unit not in operation. ➢ Alarm, short-term storage, or disposal provisions, and standby replacement equipment. ➢ Alarm and long-term storage or disposal provisions. ➢ Automatically actuated long-term storage or disposal provisions. ➢ Alarm and standby filtration units.
Sludge Thickening	• Provide redundant units or provide adequate sludge storage volume to facilitate equipment maintenance and reduce interruptions for thickening operations.[c] • Ability to thicken and dewater maximum sludge production with all units in service.[a,b]

Reference Sources:

a *Criteria for Sewage Works Design* (Ecology 2008).

b *Design Criteria for Mechanical, Electric, and Fluid Systems and Component Reliability* (EPA 1974).

c Recommended Parametrix Design Criteria.

As stated in the Ecology Orange Book:

> In accordance with the requirements of the appropriate reliability class, capabilities shall be provided for satisfactory operation during power failures, flooding, peak loads, equipment failure, and maintenance shutdown.

Other key reliability component points stated in the Orange Book include:

- Except as modified below, unit operations in the main wastewater treatment system shall be designed so that, with the largest-flow-capacity unit out of service, the hydraulic capacity (not necessarily the design-rated capacity) of the remaining units shall be sufficient to handle the peak wastewater flow. There shall be system flexibility to enable the wastewater flow to any unit out of service to be routed to the remaining units in service.
- Equalization basins or tanks will not be considered a substitute for component backup requirements.
- Designs for SBR systems must provide the same reliability of treatment required for continuous flow through designs (see Ecology requirement below). Since each SBR reactor serves several functions, it must meet the most stringent of the reliability criteria for the various components it replaces (e.g., primary clarifier, aeration basin, aerators, backup power, control logic, etc.).
- General requirements for each reliability classification are summarized in Table 5-5. The specific requirements defined in Table 5-5 are drawn from EPA's technical bulletin, *Design Criteria for Mechanical, Electrical, and Fluid System Component Reliability*, EPA 430-99-74-001.

Table 5-5. General Requirements for Each Reliability Classification

Reliability Class	General Requirements
I	For components included in the design of Reliability Class I works, the following backup requirements apply: A. **Mechanically Cleaned Bar Screens**. A backup bar screen, designed for mechanical or manual cleaning, shall be provided. Facilities with only two bar screens shall have at least one bar screen designed to permit manual cleaning. B. **Pumps**. A backup pump shall be provided for each set of pumps performing the same function. The capacity of the pumps shall be such that, with any one pump out of service, the remaining pumps will have the capacity to handle the peak flow. C. **Comminution Facility**. If comminution of the total wastewater flow is provided, an overflow bypass with a manually-installed or mechanically-cleaned bar screen shall be provided. The hydraulic capacity of the comminutor overflow bypass should be sufficient to pass the peak flow with all comminution units out of service. D. **Primary Sedimentation Basins**. The units should be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units should have a design flow capacity of at least 50 percent of the total design flow. E. **Final Sedimentation Basins and Trickling Filters**. The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 75 percent of the total design flow. F. **Activated Sludge Process Components**. 1. **Aeration Basin**. A backup basin will not be required; however, at least two equal-volume basins shall be provided. (For the purpose of this criterion, the two zones of a contact stabilization process are considered as only one basin.) 2. **Aeration Blowers or Mechanical Aerators**. There shall be a sufficient number of blowers or mechanical aerators to enable the design oxygen transfer to be maintained with the largest-capacity-unit out of service. It is permissible for the backup unit to be an uninstalled unit, provided that the installed units can be easily removed and replaced. However, at least two units shall be installed. 3. **Air Diffusers**. The air diffusion system for each aeration basin shall be designed so that the largest section of diffusers can be isolated without measurably impairing the oxygen transfer capability of the system. G. **Disinfectant Contact Basins**. The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 50 percent of the total design flow.
II	The Reliability Class I requirements shall apply except as modified below: D./E. **Primary and Final Sedimentation Basins and Trickling Filters**. The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 50 percent of the design basin flow.
III	The Reliability Class I requirements shall apply except as modified below: D./E. **Primary and Final Sedimentation Basins**. There shall be at least two sedimentation basins. F. **Activated Sludge Process Components**. 1. **Aeration Basin**. A single basin is permissible. 2. **Aeration Blowers/Mechanical Aerators or Rotors**. There shall be at least two blowers, mechanical aerators, or rotors available for service. It is permissible for one of the units to be uninstalled, provided that the installed unit can be easily removed and replaced. Aeration must be provided to maintain sufficient DO in the tanks to maintain the biota.

In addition to process mechanical components, the Orange Book also summarizes EPA reliability requirements for electrical systems as follows.

> Two separate and independent sources of electric power shall be provided to the plant either from two separate utility substations or from a single substation and a works-based generator located at the plant. If available from the electric utility, at least one of the power sources shall be a preferred source (that is, a utility source which is one of the last to lose power from the utility grid because of loss of power-generating capacity). In geographical areas where it is projected that, sometime during the design period, the electric utility might reduce the rated line voltage (i.e., brown-out) during peak utility system load demands, a generator shall be provided as an alternate power source where practicable. As a minimum, the capacity of the backup power source for each class of treatment plant shall be as listed [in Table 5-6].

Table 5-6. Minimum Capacity of the Backup Power Source for Each Reliability Classification

Reliability Class	Minimum Capacity
I	Sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions.
II	The same as Reliability Class I, except that vital components used to support the secondary processes (i.e., mechanical aerators or aeration basin air compressors) need not be operable to full levels of treatment, but shall be sufficient to maintain the biota.
III	Sufficient to operate the screening or comminution facilities, the main wastewater pumps, the primary sedimentation basins, the disinfection facility, and critical lighting and ventilation during peak wastewater flows.

Notes: Source information from EPA's technical bulletin *Design Criteria for Mechanical, Electrical, and Fluid System Component Reliability*, EPA 430-99-74-001.

5.7 CONDITION ASSESSMENT


Photograph 5-1. Outfall Pipe to Centralia Power Canal

The condition assessment of the WRF is used to identify major facility deficiencies and provide a general priority rating for mechanical equipment, treatment units, structures, and electrical, instrumentation and control (EI&C) systems. The information gathered in the assessment is used during the planning process to determine which portions of the facility can be retained, which require major upgrade, and which should be abandoned or replaced. The condition assessment for the WRF used the following step approach:

1. Review WRF record drawings and design criteria.
2. Discuss maintenance history, plant shortcomings, and general operational issues with City staff.
3. Conduct walk-through inspections, accompanied by City staff, of the major mechanical, structural, and EI&C systems of the WRF.
4. Document findings made during inspection and as described by City staff. Each major system was independently inspected in terms of the condition of its civil/mechanical, structural, and electrical/instrumentation systems. Mechanical component evaluations addressed the overall mechanical and operational condition of equipment with input from City staff. Structural component evaluations addressed the overall physical condition of the structures, as well as general assessments of visible constructed materials, coating systems, roofing systems, pipe penetrations, and pipe supports. EI&C component evaluations included primary power distribution equipment, major electrical equipment, and overall control systems architecture.

The Parametrix condition assessment contains updated information over previous information that was originally presented in the 2013 Yelm GSP. A full conditional assessment of the WRF facilities was conducted for this Plan in 2014 and is also discussed below.

5.7.1 Influent Facilities (Sub Process Areas 2, 3, and 39)

Influent facilities consist of a hydraulic control structure constructed from 54-inch-diameter HDPE pipe, temporary carbon supplementation feed station, and temporary magnesium hydroxide feed station.

Key civil/mechanical condition assessment notes for influent facilities include:

- Influent yard piping is mostly ductile iron and appears to be in good condition. However, recoating of exposed piping will be required.
- Temporary magnesium hydroxide pumps, storage tanks, tank mixers, and piping are directly exposed to outdoor conditions.
- Piping is only foam insulated at this time and is prone to freezing.
- The magnesium hydroxide feed system is deemed critical to maintaining proper alkalinity and pH for nitrification and denitrification treatment within the SBR tanks. Therefore, it is critical that future plant upgrades provide permanent shelter and protection of magnesium hydroxide storage and feed equipment to allow for uninterrupted and effective year-round operation.
- Temporary carbon supplementation pump, feed tote, and piping are directly exposed to outdoor conditions.
- The Recreational Vehicle (RV) Dump Station pump and system remains out of service. The station has been out of service since 2011. Reasons for station inactivation include lack of flow equalization provided and the concern that RV dumps were affecting WRF nitrification performance.
- The caustic alkalinity feed system remains out of service and was never used. Reasons for why this system has not been activated include the long feed lines from storage to the influent feed point that are highly prone to plugging and leaks. Piping is also not double contained to the desired feed points.

Key structural condition assessment notes for influent facilities include:

- Structural repair/rehabilitation on the influent meter vault cover is recommended as part of improvements due to damaged top from vehicle impact.
- Other area influent facility vaults are expected to demonstrate at least another 15 years of service life without any immediate rehabilitation work.

Key electrical/instrumentation assessment notes for influent facilities include:

- Additional power and control wiring could be brought into this area to supply chemical feed equipment and other future equipment. Currently existing temporary feed equipment is powered using extension cords from electrical receptacles at the SBRs.

5.7.2 Secondary Treatment – Sequencing Batch Reactor (SBR) (Sub Process Areas 4, 19, 46, 48, and 56)

Secondary treatment consists of the following key subcomponents:

- Influent and Effluent Decant Pneumatic Control Valves.
- Process Air System – Blowers, Piping, and In-Basin Membrane Diffusers.
- Sequencing Batch Reactor – Concrete Tanks, Mixing Equipment, Instrumentation, and Decanters.

- Waste Activated Sludge Pumping System.
- Scum Collection System.

Key civil/mechanical condition assessment notes for this process area include:

- In-basin mechanical mixers are in good functioning shape; operators have reported no major failures of units over the past 15 years of operation.
- One of the three process blowers (Blower B, middle blower of the arrangement) has an oil leak issue and the unit is only operated as a standby unit for precautionary purposes.
- Blowers are approaching their 20-year service life period, which ends in 2019.
- Skimmer units in each SBR tank are non-functional because skimmer units are unable to effectively convey collected skimmings into scum discharge piping.
- A limitation of the existing blower discharge piping is that Blower A and Blower C are unable to serve any one of the three SBR tanks with Blower B (the middle blower of the arrangement) in operation. Additional blower discharge piping is required to allow any blower to operate and to serve any operating SBR tank.
- During 2013, the membrane EPDM aeration diffuser discs have been replaced in all SBR tanks. However, the membrane PVC holders and tank bottom distribution piping are now over 15 years old. Some diffuser holders have cracked and no longer can hold diffuser discs. Individual SBR tanks have recently had to be taken off-line to repair damaged air distribution piping and diffuser holders (SBR No. 3 in 2013 and SBR No. 2 in 2014).
- The existing fiberglass decanters are over 15 years old and are showing wear and delamination.
- Influent and effluent pneumatic control valves are in good condition. Pneumatic actuators were recently replaced in 2013 and 2014.
- In-basin valve ductile iron piping is corroded and may need replacement or rehabilitation.
- Only a single, fixed air diffuser grid is installed in each SBR basin. If there is a failure in the grid (e.g., popped diffuser membrane or cracked diffuser distribution pipe), then process air feed into a SBR basin could be completely compromised (causing blower trip-outs or over-pressure conditions in the air distribution piping resulting in pressure relief air blow-offs at the blower). This forces Yelm Operations staff to take the SBR basin with the failed grid completely off-line and requires a complete dewatering of the off-line basin to allow maintenance of the damaged grid. In addition, repairs for damaged grids or membrane replacement in the SBRs is hampered by personnel entry into deep, hard-to-access confined space areas.
- The complete dewatering of a SBR basin is a very tedious operation due to the fact the Yelm Operations staff has to rely on the limited dewatering flow capability provided by the Drain and Sludge Pump Station and the WAS Pump Station pumps. The Drain and Sludge Pump Station pumps can only be activated to dewater a SBR basin when the basin water levels reach a low enough level. Otherwise, the drain and sludge pumps can be overwhelmed by the SBR basin drain inflows causing an overflow of the Drain and Sludge Pump Station Wet Well. Generally it takes at least a 1-day period to fully dewater a SBR basin which can cause significant operation disruptions. For example, even if a dewatering flow of 300 gpm were to be achieved from the combined operation

of the WAS and drain and sludge pumps, it would take at least 23 hours to dewater a decanted SBR basin (minimum end of decant water level in a SBR basin is 14 feet).

Key structural condition assessment notes:

- Basin ductile iron piping and piping supports are corroded and may need recoating or completely replaced.
- Concrete for SBR tanks appears to be in good condition with tanks able to provide additional service life through the end of the 2030 planning time frame.

Key electrical/instrumentation condition assessment notes for this process area include:

- The existing DO and pH tank instrumentation has been replaced with new DO and oxidation-reduction potential (ORP) sensor equipment. This new instrumentation will be carried over to the WRF upgrade work where applicable.
- Conduit and junction boxes at the SBR handrail locations show some minor corrosion.

Photograph 5-2. Worn Reject Water Pump Station Pump

Photograph 5-3. Corrosion Damage on Reclaimed Water Pump Station Pump Skid

Photograph 5-4. Single Aeration Diffuser Grid in Deep SBR Tank

5.7.3 Tertiary Treatment (Sub Process Areas 6, 7, 8, 9, 10, 11, 12, and 53)

The tertiary treatment facilities consist of the following major components:

- Equalization Storage Pond.
- Intermediate Pump Station (IPS).
- Continuous Backwash Filters.
- Effluent Discharge Pipe to Chlorine Contact Basins.
- Filter Coagulant Storage, Feed, and Mixing.
- Turbidity Monitoring Equipment.
- Reject Water Pump Station.

The IPS was constructed as part of the 1999 WRF construction efforts and is used to convey equalized SBR decant from the equalization ponds into the tertiary treatment filters. This pump station is currently configured for two-pump operation but the electrical conduit, piping, and valving is already in place to facilitate the installation of a third pump. The hydraulic capacity assessment in Section 5.6.2 indicates the third pump may not be required to meet future build-out flow conditions.

The tertiary treatment filters are continuous backwash sand filters composed of three cells with each cell having two filter modules. Each filter module has a maximum flow capacity of 5 gpm per square foot of filter area and each filter module has an area of 50 square feet. Generally, the filters are loaded from 1 to 4 gpm per square foot of filter area under normal operations. The filters are operated in contact filtration mode where only coagulant is added in a rapid mix step and flocculation and solids removal is expected to occur within the filter sand beds. The rapid mix step for this system is provided in the form of a 6- or 8-inch static mixer. As described in the hydraulic capacity section, the larger static mixer is used to accommodate higher flows.

Key deficiencies, recent repairs, recent equipment replacement, or general condition notes for the tertiary treatment related facilities include the following:

- The IPS pumps were at some point upgraded from 17.5 to 20.3 hp motors after the initial construction of the station.
- Plant staff noted difficulty in removing IPS pumps for maintenance. Lowering of guide rails or replacing the pump station wet well concrete top to facilitate pump removal/installation is recommended.
- Plant staff reported all the IPS pump discharge swing check valves show evidence of leakage (possibly damaged seat surface/misaligned seat, etc.). This leakage is thought to cause secondary effluent to flow backwards from the Dynasand filter cells into the SBR decant equalization ponds, and in turn causes the sand filter media to bind in the Dynasand unit air lift assembly. Existing check valves appear to have never been removed, as there are no couplings upstream/downstream of the valves inside the vault to facilitate removal and reinstallation. It is recommended that additional couplings and pipe spools would better facilitate regular staff inspection/repair of each check valve if this pump station is incorporated into the upcoming WRF upgrades. Valve vault may need to be replaced with larger vault to provide proposed improvements.
- The SBR decant equalization ponds are not provided with bottom drains or with connection to the existing WRF pumping systems (e.g., the Drain and Sludge Pump Station) to allow effective and complete dewatering of the ponds to facilitate maintenance.

- The coagulant static mixers are difficult to remove for inspection and cleaning. As above, additional pipe couplings and pipe spools would help to facilitate removal and reinstallation. The existing vault may need to be replaced with a larger vault to accommodate these piping changes.
- The existing pumps are now possibly 15 years in age depending on when the motor change from 17.5 hp to 20.3 hp occurred.
- Air binding problems are suspected in the influent feed piping arrangement into the filters. No degassing features are noted on the existing filter piping arrangement. Influent pipe air binding is suspected because when two or more filters are operated, one or more filters can completely lose effluent flow while at least one filter continues to operate. Operators have removed this suspected air binding condition simply by bumping influent flow to the filters, successfully reestablishing flow to all filter units.
- The reject water pumps use original parts from initial installation dating back to the 1994 lagoon treatment plant system installation, making these pumps almost 21 years old. In addition, the reject water pumps are also tied into the facility drain piping system and when the pump station check valves fail to open, then pump station flow is then forced to discharge into the waste sludge storage tanks.

5.7.4 Disinfection and Dechlorination (Sub Process Areas 13, 26, 27, 28, 29, and 30)

Dechlorination is accomplished by using gaseous sulfur dioxide, and disinfection is accomplished by using gaseous chlorine. Chlorine gas and sulfur dioxide gases are brought on site in 150 pound cylinders. Currently, the chlorine feed setup uses two 150-pound cylinders linked in tandem using an automatic switch-over valve when one cylinder is exhausted of gas. A similar arrangement exists for the sulfur dioxide feed system.

Generally six to eight chlorine gas 150-pound cylinders are kept in the Chlorine Storage Room at any one time. Also four to six sulfur dioxide gas cylinders are kept in the Sulfur Dioxide Storage Room at any one time. Depending on when deliveries occur, a variable mixture of empty and full cylinders will be on hand. After a new delivery, a maximum of six full chlorine cylinders and four full sulfur dioxide cylinders will be on hand.

Reclaimed water is used to supply chlorine and sulfur dioxide injector systems. A process water system is installed on-site to pressurize potable water in the event that pressurized water is not available from the WRF reclaimed water pumping system.

Key deficiencies, recent repairs, recent equipment replacement, or general condition notes for the disinfection and dechlorination treatment facilities include the following:

- The filter effluent pipe running from the filters into the chlorine contact basin always flows full and at very low flow velocities due to influent overflow weir placed in the chlorine contact tank mixing chamber. This pipe is roughly 500 feet long and 18 inches in diameter. At a 0.5 mgd flow, the pipe only has a flow velocity of 0.44 feet per second, providing nearly 20 minutes of detention time within this pipe section. At such low flow rates, residual solids settling problems and biofilm growth may occur.
- To achieve effective chlorine disinfection at the WRF, the daily chlorine gas dosing rate ranges from 17 to 25 pounds per day. At this dose, WRF operations staff would be changing out a gas cylinder every 6 to 8 days.
- At the stated plant design capacity flow of 1 mgd, the chlorine gas dosing volume is expected to be approximately 50 pounds per day. At this dose, the WRF operations staff would be changing out a gas cylinder every 3 days.
- For proper dechlorination, the sulfur dioxide dosing volume is 8 to 15 pounds per day at the current influent flow volume. At this dose, WRF operations staff would be changing out a gas cylinder every 12 to 20 days.
- At the stated plant design capacity flow of 1 mgd, the sulfur dioxide dosing volume will be approximately 25 to 50 pounds per day. At this dose, the WRF operations staff would be changing out a gas cylinder every 3 to 6 days.
- Gas sensors for the Sulfur Dioxide and Chlorine Cylinder Storage Rooms are over 15 years old and are considered obsolete due to the lack of spare parts.
- There are no shut-off valves present on currently operating gas cylinders (chlorine or sulfur dioxide) that can be shut off when high chlorine or sulfur dioxide concentrations are detected in the cylinder storage and feed areas.
- Potential leaks from the Chlorine Cylinder Storage and Chlorinator Rooms are discharged by the existing emergency ventilation air system directly into the surrounding atmosphere without any pre-treatment.
- The Sulfur Dioxide Storage and Feed Rooms are not provided with any ventilation or ventilation air treatment systems.

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

- There are noted faulty control wiring issues with regards to alarm lights on the chlorine feed system. However, troubleshooting control wire issues is difficult because existing conduits are completely packed with wiring. No spare conduits are available to run new control or power wiring.
- The current process water system, which pressurizes potable water for use as backup water to the Reclaimed Water Pump Station for plant use such as for chlorine and sulfur dioxide ejector feed water, is currently inactivated.
- The chlorine contact tank influent and effluent chlorine analyzers are 15 years old and spare parts, especially for electronics, may no longer be available.
- Per the Ecology Orange Book, the existing WRF chlorine contact tanks with a 4-foot operating flow depth are too shallow. The Orange Book recommends a flow depth of 6 to 15 feet be provided in chlorine contact tanks and does not recommend the use of shallower tanks.

5.7.5 Sludge Storage, Pumping and Processing (Sub Process Areas 21, 22, 23, 24, 25, and 26)

The sludge storage tank receives waste activated sludge from the SBRs. Sludge is stored in this tank until the WRF operator is ready to begin processing sludge with the Gravity Belt Thickener (GBT). The sludge storage tank actually served as a polishing tank in the original 1994 lagoon treatment plant system.

The GBT receives sludge pumped from the sludge storage tank and thickens it. This process is accomplished by adding a polymer to the sludge which causes the solids in the sludge to bind together more tightly, expelling any water in the sludge. The solids that remain are discharged from the GBT into a sludge hopper. From there, the solids are pumped to a septic hauling tanker truck for hauling off-site and disposal. Filtrate water separated from the solids is directed by a gravity drain pipe into the Reject Water Pump Station.

Key deficiencies, recent repairs, recent equipment replacement, or general condition notes for the disinfection and dechlorination treatment facilities include the following:

- Plant staff have noted no major operational failures for the GBT unit. The unit is currently over 15 years old but spare parts such as the belt are still readily available.
- The GBT is sized for a maximum hydraulic feed rate of 180 gpm. The GBT currently receives approximately 22,000 gallons of sludge for thickening each time it runs (which is currently no more than three times each week). This corresponds to a run time of 122 minutes using the maximum feed rate of 180 gpm. From this, 3,500 gallons of thickened solids and 18,500 gallons of filtrate are produced.
- However, operations staff report that an operating drain and sludge feed pump is only capable of delivering 150 gpm of sludge flow into the GBT at this time. In addition, these pumps and the associated controls are close to 21 years old having been initially installed as part of the 1994 lagoon treatment plant system.
- It is assumed that the volume of sludge to be thickened will increase proportionately with the volume of raw influent flow into the WRF. Using this assumption, it is safe to assume that at or near stated WRF design flow capacity of 1 mgd, the GBT will be processing 66,000 gallons of sludge three times per week. This corresponds to a run time of 440 minutes per 66,000-gallon batch processed assuming a sludge feed pumping rate of only 150 gpm. From this, 7,500 gallons of solids and 55,500 gallons of filtrate are estimated to be produced.

- Polymer pumps and the polymer feed system are now approaching 15 years in age.
- Within the gravity belt thickener area it was noted that corrosion of the electrical conduits and junction boxes has occurred.
- With the drain and sludge pumps each providing a 150-gpm flow rate, the draining of SBR tanks is very slow. Also, to avoid flooding out of the Drain and Sludge Pump Station wet well, plant staff use the WAS Pump Station to dewater the SBR tanks for maintenance purposes.

5.7.6 Reclaimed Water Pumping and Storage (Sub Process Areas 14 and 54)

The Reclaimed Water Pump Station takes the Class A reclaimed water produced at the WRF and pumps it into the reclaimed water system for use by the various reclaimed water customers located throughout the city and for groundwater recharge at Cochrane Park.

The pump station is a prepackaged system composed of four pumps; two 7.5-hp maintenance pumps and two 15-hp supply pumps. The supply pumps are controlled by variable frequency drives.

Under low flow operating conditions, the maintenance pumps are used to deliver reclaimed water into the reclaimed water distribution system and maintain a minimum system pressure of 65 psi. Once demand increases and the system pressure drops below 65 psi, the maintenance pumps shut off and the supply pumps take over. The supply pumps will then attempt to maintain 90 psi in the reclaimed water distribution system. The pumping system is also set up to fill the on-site storage tank in order to provide reclaimed water supply during WRF effluent flow interruptions and during reduced WRF effluent flow periods.

Key deficiencies, recent repairs, recent equipment replacement, or general condition notes for the reclaimed water facilities include the following:

- The on-site reclaimed water storage tank is over 15 years old and has not yet received a detailed inspection for structural and coatings conditions.
- The reclaimed water pump skid and pumps are showing significant corrosion damage.
- During peak flow events in maximum summer reclaimed water demand periods, the pump skid operates both 15 hp supply pumps at maximum speed.

5.7.7 Flow Measurement and Sampling (Sub Process Areas 1, 5, 9, 14, and 46)

For influent flow monitoring, a below-grade, prefabricated, concrete flow meter vault structure houses two magnetic flow meters to measure STEP influent flows into the WRF.

At grade and on top of the influent flow metering vault is an outdoor refrigerated autosampler. The autosampler uses flow signal information from the influent flow meters vault in order to draw composite samples for permit mandated influent sampling. Influent flow is conveyed from the flow meters into an influent hydraulic control structure manufactured from HDPE.

Flow measurement equipment is also installed for the following WRF flow streams:

- SBR decant flow (pitot flow tube).
- WAS Pump Station discharge flow (magnetic flow meter).
- Sludge flow into GBT (magnetic flow meter).
- IPS discharge flow (magnetic flow meter).

- Reclaimed water discharge flow into the City-wide reclaimed water distribution system (magnetic flow meter).
- Reclaimed Water Pump Station discharge flow to on-site storage.
- Reclaimed Water Pump Station discharge.
- Weirs to measure chlorine contact tank, along with an effluent flow outdoor refrigerated autosampler for collection of final WRF effluent samples.

Key deficiencies, recent repairs, recent equipment replacement, or general condition notes for the flow measurement and sampling facilities include the following:

- Influent and effluent autosamplers were replaced with new units in 2014.
- The influent 6-inch magnetic flow meter is over 15 years old and has been slated for replacement with a new unit in 2016.
- The existing IPS 8-inch magnetic flow meter is over 15 years old and has recently showed intermittent zero flow errors even though flow is known to be passing through the meter.
- The existing 6-inch WAS magnetic flower meter is over 15 years old.
- The influent autosampler uses a suction line directly off the pressurized influent pipe to draw samples. No special solenoids are provided for positive flow isolation during sample periods.
- The SBR effluent decant pitot style flow meter is inoperable ever since its initial installation due to solids plugging issues.
- There is no flow meter on the reject water pump flow station. Having a flow meter for the Reject Pump Station would better enumerate internal plant recycle flows (filter backwash waste flows, wash down flows to drain, and filtrate flows discharged from the GBT) not picked up by the influent flow metering system.
- Based on May 2013 Ecology comments on the GSP, there is a possible and significant flow discrepancy between the influent and effluent flow measurements. Ecology reviewed monthly flow data (influent flow, reclaimed water use, discharge to Power Canal, and discharge to Nisqually River) that the City reported on monthly discharge monitoring reports. The data indicate a difference of 30,000 to 60,000 gallons per day between the influent flow and combined discharges. Prior to approximately March 2007, the City reported more effluent than influent flow. From that date to the present, the reported influent flow exceeds the total effluent flows.

5.7.8 Support Systems (Electrical, Controls, and Miscellaneous) (Sub Process Areas 15, 16, 17, 18, 20, 31, 32, 33, 34, 35, 36, 38, 40, 41, 42, 43, 44, 45, and 47)

5.7.8.1 Introduction

The utility and support systems at the Yelm WRF consist of the physical systems at the WRF that are used to support the treatment process and facility operation and maintenance. The key utility and support systems at the WRF include:

- Power Supply and Distribution.
- Controls and Alarm Equipment.
- Heating, Ventilation, and Air Conditioning (HVAC).

Although these systems do not treat the wastewater, the systems are critical components of the wastewater treatment process. Without these systems, it would be impossible to adequately treat the incoming wastewater.

5.7.8.2 Power Supply and Distribution

Main Service Entrance

The main 3000-ampere (A) 480/277 V, three-phase, four-wire service conductors from Puget Sound Energy (PSE) enter the Blower Building underground from the east and terminate in a lineup of Siemens switchgear. This switchgear serves as the site main service entrance and is equipped with current transformers for revenue metering. The switchgear is rated for 65-kiloampere (kA) fault duty and is constructed with copper bussing and front accessible cable terminations. The 3000-A main and 2000-A feeder (with 1600-A trip) circuit breakers are insulated case-type mounted in drawout modules for ease of maintenance and are equipped with adjustable electronic long-time, short-time, instantaneous pick-up, and ground fault settings. These settings are determined by engineering calculations and adjusted at the time of initial startup. The settings are not to be changed without approval of a qualified electrical engineer.

The 1600-A feeder circuit breaker feeds the normal side of the automatic transfer switch. A 250-A circuit breaker feeds MCC-N1 and a 400-A space is provided for a future MCC-C3. This switchgear is equipped with local Voltmeter and Ammeter with phase selection switches which are intended for use by the operators to monitor electrical consumption during various operational stages.

The main service entrance cabinet, which contains current transformers for PSE metering, is sealed by PSE to prevent unauthorized entry. PSE prohibits customers from tampering with revenue equipment and the current transformers located in this cabinet are a lethal high voltage shock hazard when mishandled.

The existing motor control center (MCC-Exist) located in the Process Control Building (Sub Process Area 32 in Figure 5-1), serves as an 800-A 480/277 V, three-phase, four-wire service entrance with underground feed from PSE. It includes PSE metering equipment, combination starters for a number of motors, feeder circuit breaker for panelboard HP, and a feeder circuit breaker for a 75 kilovolt-ampere (kVA) dry transformer which feeds 208/120 V, three-phase, four-wire panelboards.

The MCC-Exist has a split bus which is connected via an automatic transfer switch (ATS). This enables the existing 100-kW engine generator to feed the portion of the bus supplying standby loads and prevents feedback of generator power into the PSE system. In the normal mode (generator off), the ATS connects the two sections of the split bus together so that all loads are supplied by normal PSE power.

Standby Generators

Two standby generators are located at the WRF. The 100-kW, 125-kVA generator (Sub Process Area 45 on Figure 5-1) is located in the Maintenance Building, north of the Process Control Building and was part of the original 1994 lagoon treatment plant system. This unit provides standby power to the MCC-Exist in the Control Building Electrical Room. This MCC supplies power to the north half of the WRF including the Solids Handling Building, IPS, filters, and Control Building. The generator supplies power to an ATS which is also located in the Process Control Building Electrical Room. This generator uses No. 2 diesel fuel which is stored in a 150-gallon base tank that has a rupture leak detector and low fuel level alarm.

A second generator was added as part of the WRF construction in 1999. The diesel engine generator set is rated 500 kW standby at 0.8 power factor. The engine is a Cummins six-cylinder, four-cycle, in-line, water-cooled, turbocharged, after-cooled unit with electric start. The Onan alternator is a brushless, direct-coupled, permanent magnet type conforming to NEMA MG1-1.65.

The day tank for the 500-kW generator is base mounted with 800-gallon capacity. Fuel consumption is estimated at 35.2 gallons per hour (gph) at full load and 18.6 gph at one-half load giving run times of about 23 hours and 43 hours, respectively.

The 500-kW engine is equipped with a 4000-W jacket water heater and a 75-Amp engine driven alternator for battery charging. A separate fully automatic 10-Amp float charger is provided which maintains the battery in fully charged condition at all times. The float charger is located in the Storage Room of the Blower Building. The alternator is sized to power all connected loads on MCC-C1 (see MCC section below). However, the alternator does not have capacity to start the three 150-hp blower motors simultaneously. Therefore, each of the three blower drives is equipped with an adjustable delay relay connected to inhibit simultaneous starting. All smaller motors will start immediately WHEN the automatic transfer switch connects MCC-C1 to the alternator. The delay on Blower No. 1 will prevent it from starting until the smaller motors have had sufficient time to come up to speed. The delay on Blower No. 2 will prevent it from starting until Blower No. 1 has had sufficient time to come up to speed. Blower No. 3 will be delayed until Blower No. 2 has had time to come up to speed.

The 500-kW engine generator set is housed in a self-contained outdoor enclosure and is provided with critical environment sound attenuation and seismic base mounts.

A 500-W Simplex resistive load bank is provided to facilitate off-line generator testing. It is equipped with a 700-A circuit breaker and controls that allow load adjustment in 50-kW increments. The load bank is cooled by engine radiator cooling air and is equipped with a high temperature safety switch set to disconnect the load bank if the temperature exceeds 300 degrees Fahrenheit (F).

Both generators are automatically exercised on a weekly basis.

Automatic Transfer Switch (ATS)

The Cutler Hammer ATS connects the normal 1600-A feeder in the main service panel to MCC-C1 when normal power is available, and connects the 500-kW generator to MCC-C1 upon failure of normal power. It also prevents feedback of standby power into the PSE system. The ATS is comprised of four drawout insulated case circuit breakers configured to provide automatic transfer and bypass isolation functions. The bypass isolation function allows maintenance to occur without the interruption of power to the loads. The bypass isolation circuit breakers also provide a manual transfer capability. All four circuit breakers are interchangeable and are provided with key interlocks to prevent improper manual operation.

The ATS includes contacts to start the generator upon failure of normal power, adjustable trip settings for circuit breaker coordination, and programmable microprocessor control of the automatic transfer function.

Motor Control Centers (MCCs)

All motor loads are controlled either by across-the-line starters located within the MCC enclosure or by variable frequency drives located externally from the MCC. The majority of the WRF MCC across-the-line starters are designated full voltage nonreversing (FVNR) and are mounted in plug-in units called “combination starters.”

Variable frequency drives are generally located remote from the MCCs and are fed from the MCCs via thermal magnetic circuit breakers mounted in plug-in units similar to combination motor starters. Individual VFDs are provided for the following WRF equipment motors:

- Single VFD to serve the Reclaimed Water Pumps.
- VFD for each SBR Process Air Blower (total of three).
- VFD for the sludge storage tank mixing air blower.
- VFD for each IPS pump motor (total of two).
- VFD for each Drain and Sludge Pump Station pump motor (total of two).
- VFD for Solids Handling Building ventilation fan.

The MCC-Exist located in the Process Control Building was installed as part of the 1994 lagoon treatment plant system and serves as an 800-A, 480/277-V, three-phase, four-wire service entrance with underground feed from PSE. It includes PSE metering equipment, combination starters for a number of motors (for reject water pumps and the equalization pond mixer/aerators), a feeder circuit breaker for panelboard HP, and a feeder circuit breaker for a 75-kVA dry transformer which feeds 208/120-V, three-phase, four-wire panelboards DP1 and DP2. This MCC has a split bus which is connected via an ATS. This enables the existing 100-kW engine generator to feed the portion of the bus supplying standby loads and prevents feedback of generator power into the PSE system. In the normal mode (generator off), the ATS connects the two sections of the split bus together so that all loads are supplied by normal PSE power.

MCC-C1 was installed as part of the 1999 WRF upgrades and services the SBR electrical equipment (WAS pumps, blowers, and mixers), local panelboards, filter and instrument air compressor equipment, and the Reclaimed Water Pump Station. This MCC is located in the Blower Building.

MCC-N1 was installed as part of the 1999 WRF upgrades and services the sludge storage tanks mixing blower and miscellaneous Blower Building electrical equipment such as heaters, fans, and a bridge crane motor.

MCC-C2 was also installed as part of the 1999 WRF upgrades and services the solids handling equipment (gravity belt thickener electrical motors, polymer makeup, and feed system) and IPS pumps. This MCC is located in the Solids Handling Building. MCC-C2 is served by the same generator and ATS for MCC-Exist.

Power Conditioning Units

Two power conditioning units have been included as part of the WRF electrical distribution system. The units are located in the west wall of the Blower Building Electrical Room. The units reduce the amount of harmonics generated by the electrical motors driving the blowers The power conditioning units also protect the instrumentation and control circuits from “dirty” power, which may affect the operation of the equipment.

Key deficiencies, recent repairs, recent equipment replacement, or general condition notes for the WRF electrical distribution facilities include the following:

- The MCCs and ATS equipment have not received any scheduled inspection and maintenance.
- The 100-kW generator is now 21 years in age as of 2015.
- The 500-kW generator is now 16 years in age as of 2015.
- Reclaimed Water Pump Station motor starters and VFD are located in a difficult to maintain control panel setup, separate from the main MCC gear.

- Two SBR process air blower VFDs have had to be replaced due to failure and a lack of spare parts. One outdated SBR process air blower VFD remains in service. This VFD is now over 15 years old and is deemed obsolete due to a lack of spare parts.
- The VFDs for the IPS pump motors and for the Drain and Sludge Pump Station pump motors are over 15 years old and are deemed obsolete due to a lack of spare parts.
- Equipment such as the sludge tank mixing blower and other electrical loads serviced under MCC N1 are not provided with standby power.
- The two existing power conditioning units in the Blower Building Electrical Room have been deactivated.
- The split electrical system is difficult to maintain and the City manages a separate power bill for each system.

5.7.8.3 Heating, Ventilation, and Cooling (HVAC) Facilities

Heating, ventilation, and cooling facilities are focused in the Process Control Building, Maintenance Garage Building, Blower Building, and Solids Handling Buildings.

Key deficiencies, recent repairs, recent equipment replacement, or general condition notes for the WRF HVAC facilities include the following:

- Most HVAC equipment is over 15 years in age.

5.7.8.4 Controls Facilities

The instrumentation and process control system for the WRF is comprised of instrumentation, signal conductor, programmable logic controllers (PLCs), and operator control and data collection computers. The WRF is not a fully automated facility; however, much of the WRF equipment is operated from the control computers.

The system is expandable and additional instrumentation and signals can be added to the PLC and SCADA software to receive, report, and record any additional input from the facility.

The WRF is equipped with three computers to monitor and control the plant process and monitoring system. Two computers are located in the Process Control Building office and Control Room. The third computer is located in the Blower Building Control Room. These computers are connected to each other and the PLCs via DH+ communications over a twisted-pair cable. The operators can access any of the three computers at any time to receive various instrumentation readings or modify equipment settings such as pump and blower speeds. The SCADA software is capable of restricting access to make changes to the WRF operation. Access to the system is restricted by a password security method.

The computers are connected to the three PLCs. The PLCs are the SBR, RW, and PLT. The SBR and RW PLCs are located in the Blower Building Control Room. The PLT PLC is located on the electrical mezzanine in the Solids Handling Building.

In addition to the PLCs, the computers are protected with an Uninterruptible Power Supply (UPS) system which protects the computers and support equipment from power outages and surges. The UPS units provide approximately 20 minutes of backup power in the event of a power shortage. When a power failure occurs and the SCADA system indicates a power failure and that the standby generators are operating, the information on the screen should be saved to minimize possible data loss. If the power outage is extensive, the operators should save the data periodically to minimize data loss.

The RS VIEW 32 software by Rockwell is currently installed on three control computers to control the SCADA system and assist the operators with the daily operation functions required for reporting and operating the facility.

The control computers use a Windows XP operating system. Individual computer equipment is listed in the Instrumentation and Control O&M documentation. In the event that a control computer fails to operate properly, the equipment should be replaced as soon as possible. It is important that at least two of the control computers operate properly in order to meet the facilities redundancy requirements.

Key deficiencies, recent repairs, recent equipment replacement, or general condition notes for the WRF controls facilities include the following:

- Windows XP operating software on SCADA computers is out-of-date and no longer supported by Microsoft.
- SCADA computers use out-of-date software where the software vendors are no longer in business and, therefore, software packages (e.g., for computer backup) are no longer supported.
- A single-board computer that is used in the SBR PLC is obsolete and is no longer supported by the manufacturer for spare parts.
- Electronic maintenance management or laboratory management is currently being tracked through electronic spreadsheets or paper records.
- There are no additional control wiring or spare control conduits to facilitate the installation of additional instrumentation at the SBRs or influent flow facility areas.
- The existing DH+ communication hardware for the WRF computers is outdated and lacks spare parts.
- Only one of the control computers actually logs and stores continuous data measurements for Daily Monitoring Report (DMR) reporting (e.g., effluent turbidity). The main control computer locks up from time to time and causes data storage interruptions. Maintaining a full data set at all times is critical for DMR reporting.

5.7.9 Effluent

5.7.9.1 (Sub Process Areas 37 and 55)

The effluent outfall primarily consists of 12-inch-diameter PVC piping that conveys excess WRF effluent flows not used for reclaimed water to one of two outfall discharge points through the manipulation of buried flow isolation valves located near the Centralia Power Canal outfall discharge point. One side outfall discharge point is located along the Centralia Power Canal while the other side outfall is located at the Nisqually River.

Photograph 5-5. Centralia Power Canal Outfall Pipe Screen

Key deficiencies, recent repairs, recent equipment replacement, or general condition notes for the WRF effluent outfall facilities include the following:

- A quick visual inspection is made each month of the side outfall discharge points.
- No recent, detailed inspections of the outfall pipeline and the side outfall discharge points have been conducted.
- The air-vacuum valves installed along the outfall piping alignment have not been recently inspected or maintained since installation.