PRELIMINARY ENGINEERING REPORT
City of Stevenson
Cascade Avenue Utility Improvements

April 2023

Prepared for:

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Section 1 Project Planning

1.1 Location

The City of Stevenson (City) covers 1.79 square miles in the Columbia River Gorge, about 45 miles east of Portland, Oregon. It is surrounded by unincorporated Skamania County. The nearest neighboring cities are Carson, 3 miles to the northeast, and North Bonneville, about 4 miles to the southwest. The City's Urban Area was set by federal statute in 1986 with the creation of the Columbia Gorge National Scenic Area.

The City owns and operates a Group A Community drinking water system that serves an approximate population of 1,530. According to the Washington State Department of Health (DOH) the system has 736 calculated connections and is approved for 842 connections. The DOH identification number for this water system is 842502. The existing water system map from the 2017 Water System Plan Update (WSP) is shown in **Figure 1-1** located at the end of this section. The City also owns and operates a sewer collection and treatment system that serves an approximate population of 1,081. The wastewater treatment plant discharges effluent under National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA0020672. A map of the existing sewer collection system from the 2017 General Sewer Plan and Wastewater Facilities Plan Update (GSP) is shown in **Figure 1-2**.

1.2 Environmental Resources Present

The project area is predominately located within the existing paved right-of-way (ROW) of Cascade Avenue. A portion of the roadway alignment is bound to the north by the Burlington Northern Railroad. City of Stevenson zoning designations within the project vicinity include Residential – Single Family, Recreational, and Services – Governmental.

The US Fish and Wildlife Service National Wetlands Inventory does not list the presence of wetlands within the project vicinity. The Columbia River is located southeast of the project alignment, separated by zoned parcels. The project area is within FEMA Zone C with no flood data available. Refer to **Appendix A** for wetlands inventory and FEMA zone mapping.

According to the Washington Department of Fish and Wildlife Priority Habitat and Species (PHS) mapping tool, the following species are within the project's Area of Potential Effect (APE) and are either considered locally important or sensitive to the State of Washington or threatened or endangered to Washington State/federal government under the Endangered Species Act.

- Coho (Oncorhynchus kisutch) – species of local importance
- Western Grebe (Aechmophorus occidentalis) – species of local importance
- Northern Spotted Owl (Strix occidentalis caurina) – federally threatened and state endangered.

According to the U.S. Fish and Wildlife Service's Information for Planning and Consultation mapping tool, the following federally listed species could occur within the project's APE. Note – habitat for these species and potential occurrences are mapped by township; the project site does not contain unique habitats for these species:

- Gray Wolf (Canis lupus)
- North American Wolverine (Gulo gulo luscus)
- Northern Spotted Owl (Strix occidentalis caurina)
- Yellow-Billed Cuckoo (Coccyzus amiercanus)
- Bull Trout (Salvelinus confluentus)
- Monarch Butterfly (Danaus plexippus)

The aquatic species documented above would not be subject to development-specific impacts.

1.3 Population Trends

As part of the GSP, the City generated a memo[1] to evaluate historic growth trends and establish future population benchmarks. Historic population trends within the community were evaluated by reviewing the following data sets from the US Census Bureau and Washington State Office of Financial Management (OFM).

Table 1-1 summarizes historical and projected population for the city limits and water service area. Populations are projected to converge as the number of customers in the Urban Growth Area (UGA) are brought into the city limits. The year 2015 population of 1,530 people within the city limits is anticipated to increase to 1,901 people in the year 2040, equating to a growth rate of approximately 0.87 percent per year. The full build-out population within the UGA is estimated by the City to be 4,772 people. Full build-out was calculated by projecting a density of 980 people per square mile within the 4.87 square mile UGA.

Table 1-1: Population Summary

Year	City Limits Population	City and UGA Population Connected to Water
	Historical	
2010	1,470	1,522
2011	1,500	1,553
2012	1,520	1,573
2013	1,515	1,568
2014	1,510	1,532
2015	1,530	1,583
	Projected	
2026	1,684	1,705
2036	1,836	1,834
2040	1,901	1,897

[1] *Sewer Population Benchmarks / Projections* memorandum by the City of Stevenson, dated March 22nd, 2016. See Appendix B.

1.4 Community Engagement

Upgrades to the Cascade Avenue sewer were included as a capital project in the GSP with the final design and construction within the six-year budget. The GSP was discussed publicly and open for comment during City Council meetings. Official adoption of the GSP and planning level budget included public comment periods and formal approval by Resolution 2019-327.

The City has an asbestos cement (AC) waterline replacement program as outlined in the WSP. Though the water main in Cascade Avenue is not specifically called out in the WSP for replacement, the pipe material is AC and must eventually be replaced as part of the City's AC pipe replacement program prior to failure. The WSP was approved by the City of Stevenson at the July 19th, 2018 council meeting.

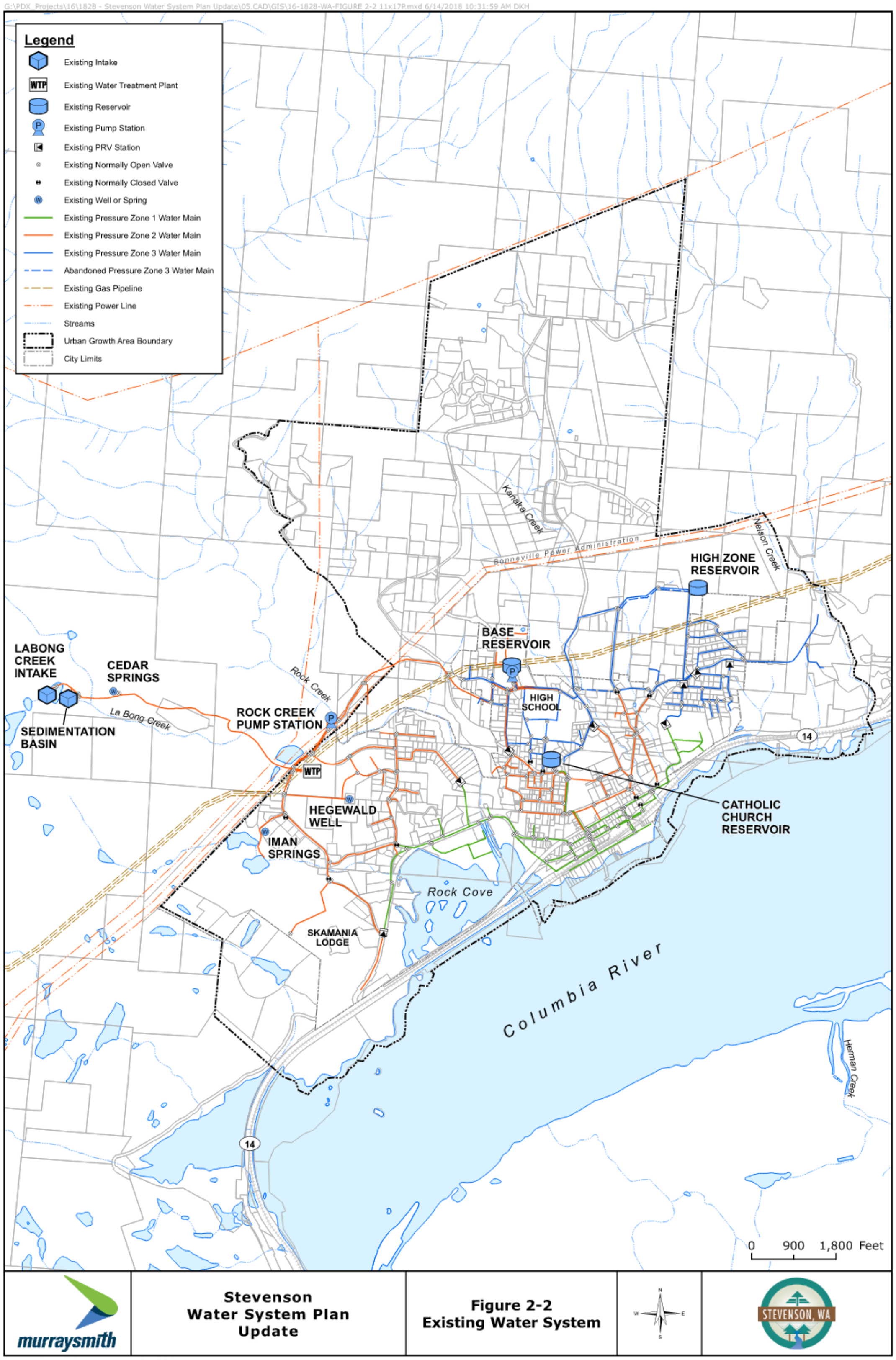


Figure 1-1: Existing Water System Map from 2017 WSP Update

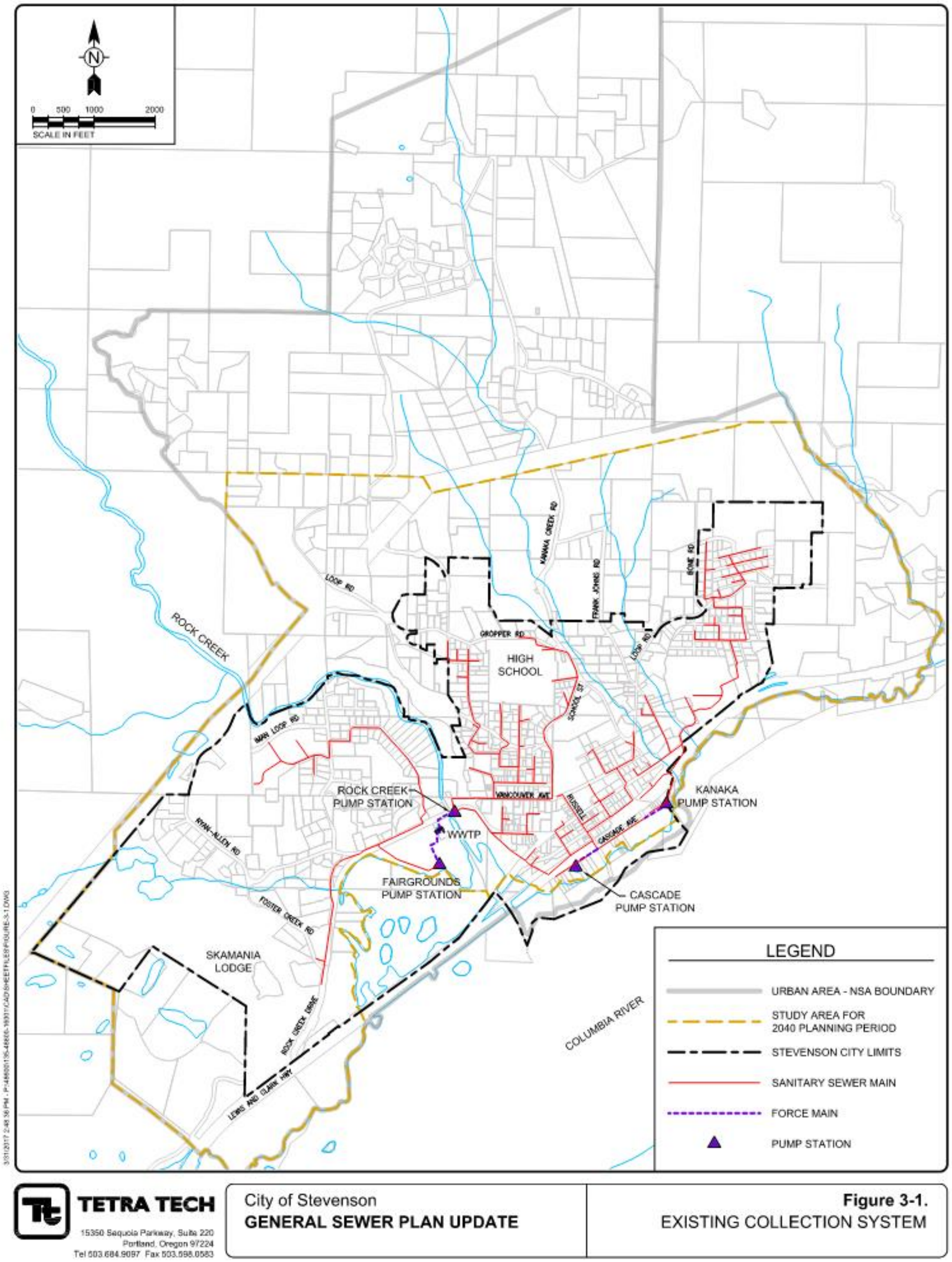


Figure 1-2: Existing Sewer Collection System Map from 2017 GSP

Section 2 Existing Facilities

2.1 Location Map

The project vicinity map is shown in **Figure 2-1.**

Figure 2-1 Project Vicinity Map

2.2 History

The City's wastewater system collects and treats wastewater from all sewered areas of the City of Stevenson. Sewer accounts consist primarily of single-family residences, commercial customers, public customers, and multi-family residential housing. Residents not connected to the wastewater system are served by on-site septic systems.

Water in Stevenson is supplied from LaBong Creek, Cedar Springs, and Rock Creek. Water from these sources is treated by the City's 1.0-million-gallon-per-day (mgd) water treatment plant, constructed in 1979. The City also utilizes Hegewald Well as an emergency groundwater source. Residents not connected to the water system are served by private wells.

The City's growth boundary was federally set under the Columbia River Gorge Scenic Area Act. The City is bounded on the south by the Columbia River and essentially can only grow to the north; growth to the east and west is constrained by Scenic Area boundaries. Topography to the north is steep and in certain areas subject to unstable ground conditions, limiting both the density and types of growth that can occur.

The conditions of existing facilities as they pertain to this project are described below in **Section 2.3**.

2.3 Condition of Existing Facilities

2.3.1 Water Main

The Cascade Avenue water main is 8-inch AC pipe that transitions to 6-inch AC pipe at address 11 SW Cascade Avenue. It is within Pressure Zone 1 of the Stevenson Water System. The pipe was likely constructed in the 1960's.

2.3.2 Sewer Main

The Cascade Avenue sewer main is 8-inch AC pipe, constructed in 1968. This section starts at manhole C1-15, continues downslope to the west through manhole C1-14 to manhole C1-13. At manhole C1-13 flows continue by gravity to the Rock Creek Pump Station located near the City's wastewater treatment plant, in a main also referred to as the Cascade Interceptor. The eastern pipe terminus at manhole C1-15 receives flow from the Kanaka Pump Station force main. Manhole C1-13 located at the intersection with Russell Avenue is the discharge point for the Cascade Pump Station force main. Modeling completed in the 2017 GSP indicates that this sewer main exceeds 80 percent of full flow capacity at existing peak-hour flow and 100 percent for the 2040 planning period peak-hour flow.

2.3.3 Cascade Pump Station

The Cascade Pump Station (see **Figure 2-2**) is located on Cascade Avenue west of Russell Avenue. It serves seven properties between the Columbia River and the railroad tracks. The pump station discharges to the Cascade Interceptor at the intersection of Cascade Avenue and Russell Avenue, which flows by gravity to the Rock Creek Pump Station. The force main consists of 470 ft of 4-inch AC pipe. This force main is adequately sized to serve the relatively small contributing sub-basin.

The pump station, constructed in 1972, consists of two vacuum primed pumps in a fiberglass enclosure over a precast concrete wet well. Standby power is not provided. Overflow is via a 6-inch pipe from the wet well, discharging to the Columbia River. The pump station is adequately sized for existing and future flows. It is in the process of being upgraded to include bypass pumping and upgraded controls, as noted in the GSP.

Figure 2-2 Cascade Pump Station Photos

2.3.4 Kanaka Pump Station

The Kanaka Pump Station (see **Figure 2-3**) is located on Cascade Avenue, west of the public boat launch ramp. The station boosts flow from Main F to the Cascade Interceptor. The pump station discharges to the Cascade Interceptor, which flows by gravity to the Rock Creek Pump Station. The force main, which was upsized in 2015, is 6-inch diameter PVC pipe with an approximate total length of 410 feet. This force main is adequately sized to accommodate future flows as determined by the GSP capacity analysis.

The pump station, constructed in 1972 and upgraded in 1993, consists of two vacuum primed pumps in a fiberglass enclosure over a precast concrete wet well. Standby power is provided by a 40-kW diesel generator. The station is equipped with a valved overflow pipe directed to Kanaka Creek, near its confluence with the Columbia River. When the valve is closed, overflows would occur through the lid of manhole F-2.

This pump station is in the design phase of full replacement. Modeling indicates that the pump station is undersized for both existing and future flows. Replacement will consist of constructing a new 500-gpm firm capacity duplex submersible pump station with new control panels and auxiliary standby power, per the GSP.

Figure 2-3 Kanaka Creek Pump Station Photos

2.3.5 Electrical

Skamania Public Utility District #1 (PUD) is the electrical provider to the City of Stevenson. The PUD's power utilities are underground within the project limits on Cascade Avenue. There are two serviceable streetlamps between Russell Avenue and Leavens Street, approximately 70 feet apart.

2.4 Financial Status of Existing Facilities

The section summarizes the financial status of the water and sewer systems. Additional information is included in the attached financial audit in **Appendix C** and the Stevenson CIP in **Appendix D**.

The City's operating statement for the current budget year and two years prior are summarized in **Table 2-1** below.

Table 2-1: Stevenson Operating Statement

Operating Revenues	Actual 2021	Actual 2022	Budget 2023
Water / Sewer Fund			
OPERATING REVENUES:			
Beginning Balances	$887,574	$1,668,439	$1,958,314
Intergovernmental Revenues	$94,923	$759,771	-
Water Sales	$793,275	$877,066	$761,675
Sewer Sales	$1,053,670	$1,237,493	$1,322,308
Interest & Other Earnings	$319,096.04	$245,533.86	$107,206.00
TOTAL OPERATING REVENUES	$3,148,538	$4,788,302	$4,149,503
OPERATING EXPENSES:			
Water Utilities	$559,364	$687,617	$876,313
Sewer Utilities	$649,544	$931,480	$1,117,449
Debt Service	$93,757	$739,121	$143,104
Capital Expenditures	$103,281	$28,185	$272,160
Interfund Transfers	$74,154	$443,587	$421,779
Ending Balance	-	-	$1,318,699
TOTAL OPERATING EXPENSES	$1,480,099	$2,829,988	$4,149,503
FUND NET CHANGE	$1,668,439	$1,958,314	-
Wastewater Short-Lived Asset Reserve Fund			
OPERATING REVENUES:			
Beginning Balances	$21,779	$43,558	$65,337
Interfund Transfers	$21,779	$21,779	$21,779
TOTAL OPERATING REVENUES	$43,558	$65,337	$87,116
OPERATING EXPENSES:			
Ending Balance	-	-	$87,116
TOTAL OPERATING EXPENSES	-	-	$87,116
FUND NET CHANGE	$43,558	$65,337	-

The table above includes information for the water and sewer enterprise funds. Short-lived asset and debt reserve fund information are presented in **Table 2-2** on the next page.

Also on the next page, **Table 2-3** presents monthly water users by meter size and customer classification. The base usage is up to the first 400 cubic feet of water consumed per customer. Additional water consumed over 400 cubic feet is included in the usage charges column.

Table 2-2: Stevenson Operating Statement Cont.

Operating Revenues	Actual 2021	Actual 2022	Budget 2023
Wastewater Debt Reserve Fund			
OPERATING REVENUES:			
Beginning Balances	$61,191	$61,191	$61,191
Interfund Transfers	-	-	-
TOTAL OPERATING REVENUES	$61,191	$61,191	$61,191
OPERATING EXPENSES:			
Ending Balance	-	-	$61,191
TOTAL OPERATING EXPENSES	-	-	$61,191
FUND NET CHANGE	$61,191	$61,191	-
Wastewater System Upgrades			
OPERATING REVENUES:			
Beginning Balances	$(57,602)	$(194,712)	$(1,179,180)
Intergovernmental Revenues	$5,400	$1,783,025	$5,028,740
Other Financing Sources	$228,427	$2,902,589	$9,637,370
Interfund Transfers	$52,375	$421,808	$400,000
TOTAL OPERATING REVENUES	$228,600	$4,912,710	$13,886,930
OPERATING EXPENSES:			
Debt Service - Interest Costs	-	$905	-
Capital Expenditures	$423,312	$6,090,985	$13,886,930
TOTAL OPERATING EXPENSES	$423,312	$6,090,985	$13,886,930
FUND NET CHANGE	$(194,712)	$(1,178,275)	-
TOTAL FUNDS NET CHANGE	$1,578,476	$906,567	-

Table 2-3: Stevenson Water Use Tabulation

Monthly Water Use By Class						
	Customers	Units	Usage (cf)	Base	Usage Chgs	Total
3/4" Inside Res	582	727	300,157	$26,912.55	$3,869.66	$30,782.21
3/4" Outside Res	29	30	14,445	$1,638.60	$351.86	$1,990.46
3/4" Senior Inside Res	26	26	15,410	$481.52	$425.17	$906.69
3/4" Senior Outside Res	2	2	418	$54.62	$1.01	$55.63
3/4" Inside Commercial	79	79	36,363	$2,926.16	$954.30	$3,880.46
1" Inside Res	4	4	1,836	$243.12	$27.03	$270.15
1" Outside Res	1	1	618	$103.51	$12.21	$115.72
1" Inside Commercial	15	15	15,958	$911.70	$571.99	$1,483.69
1 1/2" Inside Commercial	4	4	8,610	$586.88	$350.63	$937.51
2" Inside Commercial	21	21	101,236	$5,942.58	$4,513.56	$10,456.14
2" Outside Commercial	1	1	4,184	$408.82	$211.90	$620.72
3" Inside Commercial	1	1	1	$508.52	-	$508.52
4" Inside Commercial	2	2	14,804	$1,220.24	$658.19	$1,878.43
Transient Lodging Water	5	315	115,608	$5,833.80	$2,523.15	$8,356.95
Temp Const Water	9	9	1,278	-	$60.07	$60.07
TOTALS	781	1,237	630,926	$47,773	$14,531	$62,303

Table 2-4 below presents monthly sewer users by meter size and customer classification. Residential customers pay a user charge per dwelling unit. Non-residential customers pay a base user charge plus a volume charge that varies with water usage. Industrial customers pay a negotiated rate when they exceed biochemical oxygen demand (BOD) parameters.

Table 2-4: Stevenson Sewer Use Tabulation

Monthly Sewer Use By Class								
	Cust	Units	Usage (cf)	Base	Usage Charges	BOD Sur	Other	Total
Res Sewer	421	533	219,567	$62,073	-	-	$290	$62,363
3/4" Senior Res Sewer	20	20	12,813	$1,165	-	-	-	$1,165
3/4" Commercial	48	48	12,914	$5,590	$183	-	$70	$5,843
1" Commercial	10	10	7,858	$2,421	$314	-	$20	$2,755
1 1/2" Commercial	2	2	755	$721	$0	-	$10	$732
2" Commercial	6	6	10,879	$3,273	$502	-	-	$3,775
4" Commercial	1	1	3,780	$1,020	$199	-	-	$1,219
Transient Lodging	5	309	115,608	$17,996	$3,238	-	$10	$21,244
3/4" Commercial Med. BOD	4	33	10,630	$3,843	$89	$35	$20	$3,986
2" Commercial Med. BOD	4	4	19,190	$2,182	$1,038	$405	-	$3,625
4" Commercial Med. BOD	1	1	11,024	$1,020	$627	$244	-	$1,891
3/4" Commercial High BOD	14	14	19,998	$1,630	$905	$721	$20	$3,277
1" Commercial High BOD	2	2	4,723	$484	$231	$184	$10	$910
2" Commercial High BOD	1	1	1,683	$546	$76	$60	-	$682
1 1/2" Commercial Very High BOD 60%	1	1	7,855	$361	$254	$412	-	$1,027
2" Commercial Very High BOD 70%	1	1	16,160	$546	$644	$1,015	-	$2,204
Very High BOD	1	1	691		$29	$45		$73
TOTALS	542	987	476,128	$104,870	$8,330	$3,120	$450	$116,771

Table 2-5 below describes the historical and planned water rates through 2025. Customers are split into two categories: “Inside City” and “Outside City” to account for the higher cost of distributing water outside of city boundaries.

Table 2-5: Stevenson Water Rates

Service Connection Pipe Diameter (IPS)	Inside City					
	2020	2021	2022	2023	2024	2025
Base Monthly Charge Up to 3/4"	$32.00	$33.60	$35.28	$37.04	$38.89	$40.83
1"	$52.50	$55.13	$57.89	$60.78	$63.82	$67.01
1 1/2"	$126.74	$133.08	$139.73	$146.72	$154.06	$161.76
2"	$244.45	$256.67	$269.50	$282.98	$297.13	$311.99
3"	$439.28	$461.24	$484.30	$508.52	$533.95	$560.65
4"	$527.05	$553.40	$581.07	$610.12	$640.63	$672.66
6"	$1,403.97	$1,474.14	$1,547.88	$1,625.27	$1,706.53	$1,791.86
Metered Monthly Charge for Additional Water Consumed	$0.041	$0.043	$0.045	$0.047	$0.049	$0.051
Service Connection Pipe Diameter (IPS)	**Outside City**					
	2020	**2021**	**2022**	**2023**	**2024**	**2025**
Base Monthly Charge Up to 3/4"	$47.18	$49.54	$52.02	$54.62	$57.35	$60.22
1"	$89.42	$93.89	$98.58	$103.51	$108.69	$114.12
1 1/2"	$182.52	$191.65	$201.23	$211.29	$221.85	$232.94
2"	$353.15	$370.81	$389.35	$408.82	$429.26	$450.72
3"	$637.39	$669.26	$702.72	$737.86	$774.75	$813.49
4"	$766.58	$804.91	$845.16	$887.42	$931.79	$978.38
6"	$2,032.74	$2,134.38	$2,241.10	$2,353.16	$2,470.82	$2,594.36
Metered Monthly Charge for Additional Water Consumed	$0.048	$0.050	$0.053	$0.056	$0.059	$0.062

Table 2-6 below displays the planned sewer rates for 2023. The City does not provide sewer hookups for residents outside city limits.

Table 2-6: Stevenson Sewer Rates

Service Connection Pipe Diameter (IPS)	2023
Base Monthly Charge Up to 3/4"	$116.46
1"	$242.05
1 1/2"	$360.65
2"	$545.54
3"	$782.72
4"	$1,019.90
6"	$1,684.03
Metered Monthly Charge for Additional Flow Surcharge	$0.059

Refer to **Appendix C** for more financial information.

2.5 Water/Energy/Waste Audits

2.5.1 Water Audit

The City has been an active participant in the Water use Efficiency (WUE) program since its inception in 2003. Adoption of City Resolution No. 2011-245 established goals and measures to be included in the City's water conservation program. Goals and measures from the resolution are as follows:

City Goal

Reduce residential peak daily demand by two percent, lowering peak day demand from 600 gpd to 588 gpd over a six-year period.

City Performance Measures

1. Distribution of water saving tip to customers in annual water quality reports.
2. Placement of water saving educational materials on the City's website.
3. Display water saving information at public events.
4. Display water consumption history on water bills.

An important part of the WUE Program is compliance with the distribution system leakage (DSL) standard. DSL is calculated by the City and reported annually to the DOH. The DSL standard for water systems with 500 or more connections is 10 percent or less based on a three-year rolling average. Systems with DSL greater than 10 percent must create and implement a Water Loss Control Action Plan (WLCAP). The 2021 DSL was 12.4%, as reported in the most recent Water Use Efficiency Annual Performance Report. That report identified a 3-year annual average DSL of 11% for the years 2019 – 2021. The City has prepared a WLCAP to comply with the DSL standard.

2.5.2 Waste Audit

Infiltration

EPA's criterion for excessive infiltration is if the average-day flow per capita (excluding industrial and commercial flows from individual sources contributing 50,000 gallons per day or more) is 120 gallons per capita per day (gpcd) or more over a 7- to 14-day dry period during seasonal high groundwater. This amount allows up to 70 gpcd of domestic wastewater base flow and 50 gpcd of infiltration.

For Stevenson, the month of February 2015 was selected to analyze infiltration. Dry weather was experienced for the last half of the month, with only 0.1 inches of rain from February 11 through February 25 (compared to 7.9 inches from February 1-10). The period of February 16-25, 2015 was used to determine the average dry-weather flow. The average-day treatment plant effluent flow during this period was 117,800 gallons per day; for the equivalent population of 2,199, this is an average of 54 gpcd, well below the EPA criterion of 120 gpcd. Based on this analysis, infiltration is not excessive in Stevenson's wastewater collection system.

Inflow

The EPA has defined inflow as being excessive if the total daily flow (excluding industrial and commercial flow from individual sources contributing 50,000 gallons per day or more) during periods of significant rainfall exceeds 275 gpcd. **Table 2-7** lists the highest daily treatment plant effluent flows between 2001 and 2015, as well as the two highest-flow days from December 2015. For an equivalent population of 2,199, peak flows are in the range of 400 to 600 gpcd, which exceeds the EPA criterion of 275 gpcd for excessive rainfall derived inflow.

Table 2-7: Peak Day Wastewater Treatment Plant Flows 2001-2015

Rank	Date	Flow (mgd)	Flow per capita (gpcd)	24-hour Rainfall (in)	96-hour Rainfall (in)
1	21-Jan-2012	1.290	587	1.42	8.40
2	24-Jan-2012	1.240	564	0.67	2.96
3	1-Jan-2009	1.127	513	4.07	6.23
4	19-Jan-2012	1.090	496	2.96	7.10
5	6-Nov-2006	1.013	461	5.08	10.83
6	12-Dec-2010	0.992	451	2.95	6.20
7	28-Dec-2008	0.967	440	2.56	7.24
8	1-Dec-2013	0.954	434	4.71	6.32
9	29-Dec-2011	0.940	427	2.01	6.11
10	16-Jan-2011	0.918	417	3.15	6.78
11	7-Dec-2015	0.890	405	2.46	5.81
12	8-Dec-2015	0.879	400	3.19	8.83

Section 3 Need For Project

3.1 Health, Sanitation, and Security

The condition of the existing water and sewer mains on Cascade Avenue pose health and sanitation concerns. Having a safe, reliable, water system and sanitary sewer system is a critical element of public health.

The water main on Cascade Avenue is AC pipe installed over 50 years ago. AC pipe tends to be softer, and more brittle compared to PVC or ductile iron piping. That, combined with its age, means it is more prone to breakage and leaks that can disrupt water service to residents. Any significant construction activity within the roadway or adjacent land would increase the likelihood of a main break due to vibrations from compaction.

Catastrophic failure of the aging AC waterline poses several concerns. First, AC pipe that has failed is often challenging to repair due to the brittle nature of the pipe. Complications or delays in repairing the pipe will lead to a prolonged outage, depriving affected customers potable water service. Second, the Cascade Avenue sewer main is near the waterline. A significant waterline break may also compromise the sewer main. Such a scenario increases the public health risk through a potential hazardous cross contamination. A compromised sewer main on Cascade Avenue effects upstream sewerage since the Cascade Avenue sewer main receives flow from two pump stations.

Ensuring the sewer main in Cascade Avenue, the Cascade Interceptor, has adequate capacity is critical to the City's sewer system. *According to the 2017 GSP, the sanitary sewer main in Cascade Avenue is undersized for existing peak flows*. Surcharging is minimal and no overflows are predicted for existing conditions, but that may change as the system demand increases over time. Potential future development on the waterfront near Cascade Avenue would increase inflows to the existing sewer main, as will growth of contributing basins to the Kanaka and Cascade Pump Stations.

Exceeding capacity of the Cascade Interceptor will lead to overflows on Cascade Avenue, which may lead to overflows at the Kanaka and Cascade Pump Stations. These overflows pose a public health risk through direct contact at the street and diminished water quality in receiving water bodies. Beyond a potential overflow at the pump stations, regularly surcharging the force main outfall(s) can lead to premature failure of pumping systems. In addition, an unplanned outage of either station poses a health risk to customers within sewer sub-basins served by the impacted station.

As the City approves development of waterfront property along Cascade Avenue, pedestrian use is expected to increase. This increase in pedestrian use is in addition to existing traffic drawn to Sailboard Park and the public boat launch located west of the park. The existing street illumination is minimal and poses a safety and security risk to pedestrians. The local populace has expressed concern with increased drug use along Cascade Avenue, so additional street lighting will help law enforcement observe inappropriate behavior and make people feel safer in their community.

3.2 Aging Infrastructure

The expected lifespan of AC pipe is, on average, up to 50 years. This lifespan is based on the varying degrees of quality of AC pipe produced in the 1960's. The water and sewer mains are nearing their expected lifespan and thereby due to be replaced.

3.3 Reasonable Growth

The 2017 GSP identified the sewer main in Cascade Avenue as exceeding 80 percent of full flow capacity for existing conditions and exceeding 100 percent in the 2040 planning period. Additional flow monitoring was completed by ADS Environmental Services in late January / early February 2023 within the manhole located at the intersection of Russell Avenue and Cascade Avenue. The maximum flow measured over the two-week period was 0.54 MGD, corresponding to nearly 100 percent capacity of the main.

City standards state that all new sewer lines shall be designed so that under buildout peak flow, including I/I, 50% capacity of the line will not be exceeded. Modeling of the sewer main indicated that upsizing to a 12-inch would increase capacity enough to handle the 2040 planning period peak flows at a pipe capacity of less than 50%.

The 2017 WSP does not identify the 8-inch water main in Cascade Avenue as being undersized. Even with development expected to increase in the area surrounding Cascade Avenue, capacity of the current water main size will be sufficient. Therefore, the proposed replacement main will remain 8-inches in diameter.

Pedestrian traffic is expected to increase along Cascade Avenue so more lighting is necessary for security.

Section 4 Alternatives Considered

4.1 Alternative 1 – Sewer Replacement Only

4.1.1 Description

This alternative involves replacing only the sewer main in Cascade Avenue, from the intersection with Russell Avenue east to approximately 450-feet past the intersection with Leavens Street. Referencing the sewer system landmarks, the replacement is from manhole C1-13 to manhole C1-15, for an approximate length of 920 feet. The sewer main would be upsized to 12-inch pipe to provide increased capacity for current and projected future flows.

4.1.2 Design Criteria

Design criteria are based on the City of Stevenson Engineering Standards for Public Works Construction. Section 4.01 establishes planning criteria utilized for sewer design. New sewer mains shall be sized to not exceed 50 percent of the full-flow capacity under ultimate development peak flow. Less stringent standards apply to existing sewer mains, where peak flows shall not exceed 75% of the pipe capacity. The GSP established a benchmark of 80% capacity as a threshold for determining the need for replacement on a capacity basis. Modeling of the sewer system performed for the GSP indicates that the 8-inch main on Cascade Avenue exceeds 100 percent of full capacity at peak-hour flows. Based on existing and approximated future flows, the GSP identified the sewer main should be upsized to 12-inch diameter to satisfy the City's design criteria.

4.1.3 Map

A map of the project boundaries is shown in **Figure 4-1**.

Figure 4-1: Alternative 1 Project Boundaries

4.1.4 Environmental Impacts

Replacing the sewer main greatly minimizes the risk of surcharging the sewer main or overflowing the manhole. Sewer surcharging can damage the pump stations that discharge to this collector. Surcharging also pressurizes the pipe which can lead to leaks or pipe failure. Each of these potential scenarios may lead to diminished surface water quality in Kanaka Creek or the Columbia River. Replacing the sewer main reduces the likelihood of these outcomes.

Replacing only the sewer main in Cascade Avenue may lead to a break in the adjacent water main. The existing water main is AC pipe, which is more brittle and prone to breakage compared to ductile iron or PVC. A main break may result in a sink hole that would compromise other utilities, including sewer. Breaks, or even leaks in the water main would result in water loss and waste the energy used to deliver the water.

The contractor will be responsible for preparing and implementing a temporary erosion and sediment control (TESC) plan. Implementation of best management practices (BMP) within the approved TESC plan will limit the migration of sediment into the stormwater system.

4.1.5 Land Requirements

All improvements are to occur within the public ROW. The City would prefer to keep improvements to one side of the road to minimize impacts during construction and reduce construction cost.

4.1.6 Potential Construction Problems

Improvements within the roadway will involve heavy construction equipment and compaction for surface restoration. Any improvements in proximity to the water main may cause a break and disrupt water service to nearby residents and commercial businesses.

Dewatering is a potential concern for the sewer main due to proximity to the Columbia River. The contract documents would require the contractor to submit a dewatering plan as necessary.

4.1.7 Cost Estimate

The estimated cost for replacing only the sewer main in Cascade Avenue is shown in **Table 4-1**.

Table 4-1: Sewer Only Replacement Cost Estimate

Description	Cost	Notes
Construction Costs		
Mobilization/TESC	$51,000	
Utilities	$365,000	
Surface Restoration	$134,000	Road restoration & irrigation
Total Construction Costs	**$550,000**	Includes contractor overhead
Non-Construction Costs		
Land Acquisition	$0	All work within public ROW
Professional Services	$185,000	
Construction Contingency	$147,000	20% of construction & non-construction costs
Total Non-Construction Costs	**$332,000**	
Annual O&M Costs		
Operator Labor	$300	Routine inspections and maintenance
Equipment	$400	TV inspections, line jetting
Short-Lived Assets	$150	Allowance for periodic MH cover replacement
Total Annual O&M Costs	**$850**	

The construction estimate assumes the road restoration will be limited to trench patching only. An allowance for domestic iron and steel purchase in accordance with the Build America, Buy America (BABA) Act is included, although the amount of iron and steel for this project is very limited. Annual operations and maintenance (O&M) costs are primarily for TV inspections or line jetting on an approximate 3-year interval; these costs are pro-rated for an annual budget number. Manhole covers are listed as short-lived assets for periodic replacement, most commonly due to theft for scrap metal recycling.

4.2 Alternative 2 - Sewer and Water Replacement

4.2.1 Description

This alternative consists of replacing both the water and sewer main in Cascade Avenue, from Russell Avenue to approximately 450-feet east Leavens Street. Approximately 920-feet of sewer main would be upsized to 12-inch pipe to allow for higher capacity from manhole C1-13 to manhole C1-15. The water main would remain the same size at 8-inch diameter pipe. The water main would be replaced within the same corridor as the sewer main, with an approximate total length of 920 feet.

4.2.2 Design Criteria

Sewer

Design criteria are based on the City of Stevenson Engineering Standards for Public Works Construction. Section 4.01 establishes planning criteria utilized for sewer design. New sewer mains shall be sized to not exceed 50 percent of the full-flow capacity under ultimate development peak flow. Less stringent standards apply to existing sewer mains, where peak flows shall not exceed 75% of the pipe capacity. The GSP established a benchmark of 80% capacity as a threshold for determining the need for replacement on a capacity basis. Modeling of the sewer system performed for the GSP indicates that the 8-inch main on Cascade Avenue exceeds 100 percent of full capacity at peak-hour flows. Based on existing and approximated future flows, the GSP identified the sewer main should be upsized to 12-inch diameter to satisfy the City's design criteria.

Water

Design criteria for water mains include the following from the DOH Water System Design Manual:

- Capacity to deliver Peak Hour Demand (PHD) at 30 psi measured at any existing water service meters (Sections 6.2.2 and 6.2.5).
- Provide Maximum Day Demand (MDD) plus required fire flow while retaining a minimum 20 psi residual pressure at any point in the distribution system (Sections 6.2.2 and 6.2.5).
- Pipeline velocities should not be greater than 8 feet per second (fps) under PHD conditions (Section 6.2.6).

The water system's hydraulic model was used to evaluate the distribution system under current and future demands. The existing water main capacity was found to be sufficient for the planning period.

4.2.3 Map

A map of the project boundaries is shown in **Figure 4-2**. The boundaries of this alternative are identical to Alternative 1.

Figure 4-2: Alternative 2 Project Boundaries

4.2.4 Environmental Impacts

There are no adverse environmental impacts anticipated for this alternative. The contractor will be required to implement stormwater BMP's to prevent sedimentation of the stormwater system.

4.2.5 Land Requirements

All improvements are to occur within the public ROW. The City would prefer to keep improvements to one side of the road to minimize impacts during construction and reduce construction costs.

4.2.6 Potential Construction Problems

Dewatering is a potential concern for the sewer main due to proximity to the Columbia River. The contract documents would require the contractor to submit a dewatering plan as necessary.

4.2.7 Cost Estimate

Project cost estimates for the sewer main and waterline improvements described in this section are presented in **Table 4-2**.

Table 4-2: Sewer and Water Main Replacement Cost Estimate

Description	Cost	Notes
Construction Costs		
Mobilization/TESC	$102,000	
Utilities	$783,000	Includes allowance for domestic material
Surface Restoration	$218,000	Road restoration & irrigation
Total Construction Costs	**$1,103,000**	Includes contractor overhead
Non-Construction Costs		
Land Acquisition / Lease	$0	All work within public ROW
Professional Services	$245,000	
Construction Contingency	$269,600	20% of construction & non-construction costs
Total Non-Construction Costs	**$514,600**	
Annual O&M Costs		
Sewer Operator Labor	$300	Routine inspections and maintenance
Sewer Short-Lived Assets	$150	Allowance for periodic MH cover replacement
Water Operator Labor	$520	Hydrant repair, meter replacement, misc
Water Short-Lived Assets	$420	Hydrant rebuild, meter replacement
Equipment	$700	TV inspections, line jetting, service truck
Total Annual O&M Costs	**$2,090**	

The construction estimate assumes the road restoration will be roughly a half-street replacement with both utility trenches. An allowance for material procurement in accordance with the BABA Act is included, however, it predominantly impacts the waterline replacement. Annual O&M costs for sewer are the same as those presented in **Section 4.1.7**. O&M costs for the waterline are associated with periodic repair or rebuild of hydrants and meter replacement on an approximate 20-year cycle.

4.3 Alternative 3 – Sewer and Expanded Water Replacement

4.3.1 Description

This alternative includes the same sewer and water main replacement described in Alternative 2, however, it also includes expanding the waterline replacement approximately 430-feet further east from Leavens Street toward Sailboard Park. Approximately 920-feet of sewer main would be upsized to 12-inch pipe to allow for higher capacity from manhole C1-13 to manhole C1-15. Approximately 1,350-feet of 8-inch diameter waterline would be installed in Cascade Avenue from the intersection with Russell Avenue to the public boat launch. The expanded waterline would replace an existing AC main that is currently in operation, but near the end of its design life.

4.3.2 Design Criteria

Sewer

Design criteria are based on the City of Stevenson Engineering Standards for Public Works Construction. Section 4.01 establishes planning criteria utilized for sewer design. New sewer mains shall be sized to not exceed 50 percent of the full-flow capacity under ultimate development peak flow. Less stringent standards apply to existing sewer mains, where peak flows shall not exceed 75% of the pipe capacity. The GSP established a benchmark of 80% capacity as a threshold for determining the need for replacement on a capacity basis. Modeling of the sewer system performed for the GSP indicates that the 8-inch main on Cascade Avenue exceeds 100 percent of full capacity at peak-hour flows. Based on existing and approximated future flows, the GSP identified the sewer main should be upsized to 12-inch diameter pipe to stay below 80% capacity.

Water

Design criteria for water mains include the following from the DOH Water System Design Manual:

- Capacity to deliver Peak Hour Demand (PHD) at 30 psi measured at any existing water service meters (Sections 6.2.2 and 6.2.5).
- Provide Maximum Day Demand (MDD) plus required fire flow while retaining a minimum 20 psi residual pressure at any point in the distribution system (Sections 6.2.2 and 6.2.5).
- Pipeline velocities should not be greater than 8 feet per second (fps) under PHD conditions (Section 6.2.6).

The water system's hydraulic model was used to evaluate the distribution system under current and future demands. The existing water main capacity was found to be sufficient for the planning period.

4.3.3 Map

A map of the project boundaries is shown in **Figure 4-3**.

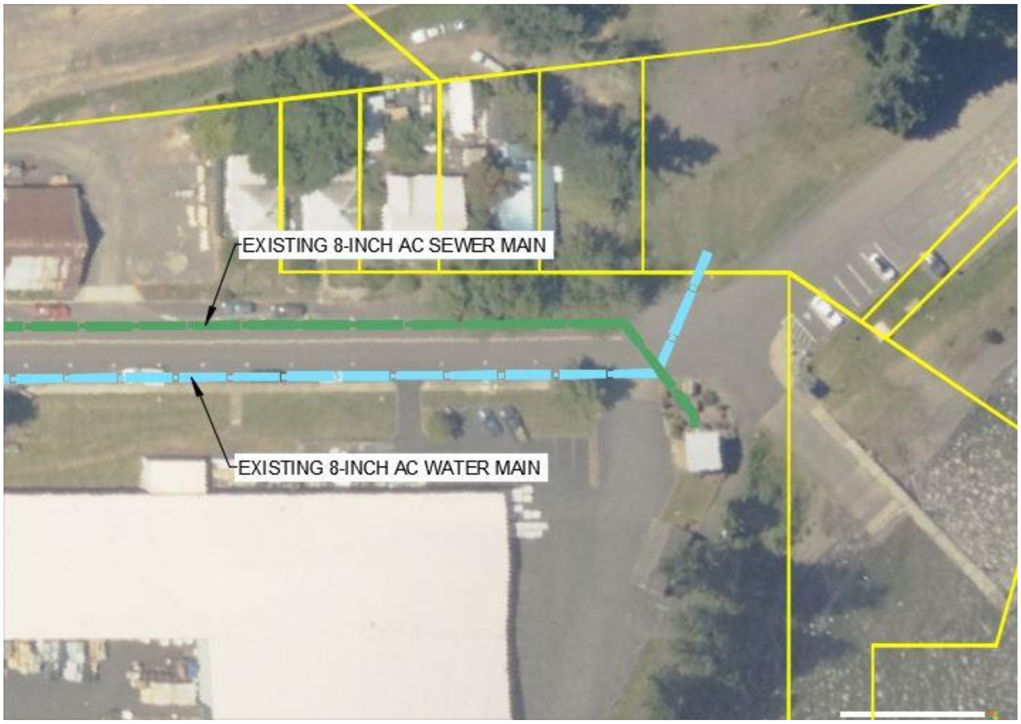


Figure 4-3: Alternative 3 Project Boundaries

4.3.4 Environmental Impacts

There are no adverse environmental impacts anticipated for this alternative. The contractor will be required to implement stormwater BMPs to prevent sedimentation of the stormwater system.

4.3.5 Land Requirements

All improvements are to occur within the public ROW. The City would prefer to keep improvements to one side of the road to minimize impacts during construction and reduce construction costs.

4.3.6 Potential Construction Problems

Dewatering is a potential concern for the sewer main due to proximity to the Columbia River. The contract documents would require the contractor to submit a dewatering plan as necessary.

4.3.7 Cost Estimate

Project cost estimates for the sewer main and waterline improvements described in this section are presented in **Table 4-3**.

Table 4-3: Sewer and Expanded Water Main Replacement Cost Estimate

Description	Cost	Notes
Construction Costs		
Mobilization/TESC	$120,000	
Utilities	$947,000	Includes allowance for domestic material
Surface Restoration	$254,000	Road restoration & irrigation
Total Construction Costs	**$1,321,000**	Includes contractor overhead
Non-Construction Costs		
Land Acquisition / Lease	$0	All work within public ROW
Professional Services	$270,000	
Construction Contingency	$318,200	20% of construction & non-construction costs
Total Non-Construction Costs	**$588,200**	
Annual O&M Costs		
Sewer Operator Labor	$300	Routine inspections and maintenance
Sewer Short-Lived Assets	$150	Allowance for periodic MH cover replacement
Water Operator Labor	$580	Hydrant repair, meter replacement, misc
Water Short-Lived Assets	$570	Hydrant rebuild, meter replacement
Equipment	$800	TV inspections, line jetting, service truck
Total Annual O&M Costs	**$2,400**	

The construction estimate assumes the road restoration will be roughly a half-street replacement with both utility trenches. An allowance for material procurement in accordance with the BABA Act is included, however, it predominantly impacts the waterline replacement. Annual O&M costs for sewer are the same as those presented in **Table 4-2**. Waterline O&M costs are slightly higher than those listed in **Section 4.2.7** due to the increased assets requiring maintenance.

4.4 Alternative 4 – Include Supplemental Lighting to Utility Improvements

4.4.1 Description

This alternative would provide additional LED street lighting to Cascade Avenue for pedestrian safety. The alternative would be supplemental to one of the previously described Alternatives 1 through 3.

4.4.2 Design Criteria

Design and installation of additional lighting would be in accordance with the standards of Skamania Public Utility District #1 (PUD) and the National Electrical Code.

4.4.3 Map

A map of the project alignment is shown in **Figure 4-4**. Streetlamp locations are marked in red and are approximately 85 feet apart.

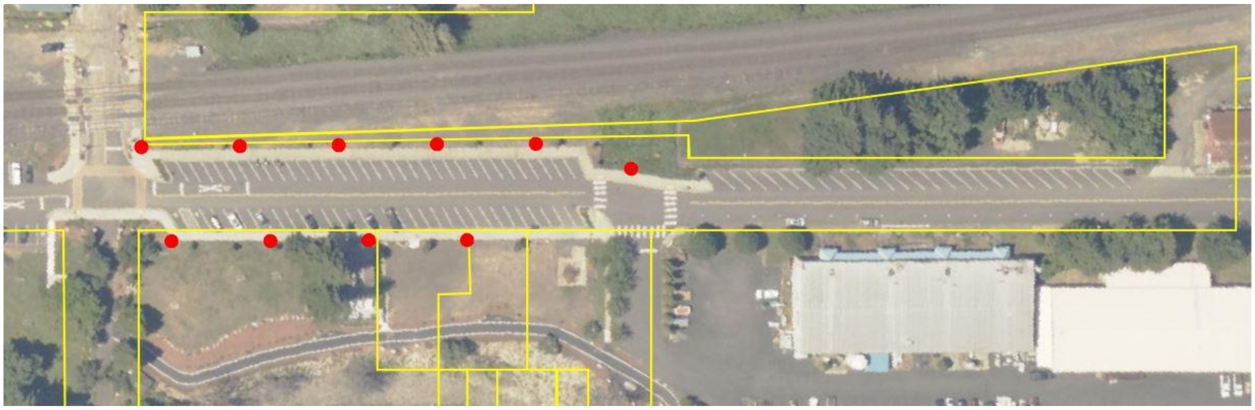


Figure 4-4: Alternative 4 Alignment

4.4.4 Environmental Impacts

This alternative would increase energy consumption. Increased load on the electrical grid is mitigated through the proposed use of LED lighting.

In regard to construction, the contractor will be required to implement stormwater BMPs to prevent sedimentation of the stormwater system during installation of the improvements.

4.4.5 Land Requirements

All improvements are to occur within the public ROW. The City would prefer to keep improvements to one side of the road to minimize impacts during construction and reduce construction costs.

4.4.6 Potential Construction Problems

The existing power is supplied through underground conduit, which eliminates risks associated with working on aerial power within the public ROW. There are not any significant construction problems anticipated for this proposed project.

4.4.7 Cost Estimate

The cost estimate for providing supplemental lighting to Cascade Avenue as an added project scope to the utility replacement is listed in **Table 4-4**.

Table 4-4: Supplemental Lighting Cost Estimate

Description	Cost	Notes
Construction Costs		
Mobilization/TESC	$18,000	Supplemental to utilities bid
Lighting Improvements	$164,000	
Surface Restoration	$22,000	
Total Construction Costs	**$204,000**	Includes contractor overhead
Non-Construction Costs		
Land Acquisition / Lease	$0	All work within public ROW
Professional Services	$70,000	
Construction Contingency	$54,800	20% of construction & non-construction costs
Total Non-Construction Costs	**$124,800**	
Annual O&M Costs		
Labor	$200	Electrician, routine maintenance
Short-Lived Assets	$100	Light replacement every 10 years
Equipment	$400	Bucket truck for light replacement
Total Annual O&M Costs	**$650**	

The construction estimate assumes this effort is an element to one of the utility improvements described in Alternatives 1 through 3. The lighting improvements would be performed under the direction of the PUD.

4.5 Other Alternatives

This subsection summarizes other options that were evaluated but ultimately not deemed feasible.

4.5.1 Install 8-Inch Sewer Parallel to Existing

Theoretically, additional sewer capacity could be obtained by installing a second 8-inch diameter gravity main. The majority of flow to this section of sewer main is received by the Kanaka Pump Station. A flow splitting manhole would be required to balance the flow between the two mains. This arrangement would increase operations and maintenance cost and potentially compromise reliability. The incremental cost to upsize the second main to 12-inch diameter is relatively small and would be exceeded by the added cost of installing a flow splitting manhole and additional piping. This alternative was not deemed a practical option.

4.5.2 No Improvements to Existing Utilities

The sewer main in Cascade Avenue is not experiencing any overflows and minimal surcharge under existing conditions. However, development activity would result in the gravity sewer main experiencing surcharge at a greater frequency and an increased likelihood of an overflow event.

The water main has not experienced any large breaks or leaks to City knowledge. It is an option to delay replacements until failure occurs. However, the existing main material type (AC) and age (~60 years) increase the likelihood of a main break during the construction of the new sewer main or at some point in the near future. A main break at this location could cause a sink hole that would compromise other utilities, including the sewer main.

This option is not deemed feasible due to the associated environmental and public health risks.

Section 5 Selection of an Alternative

5.1 Life Cycle Cost Analysis

The life cycle cost for each of the feasible alternatives are shown in **Table 5-1** below. The planning period utilized is 40 years. An interest rate of 0.5% was used to calculate present value. Total capital costs are the sum of estimated construction and non-construction costs presented for each alternative in **Section 4**.

Table 5-1: Life Cycle Costs for Presented Alternatives

Alternative	Total Capital Cost	Annual O&M	Net Present Value
Sewer Replacement Only	$882,000	$850	$912,747
Sewer and Water Replacement	$1,617,600	$2,090	$1,693,200
Sewer and Expanded Water Repl.	$1,909,200	$2,400	$1,996,014
Supplemental Lighting	$328,800	$700	$354,121

The sewer replacement only alternative does not consider the costs associated with delayed installation of the water main. These costs for delayed waterline installation would include emergency pipe repairs, surface restoration, and potentially expediting waterline replacement at that point in time. Given the extent of unknowns, these costs were not quantified.

The sewer and water replacement covers utility improvements from Russell Avenue to Leavens Street.

The sewer and expanded water replacement includes additional waterline replacement from Leavens Street, east toward Sailboard Park.

The supplemental lighting alternative is the cost for including lighting improvements to one of the three base utility improvement alternatives.

5.2 Non-Monetary Factors

Non-monetary factors are considered for the sewer replacement alternative, the sewer and water replacement alternative, and supplemental lighting alternative.

5.2.1 Sewer Replacement Only

The predominant non-monetary factors of this alternative are potential environmental impacts of a water main break and extended construction on Cascade Avenue.

As discussed previously, heavy construction in the vicinity of the aging AC water main may cause breakage or increased leakage of the pipe. Failure of this pipe has the potential to disrupt service and compromise other utilities.

If only the sewer main is replaced as part of this project, the water main will still need to be replaced in the near future. A future water main replacement would mean repeated construction on Cascade

Avenue and disruption to local traffic and users of the waterfront area. The waterfront area is popular in warmer months for recreation activities so extended construction in the roadway would not be preferred.

5.2.2 Sewer and Water Replacement

Replacing both the water and sewer main in Cascade Avenue would mitigate the aforementioned environmental impacts. Water main breaks are less likely as construction sequencing typically allows for the water main to be replaced before the sewer main. Replacement of the water and sewer mains would not be required again until the pipe has reached the end of its life, reducing construction related to public utilities on Cascade Avenue.

5.2.3 Supplemental Lighting

Increasing street lighting would improve pedestrian safety along Cascade Avenue. The City performed street improvements in 2015 to improve access and parking through this corridor. Additional development along the waterfront, coupled with the proximity of Sailboard Park and the adjacent Cascade Boat Launch, make this area a local draw for the community and tourism. Enhancing street lighting should help improve security for those visitors.

5.3 Selected Alternatives Summary

Alternative 3 and Alternative 4 are the preferred alternatives. Alternative 3 replaces approximately 920-feet of sewer main from Russell Avenue and extending east past Leavens Street, and it replaces approximately 1,350-feet of waterline from Russell Avenue to Sailboard Park. Alternative 4 provides additional street lighting along Cascade Avenue.

Replacement of the sewer main is necessary from a public health standpoint. Replacing the waterline from Russell Avenue to Sailboard Park would eliminate the uncertainty of operating an aging AC main. There is concern the existing AC main will compromise the new gravity sewer main, existing force main, or the Kanaka Pump Station if left in operation. Significant health and cost implications are associated with catastrophic failure of the AC main. Proactive replacement, prior to such failure, is prudent given the existing waterline material age and type.

Selection of Alternative 4, supplemental lighting, is desired for the non-monetary factors. The City desires this section of waterfront to be a destination for the community and tourism. Enhancing the safety of this corridor will support that endeavor.

Section 6 Proposed Project (Recommended Alternative)

6.1 Preliminary Project Design

6.1.1 Water

Water replacement consists of replacing 1,350 feet of 8-inch AC pipe with new 8-inch Ductile Iron (DI) pipe, with new hydrants and appurtenances. The design will include connections to the existing system at the intersections with Russell Avenue and Leavens Street. The dead-end line east of Leavens Street is sized to be 8-inch diameter to accommodate a fire hydrant for fire suppression and flushing. Design will also include stub-outs to vacant waterfront properties in preparation for future development and relocating fire hydrants to be outside of sidewalk boundaries as necessary.

6.1.2 Sewer

Sewer replacement consists of upsizing 920 feet of 8-inch pipe with new 12-inch pipe between manholes C-13 and C-15. The 6-inch Kanaka Pump Station force main will need to be replumbed to discharge into the new main. Design will also include stub-outs to vacant waterfront properties in preparation for future development.

6.1.3 Electrical

Six streetlamps will be placed along the north side of the road and four on the south side, in between the back of sidewalk and edge of ROW. The streetlamps will match the style of those located on 2nd street with an approximate separation of 80 feet.

6.1.4 Surface Restoration

The intent is for surface restoration to be kept to one lane to minimize cost and traffic interruptions. Final design will determine the feasibility of limiting disturbance to a single lane based on the location of other utilities and roadway geometry. Final design will also include any necessary regrading of the roadway to prevent standing water due to lack of drainage.

6.2 Project Schedule

Table 6-1: Project Schedule

Task	Begin	End
Engineering Design	May 2023	December 2023
Permitting	September 2023	December 2023
Bidding and Contract Award	January 2024	February 2024
Construction	March 2024	December 2024

6.3 Permit Requirements

It is anticipated that a State Environmental Policy Act (SEPA) review will be needed to satisfy funding requirement criteria.

6.4 Total Project Cost Estimate (Engineer's Opinion of Probable Cost)

The total estimated recommended project cost estimate is summarized below; all costs are rounded to the nearest dollar. The construction cost estimate includes an allowance for material procurement in accordance with the BABA Act. A 20% contingency and land acquisition costs are included in the non-construction costs.

Total Capital Cost: $2,120,400 (construction & non-construction)

Total 50-Year Life Cycle Present Worth Cost: $2,231,810

The present worth cost comprises of the following three components:

- Construction Costs: $1,432,000
- Non-Construction Costs: $688,400
- 50-Year Life Cycle Present Worth O&M Costs: $111,410

The O&M costs include an allowance for short-lived assets. Those assets and the estimated replacement pro-rated annual costs for the noted life cycle are shown in **Table 6-2** below.

Table 6-2: Short Lived Asset Summary

Description	Cost	Notes
Sewer manhole covers	$150	10-year cycle
Hydrant repair / rebuild	$300	10-year cycle
Valve box covers	$45	10-year cycle
Water meter replacement	$225	20-year cycle
LED light replacement	$100	10-year cycle

Castings for sewer manhole and valve box covers are budgeted for replacement every 10-years. This replacement cycle accounts for breakage from overloading and theft. Theft of municipal castings for scrap recycling has increased in recent years.

Hydrant repair or rebuilds are budgeted for 10-year cycles. This allowance for replacing internal components that may compromise flow or prevent proper sealing when the hydrant is not in use. Quick operation of hydrants and overtightening are common factors that affect internal components.

Water meter replacement is scheduled for 20-year cycles. Meter registering can slow down with age, which leads to lost revenue.

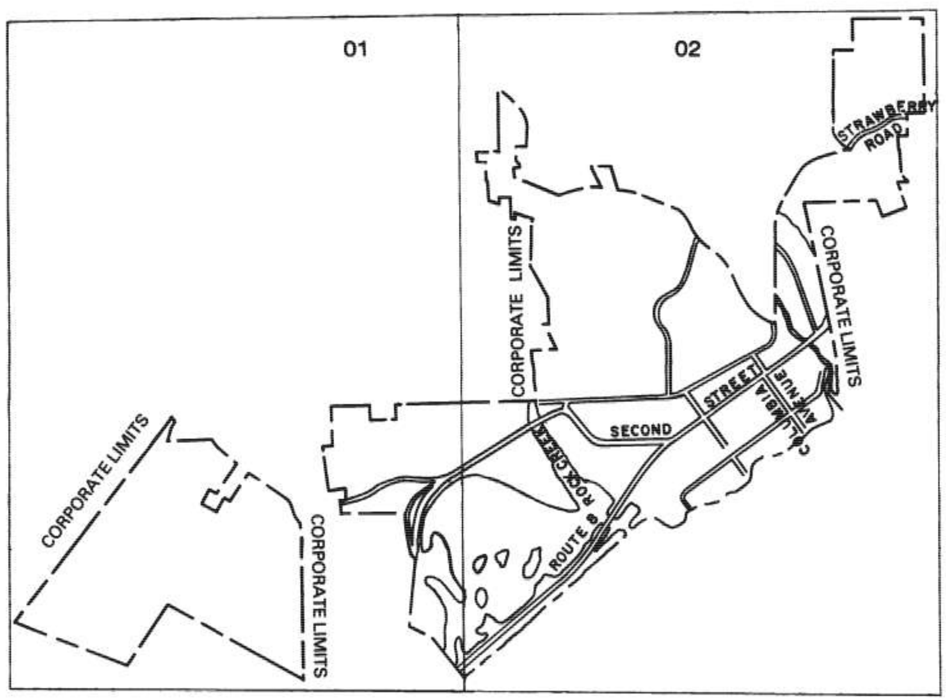
LED streetlights have an expected lifespan of 10 to 15 years. Lighting replacement is budgeted on the conservative end of the estimated range.

6.5 Annual Operating Budget

Refer to **Appendix C** for the most recent financial audit.

Appendix A

Environmental Resource Figures



KEY TO MAP

Zone Designations	ZONE C ZONE A ZONE C
Elevation Reference Mark	RM7x
Zone D Boundary	—— ——
River Mile	•M1.5

EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood.
C	Areas of minimal flooding.
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.

NOTES TO USER

INITIAL IDENTIFICATION:
APRIL 23, 1976

FLOOD HAZARD BOUNDARY MAP REVISIONS:
NONE

FLOOD INSURANCE RATE MAP EFFECTIVE:
JULY 17, 1986

FLOOD INSURANCE RATE MAP REVISIONS:
NONE

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

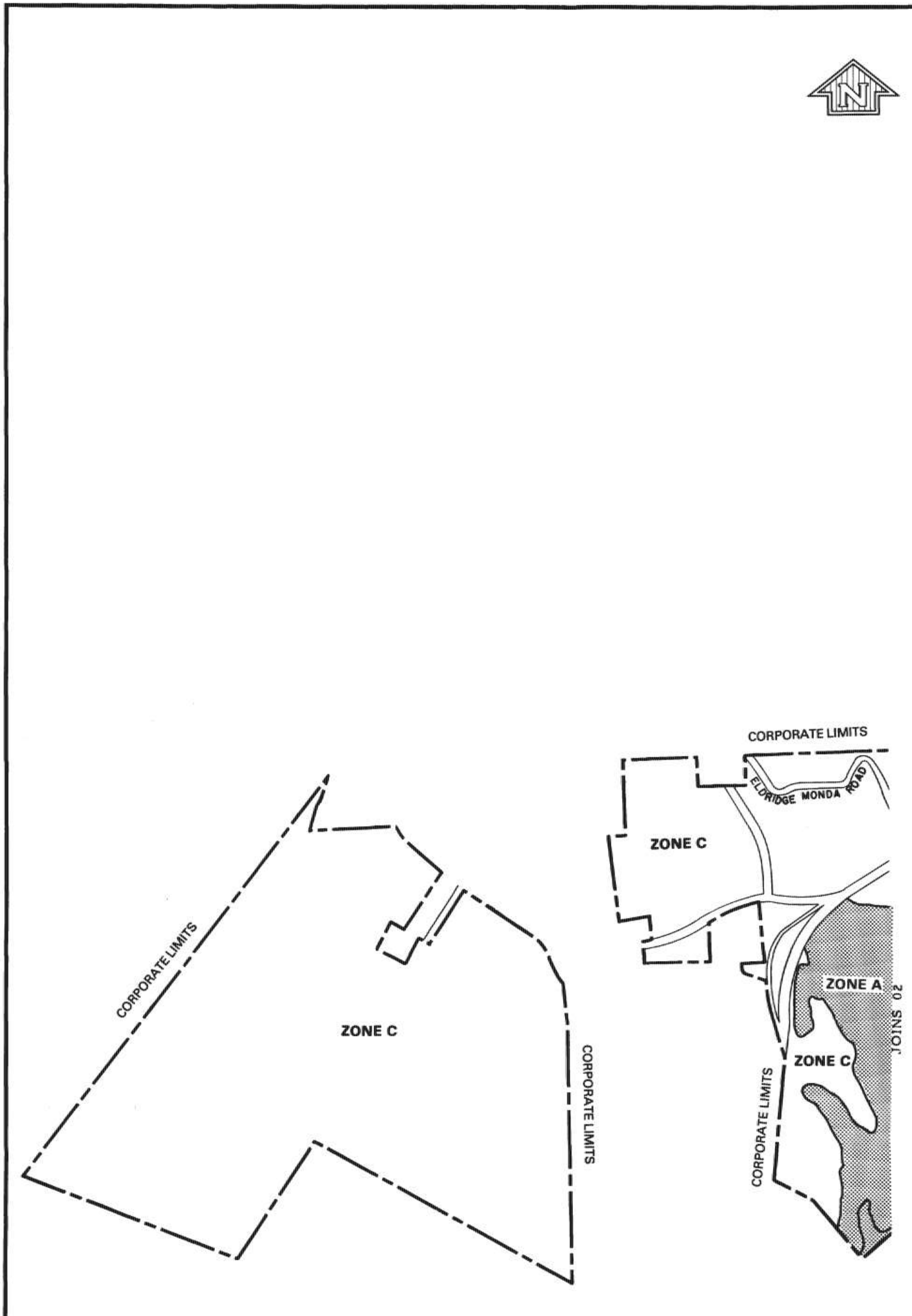
FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD INSURANCE RATE MAP
PANEL(S) 01-02

MAP INDEX

CITY OF STEVENSON, WA
(SKAMANIA CO.)

COMMUNITY NO. 530161 A



FEDERAL EMERGENCY MANAGEMENT AGENCY

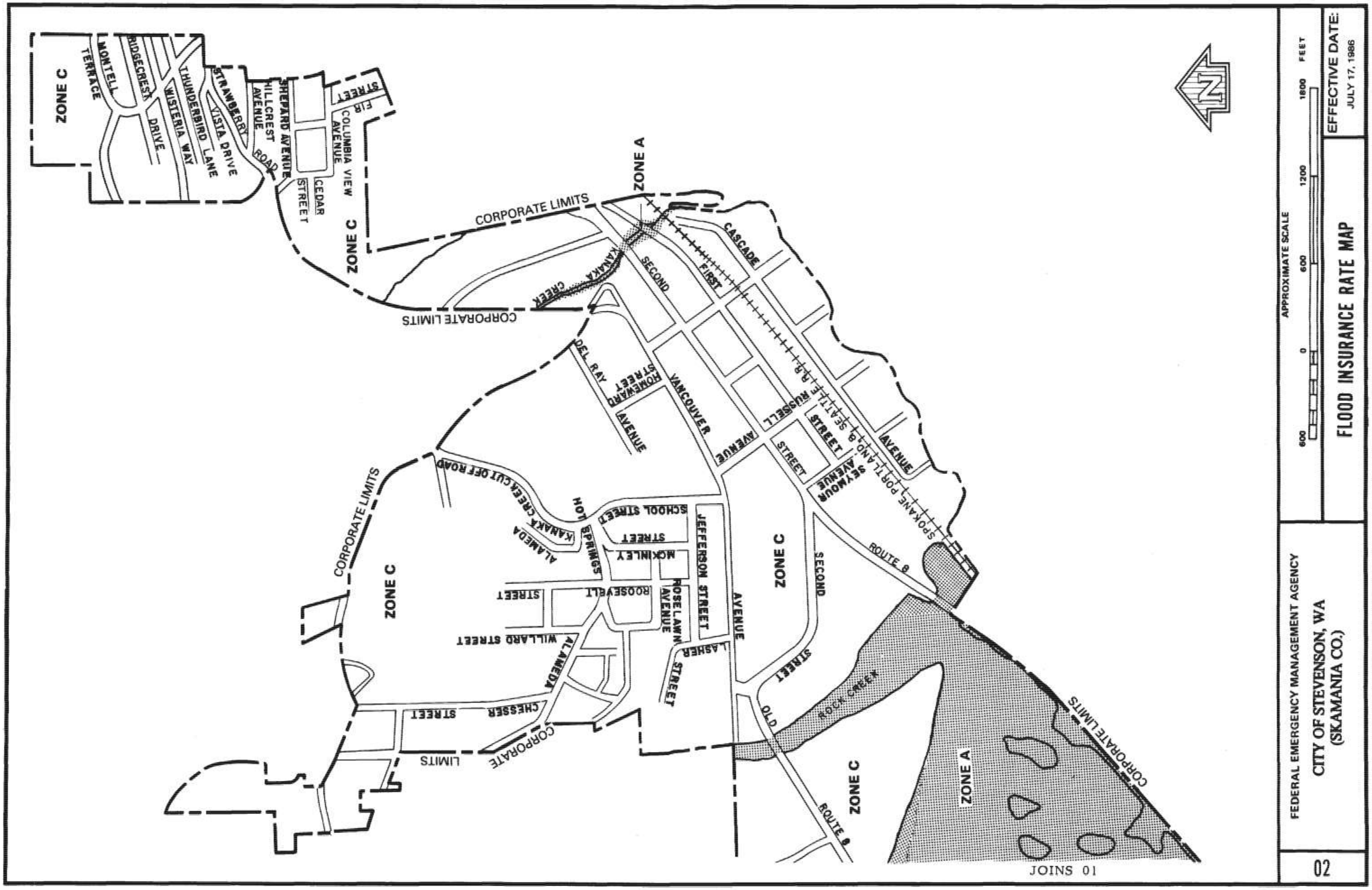
CITY OF STEVENSON, WA
(SKAMANIA CO.)

APPROXIMATE SCALE

600 0 600 1200 1800 FEET

FLOOD INSURANCE RATE MAP

EFFECTIVE DATE:
JULY 17, 1986


FEDERAL EMERGENCY MANAGEMENT AGENCY
CITY OF STEVENSON, WA
(SKAMANIA CO.)
FLOOD INSURANCE RATE MAP
EFFECTIVE DATE:
JULY 17, 1986
APPROXIMATE SCALE
600 0 600 1200 1800 FEET
02
JOINS 01
ZONE A
ZONE C
CORPORATE LIMITS
ROUTE 8
ROCK CREEK
KANAKA CREEK
SPOKANE PORTLAND & SEATTLE R.R.
CASCADE AVENUE
FIRST STREET
SECOND STREET
RUSSELL AVENUE
SEYMOUR AVENUE
VANCOUVER AVENUE
HOMEWARD STREET
DEL RAY AVENUE
SCHOOL STREET
HOT SPRINGS
MCKINLEY STREET
ROOSEVELT STREET
WILLARD STREET
ALAMEDA
CHESSER STREET
JEFFERSON STREET
ROSELAWN AVENUE
LASHER STREET
OLD
KANAKA CREEK CUT OFF ROAD
COLUMBIA VIEW AVENUE
CEDAR STREET
FIR STREET
SHEPARD AVENUE
HILLCREST AVENUE
ROAD
STRAWBERRY
VISTA DRIVE
THUNDERBIRD LANE
WISTERIA WAY
RIDGECREST DRIVE
MONTELL TERRACE

U.S. Fish and Wildlife Service

National Wetlands Inventory

Surface Water and Wetlands Inventory

January 25, 2023

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

Appendix B

Sewer Population Benchmarks Memo

City of Stevenson
Planning Department

(509)427-5970

7121 E Loop Road, PO Box 371
Stevenson, Washington 98648

TO:	**Gordon Monro, PE Tetra Tech**
CC:	**Eric Hansen, Stevenson Public Works Director**
FROM:	**Ben Shumaker**
DATE:	**March 22nd, 2016**
SUBJECT:	**Sewer Population Benchmarks/Projections**

Introduction

This memo provides a range of population benchmark scenarios that can be used in the design of the Sewer Department's collection system and the sizing of infrastructure at the Waste Water Treatment Plant. The scenarios are based on observed population trends, a range of future projections, and the objectives of the City's land use and development plans.

Population Growth

Observed Population Growth

The information used in this memo is derived from the United State Census Bureau, the Washington Office of Financial Management, and calculations by the Stevenson Planning Department. The US Census Bureau data are based on the decennial census, or 10-year full population count, which collects data from all residents and reports the raw findings with limited room for error. The decennial nature of this effort leaves us with outdated or "stale" data in the 10 year interim between censuses. Seeking to overcome the limitations of the federally-provided Census information, the Washington State Office of Financial Management (OFM) collects annual population counts from officials in each city and county in the state. This annually reported information does not become stale, but does only provide an estimated headcount of the population and is subject to errors of estimation.

Projected Population Growth

Using the above information sources, the Planning Department developed population projections using the linear progression method. The Low, Mid-range, and High population levels for 2040 were based on the following three assumptions 1) that historic growth rates (0.87% for City & 1.14% for County) will be maintained into the future, 2) that annual growth rates will hold steady at 1%, and 3) that annual growth rates will increase to 2.5%. The following table shows the results of this projection method and compares it to the projections developed by OFM using the "Cohort-Component" method of projection for counties.

	2040-Low	2040-Mid-Range	2040-High
Stevenson	1,901	1,962	2,837
Skamania County	14,679	16,676	21,191
Skamania County (OFM)	11,505	13,082	15,509

Words of Caution

- Predicting the future is impossible.
- Since standard prediction methods were modeled on large places, they do not easily transfer to small jurisdictions like Stevenson.
- The projection is not intended to predict annual growth for each year within the 25-year period. Annual growth rates may vary widely in individual years.
- These projections are predictions of future population growth, not policy goals for how much growth is desired.
- Decisions made with this sewer plan and its implementation will influence future population growth rates.
- Innumerable external factors will also influence future population growth rates.

To overcome the inherent limitations of this information, the Planning Department recommends treating these projections as benchmarks of population growth on the way to full build-out. Doing so will require continual monitoring of population growth and sewer connection data as it becomes available. Informed decisions can then be made to ensure the City's financial commitments for the sewer collection and treatment system are made in sustainable ways for the rate payers.

Housing Growth

The following information assists in forming population benchmarks for sewer planning purposes. The information here is also derived from the US Census Bureau, OFM, and the Planning Department. To simplify the discussion, only the Low and High population projections are used.

	Current	2020		2040		Full
	Density	**Low**	**High**	**Low**	**High**	**Build-Out**
Population	1,530	1,598	1,731	1,901	2,837	4,772
Household Size	2.10	2.17	2.17	2.13	2.13	2.16
Housing Units	730	735	797	893	1,333	2,211
Density (per sq mi)	1,005.21	980.24	980.24	983.57	983.57	979.86
Land Base (sq mi)	1.52	1.52	1.77	1.93	2.88	4.87

Limitations

The above information contains no detailed information on commercial and industrial area growth and assumes that the current proportion of land uses will continue into the future. This assumption is not based on any underlying information. This information also contains no information on the population, housing, and density of existing sewered areas versus unsewered areas. Without that information, the resulting projections assumes densities will continue according to the current proportion of these areas. Specific information is not immediately available to the Planning Department, but its collection and analysis may be possible and would help bridge a gap between the City's capital improvement and land use plans.

City Policies

In addition to regional population trends, the City Comprehensive and Capital Improvement plans and our land development ordinances will be factors in where, how, and how soon growth occurs in Stevenson. This memo addresses Comprehensive Plan objectives related to sewer provision.

Comprehensive Plan

Goal 2- Urban Development

2.2-6- Consider stream corridors for multiple use in conformance with other plans.

2.7-1- Consider designating areas not served by the public sewer and/or water systems as an "urban reserve" until such systems are made available.

2.8-Establish policies to review annexation proposals.

2.8-1 Prefer annexation of developed areas abutting the city.

2.9- Encourage the establishment of a subarea plan and land use regulations within the unincorporated Urban Area.

2.9-2- Discourage development within the unincorporated Urban Area until suitable land within the City has been developed.

2.9-3- Ensure the highest and best use of riverfront properties within the unincorporated Urban Area by protecting them from development and redevelopment until urban utilities and services can be provided.

2.10- Use the type, location, and phasing of public facilities as a factor to guide urban expansion.

2.10-1- Manage urbanization through the expansion of public infrastructure such as the sewer and water systems.

Goal 3- Housing

3.2- Encourage a range of residential land uses, housing sizes, types and price ranges and establish appropriate development criteria.

3.6- Review and carefully consider the immediate and long term effects of fees, charges, regulations, and standards on dwelling costs.

Goal 5- Business & Industry

5.1-2- Designate additional areas for various types of industrial activity as needs change and demand develops. The designations should ensure the viability of and compatibility with surrounding properties.

5.5- Facilitate and support provision of adequate utility, transportation, and communications infrastructure to meet the needs of Stevenson's business community.

5.8- Preserve lands designated for industrial use for that use, protect them from incompatible uses, and ensure access to good infrastructure.

5.8-1- Consider the feasibility and benefits of establishing industrial areas along Ryan Allen Road near the garbage transfer station.

Goal 8- Utilities & Services

8.2- Develop a long-range financial plan.

8.3- Periodically review and revise the capital facilities plan.

8.4- Identify and correct health and safety hazards within the Stevenson Urban Area.

8.5- Establish maintenance programs to preserve the long-term viability of the City's capital facilities.

8.6- Offset the cost of new development to existing city residents by establishing development charges.

8.8- Base the provision of future public facilities and utilities upon financial cost and adequacy of desired levels of service.

8.8-1- Consider providing public facilities and utilities in advance of need.

8.8-3- Continue to provide water and sewer services within the Urban Area.

8.9- Manage urbanization through the expansion of the sewer system.

8.9-1- Permit septic systems only when provision of sewer services is technically infeasible within the planning period.

8.9-2- Revise land development regulations to prohibit septic system installations in areas where provision of sewer service is feasible during the planning period.

8.10- Consider alterative waste disposal systems for difficult sites and to encourage conservation of water.

8.11- Coordinate the infrastructure improvement and maintenance projects of multiple utilities to reduce costs and disruptive impacts.

Scenarios

The attached 5 maps demonstrate the Planning Department's best guess at sewer trends necessary to serve several benchmarks in the City's urbanization. The maps begin with a full build-out scenario and work backward to consider different scenarios based on residential and trade-related (commercial/industrial) growth. These scenarios are not intended to be definitive and should be evaluated and reevaluated based on the evolving draft of the sewer plan.

Build-Out Benchmark

A 50-100 year benchmark, this scenario involves service to the entire Stevenson Urban Area. This scenario totals at least 4 pump stations and miles of sewer pipe.

Comprehensive Plan Future Land Use Benchmark

A 20-50 year benchmark, this scenario combines the efforts to the benchmarks that follow. The scenario assumes the First Falls View and Iman Cemetery areas will remain unsewered, as will other areas near Rock Creek, and the lower elevations of the eastern fringe. Miles of sewer pipe and at least two pump stations could be necessary to bring this scenario into reality.

New & Existing Residential

This benchmark could also occur in the 5-20 year time frame, and would add additional gravity collection systems to serve the Foster Creek Road/Ryan Allen Road areas, areas near upper maple way. A pump station is added for consideration if necessary to serve properties adjacent to the First Falls View and Iman Cemetery Loop roadways.

Existing Residential

Another 5-20 year benchmark, this scenario focuses on closing the gaps where the sewer collection system does not serve existing residential development. Sewer mains to serve areas between School Street and Bone Road would need to be extended as would service up Maple Way. Assuming the capacity at the Rock Creek pump station is available, no pump stations would be associated with this scenario.

Trade-Based Growth

A 5-20 year benchmark, this scenario would focus all sewer collection improvements on areas where the Future Land Use Map has designated future commercial and industrial growth. Achieving this scenario could require a pump station near the western waterfront properties which could collect waste from the "DeGroote Trust" properties on Mallicott Road and support intensive redevelopment of the former industrial waterfront properties. Another pump station would likely be needed to support industrial development of the properties to the east of the County's garbage transfer station which lie lower than the adjacent roadway and are separated from the Wastewater Treatment Plant by the Piper Road Landslide. Pressure mains and standard collection pipe would also be needed.

Prepared by,

Ben Shumaker
Planning Director

Appendix C

Financial Audit

Office of the Washington State Auditor
Pat McCarthy

Financial Statements Audit Report

City of Stevenson

For the period January 1, 2021 through December 31, 2021

Published December 22, 2022

Report No. 1031666

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Office of the Washington State Auditor
Pat McCarthy

December 22, 2022

Mayor and City Council
City of Stevenson
Stevenson, Washington

Report on Financial Statements

Please find attached our report on the City of Stevenson's financial statements.

We are issuing this report in order to provide information on the City's financial activities and condition.

Sincerely,

Pat McCarthy, State Auditor

Olympia, WA

Americans with Disabilities

In accordance with the Americans with Disabilities Act, we will make this document available in alternative formats. For more information, please contact our Office at (564) 999-0950, TDD Relay at (800) 833-6388, or email our webmaster at webmaster@sao.wa.gov.

Insurance Building, P.O. Box 40021 • Olympia, Washington 98504-0021 • (564) 999-0950 • Pat.McCarthy@sao.wa.gov

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City of Stevenson

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FAX (509) 427-8202
7121 E Loop Road, PO Box 371
Stevenson, Washington 98648

SUMMARY SCHEDULE OF PRIOR AUDIT FINDINGS

City of Stevenson
January 1, 2021 through December 31, 2021

This schedule presents the status of findings reported in prior audit periods.

Audit Period: 2020	**Report Ref. No.:** 1029079	**Finding Ref. No.:** 2020-001

Finding Caption:

The City did not have adequate internal controls to ensure accurate financial reporting on the Schedule of Expenditures of Federal Awards.

Background:

The City prepared a Schedule of Expenditures of Federal Awards (SEFA) to document the federal grant funding it spent during the year. The SEFA is required by the federal government and used to determine which federal programs require additional audit procedures. The City did not have a process in place to ensure only federal expenditures incurred during the year were reported on the schedule.

Status of Corrective Action: (check one)

☒ Fully Corrected ☐ Partially Corrected ☐ Not Corrected ☐ Finding is considered no longer valid

Corrective Action Taken:

Staff attended training in the fall of 2021 on federal award requirements and will continue to pursue additional trainings as they are offered to keep up to date on current requirements.

The city has created a master contract spreadsheet which contains information on funding sources, reimbursement percentage, amount reimbursed and other pertinent information. This document is then used to tie-out to the information on the contract within the financial software and the SEFA.

Each project also has a checklist within the file which tracks applicable contract requirements. It includes account set-up requirements for the financial software system, funding sources and reporting requirements. The foundation is set and we will continue to improve this tool and update as needed.

INDEPENDENT AUDITOR'S REPORT

Report on Internal Control over Financial Reporting and on Compliance and Other Matters Based on an Audit of Financial Statements Performed in Accordance with *Government Auditing Standards*

City of Stevenson
January 1, 2021 through December 31, 2021

Mayor and City Council
City of Stevenson
Stevenson, Washington

We have audited, in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States, the financial statements of the City of Stevenson, as of and for the year ended December 31, 2021, and the related notes to the financial statements, which collectively comprise the City's financial statements, and have issued our report thereon dated December 14, 2022.

We issued an unmodified opinion on the fair presentation of the City's financial statements in accordance with its regulatory basis of accounting. We issued an adverse opinion on the fair presentation with regard to accounting principles generally accepted in the United States of America (GAAP) because the financial statements are prepared by the City using accounting practices prescribed by state law and the State Auditor's *Budgeting, Accounting and Reporting System* (BARS) Manual described in Note 1, which is a basis of accounting other than GAAP. The effects on the financial statements of the variances between the basis of accounting described in Note 1 and accounting principles generally accepted in the United States of America, although not reasonably determinable, are presumed to be material.

REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING

In planning and performing our audit of the financial statements, we considered the City's internal control over financial reporting (internal control) as a basis for designing audit procedures that are appropriate in the circumstances for the purpose of expressing our opinions on the financial statements, but not for the purpose of expressing an opinion on the effectiveness of the City's internal control. Accordingly, we do not express an opinion on the effectiveness of the City's internal control.

A *deficiency in internal control* exists when the design or operation of a control does not allow management or employees, in the normal course of performing their assigned functions, to prevent, or detect and correct, misstatements on a timely basis. A *material weakness* is a deficiency, or a combination of deficiencies, in internal control such that there is a reasonable possibility that a material misstatement of the City's financial statements will not be prevented, or detected and corrected on a timely basis. A *significant deficiency* is a deficiency, or a combination of deficiencies, in internal control that is less severe than a material weakness, yet important enough to merit attention by those charged with governance.

Our consideration of internal control was for the limited purpose described above and was not designed to identify all deficiencies in internal control that might be material weaknesses or significant deficiencies. Given these limitations, during our audit we did not identify any deficiencies in internal control that we consider to be material weaknesses. However, material weaknesses or significant deficiencies may exist that were not identified.

REPORT ON COMPLIANCE AND OTHER MATTERS

As part of obtaining reasonable assurance about whether the City's financial statements are free from material misstatement, we performed tests of its compliance with certain provisions of laws, regulations, contracts and grant agreements, noncompliance with which could have a direct and material effect on the financial statements. However, providing an opinion on compliance with those provisions was not an objective of our audit, and accordingly, we do not express such an opinion.

The results of our tests disclosed no instances of noncompliance or other matters that are required to be reported under *Government Auditing Standards*.

PURPOSE OF THIS REPORT

The purpose of this report is solely to describe the scope of our testing of internal control and compliance and the results of that testing, and not to provide an opinion on the effectiveness of the City's internal control or on compliance. This report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the City's internal control and compliance. Accordingly, this communication is not suitable for any other purpose. However, this report is a matter of public record and its distribution is not limited. It also serves to disseminate information to the public as a reporting tool to help citizens assess government operations.

Pat McCarthy, State Auditor

Olympia, WA

December 14, 2022

INDEPENDENT AUDITOR'S REPORT

Report on the Audit of the Financial Statements

City of Stevenson
January 1, 2021 through December 31, 2021

Mayor and City Council
City of Stevenson
Stevenson, Washington

REPORT ON THE AUDIT OF THE FINANCIAL STATEMENTS

Unmodified and Adverse Opinions

We have audited the financial statements of the City of Stevenson, as of and for the year ended December 31, 2021, and the related notes to the financial statements, as listed in the table of contents.

Unmodified Opinion on the Regulatory Basis of Accounting (BARS Manual)

As described in Note 1, the City has prepared these financial statements to meet the financial reporting requirements of state law and accounting practices prescribed by the State Auditor's *Budgeting, Accounting and Reporting System* (BARS) Manual. Those accounting practices differ from accounting principles generally accepted in the United States of America (GAAP). The differences in these accounting practices are also described in Note 1.

In our opinion, the accompanying financial statements referred to above present fairly, in all material respects, the cash and investments of the City of Stevenson, and its changes in cash and investments, for the year ended December 31, 2021, on the basis of accounting described in Note 1.

Adverse Opinion on U.S. GAAP

The financial statements referred to above were not intended to, and in our opinion, they do not, present fairly, in accordance with accounting principles generally accepted in the United States of America, the financial position of the City of Stevenson, as of December 31, 2021, or the changes in financial position or cash flows thereof for the year then ended, because of the significance of the matter discussed below.

Basis for Unmodified and Adverse Opinions

We conducted our audit in accordance with auditing standards generally accepted in the United States of America (GAAS) and *Government Auditing Standards*. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are required to be independent of the City, and to meet our other ethical responsibilities, in accordance with the relevant ethical requirements relating to our audit. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit unmodified and adverse opinions.

Matter Giving Rise to Adverse Opinion on U.S. GAAP

Auditing standards issued by the American Institute of Certified Public Accountants (AICPA) require auditors to formally acknowledge when governments do not prepare their financial statements, intended for general use, in accordance with GAAP. As described in Note 1 of the financial statements, the financial statements are prepared by the City in accordance with state law using accounting practices prescribed by the BARS Manual, which is a basis of accounting other than accounting principles generally accepted in the United States of America. The effects on the financial statements of the variances between the regulatory basis of accounting and accounting principles generally accepted in the United States of America, although not reasonably determinable, are presumed to be material and pervasive.

Responsibilities of Management for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with the financial reporting provisions of state law and the BARS Manual described in Note 1. This includes determining that the basis of accounting is acceptable for the presentation of the financial statements in the circumstances. Management is also responsible for the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is required to evaluate whether there are conditions or events, considered in the aggregate, that raise substantial doubt about the City's ability to continue as a going concern for twelve months beyond the financial statement date, including any currently known information that may raise substantial doubt shortly thereafter.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinions. Reasonable assurance is a high level of assurance but is not absolute assurance and therefore is not a guarantee that an audit conducted in accordance with GAAS and

Government Auditing Standards will always detect a material misstatement when it exists. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control. Misstatements are considered material if there is a substantial likelihood that, individually or in the aggregate, they would influence the judgment made by a reasonable user based on the financial statements.

Performing an audit in accordance with GAAS and *Government Auditing Standards* includes the following responsibilities:

- Exercise professional judgment and maintain professional skepticism throughout the audit;
- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, and design and perform audit procedures responsive to those risks. Such procedures include examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements;
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the City's internal control. Accordingly, no such opinion is expressed;
- Evaluate the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluate the overall presentation of the financial statements;
- Conclude whether, in our judgment, there are conditions or events, considered in the aggregate, that raise substantial doubt about the City's ability to continue as a going concern for a reasonable period of time; and
- We are required to communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit, significant audit findings, and certain internal control-related matters that we identified during the audit.

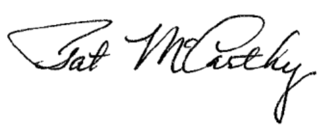
Supplementary Information

Our audit was conducted for the purpose of forming an opinion on the financial statements that collectively comprise the City's financial statements. The Schedule of Liabilities is presented for purposes of additional analysis, as required by the prescribed BARS Manual. This schedule is not a required part of the financial statements. Such information is the responsibility of management and was derived from and relates directly to the underlying accounting and other records used to prepare the financial statements. The information has been subjected to the auditing procedures applied in the audit of the financial statements and certain additional procedures, including comparing and reconciling such information directly to the underlying accounting and other records used to prepare the financial statements or to the financial statements themselves, and other additional procedures in accordance with auditing standards generally accepted in the United

States of America. In our opinion, the information is fairly stated, in all material respects, in relation to the financial statements taken as a whole.

OTHER REPORTING REQUIRED BY GOVERNMENT AUDITING STANDARDS

In accordance with *Government Auditing Standards*, we have also issued our report dated December 14, 2022 on our consideration of the City's internal control over financial reporting and on the tests of its compliance with certain provisions of laws, regulations, contracts and grant agreements and other matters. The purpose of that report is to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing, and not to provide an opinion on the effectiveness of the City's internal control over financial reporting or on compliance. That report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the City's internal control over financial reporting and compliance.



Pat McCarthy, State Auditor

Olympia, WA

December 14, 2022

FINANCIAL SECTION

City of Stevenson
January 1, 2021 through December 31, 2021

FINANCIAL STATEMENTS

SUPPLEMENTARY AND OTHER INFORMATION

City of Stevenson
Fund Resources and Uses Arising from Cash Transactions
For the Year Ended December 31, 2021

		Total for All Funds (Memo Only)	001 General Expense Fund	100 Street Fund	103 Tourism Promo & Develop Fund
Beginning Cash and Investments					
308	Beginning Cash and Investments	4,860,242	2,746,656	310,692	631,600
388 / 588	Net Adjustments	-	-	-	-
Revenues					
310	Taxes	1,806,862	904,720	357,887	483,909
320	Licenses and Permits	5,343	4,918	425	-
330	Intergovernmental Revenues	753,680	475,591	45,839	-
340	Charges for Goods and Services	2,221,745	249,199	-	-
350	Fines and Penalties	15,526	15,526	-	-
360	Miscellaneous Revenues	344,447	26,684	(10)	(1,219)
Total Revenues:		5,147,603	1,676,638	404,141	482,690
Expenditures					
510	General Government	384,625	384,625	-	-
520	Public Safety	308,164	308,164	-	-
530	Utilities	1,208,908	-	-	-
540	Transportation	523,936	-	411,192	-
550	Natural/Economic Environment	370,272	370,272	-	-
560	Social Services	10,421	10,225	196	-
570	Culture and Recreation	359,454	45,964	-	313,490
Total Expenditures:		3,165,780	1,119,250	411,388	313,490
Excess (Deficiency) Revenues over Expenditures:		1,981,823	557,388	(7,247)	169,200
Other Increases in Fund Resources					
391-393, 596	Debt Proceeds	228,427	-	-	-
397	Transfers-In	77,586	-	66,995	-
385	Special or Extraordinary Items	-	-	-	-
381, 382, 389, 395, 398	Other Resources	5,392	-	5,392	-
Total Other Increases in Fund Resources:		311,405	-	72,387	-
Other Decreases in Fund Resources					
594-595	Capital Expenditures	631,376	7,951	59,375	3,021
591-593, 599	Debt Service	93,756	-	-	-
597	Transfers-Out	77,586	-	-	-
585	Special or Extraordinary Items	-	-	-	-
581, 582, 589	Other Uses	-	-	-	-
Total Other Decreases in Fund Resources:		802,718	7,951	59,375	3,021
Increase (Decrease) in Cash and Investments:		**1,490,510**	**549,437**	**5,765**	**166,179**
Ending Cash and Investments					
50821	Nonspendable	-	-	-	-
50831	Restricted	1,335,522	274,812	-	797,781
50841	Committed	-	-	-	-
50851	Assigned	3,967,445	1,973,494	316,457	-
50891	Unassigned	1,047,784	1,047,784	-	-
Total Ending Cash and Investments		**6,350,751**	**3,296,090**	**316,457**	**797,781**

The accompanying notes are an integral part of this statement.

City of Stevenson
Fund Resources and Uses Arising from Cash Transactions
For the Year Ended December 31, 2021

		105 Affordable Housing Fund	300 Capital Improvement Fund	309 Russell Ave	311 First Street
Beginning Cash and Investments					
308	Beginning Cash and Investments	1,216	107,274	(119)	(40,967)
388 / 588	Net Adjustments	-	-	-	-
Revenues					
310	Taxes	5,161	55,185	-	-
320	Licenses and Permits	-	-	-	-
330	Intergovernmental Revenues	-	-	67,115	64,812
340	Charges for Goods and Services	-	-	-	-
350	Fines and Penalties	-	-	-	-
360	Miscellaneous Revenues	-	(64)	-	-
Total Revenues:		5,161	55,121	67,115	64,812
Expenditures					
510	General Government	-	-	-	-
520	Public Safety	-	-	-	-
530	Utilities	-	-	-	-
540	Transportation	-	-	-	-
550	Natural/Economic Environment	-	-	-	-
560	Social Services	-	-	-	-
570	Culture and Recreation	-	-	-	-
Total Expenditures:		-	-	-	-
Excess (Deficiency) Revenues over Expenditures:		5,161	55,121	67,115	64,812
Other Increases in Fund Resources					
391-393, 596	Debt Proceeds	-	-	-	-
397	Transfers-In	-	-	-	10,591
385	Special or Extraordinary Items	-	-	-	-
381, 382, 389, 395, 398	Other Resources	-	-	-	-
Total Other Increases in Fund Resources:		-	-	-	10,591
Other Decreases in Fund Resources					
594-595	Capital Expenditures	-	-	-	34,436
591-593, 599	Debt Service	-	-	-	-
597	Transfers-Out	-	10,591	66,995	-
585	Special or Extraordinary Items	-	-	-	-
581, 582, 589	Other Uses	-	-	-	-
Total Other Decreases in Fund Resources:		-	10,591	66,995	34,436
Increase (Decrease) in Cash and Investments:		**5,161**	**44,530**	**120**	**40,967**
Ending Cash and Investments					
50821	Nonspendable	-	-	-	-
50831	Restricted	6,376	151,804	-	-
50841	Committed	-	-	-	-
50851	Assigned	-	-	-	-
50891	Unassigned	-	-	-	-
Total Ending Cash and Investments		**6,376**	**151,804**	**-**	**-**

The accompanying notes are an integral part of this statement.

City of Stevenson
Fund Resources and Uses Arising from Cash Transactions
For the Year Ended December 31, 2021

		400 Water/Sewer Fund	500 Equipment Service Fund
Beginning Cash and Investments			
308	Beginning Cash and Investments	912,942	190,948
388 / 588	Net Adjustments	-	-
Revenues			
310	Taxes	-	-
320	Licenses and Permits	-	-
330	Intergovernmental Revenues	100,323	-
340	Charges for Goods and Services	1,846,944	125,602
350	Fines and Penalties	-	-
360	Miscellaneous Revenues	319,096	(40)
Total Revenues:		2,266,363	125,562
Expenditures			
510	General Government	-	-
520	Public Safety	-	-
530	Utilities	1,208,908	-
540	Transportation	-	112,744
550	Natural/Economic Environment	-	-
560	Social Services	-	-
570	Culture and Recreation	-	-
Total Expenditures:		1,208,908	112,744
Excess (Deficiency) Revenues over Expenditures:		1,057,455	12,818
Other Increases in Fund Resources			
391-393, 596	Debt Proceeds	228,427	-
397	Transfers-In	-	-
385	Special or Extraordinary Items	-	-
381, 382, 389, 395, 398	Other Resources	-	-
Total Other Increases in Fund Resources:		228,427	-
Other Decreases in Fund Resources			
594-595	Capital Expenditures	526,593	-
591-593, 599	Debt Service	93,756	-
597	Transfers-Out	-	-
585	Special or Extraordinary Items	-	-
581, 582, 589	Other Uses	-	-
Total Other Decreases in Fund Resources:		620,349	-
Increase (Decrease) in Cash and Investments:		**665,533**	**12,818**
Ending Cash and Investments			
50821	Nonspendable	-	-
50831	Restricted	104,749	-
50841	Committed	-	-
50851	Assigned	1,473,727	203,767
50891	Unassigned	-	-
Total Ending Cash and Investments		**1,578,476**	**203,767**

The accompanying notes are an integral part of this statement.

City of Stevenson
Fiduciary Fund Resources and Uses Arising from Cash Transactions
For the Year Ended December 31, 2021

		Custodial
308	Beginning Cash and Investments	-
388 & 588	Net Adjustments	-
310-390	Additions	9,140
510-590	Deductions	9,140
	Net Increase (Decrease) in Cash and Investments:	-
508	Ending Cash and Investments	-

The accompanying notes are an integral part of this statement.

City of Stevenson
Notes to the Financial Statements
For the year ended December 31, 2021

Note 1 - Summary of Significant Accounting Policies

The City of Stevenson was incorporated on December 2, 1907 and operates under the laws of the state of Washington applicable to a non-charter code City with a mayor-council form of government. The City is a general-purpose local government and provides public safety, fire prevention, street maintenance, planning, parks maintenance, water and sewer, municipal court, health and social services and general administrative services.

The City reports financial activity in accordance with the *Cash Basis Budgeting, Accounting and Reporting System* (BARS) Manual prescribed by the State Auditor's Office under the authority of Washington State law, Chapter 43.09 RCW. This manual prescribes a financial reporting framework that differs from generally accepted accounting principles (GAAP) in the following manner:

- Financial transactions are recognized on a cash basis of accounting as described below.
- Component units are required to be disclosed, but are not included in the financial statements (see *Notes to the Financial Statements*).
- Government-wide statements, as defined in GAAP, are not presented.
- All funds are presented, rather than a focus on major funds.
- The *Schedule of Liabilities* is required to be presented with the financial statements as supplementary information.
- Supplementary information required by GAAP is not presented.
- Ending balances are presented using classifications that are similar to the ending balance classification in GAAP.

A. Fund Accounting
Financial transactions of the government are reported in individual funds. Each fund uses a separate set of self-balancing accounts that comprises its cash and investments, revenues and expenditures. The government's resources are allocated to and accounted for in individual funds depending on their intended purpose. Each fund is reported as a separate column in the financial statements, except for fiduciary funds, which are presented by fund types. The total column is presented as "memo only" because any interfund activities are not eliminated. The following fund types are used:

GOVERNMENTAL FUND TYPES:

General Fund
This fund is the primary operating fund of the government. It accounts for all financial resources except those required or elected to be accounted for in another fund.

Special Revenue Funds
These funds account for specific revenue sources that are restricted or committed to expenditures for specified purposes of the government. The City uses three Special Revenue Funds: A Street Fund, a Tourism Promotion Fund (Lodging tax fund) and an Affordable Housing Fund.

Capital Projects Funds
These funds account for financial resources which are restricted, committed, or assigned for the acquisition or construction of capital facilities or other capital assets. The City uses one primary Capital Projects Fund with separate capital projects funds for each major project.

PROPRIETARY FUND TYPES:

Enterprise Funds
These funds account for operations that provide goods or services to the general public and are supported primarily through user charges. The City uses one Enterprise Fund, the combined Water/Sewer Fund.

Internal Service Funds
These funds account for operations that provide goods or services to other departments or funds of the government on a cost reimbursement basis. The City uses one Internal Service Fund, the Equipment Service Fund.

FIDUCIARY FUND TYPES:

Fiduciary funds account for assets held by the government in a trustee capacity or as a custodian on behalf of others.

Custodial Funds
These funds are used to account assets that the government holds on behalf of others in a custodial capacity. The City uses one Custodial Fund for Municipal Court Activities which are passed through to the state or other agencies.

B. Basis of Accounting and Measurement Focus
Financial statements are prepared using the cash basis of accounting and measurement focus. Revenues are recognized when cash is received, and expenditures are recognized when paid.

In accordance with state law the City also recognizes expenditures paid during twenty days after the close of the fiscal year for claims incurred during the previous period.

C. Cash and Investments
See Note 4 - *Deposits and Investments*.

D. Capital Assets
Capital assets are assets with an initial individual cost of more than $5,000 and an estimated useful life in excess of one year. Capital assets and inventory are recorded as capital expenditures when purchased.

E. Compensated Absences
Vacation leave may be accumulated up to 30 days and is payable upon separation or retirement. Sick leave may be accumulated up to 1,440 hours. Upon separation after 25 years or retirement employees do receive payment for unused sick leave at the rate of 25% of the total remaining balance. Payments are recognized as expenditures when paid.

F. Long-Term Debt
See Note 6 – *Long Term Debt*.

G. Restricted and Committed Portion of Ending Cash and Investments
Beginning and Ending Cash and Investments are reported as restricted or committed when it is subject to restrictions on use imposed by external parties or due to internal commitments established by City Council. When expenditures that meet restrictions are incurred, the City intends to use the most restricted resources first.

Restrictions and commitments of Ending Cash and Investments consist of:

- General Fund – The primary source of revenue is American Rescue Plan Act (ARPA) funds restricted by the Act, unclaimed property, which is reserved in accordance with RCW 63.29 and a private pass-through grant for the Park Plaza Project.
- Tourism Promotion Fund – The primary source of revenue is lodging tax receipts, which are reserved for tourism promotion activities per state law (RCW 67.28.1816)
- Affordable Housing Fund – The primary source of revenue is the sales tax credit authorized in 2019 by SHB 1406, which is reserved for affordable housing activities per state law (RCW 82.14.540)
- Capital Improvement Fund – The primary source of revenue is the Real Estate Excise Tax (REET), which is reserved for certain types of capital improvements per state law (RCW 82.46.010)
- Water/Sewer Fund –Balances required as part of USDA loans the City has incurred.

Note 2 - Budget Compliance

The City adopts annual appropriated budgets for 14 funds, for a total of 9 funds when rolled up. These budgets are appropriated at the fund level. The budget constitutes the legal authority for expenditures at that level. Annual appropriations for these funds lapse at the fiscal year end.

Annual appropriated budgets are adopted on the same basis of accounting as used for financial reporting.

The appropriated and actual expenditures for the legally adopted budgets were as follow:

Fund/Department	Final	Actual	Variance
001 - General Expense Fund	1,280,666.16	1,127,202.32	153,463.84
100 - Street Fund	628,550.00	470,763.36	157,786.64
103-Tourism Promo& Develop Fund	598,100.00	316,510.51	281,589.49
300 - Capital Improvement Fund	73,700.00	10,590.54	63,109.46
309 - Russell Ave	0.00	66,995.41	-66,995.41
311 - First Street	619,100.00	34,435.67	584,664.33
400 - Water/Sewer Fund			
Water/Sewer Fund	1,534,019.07	1,405,945.45	128,073.62
Wastewater System Upgrades	2,609,468.47	423,312.47	2,186,156.00
Total 400 - Water/Sewer Fund	4,143,487.54	1,829,257.92	2,314,229.62
500 - Equipment Service Fund	152,750.00	112,742.72	40,007.28

Budgeted amounts are authorized to be transferred between departments within any fund/object classes within departments; however, any revisions that alter the total expenditures of a fund, or that affect the number of authorized employee positions, salary ranges, hours, or other conditions of employment must be approved by the City's legislative body.

For reporting purposes, the Water System Improvements Fund was rolled into the Water/Sewer Fund.

Interfund activity between managerial funds for transactions such as transfers and loans has been eliminated in the consolidation of the financials.

The Actual Expenditures for the Russell Ave fund was a transfer to the Street Fund of additional grant funds received for the project as part of the close-out process, no outside expenditures were made.

Note 3 – COVID-19 Pandemic

In February 2020, the Governor of the state of Washington declared a state of emergency in response to the spread of COVID-19. Precautionary measures to slow the spread of the virus continued throughout 2021. These measures included limitations on business operations, public events, gatherings, travel, and in-person interactions.

On March 17, 2020 Mayor Scott Anderson issued an Emergency Proclamation declaring the COVID-19 pandemic to be an Emergency in the City of Stevenson. The local 258-room resort was closed from March 18th until June 1st, 2020 a significant impact to the City's lodging tax, sales tax and utility revenues. It slowly reopened with lower occupancy rates to comply with local health requirements. A local beverage producer also notified the City they would be cutting back dramatically on production, impacting the City's utility revenues. While the City has seen a decrease in revenues, expenses have also been reduced allowing the City to maintain adequate fund balances and reserves. While Skamania County is slowly reopening, the CDC continues to recommend limited travel, which impacts our local tourism economy.

The length of time these measures will continue to be in place, and the full extent of the direct or indirect financial impact on the City is unknown at this time.

Note 4 – Deposits and Investments

Investments are reported at original cost. Deposits and investments by type at December 31, 2021 are as follows:

Type of deposit or investment	City's **own** deposits and investments	Total
Bank deposits	$1,161,963	$1,161,963
Local Government Investment Pool	3,273,323	3,273,323
U.S. Government securities	1,915,465	1,915,465
Total	**$6,350,751**	**$6,350,751**

It is the City's policy to invest all temporary cash surpluses. The interest on these investments is prorated to the various funds.

<u>Investments in the State Local Government Investment Pool (LGIP)</u>
The City is a voluntary participant in the Local Government Investment Pool, an external investment pool operated by the Washington State Treasurer. The pool is not rated and not registered with the SEC. Rather, oversight is provided by the State Finance Committee in accordance with Chapter 43.250 RCW. Investments in the LGIP are reported at amortized cost, which is the same as the value of the pool per share. The LGIP does not impose any restrictions on participant withdrawals.

The Office of the State Treasurer prepares a stand-alone financial report for the pool. A copy of the report is available from the Office of the State Treasurer, PO Box 40200, Olympia, Washington 98504-0200, online at www.tre.wa.gov.

Custodial Credit Risk

Custodial credit risk for deposits is the risk that, in event of a failure of a depository financial institution, the City would not be able to recover deposits or would not be able to recover collateral securities that are in possession of an outside party. The City's deposits and certificates of deposit are mostly covered by federal depository insurance (FDIC) or by collateral held in a multiple financial institution collateral pool administered by the Washington Public Deposit Protection Commission (PDPC).

All investments are insured, registered or held by the City or its agent in the government's name.

Intergovernmental Loans

In 2022, the City loaned the Stevenson Community Pool District $40,000 to be paid back over two years at 2% interest.

Note 5 – Environmental and Certain Asset Retirement Liabilities

The City owns 1 well located on city owned property. The life of the well is perpetual due to its use as an emergency water source on an intermittent basis. There are currently no decommissioning requirements.

Note 6 – Long-Term Debt *(formerly Debt Service Requirements)*

The accompanying Schedule of Liabilities provides more details of the outstanding debt and liabilities of the city and summarizes the city's debt transactions for year ended December 31, 2021.

The debt service requirements for revenue bonds, public works and private loans are as follows:

Year	Principal	Interest	Total
2022	$ 649,939	$ 25,688	$ 675,627
2023	113,012	22,345	135,357
2024	115,266	20,319	135,585
2025	117,577	18,242	135,820
2026	119,948	16,113	136,061
2027 - 2031	464,665	48,647	513,312
2032 - 2036	228,509	17,961	246,470
2037-2041	234,737	6,579	241,317
Total	**$2,043,653**	**$175,894**	**$2,219,549**

The city received principal forgiveness from a design loan for the Wastewater System Upgrades through the Washington State Department of Ecology in the amount of $562,947.38, which payment is confirmed for 2022.

The city also has a loan for the construction of Wastewater System Upgrades through the Washington State Department of Ecology it will be drawing on from 2022 through 2023. The total loan of $9,936,000 contains $931,946 of forgivable principal.

The city has also secured a loan through USDA Rural Development of $873,000 for wastewater collection system improvements at a term of 40 years at 1.375% interest. The city will begin drawing on this loan in 2022 and the project is expected to be complete in 2023.

Assets Pledged as Collateral for Debt
The following debt is secured by assets that are pledged as collateral:

Debt	Asset
2020 Opus Loan	City Water Meters

Note 7 – Pension Plans

A. State Sponsored Pension Plans
Substantially all City's full-time and qualifying part-time employees participate in the following statewide retirement systems administered by the Washington State Department of Retirement Systems (DRS), under cost-sharing, multiple-employer public employee defined benefit and defined contribution retirement plans PERS.

The State Legislature establishes, and amends, laws pertaining to the creation and administration of all public retirement systems.

The Department of Retirement Systems, a department within the primary government of the State of Washington, issues a publicly available Annual Comprehensive Financial Report (ACFR) that includes financial statements and required supplementary information for each plan. The DRS ACFR may be obtained by writing to:

Department of Retirement Systems
Communications Unit
P.O. Box 48380
Olympia, WA 98540-8380

Also, the DRS ACFR may be downloaded from the DRS website at www.drs.wa.gov.

The City also participates in the Volunteer Fire Fighters' and Reserve Officers' Relief and Pension Fund (VFFRPF) administered by the State Board for Volunteer Fire Fighters and Reserve Officers. Detailed information about the plan is included in the State of Washington ACFR available from the Office of Financial Management website at www.ofm.wa.gov.

At June 30, 2021 (the measurement date of the plans), the City's proportionate share of the collective net pension liabilities, as reported on the Schedule of Liabilities, was as follows:

Plan	Employer Contributions	Allocation %	Liability (Asset)
PERS 1	$37,931	0.005092%	$62,185
PERS 2/3	$61,915	0.006536%	($651,091)
VFFRPF	$ 660	0.34%	($74.662.25)

Note 8 - Property Tax

The county treasurer acts as an agent to collect property tax levied in the county for all taxing authorities. Collections are distributed after the end of each month.

Property tax revenues are recognized when cash is received by City. Delinquent taxes are considered fully collectible because a lien affixes to the property after tax is levied.

The City's regular levy for the year 2021 was $1.867137 per $1,000 on an assessed valuation of $268,252,761 for a total regular levy of $500,865.

Note 9 – Risk Management

The City of Stevenson is a member of the Washington Cities Insurance Authority (WCIA). Utilizing Chapter 48.62 RCW (self-insurance regulation) and Chapter 39.34 RCW (Interlocal Cooperation Act), nine cities originally formed WCIA on January 1, 1981. WCIA was created for the purpose of providing a pooling mechanism for jointly purchasing insurance, jointly self-insuring, and / or jointly contracting for risk management services. WCIA has a total of 166 members.

New members initially contract for a three-year term, and thereafter automatically renew on an annual basis. A one-year withdrawal notice is required before membership can be terminated. Termination does not relieve a former member from its unresolved loss history incurred during membership.

Liability coverage is written on an occurrence basis, without deductibles. Coverage includes general, automobile, police, errors or omissions, stop gap, employment practices and employee benefits liability. Limits are $4 million per occurrence in the self-insured layer, and $16 million in limits above the self-insured layer is provided by reinsurance. Total limits are $20 million per occurrence subject to aggregates and sublimits. The Board of Directors determines the limits and terms of coverage annually.

Insurance for property, automobile physical damage, fidelity, inland marine, and boiler and machinery coverage are purchased on a group basis. Various deductibles apply by type of coverage. Property coverage is self-funded from the members' deductible to $750,000, for all perils other than flood and earthquake, and insured above that to $400 million per occurrence subject to aggregates and sublimits. Automobile physical damage coverage is self-funded from the members' deductible to $250,000 and insured above that to $100 million per occurrence subject to aggregates and sublimits.

In-house services include risk management consultation, loss control field services, and claims and litigation administration. WCIA contracts for certain claims investigations, consultants for personnel and land use issues, insurance brokerage, actuarial, and lobbyist services.

WCIA is fully funded by its members, who make annual assessments on a prospectively rated basis, as determined by an outside, independent actuary. The assessment covers loss, loss adjustment, reinsurance and other administrative expenses. As outlined in the interlocal, WCIA retains the right to additionally assess the membership for any funding shortfall.

An investment committee, using investment brokers, produces additional revenue by investment of WCIA's assets in financial instruments which comply with all State guidelines.

A Board of Directors governs WCIA, which is comprised of one designated representative from each member. The Board elects an Executive Committee and appoints a Treasurer to provide general policy direction for the organization. The WCIA Executive Director reports to the Executive Committee and is responsible for conducting the day-to-day operations of WCIA.

Note 10 – Health & Welfare

The City of Stevenson is a member of the Association of Washington Cities Employee Benefit Trust Health Care Program (AWC Trust HCP). Chapter 48.62 RCW provides that two or more local government entities may, by Interlocal agreement under Chapter 39.34 RCW, form together or join a pool or organization for the joint purchasing of insurance, and/or joint self-insurance, to the same extent that they may individually purchase insurance, or self-insure.

An agreement to form a pooling arrangement was made pursuant to the provisions of Chapter 39.34 RCW, the Interlocal Cooperation Act. The AWC Trust HCP was formed on January 1, 2014 when participating cities, towns, and non-city entities of the AWC Employee Benefit Trust in the State of Washington joined together by signing an Interlocal Governmental Agreement to jointly self-insure certain health benefit plans and programs for participating employees, their covered dependents and other beneficiaries through a designated account within the Trust.

As of December 31, 2021, 262 cities/towns/non-city entities participate in the AWC Trust HCP.

The AWC Trust HCP allows members to establish a program of joint insurance and provides health and welfare services to all participating members.

In April 2020, the Board of Trustees adopted a large employer policy, requiring newly enrolling groups with 600 or more employees to submit medical claims experience data in order to receive a quote for medical coverage. Outside of this, the AWC Trust HCP pools claims without regard to individual member experience. The pool is actuarially rated each year with the assumption of projected claims run-out for all current members.

The AWC Trust HCP includes medical, dental and vision insurance through the following carriers: Kaiser Foundation Health Plan of Washington, Kaiser Foundation Health Plan of Washington Options, Inc., Regence BlueShield, Asuris Northwest Health, Delta Dental of Washington, and Vision Service Plan. Eligible members are cities and towns within the state of Washington. Non-City Entities (public agency, public corporation, intergovernmental agency, or political subdivision within the state of Washington) are eligible to apply for coverage into the AWC Trust HCP, submitting application to the Board of Trustees for review as required in the Trust Agreement.

Participating employers pay monthly premiums to the AWC Trust HCP. The AWC Trust HCP is responsible for payment of all covered claims. In 2020, the AWC Trust HCP purchased stop loss insurance for Regence/Asuris plans at an individual stop loss (ISL) of $1.5 million through Commencement Bay Risk Management, and Kaiser ISL at $1 million with Companion Life through ASG Risk Management. The aggregate policy is for 200% of expected medical claims.

Participating employers contract to remain in the AWC Trust HCP for a minimum of three years. Participating employers with over 250 employees must provide written notice of termination of all coverage a minimum of 12 months in advance of the termination date, and participating employers with under 250 employees must provide written notice of termination of all coverage a minimum of 6 months in advance of termination date. When all coverage is being terminated, termination will only occur on December 31. Participating employers terminating a group or line of coverage must notify the AWC Trust HCP a minimum of 60 days prior to termination. A participating employer's termination will not obligate that member to past debts, or further contributions to the AWC Trust HCP. Similarly, the terminating member forfeits all rights and interest to the AWC Trust HCP account.

The operations of the Health Care Program are managed by the Board of Trustees or its delegates. The Board of Trustees is comprised of four regionally elected officials from Trust member cities or towns, the Employee Benefit Advisory Committee Chair and Vice Chair, and two appointed individuals from the AWC Board of Directors, who are from Trust member cities or towns. The Trustees or its appointed delegates review and analyze Health Care Program related matters and make operational decisions regarding premium contributions, reserves, plan options and benefits in compliance with Chapter 48.62 RCW. The Board of Trustees has decision authority consistent with the Trust Agreement, Health Care Program policies, Chapter 48.62 RCW and Chapter 200-110-WAC.

The accounting records of the AWC Trust HCP are maintained in accordance with methods prescribed by the State Auditor's office under the authority of Chapter 43.09 RCW. The AWC Trust HCP also follows applicable accounting standards established by the Governmental Accounting Standards Board ("GASB"). In 2018, the retiree medical plan subsidy was eliminated, and is noted as such in the report for the fiscal year ending December 31, 2018. Year-end financial reporting is done on an accrual basis and submitted to the Office of the State Auditor as required by Chapter 200-110 WAC. The audit report for the AWC Trust HCP is available from the Washington State Auditor's office.

Note 11 – Significant Obligation

On July 6, 2017 the City of Stevenson was put under an Administrative Order related to the operation of its Wastewater Treatment Plant. The Order requires construction of improvements to the Plant. The current contractual obligation for the construction totals $12,670,726. Staff continues to pursue grants, however there will be significant debt incurred to fulfill the requirements of the Order. The sewer rates and system development charges have increased, and will continue to do so, in order to meet the increased debt obligations.

City of Stevenson
Schedule of Liabilities
For the Year Ended December 31, 2021

ID. No.	Description	Due Date	Beginning Balance	Additions	Reductions	Ending Balance
Revenue and Other (non G.O.) Debt/Liabilities						
252.11	PWTF Loan, Water System Upgrade	6/1/2026	139,641	-	23,273	116,368
252.11	USDA RD Loan, Sewer Outfall	12/20/2033	320,208	-	24,029	296,179
252.11	DOE SRF Loan, WWTP Design	12/30/2041	1,124,011	228,427	-	1,352,438
252.11	SMART Water Lease	4/1/2030	307,287	-	28,621	278,666
264.30	State Retirement System		254,303	-	192,118	62,185
259.12	Sick Leave Buyout		849	1,893	-	2,742
259.12	Vacation Accrual		48,041	-	11,338	36,703
	Total Revenue and Other (non G.O.) Debt/Liabilities:		**2,194,340**	**230,320**	**279,379**	**2,145,281**
	Total Liabilities:		**2,194,340**	**230,320**	**279,379**	**2,145,281**

ABOUT THE STATE AUDITOR'S OFFICE

The State Auditor's Office is established in the Washington State Constitution and is part of the executive branch of state government. The State Auditor is elected by the people of Washington and serves four-year terms.

We work with state agencies, local governments and the public to achieve our vision of increasing trust in government by helping governments work better and deliver higher value.

In fulfilling our mission to provide citizens with independent and transparent examinations of how state and local governments use public funds, we hold ourselves to those same standards by continually improving our audit quality and operational efficiency, and by developing highly engaged and committed employees.

As an agency, the State Auditor's Office has the independence necessary to objectively perform audits, attestation engagements and investigations. Our work is designed to comply with professional standards as well as to satisfy the requirements of federal, state and local laws. The Office also has an extensive quality control program and undergoes regular external peer review to ensure our work meets the highest possible standards of accuracy, objectivity and clarity.

Our audits look at financial information and compliance with federal, state and local laws for all local governments, including schools, and all state agencies, including institutions of higher education. In addition, we conduct performance audits and cybersecurity audits of state agencies and local governments, as well as state whistleblower, fraud and citizen hotline investigations.

The results of our work are available to everyone through the more than 2,000 reports we publish each year on our website, www.sao.wa.gov. Additionally, we share regular news and other information via an email subscription service and social media channels.

We take our role as partners in accountability seriously. The Office provides training and technical assistance to governments both directly and through partnerships with other governmental support organizations.

Stay connected at sao.wa.gov

- Find your audit team
- Request public records
- Search BARS manuals (GAAP and cash), and find reporting templates
- Learn about our training workshops and on-demand videos
- Discover which governments serve you — enter an address on our map
- Explore public financial data with the Financial Intelligence Tool

Other ways to stay in touch

- Main telephone: (564) 999-0950
- Toll-free Citizen Hotline: (866) 902-3900
- Email: webmaster@sao.wa.gov

Appendix D

Stevenson CIP

Stevenson Capital Improvement Program as of October 12, 2022

Capital Funding	Type	2023	2024	2025	2026	2027	2028		2023-2038 Total CIP
Grand Totals		**8,664,511**	**2,954,000**	**2,920,000**	**1,832,000**	**1,000,000**	**7,285,000**	**-**	**$ 44,390,511**
Water		**1,117,000**	**688,000**	**-**	**132,000**	**200,000**	**-**	**-**	**$ 2,612,000**
Wastewater		**5,931,511**	**441,000**	**1,050,000**	**-**	**-**	**-**	**-**	**$ 10,177,511**
Streets		**1,526,000**	**1,825,000**	**1,870,000**	**1,700,000**	**800,000**	**1,285,000**	**-**	**$ 25,511,000**
Planning		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**$ -**
Fire Hall		**-**	**-**	**-**	**-**	**-**	**6,000,000**	**-**	**$ 6,000,000**
Parks		**90,000**	**-**	**-**	**-**	**-**	**-**		**$ 90,000**
Water Treatment Plant	W	100,000							100,000
Hegewald Well	W								-
Church Reservoir Transmission	W		425,000						425,000
School St. Waterline Replacement	W	250,000							250,000
School Street Grind and Inlay	S		440,000						440,000
Bulldog-School-Kanaka Intersection	S		50,000						50,000
Loop Road Waterline Replacement	W								-
Main D Extension (phase 1)	WW								-
Loop Road Grind and Inlay	S	390,000							390,000
Loop Rd. Sidewalk Extension	S	-							200,000
Frank Johns PRV	W	157,000							157,000
Frank Johns South	W	283,000							283,000
Frank Johns Sidewalk (Loop-Second)	S		25,000	50,000	400,000				475,000
East SR-14 Improvements-Low Phase	S					50,000	340,000		390,000
East SR-14 Improvements-Roundabout	S								4,200,000
Frank Johns North	W	237,000							237,000
Main D Extension (phase 2)	WW								1,230,000
Sheppard-Major-Loop (WW Extension not	WW								No Est
W-SR-14 and Rock Creek Improvements	S				100,000	600,000			700,000
SW Atwell Rd	W		263,000						263,000
Rock Creek Drive	W			-					375,000
Rock Creek PRV Relocation	W								100,000
WWTP Improvements	WW	4,000,000							4,000,000
Rock Creek PS	WW								-
Fairgrounds PS-Phase 1 &2	WW	781,511							781,511
Cascade Interceptor	WW								-
Cascade Interceptor Phase 2 (MH CI-4 to 1	WW			1,050,000					1,050,000
Rock Creek Stormwater	S								-

Capital Funding	Type	2023	2024	2025	2026	2027	2028		2023-2038 Total CIP
Grand Totals		**8,664,511**	**2,954,000**	**2,920,000**	**1,832,000**	**1,000,000**	**7,285,000**	-	**$ 44,390,511**
Water		**1,117,000**	**688,000**	-	**132,000**	**200,000**	-	-	**$ 2,612,000**
Wastewater		**5,931,511**	**441,000**	**1,050,000**	-	-	-	-	**$ 10,177,511**
Streets		**1,526,000**	**1,825,000**	**1,870,000**	**1,700,000**	**800,000**	**1,285,000**	-	**$ 25,511,000**
Planning		-	-	-	-	-	-	-	**$ -**
Fire Hall		-	-	-	-	-	**6,000,000**	-	**$ 6,000,000**
Parks		**90,000**	-	-	-	-	-		**$ 90,000**
West SR-14 Improvements Low Phase	S					50,000	340,000		390,000
West End Roundabout	S								2,500,000
Rock Creek Bridge Replacement	S								8,200,000
First Street Overlook	S	800,000							800,000
Columbia Ave Realignment	S			625,000	1,200,000				1,825,000
NE Major St (water)	W				132,000				132,000
Chipseal (Major, Hillcrest, E. Loop Rd.)	S								35,000
Vancouver West Waterline (not on plan)	W								-
Russell Avenue Phase 2 (Van-2nd)	S								400,000
Chipseal Vancouver	S	45,000							45,000
Vancouver Sidewalk-East End	S								125,000
Cascade PS-Phase 1 &2	WW	413,000							413,000
Cascade Avenue Sewer (8-12")	WW		441,000						441,000
Kanaka PS-Phase 1 &2	WW	697,000							697,000
Kanaka Underpass-Phase 1	S								-
Kanaka Underpass-Phase 2	S					100,000			-
Foster Creek Waterline	W								-
Foster Creek Rd/Ryan Allen (WW)	WW								1,525,000
Foster Creek Rd-by int. w/Rock Creek Dr. (	WW								No Est.
Foster Creek Rd (TIP aquire additional ROV	S	-							No Est.
Lasher Street, Sidewalks & Storm	S		250,000	1,100,000					1,350,000
Lasher to School St-SRTS	S	150,000	800,000						950,000
Chip Seal McEvoy, Wisteria, Ridgecrest	S	36,000							36,000
El Paso Road Reconstruction	S								No Est.
Roosevelt Street Overlay	S								670,000
Iman Cemetery to Osprey Overlay	S								-
Iman Loop-Iman Cemetery Sidewalk	S								75,000
Monda Rd	S								200,000

Capital Funding	Type	2023	2024	2025	2026	2027	2028		2023-2038 Total CIP
Grand Totals		**8,664,511**	**2,954,000**	**2,920,000**	**1,832,000**	**1,000,000**	**7,285,000**	**-**	**$ 44,390,511**
Water		**1,117,000**	**688,000**	**-**	**132,000**	**200,000**	**-**	**-**	**$ 2,612,000**
Wastewater		**5,931,511**	**441,000**	**1,050,000**	**-**	**-**	**-**	**-**	**$ 10,177,511**
Streets		**1,526,000**	**1,825,000**	**1,870,000**	**1,700,000**	**800,000**	**1,285,000**	**-**	**$ 25,511,000**
Planning		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**$ -**
Fire Hall		**-**	**-**	**-**	**-**	**-**	**6,000,000**	**-**	**$ 6,000,000**
Parks		**90,000**	**-**	**-**	**-**	**-**	**-**		**$ 90,000**
Roselawn Ave Overlay	S		165,000						165,000
Fire Hall	F						6,000,000		6,000,000
Engineering Standard Updates	W								-
Engineering Standard Updates	WW								-
Engineering Standard Updates	S								-
Sewer SDC Updates	WW	30,000							30,000
Water SDC Updates	W	30,000							30,000
Shoreline Program Grant-Public Access	PK	50,000							50,000
GIS	W	10,000							10,000
GIS	WW	10,000							10,000
GIS	S	10,000							10,000
Rock Creek Water Intake	W	50,000							50,000
Parks Plan	PK	40,000							40,000
Park Plaza	PK								-
Walnut Park	PK								-
Triangle Park	PK								-
Gropper Park	PK								-
Paving Gravel Roads	S	50,000							50,000
Lakeview Road	S	45,000							45,000
Ash Alley	S		95,000						95,000
Holly Street	S			95,000					95,000
Del Rey	S						95,000		95,000
Gropper Park Loop	S						95,000		95,000
H&H Ave	S						95,000		95,000
Maple Alameda	S						95,000		95,000
Leavens Street, Sidwalks, Storm, etc	S						225,000		225,000
Water System Plan	W					200,000			200,000

Appendix E

2017 GSP

General Sewer Plan and Wastewater Facilities Plan Update

Final

TETRA TECH

November 2017

City of Stevenson General Sewer Plan and Wastewater Facilities Plan Update

November 2017

PREPARED FOR

City of Stevenson
7121 E. Loop Road
Stevenson, WA 98648

PREPARED BY

Tetra Tech
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Fax: 503.598.0583
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Katy Isaksen & Associates
PO Box 30008
Seattle, WA 98113
Phone: 206.706.8893
Fax: 206.706.7702

November 17, 2017

Authorization

The City of Stevenson has authorized a consultant team led by Tetra Tech to prepare the City of Stevenson General Sewer Plan and Wastewater Facilities Plan Update. In addition to Tetra Tech, the consultant team includes Katy Isaksen Associates (financial analysis).

Tetra Tech Project #135-48600-16001

P:\48600\135-48600-16001\Docs\Reports\Final Sewer Plan Update\General Sewer Plan Update_Final_2017-11-17.docx

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ACRONYMS/ABBREVIATIONS

Acronym or Abbreviation	Definition
ATS	automatic transfer switch
BOD	biochemical oxygen demand
CCTV	closed-circuit television
CF	cubic feet
CFR	Code of Federal Regulations
CI	Cascade Interceptor
CIP	capital improvement plan
CMOM	Capacity, Management, Operation and Maintenance
CSWD	Criteria for Sewage Works Design
D	depth
DNA	deoxyribonucleic acid
DO	dissolved oxygen
EO	Executive Order
EPA	Environmental Protection Agency
ERU	equivalent residential unit
FEMA	Federal Emergency Management Agency
FM	force main
GIS	geographic information system
gpad	gallons per acre per day
gpcd	gallons per capita per day
gpm	gallons per minute
HP	horsepower
I/I	infiltration and inflow
in	inches
kWh	kilowatt-hour
L	length
LPHO	low-pressure, high output
LPLO	low-pressure, low output
MCC	motor control center
mg/L	milligrams per liter
mgd	million gallons per day
MH	manhole
mJ	millijoule
mL	milliliter
MLSS	mixed liquor suspended solids
MLVSS	mixed liquor volatile suspended solids
MPHO	medium-pressure, high output
MSL	mean sea level
NEIWPCC	New England Interstate Water Pollution Control Commission
nm	nanometer
NOAA	National Oceanic and Atmospheric Administration

Acronym or Abbreviation	Definition
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
OMI	Operations Management International (now CH2M contract operations)
Orange Book	Criteria for Sewage Works Design
PLC	programmable logic controller
ppd	pounds per day
PS	pump station
PUD	public utility district
PVC	polyvinyl chloride
RAS	return activated sludge
RPM	rotations per minute
SCADA	supervisory control and data acquisition
SDC	system development charge
SEPA	State Environmental Policy Act
SG	slide gate
TSS	total suspended solids
UV	ultraviolet
W	width
WAC	Washington Administrative Code
WAS	waste activated sludge
WWTP	wastewater treatment plant

AUTHORIZATION

City of Stevenson
Public Works Department

(509)427-5970

7121 E Loop Road, PO Box 371
Stevenson, Washington 98648

November 13, 2017

Department of Ecology
Southwest Regional Office
PO Box 47775
Olympia, WA 98504-7775

RE: National Pollutant Discharge Elimination System (NPDES) Permit No. WA0020672

To whom it may concern:

This letter is to grant authorization to Cynthia L. Bratz, P.E., Senior Project Manager, Tetra Tech, to sign the General Sewer Plan, Facilities Plan, Plan to Maintain Adequate Capacity, and other reports that may be required by the Department of Ecology as per our NPDES/State Waste Discharge Permit.

Sincerely,

Frank Cox
Mayor

EXECUTIVE SUMMARY

The *City of Stevenson General Sewer Plan and Wastewater Facilities Plan* is a comprehensive planning document for all elements of the City of Stevenson's wastewater system—collection, treatment, solids handling and effluent disposal. It addresses all areas currently served by the City's wastewater system as well as those expected to be served by the system over a planning period extending through 2040. The plan identifies improvements needed to collect and treat wastewater in the City's sewer service area and provides a capital improvement plan to implement the improvements.

WASTEWATER SERVICE AREA DESCRIPTION

The City of Stevenson covers 1.79 square miles in the Columbia River Gorge, about 45 miles east of Portland. It is surrounded by unincorporated Skamania County. The nearest neighboring cities are Carson, 3 miles to the northeast, and North Bonneville, 4 miles to the southwest. The City's Urban Area was set by federal statute in 1986 with the creation of the Columbia Gorge National Scenic Area.

The City's wastewater system collects and treats wastewater from all sewered areas of the City of Stevenson. There are currently 437 residential and commercial sewer accounts. These consist of single-family residences (324), commercial customers (68 accounts), public customers (17 accounts) and multi-family residential housing (28 accounts). The City had an estimated population of 1,530 as of 2015, including an estimated 1,081 residents served by the City wastewater system. The remainder of the population is not connected to the wastewater system and instead is served by on-site septic systems.

There are no permitted significant industrial users currently authorized by the Department of Ecology (Ecology) in the City. However, the commercial user category includes both commercial kitchens and beverage producers, which are major sources of wastewater flow and of biochemical oxygen demand (BOD) in the City's wastewater system. Ecology has indicated that the increasing size and number of commercial high-strength wastewater dischargers and their impact on wastewater treatment plant (WWTP) operations will require greater oversight. New and existing large commercial users will be required to obtain discharge permits from Ecology. Based on federal definitions of "significant commercial and industrial operations," discharge permits are expected to be required for dischargers that meet at least one of the following criteria:

- Discharge an average of 25,000 gallons per day or more of process wastewater
- Have average dry-weather flow or load equal to 5 percent or more of the WWTP capacity
- Have a reasonable potential to adversely affect the WWTP's operation or violate pretreatment standards.

GROWTH PROJECTIONS

Wastewater flows are contributed by residential and commercial/industrial/public sources. To simplify wastewater planning and ensure consistency, non-residential sources are often estimated as a comparable residential source, using the concept of the equivalent residential unit (ERU). An ERU represents the amount of wastewater contributed by an average residential household in the planning area.

Residential ERUs will typically grow at a faster rate than overall population because new development can be assumed to occur in sewered areas of the City. The number of residential ERUs are projected to increase by 168 by 2040, an average annual growth rate of 1.19 percent. A projection of future population growth by the City of Stevenson Planning Department, based on historic growth rates for the City and Skamania County, shows population increasing from 1,530 in 2016 to 1,901 in 2040.

In addition to new growth, there are two sewer basins in the City that are likely to receive sewer service during the planning period through planned sewer extensions (Loop Road and Iman Cemetery Road). In each basin, it is assumed that all parcels will convert to sewer from septic within 5 years of construction of the sewer extension.

Non-residential sewer ERUs in the City include commercial, industrial, and public sewer users. In general, non-residential growth in the City is assumed to be proportional to residential growth. However, the City has recently experienced significant growth in the beverage industry (breweries, distilleries, etc.). Beverage sector users were estimated to represent only 55 of the 621 non-residential ERUs at the start of 2016. However, because of their high growth potential and often high-strength wastewater, these ERUs have been broken out as a subset of non-residential ERUs when planning for future growth.

Beverage ERUs are assumed to grow at a rate twice that of the residential ERUs—an average of 2.38 percent per year. This will result in an additional 64 ERUs by 2040. In addition to this steady growth, there was a higher rate of growth in 2016 due to the startup of new beverage industry businesses, which added an estimated 27 ERUs. A total of 89 new beverage ERUs are projected be added by 2040.

All other non-residential ERUs are assumed to grow at a rate equal to that of residential ERUs, or an average of 1.19 percent each year. This will result in an additional 195 ERUs by 2040.

WASTEWATER FLOW AND LOAD PROJECTIONS

Wastewater Flows

Wastewater system improvements must be sized to have adequate capacity for the wastewater flows the system is projected to convey and treat over the course of the planning period. System flows consist of base sewage flow from connected customers (residential and commercial) as well as infiltration and inflow (I/I) into the system from groundwater and stormwater.

The average base wastewater generation in the City is assumed to be 55 gallons per capita per day (based on City winter water use records) and the average household size is assumed to be 2.21 persons per household. With these estimates, one ERU is equivalent to 122 gallons per day of wastewater.

The City has taken steps to control I/I for many years, but like all sanitary sewer systems in western Washington its total wastewater flow rate is still significantly affected by I/I. I/I is commonly evaluated as a unit flow per acre of contributing area. Existing I/I rates were estimated by using WWTP flow data for different design conditions (annual average flow, maximum-month flow, etc.), subtracting the assumed sanitary base flow, and then dividing by the contributing service area. Future I/I rates were estimated by assuming 10 percent increase throughout the planning period as an allowance for future larger storms resulting from climate change. Areas to be served by new sewers were assigned I/I rates based on planning criteria developed in 2014 by King County, Washington.

Wastewater Loads

Wastewater treatment facilities must be sized to have adequate capacity to treat expected pollutant loads to the treatment plant through the end of the planning period. Like wastewater flows, wastewater loads are projected using the projections of future population and development in combination with unit design criteria and peaking factors. The key pollutant loads of interest for planning for Stevenson are BOD and total suspended solids (TSS).

Residential BOD load was assumed to be 0.44 pounds per day per ERU, based on the 0.2 pounds per day per capita recommended in Ecology's *Criteria for Sewage Works Design*. BOD from high-load commercial dischargers ("high-load" is defined as significant quantities of high-strength wastewater; at present, all high-load dischargers in the City are beverage producers) was estimated to be 2.82 pounds per day per ERU, based on results of a September 2016 sampling program conducted by the City. Other non-residential ERUs were assumed to have BOD loads equal to residential ERUs.

Ecology recommends designing for a residential TSS load of 0.2 pounds per day per capita. TSS load data collected during the September 2016 sampling program showed unexpectedly low TSS loads in proportion to BOD load at the same sampling points, despite TSS loads at the WWTP being comparable to BOD loads during the sampling period. As a result, TSS load data from the sampling effort were not used to estimate future TSS load. Instead, projections of TSS load were based on the conservative assumption that future TSS loads will be equal to calculated BOD loads.

BOD and TSS loads were calculated for each year in the planning period based on the estimated number of ERUs. Maximum-month and peak-day loads were calculated for each year using peaking factors calculated from historical peaking factors for the WWTP.

Pretreatment

Two levels of pretreatment for high-load commercial dischargers were evaluated for this facilities plan. Alternative 1 assumes minimal pretreatment, in which high-load dischargers would install and operate pretreatment facilities to reduce their effluent BOD (discharged to the City sewer system) by approximately 20 percent. Alternative 2 assumes pretreatment to domestic strength, in which high-load dischargers would install and operate pretreatment facilities to reduce effluent BOD by approximately 85 percent.

Summary

Table ES-1 summarizes wastewater flow and load design projections based on the above assumptions. These are the flow and load projections that are carried forward as the design conditions for treatment process sizing and alternatives comparisons.

Table ES-1. Current and Projected Flow and Load Design Conditions

Parameter	Base (Dry Weather Average)		Maximum Month		Peak Day		Peak Hour	
	2016	2040	2016	2040	2016	2040	2016	2040
Flow (million gallons/day)	0.135	0.200	0.460	0.657	1.30	1.71	1.96	2.56
BOD (pounds/day)								
No pretreatment	620	1,070	961	1,798	1,985	3,758	n/a	n/a
20% pretreatment	589	989	890	1,611	1,662	2,912	n/a	n/a
85% pretreatment	488	724	658	1,003	1,294	1,916	n/a	n/a
TSS (pounds/day)								
No pretreatment	477	823	787	1,380	2,052	3,240	n/a	n/a
20% pretreatment	453	761	744	1,267	1,980	3,052	n/a	n/a
85% pretreatment	376	557	605	901	1,825	2,646	n/a	n/a

WASTEWATER COLLECTION SYSTEM

Existing Facilities

Stevenson's sanitary sewer collection system conveys flows to the City's wastewater treatment plant. It consists of 55,000 feet of gravity sewer mains, four pump stations, and 2,100 feet of force main. The oldest sewer was installed in 1911 in Russell Street, and consisted of vitrified clay pipe before being replace with concrete pipe in 1972. The wastewater treatment plant was constructed in 1971, and the majority of the gravity collection system was installed in 1972.

System Condition Evaluation

In general, the sewer lines in the worst condition are constructed of concrete and were installed prior to 1980. Concrete sewer pipes are prone to leaks at joints and cracks in the pipe. Newer sewer lines installed since 1990 are generally PVC with rubber gaskets and perform much better preventing I/I.

Each of the City's four pump stations has some or all of the following deficiencies: inadequate pumping capacity, equipment past its design life, access and safety issues, and lack of telemetry for remote monitoring.

Infiltration and Inflow

I/I in the City was analyzed using historical flow data at the WWTP and pump stations, along with rainfall data. This analysis identified areas of the City with I/I issues and showed that there has not been a noticeable increasing trend in I/I in the last 10 years. The City's I/I currently meets the federal definition for excessive inflow but does not meet the definition for excessive infiltration.

Capacity Analysis

Capacity analysis was performed through computer modeling of the collection system under existing peak-day and peak-hour flows. The peak-hour wet-weather flow simulations indicated several gravity sewers that experience flows exceeding 80 percent of full flow capacity and two lines with flows exceeding 100 percent of full capacity. However, surcharging is minimal and no overflows are predicted. Model results also showed that existing peak flows exceed the firm capacities of the Rock Creek and Kanaka Pump Stations.

The model was also run to evaluate collection system conditions under future conditions. The peak-hour wet-weather flow simulations for 2040 indicated that 17 pipe segments would experience flows exceeding 80 percent of their capacity, and 10 of these would see flows exceeding 100 percent of full capacity. No overflows are predicted due to insufficient pipe capacity, as long as pump stations are sized to handle future inflows. Model results showed that 2040 peak flows would exceed the existing firm capacities of the Rock Creek, Fairgrounds, and Kanaka Pump Stations.

Recommended Improvements

The modeling results were used to identify a series of projects to improve the City's collection system and meet current and future demands. Projects were divided into two phases: Phase 1 projects address areas with inadequate capacity for current demands, and Phase 2 projects address areas with inadequate capacity for future demands.

Improvements to the gravity sewer system focus on installing larger pipes to increase capacity in problem areas identified by the model results. Sewer extensions to currently unsewered areas have been laid out to facilitate conversions of existing septic systems and allow future extensions to developable areas in the City. Pump station improvements include full replacement of some pump stations found to have inadequate capacity and phased upgrades to other pump stations to enhance safety, reliability, and operability.

WASTEWATER TREATMENT PLANT EVALUATION

Existing Facilities

The Stevenson WWTP is located on the banks of Rock Creek, on Rock Creek Drive in the west end of Stevenson. The plant is designed for a peak-hour flow of 1.5 million gallons per day. It was constructed in 1971 as a package treatment plant with a chlorine contact tank for disinfection and a sludge lagoon. In 1992, the plant was upgraded with the current oxidation ditch, secondary clarifiers, and ultraviolet (UV) disinfection facility. Some components from the original plant were kept as backup to the new facilities or were converted for use in solids handling.

Permit Compliance

Under current conditions, average monthly influent BOD and TSS loads at the Stevenson WWTP regularly exceed the facility's National Pollutant Discharge Elimination System (NPDES) permit limits. In 2016, average monthly influent BOD loads exceeded the maximum-month influent BOD permit limit seven times, and the average monthly influent TSS load exceeded the permit limit three times.

Effluent permit requirements have been exceeded five times in the last five years. All five exceedances were connected to two events: an unusually high TSS reading in April 2016 that may be the result of a sampling error, and a sludge pump failure in September 2016.

Capacity and Condition

The treatment capacity of the existing WWTP is defined in the design documents for the 1992 upgrade and in the City's NPDES permit. Current flows at the WWTP are within the plant's design capacity, but with expected steady growth in the City the maximum-month and peak-day flows will soon exceed the design hydraulic capacity. Current BOD and TSS loads at the WWTP already exceed the plant's design capacity, by a factor of two in the case of BOD loads, and are expected to continue growing.

Facilities and equipment at the WWTP are generally in good working order but most are at least 25 years old and at or beyond the end of their design life. In addition, most unit processes at the WWTP do not meet current Ecology requirements for redundancy; the plant contains only one unit for major treatment processes like the oxidation ditch and disinfection reactor, and even where two units are in place, they are not adequately sized to operate at design flows with one unit offline.

TREATMENT PLANT IMPROVEMENTS

Based on the assessment of existing conditions and future requirements for the facilities at the Stevenson WWTP, alternatives were identified and evaluated for treatment improvements to ensure that the City can provide reliable wastewater treatment through the end of the planning period. The alternatives include facilities to pretreat high-strength commercial wastewater and facilities to improve treatment, reliability and operations at the WWTP.

Two alternatives were considered for improving the Stevenson WWTP. Alternative 1 (which has two variant options—1A and 1B—based on the secondary treatment technology used) provides WWTP improvements needed if minimal pretreatment is provided for wastewater from high-load dischargers. Alternative 2 provides WWTP improvements needed if wastewater from high-load dischargers is pretreated to domestic strength. These alternatives include upgrades of existing facilities to accommodate redundancy requirements and operational issues, as well as upgrades to provide additional hydraulic, biological treatment and solids handling capacity. The improvements have been tailored to accommodate, wherever possible, continued use of the existing major facilities, including the oxidation ditch, clarifiers, pump building, UV disinfection, outfall, aerobic digester and in-plant pump station.

Alternative 1 would replace the existing headworks with a new larger headworks; modify the existing secondary treatment process by adding selector basins, expanded secondary treatment capacity (oxidation ditches with 1A and conventional activated sludge reactors with 1B), a third final clarifier, and an aeration building; and install a second UV disinfection channel. A new sludge thickening building with mechanical sludge thickener would be added. The existing laboratory/control building would be replaced by a laboratory and operations building. The existing maintenance facility would remain in place. A future maintenance shop and dewatering facility may replace the existing maintenance facility after 2040.

Alternative 2 would have essentially the same WWTP improvements as Alternative 1A, with smaller treatment capacity required because a higher level of pretreatment would be provided.

Table ES-2 summarizes planning-level cost estimates for Alternatives 1B and 2 (Alternative 1B was identified as preferable to Alternative 1A). The total cost shown includes only the improvements at the Stevenson WWTP; the pretreatment improvements are expected to have different funding sources and mechanisms. These estimates are for comparison of the alternatives only. Future cost estimates will narrow the focus and provide a more accurate overall WWTP treatment plant cost for budgeting.

Table ES-2. Planning Level WWTP Cost Estimates

	Capital Project Cost		Annual O&M Cost		20-Year Present Worth	
Component	Alt 1B	Alt 2	Alt 1B	Alt 2	Alt 1B	Alt 2
Pretreatment Improvements at Other Locations						
High-Load Commercial Pretreatment	$711,000	$2,444,000	$10,021	$70,078	$888,000	$3,683,000
Stevenson WWTP Improvements						
Headworks	$1,870,000	$1,037,000	$43,573	$37,844	$2,829,000	$1,706,000
Secondary Treatment	$4,714,000	$5,126,000	$107,667	$133,330	$7,098,000	$7,148,000
Disinfection	$1,090,000	$1,090,000	$23,411	$23,411	$1,504,000	$1,504,000
Solids Handling	$1,066,000	$884,000	$155,040	$163,141	$5,636,000	$3,770,000
Support Facilities	$3,084,000	$3,084,000	$75,269	$75,269	$8,390,000	$8,611,000
Flood Protection	$202,000	$202,000	$1,507	$1,507	$229,000	$229,000
Effluent Pumps	$576,000	$576,000	$7,004	$7,004	$700,000	$700,000
WWTP Mgt Tasks			$62,400	$62,400	$1,103,687	$1,103,687
Lab Labor			$93,600	$93,600	$1,655,531	$1,655,531
Pretreatment Program Labor			$62,400	$62,400	$1,103,687	$1,103,687
WWTP Total (excluding Pretreatment)	$12,602,000	$11,999,000	$631,870	$659,907	$30,248,906	$27,530,906

RECOMMENDED PLAN

The phased improvements to the gravity sewer system and pump stations are all recommended for inclusion in the City's capital improvement plan. All Phase 1 projects are intended to address current problems in the system, including inadequate capacities in some pipes and pump stations, and should be considered high priority. The collection system extensions to unsewered areas should be conducted as required by City growth.

The City's aging WWTP is consistently overloaded and requires upgrades in the near future to protect the environment and accommodate continued growth. Alternative 1B is the recommended treatment plant improvement alternative due to its higher treatment capacity at the WWTP site and ability to accommodate smaller offsite pretreatment facilities. The proposed WWTP improvements will upgrade the plant so that it can reliably treat the wastewater flows and loads projected through 2040.

Predesign for the WWTP improvements is scheduled for 2018. Table ES-3 shows the capital improvement plan through 2022, with yearly costs to implement the recommended collection system and wastewater treatment plant improvements.

Table ES-3. Capital Improvements Plan for the Recommended Alternatives

Item	2018	2019	2020	2021	2022
Wastewater Treatment Plant Improvements (Alt 1B)	$600,000	$600,000	$2,443,000	$8,959,000	
Rock Creek Pump Station (PS-01)	$58,000	$58,000	$238,000	$872,000	
Fairgrounds Pump Station – Phase 1 (PS-02)	$5,000	$5,000	$22,000	$79,000	
Cascade Pump Station – Phase 1 (PS-05)				$3,000	$34,000
Cascade Avenue Sewer – Phase 1 (S-01)				$42,000	$399,000
Kanaka Pump Station – Phase 1 (PS-04)				$73,000	$697,000
Cascade Interceptor - Rock Cr PS to MH CI-4 (S-02)				$65,000	$617,000
Total	$663,000	$663,000	$2,703,000	$10,093,000	$1,747,000

1. INTRODUCTION AND BACKGROUND

1.1 ABOUT THIS PLAN

1.1.1 Purpose

The City of Stevenson needs an up-to-date general sewer plan and wastewater facilities plan to evaluate existing City wastewater infrastructure relative to current and projected flows and loads. Such an evaluation is needed to ensure that the City can continue to meet wastewater discharge permit requirements.

The City's most recent comprehensive wastewater planning document, the September 1991 *City of Stevenson Wastewater Facilities Plan* (the 1991 Facilities Plan) is now 26 years old. A series of technical memorandums evaluating wastewater treatment capacity relative to updated flows were prepared in May 2010, but a more comprehensive update of the 1991 Facilities Plan is needed. A variety of developments in the years since that plan was prepared warrant a complete wastewater comprehensive plan update:

- The City has experienced a rate of growth comparable to the estimates in the 1991 Facilities Plan; however, the total sewered population and wastewater flows have not reached the predicted levels.
- In the last two years, a number of commercial sewer dischargers that typically discharge high-strength wastewater have established themselves in the City. These dischargers include breweries, a distillery, and a cider producer.
- No major upgrades or equipment replacements have been made to the wastewater treatment plant (WWTP) since the 1992 upgrade. As a result, many of the equipment items and unit processes are nearing or at the end of their design life.

1.1.2 Project Scope

This *City of Stevenson General Sewer Plan and Wastewater Facilities Plan Update* is a comprehensive planning document for all elements of the City's wastewater system—collection, treatment, solids handling and effluent disposal. It addresses all areas currently served by the City's wastewater system as well as those expected to be served by the system throughout the planning period through 2040.

The *General Sewer Plan and Facilities Plan Update* identifies improvements needed to collect and treat wastewater in the City's sewer service area and provides a capital improvement plan (CIP) to implement the improvements over the next 23 years. The City will use the CIP as a basis for updating the wastewater facilities development fee that the City charges for new sewer connections.

The updated plan complies with requirements for a wastewater facilities engineering report as defined in Washington Administrative Code (WAC) 173-240-060 and with requirements for a federal wastewater facilities plan as defined in the Code of Federal Regulations under 40 CFR 35.917-1. The plan will be submitted to the Washington Department of Ecology for approval so the City can proceed with design and implementation of the recommended improvements.

Preparation of this updated plan included the following activities:

- Gathering and reviewing key information
- Coordinating with regulatory authorities and preparing an overview of regulations that apply to City wastewater facilities
- Characterizing the basic planning area, including existing and future land use, existing population, and population projections
- Determining the capacity of the existing wastewater collection system and identifying improvements needed to provide reliable sewer service to existing and future development
- Evaluating the existing wastewater treatment system and identifying improvements needed to provide reliable treatment for existing and future development
- Completing all required environmental documentation.

1.2 RELATED STUDIES

The following studies were reviewed in the preparation of this updated plan:

- City of Stevenson Wastewater Facilities Plan. Prepared for the City of Stevenson by KCM. Portland, OR. September 1991.
- City of Stevenson Comprehensive Plan. Prepared for the City of Stevenson by the Stevenson Planning Department with the assistance of Cogan Owens Cogan. Portland, OR. April 2013.
- City of Stevenson Draft Evaluation of Existing Wastewater Treatment Plant Facilities. Prepared for the City of Stevenson by Tetra Tech. Seattle, WA. May 2010.
- City of Stevenson Draft Recommendations for Addressing Treatment Plant Capacity Needs. Prepared for the City of Stevenson by Tetra Tech. Seattle, WA. May 2010.
- City of Stevenson Draft Wastewater Treatment Plant Flow and Load Evaluation. Prepared for the City of Stevenson by Tetra Tech. Seattle, WA. May 2010.
- City of Stevenson Kanaka Pump Station Capacity Report; Cascade Avenue Improvements. Prepared for the City of Stevenson by Berger ABAM. Portland, OR. September 2014.
- City of Stevenson Sewer Population Benchmarks/Projections. Prepared by the City of Stevenson Planning Department. March 2016.
- City of Stevenson Wastewater Treatment Plant Upgrade Operations and Maintenance Manual. Prepared for the City of Stevenson by KCM. Portland, OR. July 1993.
- City of Stevenson Emergency Outfall Work Environmental Record. Prepared for the City of Stevenson by Gray & Osborne, Inc. Seattle, WA. April 2013.
- City of Stevenson Reasonable Potential Analysis. Prepared for the City of Stevenson by Cosmopolitan Marine Engineering. Gig Harbor, WA. March 2013.

1.3 WASTEWATER SERVICE AREA DESCRIPTION

1.3.1 Physical Features

Geographic Limits

The City of Stevenson covers 1.79 square miles in the Columbia River Gorge, approximately 45 miles east of Portland and 5 miles east of Bonneville Dam. It is surrounded by unincorporated Skamania County. The nearest neighboring cities are Carson approximately 3 miles to the northeast and North Bonneville approximately 4 miles to the southwest. The City's Urban Area was set by federal statute in 1986 with creation of the Columbia Gorge National Scenic Area. The planning area for this facilities plan is defined as the Urban Area, which is shown on Figure 1-1.

Source: Stevenson Comprehensive Plan, April 2013

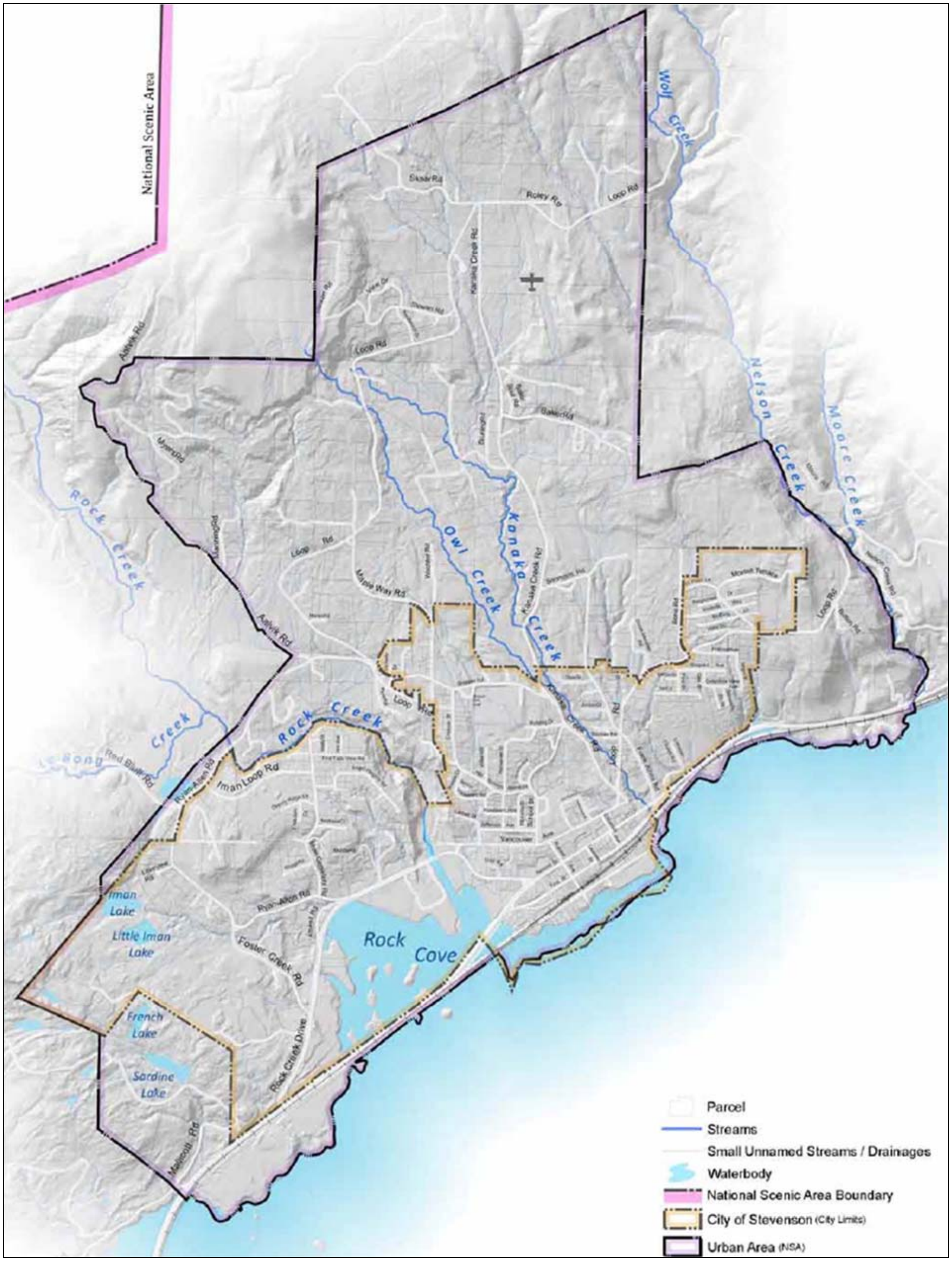


Figure 1-1. Boundary Map

Topography and Geology

The City of Stevenson is on the north bank of the Columbia River, within the scenic Columbia Gorge. Figure 1-2 shows the general vicinity and topography. Stevenson is located on a gently sloping shoreline adjacent to the reservoir pool that Bonneville Dam creates in the Columbia River.

Source: nationalmap.gov

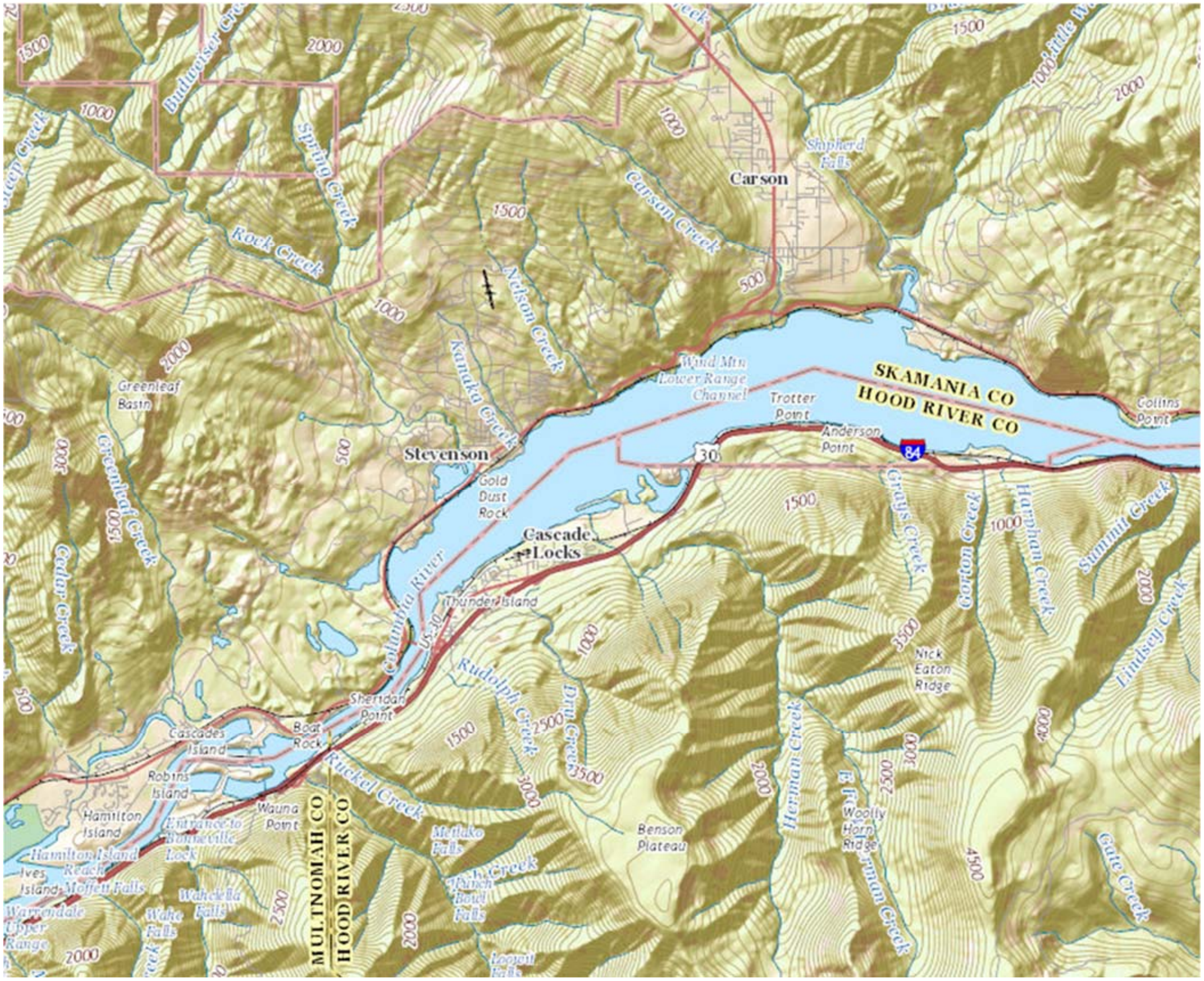


Figure 1-2. Vicinity Map

Elevations within Stevenson's corporate limits range from 74 feet mean sea level (MSL) to more than 450 feet MSL within one mile of the Columbia River shoreline. Land at elevations between 74 feet and 77 feet MSL is susceptible to flooding due to fluctuations in the Bonneville Dam Reservoir. The average reservoir level is 74 feet MSL, with the maximum operating level being 77 feet MSL. Just beyond the boundaries of the city, the geography changes from a steadily rising plane to a series of small, steeply sided valleys. The valley rims reach heights that are 2,000 feet above the river level within 3 miles of its shore. Rock Creek flows through one of the valleys and through the center of the city to its confluence with the Columbia River.

Most of the city lies within the Rock Creek drainage basin, which flows north to south to enter the Columbia River at a point in the Skamania County Fairgrounds. The eastern portion of the City drains to Kanaka Creek prior to entering the Columbia River.

Climate

The climate is generally mild. Stevenson is located between the Coast Range and the Cascade Range of mountains. The Coast Range protects this area from the force of winter storms originating off the Pacific Coast. The Cascade Range prevents the extreme summer temperatures of the eastern portion of the state from affecting the area. The average annual precipitation over the past three years is 79.3 inches, with 75 percent of the rain occurring from November through May. The mean temperature for the region is 50.8 degrees Fahrenheit.

1.3.2 Built Environment

Wastewater System Ownership and Operation

The City of Stevenson owns and operates all portions of its wastewater system, with the exception of the Stevenson Wastewater Treatment Plant, which is owned by the City but operated by CH2M contract operations. CH2M operates the Hood River WWTP and uses this as a home base for its staff that operate the Stevenson plant. Contact information is as follows:

- Stevenson WWTP Phone: (509) 427-5970
- Stevenson WWTP Address: 7121 E Loop Road, Stevenson, WA 98648
- Hood River WWTP Phone: (541) 368-242

Development Served

The City's wastewater system collects and treats wastewater from all sewered areas of the City of Stevenson. There are currently 437 residential and commercial sewer accounts. These consist primarily of single-family residences (324), commercial customers (68 accounts), public customers (17 accounts) and multi-family residential housing (28 accounts). There are no permitted significant industrial users currently authorized by the Department of Ecology (Ecology) in the City. However, the commercial user category includes both commercial kitchens and beverage producers, which are major sources of base flow and biochemical oxygen demand (BOD) in the City's wastewater system. Ecology has indicated that the increasing size and number of commercial high-strength-wastewater dischargers, and their impact on WWTP operations, means that greater oversight will be required in the City. New and existing large commercial users will be required to apply for discharge permits from Ecology.

The City had an estimated population of 1,530 as 2015. This includes an estimated 1,081 residents served by the City wastewater system. The remainder of the population is not connected to the wastewater system and instead is served by on-site septic systems.

The City's growth boundary was federally set under the Columbia River Gorge Scenic Area Act. The City is bounded on the south by the Columbia River and essentially can only grow to the north; growth to the east and west is constrained by Scenic Area boundaries. Topography to the north is steep and in certain areas subject to unstable ground conditions, limiting both the density and types of growth that can occur.

Water Supply

Water in Stevenson is supplied from LaBong Creek, Cedar Springs, and Rock Creek. Water from these sources is treated by the City's 1.0-million-gallon-per-day (mgd) water treatment plant, constructed in 1979. The City also holds water rights for groundwater withdrawals that are currently used as a backup supply. The primary groundwater source is Hegewald Well, with a 650-gallon-per-minute (gpm) installed production capacity. Iman Springs, a supplemental surface water source, is currently off line until transmission facilities can be upgraded.

Adjacent Wastewater Systems

The only wastewater system currently adjacent to the City of Stevenson is the system owned and operated by the City of North Bonneville, about 4 miles southwest of the Stevenson treatment plant. The North Bonneville wastewater system serves all of the City of North Bonneville, with an estimated 2015 population of 971. A regional wastewater treatment approach does not appear practical; the only available community is relatively distant and significant portions of the area between the two communities have limited development potential due to restrictions placed by the Columbia River Gorge National Scenic Area.

1.4 PERMITS, REQUIREMENTS AND REGULATIONS

Wastewater must be collected, treated, and disposed of or reused in a way that protects public health and receiving water quality, generates no objectionable off-site odors or aesthetic nuisances, and complies with all applicable regulations. Wastewater treatment facilities must meet the regulations and requirements of many federal, state, and local regulatory agencies. Appendix A presents rules and regulations that typically apply to wastewater projects. Key points are summarized in the sections below.

1.4.1 Federal Regulations and Guidelines

Programs and policies to protect water quality were first initiated on a nationwide scale by the federal Water Pollution Control Act of 1956. That act has seen numerous amendments, including the Clean Water Act of 1977, which, among other changes, established National Pollutant Discharge Elimination System (NPDES) permits that regulate point discharges into water. The current Water Pollution Control Act requires publicly owned wastewater treatment facilities to provide a minimum of secondary treatment, with the following standards for effluent quality:

- The monthly average of BOD and total suspended solids (TSS) concentrations shall not exceed 30 milligrams per liter (mg/L).
- The weekly average of BOD and TSS concentrations shall not exceed 45 mg/L.
- The monthly average removal of BOD and TSS shall be at least 85 percent.
- The pH of the effluent shall be between 6.0 and 9.0.

Sewage solids generated at wastewater treatment plants is subject to standards set under Part 503 of the Code of Federal Regulations. Solids management requirements under this regulation apply to pathogen reduction, vector-attraction reduction, metals concentrations, reporting, monitoring, and management practices.

An important reference for wastewater treatment plant equipment reliability is the U.S. Environmental Protection Agency’s 1974 *Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability*. This document outlines requirements in three reliability classes, with provisions for each common treatment plant unit process.

Beyond these wastewater-specific federal requirements, any work proposed in this facilities plan will have to comply with federal requirements relating to the environment, agricultural lands, and cultural and historic resources.

In addition to regulatory requirements, the U.S. Environmental Protections Agency (EPA) has developed a set of guidelines for wastewater system practices to reduce sewage overflows. The guidelines are recommended but not required. They are presented in the EPA’s Capacity, Management, Operation and Maintenance (CMOM) program. CMOM programs incorporate many standard operation and maintenance activities, but they also include information management to achieve the following:

- Better manage, operate, and maintain collection systems
- Investigate capacity-constrained areas of the collection system
- Proactively prevent sanitary sewer overflows
- Respond to sanitary sewer overflows.

Under the 1977 federal Executive Order 11988, regulatory oversight agencies for federally regulated projects must consider floodplains and their management in making project-related decisions.

1.4.2 State Policies and Regulations

Washington State has developed several requirements pertaining to surface water quality that are relevant for wastewater planning in Stevenson:

- The state's Water Quality Standards for Surface Waters (WAC 173-201A) define expected uses for various segments of the Columbia River, with water quality criteria that apply to each segment depending on its designated uses.

The Washington Department of Ecology oversees the NPDES permitting of the City of Stevenson wastewater treatment plant. The current permit (Permit No. WA0020672), modified in June 2013, defines the following requirements (the permit is provided in Appendix B):

- The following limits are established for influent flow to the treatment plant, per Section S4, Prevention of Facility Overloading (note that the BOD limit is lower than the plant's actual current influent BOD loading, indicating that the plant is overloaded):
    - Average treatment plant influent flow for the maximum month not to exceed 0.45 mgd,
    - BOD influent loading for the maximum month not to exceed 612 pounds per day (ppd)
    - TSS influent loading for the maximum month not to exceed 612 ppd
- Effluent limits are established as summarized in Table 1-1
- Monitoring requirements are defined, including monitoring of effluent nutrient and temperature levels

Table 1-1. NPDES Permit Limits for Stevenson Wastewater Treatment Plan Effluent Discharge

Parameter	Monthly	Weekly
Biochemical Oxygen Demand (5-day)		
Maximum Average Concentration	30 mg/L	45 mg/L
Maximum Average Load	92 ppd	138 ppd
Minimum Average Removal of Influent Load	85%	—
Total Suspended Solids		
Maximum Average Concentration	30 mg/L	45 mg/L
Maximum Average Load	92 ppd	138 ppd
Minimum Average Removal of Influent Load	85%	—
Fecal Coliform Bacteria		
Geometric Mean	200/100 mL	400/100 mL
Daily pH		
Minimum	6.0	
Maximum	9.0	

The state also has its own standards for water reclamation, use and disposal of solids, treatment plant equipment reliability, on-site sewage (septic) systems, and protection of environmental and cultural resources. These standards are described in the Department of Ecology's *Criteria for Sewage Works Design* (the Orange Book).

1.4.3 Local Policies

The City of Stevenson municipal code establishes requirements for installing sewer systems with new or revised development in the city. The code also sets regulations that may apply to work proposed in this facilities plan, relating to critical areas, stormwater management, shoreline protection, and building structural and fire safety.

2. PLANNING INFORMATION

2.1 GROWTH PROJECTIONS

Planning for wastewater system future needs requires projections of growth in the planning area. Such projections determine the expected quantities of wastewater that system facilities need to be able to accommodate over the course of a defined planning period. The planning period for this sewer plan is through 2040. The following sections describe anticipated changes in land use over that period and the associated growth in population.

2.1.1 Residential Population Growth

A projection of future population growth was provided by the City of Stevenson Planning Department, based on historic growth rates for the City and Skamania County. This projection shows population increasing from 1,530 in 2016 to 1,901 in 2040. This equates to a growth rate of approximately 0.87 percent per year. The City's estimates on population per household vary based on the source, but this report assumed it to be approximately 2.21 at the current density.

2.1.2 Equivalent Residential Units

Wastewater flows are contributed by residential and commercial/industrial/public sources, and therefore are affected by planning area population as well as planning area non-residential development. To simplify wastewater planning and ensure consistency, non-residential sources are often estimated as a comparable residential source, using the concept of the equivalent residential unit (ERU). An ERU represents the amount of wastewater contributed by an average residential household in the planning area.

Based on winter water usage records provided by the City, average water use in the City was calculated to be approximately 55 gallons per capita per day (gpcd). Wastewater generation was assumed to be roughly equal to water use. Using the average household size of 2.21 persons per household, this means that one ERU is equivalent to about 122 gallons per day of wastewater. For the majority of water users in the City, winter water use was used to estimate the number of ERUs; however, for Skamania Lodge, an annual average water use was used due to the winter being a low period in water use for this user. The City was estimated to have 489 residential sewer ERUs and 621 non-residential sewer ERUs in 2016.

Residential ERU growth

Residential ERUs will typically grow at a faster rate than overall population because new development can be assumed to occur in sewered areas of the City. As a result, using the population projections discussed above and the average household size of 2.21, the number of residential ERUs is projected to increase by 168 by 2040, an average annual growth rate of 1.19 percent. For sewer modeling purposes, it was assumed that this increase in residential ERUs is expected to be faster in from 2017 through 2020, due to the 83-lot Chinidere residential development currently being built.

In addition to new growth, two sewer basins in the City—Loop Road and Iman Cemetery Road—are likely to receive sewer service during the planning period as a result of planned sewer extensions. Within these basins, it was assumed that all parcels will convert to sewer from septic over a period of five years after each sewer extension is constructed, due to City requirements to connect to public sewers when they are available. The Loop Road sewer extension is conservatively assumed to be constructed in 2021 and result in a total of 54 new sewer ERUs. The Iman Cemetery Road sewer extension is conservatively assumed to be constructed in 2026 and result in 32 new sewer ERUs. If these projects occur at a later date, the change will not affect the City's scheduling of capital projects, because the estimated additional flows are only about 5 percent of the total flow in 2040.

Future Non-Residential ERU Growth

Non-residential sewer ERUs in the City include commercial, industrial, and public sewer users. Non-residential growth in the City is assumed to be approximately proportional to residential growth. However, the City has recently experienced significant growth in the beverage industry (breweries, distilleries, etc.). While beverage sector users were estimated to represent only 55 of the 621 non-residential ERUs at the start of 2016, these users' high growth potential and often high-strength wastewater mean that these ERUs have been broken out as a subset of non-residential ERUs when considering future growth.

Beverage ERUs are assumed to grow at a rate twice that of the residential ERUs, or an average of 2.38 percent each year. This results in an additional 64 ERUs by 2040. In addition to this steady growth, there was a higher rate of growth in 2016 due to the startup of new beverage industry businesses that added an estimated 27 ERUs. The growth rate is expected to return to the estimated 2.38 percent after 2016 because much of the available waterfront building space that is well suited for this type of use is now occupied. Combining the faster growth in 2016 and steady growth thereafter, a total of 89 new beverage ERUs will be added by 2040. It should be noted that the understanding of growth for high load industry is still developing.

All other non-residential ERUs are assumed to grow at a rate equal to that of residential ERUs, or an average of 1.19 percent each year. This will result in an additional 195 ERUs by 2040.

Summary

Table 2-1 and Figure 2-1 summarize the projected growth of residential and non-residential ERUs in Stevenson.

2.2 WASTEWATER FLOWS

Wastewater system improvements must be sized to have adequate capacity for the wastewater flows the system is projected to convey and treat over the course of the planning period. Future wastewater flows are estimated using the projections of future population and development in combination with two types of design criteria:

- Unit design criteria define the typical amount of flow from a single "unit" such as a person, household, business, or acre of land. Numerous sources are available for determining the best accepted standard unit flows and loads for a given planning area.
- Peaking factors define standard ratios between average flows and likely peak values.

System flows consist of base sewage flow from connected customers as well as infiltration and inflow (I/I) into the system from groundwater and stormwater. The sections below describe total flows as well as the individual components of flow.

2.2.1 Historical Total Treatment Plant Influent Flows

Total wastewater flows from the City service area are measured by the effluent flow meter at the wastewater treatment plant. The effluent flow meter provides the only measurement of total treatment plant flows. It provides an accurate indication of daily-average influent flows, but not instantaneous or peak-hour flows, because influent flow variations are attenuated through the plant upstream of the effluent flow meter. Table 2-2 summarizes historical sewage flows measured at the treatment plant.

Table 2-1. ERU Growth Summary

Year	City Population	Residential Sewer ERUs			Non-Residential Sewer ERUs					Total ERUs
		New from Septic Conversion	New from Development	Total	Beverage New	Beverage Total	Non-Beverage New	Non-Beverage Total	Total	
Current	1,530	0	0	489		55	0	566	621	1,110
2016	1,543	0	3	492	1	82	7	573	655	1,147
2017	1,557	0	21	513	2	84	7	580	664	1,177
2018	1,570	0	21	534	2	86	7	587	673	1,207
2019	1,584	0	21	555	2	88	7	594	682	1,237
2020	1,598	0	20	575	2	90	7	601	691	1,266
2021	1,612	11	3	590	2	92	7	608	700	1,290
2022	1,626	11	3	604	2	94	7	615	709	1,314
2023	1,640	11	4	619	2	97	7	622	719	1,338
2024	1,655	11	4	634	2	99	7	630	729	1,362
2025	1,669	10	4	647	2	101	7	637	739	1,386
2026	1,684	7	4	658	2	104	8	645	749	1,407
2027	1,698	7	4	669	2	106	8	653	759	1,428
2028	1,713	6	4	679	3	109	8	660	769	1,448
2029	1,728	6	4	689	3	111	8	668	779	1,469
2030	1,743	6	4	700	3	114	8	676	790	1,490
2031	1,758	0	4	704	3	117	8	684	801	1,505
2032	1,774	0	4	708	3	119	8	692	812	1,520
2033	1,789	0	4	712	3	122	8	701	823	1,535
2034	1,805	0	4	717	3	125	8	709	834	1,551
2035	1,821	0	4	721	3	128	8	717	845	1,567
2036	1,836	0	4	726	3	131	9	726	857	1,583
2037	1,852	0	4	730	3	134	9	734	869	1,599
2038	1,869	0	4	734	3	138	9	743	881	1,615
2039	1,885	0	4	739	3	141	9	752	893	1,632
2040	1,901	0	5	743	3	144	9	761	905	1,649
Increase	371	n/a	n/a	254	n/a	89	n/a	195	284	539

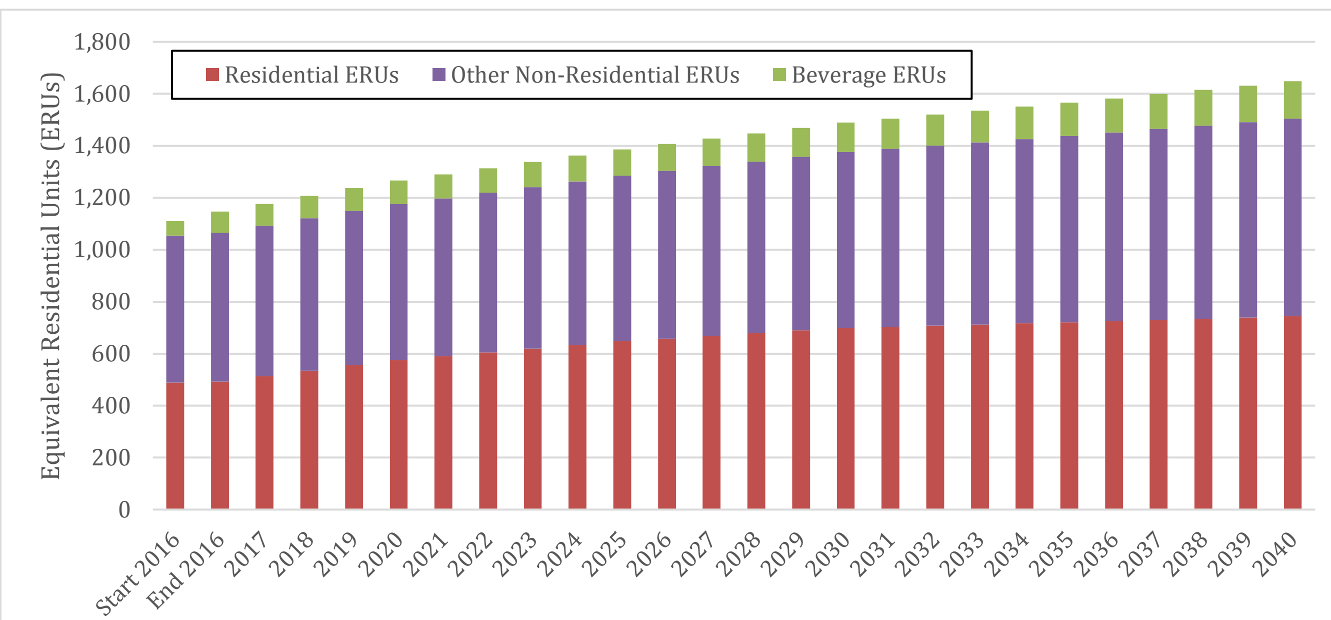


Figure 2-1. ERU Growth Chart

Table 2-2. Historical Treatment Plant Flow Data

Year	Average Dry-Weather Flow (mgd)	Annual Average Flow (mgd)	Maximum-Month Flow (mgd)	Peak-Day Flow (mgd)
2007	0.156	0.180	0.319	0.849
2008	0.167	0.191	0.245	0.967
2009	0.141	0.186	0.289	1.127
2010	0.151	0.201	0.404	0.992
2011	0.108	0.168	0.286	0.940
2012	0.120	0.212	0.424	1.290
2013	0.120	0.141	0.205	0.954
2014	0.107	0.171	0.325	0.805
2015	0.119	0.165	0.401	0.890
2016	0.147	0.190	0.290	0.506

2.2.2 Infiltration and Inflow

The following data are of note:

- Average dry-weather flow during the extremely dry summer of 2015 was 0.119 mgd.
- The annual average flow has grown to 0.165 mgd.
- The maximum-month flow was 0.424 mgd in January 2012.
- The greatest peak-day flow was 1.29 mgd, on January 21, 2012 following an extremely rainy period.

Infiltration and inflow are sources of water other than sanitary sewage entering the sewer system:

- Infiltration is typically defined as groundwater that enters a wastewater conveyance system through cracks or other defects in buried infrastructure. Infiltration can be categorized as rapid or base. Rapid infiltration is observed soon after rainfall events; base infiltration is present during dry periods and is generally associated with high groundwater, which can have seasonal variations.
- Inflow is precipitation runoff that enters a wastewater conveyance system through manhole covers, roof drains or other surface openings connecting to the system. It is difficult to differentiate rapid infiltration from inflow when analyzing flow records. They are often combined and referred to as rainfall-derived I/I.

Figure 2-2 illustrates how base infiltration and rainfall-derived I/I can contribute to total wastewater system flows over a period of several days.

Stevenson's wastewater system must have capacity for both base flow and I/I, which occurs in all sanitary sewer systems in western Washington. The City has taken steps to control I/I for many years. The City's total wastewater flow rate is significantly affected by I/I. The rainfall and flow graph in Figure 2-3 shows that flow at the treatment plant is highly correlated with rainfall.

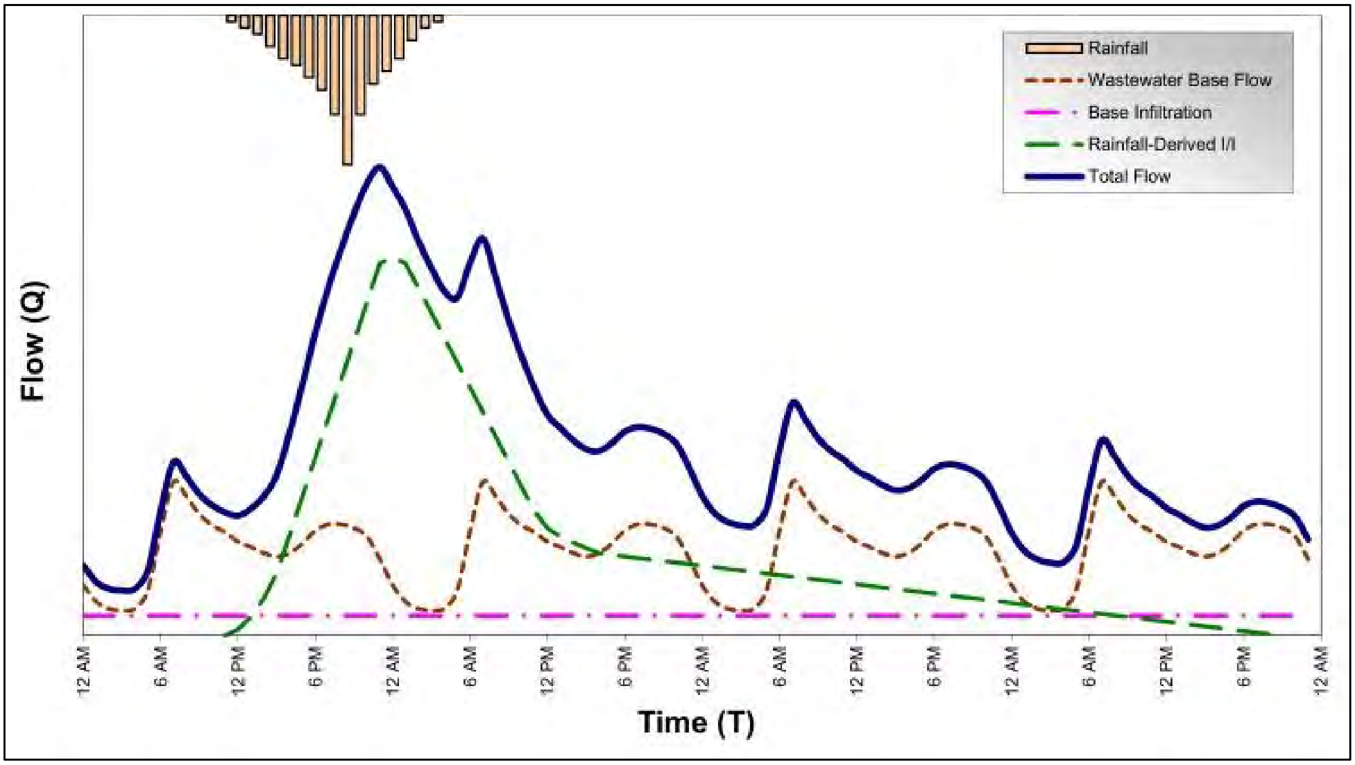


Figure 2-2. Wastewater Components of Flow

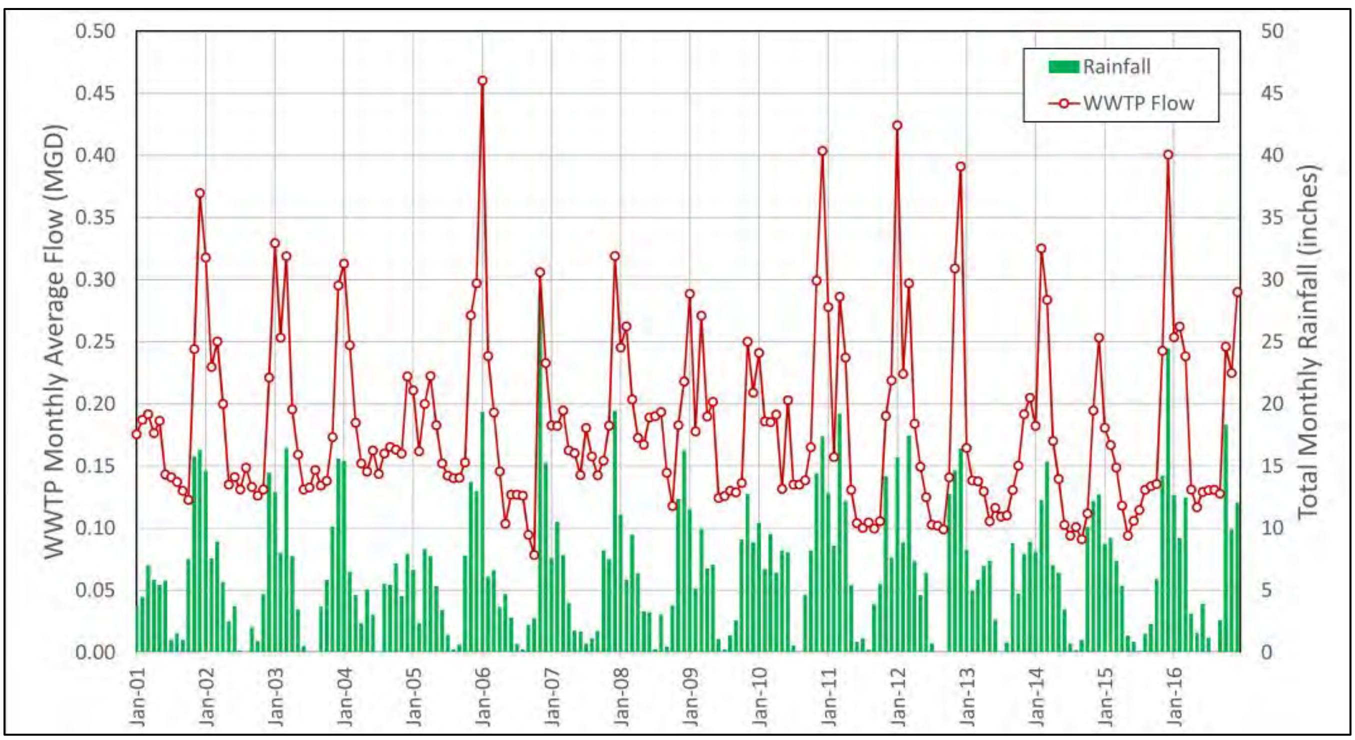


Figure 2-3. WWTP Monthly Average Flow and Total Rainfall 2001 – 2016

Estimated Current I/I

I/I is commonly evaluated as a unit flow per acre of contributing area. The per-acre unit I/I in gallons per acre per day (gpad) was estimated based on WWTP flow data for average annual flow, maximum-month flow, peak-day flow, and peak-hour flow. I/I was calculated from the total flow data by subtracting the assumed sanitary base flow of 0.121 mgd (see Section 2.2.3). The result was then divided by the contributing service area of 335 acres. Based on the analysis of discharge monitoring reports from 2001 through 2016, I/I rates were calculated as shown in Table 2-3.

Table 2-3. Recorded I/I Flows, 2001-2016

	Average Annual Flow	Maximum-Month Flow	Peak-Day Flow	Peak-Hour Flow[c]
Date of Recorded Event	2001 – 2016	January 2006	January 21, 2012	January 21, 2012
Total Recorded Flow	0.18 mgd	0.46 mgd	1.29 mgd	1.94 mgd
Calculated I/I Flow[a]	0.06 mgd	0.34 mgd	1.17 mgd	3.06 mgd
Unit I/I Flow[b]	185 gpad	1,012 gpad	3,499 gpad	5,058 gpad

a. I/I flow calculated as total recorded flow minus the sanitary base flow value listed in Section 2.2.3.
b. Unit I/I flow calculated as I/I flow divided by the service area of 335 acres.
c. Continuous flow monitoring data is not recorded at the WWTP. Peak-Hour Flow is therefore estimated as 1.5 x Peak-Day Flow.

Influence of Climate Change on Precipitation and I/I

For 2030 to 2059, change in annual average precipitation in the Northwest is projected to be within a range of an 11-percent decrease to a 12-percent increase, according to the 2014 National Climate Assessment by the U.S. Global Change Research Program. Very heavy precipitation events have increased nationally and are projected to increase in all regions. Therefore, an increase allowance of 10 percent in I/I in existing sewers due to heavy precipitation events was included in the projection of future flows.

I/I Design Criteria for This Sewer Plan

Facility plan design criteria for I/I are summarized in Table 2-4.

Table 2-4. I/I Design Criteria

	Existing Sewers	New Sewers
Annual Average I/I Unit Flow	204 gpad	100 gpad
Maximum-Month I/I Unit Flow	1,114 gpad	550 gpad
Peak-Day I/I Unit Flow	3,849 gpad	1,700 gpad
Peak-Hour I/I Unit Flow	5,565 gpad	2,500 gpad

These criteria were selected as follows:

- I/I in existing sewers is assumed to increase by 10 percent throughout the planning period from the current levels shown in Table 2-3. This assumes the City will implement an annual I/I maintenance program to prevent existing I/I from increasing due to defects in the collection system infrastructure. The 10-percent increase is an allowance for future larger storms resulting from future climate change.
- I/I for new sewers is assumed to be as follows:
  - ➢ A new-sewer peak-hour I/I rate of 2,500 gpad is assumed, based primarily on King County 2014 planning criteria. This represents a realistic level of I/I for new sewers in western Washington.
  - ➢ Average annual, maximum-month and peak-day I/I unit flows for new sewers were calculated assuming that the ratio of each of those flows to the peak-hour flow is approximately the same as for existing sewers.

2.2.3 Wastewater Flow Design Criteria

To evaluate the capacity of existing WWTP facilities and size future facilities, the following design conditions were considered:

- Dry weather average—Represents typical influent wastewater flow, expressed as a daily average
- Maximum month—Represents largest 30-day flow anticipated to occur during a continuous 30-day period, expressed as a daily average
- Peak day—Represents largest flow anticipated to occur during a 24-hour period
- Peak hour—Represents largest flow anticipated to occur during a 1-hour period

For future projections, 2025 and 2040 were selected as design years.

Base Flow

Base flows are the direct contributions of sewage to a wastewater system from connected residential and commercial users. As described in Section 2.1.2, the average wastewater generation in the City was assumed to be 55 gallons per capita per day (based on City winter water use records supplemented with annual water use records for Skamania Lodge) and average household size was assumed to be 2.21 persons per household, meaning that one ERU was equivalent to about 122 gallons per day of wastewater. The starting point for both flow and load projections was the start of calendar year 2016, at which time it was estimated that the City had 489 residential sewer ERUs and 621 non-residential sewer ERUs, resulting in an estimated total base flow of 0.135 mgd. For analysis of I/I, a lower base flow of 1.21 mgd for the wet-weather season was used, representing a reduced water use because Skamania Lodge is in its seasonal low water use period.

Maximum-Month Flow

Historical maximum-month flows at the Stevenson WWTP occur in winter, indicating that precipitation-driven I/I in the sewer system is a factor. Due to the importance of weather events, the current maximum-month flow was selected based on the highest observed maximum-month flow: 0.460 mgd, in January 2006.

Peak-Day Flow

Like maximum-month flows, peak-day flows occur in winter and are associated with precipitation events. The current peak-day flow was selected based on the highest observed peak-day flow: 1.290 mgd, on January 21, 2012.

Peak-Hour Flow

Hourly flow data are not collected at the WWTP, so current peak-hour flows were estimated based on the peak-day flow. Peaking factors for peak-day to peak-hour flow were reviewed for nine WWTPs throughout western Oregon and Washington and were found to have an average of 1.50. Using this 1.50 peaking factor and the peak-day flow of 1.290 mgd, the peak-hour flow was calculated to be 1.935 mgd.

2.2.4 Projected Future Flows

Flow projections include two components. First, the base flows increase as a result of new residential users and new or expanded non-residential sewer users. Second, I/I contributions increase as the sewer system both grows and ages. Table 2-5 summarizes flow projections in the design years 2025, 2030, and 2040. Figure 2-4 shows historic flow information (annual dry weather average, maximum month, and peak day) and projected flows (base, maximum month, and peak day).

Table 2-5. Current and Projected Flow Design Conditions

	2016	2025	2030	2040
Base (Dry Weather Average) Flow	0.135 mgd	0.168 mgd	0.181 mgd	0.200 mgd
Maximum-Month Flow	0.460 mgd	0.539 mgd	0.578 mgd	0.657 mgd
Peak-Day Flow	1.30 mgd	1.46 mgd	1.54 mgd	1.71 mgd
Peak-Hour Flow	1.96 mgd	2.19 mgd	2.31 mgd	2.56 mgd

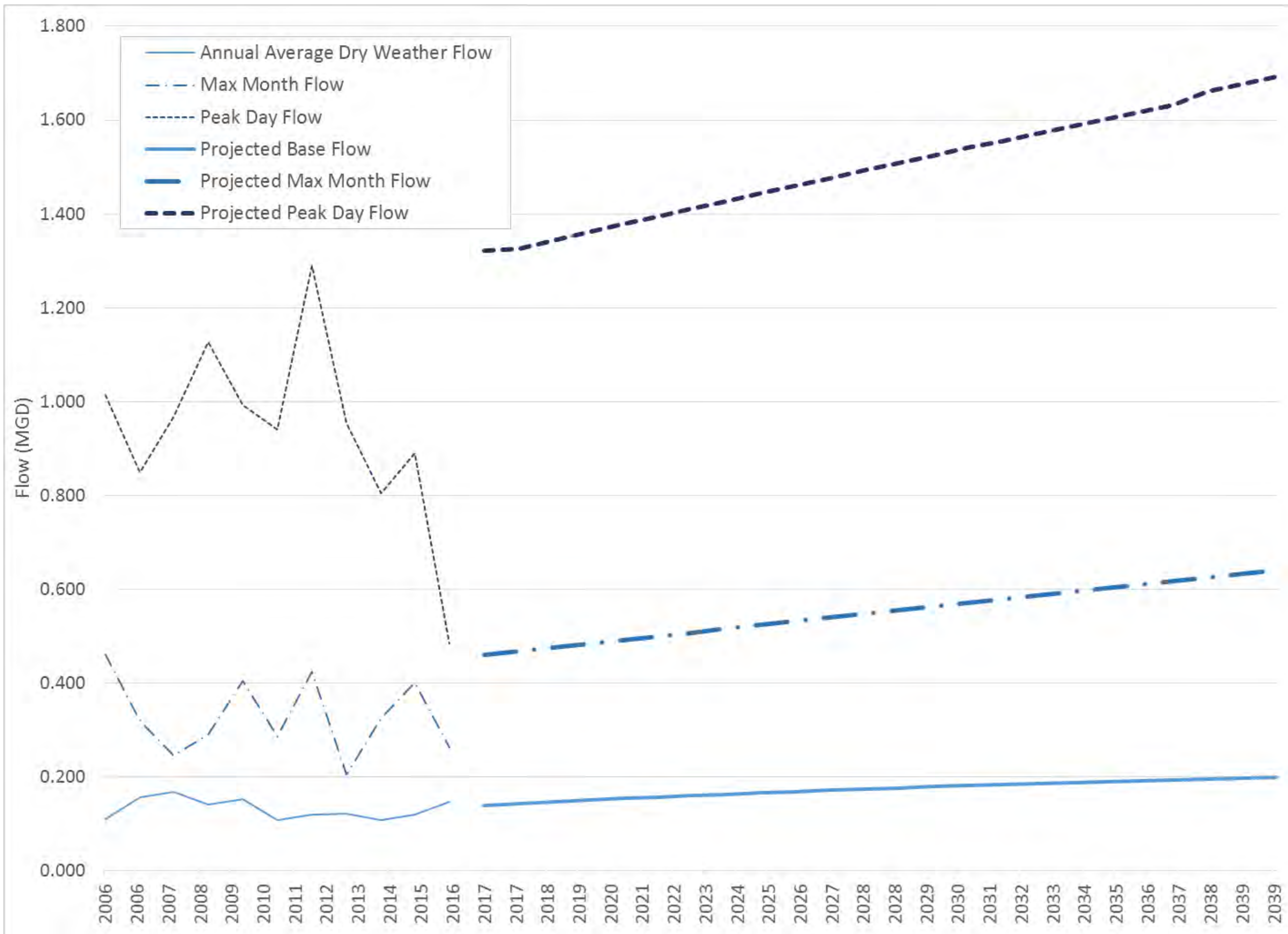


Figure 2-4. Historic and Projected Flows

Projected base flows were calculated using the yearly ERU estimate described in Section 2.1.2 and the assumption that the household size and flow per ERU will remain comparable. Projected maximum-month flows were obtained from the Stevenson sewer system model developed by Tetra Tech, and assume a linear growth in maximum-month flows due to steady growth in I/I flow. Projected peak-day flows were calculated by adding the projected base flow to a peak-day I/I flow. Peak-day I/I flows were obtained from the Stevenson sewer system model developed by Tetra Tech.

Projected peak-hour flows were calculated using the projected base flow, projected peak I/I flows obtained from the sewer system model, and a diurnal peaking factor to account for variations in base sewer usage over the course of a typical day. The diurnal peaking factor used for base flows was 2.0, based on flow monitoring results from a similar project.

2.3 WASTEWATER LOADS

Wastewater treatment facilities must be sized to have adequate capacity to treat expected pollutant loads to the treatment plant through the end of the planning period. Like wastewater flows, wastewater loads are projected using the projections of future population and development in combination with unit design criteria and peaking factors. The key pollutant loads of interest for planning for Stevenson are biochemical oxygen demand (BOD) and total suspended solids (TSS). The sections below describe historical and projected future levels of these loads.

2.3.1 Influent BOD Loads

Historical BOD Loads

Currently, the BOD load in influent wastewater at the plant is measured twice per week. The historical BOD loads measured at the treatment plant from January 2006 to December 2016 are summarized in Figure 2-5 and Table 2-6. BOD loads generally increased during the recorded period, particularly in the last two years when commercial and industrial users are believed to have increased their discharge to the sewer system. Earlier peak loads in the period 2009 to 2012 are believed to have been caused by commercial users; increased regulation of grease trap use at commercial kitchens beginning in early 2012 resulted in lower loads.

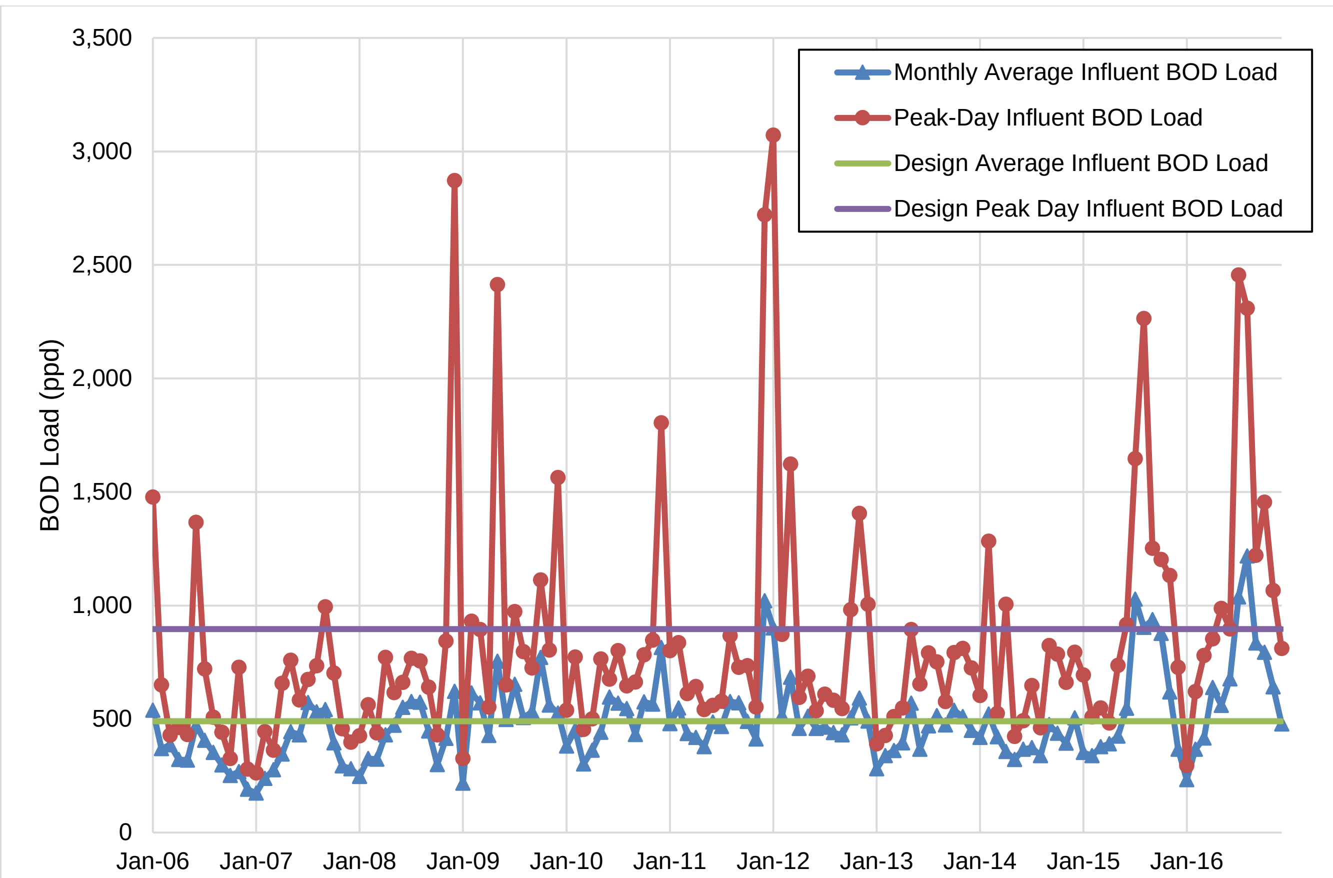


Figure 2-5. Historical Treatment Plant Influent BOD Loads

Table 2-6. Historical BOD Data

Year	Annual Average BOD Load (ppd)	Maximum-Month BOD		Peak-Day BOD	
		Load (ppd)	Peaking Factor	Load (ppd)	Peaking Factor
2006	348	539	1.55	1,477	4.24
2007	377	573	1.52	994	2.64
2008	440	621	1.41	2,871	6.53
2009	552	771	1.40	2,413	4.37
2010	503	815	1.62	1,804	3.59
2011	524	1,021	1.95	2,720	5.19
2012	537	901	1.68	3,071	5.72
2013	439	569	1.30	894	2.04
2014	411	521	1.27	1,282	3.12
2015	597	1,027	1.72	2,263	3.79
2016	664	1,218	1.83	2,456	3.70

BOD Design Criteria for This Facilities Plan

Residential BOD load was assumed to be 0.2 pounds per day (ppd) per capita, as recommended in Table G2-2 of the Department of Ecology's *Criteria for Sewage Works Design* (the Orange Book). Using the average household size of 2.21, this results in a base load of 0.44 ppd per ERU.

BOD load from high-load commercial dischargers ("high-load" is defined as significant quantities of high-strength wastewater; at present, all high-load dischargers in the City are beverage producers) was estimated based on the sampling program results documented in the pretreatment memo included in Appendix F. Samples were collected from three beverage producers, which had average BOD loads of 2.45, 2.82, and 3.05 ppd per ERU during the sampling period. The average of these readings is 2.82 ppd per ERU, which was used as the base load for high–load commercial (beverage) ERUs.

Significant BOD load from these high-load commercial dischargers is new to Stevenson, and the city has only performed one industrial waste survey (sampling program). More BOD data is needed in order to develop a better understanding of industrial dischargers' loadings.

The majority of non-residential, non-beverage wastewater in the City is received from Skamania Lodge. During the sampling program, the BOD load for Skamania Lodge was comparable to the assumed residential BOD load of 0.44 ppd per ERU, and this was used as the base load for non-residential, non-beverage ERUs.

Using these assumed loads and the estimated number of ERUs of each usage type at the start of 2016, the average BOD load was calculated to be 620 ppd. Influent data for October 2015 through September 2016 show that the recorded average BOD load was 653 ppd, which is within 5 percent of the calculated average BOD load, indicating that the selected assumptions are reasonable.

Maximum-Month BOD Load

Maximum-month BOD load was estimated using a peaking factor. Separate peaking factors were calculated for beverage and non-beverage (i.e. residential and other commercial) ERUs, because beverage industries are believed to experience relatively large changes in BOD strength due to batch operations and seasonal changes. Beverage industry peaking factors were estimated using a comparison of maximum-month and average-day BOD values in Stevenson WWTP influent data for the years 2015 and 2016, during which time beverage industries were operating in the City. Non-beverage peaking factors used data for 2013 and 2014, when flow from beverage industries was limited. This method yielded a beverage industry BOD peaking factor of 2.3 and a non-beverage peaking factor of 1.3.

Using the calculated annual average BOD load of 620 ppd and the above beverage and non-beverage peaking factors, the calculated maximum-month BOD load is 961 ppd for the start of 2016, rising to 1,142 ppd by the end of 2016 due to the significant growth of the beverage industry. Influent data for October 2015 through September 2016 show that the recorded maximum-month BOD load was 1,221 ppd, indicating that the selected peaking factor is reasonable.

Peak-Day BOD Load

Current peak-day BOD load was estimated using a comparable peaking factor approach to that used for maximum-month BOD load. This method yielded a beverage industry BOD peaking factor of 5.0 and a non-beverage peaking factor of 2.6.

Future BOD Projections

As described in the base loads section above, BOD loads are calculated for each year in the planning period based on the number of ERUs in the City. Maximum-month and peak-day BOD loads were calculated for each year based on the selected peaking factors multiplied by the average-day BOD loads. Table 2-7 summarizes load projections in the design years 2025 and 2040.

Table 2-7. Current and Projected BOD Design Conditions

	BOD (ppd)		
	Base (Dry Weather Average)	Maximum Month	Peak Day
No pretreatment			
2016	620	961	1,985
2025	852	1,394	2,902
2040	1,070	1,798	3,758
20% pretreatment			
2016	589	890	1,662
2025	795	1,262	2,307
2040	989	1,611	2,912
85% pretreatment			
2016	488	658	1,294
2025	609	835	1,687
2040	724	1,003	1,916

Future Maximum-Month BOD Projections for High-Load Commercial Dischargers

Current high influent BOD loading is higher than the Stevenson WWTP's permitted influent loading limit, per Section S4 of the City's NPDES permit. In response to this issue, the City instituted a sampling and testing program (industrial waste survey) in the fall of 2016 at seven locations, in order to identify and characterize major sources of high load wastewater. The sampling/testing results were used to prepare a preliminary assessment of source control and pretreatment alternatives for the major high load dischargers.

Two pretreatment options were prepared for this facilities plan, to project the impacts for the Stevenson WWTP given two different levels of pretreatment (source control) for the high-load dischargers:

- Option 1—Minimal Pretreatment. Under Option 1, high-load dischargers would install and continuously operate pretreatment facilities that would reduce their effluent BOD (discharged to the City sewer system) by approximately 20 percent.
- Option 2—Pretreatment to Domestic Strength. Under Option 2, high-load dischargers would install and continuously operate pretreatment facilities that would reduce their effluent BOD (discharged to the City sewer system) by approximately 85 percent. This 85-percent reduction in BOD load would mean that the effluent discharged to the City sewer system would be approximately domestic strength.

Figure 2-6 shows BOD loading to the Stevenson WWTP including the 20-percent reduction in BOD load from the high-load commercial dischargers. Figure 2-7 shows BOD loading including pretreatment to domestic strength (85-percent reduction in BOD load) from the high-load commercial dischargers.

Table 2-7 shows historical monthly BOD loads and projected BOD average, maximum-month, and peak-day BOD loads through 2040 with no pretreatment, 20 percent pretreatment, and 85 percent pretreatment. These pretreatment options are integrated into the WWTP improvement alternatives described in Chapter 8 of this facilities plan.

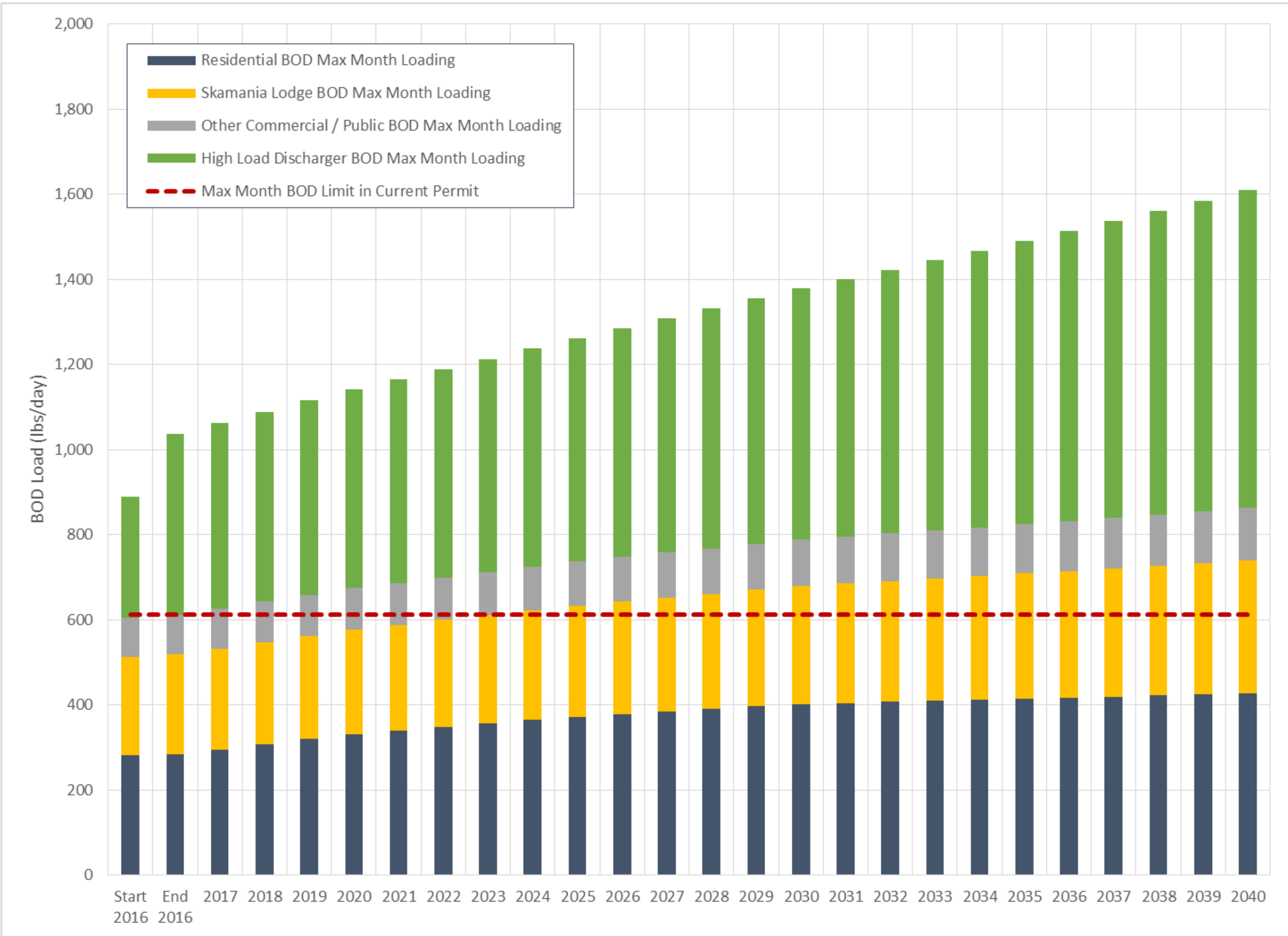


Figure 2-6. Maximum-Month BOD Loading with 20 Percent Pretreatment

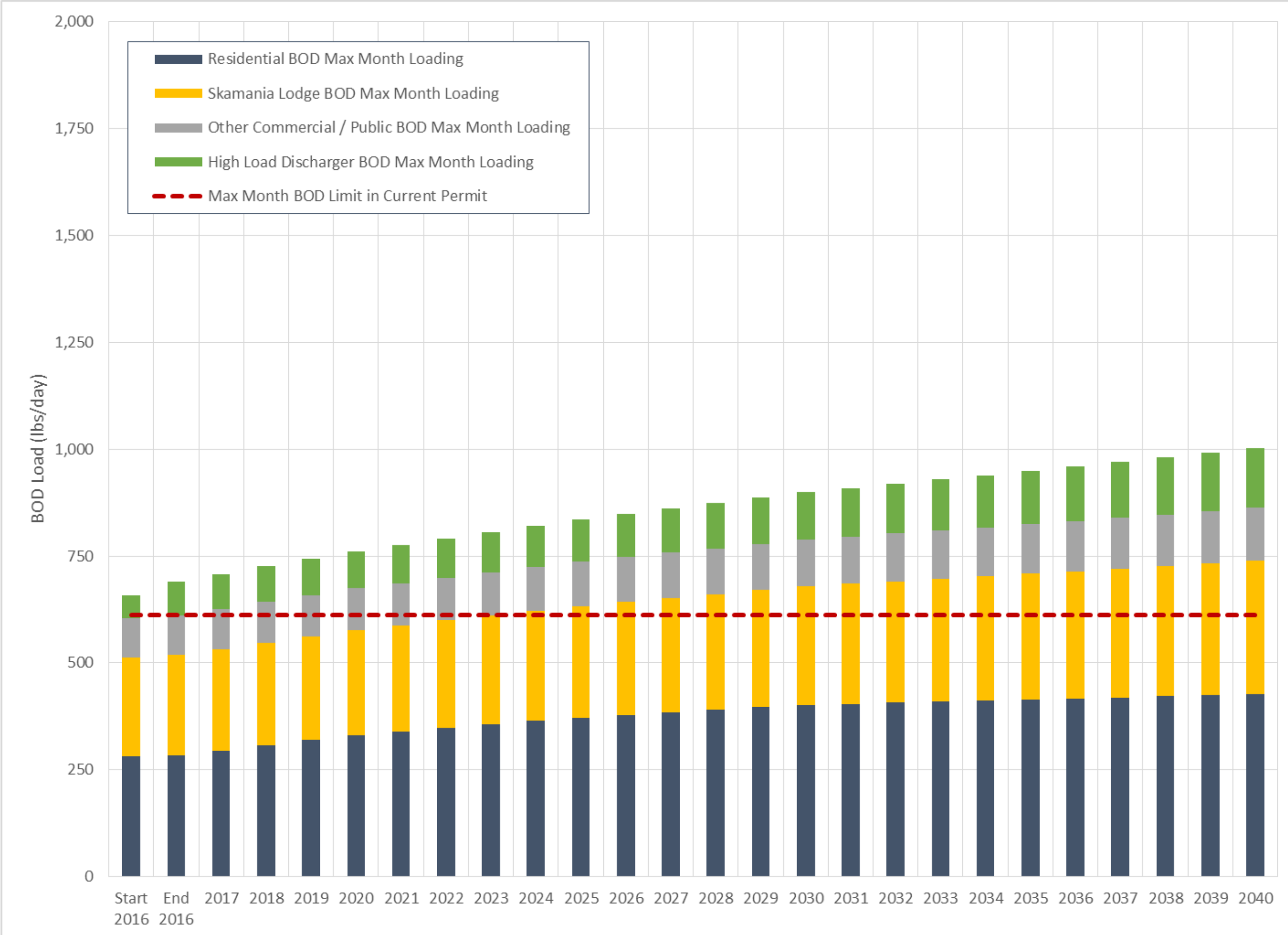


Figure 2-7. Maximum-Month BOD Loading with 85 Percent Pretreatment

2.3.2 Influent TSS Loads

Historical TSS loads

Influent concentrations of TSS are determined from analyses conducted on the same samples collected for BOD analyses. The historical TSS loads measured at the treatment plant from January 2006 to September 2016 are summarized in Table 2-8 and Figure 2-8. TSS loads generally increased during the recorded period. This growth is similar to growth in BOD loads during this period.

TSS Design Criteria for This Facilities Plan

The Orange Book recommends designing for a residential TSS load of 0.2 ppd per capita. TSS load data collected during the sampling program showed unexpectedly low TSS loads in proportion to BOD load at the same sampling points, despite TSS loads at the WWTP being comparable to BOD loads during the sampling period. As a result, TSS load results from the sampling period were not used to estimate future TSS load.

The ratio of BOD to TSS was calculated for daily influent data recorded at the WWTP. The average ratio for the last 10 years was 1.323, and the average ratio for the last two years was 1.291. However, because the reason for the low proportion of TSS loading to BOD loading is not known, for the purpose of projecting TSS loads it has been conservatively assumed that future TSS loads will be equal to future BOD loads.

Table 2-8. Historical TSS Data

Year	Annual Average TSS Load (ppd)	Maximum-Month TSS		Peak-Day TSS	
		Load (ppd)	Peaking Factor	Load (ppd)	Peaking Factor
2006	310	507	1.64	869	2.80
2007	286	403	1.41	522	1.83
2008	360	594	1.65	1,548	4.30
2009	396	592	1.49	1,483	3.74
2010	416	623	1.50	1,018	2.45
2011	431	562	1.30	1,135	2.63
2012	334	437	1.31	1,158	3.47
2013	329	437	1.33	1,161	3.53
2014	397	706	1.78	2,580	6.50
2015	472	848	1.80	1,481	3.14
2016	537	866	1.61	2,273	4.23

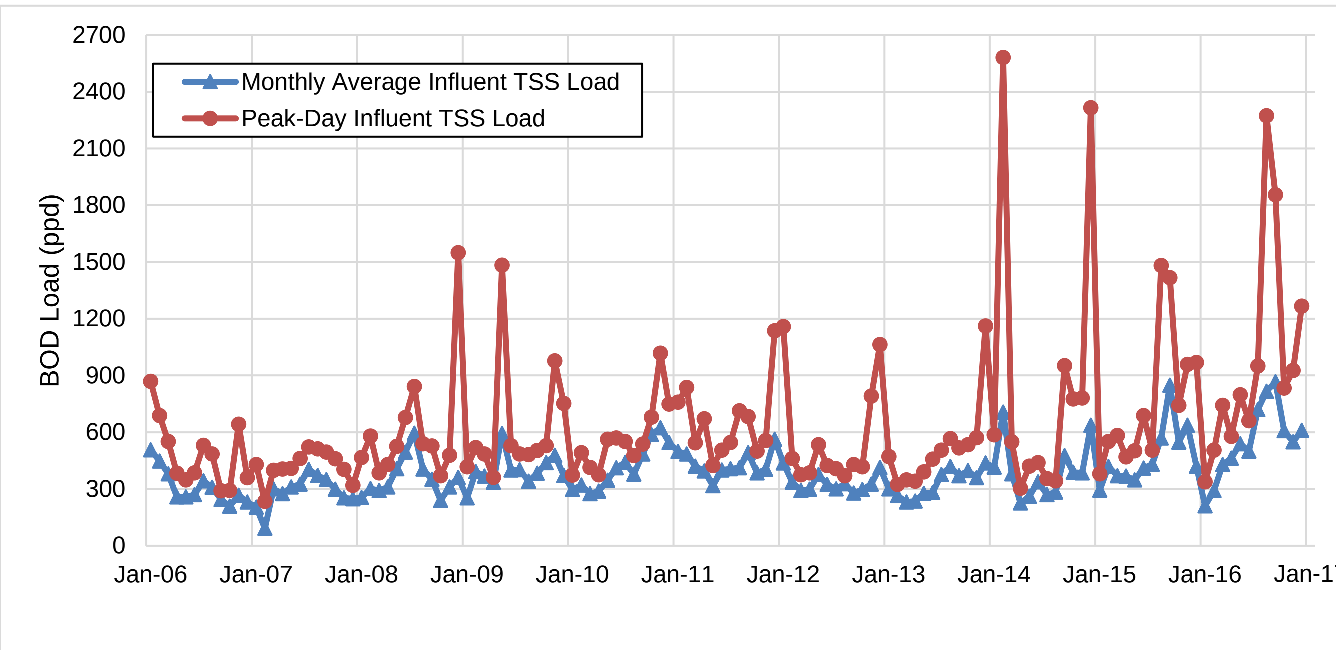


Figure 2-8. Historical Treatment Plant Influent TSS Loads

Using this ratio and the estimated BOD load at the start of 2016, the average TSS load was calculated to be 620 ppd. For the end of 2016, due to the increased flows and loads from rapid growth in the beverage industry, the average TSS load was calculated to be 539 ppd, indicating that the selected assumptions are reasonable.

Future TSS loads

As described in the section above, TSS loads are calculated based on the calculated BOD loads. Table 2-9 summarizes flow projections in the design years 2025 and 2040. Figure 2-9 shows historic monthly TSS loads and projected TSS average, maximum-month, and peak-day TSS loads through 2040 with no pretreatment, 20 percent pretreatment, and 85 percent pretreatment.

Table 2-9. Current and Projected TSS Design Conditions

	TSS (ppd)		
	Base (Dry Weather Average)	Maximum Month	Peak Day
No pretreatment			
2016	620	961	1,985
2025	852	1,394	2,902
2040	1,070	1,798	3,758
20% pretreatment			
2016	589	890	1,662
2025	795	1,262	2,307
2040	989	1,611	2,912
85% pretreatment			
2016	488	658	1,294
2025	609	835	1,687
2040	724	1,003	1,916

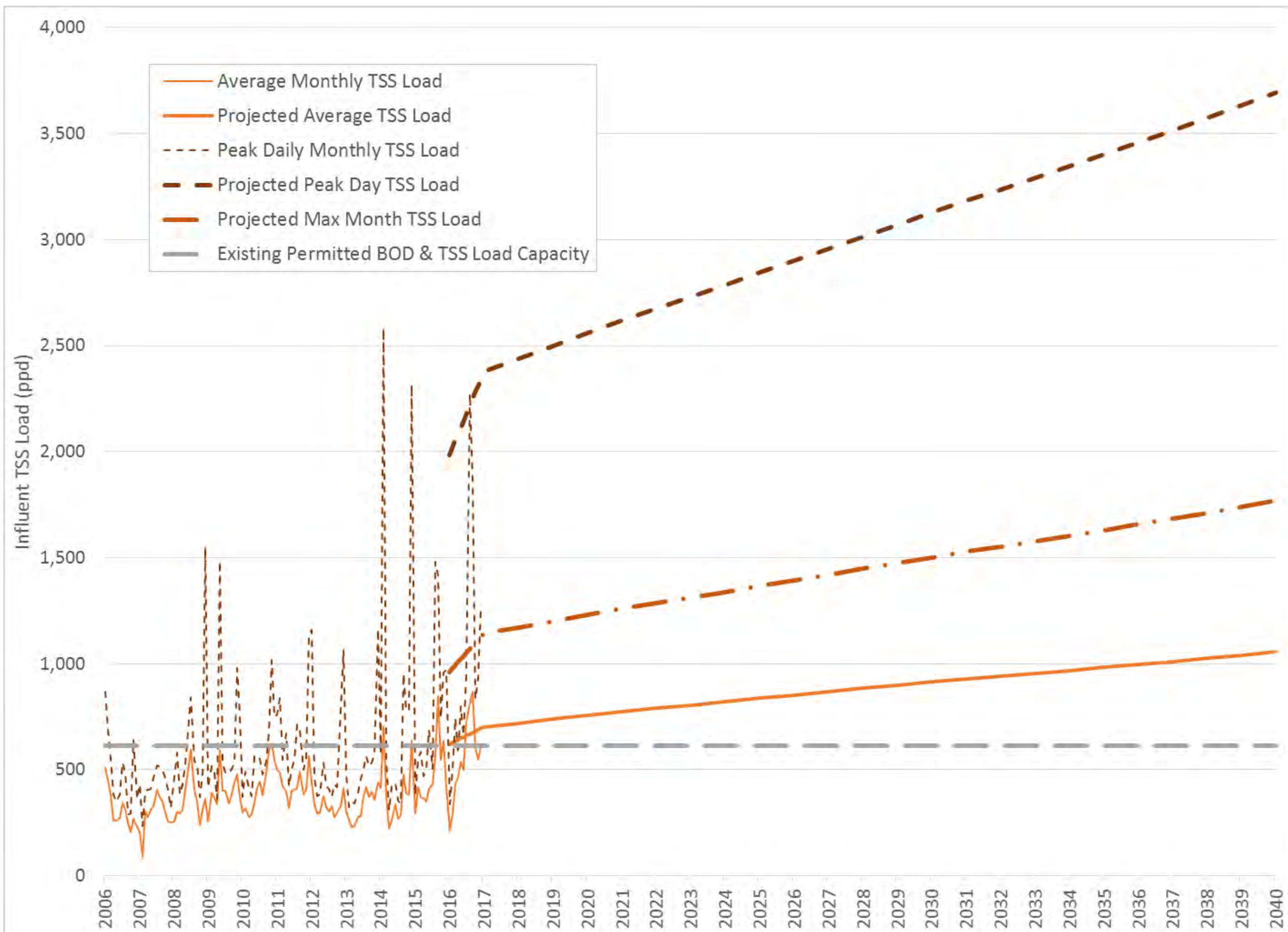


Figure 2-9. Historic and Projected TSS Loads

2.4 WASTEWATER FLOW AND LOAD SUMMARY

Table 2-10 summarizes flow, BOD loads, and TSS loads in the design years 2025 and 2040. For BOD and TSS, projections are shown with no pretreatment, 20 percent pretreatment, and 85 percent pretreatment. Pretreatment is not expected to reduce total flow to the WWTP.

Table 2-10. Current and Projected Flow and Load Design Conditions

Parameter	Base (Dry Weather Average)			Maximum Month			Peak Day			Peak Hour		
	2016	2025	2040	2016	2025	2040	2016	2025	2040	2016	2025	2040
Flow (mgd)	0.135	0.168	0.200	0.460	0.539	0.657	1.30	1.46	1.71	1.96	2.19	2.56
BOD (ppd)												
No pretreatment	620	852	1,070	961	1,394	1,798	1,985	2,902	3,758	n/a	n/a	n/a
20% pretreatment	589	795	989	890	1,262	1,611	1,662	2,307	2,912	n/a	n/a	n/a
85% pretreatment	488	609	724	658	835	1,003	1,294	1,687	1,916	n/a	n/a	n/a
TSS (ppd)												
No pretreatment	620	852	1,070	961	1,394	1,798	1,985	2,902	3,758	n/a	n/a	n/a
20% pretreatment	589	795	989	890	1,262	1,611	1,662	2,307	2,912	n/a	n/a	n/a
85% pretreatment	488	609	724	658	835	1,003	1,294	1,687	1,916	n/a	n/a	n/a

3. EXISTING COLLECTION SYSTEM

3.1 HISTORY OF SYSTEM DEVELOPMENT

Stevenson's sanitary sewer collection system conveys flows to the City's wastewater treatment plant. It consists of approximately 55,000 lineal feet of gravity sewer mains, four pump stations, and approximately 2,100 lineal feet of force main. The majority of the collection system was installed in 1972. The oldest sewer was a vitrified clay pipe installed in 1911 in Russell Street, which was replaced with concrete pipe in 1972. Table 3-1 summarizes major expansions of the collection system.

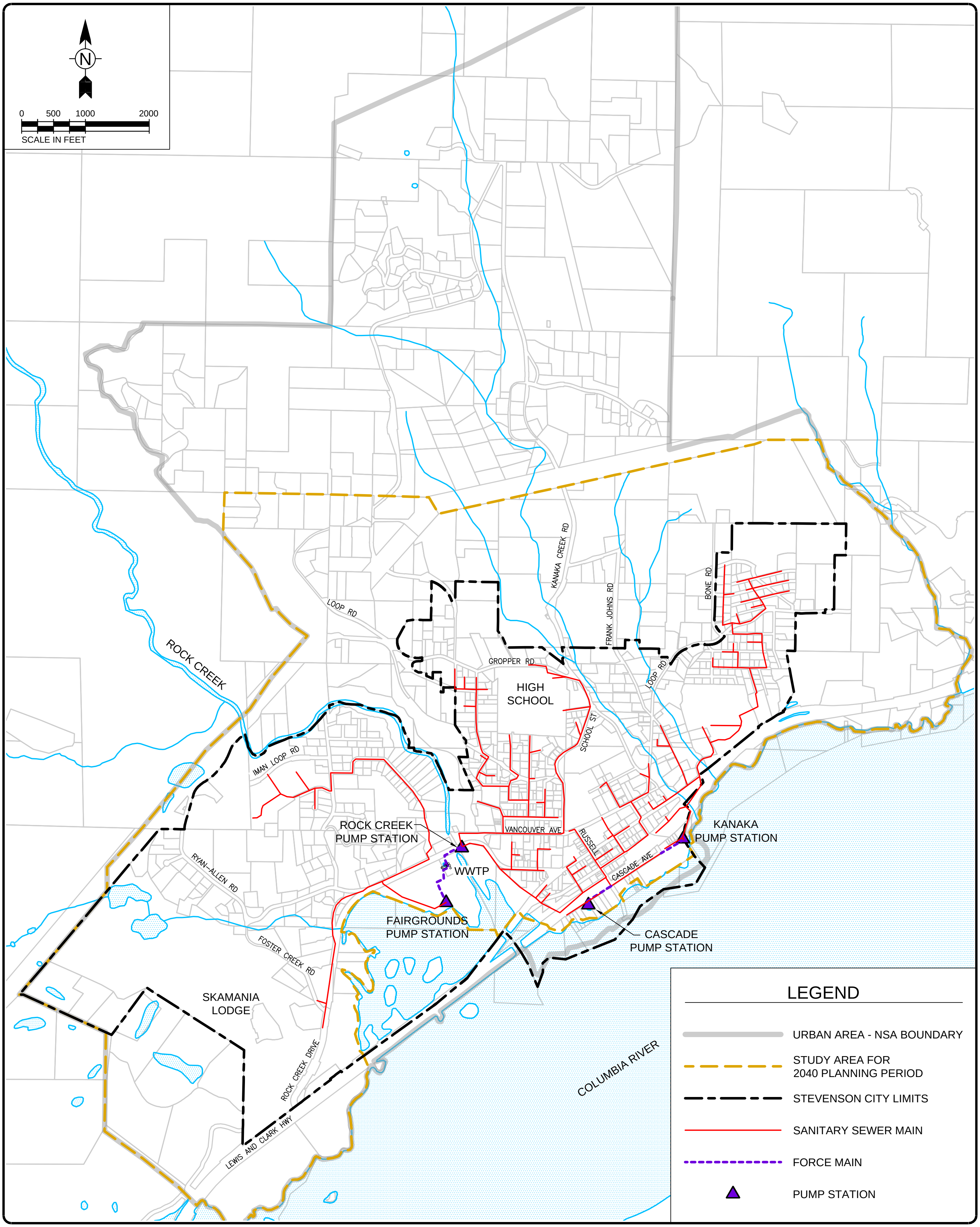
Table 3-1. Collection System Expansion

Name	Year Built	Location	Length (feet)	Pipe Diameter	Material
Russell Street	1911	Central Downtown Area	1,000	8"	Vitrified Clay Pipe (Replaced 1972)
School Interceptor	1956	North-Central portion of the City, with service to the High School	3,100	10"	Concrete pipe with mortar joints
Main Sanitary Sewer System	1972	Central and eastern portions of the City	33,600	6" – 15"	Concrete pipe with rubber gasket joints
Interceptor F-7	1979	Northeast portion of the City	3,700	6" – 8"	Concrete pipe with rubber gasket joints
Second Street Sewer	1993	Western portion of the City, with service to Skamania Lodge	2,900	8" – 12"	PVC pipe with rubber gasket joints
Angel Heights Subdivision	2005	North-Central portion of the City	3,100	8"	PVC pipe with rubber gasket joints
Hidden Ridge Subdivision	2007	North-Central portion of the City	2,800	8"	PVC pipe with rubber gasket joints
Chinidere Mountain Estates—Phase 1	2009	Eastern Portion of the City near Lutheran Church Road	2,600	8"	PVC pipe with rubber gasket joints

3.2 GRAVITY SEWERS

All flows to the WWTP are delivered by the Fairgrounds Pump Station and Rock Creek Pump Station. Flows to these pump stations are conveyed by gravity sewers ranging in diameter from 6 to 15 inches. Two additional pump stations (Cascade and Kanaka) discharge into the Cascade Interceptor, which conveys flow by gravity to the Rock Creek Pump Station.

Figure 3-1 shows the existing collection system. Figure 3-2 shows existing topography and surface waters. Figure 3-3 shows the potable water system facilities. A complete sewer system map with the City's manhole numbers and pipe sizes is included in Appendix G.



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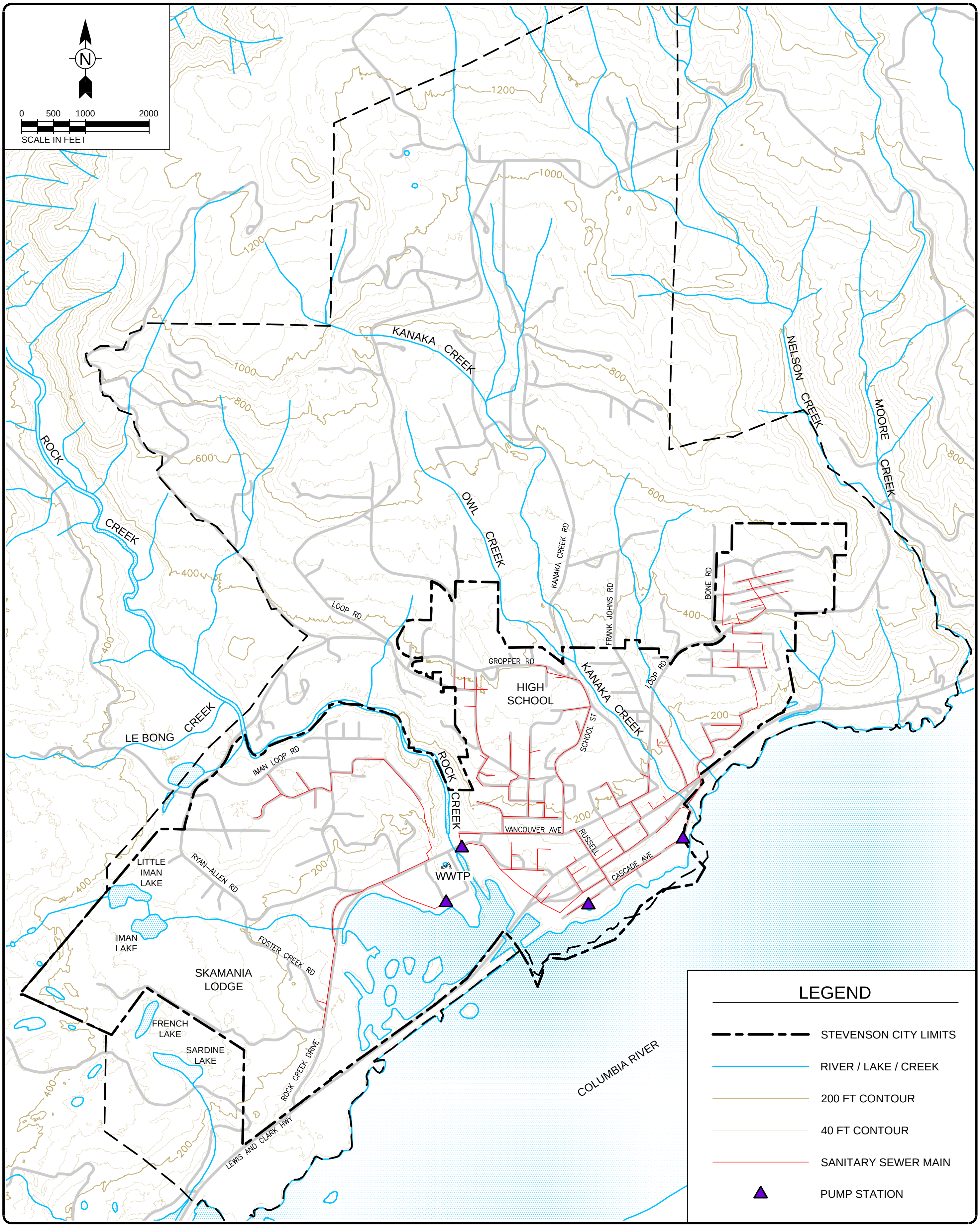
TETRA TECH
15350 Sequoia Parkway, Suite 220
Portland, Oregon 97224
Tel 503.684.9097 Fax 503.598.0583

City of Stevenson
GENERAL SEWER PLAN UPDATE

Figure 3-1.
EXISTING COLLECTION SYSTEM



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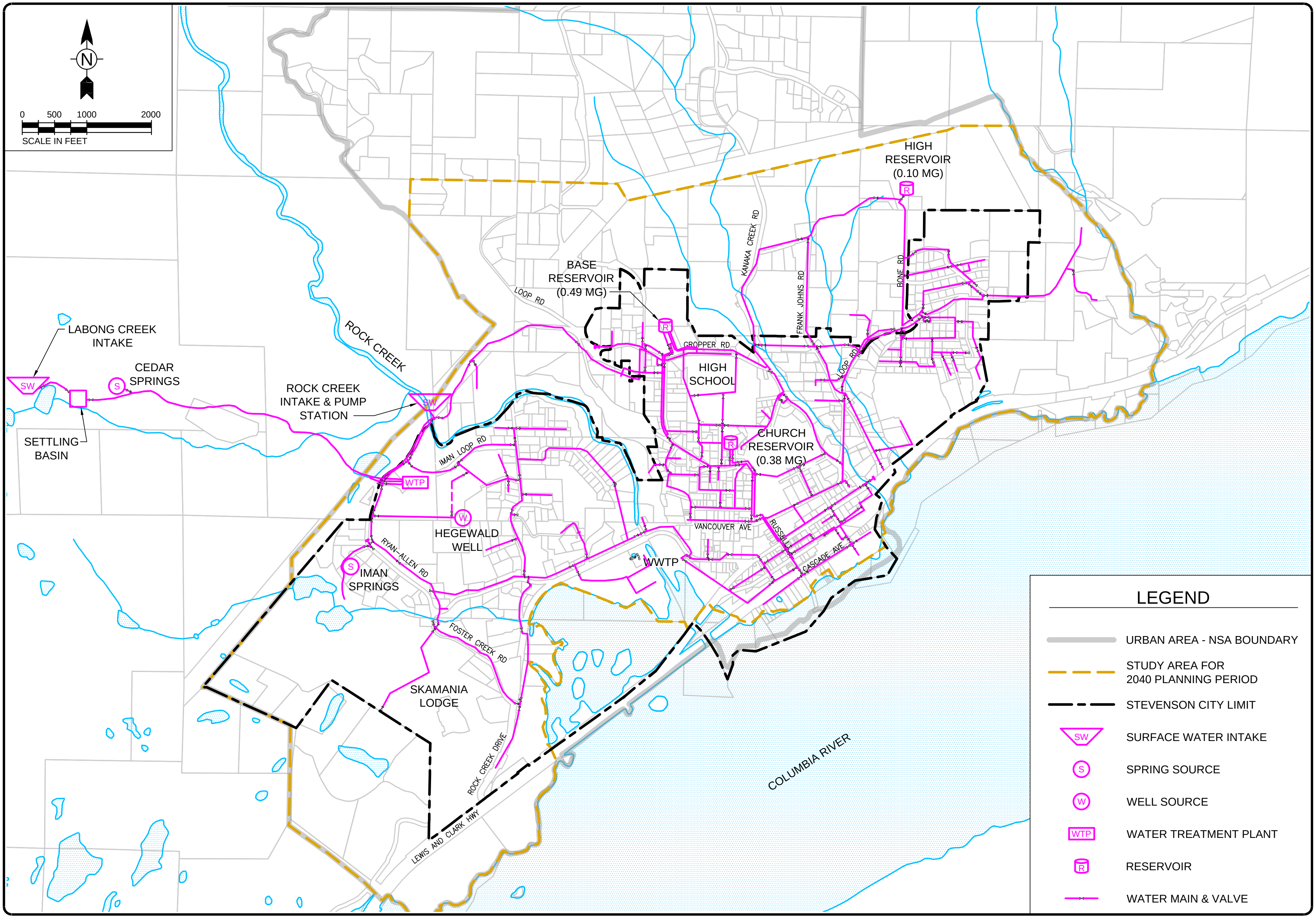
City of Stevenson
GENERAL SEWER PLAN UPDATE

Figure 3-2.
SURFACE WATERS AND TOPOGRAPHY



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City of Stevenson
GENERAL SEWER PLAN UPDATE

Figure 3-3.
WATER SYSTEM FACILITIES

3.3 PUMP STATIONS AND FORCE MAINS

3.3.1 Rock Creek Pump Station

The Rock Creek Pump Station (see Figure 3-4) is located on Rock Creek Drive at the east end of the Rock Creek Bridge. The pump station discharges to the WWTP headworks via an 8-inch force main attached to the Rock Creek Bridge.

Figure 3-4. Rock Creek Pump Station Photos

The pump station consists of a separate dry pit and wet well and was originally constructed in 1971. It was upgraded in 1993 with larger pumps to handle increased flows. Standby power is provided by a generator at the WWTP. The overflow for this pump station is via an 8-inch pipe from the wet well, discharging to Rock Creek. A valve is installed on the overflow pipe. When it is closed, overflows would occur through the lid of Manhole (MH) CI-3, approximately 800 feet upstream of the pump station. The controls for the pump station are located at the WWTP. Table 3-2 summarizes design data for the pump station.

3.3.2 Fairgrounds Pump Station

The Fairgrounds Pump Station (see Figure 3-5) is located on Skamania County Fairgrounds just south of the treatment plant. The pump station lifts raw sewage from the areas west of the WWTP and discharges at the WWTP headworks.

Table 3-2. Rock Creek Pump Station Data

Type	Packaged Wet Pit/ Dry Pit
Year Built / Upgraded	1972 / 1993
No. Pumps	2
Original Design Capacity—1 Pump	900 gpm @ 43' total dynamic head
Observed Capacity	
Year Tested	2010
Pump #1 Capacity (gpm)	540
Pump #2 Capacity (gpm)	465
Both Pumps Running (gpm)	685
Motor	20 hp (variable frequency drive), 1760 RPM
Wet Well Dimensions	Wet Pit: 4 feet diameter by 19 feet deep
	Dry Pit: 7 feet diameter by 19 feet deep
Standby Power	Generator located at WWTP
SCADA (supervisory control & data acquisition) / Telemetry	Autodialer—Power Loss, High Level
Force Main—Size / Length / Material	8" / 490 feet / Cast Iron & Steel

Figure 3-5. Fairgrounds Pump Station Photos

The pump station consists of two self-priming pumps housed in a fiberglass enclosure over a precast concrete wet well. It was built in 1978. Standby power is provided by a generator at the WWTP. No overflow piping is provided. If the pump station fails, overflows would occur through the lid of MH J-1, approximately 200 feet upstream of the pump station. The controls for the pump station are located at the WWTP. Table 3-3 summarizes design data for the pump station, based on prior studies. Information such as motor data and wet well size and configuration were not available.

Table 3-3. Fairgrounds Pump Station Data

Type	Packaged Self Priming
Year Built/ Upgraded	1978
No. Pumps	2
Original Design Capacity—1 Pump	400 gpm (total dynamic head not available)
Observed Capacity:	
Year Tested	2010
Pump #1 Capacity (gpm)	280
Pump #2 Capacity (gpm)	280
Both Pumps Running (gpm)	410
Motor	(Info not available)
Wet Well Dimensions	(Info not available)
Stand-by Power	Generator located at WWTP
SCADA / Telemetry	Autodialer—Power Loss, High Level
Force Main—Size / Length / Material	6” / 800 feet / Unknown

3.3.3 Kanaka Pump Station

The Kanaka Pump Station (see Figure 3-6) is located on Cascade Avenue just west of the public boat launch ramp. The pump station lifts raw sewage from Main F into the Cascade Interceptor, which conveys flow by gravity to the Rock Creek Pump Station.

The pump station consists of two self-priming pumps in a fiberglass enclosure over a precast concrete wet well. It was originally built in 1972 and upgraded in 1993 to handle increased flows. Standby power for the pump station is provided by a 40-kW diesel generator in a wood frame building adjacent to the pump station. The overflow for this pump station is located upstream in MH F-2. Overflows would be directed to Kanaka Creek close to its confluence with the Columbia River. A valve is installed on the overflow pipe. When it is closed, overflows would occur through the lid of MH F-2. Table 3-4 summarizes design data for the pump station.

3.3.4 Cascade Pump Station

The Cascade Pump Station (see Figure 3-7) is located on Cascade Avenue west of Russell Avenue. It serves seven properties between the Columbia River and the railroad tracks. The pump station discharges to the Cascade Interceptor, which conveys flow by gravity to the Rock Creek Pump Station. The pump station, built in 1972, consists of two vacuum primed pumps in a fiberglass enclosure over a precast concrete wet well. Standby power is not provided. Overflow is via a 6-inch pipe from the wet well, discharging to the Columbia River. Table 3-5 summarizes design data for the pump station.

Figure 3-6. Kanaka Pump Station Photos

Table 3-4. Kanaka Pump Station Data

Type	Packaged Self Priming
Year Built / Upgraded	1972 / 1993
No. Pumps	2
Original Design Capacity—1 Pump	200 gpm @ 37' total dynamic head
Observed Capacity:	
Year Tested	2014 (4" Force Main has since been upsized to 6")
Pump #1 Capacity (gpm)	143 (Estimated 230 gpm w/ 6" FM)
Pump #2 Capacity (gpm)	122 (Estimated 195 gpm w/ 6" FM)
Both Pumps Running (gpm)	120
Motor	7.5 hp, 1200 RPM
Wet Well Dimensions	4 feet diameter by 12 feet deep
Standby Power	40 kw generator
SCADA / Telemetry	Autodialer—Power Loss, High Level
Force Main—Size / Length / Material	6" (upsized from 4" in 2015) / 410 feet / PVC

Figure 3-7. Cascade Pump Station Photos

Table 3-5. Cascade Pump Station Data

Type	Packaged, Vacuum-Primed
Year Built / Upgraded	1972
No. Pumps	2
Original Design Capacity—1 Pump	80 gpm @ 21' total dynamic head
Observed Capacity	Not Tested
Motor	1.5 hp, 1200 RPM
Wet Well Dimensions	4 feet diameter by 13 feet deep
Standby Power	None
SCADA / Telemetry	None. Audible alarm (horn) for High Level
Force Main—Size / Length / Material	4" / 470 feet / Asbestos Cement

3.4 OPERATION AND MAINTENANCE

3.4.1 Sewers

Sewers are currently inspected in response to reports of potential issues from members of the public. For cleaning or video inspection of sewers, the City primarily uses on-call contractors to perform the work under the supervision of Public Works staff members. Video inspections and cleaning records are available from 1991, 2007 and 2010. The City performed smoke testing in the past to identify cross-connections but has discontinued the practice as no additional inflow sources were identified.

3.4.2 Pump Stations

The collection system pump stations are typically inspected once per week by CH2M contract operations. Maintenance of mechanical equipment is performed as outlined in the operation and maintenance manual for each item. This is supplemented by interim maintenance when issues are identified by inspection or by telemetry warning signals.

3.5 AREAS NOT SERVED BY THE COLLECTION SYSTEM

On-site septic systems currently provide sewage treatment and disposal for approximately 170 residential properties within the city limits. This amounts to about one-third of the residential development in the City. No sewer service is currently provided outside the city limits, and it is assumed that all of these residences are served by on-site septic systems.

Because of the environmental contamination that can result when septic systems fail, the City has adopted measures requiring sewer service for almost all new development within the City. If feasible, conversion to sewer service should also be required for existing properties where septic systems have failed. Conversion of existing septic systems may be difficult and relatively expensive if it requires new construction of sewer mains to extend service to these properties. Several sewer main extension projects recommended in Chapter 5 are intended to facilitate septic conversions and allow future development in areas not currently served by sewers.

4. COLLECTION SYSTEM EVALUATION

4.1 SYSTEM CONDITION

4.1.1 Pipe Condition

In general, the City sewer lines in the worst condition are constructed of concrete and were installed prior to 1980. Concrete sewer pipes are prone to leaks at joints and cracks in the pipe. Sewer lines installed since 1990 are generally PVC with rubber gaskets and perform much better preventing inflow and infiltration. Figure 4-1 shows the location of PVC and concrete pipeline in Stevenson's collection system.

Closed-circuit television (CCTV) inspection of parts of the City's collection system has been conducted in the past as part of previous collection system rehabilitation. Locations of past inspections are shown on Figure 4-1 and summarized in Table 4-1. A field survey of the collection system was conducted in July 2016. A general summary of observations is presented in Table 4-2. Complete survey notes can be found in Appendix H.

4.1.2 Pump Stations

The following sections summarize existing pump station conditions. Estimated flows presented in these sections based on pump run-time data should not be used as a design flow, nor used in place of modeled peak flows, since they reflect average flow to the station over a period of a week or more.

Rock Creek Pump Station

The following deficiencies have been identified at this pump station:

- **Pumping Capacity**—Testing performed in 2010 indicated that the pumping capacities of the station's two pumps are 540 and 465 gpm. Therefore, the firm capacity of the station is only 465 gpm, compared to the original design capacity of 900 gpm. Reasons for the discrepancy could include impeller wear or blockage in the force main. Modeling estimates existing peak-hour flows to be 1,110 gpm (see Section 4.3.3). Operators noted that in December 2015 the station came close to overflowing while both pumps were in continuous operation. Pump run-time records were provided for January and February 2012, all of 2015, and January through September 2016. Table 4-3 summarizes the run-time data, indicating that the pump station is undersized for existing flows.
- **Access to pumps**—Pumps are located in a dry pit 20 feet below ground surface and are accessed by a ladder in a 3-foot diameter entrance tube.
- **Safety**—The control panel and generator are located off-site at the WWTP. This is a concern for lock out/ tag-out and the potential for someone to inadvertently start equipment while it is being worked on.
- **Age**—The electrical and mechanical equipment was upgraded in 1993 and is now 24 years old and potentially reaching the end of its design life (typical design life for pumps and controls is 25 to 35 years).
- **Force Main Size**—The velocity in the force main would be approximately 7 feet per second if pumps were sized to handle existing peak inflow. This is near the limit of good practice; should the future peak flow increase, the force main will need to be upsized to keep the velocity between 3 and 8 feet per second.

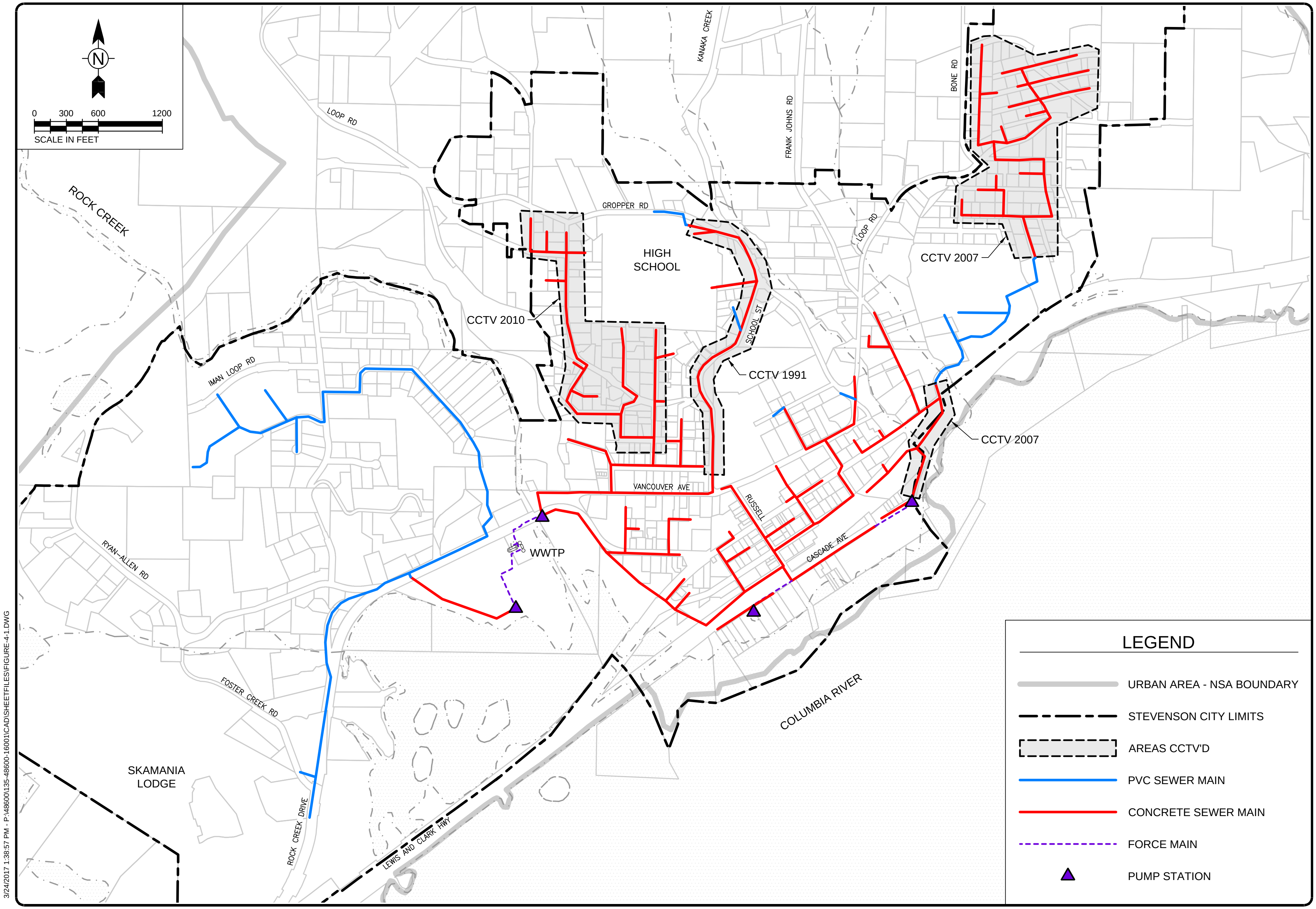

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Figure 4-1.
EXISTING PIPE MATERIAL AND PAST INSPECTIONS

Table 4-1. Summary of Past CCTV Collection System Inspections

Date	Location	Sewers	Description/Conditions
June 1991	From high school, south along School Street to Vancouver Avenue	Constructed in the 1950s, consisting of 3-foot-long segments of concrete pipe with mortar joints	Inspection found many leaking joints. Mortar joints are prone to leakage. This area also has old manholes with brick risers and outside drop connections that can be prone to leaking. 530 pipe joints were pressure tested and 430 joints were sealed with grout. Lines were also cleaned and roots cut.
March 2007	Northeast Area: North of Loop Road near Montell Terrace and Bone Road	Sewers are mostly concrete, constructed in the 1970s	Inspection found many leaks in pipe joints and at manholes. Lines were cleaned and roots removed. Crews performed dig up repairs at locations where the pipe defects were greatest.
March 2010	Central Residential Area: North of Vancouver Avenue and west of School Street. Included Roosevelt Street, Chesser Street, Roselawn Street, and Hotsprings Alameda Road	Sewers are mostly concrete, constructed in the 1970s	Inspection found many leaks in pipe joints and at manholes. Lines were cleaned and roots removed. No repairs were performed.

Table 4-2. Summary Observations from July 2016 Field Survey

Location	Description/Conditions
Northeast Area: North of Loop Road near Montell Terrace and Bone Road	Evidence of slope instability in this area was noted during the July 2016 field survey, including an area around MH F-4-11A where the street has subsided. City staff noted that this entire hillside continually moves. It is likely that the slope instability causes joint separation, pipe breaks and disruption of manholes, allowing I/I. Manhole F-4-11A, in the area where the street subsided, had shifted at its joints. A drainage was noted parallel to the sanitary sewer where the I/I started. I/I is likely entering the system through shifted joints or cracked pipes. With a constantly moving hillside, I/I sources are likely to continue to be created, regardless of improvements and repairs completed.
High School Pool	It has been speculated that the high school pool's subsurface drain system may be connected to the sanitary sewer, but investigation has found no connection. However, it is clear that I/I is coming into the system from this area. Even during summer there is flow into the system from this location, and no extraneous flow enters the system upstream.
Stone Brooke Court	At the end of the cul-de-sac there is a large tree growing over the service line that has likely caused root intrusion through the joints as there is a constant flow of liquid from the service line.
SW Rock Creek Drive	Manholes are lined with grease from Foster Creek Road to about Ryan-Allen Road. Some of the grease is making it to the Fairgrounds Pump Station. Some of the manhole rims show rust. Staff noted that wastewater in this area is often very hot.

Table 4-3. Rock Creek Pump Station—Pump Run-Times

	Time Period	Pump 1 Run-Time (hours /day)	Pump 2 Run-Time (hours /day)	Total Run-Time (hours /day)	Estimated Average Influent Flow (gpm)
Average Dry Weather	7/1/16 – 9/9/16	1.2	1.3	2.5	52
Wet Weather Event 1	12/29/11 – 1/6/12	12.6	11.4	24.0	505
Wet Weather Event 2	12/4/15 – 12/18/15	9.9	11.0	20.9	434

Fairgrounds Pump Station

The following deficiencies have been identified at this pump station:

- **Capacity**—Testing performed in 2010 indicated that the pumping capacities of the station's two pumps are each 280 gpm. Therefore, the actual firm capacity of the station is only 280 gpm, compared to the original design capacity of 400 gpm. Reasons for the discrepancy could include impeller wear or a blockage in the force main. Modeling estimates existing peak-hour flows to be 225 gpm (see Section 4.3.3). Pump run-time records were provided for January and February 2012, and January through September 2016. These records do not indicate that the pump station is undersized for existing flows. An analysis is summarized in Table 4-4. High flows at the pump station appear to be influenced more by occupancy at Skamania Lodge than by I/I.
- **Safety**—The control panel and generator are located off-site at the WWTP. This is a concern for lock out/ tag out and the potential for someone to inadvertently start equipment while it is being worked on.
- **Age**—The electrical and mechanical equipment was installed in 1978 and is now 39 years old, and may be beyond its design life (typical design life for pumps and controls is 25 to 35 years).
- **Pump Efficiency**—Self priming pumps have low pumping efficiency compared to submersible non-clog sewage pumps that are available and widely used today. Current electricity use for pump operation could be potentially be cut in half with the installation of new submersibles.
- **Limited Access to Wet Well**—Pumps are installed in a fiberglass enclosure located on top of the wet well, which leaves limited access to the wet well below for inspection, cleaning, and maintenance. The enclosure is several feet off the ground, making access even more difficult.
- **Priming**—Losing prime can be an issue with this type of pump.

Table 4-4. Fairgrounds Pump Station—Pump Run-Times

	Time Period	Pump 1 Run-Time (hours /day)	Pump 2 Run-Time (hours /day)	Total Run-Time (hours /day)	Estimated Average Influent Flow (gpm)
Average Flow	3/4/16 – 6/3/16	1.8	1.6	3.5	40
Wet Weather Event	1/15/16 – 1/21/16	1.4	3.9	5.3	62
High Flow Period	7/29/16 – 8/26/16	4.4	2.1	6.5	76

Kanaka Pump Station

The following deficiencies have been identified at this pump station:

- **Pumping Capacity**—Testing performed in 2014 indicated that the pumping capacities of the station's two pumps are 143 gpm and 122 gpm. Therefore, the actual firm capacity of the station is only 122 gpm, compared to the original design capacity of 200 gpm. In 2015 the force main was upsized from 4 inches to 6 inches. Based on analysis of the pump curve and system curve, the estimated current pump capacities with the larger force main are 230 gpm and 195 gpm. Modeling estimates existing peak-hour flows to be 325 gpm (see Section 4.3.3). Pump run-time records were provided for January and February 2012, all of 2015, and January through September 2016. Table 4-5 summarizes the pump run-time data.
- **Wet Well Operating Volume**—The existing wet well is undersized, which results in excessive pump cycles and motor wear.
- **Limited Access to Wet Well**—Pumps are installed in a fiberglass enclosure located on top of the wet well, which leaves limited access to the wet well below for inspection, cleaning, and maintenance.
- **Corrosion**—Piping located in the wet well is heavily corroded.
- **Age**—The electrical and mechanical equipment was upgraded in 1993 and is now 24 years old, and potentially reaching the end of its design life (typical design life for pumps and controls is 25 to 35 years).

Table 4-5. Kanaka Pump Station—Pump Run-Times

	Time Period	Pump 1 Run-Time (hours /day)	Pump 2 Run-Time (hours /day)	Total Run-Time (hours /day)	Estimated Average Influent Flow (gpm)
Average Dry Weather	8/12/16 – 8/26/16	0.9	1.1	2.0	18
Wet Weather Event 1	1/20/12 – 1/27/12	7.7	12.4	20.1	109
Wet Weather Event 2	12/4/15 – 12/11/15	7.0	7.5	14.5	128

- **Pump Efficiency**—Self priming pumps have low pumping efficiency compared to submersible non-clog sewage pumps that are available and widely used today. According to the pump curve, the existing pumps are operating at about 35-percent efficiency. Submersible pumps in this size can have efficiencies in the range of 60 percent to 75 percent. Current electricity use for pump operation could be potentially be cut in half with the installation of new submersibles.
- **Priming**—Losing prime can be an issue with this type of pump.

Cascade Pump Station

The following deficiencies have been identified at this pump station:

- **Capacity**—Pump capacity testing has not been performed. The original design capacity is 80 gpm per pump, which is much more than is needed for the seven properties it currently serves. Pump run-time records were provided for January and February 2012, and January through September 2016. These records indicate that the pumps are adequately sized for existing flows. An analysis of pump run-time data is summarized in Table 4-6.
- **Age**—The electrical and mechanical equipment was installed in 1972 and is now 45 years old, and potentially reaching the end of its design life (typical design life for pumps and controls is 25 to 35 years).
- **Limited Access to Wet Well**—Pumps are installed in a fiberglass enclosure located on top of the wet well, which leaves limited access to the wet well below for inspection, cleaning, and maintenance. The enclosure is several feet off the ground, making access even more difficult. The discharge isolation and check valves are located inside the wet well, and they are difficult to access and operate.
- **Remote Notification**—Systems for supervisory control and data acquisition (SCADA) and telemetry are not provided at this pump station to notify operations staff of a pump failure or high wet well level.

Table 4-6. Cascade Pump Station—Pump Run-Times

	Time Period	Pump 1 Run-Time (hours /day)	Pump 2 Run-Time (hours /day)	Total Run-Time (hours /day)	Estimated Average Influent Flow (gpm)
Average Dry Weather	5/22/15 – 9/4/15	0.22	0.09	0.31	1.1
Wet Weather Event	12/4/15 – 12/11/15	0.66	0.01	0.67	2.2

4.1.3 Sanitary Sewer Overflows

A sanitary sewer overflow was reported on November 21, 2016, in which 20 to 30 gallons of sewage spilled onto a gravel parking lot due to a controls failure at the Rock Creek Pump Station. The failure has since been corrected. No other reports of sanitary sewer overflows are available.

There is an overflow configured with a valve located on SW Cascade Avenue east of the Kanaka Pump Station. Since the force main for the Kanaka Pump Station was upgraded to 6-inch diameter, there have been no overflows at this location.

4.1.4 Infiltration and Inflow

Excessive I/I can lead to overflows where sewers have insufficient capacity to convey the I/I flow. I/I can also cause increased pumping costs and increased treatment cost. When planning infrastructure improvements, costs to upsize conveyance and treatment systems should be compared to costs of reducing I/I, in order to determine the most cost-effective use of funding resources.

Areas of Known High I/I

In 1988, Westech Engineering performed a study of I/I in Stevenson's collection system. Based on that study and on interviews with City staff, several areas in the collection system are known to experience significant I/I. These areas are shown on Figure 4-2.

I/I rates will vary throughout a collection system depending on pipe material, age, condition, type of joints, groundwater depth and locations of direct stormwater connections. Per Table 2-3, the peak-hour I/I rate for the entire collection system is 5,058 gpad.

Three rates were used to evaluate and model the collection system:

- Lowest rate for newer PVC pipe
- Medium rate for older concrete pipe
- High rate for areas of known I/I problems (Locations based on input from City staff)

The City's collection system was divided into 28 sub-basins as shown on Figure 4-3. Low, medium, or high I/I rates were assigned to each basin currently served by sewers, based on pipe type and age and known locations of I/I problems. The I/I rates were adjusted iteratively until the total equaled the peak-hour I/I of 5,058 gpad for the collection system as a whole. The resultant three levels of I/I worked out to the following:

- Low = 2,500 gpad
- Medium = 5,000 gpad
- High = 7,850 gpad

Refer to Appendix C for sewer sub-basin design data, including I/I rates assigned to individual basins.

Total Annual Average I/I

Daily flow data were examined from Stevenson's wastewater treatment plant effluent flow meter, as reported in the plant's discharge monitoring reports for the period between 2001 and 2015. The treatment plant flows were compared to daily rainfall data in order to assess total I/I. Rainfall data was obtained from the NOAA Climate Data Center for the gauge at the Bonneville Dam. Table 4-7 lists the yearly data for rainfall, average annual plant flow, and average annual I/I.

Figure 4-4 is a plot of the yearly rainfall and average-day I/I values listed in Table 4-7. The trend line and regression equation are also shown. Table 4-8 compares the observed I/I at the WWTP to the expected I/I calculated using the regression equation in Figure 4-4. The results of Table 4-8 show that there has not been a noticeable increasing trend in I/I from 2007 to present.

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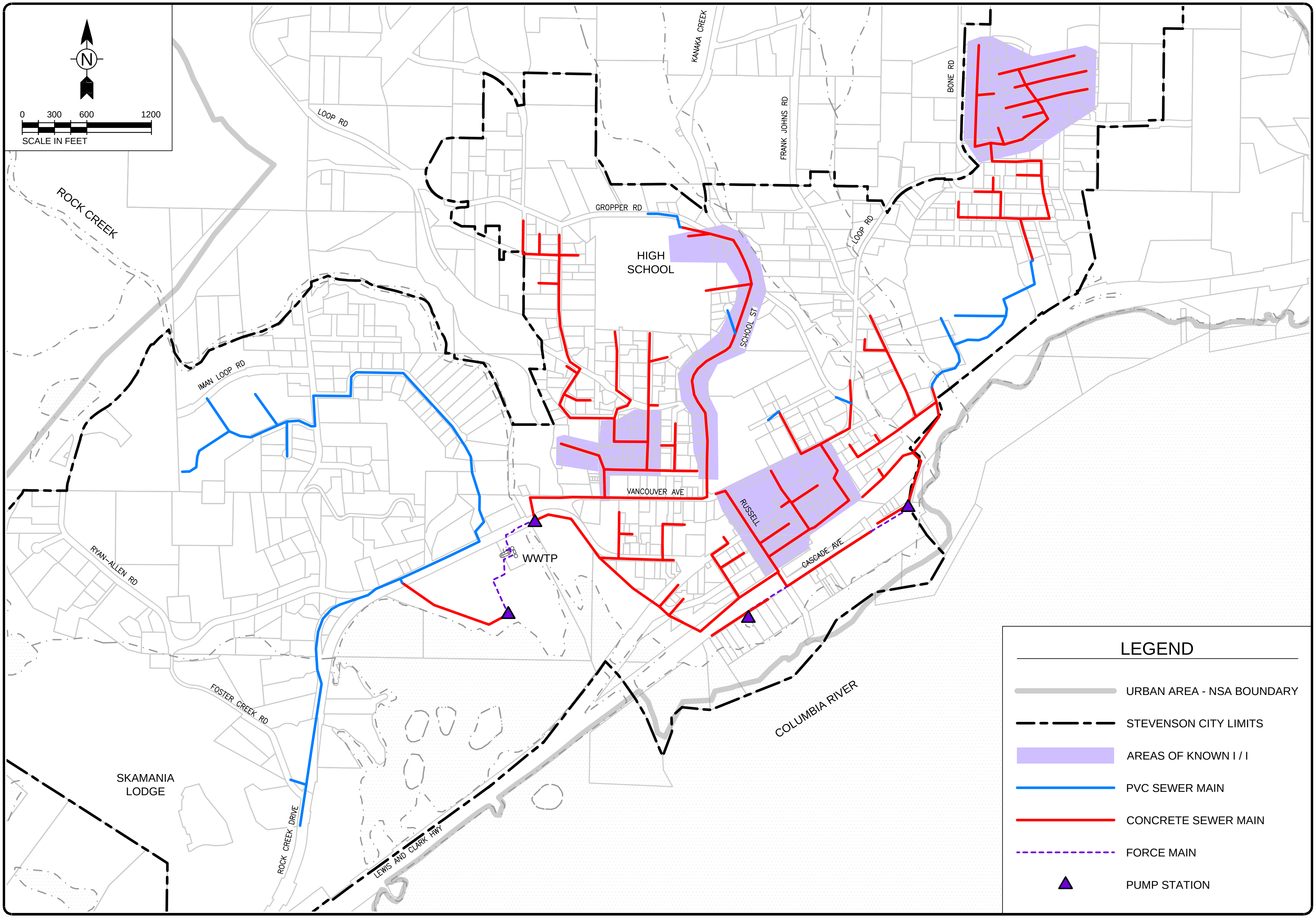

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Figure 4-2.
AREAS OF KNOWN I / I

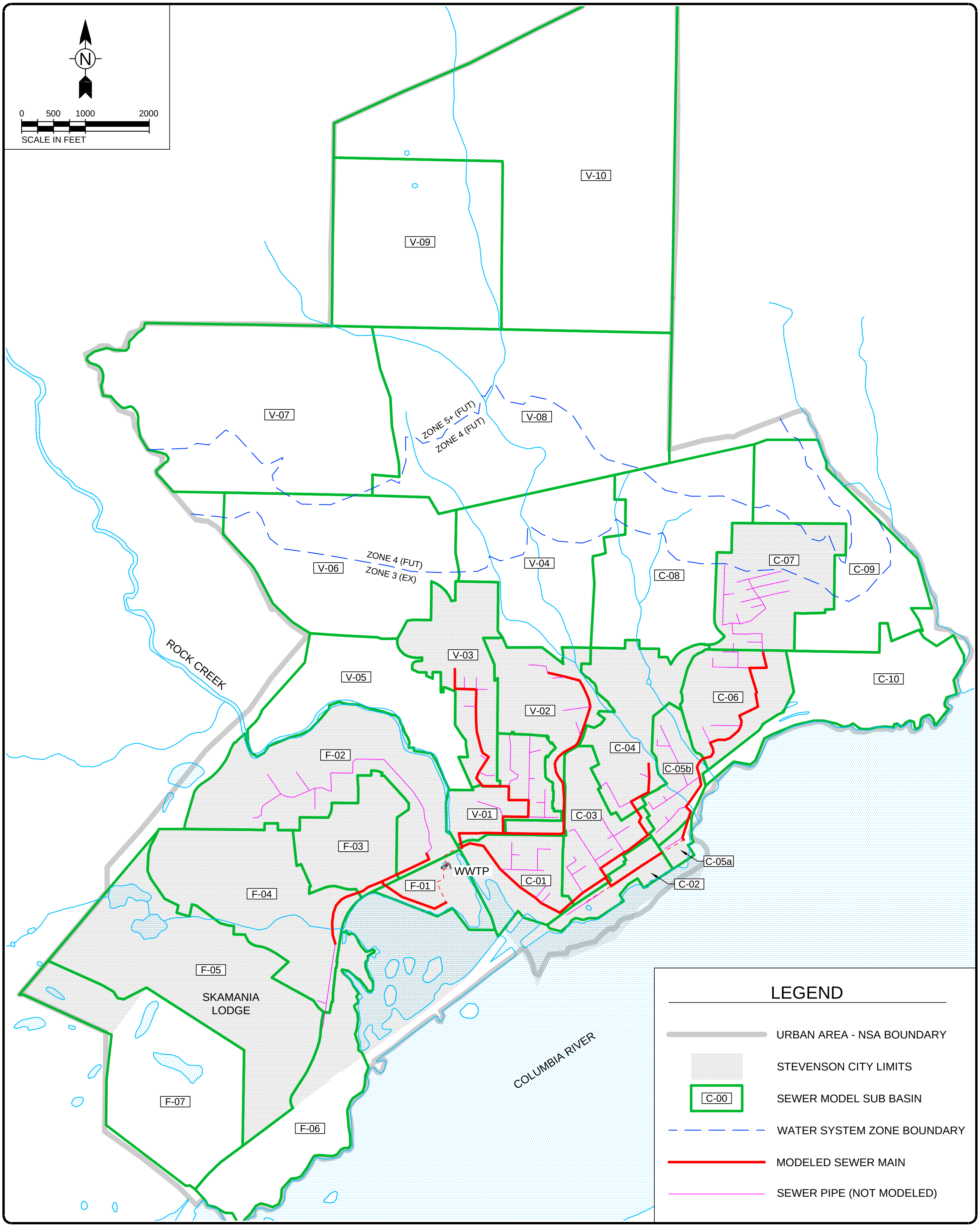

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Figure 4-3.
SEWER SUB BASINS AND MODELED SEWER MAINS

Table 4-7. Annual Flow and Rainfall at Stevenson Wastewater Treatment Plant, 2001 – 2015

Year	Rainfall (inches)a	Average Annual Flow (mgd)b	Wastewater Base Flow (mgd)c	Average Day I/I (mgd)d
2001	75.4	0.184	0.143	0.041
2002	65.3	0.180	0.137	0.043
2003	84.5	0.201	0.138	0.063
2004	67.6	0.185	0.150	0.035
2005	70.6	0.190	0.146	0.044
2006	93.3	0.186	0.111	0.075
2007	72.1	0.180	0.156	0.024
2008	75.5	0.191	0.167	0.024
2009	76.4	0.186	0.133	0.053
2010	94.6	0.201	0.141	0.060
2011	91.7	0.168	0.104	0.064
2012	105.0	0.212	0.110	0.102
2013	67.0	0.141	0.111	0.030
2014	89.6	0.171	0.102	0.069
2015	81.4	0.165	0.116	0.049
Average	80.7	0.183	0.131	0.052

a. Measured at Bonneville Dam rain gauge
b. Average annual flow = Average-day effluent flow at the treatment plant
c. Estimated by average-day effluent flow at the treatment plant between May and October on days when measured rainfall was less than 0.1”
d. Calculated by subtracting wastewater base flow from average annual flow

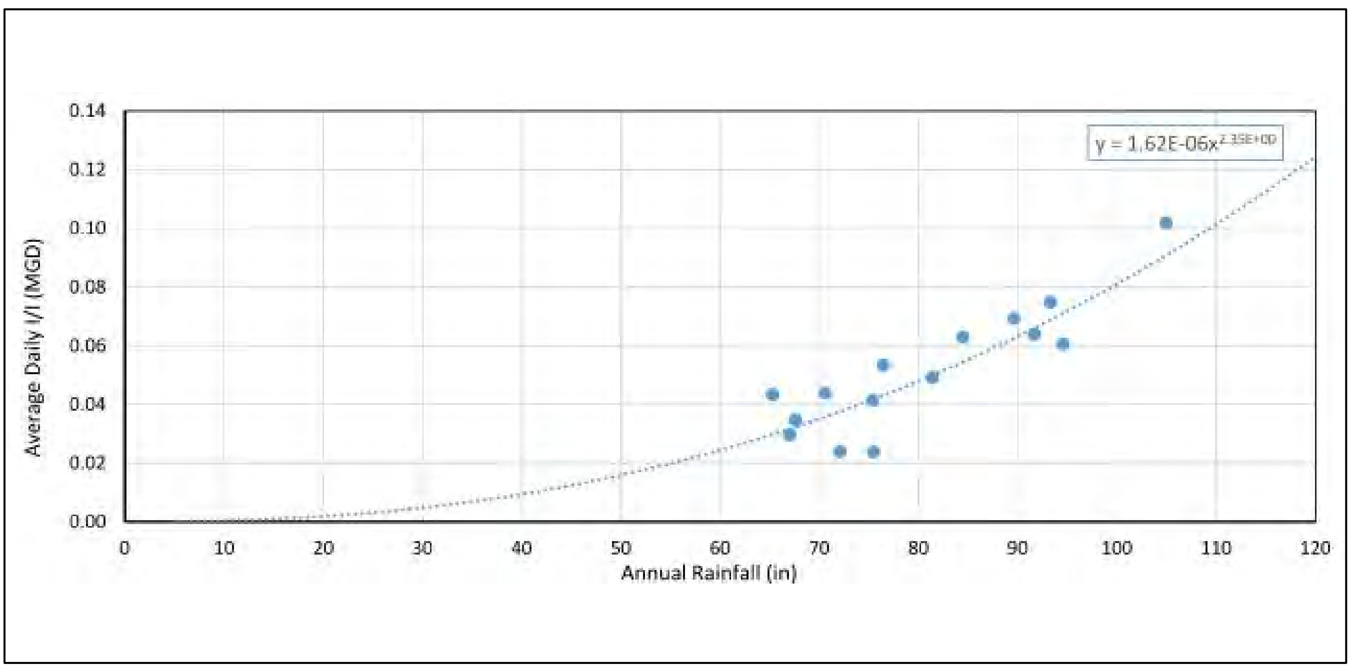

Figure 4-4. Annual Rainfall vs. I/I at Stevenson Wastewater Treatment Plant

Table 4-8. Observed vs Expected Inflow & Infiltration

Year	I/I (mgd)		Difference:
	Observed: Based on Flow Data[a]	Calculated from Equation[b]	
2001	0.041	0.042	(1%)
2002	0.043	0.030	46%
2003	0.063	0.055	15%
2004	0.035	0.032	7%
2005	0.044	0.036	22%
2006	0.075	0.069	8%
2007	0.024	0.038	(37%)
2008	0.024	0.042	(43%)
2009	0.053	0.043	23%
2010	0.060	0.071	(15%)
2011	0.064	0.066	(3%)
2012	0.102	0.091	12%
2013	0.030	0.032	(6%)
2014	0.069	0.063	11%
2015	0.049	0.050	(2%)

a. From Table 4-7. Equal to average annual flow minus wastewater base flow.
b. Calculated based on the total annual rainfall using the regression equation in Figure 4-4.

Evaluation Criteria

The U.S. Environmental Protection Agency (EPA) has established criteria for what it considers excessive I/I. It is based on surveys performed in 270 cities of total sewer system flows on a per capita basis per day. When I/I exceeds the established criteria, the EPA requires additional study to quantify I/I and evaluate corrective measures before providing grants for sewer system improvements. For Stevenson, an equivalent population of 2,199 was determined per Table 4-9.

Table 4-9. Stevenson Equivalent Sewer Service Population

Residential ERUs[a]	Commercial / Industrial ERUs[a]	Total ERUs[a]	Population / ERU[a]	Equivalent Population
489	506	995	2.21	2,199

a. Data from Growth Projections Technical Memorandum dated October 24, 2016

Infiltration

EPA's criterion for excessive infiltration is if the average-day flow per capita (excluding industrial and commercial flows from individual sources contributing 50,000 gallons per day or more) is 120 gallons per capita per day (gpcd) or more over a 7- to 14-day dry period during seasonal high groundwater. This amount allows to 70 gpcd of domestic wastewater base flow and 50 gpcd of infiltration.

For Stevenson, the month of February 2015 was selected to analyze infiltration. Dry weather was experienced for the last half of the month, with only 0.1 inches of rain from February 11 through February 25 (compared to 7.9 inches from February 1 – 10). The period of February 16 – 25, 2015 was used to determine the average dry-weather flow. The average-day treatment plant effluent flow during this period was 117,800 gallons per day; for the equivalent population of 2,199, this is an average of 54 gpcd, well below the EPA criterion of 120 gpcd. Based on this analysis, infiltration is not excessive in Stevenson's wastewater collection system.

Inflow

The EPA has defined inflow as being excessive if the total daily flow (excluding industrial and commercial flows from individual sources contributing 50,000 gallons per day or more) during periods of significant rainfall exceeds 275 gpcd. Table 4-10 lists the 10 highest daily treatment plant effluent flows between 2001 and 2015, as well as the two highest-flow days from December 2015. For an equivalent population of 2,199, peak flows are in the range of 400 to 600 gpcd, which exceeds the EPA criterion of 275 gpcd for excessive rainfall-derived I/I.

Table 4-10. Peak-Day Wastewater Treatment Plant Flows 2001 – 2015

Rank	Date	Flow (mgd)	Flow per capita (gpcd)[a]	24 Hour Rainfall (in)	96 Hour Rainfall (in)
1	21-Jan-2012	1.290	587	1.42	8.40
2	24-Jan-2012	1.240	564	0.67	2.96
3	1-Jan-2009	1.127	513	4.07	6.23
4	19-Jan-2012	1.090	496	2.96	7.10
5	6-Nov-2006	1.013	461	5.08	10.83
6	12-Dec-2010	0.992	451	2.95	6.20
7	28-Dec-2008	0.967	440	2.56	7.24
8	1-Dec-2013	0.954	434	4.71	6.32
9	29-Dec-2011	0.940	427	2.01	6.11
10	16-Jan-2011	0.918	417	3.15	6.78
11	7-Dec-2015	0.890	405	2.46	5.81
14	8-Dec-2015	0.879	400	3.19	8.83

a. Based on an equivalent population of 2,199, which accounts for commercial and industrial wastewater sources.

4.2 EXISTING CAPACITY ANALYSIS

4.2.1 Model Construction

An analysis of the wastewater collection system was performed using Autodesk's Storm and Sanitary Analysis software, which is compatible with and runs on the EPA's Storm Water Management Model software.

Data Sources

As-built drawings provided by the City were used to construct a collection system map. Information provided by Skamania County GIS was used to assist in the creation of the collection system map. Data layers provided by the County included tax lots, contours, streets, building footprints and aerial photographs. Once the collection system map was completed in AutoCAD Civil 3D, the portions of the system to be modeled were imported into the Autodesk Storm and Sanitary Analysis software.

Modeling of Physical System Features

Manholes and Sewers

Stevenson's collection system was laid out in AutoCAD Civil 3D based on the as-built drawings and County GIS data. This included the location of manholes and details on pipe material and diameters. For the portions of the system to be included in the model, manhole rim elevations, pipe invert elevations, and pipe slopes were included.

Downstream Boundary Condition

The downstream boundary conditions for the model (the discharge to Rock Creek Pump Station and Fairgrounds Pump Station) were both modeled as a free discharge outfalls since they discharge directly to the WWTP, and do not have any collection system elements downstream of either station.

Pump Stations

The Rock Creek and Fairgrounds Pump Stations were modeled as free discharge outfalls as discussed above. The Cascade Pump Station was not included in the model since it is relatively small, serving only 7 properties. The Kanaka pump station was included in the model as a pump element. It was assigned a variable discharge rate equal to the inflow rate into the wet well. This approach was selected so that the upstream sewer capacity could be assessed without backwater conditions related to station capacity. Comparison of peak pump station inflows to the firm capacity at each pump station was done separately.

Flow Distribution

Sanitary Base Flow

Base flow was estimated from City water consumption data and was distributed throughout the collection system. Large water users were located based on their physical address and ERUs assigned based on water consumption. All single-family residential services were assumed to be equal to one ERU. They were distributed among 28 sub-basins based on aerial photographs of current development and the County's tax lot data. A peaking factor of 2.0 was applied to the base flow for simulation of peak-hour flows.

Inflow and Infiltration

While the treatment plant data allowed calibration of the peak-day wet-weather flows, limited data was available to calibrate model results across the City or for peak-hour flows; therefore, the model is less accurate for localized areas in the upstream system. No temporary flow monitoring information from mainline sewers was available. However, historical flows at Rock Creek, Fairgrounds, and Kanaka Pumps Stations were estimated for peak wet-weather events based on pump run-time data and pump drawdown test results. Pump run-time data is collected on a weekly basis, so estimates for peak-day and peak-hour flows had to be made. Separate I/I rates were applied to each of the 28 sub-basins as described in Section 4.1.4

Sub-Basins and Flow Input Model Junctions

Estimated existing base flows and I/I were aggregated for each sub-basin and attributed to the flow input model junction. Figure 4-3 shows the delineation of the existing system sub-basins. The sub-basin boundaries were established for existing sewered areas based on location of existing pipe and direction of flow.

In each sub-basin, a model junction was selected to represent the point of flow input. The flow input junctions were selected to be close to the upper end of each basin as a conservative starting point. Where modeling results indicated undersized sewers, the flow input location in that basin was revisited, and adjusted if necessary to more accurately depict actual conditions.

Model Calibration

Model runs were performed for existing peak-day and existing peak-hour flows that were determined in Section 2.2.3. I/I rates were chosen as the variable to calibrate the model, since it has the most uncertainty due to lack of flow monitoring information throughout the collection system. Each sub-basin I/I rate was adjusted iteratively until model runs produced total system flows to the WWTP equal to those established in Section 2.2.3.

4.2.2 Results—Existing Peak-Hour Flow

The results of the modeling simulations are based on the best currently available information; however, they should be considered approximate because of the numerous assumptions used to estimate the distribution of I/I flows in the sewer system as well as the total peak-hour flow at the WWTP. These model results should be re-evaluated as additional flow data becomes available to confirm their accuracy.

Gravity Sewer Piping

The peak-hour wet-weather flow simulations for existing conditions indicate that several gravity sewers exceed 80 percent of full flow capacity. These areas are confined to the Cascade Interceptor and the 8-inch sewer line in Cascade Avenue. Modeling results indicate that two of the lines in the Cascade Interceptor exceed 100 percent of full capacity at current peak-hour flows; however, surcharging is minimal and no overflows are predicted. Figure 4-5 shows the gravity sewer locations that exceed 80 percent and 100 percent capacity.

Pump Stations

Model results show that existing peak flows exceed the firm capacities of Rock Creek and Kanaka Pump Stations. Existing modeled peak-hour flows are compared to existing pump station firm capacities for Rock Creek, Fairgrounds and Kanaka Pump Stations in Section 4.3.3.

4.3 FUTURE CAPACITY ANALYSIS

Two models were created for analysis of future capacity:

- **Year 2040—**The purpose of the Year 2040 model is to identify capacity deficiencies due to growth within the city limits and extensions of sewer system to unsewered areas. Model results are used to recommend improvement projects for implementation within the planning period.
- **Buildout—**The buildout scenario assumes annexation of the entire Stevenson Urban Area, which is not anticipated to occur within the 2040 planning period, or for quite some time afterward. The purpose of this model is to get a rough estimate of ultimate future flows to ensure that proposed gravity sewer improvements, (which can have a design life of 75 years or more) are sized adequately for all potential future flows.

4.3.1 Future Development

Refer to Figure 4-3 for a map of current and future sewer sub-basins. Boundaries for unsewered areas were selected based on anticipated sewer system development which is primarily influenced by topography and right-of-way location. These boundaries should be considered flexible, as development often occurs differently than expected or from what makes sense when looking solely at the sewer system characteristics. Pump stations are assumed to provide service to the sub-basins as shown in Table 4-11. If development occurs differently than shown in Table 4-11, then additional analysis of pump station capacity would be advised.

The sub-basins in the northern part of the urban area (V-07, V-08, V-09, and V-10) are not expected to receive sewer service during the planning period as they are at an elevation above any near term planned water system expansions. These basins were only modeled for build out conditions to ensure proposed gravity sewers are sized to handle potential future flows that are beyond the planning period.

Table 4-11. Pump Station Service Areas

Pump Station Name	Existing Sub-Basins Served	Future Sub-Basins Served
Cascade PS	C-02	-
Fairgrounds PS	F-01 through F-05	F-06, F-07
Kanaka PS	C-05a, C-05b, C-06, C-07	C-09, C-10
Rock Creek PS	C-01 through C-07, V-01 through V-03	C-08 through C-10, V-04 through V-10
Future PS-A	—	F-06, F-07
Future PS-B	—	V-05
Future PS-C	—	C-10

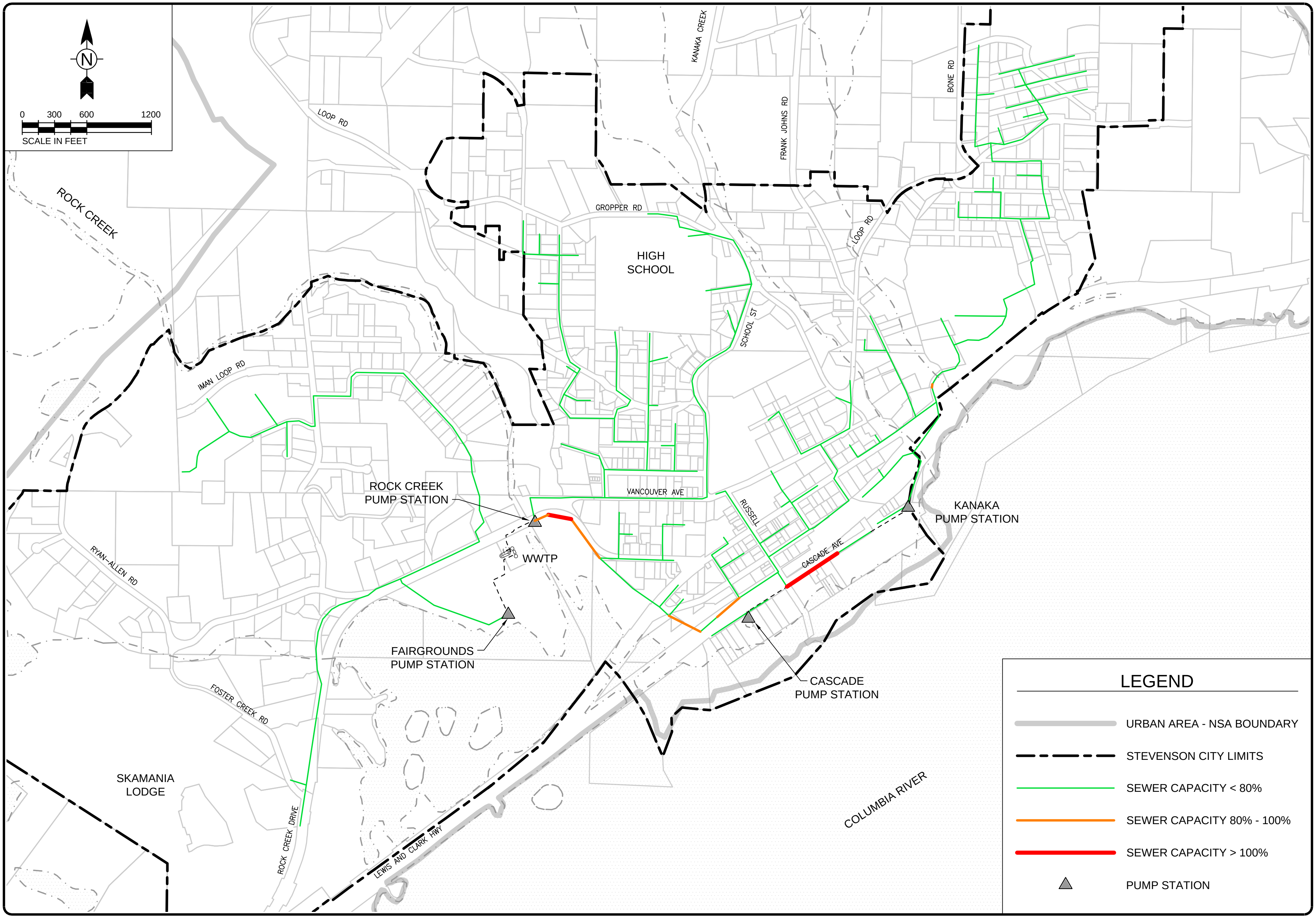

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Figure 4-5.
MODEL RESULTS - EXISTING SYSTEM, PEAK FLOW

Portions of sub-basins V-04, V-06, C-07, C-08, and C-09 are also located at an elevation that is above planned water system expansions. For these basins, growth during the planning period was projected only for the lower elevations areas that have potential to receive water service.

Sub-basin C-10 is not expected to see much, if any, development during the planning period due to steep terrain and shallow bedrock. Construction of a new pump station and force main would likely be required to serve this basin.

Commercial and industrial growth is envisioned in sub-basins V-05, F-06 and F-07. Service to basins F-06 and F-07 would require construction of new pump station and force main. A separate new pump station and force main would likely be required in basin V-05 to avoid gravity sewer construction within the Rock Creek landslide zone.

4.3.2 Model Construction

Flow Distribution

Base Flow—Year 2040

Base flow for the 2040 planning period was modeled as follows:

- **Residential Flow—**The additional sewered population used for the future condition is documented in Section 2.1. This includes additional sewered population resulting from future development and from connection of currently unsewered development. The equivalent residential flow load was based on the housing density associated with the zoning, adjusted uniformly so that the total population matched the estimates in Section 2.1.
- **Commercial Flow—**The additional commercial flows and equivalent residential units used for the future condition are documented in Section 2.1. The equivalent commercial flow was distributed based on input from City staff about expected areas of growth, particularly in the beverage industry.
- **Peaking Factor—**A peaking factor of 2.0 was used for the simulation of diurnal variation in base flows. This was applied to both residential and commercial flows.

Base Flow—Buildout

Flows for buildout in unsewered areas were created based on development density associated with the zoning, including allowances for future right of way, open spaces, and steep slopes. Flows for currently developed areas assume infill of undeveloped properties in accordance with zoning densities, as well as conversion of all existing septic systems.

Inflow and Infiltration

I/I from existing sewered development was assumed to increase by 10 percent from current levels due to climate change as described in Section 2.2.2. I/I for future development was estimated by assuming 2,500 gpad for both the Year 2040 model and the Buildout model. This represents the 2,000 gpad suggested by King County for new development, with a provision for degradation of the collection system over time. King County suggests a 7-percent increase in I/I per decade.

Sub-Basins and Flow Input Model Junctions

Estimated existing base flows and I/I were aggregated for each sub-basin and attributed to the flow input model junction. A model junction was selected to represent the point of flow input at an upper end of the modeled collection system, most likely to receive these future flows. Figure 4-3 shows sewer sub-basins, and Appendix C provides sewer sub-basin design data, including I/I rates, ERUs, and developed area for each sub-basin and each time period used in the model.

4.3.3 Results—Year 2040 Peak-Hour Flow

Gravity Sewer Piping

The peak-hour wet-weather flow simulations for the 2040 planning period indicate that 17 pipe segments exceed 80 percent of full flow capacity, and 10 of these exceed 100 percent of full capacity. These areas are confined to the Cascade Interceptor, the 8-inch sewer line in Cascade Avenue, and Main F upstream of the Kanaka Pump Station. No overflows are predicted due to insufficient pipe capacity, assuming pump stations are sized to handle future inflows. Figure 4-6 shows the gravity sewer locations that exceed 80 percent and 100 percent capacity.

Pump Stations

Model results show that 2040 peak flows exceed the firm capacities of Rock Creek, Fairgrounds, and Kanaka Pump Stations. Existing and Year 2040 modeled peak-hour flows are compared to existing pump station firm capacities for Rock Creek, Fairgrounds and Kanaka Pump Stations in Table 4-12.

Table 4-12. Existing Pump Station Capacities and Modeled Peak Flows

Pump Station	Existing Station Firm Capacity		Modeled Existing Peak-Hour Flow		Modeled 2040 Peak-Hour Flow	
	(gpm)	(mgd)	(gpm)	(mgd)	(gpm)	(mgd)
Rock Creek	465	0.67	1110	1.60	1460	2.10
Fairgrounds	280	0.40	225	0.32	355	0.51
Kanaka	195	0.28	325	0.47	475	0.68
Cascade	80	0.12	N/A[a]			

a. Cascade Pump Station not modeled. Pump run-time records show that station has adequate capacity for existing and future flows.

4.3.4 Results—Buildout Peak-Hour Flow

Refer to Appendix C for a summary of results for buildout peak-hour flows. It lists the following information for each pipe segment in the model:

- Existing pipe diameter, slope and capacity
- Pipe segment design flow for buildout conditions
- Required pipe diameter to convey buildout flows at current pipe slope.

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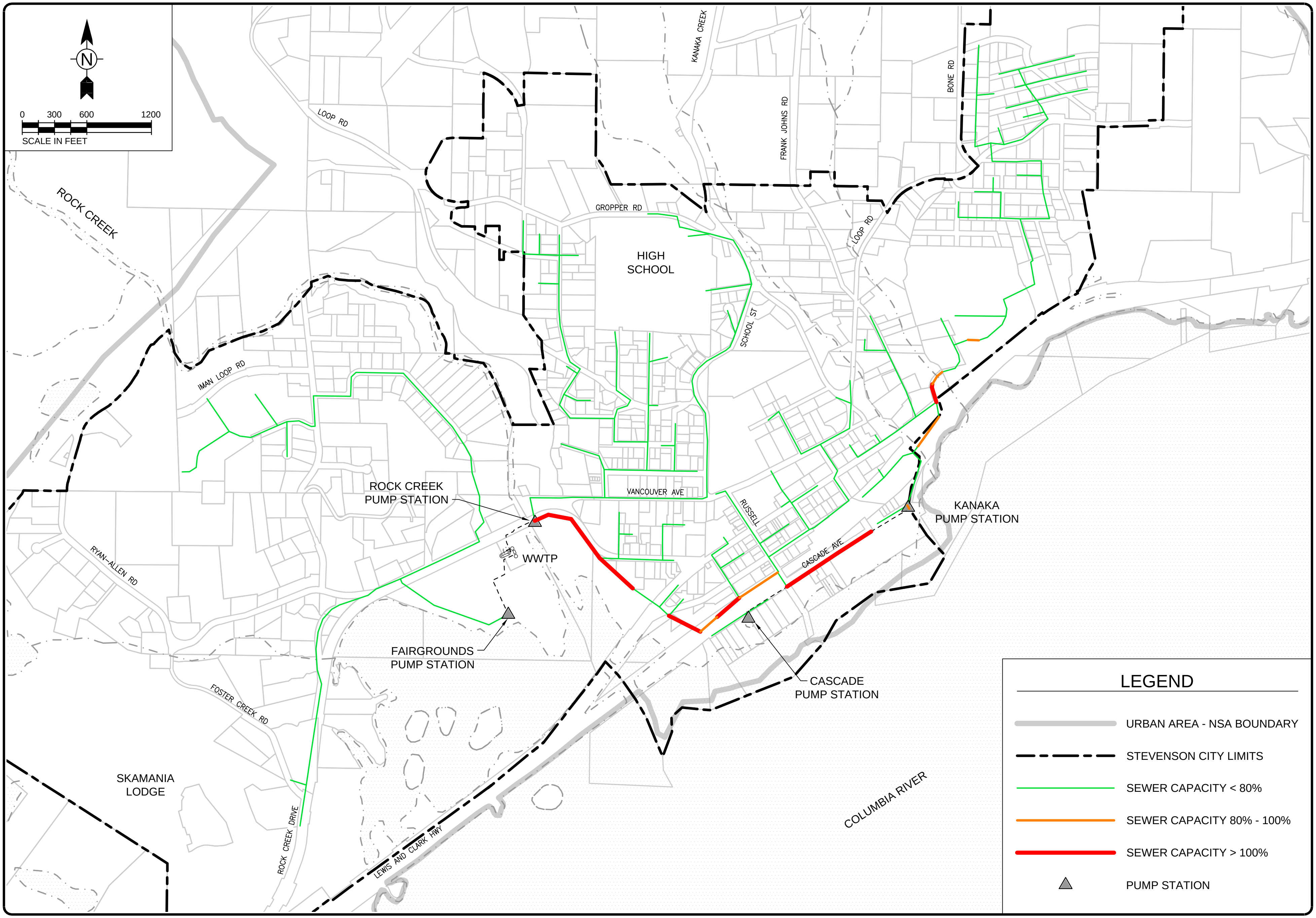

4/2/2017 2:25:31 PM - P:\48600\135-48600-16001\CAD\SHEETFILES\FIGURE-4-6.DWG

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City of Stevenson
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Figure 4-6.
MODEL RESULTS - YEAR 2040, PEAK FLOW

5. COLLECTION SYSTEM IMPROVEMENTS

The collection system improvements recommended in this section are covered in two phases. Phase 1 covers the period from 2017 through 2025, and Phase 2 covers the period from 2025 through 2040. Estimated overall capital costs are provided for each project. A detailed estimate of overall cost and description of work items that make up the recommended improvements is included in Appendix D.

5.1 GRAVITY SEWER CAPACITY UPGRADES

The following improvements are needed to address capacity deficiencies identified by collection system modeling. Figure 5-1 shows the locations of the proposed collection system improvement projects.

5.1.1 Cascade Avenue Sewer—Phase 1 (Project S-01)

The existing 8-inch sewer in Cascade Avenue, east of Russell Avenue between MH CI-13 and CI-15 is undersized for existing and future peak flows. This line should be upsized prior to any capacity upgrades to the Kanaka Pump Station. The project consists of replacing 920 feet of 8-inch sewer pipe with new 12-inch pipe. The estimated capital project cost is $441,000.

5.1.2 Cascade Interceptor—Phase 1 (Project S-02)

This portion of the existing 12-inch Cascade Interceptor is undersized for both existing and future peak flows, located in Rock Creek Drive starting at the Rock Creek Pump Station and continuing upstream to MH CI-4. The project consists of replacing 1,250 feet of 12-inch sewer pipe with new 18-inch pipe. The estimated capital project cost is $682,000.

5.1.3 Cascade Interceptor—Phase 2 (Project S-03)

This portion of the existing 12-inch Cascade Interceptor is undersized for year 2040 peak flows. It starts at MH CI-4 and continues upstream to MH CI-12 at the intersection of Russell Avenue and Railroad Street. The project consists of replacing 1,650 feet of 12-inch sewer pipe with new 18-inch pipe. The estimated capital project cost is $1,050,000.

5.2 EXTENSIONS TO UNSEWERED AREAS

It is expected that the collection system eventually will be extended to provide service to all currently unsewered development within the city limits. The system also will be extended into any parts of the Urban Area that become annexed to the city in response to requests associated with proposed development. The following projects will facilitate conversions of existing septic systems as well as allow future extensions to potential development. These projects can be constructed in Phase 1 or Phase 2, depending on availability and type of funding, rates of septic failures, and development trends within the City and adjoining Urban Area. Costs assume installation of service laterals to the property line. Installation of sewer laterals on private property and septic system conversions are not included in the costs. These projects are not included in the CIP plan as it is assumed they will be primarily private funded.

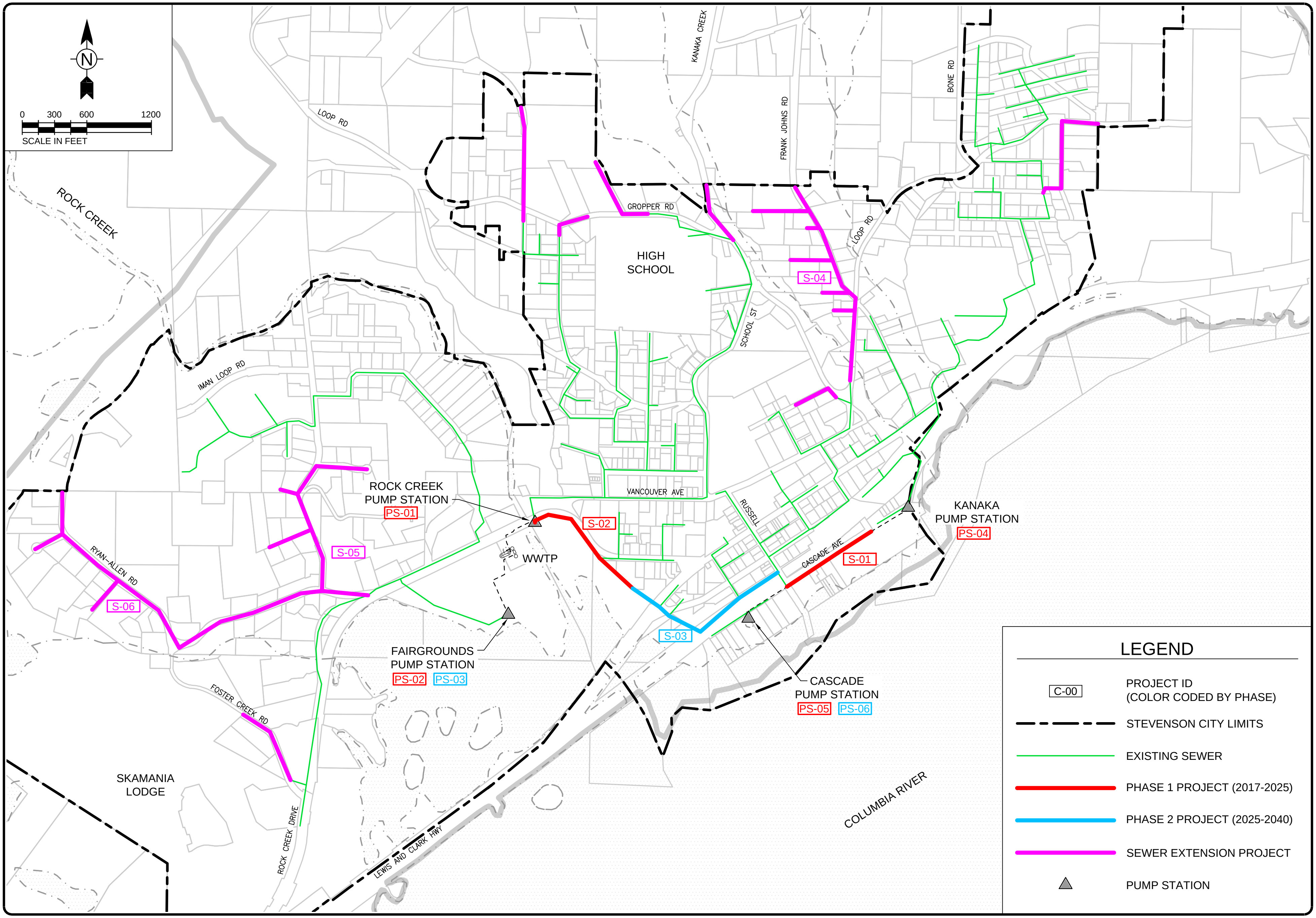

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Figure 5-1.
PROPOSED COLLECTION SYSTEM IMPROVEMENTS

5.2.1 Main D Extension (Project S-04)

This project will extend Sewer Main D north along East Loop Road and Frank Johns Road to provide an available sewer to connect to for properties currently on septic. Spur lines will be provided to serve properties on Thomas Street, Jordan Street, Carrick Road, and Gale Street. It would also allow for future extension north on Frank Johns Road beyond current city limits to serve new development. The project consists of installing 3,500 feet of 8-inch sewer pipe. It will provide possible sewer connection for 31 properties currently on septic as well as future service to undeveloped properties located near the line. The estimated capital project cost is $1,330,000.

5.2.2 Iman Cemetery Road (Project S-05)

This project will extend sewer closer to properties within city limits that are currently on septic to allow conversion to the sewer system. The new sanitary sewer will start at Rock Creek Drive and Ryan Allen Road, continuing north on Iman Cemetery Road. Spur lines will be provided to serve properties on SW Briggs Road, NW Kaspar Road, and Nicklaus Court. The project consists of installing 2,800 feet of 8-inch sewer pipe. It will provide a possible sewer connection to 20 properties currently on septic as well as future service to undeveloped properties located near the line. The estimated capital project cost is $1,045,000.

5.2.3 Foster Creek Road (Project S-06)

This project will extend sewer closer to properties within city limits that are currently on septic to allow conversion to the sewer system. The new sanitary sewer will start from the intersection of Ryan Allen Road and Iman Cemetery Road, continue east to Foster Creek Road, and then continue north to the intersection of Foster Creek Road and Hollstrom Road. Spur lines will be provided to serve properties on Lakeview Road and SW Jayden Lane. The project consists of installing 4,000 feet of 8-inch sewer pipe. It will provide a possible sewer connection to 24 properties currently on septic as well as future service to undeveloped properties located near the line. The estimated capital project cost is $1,525,000.

5.2.4 Other Extension Projects

Additional extension projects are shown on Figure 5-1, but not assigned a project ID. These projects would likely be privately funded as part of future development. All of these proposed pipes will likely only need to be 8” diameter given the steep terrain and relatively small service areas. Pipe sizing should be verified by the developer during the design review process.

5.3 PUMP STATION UPGRADES

All pump stations need to be outfitted to allow bypass pumping systems to be installed in case of extended power outage or failure of the pump or control systems. Needed modifications would include suction connection, appropriate pump selection, and a discharge connection to the force main.

5.3.1 Rock Creek Pump Station—Phase 1 (Project PS-01)

Modeling indicates that the Rock Creek Pump Station is undersized for both existing and future flows. Pump run-time data and staff observations corroborate the model results. Therefore, full pump station replacement is recommended. This project consists of constructing a new 1,500-gpm firm capacity duplex or triplex submersible pump station with new control panel, auxiliary standby power, and new 12-inch force main to the WWTP. The estimated capital project cost is $1,226,000.

5.3.2 Fairgrounds Pump Station—Phase 1 (Project PS-02)

Modeling indicates that this pump station is adequately sized for current flows, but might be slightly undersized for 2040 flows. It is recommended that flows to this pump station be monitored to verify modeling assumptions and allow for more accurate predictions of existing and future peak-hour flows. In the interim, the following improvements are recommended:

- Provide provision for bypass pumping.
- Install new flow meter on the force main discharge piping.
- Integrate new flow recorder into existing controls.
- Relocate portion of force main if necessary for WWTP expansion.

The estimated capital project cost is $111,000.

5.3.3 Fairgrounds Pump Station—Phase 2 (Project PS-03)

The following Phase 2 work items are recommended at the Fairgrounds Pump Station:

- Replace pump station with new submersible pumps in new wet well.
- Provide a new control panel and instrumentation.
- Provide new electrical equipment, including standby generator and automatic transfer switch.

The estimated capital project cost is $917,000.

5.3.4 Kanaka Pump Station—Phase 1 (Project PS-04)

Modeling indicates that this pump station is undersized for both existing and future flows. Average weekly pump run-times of 14.5 hours per day were observed in December 2015, which is high for systems with large peaking factors, as is suggested by WWTP flow records.

At a minimum, a flow meter should be installed at the pump station to verify modeling assumptions and allow for more accurate predictions of existing and future peak-hour flows. However, full pump station replacement is recommended, given the potential near-term additional flows from development of the Chinidere Mountain subdivision as well as the station deficiencies listed in Section 4.1.2.

Pump station replacement will consist of constructing a new 500-gpm firm capacity duplex submersible pump station with new control panel and auxiliary standby power. The existing 6-inch force main installed in 2015 will not need replacement as it is adequately sized for projected flows. The estimated capital project cost is $770,000.

5.3.5 Cascade Pump Station—Phase 1 (Project PS-05)

The Cascade Pump Station is adequately sized for existing and future flows. The following improvements are recommended:

- Provide provision for bypass pumping.
- Upgrade controls to include an auto-dialer or remote telemetry unit to notify operations staff of high wet well level or equipment malfunction.

The estimated capital project cost is $37,000.

5.3.6 Cascade Pump Station—Phase 2 (Project PS-06)

The following Phase 2 work items are recommended at the Cascade pump station:

- Replace pump station with new submersible pumps in new wet well.
- Provide a new control panel and instrumentation.

The estimated capital project cost is $509,000.

5.4 IMPROVED OPERATION AND MAINTENANCE

5.4.1 Sewers

Sewer Inspection and Cleaning

It is recommended that all City sewers be systematically inspected by CCTV, with the oldest sewers to be inspected in the first two years and the remaining sewers over 10 years. The inspection should be done to the standards of the Pipeline Assessment Certification Program, with the video and subsequent reports archived. This inspection should identify system defects and help identify sewers that need significant maintenance, rehabilitation and replacement. A system of preventive maintenance should be implemented that includes cleaning and removal of tree roots. For sewers of greater significance or with likelihood of recurring issues, a schedule for preventative maintenance should be set.

It is recommended that the City budget $5,000 per year for CCTV work.

Pipe and Manhole Rehabilitation

It is recommended that the City begin a yearly program of pipe and manhole rehabilitation in specific areas, including older parts of the collection system and known areas of high I/I, such as School Street and the downtown areas. Pipe rehabilitation can include new pipe, pipe bursting or cured-in-place pipe lining.

It is recommended that the City budget $80,000 per year for upgrades. Based on results of past I/I repairs, significant reductions in flow are not anticipated. Rather, the control program will likely maintain the collection system's current I/I rate as it ages.

Geotechnical Considerations

It is recommended that a geotechnical engineer be consulted before making I/I repairs in areas of known or suspected slope instability (such as the northeast area of the collection system), because I/I repairs could change subsurface drainage patterns and increase the risk of a landslide.

5.4.2 Flow Monitoring and Data Collection

Collection of flow monitoring data will enable measurement of base flow and I/I in City sewers. It is recommended that the gravity sewer system be visually checked at key locations to estimate dry-weather and wet-weather flows. Combining velocity readings from a portable velocity sensor with estimates of water depth would enable estimates of flow at each location.

Periodic installation of temporary flow monitors at key locations in the network is also recommended. These flow monitors should record both water depth and water velocity, so that total flow can be derived. Installation of the meters should be at locations that have been screened to ensure that poor site hydraulics do not limit the accuracy of the data collection. A typical flow monitor installation would occur during the wet-weather season between September and April. This period may be extended if specific dry-weather flow information is desired.

5.4.3 CMOM Program

It is recommended that the City implement a Capacity, Management, Operation, and Maintenance (CMOM) program following EPA guidance. A CMOM program should incorporate the following elements:

- Level of service
- Performance measurements
- Information systems
- Asset identification and capitalization
- Failure impact evaluation and risk management
- Condition assessment
- Rehabilitation and replacement planning
- Capacity assurance planning
- Maintenance analysis and planning
- Financial management
- Continuous improvement.

5.5 PRELIMINARY COLLECTION SYSTEM CAPITAL COST ESTIMATE

Planning level capital cost estimates for the recommended collection system improvements are presented in Table 5-1. A detailed cost estimate by work item is included in Appendix D. This is a Class 4 cost estimate as defined by the Association for the Advancement of Cost Engineering International. These costs represent planning level cost estimates in 2017 dollars and should be considered accurate in the range of +50 to -30 percent.

Table 5-1. Planning Level WWTP Capital Cost Estimates

Component	Estimated Capital Cost
Phase 1 Projects 2017-2025	
S-01—Cascade Avenue Sewer	$441,000
S-02—Cascade Interceptor - Rock Cr PS to MH CI-4	$682,000
PS-01—Rock Creek Pump Station	$1,226,000
PS-02—Fairgrounds Pump Station - Phase 1	$111,000
PS-04—Kanaka Pump Station	$770,000
PS-05—Cascade Pump Station - Phase 1	$37,000
Total	$3,267,000
Phase 2 Projects 2025-2040	
S-03—Cascade Interceptor - MH CI-4 to CI-12	$1,050,000
PS-03—Fairgrounds Pump Station - Phase 2	$917,000
PS-06—Cascade Pump Station - Phase 2	$509,000
Total	$2,476,000
Extensions to Unsewered Areas	
S-04—Sewer Main D Extension	$1,330,000
S-05—Iman Cemetery Road Extension	$1,045,000
S-06—Foster Creek Road Extension	$1,525,000
Total	$3,900,000
Annual Operations and Maintenance	
Annual Pump Station Operation & Maintenance	$41,200
Annual Sewer Inspection & Cleaning	$5,000
Annual Pipe and MH Rehab	$80,000

6. EXISTING WASTEWATER TREATMENT PLANT

6.1 WASTEWATER TREATMENT PLANT OVERVIEW

The City of Stevenson Wastewater Treatment Plant (Stevenson WWTP) is located on the banks of Rock Creek, on Rock Creek Drive in the west end of Stevenson. The plant is designed for a peak-hour flow of 1.5 million gallons per day (mgd). It uses an oxidation ditch for treatment and discharges treated and disinfected effluent to the Bonneville Pool of the Columbia River. Figure 6-1 shows the current WWTP site.

Figure 6-1. Stevenson WWTP Site

The Stevenson WWTP was constructed in 1971 and originally consisted of a Smith and Loveless Oxygest package treatment plant with a chlorine contact tank for disinfection and a sludge lagoon. In 1992, the original plant was upgraded with largely new current facilities, including the oxidation ditch, secondary clarifiers, and UV disinfection facility. Some components from the original plant were kept as back-up to the new facilities or for solids handling.

Figure 6-2 shows the overall process diagram of the Stevenson WWTP. Treatment processes are summarized below.

6.1.1 Liquid Treatment

Current processes for the liquid stream at the Stevenson WWTP are as follows:

- Wastewater enters the Rock Creek Pump Station (serving portions of the City east of the WWTP) and Fairgrounds Pump Station (serving portions of the City west of the WWTP). These serve as the WWTP's current influent pump stations.
- The In-Plant Pump Station receives tank drain flow from the solids holding tank, oxidation ditch, secondary clarifiers, solids loading area, and disinfection facilities and pumps to the force main downstream of the Fairgrounds Pump Station, upstream of the headworks.
- The combined force main from the influent pump stations discharges to the headworks facility. The combined raw wastewater flows are typically discharged to the south channel of the headworks, which features a mechanical bar screen to remove screenings entering the plant. The north channel contains a manually cleaned bar screen and is used for overflow and maintenance purposes.
- Screened wastewater flows by gravity to the oxidation ditch, which is aerated by one or two brush rotors.
- Mixed liquor from the oxidation ditch is conveyed to one or both of the secondary clarifiers.
- Secondary effluent from the clarifiers is combined and conveyed to the UV disinfection channel for disinfection.
- Disinfected effluent leaves the WWTP through a 21-inch reinforced concrete outfall pipe from the effluent structure; a portion of the disinfected flow is recycled as non-potable plant reuse water.

6.1.2 Solids Handling

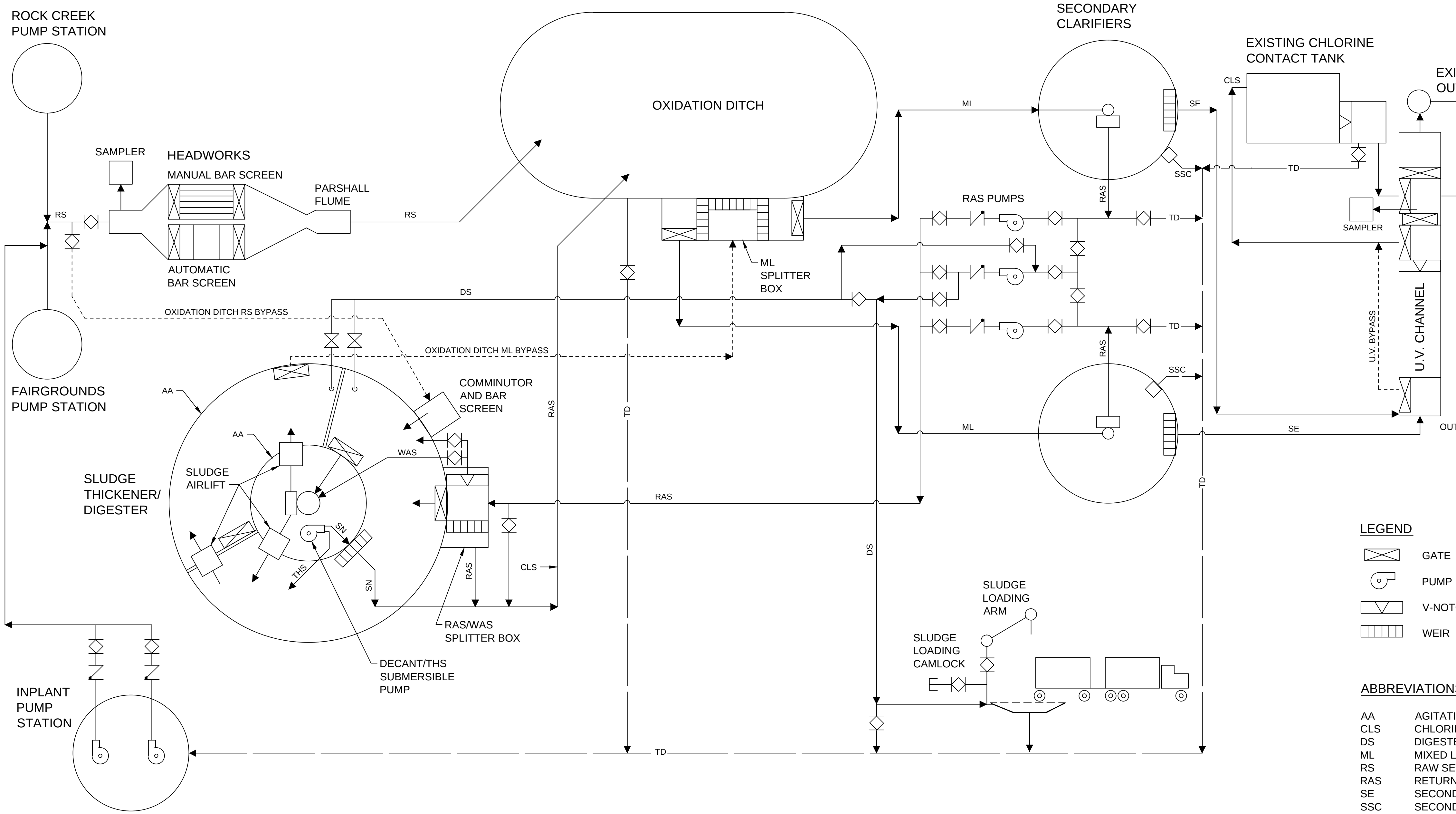
Current processes for the solids stream at the Stevenson WWTP are as follows:

- A pump station located between the secondary clarifiers pumps return activated sludge (RAS) and waste activated sludge (WAS) from the clarifiers to the RAS/WAS splitter box at the sludge holding tank. RAS flows to the oxidation ditch, and WAS flows to the solids holding tank.
- Settled sludge from the aerated solids holding tank is pumped into a 6,000-gallon sludge truck and hauled off-site to the Hood River WWTP digester complex, where it is digested to produce Class B biosolids and land-applied to neighboring agricultural property.

6.2 SYSTEM COMPONENTS

6.2.1 Influent Pumping

Influent to the Stevenson WWTP is pumped by the Rock Creek and Fairgrounds pump stations. For information about the influent pump stations, see Sections 3.3.1 and 3.3.2.



LEGEND

[symbol]	GATE
[symbol]	PUMP
[symbol]	V-NOTCH WEIR GATE
[symbol]	WEIR

ABBREVIATIONS

AA	AGITATION AIR
CLS	CHLORINE SOLUTION
DS	DIGESTED SLUDGE
ML	MIXED LIQUOR
RS	RAW SEWAGE
RAS	RETURN ACTIVATED SLUDGE
SE	SECONDARY EFFLUENT
SSC	SECONDARY SCUM
TD	TANK DRAIN
WAS	WASTE ACTIVATED SLUDGE

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CITY OF STEVENSON, WA
GENERAL SEWER PLAN UPDATE

EXISTING WWTP
PROCESS FLOW DIAGRAM

Project No.: 135-48600-16001
Date: MARCH 2017
Designed By:
Supplemental
FIGURE 6-2

Bar Measures 1 inch

4/3/2017 1:52:31 PM - P:\48600\135-48600-16001\CAD\SHEETFILES\FIGURE-6-2.DWG - BENNETTDAGGETT, HUNTER

6.2.2 Headworks

The Stevenson WWTP headworks (see Figure 6-3) is upstream of the oxidation ditch and consists of two channels (north and south), each 2 feet wide. Raw sewage from the influent pump stations and In-Plant Pump Station discharges to the south channel, where it passes through the mechanical bar screen before going to the oxidation ditch. The north channel contains a manually cleaned bar screen and is used in high flow situations and when repairs to the mechanical bar screen are required.

Slide gates SG-1 and SG-2 (upstream) and SG-3 and SG-4 (downstream) isolate the two channels. A Parshall flume is located downstream of the channels, with a stilling well adjacent to the channel for the future installation of a flow recorder.

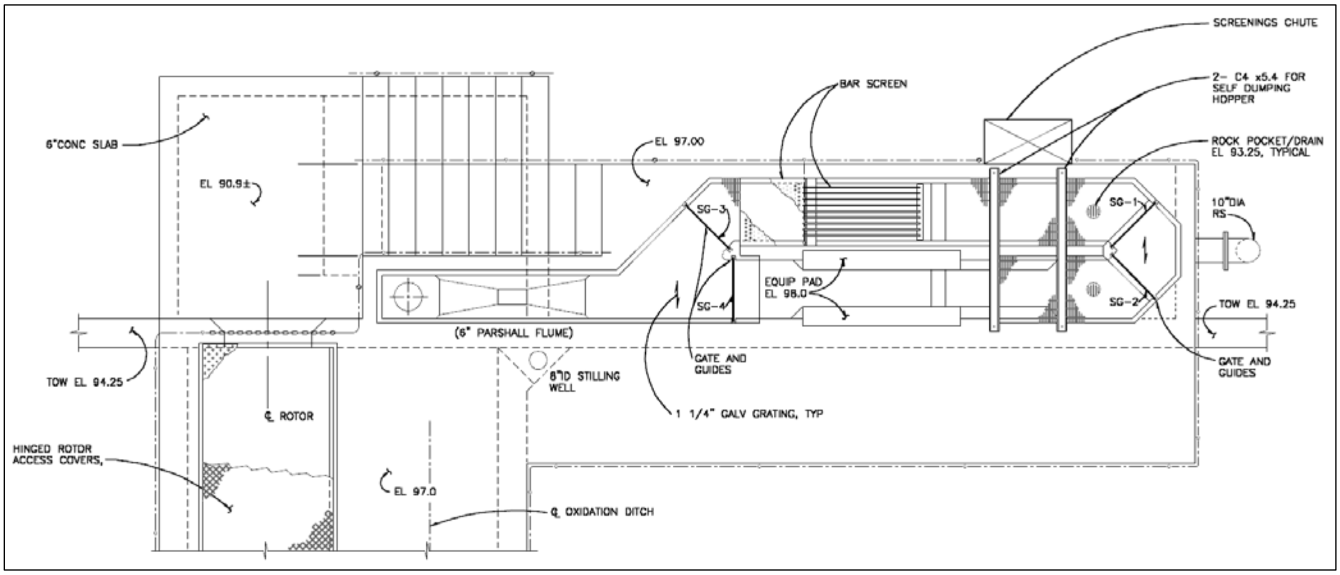


Figure 6-3. Stevenson WWTP Headworks

6.2.3 Oxidation Ditch

The oxidation ditch is a 103-foot-long oval structure with a central dividing wall, located next to the headworks (see Figure 6-4). Screened wastewater from the headworks and RAS from the RAS/WAS splitter box enter the oxidation ditch from pipes in the base of the oxidation ditch and are mixed with the mixed-liquor suspended solids (MLSS) activated sludge already present in the oxidation ditch. Two brush rotors supply oxygen from the air and keep the contents of the oxidation ditch mixed and moving. The rotors are covered with hinged access covers. Each rotor is sized to provide required air and mixing energy at peak design flows; the second rotor is therefore a redundant standby unit. Mixed liquor flows out of the oxidation ditch into the mixed liquor splitter box via a 13-foot-long adjustable weir gate. The splitter box routes mixed liquor to secondary Clarifier #1 or #2 for solids settling and removal.

MLSS consists mostly of microorganisms and non-biodegradable suspended matter. When raw sewage with high organic load mixes with MLSS in the presence of oxygen, the organic load is oxidized by the microbes. Dissolved oxygen (DO) concentration in the oxidation ditch is controlled by adjusting the immersion depth of the brush rotors. High DO levels occur immediately downstream of each operating rotor, and DO levels decrease as the mixed liquor flows downstream, yielding low-DO or anoxic zones downstream. The next operating rotor creates a high-DO zone, and so on, as mixed liquor circulates around the oxidation ditch. These alternating zones may promote nitrification, denitrification, alkalinity recovery and energy conservation.

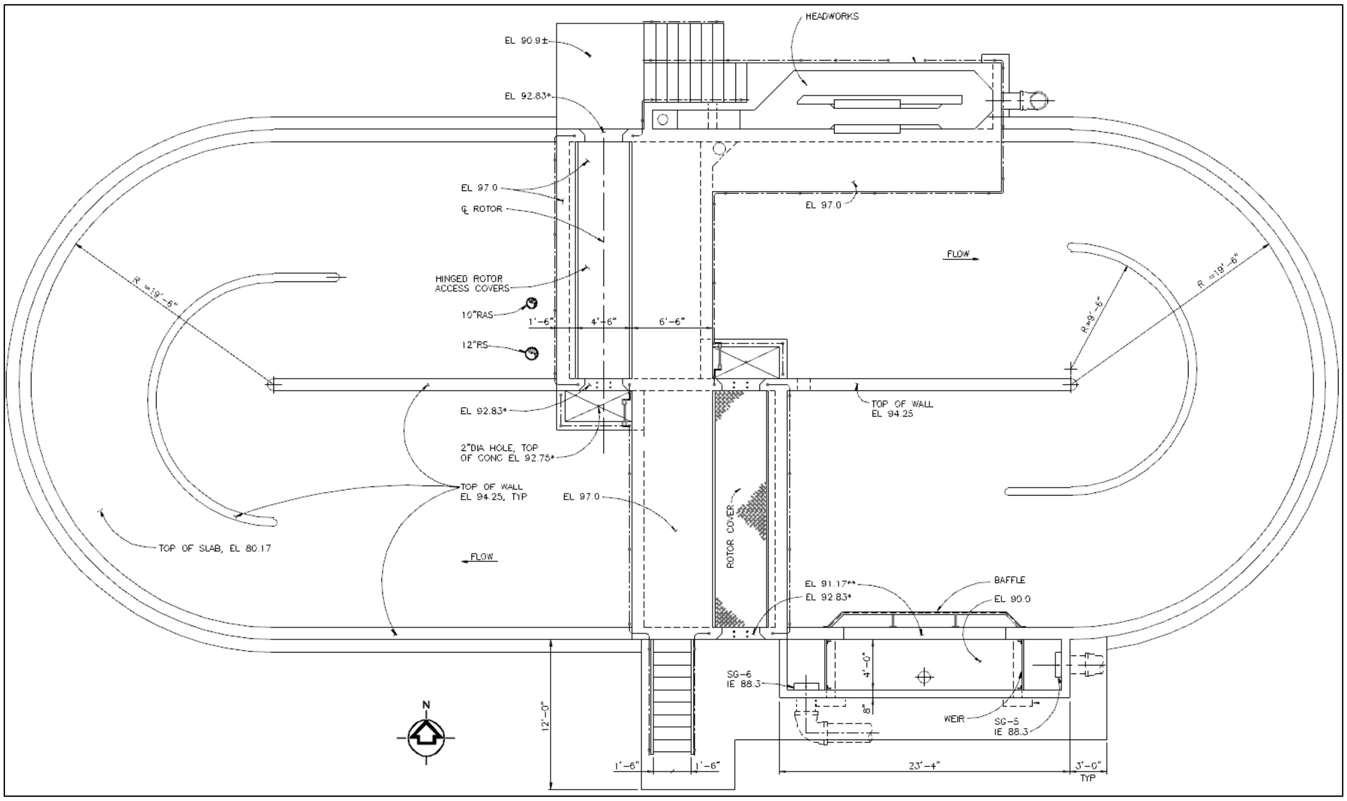


Figure 6-4. Oxidation Ditch

When the rotor immersion depth is increased by manually adjusting the effluent weir at the secondary clarifier flow splitter box, more oxygen is transferred to the mixed liquor, the mixed liquor circulates faster around the oxidation ditch, and energy consumption increases. The immersion depth of the rotor can be controlled by varying the water level, which is accomplished by adjusting the outlet tipping weir up or down using a hand wheel. Aeration and mixing performance can also be adjusted by changing the rotor rotation speed with different size sheaves. Lower speeds provide more mixing and less aeration per horsepower; higher speeds do the opposite.

6.2.4 Clarifiers

The Stevenson WWTP has two secondary clarifiers, as shown in Figure 6-5 and Figure 6-6. MLSS settles in each clarifier and is transported to the center of the clarifier by rotating rake arms. The concentrated, settled sludge is then withdrawn by pumps and pumped to the RAS/WAS splitter box adjacent to the sludge holding tank.

Clarifiers #1 and #2 are each 35 feet in diameter with 14-foot side water depth and 1:12 bottom slope. Mixed liquor enters through a 14-inch pipe from the mixed liquor splitter box at the oxidation ditch. Clarified effluent leaves each clarifier via outlet weirs and a 14-inch diameter pipe to the disinfection facility. Settled sludge is removed from the clarifiers through 8-inch RAS lines and is pumped by three RAS pumps in the RAS pump station adjacent to the two clarifiers. Scum is deposited by the skimmer in a scum box located in each clarifier, where it flows by gravity through a 6-inch pipe to the plant drain system and In-Plant Pump Station.

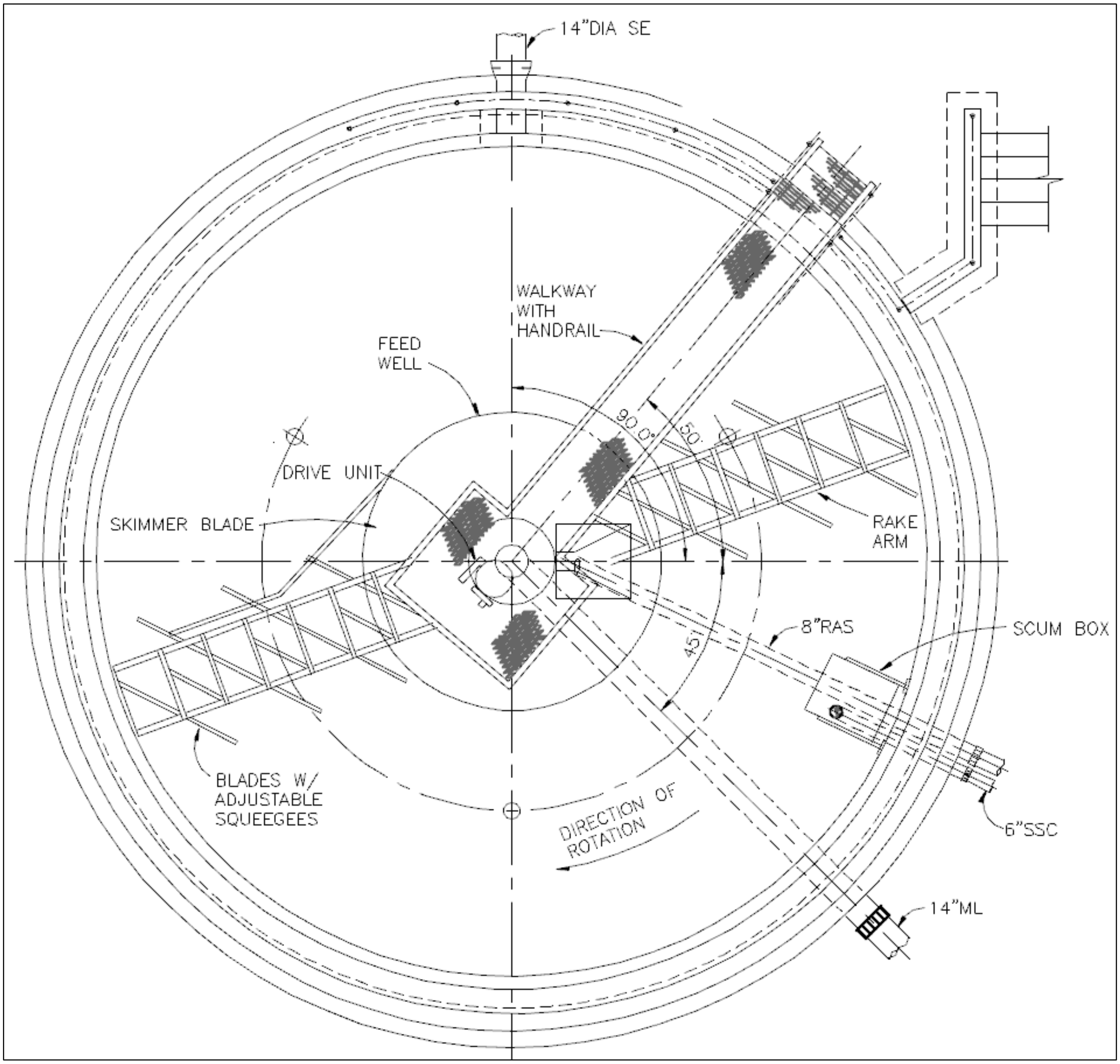


Figure 6-5. Secondary Clarifier (Plan View)

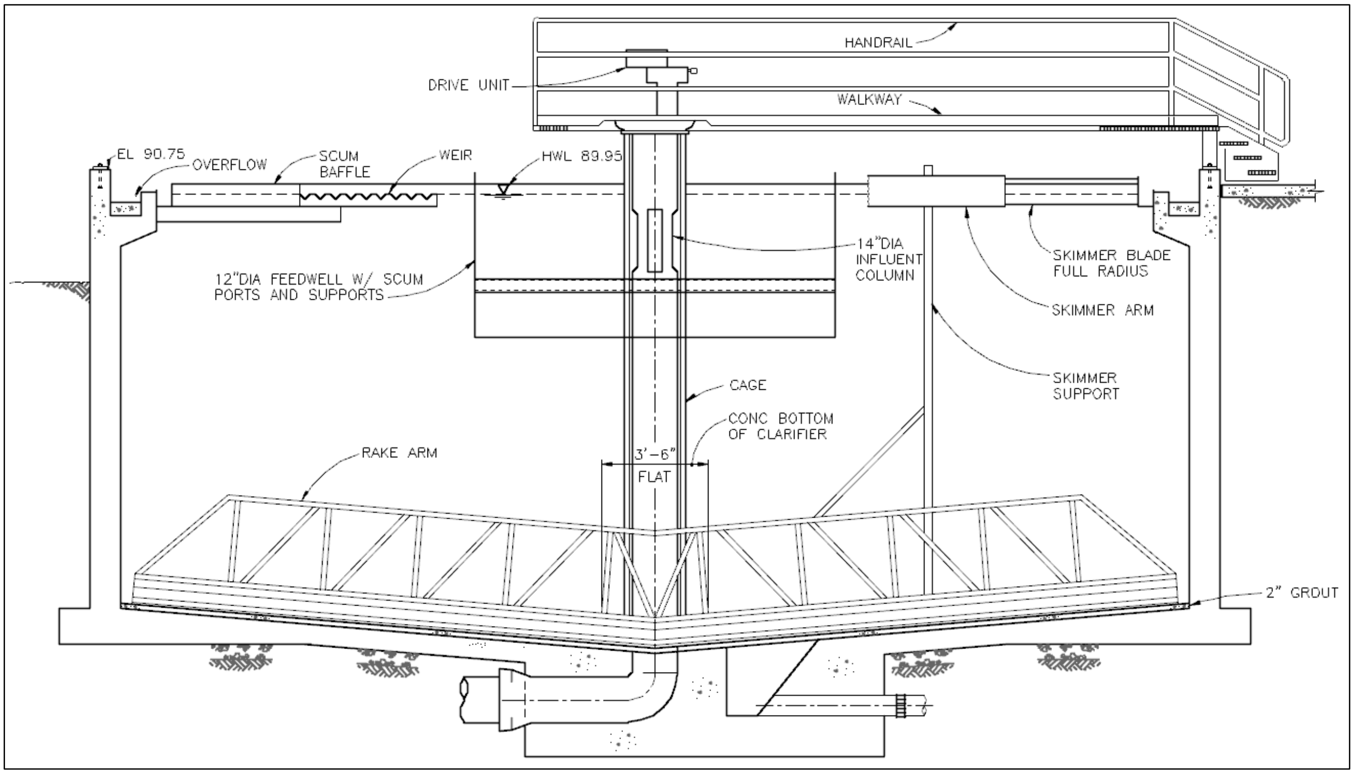


Figure 6-6. Secondary Clarifier (Section View)

6.2.5 Disinfection System

The disinfection system consists of one UV unit in an open channel and a standby chlorine system.

UV Disinfection

The UV disinfection facility consists of an open, concrete channel, UV lamp modules, electrical distribution center and weir to maintain a steady water elevation at the UV lamps, as shown in Figure 6-7. After passing through the UV unit and flowing over the finger weir, disinfected effluent is metered using a V-notch weir and ultrasonic level sensor. After overflowing the V-notch weir, disinfected effluent flows through a stop gate and to the WWTP outfall by gravity.

Chlorine Disinfection

The chlorination system was constructed in 1971 with the original treatment plant and maintained as a standby system in the 1992 upgrade. The system consists of a chlorinator and chlorine contact tank. The chlorinator uses chlorine gas from 150-pound cylinders, delivered through a manually adjusted V-notch chlorinator and dissolved in water at a chlorine injector to form a concentrated chlorine solution, which is injected into the influent pipe approximately 5 feet upstream of the contact tank. The contact tank is a 12-foot by 20-foot concrete tank with an average depth of 5 feet. The tank's single chamber is divided with wooden baffles to produce a serpentine flow.

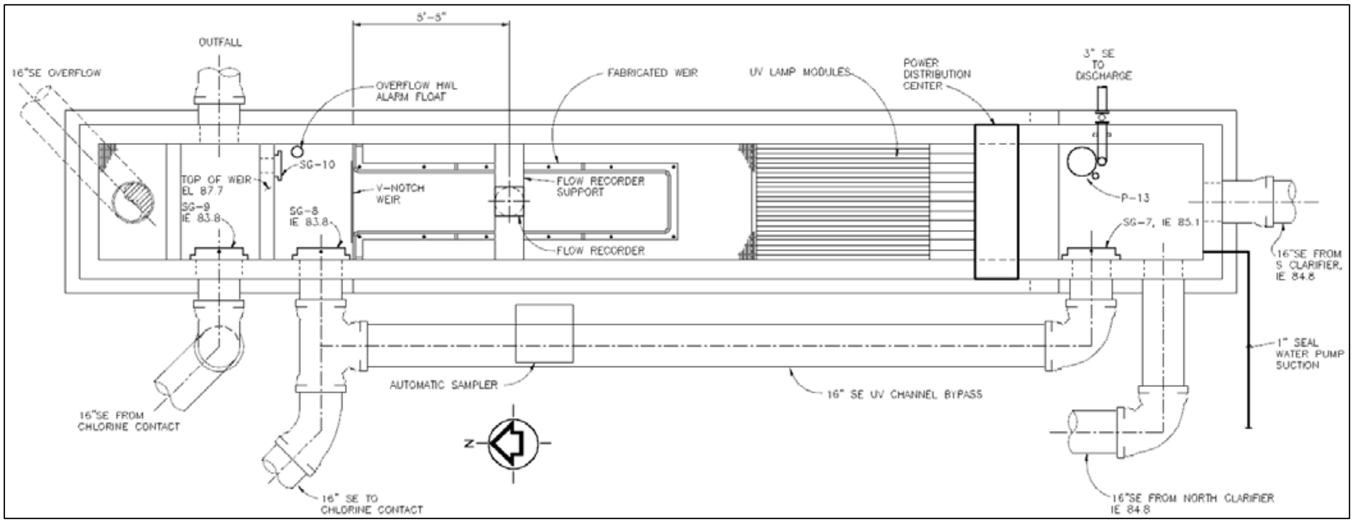


Figure 6-7. UV Disinfection

6.2.6 Effluent Outfall

Disinfected effluent flows by gravity to an effluent manhole and on to the outfall in the Columbia River. The outfall piping consists of approximately 850 feet of 15-inch PVC pipe, followed by approximately 2,020 feet of 18-inch HDPE pipe. Following partial blockage of the existing discharge in 2007 due to landslide activity, the existing outfall was extended by approximately 300 feet in 2013.

The WWTP also has a permitted secondary outfall to Rock Creek, allowable only when the primary outfall is inoperative or during essential maintenance. Discharge to Rock Creek is accomplished using a 10-inch concrete pipe directly to the creek.

6.2.7 Solids Handling

RAS/WAS from the clarifiers is pumped to the RAS/WAS splitter box adjacent to the solids holding tank, which is converted from the original Oxygest treatment plant. The holding tank has a total volume of approximately 170,000 gallons, divided into three chambers:

- The center chamber serves as an inlet and solids thickener, and has a volume of 37,650 gallons.
- The large section of the outer chamber is used for aerobic digestion, and has a volume of 88,000 gallons.
- The smaller section of the outer chamber is used for solids stabilization and storage, and has a volume of 44,000 gallons.

Process flow within the solids facility is shown in Figure 6-8. During normal operation WAS flows from the RAS/WAS splitter box to the center chamber (thickener) for thickening prior to being pumped to the larger outer section (digester) for digestion.

Thickening is accomplished by allowing the solids to settle by gravity prior to being pumped to the outer digester chamber. Sweep arms in the thickener chamber move the thickened solids to the center of the chamber. Six drop legs with three air diffusers each provide aeration in the thickener, and sixteen drop legs with three diffusers each provide coarse bubble aeration and mixing within the digester chamber. Solids transfer between chambers is accomplished using airlifts. Supernatant from the thickener is pumped to the oxidation ditch using a solids decant pump.

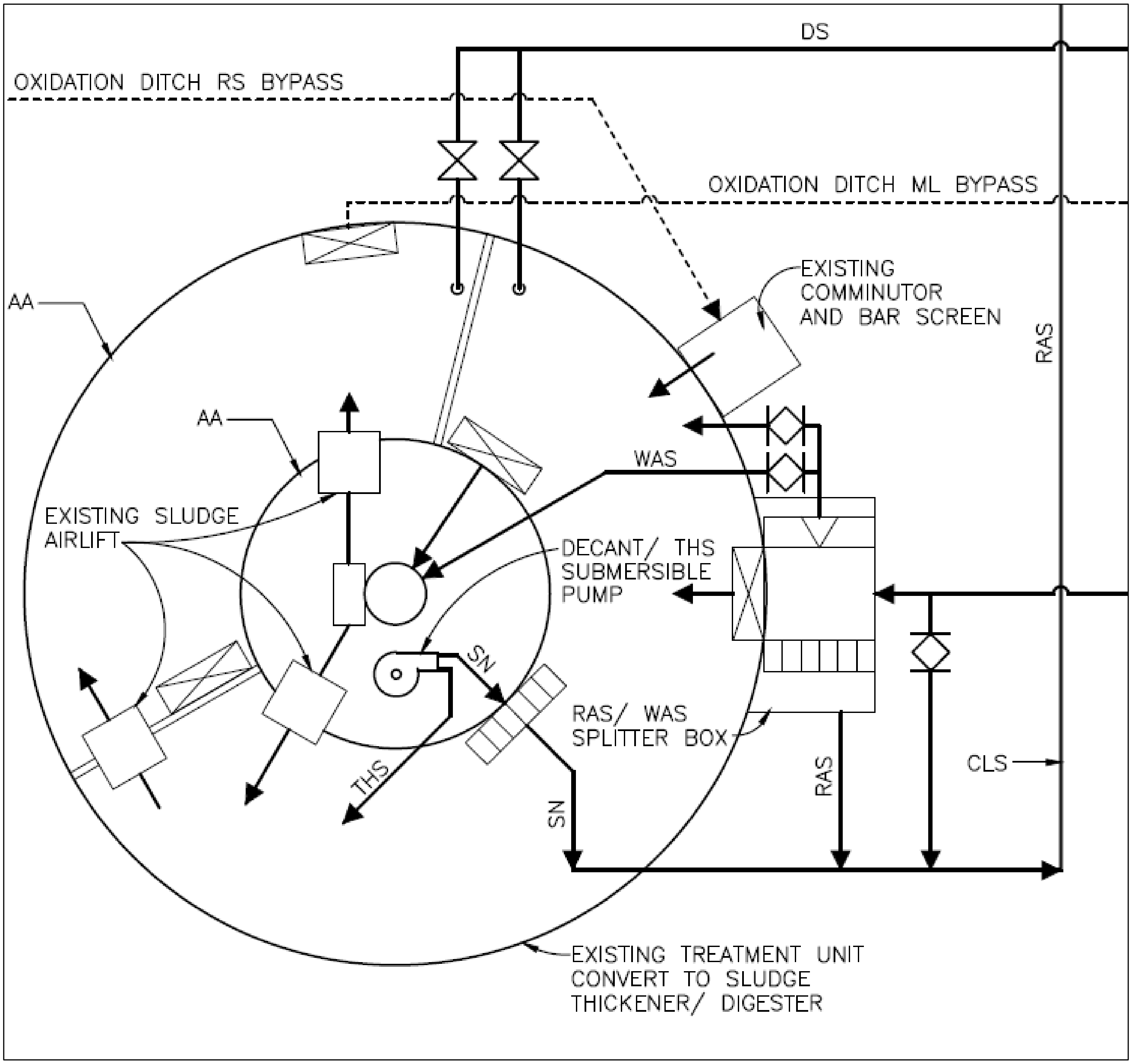


Figure 6-8. Solids Process Flow Schematic

Thickened and partially digested solids are transferred to trucks and hauled to the Hood River WWTP for further digestion and disposal. Solids are withdrawn from either of the outer chambers and pumped to a solids loading arm using P-2, one of the RAS/WAS transfer pumps. The solids hauling truck has a capacity of 6,000 gallons and is typically used to haul two loads per week. This system imposes two limits on the Stevenson WWTP’s ability to dispose of solids:

- The hauling truck is owned by Hood River and additional trips are typically not possible. As a result, it is not currently possible to remove a higher total volume of solids.
- The pump used to remove solids from the solids facility and pump to the truck cannot successfully pump sludge with a total solids concentration greater than 2 percent; the typical percentage is reportedly 1.3 percent. As a result, it is not currently possible to remove a higher total mass of solids under the current pumping and hauling regime.

6.2.8 Support Facilities

Flow Measurement

Total WWTP Flow

Total wastewater flows from the City service area are measured with the effluent flow meter at the UV disinfection channel. Disinfected effluent from the UV units flows through the disinfection channel and over a finger weir, where water surface elevation is measured using an ultrasonic level meter upstream of a V-notch weir. This water surface elevation is used to calculate effluent flow. The effluent flow meter provides an accurate indication of daily-average influent flows, but not instantaneous or peak-hour flows, because influent flow variations are attenuated through the WWTP upstream of the effluent flow meter. The headworks includes a Parshall flume, but currently lacks instrumentation for flow measurement.

Internal WWTP Flows

Internal plant flows of liquids and solids are measured at the 6-inch RAS/WAS flow meter on the 8-inch RAS/WAS force main in the RAS/WAS pump building.

Internal Pump Systems

In-Plant Pump Station

The In-Plant Pump Station wet well and valve vault are located below grade adjacent to the RAS/WAS pump building. The wet well is an 8-foot-diameter precast manhole 19 feet deep. The wet well receives sewage wastes from the following sources:

- Laboratory/control building restroom
- Screening area catch basin (adjacent to oxidation ditch)
- Solids loading area catch basin
- RAS/WAS pump building drain
- Scum skimmings from both clarifiers.

In addition, the pump station can be used to drain tanks when required for inspections or maintenance. By changing default valve settings, the pump station can drain the following locations:

- Headworks
- Oxidation ditch
- Both clarifiers
- UV disinfection channel
- Chlorine contact tank.

The pump station includes two submersible pumps, with one duty and one standby. Each pump has a rated capacity of 180 gpm. Each pump’s 6-inch pump discharge line contains a check valve and a plug valve in a vault downstream from the wet well. The two 6-inch discharge lines combine at a wye section. The pump station typically discharges to the WWTP headworks. The discharge can also be pumped to the solids facility through the 10-inch standby raw sewage pipeline.

RAS/WAS Pumping

Three variable-speed sludge pumps for Clarifiers #1 and #2 are located in the RAS/WAS pump building. Each has a rated capacity of 350 gpm at a total dynamic head of 30 feet, and a minimum flow of 190 gpm at 9 feet of total dynamic head. If both Clarifiers #1 and #2 are in service, one pump is set to pump RAS/WAS from Clarifier #1, another is set to pump from Clarifier #2, and the third is a standby pump. RAS/WAS is pumped to the RAS/WAS splitter box adjacent to the solids facility.

Spray Water Pumping

The spray water pump is a submersible unit located in the UV channel, upstream of the UV lamp modules. The spray water pump supplies sprayers at the solids facility for use in foam control.

Laboratory

The WWTP laboratory is located in the laboratory/control building. Laboratory space limitations preclude providing all desired laboratory functions, and available equipment is out of date. The plant laboratory is currently used to measure only pH, dissolved oxygen and sludge settleability. All other laboratory analyses for the Stevenson WWTP are performed at the Hood River WWTP.

Plant Electrical Power Supply

Skamania County PUD supplies electric power to a pad-mounted transformer adjacent to the WWTP entrance. Power at 277/480 volts is supplied to the motor control center (MCC). All loads are fed by circuit breakers in the MCC. Loads of 120/208 volts are served through dry-type step-down transformers and 120/208 panel boards.

Standby Power Generation

Standby power is supplied by the 100-kilowatt diesel generator located in the RAS/WAS pump building. The generator automatically provides power to the WWTP and Rock Creek and Fairgrounds pump stations when any phase of the normal source drops below 80 percent and the standby capacity is at 90 percent of rated voltage. The automatic transfer switch (ATS) switches back to commercial power when all phases of the normal source are 90 percent or more for 30 seconds. The diesel generator has a 150-gallon skid-mounted fuel tank.

Control Systems

The RAS/WAS pump building contains the MCC for the treatment equipment as well as the annunciator panel and auto dialer. The MCC, located in the RAS/WAS pump room, contains the main service entry and breaker, the circuit breakers for the building and existing panels, and the motor controls for the WWTP motors and Rock Creek and Fairgrounds pump station motors. The motor controls contain HAND-OFF-AUTO switches for the equipment. All remote motors have lock-out stops that facilitate maintenance.

The building panel (Panel B) is located in the standby generator room of the RAS/WAS pump building. The building panel contains circuit breakers for the HVAC equipment, UV disinfection systems, seal water pumps, lighting and irrigation system controller, with several spare circuits.

Controls for outside lighting are also located in the standby generator room of the RAS/WAS pump building. These controls are set up to be turned on and off by photocells on the roof of the building, a timer, or a combination of the two.

A panel in the laboratory/control building contains circuit breakers for the laboratory/control building lights, HVAC equipment, digester unit controls, digester air compressors, and chlorination equipment controls.

The annunciator panel is located in the RAS/WAS pump room. Green lights indicate the equipment is operational, while red lights indicate an alarm condition. This panel provides an overview of equipment status, showing the following conditions:

- Rock Creek Pump Station Pump No. 1 fail
- Rock Creek Pump Station Pump No. 2 fail
- Fairgrounds Pump Station Pump fail
- In-Plant Pump Station Pump No. 1 fail
- In-Plant Pump Station Pump No. 2 fail
- In-Plant Pump Station wet well level high
- In-Plant Pump Station wet well level low
- Automatic bar screen fail
- Parshall flume level high
- Oxidation Ditch Rotor No. 1 fail
- Oxidation Ditch Rotor No. 2 fail
- RAS/WAS Pump No. 1 fail
- RAS/WAS Pump No. 2 fail
- RAS/WAS Pump No. 3 fail
- Secondary Clarifier Motor No. 1 fail
- Secondary Clarifier Motor No. 2 fail
- Seal water pump fail
- UV system fail
- Spray water pump fail
- Outfall level high

Under specified alarm conditions, an autodialer will begin calling the programmed phone numbers. It will call as many as eight numbers in turn until the unit is called back or a touch tone key is activated. The autodialer also has the capacity to answer incoming calls and report on alarm status.

7. WASTEWATER TREATMENT PLANT EVALUATION

7.1 PERMIT COMPLIANCE

7.1.1 Influent Limits

The Stevenson WWTP NPDES permit specifies maximum-month influent limits for total flow, BOD load and TSS load. Table 7-1 compares the permit limits to existing flows and loads from WWTP monitoring records.

Table 7-1. Permit Influent Limits and Existing Flows and Loads

Description	Existing	NPDES Permit Limits
Maximum-Month Flow	0.41 mgd (2015)	0.45 mgd
Maximum-Month BOD Load	1,218 ppd (2016)	612 ppd
Maximum-Month TSS Load	866 ppd (2016)	612 ppd

Under current conditions, average monthly influent BOD and TSS loads at the Stevenson WWTP regularly exceed the facility's NPDES permit limits. In 2016, average monthly influent BOD loads exceeded the maximum-month influent BOD permit limit seven times, and the average monthly influent TSS load exceeded the permit limit three times. The influent load data from 2012-2016 are plotted in comparison to permit requirements in Figure 7-1.

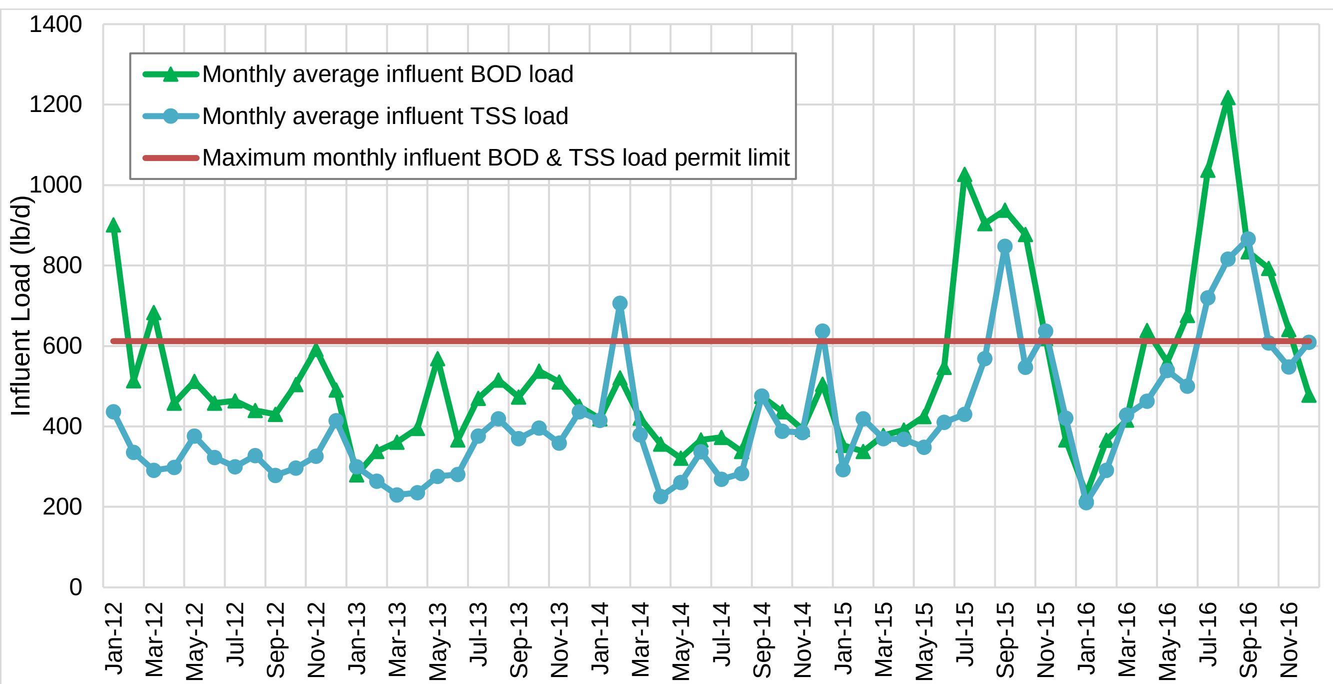


Figure 7-1. 2012-2016 Influent BOD and TSS Load

The permit states that an engineering report must be prepared and a schedule developed for steps to maintain WWTP capacity if flows or loads exceed the limits or if they reach 85 percent of the limits for three or more consecutive months. This facilities plan is intended, in part, to serve as the engineering report to comply with that requirement.

7.1.2 Effluent Limits

The Stevenson WWTP's discharge monitoring reports provide data on the plant's effluent that can be used to assess compliance with the NPDES permit requirements (see Table 1-1). Discharge monitoring report effluent data from 2012 through 2016 were reviewed to assess the plant's recent record of compliance.

BOD and TSS

Effluent BOD and TSS samples are collected and analyzed twice per week. Table 7-2 summarizes the average monthly and highest weekly average BOD and TSS effluent data. The data are plotted in comparison to permit requirements in Figure 7-2 through Figure 7-7.

Table 7-2. Average Monthly and Average Weekly Flow, BOD and TSS

		BOD					TSS				
		Concentration (mg/L)		Load (ppd)			Concentration (mg/L)		Load (ppd)		
	Average Flow (mgd)	Monthly Average	Highest Weekly Average	Monthly Average	Highest Weekly Average	Removal (%)	Monthly Average	Highest Weekly Average	Monthly Average	Highest Weekly Average	Removal (%)
Jan-12	0.424	1.8	5.0	4.5	8.0	99.4	2.7	4.0	7.6	17.0	98.4
Feb-12	0.224	1.1	1.0	2.0	3.0	99.6	2.0	3.0	3.5	4.0	99.0
Mar-12	0.297	1.5	2.0	4.0	6.0	99.5	2.0	2.0	4.3	6.0	98.6
Apr-12	0.184	1.5	2.0	2.2	3.0	99.5	1.9	4.0	2.8	5.0	99.1
May-12	0.149	2.7	3.0	3.1	4.0	99.4	3.4	4.0	4.1	4.0	98.9
Jun-12	0.125	2.2	4.0	2.2	4.0	99.5	2.8	4.0	2.9	4.0	99.1
Jul-12	0.103	2.3	3.0	2.0	3.0	99.6	4.9	10.0	4.4	10.0	98.6
Aug-12	0.102	1.4	2.0	1.2	2.0	99.7	2.6	4.0	2.1	3.0	99.4
Sep-12	0.100	2.0	4.0	2.0	3.0	99.6	3.0	6.0	3.0	5.0	99.0
Oct-12	0.141	2.1	4.0	3.1	9.0	99.6	2.0	4.0	2.9	8.0	99.3
Nov-12	0.309	2.4	4.0	8.6	20.0	98.8	3.3	6.0	9.5	16.0	97.1
Dec-12	0.391	2.0	3.0	7.2	12.0	98.7	3.2	5.0	10.5	14.0	97.4
Jan-13	0.164	1.3	2.0	1.8	2.0	99.4	2.4	3.0	3.2	4.0	98.9
Feb-13	0.138	1.6	2.0	1.7	3.0	99.6	1.4	3.0	1.5	3.0	99.5
Mar-13	0.138	2.0	4.0	2.1	4.0	99.5	2.1	3.0	2.3	4.0	99.1
Apr-13	0.130	1.2	1.0	1.2	2.0	99.7	2.1	3.0	2.2	4.0	99.1
May-13	0.106	1.8	2.0	1.6	2.0	99.7	2.4	4.0	2.3	4.0	99.2
Jun-13	0.116	1.5	2.0	1.3	2.0	99.7	2.8	4.0	2.5	4.0	99.1
Jul-13	0.109	2.0	3.0	1.7	2.0	99.6	2.8	4.0	2.3	4.0	99.4
Aug-13	0.110	1.8	2.0	1.7	2.0	99.7	2.3	3.0	2.0	2.0	99.5
Sep-13	0.131	2.3	2.5	2.6	3.0	99.5	2.8	3.5	3.3	3.5	99.2
Oct-13	0.150	2.1	2.5	2.8	3.5	99.5	2.4	4.0	3.3	6.0	99.3
Nov-13	0.192	2.4	3.0	3.8	4.0	99.2	2.9	4.0	4.9	6.0	99.0
Dec-13	0.205	3.1	6.0	4.4	7.0	99.1	3.8	6.0	5.2	6.0	98.8
Jan-14	0.182	2.0	2.0	2.8	4.0	99.4	3.4	5.0	4.8	6.5	99.0

		BOD					TSS				
		Concentration (mg/L)		Load (ppd)			Concentration (mg/L)		Load (ppd)		
	Average Flow (mgd)	Monthly Average	Highest Weekly Average	Monthly Average	Highest Weekly Average	Removal (%)	Monthly Average	Highest Weekly Average	Monthly Average	Highest Weekly Average	Removal (%)
Feb-14	0.325	2.8	5.0	7.5	13.0	98.8	3.6	6.0	10.5	18.5	98.7
Mar-14	0.284	2.4	3.0	5.3	8.5	98.9	4.0	6.0	8.4	13.5	97.9
Apr-14	0.170	2.0	2.0	2.6	3.0	99.3	2.1	3.0	2.6	3.5	98.8
May-14	0.140	2.6	4.0	2.7	3.5	99.1	4.8	8.0	4.7	7.0	98.1
Jun-14	0.103	2.2	2.6	1.8	2.0	99.5	3.8	4.8	3.1	4.0	99.1
Jul-14	0.094	2.3	3.5	1.5	2.0	100.0	4.7	10.5	2.8	5.0	98.8
Aug-14	0.101	2.6	4.1	2.1	3.6	99.4	3.2	4.8	2.6	4.2	99.1
Sep-14	0.091	2.3	3.2	1.7	2.7	99.6	2.9	4.5	2.1	3.1	99.5
Oct-14	0.112	2.1	2.2	1.8	2.8	99.6	1.8	3.0	1.4	2.0	99.6
Nov-14	0.195	2.1	2.4	3.3	5.7	99.3	2.6	4.3	4.5	10.3	99.1
Dec-14	0.253	3.1	4.0	8.5	23.5	98.8	3.8	8.0	13.1	46.0	98.6
Jan-15	0.181	2.6	4.0	4.3	8.5	99.0	3.8	5.8	6.1	12.7	98.3
Feb-15	0.167	2.1	2.3	3.2	6.3	99.2	3.7	4.5	6.1	13.9	98.9
Mar-15	0.149	2.2	2.7	2.6	3.8	99.4	2.5	3.5	2.7	5.8	99.3
Apr-15	0.118	3.4	7.2	3.2	6.9	99.2	3.1	5.5	2.8	5.3	99.3
May-15	0.094	3.4	7.0	2.7	5.1	99.4	2.9	5.5	2.3	4.0	99.3
Jun-15	0.106	2.2	2.5	1.7	2.0	99.7	1.4	2.3	1.0	2.0	99.7
Jul-15	0.115	3.8	5.1	6.6	4.9	99.7	3.6	6.0	3.4	5.7	99.2
Aug-15	0.131	3.2	5.9	3.6	6.4	99.6	3.9	8.3	4.3	8.9	99.2
Sep-15	0.134	2.2	2.8	2.3	2.9	99.7	2.9	5.5	3.1	6.0	99.6
Oct-15	0.135	2.8	3.3	2.9	3.3	99.7	4.8	6.0	5.0	6.2	99.1
Nov-15	0.243	3.2	7.0	10.8	35.5	99.1	8.7	24.5	34.3	126.7	97.4
Dec-15	0.401	2.5	3.6	10.6	26.3	98.3	4.1	4.5	15.0	33.3	97.7
Jan-16	0.254	2.0	2.0	4.0	7.0	98.5	3.0	4.0	6.0	8.0	97.3
Feb-16	0.262	5.0	4.0	10.0	8.0	97.3	5.0	5.0	11.0	9.0	96.3
Mar-16	0.238	9.0	19.0	23.0	62.0	95.9	15.0	36.0	39.0	122.0	93.5
Apr-16	0.131	8.0	13.0	8.0	14.0	98.8	57.0[a]	163.0[a]	69.0	198.0[a]	87.4
May-16	0.117	7.1	18.0	6.7	16.0	98.8	9.8	23.0	9.1	20.0	98.2
Jun-16	0.129	3.3	4.5	3.4	5.0	99.5	3.6	5.0	3.7	5.0	99.3
Jul-16	0.130	10.0	25.8	11.0	27.0	98.9	6.3	10.2	6.9	11.0	99.0
Aug-16	0.131	6.5	14.0	7.2	15.0	99.4	6.2	10.0	6.8	10.0	99.2
Sep-16	0.128	20.1	40.4	23.8	50.6	97.4	32.8[a]	53.8[a]	39.5	68.0	95.7
Oct-16	0.246	3.0	4.0	6.0	8.0	99.3	5.0	7.0	9.0	10.0	98.6
Nov-16	0.225	4.0	9.0	8.0	17.0	98.9	7.0	18.0	14.0	37.0	97.6
Dec-16	0.290	4.0	8.0	14.0	29.0	97.0	11.0	21.0	34.0	73.0	95.0

a. Failed to achieve permit requirement.

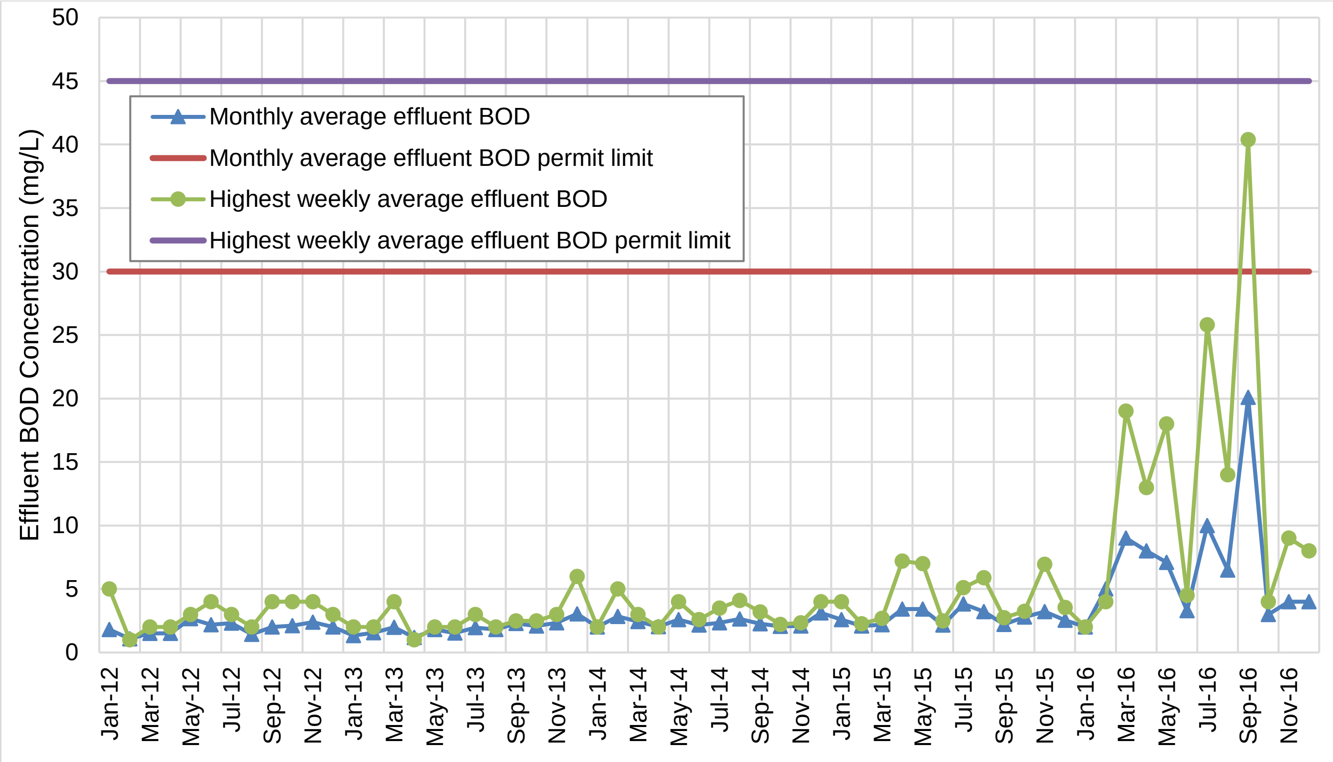


Figure 7-2. 2012-2016 Effluent BOD Concentration

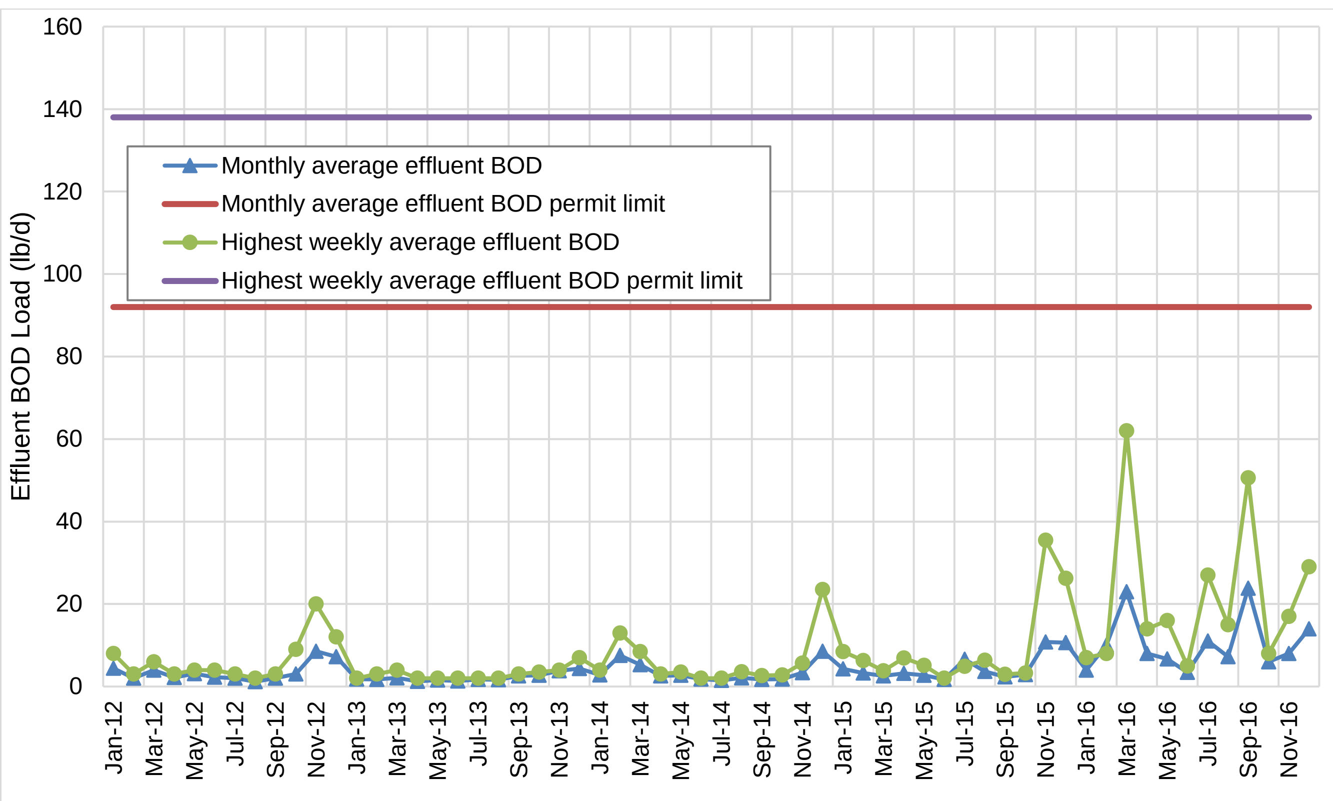


Figure 7-3. 2012-2016 Effluent BOD Load

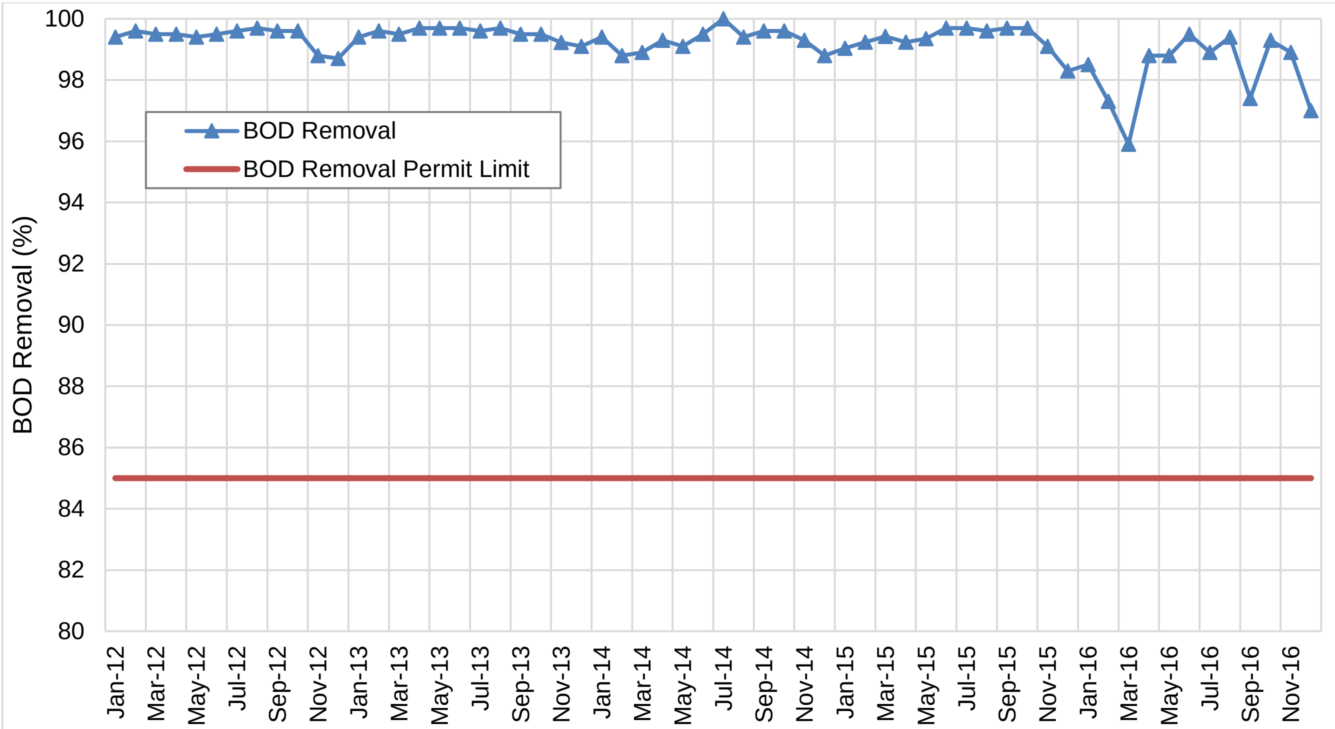


Figure 7-4. 2012-2016 Monthly Percent Removal BOD

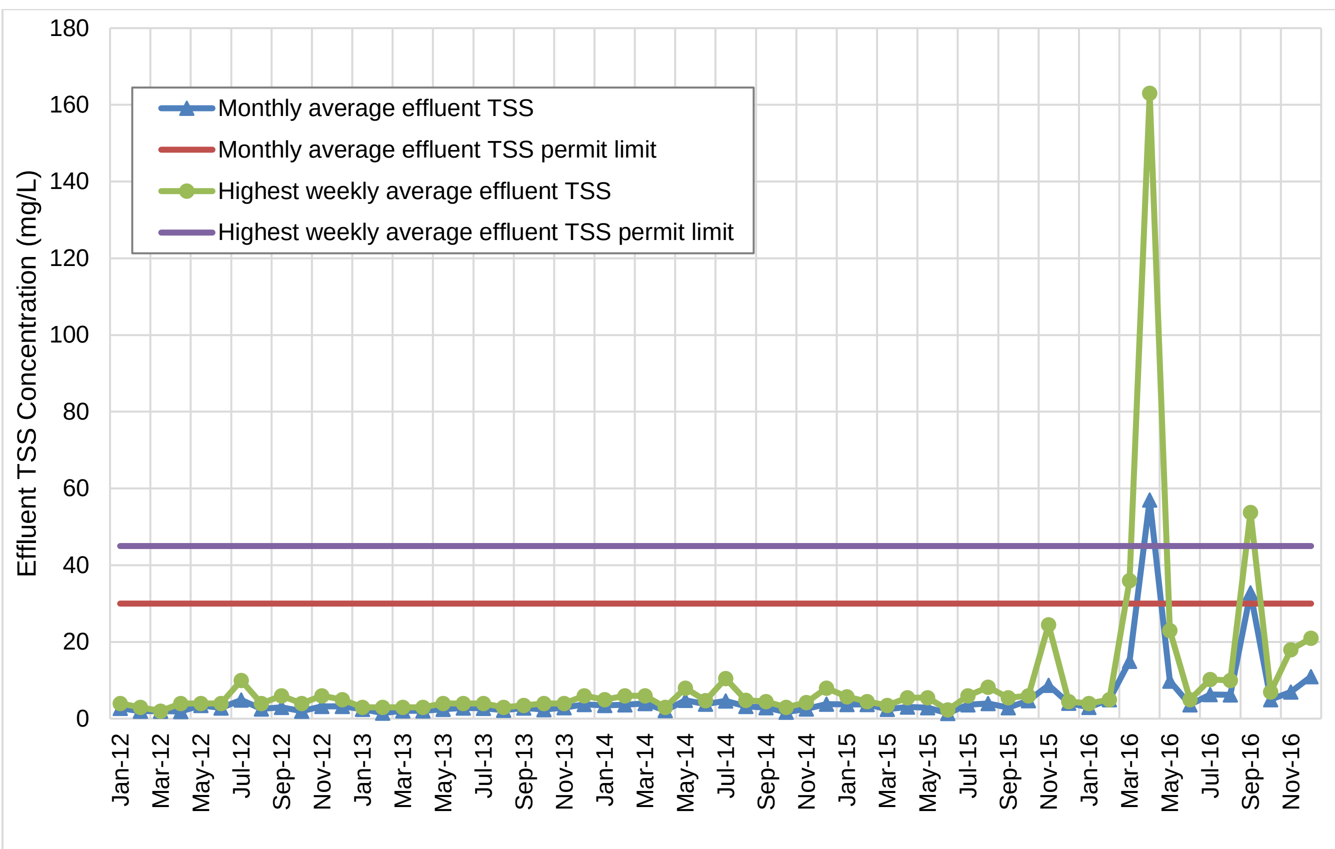


Figure 7-5. 2012-2016 Effluent TSS Concentration

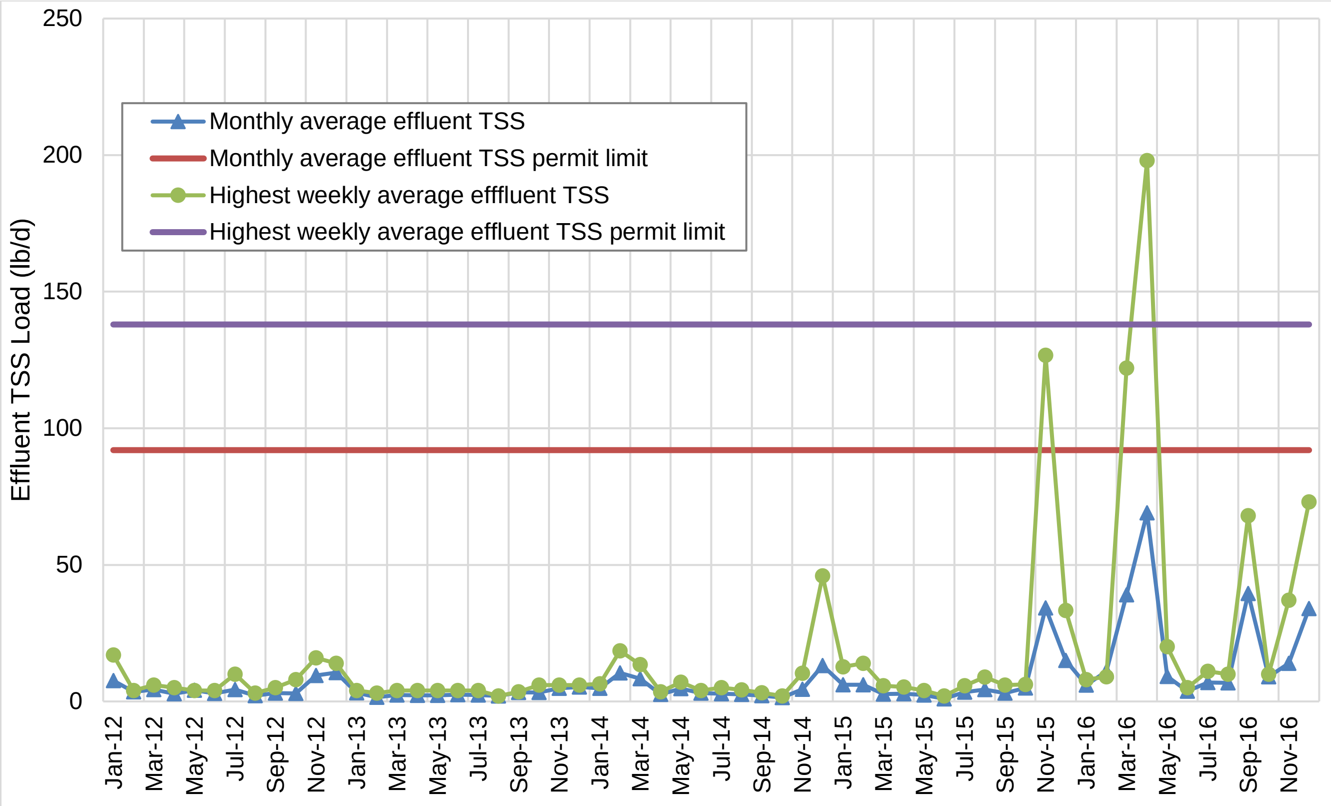


Figure 7-6. 2012-2016 Effluent TSS Load

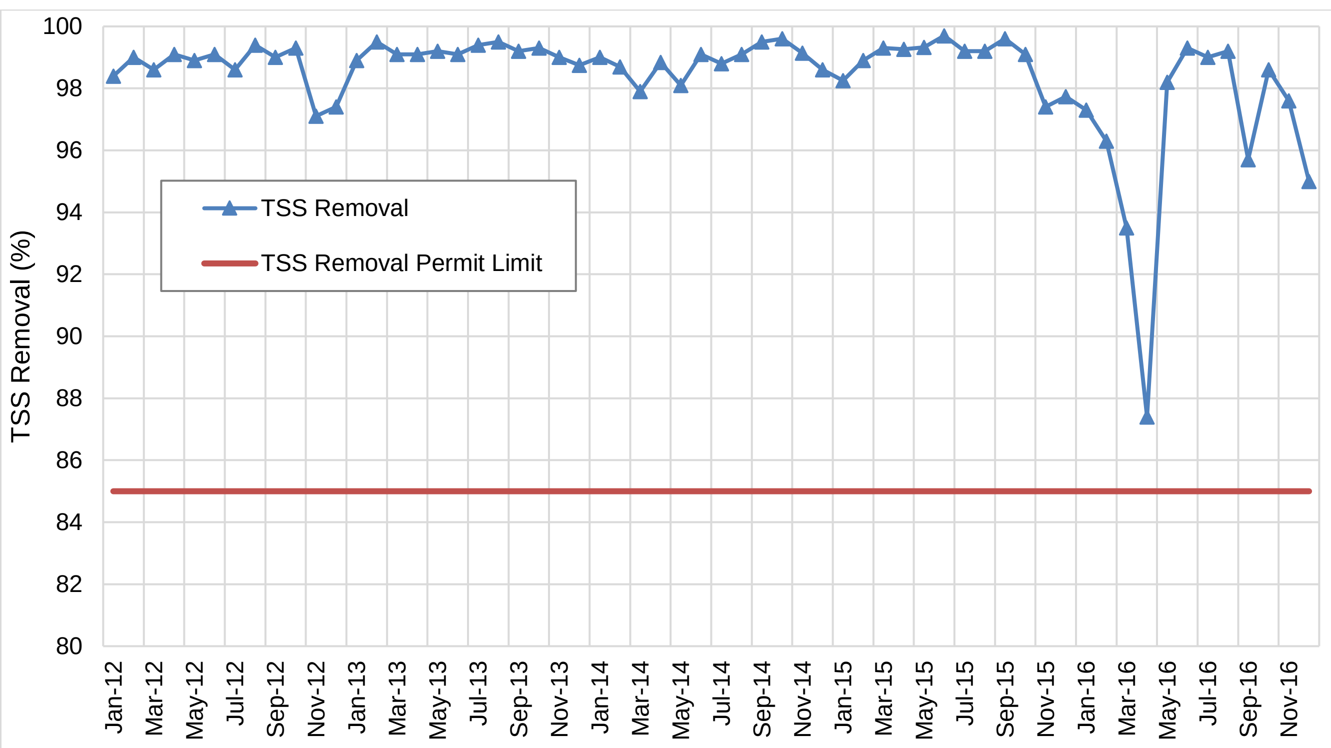


Figure 7-7. 2012-2016 Monthly Percent Removal TSS

The BOD and TSS permit requirements were met in all but the following months:

- Monthly average effluent TSS concentration, April 2016 and September 2016
- Highest weekly average effluent TSS concentration, April 2016 and September 2016
- Highest weekly average effluent TSS load, April 2016

The permit compliance issues in April 2016 are due to effluent TSS data from one day: April 18, 2016. WWTP performance for this day was otherwise normal, with typical influent flows and loads and typical BOD removal. However, the reported TSS removal for the day was 0 percent, which is so low as to indicate possible sampling or laboratory errors.

The permit compliance issues in September 2016 occurred because the RAS pumps failed to start after a power failure.

Fecal Coliform Bacteria

Fecal bacteria samples are collected and analyzed two times each week. Figure 7-8 shows WWTP records for effluent fecal coliform compared to the NPDES permit limit. The plant has met the permit limits consistently since 2012.

pH

Samples are collected and analyzed for pH every day. Figure 7-9 shows WWTP records for effluent pH compared to the NPDES permit limit. The plant has met the permit limits consistently since 2012.

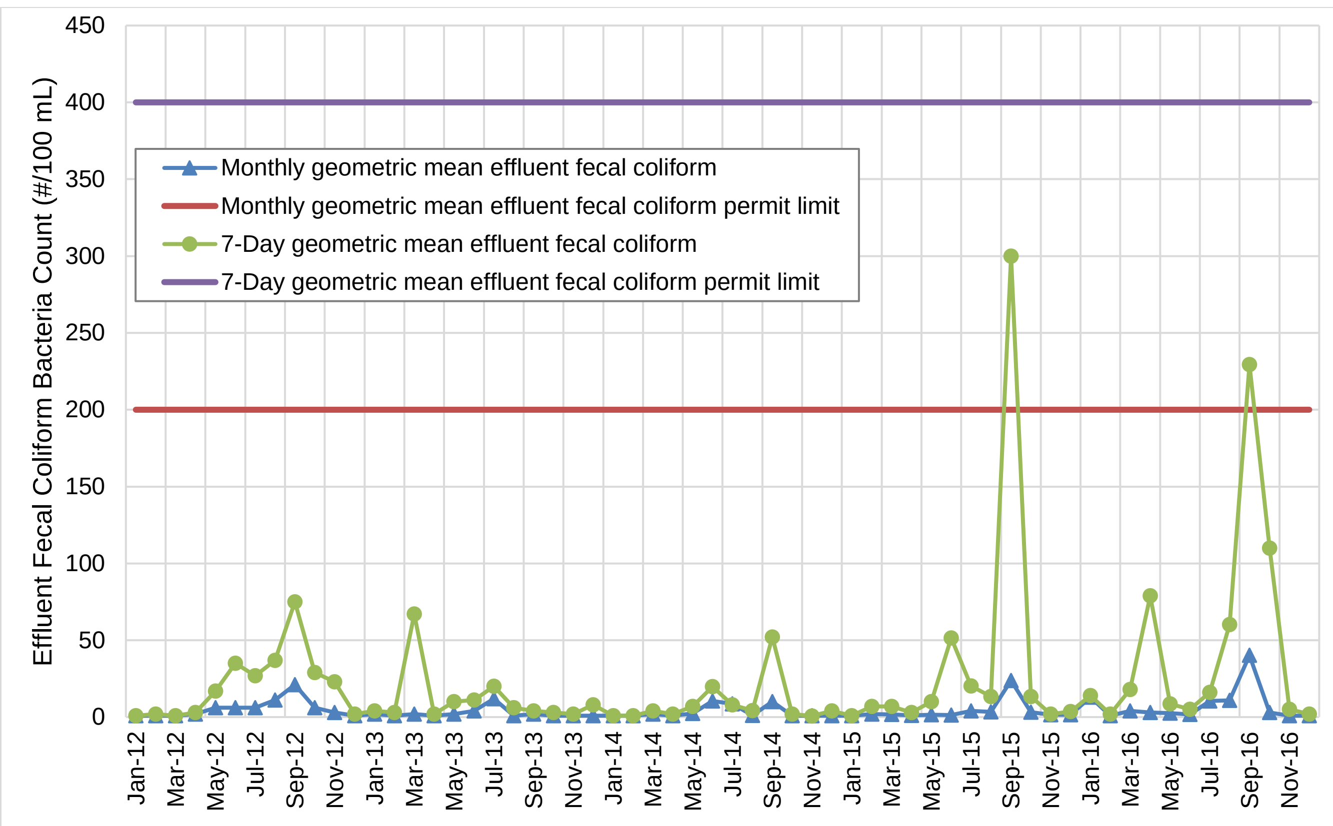


Figure 7-8. 2012-2016 Effluent Fecal Coliform Bacteria Count

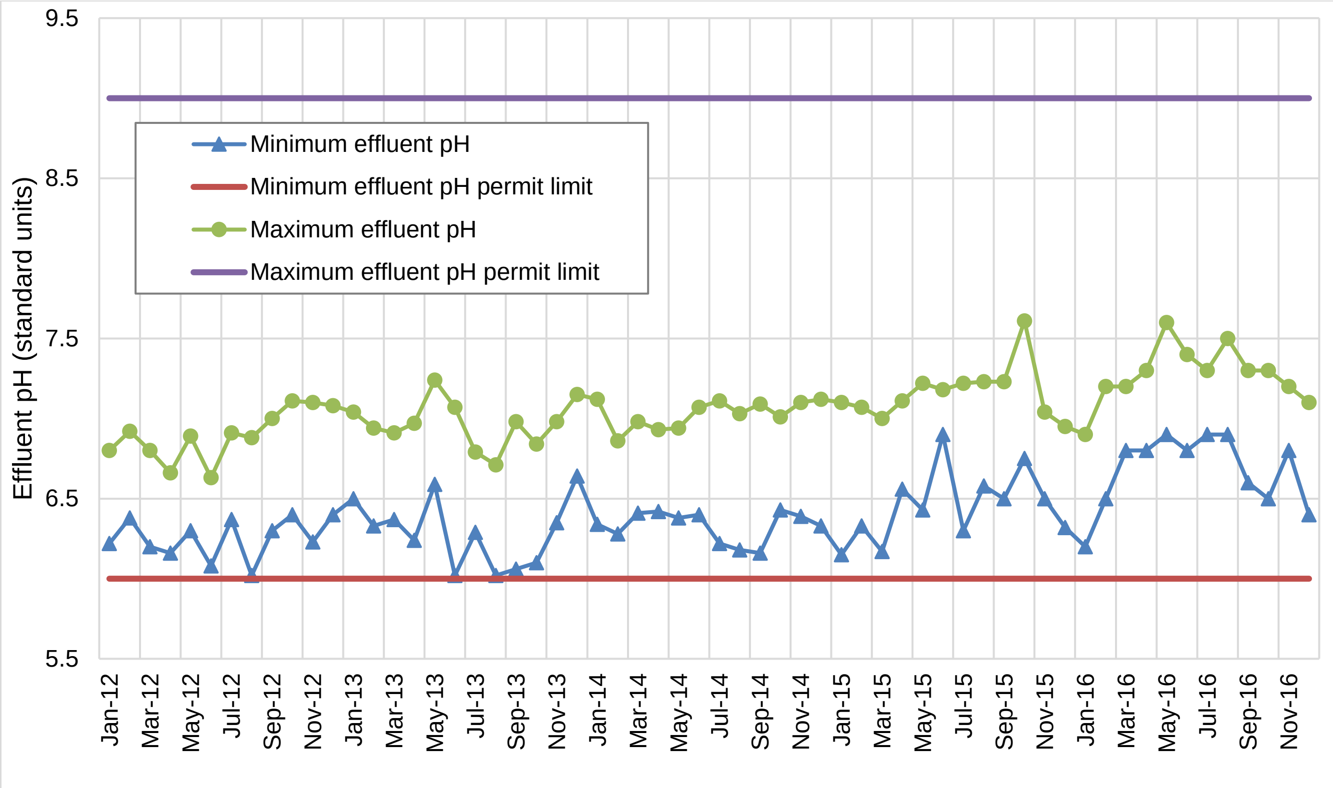


Figure 7-9. 2012-2016 Effluent pH

7.1.3 Notice of Violation and Compliance Schedule

The City received a Notice of Violation from Ecology on April 7, 2017. The City has submitted a Compliance Schedule to Ecology, to demonstrate the steps the City plans to take to expand the WWTP to maintain adequate treatment capacity. The City received an Administrative Order from Ecology, dated June 30, 2017. The Administrative Order includes six requirements that the City must meet in order to comply with the Administrative Order, including submitting this Draft General Sewer Plan and Wastewater Facilities Plan Update (as the Plan for Maintaining Wastewater Treatment Capacity) to Ecology by July 31, 2017.

7.2 LIQUID STREAM CAPACITY AND CONDITION EVALUATION

An analysis was performed to evaluate the ability of each unit process to satisfy Ecology design criteria and existing permit limits under existing and design year flows and loads. Reliability issues were also evaluated for some processes, along with the condition of equipment.

7.2.1 Overall WWTP Design Capacities

Hydraulic Capacity

The hydraulic capacity of the Stevenson WWTP is identified in the 1991 Facilities Plan and 1993 Operations and Maintenance Manual. Table 7-3 summarizes the hydraulic capacities indicated by these documents for the WWTP. The table also shows current flows based on monitoring data. The existing overall WWTP flows are below the plant's design capacity, but with expected steady growth in the City, the maximum-month and peak-day flows will soon exceed the design hydraulic capacity.

Table 7-3. Stevenson WWTP Hydraulic Capacity

Flow	Hydraulic Capacity	Existing Flows (2015-2016)[a]
Dry-Weather Average Flow	0.24 mgd	0.12 mgd (2015-2016)
Maximum-Month Flow	0.45 mgd	0.40 mgd (2015)
Peak-Day Flow	1.00 mgd	0.89 mgd (2015)
Peak-Hour Flow	1.50 mgd	Unknown[b]

a. Existing flows from historical Stevenson WWTP flow data (see Table 2-2).
b. Hourly flows are not available at the Stevenson WWTP.

Treatment Process Capacity

The 1991 Facilities Plan and 1993 Operations and Maintenance Manual also define overall treatment capacity for influent BOD and TSS. Table 7-4 compares these design capacities to reported WWTP influent loads. The existing overall Stevenson WWTP loads exceed the design capacity, as discussed in Section 7.1.1.

Table 7-4. Stevenson WWTP Treatment Process Capacity

Load	Treatment Process Capacity	Highest Reported Loads (2015-2016)[a]
Maximum-Month BOD Load[a] (ppd)	612 ppd	1,218 ppd
Maximum-Month TSS Load[a] (ppd)	612 ppd	866 ppd

a. Existing loads are highest observed loads in 2015 and 2016 (see Figure 7-1).

7.2.2 Influent Pump Station

Influent sewage is pumped from the Rock Creek and Fairgrounds pump stations to the WWTP headworks. See Section 4.1.2 for an evaluation of these pump stations.

7.2.3 Headworks

The headworks is designed to handle a 1.5-mgd peak influent flow through the automatic bar screen in the south channel. Although the headworks has not had capacity issues, it creates a hydraulic bottleneck for the treatment plant. The hydraulic capacity of the headworks would be difficult to expand because the structure has limited freeboard to carry more flow. It also is connected to the existing oxidation ditch, with no room to add a channel or route flows to additional secondary treatment facilities.

The headworks performs screening only and does not provide grit removal; all the grit in the raw wastewater passes through the headworks and either settles in the oxidation ditch or is pumped to the sludge holding tank. Experience has shown that grit does not create problems in mechanically aerated oxidation ditches such as used at the Stevenson WWTP. Based on measurements taken in December 2016, grit accumulations in the oxidation ditch are small, even though the ditch has not been emptied and cleaned out since it was built in 1992.

7.2.4 Oxidation Ditch

The existing oxidation ditch has not experienced hydraulic capacity issues and has generally performed well. The ability to waste sludge is limited by the solids handling facility's capacity issues (see Section 7.4). This is the primary operational issue for the oxidation ditch because it limits flexibility to manage the solids detention time and sludge settleability.

The physical structure of the oxidation ditch is in generally good condition, as are the mechanical components. However, the lack of redundancy prohibits the oxidation ditch from being drained for cleaning and maintenance below the waterline.

7.2.5 Clarifiers

According to Department of Ecology criteria for oxidation ditches, each clarifier should perform acceptably with peak-hour overflow rates up to 700 gallons per day per square foot, with MLSS up to 3,500 mg/L, and with a sludge volume index, which is a measure of sludge settleability, up to 150 mL/g.

Table 7-5 compares recent MLSS and sludge volume index to design criteria from the 1992 upgrade plans and the Ecology Orange Book. The clarifiers are operated below their design capacity and much higher sludge volume index for dry weather, maximum-month and peak-day conditions, and slightly above the peak-hour design capacity, as shown in Table 7-6 and Table 7-7.

Table 7-5. Clarifier MLSS Loading and Sludge Volume Index

	2012-2016	Design	Department of Ecology Criteria	
	Conditions	Capacity[a]	Oxidation Ditch	Activated Sludge
MLSS (mg/L)	1,544-5,608	3,000	2,500–3,500	1,500–3,500
Sludge Volume Index (mL/g)	190-433	not specified	150	150

a. Design data shown on Sheet G3 in the construction drawings for the 1992 Wastewater Treatment Facilities Improvements

Table 7-6. Clarifier Hydraulic Loading Rates

	Influent Flow (mgd)		Loading (gallons/day/square foot)			
	2012-2016	Design	2012-2015	Design	Ecology Criteria	
	Conditions	Capacity[a]	Conditions	Capacity[a]	Oxidation Ditch	Activated Sludge
Dry-Weather Flow	0.15	0.24	78	125		
Maximum-Month Flow	0.42	0.45	218	234		
Peak-Day Flow	1.29	1.0	670	520		
Peak-Hour Flow	1.95 / 1.6[b]	1.5	1013 / 831	780	700	1,200

a. Design data shown on Sheet G3 in the construction drawings for the 1992 Wastewater Treatment Facilities Improvements
b. 1.95 mgd is the estimated combined flow to Rock Creek and Fairgrounds pump stations. Actual peak flows to the treatment plant are limited to the combined capacity of the two pump stations with all pumps running, approximately 1.6 mgd. Higher flows are stored in the sewers upstream of the pump stations as discussed in Section 4.1.2.

Table 7-7. Clarifier Hydraulic and Solids Loading Rates

	Influent Flow (mgd)		RAS Loading (pounds/day/square foot)				
	2012-2016	Design	2012-2016 Conditions[c]		Design	Ecology Criteria	
	Conditions	Capacity[a]	RAS @4000 mg/L	RAS @3000 mg/L	Capacity[a]	Oxidation Ditch	Activated Sludge
Dry-Weather Flow	0.15	0.24	5	4	6		
Maximum-Month Flow	0.42	0.45	15	11	12		
Peak-Day Flow	1.29	1.0	35	34	26		
Peak-Hour Flow	1.95 /1.6[b]	1.5	51 / 42	38 / 31	33	40	40

a. Design data shown on Sheet G3 in the construction drawings for the 1992 Wastewater Treatment Facilities Improvements
b. Estimated
c. RAS at 3,000 mg/L and RAS at 100% dry-weather flow, 100% maximum-month flow and 1 mgd @ peak-day flow & peak-hour flow

7.2.6 Disinfection

The UV disinfection system has performed well, but the standby chlorine contact chamber has not been used in years. A redundant UV reactor in a second channel would provide a more reliable standby capability, as it could be rotated into service regularly and with less operational complications than required to switch to the chlorine system.

7.3 EFFLUENT DISPOSAL ANALYSIS

The Stevenson WWTP outfall facilities include a primary outfall pipe ending in a single port diffuser in the Bonneville Pool of the Columbia River. A secondary outfall that discharges to Rock Creek can be used only under certain conditions described in the Stevenson NPDES permit: "Secondary Outfall may be used when the Primary Outfall is inoperative or during essential maintenance if the Permittee is working to restore the Primary Outfall at the soonest possible date." Given this requirement, the primary outfall to the Bonneville Pool must be used whenever it is operational.

The primary outfall pipe was extended by approximately 300 feet in 2013 following blockage of the existing outfall location by landslide deposits. The primary outfall is performing well, according to the 2013 Outfall Mixing Zone Study (see Appendix E). In future, an effluent pump station may be required to route flows to the receiving water body during future peak flow conditions.

7.3.1 Evaluation of Reclaimed Water Opportunities

Disinfected effluent could be reused onsite for washdown water and process water as needed. Other opportunities to use reclaimed effluent include:

- Irrigation of golf courses. However, the nearest golf course is Skamania Lodge Golf Course, which would require pumping reclaimed water nearly one mile. Skamania Lodge currently irrigates the golf course with well water.
- Irrigation of City parks. Rainfall is adequate (approximately 80 inches per year) so there is generally little demand for reclaimed water at City parks. The City has adequate water supply and water rights to irrigate parks. Due the scattered location of the City parks, the cost of installing a reclaimed water distribution piping network makes a reclaimed water system economically impractical.

7.4 SOLIDS FACILITIES ANALYSIS

There have been significant problems with the solids handling facilities at the treatment plant in recent years. The facilities are barely able to keep up with solids wasting needed for good performance of the liquid treatment process, and equipment limitations do not allow full use of the thickening facilities.

7.4.1 Solids Holding and Digestion

The converted Oxygest plant is used as a multi-chamber solids thickener, digester, and holding tank. The hydraulic capacity of the facility is generally adequate. The primary limitation on solids handling is the pump, as described below. The facility could otherwise produce more concentrated solids for disposal, increasing the operational capacity of the solids facility and thereby the secondary treatment facilities.

7.4.2 Solids Pumping and Thickening

Solids pumping to trucks for off-site disposal is currently conducted using P-2, one of the RAS/WAS transfer pumps. This pump cannot successfully pump solids with a total solids concentration greater than 2 percent; the typical percentage is reportedly 1.3 percent. In addition, the pumping configuration does not allow other pumps to be used for truck loading, providing no redundancy. A dedicated solids pump capable of pumping higher percent solids would allow the solids facilities to be used more efficiently.

A new sludge thickening facility would provide 6-percent solids consistently to the existing digester, so that it could meet the time and temperature requirements of the 40 CFR Part 503 Regulations (503 Regulations).

7.5 SUPPORT FACILITIES ANALYSIS

7.5.1 Enclosed Structures

The condition of the three main buildings at the plant is as follows:

- The laboratory/control building is original to the treatment plant. The building is nearly 50 years old and is showing signs of age. It is significantly undersized for the current plant and staff. During the next plant upgrade, a new laboratory should be considered to provide additional analytical capacity.
- The maintenance facility is original to the treatment plant. It is used for City vehicles and is not available for WWTP maintenance activities. During the next plant upgrade, new shop facilities should be considered to provide space for maintenance of WWTP equipment and vehicles.
- The pump building was constructed in 1992. The building is in good condition and sufficient in space for its current uses. However, the building does not have spare room for additional pumps and controls, which will be required when the plant is next upgraded. It is likely that an additional building, or expansion of the existing building, will be required at that time.
- The floor of the pump building is at elevation 87.0, 2 to 3 feet below the 89- to 90-foot draft 100-year flood elevations discussed in Section 7.7.2 of this report. The building and the mechanical and electrical equipment inside the building are protected from flooding by the flood wall described in Section 7.7.2. Future plant improvements should raise or relocate the electrical equipment above the 100-year flood to provide more reliable flood protection.

7.5.2 Flow Measurement and Sampling

The headworks includes a Parshall flume to allow for the installation of a flow recorder, which was never installed. If a new headworks is installed to accommodate additional secondary treatment, a flow recorder should be installed to allow more precise measurement of influent flow rather than using effluent flow as a proxy. The existing effluent flow meter in the UV channel is performing adequately, but may need to be replaced when the UV treatment facility is replaced or expanded.

The existing wastewater samplers need modifications to reliably obtain representative samples of treatment plant influent and effluent. Both collect time-composite samples rather than flow-proportional samples, and the influent sampler takes samples from the headworks channel whether the influent pump stations are running or not. These conditions result in unrepresentative samples. The influent sampler is within the Class 1, Division 2 hazardous (classified) zone, which extends 18 inches above the headworks.

7.5.3 Standby Power

The current standby power system is functional but should be upgraded during the next major WWTP upgrade. The existing 100-kW generator was installed in 1992 and is nearing the end of its expected service life. It should be replaced soon for reliable service.

The WWTP is assumed to be classified as a Reliability Class II facility as defined in Table G2-8 of the Orange Book, because its discharge “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).” In order to meet current Ecology and EPA standby power requirements for a Reliability Class II facility, a generator larger than the current one will be required so that operation of vital components can be maintained at a level sufficient to maintain biota.

7.5.4 SCADA

The SCADA system has extensive deficiencies:

- The main control panel was built in 1992 and is obsolete and needs to be replaced.
- A new alarm system is needed with more alarms, better alarm logs, callout features and remote access.
- More automation is needed to improve WWTP performance and reliability.
- New input/output blocks and programming are needed for the following processes:
    - Flow-proportional control of samplers
    - Oxidation ditch aeration control based on levels of dissolved oxygen and oxygen reduction potential
    - UV reactor flow pacing and on/off valves
    - Flow control for RAS and WAS pumping
    - Integration of existing pump controls
    - Influent and effluent flow meters
    - Better data management and logging.

7.6 OPERATION AND MAINTENANCE

Currently the WWTP is operated by CH2M contract operations. CH2M provides staff for operations and maintenance 3 to 4 hours per day, five days a week (approximately 0.4 FTE). The City provides WWTP operations staff on weekends, during the week as needed, for emergency response, and to assist with maintenance projects (approximately 0.3 FTE). The total WWTP operations staff from CH2M and the City is less than 1 FTE.

Liquid sludge is currently hauled by CH2M to the Hood River WWTP for treatment and disposal; labor for this is included in the FTE count above. Laboratory compliance samples are collected and transported to Hood River or The Dalles for testing. Laboratory sample transportation time is also included in the FTE count above.

In the event that WWTP influent characteristics exceed the design criteria shown in Section S4.A of the City’s NPDES permit (Prevention of Facility Overloading), CH2M is allowed 5 to 30 days to return the plant effluent to the characteristics required by the NPDES permit.

An operations assessment performed for this facilities plan considered two models to estimate current and projected staffing needs for the Stevenson WWTP:

- “Estimating Staffing for Municipal Wastewater Treatment Facilities” based on EPA Publication MO-1 dated March 1973. This model was determined to be outdated and did not include the type of equipment and treatment levels required at the Stevenson WWTP.
- “Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants” from the New England Interstate Water Pollution Control Commission (NEIWPCC). This model was sufficient to estimate FTE requirements based on type of treatment and equipment in service.

The assessment found that the Stevenson WWTP is not staffed at recommended levels. According to the NEIWPCC guide, there should be approximately 2 FTEs assigned to an oxidation ditch WWTP with the equipment in the existing facility.

7.7 TREATMENT PLANT SITE ANALYSIS

7.7.1 Stormwater

Stormwater at the treatment plant is captured by catch basins and flows to the outfall facilities with no treatment.

7.7.2 Flood Protection

Ground elevation around the perimeter of the Stevenson WWTP site is more than 3 feet above FEMA's latest draft 100-year flood elevations, effectively providing a more than 3-foot high levee around the site. In 2009 the City constructed an emergency flood protection wall to the north and east of the WWTP site to protect the site from flooding in Rock Creek. The flood protection wall is constructed of precast concrete ecology blocks and includes provisions for a temporary timber wall to block Rock Creek Drive during flood conditions. Drawings for the flood protection wall indicate that the top of the wall will be at least 3 feet above the estimated 100-year flood elevation, meeting the requirements of Executive Order 13690.

The elevation of the lowest storm drain inlet grating in the driveway at the center of the WWTP site is about the same elevation as the 100-year flood, and the floor of the RAS pump building and old treatment plant equipment building are about 1 foot above the 100-year flood. Storm drains at the WWTP site have provisions to prevent backflow into the site during flood conditions.

The 1992 Stevenson Wastewater Facilities Improvements drawings were based on the City of Stevenson datum, which is 3.8 feet lower than the FEMA datum. To avoid confusion from the datum difference, the FEMA flood map is not included in this report.

7.7.3 Security

Site security is provided by a chain link fence around the site. All access gates remain closed and locked when a qualified operator is not on site. The primary access gate to the plant from Rock Creek Drive is left open when an operator is on site. Other access gates are opened when needed but are closed and locked when access is no longer needed. Treatment plant security has not been an issue.

7.7.4 Mitigation, Buffers and Aesthetics

The plant site has adequate buffering from the neighboring community as follows:

- To the south and west, the plant borders the Skamania County Fairground facilities.
- To the north, the plant is bordered by Rock Creek Drive and is largely out of view due to trees and elevation.
- To the east, the plant is bordered by Rock Creek.

The plant is visible from the County Fairground facilities but sheltered from the adjacent road. Aesthetic concerns at the site have not been reported.

8. TREATMENT IMPROVEMENTS

Based on the assessment of existing conditions and future requirements for the facilities at the Stevenson WWTP, alternatives were identified and evaluated for treatment improvements to ensure that the City can provide reliable wastewater treatment through the end of the planning period. The alternatives include facilities to pretreat high-strength commercial wastewater and facilities to improve equipment and operations at the Stevenson WWTP. They also include upgrades of existing facilities to accommodate redundancy requirements and operational issues, as well as upgrades to provide additional hydraulic, biological treatment and solids handling capacity. The improvements have been tailored to accommodate, wherever possible, continued use of the existing major facilities including the oxidation ditch, clarifiers, pump building, UV disinfection, outfall, solids holding tank and In-Plant Pump Station.

8.1 PRETREATMENT FACILITIES

In addition to low-strength wastewater discharged primarily by residential sewer users, significant amounts of high-strength wastewater are discharged by commercial sewer users in Stevenson, as discussed in Chapter 2. Pretreatment is needed for this wastewater so the Stevenson WWTP can operate reliably and effectively. Two groups of businesses discharge high-strength wastewater. One group includes 21 commercial kitchens at restaurants, hotels and schools; the other group consists of four beverage producers—two microbreweries, a distillery and a bottling business.

8.1.1 Commercial Kitchens

The City implemented measures to reduce high-strength wastewater from commercial kitchens several years ago. The City required installation of grease traps to reduce sewer discharges of fats, oils and grease (FOG) and settleable food solids. Also, the City requested that commercial kitchens voluntarily stop putting food waste in the sewer and dispose of it as solid waste instead. These measures significantly reduced BOD loads at the WWTP and provided sufficient control of commercial kitchen wastewater so the plant can operate successfully. Recently, one large commercial kitchen began treating its food waste in a small aerobic digester and discharging to the sewer. The City is evaluating whether this provides adequate reduction of BOD load discharged to the sewer. This facilities plan assumes that the City's existing measures, and possibly allowing on-site digestion of food waste, will provide sufficient control of commercial kitchen wastewater, and no additional pretreatment is needed.

8.1.2 High-Load Dischargers

Based on the fall 2016 industrial waste survey, the City's beverage producers discharge wastewater with BOD concentration approximately 6 times higher on average than normal domestic wastewater, and with significant variations in BOD, pH and temperature. The Stevenson WWTP successfully treated raw beverage wastewater with no pretreatment in the past when quantities were small. However, pretreatment is now needed because the beverage producers have grown and will continue to grow through the end of the planning period in 2040. Commercial dischargers of significant quantities of high-strength wastewater are referred to in this facilities plan as high-load dischargers. This facilities plan considers two levels of pretreatment for high-load wastewater:

- **Minimal Pretreatment**—This would provide the minimal pretreatment needed to prevent upsets at the Stevenson WWTP, and it relies on the Stevenson WWTP to treat most of the pollutants. The pretreatment facilities would include an aerated tank to equalize and aerate the high-load wastewater. The tank would be sized to hold about 2 days of peak high-load commercial wastewater flow. This is estimated to be 100,000 gallons, and the volume would be confirmed during preliminary design. This would eliminate extreme variations in BOD, pH and temperature that can upset the Stevenson WWTP and remove about 20 percent of the BOD. Wastewater would be conveyed to the aerated holding tank with a new pump station and force main.

- **Pretreatment to Domestic Strength**—This would provide pretreatment of wastewater from high-load dischargers to approximately the same strength as domestic wastewater so it would be as easily treated at the Stevenson WWTP as normal residential sewage. The pretreatment facilities would include screening, flow equalization, biological treatment, solids handling and disposal, and possibly chemical addition to adjust influent pH. This would remove about 85 percent of the BOD and suspended solids. Details on the pretreatment facilities are provided in Appendix F.

The actual level of pretreatment that is ultimately provided will be determined jointly by the City and the high-load dischargers based on cost effectiveness and other considerations. Table 8-1 summarizes flows and loads to be treated at the Stevenson WWTP with no pretreatment, minimal pretreatment or pretreatment to domestic strength. It is assumed for this facilities plan that no pretreatment will not be acceptable to the Washington Department of Ecology, since influent loading to the Stevenson WWTP currently needs to be reduced to comply with the City's NPDES permit. The actual level of pretreatment provided will be determined jointly by the City and beverage producers, with approval from Ecology, based on cost effectiveness and other considerations.

Table 8-1. Current and Projected Flow and Load Design Conditions

Parameter	Base (Dry Weather Average)			Maximum Month			Peak Day			Peak Hour		
	2016	2025	2040	2016	2025	2040	2016	2025	2040	2016	2025	2040
Flow (mgd)	0.135	0.168	0.200	0.460	0.539	0.657	1.30	1.46	1.71	1.96	2.19	2.56
BOD (ppd)												
No pretreatment	620	852	1,070	961	1,394	1,798	1,985	2,902	3,758	n/a	n/a	n/a
20% pretreatment	589	795	989	890	1,262	1,611	1,662	2,307	2,912	n/a	n/a	n/a
85% pretreatment	488	609	724	658	835	1,003	1,294	1,687	1,916	n/a	n/a	n/a
TSS (ppd)												
No pretreatment	477	656	823	787	1,093	1,380	2,052	2,663	3,240	n/a	n/a	n/a
20% pretreatment	453	612	761	744	1,014	1,267	1,980	2,531	3,052	n/a	n/a	n/a
85% pretreatment	376	469	557	605	757	901	1,825	2,245	2,646	n/a	n/a	n/a

Significant BOD loads from high-load commercial dischargers are new to Stevenson, and the City to date has performed only one industrial waste survey to measure these loads. More BOD data is needed in order to develop a better understanding of existing industrial dischargers' loadings and to better project future flows and loads.

Two alternatives were identified for improving the Stevenson WWTP. Alternative 1 provides WWTP improvements needed with minimal pretreatment of wastewater from high-load dischargers, and Alternative 2 provides WWTP improvements needed with domestic strength pretreatment of wastewater from high-load dischargers. The following sections describe the two alternatives.

8.2 WWTP ALTERNATIVE 1—IMPROVEMENTS WITH MINIMAL PRETREATMENT

Alternative 1 would include improvements needed at the Stevenson WWTP when minimal pretreatment is provided for high-load commercial wastewater. This alternative would replace the existing headworks with a new, larger headworks; modify the existing secondary treatment process by adding selector basins, expanded secondary treatment capacity and a third final clarifier; and add a second UV disinfection channel. The existing laboratory/control building would be replaced by a new laboratory and operations building. A new aeration building to house blowers and electrical equipment would be constructed. A preliminary site plan for Alternative 1B is shown in Figure 8-1.

8.2.1 Headworks

Under future flow conditions, the existing headworks configuration is not adequate to support the required process facilities. Required headworks functions include screening, flow measurement and flow split to two secondary treatment units (one existing and one new). Grit removal should ultimately be provided, but may not be required at this time. Because of configuration and siting constraints, it will not be possible to expand the existing headworks and provide all of these functions. The following sections assess headworks equipment for screening and grit removal.

Screening/Washing/Compacting Equipment

Recent developments in fine screen technology have led to the prevalent use of 6-millimeter fine screens as standard in the wastewater industry today. Fine screens with washers and compactors can produce a drier and cleaner material. Under EPA requirements, screenings must meet the paint filter test and so must be a drier material.

Screenings washing followed by compacting is frequently used to remove most of the organics from the screenings and then dewater the screenings in order to pass the EPA paint filter test, as required by federal regulations in 40 CFR 264.314 and 40 CFR 265.314. Several fine-screen units combine screening, washing, compacting and conveyance in a single piece of equipment.

Grit Removal

If installed, a grit removal system would be downstream of the screening units. The fine screens would remove the floatable material, debris and rags, which could otherwise wrap around the grit chamber mechanism and other downstream equipment, creating maintenance problems.

Grit removal is a physical separation process. Grit particles have higher densities, and therefore higher settling velocities, than organic particles. Grit removal devices are designed to allow grit to settle while most organic material remains in suspension. Aerated grit chambers, detritus tanks, and vortex grit chambers can all be used.

Aerated Grit Chamber

In a typical aerated grit chamber, air diffusers create a roll or agitation in the chamber to keep small organic particles in suspension while allowing grit to settle. Settled grit is conveyed to a hopper by gravity, with flow currents across a sloping channel floor. Grit is usually removed using air lift pumps. Provisions should be made for purging the grit hopper and pump suction line with high-pressure air or water to break up bridged grit prior to pumping.

The collected grit usually contains organic matter that must be washed, with the organics returned to the waste stream. A grit cyclone/classifier or similar equipment can be used, with the cyclone separating solids from the water stream and classifier to concentrate, wash and dewater the grit. Light organic and inorganic particles are carried over a weir at the back of the classifier and discharged to the treatment process.

Detritus Tank

The detritus tank is a constant-level sedimentation tank with a fairly short hydraulic retention time. The settled grit is scraped spirally toward a hopper by a rotating sweep arm. Detritus tanks require very low hydraulic loading to work efficiently, and thus require a larger footprint than aerated grit or vortex grit chambers. They were installed at many WWTPs prior to the 1990s, but appear to not perform as well as aerated grit and vortex grit chambers, which are currently the most common grit removal systems installed post-1990. For these reasons, detritus tanks were not considered further.

Vortex Grit Chamber

A typical vortex grit chamber consists of a circular basin to which flow enters tangentially. The vortex action causes particles to move to the center of the tank, settle and collect in a hopper. Velocity is maintained low enough to encourage grit settlement and high enough to maintain most organics in suspension to pass through the grit chamber. Air scour or water scour is usually provided at the hopper a few minutes prior to beginning grit pumping, to resuspend organics and break up bridged grit at the grit hopper.

Settled grit can be removed with an airlift pump or horizontal recessed impeller pump. Horizontal recessed impeller pumps, installed with flooded suction, are more reliable and effective in this application. The collected grit usually contains organic matter that must be washed, with the organics returned to the waste stream. A grit cyclone/classifier or similar equipment can be used, with the cyclone separating solids from the water stream and classifier to concentrate, wash and dewater the grit. Light organic and inorganic particles are carried over a weir at the back of the classifier and discharged to the treatment process.

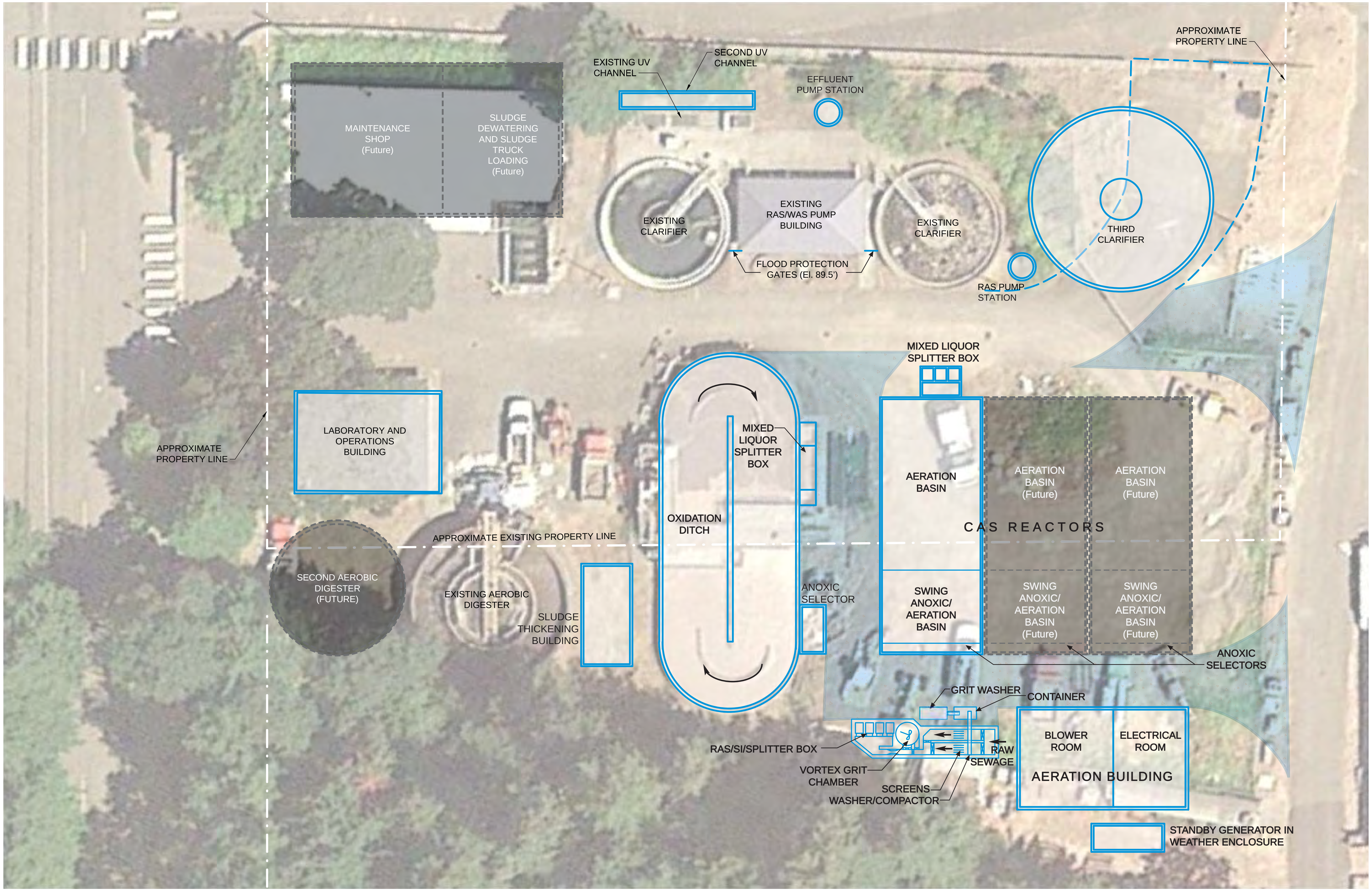
A vortex grit chamber with horizontal recessed impeller pump is preferred from a site footprint standpoint and is the most effective grit removal system compared to aerated grit or a detritus tank. Therefore, it is the system that is shown for the Stevenson WWTP alternatives.

Selected Headworks for Alternative 1

For this facilities plan, equipment costs and descriptions used in the headworks alternatives were based on fine screens and vortex grit removal for conventional activated sludge secondary treatment systems. Grit removal would not be needed for oxidation ditch systems for reasons described below (Alternative 1A – Expand the Existing Oxidation Ditch System). It is recommended that a final equipment evaluation and selection take place during the predesign phase.

Alternative 1 would include a new headworks to be constructed southwest of the existing oxidation ditch. The existing headworks, located on the north side of the oxidation ditch, would be abandoned. The new headworks facility would be designed to handle 2040 peak-hour flow of 2.56 mgd.

Significant yard piping would be required to route flows from the existing Fairgrounds Pump Station and the new Rock Creek Pump Station interceptors to the new headworks. The new headworks would include a junction box for these two interceptors, a new sampling station, and flow metering. A new screening facility would be equipped with one screening channel containing a 6-millimeter fine screen and an emergency bypass channel containing a manual bar screen.



LEGEND

- Initial Upgrades
- Future Upgrades
- New Access Road/Pavement
- Existing Driveway to Be Abandoned

N

0 7.5' 15' 30'
SCALE: 1" = 30'

TETRA TECH
www.tetratech.com
15350 SW Sequoia Parkway, Suite 220
Portland, OR 97224

CITY OF STEVENSON, WA
GENERAL SEWER PLAN UPDATE

WWTP IMPROVEMENTS
ALTERNATIVE 1B

Project No.:	135-48600-16001
Date:	OCTOBER 2017
Designed By:	

Supplemental
FIGURE 8-1

Bar Measures 1 inch

Figure-8-1_Alt1B_NoPhasing.ai

8.2.2 Secondary Treatment

Under future conditions with minimal pretreatment of high-load commercial wastewater, the single treatment train (existing oxidation ditch and clarifiers) would not be adequate to provide secondary treatment, and would not provide sufficient redundancy, so expansion is required. Higher-rate, more heavily loaded biological reactors would be needed to treat projected BOD loads and fit on the existing site. Additional clarifier capacity would be needed for higher flows. The following sections describe two options to address these treatment needs.

Comparison of Biological Reactors

Two parallel biological reactor trains are needed, as required for Class II reliability and redundancy requirements. Each train would be loaded at less than 20 pounds of BOD per 1,000 cubic feet and a food-to-microorganism ratio (F/M) of approximately 0.1 pounds of BOD per pound of mixed liquor volatile suspended solids (MLVSS) during maximum-month load conditions. This is normal loading for conventional activated sludge and approximately thirty percent higher than the 15 pounds of BOD per 1,000 cubic feet maximum-month design loading of the existing oxidation ditch. The higher loading rate is proposed for economy and because there is insufficient room on the site to use bioreactors loaded at only 15 pounds of BOD per 1,000 cubic feet. The higher loading rate will require more precise operation and control than has been required for the more forgiving, lower loading rate oxidation ditch.

Two options were considered, as described below. Because of the significant differences between these two options, the overall WWTP Alternative 1 has been divided into two alternatives based on which type of secondary treatment process is selected:

- Alternative 1A—Expand the Existing Oxidation Ditch System
- Alternative 1B—Existing Oxidation Ditch with Conventional Activated Sludge Reactor.

Alternative 1A—Expand the Existing Oxidation Ditch System

The existing oxidation ditch has enough volume and aeration capacity to serve as the aeration zone for one of the two required reactor trains. Both brush aerators in the existing ditch would be used to provide sufficient aeration capacity for the design BOD loads and provide Class II reliability in the event that one of the brushes fails. A second oxidation ditch would be constructed at the same size as the existing ditch (105 feet long, 41 feet wide and 15 feet deep). Two new anoxic selector tanks would be constructed external to the oxidation ditches. A submersible low head propeller pump would circulate mixed liquor between the anoxic zone tank and the oxidation ditch aerobic zone. The anoxic tanks would be 20 feet deep to minimize the tank footprint.

To achieve the proposed loading of less than 20 pounds BOD per 1,000 cubic feet and F/M of 0.1 pounds BOD per pound MLVSS, each reactor train would have a total volume of 310,000 gallons: a 300,000-gallon aerobic zone and a 10,000-gallon anoxic selector zone. The aerobic zone would provide carbonaceous BOD removal and nitrification, and the anoxic zone would function as a selector to improve sludge settleability and provide denitrification, alkalinity recovery and pH control.

Grit removal at the headworks could be deferred to a later construction phase, because recent measurements at Stevenson show that only a few inches of grit accumulated in the existing oxidation ditch since it was placed in service 25 years ago, in 1992.

As this facility planning effort progressed, it became apparent that the existing treatment plant site will have little space available for future expansions if the City builds more oxidation ditch biological reactors, which are limited to depths of 12 to 14 feet. Therefore, this option was not carried forward and Alternative 1B was developed with deeper biological reactor tanks and smaller footprints than oxidation ditches.

Alternative 1B—Existing Oxidation Ditch with Conventional Activated Sludge Reactor

This alternative would keep the existing oxidation ditch in operation and build a new conventional activated sludge (CAS) reactor. The new CAS reactor would have the same aerobic zone volume as the existing oxidation ditch—300,000 gallons—but would have a 20-foot side-water depth with about two-thirds the footprint of the 12-foot side-water depth oxidation ditch, minimizing the tank footprint on the small site. Space would be provided for two more identical CAS reactors that could be constructed in the future. The CAS reactors would use fine bubble aeration for more energy-efficient oxygen transfer; blowers would be installed in a new aeration building south of the new headworks.

Each CAS reactor would include a 10,000-gallon anoxic zone at the influent end of the tank. A 10,000-gallon anoxic selector would be constructed external to the existing oxidation ditch, to be operated in series with the oxidation ditch. Each selector tank would have a submersible mixer. A submersible low-head propeller pump would circulate mixed liquor between the CAS tank or oxidation ditch and the anoxic selector tank in each reactor train. Approximately one-third of the CAS reactor would serve as a swing anoxic/aeration basin, capable of functioning as either a mixed anoxic zone or an aerated zone, depending on aeration demand and controlled by SCADA in response to DO feedback from the CAS reactor. This functionality would conserve power and optimize treatment performance.

To achieve the proposed loading of less than 20 pounds BOD per 1,000 cubic feet and F/M of 0.1 pounds BOD per pound MLVSS, the new CAS reactor train would have a total volume of 310,000 gallons: a 300,000-gallon aerobic zone and a 10,000-gallon anoxic selector zone. The aerobic zone would provide carbonaceous BOD removal and nitrification, and the anoxic zone would function as a selector to improve sludge settleability and provide denitrification, alkalinity recovery and pH control.

Grit removal would be required at the headworks to ensure that the fine bubble diffusers would not be fouled by grit settling in the CAS tanks. Annual draining and cleaning of the CAS tanks would be required to inspect and service the diffusers and remove any grit that settles in the tanks.

The main advantage of CAS reactors is that they use deeper tanks with a smaller footprint, have higher treatment capacity for the given footprint, and use less energy. This alternative would have slightly higher capital costs and slightly higher operation and maintenance (O&M) costs than Alternative 1A. The energy savings provided by the fine bubble diffusers typically would not offset the added O&M cost for annual draining and cleaning and aerator servicing required for each CAS reactor, and for the grit removal system, which are not needed with oxidation ditches.

Selected Biological Reactor Process for Alternative 1

Alternative 1B would allow for more treatment capacity on the existing site and is therefore preferred over Alternative 1A. Therefore, no further assessment of Alternative 1A was performed.

Clarifiers

A new clarifier is needed to provide additional capacity for projected peak flows. The new clarifier would be 50 feet in diameter and have the same surface area as the combined area of the two existing clarifiers. This would provide clarifier loading rates well within Ecology’s current clarifier loading guidelines for the projected flows at the plant through 2040. The loading rates would also be about 15 percent lower than the existing clarifier design loadings, making the plant easier to operate than the existing plant and ensuring regulatory compliance. RAS pumping for the new clarifier would be provided with two submersible pumps—one duty and one standby—in a wet well next to the new clarifier. This would meet Ecology Class II reliability and redundancy requirements, because the plant would still have 50 percent of the design capacity with the largest clarifier out of service. The existing flow splitter box would be modified or a new flow splitter box would be constructed to route flows to the three clarifiers.

8.2.3 Disinfection

Ultraviolet (UV) disinfection is a physical disinfection method, which uses light in the UV spectrum to disrupt microbial cell DNA, preventing replication. The germicidal wavelength is 254 nm, and low-pressure UV lamps have a high percentage of light output at this wavelength. UV disinfection has been used at the Stevenson WWTP since 1992. The plant's low-pressure, low-output UV system has proven to be a reliable, low-maintenance system.

Comparison of UV Equipment

There are three UV technologies currently on the market:

- Low-pressure, low output (LPLO)
- Medium-pressure, high output (MPHO)
- Low-pressure, high output (LPHO)

Table 8-2 summarizes characteristics of each of these systems.

Table 8-2. Available UV Technologies

UV Lamp Type	Input Power (W)	Efficiency %	Temperature ºC	Manufacturers
LPLO	65 to 80	35 to 38	60	Trojan, Calgon, Siemens, Ozonia (Suez)
LPHO	250 to 1000	38 to 40	110 to 130	Wedeco (Xylem), Trojan, Calgon, Ozonia (Suez), Siemens, Enaqua
MPHO	2,800 to 20,000	10 to 16	400 to 900	Aquionics, Calgon, Trojan

LPLO UV Systems

The Stevenson UV system is a Trojan UV3000 LPLO UV system, which does not have automatic cleaning. The Stevenson UV system has only one bank of UV lamps, with backup disinfection provided by the chlorine contact basin. This UV system is now in need of expansion, so more banks of lamps would be provided in order to meet the future peak-hour design flow rate. With more banks of lamps in operation, some banks can be offline during low flow periods, to optimize energy efficiency. This would create an issue with quartz sleeve fouling, since offline UV banks rapidly foul with biofilm, so would be fouled when brought back online. Other UV technologies are provided with automatic cleaning systems that maintain quartz sleeves in clean condition, so that when banks are brought online, they are in clean condition and ready for effective disinfection. Therefore, UV systems without automatic cleaning, including LPLO systems, were not considered further.

MPHO UV Systems

MPHO UV systems were introduced to the US in the mid-1990s. This type of lamp has a significantly higher output than low-pressure lamps, so fewer lamps are required. MPHO systems have automatic cleaning systems for quartz sleeves. However, this type of lamp uses 3 to 3.5 times the power of LPHO or LPLO systems to deliver an equivalent dose. Although MPHO systems compete well against LPLO and LPHO systems on a capital cost basis, power costs are significantly higher. Labor costs appear to be higher as well, based on data from operating installations. Over a 20-year life, MPHO has a higher overall cost (capital plus O&M) compared to LPLO or LPHO, so it is the worst option based on life cycle cost. There are also redundancy issues associated with smaller installations, such as at the Stevenson WWTP. Therefore, this technology was not considered further.

LPHO UV systems

LPHO UV systems were introduced to the US in the late 1990s. This type of lamp has an output higher than LPLO lamps and lower than MPHO lamps. This is the highest efficiency of the available technologies and is generally the most cost-effective, reliable technology. This technology is the current state of the art and is therefore selected for the UV facility expansion at the Stevenson WWTP.

Selected Disinfection Process for Alternative 1

A second UV channel would be constructed parallel to the existing UV channel, with upstream Parshall flumes providing flow split and flow measurement. The existing UV channel would be retrofitted with two banks of LPHO UV lamps and the second UV channel would also contain two banks of LPHO UV lamps. This would provide the required level of reliability and redundancy for disinfection.

8.2.4 Effluent Pumping

Under normal conditions, effluent could flow by gravity to discharge through the WWTP’s primary outfall at the Bonneville Pool of the Columbia River. The plant’s NPDES permit requires that this outfall be used (rather than the secondary outfall) whenever it is operational (see Section 7.3). The City’s 2013 extension of the primary outfall was designed to accommodate a peak flow of 2.1 mgd, according to Gray & Osborne’s 2013 *City of Stevenson Emergency Outfall Work Preliminary Engineering Report*. Therefore, effluent pumping will be needed for peak flows greater than 2.1 mgd.

At a new effluent pump station included in this alternative to accommodate high peak flows, two 15-horsepower effluent pumps would be provided, one duty and one standby. Effluent would be conveyed by gravity from the disinfection facilities to the effluent pump station. An 8-inch force main would connect the effluent pump station to the existing outfall pipeline.

8.2.5 Biosolids Management

Sludge Thickening and Digestion

The converted Oxygest plant is used as a multi-chamber solids thickener, aerobic digester, and holding tank. A new sludge thickener would be provided that would send sludge at 6-percent total solids to the digester. This would increase the solids loading capacity of the existing aerobic digester so that it would meet the time and temperature requirements of federal 503 Regulations to produce Class B biosolids through 2040.

The existing aerobic digester has adequate volume for this practice, but the following improvements would be needed for sludge thickening, aeration and pumping:

- Refurbish the existing aerobic digester, including new partition walls and a new aeration diffuser system with increased oxygen transfer efficiency.
- Construct a new solids thickening building. This building would house two new mechanical thickeners by 2040, along with associated pumps and a polymer system.
- Install a new mechanical thickener (assumed to be a rotary drum thickener) to thicken raw waste sludge to concentrations up to 6 percent and achieve 3-percent solids concentration after volatile solids destruction in the digester.
- Provide two waste sludge pumps to feed thin waste sludge to the thickener from a raw sludge holding chamber in the solids holding tank.
- Provide two thickened sludge pumps to convey thickened sludge to the aerobic digester.
- To provide air to the aerobic digester over a range of operating depths, install two new blowers in the blower room of the new aeration building south of the new headworks.

The mechanical thickening system would increase the concentration of sludge in the aerobic digester instead of continuing to use gravity thickening in the solids holding tank. This would improve performance of the secondary treatment and aerobic digestion facilities. It would eliminate recycle of decanted supernatant with poor settling sludge from the aerobic digester to the secondary treatment process, which can adversely impact sludge settleability. It would increase the solids detention time and volatile solids destruction in the aerobic digester, would produce Class B biosolids, and would reduce the mass and volume of sludge hauled to Hood River or Vancouver.

Biosolids Disposal

Two biosolids disposal options were evaluated, both using Class B biosolids:

- Haul liquid Class B biosolids to a neighboring WWTP for disposal.
- Haul dewatered Class B biosolids to land application site.

Haul Liquid Class B Biosolids to Neighboring WWTP

This alternative would continue the existing solids handling practice of hauling liquid Class B biosolids to the Hood River WWTP for further digestion and land application. The City contract operators have been hauling liquid sludge to the Hood River WWTP for a number of years. Recently, Hood River staff stated that the Hood River plant has a digester out of service (in need of cleaning) and is limited in its solids storage capacity and land application sites. Therefore, Hood River cannot accept more than two trucks of solids (10,000 gallons) per week. The City of Stevenson has contracted with the City of Vancouver through 2018 to allow Stevenson’s sludge to be hauled to the Vancouver Westside WWTP for incineration if Hood River is unable to accept sludge.

Haul Dewatered Class B Biosolids to Land Application Site

This option was developed as a theoretical exercise to assess whether it is worth considering dewatering at the Stevenson WWTP. In order to use land application to agricultural land as the end disposal method for solids, the City would need to either buy its own biosolids hauling trucks (and possibly land application equipment) or hire a contract hauler to haul biosolids to agricultural land for land application. This option assumes the use of a contract hauler. It would include construction of a dewatering facility at the WWTP, since hauling dewatered biosolids at 20-percent total solids rather than liquid sludge at 3-percent total solids would reduce the number of trips by 85 percent. The dewatering facility would include sludge feed pumps, one screw press, screw conveyors and a drive-through truck loading station. The screw press is included because it can operate unmanned around the clock.

Stevenson is surrounded by steep forested slopes to the north, east and west, and the Columbia River borders the City to the south. There are no agricultural areas within a 20-mile radius of the City. This option assumes a round-trip hauling distance of 120 miles to the Dallesport/Goldendale area, where there is significant agriculture. The City has not yet begun searching for farmers willing to accept Class B biosolids for land application.

Comparison of Biosolids Disposal Options

Table 8-3 compares estimated costs of the two biosolids management options. Hauling liquid Class B biosolids to neighboring WWTPs has lower present worth costs than constructing a dewatering facility and hauling dewatered biosolids to agricultural land.

Table 8-3. Planning Level Biosolids Disposal Cost Comparison

Component	Capital Project Cost	Annual O&M Cost [b]	20-Year Present Worth
Haul Liquid Biosolids to Neighboring WWTP	n/a[a]	$176,865	$3,128,000
Haul Dewatered Biosolids to Land Application Site	$1,869,000	$105,518	$3,735,000

a. Capital costs are relative and include only those costs that are different between the two disposal options. All capital improvements required for hauling liquid biosolids are also required for hauling dewatered biosolids, so the relative capital cost for this option is zero.
b. O&M costs are relative and include only those costs that are different between the two disposal options. For liquid biosolids, the only O&M costs are for hauling and tipping fees, while for dewatered biosolids the O&M cost also includes labor and power costs for the additional dewatering equipment.

Selected Biosolids Process for Alternative 1

Hauling liquid Class B biosolids to neighboring WWTPs is the approach the City of Stevenson has been using for more than 20 years. It is more cost-effective than dewatering and hauling biosolids to agricultural land. Therefore, the selected biosolids management alternative is to haul liquid Class B biosolids to neighboring WWTPs.

8.2.6 Support Facilities

The support facilities category includes the following facilities that are essential to plant operations:

- New laboratory and operations building
- New aeration building
- New electrical and control facilities, including a new standby generator and SCADA facilities
- Maintenance shop.

Laboratory and Operations Building

The existing laboratory/control building would be demolished and a new laboratory and operations building would be constructed in its place. The operations area would include one office and one control room. The laboratory would be sufficient for process control testing. Samples taken for compliance monitoring would be sent to an outside laboratory, such as Pixis.

Aeration Building

A new building would be constructed south of the new headworks to house blowers for the CAS reactors and the aerobic digesters, as well as electrical equipment.

Electrical and Control Facilities

Existing WWTP electrical and control facilities would be modified as follows:

- A new service entrance and transformer would provide power for expanded plant facilities.
- A new larger generator would be located along the west property border, to replace the existing standby generator. The new generator would be provided with a prefabricated outdoor weatherproof enclosure.
- New MCCs would be located in the pump building generator room.
- A new SCADA control system would be provided, including new control panel and operator workstation in the operations building and remote SCADA access from City Hall and potentially from the Hood River WWTP (for contract operators to monitor the Stevenson WWTP).

Maintenance Shop

The existing maintenance facility would remain in its present location. A new maintenance shop may be built at that location sometime after 2040, to be used for equipment and treatment plant vehicle maintenance.

8.2.7 Flood Protection

Ground elevation around the perimeter of the Stevenson WWTP site is more than 3 feet above FEMA's latest draft 100-year flood elevations, effectively providing a more than 3-foot high levee around the site. The ecology block walls on the north and east sides of the site provide even higher flood protection from high water levels in Rock Creek. The elevation of the lowest storm drain inlet grating in the driveway at the center of the WWTP site is about the same elevation as the 100-year flood, and the floor of the RAS pump building and old treatment plant equipment building are about 1 foot above the 100-year flood. Treatment plant improvements to mitigate flood risk include the following items:

- Install flood stop-log gates at the existing RAS pump building doors. The floor of the building is currently at elevation 87 feet, about 1.2 feet above the 100-year flood elevation.
- Raise the top of the existing in-plant pump station wet well by approximately 3 feet, to meet flood standards. Currently the top of the wet well is at elevation 85.8 feet, about the same elevation as the 100-year flood.
- Add check valves and/or gates on the storm drain and emergency effluent outfalls to prevent backflow into the plant site from Rock Creek during flood conditions.
- Use portable pumps to bail rain water from the low point in the stormwater system when it cannot drain by gravity to Rock Creek during flood conditions.
- The new laboratory and operations building would be constructed at the appropriate elevation to meet flood protection standards. If the project is constructed in phases, the new laboratory and operations building may be deferred to the second phase. For the first phase, a new interim office in the RAS pump building generator room would be provided, with a computer control station, laboratory sink and countertop, instead of flood-proofing the existing office in the original treatment plant equipment building. The original building has light duty stud construction and cannot be readily flood protected with stop logs at the entry doors.
- Use blowers in the proposed new blower building to aerate the aerobic digester instead of flood-proofing the old digester blowers in the original equipment building.
- Use neighboring restrooms during flood conditions instead of flood-proofing the restroom in the original equipment building.

8.3 WWTP ALTERNATIVE 2—IMPROVEMENTS WITH PRETREATMENT TO DOMESTIC STRENGTH

Alternative 2 would include improvements needed at the Stevenson WWTP if pretreatment is provided to reduce high-strength commercial wastewater from high-load dischargers to normal domestic strength. This alternative would replace the existing headworks with a new larger headworks, improve the secondary treatment process by adding selector basins, a second oxidation ditch and a third final clarifier, and add a second UV channel. The existing laboratory/control building would be replaced by a new solids handling/blower building. The existing maintenance facility would be relocated offsite, and a new operations/laboratory/shop facility would be provided at the former location of the maintenance facility. A preliminary site plan for Alternative 2 is shown in Figure 8-2.

8.3.1 Headworks

Under future flow conditions, the existing headworks configuration is not adequate to support the required process facilities. It would require screening, grit removal, flow measurement and flow split to two future oxidation ditches (one is existing). Because of configuration and siting constraints, it would not be possible to expand the existing headworks and provide all of these functions.

Alternative 2 would include a new headworks to be constructed along the west side of the WWTP, similar to that described for Alternative 1, but without grit removal. Space would be provided for future construction of a grit removal system. The existing headworks would be abandoned. Equipment costs and descriptions for this headworks alternative are based on 6-mm fine screens. Because Alternative 2 includes an oxidation ditch secondary treatment system, construction of the vortex grit chamber could be deferred to a later time.

8.3.2 Secondary Treatment

Like Alternative 1, Alternative 2 requires additional biological reactor capacity and a third clarifier for existing conditions and future conditions through the end of the planning period. However, because of the assumed higher level of pretreatment resulting in a significantly lower BOD load to the WWTP, sufficient additional biological reactor capacity could be provided by adding a second oxidation ditch similar to the existing ditch. The ditches would have capacity for 1,222 ppd BOD if loaded at 15 ppd BOD per 1,000 cubic feet and a 0.095 F/M ratio like the existing ditch. They would have 219 ppd BOD reserve capacity in 2040. A lower level of pretreatment (62-percent BOD removal rather than 85-percent removal) would load the ditches to full capacity by 2040.

The two ditches would function like the original ditch, with one duty brush aerator and one standby brush aerator per ditch. An aerobic zone would extend about 75 percent of the way around each ditch downstream of the aerator, and an anoxic zone would extend about 25 percent upstream of the aerator. The second oxidation ditch would be located next to the existing ditch, preserving room on the site to add a third ditch and separate anoxic selector tanks if needed, as shown for Alternative 1A.

A new clarifier, RAS pumps and a flow splitter box would be provided to increase capacity for existing and projected peak flows, the same as for Alternative 1.

8.3.3 Disinfection

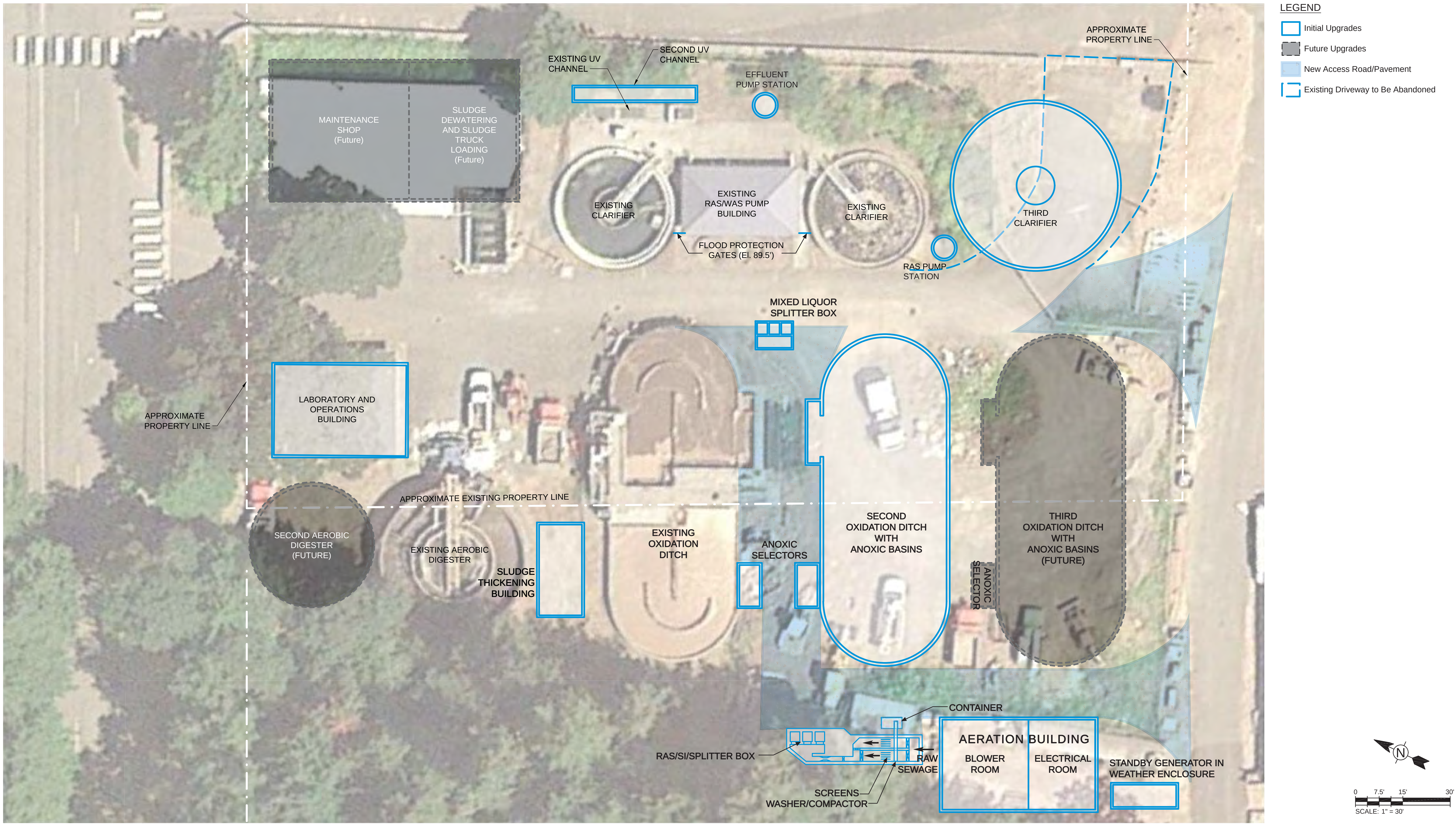
Disinfection for Alternative 2 would be the same as for Alternative 1.

8.3.4 Biosolids Management

Biosolids management for Alternative 2 would be the same as for Alternative 1, with liquid biosolids hauled to a neighboring WWTP, except that the sludge thickener and pumps would have smaller capacity, because waste sludge quantities would be less for the oxidation ditch process (which has a longer SRT) than for the CAS reactor process.

8.3.5 Support Facilities

The support facilities for Alternative 2 would be the same as for Alternative 1 except the new power supply and generator would be smaller and fewer new MCCs would be needed.



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CITY OF STEVENSON, WA
GENERAL SEWER PLAN UPDATE

WWTP IMPROVEMENTS
ALTERNATIVE 2

Project No.:	135-48600-16001
Date:	NOVEMBER 2017
Designed By:	

Supplemental
FIGURE 8-2

Bar Measures 1 inch

8.4 COMPARISON OF ALTERNATIVES

8.4.1 Life-Cycle Cost Comparison, Alternatives 1B and 2

Table 8-4 presents planning level capital cost estimates, annual O&M costs, and 20-year present worth costs for Alternatives 1B and 2. A detailed cost estimate by work item is included in Appendix I. The total cost shown includes only the improvements at the Stevenson WWTP; the pretreatment improvements are expected to have different funding sources and mechanisms. This is a Class 4 cost estimate as defined by the Association for the Advancement of Cost Engineering International. These costs represent planning level cost estimates in 2017 dollars and should be considered accurate in the range of +50 to –30 percent.

Table 8-4. Planning Level Alternatives Capital Cost Comparison

	Capital Project Cost		Annual O&M Cost		20-Year Present Worth	
Component	Alt 1B	Alt 2	Alt 1B	Alt 2	Alt 1B	Alt 2
Pretreatment Improvements at Other Locations						
High-Load Commercial Pretreatment	$711,000	$2,444,000	$10,021	$70,078	$888,000	$3,683,000
Stevenson WWTP Improvements						
Headworks	$1,870,000	$1,037,000	$43,573	$37,844	$2,829,000	$1,706,000
Secondary Treatment	$4,714,000	$5,126,000	$107,667	$133,330	$7,098,000	$7,148,000
Disinfection	$1,090,000	$1,090,000	$23,411	$23,411	$1,504,000	$1,504,000
Solids Handling	$1,066,000	$884,000	$155,040	$163,141	$5,636,000	$3,770,000
Support Facilities	$3,084,000	$3,084,000	$75,269	$75,269	$8,390,000	$8,611,000
Flood Protection	$202,000	$202,000	$1,507	$1,507	$229,000	$229,000
Effluent Pumps	$576,000	$576,000	$7,004	$7,004	$700,000	$700,000
WWTP Mgt Tasks			$62,400	$62,400	$1,103,687	$1,103,687
Lab Labor			$93,600	$93,600	$1,655,531	$1,655,531
Pretreatment Program Labor			$62,400	$62,400	$1,103,687	$1,103,687
WWTP Total (excluding Pretreatment)	$12,602,000	$11,999,000	$631,870	$659,907	$30,248,906	$27,530,906

8.4.2 Qualitative Comparison, Alternatives 1B and 2

Alternatives 1B and 2 are qualitatively similar except as follows:

- Alternative 1B would provide higher treatment capacity at the existing WWTP site.
- Alternative 1B would provide treatment capacity for higher influent loads, which would allow for smaller pretreatment facilities offsite. This means that the existing waterfront building, where three of the high-load commercial facilities are located, would have minimal visual and odor impacts from pretreatment facilities.

8.4.3 Overall Comparison and Recommendation

Capital costs of the two alternatives are within 12 percent of each other, which is within the margin of error for the cost estimates. The 20-year present worth costs are within 13 percent of each other.

It is important to plan for the higher treatment capacity at the existing WWTP provided by Alternative 1B. This alternative also allows for smaller pretreatment facilities, particularly at the waterfront building. It is also important to maintain Stevenson waterfront aesthetics, particularly from a visual and odor standpoint.

Therefore, Alternative 1B is the recommended alternative.

8.5 POTENTIAL PHASING OF RECOMMENDED ALTERNATIVE

A phasing plan was investigated as a potential way to reduce initial construction costs for recommended Alternative 1B. Figure 8-3 shows the layout for this phased approach. Table 8-5 summarizes the estimated capital costs for each phase. A table of design criteria for the two phases is provided in Appendix K.

Table 8-5. Estimated Costs for Phased Project Implementation

Component	Capital Project Cost	
	Alt 1B, Phase 1	Alt 1B, Phase 2
Pretreatment Improvements at Other Locations		
High-Load Commercial Pretreatment	$711,000	$0
Stevenson WWTP Improvements		
Headworks	$1,870,000	$0
Secondary Treatment	$2,230,000	$2,484,000
Disinfection	$1,090,000	$0
Solids Handling	$1,066,000	$0
Support Facilities	$1,819,000	$1,493,000
Flood Protection	$202,000	$0
Effluent Pumps	$0	$576,000
WWTP Total (excluding Pretreatment)	$8,277,000	$4,553,000

A phased approach would reduce the cost of initial construction (scheduled for 2020-2021) but would increase the overall project cost by approximately $228,000. This is due to postponing the new laboratory and operations building until Phase 2 (in 2030) and providing an interim office in Phase 1 by remodeling the old generator room in the existing RAS/WAS pump building. The existing laboratory/control building would remain through Phase 1 to serve the function of process control laboratory testing and to provide a restroom for plant staff use. This structure is more than 50 years old and is past the end of its useful life. Therefore, if initial project funding allows, it is recommended that Alternative 1B be implemented without phasing.

8.6 FUTURE OPERATION AND MAINTENANCE REQUIREMENTS

The existing WWTP is understaffed, with less than 1 FTE. The New England Interstate Water Pollution Control Commission (NEIWPCC) model provides am accurate, systematic, and cost-effective approach to estimating staffing levels needed to operate and maintain a modern treatment facility. Using the NEIWPCC model specific to an oxidation ditch facility indicates a need for 2 FTEs for the existing Stevenson WWTP.

Assessment using the NEIWPCC model for the future WWTP following construction of the recommended improvements made the following findings:

- A WWTP operator with Class III certification will be required to perform the duties of operator in charge of plant operations and maintenance.
- There will be a need for 3 FTEs for operation and maintenance of the WWTP following construction of the Alternative 1B improvements in 2021.
- There will be a need for 3.5 FTEs for operation and maintenance of the future WWTP by 2040.

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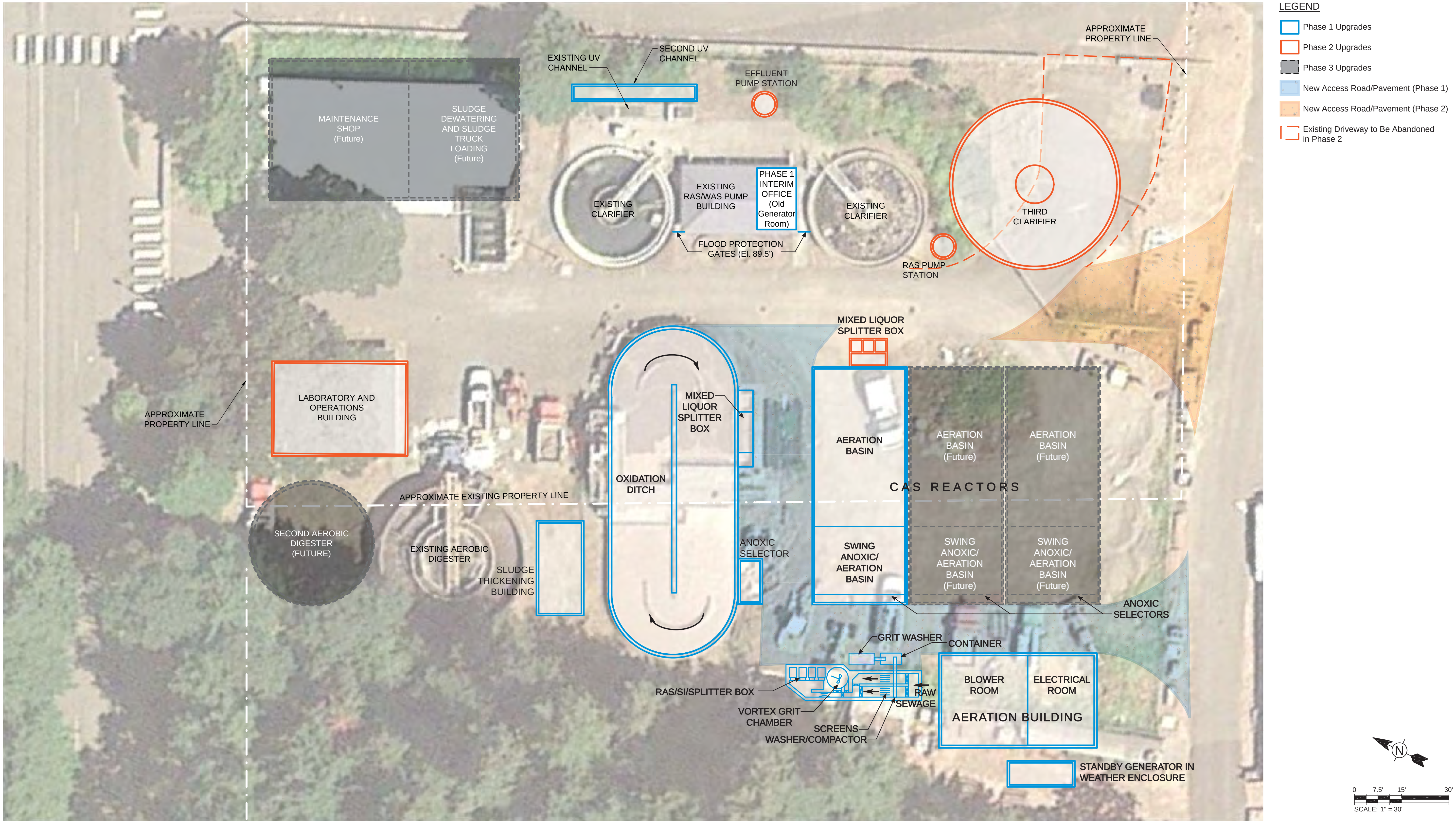

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CITY OF STEVENSON, WA
GENERAL SEWER PLAN UPDATE

RECOMMENDED ALTERNATIVE 1B
WITH PHASED IMPLEMENTATION

Project No.: 135-48600-16001
Date: OCTOBER 2017
Designed By:
Supplemental
FIGURE 8-3

Bar Measures 1 inch

Figure-8-3_Alt1B_wPhasing.ai

The current contract has wording that limits the flexibility, duties and responsibilities of the contract operator. While these limit the cost of the services, they do not always serve the City's best interest with regard to meeting plant permit requirements. The City has two alternatives for future plant operations:

- Renegotiate the contract operations services to better meet the needs of the City.
- Convert to City operation of the WWTP, which would require hiring staff.

An evaluation comparing these alternatives found the following:

- City operations would not be confined by the limits of the contract.
- City operations staff would have leeway to address rapidly changing influent conditions during storm events, conditions with high or variable influent loading, process upsets, and other events that may occur, in order to maintain permit compliance.
- With City operation of the WWTP, the City would have staff operating the water treatment plant, WWTP and collection system. All of these facilities have common types of mechanical equipment, processes (to some degree) and piping. Employee cross-training and job sharing may provide benefits to the City in terms of ability to provide additional staff under emergency conditions, to cover vacations, and to provide effective shifting of labor for maintenance projects.
- With City operation, the City would need to find an operator with Class III certification. This may be difficult since many senior operators have retired in recent years.
- Contract operation provides a cost-effective option. Contract operation provides trained professional staff who work at several wastewater facilities in the area.

These two alternatives can be compared for cost and other criteria if and when the City is ready to consider them.

8.7 ENVIRONMENTAL REVIEW

Treatment improvements would be constructed at the existing WWTP site. A comprehensive, project specific State Environmental Policy Act (SEPA) checklist is attached in Appendix J to address environmental elements of the project.

9. RECOMMENDED PLAN

This chapter summarizes the recommended plan for upgrading the City of Stevenson's wastewater collection and treatment facilities. The recommended plan covers collection system improvements in two phases and WWTP improvements in one phase.

9.1 RECOMMENDED IMPROVEMENTS

9.1.1 Collection System Improvements

Gravity Sewer Capacity Upgrades

The following projects will upgrade existing gravity sewers to provide additional capacity.

- **Cascade Avenue Sewer, Phase 1 (Project S-01)—**Replace 920 feet of 8-inch sewer pipe in Cascade Avenue with new 12-inch pipe
- **Cascade Interceptor, Phase 1 (Project S-02)—**Replace 1,250 feet of 12-inch Cascade Interceptor located in Rock Creek Drive with new 18-inch pipe
- **Cascade Interceptor, Phase 2 (Project S-03)—**Replace 1,650 feet of 12-inch Cascade Interceptor from Rock Creek Drive to Railroad Avenue and Russell Avenue with new 18-inch pipe

Phase 1 projects (to be completed from 2017 to 2025) are those required to address areas identified by modeling to have inadequate capacity for existing flows. Phase 2 projects (to be completed from 2025 to 2040) are those required to address future capacity issues.

Extensions to Unsewered Areas

The following projects are intended to facilitate conversions of existing septic systems and allow future extensions to developable areas in the City. Phasing is not explicitly defined for these projects because their timing will depend on funding, rates of septic failures, and development trends.

- **Main D Extension (Project S-04)—**Extend Sewer Main D north along East Loop Road and Frank Johns Road by installing 3,500 feet of 8-inch sewer pipe
- **Iman Cemetery Road (Project S-05)—**Extend sewer from Rock Creek Drive and Ryan Allen Road continuing north on Iman Cemetery Road by installing 2,800 feet of 8-inch sewer pipe
- **Foster Creek Road (Project S-06)—**Extend sewer from the intersection of Ryan Allen Road and Iman Cemetery Road and continuing east to Foster Creek Road and north to the intersection of Foster Creek Road and Hollstrom Road by installing 4,000 feet of 8-inch sewer pipe

Pump Station Upgrades

The following projects address deficiencies at existing pump stations

- **Rock Creek Pump Station, Phase 1 (Project PS-01)—**Existing equipment is undersized and full pump station replacement is required. Construct new 1,500-gpm firm capacity duplex or triplex submersible pump station with new control panel, auxiliary standby power, and new 12-inch force main to the WWTP.
- **Fairgrounds Pump Station, Phase 1 (Project PS-02)—**Minor upgrades are required, including provision for bypass pumping, new discharge flow meter, and integration of new flow recorder into existing controls. Relocation of a portion of force main may be required to accommodate WWTP expansion.
- **Fairgrounds Pump Station, Phase 2 (Project PS-03)—**Future increases in flow will require additional capacity upgrades, including new submersible pumps in new wet well, new control panel and instrumentation, and new electrical equipment including standby generator and automatic transfer switch.
- **Kanaka Pump Station, Phase 1 (Project PS-04)—**At a minimum, a flow meter should be installed to verify model results that show pump station to be undersized. Pump station replacement is recommended, consisting of a new 500-gpm firm capacity duplex submersible pump station with new control panel and auxiliary standby power.
- **Cascade Pump Station, Phase 1 (Project PS-05)—**Minor upgrades are required, including provision for bypass pumping and upgrade of controls to include an auto-dialer or remote telemetry unit.
- **Cascade Pump Station, Phase 2 (Project PS-06)—**Future increases in flow will require additional capacity upgrades, including replacement of pumps with new submersible pumps in a new wet well and new control panel and instrumentation.

Phase 1 projects (to be completed from 2017 to 2025) are those required to address current capacity or safety issues. Phase 2 projects (to be completed from 2025 to 2040) are those required to address future capacity issues.

Project Prioritization

Table 9-1 shows the Phase 1 collection system improvements sorted by priority. Design and construction of the Rock Creek Pump Station improvements and Phase 1 Fairgrounds Pump Station Improvements have been scheduled to coincide with the WWTP improvements because standby power for the pump stations is provided by the generator at the WWTP, and because control improvements at the pump stations will need to be linked to new control systems at the WWTP. A second group of collection systems improvements has been scheduled for the following year.

Table 9-1. Phase 1 Collection System Improvements Prioritization

Priority	Project ID	Project Name	Year
1	PS-01	Rock Creek Pump Station	2021
2	PS-02	Fairgrounds Pump Station - Phase 1	2021
3	PS-05	Cascade Pump Station - Phase 1	2022
4	S-01	Cascade Avenue Sewer	2022
5	PS-04	Kanaka Pump Station	2022
6	S-02	Cascade Interceptor - Rock Cr PS to MH CI-4	2022

The Phase 2 collection system improvements will need to be initiated when the capacity of the gravity sewer and/or pump station is no longer adequate or when the age of the equipment is causing excessive operation or maintenance issues. Table 9-2 summarizes the trigger or triggers for each of the Phase 2 projects.

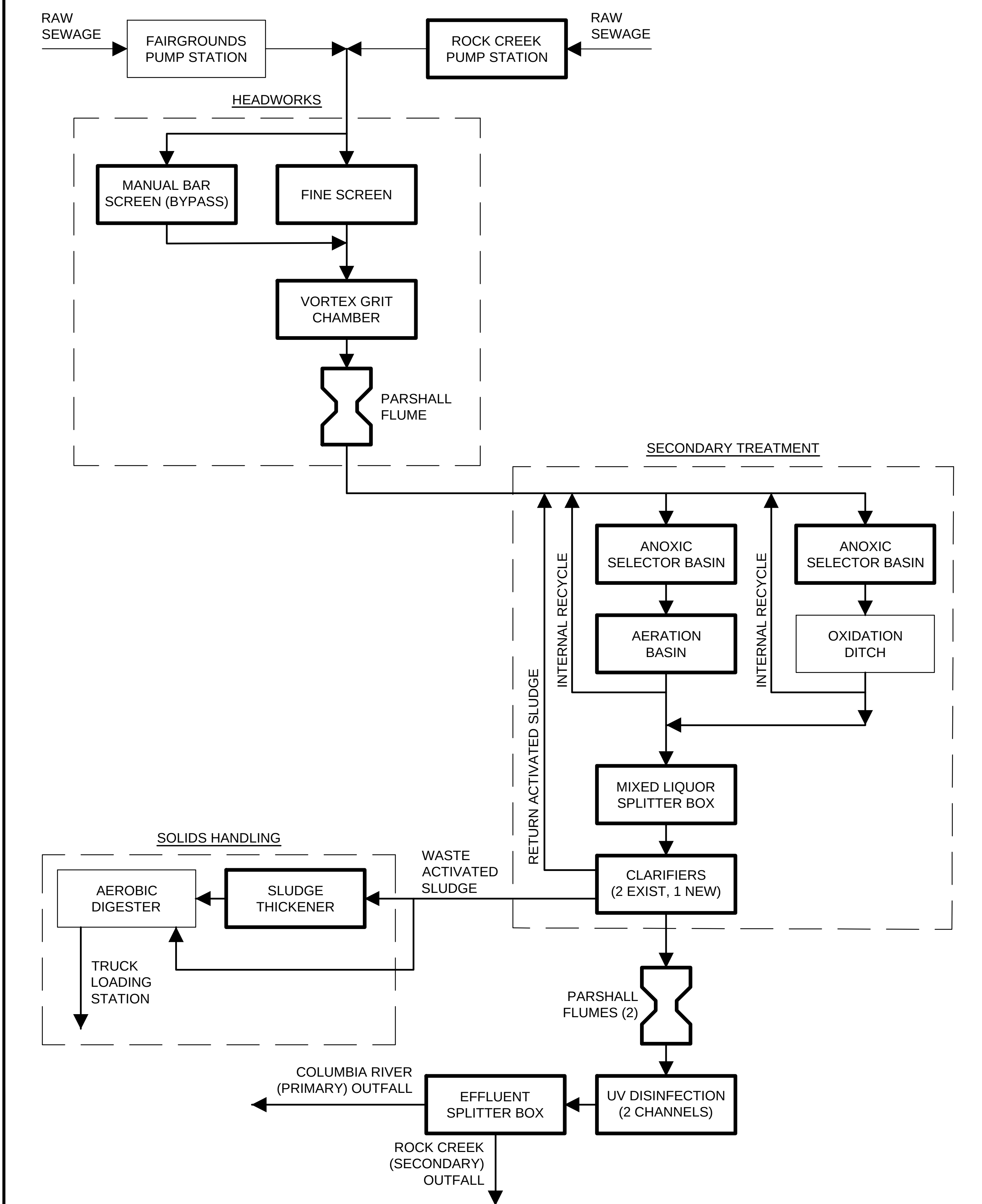
Table 9-2. Phase 2 Collection System Improvements

Project ID	Project Name	Trigger
S-03	Cascade Interceptor - Phase 2	Capacity: The trigger for upgrade will be when the pipe reaches full capacity and surcharges during peak-hour flow. • Existing Pipe Capacity = 650 gpm • Existing Peak-Hour Flow = 580 gpm • Year 2040 Peak-Hour Flow = 810 gpm Full capacity will be reached when approximately 150 new ERUs are added to the Cascade Interceptor service area.
PS-03	Fairgrounds Pump Station - Phase 2	Capacity: • Existing Station Firm Capacity = 280 gpm • Existing Peak-Hour Flow = 225 gpm • Year 2040 Peak-Hour Flow = 355 gpm Full capacity will be reached when approximately 115 new ERUs are added to the pump station service area. Age: The station is 39 years old, whereas the typical design life for pump station mechanical and electrical equipment is 30 years. Increased maintenance time, limited availability of replacement parts, and funding availability are likely triggers for the project.
PS-06	Cascade Pump Station - Phase 2	Age: The station is 45 years old whereas the typical design life for pump station mechanical and electrical equipment is 30 years. Increased maintenance time, limited availability of replacement parts, safety issues related to accessing the equipment, and funding availability are likely triggers for the project.

9.1.2 Wastewater Treatment Plant Improvements

Alternative 1B is the recommended alternative. The improvements would increase plant capacity for conditions projected through 2040. Figure 9-1 shows a flow diagram of the recommended WWTP improvements; Figure 9-2 shows a site plan. Specific improvements, to be implemented before 2022, are as follows:

- **Headworks**—Construct new headworks southwest of the existing oxidation ditch and abandon the existing headworks. The new headworks facility would be designed to handle a peak-hour flow of 2.7 mgd. It would include a junction box for two interceptors, a new sampling station, flow metering, a new screening facility consisting of one screening channel with a 6-mm fine screen and an emergency bypass channel with a manual bar screen, and a vortex grit chamber with horizontal recessed impeller grit pump and grit cyclone/classifiers.
- **Secondary Treatment, Conventional Activated Sludge**—Maintain the existing oxidation ditch in operation and construct one new conventional activated sludge (CAS) biological reactor, with space for two more to be constructed in the future. Provide fine-bubble aeration in the CAS reactors, using blowers to be installed in a new aeration building. Install two 10,000-gallon anoxic selector tanks (one for the oxidation ditch and one for the CAS reactor) equipped with submersible mixers and submersible low-head propeller pumps to circulate mixed liquor between each biological reactor and anoxic selector in each reactor train.
- **Secondary Treatment, Clarifier**—Construct new 50-foot diameter clarifier adjacent to existing clarifiers. Provide RAS pumping using two submersible pumps, one duty and one standby, in a wet well next to the new clarifier. Construct a new flow splitter box to route flows to the three clarifiers.
- **Disinfection**—Construct a second UV channel parallel to the existing UV channel, with upstream Parshall flumes providing a flow split and flow measurement. Retrofit the existing UV channel with two banks of LPHO UV lamps and provide two matching banks of LPHO UV lamps for the new second channel.



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City of Stevenson
GENERAL SEWER PLAN UPDATE

Figure 9-1.
RECOMMENDED IMPROVEMENTS
WWTP FLOW DIAGRAM

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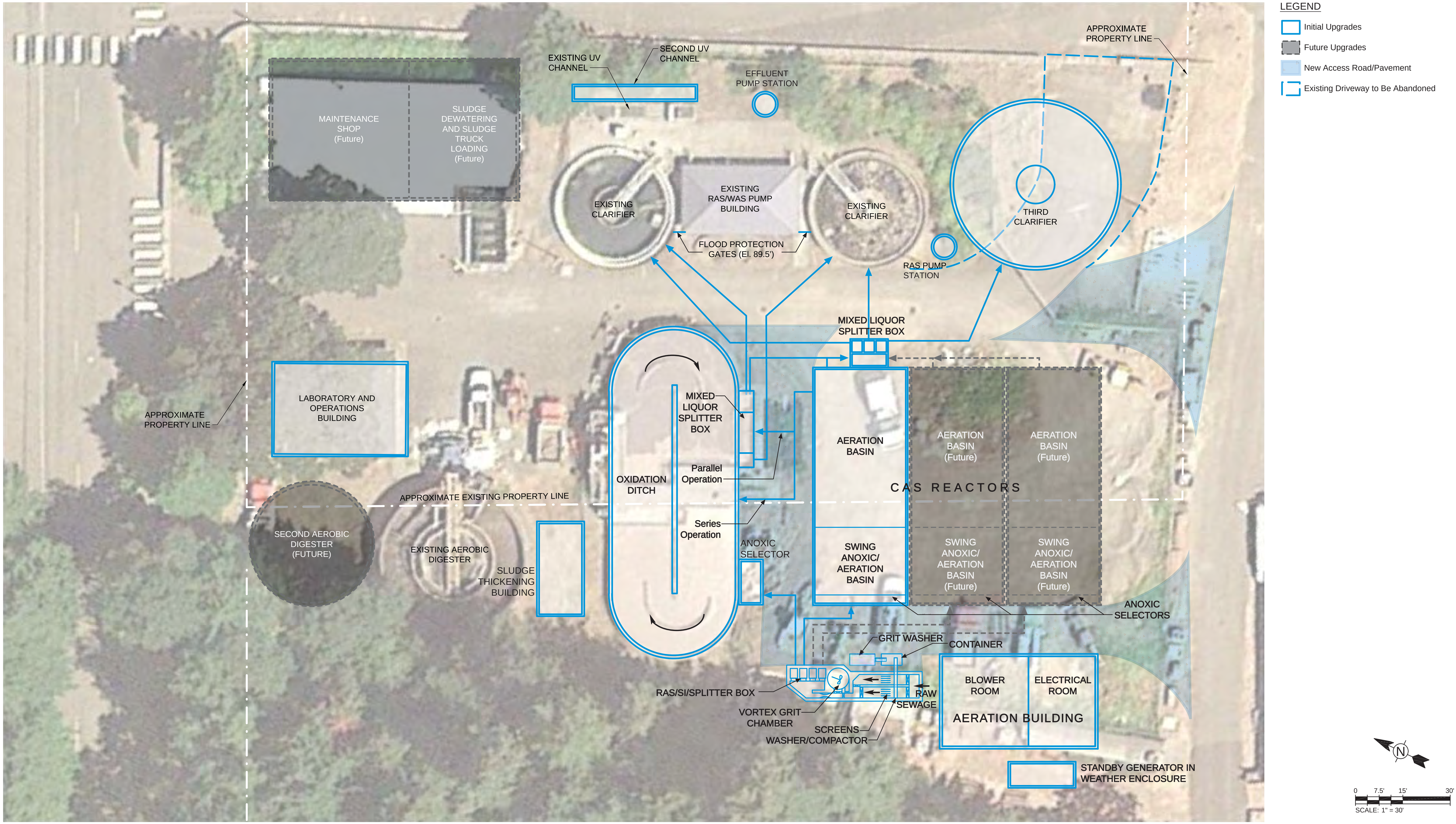

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CITY OF STEVENSON, WA
GENERAL SEWER PLAN UPDATE

RECOMMENDED IMPROVEMENTS
WWTP SITE PLAN

Project No.:	135-48600-16001
Date:	OCTOBER 2017
Designed By:	

Supplemental
FIGURE 9-2

Bar Measures 1 inch

Figure-9-2_RecommednedSitePlan.ai

- **Effluent Pump Station**—Construct a new 15-hp effluent pump station to pump effluent to discharge through the primary outfall to the Bonneville Pool when flows are greater than 2.1 mgd.
- **Sludge Thickening and Digestion**—Construct a new sludge thickening building to house a new mechanical thickener to thicken raw waste sludge, two new waste sludge pumps to feed the thickener, a polymer system to assist with sludge thickening, and two new thickened sludge pumps to convey thickened sludge to the aerobic digester. Refurbish the existing aerobic digester, including new partition walls and a new aeration diffuser system, which will use blowers housed in a new aeration building.
- **Support Facilities**—Demolish the existing laboratory/control building and construct a new laboratory and operations building at that location. Construct a new aeration building to house blowers for the CAS reactors and aerobic digester, as well as electrical equipment. Provide a new service entrance and transformer to provide power for expanded plant facilities. Replace the existing standby generator with a new larger generator located west of the future aeration basins. Provide new MCCs in the pump building generator room. Provide new SCADA control system, including new control panel and operator workstation in the operations building and remote SCADA access from City Hall and potentially from the Hood River WWTP (for contract operators to monitor the Stevenson WWTP).

Design criteria for the recommended upgrades are shown in Table 9-3.

Table 9-3. Design Criteria for Treatment Plant Facilities

Process/Equipment Description	Existing Design	Year 2040
Treatment Plant Rated Capacity		
Flow[a]		
Base (Dry Weather Average)	0.24 mgd	
Maximum Month	0.45 mgd	0.66 mgd
Peak Day	1.0 mgd	1.71 mgd
Peak Hour	1.5 mgd	2.56 mgd
Pollutant Loadings - BOD or SS[a]		
Maximum-Month	611 ppd	1,611 ppd
Peak Day		2,912 ppd
Peak Hour (1.5 peaking factor)		182 pphr
Headworks		
Mechanical Fine Screen		
Number	1 + manual screen bypass	1 + manual screen bypass
Type	Automatic bar screen	6 mm automatic fine screen
Peak Flow Capacity per Screen	1.5 mgd	2.56mgd
Washer Compactor		
Number	None	1
Screenings Volume Reduction	n/a	80%
Organic Constituents Removal from Screenings	n/a	95%
Grit Chambers		
Type	None	Vortex
Number	n/a	1 + bypass
Grit Pumps		
Type	None	Horizontal recessed impeller
Number	n/a	1
Grit Washing / Transport		
Type	None	Cyclone / classifier
Number	n/a	1

Process/Equipment Description	Existing Design	Year 2040
Influent Monitoring		
Influent flow measurement	6-inch Parshall Flume	9-inch Parshall Flume
Influent sampler	Time composite sampler, portable, ice cooled	Flow paced composite sampler, refrigerated
Secondary Treatment		
Biological Reactors		
Anoxic Selectors		
Total Volume (at Reactors 1 & 2)	—	20,000 gallons
Detention Time		
Maximum month (with 50% RAS flow)	—	29 min
Peak day (with 100% MM RAS flow)	—	12 min
Reactor 1		
Type	Oxidation ditch	Oxidation ditch
Volume		
Anoxic selector basin	—	10,000 gallons
Swing Zone (Anoxic/Aerobic)	100,000 gallons	100,000 gallons
Aerobic Zone	200,000 gallons	200,000 gallons
Total	300,000 gallons	310,000 gallons
Dimensions		
Reactor	103 feet long 39 feet wide 12-foot side water depth	103 feet long 39 feet wide 12-foot side water depth
Separate Selector Basin	—	14 feet long 7 feet wide 12-foot side water depth
Aeration		
Type	Brush aerators	Brush aerators
Number	2 (1 active, 1 standby)	2 (1 active, 1 standby)
HP each	40	40
HP total	80	80
PD duty / standby HP	40 / 40	40 / 40
PH duty / standby HP	80 / 0	80 / 0
Reactor 2		
Type		Conventional activated sludge
Volume		
Anoxic selector	—	10,000 gallons
Swing Zone (Anoxic/Aerobic)	—	100,000 gallons
Aerobic Zone	—	200,000 gallons
Total	—	310,000 gallons
Dimensions	—	75 feet long 28 feet wide 20-foot side water depth
Aeration		
Type	—	Blowers and fine bubble diffusers
Number of blowers	—	2 active, 1 standby
HP (each)	—	30
HP (total)	—	90
Capacity cfm (each)	—	500 cfm

Process/Equipment Description	Existing Design	Year 2040
Swing Zone Mixer Power (hp)		4
Recirculation pump Capacity 300% MM flow HP Drive		 2 mgd 5 Variable Frequency Drive
Total Biological Reactors		
Volume	300,000 gallons	620,000 gallons
Detention time (max. month)	16 hours	23 hours
Mixed Liquor Suspended Solids (max month)	3,000 mg/L	3,000 mg/
Mixed Liquor Volatile Solids Concentration (max month)	2550mg/L	2700 mg/L
Mixed Liquor Volatile Solids % of Total (max month)	85%	90%
F/M (max month)	0.094 pounds BOD per pound MLVSS	0.115 pounds BOD per pound MLVSS
Sludge Yield (max month)		0.9 lb / lb BOD applied
Sludge Age (max month)	15 days	11 days
BOD ppd/1000 cf (max month)	15.2 ppd / kcf	19.4 ppd / kcf
Clarifiers		
Number	2	2 existing + 1 new
Diameter	35 feet	2 @ 35 feet + 1 @ 50 feet
Depth	14 feet	14 feet
Area (total)	1,924 square feet	3,887 square feet
Overflow Rate Maximum month Peak Day	 234 gal/day/sq foot 520 gal/day/sq foot	 170 gal/day/sq foot 440 gal/day/sq foot[b]
Solids Loading Rate Maximum month + RAS @ 100% MM Peak Day + RAS @ 100% MM Peak Hour + RAS @ 100% MM	 12 19 25	 8 15[b] 21[b]
Return Activated Sludge Pumping		
Type	Non-clog, centrifugal	Non-clog, centrifugal
Number	3 (2 duty)	3 existing (2 duty) + 2 new (1 duty)
Capacity (each)	350 gpm	400 gpm (new pumps only)
Capacity (total, firm)	700 gpm (1 mgd)	1100 gpm (1.6 mgd)
Drive	Variable frequency drives	Variable frequency drives
RAS Filament Control	Hypochlorite addition	Hypochlorite addition
UV Disinfection		
Reactor Type	Open channel	Open channel
Number	1	2
Peak Flow Capacity (each)	1.5 mgd	2.56 mgd
Light transmittance	65%	65%
Minimum UV dose	—	30 mJ per square cm
Lamp type	Low-pressure, low-output	Low-pressure, high-output

Process/Equipment Description	Existing Design	Year 2040
Effluent Monitoring		
Effluent flow measurement	V-notch weir	Mag meter
Effluent sampler	Time composite, portable sampler, ice cooled	Flow paced composite sampler, refrigerated
Effluent Pumping		
Type	—	Submersible Centrifugal
Number	—	2
Capacity (total, firm)	—	2.56 mgd
Sludge Thickening		
Type	Gravity Decant	Rotary drum screen
Number		1
Capacity		150 gpm
Feed solids mg/l		5,000 mg/l
Thickened solids %		5%
Sludge Pumps		
Thickener feed pumps		
Type		Progressive cavity w/ variable frequency drive
Number		2
Capacity		150 gpm
HP each		10
Thickened sludge pumps		
Type		Progressive cavity w/ variable frequency drive
Number		2
Capacity each		60 gpm
HP each		5 HP
Sludge Holding Tank (Thickener Feed Tank)		
Tank depth	12.5 feet	12.5 feet
Tank Area	320 sf	320 sf
Volume	30,000 gallons	30,000 gallons
Hydraulic Detention time without decant (MM)	2.5 days	0.9 days
Solids concentration	5,000 mg/L	5,000 mg/L
Sludge Digester		
Tank Depth	14.25 feet	14.25 feet
Volume	134,000 gallons	134,000 gallons
Hydraulic Detention Time (without decant)	11 days	41 days
Solids concentration	14,000 mg/L[c]	30,000 mg/L
Volatile solids concentration	83%[c]	84%
Volatile solids destruction	15%[c]	42%
Class B biosolids (>38% VS destruction)	NO	YES

Process/Equipment Description	Existing Design	Year 2040
Sludge Tank Aeration System		
Type	Sock diffusers	Porous diffusers
Aeration blowers		
Number	1 duty + 1 standby	2 duty + 1 standby
Capacity each	440 cfm	660
HP each	20 hp	30 hp
HP total	40 hp	90 hp

Notes: a. Flows and loads from Table 2-10 with 20% pretreatment
b. Year 2040 clarifier hydraulic capacity with two 35' and one 50' diameter clarifiers at design overflow & solids loading rates:
Peak day—3.1 mgd @ 800 gpd/sf and 30 ppd/sf
Peak hour—4.7 mgd @ 1200 gpd/sf and 40 ppd/sf
c. Existing performance

9.2 IMPLEMENTATION SCHEDULE

A summary of the recommended improvements to Stevenson's collection system and wastewater treatment plant and annual capital costs through year 2025 is provided in Table 9-4. Improvements to the wastewater treatment plant as well as the two closely linked pump station projects are expected to be designed in 2018 and 2019; engineering costs have been divided evenly between these two years. Construction of the WWTP and pump station improvements are expected to begin in October 2020 and be complete in November 2021; the costs for construction and engineering services during construction have been allocated by year according to this estimated construction schedule. The remaining Phase 1 collection system improvements have been grouped into a second set of projects for funding purposes; these projects are expected to be designed in 2021 and constructed in 2022.

Phase 2 collection system improvements will be constructed after 2025; their timing will be based on the trigger conditions discussed in Section 9.1.1. Based on current flow and load projections, additional major improvements to the wastewater treatment plant are not expected to be required before 2040.

Table 9-4. Capital Improvements Plan for the Recommended Alternatives

Item	2018	2019	2020	2021	2022	2023	2024	2025
Wastewater Treatment Plant Improvements (Alt 1B)	$600,000	$600,000	$2,443,000	$8,959,000				
Rock Creek Pump Station (PS-01)	$58,000	$58,000	$238,000	$872,000				
Fairgrounds Pump Station – Phase 1 (PS-02)	$5,000	$5,000	$22,000	$79,000				
Cascade Pump Station – Phase 1 (PS-05)				$3,000	$34,000			
Cascade Avenue Sewer – Phase 1 (S-01)				$42,000	$399,000			
Kanaka Pump Station – Phase 1 (PS-04)				$73,000	$697,000			
Cascade Interceptor - Rock Cr PS to MH CI-4 (S-02)				$65,000	$617,000			
Total	$663,000	$663,000	$2,703,000	$10,093,000	$1,747,000	$0	$0	$0

10. FINANCIAL PROGRAM

This chapter describes the City's sewer utility financial history, financial policies, potential capital funding sources and a financing plan for the capital improvements along with the impact on rates and fees.

10.1 FINANCIAL HISTORY

The City owns and operates both a water and a sewer system, and accounts for the combined water/sewer utility in Fund 400, attempting to operate each system in a self-supporting manner. The City prepares an annual budget and reviews rates to ensure the utility can meet its obligations. The sewer portion of the operating expenditures, debt repayment and capital projects were separated from water for this financial analysis. Monthly sewer service charges are the primary source of ongoing revenue. Other miscellaneous revenue includes investment interest, inspection/installation fees, and capital contributions from new connections, known as system development charges (SDCs). The three-year financial history is summarized in Table 10-1.

Table 10-1. Sewer Financial History

Sewer Portion of Water/Sewer Fund 400	2015	2016	2017 Budget
SEWER REVENUE			
Sewer Service Income	$355,173	$377,705	$360,000
Installation Sewer	150	300	50
Interest on Investments (50% of fund total)	2,373	2,689	2,000
Sewer Miscellaneous Income	—	—	50
Sewer Capital Contributions	8,400	14,000	10,000
Total Sewer Revenue	*366,096*	*394,694*	*372,100*
SEWER EXPENDITURES			
Administration, Conservation	26,218	19,845	29,000
Training	1,205	777	2,500
Maintenance	17,853	27,727	25,500
Contracted Processing & Operations	112,930	117,575	124,000
Customer Service & Marketing	47,842	52,473	57,500
Operating - General	51,649	105,959	68,500
Sewer Taxes	8,721	9,256	10,500
Subtotal Operating Expenditures	*266,418*	*333,612*	*317,500*
Debt Service - USDA-RD (principal + interest)	32,670	32,670	32,671
Sewer Capital Projects	91,224	137,380	110,690
Total Sewer Expenditures	*390,312*	*503,662*	*460,861*
Annual Increase (Use) of Reserves	($24,216)	($108,968)	($88,761)

The entry for annual increase (use) of reserves at the bottom of Table 10-1 indicates whether revenue was sufficient to meet expenses each year. If revenue exceeds expenses, then the reserves are increased. If revenue is less than expenditures, then reserves are used to balance the year. This line is negative in each year, as the City has been using some reserves to fund capital improvements and planning that are underway. The use of reserves has been less than the capital projects, so the utility has been self-sustaining when those projects are excluded.

The sewer utility's portion of the 2017 beginning balance was $298,333. This includes $214,050 from system development charges, $51,613 unreserved sewer balance and $32,670 debt reserve for an existing loan for a sewer outfall project. After deducting the debt reserve and the anticipated 2017 use of reserves, there is approximately $177,000 available for future capital investment.

10.2 OUTSTANDING DEBT

The City currently has one outstanding sewer debt issue from the U.S. Department of Agriculture Rural Development program for the recent sewer outfall project. The annual debt payment is $32,670 through 2033. The loan was for $500,000 over 20 years at 2.75-percent interest. There will be a reduction in the final year to reflect the $23,562 that the City returned as unused at project completion.

10.3 CURRENT RATES & CHARGES

The City Council has authority to set rates and charges for the sewer utility to ensure it remains self-sufficient and meets all covenants on outstanding and future debt.

10.3.1 Monthly Sewer Rates

The City bills customers monthly for sewer service. Residential customers (including multi-family and mobile home parks) pay a user charge per dwelling unit. Non-residential customers pay a base user charge plus a volume charge that varies with water usage. Industrial customers pay a negotiated rate when they exceed BOD parameters. A typical single-family customer currently pays a flat rate of $29.95 per month for sewer service. These rates have been in effect since 2010 and are shown in Table 10-2.

Table 10-2. Current Sewer Rates

Customer Class	Monthly	Description
Residential		
Single 3/4" Meter Service	$29.95	flat rate
Multi-family	$29.95	per dwelling unit
Non-Residential		
Transient Quarters	$15.00	per each overnight room/suite + 40% water charges
Other Commercial*		by size of meter + volume:
3/4" Meter	$29.95	+ 40% water charges
1" Meter	$62.25	+ 40% water charges
1-1/2" Meter	$92.75	+ 40% water charges
2" Meter	$140.30	+ 40% water charges
3" Meter	$201.30	+ 40% water charges
4" Meter	$262.30	+ 40% water charges
6" Meter	$433.10	+ 40% water charges

* Up to 400 cubic feet exempt from metered water charge

The volume rate for the commercial sewer customers is based on 40 percent of the water bill, including the water base rate and water usage charges. With this dynamic, the commercial sewer rates were last increased in 2013 when the water rates were adjusted. It is more common for water/sewer utilities to have a separate sewer volume rate. The City may consider separating the sewer volume rate to stand on its own. This would help clarify necessary adjustments for a multi-year rate ordinance.

The City is reviewing rates and system development charges in coordination with this facilities plan to ensure that they adequately cover this plan's CIP, anticipated debt and increased costs of operating the upgraded plant.

10.3.2 Sewer System Development Charge

The sewer system development charge is charged for each new or upgraded connection to the sewer system. These charges are for the right to connect and make use of the system. All connections must obtain a sewer permit and pay the associated inspection fees. The current sewer SDC for a new single-family residence is $2,800. Non-residential customers must convert their anticipated use to ERUs. Common commercial uses are included in a table in Ordinance 993 from 2005. Others need to be determined in order to calculate the appropriate SDC.

10.3.3 Comparison to Other Local Jurisdictions

Table 10-3 compares current sewer rates and connection charges in Stevenson and nearby communities for a single-family residence using 500 cubic feet per month in the winter. Stevenson's monthly rates are lower than those of all the other communities investigated, and its SDCs are in the middle of the identified range.

Table 10-3. Comparison of Single Family Residential Charges

Jurisdiction	Monthly Sewer	Connection Charge
Stevenson	$29.95	$2,800
Bingen	$46.00	$2,000
Goldendale	$31.50	$2,000
North Bonneville	$46.56	$4,500
Washougal	$54.25	$5,620

10.4 AFFORDABILITY AND HARDSHIP

The EPA defines affordable sewer rates as 2 percent of median household income for a community. This also reflects the test applied by Ecology to determine the level of hardship in a community when applying for grants and loans for sewer improvement projects. The level of hardship can influence the financial assistance offered. If the rates are higher than the affordability threshold, the community will be considered in hardship and will receive extra points on its funding application, resulting in potential for a partial grant, lower interest rate, longer repayment term or combination of the three.

The most recent Ecology water quality funding guidelines (FY2018) show a median household income for the City of Stevenson of $43,281, which is 72 percent of the statewide median household income ($60,294). The threshold for hardship at 2 percent of median household income would be residential sewer rates of $72.00 per month. A typical residence in Stevenson currently pays a flat rate of $29.95 per month. This level is considered affordable and is non-hardship. Table 10-4 shows Ecology's hardship designations for the recent program year.

After the CIP funding, additional debt service and increased O&M costs recommended in this plan are included, Stevenson's rate is expected to reach a hardship level.

Table 10-4. Ecology Hardship Continuum for Stevenson's Median Household Income of $43,281

Hardship Designation	Sewer Fee Divided by Median Household Income	Monthly Sewer Fee
Non-hardship	<2%	up to $72
Moderate Hardship	> 2% but <3%	$73 - $108
Elevated Hardship	>3% but <5%	$109 - $180
Severe Hardship	> 5%	$181 +

Based on funding program guidelines for FY2018 with applications due October 2016

10.5 CAPITAL IMPROVEMENT FUNDING

10.5.1 Capital Funding Sources

The City has successfully used a variety of funding sources for capital improvements in the past. These include grants coordinated by the Mid-Columbian Economic Development Council and USDA Rural Development loans for the recent sewer outfall, connection fees, developer extensions, monthly rates, and reserves. Other sources of capital funding available for sewer include state grants and low-interest loans from Ecology's Centennial Clean Water Fund and Clean Water State Revolving Fund. The following sections describe key funding opportunities.

Washington Department of Ecology

The Washington Department of Ecology has an annual competitive cycle for combined water quality funding sources. The application cycle is typically in October of each year. Early planning is recommended, as Ecology requires certain approvals prior to application, including approval of this facilities plan. The loans will be available the following year at low interest. This is the primary state funding program for sewer improvements at this time.

For the WWTP project, a separate application will be necessary for design and preconstruction activities. It appears that the City will be eligible for hardship on the preconstruction program (up to 80 percent of the state's median household income), which could result in up to 50 percent forgivable principal (grant) for the preconstruction activities. Then the plans and specifications will need to be approved by Ecology in order to apply for construction funding. There is a separate category (Step IV) for projects that combine design and construction into one funding application. Step IV projects must be $5 million or less.

The typical Ecology loan is for 20 years. The program is working on the potential for extending to 30 years in some instances. The interest rate is set each program year for standard loans at 60% of a government bond rate. If a community is determined to be in hardship, the loan offer can include principal forgiveness (grant), or lower interest rates.

U.S. Department of Agriculture Rural Development Water and Waste Disposal

The U.S. Department of Agriculture's Rural Development Water and Waste Disposal program is a federal loan program with partial grants in some hardship cases for higher-cost projects, such as the WWTP project. The interest rates vary based on three categories of hardship tied to median household income. The interest rates are adjusted quarterly. Recent rates ranging from 2 to 3.375 percent. Typical loans are for 40 years for a project such as the WWTP upgrade. Applications are open year-round. This program is designed for small communities that cannot borrow with reasonable terms.

Washington Department of Commerce Public Works Trust Fund

The Washington State Department of Commerce Public Works Trust Fund is a competitive low-interest loan program. It has an application cycle in May every other year, with funds available the following year. This program has been on and off hiatus in recent years due to state budget issues. The City can monitor to determine whether the program is open for applications, with the understanding that there is no certainty of funding.

Other Potential Sources

Other potential capital funding sources include the following:

- Appropriation from State Legislature—Requests are typically submitted through the City's legislators and must be sponsored.
- The Washington State Department of Commerce has energy-efficiency grants and the Community Economic Revitalization Board program geared to infrastructure improvements for job creation. The maximum grant is $300,000 for public facilities projects to attract or retain private business, create permanent jobs and promote economic development.
- Community Development Block Grants through the Department of Commerce provide funding for construction of public infrastructure and community facilities based on low to moderate income households in the project area. Recent grants have been up to $750,000.
- The U.S. Department of Commerce Economic Development Administration's Public Works and Economic Development Program supports public infrastructure that is necessary to generate or retain private sector jobs and investments, attract private sector capital and promote regional competitiveness. Typical maximum grants are up to $ 3 million and may be in connection with a required loan.
- Skamania County has an economic development grant/loan program that is funded by the 0.09-percent rural county sales tax.

Online sources of grant information include the Association of Washington Cities, the Municipal Resource Service Center, the funding program matrix of the Infrastructure Assistance Coordinating Council (www.infrafunding.com), and the Public Works Board Website, www.pwb.wa.gov.

10.5.2 Local Funding Sources

Monthly sewer rates can provide an ongoing level of funds for planned capital repairs and improvements. These funds are appropriate for repair and replacement of the sewer system to serve existing customers. System development charges from new connections are also available to fund improvements to the sewer system. The sewer utility is able to borrow from the above-mentioned financial assistance programs, and any loans need to be repaid by sewer rates and connection charges.

The sewer utility is able to sell revenue bonds and/or general obligation bonds to fund planned system improvements. Revenue bonds are repaid by sewer rates and connection fees. General obligation bonds can be repaid by sewer rates and charges or general city tax revenue. The City collects real estate excise taxes that could be assigned to fund a portion of the improvements. Typically, there are other higher priority uses for these funds and they are not available for sewer projects.

The cost of developer-funded projects is not addressed in this financial plan. These projects will be completed as necessary by developers in order to connect their property to the system. When developers complete certain projects that are approved by the City, the infrastructure is deeded over to the City. The developer can negotiate a latecomers/recovery agreement with the City to be reimbursed by new development making use of the facilities constructed by the developer for a specified period of time allowed by state law.

The City has the option to complete area-specific projects and be reimbursed as new development occurs through a special connection charge. The City also has the option to establish a Utility Local Improvement District where the properties specially benefiting from an infrastructure investment would pay their share through an assessment.

In a separate coordinated effort, the City is considering a strength-based rate structure through which higher-strength BOD dischargers would pay higher rates than residential or domestic strength. The current rate structure is based on the volume of flow into the plant, not the strength of the discharge.

10.6 SEWER CAPITAL IMPROVEMENTS

Chapter 9 of this facilities plan identifies $16,222,000 in recommended capital improvements for the sewer system for the first six years (2018 to 2023). These cost estimates are in 2017 dollars for the year of construction and include both collection system and wastewater treatment plant improvements. The 20-year improvements include the extension of sewer into unsewered areas.

10.6.1 Six-Year Capital Improvement Funding

The six-year CIP projects have been reviewed for potential funding sources, such as pay-as-you-go through rates and borrowing from an Ecology or USDA-RD grant/loan. Given the cost of recommended improvements and the level of sewer funds available, the financial plan assumes that the City will need to borrow in two groups:

- The first group will include the design and construction of the WWTP improvements, including the Rock Creek and Fairgrounds Pump Stations, which are connected with the plant. Ecology requires a separate application and loan for preconstruction activities; however, USDA-RD does not separate design and construction.
- The second group will complete the recommended six-year improvements for the collection system when the plant improvements are complete. At less than $5 million, this group would be eligible for a Step IV design and construction loan from Ecology.

The six-year projects are listed by year in Table 10-5 as recommended over the planning period. By grouping projects, the City can save on administrative costs and focus on completing the projects in an efficient manner. Because federal money will be involved in the WWTP loan, federal requirements must be met. Different funding agencies may specify the process in different manners. It may be helpful for the City to request a meeting at which the agencies can help guide City staff through the funding process. This can be done at the Infrastructure Assistance Coordinating Council conference each October in Wenatchee.

Table 10-5. Six-Year Capital Improvements

Six-Year Sewer Capital Improvements	2018	2019	2020	2021	2022	2023
Funding Group 1						
Wastewater Treatment Plant Improvements	600,000	600,000	2,443,000	8,959,000		
Rock Creek Pump Station	58,000	58,000	238,000	872,000		
Fairgrounds Pump Station – Phase 1	5,000	5,000	22,000	79,000		
Funding Group 2						
Cascade Pump Station – Phase 1				3,000	34,000	
Cascade Avenue Sewer – Phase 1				42,000	399,000	
Kanaka Pump Station – Phase 1				73,000	697,000	
Cascade Interceptor - Rock Cr PS to MH CI-4				65,000	617,000	
Total CIP by Year	663,000	663,000	2,703,000	10,093,000	1,747,000	—
Total Six-Year CIP	16,222,000					

The City is placing a high priority on securing grants to make the improvements most affordable to the current ratepayers. Grants and legislative appropriations will help provide funding to complete the project and do not have to be repaid. However, grants and appropriations are typically uncertain in timing, availability and amount. Table 10-6 shows the funding sources without any grants.

Table 10-6. Six-Year CIP Funding Sources - Without Grants

CIP Funding Source	2018	2019	2020	2021	2022	2023
Ecology Loan 1 - WWTP, Influent Pump Stations	663,000	663,000	2,7003,000	9,910,000		
Ecology Loan 2- Pump Stations, Cascade Avenue	-	-	-	183,000	1,747,000	
Total CIP Funding Sources	663,000	663,000	2,703,000	10,093,000	1,747,000	—

New annual debt payments were estimated without grants and with $5 million in grants, as shown in Table 10-7. The annual debt service in 2023 is estimated to be $1,040,000 to complete the six-year CIP as planned if no grants are available. With a $5 million grant, the new debt service would be reduced to $720,000—an annual savings of $320,000. These estimated debt payments assumed 20-year loans at 2.5-percent interest. The timing and amount of debt payments will depend on the actual financing package. While that is not known at this time, it is important for the City to plan to ramp rates up over the years to make it easier for ratepayers.

Table 10-7. Estimated New Annual Debt Payments – With and Without Grants

New CIP Estimated Debt Payments	2018	2019	2020	2021	2022	2023
Ecology Loan 1					894,100	894,100
Ecology Loan 2						123,800
Est. New Debt Payments - Without Grants					*894,100*	*1,017,900*
Est. New Debt Payments - With $5 Million Grants					*573,400*	*697,200*

Debt payments assume 20-year loan at 2.5% interest

10.7 SIX-YEAR FINANCIAL PLAN

With many uncertainties at this time, the six-year financial plan presented here is a conservative plan to show how the City can fund the recommended improvements and changes in O&M costs and be able to afford the new debt service. This plan can be updated and refined as key elements become better known. By being conservative in this plan, the intention is that the CIP can be funded and the projects completed within the planning period.

The base year in the financial plan is the adopted 2017 budget. The following key assumptions were used in making the six-year projections:

- Growth in new homes/ERUs per year = 25
- Cost escalation, general = 3.0 percent
- 2017 SDC for new connections per ERU = $2,800
- Assumed 2018 SDC per ERU = $5,600
- 2017 single family monthly rate = $29.95.

The number of new homes or ERUs used in this financial outlook is lower than the engineering design flow and loads earlier in the plan. This is conservative from a financial perspective because it allows balancing the budget with a lower level of growth.

The current SDC for new connections of $2,800 has been in effect since 2005. The City is reviewing the charge at this time. This outlook assumes a higher number of $5,600 beginning in 2018 through 2023. The 2017 single-family monthly rate is $29.95 per dwelling unit.

10.7.1 Six-Year Rate Outlook

The two scenarios—without grants and with $5 million in grants—are shown to provide a range of impact on the monthly residential sewer rate:

- **Scenario F-1, $0 grant**—Adds a new high-strength rate, no grants, and Ecology loans for the entire CIP. Rates would need to increase $13.50 per month each year through 2023. Savings could be used to reduce the amount borrowed for the collection system improvements after the WWTP financing details are known.
- **Scenario F-2, $5 million grant**—Adds a new high-strength rate, $5 million in grants for the WWTP, and Ecology loans for entire CIP. Rates would need to increase $10 per month each year through 2023. Savings could be used to reduce the amount borrowed for the collection system improvements after the WWTP financing details are known.

The six-year sewer rate outlook is summarized in Table 10-8. It is estimated that the monthly rate would need to be between $90 and $111 per month in 2023, depending on the scenario. These rates would be designated as moderate or elevated hardship on Ecology's continuum and would qualify for grant assistance up to $5 million and a lower interest rate. The City has the option to select a repayment period to 25 years at a slightly higher rate of interest.

Table 10-8. Six-Year Rate Outlook

	Monthly Residential Sewer Rate						
	Existing	2018	2019	2020	2021	2022	2023
Scenario F-1, $0 grant	$29.95	$43.45	$56.95	$70.45	$83.95	$97.45	$110.95
Scenario F-2, $5 million grant	$29.95	$39.95	$49.95	$59.95	$69.95	$79.95	$89.95

The detailed six-year outlook for the sewer fund is shown in Table 10-9. Scenario F-2 is shown with $5 million grant funding toward the WWTP. The City will be working hard to attract maximum grants from a variety of programs, including a legislative appropriation and working with the Mid-Columbia Economic Development Council to assist.

10.7.2 Sewer Revenue

The sewer service charges for 2017 were adjusted upward from the budget to reflect the actual 2016 sewer service income of $377,000. New customers are added each year as paying service charges and the SDC for new connections. Additional new connections will positively impact the sewer bottom line and be available to fund additional projects now or in the future.

The financial plan assumes that the City will implement a strength-based volume rate for sewer where higher-BOD dischargers will pay more than those who generate residential or domestic strength wastewater. The City is working with the high-strength dischargers, and the Council is expected to consider a high-strength volume rate. Therefore, a conservative low revenue estimate has been included, in which the rates would be implemented and stepped up over several years. Scenario F-2 shows $46,000 in 2018, growing to $131,000 in 2021 from the high-strength surcharge. The monthly residential sewer rates for Scenario F-2 would need to grow from $29.95 in 2017 to an estimated $89.95 in 2023.

Table 10-9. Six-Year Sewer Financial Plan (Scenario F-2)

	Est. 2017	2018	2019	2020	2021	2022	2023
Assumptions							
New Homes / ERUs	3.6	25	25	25	25	25	12
General Cost Escalation		3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Installation/Inspection Fee	50	50	50	50	50	50	50
System Development Charge per ERU	$2,800	$5,600	$5,600	$5,600	$5,600	$5,600	$5,600
Monthly Residential Sewer	$29.95	$39.95	$49.95	$59.95	$69.95	$79.95	$89.95
Assumed increase in residential rates/month		$10.00	$10.00	$10.00	$10.00	$10.00	$10.00
SEWER REVENUE							
Sewer Service Income	377,000	515,000	659,000	809,000	965,000	1,127,000	1,281,000
New High Strength Surcharge		46,000	75,000	104,000	131,000	134,900	138,900
Installation Sewer	50	1,250	1,250	1,250	1,250	1,250	600
Interest on Investments	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Sewer Miscellaneous Income	50	50	50	50	50	50	50
Sewer Capital Contributions (SDC)	10,000	140,000	140,000	140,000	140,000	140,000	67,200
Subtotal Sewer Operating Revenue	*379,100*	*564,300*	*737,300*	*916,300*	*1,099,300*	*1,265,200*	*1,422,550*
Subtotal Sewer Capital Contributions	*10,000*	*140,000*	*140,000*	*140,000*	*140,000*	*140,000*	*67,200*
Total Sewer Revenue (Operations + Capital)	*389,100*	*704,300*	*877,300*	*1,056,300*	*1,239,300*	*1,405,200*	*1,489,750*
SEWER EXPENDITURES							
Administration & Training	31,500	32,400	33,400	34,400	35,400	36,500	37,600
O&M - T&D Collection, City	54,000	55,600	57,300	59,000			
NEW: Build Up Collection O&M					112,700	116,100	119,600
O&M - WWTP Plant, City	164,000	168,900	174,000	179,200	—	—	—
NEW: Build Up WWTP O&M					303,700	482,200	441,000
General Operations, Testing, Phone, Insurance	9,000	9,300	9,600	9,900	10,200	10,500	10,800
Customer Service & Marketing	57,500	59,200	61,000	62,800	64,700	66,600	68,600
Sewer Taxes	10,500	17,700	25,200	33,400	42,200	50,700	58,000
Subtotal Operating Expenditures	*326,500*	*343,100*	*360,500*	*378,700*	*568,900*	*708,600*	*735,600*
Existing Debt - USDA-RD (principal + interest)	32,671	32,671	32,671	32,671	32,671	32,671	32,671
New Debt for CIP	—	—	—	—	—	573,400	697,200
Subtotal Debt Expenditures	*32,671*	*32,671*	*32,671*	*32,671*	*32,671*	*606,071*	*729,871*
Sewer Capital Projects	110,690	663,000	663,000	2,703,000	10,093,000	1,747,000	—
Ecology Loan Proceeds for CIP		(663,000)	(663,000)	(2,703,000)	(10,093,000)	(1,747,000)	—
Subtotal Rate-Funded Capital	*110,690*	—	—	—	—	—	—
Total Sewer Expenditures	*469,861*	*375,771*	*393,171*	*411,371*	*601,571*	*1,314,671*	*1,465,471*
Planned use of reserves	*81,000*	—	—	—	—	—	—
Annual Increase (Use) of Reserves	239	328,529	484,129	644,929	637,729	90,529	24,279
Sewer Fund Balance	2017	2018	2019	2020	2021	2022	2023
Sewer Beginning Fund Balance - actual 2017	265,000	184,239	512,768	996,897	1,641,826	2,279,555	2,370,084
Planned use of reserves	(81,000)	—	—	—	—	—	—
Annual Increase (Use) of Reserves	239	328,529	484,129	644,929	637,729	90,529	24,279
Estimated Sewer Ending Balance	*184,239*	*512,768*	*996,897*	*1,641,826*	*2,279,555*	*2,370,084*	*2,394,363*
Target Minimum Balance for Emergency					*700,000*	*700,000*	*700,000*
Ecology Required Debt Reserve on Loans						*573,400*	*697,200*
Available for CIP/Debt Payments					1,579,555	1,096,684	997,163

10.7.3 Sewer Expenditures

The operating expenses are generally projected to increase by cost escalation at 3 percent per year, except that the higher O&M costs estimated in this plan have been included in 2021. The 2021 O&M cost for the collection system is estimated at $112,700. The estimated O&M at the upgraded treatment plant in its first full year of operation is $428,000. The financial plan assumes that the City will step up operations at the plant from 2020 ($179, 000) to 2021 ($304,000) to 2022 ($428,000).

The outlook's bottom line is indicated by what happens to the annual increase (use) of reserves. By stepping the rates up each year so that the future debt payments can be afforded, excess revenue will be generated. This money will be held in reserve and be available to meet the Ecology required debt reserve on anticipated loans; the remainder will be available for future capital sewer projects. As the WWTP project gets well underway, the City will have a sense of what is the best use for the funds. It is recommended that the funds be used to reduce or avoid future loans. In this way, the City will have a better idea of the WWTP project cost and financing package and be able to update the financial plan and rate outlook for the best advantage of the ratepayers.

10.7.4 Sewer Reserves

The target minimum reserve in this financial plan is $700,000, which includes two-months of operating expense for cash flow plus $500,000 emergency reserve. The new debt for the CIP will likely require a debt reserve equivalent to one year's debt payment and has been included in this scenario: $573,000 for 2022 and $697,000 for 2023. These amounts are set aside within the fund balance. The remainder is available for future CIP and/or debt payments. The 2023 ending sewer balance is estimated to be $2.4 million, including $1.4 million in cash flow, emergency and debt reserves, with $1 million available for future sewer investment. The outlook shows approximately $1 million available compared to the cost for the second group of improvements of approximately $2 million.

10.8 FINANCIAL CONCLUSION

The City is under orders from the Department of Ecology to plan for a major upgrade to the WWTP. This is an expensive undertaking and is planned for design in 2018-2019, construction in 2020-2021 and the first full year of operation in 2022. The City does not have the funds available to invest in such a project and will need to secure grants and loans to be able to pay for the project. This is expected to have a significant impact on the monthly rates of all customers to meet the increased O&M costs and the debt service related to the loans. The City is currently seeking grants, reviewing rates, considering adding a high-strength volume rate to have higher strength dischargers pay their share, and reviewing system development charges to make sure new connections also pay their fair share. The City is committed to completing the project and meeting its debt obligations in a fair and equitable manner.

The excess revenue that is generated by stepping rates up will be saved in reserve to reduce or avoid future loans, such as the second loan for collection system improvements. The City will continue to review the financial outlook periodically to make sure that obligations can be met and to avoid drastic impacts on ratepayers.

These projections are based on current known information and reasonable assumptions, and may or may not reflect actual conditions. Results should be monitored each year during the budget process. An increase in new connections above the 25 assumed will improve the City's sewer financial outlook.

Appendix F

2017 WSP

Section 1

Water System Plan Overview

1.1 Introduction

Regulations promulgated by the Washington Department of Health (DOH) under Chapter 246-290 of the Washington Administrative Code (WAC) currently require submittal of a Water System Plan (WSP) every 10 years for each Group A Public Water System that meets the conditions outlined in WAC 246-290-100. Although the City of Stevenson (City) does not qualify as requiring a plan update, they have opted to do so to be eligible for public funding opportunities. The previous water system planning effort was completed in September 2007. This WSP updates the 2007 Stevenson WSP and addresses current DOH planning requirements.

The WSP update is an opportunity for the City to:

- Document the City's managerial, technical, and financial operations
- Identify the current condition of the City's water supply facilities
- Demonstrate compliance with relevant local, state, and federal regulations
- Identify present and future needs of the City's water system
- Set forth the financial plan addressing the operating and capital needs of the utility

1.2 Water System Plan Organization

This WSP summarizes the City's policies, presents a technical analysis of the water system, documents the City's Water Use Efficiency, Source Water Protection, Financial Program, and delineates costs and schedules for needed improvements. The WSP also summarizes the City's organizational structure, operation and maintenance practices, water quality sampling schedules, emergency operating procedures, Cross-Connection Control Program, reporting and record keeping requirements, and design and construction standards.

This document has been prepared to conform with DOH requirements for a comprehensive water system plan as specified in WAC 246-290-100. The WSP is intended to function as a resource management and capital improvement tool to assist the City in future decision making. The DOH WSP Content Checklist, which shows the location of required sections, is presented in Appendix A.

1.3 Plan Preparation

This WSP has been prepared in accordance with an agreement between the City and Murraysmith. All components of the WSP were prepared as a joint effort by Murraysmith and City staff.

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Section 2

Water System Description

2.1 Water System Owner and Manager

City of Stevenson
7121 East Loop Road
P.O. Box 371
Stevenson, Washington 98648
(509) 427-5970
(509) 427-8202 (FAX)
DOH Water System ID #842502

The City of Stevenson currently owns and operates the City's public water system. The system is classified as a Group A Community and is under municipal management of the City Public Works Department. The City's Water System Manager is responsible for day-to-day operations of the system, under the direction of the Public Works Director. The Water Manager, Public Works Director, and City Administrator oversee: 1) system operations, 2) design and development projects, 3) monitor budgets, and 4) serve as advisors to the Stevenson City Council, who set the general policy for the Water Utility. The mission of the Water Utility is to provide quality service ensuring that each customer will have reliable water of excellent quality, at the quantity needed, and at the most affordable price possible.

It is the goal of the City with the WSP Update to provide a blueprint for improving the operation and the infrastructure of the water system. Critical issues that are addressed include:

- Ensuring adequate funding is generated to address replacement of aging infrastructure as well as accommodate new growth while minimizing rate impacts.
- Encouraging conservation in the use of all water.
- Addressing growth in a managed manner.
- Improving operation and maintenance of the entire system to maintain quality and increase operational efficiency.

2.2 Water System Description and History

As shown in **Figure 2-1**, the City of Stevenson is in southwest Washington, approximately 41 miles east of Vancouver. The City is a small rural center incorporated as a non-charter code city under the Washington State Codes. The City operates the Stevenson Water System which provides water service within the City and to a small number of customers outside City limits. Due to its historically slow population growth, the City is not subject to the full planning requirements of the Growth Management Act.

Water system development within the City dates to 1904 with the founding of the Stevenson Water and Improvement Company (SWIC) which constructed water lines to serve a collection of ten families. Following incorporation of the Town of Stevenson in 1907, the SWIC operated under franchise, completing numerous water system improvements and extensions over the next 22 years. It was not until 1929 that the residents voted to establish a public water system and purchase the facilities owned by the SWIC. The City has operated the water system since 1929 and made the decision to no longer serve new customers living outside City limits in 1981. Most of the annexations (366.84 acres in the past 30 years) have been driven by the need of surrounding neighborhoods for access to public water. Over the past 25 years, net population gain has been 383 persons.

The City's growth boundary was federally set under the Columbia River Gorge Scenic Area Act. The only open area for growth is to the north because the City is bounded on the south by the Columbia River and to the east and west by Scenic Area boundaries. Topography to the north is steep and in certain areas subject to unstable ground conditions. These factors limit both the density and types of growth that can occur.

2.3 Description of Existing Facilities

This section describes the major facilities that make up the Stevenson Water System. A copy of the system Water Facilities Inventory (WFI) is included in **Appendix C**. The water system is shown in **Figure 2-2, Existing Water System**.

2.3.1 Source and Treatment

The City currently draws its water supply from LaBong Creek, Cedar Springs, and Rock Creek. Iman Springs, listed as a supplemental surface water source, is currently off line and not used by the City. Surface water is treated by the City's 1.0 MGD Water Treatment Plant (WTP). Constructed in 1979, the WTP was part of a significant water system improvement project that included storage and distribution system construction.

The City completed purchase of Hegewald Well in July 2017. The well has an assumed production capacity of 650 gpm[1]. The well is utilized by the City as a backup supply but lacks the correct treatment facilities to be used on a continuous basis.

[1] The well log states a test capacity of 850 gpm but the pump capacity is 650 gpm.

2.3.2 Water Transmission and Distribution

The City's water distribution system is in good condition. Water mains range in size from four-inch to 12-inch diameter. Steel and ductile iron are the principal pipe materials, although limited quantities of PVC and asbestos cement pipe remain. **Table 2-1** lists the City's transmission and distribution system by pipe material, size, and length. The City has been proactively replacing these older mains. For new construction, the City design standards require ductile iron pipe.

Water system improvements completed in 1979 helped eliminate undersized mains and dead-end lines. Approximately three miles of undersized mains have been replaced in the past five years.

Table 2-1
Transmission and Distribution System

Material	Diameter (In.)	Length (Ft.)
Asbestos-cement	4	11,551
Asbestos-cement	6	15,413
Asbestos-cement	8	12,512
Asbestos-cement	10	606
Ductile Iron	2	313
Ductile Iron	4	274
Ductile Iron	6	16,865
Ductile Iron	8	29,142
Ductile Iron	10	4,661
Ductile Iron	12	21,509
High-Density Polyethylene	14	1,413
Polyvinyl Chloride	1	2,791
Polyvinyl Chloride	2	4,475
Polyvinyl Chloride	4	2,402
Polyvinyl Chloride	6	4,498
Polyvinyl Chloride	8	4,758
Steel	2	3,549

2.3.3 Water Storage and Booster Pump Stations

The City is served by three reservoirs storing 0.96 million gallons (MG) of finished water. These facilities serve three primary pressure zones. These zones are further divided into sub-zones by pressure reducing valves.

- Pressure Zone (PZ) 1 is the lowest elevation pressure zone with a hydraulic grade line (HGL) of 296 feet above mean sea level (MSL)[2]. It serves the downtown and commercial area along State Route (SR) 14. Storage is provided by the 380,000-gallon Catholic Church Reservoir. Catholic Church Reservoir is filled by gravity through a six-inch altitude valve from Pressure Zone 2. The altitude valve is operated based on the water level in the reservoir.

- PZ 2 is the middle elevation pressure zone with an HGL of 456 feet MSL. Storage is provided by the 485,000-gallon Base Reservoir, a partially buried concrete reservoir filled directly from the WTP or Hegewald Well.

- PZ 3 is currently the highest elevation pressure zone with an HGL of 585 feet MSL. Storage is provided by the 100,000-gallon concrete High Zone Reservoir. A booster pump station located at the Base Reservoir supplies the High Zone Reservoir with three (3) 450 gpm pumps. The booster pump station was constructed in 2007.

[2] Elevations based on the North American Vertical Datum 1988 (NAVD88)

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2.4 Related Planning Documents

City of Stevenson Comprehensive Plan **–** In 1990, the State of Washington enacted the Growth Management Act (GMA) establishing general rules for smaller cities for the protection of Critical Areas. The City of Stevenson is not subject to the more comprehensive GMA community planning rules required of larger communities within the State. However, with its limited fiscal and staff resources, the City Planning Department uses the GMA regulations as guidelines including the goal of ensuring the City's Capital Facility Plan conforms to the Comprehensive Plan. Originally prepared in 1984 by the City Planning Commission, this document was most recently updated in 2013. The latest revision of the City zoning ordinance is addressed in this plan.

Carson Water System Plan **-** A water plan was completed for this adjacent water utility in 2013. The two plans are compatible.

Management Plan for the Columbia River Gorge National Scenic Area **-** The adoption of this management plan in 1991 included the implementation of Urban Growth Boundaries and growth policies for cities within the National Scenic area, including Stevenson. This plan is in conformance with these provisions and all established boundaries.

Western WRIA 29 Watershed Management Plan **-** This report was adopted in December 2005 for the western area of Water Resource Inventory Area (WRIA) 29. This watershed planning effort provides an inventory of water resources in the area and examines water quality, quantity, fish habitat, and in-stream flows. The City of Stevenson was a member of the planning group and adopted a Detailed Implementation Plan in 2015.

2.4.1 Regional Supplement of Coordinated Water System Plan

Skamania County is not a critical water supply service area and has not completed any coordinated water system planning efforts.

2.4.2 County Response on Compatibility with Land Use Plans and Growth Policies

The Stevenson Water System Plan has been submitted to Skamania County for their review. The plan is compatible with the City's current and proposed land use planning. See the Local Government Consistency section below.

2.4.3 Previous Water System Plans

This Water System Plan supersedes the previous water system studies completed in 1959, 1975, 2000, and 2007. The 1975 study focused primarily on the need for a water treatment plant, distribution, and storage facility improvements. Those concerns were largely addressed through a substantial water system improvements project completed in 1979.

2.5 Land Use

The City is bordered by the Gifford Pinchot National Forest to the north, the Columbia River to the south, and is wholly within the Columbia River Gorge National Scenic Area. Created in 1986, the Federal Columbia Gorge National Scenic Area (Scenic Area Act) established urban growth boundaries for the City of Stevenson. Under the Scenic Area Act, utility extensions to serve land parcels lying outside urban centers are prohibited.

The City's Zoning Ordinance and Comprehensive Plan control land use and this study's land use area reflects the federally created boundaries. **Table 2-2** summarizes the City's zoning classifications and associated areas. **Figure 2-3** identifies the current City limits, Retail Service Area, Service Area, zoning areas, and Urban Growth Boundary.

Table 2-2
Zoning Classification Summary

Zone	Min lot (sq ft)	Total Acres	Permitted Uses
Commercial (C1)	Varies	71.73	Retail, office, restaurant, manufacturing, transient lodging
Light Industrial (M1)	Varies	10.28	Manufacturing, warehouses, wholesale, docks
Public Use & Recreation (PR)	10,000	35.46	Public offices, fair buildings, public works, recreational facilities
Education (ED)	43,560	33.96	Schools, school facilities, recreational facilities
Single Family Residential (R1)	6,000	206.18	Single family residential (SFR)
Two Family Residential (R2)	7,500	25.3	Duplexes and SFR
Multi-family Residential (R3)	7,500	61.93	Multi-family and SFR
Suburban Residential (SR)	15,000	247.7	SFR, horticultural activities
Commercial Recreation (CR)	10,000	270.96	Lodging, recreational facilities, theaters, restaurants
CR/SR	-	152.58	Single lot with mixed CR/SR in CR use

2.5.1 Future Land Use Considerations

The City of Stevenson and Skamania County are not required to complete full GMA planning efforts as previously discussed. Local planning efforts are guided by the City of Stevenson's 2013 Comprehensive Plan. The City Planning Commission is composed of citizens, a planning advisor and the City Council. Future growth areas addressed by this plan were outlined by staff following discussions with local business leaders and realtors to help identify those areas most likely to experience growth in the future. The Comprehensive Plan incorporates the communities four Cornerstone Principles: Active Waterfront, Healthy Economy, High Quality of Life, and Natural / Scenic Beauty. These principles and the specific objectives and tactics listed in the plan help guide City actions as it accommodates the growth expected.

The UGA covers approximately 3,120 acres, of which approximately 970 acres are presently within the City Limits. City planning efforts are impacted by the Scenic Area Act by the fact that the legislation has set the City's UGA and has directed new commercial/industrial development to urban growth areas. The City provides for future commercial and industrial development through its Comprehensive Plan.

The City's Water Utility works with the Planning Department to ensure compatibility with local land uses and future land use plans. Both the Comprehensive Plan and Zoning Plan relied on the City's 2007 Water Plan as a basis for developing their regulations and mapping. With the implementation of the Critical Areas regulations, the City has modified density estimates to address areas removed due to unstable slopes and wetlands. Appropriate agencies were notified of the City's proposal to update its Water Plan to prevent inconsistencies between the various plans.

2.6 Service Area

The City's Service Area is coincident with the Urban Growth Boundary. All existing City services lie within this urban boundary and, under the Scenic Area Act, there cannot be extensions of services outside this urban boundary. The City's Retail Service Area corresponds to the incorporated City Limits with 683 active water service connections; 58 of which are grandfathered services outside current City Limits. The system is currently approved for 842 connections.

2.6.1 Areas to be Served in the Future

The existing water system infrastructure will be upgraded to address infill and be extended to serve future development within the Retail Service Area. This plan focuses on the area within the city limits shown in **Figure 2-3**.

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2.7 Water System Policies

The following summarizes current City water system policies:

- *Wholesale and Wheeling of Water* - The City would consider a request for wholesale water but does not currently have any wholesale water customers or connections to other systems.

- *Annexation* - The City presently requires annexation as a condition of service. The City could consider agreements that would lead to future annexations instead of requiring annexation prior to service.

- *Direct Connection or Remote System* - The City requires direct service from its main system. At present, the City has no plans to own, operate, or manage remote systems.

- *Design and Performance Standards* - The City has prepared a comprehensive set of engineering and construction standards for public works construction. All new water system improvements must meet these criteria. A copy of the water standards is included in Appendix G.

- *Surcharge for Outside Customers* - Connections outside the City limits pay a 32 percent surcharge on monthly base service rates and 15 percent surcharge on excess water charges.

- *LID Formation Outside City* - The City would only assist with formation of an LID outside the City limits but within its service area if annexation or annexation agreements were a condition of additional or new services.

- *Late-Comer Agreements* - The City would allow the creation of late-comer agreements to facilitate efficient construction of water system facilities.

- *Oversizing Policy* - The City will provide financial assistance for over-sizing of water facilities when the needs of the system exceed the development's requirements.

- *Cross-Connection Control Policy* - The City has implemented a comprehensive cross-connection control program. When cross-connections are identified, the City will provide limited assistance to correct the problem but will ultimately terminate service if uncorrected.

- *System Extension* - All developer extensions to the City's water system must meet its adopted engineering standards. Where desirable to satisfy long-term system needs, the City will pay for oversizing in accordance with their policy on oversizing.

- *Financial Standards* - The City of Stevenson reports as a Category 1 municipality under Washington State Accounting Standards, reporting on the Cash basis of accounting as authorized by the *Cash Basis Budgeting, Accounting and Reporting System (BARS)* manual issued by the State Auditor's Office.

2.8 Conditions of Service

The following conditions of service cover the responsibilities of the City and the prospective customer:

- *Purveyor Responsibilities* - The City is responsible for providing water that meets quality and quantity standards of the State of Washington and the City's design standards. The City will attempt to minimize service interruptions during maintenance, repair, and construction activities.

- *Customer Responsibilities* - The customer is responsible for payment of all charges incurred from their water service and to respond to the City's requests for water conservation during emergencies.

- *Connection Fees* - The current water system development charge is $3,000/connection; in addition, the customer pays for the actual cost of installation.

- *Meter and Materials Requirements* - The City will provide and install all meters up to 2-inch in size. Larger meters and water system materials must meet the engineering and construction standards. Larger meters are paid for by the customer.

- *Consent* - The customer must consent to access by the City for inspection, maintenance, and repair of water facilities. All new facilities must be located within either the public right-of-way or within a dedicated utility easement.

- *Cross-Connection* - The customer is responsible for selection and installation of cross-connection control devices that meet the City's standards. The customer is also responsible for annual testing where appropriate.

- *Late-Comers* - Where a new connection will be served by connection to facilities covered by a late-comer agreement, the City will not permit service until the appropriate fee has been paid and clearly documented.

- *Service Connection Responsibility* - Service taps on new mains will be completed by the developer's contractor following notification of the City. The City then supervises the service tap. All service taps on existing mains will be made by the City.

- *Developer Extension Requirements* - All developer extensions must meet the City's engineering and construction standards including design by a professional engineer. Financing of extensions is the developer's responsibility with the possible addition of utility oversizing by the City.

- *Design Standards Compliance* - Exceptions to the design standards will be considered by the City in extreme situations and when a reasonable alternative is suggested.

The City has prepared materials outlining the standards for construction of new system upgrades and service area policies/conditions of service for distribution to prospective developers and customers. City personnel have prepared forms for reviewing requests and acceptance of developer extensions.

2.9 Duty to Serve

The Retail Service Area identifies all areas where the City currently provides water service. The City has a "Duty to Serve" in its Retail Service Area that requires the City to provide water service to new connection requests that meet four threshold tests:

1. The District has sufficient capacity to serve the request in a safe and reliable manner,
2. The service request is consistent with adopted local plans and development regulations,
3. The District has sufficient water rights to provide service, and
4. Service can be provided in a timely and reasonable manner. Water system service policies are described in Section 2.7 above.

2.10 Local Government Consistency

The Stevenson Water System Plan has been submitted to Skamania County for their review. A copy of the Local Government Consistency statement is provided in **Appendix D**.

2.11 Watershed Management

The LaBong Creek watershed is composed of property owned primarily by the City. The watershed is managed for the protection of the City water supply to maintain high quality raw water. A forester is retained by the City to provide direction with periodic logging and cleanup to assure forest health, as well as provide additional revenue to the City.

The Rock Creek watershed is composed of property primarily managed by the Washington Department of Natural Resources. Activities within the watershed are governed by standard forest practice rules and regulations. Stream headwaters are located in the Gifford Pinchot National Forest which has experienced limited logging for quite some time.

Iman Springs is located on City owned property adjacent to BPA transmission line right-of-way.

A Watershed Management Plan has been completed by the City for LaBong Creek and Rock Creek in conjunction with water system planning and is included in Appendix B.

2.12 Well Head Protection

Hegewald Well is located on a parcel measuring 200 feet square. It is isolated from surrounding development and adequately protected from contamination despite not having a sanitary control area established or recorded. The City completed a Ground Water Susceptibility Survey (Appendix C) to provide the basis of obtaining reduced frequency testing waivers for the Hegewald Well source. The City will move forward with a Wellhead Protection Plan and chemical addition improvements for pH adjustment now that a purchase agreement has been reached with the County.

2.13 Satellite System Management

The City does not participate in any satellite management service agreements due to personnel limitations.

2.14 System Interties

Currently, the City's water system is not connected with any other water supply system. Neighboring water purveyors include the community of Carson and City of North Bonneville. The potential for future interties between these systems is limited by the rural nature of the area, distance between rural centers, difficulty of terrain, and utility service provisions incorporated into the Scenic Area Act.

According to the Source Water Assessment Program (SWAP) Map, the City of Stevenson has one Group A and five Group B systems within the City's Service Area that have more than two connections. However, the Jermann Short Plat, is the only one shown within the limits of the City's Retail Service Area. The City of Stevenson contacted the responsible party for the Jermann Short plat water system and confirmed this system is approximately 2,000 feet from the City's nearest water main, situating it outside of the City's Retail Service Area. There is however, one group B system that is not listed on the SWAP Map that is within the City's Retail Service Area. This system is located at 6291 Loop Rd, serves five connections and is not connected to the City water system. Table 2-3 lists neighboring water systems that have more than two connections.

Table 2-3
Neighboring Water Systems

Water System	Water System Type	Number of Connections
Maple Hill Water Services	Group A	21
Bruning Short Plat	Group B	4
Bridge View Heights	Group B	4
Maple Way	Group B	4
6291 Loop Road	Group B	5
Vista Springs	Group B	6

2.15 Wholesale Customers

There are no wholesale customers at present nor is there anticipated to be any in the next 20 years.

Section 3

Evaluation Methodology

3.1 General

This section describes the common analysis methodology used to evaluate the following components of the City of Stevenson water system:

- Demand Forecast
- Source Adequacy
- Water Rights Adequacy
- Treatment Adequacy
- Storage Adequacy
- Transmission / Distribution System Adequacy
- Water Quality Adequacy
- Evaluation of System Improvements

The system analyses, which is documented in Section 4, follows the methodology described in this section except as otherwise noted.

3.2 Demand Forecast

3.2.1 Water Demands

For planning purposes, the demand of each customer class can be expressed in terms of Equivalent Residential Units (ERUs). One (1) ERU is equivalent to the average annual amount of water used by a single-family residence. The number of ERUs represented by the demand of the other customer groups (i.e. commercial) is determined from the total demand of the customer group and the demand per ERU calculated from the single family residential demand data. This section describes the methodology used to develop ERU and water demand forecasts for the City. The number of ERUs, average day demand (ADD), and maximum day demand (MDD) were calculated as discussed below.

The City provided the number of residential connections, the number of multi-family connections, the number of commercial connections, and the amount of water sold by type of connection from 2010 through 2015. The water demand per Residential ERU, expressed in gallons per day (gpd), was calculated by dividing the volume of water sold (V) to residential customers by the total number of residential connections (N) as follows:

$$Demand_{avg.residential}(\frac{gpd}{ERU}) = \frac{V_{residential\ sold}\ (gallons/year)}{N_{residential} * 365\ days/year}$$

The volume of water sold to other customer groups in each year was divided by the water demand per Residential ERU for that same year to determine the number of ERUs for the customer group by year. For example, the formula to calculate commercial ERUs is as follows:

$$Commercial\ ERUs = \frac{V_{commercial\ sold}\ (gallons/year)}{Demand\ _{avg.residential}\left(\frac{gpd}{ERU}\right) * 365\ days/year}$$

The total number of ERUs for the years 2010 through 2015 was then calculated by summing the number of residential ERUs and other customer group ERUs.

As outlined above, metered consumption data is used to calculate historic ERUs. For projecting future water demands, metered source production rather than consumption is utilized in the calculation of ADD and MDD demand values. This provides an allowance for distribution system leakage and unmetered uses including system flushing and construction use. The average of the six years ADD was used for demand projections. ADD for the years 2010 through 2015 was calculated as follows:

$$ADD_n(gpd) = \frac{Total\ Production\ (\frac{gal}{year})}{(Total\ ERUs * 365\frac{days}{year})}, n = year$$

MDD for the years 2010 through 2015 was provided by the City in units of thousands of gallons per day. The average of the six years MDD was used for demand projections. MDD was calculated as follows:

$$MDD_n(gpd) = \frac{Max.V_{produced}\ (gal)}{Total\ ERUs}, n = year$$

3.2.2 ERU Projections

The 2007 WSP allocated ERUs to the three pressure zones, divided into the various customer groups. For the current plan, ERU’s were classified into Residential and Non-Residential categories with Non-Residential further divided into Beverage and Non-Beverage groups. The purpose of specifically identifying Beverage groups was to account for the recent growth of the beverage industry connected to the Stevenson Water System. These classifications form the basis of future growth projections beginning in 2015.

Recent residential development projects and anticipated beverage industry growth, in ERUs, were allocated to respective pressure zones to account for known growth. The number of ERUs by classification within each pressure zone was projected over the 20-year planning period based on an average annual (compound) growth rate determined through coordination with the City.

Individual rates were used for Residential, Beverage, and Non-Beverage groups to reflect the degree of growth anticipated. Projected ERUs were calculated as follows:

$$ERU_{future} = ERU_{present} * \left(1 + i_{growth\ rate}\ (\%)\right)^{(n)}, n = years$$

The year 2016, 2026 and 2036 ADD and MDD were calculated by multiplying the total number of projected ERUs for the given year by the design water demand for an ERU as follows:

$$ADD_n(gpd) = ADD\ \left(\frac{gpd}{ERU}\right) * ERU_n;\ n = planning\ year$$

$$MDD_n(gpd) = MDD\ \left(\frac{gpd}{ERU}\right) * ERU_n;\ n = planning\ year$$

ADD and MDD projections over the 20-year planning period are not adjusted for a conservation scenario (e.g., 1 percent reduction in demand) since the City has already implemented a Water Use Efficiency (WUE) Program in accordance with DOH requirements and guidelines. Thus, the Water Use Efficiency goals and demand reductions are incorporated into the demand projections for the City's water system based on the analysis of production records for determining ERU design values. Additional discussion of the City's Water Use Efficiency Program is provided in **Section 9**.

3.3 Source Adequacy

Source adequacy evaluates the ability of existing sources to satisfy projected MDD in the planning period. The capacity of each source (in gallons per day) was assumed to equal the rated capacity (in gallons per minute) multiplied by 1,440 minutes per day. The sum of available source capacities was then compared with the projected MDD to determine if the system has adequate source capacity. An evaluation of source adequacy was also conducted for individual pressure zones applying the same methodology to booster pump stations, altitude valves, and pressure reducing stations (as applicable) as internal sources.

In addition to evaluating source adequacy over the planning period, the maximum number of ERUs that can be served by available sources was also calculated. The maximum number of ERUs is the number of ERUs that results in the MDD being equal to the total source capacity. The maximum number of ERUs estimate is provided to assist the City and DOH in determining the total number of customers that can be served by each source.

3.4 Water Rights Adequacy

3.4.1 Instantaneous Withdrawal Limits

The ability of existing water rights to satisfy the projected MDD was evaluated for the water system. The instantaneous withdrawal rate (Q_i) associated with each water right (in gallons per minute) was multiplied by 1,440 minutes per day to provide an available quantity (in gallons per day). The sum of existing instantaneous quantities was then compared with the projected MDD to determine if the system has adequate instantaneous water rights over the 20-year planning period.

3.4.2 Annual Withdrawal Limits

The ability of existing water right quantities to satisfy the projected ADD was evaluated for the water system. The sum of existing annual withdrawal limits (Q_a) (converted from acre-feet per year to gallons per day) was compared with the projected ADD to determine if the system has adequate annual water rights over the 20-year planning period.

3.4.3 Maximum ERUs

In addition to evaluating water rights adequacy over the 20-year planning period, the maximum number of ERUs that can be served by existing water rights was also calculated. The estimated maximum number of ERUs is used to assist the City and DOH in determining the total number of customers that can be served by each type of water right. The maximum number of ERUs is the number of ERUs that results in either the MDD being equal to the total instantaneous quantity or the ADD being equal to the total annual quantity as follows:

$$Water\ Right\ Q_i\ Max\ ERUs = \frac{Q_i\ (gpd)}{MDD\ (\frac{gpd}{ERU})}$$

$$Water\ Right\ Q_a\ Max\ ERUs = \frac{Q_a\ (gallons/year)}{365\frac{days}{year} * ADD\ (\frac{gpd}{ERU})}$$

3.5 Treatment Adequacy

Treatment adequacy evaluates the existing treatment facilities serving the water system. The capacity of the treatment system was considered in the evaluation of source capacity described above in Section 3.3. In other words, the capacity of each source (in gallons per day) used in the source adequacy evaluation was not allowed to exceed the capacity (in gallons per day) of the corresponding treatment system. The WTP was reviewed with the City to evaluate its current condition. The age of the treatment system was considered and deficiencies in the existing treatment system are noted, if applicable.

3.6 Storage Adequacy

Storage adequacy evaluates the ability of existing storage facilities to satisfy projected demands through the planning period. The required volume of Operational Storage (OS), Equalizing Storage (ES), Standby Storage (SB), and Fire Suppression Storage (FSS) (in gallons) was calculated as described below.

3.6.1 Operational Storage

Storage between a reservoir's operating points controls water production, pump cycling, and promotes reservoir turnover. The volume of water stored between the pump "off" and pump "on" settings is the Operational Storage volume. The settings for each reservoir were provided by the City.

3.6.2 Equalizing Storage

Equalizing Storage is provided to supplement source capacity during periods of peak demand. The bottom of the ES component is to be stored at an elevation sufficient to maintain a minimum service pressure of 30 psi throughout the distribution system during Peak Hour Demand (PHD). The required Equalizing Storage volume is calculated from the following equation:

ES (gallons) = 150 minutes * (PHD - Q), where

PHD = Peak Hour Demand (gpm), as defined in the DOH Water System Design Manual Equation 5-1

Q = Total Source Capacity (gpm)

3.6.3 Standby Storage

Standby Storage provides water to all service connections during emergencies such as pipeline failures, power outages or natural disasters. The bottom of the SB component is to be stored at an elevation sufficient to maintain a minimum service pressure of 20 psi throughout the distribution system during MDD. The required standby storage volume equals the greater of; 1) the ADD multiplied by 2 days minus a multi-source credit (if applicable) or 2) 200 gpd per ERU. A multi-source credit, in which the source pump with the highest capacity is assumed out-of-service, applies to systems with multiple sources, reliable power supplies, and adequate hydraulic looping.

Single Source SB Storage = (2 Days * ADD * N)

Multiple Source SB Storage = (2 Days * ADD * N) – 1,440(Q_s-Q_l)

Minimum SB Storage = 200 * N;

Where N equals the number of ERUs, Q_s is the total source pumping capacity (gpm) and Q_l is the largest capacity source available (gpm).

3.6.4 Fire Suppression Storage

This WSP Update includes general criteria for use in planning for fire protection. These values are based on the Uniform Fire Code, adopted requirements in other counties and water systems, and discussions with the City. The values used for water system planning and comparable values from other standards are presented in **Table 3-1**.

Table 3-1
Planning Fire Flow Requirements

<table>
<tr><th rowspan="2">Land Use Classification</th><th colspan="2">Fire Flow Requirements (gpm)</th></tr>
<tr><th>Stevenson Water System Plan</th><th>Public Water System Coordination Act[1]</th></tr>
<tr><td>Large Industrial / Commercial</td><td>2,000</td><td>1,000</td></tr>
<tr><td>Small Commercial / Institutional</td><td>1,500</td><td>750</td></tr>
<tr><td>New Residential</td><td>1,000</td><td rowspan="2">500</td></tr>
<tr><td>Existing Residential</td><td>500</td></tr>
</table>

1. Public Water System Coordination Act values taken from WAC 246-293-640 – Minimum Standards for Fire Flow.

The minimum flow duration depends on the rate of flow and determines the amount of reservoir storage required for fire protection. **Table 3-2** provides flow durations for different peak flow rates as recommended by the Washington Survey and Rating Bureau.

Table 3-2
Fire Flow Durations

Washington State Survey and Rating Bureau	
Flow Rate (gpm)	Flow Duration (hours)
10,000 and greater	10
<10,000	9
<9,000	8
<8,000	7
<7,000	6
<6,000	5
<5,000	4
<4,000	3
2,500 or less	2

The Stevenson water system service area consists primarily of medium density residential development. There are also commercial developments and large structures without sprinkler systems. Large structures include the high school, Skamania County Courthouse, and commercial development along Second Street. The highest fire flow requirement of 2,000 gpm addresses future west side industrial development and providing fire flow to Skamania Lodge. However, these fire flow requirements are less than those required by the Uniform Fire Code (UFC) for schools or large institutional and commercial structures. Because the City does not currently have adequate facilities to accommodate UFC flows, large structures are required to meet the provisions of the UFC.

3.6.5 Evaluation Criteria

The sum of existing storage capacities at sufficient elevation to provide greater than 30 psi to the highest elevation customer was compared with the required volume of operational storage and equalizing storage for years 2016, 2022 and 2036. The sum of existing storage capacities at sufficient elevation to provide greater than 20 psi to the highest elevation customer was compared with the required volume of operational storage, equalizing storage and the larger of either standby storage or fire flow storage for years 2016, 2022 and 2036. Thus, the required standby and fire flow storage volumes were nested. The evaluation of storage adequacy was done for individual pressure zones using this methodology.

3.7 Transmission/Distribution System Adequacy

The hydraulic model was updated for the 2016 WSP based on coordination with the DOH regional engineer. It was agreed that this model update did not require recalibration due to low growth and no changes to individual system fire flow requirements. **Section 5** discusses model updates in more detail.

3.8 Water Quality Adequacy

The City is required to comply with both the provisions of the Federal Safe Drinking Water Act (SDWA) and the Washington Administrative Code (WAC) chapter 246-290. The City's high-quality source waters yield high quality treated water. There were no water quality violations between 2010 and 2015. Water quality data has been reviewed and is summarized in **Section 5**.

3.9 System Improvements

Deficiencies in source, water rights, treatment, storage, or transmission/distribution were determined for the entire system using the evaluation methodologies described here. Where needed, specific projects were developed to address deficiencies expected to occur within the six and 20-year planning periods. A preliminary, planning-level cost estimate and implementation schedule was then prepared for each project. The cost estimates and implementation schedules are order-of-magnitude estimates to be used as general guidance in project evaluation. Projects were scheduled for implementation based on the priority and need associated with the project. Total project costs include:

- Design & Construction Engineering (20 percent)
- Sales Tax (7.7 percent)
- Contingency (30 percent)

MSA recommends completing pre-design studies, particularly for larger projects, prior to pursuing funding or engaging in final design contracts. Doing so allows the City to better define the project and refine the project budget.

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Section 4

Planning Data

4.1 Introduction

This section summarizes population, past water demands, and future projected water demands of the Stevenson Water System. Projected water demands are used in Section 5 to analyze existing supply, transmission, and storage facilities which form the basis for sizing future water system improvements in Section 6.

4.2 Current Population and Service Connections

4.2.1 Population and Household Size

The City is completing an update to their General Sewer Plan concurrently with this WSP. To support these planning efforts, the City generated a memo[1] which evaluated historic growth trends and established future population benchmarks. The historical average annual (compound) growth rate in the City was 0.87 percent, compared to 1.14 percent for the County, for the 20-year period preceding 2015 (1996-2015).

The population on water is different than the population within the city limits because there are parcels that are on individual wells. Due to this difference, water service area population is not available, as it is within the city limits, through tracked census data from the Washington State Office of Financial Management (OFM). Population projections served by water were provided by the City.

Table 4-1 summarizes historical and projected population for the city limits and water service area. Populations are projected to converge as the number of customers in the UGA are brought into the city limits. The year 2015 population of 1,530 people within the city limits is anticipated to increase to 1,836 by 2036 while population in the City's water service area is anticipated to increase to 1,834 people in the year 2036. The full build-out population within the UGA is estimated by the City to be 4,772 people[2].

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[1] *Sewer Population Benchmarks / Projections* memorandum by the City of Stevenson, dated March 22nd, 2016. See **Appendix B**.

[2] Calculated by projecting a density of 980 people per square mile within the full 4.87 square mile UGA.

The average household size in the City has declined in the last decade, which is consistent with the national trend of decreasing household size. Current average household size in Stevenson is given as 2.10 persons per household and is expected to hold nearly constant into the future.

Table 4-1
Population Summary

Year	City Limits Population	City & UGA Population on Water
Historical[1]		
2010	1,470	1,522
2011	1,500	1,553
2012	1,520	1,573
2013	1,515	1,568
2014	1,510	1,562
2015	1,530	1,583
Projected[1]		
2026 (10 year)	1,684	1,705
2036 (20 year)	1,836	1,834
2040[2]	1,901	1,897

Notes:
1. Population numbers provided by the City of Stevenson.
2. City projections end in the year 2040.

4.2.2 Water Service Connections

The water system has two classes of water service connections: residential and non-residential. Residential services consist of single-family residences and multi-family residences served by one meter. Non-residential connections include commercial buildings, mixed-use buildings, dedicated irrigation meters, transient lodging, industries, institutions, and city-owned facilities. **Table 4-2** is a summary of historical water connections by customer class. The active number of residential water service connections can vary from month to month due to changes in rental properties and seasonal population migration.

Table 4-2
Historic Water Service Connections

Customer Class	Water Service Connections					
	2010	2011	2012	2013	2014	2015
Single-Family Residential[1]	495	498	500	502	505	511
Multi-Family Residential	32	32	33	33	34	34
Commercial	71	71	71	71	71	71
Public	23	23	25	25	25	25
Total Connections	621	624	629	631	635	641

Notes:
1. Includes 58 grandfathered connections outside city limits.

4.3 Historic Water Use

4.3.1 Water Production

The City uses its surface water sources and Water Treatment Plant (WTP) as the primary source of supply for the system, supplementing with water from the Hegewald Well as necessary. Source meter readings are recorded daily and were obtained from the City. Daily supply to the system should not only consider source production, but also fluctuations in storage volume during the day. **Table 4-3** summarizes total monthly and annual water production in millions of gallons (MG) for the combined WTP and Hegewald Well from 2010 to 2015.

Table 4-3
Historic Monthly and Annual Water Production

Month	Combined Water Production (MG)					
	2010	2011	2012	2013	2014	2015
January	5.36	5.04	6.56	4.43	4.94	4.38
February	4.92	4.59	4.40	4.40	4.84	4.37
March	5.77	5.73	4.28	4.96	5.03	5.02
April	5.71	4.58	4.71	5.76	5.28	7.39
May	6.60	5.56	5.71	7.74	6.14	6.67
June	6.56	6.98	5.70	7.85	6.95	10.48
July	11.64	9.45	8.61	11.29	9.39	12.51
August	12.52	11.09	11.49	10.50	10.31	11.84
September	7.99	8.79	8.74	7.60	8.11	10.13
October	6.68	5.45	6.47	6.03	5.88	7.87
November	5.29	4.16	4.54	4.92	4.87	6.66
December	5.30	3.86	5.17	5.16	4.85	6.43
Total	84.33	75.26	76.38	80.64	76.59	93.75

4.3.2 Water Consumption

Consumption is derived from billing records for individual service meters and is typically lower than the supply volume for the same period. Differences between production and consumption are referred to as unaccounted water use, which includes unmetered authorized and unauthorized uses. For a fully metered system like Stevenson with limited authorized, unmetered usage, unaccounted for water is primarily Distribution System Leakage (DSL). **Table 4-4** summarizes annual authorized water use by customer class and estimated DSL.

As shown in the table, the majority of the City's overall water consumption is attributed to single family residential customers. Although nearly 80 percent of the City's customers are single family residential, they only used approximately 50 percent of the total water consumed between 2010 and 2014, and only 44 percent of the water consumed in 2015.

Table 4-4
Historic Authorized Use and DSL

Customer Class	Metered Authorized Use (MG)					
	2010	2011	2012	2013	2014	2015
Single Family	33.63	33.94	33.05	32.51	31.95	33.58
Multi-Family	5.11	5.00	5.35	4.17	5.02	6.63
Commercial	8.25	7.36	7.30	8.56	7.94	10.42
Public	9.56	9.60	8.08	8.37	9.49	10.68
Skamania Lodge	12.07	11.92	12.01	12.78	12.51	14.89
Total Metered Authorized Use	68.62	67.82	65.79	66.40	66.91	76.20
Total Production	84.33	75.26	76.38	80.64	76.59	93.75
DSL (MG)[1]	15.71	7.44	10.60	14.23	9.68	17.56
% of Total Supply (Annual)	18.6%	9.9%	13.9%	17.7%	12.6%	18.7%
% of Total Supply (3-Yr Average)	-	-	14.3%	13.9%	14.8%	16.5%

Notes:

1. Distribution System Leakage is calculated as the difference between Total Production and Total Metered Authorized Use.

The Water Use Efficiency Rule (Rule), which became effective in January 2007, requires all municipal water suppliers to maintain DSL at or less than 10 percent of production. Compliance with the Rule is measured on the 3-year rolling average of DSL as a percentage of total supply. Per WAC 246-290-820(4), the City is required to have a Water Loss Control Action Plan (WLCAP) because their 3-year average is greater than 10 percent.

The City has worked to reduce DSL over the years and continues a water loss control program focused on maintaining accurate service meters, replacing aging water mains, replacing aging service lines, and completing leakage surveys. A copy of the City's water loss control action plan is included in **Appendix C** which outlines steps and timelines for reducing leakage.

4.3.3 Large Water Users

Authorized water use went from 66.91 MG in 2014 to 76.20 MG in 2015, an increase of almost 14 percent. The dramatic rise in consumption was partly due to the addition of a new beverage-based business. LDB Beverage began operations in 2015 and accounted for nearly 2.0 MG of consumption that year, almost 20 percent of commercial billings. Skamania Lodge consumption also increased dramatically from 2014 to 2015. Averaging roughly 12 MG per year for the prior four years, billing increased by 2.38 MG or 19 percent in 2015.

Although not included in **Table 4-4**, billing data for 2016 shows that commercial water use continued to increase with Backwoods Brewing opening in the Port complex that year. It is difficult to determine precisely how much water Backwoods Brewing used in 2016 because several businesses are served from a single meter. However, comparing historic usage it is evident that it was more than 1.0 MG, equivalent to 18 ERUs. This amount of ERUs was added to the total Beverage ERUs in 2016 and therefore included in the overall growth projection for this category.

Table 4-5 shows the top 10 water customers with the highest consumption in 2015. The total water consumption of these customers represents approximately 38.5 percent of the total consumption for 2015. **Table 4-5** consists mostly of multi-family complexes and public properties.

Table 4–5
2015 Largest Water Users

Name	Water Use Type	Annual Consumption (1,000 gal)
Skamania Lodge	Skamania Lodge	14,793
Rock Creek Terrace	Multi-Family	3,281
SCSD Football Field	Public	2,585
LDB Beverage	Commercial	1,989
SCSD Grade School Irrigation	Public	1,370
Port Boat Loading Dock	Public	1,238
SCSD Practice Field	Public	1,156
Cascade Village	Multi-Family	1,138
Skamania County Sheriff's Office	Public	1,053
Rock Cove Assisted Living	Multi-Family	769
	Largest Water Users Total	**29,372**
	Water System Total Consumption	**76,196**
	Percent of Total	**38.5%**

4.4 Equivalent Residential Units

As discussed in **Section 3**, customer classes other than single family residential are expressed in terms of Equivalent Residential Units (ERUs). One ERU is equivalent to the average amount of water used by a single-family residence. The number of ERUs represented by the demand of the other customer classes is determined from the total demand of the customer class and the base demand per ERU calculated from the single family residential demand data.

Table 4-6 presents the computed base demand, the number of ERUs computed for each customer class, and the total number of ERUs served by the City between 2010 and 2015. Customer class demands are based on consumption and therefore do not include non-billed authorized consumption or DSL.

Table 4-6
Equivalent Residential Units (ERUs)

Description	Year					
	2010	2011	2012	2013	2014	2015
Single-Family Residential						
Single-Family Residential Connections (ERU)	495	498	500	502	505	511
Single-Family Use (MG)	33.63	33.94	33.05	32.51	31.95	33.58
Base Demand (gpd/ERU)	186	187	181	177	173	180
Multi-Family Residential						
Multi-Family Billing (MG)	5.11	5.00	5.35	4.17	5.02	6.63
Multi-Family ERUs	75	73	81	64	79	101
Commercial						
Commercial Billing (MG)	8.25	7.36	7.30	8.56	7.94	10.42
Commercial ERUs	121	108	110	132	125	159
Public Facilities						
Public Billing (MG)	9.56	9.60	8.08	8.37	9.49	10.68
Public ERUs	141	141	122	129	150	162
Skamania Lodge						
Skamania Lodge Billing (MG)	12.07	11.92	12.01	12.78	12.51	14.89
Skamania Lodge ERUs	178	175	182	197	198	226
Total						
Total ERUs	1,010	995	995	1,024	1,057	1,159
% Change by Year	-	1.49%	0.02%	3.02%	3.15%	9.59%

Notes:

1. While the Stevenson Water System serves 211 multi-family units, actual water usage for such connections indicate these units use approximately 52 percent less water than single family units.

4.4.1 Residential ERU Projections

The total number of residential ERUs (single-family plus multi-family) for the year 2015 is 612. For planning purposes, residential ERU growth in the City of Stevenson is assumed to match the historic annual average population growth rate of 0.87 percent as determined by the City. This growth rate results in 734 Residential ERUs in the year 2036, an increase of 122 ERUs from current numbers.

In addition to average annual growth, there are two new subdivisions in the City that will contribute a total of 117 new residential lots (ERUs). The Chinidere Subdivision, an 83-lot development, is assumed to be online by 2017 and built out by 2020. Fifty-six lots are within Zone 1 while twenty-seven lots are within Zone 3. Hidden Ridge Subdivision is located within Zone 2 and is currently owned by the bank. For planning purposes, this 34-lot development is assumed to be online in 2018 and built out by 2027. Finally, for planning purposes, it is assumed there will be 25 new ERUs in a future Zone 4 by 2036. Adding these ERUs to the average annual growth results in a total of 876 Residential ERUs in the year 2036.

4.4.2 Non-Residential ERU Projections

As presented in Section 4.3, the City experienced a dramatic increase in water use because of new customers from the beverage industry beginning in 2015. LDB Beverage accounted for almost 20 percent of commercial billings in 2015 and 25 percent of commercial billings in 2016. Backwoods Brewing started operations in 2016 and accounted for 10 percent of commercial billings that year. Because of the influx and potential growth of beverage industry customers, non-residential ERUs are divided into two categories. The two categories are non-beverage and beverage.

Using the 2015 base demand of 180 gpd/ERU and the sum of authorized water consumption for commercial, public, and Skamania Lodge customer classes, minus the water used by beverage industry customers, the total number of non-beverage ERUs in 2015 was 510. Growth of non-beverage ERUs is assumed to match residential population growth at 0.87 percent, resulting in 612 non-beverage ERUs in the year 2036, an increase of 102 ERUs.

Beverage industry customers water use was equivalent to 37 ERUs in 2015 with 30 ERUs attributable to LDB Beverage and seven to Walking Man Brewery. Water use by LDB Beverage increased by 14 ERUs between 2015 and 2016 for a total of 44 ERUs. Backwoods Brewing water use was equivalent to 18 ERUs in 2016. A total of 68 Beverage ERUs are the basis of growth projections beginning in 2016. Beverage industry customers are assumed to grow at twice the rate of the residential population or 1.74 percent over the 20-year planning period. All three of these beverage industry customers are in Zone 1.

Non-Residential ERUs, the sum of non-beverage and beverage ERUs, are estimated to grow from 547 in 2015 to 708 in 2036, a roughly 30 percent increase.

4.4.3 ERU Growth Summary

ERU projections for the City of Stevenson over the 20-year planning period are summarized in Table 4-7. The total number of 2015 ERUs is estimated to be 1,159. The total number of ERUs in 2036 is estimated to be 1,584.

Table 4-7
ERU Growth Summary

Description		ERUs			
		2015	2016	2026	2036
Residential[1]	Single Family	511	617	787	876[2]
	Multi-Family	101			
Non-Residential	Non-Beverage[3]	510	515	561	612
	Beverage[4]	37	68	81	96
Total		**1,159**	**1,200**	**1,429**	**1,584**

Notes:

1. Residential ERUs calculated using an annual average growth rate of 0.87 percent.
2. Includes 25 new ERUs allocated to a future Zone 4. See **Section 4.4.4** below for more information.
3. Non-Beverage ERUs calculated using an annual average growth rate of 0.87 percent.
4. Beverage ERUs calculated using an annual average growth rate of 1.74 percent, twice the historic annual average growth rate in the city limits.

4.4.4 ERUs by Pressure Zone

The 2007 WSP provided allocations of ERUs between the water system primary pressure zones. Only 13 Residential ERUs and 25 Non-Residential ERUs were added between 2007 and 2015. These new ERUs were allocated to the three primary pressure zones as follows:

- Zone 1: 25 new Non-Residential ERUs
- Zone 2: 13 new Residential ERUs

Table 4-8 presents the projected number of ERUs for each connection category within the three pressure zones of the Stevenson Water System. The distribution of ERUs by pressure zone in 2015 was provided by the City. ERUs associated with the Chinidere and Hidden Ridge subdivisions are in Zones 1, 2, and 3. All Beverage ERUs are in Zone 1.

Table 4-8
ERUs by Pressure Zone

Description	ERUs			
	2015	2016	2026	2036
Zone 1				
Residential	232	234	282	305
Non-Residential	150	182	205	232
Total	382	416	487	537
Zone 2				
Residential	269	271	383	413
Non-Residential	307	310	338	368
Total	576	581	721	781
Zone 3				
Residential	107	108	118	128
Non-Residential	90	91	99	108
Total	197	199	217	236
Zone 4				
Residential[1]	4	4	4	30
Non-Residential	0	0	0	0
Total	4	4	4	30
Grand Total	**1,159**	**1,200**	**1,429**	**1,584**

Notes:

1. Existing ERUs located above the existing Zone 3 service area were provided by the City.
2. Year 2036 projection for an additional 25 ERUs in Zone 4 assumed for planning purposes.

In addition to the above assumptions, the City Planning Commission, based on recent building permits, projects future development to be higher-end housing that often has higher water demands due to such amenities as sprinkler irrigation and convenience appliance installation. Based on recent home sales, the City also anticipates significant immigration of a retired or semi-retired demographic typically characterized by older or no children.

4.5 Projected Water Demands

This section summarizes past water demands and future projected water demands of the system. The distinct types of demands that were analyzed include: average day demand (ADD), maximum day demand (MDD), and future projected peak hour demand (PHD). While ERUs were estimated based on consumption data, production data was used to calculate historical ADD. Maximum day water production (in 1,000 gallons) was provided by the City and converted to MDD using total ERUs. These values, combined with ERU projections, are used to estimate future water demands, which are used in **Section 5** to analyze the existing water system facilities.

4.5.1 Historic Water Demand

Using production data instead of consumption data to estimate water demand provides an allowance for unmetered uses and Distribution System Leakage. Therefore, an additional allowance to account for these volumes is not included. ERUs are divided into residential and non-residential customer classes as discussed in **Section 4.4**. **Table 4-9** summarizes the determination of design values for average day demand and maximum day demand for the Stevenson Water System.

Table 4-9
Historic Water Demands Summary

Description	2010	2011	2012	2013	2014	2015
Total Production (MG/YR)	84.33	75.26	76.38	80.64	76.59	93.75
Total ERUs[1]	1,010	995	995	1,025	1,058	1,159
Calc. ADD (gpd/ERU)	229	207	210	215	198	222
Six-year Avg ADD (gpd/ERU)	214					
Max Day Water Use (1,000 gal)	537	465	488	467	445	588
MDD (gpd/ERU)[2]	532	467	490	455	421	507
Six-year Average MDD (gpd/ERU)	479					

Notes:
1. ERUs determined per **Table 4-6**.
2. Maximum day water production values provided by the City of Stevenson. MDD calculated by dividing maximum day production by the total number of ERUs calculated for that year.

The system-wide average demand per ERU from 2010 through 2015 was 214 gallons per day, which is less than the average demand per ERU presented in the City's 2007 WSP Update of 231 gallons per day. An ADD of **214 gpd/ERU** and MDD of **479 gpd/ERU** are used to forecast water demands. These figures are lower than the ones used in the previous water plan but remain conservatively estimated to account for future residential and non-residential development that may not be anticipated in the ERU calculations.

4.5.2 Water Demand Forecast

The water demand forecast for Stevenson was calculated in accordance with the demand forecast methodology described in **Section 3**. A summary of the demand forecast for the full system and individual pressure zones for the current, 10- and 20-year planning periods is presented in **Table 4-10**. The future demand projections for the full system are shown both with and without estimated reductions in water use from achieving the City's conservation goals. The future water demand projections with conservation are based on a five percent reduction in demand that would meet the City's water use reduction goals, outlined in the City's Water Loss Control Action Plan in **Appendix C**.

The projected demand data without conservation reductions was used for the evaluation of the planned improvements presented in **Section 6** to ensure the future system will be sized properly to meet all requirements, regardless of whether additional water use reductions from conservation are achieved.

Table 4-10
Demand Forecast Summary

Description	2016	2026	2036
Full System			
Total ERUs	1,200	1,429	1,584
Avg Day Demand (ADD), gpd	256,289	305,318	338,362
Avg Day Demand with Conservation, gpd	243,475	290,052	321,444
Maximum Day Demand (MDD), gpd	574,441	684,333	758,397
MDD with Conservation, gpd	545,719	650,117	720,477
Peak Hour Demand (PHD), gpm	731	853	935
PHD with Conservation, gpd	695	811	889
Pressure Zone 1			
Total ERUs	416	487	537
Average Day Demand (ADD), gpd	88,865	104,119	114,736
Maximum Day Demand (MDD), gpd	199,179	233,371	257,167
Peak Hour Demand (PHD), gpm	309	351	379
Pressure Zone 2			
Total ERUs	581	721	781
Average Day Demand (ADD), gpd	124,114	153,959	166,882
Maximum Day Demand (MDD), gpd	278,186	345,080	374,045
Peak Hour Demand (PHD), gpm	402	476	508
Pressure Zone 3			
Total ERUs	199	217	236
Average Day Demand (ADD), gpd	42,449	46,300	50,501
Maximum Day Demand (MDD), gpd	95,144	103,776	113,191
Peak Hour Demand (PHD), gpm	175	187	200
Pressure Zone 4			
Total ERUs	4	4	30
Average Day Demand (ADD), gpd	862	862	6,357
Maximum Day Demand (MDD), gpd	1,932	1,932	14,248
Peak Hour Demand (PHD), gpm	22	22	48

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Section 5

System Evaluation and Assessment

5.1 Introduction

This chapter presents the analysis of the City's water system. Individual water system components were analyzed under both existing and future water demand conditions to determine their ability to satisfy design criteria. The water demand forecasts summarized in **Section 4** are used in conjunction with the criteria to assess the adequacy of the water system to deliver sufficient quantities of water under peak or fire flow conditions at acceptable pipeline velocities and system pressures. Planned water system capital improvements that resolve the deficiencies identified in this chapter are presented in Chapter 6.

5.2 Design Criteria

The City has adopted engineering standards for public works construction. The standards incorporate the most current standards of the American Public Works Association (APWA). Water system planning, design and construction standards are included in **Appendix G**. For this plan, the water system capacity analysis is based on the design criteria contained in the Washington Department of Health (DOH) Water System Design Manual (December 2009).

Other general references for design criteria include:

1. Washington State Department of Health, Group A Public Water Systems, Chapter 246-290 WAC (April 1999, or most recent version).
2. Recommended Standards for Water Works, Great Lakes Upper Mississippi River Board of State Public Health & Environmental Managers (1992), also known as the Ten State Standards.
3. American Water Works Association (AWWA) Standards.

The following sections evaluate the capacity of the water system to meet existing as well as projected 10 and 20-year demands.

5.3 Water System Facility Capacity Summary

Pertinent summary information about the Stevenson Water System is included in **Table 5-1**. Summary information presented includes current number of connections, estimated population and number of ERUs served by the system. In addition, the source capacity, water rights limitations, storage capacities and distribution / transmission capacity are presented in ERUs.

Table 5-1
System Capacity Summary

Item	Stevenson Water System
Number of Accounts Served, Year 2015	
Residential[1]	545
Commercial	71
Public	25
Total	641
Population, 2015	1,530
Estimated Number of ERUs Served, Year 2015	
Residential[2]	612
Commercial	159
Public	162
Skamania Lodge	226
Total	1,159
Existing Water Facility Capacity	
Total Source Capacity, gpd[3]	792,000
Total Instantaneous Water Right Capacity, gpd	1,510,272
Total Annual Water Right Capacity, acre-feet	1,326
Total Annual Water Right Capacity, gpd	1,183,696
Total Storage Capacity, gallons[4]	824,000
Number of Pressure Zones	3
System Capacity in ERUs	
Source	1,654
Treatment	1,654
Storage, PZ 1	591
Storage, PZ 2	992
Storage, PZ 3	344
Distribution[5]	>1,654
Transmission[5]	>1,654
Water Rights	3,154
Water System Physical Capacity	1,654

Notes:
1. Residential connections include single and multi-family accounts.
2. Residential ERUs is the sum of single family and multi-family.
3. Total source capacity based on firm pump capacity of the WTP (550 gpm).
4. Total storage capacity based on the current operating parameters of the reservoirs.
5. Distribution and transmission capacity greater than the source capacity.

5.4 Source Summary

5.4.1 Surface Water Sources

5.4.1.1 LaBong Creek

LaBong Creek is utilized nearly year-round as the primary source of water to the treatment plant. The LaBong Creek concrete diversion structure is in good condition. The City installed a self-cleaning screen to reduce clogging and associated maintenance in 2012. This surface water source currently has no stream flow records or measuring installations, but capacity is estimated at 300 gallons per minute (gpm).

A settling basin is located downstream of the LaBong Creek diversion structure at the site of the abandoned chlorination facilities. This basin prevents the entry of leaves and animals into the intake pipe through the use of dual screens. This facility is inspected daily during the fall to clean the outlet screens.

5.4.1.2 Cedar Springs

Cedar Springs is located below the LaBong Creek settling basin. The spring enters a catchment as the water comes out of the ground. The water is piped through an abandoned pump building to a connection with the LaBong Creek transmission main. Flow records are not available for this source but estimated capacity is approximately 30 gpm with little variation throughout the year.

5.4.1.3 LaBong Creek and Cedar Springs Transmission Main

The City inspects the entire length of eight-inch transmission main annually. Constructed of Asbestos Cement (AC) pipe, the transmission main capacity is estimated at 540 gpm. Specific locations are inspected on a regular basis due to a history of ground movement and resulting line breaks. Couplings have been installed in these areas to provide greater line flexibility to minimize breaks.

5.4.1.4 Rock Creek Pump Station

Between July and October, low flows in LaBong Creek coincide with high consumption periods resulting in the need to use Rock Creek and the Rock Creek pumping station as a supplementary source to satisfy demands. The Rock Creek Pump Station was constructed with the 1979 Water System Improvements project. Pump discharge piping, valves and controls are in a below grade concrete structure. This facility is in good condition and consists of three stainless steel slotted intake screens extending under the creek bed with one 460 gpm and two 230 gpm submersible pumps. Pumps were replaced in 2016. The installed pump capacity is sufficient to meet treatment plant capacity during periods of peak demand. Intake screens require daily back flush with raw water from LaBong Creek during periods of continuous operation. The pump station site is fenced to limit access and discourage vandalism.

5.4.1.5 Iman Springs

Iman Springs is located southwest of town and is not currently utilized as a drinking water source. The spring previously provided an estimated 75 gpm to a limited service area on the west side of town now served by PZ 1. The spring now drains to Iman Lake which is used by Skamania Lodge for irrigation purposes.

5.4.2 Ground Water Sources

Hegewald Well is currently utilized as a backup supply, operated for limited periods of time when the City's surface water treatment plant faces poor raw water quality. During these periods, 100 percent of the system's water supply can be readily provided by the well. The well is equipped with a 600 gpm vertical turbine pump and was used as an active source between 1970 and 1974 before experiencing cavitation problems due to what was characterized at the time as excessive drawdown.

A concrete masonry block building houses the well pump, controls and discharge piping, with necessary provisions for chlorine addition during operation. A manual transfer switch is installed at the well to accommodate a recently acquired portable diesel generator sized to operate the well or water treatment plant during periods of extended power outage. The addition of a portable generator provides increased system reliability.

Over the last couple years, the City has operated the well for extended periods at various capacities to monitor drawdown. While seasonal variations in water level were noted, significant drawdown was not experienced during operation at full capacity. For this plan, it is assumed the well is capable of reliable extended operation, though a pump test and continued drawdown monitoring is recommended.

Residential development is encroaching on the well site. While all new development will be outside the sanitary control zone, the City has concerns that groundwater quality could be impacted long term. To address this concern, the City will examine the potential development of a new replacement well in the City controlled LaBong watershed or near the Columbia River during the 20-year planning period.

5.4.3 Water Treatment Plant

The City’s water treatment plant is an ECI Keystone Package Plant, with an original design capacity of 1.0 MGD (694 gpm continuous). The plant consists of chemical coagulation and dual steel package treatment units including hydraulic flocculation, tube clarification (settlers), and filtration. Effluent from the treatment plant is delivered to a 58,000-gallon clearwell/chlorine contact tank prior to pumping into the intermediate pressure zone (PZ 2). Water is delivered to the distribution system by one 675 gpm and two 275 gpm canned vertical turbine pumps. Firm capacity is 550 gpm.

The treatment facility was constructed in 1979. Since the 2007 WSP Update, the City has completed extensive rehabilitation work to extend the life of these facilities. Work has included installation of a streaming current meter for alum injection, a reagentless chlorine analyzer, large volume flow meters, replacement of the effluent meter, replacing of the turbine pump control valves, and servicing of the turbine pumps. Overall operation and maintenance by City staff has been excellent.

5.5 System Analysis

5.5.1 Evaluation of Source Adequacy

This section evaluates the City's sources of supply by comparing existing and projected Maximum Day Demand (MDD) for the water system to the available supply from the sources. The Water Treatment Plant (WTP) delivers water to the City's entire water system and is supplied directly into PZ 2, meeting customer demands and filling the Base and Catholic Church reservoir's. Because running all three pumps exceeds the capacity of the WTP, the firm pump capacity of the WTP (550 gpm) was used for the Full System evaluation. The supply capacity analysis conservatively assumes the Hegewald Well ground water source is not available.

The results of the Full System evaluation, as shown in **Table 5-2A**, indicate the City's surface water sources and treatment capacities meet the existing and future supply requirements of the system through 2036. Additional ERUs could be served if the current capacity of the WTP was increased to its rated capacity of 1.0 MGD or if the ground water source capacity of the Hegewald well was included in the analysis.

Table 5-2A
Evaluation of Source Adequacy - Full System

Projected ERUs and Demand Full System[1]	2016	2026	2036	Max[2]
Equivalent Residential Units (ERUs)	1,200	1,429	1,584	1,654
Average Day Demand (ADD), gpd	256,289	305,318	338,362	353,354
Maximum Day Demand (MDD), gpd	574,441	684,333	758,397	792,000
Available Sources, gpd[3]				
Rock Creek (920 gpm)	1,324,800	1,324,800	1,324,800	1,324,800
LaBong Creek (300 gpm)[4]	432,000	432,000	432,000	432,000
Cedar Springs (30 gpm)[4]	43,200	43,200	43,200	43,200
Hegewald Well (550 gpm)[5]	0	0	0	0
Water Treatment Plant (550 gpm)	792,000	792,000	792,000	792,000
Total Available Treatment	792,000	792,000	792,000	792,000
Total Available Source	792,000	792,000	792,000	792,000
Source Surplus/(Deficiency)	217,559	107,667	33,603	0

Notes:
1. Projected number of ERUs and demand forecast as presented in **Section 4**.
2. Maximum number of ERUs at MDD that can be served by existing and available sources.
3. Available sources assumed to be operating 24 hrs/day at the maximum production rate.
4. Rock Creek is the primary source during peak demand periods. LaBong Creek and Cedar Springs assumed unavailable for the purposes of this analysis.
5. Hegewald Well conservatively assumed unavailable for the purposes of this analysis.

PZ 1 is supplied with water from PZ 2 through the altitude valve at the Catholic Church Reservoir. Four pressure reducing stations are set as a backup source to provide water from PZ 2 and PZ 3 in times of peak hour or fire flow demands. Therefore, under typical operation the reservoir altitude valve is considered the primary source. The criteria for evaluating the capacity of the altitude valve is the same as other sources in that it must meet MDD for PZ 1.

The results of the PZ 1 evaluation, as shown in **Table 5-2B**, indicate the altitude valve has sufficient capacity to meet the existing and future supply requirements of PZ 1 through 2036.

Table 5-2B
Evaluation of Source Adequacy –PZ 1

Projected ERUs and Demand PZ 1[1]	2016	2026	2036	Max[2]
Equivalent Residential Units (ERUs)	416	487	537	752
Average Day Demand (ADD), gpd	88,865	104,119	114,736	160,615
Maximum Day Demand (MDD), gpd	199,179	233,371	257,167	360,000
Available Sources, gpd[3]				
Church Reservoir Altitude Valve (250 gpm)	360,000	360,000	360,000	360,000
Total Available Source	360,000	360,000	360,000	360,000
Source Surplus/(Deficiency)	160,821	126,629	102,833	0

Notes:
1. Projected number of ERUs and demand forecast as presented in **Section 4**.
2. Maximum number of ERUs at MDD that can be served by existing and available sources.
3. Available sources assumed to be operating 24 hrs/day at the maximum production rate.

PZ 3 is supplied with water from PZ 2 by the PZ 3 Booster Pump Station. Replaced in 2007, the PZ 3 Booster Pump Station is equipped with three 20 horsepower pumps and was oversized to supplement the small storage volume of the High Zone Reservoir. The criteria for evaluating the capacity of the PZ 3 Booster Pump Station assumes meeting the combined MDD of PZ 3 and future PZ 4. With each pump delivering 425 gpm, the analysis conservatively assumes only one of the three pumps are available. The results of the PZ 3 evaluation, as shown in **Table 5-2C**, indicate the booster pump station has sufficient capacity to meet the existing and future supply requirements of PZ 3 and PZ 4 through 2036.

Table 5-2C
Evaluation of Source Adequacy –PZ 3

Projected ERUs and Demand PZ 3[1]	2016	2026	2036	Max[2]
Equivalent Residential Units (ERUs)	203	221	266	1,278
Average Day Demand (ADD), gpd	43,311	47,240	56,857	273,046
Maximum Day Demand (MDD), gpd	97,075	105,883	127,439	612,000
Available Sources, gpd[3]				
PZ 3 Pump Station (425 gpm)	612,000	612,000	612,000	612,000
Total Available Source	612,000	612,000	612,000	612,000
Source Surplus/(Deficiency)	514,925	506,117	484,561	0

Notes:
1. Projected number of ERUs and demand forecast as presented in **Section 4**. Sum of PZ 3 and PZ 4.
2. Maximum number of ERUs at MDD that can be served by existing and available sources.
3. Available sources assumes single source pump operating 24 hrs/day at the current production rate.

5.5.2 Evaluation of Water Rights Adequacy

The following table summarizes water rights for the existing City sources. The existing and forecasted water rights status is further summarized in the Water Rights Self-Assessment Forms included in **Appendix B**.

Table 5-3
Existing Water Sources/Water Rights Provisions

Cert #	Priority Date	Right holder	Source Name / Number	Permit Provisions	Maximum Flow Rate (gpm)	Allowable Annual Withdrawal (acre-ft)
1092	6/10/1938	Town of Stevenson	LaBong – Lindis (aka Cedar) Springs / S01 - S02	Primary	448.8	600
G2-00921C	2/6/1974	Town of Stevenson[1]	Hegewald Well / S04	Primary	600	726
S2-23749C	9/24/1976	Town of Stevenson	Iman Springs / S05	Non-Additive	76	126
S2-24320C	5/14/1982	City of Stevenson	Rock Creek / S03	Non-Additive	1,680	600
				Total	**1,048.8**	**1,326**

Notes:

1. Water right was originally issued to the Skamania County Department of Public Works.

As outlined in **Table 5-3**, the City currently has water rights covering all the City sources with a total allowable maximum instantaneous withdrawal of 1,048.8 gpm and allowable annual withdrawal of 1,326 acre-feet/year based on combined surface and ground water rights. **Table 5-4** summarizes the projected City water rights evaluation along with the maximum number of ERUs supported by water rights.

Table 5-4
Evaluation of Water Rights Adequacy

Projected ERUs and Demand Full System[1]	2016	2026	2036	Max. Instant.[2]	Max. Annual[3]
Equivalent Residential Units (ERUs)	1,200	1,429	1,584	3,154	5,541
Average Day Demand (ADD), gpd	256,289	305,318	338,362	-	1,183,696
Maximum Day Demand (MDD), gpd	574,441	684,333	758,397	1,510,272	-
Water Rights for Available Sources, gpd[4,5]					
LaBong/Cedar Springs (448.8 gpm)	646,272	646,272	646,272	646,272	535,609
Hegewald Well (600 gpm)	864,000	864,000	864,000	864,000	648,087
Iman Springs (76 gpm)[6]					
Rock Creek (1,155.2 gpm)					
Total Water Rights for Available Source	1,510,272	1,510,272	1,510,272	1,510,272	1,183,696
Water Rights Surplus/(Deficiency)	935,831	825,939	751,875	0	0

Notes:

1. Projected number of ERUs and demand forecast as presented in **Section 4**.
2. Maximum number of ERUs at MDD that can be served by instantaneous water rights for available sources.
3. Maximum number of ERUs at ADD that can be served by annual water rights for available sources.
4. Instantaneous water rights for available sources assumes largest sources are pumped 24 hrs/day at the limit of instantaneous water rights. Instantaneous water rights are shown in **Table 5-3**.
5. Annual water rights for available sources in acre-feet/year are shown in **Table 5-3**.
6. Iman Springs not used by the City therefore not included in the analysis.

As outlined in **Table 5-4**, the City has sufficient water rights to satisfy projected source requirements for the planning period.

5.5.3 Evaluation of Treatment Adequacy

A comprehensive performance evaluation of the water treatment plant was completed in June 2006 by The Cadmus Group, Inc. in conjunction with the DOH technical assistance program. The purpose of this evaluation was to help surface water systems satisfy DOH optimization goals for filtered water quality. The final report from this evaluation identified the need for minor improvements in the areas of policy making and operations, adoption of DOH optimization guidelines, and recommended a CT disinfection study.

PACE Engineers completed a CT study in 2007. Results for the low (275 gpm) and high (550 gpm) flow tests indicated that the water treatment plant achieves more than the 1.0 log inactivation required, with the results in general agreement with an earlier 1993 study.

Current effluent pump capacities limit production at the plant to less than the rated 1.0 MGD (694 gpm). To realize the full capacity of the plant, it is recommended that the existing 675 gpm pump be replaced with an approximately 275 gpm pump, similar to the existing 275 gpm pumps. The ultimate capacity of the new pump should be selected to permit the full production capacity of the plant while operating in parallel with the other two existing pumps.

5.5.4 Evaluation of Storage Adequacy

The City is served by three reservoirs providing 824,000 gallons of stored water based on current operating parameters. These facilities in turn serve three primary pressure zones, which are further divided into sub-zones by pressure reducing valves. The reservoirs and general pressure zones are illustrated in **Figure 5-1**, Topography and Pressure Zones. Ideally, each tank would serve a single pressure zone. However, due to topographic challenges and constraints imposed by the development of the original distribution system, reservoirs may serve multiple pressure zones. **Figure 5-2**, Water System Elevation Diagram, presents a hydraulic schematic of the elevation range served by each reservoir. The multiple pressure zones within the range served by the PZ 2 and PZ 3 reservoirs are not illustrated in detail.

The following analysis of existing reservoir storage capacity is based on the sizing criteria presented in the DOH Water System Design Manual. This includes an analysis of reservoir and booster pump station capacity based on the pressure zone served.

5.5.4.1 Pressure Zone 1 – Catholic Church Reservoir

The Catholic Church Reservoir serving PZ 1 is constructed of welded steel and has a total volume of 313,000-gallon based on current operating parameters. Built with the 1979 water system improvements project, this 56-foot diameter tank is in excellent condition and is cleaned on a three-year rotation. The reservoir is filled by gravity from PZ 2 through altitude valve level control and has an overflow elevation of 296 feet. The altitude valve was replaced in 2011. Level monitoring is currently not available through the City's SCADA system.

The PZ 1 service area also utilizes PRV regulated interties to supplement flows during periods of peak demand. Interties with PZ 2 are at the intersection of Foster Creek Road and Rock Cove Parkway and at the end of Angel Heights Road. A third intertie with PZ 3 is on Lutheran Church Road in the Chinidere Subdivision. The Catholic Church Reservoir currently serves approximately 416 ERUs, including 165 residential services.

Table 5-5A provides a summary of system demand and reservoir storage requirements for the planning period. The required fire storage volume is based on a 2,000 gpm demand for 2-hour duration in the downtown commercial area.

Table 5-5A
Catholic Church Reservoir Storage Analysis – PZ 1

Description	2016	2026	2036
Equivalent Residential Units (ERUs)	416	487	537
Average Day Demand (ADD), gpd	88,865	104,119	114,736
Maximum Day Demand (MDD), gpd	199,179	233,371	257,167
Peak Hour Demand (PHD), gpm	309	351	379
Available Sources			
Altitude Valve (250 gpm), gpd[1]	360,000	360,000	360,000
Total Available Sources, gpd	360,000	360,000	360,000
Storage Components			
Operational Storage, gal	36,828	36,828	36,828
Equalizing Storage, gal[2]	8,780	15,191	19,283
Standby Storage, gal[3]	177,729	208,238	229,472
Fire Flow Storage, gal	240,000	240,000	240,000
Total Required Storage, gal[4]	285,608	292,019	296,111
Storage Evaluation			
Available Volume, gal[5]	313,000	313,000	313,000
Volume Surplus / (Deficiency), gal	27,392	20,981	16,889

Notes:
1. Altitude valve capacity assumed at 250 gpm.
2. Equalization Storage assumes firm source capacity equal to altitude valve capacity.
3. Standby Storage volume based on single-source criteria.
4. Standby Storage volume nested with Fire Flow Storage volume.
5. Volume available based on current operating set points.

The Catholic Church Reservoir has adequate capacity to satisfy current and projected demands. Operational storage calculations are based on the existing altitude valve set points.

5.5.4.2 Pressure Zone 2 – Base Reservoir

The Base Reservoir is the water system's largest storage facility and has a total volume of 418,000 gallons based on current operating parameters. This partially buried concrete reservoir was constructed in the early 1960s and is composed of three completely enclosed interconnecting storage cells. The reservoir has an overflow elevation of 456 feet, with level control via pressure transducer tied in with the City's telemetry system. The reservoir is filled by the water treatment plant effluent pumps or Hegewald Well. Overall, the reservoir is in good condition although a recent sanitary survey identified deficiencies where the new siding meets the existing roof. In addition, the roof overlay of gravel and emulsified asphalt is due for replacement.

The Base Reservoir currently serves approximately 581 ERUs, including 247 residential services and the Skamania Lodge. Table 5-5B provides a summary of system demand and reservoir storage requirements for existing connections and future growth. Required fire storage volumes are based on a 2,000 gpm demand for 2-hour duration at Skamania Lodge. The storage analysis assumes the following:

- Source supply can be provided by operation of the water treatment plant or Hegewald Well. For the purpose of calculating equalization storage, the firm production capacity of the WTP (550 gpm) is assumed.
- Projected peak hour demand is the sum of calculated PHD for PZ 2, altitude valve capacity of 250 gpm, and single pump capacity of PZ 3 Booster Pump Station (425 gpm)
- Standby Storage assumes a firm source capacity of 550 gpm, largest source capacity of 275 gpm and no flow going to PZ 1 or PZ 3 because both zones have sufficient standby storage to satisfy projected demands. PZ 1 would need to be isolated from PZ 2 in an emergency situation in order to prevent excess water from leaving PZ 2.

The 1.0 MGD capacity of the WTP is currently not being realized as discussed in Section 5.5.3. Replacing the large pump with a properly sized pump would allow the City to take advantage of the full capacity of the plant if additional source capacity was needed.

Table 5-5B
Base Reservoir Storage Analysis – PZ 2

Description	2016	2026	2036
Equivalent Residential Units (ERUs)	581	721	781
Average Day Demand (ADD), gpd	124,114	153,959	166,882
Maximum Day Demand (MDD), gpd	278,186	345,080	374,045
Peak Hour Demand (PHD), gpm	402	476	508
Available Sources			
Water Treatment Plant (550 gpm/694 gpm), gpd	792,000	792,000	1,000,000
Hegewald Well (550 gpm), gpd	0	0	0
Total Available Sources, gpd[1]	792,000	792,000	1,000,000[2]
Storage Components			
Operational Storage, gal	87,764	87,764	87,764
Equalizing Storage, gal[3]	79,036	90,185	73,412
Standby Storage, gal[4]	116,205	144,148	156,247
Fire Flow Storage, gal	240,000	240,000	240,000
Total Required Storage, gal[5]	406,800	417,949	401,177
Storage Evaluation			
Available Volume, gal[6]	418,000	418,000	418,000
Volume Surplus / (Deficiency), gal	11,200	51	16,823

Notes:
1. Analysis based on operation of the WTP only, firm capacity of 550 gpm based on current pump capacities.
2. Assumes effluent pump capacity increased to maximize production capacity of the WTP.
3. Equalization Storage based on the sum of PZ 2 PHD, 250 gpm, and 425 gpm.
4. Standby Storage volume based on minimum criteria.
5. Standby Storage volume nested with Fire Flow Storage volume.
6. Volume available based on current operating set points.

The Base Reservoir has adequate capacity to satisfy current and projected demands through 2026. Additional source capacity is required to satisfy projected demands through 2036. This analysis assumed increasing the effluent pump capacity of the WTP. Alternatively, additional capacity can be provided by adding treatment to the Hegewald Well so it can be operated on a continuous basis.

5.5.4.3 Pressure Zone 3 – High Reservoir

The High Zone Reservoir is a 36-foot diameter concrete structure, is in fair condition, and has a total volume of 93,000 gallons based on current operating parameters. The PZ 3 Booster Pump Station, an above-grade building drawing suction from the Base Reservoir, delivers water from PZ 2. The High Zone Reservoir has an overflow elevation of 584 feet, with reservoir level monitored by pressure transducer. While the High School is in the PZ 3 service area, fire flows are supplemented by a low-pressure main extended from the Base Reservoir (PZ 2) to allow fire pumper truck connection. The High Zone Reservoir provides adequate capacity to satisfy fire flow requirements for existing residential development (500 gpm @ 2-hour duration). PZ 3 can support 344 ERUs and still satisfy this fire flow requirement in the reservoir. For determining 10 and 20-

year fire storage volumes, a 1,000 gpm demand for 2-hour duration is assumed for future, higher density, residential development.

Table 5-5C
High Reservoir Storage Analysis – PZ 3

Description	2016	2026	2036
Equivalent Residential Units (ERUs)	203	221	236
Average Day Demand (ADD), gpd	43,311	47,240	50,501
Maximum Day Demand (MDD), gpd	97,075	105,883	113,191
Peak Hour Demand (PHD), gpm	178	190	200
Available Sources			
PZ 3 BPS (830 gpm), gpd[1]	1,195,200	1,195,200	1,195,200
Total Available Sources, gpd	1,195,200	1,195,200	1,195,200
Storage Components			
Operational Storage, gal	24,123	24,123	24,123
Equalizing Storage, gal[2]	0	0	0
Standby Storage, gal[3]	40,551	44,230	47,282
Fire Flow Storage, gal	60,000	120,000	120,000
Total Required Storage, gal[4]	84,123	144,123	144,123
Storage Evaluation			
Available Volume, gal[5]	93,000	93,000	93,000
Volume Surplus / (Deficiency), gal	8,877	(51,123)	(51,123)

Notes:

1. PZ 3 BPS firm capacity of 830 gpm, single pump capacity of 425 gpm.
2. Equalization Storage assume firm source capacity equal to 830 gpm.
3. Standby Storage volume based on minimum criteria.
4. Standby Storage volume nested with Fire Flow Storage volume.
5. Volume available based on current operating set points.

As outlined in Table 5-5C, the High Zone Reservoir is deficient with respect to future fire storage requirements under the assumptions discussed above. However, with 830 gpm of firm source capacity from the PZ 3 booster pump station, the reservoir only needs to store 29,832 gallons of fire storage ((170 gpm fire+78 gpm MDD)*120 minutes). The resulting nested volume would be equal to the standby storage volume which leaves a surplus of 12,162 gallons in the year 2036.

The High Zone Reservoir has adequate capacity to satisfy current and projected demands. However, this assumes the Base Reservoir is available as a source for the PZ 3 booster pump station. Removing the Base Reservoir from service for maintenance or repair would leave PZ 2 and 3 without adequate storage. Murraysmith recommends the following with respect to evaluating storage in PZ 3:

- Complete a condition assessment of the Base Reservoir to understand its level of resiliency and anticipate future maintenance requirements.

5.5.4.4 Future Pressure Zone 4

Projected growth outside the PZ 3 service area will require the creation of a new, higher elevation pressure zone and associated reservoir. The proposed PZ 4 reservoir will serve new connections in this higher elevation area while also improving system pressures for existing services in Pressure PZ 3 and supplementing future storage deficiencies in lower elevation pressure PZs.

The future PZ 4 service area is estimated to be approximately 320 acres with a mix of suburban and single family residential zoning. Approximately 975 connections are estimated at full buildout. The following general reservoir storage criteria was used for preliminary sizing and cost estimating, assuming residential fire storage requirements. A more detailed sizing analysis based on DOH sizing criteria will be completed at the time of reservoir design.

Fire Flow Storage:	120,000 gal (1,000 gpm for 2-hour duration)
Standby Storage:	292,500 gal (200 gallons / connection)
Equalization Storage:	97,500 gal (100 gallons / connection)
Subtotal:	390,000 gal
Operating:	60,000 gal
Total:	450,000 gal

It is recommended that either a single 500,000-gallon reservoir or dual 250,000-gallon reservoirs be constructed to serve growth above the PZ 3 service area. With an overflow elevation of approximately 725 feet, the proposed facility would serve an elevation range of 655 feet – 515 feet (30 - 90 psi). The actual reservoir site location may result in a slightly higher or lower pressure service range. The construction of a PRV station between PZ 4 and PZ 3 will allow the new reservoir to supplement flows during periods of high demand. Alternatives for upgrading the distribution system to supply water to the proposed PZ 4 reservoir are discussed in **Section 6**.

5.5.5 Evaluation of Transmission / Distribution System Adequacy

The City's existing distribution and transmission mains were evaluated using a hydraulic network analysis model to determine if the system is sized and looped adequately to provide the necessary flow rates and service pressures to meet existing and future demands. A hydraulic model of the system was updated from the existing model using WaterCAD V8i, a modeling program developed by Bentley. The model was used in a steady state mode to identify existing system deficiencies. The process of updating and calibrating the model against field measurements is summarized in the following paragraphs.

5.5.5.1 Hydraulic Model Development

Facilities modeled for the City's distribution system analysis are illustrated on **Figure 5-3**, Pipe Size and Material. Existing CAD files were converted to GIS format and, along with record drawings obtained from the City, added to the existing model as a background layer. This layer allowed nodes and pipes to be adjusted to match the existing layout. Physical parameters for pipelines, tanks, junctions, and pumps were also verified. Other sources of input used to establish the model base included:

- Source water pumping facilities were input based on available existing pump model information. Individual pumps within the City's PZ 3 pump station were input to the model based on manufacturer's pump curves provided by the City. For WTP pumping facilities, a constant supply was modeled based on current operational capacities. Sources that feed the WTP were not included in the model.
- Storage facilities were modeled based on current operating parameters provided by the City.
- Pressure reducing stations were modeled based on current outlet pressures provided by the City.

5.5.5.2 Model Scenarios and Demand Input

Model scenarios were defined to analyze the performance of the system under multiple demand and fire flow conditions. Specifically, scenarios were created for ADD, MDD plus fire flow, and PHD conditions for existing and projected 2026 and 2036 ERUs developed in **Section 4**.

Existing and projected water demands were allocated to nodes within the model. The total demand associated with each pressure zone was distributed evenly throughout model nodes that belong in that zone, excluding nodes that would not have service connections associated with them such as on transmission lines leading to or from a reservoir. The distribution was calculated by dividing the total zone demand by the number of nodes in that zone to determine a per node demand in gallons per minute.

Facility settings within the model differ for the various scenarios. Reservoir levels were set at the bottom of operational and equalization volumes for ADD and PHD scenarios. Reservoir water level was set one foot above the floor for MDD plus fire flow scenarios. These represent the most conservative operating parameters. Source of supply facilities operating during each of the scenarios was determined by existing system operational protocol and set points, which are dictated by reservoir levels.

5.5.5.3 Calibration

Hydraulic model calibration is the process of using field pressure and flow data to modify model input parameters, resulting in simulations that more accurately replicate actual system operation. Model calibration was done for the 2007 WSP Update. That effort was partially successful in meeting DOH goals for accuracy which require a minimum analysis of five percent of the system nodes to have an accuracy of ±five psi for 100 percent of the readings.

All of PZ 1 flow tests met DOH requirements in 2007. Some of the nodes within PZ 2 did not meet the five-psi requirement, however, all nodes fell within 10 psi of the field measurement results. PZ

2-1 produced several inaccurate results and calibration was largely not achieved. Two of the five flow tests in PZ 3 did not meet DOH requirements. Inaccurate results are attributed to the age of the system and a lack of reliable information regarding existing pipe sizes and, in some cases, locations.

Few changes have been made to the distribution system since the 2007 WSP update. As a result, the previous model was not re-calibrated for the current WSP update. The model was updated with facility replacements and current operational parameters to reflect the changes that have been made. This approach was reviewed with and approved by DOH.

5.5.5.4 Criteria

Criteria for evaluating the capacity and reliability of the distribution system piping network are summarized in **Table 5-6**.

Table 5-6
Water Supply Criteria

No.	Criteria Description	Reference	Necessity
1	Capacity to deliver PHD at 30 psi measured at any existing water service meters	WAC-246-290-230(5)	Required
2	Provide MDD plus required fire flow while retaining a minimum 20 psi residual pressure at any point in the distribution system	WAC-246-290-230(6)	Required
3	Distribution system mains should be looped whenever feasible	DOH *2009 Water System Design Manual*	Reliability Consideration
4	Pipeline velocities should not be greater than 8 feet per second (fps) under PHD conditions	DOH *2009 Water System Design Manual*	Reliability Consideration
5	All pipelines can be flushed at a flow velocity of at least 2.5 fps	DOH *2009 Water System Design Manual*	Reliability Consideration
6	All mains should have appropriate internal and external corrosion protection	DOH *2009 Water System Design Manual*	Reliability Consideration
7	Firefighting demands should not create pressures below 30 psi in the distribution system to prevent cross-connection contamination	DOH *2009 Water System Design Manual*	Reliability Consideration

5.5.5.5 Distribution and Transmission Analysis

The distribution and transmission analysis used the hydraulic model to test the existing system's ability to provide PHD or MDD plus fire flow while maintaining minimum required system pressures. For the fire flow analysis, system adequacy was assessed using a 2,000 gpm fire flow to PZ 1 and PZ 2 and a 1,000 gpm fire flow to PZ 3. Model scenarios were developed to test the existing system with current (2016) and future 2026 and 2036 projected demands.

The results of the modeling analysis are summarized below.

5.5.5.5.1 Pressure Zone 1

Static pressures in PZ 1 range from 35 to 85 psi. Three PRV interties with PZ 2 and one PRV intertie with PZ 3 supplement fire flow. Minimum system pressures during PHD simulations remain above DOH requirements and water main velocities are well below 8 fps. However, much of this PZ fails to meet MDD plus fire flow (2,000 gpm) simulations. Three (3) existing piping deficiencies were identified:

- An estimated 990 linear feet (LF) of existing six-inch main along School Street and Vancouver Avenue, north of Russell Avenue and an estimated 460 LF of six-inch main along Russell Avenue, from Vancouver Avenue to Highway 14. Upgrading this portion to 12-inch waterline corrects the majority of deficiencies in the downtown area.

- An estimated 1,000 LF of four-inch main along SW Atwell Road, adjacent to Rock Creek Drive. Upgrading this portion to eight-inch waterline corrects deficiencies on the western-end of the PZ.

- An estimated 800 LF of existing six-inch main along Rock Creek Drive, between Ryan Allen Road and Monda Road as well as an estimated 630 LF of existing six-inch main along Rock Creek Drive, between Monda Road and the intersection with the Angel Heights PRV water main. The 630 LF section provides the greatest benefit to the area, nearly meeting fire flow requirements. Replacement of both sections provides the minimum 2,000 gpm at 20 psi.

5.5.5.5.2 Pressure Zone 2

Static pressures in PZ 2 range from 41 to 144 psi with high pressure service areas utilizing individual service PRV's. Minimum system pressures during PHD simulations remain above DOH requirements and water main velocities are well below 8 fps. PZ 2 also meets minimum system pressure requirements during MDD plus fire flow (2,000 gpm) simulations.

5.5.5.5.3 Pressure Zone 2-1

Static pressures in this sub-zone range from 33 to 124 psi. PZ 2-1 is served from both PZ 2 and PZ 3 through separate pressure reducing valves (PRV). This sub-zone is located in the center of the system, south of Hot Springs Alameda Road. The PZ 2 PRV is located at the intersection of

Chesser/Hot Springs Roads and the PZ 3 PRV is located on Kanaka Creek Road, just south of Bulldog Drive. High pressure service areas utilize individual service PRV's.

Minimum system pressures during PHD simulations remain above DOH requirements and water main velocities are well below 8 fps. However, all but one node fails to meet MDD plus fire flow (2,000 gpm) simulations. One (1) improvement corrects over 75 percent of the deficiencies:

- Construct a PRV intertie with PZ 3 in place of a currently closed valve near the intersection of Frank Johns Road and Gale Street.

The remaining junctions that do not meet the 2,000 gpm criteria are limited by a dead-end line extending east on Loop Road. Two (2) existing piping deficiencies were identified to correct the remaining fire flow deficiencies:

- An estimated 900 linear feet (LF) of existing six-inch main along Frank Johns Road from Gale Street to Loop Road. This portion of waterline should be upgraded to eight-inch diameter.

- An estimated 1,000 linear feet (LF) of existing six-inch main along Frank Johns Road from Loop Road to north of Highway 14. This portion of waterline should be upgraded to eight-inch diameter.

5.5.5.5.4 Pressure Zone 3

Static pressures in PZ 3 range from 38 to 138 psi. High pressure service areas utilize individual service PRV's. Minimum system pressures during PHD simulations remain above DOH requirements and water main velocities are well below 8 fps. PZ 3 also meets minimum system pressure requirements during MDD plus fire flow (1,000 gpm) simulations.

Redundancy is also an issue within PZ 3 as the High Zone Reservoir relies on waterlines crossing though areas of unstable ground and under creeks to supply the storage reservoir. An eight-inch DI transmission main crosses both Kanaka Creek and Vallett Creek through areas with limited access. This line is currently isolated due to leakage. The existing eight-inch AC water line along Bone Road also experiences breaks due to ground movement. It is recommended that these lines be replaced with larger diameter mains to improve reliability and increase transmission capacity.

5.5.5.5.5 Pressure Zone 3-1

PZ 3-1 is in the northeast region of the system. Though it comprises a relatively small part of the overall system, it is served through three PRV stations. One PRV station is at the intersection of Hillcrest Avenue and Loop Road. The second is on Loop Road just north of Pine Street. The third is a small PRV that serves two houses on a dead-end line on NE Major Street, north of Hillcrest Avenue. Static pressures in this sub-PZ range from 36 to 78 psi. High pressure service areas utilize individual service PRV's.

Minimum system pressures during PHD simulations remain above DOH requirements and water main velocities are well below 8 fps. Much of PZ 3-1 meets MDD plus fire flow (1,000 gpm) simulations except for the area at the south end of Major Street due to a single four-inch AC main serving this area.

- An estimated 500 linear feet (LF) of existing four-inch main along Hillcrest Avenue and NE Major Street. Upgrading this portion to eight-inch waterline corrects the fire flow deficiency at the end of this pipeline.

In addition to the above deficiency, it is recommended that the small PRV serving the two houses on NE Major Street, north of Hillcrest Avenue, be transferred to the larger diameter water lines in Hillcrest Avenue. The small PRV and small diameter mains serving these houses could then be abandoned.

5.5.6 Water Quality Evaluation

5.5.6.1 General

The water quality evaluation was conducted in accordance with the methodology outlined in **Section 3**. A review of key information relevant to the water quality evaluation of the Stevenson Water System is included below:

- Estimated Population Served in 2015: 1,530
- Type of System: Group A Community
- Sources: Three surface water sources used for production (LaBong Creek, Cedar Springs and Rock Creek) and one groundwater source (Hegewald Well)
- Treatment: 1.0 MGD surface water treatment plant.

The LaBong Creek, Cedar Springs and Rock Creek surface water sources serving the City have excellent raw water quality and are in compliance with current water quality regulations. Hegewald Well has excellent raw water quality except for pH issues as discussed later in this section.

Table 5-7 summarizes the compliance of the Stevenson Water System in 2016 based on the DOH Sentry database. **Table 5-8** summarizes current water quality monitoring requirements. Promulgated and anticipated future regulations are not anticipated to impact operation of the water system.

Table 5-7
Compliance with Existing Water Quality Regulations - 2016

Monitoring Location	Regulated Contaminant or Action	Monitoring Compliance	Water Quality Compliance
Source (LaBong Creek)	IOCs	Yes	Yes
	Nitrate	Yes	Yes
	VOCs	Yes	Yes
	SOCs	Yes	Yes
	Radionuclides	Yes	Yes
Source (Cedar Springs)	IOCs	Yes	Yes
	Nitrate	Yes	Yes
	VOCs	Yes	Yes
	SOCs	Yes	Yes
	Radionuclides	Yes	Yes
Source (Rock Creek)	IOCs	Yes	Yes
	Nitrate	Yes	Yes
	VOCs	Yes	Yes
	SOCs	Yes	Yes
	Radionuclides	Yes	Yes
Source (Iman Spring)	IOCs	Yes	Yes
	Nitrate	Yes	Yes
	VOCs	Yes	Yes
	SOCs	Yes	Yes
	Radionuclides	Yes	Yes
Source (Hegewald)	IOCs	Yes	Yes
	Nitrate	Yes	Yes
	VOCs	Yes	Yes
	SOCs	Yes	Yes
	Radionuclides	Yes	Yes
Treatment System (WTP)	Raw Water Fecal Coliform	Yes	Yes
	Turbidity	Yes	Yes
	CT Ratio	Yes	Yes
	Residual Chlorine	Yes	Yes
Treatment System (Hegewald Well)	Residual Chlorine	Yes	Yes
Distribution System	Bacteriological	Yes	Yes
	Residual Chlorine	Yes	Yes
	DBPs	Yes	Yes
	Lead and Copper	Yes	Yes

Notes:
IOC = Inorganic Chemical and Physical parameters
VOC = Volatile Organic Compounds
SOC = Synthetic Organic Compounds (e.g., pesticides)
DPBs = Disinfection By Products including Total Trihalomethanes and 5 Haloacetic Acids

Table 5-8
Water Quality Monitoring Requirements

Constituent	Samples Required	Compliance Period	Frequency	Last Sample Date
Coliform and Chemical Monitoring				
Coliform Monitoring	2 / Month	Annual	Monthly	
Lead and Copper	10	Jan 2015 - Dec 2017	Standard - 3 year	10/14/2014
Asbestos	1	Jan 2011 - Dec 2019	Standard - 9 year	5/18/2010-
Total Trihalomethane (THM)	1	Jan 2017 - Dec 2017	Reduced - 1 year	3/28/2017
Halo-Acetic Acids (HAA5)	1	Jan 2017- Dec 2017	Reduced - 1 year	3/28/2017
Source Monitoring				
S01 LaBong Creek - Permanent, Surface Water				
Nitrate	1	Jan 2017- Dec 2017	Standard - 1 year	9/20/2016
Complete Inorganic (IOC)	1	Jan 2011 - Dec 2019	Waiver - 9 year	3/31/2011
Volatile Organics (VOC)	1	Jan 2014 - Dec 2019	Waiver - 6 year	3/31/2011
Herbicides	1	Jan 2014 - Dec 2022	Waiver - 9 year	10/28/2009
Pesticides	0	Jan 2017- Dec 2019	Waiver - 3 year	10/28/2009
Soil Fumigants	0	Jan 2017- Dec 2019	Waiver - 3 year	-
Gross Alpha	1	Jan 2014 - Dec 2019	Standard - 6 year	12/29/2016
Radium 228	1	Jan 2014 - Dec 2019	Standard - 6 year	12/29/2016
S02 Cedar Springs - Seasonal, Surface Water				
Nitrate	1	Jan 2017 - Dec 2017	Standard - 1 year	9/20/2016
Complete Inorganic (IOC)	1	Jan 2011 - Dec 2019	Waiver - 9 year	7/25/2011
Volatile Organics (VOC)	1	Jan 2014 - Dec 2019	Waiver - 6 year	7/25/2011
Herbic ides	1	Jan 2014 - Dec 2022	Waiver - 9 year	7/27/2009
Pesticides	0	Jan 2017 - Dec 2019	Waiver - 3 year	7/27/2009
Soil Fumigants	0	Jan 2017 - Dec 2019	Waiver - 3 year	-
Gross Alpha	1	Jan 2014 - Dec 2019	Standard - 6 year	12/29/2016
Radium 228	1	Jan 2014 - Dec 2019	Standard - 6 year	12/29/2016
S03 Rock Creek - Seasonal, Surface Water				
Nitrate	1	Jan 2017 - Dec 2017	Standard - 1 year	9/20/2016
Complete Inorganic (IOC)	1	Jan 2011 - Dec 2019	Waiver - 9 year	7/25/2011
Volatile Organics (VOC)	1	Jan 2014 - Dec 2019	Waiver - 6 year	7/25/2011
Herbicides	1	Jan 2014 - Dec 2022	Waiver - 9 year	7/27/2009
Pesticides	0	Jan 2017 - Dec 2019	Waiver - 3 year	7/27/2009
Soil Fumigants	0	Jan 2017 - Dec 2019	Waiver - 3 year	-
Gross Alpha	1	Jan 2014 - Dec 2019	Standard - 6 year	12/29/2016
Radium 228	1	Jan 2014 - Dec 2019	Standard - 6 year	12/29/2016
S04 Hegewald Well #1 - Seasonal, Well				
Nitrate	1	Jan 2017 - Dec 2017	Standard - 1 year	9/20/2016
Complete Inorganic (IOC)	1	Jan 2011 - Dec 2019	Waiver - 9 year	11/21/2005
Iron	1	Jan 2017 - Dec 2019	Standard - 3 year	9/20/2016
Volatile Organics (VOC)	1	Jan 2014 - Dec 2019	Waiver - 6 year	7/25/2009
Herbicides	1	Jan 2014 - Dec 2022	Waiver - 9 year	9/13/2006
Pesticides	0	Jan 2017 - Dec 2019	Waiver - 3 year	10/02/2006
Soil Fumigants	0	Jan 2017 - Dec 2019	Waiver - 3 year	-
Gross Alpha	1	Jan 2014 - Dec 2019	Standard - 6 year	12/29/2015
Radium 228	1	Jan 2014 - Dec 2019	Standard - 6 year	12/29/2015

5.5.6.2 Hegewald Well

In the past, extended operation of Hegewald Well has resulted in complaints about water quality. The well's existing water quality monitoring records have been reviewed to identify likely causes for customer responses. The well generally has good water quality with respect to the required testing parameters and is comparable to other high-production municipal wells in southwest Washington. However, this similarity includes a pH of approximately 6.5. Other communities with similar mildly acidic water resulted in excessive levels of copper in customer tap water because of corrosion of household piping and fixtures. Elevated copper levels were discovered at several customer taps when Hegewald Well was operated for a six-week period during the rehabilitation of the water treatment plant in 2001.

Treatment to raise the pH should reduce the degree of customer concerns and would effectively eliminate the observed increase in copper levels which exceeded the standards of the Lead and Copper Rule. Based on the experience of other similar water systems and the water chemistry of this well, the recommended treatment would be the addition of caustic soda to raise the pH to at least 7.0. Given the limited production volume for this well the installation of bulk chemical handling facilities would not be necessary. The chemical supply could be in dry or liquid form depending on operator preference and the accessibility and storage capabilities of the existing well building.

5.6 Long-Term Water System Viability

5.6.1 Financial Viability

The largest concern with small water systems is their financial viability as they face expensive infrastructure replacement and upgrades to meet new standards. Impacts of the Safe Drinking Water Act also have significant cost implications for small water utilities both for testing costs and operating requirements. The Stevenson water system is financially healthy and can generate the revenue necessary to meet both water quality testing requirements and the ongoing system maintenance and replacement requirements.

Future extension of the water system will require development to cover the cost of water main construction as well as provide capital reserves to finance increases to supply, storage and transmission facilities that will be necessary. Adherence to the system development standards developed in conjunction with water system planning and a policy of increasing both connection fees and user fees to reflect actual costs will place the City in an excellent position to maintain long-term viability. See Section 8 for additional discussion of financial viability.

5.6.2 Long-Term Water Supply Evaluation and Recommendations

This section presents a brief analysis of the City of Stevenson's water supply as it relates to the long-term viability of the water system. This analysis is based on water demand projections established in Section 4, the evaluation and assessment discussed previously as well as discussions with City staff. Recommendations generated through this analysis are incorporated into the capital improvement program presented in **Section 6**.

While the City has sufficient supply capacity to meet projected 20 year demands with its current surface water sources, several factors associated with utilizing surface water have prompted the City to consider alternatives. These factors include:

- Seasonal variation in stream flows, particularly during peak demand periods
- Aging infrastructure, including raw water transmission mains and the water treatment plant
- An increasingly stringent regulatory environment surrounding surface water

Evaluating alternative water supply options now allows the City to plan for improvements which will offer maximum flexibility in providing potable water to existing and future customers.

5.6.2.1 Alternative Supply Options

Two long-term water supply options are discussed in this section. They include the following:

Option 1: Continued use of surface water supply
Option 2: New groundwater supplies

A detailed discussion of each of the supply alternatives is presented below followed by a summary of findings and presentation of a water supply development strategy.

5.6.2.1.1 Option 1: Continued Use of Surface Water Supply

The City's existing primary surface water supplies are LaBong Creek and Cedar Springs with Rock Creek being used during periods of peak demand when flows in LaBong Creek are low. These sources provide sufficient capacity to meet current and projected 20-year demands. In addition, the City has water rights for these sources in excess of what is required in the foreseeable future.

While raw water quality is good, treatment regulations are becoming more stringent which may ultimately prove difficult for the current plant to meet. In addition, the plant is nearly 40 years old, and although well maintained, will likely require major upgrades within the 20-year timeline covered in this plan. The City's rights are senior to instream flow rights. However, should the City require rights above their current values, they will be affected by instream flow minimums for fish habitat.

This option assumes continued use of the City's surface water sources and water treatment plant. In order to keep using the surface water sources and water treatment plant, improvements and ongoing maintenance will need to be planned for. The City has identified short-term improvements needed at the plant to keep it functioning at its current level. These include replacement of the existing electrical controls with Programmable Logic Controller (PLC)-based controls, new motor starters, a manual transfer switch for a portable backup generator, and new radio based SCADA system. Improvements to the effluent pumps to meet future demands as discussed previously will also need to be completed if surface water is intended to be the primary source of water.

Besides the capital projects described above, the raw water intakes, transmission facilities and treatment plant will require continued maintenance over time. Projects include replacement of intake screens, repair and / or replacement of aging transmission pipelines, and replacement of filter media. This list of projects is not meant to be exhaustive but rather represent the type of continuing expenses the City should expect by continued operation of surface water sources.

5.6.2.1.2 Option 2: New Groundwater Supplies

The City currently operates the Hegewald Well as a backup supply to its surface water sources. With an installed capacity of 550 gpm and water right of 600 gpm, the well is a valuable resource to the water system. However, in order to provide additional water supply capacity to meet increasing demands and provide redundancy, the City will need to drill additional wells if groundwater supply is part of the City's long-term water supply development strategy. Well exploration areas should be selected based on key considerations which will affect the well's productivity and relative cost. These factors include:

1. Hydrogeologic evaluation
2. Potential for hydraulic connection with surface water
3. Water quality
4. Interference between new and existing wells
5. Available infrastructure

A brief summary of each factor is provided below:

Hydrogeologic Evaluation – A hydrogeologic evaluation is needed to better understand local aquifer characteristics and determine its long-term yield capabilities. The evaluation will identify well locations with the highest probability for success.

Hydraulic Connection with Surface Water – The City will need to apply for a new water right from the Department of Ecology (DOE) if new groundwater sources are desired. DOE should find a new municipal-use groundwater application to be consistent with the findings of Water Resource Inventory Area 29, Wind-White Salmon, which covers the area surrounding the City, so long as the groundwater is not found to be linked to surface water, or if the only hydrogeologic link is found to be the Columbia River. Potential well locations should be carefully identified such that hydraulic connection between groundwater and surface water is unlikely. In addition, determination of the basin to which the aquifer is contributing water will be a significant factor in determining the viability of new groundwater sources.

Water Quality – In general, the existing City well produces high quality water but with a low pH. As discussed previously, installation of treatment to raise the pH is recommended if the well is to be used on a permanent basis. It is unknown if pH adjustment would be a requirement for wells in other parts of the City, but for budgeting purposes, it can be assumed that treatment facilities to adjust pH will be required. Testing of water samples will be required to determine water quality parameters of new sources. Disinfection through chlorination will likely be required regardless of well location.

Interference Between New and Existing Wells – New groundwater sources should have no adverse impact on existing wells. Identifying the potential for negative effects on adjacent wells will be part of the initial evaluation. Water levels in surrounding wells will be measured during drawdown tests of proposed sources.

Available Infrastructure – New wells would ideally be placed at locations suited to use existing water treatment and distribution facilities because of the high cost to construct separate facilities for each additional increment of capacity. Based on this consideration, ideal new well sites would be near existing treatment facilities and / or the Hegewald Well. A significant drawback to locating new wells close to existing wells or to each other is the increased potential for excessive well drawdown interference, which may limit or reduce individual well capacities.

5.6.2.2 Supply Analysis Findings Summary

The key findings of the supply options analysis are summarized as follows:

- Steps should be taken to optimize the City's existing surface water supply system to meet current and future needs. This includes increasing WTP effluent pump capacity assuming the existing surface water sources continue to be used as the primary source.
- Improvements and ongoing maintenance will be required for continued operation of surface water facilities.
- pH adjustment will be required at the Hegewald Well if it will be used on a more regular basis.
- Further groundwater development to serve the City's future demands requires additional data collection. An exploratory well drilling program should precede development of a production well to confirm aquifer suitability, water quality conditions and anticipated sustainable yield at a given site.
- A preliminary engineering analysis should be completed in conjunction with a hydrogeologic study to identify proposed system improvements, associated costs, and implementation schedule.
- The City will need to acquire water rights for future groundwater supply if it is determined that groundwater development is the preferred alternative. It is recommended that the City submit an application for a new water right permit as soon as practical following completion of a hydrogeologic evaluation and preliminary engineering effort.

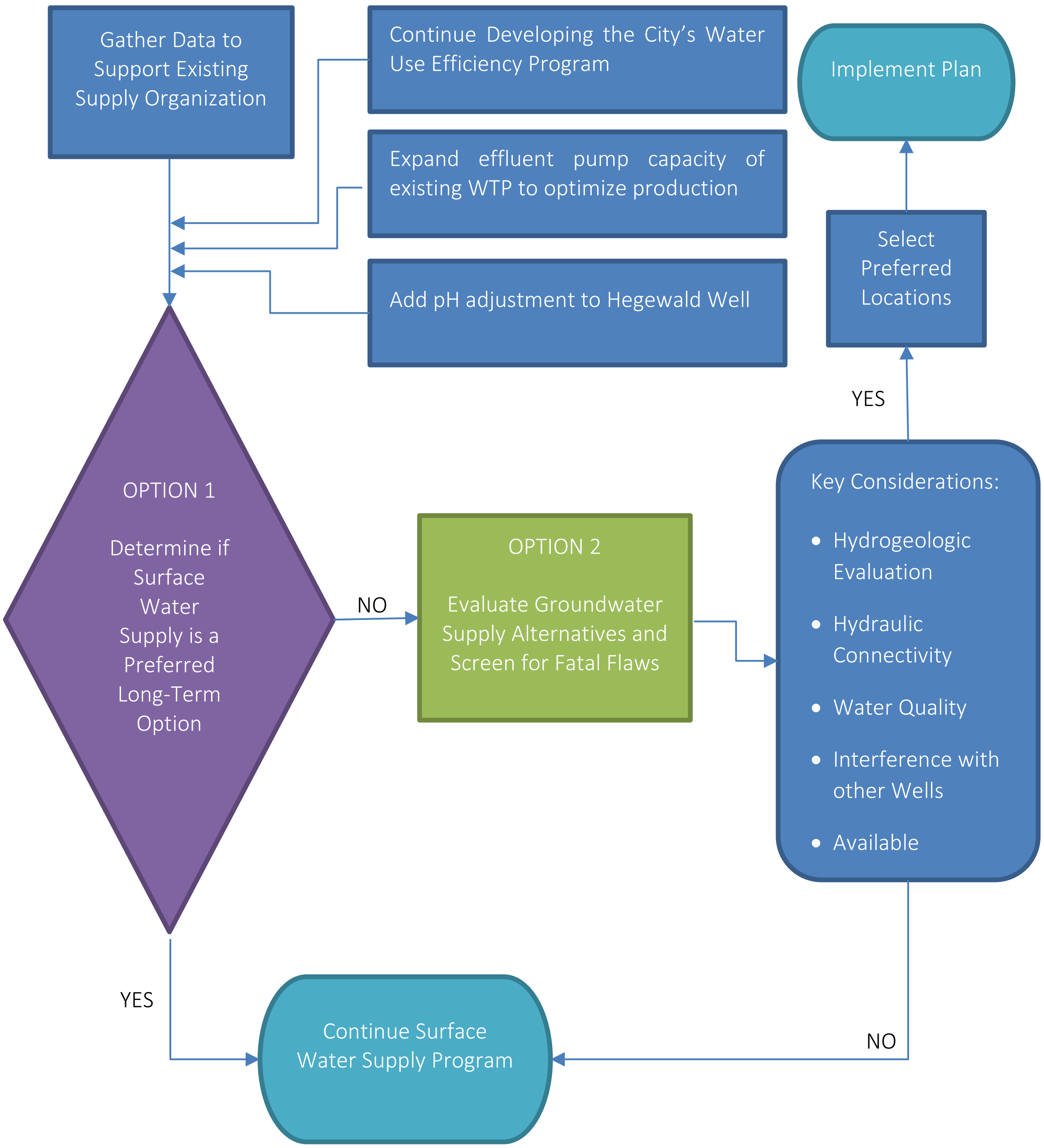
5.6.2.3 Development Strategy

The ultimate development and implementation of a long-term water supply strategy has a number of variables and unknowns. **Figure 5-4** illustrates a recommended strategy for systematically evaluating supply Options 1 and 2. The purpose of following a systematic approach is to minimize the cost and risk as the City pursues the development of a long-term water supply.

The water supply development strategy emphasizes the implementation of low cost measures initially while continuing to optimize and develop additional capacity to meet water supply needs. This approach offers the following benefits:

- Provides the City with time to gather the necessary data to fully evaluate the potential of local groundwater resources to meet the City's long-term water supply needs while addressing needs for expanded water supply to meet increasing demands at the lowest possible cost.
- Allows analysis of alternative water supply sources to be advanced, refining the costs and risks associated with water supply development options before selecting a preferred approach.
- The City should also consider continued water efficiency measures to reduce peak demands on the system. These measures, discussed below, if deemed feasible and cost effective, could allow the City to defer supply development projects.
  - Water System Efficiency: These measures include implementation of water conservation programs (customer education, rebates for high efficiency appliances and fixtures, etc.) and water loss audits and actions to reduce system losses (water main replacement, leak detection program, improved metering) as outlined in the City's Water Use Efficiency plan. These programs could make better use of existing supplies.

Figure 5-4
Water Supply Development Strategy Decision Schematic



Section 6 presents budget level estimates for capital costs associated with the ongoing implementation of groundwater supply and development of a data collection and well maintenance program.

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Section 6

Capital Improvement Plan

6.1 Introduction

This section describes the water system improvements to the City's service area to address deficiencies identified in **Section 5**. It includes projects recommended within 1- to 10 and 11- to 20-year planning horizons. The recommended improvement projects are shown in **Figure 6-2** and **Figure 6-3** and are summarized in **Tables 6-1** and **6-2**.

The information presented is intended to assist the City with its annual budgeting process, but more definitive project costs should be developed as the design for each recommended improvement is developed. The total cost of projects within the 1- to 10-year timeframe is approximately $2.6 Million (M) and within the 10- to 20-year timeframe is approximately $8.7 M, bringing the 20-year total to $11.3 M.

6.2 Cost Estimates

An estimated project cost has been developed for each improvement project presented in the CIP. Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The Association for the Advancement of Cost Engineering International (AACE International) classifies cost estimates depending on project definition, end usage and other factors. *The cost estimates presented here are considered Class 5 with the end usage being concept screening for long-range planning and an expected accuracy range of -30 percent to +50 percent.*

During the design phase, final sizing, location, and project components should be verified and a Preliminary Engineering Report completed. As part of the Preliminary Engineering Report or predesign, the cost estimate should be refined. Therefore, project feasibility and any associated risks should be carefully reviewed prior to making specific financial decisions or establishing yearly project budgets to help ensure adequate project funding.

Estimated project costs include approximate construction costs and allow for contingency, permitting, administration, and engineering fees. Costs do not typically include any land or right-of-way acquisition and do not include any ongoing maintenance or operation expenses. Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News Record (ENR) CCI is a commonly used index for this purpose. For purposes of updating cost estimates in the future, the current ENR CCI for Seattle, Washington is 10698.72 (April 2017).

Construction costs are based on the preliminary concepts and layouts of the water system components developed during the system analysis. The detailed cost methodology is presented in **Appendix F**. The City performs a significant amount of its pipeline replacement, however to be conservative, all costs assume contracted engineering and labor.

6.3 Water System Improvements

The City generally has adequate source, treatment, storage, and pumping capacity to meet existing and projected future demands. Capital Improvement Projects identified here will address distribution system deficiencies, source of supply reliability, and reservoir resiliency. There are also projects focusing on improving the quality of system information through telemetry and SCADA upgrades.

Some projects combine multiple components (e.g. pipe, pump, tank, SCADA, etc.) while others are only one component. All projects are identified with a numeric project ID. The location of projects, particularly new facilities, are approximate as depicted in **Figure 6-2** and **Figure 6-3**. Specific locations will be determined during design.

The projects are organized in two timeframes, those to be constructed over the next 10 years and those recommended for completion between years 11 through 20. Within these groupings the projects are not placed in any order. As the City annually reviews system growth, available budget, and other factors, the list of projects to be constructed will be determined and may vary from the recommendations in this section. Detailed descriptions of the projects are provided below.

6.3.1 Completed Improvements

Below is a list of completed Capital Improvement Projects from the City's 2007 Water System Plan update:

a. S5 – LaBong Creek Self Cleaning Screen
b. S8 – Streaming Current Monitor
c. R1 – Zone 3 Booster Pump Station Improvements
d. D1a – Zone 3 Gropper / Kanaka Creek / Simmons Road Improvements
e. D1b – Zone 3 Lucas Street / Loop Road Improvements
f. D10 – Zone 1/3 Chinidere Water Improvements
g. D13 – Zone 2-1 Lower Kanaka Creek Road Improvements
h. D14 – Hidden Ridge Water Improvements
i. D15 – Meter and Waterline Replacement

6.3.2 Projects Years 1 to 10

1 – Water Treatment Plant

Complete miscellaneous improvements at the water treatment plant including the upgrade of controls to a PLC based system and installing a manual transfer switch at the WTP to allow operation by portable emergency generator in the event of an extended power outage.

2 – Telemetry / SCADA Improvements

Replacement and upgrade of telemetry and SCADA systems for the water system. It is assumed the existing telemetry system would be replaced with a cellular-based system. New SCADA panels will be provided for the WTP, Hegewald Well, Base Reservoir / Pump Station 3, Catholic Church Reservoir, and High Zone Reservoir.

3 – Hegewald Well

Install chemical addition to adjust the pH of raw water to satisfy the requirements of the Lead and Cooper Rule. Adjustment of the pH will reduce customer complaints when the City uses the well.*4 – New Groundwater Source Study*

Investigate a replacement well in either the City-owned LaBong Creek watershed, near the Hegewald Well, or close to the Columbia River. Work will include an initial hydrogeologic investigation, preliminary engineering report, and test well. Assuming completion of a successful test well, development of new groundwater source(s) would include electrical / controls, chemical building, transmission main to distribution system, and water rights.

5 – Base Reservoir Roof

The existing roof is made of Portland Cement Concrete (PCC) with integral beams and has an overlay of gravel and emulsified asphalt. The asphalt is worn off in several places, leaving the PCC exposed and subject to degradation. The proposed project consists of removing the existing gravel / asphalt overlay and replacing it with a new membrane overlay. The roof and sidewall interface will be constructed to be watertight during replacement of the existing reservoir roof. Deficiencies where the new siding meets the existing roof will be filled with mortar to seal the structure.

6 – Base Reservoir Condition Assessment

The Base Reservoir is the largest reservoir in the Stevenson Water System and is a vital link in the system. The project will be a high-level assessment of the seismic resilience of the structure. This assessment will be based on materials of construction, age and as-built drawings of the wall thickness, reinforcing, and foundation. Needed future investigations and structural evaluation of the reservoir will be identified.

7 – Zone 1 Distribution Improvements

Three improvement projects are proposed for the PZ 1 distribution system to address existing system deficiencies. Each project is described below.

The first project involves the replacement of the six-inch reservoir transmission main routed along School Street and Russell Avenue. This line is undersized to provide existing and future fire flow goals to the commercial district. Replacing the six-inch main with, at a minimum, an eight-inch main will improve fire flow capabilities to the downtown commercial area. Total length is approximately 1,450 feet.

The second project is the replacement of undersized AC waterlines along SW Atwell Road between Rock Creek Drive. Replacement of this four-inch main with an eight-inch main will increase available fire flow to this area thereby meeting the 2,000 gpm fire flow goal. Total length is approximately 1,000 feet.

The third project is the replacement of undersized AC waterlines along Rock Creek Drive between Ryan Allen Road and Monda Road and along Rock Creek Drive from Monda Road to the intersection with the water main from the Angel Heights PRV. Replacement of these six-inch mains with eight-inch mains will increase available fire flow to this area thereby meeting the 2,000 gpm fire flow goal for future commercial development. Total length is approximately 1,430 feet.

8 – Zone 2-1 Distribution Improvements

Three improvement projects are proposed for the PZ 2-1 distribution system to address existing system deficiencies. Each project is described below.

The first project is the construction of a new PRV station intertie with PZ 3. The PRV would replace a closed valve on Frank Johns Road near Gale Street. Addition of an intertie in this location increases available fire flow to the Frank Johns and Loop Road areas.

The second project is the replacement of undersized AC water mains in Frank Johns Road from Gale Street to Loop Road. Replacing the six-inch water main with an eight-inch main increases available fire flow to the Frank Johns and Loop Road areas. Total length is approximately 900 feet.

The third project is the replacement of undersized AC water mains in Frank Johns Road from Loop Road to just north of Highway 14. Replacing the six-inch water main with an eight-inch main satisfies available fire flow to the lower reaches of Frank Johns Road. Total length is approximately 1,000 feet.

In addition to the projects described above, it is recommended that the remaining AC water mains in the zone be upsized to eight-inch when they are replaced as part of the City's AC pipe replacement program. Opportunities to transfer lower elevation portions of this area to PZ 1 should be explored as new development is proposed east of the downtown area.

9 – Zone 3-1 Distribution Improvements

One improvement project is proposed for the PZ 3-1 distribution system to address existing system deficiencies. The project is described below.

Replacement of an undersized AC water main in Hillcrest Avenue and NE Major Street. Replacing the four-inch water main with an eight-inch main satisfies available fire flow to the lower reaches of NE Major Street. Total length is approximately 500 feet.

6.3.3 Projects Years 11 to 20

10 – Water System Plan Update

This project includes funds to complete two updates to this Water System Plan over the 20-year horizon.

11 –Zone 1 Distribution Improvements

Two improvement projects are proposed for the Zone 1 distribution system to accommodate future growth. Each project is described below.

The first project includes an extension of 12-inch main along SR-14 to the easternmost limits of the Urban Growth Area. This extension will satisfy the 2,000 gpm fire flow goal for potential development at the eastern end of PZ 1. Total length of pipe is approximately 3,280 feet.

A second project includes the extension of a 12-inch main west on Rock Creek Drive and SR-14 to the westernmost limits of the Urban Growth Area. This project will also satisfy the 2,000 gpm fire flow goal for potential developments at the west end of PZ 1. Total length is approximately 3,200 feet.

12–Zone 2 Distribution Improvements

Two improvement projects are proposed for the PZ 2 distribution system to accommodate future growth. Each project is described below.

The first is the relocation of the existing pressure reducing station near the Interpretive Center to restructure the service zone for this area. Relocating this pressure reducing station from Rock Creek Drive to just north of the intersection of Ryan Allen Road and Foster Creek Road will benefit this area by transferring existing waterlines on both roads from PZ 2 to PZ 1.

A second improvement for PZ 2 is to provide looping at the west end of the system by extending the 12-inch water mains adjacent to Skamania Lodge to the proposed PZ 1 waterline extension at the west end of the system. This improvement will require the installation of a pressure reducing valve to connect the two zones. Total length is approximately 2,500 feet.

13 – Zone 3 Distribution Improvements

Two improvement projects are proposed for the Zone 3 distribution system to accommodate future growth. Each project is described below.

The first project includes an extension of an eight-inch main north on Maple Way Road from the intersection with Gropper, and an extension of eight-inch main along West Loop Road. Total length of pipe is approximately 5,700 feet.

The second project is a eight-inch main on Maple Way Road between West Loop and Kanaka Creek Road that will provide the backbone for future development. Total length of pipe is approximately 1,700 feet.

14 – Pressure Zone 4 Improvements

A single project is identified for Zone 4 and will be dependent upon development extending into this higher elevation area. This project includes construction of a 500,000-gallon reservoir, booster pump station, PRV intertie, and extension of a 12-inch water main north along Kanaka Creek Road to the future PZ 4 reservoir site. Total length of pipe is assumed to be approximately 4,600 feet for cost estimating purposes. Because this is outside of the Retail Service Area, a water system plan amendment will be needed to expand the boundary.

There are two alternatives for upgrading the distribution system to supply water to the proposed Zone 4 reservoir. These alternatives are described below and represented graphically in **Figure 6-1**.

Alternative A - Install a booster pump station to supply the proposed PZ 4 reservoir from the PZ 3 distribution system. PZ 4 reservoir construction will include the construction of a new lift station and PRV intertie within PZ 3. The construction of a future PZ 4 reservoir and pressure reducing intertie will supplement PZ 3 fire storage deficiencies.

Alternative B - Upgrade the Zone 3 booster pump station with higher head pumps and transfer the Gropper Road / Kanaka Creek Road transmission main to directly serve the proposed Zone 4 reservoir. This alternative would require that the High Zone reservoir be fed directly from the proposed PZ 4 reservoir and isolating PZ 3 distribution system connections to the Gropper Road / Kanaka Creek Road transmission main, or installing pressure reducing connections between the high-pressure transmission main and PZ 3 distribution system.

For developing this plan, the Alternative A improvements will provide the basis of future capital improvements. However, the potential to implement both alternatives will be evaluated during the review of development proposals and design of critical infrastructure components.

The City completed a preliminary siting study for the proposed PZ 4 reservoir which was summarized in the August 2003 Water System Plan Amendment. This study included a geotechnical investigation by Squier & Associates which resulted in the identification of four potential reservoir sites with relatively favorable conditions in respect to landslide hazards. The following is a summary of the potential sites as presented in the Squier report (see **Appendix J**).

Site A - This site is located east of Loop Road in a debris flow zone with a designated "moderate" hazard characterization. While deep seated landslide hazards do not appear to present a significant threat, upslope failures could result in rapidly moving debris flows, though the potential for upslope landslide debris reaching the site is considered low.

Site B - This site is located on a high bluff upslope of Baker Road with a designated "low" hazard characterization. Steep escarpments bound this area with older landslide deposits below. Siting a reservoir in this area will require careful evaluation of slope stability for the site, including evaluation of the stability of the escarpments. Siting a reservoir in this area will also require the City to verify available properties as the general location is currently being developed.

Site C - This site is located near the existing Zone 3 Reservoir at the upper extent of Bone Road with a designated "low" hazard characterization. This site is located on a ridge line that parallels an apparently dormant landslide area where the existing reservoir is located.

Site D - This site is located on the nose of a long northwest trending ridge upslope of the Williams gas pipeline at the eastern limits of the growth boundary with a designated "low" hazard characterization. Roadway access to this area does not presently exist.

In comparing the reservoir site alternatives, consideration was given to transmission main routing, vacant properties, areas of current and future development, and total infrastructure and land costs. Based on these considerations, it was concluded that Site B and C are the preferred sites. These sites are centrally located within the service area, reside within "low" landslide hazard ratings, and provide the lowest cost for installing transmission main to the site from the existing PZ 3 distribution system. If unanticipated future development occurs primarily in the eastern or western fringes of PZ 4, Site A or Site D may warrant further investigation. Once the preferred site has been selected, a site-specific preliminary engineering report, including reservoir foundation investigation, should be conducted at the site. For developing capital improvement projects and costs, the proposed PZ 4 reservoir is shown near Site B.

6.4 Ongoing Pipe Replacement

The City does not currently maintain an annual budget for the replacement of smaller diameter and poor condition pipe. However, they recognize the need to replace older water mains, especially those constructed of asbestos cement pipe because this material has been the primary source of leaks and water main breaks in the system. On average, the City replaces approximately 400 feet of water main each year. Most of this replacement work has been self-performed by City crews which allows for more pipe to be installed, per dollar invested, when compared to using a contractor.

With most of the water system being installed since the 1960's, the City has a head-start on maintaining a 100+/- year cycle on its pipe. The City is working to develop an annual pipe replacement budget while recognizing that the budget will likely need to be leveraged for other system projects such as fire flow improvements and coordination with street or other infrastructure system improvements.

Zone restructuring to reduce the extent of high pressure areas and reliance of individual pressure reducing valves has been examined during previous water plan updates. However, given the challenging topography as previously discussed and length of time many areas have been adequately served by existing facilities, it is difficult to justify the construction of upgrades during a period when the resources of the City are limited. Opportunities to transfer existing waterlines or service areas to an "ideal" pressure zone will be examined in additional detail when future waterline projects make such a project feasible.

6.4.1 Leak Reduction Program

The City's Water Loss Control Action Plan (WLCAP) outlines actions the City will take to reduce its leakage rate to below 10%. These efforts include leak detection surveys, calibration of large service meters, replacement of outdated water mains, and having pressure reducing valves serviced regularly. The WLCAP in **Appendix C** discusses how these activities will be paid for.

Current pipe replacement priorities include 1) replacing approximately 2,000 feet of six-inch AC mains with eight-inch ductile iron on Ryan Allen Road between Foster Creek Road and SW Rock Creek Drive and 2) replacing approximately 1,300 feet of six-inch AC mains with eight-inch ductile iron on Upper School Street between Hot Springs Alameda Road and Kanaka Creek Road.

6.5 Summary

Recommended projects are divided across two-time periods, those recommended within 10 years and those in years 11 through 20. Projects are intended to address system deficiencies projected during these time periods but should be evaluated annually through City reviews of demand growth, available budget and system development pressure. Within each time period, the projects are not placed in any particular order. **Table 6-1** summarizes the recommended system improvements for years 1 through 10. **Table 6-2** summarizes the recommended system improvements for years 11 through 20. The proposed improvements are shown on **Figure 6-2** and **Figue 6-3**.

Section 7

Operations and Maintenance

7.1 Introduction

This section addresses the operations and maintenance personnel and procedures of the Stevenson Water System.

7.2 Water System Operators

The water system has five certified operators. **Table 7-1** lists the operators and their associated certifications.

Table 7-1
Stevenson Certified Water Operators

Name	Certification Number	Operator Certification Classification					
		WTPO 1	WTPO 2	WDM 1	WDM 2	CCS	B.A.T.
Gordy Rosander	8277		X		X	X	
Eric Hansen	11516	X			X	X	
Karl Russell	11448		X		X	X	X
Mark Tittle	11929	X				X	
Tyson Schupbach	14338			X		X	

7.3 Description of Routine Operating Procedures

All operating procedures are performed by certified City staff.

LaBong Creek / Cedar Springs Diversion Structures - The diversion site is visited every other day, most of the year, with daily visits during the fall to clear leaves from the intake screens.

Settling Basin - The settling basin is visited every other day, most of the year, with daily visits during the fall to clear leaves from the outlet screens. Accumulated sediment is removed annually.

Raw Water Transmission Line - The entire line is inspected each spring to identify leaks and plan for routine maintenance as required.

Rock Creek Pumping Station - During regular operation of the Rock Creek facility, the pump station is visited daily. Sediment accumulation in the intake screens is flushed daily with raw water from the LaBong Creek transmission main.

Water Treatment Plant - The plant is visited at least twice a day to observe operations. Most performance information is recorded continuously. The plant operating rate is adjusted seasonally.

Hegewald Well - The well pump is operated every other day with discharge to waste to adequately exercise the pump and flush the column pipe. Bacteriological sampling is completed monthly to assure water quality during an emergency demand situation.

Reservoirs - The reservoir sites for the City's three pressure zones are visited weekly to observe conditions and ensure security. The interiors of the reservoirs are routinely inspected. The High Zone Reservoir is cleaned annually. The Base Reservoir was cleaned in 2015 and Catholic Church Reservoir was cleaned in 2016.

Valves - Valves are inspected and exercised annually to ensure they remain accessible and operational.

Pressure Reducing Valves - System PRVs are inspected annually to ensure proper operation.

Source Meter - The treatment plant effluent meter has not been calibrated since installation. Calibration should occur at least every three years.

Service Meters - The water meters are read every other month by the City. During this visit, the condition of the meter, box, and service are observed. Items in need of replacement or repair are noted and attended to as convenient. The water meters are replaced as needed due to damage, age, or if believed to be indicating low or incorrect readings.

Line Flushing - The City completes flushing on an annual basis. This flushing is scheduled for non-peak demand weeks.

Filter Plant Controls - The functions of the filter plant control equipment are inspected weekly to ensure proper operation of valves, level controls, back wash operation, etc.

Telemetry Equipment - Telemetry equipment is inspected visually for problems and values validated with appropriate system elements. When service is required, the utility contracts with a private firm with technical expertise and experience with the City system.

Fire Hydrants - Fire hydrants are maintained by the City Public Works Department. The City performs annual flushing and exercising, lubricates, cleans, and paints the hydrants as needed.

Spare Parts - The City maintains an inventory of spare parts commonly required for routine maintenance of its water system.

Landscaping - The access routes to the surface water intake and reservoir sites are periodically maintained, as needed, to ensure safe and reliable site access.

7.4 Description of Water Quality Sampling Procedures

The water sampling location for most monitoring requirements is at the water treatment facility. Bacteriological sampling is performed in accordance with the system's Coliform Monitoring Plan.

All sampling is performed by the water system operator with prompt delivery to a certified testing laboratory for analysis. All results are either sent directly to DOH or will be reported within 24 hours if a violation is determined for treatment, monitoring, or MCL requirements.

Coliform Monitoring Plan - The Coliform Monitoring Plan provides details on coliform sampling sites and schedules. A copy of this document is included in **Appendix C**. This plan is kept on file and made available to the Health Department for inspection or review upon request. This plan must be revised or expanded at any time the plan no longer ensures representative monitoring of the system, or as directed by the Department.

Public Notification - The water system is required to provide public notification when maximum contaminant levels are exceeded. These requirements and specific language required are contained in WAC 246-290. The basic procedure is publication of a notice in a local newspaper, posting in public place(s), or contacting customers by phone or mail. Notices shall be issued in a manner that assures that system customers have adequate information of the rules violation or system failure. The notice shall be easily understood and disclose all material facts regarding the nature of the problem. The notice shall describe any measures the customer should take for their protection and what mitigating or corrective measures the City is taking.

Repeat Sampling - Repeat sampling is also required for verification of the contaminant presence. For coliform sampling, the location for the three follow-up samples is contained in the Coliform Monitoring Plan. For other water quality parameters, the location is the same as the original sample.

Records - Water quality testing records are required to be kept by the water system as specified in WAC 246-290-480. The following records of the water system must be maintained for the time indicated:

Bacteriological Test:	5 years
Chemical Test:	Life of Facility

7.5 Emergency Response Activities

The City has prepared an Emergency Response Plan as included in **Appendix I**. The City is not required to satisfy Vulnerability Assessment requirements mandated by the EPA based on the population served. However, the Emergency Response Plan does incorporate elements required under these guidelines. **Table 7-2** provides the essential information related to emergency response:

Table 7-2
Emergency Phone Numbers

Utility Contact Information	
City of Stevenson:	
Day Time Phone Number	(509) 427-5970
Evening Phone Number	(541) 490-3288
Public Works Director:	Eric Hansen
Other Emergency Phone Numbers	
Washington State Department of Health, Southwest Region Drinking Water Operations (Olympia):	(360) 236-3030 / Fax (360) 236-3029
Regional Engineer:	Kay Rottell, P.E. / (360) 236-3037
Skamania PUD: (Adjacent Water Utility)	
Phone Number	(509) 427-5126
Water System Operator:	John Shields
Department of Emergency Management:	
Phone Number	(509) 427-8076
Skamania County Director:	John Carlson
Stevenson Police Department:	(509) 427-9490
Stevenson Volunteer Fire Department:	(509) 427-5552
General Emergency Response:	911

Utility contact information is contained on the water system bills. The Mayor and the Public Works Director have the authority to make emergency decisions relating to system operation and rental of emergency equipment, supplies, and services. The City shall immediately notify the DOH by telephone when an emergency arises which causes or threatens to cause a loss in water service of more than 24 hours or reduces water quality such that public health may be threatened. The phone number for the DOH is listed in the table above.

7.6 Most Vulnerable System Facilities

7.6.1 Source

Power Outage - The LaBong Creek diversion structures and transmission line would be unaffected. The Rock Creek Pump Station does not have backup power provisions and would be inoperable. The reliability of electrical power to these facilities has been good during recent years with limited, short duration, outages.

The City secured a portable backup power generator. A manual transfer switch has been installed at Hegewald Well. A transfer switch for the treatment plant is planned for the future.

Vandalism - Access to the LaBong Creek diversion structure is restricted by a locked access gate. The Hegewald Well pump building is locked and completely fenced. The Rock Creek pump station vault door is locked and the above grade portion of the concrete structure is fenced.

Equipment Failure - The City has two independent surface water sources and a well. Each source can supply water independent of each other depending on the nature of equipment failure.

7.6.2 Treatment

Power Outage - The treatment facility relies on electrical power for operation and currently has no backup power provisions. The reliability of electrical power to these facilities has been good during recent years with limited, short duration, outages.

A manual transfer switch is proposed for the treatment facility to allow for operation utilizing the portable backup power generator.

Vandalism - The entire site is fenced with a locked gate to restrict entry. The treatment plant building is also locked.

Equipment Failure - The facility includes two complete treatment trains that can be operated independently. Redundant components are also available for all other equipment.

7.6.3 Storage

Power Outage - The storage reservoirs operate by gravity and are not affected by power outages. Available storage volumes and low consumption rates likely experienced during a power outage, due to the season and curtailed use, should enable the water system to provide continuous supply even during an extended power outage, should it occur.

A permanent backup power generator was installed with the new High Zone Reservoir booster pump station.

Vandalism - Vehicle access to the Base and Church Reservoir sites are restricted with a locked gate. The High Zone reservoir site is unfenced with unrestricted access. All reservoir access hatches are locked.

Equipment Failure – Pumps supply the High Zone and Base Reservoirs. The low zone reservoir is supplied by gravity from the Base Reservoir.

7.6.4 Distribution System

Power Outage - There are no closed systems or customers with individual booster pumps in the water system. Therefore, no residences will be impacted in the event of a power outage.

Water Main Breaks - The water system has adequate valving to allow isolation of individual line segments. These isolation valves limit the area of service interruption while repairs are being made. Much of the core transmission system is looped which allows bypassing of a line that is out of service. Primary transmission main segments for both the high and intermediate zones lack looped lines.

Vandalism - Virtually all parts of the distribution system are below ground which limits the threat of casual vandalism. Valves and fire hydrants are easily accessible and could be opened by anyone with the necessary tools. This is normal for all water systems and considered an acceptable vulnerability.

Equipment Failure - All three pressure zones within the City are fed by gravity from the respective reservoirs and are therefore not vulnerable to equipment failure.

7.7 Cross Connection Control Program

There are few potential cross-connection hazards in the water system due to limited commercial and industrial activity. The City has implemented a full cross-connection control program including the adoption of an ordinance, operating policies, and operator certification. Important elements of the cross-connection control program include the source of authority, procedures for the identification and elimination of hazards to assure the protection of the water system, and an abbreviated list of premises requiring mandatory service protection as well as facilities with backflow potential.

The City's design standards provide the requirements for the type of cross-connection control device and place the responsibility upon the customer. When the City identifies an unprotected potential cross-connection, the customer shall be notified. If the problem is not corrected, then the City will ultimately discontinue service. The City shall also perform all necessary testing and inspection for all backflow devices, with the owner responsible for payment of all fees.

7.8 Water System Supplier / Chemical Inventory

The following is a list of common chemicals and testing equipment utilized by the City for standard operations and maintenance and associated suppliers.

7.8.1 Suppliers

Name	Jon Dyer	Jack C. Talmadge
Company	Consolidated Supply Company	RFI – Tech Solutions
Address	P.O. Box 5788 Portland, Oregon 97228	Ridgefield, Washington
Phone	(503) 620-7050	(360) 887-1500
Fax	-	(360) 887-1515

7.8.2 Chemical and Equipment Information

Chemicals

Vendor: Hach Company
P.O. Box 389, Loveland, Colorado 80539
Phone: (303) 669-3050

Item	Product Number
Phenolphthalein Indicator Powder Pillows	Cat #942
Bromcresol Green-Methyl Red Powder Pillows	Cat #943
Sulfuric Acid, Standard Solution 0.030N	Cat #413-32
Total Chlorine Reagent Powder Pillows	Cat #21056-69
Free Chlorine Reagent Powder Pillows	Cat #21055-69
Buffer Powder Pillows, pH 4.01	Cat #22269-66
Buffer Powder pillows pH 7.00	Cat #22270-66
Free Chlorine Indicator Solution	Cat #23140-11
Free Chlorine Buffer	Cat #23141-11
D.N.D. Compound	Cat #22972-55
Potassium Chloride Electrolyte	Cat #25469-02

Vendor: Univar USA, Inc.
6100 Carillon Point, Kirkland, Washington 98033
Phone: (425) 889-3400

Item	Product Number
Sodium Hypochlorite “Liquichlor” – 12.5%; 53-gallon drums	#670286
Aluminum Phosphate “Liquid” – 48%; 53-gallon drums	#200191

Testing Equipment

Vendor: Hach Company P.O. Box 389, Loveland, Colorado 80539 Phone: (303) 669-3050	
Item	Product Number
Hach 1720D Turbidimeter	P/N 52010-60
Hach One pH Meter,	Model #43800-00
Hach Table Turbidimeter	Model #2100P, P/N 46500-00
Turbidity Stablcal Ampule Kit	Cat #26591-05
Hach Portable Colorimeter for Chlorine	Cat #46700-00
Hach Alkalinity Tester	Cat #24443-00
Chemtrac CL2 Residual Chorine Analyzer CRA3500	P/N 46780-00
Chemtrac Streaming Current Meter SCM2500	P/N 46780-00

7.9 Complaints

The City currently has no unresolved complaints on record. If a complaint is received, a record is drafted and forwarded to Public Works for review and action and reviewed periodically by the City Council. Every attempt would be made to address complaints in a timely manner. A file of complaints is maintained for future reference.

Section 8

Financial Program

8.1 Historical Financing

The City of Stevenson has maintained financial records for its water system for over one hundred years. Operating budgets and capital facility plans are prepared annually. While the water and sewer funds were combined into one fund in 1975, their operations are maintained separately to meet bond covenants. All bond redemption accounts and bond reserve accounts are held within the Water/Sewer Fund rather than separated into individual bond funds. The basis of accounting was converted in 2014 from a full accrual system (including full depreciation) to a Cash Basis system. The financial statements are prepared according to accounting practices prescribed by the Washington State Auditor's Office Cash Basis *Budgeting, Accounting & Reporting System (BARS)*.

Historically, the City has relied on a variety of revenue sources to fund operations and provide capital for system improvements. Water sales, connection charges, and interest earnings have supported general operations. Until 1993, the City's water system was typical of most small-town systems with a mix of small commercial/institutional and residential users. In 1993 a large single user was added to the system; this user currently accounts for 22 percent of total water consumption. Commercial/institutional users now represent approximately 42 percent of operating revenues.

To finance capital improvements, the City has issued revenue bonds; used federal and state grants and loans; made small, short term inter-fund loans; transferred real estate excise tax revenues from the Capital Improvement Fund; sold timber from the City's watershed; and collected system development charges. Developers have financed and/or installed water mains and plant improvements over the past eighty years. The City does not plan under the State GMA and therefore is not eligible for impact fee assessments.

Table 8-1 summarizes the operating statements for the utility from 2010 to 2016 with system development charges and principal payments listed separately below the Net Income/Loss. The revenue and expense account lines follow the standards established by the Washington State Budgeting, Accounting and Reporting Standards (BARS) and the DOH Financial Viability Manual (2013). The beginning and ending balances represent those of the entire combined water/sewer fund and not only the water utility. The water utility operating revenues remain consistent with gradual increases. Residential and commercial growth was stagnant in 2013-2014 coinciding with the economic downturn. Operational costs fluctuate. Rates were increased in 2009, 2011 & 2012 and adjusted in 2013.

Table 8-2 summarizes the overall utility account balances from 2010 to 2016. These balance sheets include the total value of installed facilities, accumulated depreciation and amortization of capital grants, construction reserves, debt liabilities and debt reserves for 2010-2012. The accounting system switched to Cash Basis in 2013 and is no longer reported.

Table 8-1
Previous Operating Statements

	GAAP BASIS REPORTING			CASH BASIS REPORTING			
	FY2010	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016
Combined Water/Sewer Beg. Bal.	**576,361**	**701,059**	**789,779**	**912,171**	**871,194**	**1,065,534**	**824,990**
Revenues							
Water Sales	402,077	427,452	464,737	459,839	464,406	505,829	526,713
Fees & Services	7,350	7,786	7,495	6,852	6,986	6,835	7,126
Other Revenue	0	0	1,275	0	0	0	0
Total Revenue	409,427	435,237	473,507	466,690	471,392	512,665	533,839
Expenses							
General Operations	(201,930)	(211,077)	(202,109)	(191,455)	(230,689)	(270,666)	(258,101)
Maintenance	(35,845)	(51,621)	(23,661)	(42,718)	(62,224)	(84,423)	(73,253)
Customer Service	(41,361)	(44,745)	(46,365)	(50,909)	(53,556)	(48,608)	(54,431)
Gen Administration	(18,418)	(21,667)	(17,861)	(30,718)	(25,303)	(25,093)	(25,128)
Staff Training	(1,061)	(1,540)	(1,239)	(81)	(1,818)	(3,796)	(1,298)
Total Op Expenses	(298,615)	(330,650)	(291,236)	(315,881)	(373,590)	(432,586)	(412,211)
Other Expenses							
Depreciation	(107,832)	(105,113)	(108,978)	0	0	0	0
Taxes	(21,385)	(21,915)	(23,715)	(23,618)	(23,479)	(26,234)	(27,281)
Total Other Expenses	(129,217)	(127,028)	(132,693)	(23,618)	(23,479)	(26,234)	(27,281)
Other Income							
Grants	5,220	0	8,612	0	0	0	0
Costs for Install	1,949	5,213	6,458	126	1,238	14,845	11,688
Interest on Investment	752	676	786	704	414	2,373	2,939
Miscellaneous Income	0	0	0	913	894	729	(31)
NSF Fee Recovery	0	0	175	165	130	120	140
Total Other Income	7,921	5,890	16,031	1,907	2,676	18,067	14,736
Other Deductions							
Interest Payments	(2,654)	(2,363)	(2,064)	(1,801)	(1,513)	(1,280)	(1,280)
Theft/Adjustment	2	(0)	0	0	0	1	0
Total Other Deductions	(2,653)	(2,363)	(2,064)	(1,801)	(1,513)	(1,279)	(1,280)
Net Income/Loss	(13,136)	(18,914)	63,545	127,298	75,487	70,633	107,804
Capital Uses/Charges							
System Development Charges	29,940	9,000	9,000	3,000	3,420	24,000	18,000
Principal Payments	(32,233)	(32,412)	(32,594)	(31,729)	(23,273)	(23,273)	(23,273)
Capital Expenses	0	0	0	(39,641)	(24,612)	(287,687)	(195,148)
Total Capital Uses/Charges	(2,293)	(23,412)	(23,594)	(68,371)	(44,465)	(286,960)	(200,421)
Combined Water/Sewer End Bal.	**701,059**	**789,779**	**912,171**	**871,194**	**1,065,534**	**824,990**	**623,155**

Table 8-2
Comparative Balance Sheet Combined Water/Sewer

	GAAP BASIS REPORTING			CASH BASIS REPORTING			
	FY2010	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016
ASSETS							
Current/Accrued							
Cash/Investments	330,620	404,740	515,332	478,688	648,429	322,699	88,971
Receivables	81,630	74,468	78,247	-	-	-	-
Inventory	29,471	35,487	31,095	-	-	-	-
Total Current Assets	441,720	514,696	624,674	478,688	648,429	322,699	88,971
Restricted Assets							
Bond Funds	12,568	12,509	12,451	12,393	12,335	14,323	14,255
Construction Reserve	370,439	385,039	396,839	402,639	422,859	455,259	487,259
Sewer Outfall Debt Reserve	-	-	-	-	-	32,670	32,670
Customer Dep Bankruptcy	-	-	-	-	-	39	-
Total Restricted Assets	383,007	397,549	409,290	415,032	435,194	502,291	534,184
Utility Plant							
Utility Plant	10,277,410	10,381,635	10,586,120	-	-	-	-
Work in Progress	140,978	98,772	23,817	-	-	-	-
Less: Accum Depreciation	(3,026,456)	(3,220,320)	(3,421,466)	-	-	-	-
Total Property	7,391,932	7,260,087	7,188,471	-	-	-	-
TOTAL ASSETS	8,216,658	8,172,331	8,222,435	893,720	1,083,623	824,990	623,155
EQUITY/LIABILITIES							
Current Liabilities							
Warrants Payable	7,042	6,208	19,915	20,999	18,088	-	-
Accrued Interest	931	873	815	-	-	-	-
Other	16,129	13,271	15,058	-	39	39	0
Total Current Liabilities	24,102	20,352	35,787	20,999	18,127	39	0
Long Term Debt							
Advances	26,915	17,777	8,456	-	-	-	-
PWTF Loan Payable	372,374	349,101	325,827	-	-	-	-
Total Long Term Debt	399,290	366,878	334,283	-	-	-	-
Total Liabilities	423,392	387,230	370,070	20,999	18,127	39	0
Equity							
Contributed Capital	6,015,650	6,095,550	6,095,550	-	-	-	-
Less: Amortization	(1,556,359)	(1,647,466)	(1,736,361)	-	-	-	-
Reserve (Construction&Debt)	370,439	385,039	396,839	402,639	422,859	487,929	487,259
Retained Earnings	2,963,536	2,951,979	3,096,337	470,082	642,636	337,022	135,896
Total Equity	7,793,267	7,785,102	7,852,365	872,721	1,065,495	824,951	623,155
TOTAL EQUITY/LIABILITIES	8,216,658	8,172,331	8,222,435	893,720	1,083,623	824,990	623,155

8.2 Historic, Existing, and Future Water Rates

Table 8-3 summarizes the current and historic water rates for all customers. All water services are metered and are read bimonthly. Base rates are classified by size of meter and class of customer (inside or outside city). Base rate collections are designed to minimally cover all fixed operating costs. The usage is billed in a two-tiered structure where the minimum monthly bill includes the first 400 cu. ft. of water consumed. Uniform volume rates for additional water used are charged per cubic foot consumed above 400 cu. ft. The volume rates are designed to collect revenues for addressing variable expenses and are listed at the bottom of Table 8-3. Two rate schedules are used, one for inside City users and the other for outside City users. Outside City user rates are higher, reflecting the increased cost of delivery to perimeter areas.

Table 8-3
Historic Water Rates

Class	Meter Size	2009 Inside/Outside Base Rate	2011 Inside/Outside Base Rate	2012 Inside/Outside Base Rate	2013-Current Inside/Outside Base Rate
Residential/Commercial	3/4-inch	$18.50/$27.25	$19.50/$28.75	$19.50/$28.75	$19.50/$28.75
Residential/Commercial	1-inch	$30.50/$52	$32/$54.50	$32/$54.50	$32.00/$54.50
Residential/Commercial	1.5-inch	$73.50/$106	$77.25/$111.25	$77.25/$111.25	$77.25/$111.25
Residential/Commercial	2-inch	$142/$205	$149/$215.25	$149/$215.25	$149.00/$215.25
Residential/Commercial	3-inch	$255/$370	$267.75/$388.50	$267.75/$388.50	$267.75/$388.50
Residential/Commercial	4-inch	$306/$445	$321.25/$467.25	$321.25/$467.25	$321.25/$467.25
Residential/Commercial	6-inch	$815/$1180	$855.75/$1239	$855.75/$1239	$855.75/$1239.00
Excess water >400 cu ft		$0.027/$0.032 per cu ft	$0.032/$0.0375 per cu ft	$0.040/$0.047 per cu ft	$0.039/$0.046 per cu ft

Note:
The City also has hydrant use charges, fees for overdue payments, service termination fees, disconnect and reconnect fees.

The City of Stevenson's service population is somewhat unique for a small water system purveyor. The commercial/institutional customer accounts for more than one third of water consumption. In addition, there are a disproportionate number of low-income users. The high percentage of low-income users is because the City is one of only two locations in the entire County with public water and sewer. Consequently, most of the subsidized 504 housing, low-income apartment housing, and assisted living complexes are sited within the community. The City Council is sensitive to the need to provide a minimal volume of water to its low-income residents at a reasonable rate while still covering fixed expenses. Low-income seniors that qualify based on poverty thresholds may apply for discounted rates.

Residential users average 181 gpd or 736 cu. ft./mo. for an average monthly bill of $32.60 inside the City; well below 1.5 percent of the median household income (a commonly used guide to determine the affordability of water rates-see discussion under Financial Viability). Water use is seasonally impacted, with approximately 35 percent to 40 percent of all users consuming less than the minimum during the winter (400 cu. ft.), and 20 percent to 25 percent of all users consuming less than the minimum during the summer. Over the past seven years, water sales have oscillated, reflecting the impacts of seasonal irrigation on the consumption patterns.

Table 8-4 compares the percentage of ERU's from commercial users, residential users, and the Skamania Lodge to the percentage of water revenue for each user group. Water use from public facilities was not included in the calculation.

Table 8-4
Historic ERU and Revenue Comparison by User Classification

User Classification	2013	2014	2015
% ERU			
Commercial	14.7%	13.8%	15.9%
Residential	63.2%	64.4%	61.4%
Skamania Lodge	22.0%	21.8%	22.7%
% Revenue			
Commercial	34.3%	40.8%	40.4%
Residential	50.9%	45.9%	45.5%
Skamania Lodge	14.8%	13.4%	14.1%

A review of water rates across Washington State indicate that the City's rates are still above the Washington State average, ranking in the top third of the cities responding to the 2012 AWC user fee study.

Fees are collected for hydrant usage, delinquent payments after delivery of a shut-off notice, and service termination fees. Revenues are also received from investment earnings, sale of used equipment and/or scrap materials, and the actual costs for installing new services. The City assesses two charges for the installation of new services: a charge for the actual cost of materials and labor for the installation of a new service and a system development charge (capital contributions) often referred to as the "capacity buy-in" fee.

Table 8-5
Historic Connection Fees & System Development Charges

Meter Size	Cost to Install Meter and service	Meter only	System Development Fee or capacity buy in
¾ inch	Actual Costs	Note 1	$3,000
1-inch	Actual Costs	Note 1	$6,000
1.5-inch	Actual Costs	Note 1	$9,000
2-inch	Actual Costs	Note 1	$12,000
3-inch	Note 2	Note 2	$27,000
4-inch	Note 2	Note 2	$42,000
6-inch	Note 2	Note 2	$90,000

Notes:
As listed on prior year's inventory
The City does not install services larger than two inches. For larger services, the customer is responsible for submitting drawings for City approval prior to installation of the service.

Development charges for each unit of a multifamily dwelling shall be fifty-seven percent (57 percent) of the connection fee (or system development charge) for a single –family dwelling (3/4").

8.3 Financial Viability

The Department of Health has developed a program to assess the financial viability of small water utilities. The City of Stevenson has prepared a slightly modified version of this analysis. The modifications more closely reflect account line categories required by the Washington State Auditor's Budget Accounting and Reporting Systems guidelines in both their annual budgets and reports.

During the preparation of its budget, the City of Stevenson's Water Utility System:

- Annually prepares a budget and assesses budget needs and projected revenue flows
- Reviews its rates to determine the adequacy to meet operating costs
- Requires a minimum of two months operating budget to be held in the general operating cash accounts
- Annually reviews its construction reserves and system development rates
- Annually updates the water portion of the capital facility plan
- Is prepared to deny building permits, subdivision approval and annexations if the City's ability to provide adequate water is at risk

The objective of the financial viability assessment is to ensure the ability of the water utility to meet short-term emergency needs and provide long-term reliable water system finances. To meet short-term emergency needs the City has identified an emergency reserve of $150,000. To address needs in excess of this, the City has access to funds generated by timber sales from a section of timberland under City management and ownership. A portion of the timberland was logged in 2017 to take advantage of higher market prices, with the revenues generated held in a reserve account. In 2015, the City's forester provided an estimate of current conifer stock (principally Douglas Fir), with 2,278,000 board feet remaining after the 2017 logging, there is a net value (after logging costs) of $1,003,434.

The basis for the revenue and expenditure projections are summarized below and evaluated.

8.3.1 Revenue Projections

The basis for all revenue projections is the number of service connections coupled with the historic consumption by class and meter size. For budget projection purposes revenues for the years 2016-2026 were developed assuming a 0.87 percent residential and non-beverage industry commercial growth rate, and a 1.74 percent beverage industry commercial growth rate. The model assumes a rate increase of 25% in 2018, 25% in 2019 and then an annual increase of 5% for 2020 and beyond.

Revenue projections include maintaining sufficient cash flow to meet depreciation of existing facilities as well as meeting the loss of reserve capacity when new connections are absorbed into the system. The City is interested in increasing the frequency of rate increases to avoid operating losses and to maintain sufficient cash flow to address system replacement needs. Capital sources also recognize other financial resources such as bond sales, developer contributions, cash provided from depreciation, cash from reserves, contribution from the Capital Improvement or General Funds and from planned timber sales in the watershed.

8.3.2 Expense Projections

Expenses are separated into 1) operation and maintenance costs (variable costs) and 2) debt service (fixed costs). The projections assume a 5 percent increase in inflationary costs for all expense account lines.

Capital needs were identified in the 10-year Capital Improvement Plan and projected accordingly. All system development fees will be set aside to address new facility capacity.

Table 8-6
Projected 10-Year Revenue Requirements

	Projected Y-E	Projected									
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Operating Revenues	$ 515,250	$577,000	$ 658,000	$690,000	$ 723,000	$759,000	$ 796,000	$ 835,000	$876,000	$ 918,000	$ 964,000
Operating and Maintenance Expenses	$ 456,000	$512,000	$ 527,000	$542,000	$ 559,000	$575,000	$ 593,000	$ 611,000	$630,000	$ 649,000	$ 668,000
Debt Service Expenses	$ 24,437	$ 24,320	$ 24,204	$ 84,633	$ 84,516	$110,392	$ 151,678	$ 151,678	$151,678	$ 151,678	$ 190,696
System Development Charge Revenue	$ 33,000	$ 45,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000
Loan/Grant Financing	$ -	$ -	$ 990,000	$ -	$ 425,000	$677,000	$ -	$ -	$ -	$ 638,000	$ -
CIP Expenses	$ 75,000	$120,000	$1,040,000	$ -	$ 425,000	$677,000	$ 50,000	$ -	$ -	$ 638,000	$ 75,000
Surplus (Shortfall)	**$ (7,187)**	**$ (34,320)**	**$ 91,796**	**$ 98,367**	**$ 114,484**	**$108,608**	**$ 36,322**	**$ 107,322**	**$129,322**	**$ 152,322**	**$ 65,304**
Running Balance	**$ (7,187)**	**$ (41,507)**	**$ 50,289**	**$148,656**	**$ 263,140**	**$371,748**	**$ 408,070**	**$ 515,392**	**$644,714**	**$ 797,037**	**$ 862,341**

*Use of Beginning Balances to cover the shortfalls for 2017 and 2018.

The City has not increased rates since 2013 despite capital expenditures and an increase in operations and maintenance expenses. To catch up to the needs of the water department there will be two base rate incrases of 25% for 2018 and 2019 with the increases leveling out to 5% thereafter to keep up with department needs as outlined in this plan.

8.3.3 Operating Cash Reserve

The operating cash reserve is set to provide resources during periods of the year when expenses may exceed revenues. More than sufficient cash reserves exist to address all operating cash flow needs due to seasonal variations. At the end of the 2015 fiscal year the City held $322,699 in operating cash/investments in the Water/Sewer Utility Fund. In addition, the City has other non-utility funds that can be loaned in the event of an unusual cash flow event.

8.3.4 Emergency Reserve

The emergency reserve is expected to fund unexpected emergent needs and be of an amount sufficient to address the replacement of that piece of equipment. The most likely emergency for this utility would be the loss of a pump or pump station, the loss of a critical transmission line, or damage to a reservoir. These repairs have been estimated at $150,000. The City carries extensive property insurance that potentially could address these repairs depending on the reason for the loss. Alternatively, the City could fund a portion of this need through the operating and/or capital reserves. Temporary cash loans would be available from other City funds (Capital Improvement Account, General Fund Account, etc.) or through a line of credit. A large emergency expenditure could be funded through a sale of timber from the City's timber holdings. If the money were to be used to replace infrastructure, this resource could be used. The only problem would be the timing between the actual emergency and the ability to arrange the timber sale that could be addressed with a line of credit.

8.3.5 Capital Cash Reserve

Cash reserves are also set aside to address new capital facility costs. The City is committed to balancing the need to build for the future, maintain the current system to today's new and more demanding standards, and not create a billing rate that will provide a burden to the community or be a disincentive for business investment. The balance in the capital construction reserves at the end of 2015 totals $455,259.17; $255,209.17 represents total water system development charges.

Remaining cash balances not set aside as new facility replacement, emergency reserves or minimum operating reserves are not addressed in the DOH financial viability format. These additional cash reserves will be held in the general operating fund.

8.3.6 Median Household Income Index (MHII)

The last financial viability criterion is the affordability of the water utility for its customers. This criterion is more of a guideline than a rule and indicates the importance of evaluating the level of service that can be provided. It is a balance of the customer's ability to pay, the quality of service and maintenance, the commitment to a capital-spending program, and the community's growth needs. The current standards used by EPA recommend that the monthly average water bills be less than 1.5 percent of the median household income for the service area.

The average annual water bill (based on average residential use) was $391.20 (does not include commercial uses). The median household income (from State records) in 2016 was $52,700 for Skamania County. The current water rates are less than 1.0 percent of the median household income.

8.4 Financing Capital Improvements

8.4.1 Alternative Methods of Financing

When considering the financing of water systems, one should consider the capital costs separately from the operation and maintenance (O&M) costs.

There are several methods available for the financing of water system improvements that will be required over the planning period. It is likely that one, or a combination of methods, depending upon the circumstances, will finance the improvements. The following are the methods of finance that will most likely be used.

8.4.1.1 Bonds

Water systems typically require a large one-time expenditure, such as a water treatment plant expansion or a new reservoir. These improvements can be financed by a general obligation or revenue bond that is repaid during the life of the new facility. The bond is normally repaid from revenues derived from monthly service charges. Normally, all customers share in the bond repayment. If bond payments are made from monthly utility charges, the existing citizens effectively finance a proportionate share of the growth. If bond payments are made from future impact fees, then growth pays for itself. Where system development charges are used to retire the bond, these charges should be set sufficiently high to also pay for other distribution system capacity upgrades that will be needed to restore the capacity lost because of that development.

8.4.1.2 Connection Charges/System Development Fees/Capacity Buy-In Fees

Many municipalities finance water and wastewater expansion with surplus funds built up by connection fees. As connections to the system are made, a connection fee is charged. It is used to finance capacity upgrades. The rationale behind these fees is that the existing system has a limited amount of excess capacity. As growth occurs, the capacity is decreased. The fees are meant to collect funds to replace lost capacity. If such fees are too low, a city is eventually faced with two choices. One is to finance expansions out of revenue from monthly service charges paid by all the ratepayers (in other words, to subsidize growth). The other is to curtail growth. If fees are too low, the consequences will be realized regardless of how fast a community is growing; it is simply a matter of time.

Even where connection fees are set sufficiently high to finance growth, if a very large demand is placed upon the system, there could be a problem bridging the gap in finances. The issuance of bonds finances such gaps.

8.4.1.3 Timber Revenue and Capital Fund Reserves

As previously discussed, the sale of City owned timber in the City's watershed may be used to finance infrastructure improvements with the authorization of the City council. The City owns a section of timberland and has been managing the property since 1984 as timberland.

For new capital construction the Capital Fund Reserves can be used to finance the construction of infrastructure if the City Council so decides and the project is included on the Capital Improvement Plan.

8.4.1.4 Revolving Loan Fund Program

The State of Washington has a program whereby the City can obtain low interest loans to finance utility system improvements. The loan could be paid back with a funding program like that used to retire bonds.

8.4.1.5 Developer Financing

Utility distribution, collection, or even treatment facility improvements could be developer financed. This method of financing for utility line extensions is often used in conjunction with system development charges. In some cases, the developer is reimbursed for expenditures from future connection charges (latecomer fees). The developer constructs the necessary utility line extensions and pays a system development charge that covers the downstream utility lines and necessary treatment facility capacity. If latecomer fees are imposed, the developer who constructs the improvements is reimbursed by the future connections to that improvement.

8.4.1.6 State and Federal Funding Programs

There are several State and Federal funding programs available to finance water facility expansions. The nature of these programs varies with the political climate. The recent trend has been for the availability of funds from these programs to decrease. Another recent trend has been for the funds to be limited to current needs and environmental improvement projects, rather than to finance expansions for future growth.

8.4.1.7 Local Improvement District (LID)

For water system expansions, a local improvement district (LID) for the area can be formed and revenue bonds can be sold whereby the property owners recover the expenses through monthly service charges.

8.5 Capital Improvement Fund Requirements

The costs of water system capital improvement projects within the 10-year planning period are summarized in Section 6. In Table 8-7 we plan for the completion of those projects under the following assumptions:

- Connection system development charges will be increased in late 2017 or mid-2018.
- An inflation factor of 3 percent is being applied to annual expense calculations
- Assumes a water rate increase beginning in 2018.
- Accounts for additions of new facilities to the depreciation schedule and dropping of older assets.
- Accounts for loans and bonds maturing and addition of new debt.

All dollar values are given in constant dollars and it is assumed that all construction charges will rise equal to the rate increases to reflect inflation.

Table 8-7
Projected 10-Year Capital Improvement Fund Requirements

Capital Funding	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2018-2027 CIP	2018-2037 Total CIP
CIP 2018-2037												
Water Treatment Plant		100,000									100,000	100,000
Telemetry/SCADA Improvements	50,000										50,000	50,000
Hegewald Well						50,000					50,000	50,000
New Groundwater Source Study											-	250,000
Base Reservior Roof	50,000										50,000	50,000
Base Reservior Condition Assessment	20,000										20,000	20,000
Church Reservoir Transmission				425,000							425,000	425,000
Russel Dr. South		50,000									50,000	50,000
SW Atwell Rd									263,000		263,000	263,000
Rock Creek Drive									375,000		375,000	375,000
Frank Johns PRV					157,000						157,000	157,000
Frank Johns North					237,000						237,000	237,000
Frank Johns South					283,000						283,000	283,000
NE Major St											-	132,000
School St. Waterline Replacement		250,000									250,000	250,000
Water System Plan Update										75,000	75,000	150,000
SR-14 East											-	960,000
SR-14 West											-	937,000
Rock Creek PRV Relocation											-	100,000
West-End Looping											-	657,000
Maple Way East											-	1,323,000
Maple Way West											-	412,000
Zone 4 Predesign											-	75,000
Zone 4 Improvements											-	4,038,000
Meter Replacement		640,000									640,000	640,000
Total Capital Projects	**120,000**	**1,040,000**	**-**	**425,000**	**677,000**	**50,000**	**-**	**-**	**638,000**	**75,000**	**3,025,000**	**11,984,000**

8.6 Financing Operation and Maintenance

The alternatives presented above are limited to methods of financing capital improvements. The other type of cost associated with capital improvement projects is the cost of operation and maintenance. The City uses funds generated by connection fees to pay for capacity upgrades. Funds generated by monthly service charges are limited to operation and maintenance expenses, including equipment replacement. Typical operation and maintenance improvements to be funded using monthly water fees shall include the replacement of items such as: steamer ports on fire hydrants, purchasing of necessary meter equipment to improve water system records, and other miscellaneous improvements determined necessary by the public works staff. Unanticipated capital improvements shall include such items as water main breaks, surface restorations, equipment replacement, and source treatment equipment. Monthly revenues will also provide the funds for long-term replacement of capital facilities that have reached the end of their useful life. The City should adjust the monthly rates, as necessary, to reflect changes in the economy and to meet varying staffing demands.

Section 9

Water Use Efficiency Program

9.1 Water Use Efficiency Rule

DOH established the Water Use Efficiency (WUE) Rule with the passage of the Municipal Water Law in 2003. Requirements of the WUE can be found in WAC 246-290. The benefits of efficient water use include lower water system operation costs due to reduced hours of treatment plant operation and pumping, and greater availability of resources in the event of an interruption in supply. The rule affects any Group A community water system that serves at least 15 residential service connections. Key elements of this rule include the following:

- Planning
- Distribution System Leakage Standards
- Goal Setting and WUE Reporting

9.2 Current WUE Program

The City of Stevenson has been an active participant in the WUE program since it became effective. Adoption of City Resolution No. 2011-245 established goals and measures to be included in the City's water conservation program. Goals and measures from the resolution are as follows:

City Goal

1. Reduce residential peak daily demand by two percent, lowering peak day demand from 600 gpd to 588 gpd over a six-year period.

City Performance Measures

1. Distribution of water saving tips to customers in annual water quality reports.
2. Placement of water saving educational materials on the City's website.
3. Display water saving information at public events.
4. Display water consumption history on water bills.

As part of the WUE program, the City engages in public outreach intended to build and reinforce a water conservation ethic among customers. These efforts include distribution of indoor water conservation kits and brochures, along with other efforts.

The estimated conservation savings the City will have while participating in the WUE program will be a two percent reduction in peak water demand. The City measures the effectiveness of the program by monitoring water use. Water use is metered and calculated every two months. The City is able to compare the results of before and after the program was implemented.

9.3 Source and Service Meters

The water treatment facility includes a finish water production meter and all system customers are metered. The City has established a system to track the age of all service meters. This database, in addition to monitoring changes in water usage, assists in identifying meters for replacement. In addition, meter readers carry a service meter during bi-monthly reads to replace meters identified for replacement. The City is in the process of transitioning to an Automatic Meter Reading (AMR) or Automated Metering Infrastructure (AMI) system with the intent of increasing both efficiency of operations and efficiency of water use.

9.4 Water Loss Control Action Plan

An important element of the WUE Program is compliance with the distribution system leakage (DSL) standard. DSL is calculated by the City and reported annually to the DOH. The DSL standard for water systems with 500 or more connections is 10 percent or less based on a three-year rolling average. Systems with DSL greater than 10 percent must create and implement a Water Loss Control Action Plan (WLCAP). The City has prepared a WLCAP to comply with the DSL standard. A copy of the plan is included in Appendix C.

9.5 Water Supply Characteristics

The City of Stevenson gets its water from surface water and groundwater. Surface water sources include LaBong Creek, Cedar Creek, and Rock Creek. Water is piped by gravity from LaBong and Cedar Creek to the water treatment plant. Water from Rock Creek is pumped to the water treatment plant. Current groundwater sources are limited to the Hegewald Well although the City intends to investigate additional groundwater sources in the future. Following treatment, water is delivered to the distribution system and its three storage reservoirs.

9.6 Source of Supply Analysis

The City has sufficient water supply capacity and water rights to meet current and projected water demands. Therefore, a source of supply analysis is not included in this plan.