City of Carlton

Wastewater Facilities Plan

Final

TETRA TECH

May 2018

Wastewater Facilities Plan

May 2018

PREPARED FOR

City of Carlton
191 E. Main Street
Carlton, OR 97111

PREPARED BY

Tetra Tech
15350 SW Sequoia Parkway
Suite 220
Portland, OR 97224
Phone: 503-684-9097
Fax: 503-598-0583
tetratech.com

Tetra Tech Project #135-13914-16001-03

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ACRONYMS/ABBREVIATIONS

Acronym or Abbreviation	Definition
AAF	Average annual flow
ADWF	Average dry weather flow
AWWF	Average wet weather flow
BOD	Biochemical oxygen demand
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CWSRF	Clean Water State Revolving Fund
DEQ	Oregon Department of Environmental Quality
DMR	Discharge monitoring report
EPA	United States Environmental Protection Agency
ERU	Equivalent residential unit
FEMA	Federal Emergency Management Agency
GIS	Geographic information systems
gpcd	gallons per capita per day
gpm	Gallons per minute
HDPE	High density polyethylene
HP	Horsepower
I/I	Infiltration and inflow
kW	Kilowatt
mgd	Millions of gallons per day
mg/L	Milligrams per liter
MMDWF	Maximum month dry weather flow
MMWWF	Maximum month wet weather flow
NPDES	National Pollutant Discharge Elimination System
OAR	Oregon Administrative Rule
OECDD	Oregon Economic and Community Development Department
O&M	Operations and maintenance
OSU	Oregon State University
PDF	Peak day flow
PHF	Peak hour flow
ppd	Pounds per day
PVC	Polyvinyl chloride
RD	Rural Development Administration
RDII	Rainfall-derived inflow and infiltration
SDC	System development charge
SPWF	Special Public Works Fund
TDH	Total dynamic head
TSS	Total suspended solids
UGB	Urban growth boundary
WWTP	Wastewater treatment plant

EXECUTIVE SUMMARY

This wastewater facilities plan was prepared to review existing conditions, determine regulatory requirements, identify future requirements, identify deficiencies, evaluate alternatives, and recommend a plan for upgrading wastewater collection and treatment facilities in the City of Carlton. The facilities plan evaluates the requirements for wastewater system improvements over the next 20 years.

STUDY AREA

The City of Carlton's wastewater treatment plant (WWTP) and collection system currently serves developed areas within the Carlton city limits. Its service area for the 20-year study period is defined as the area within the City's urban growth boundary (UGB).

The most recent population forecast information available is the *Coordinated Population Forecast for Yamhill County, its Urban Growth Boundaries (UGB), and Area Outside UGBs 2017-2067*, published by Portland State University's Population Research Center in June 2017. This document's projections estimate a Carlton population of 3,041 by 2037, representing an average annual growth of approximately 1.7 percent until 2035, and 0.9% after 2035. Table ES-1 shows the projected future populations.

Table ES-1. Projected Population Growth

Year	Population	Year	Population
2017	2,205	2032	2,839
2020	2,319	2035	2,987
2025	2,523	2037	3,041
2030	2,745		

EXISTING FACILITIES

The existing wastewater facilities in the City of Carlton consist of a conventional sewer collection system, including two pump stations, which conveys flows to a wastewater treatment plant that provides secondary treatment and disinfection. Effluent is discharged to the North Yamhill River from November through April and is used for irrigation on land adjacent to the treatment plant lagoons in the summer.

Table ES-2 summarizes the inventory of pipes in the gravity system. Table ES-3 summarizes design data for the Howe Street Pump Station. Table ES-4 summarizes design data for the Hawn Creek Pump Station.

Table ES-2. Existing Collection System Pipe Inventory Summary

	Approximate Date Built	Approximate Quantity
6-, 8-, 10- and 16-Inch Clay Pipe	1928	15,800 feet
6- and 8-Inch Concrete Pipe	1928	7,000 feet
6-, 8- and 10-Inch Concrete Pipe	1952	5,700 feet
8-Inch Asbestos Cement Pipe	1968	4,200 feet
8-Inch Concrete Pipe	1968	1,700 feet
8- Inch PVC Pipe	1975 to Present	8,500 feet
Total Length		**42,900 feet**

Table ES-3. Howe Street Pump Station Data

Pump Station Type	Submersible Duplex
Pumps	2 Constant Speed
Redundant Design Flow	110 gpm (approx.); total dynamic head unknown
Level Control	Floats
Force Main	340 feet, 4-inch cast iron
Wet Well	60-inch Diameter Concrete
Overflow	Manhole rim at Johnson Avenue and Howe Street

Table ES-4. Hawn Creek Pump Station Data

Pump Station Type	Duplex submersible, non-clog
Capacity (per pump)	1175 gpm @ 118 feet TDH (static head approx. 43 feet)
Horsepower, HP	60 HP each
Motor Data	460-volt 3 phase 60 cycle
Firm Capacity of Pump Station	1.7 mgd (1175 gpm)
Maximum Pump Starts per Hour	15
Wet Well Volume	750 gallons (pumps off to lead pump on)
Level Control Type	Transducer and backup floats
Overflow Point	Bypass sewer in wet well
Backup Power	80 kW stationary diesel-powered standby generator

The wastewater treatment plant consists of the following elements:

- **Headworks** consisting of an automatic self-cleaning bar screen and the bypass channel is equipped with a manual bar screen.
- **Main Pump Station** consisting of four submersible pumps in a trench style wet well and was last upgraded in 2011. The pump station includes two 60-horsepower primary pumps with a capacity of 2,200 gpm each and two 10-horsepower jockey pumps with a capacity of 822 gpm each.
- **Force Mains** from the main pump station to the splitter box at the lagoons consisting of a 12-inch diameter PVC and a 10-inch diameter PVC force main.
- **Lagoons** consisting of two primary aerated lagoons with a total area of 9 acres and a secondary lagoon of 3.8 acres. The lagoons are all lined with 20-mil PVC covered by 12 inches of soil. The two primary lagoons have three 2-hp aerators each.
- **Disinfection** is accomplished using chlorine with a contact chamber consisting of a 240-foot-long 48-inch pipe. Dechlorination is achieved by injection of sulfur dioxide.

- **Wet Weather Outfall** is used for the winter time and consists of 1,300 feet of 10-inch PVC gravity pipe and discharges to the river through a single-port diffuser near the bank. During high flows, the gravity discharge to the river is assisted by pumping using a 4-inch above-ground irrigation pipe.
- **Dry Weather Land Application** consists of crop irrigation on the land surrounding the lagoons including 34.4 acres owned by the City and 24 acres owned by a local farmer. There is one 20-hp pump with a design flow of 150-225 gpm that transfers the effluent to the irrigation equipment owned by the farmer.

The design flows and loads are shown in Table ES-5.

Table ES-5. Treatment Facility Design Flows and Loads

	Projected 2010 (1991 Design)
Average dry-weather flow (mgd)	0.165
Average wet-weather flow (mgd)	0.191
Average daily biochemical oxygen demand (BOD) (lbs/day)	359
Lagoon 1 and 2 organic loading (lbs/acre/day)	40
Overall organic loading (lbs/acre/day)	28

Sources: April 1991 construction drawings prepared by Fetrow Engineering, 2014-2016 Discharge Monitoring Report Data

The system deficiencies noted are as follows:

- Collection System
  - The high wet-weather I/I due to old pipe in the collection system and clay pipe.
  - The City's two pump stations in the collection system have both been recently upgraded, but upsizing the pumps is expected to be required to allow the Hawn Creek pump station to meet demand in 2037.
- Treatment Plant
  - The splitter box upstream of the treatment lagoons is undersized and is submerged during peak wet-weather flows.
  - The transfer piping that is used for gravity flow between lagoons is not adequately sized for current and projected flows and needs to be upsized.
  - The existing chlorine contact pipes do not provide sufficient chlorine contact time for current and projected peak wet-weather flows.
  - The existing chlorination and dechlorination equipment needs to be replaced due to size and condition issues.
  - The City has limited control over the timing of reclaimed water use for irrigation and no control over the volume of reclaimed water used. Direct City control of irrigation for all City-owned application areas is recommended to optimize water usage.
  - The lagoons have storage capacity issues that often lead to early discharge. Increasing capacity by raising the dikes around the lagoons and/or installing an additional lagoon is recommended.
  - The lagoons do not have adequate treatment capacity to accommodate existing loading. Additional capacity in the form of additional aeration is needed to meet current and future loading.
  - The existing irrigation pump station has only one pump. Should the pump have mechanical problems, lagoon storage is used until the system can be brought back into operation, reducing freeboard at the lagoons. An additional backup pump is recommended, although it is not a DEQ requirement

- The capacity of the gravity effluent discharge pipe to the river is insufficient during peak-flow periods when the river level is high. This has resulted in the operator having to supplement the gravity effluent discharge with a pumped discharge to the river using the irrigation system piping. The outfall is also currently situated at a bend in the river, making it susceptible to erosion, and the outfall discharge is required by the City's current permit to be upgraded to improve mixing.
- Access to the treatment plant has been temporarily cut off for periods of several days when the North Yamhill River floods its banks. This appears to occur several times each winter. The plant is surrounded by floodplain and the access road was not constructed to an elevation that rises above the floodplain.

FLOW AND LOAD PROJECTIONS

Table ES-6 summarizes the resulting flow projections. ADWF flow rate is based on 110 gallons per capita per day (gpcd). This is a fairly typical number.

Table ES-6. 20-Year Wastewater Flow Projections

Year	Population	Projected Wastewater Flows (mgd)					
		ADWF	AWWF	MMDWF	MMWWF	PDF	PHF
2020	2,319	0.203	0.717	0.44	1.14	3.25	4.66
2025	2,523	0.225	0.745	0.48	1.18	3.34	4.78
2030	2,745	0.249	0.776	0.53	1.23	3.44	4.90
2032	2,839	0.260	0.789	0.55	1.25	3.48	4.95
2035	2,987	0.276	0.809	0.58	1.28	3.54	5.03
2037	3,041	0.282	0.817	0.59	1.30	3.57	5.06

Table ES-7 summarizes the resulting load projections. The unit loads are 0.251 pounds per capita day for BOD, and 0.359 pounds per capita day for TSS. These are higher than expected and the BOD and TSS attributed to the high strength users (such as wineries), and a portion of the TSS to the substantial I/I due to the clay pipes that are likely allowing in soil. This is evidenced by pipe collapses and cavities where sink holes are forming.

Table ES-7. 20-Year Wastewater Load Projections

Year	Population	BOD (ppd)				TSS (ppd)			
		Average	Max Month	Peak Week	Peak Day	Average	Max Month	Peak Week	Peak Day
2020	2,319	550	946	1,236	1,809	784	1,429	1,765	2,895
2025	2,523	598	1,030	1,345	1,968	853	1,554	1,920	3,149
2030	2,745	651	1,120	1,463	2,141	928	1,691	2,089	3,426
2032	2,839	673	1,158	1,513	2,215	960	1,749	2,161	3,544
2035	2,987	708	1,219	1,592	2,330	1,009	1,840	2,273	3,727
2037	3,041	721	1,241	1,621	2,372	1,028	1,873	2,314	3,795

BASIS OF PLANNING

The NPDES permit establishes the following limitations for the effluent discharged through the North Yamhill River outfall (Outfall 001):

- E. coli—Maximum monthly geometric mean: 126 organisms/100 ml; Single sample maximum: 406 organisms/100 ml

- pH—Shall be within the range 6.0 to 9.0
- Removal of BOD_5 and TSS —Minimum 85% removal of BOD_5 monthly average and 65% removal of TSS monthly average
- Chlorine Residual—Shall not exceed 0.09 mg/L daily maximum and 0.04 mg/L monthly average.
- Mixing Zone—Mixing zone shall be within 25 feet from the west bank, 50 feet downstream and 10 feet upstream of the outfall.
- BOD and TSS limits as listed in Table ES-8.

Table ES-8. NPDES Permit BOD and TSS Limits for North Yamhill River Outfall 001; Nov. 1–April 30

	Maximum Concentration		Maximum Mass Load[a]		
	Monthly Average	Weekly Average	Monthly Average	Weekly Average	Daily
BOD_5	30 mg/L	45 mg/L	92 ppd	138 ppd	184 ppd
TSS	50 mg/L	80 mg/L	153 ppd	229 ppd	306 ppd

a. Based on average annual discharge of 0.367 mgd (projected for design year 2010)

NPDES permit requirements for effluent recycled water (Outfall 002) define limits on total coliform in addition to establishing the following non-quantitative conditions:

- Total coliform is limited to 240 organisms per 100 ml in two consecutive samples and a seven-day median of 23 organisms per 100 ml.
- Ground surface ponding, creation of odors, mosquito breeding, and other nuisance conditions are prohibited.
- Overloading the soil with nutrients, organics or other pollutants, or negatively impacting groundwater usage is prohibited.
- Discharge for irrigation shall be in accordance with an approved Effluent Reuse Plan.

Based upon the result of the mixing zone study and reasonable potential analysis (RPA), it is assumed that ammonia will not be in the future permit and treatment for ammonia will not be required. pH will only need to be considered with regard to any current compliance issues.

With regard to permit compliance, there have been exceedances as follows in the last six years (2011 to 2016):

- BOD effluent concentrations exceeded permit limits two times, both in March 2015 when the weekly maximum loading and monthly maximum loading were exceeded.
- BOD effluent loadings exceeded permit limits nine times, with exceedances occurring in five discrete months.
- BOD removal percentages were below the required limit eight times.
- TSS effluent loadings exceeded permit limits two times, both in October 2013 when the weekly maximum loading and monthly maximum loading were exceeded.
- TSS removal percentages were below the required limit two times, in February 2014 and November 2015.
- pH samples did not meet permit requirements eight times. In all eight cases, the maximum pH limit was exceeded.
- Chlorine residual samples exceeded the permit limit 39 times.

EVALUATION OF SYSTEM IMPROVEMENT

Collection System

The improvements to the collection system are aimed at I/I reduction as well as structural improvements, which are both accomplished through the replacement of the clay pipe. Table ES-9 presents a proposed pipe replacement program with the following prioritization.

Table ES-9. Collection System Improvement Costs

Project	Cost
Clay Pipe Replacement Program	
C1A. 1,585 feet of 16-inch trunk main	$710,000
C1B. 741 feet of 8-inch pipe in Yamhill St and W. Garfield St.	$270,000
C2. 1,265 feet of 10-inch trunk main in Grant Street	$500,000
C3. 710 feet of 10-inch and 1,190 feet of 8-inch pipe in East Main Street	$680,000
C4. 320 feet of 6-inch, 430 feet of 8-inch, and 1,455 feet of 10-inch pipe in West Main Street	$840,000
C5. 1,400 feet of 6-inch and 790 feet of 8-inch pipe in South Pine and South Park Streets	$750,000
C6. 1,825 feet of 6–inch and 290 feet of 8-inch pipe in Kutch Street and vicinity	$700,000
C7. 1,625 feet of 6-inch pipe in West Jefferson Street, West Johnson Street and vicinity	$440,000
C8. 275 feet of 6-inch and 2,020 feet of 8-inch pipe in East Monroe Street and vicinity	$790,000
Subtotal	***$5,680,000***
Pump Stations	
P1. Hawn Creek Pump Station Pump Replacement	$210,000
Total	**$5,890,000**

Treatment System

The treatment plant improvements generally include elements related to hydraulic capacity, biological treatment capacity, upgrade of equipment, and regulatory requirements. They are summarized as in Table ES-10 and Table ES-11. Project T11B, which is biosolids removal from the lagoons, is a significant cost and the need for it should be revisited (measuring sludge depth in the lagoons) on a yearly basis. Currently, the accumulation is not substantial, but with the change in treatment system, more biosolids may be produced in the future.

Table ES-10. Near-Term Treatment Facility Improvement Costs

Project	Cost
T1. Headworks Upgrade	$640,000
T2A. Lagoon Aeration Improvements - Phase 1	$430,000
T3A. Lagoon Capacity Improvement - Raise Dikes	$620,000
T4. Lagoon Piping Improvements	$410,000
T5. Lagoon Disinfection Improvements	$230,000
T6. Miscellaneous Plant Improvements (Water/Electrical Service, Small Building)	$440,000
T7. Raise Access Road to Elevation 125.0' (Approx. 50-year Floodplain)	$400,000
T8. Effluent Pump Station	$800,000
T9. Effluent Force Main and River Outfall	$810,000
T10. Irrigation Piping and Equipment	$590,000
Total	**$5,370,000**

Table ES-11. Long-Term treatment Facility Improvement Costs

Project	Cost
T2B. Lagoon Aeration Improvements - Phase 2	$60,000
T11A. Biosolids Management Plan	$20,000
T11B. Dredging and Biosolids Land Application	$820,000
Total	**$900,000**

High Strength Users

The high strength users are having a significant impact on the loading to the treatment plant. The City has existing language in the City Code to address high strength wastewater, and it is recommended that the City begin to enact the limits that the code allows for high strength users. This would require:

- An industrial user ordinance
- Individual permits for high strength users
- Pretreatment for high strength users

The City would need to retro-actively work with existing high strength users and enforce the requirements for new high strength users.

RECOMMENDED PLAN

Design Data

The recommended improvements were designed to accommodate wastewater flows and loads based on growth assumptions through 2037. Table ES-12 and Table ES-13 summarize the resulting design data for the proposed collection system and treatment plant improvements, respectively.

Table ES-12. Design Data for Recommended Collection System Improvements

Design Parameter	Design Criteria
Clay Pipe Replacement	*See Report Chapter 6.*
Hawn Creek Pump Station Upgrade	
Design Capacity	1,600 gpm (approximate, required capacity to be revisited when project is initiated)
Force Main	Use existing 2,770 linear feet of 6-inch steel force main and 3,865 linear feet of 8-inch PVC force main
Wet Well	Use existing 8-foot diameter wet well
Level Sensing	Use existing instrumentation

Table ES-13. Design Data for Recommended Treatment Plant Improvements

Design Parameter	Design Criteria
HEADWORKS—Screening	
Screen Type	Fine, rotary
Number	1
Peak Flow Capacity	5.1 mgd
Screenings Washing and Compaction	Yes
Bypass Screen	Manually cleaned coarse bar screen

Design Parameter	Design Criteria
LAGOON AERATION	
Phase 1 (near term)	16 replacement 3-hp aerators per lagoon
Phase 2 (before 2030)	2 additional 3-hp aerators per lagoon
LAGOON CAPACITY—Dike Raise	
Total Height Raise	1 foot
Minimum Berm Width After Raise	5 feet
Additional Volume	4.2 million gallons
Liner	20 mil PVC, welded to top of existing PVC line
LAGOON PIPING	
Splitter Box Dimensions	10.33 feet wide, 22 feet long, 8.5 feet deep
Overflow Piping	80 linear feet of 12-inch PVC pipe
Transfer Piping	710 linear feet of 16-inch PVC pipe
DISINFECTION	
Effluent Chlorination	
Type	Gaseous chlorination
Number of Chlorinators	1
Capacity, per Chlorinator	120 ppd
Feed Rate, Average	10 ppd
Feed Control	Flow-paced
Chlorine Contact	
Existing Facilities	48-inch diameter chlorine contact pipe
Additional Volume	11,750 gallons w/flash mixer
Additional Length of 48-Inch Pipe Required	125 feet
Minimum Contact Time, at AWWF (1.32 mgd)	60 minutes
Contact Time, at MMWWF plus Rainfall (2.44 mgd)	20 minutes
Effluent Dechlorination	
Type	Gaseous sulfur dioxide
Number of Sulfonators	1
Feed Control	Flow-paced
EFFLUENT DISPOSAL	
Wet Weather Outfall 001 (Discharge to the N. Yamhill River)	
Existing Gravity Discharge	10-inch
High-River Pumped Discharge	
Number of Pumps	Two submersible constant-speed pumps
Capacity	1,700 gpm each
Wet Well	6-by-10-foot precast concrete vault
Pressurized Outfall	18-inch pipe
Outfall Type	Two submerged duckbill-type diffusers
Dry Weather Outfall 002 (Reclaimed water use)	
Available Land Area, Design Year 2037	34.4 acres
Land Management	Irrigation equipment owned and operated by City
Irrigation Pumps	
Number and Type of Pumps	Two constant-speed submersible pumps
Capacity	300 gpm
Irrigation Main	6-inch pipe
Backup Power	Receptacle for Backup Power Generator

Capital Improvement Plan

The improvements have been combined into a capital improvement plan (CIP), as shown in Table ES-14.

Table ES-14. CIP

Project	Cost	Year	SDC Eligible
C4 Main Street 320 feet of 6-inch, 430 feet of 8-inch, and 1,455 feet of 10-inch pipe	$840,000	2020	No
Phase 1 Near Term WWTP (T2A, T3A, T4, T5, T8, T9, T10)	$3,890,000	2022	Yes
P1. Hawn Creek Pump Station Pump Replacement	$210,000	2024[a]	Yes
Phase 2 Near Term WWTP (T1, T6,T7) & C1A. 1,585 feet of 16-inch trunk main	$2,190,000	2027	Partially
T2B. Lagoon Aeration Improvements - Phase 2	$60,000	2028[b]	Yes
T11A & T11B. BMP & Dredging and Biosolids Land Application	$840,000	2028[c]	No
C1B & C2. 1,265 feet of 10-inch trunk main in Grant St, 741 feet of 8-inch pipe in Yamhill St and W. Garfield St.	$770,000	2030	No
C3. 710 feet of 10-inch and 1,190 feet of 8-inch pipe in East Main St	$680,000	2032	No
C5. 1,400 feet of 6-inch and 790 feet of 8-inch pipe in South Pine and South Park St	$750,000	2035	No
C6. 1,825 feet of 6–inch and 290 feet of 8-inch pipe in Kutch Street and vicinity	$700,000	2036	No
C7. 1,625 feet of 6-inch pipe in West Jefferson Street, West Johnson Street and vicinity	$440,000	2037	No
C8. 275 feet of 6-inch and 2,020 feet of 8-inch pipe in East Monroe Street and vicinity	$790,000	2038	No
Total	**$12,160,000**		

a. Actual timing of this upgrade will be based upon when development occurs. The City should consider an upgrade when the station reaches 80% capacity.
b. Actual timing will depend on the loading to the WWTP which will be dependent upon development.
c. This work will only be done as required. The City should measure the depth of the sludge in the lagoons yearly to determine when sludge needs to be removed. It has not been required yet, but with the change in treatment more sludge may accumulate.

Schedule

The collection system improvements on Main Street need to be done in 2020 to meet the schedule for the ODOT Main Street improvements scheduled for construction in 2021. This project will also be coordinated with undergrounding the utilities on Main Street. The near-term treatment plant projects are necessary to meet current system demands and consequently should be constructed as soon as possible. The following are the key project milestones for the two improvement projects:

- Review of Draft Facilities Plan Complete (DEQ and City): February 2018
- Facilities Plan Finalized: May 2018
- Begin Design of C4: March 2018
- Coordinate with ODOT: March 2018 – March 2020
- Apply for Construction Funding: by May 2018
- Complete Design of C4: December 2018
- Coordinate Design with Utility Undergrounding: July 2018 – July 2019
- Construction C4: October 2019 – May 2020
- Begin Funding for Phase 1 WWTP Improvements: June 2018
- Begin Design for Phase 1 WWTP Improvements: September 2019
- Bid Out the Project: September 2020
- Construction: December 2020 to March 2022

Staffing

With the increase in complexity of the treatment plant, it is recommended that the City re-evaluate staffing and consider adding one staff.

High Strength Users

It is recommended that the City begin to address high strength users in order to reduce the biological load to the treatment plant. There are several steps involved with this that include the following:

- Develop an industrial user ordinance.
- Develop a rate structure for industrial users. This should consider flow, BOD and TSS.
- Require pretreatment at the industrial user facilities.
- Incorporate addressing high strength users into the development review process.

There are existing winery facilities in the community that would be in this category of user, and it is recommended that the City begin to work with these users to implement pretreatment. There are several steps to this process and it is suggested that it includes the following:

- Implement monitoring of the wastewater from the facilities. This should be done at least over a year's period to try to capture all the changes in the wastewater due to operations.
- Based upon the results of the monitoring, develop pretreatment requirements.
- Develop individual permits for each winery.

FUNDING

Wastewater system improvements may be financed by the City's wastewater user fees (rates), system development charges (SDCs), federal or state loan programs, grants, and bonds. A financial analysis, evaluation of rates and SDCs, will be conducted outside of the Facility Plan Update. This chapter includes a brief summary of funding programs available to the City.

ENVIRONMENTAL ASSESSMENT

A formal environmental assessment is not included in the scope for the Wastewater Facility Plan. It is recommended that a formal environmental assessment be performed after the funding package is determined so that the evaluation will meet the requirements of the funding agencies and match the project that the City is pursuing.

1. INTRODUCTION

1.1 PURPOSE

This wastewater facilities plan was prepared to review existing conditions, determine regulatory requirements, identify future requirements, identify deficiencies, evaluate alternatives and recommend a plan for upgrading wastewater collection and treatment facilities in the City of Carlton. The facilities plan evaluates the requirements for wastewater system improvements over the next 20 years. It addresses the capacity of conveyance facilities, the capacity of the wastewater treatment plant, North Yamhill River water quality issues, and financing for capital improvements, operation, maintenance, and equipment replacement.

Carlton's treatment plant was last upgraded in 1991 to serve an estimated 2010 population of 1,793. The current population of approximately 2,205 exceeds that design capacity. Although the existing collection system and wastewater treatment plant are generally performing adequately, there have been a number of permit violations in the last six years. Updates to both will be required to maintain permit compliance.

1.2 AUTHORIZATION

On December 14, 2016, the City of Carlton contracted with Tetra Tech to update this wastewater facilities plan in conformance with regulations and guidelines of the Oregon Department of Environmental Quality (DEQ) and the Oregon Economic and Community Development Department (OECDD).

2. STUDY AREA CHARACTERISTICS

2.1 SERVICE AREAS

The City of Carlton's wastewater treatment plant (WWTP) currently serves developed areas within the Carlton city limits. Its service area for the 20-year study period is defined as the area within the City's urban growth boundary (UGB). Figure 2-1 shows the UGB, which is the same as the city limits.

The City's wastewater collection system includes two pump stations: the Hawn Creek Pump Station and the Howe Street Pump Station. To determine the pump stations' capacity requirements, this study identified service areas for each pump station, as shown in Figure 2-1. A third pump station, the Main Pump Station, is located at the treatment plant headworks and it pumps the entire flow to the WWTP.

2.2 PHYSICAL ENVIRONMENT

2.2.1 Topography

The City of Carlton is in Yamhill County, on the western edge of the upper Mid-Willamette Valley. The terrain is gently rolling, with ground slopes ranging from 0 to 5 percent. Land elevations vary from approximately 200 feet in the central portion of the City to 170 feet on the fringes. The City is situated between the North Yamhill River to the west and Hawn Creek to the east.

2.2.2 Climate

The climate of the Carlton area is characterized by mild winters and cool summers. Rainfall averages about 42 inches per year; approximately 75 percent of this total falls in the wet-weather months from November through April. Average annual air temperature is about 54 degrees Fahrenheit. Temperature extremes typically range from the low 20s to high 90s.

2.2.3 Soils/Geologic Hazards

The geology of Carlton is characterized by Willamette Valley terrace formations, consisting of areas of silty alluvium. The soils are predominantly of the Woodburn series, a moderately well-draining soil formed of silt and loam. There are no known geologic hazards within the City, although a small portion of the planning area is located with the 100-year floodplain of the North Yamhill River.

2.2.4 Public Health Hazards

There are no known public health hazards within the City of Carlton.

2.2.5 Energy Production and Consumption

Electricity is provided to the community by Portland General Electric. Natural gas service is not currently available in Carlton. Propane gas service is available locally from several providers.

2.2.6 Water Resources

The City's present water supply is from Panther Creek, which flows east out of the Coast Range to the Yamhill River. The City operates a raw water reservoir on the creek, treatment facilities located approximately a mile downstream of the reservoir, two finished water reservoirs and a distribution system. Treatment is by pressure filtration.

2.2.7 Flora and Fauna

The study area encompasses upland areas as well as riparian areas adjacent to the North Yamhill River; hence, there is a wide variety of plant life in the study area. Common plants in the study area are Douglas Fir, hardwood trees such as Oregon white oak and maple, Oregon grape, dogwood, wild rose, sycamore, poplar and alder. Situated adjacent to the Carlton Lake State Wildlife Refuge, the area includes a diversity of wildlife. Muskrat, beaver, opossum, river otter, raccoon, skunk, coyote, and deer are known to populate the area. A wide variety of birds are found in the area during both breeding and wintering. Fish in the North Yamhill River include steelhead, several species of trout, carp, long-scale sucker, and northern squawfish.

2.2.8 Environmentally Sensitive Areas

The North Yamhill River and Hawn Creek, as well as the riparian areas and wetlands adjacent to these natural waterways, are considered to be environmentally sensitive areas.

2.3 SOCIO-ECONOMIC ENVIRONMENT

2.3.1 Economic Conditions and Trends

Historically, Carlton's economy was based primarily on lumber and agriculture. Since the local mill closed in the 1950s, Carlton has increasingly become a bedroom community, with most working residents commuting to McMinnville, the Highway 99 corridor and Salem. Recently, Carlton has enjoyed the economic benefits of the area's growing wine industry, specifically with wine-related tourism. Six wineries have moved into Carlton since 2007.

Historical Population

Population change in Carlton has been relatively slow but steady in recent years, affected primarily by factors outside the community. Table 2-1 shows the City's population since 1970 and corresponding average annual growth rates.

Table 2-1. Historical Carlton Population Growth

	1970	1980	1990	2000	2010
Population	1,126	1,302	1,289	1,514	2,007
Average Annual Growth Rate over Preceding 10 Years	—	1.6%	-0.1%	1.8%	3.3%

Source: U.S. Census Data and Portland State University Center for Population Research

2.3.2 Projected Population

The most recent population forecast information available is the *Coordinated Population Forecast for Yamhill County, its Urban Growth Boundaries (UGB), and Area Outside UGBs 2017-2067*, published by Portland State University's Population Research Center in June 2017. This document's projections estimate a Carlton population of 3,041 by 2037, representing an average annual growth of approximately 1.7 percent until 2035, and 0.9 percent after 2035. Table 2-2 summarizes the population projections.

LEGEND

- UGB / CITY LIMITS
- HOWE ST PUMP STATION SERVICE AREA
- HAWN CREEK PUMP STATION SERVICE AREA

HOWE ST PUMP STATION

HEADWORKS AND MAIN PUMP STATION

WASTEWATER TREATMENT LAGOONS

HAWN CREEK PUMP STATION

Carlton

N Howe St
N Coolidge St
N Lilly St
E Lincoln St
E Garfield St
E Johnson St
NE Modaffari Rd
47
N Scott St
NW Bakeman Ln
NW Bakemans Ln
N Yamhill St
N Kutch St
N Pine St
N 1st St
N 2nd St
E Madison St
E Monroe St
E Market St
N 7th St
S 6th St
S Carr St
W Grant St
S River St
S Yamhill St
S Kutch St
E Washington St
E Harrison St
W Taft St
E Taft
S Pine St
S 2nd St
S 3rd St
S Park St
S Arthur St
Tualatin Valley Hwy
S 1st St
W 1st St
NE Old McMinnville Hwy

TETRA TECH www.tetratech.com 15350 SW Sequoia Parkway, Suite 220 Portland, OR 97224 (503) 684-9097	CITY OF CARLTON WASTEWATER FACILITIES PLAN URBAN GROWTH BOUNDARY AND PUMP STATION SERVICE AREAS MAP	Project No.: 135-13914-16001 Date: SEPTEMBER 2017 Designed By: NGN Supplemental FIG 2-1

Bar Measures 1 inch

Table 2-2. Projected Population Growth

Year	Population	Year	Population
2017	2,205	2032	2,839
2020	2,319	2035	2,987
2025	2,523	2037	3,041
2030	2,745		

2.3.3 Zoning and Land Use

Figure 2-2 shows current zoning designations within the City's UGB. For each land use type, the approximate acreage was calculated in the 2007 Facilities Plan based on GIS data, and has been updated using aerial imagery where development has occurred. Also listed are the estimated number of equivalent residential units (ERUs), which are a measure of how many standard residential dwelling units would contribute an equivalent amount to the system.

Future land use conditions for this study are defined as expected development at the end of the 20-year planning period (through 2037). There does not appear to be enough undeveloped, residential-zoned land within the UGB to accommodate the population growth shown in Table 2-2, meaning that the UGB will likely need to be expanded within the 20-year planning period. Table 2-3 shows the effect of this development on total ERUs within the service area.

Table 2-3. Land Use Area and ERUs

Land Use	Area (acres)	ERUs
Existing		
Multifamily Residential	12	53
Suburban Residential	276	671
Manufactured Homes	8	38
Commercial/Industrial	33	123
Agriculture Holdings	191	—
Public Facilities	23	—
Total, Existing	***543***	***885***
Future		
Suburban Residential		280
Commercial/Industrial		53
Total		**1,218**

LEGEND

- AGRICULTURAL HOLDING
- COMMERCIAL
- COMMERCIAL INDUSTRIAL
- GENERAL INDUSTRIAL
- MULTI-FAMILY RESIDENTIAL
- PUBLIC FACILITY
- SUBURBAN RESIDENTIAL
- MANUFACTURED HOME
- UGB / CITY LIMITS

600' 0' 600' 1200'

GRAPHIC SCALE 1"=600'

N

MEADOWLAKE ROAD

MONROE ST.

W. MAIN ST.

GRANT ST.

HOWE ST.

YAMHILL ST.

2ND ST.

RAILROAD ROW

12/10/2018 2:39:37 PM - P:\13914\135-13914-16001-03\CAD\SHEETFILES\ZONING.DWG - BENNETTDAGGETT, HUNTER

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CITY OF CARLTON

WASTEWATER FACILITIES PLAN

ZONING MAP

Project No.:	135-13914-16001
Date:	SEPTEMBER 2017
Designed By:	NGN

Supplemental

FIG 2-2

Bar Measures 1 inch

3. EXISTING FACILITIES

The existing wastewater facilities in the City of Carlton consist of a conventional sewer collection system, including two pump stations, which conveys flows to a wastewater treatment plant that provides secondary treatment and disinfection. Effluent is discharged to the North Yamhill River from November through April and is used for irrigation on land adjacent to the treatment plant lagoons in the summer. There are no known on-site septic systems in the City.

3.1 COLLECTION SYSTEM

3.1.1 Gravity System

Sewer Inventory

The gravity sewer system was built in stages, with the oldest pipes reportedly dating to the late 1920s. As can be expected with construction occurring over many years, the system has a variety of pipe materials, including clay and concrete pipe with grouted joints, and concrete, asbestos and PVC pipe with gasketed joints. Table 3-1 summarizes the inventory of pipes in the gravity system. Pipe locations are shown on Figure 3-1.

Table 3-1. Existing Collection System Pipe Inventory Summary

	Approximate Date Built	Approximate Quantity
6-, 8-, 10- and 16-Inch Clay Pipe	1928	15,800 feet
6- and 8-Inch Concrete Pipe	1928	7,000 feet
6-, 8- and 10-Inch Concrete Pipe	1952	5,700 feet
8-Inch Asbestos Cement Pipe	1968	4,200 feet
8-Inch Concrete Pipe	1968	1,700 feet
8- Inch PVC Pipe	1975 to Present	8,500 feet
Total Length		**42,900 feet**

Infiltration/Inflow

About 37 percent of the system consists of clay pipe with cement mortar joints. Clay pipe is much more susceptible to cracking and structural failure than other pipe materials. Problems in the clay pipe portion of the collection system have been confirmed by video inspection and have resulted in high rates of infiltration and inflow (I/I) into the system.

The EPA provides criteria for evaluating the magnitude of I/I issues. The first criterion is criteria for I/I base infiltration, which is infiltration to the collection system that occurs during periods with high groundwater (typically January through May in Oregon) and little to no rainfall. Base infiltration greater than 120 gallons per capita per day (gpcd) is considered to be excessive by the EPA criteria. The period of April 27 – May 14, 2016 was used to assess base infiltration in the City; during this period without rain the average influent flow to the WWTP was 172,000 gallons per day and the estimated population was 2,063, yielding a base infiltration flow of approximately 83 gpcd. Based on the EPA criteria, base infiltration in the City is not excessive.

The EPA also provides criteria for rainfall-derived inflow and infiltration (RDII), which evaluates the impact of periods of significant rainfall on the WWTP. RDII greater than 275 gallons per capita per day (gpcd) is considered to be excessive by the EPA criteria. Table 3-2 lists the 10 highest daily treatment plant influent flows between 2011 and 2016 and calculates per capita RDII based on estimated populations for the year when the event occurred. Based on the EPA criterion of 275 gpcd, RDII in the City's collection system is excessive.

Table 3-2. Peak-Day Wastewater Treatment Plant Flows 2011-2016

Rank	Date	Flow (mgd)	Flow per capita (gpcd)	24 Hour Rainfall (in)
1	11/20/2012	5.600	2,915	0.80
2	12/17/2015	3.131	1,545	2.61
3	11/19/2012	3.100	1,613	0.65
4	12/5/2012	3.100	1,613	0.00
5	11/24/2016	2.900	1,405	3.43
6	1/19/2012	2.810	1,463	1.00
7	11/18/2012	2.700	1,406	1.00
8	12/21/2012	2.700	1,406	0.35
9	12/8/2015	2.630	1,298	2.44
10	1/17/2015	2.590	1,278	2.20

Based on discussions with City maintenance staff, the primary source of I/I is the older clay pipe, and to a lesser extent the older concrete pipe. Of particular concern are the clay pipe joints. In 1991, an I/I reduction project was performed in an unsuccessful attempt to improve the condition of the system, primarily the clay pipe. The City is reasonably sure that many of the clay pipe joints were damaged by the joint packing equipment. No additional I/I repair projects have been conducted since 1991. The clay pipe portion of the system is in very poor condition and requires replacement.

Small sections of clay pipe have been replaced due to breakage, but no large-scale replacement projects have been conducted. There continue to be failures of the clay pipe and more is expected as the pipe ages.

Even though the manholes throughout the system appear to be in acceptable condition with no obvious structural problems, it is recommended that the manholes within the clay-pipe sections of the system be replaced at the same time as the pipe, due to their age.

In 1989 the City performed smoke testing on the entire collection system and disconnected inflow sources that were found. Since that time, as the City finds new inflow sources that are disconnected from the system. No additional smoke testing has been conducted. It is good practice to periodically smoke test the system as new inflow sources can occur.

3.1.2 Pump Stations

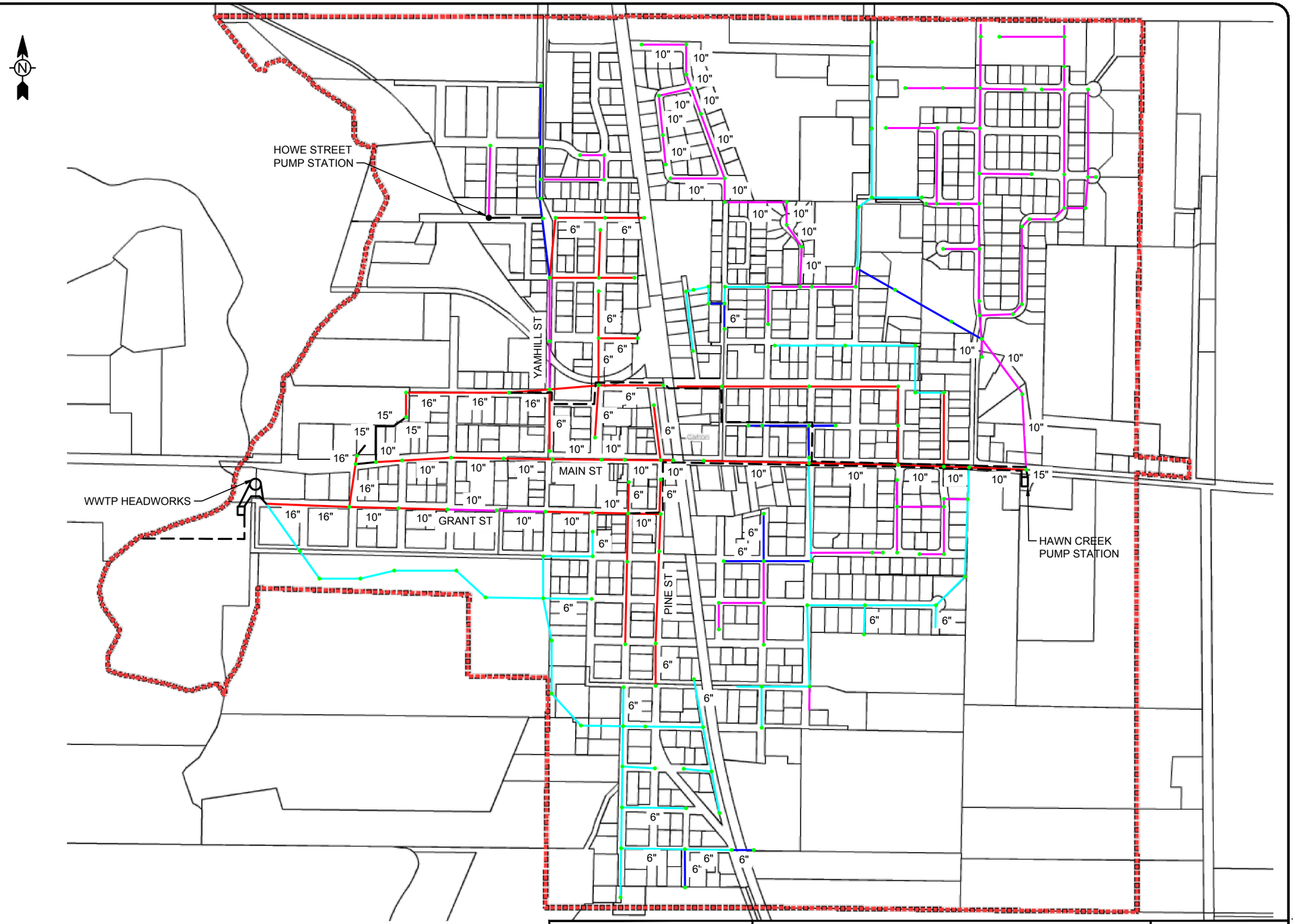
Howe Street Pump Station

The Howe Street Pump Station, located in a manhole in the intersection of Johnson Avenue and Howe Street, is a duplex submersible lift station that serves 14 residences. It was upgraded in 2007, and the pumps were upgraded to the current capacity of 110 gallons per minute (gpm). No capacity issues were noted at the prior pump capacity of 50 gpm, indicating that the upgraded capacity will be sufficient through the study period given the limited growth expected in the pump station's catchment area. The pump station has a 340-foot long 4-inch force main that discharges to the manhole at the intersection of Johnson Avenue and Yamhill Street. Table 3-3 summarizes design data for the Howe Street Pump Station. Figure 3-1 shows pump station and force main locations.

LEGEND

- CLAY SANITARY SEWER
- CONCRETE SANITARY SEWER
- ASBESTOS CEMENT SANITARY SEWER
- PVC SANITARY SEWER
- SANITARY FORCE MAIN
- SANITARY SEWER MH
- UGB / CITY LIMITS

ALL PIPES ARE 8 INCHES UNLESS OTHERWISE NOTED



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CITY OF CARLTON
WASTEWATER FACILITIES PLAN

SANITARY SEWER SYSTEM MAP

Project No.: 135-13914-16001
Date: SEPTEMBER 2017
Designed By: NGN

Supplemental
FIG 3-1

Bar Measures 1 inch

12/10/2018 2:38:26 PM - P:\13914\135-13914-16001-03\CAD\SHEETFILES\SANITARY SEWER SYSTEM MAP.DWG - BENNETTDAGGETT, HUNTER

Table 3-3. Howe Street Pump Station Data	
Pump Station Type	Submersible Duplex
Pumps	2 Constant Speed
Redundant Design Flow	110 gpm (approx.); total dynamic head unknown
Level Control	Floats
Force Main	340 feet, 4-inch cast iron
Wet Well	60-inch Diameter Concrete
Overflow	Manhole rim at Johnson Avenue and Howe Street
Alarm System	Strobe light a sign indicating who to call
Stand-by Power	Manual transfer switch for a mobile generator

Hawn Creek Pump Station

The Hawn Creek Pump Station was built in the early 1950s and was last upgraded in 2007. The pump station is a duplex submersible station with an 8-foot diameter wet well. The motor controls and autodialer are stationed adjacent to the wet well that contains the pumps. The station discharges to two force mains—a 6-inch steel pipe constructed with the original installation and an 8-inch PVC pipe added with the upgrade. Table 3-4 summarizes design data for the Hawn Creek Pump Station. Figure 3-1 shows pump station and force main locations.

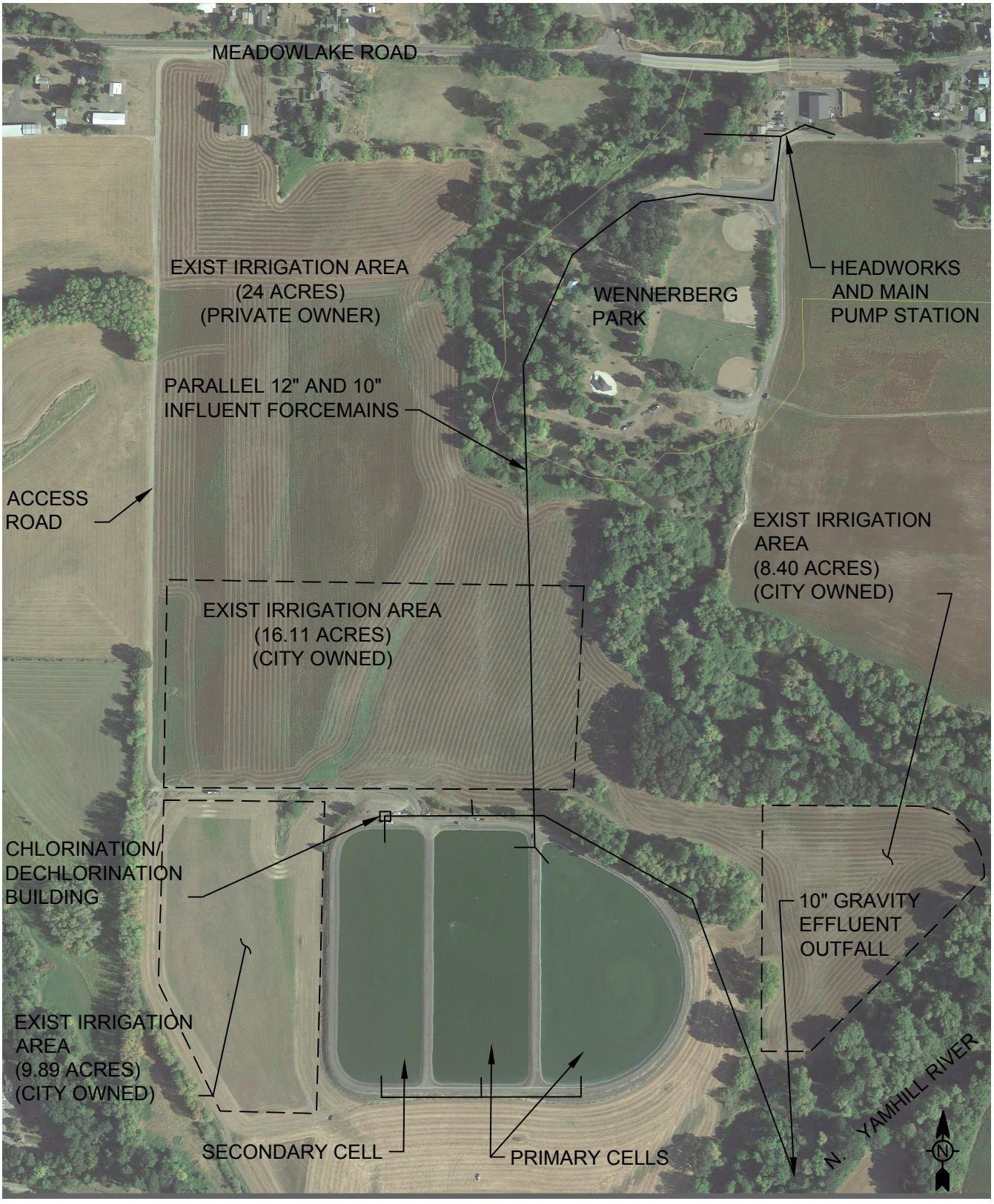
Table 3-4. Hawn Creek Pump Station Data	
Pump Station Type	Duplex submersible, non-clog
Capacity (per pump)	1175 gpm @ 118 feet TDH (static head approx. 43 feet)
Horsepower, HP	60 HP each
Motor Data	460-volt 3 phase 60 cycle
Firm Capacity of Pump Station	1.7 mgd (1175 gpm)
Maximum Pump Starts per Hour	15
Wet Well Volume	750 gallons (pumps off to lead pump on)
Level Control Type	Transducer and backup floats
Overflow Point	Bypass sewer in wet well
Alarm System	Autodialor
Backup Power	80 kW stationary diesel-powered standby generator

3.1.3 Collection System Deficiencies

Much of the City's collection system is over 85 years old and is well beyond its service life. This includes all of the clay pipe portion of the system and some sections of concrete pipe. The high wet-weather flow rates attributable to I/I create hydraulic problems in the collection system and at the treatment plant. The City's two pump stations in the collection system have both been recently upgraded, but upsizing the pumps is expected to be required to allow the Hawn Creek Pump station to meet demand in 2037.

3.2 TREATMENT FACILITIES

The City's existing treatment plant is a three-celled facultative lagoon system designed for discharge to the North Yamhill River during wet weather (November through April). The existing wastewater facilities are shown on Figure 3-2. Figure 3-3 shows the process flow diagram for the existing wastewater treatment facilities. The plant headworks, Main Pump Station and office/lab are located at the west end of Grant Street, north of Wennerberg Park, on the east side of the river. The lagoons and effluent reuse sites are located on the opposite side of the river approximately 2,700 feet to the south. The lagoon system was installed in 1991; the trickling filter and clarifiers that had been used until that time were abandoned and left in place.



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Portland, OR 97224
Tel 503.684.9097 Fax 503.598.0583

CITY OF CARLTON

WASTEWATER FACILITIES PLAN

EXISTING WASTEWATER TREATMENT FACILITIES SITE OVERVIEW

Project No.:135-13914-16001-03

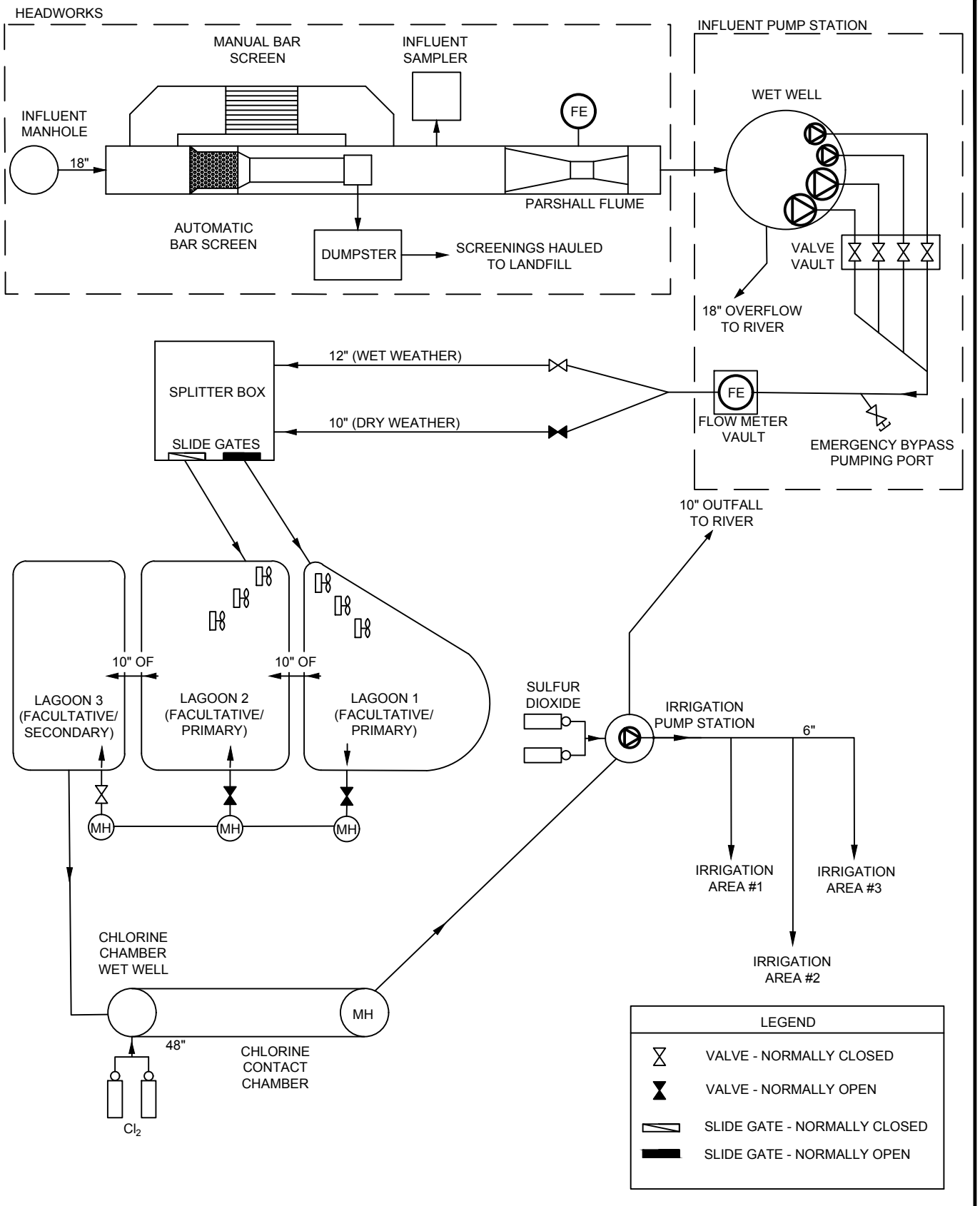
Date: JUNE 2017

Designed By:

Figure

FIG 3-2

Bar Measures 1 inch



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CITY OF CARLTON

WASTEWATER FACILITIES PLAN

EXISTING WASTEWATER TREATMENT FACILITIES PROCESS FLOW DIAGRAM

Project No.:135-13914-16001-03

Date: JUNE 2017

Designed By:

Figure

FIG 3-3

Bar Measures 1 inch

Raw sewage is screened and flows are measured at the headworks, then the flow is pumped by the Main Pump Station to the treatment lagoons, a distance of approximately 2,700 feet. The two force mains discharge into a splitter box at the lagoons, allowing the primary cells to be operated in series or parallel. Treated effluent from the ponds is disinfected and discharged directly to the river during wet-weather months and land-applied for crop irrigation during dry-weather months. The irrigation pump for land application can be used to pump effluent during the winter should a high river level require it.

The 1991 upgrade was designed to provide capacity for a 2010 design population of 1,793. Table 3-5 compares the design flows and loads in 1991, average flow and load data for the last three years, and the projected flows and loads in 2037. As expected due to the 2016 population exceeding the 2010 design population, influent flows and loads also exceed the 2010 design, and the capacity of the treatment facility will need to be upgraded.

Table 3-5. Treatment Facility Design Flows and Loads

	Projected 2010 (1991 Design)	2014-2016 Average	2037
Average dry-weather flow (mgd)	0.165	0.19	0.28
Average wet-weather flow (mgd)	0.191	0.30	0.82
Average daily biochemical oxygen demand (BOD) (lbs/day)	359	518	763
Lagoon 1 and 2 organic loading (lbs/acre/day)	40	58	85
Overall organic loading (lbs/acre/day)	28	40	60

Sources: April 1991 construction drawings prepared by Fetrow Engineering, 2014-2016 Discharge Monitoring Report Data

3.2.1 Headworks

The plant headworks facilities consist of a dual-channeled concrete structure with primary and bypass flow channels. The primary channel is fitted with an automatic self-cleaning bar screen, and the bypass channel is equipped with a manual bar screen. The system overflows to the bypass channel when flows reach 1.7 million gallons per day (mgd). From the headworks channel, flow is directed into an overflow structure containing a weir that bypasses flows higher than the Main Pump Station's capacity directly to the river. Overflows are measured using a V-notched weir. No bypasses of untreated wastewater to the river have occurred since the Main Pump Station was upsized in 2011.

Although there is a Parshall flume at the headworks, it is no longer used to measure flow. When the Main Pump Station was upgrade an electromagnetic flow meter was installed.

3.2.2 Main Pump Station

The Main Pump Station houses four submersible pumps in a trench style wet well, and was last upgraded in 2011. The pump station includes two 60-horsepower primary pumps with a capacity of 2,200 gpm each and two 10-horsepower jockey pumps with a capacity of 822 gpm each. All pumps are equipped with variable frequency drives. Table 3-6 summarizes the pump station's measured design data.

Wastewater is pumped from the Main Pump Station to the lagoons using two force mains: a 12-inch diameter PVC force main installed at the time of the 2011 pump station upgrade and a 10-inch diameter PVC force main installed when the lagoon facility was built. Flow to the force mains is controlled by manually closed valves; during dry weather only the 10-inch diameter force main is used. There is no odor issue at the splitter box where the two force main discharge at the treatment lagoons. The design point for the upgraded pump station, pumping through both force mains, is 3,100 gpm. Influent flows are using an electromagnetic flow meter located in a vault downstream of the main pump station. The station is equipped with an autodialer for alarms.

Table 3-6. Main Pump Station Design Data

Pump Station Type	Quad-plex wet well.
Pumps	2 Small Submersible Pumps, 10 Hp, 1,745 rpm 2 Large Submersible Pumps, 60 Hp, 1,170 rpm
Low Flow Pump	822 gpm @ 32 feet TDH
Actual Flow Capacity	Pumps 1 and 2: 2,200 gpm @ 64 feet TDH Pumps 3 and 4: 822 gpm @ 32 feet TDH
Level Control	Ultrasonic
Force Mains	2,698 feet, Primarily 10" PVC; 8" Cast Iron at River Crossing
	2,700 feet, 12" PVC
Backup Power	80-kW Onan Diesel Generator
Telemetry	Auto-dialer
Overflow Point	Overflow weir upstream of wet well; Elevation 129.00 feet
Hydrogen Sulfide Control	None

3.2.3 Treatment Lagoons

The treatment lagoons consist of two primary aerated lagoons with a total area of 9 acres and a secondary lagoon of 3.8 acres. The lagoons are all lined with 20-mil PVC covered by 12 inches of soil. The force mains from the Main Pump Station discharge into a splitter box that allows the primary lagoons to be operated in parallel or series. The splitter box has not been upsized to account for the greater flows from the upgraded Main Pump Station, and as a result overflows have been observed when both force mains are in operation.

Effluent from the secondary lagoon enters the chlorine contact pipe and then is discharged to the North Yamhill River during wet-weather months and land-applied during dry weather months. The lagoons are generally in good condition. Solids have not been dredged from the lagoons since their installation; City staff measured that current solids depth in the lagoons and it is three to eight inches. Table 3-7 summarizes design data for the lagoons.

Table 3-7. Existing Lagoon Design Data

	Primary Cell 1	Primary Cell 2	Secondary Cell 3
Area at middle depth of lagoon	4.5 acres	4.5 acres	3.8 acres
Aeration	3 – 2-hp Aerators	3 – 2-hp Aerators	None
Maximum depth	6 feet	6 feet	6 feet
Volume at maximum depth	9.1 million gallons	9.1 million gallons	7.7 million gallons
Design freeboard	2 feet	2 feet	3 feet
Berm top width	10 feet	10 feet	10 feet
Berm inside slope (horizontal to vertical)	2:1	2:1	3:1

3.2.4 Effluent Disinfection

Effluent disinfection prior to discharge is by gaseous chlorine injection, with chlorine contact time provided in 240 feet of 48-inch-diameter pipe. Dechlorination is achieved by injection of sulfur dioxide gas. The chlorine contact pipe was sized to provide 60 minutes of contact time at a peak-day flow of 0.533 mgd. As a result, it is undersized for current and design flows and needs to be upsized.

The disinfection/dechlorination equipment is housed in a small building on the north side of the treatment lagoons. In the event of a power outage, an auto-dialer notifies the operator and the effluent discharge is manually shut down. The existing chlorination and dechlorination equipment is original to the 1991 plant upgrade and needs replacement.

3.2.5 Wet-Weather North Yamhill River Outfall

During wet-weather months, effluent is discharged to the North Yamhill River following chlorination and dechlorination. Effluent flows to the river via gravity through 1,300 feet of 10-inch PVC pipe and discharges to the river through a single-port diffuser. During high river periods there is insufficient head to discharge all the flow by gravity. The gravity discharge to the river is assisted by pumping at the river bank, using a 4-inch above-ground irrigation pipe.

3.2.6 Dry-Weather Land Application of Reclaimed Wastewater

During dry-weather months, reclaimed water is used for irrigation of crops on land adjacent to the lagoons—34.4 acres owned by the City and 24 acres owned by a local farmer. Currently, the City has a lease agreement with a local farmer for the City owned land. Irrigation of the private property area is based on an informal agreement. Effluent for irrigation is pumped following the chlorine contact chamber and applied to the fields with wheel line irrigators according to the City's approved Reclaimed Water Use Plan. The farmer also uses a spray gun for irrigation. Table 3-8 summarizes the design data for the existing irrigation system.

Table 3-8. Irrigation System Design Data

Pump Station Type	Simplex
Pumps	1 Constant Speed 20 Hp
Design Flow	150-225 gpm @ 150 feet TDH
Flow Meter	6-inch propeller flow meter
Application Area	34.4 acres (City owned) 24 acres (Privately owned)
Approved Crops	Seed grass, grass hay or alfalfa
Irrigation Period	May through October

Currently, the irrigation is limited to when and how much the farmer wants the water. This is labor intensive for the City as it can occur at a moment's notice any day of the week and any time of the day. This is not conducive to optimal operation of the WWTP.

3.2.7 Flow Measurement and Sampling

Influent flow is measured using an electromagnetic flow meter located in a concrete vault just downstream of the Main Pump Station. The influent flow meter was installed when the Main Pump Station was upgraded in 2011. The parshall flume was left in place at the headworks, but it is no longer used to measure flow. The effluent flow meter is located upstream of the rectangular weir at the chlorine contact chamber wet well. Flow measurement is summarized in Table 3-9.

Table 3-9. Existing Flow Measurement

Meter	Location	Reading Type and Frequency
Influent flow meter	Main Pump Station	Totalized flow recorded daily
Effluent flow meter	Chlorine Contact Chamber Wet Well	Totalized flow recorded daily

Influent sampling is achieved by a refrigerated automatic composite sampler located at the headworks channel. Effluent sampling is provided by an automatic refrigerated composite sampler located adjacent to the chlorination building.

3.3 TREATMENT PLANT DEFICIENCIES

Overall the treatment plant functions adequately and meets permit requirements during non-peak-flow periods. However, flows and loads to the plant now exceed the design parameters for the plant and much of the existing mechanical equipment has reached the end of its design life. The following deficiencies were noted:

- The splitter box upstream of the treatment lagoons is undersized and is submerged during peak wet-weather flows.
- The transfer piping that is used for gravity flow between lagoons is not adequately sized for current and project flows and needs to be upsized.
- The existing chlorine contact pipes do not provide sufficient chlorine contact time for current and projected peak wet-weather flows.
- The existing chlorination and dechlorination equipment needs to be replaced due to size and condition issues.
- The City has limited control over the timing of reclaimed water use for irrigation, and no control over the volume of reclaimed water used. Direct City control of irrigation for all City-owned application areas is recommended to optimize water usage.
- The lagoons have storage capacity issues that often lead to early discharge. Increasing capacity by raising the dikes around the lagoons and/or installing an additional lagoon is recommended.
- The lagoons do not have adequate treatment capacity to accommodate existing loading. Additional capacity in the form of additional aeration is needed to meet current and future loading.
- The existing irrigation pump station has only one pump. Should the pump have mechanical problems, lagoon storage is used until the system can be brought back into operation, reducing freeboard at the lagoons. An additional backup pump is recommended, although it is not a DEQ requirement
- The capacity of the gravity effluent discharge pipe to the river is insufficient during peak-flow periods when the river level is high. This has resulted in the operator having to supplement the gravity effluent discharge with a pumped discharge to the river using the irrigation system piping. The outfall is also currently situated at a bend in the river, making it susceptible to erosion, and the outfall discharge is required by the City's current permit to be upgraded to improve mixing.
- Access to the treatment plant has been temporarily cut off for periods of several days when the North Yamhill River floods its banks. This appears to occur several times each winter. The plant is surrounded by floodplain and the access road was not constructed to an elevation that rises above the floodplain.

4. FLOW AND LOAD PROJECTIONS

4.1 WASTEWATER FLOWS

Evaluation and design of wastewater collection and treatment facilities requires estimates of the expected rates of wastewater flow. These estimates are used to ensure that the facilities have the capacity to handle the highest flows expected over the planning period. Design flows for the Carlton wastewater treatment plant are based on expected 20-year (2037) land use conditions. Wastewater facility evaluation and design typically account for the following standard flow rates:

- Average dry-weather flow (ADWF)—Average daily wastewater flow during the dry-weather months of May through October
- Average wet-weather flow (AWWF)—Average daily wastewater flow during the wet-weather months of November through April
- Average annual flow (AAF)— Daily wastewater flow averaged over the entire year
- Maximum-month dry-weather flow (MMDWF)—Maximum monthly flow during the dry-weather months
- Maximum-month wet-weather flow (MMWWF)—Maximum monthly flow during the wet-weather months
- Peak-day flow (PDF)—Maximum one-day flow during wet weather
- Peak-hour flow (PHF)—Maximum flow over a short duration (peak hour).

In addition to these standard flow parameters, a "peak effluent flow" was calculated for this study as the sum of the MMWWF and the rainfall volume on the lagoons from a 24-hour storm event with a 5-year recurrence interval. This accounts for the flow attenuation provided by the lagoons, which makes the peak effluent flow lower than the influent peak-day flow to the treatment plant.

4.1.1 Plant Flow Records

The City's treatment plant Discharge Monitoring Reports (DMRs) filed with the DEQ for the period from January 2011 through December 2016 were evaluated to determine current flows to the plant. Table 4-1 summarizes measured flows at the plant in millions of gallons per day (mgd). A more detailed summary sheet is found in Appendix A.

Table 4-1. Summary of Plant Influent Flow Data; 2011 through 2016

Year	ADWF (mgd)	AWWF (mgd)	AAF (mgd)	MMDWF (mgd)	MMWWF (mgd)	PDF (mgd)
2011	0.38	0.59	0.48	0.41	0.92	2.20
2012	0.22	0.61	0.41	0.33	1.04	5.60
2013	0.23	0.28	0.25	0.30	0.37	1.75
2014	0.19	0.52	0.36	0.30	0.73	2.19
2015	0.17	0.59	0.38	0.20	1.29	3.13
2016	0.21	0.61	0.41	0.52	0.83	2.90

4.1.2 Existing Design Flows

Existing design flows, on which projected future design flows are based, were generated using procedures developed by DEQ and plant flow data from the last three years. The last three years were used because the prior three years had significant spikes in influent loading; a possible explanation for these spikes is lack of pretreatment when new commercial dischargers have opened in the City. The DEQ guidelines and graphs generated with this procedure are contained in Appendix A. The resulting 2016 design flows are presented in Table 4-2.

Table 4-2. 2016 Design Flows from DEQ Guidelines

	ADWF	AAF	MMDWF	MMWWF	PDF	PHF
Recurrence Interval	2-Year	2-Year	10-Year	5-Year	5-Year	5-Year
Flow (mgd)	0.19	0.38	0.41	1.10	3.20	4.60

Because ADWF represents a "base flow" that includes little to no I/I, a comparison of peak flow to ADWF indicates the magnitude of the collection system's peak I/I. For the 5-year peak-day flow of 3.20 mgd, approximately 94 percent of the flow is I/I.

4.1.3 Wastewater Flow Projections

Wastewater flows through the planning period were projected based on the design flows (Table 4-2), anticipated population increases (see Chapter 2), and standard "peaking factors," which relate increases in ADWF to increases in higher flows such as MMWWF and PDF. ADWF flow rate increases were calculated from projected population increases assuming a base flow of 110 gallons per capita per day (gpcd). Increases in other flows were based on the following peaking factors:

- Increase in MMDWF = 2 x Increase in ADWF
- Increase in MMWWF = 3 x Increase in ADWF
- Increase in PDF = 4 x Increase in ADWF
- Increase in PHF = 5 x Increase in ADWF

AWWF was estimated as 63 percent of MMWWF, based on the average ratio between AWWF and MMWWF in the years 2014 through 2016. Table 4-3 summarizes the resulting flow projections.

Table 4-3. 20-Year Wastewater Flow Projections

		Projected Wastewater Flows (mgd)					
Year	Population	ADWF	AWWF	MMDWF	MMWWF	PDF	PHF
2020	2,319	0.203	0.717	0.44	1.14	3.25	4.66
2025	2,523	0.225	0.745	0.48	1.18	3.34	4.78
2030	2,745	0.249	0.776	0.53	1.23	3.44	4.90
2032	2,839	0.260	0.789	0.55	1.25	3.48	4.95
2035	2,987	0.276	0.809	0.58	1.28	3.54	5.03
2037	3,041	0.282	0.817	0.59	1.30	3.57	5.06

4.1.4 Pump Station Service Area Flows

The City's collection system includes two pump stations, each with its own service area (see Figure 2-1). Table 4-4 shows existing and future peak-hour flows for these areas, which were estimated to identify capacity deficiencies in the collection system.

Table 4-4. Pump Station Design Flows

Subarea	Peak-Hour Flow (mgd)	
	Existing	2037
Howe Street Pump Station	0.04	0.04
Hawn Creek Pump Station	1.37	1.84

4.2 WASTEWATER LOADS

In addition to the expected wastewater flows, evaluation and design of wastewater facilities requires estimates of the expected loads of various pollutants in the wastewater. Treatment facilities must be designed with operating capacity to treat the highest expected loads of pollutants over the planning period. Pollutants used as design parameters for this study were biochemical oxygen demand (BOD; sometimes measured as a five-day oxygen demand and expressed as BOD_5) and total suspended solids (TSS). The following classifications of wastewater pollutant loads were used:

- Average Load—Average daily wastewater load
- Maximum Load—Daily wastewater load during the maximum month.

4.2.1 Plant Load Records

Loading data are based on composite samples taken every other week to measure BOD_5 and TSS concentration and the influent flow on the day of the sampling. Pollutant loading in pounds per day (ppd) is calculated from the pollutant concentration for each sample and the influent flow at the time the sample was taken. Table 4-5 summarizes annual average, seasonal maximum month, and seasonal peak day influent loads at the plant.

Table 4-5. Summary of Plant Influent Load Data; 2011 through 2016

Year	BOD Loading					TSS Loading				
	AA (ppd)	MMDW (ppd)	MMWW (ppd)	PDDW (ppd)	PDWW (ppd)	AA (ppd)	MMDW (ppd)	MMWW (ppd)	PDDW (ppd)	PDWW (ppd)
2011	637	1,320	693	2,299	936	1,951	4,269	3,528	5,956	4,695
2012	1,007	921	3,161	1,179	6,631	1,882	2,799	6,105	4,736	9,903
2013	637	1,102	894	1,688	1,251	1,553	3,771	1,808	4,815	3,128
2014	564	977	1,030	1,189	2,068	636	891	1,031	1,123	1,859
2015	556	861	975	1,354	2,183	907	1,210	1,551	1,676	3,322
2016	434	864	678	1,204	877	678	698	1,464	918	2,552

AA = Average annual; MMDW = maximum-month dry weather; MMWW = maximum-month wet weather; PDDW = peak-day dry weather; PDWW = peak-day wet weather

Current loadings were calculated using load data from January 2014 through December 2016 and are shown in Table 4-6. The sampling frequency does not provide peak week data; these unit loadings were calculated using a peak week to average day peaking factor of 2.25. Appendix A provides a summary of these data.

The average monthly loading is the average of the influent loadings calculated from the two composite samples taken each month. Because the lagoons have a combined detention time of at least one month at existing maximum-month flows, a maximum-month design loading is used instead of a maximum-week or maximum-day loading when sizing some elements of the wastewater treatment process.

Table 4-6. Unit Wastewater Loads (2014-2016)

	Unit Load (pounds per capita per day)	
	BOD	TSS
Average	0.237	0.338
Maximum Month	0.408	0.616
Peak Week	0.533	0.761
Peak Day	0.780	1.177

Because composite samples were taken only every two weeks, it is possible that some of the monthly averages are not representative of actual loads to the treatment facility. This concern is addressed by using monitoring data over a period of three years, providing a large enough data set to reflect actual loadings.

The average unit loads (lbs/capita/day) for BOD and TSS are higher than average. There are two potential sources for this. There are six wineries in Carlton that do not have pretreatment, and these types of facilities typically will have high BOD loads and TSS loads. The high TSS loads may also be due to the old clay and concrete pipes in the collections system which allow high I/I rates and potentially soil.

These unit loads were used to project future loads, with the assumption that per capita BOD and TSS loadings will remain constant over the 20-year planning period. This assumption relies on the following understandings:

- Per capita BOD loading will stay constant because we assume there will be no significant change in the wastewater sources.
  - The primary sources of wastewater in the City are domestic sources with fairly uniform pollutant concentrations and there is no reason to believe this will change significantly.
  - There are high strength industrial users that do not currently have pretreatment, and it is recommended that the City begin the process of addressing this. However, the timing of the improvement is unknown, and the effect of the improvements is unknown. It appears prudent to base the projections on known data that would provide a conservative approach.
- Although new sewer extensions and replacement of existing sewers will result in less I/I than currently exists, the reduction in TSS per capita, if any, will likely be relatively small.

4.2.2 Load Projections

The unit wastewater loads presented in Table 4-6 and the population increases discussed in Chapter 2 were used to project future wastewater loads. Table 4-7 summarizes the resulting load projections. The 20-year (2037) wastewater loads represent the design loads.

Table 4-7. 20-Year Wastewater Load Projections

		BOD (ppd)				TSS (ppd)			
Year	Population	Average	Max Month	Peak Week	Peak Day	Average	Max Month	Peak Week	Peak Day
2020	2,319	550	946	1,236	1,809	784	1,429	1,765	2,895
2025	2,523	598	1,030	1,345	1,968	853	1,554	1,920	3,149
2030	2,745	651	1,120	1,463	2,141	928	1,691	2,089	3,426
2032	2,839	673	1,158	1,513	2,215	960	1,749	2,161	3,544
2035	2,987	708	1,219	1,592	2,330	1,009	1,840	2,273	3,727
2037	3,041	721	1,241	1,621	2,372	1,028	1,873	2,314	3,795

5. BASIS OF PLANNING

5.1 PERMITTING

5.1.1 Effluent Quality Requirements

The treatment plant is regulated under its National Pollutant Discharge Elimination System (NPDES) permit from Oregon DEQ (see Appendix B). The existing permit was last renewed on September 20, 2010 with an expiration date of June 30, 2015. This permit will remain effective until an updated permit is issued by DEQ. The NPDES permit establishes the following limitations for the North Yamhill River outfall (Outfall 001):

- E. coli—Maximum monthly geometric mean: 126 organisms/100 ml; Single sample maximum: 406 organisms/100 ml
- pH—Shall be within the range 6.0 to 9.0
- Removal of BOD_5 and TSS —Minimum 85% removal of BOD_5 monthly average and 65% removal of TSS monthly average
- Chlorine Residual—Shall not exceed 0.09 mg/L daily maximum and 0.04 mg/L monthly average.
- Mixing Zone—Mixing zone shall be within 25 feet from the west bank, 50 feet downstream and 10 feet upstream of the outfall.
- BOD and TSS limits as listed in Table 5-1.

Table 5-1. NPDES Permit BOD and TSS Limits for North Yamhill River Outfall 001; November 1 – April 30

	Maximum Concentration		Maximum Mass Load[a]		
	Monthly Average	Weekly Average	Monthly Average	Weekly Average	Daily
BOD_5	30 mg/L	45 mg/L	92 ppd	138 ppd	184 ppd
TSS	50 mg/L	80 mg/L	153 ppd	229 ppd	306 ppd

a. Based on average annual discharge of 0.367 mgd (projected for design year 2010)

NPDES permit requirements for effluent reuse (Outfall 002) define limits on total coliform in addition to establishing the following non-quantitative conditions:

- Total coliform is limited to 240 organisms per 100 ml in two consecutive samples and a seven-day median of 23 organisms per 100 ml.
- Ground surface ponding, creation of odors, mosquito breeding and other nuisance conditions are prohibited.
- Overloading the soil with nutrients, organics or other pollutants, or negatively impacting groundwater usage is prohibited.
- Discharge for irrigation shall be in accordance with an approved Effluent Reuse Plan.

5.1.2 Mixing Zone Study

Currently there are no limits in the discharge permit for ammonia however it is a constituent of concern for the future. While there are current discharge limits for pH it is also a constituent of concern for the future. A reasonable potential analysis (RPA) was conducted to determine if there is a reasonable potential to exceed water quality criterion at the edge of the mixing zone in the future. The mixing zone study can be found in Appendix G.

Neither constituent was identified as having a reasonable potential to exceed water quality criterion in the future. Therefore, it is assumed that ammonia will not be in the future permit and treatment for ammonia will not be required. pH will only need to be considered with regard to any current compliance issues.

5.1.3 Permit Compliance

The Carlton WWTP's discharge monitoring reports provide data on the plant's effluent that can be used to assess compliance with the NPDES permit requirements. Discharge monitoring report effluent data from 2011 to 2016 were reviewed to assess the plant's recent record of compliance.

BOD

Effluent BOD samples are collected and analyzed once every two weeks. The following permit limit exceedances occurred in the period 2011 to 2016:

- BOD effluent concentrations exceeded permit limits two times, both in March 2015 when the weekly maximum loading and monthly maximum loading were exceeded.
- BOD effluent loadings exceeded permit limits nine times, with exceedances occurring in five discrete months.
- BOD removal percentages were below the required limit eight times.

BOD-related exceedances typically occurred in the months of February to April and were associated with periods of high flow. The likely explanation is that the existing lagoon aeration is inadequate during high flow periods, resulting in insufficient BOD reduction as flow passes through the lagoons. Additional aeration capacity in the lagoons is the proposed solution.

TSS

Effluent TSS samples are collected and analyzed once every two weeks. The following permit limit exceedances occurred in the period 2011 to 2016:

- TSS effluent loadings exceeded permit limits two times, both in October 2013 when the weekly maximum loading and monthly maximum loading were exceeded.
- TSS removal percentages were below the required limit two times, in February 2014 and November 2015.

The two TSS loading exceedances are the result of a single data point and do not appear to indicate an ongoing issue with TSS removal. The two TSS removal percentage exceedances occur during months where the BOD removal limit was also exceeded; additional aeration capacity resulting in greater BOD reduction is likely to also result in TSS removal remaining within permit limits.

pH

pH samples are collected and analyzed twice per week. pH samples did not meet permit requirements eight times. In all eight cases, the maximum pH limit was exceeded. The pH issues may indicate the influence of wineries employing improper disposal procedures before being given further instruction by City staff.

E. coli Bacteria

E. coli samples are collected and analyzed once a week. All samples were within permit limits from 2011 to 2016.

Chlorine Residual

Chlorine residual samples are collected and analyzed daily.

Chlorine residual samples exceeded the permit limit 39 times and typically occurred during the summer months. The large number of permit exceedances indicates that the dechlorination approach at the WWTP needs to be reviewed. It may be necessary to increase dechlorination dose, increase the size of the dechlorination equipment or to upgrade the system to allow some form of flow pacing for dechlorination.

Total Coliform (summer irrigation)

Samples are taken once a week when irrigation is in use. In the last six years there have been nine permit violations. Two violations have been for maximum concentrations and seven have been for average concentrations. It should be noted that the two of the seven average concentration violations occurred when there was a maximum concentration violation. This occurs as very few samples are taken, so there is not sufficient data to average out the values.

This indicates issues with the disinfection system, possibly due to insufficient contact time, insufficient mixing or short circuiting. As the contact chamber is a pipe it is not likely that short circuiting is an issue.

5.2 SLUDGE STABILIZATION REQUIREMENTS

The treatment plant is required to comply with federal regulations regarding the stabilization and disposal of sewage sludge, as established in the Code of Federal Regulations (40 CFR Part 503). Part 503 classifies sludge as either Class A or Class B, based on the level of treatment. The criteria are pathogen reduction and vector-attraction reduction. Pathogens are disease-causing organisms that include but are not limited to certain bacteria, protozoa, viruses, and viable helminth ova. Vector attraction is the characteristic of sewage sludge that attracts rodents, flies, mosquitoes, or other organisms capable of transporting infectious agents. Pathogen reduction and vector-attraction reduction requirements are much stricter for Class A sludge than for Class B sludge. The City has not needed to haul biosolids from the plant, so stabilization requirements have not come into effect.

5.3 RELIABILITY/REDUNDANCY CRITERIA

5.3.1 Treatment Facilities

The EPA has established standards of reliability for wastewater equipment whose failure could lead to the release of under-treated effluent. The EPA standards define equipment reliability based on standard classifications. Treatment facilities for Carlton are defined by the DEQ as Reliability Class 1, which applies to equipment that discharges into “navigable waters that could be permanently or unacceptably damaged by effluent which was degraded in quality for only a few hours” (EPA 1974). The Reliability Class 1 designation requires redundant pumping capability at the Main Pump Station and provisions for standby power to keep key equipment operating in the event of the primary power source’s failure. The City has both of these items. The plant must be able to remain fully operational during a 25-year flood and withstand a 100-year flood without physical damage.

5.3.2 Collection System and Pump Stations

Oregon Administrative Rule (OAR) 340-041-0009 (DEQ Bacterial Rule) imposes the following restrictions on collection system overflows, effective January 1, 2010:

- No overflows resulting from storm events of lower magnitude than a 5-year, 24-hour event may occur during winter months (November 1 through May 21).
- No overflows resulting from storm events of lower magnitude than a 10-year, 24-hour event may occur during summer months (May 22 through October 31).

There have been no known overflows.

5.4 EFFLUENT REUSE REQUIREMENTS

Requirements and conditions pertaining to effluent reuse are set forth in OAR 340-055. Requirements are established for parameters including reuse site buffers, monitoring, reuse site signage, disinfection, site access and crops that can be grown. A complete listing of requirements for Class B effluent, which are applicable for the City of Carlton, is contained in Appendix C. The City is in compliance with these requirements except for the nine permit violations for total coliform.

5.5 COST ESTIMATING

Budget-level estimates developed for this plan are based on recent work in the area and are reliable to within 20 percent. Estimated costs include a 20-percent construction contingency and 25-percent markup for engineering, legal and administrative costs. Costs are in 2017 dollars unless otherwise noted.

5.6 DESIGN CRITERIA FOR THE WASTEWATER TREATMENT PLANT

Modifications to the wastewater treatment facilities have to be designed to accommodate wastewater flows and loads based on growth assumptions for the planning period through 2037. Flow and load projections were determined as described in Chapter 4. Load parameters established in the design criteria are BOD and TSS. Design criteria are as follows:

- Design Year——2037
- Design Population——3,041
- Flow (mgd):
  - Average Dry-Weather Flow——0.28
  - Maximum-Month Dry-Weather Flow——0.59
  - Maximum-Month Wet-Weather Flow——1.30
  - Peak-Day Flow——3.57
  - Peak-Hour Flow——5.1
- Load (ppd):
  - Annual Average BOD Load——721
  - Maximum-Month BOD Load——1,241
  - Peak-Week BOD Load——1,621
  - Peak-Day BOD Load——2,372
  - Annual Average TSS Load——1,028
  - Maximum-Month TSS Load——1,873
  - Peak-Week TSS Load——2,314
  - Peak-Day TSS Load——3,795

6. EVALUATION OF SYSTEM IMPROVEMENTS

6.1 CONVEYANCE SYSTEM IMPROVEMENTS

6.1.1 Sewer Pipe Condition

As discussed in Chapter 3, about 37 percent of the gravity collection system consists of clay pipe with cement mortar joints. Due to the poor condition of this pipe, the City's high I/I, and the need for periodic emergency repairs, it is recommended that the City adopt an ongoing program to eventually replace all of these pipes. Table 6-1 and Figure 6-1 present a proposed pipe replacement program with the following prioritization (from highest to lowest):

1. Trunk mains and collectors with high flows
2. Pipes within arterial roads
3. Lower-flow pipes in residential areas.

Should the City have a street improvement project in an area with clay pipe, replacement of the pipe should be included with the project regardless of the priority. Costs include manhole replacement as well as service line replacement to the property line.

Table 6-1. Clay Pipe Replacement Program

Project #	Description	Approximate Length	Estimated Cost [a]
C1A	16-inch Trunk Main	1,585 feet	$710,000
C1B	Selected High Priority 8-inch Pipes	741 feet	$270,000
C2	10-inch Trunk Main in Grant Street	1,265 feet	$500,000
C3	8-inch and 10-inch Pipe in East Main Street	10-inch: 710 feet 8-inch: 1,190 feet	$680,000
C4	6-inch, 8-inch and 10-inch Pipe in West Main Street	10-inch: 1,455 feet 8-inch: 430 feet 6-inch: 320 feet	$840,000
C5	6-inch and 8-inch Pipe in South Pine Street and South Park Street	8-inch: 790 feet 6-inch: 1,400 feet	$750,000
C6	6-inch and 8-inch Pipe along Kutch Street and vicinity	8-inch: 290 feet 6-inch: 1,825 feet	$700,000
C7	6-inch Pipe along West Jefferson Street, West Johnson Street and vicinity	1,625 feet	$440,000
C8	6-inch and 8-inch Clay Pipe along East Monroe Street and vicinity	8-inch: 2,020 feet 6-inch: 275 feet	$790,000

a. See detailed cost estimate in Appendix D.

6.1.2 Sewer Trunk Main Capacity

Currently the City's collection system has a 16-inch trunk main and a 10-inch trunk main. The 16-inch trunk main conveys flow from the northwestern portion of the City and approximately 80 percent of the flow from the Hawn Creek Pump Station. The 10-inch main runs along Grant Street and conveys flow from along Grant Street and approximately 20 percent of the flow from Hawn Creek Pump Station. The two trunk mains join at the intersection of Grant and Cunningham Streets. Flows from the southwestern portion of the city enter the 16-inch main trunk just prior to the treatment plant.

A hydraulic analysis of these systems was performed for existing and future flow conditions. Detailed results of the analysis are presented in Appendix E. Based on the hydraulic analysis, both trunk mains can be expected to experience localized surcharging during high flow events but have adequate capacity to convey existing and future peak flows and require no improvement to accommodate expected flows. However, segments of the trunk mains are recommended for replacement due to deteriorating pipe condition, as indicated in Table 6-1.

6.1.3 Pump Stations

Both collection system pump stations were recently upgraded. The Howe Street Pump Station is not expected to need additional upgrades during the planning period. The Hawn Creek Pump Station upgrades were sized for a projected 2024 peak hour flow of 1,175 gpm. As a result, an additional upgrade is expected to be required within the next ten years to accommodate continued growth in the Hawn Creek Pump Station basin. Current flow estimates indicate that the future upgrade should be sized to accommodate a peak hour flow of approximately 1,600 gpm, but the capacity required will need to be analyzed again at the time of the upgrade to account for changes in growth.

This upgrade, labeled as project number P1, is expected to consist of upsizing the pumps. For cost estimating purposes it has been assumed that the existing wet well can be reused and that the existing electrical equipment will be adequate. The estimated cost for the pump station upgrade $210,000; a concept level cost estimate is provided in Appendix D.

6.2 TREATMENT FACILITIES

6.2.1 Initial Screening of Alternatives

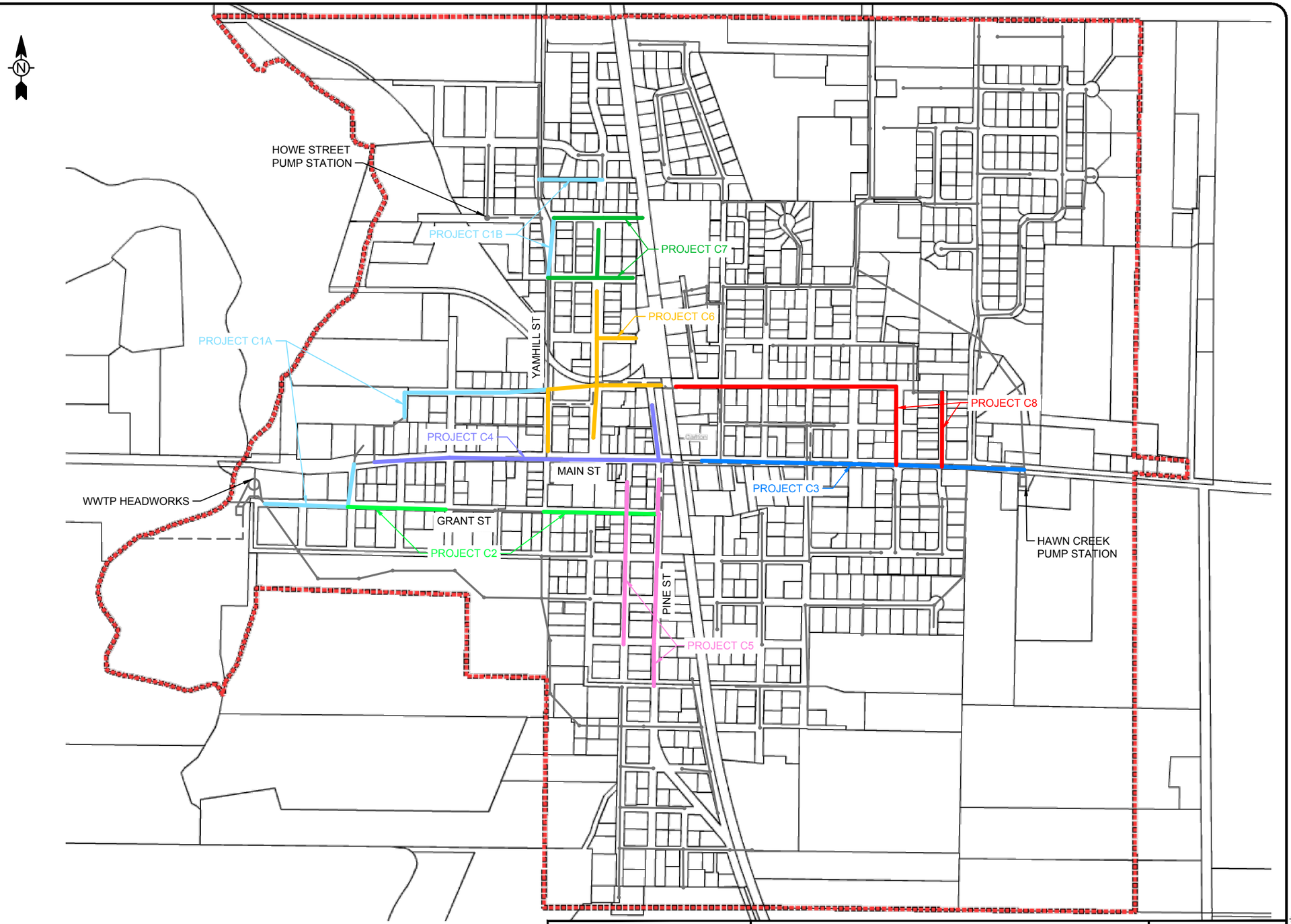
The treatment plant is in good condition and generally provides adequate treatment. The major issues with the plant are related to hydraulic capacity and future biological capacity. In the evaluation of treatment plant improvements, four general approaches were initially considered for each facility with identified deficiencies:

- **No-Action**—Make no improvements to address the deficiency.
- **Provide Higher Level of Treatment**—Implement improvements to provide higher-quality effluent than produced by existing treatment facilities; generally, existing facilities would be replaced with different technologies to achieve the higher level of treatment. This would essentially be a mechanical treatment plant.
- **Upgrade Existing Facility**—Improve existing facilities to provide adequate capacity and reliability for the 20-year planning period, while maintaining the current quality of treated effluent.
- **Regional Opportunities** – Combine the wastewater system with other nearby facilities.

The no-action alternative was not found to be acceptable, as the issues caused by identified plant deficiencies must be addressed. Without improvements, for example, high flows could cause the lagoon dikes to be breached, future biological treatment would be inadequate and operational issues with the reuse system could contribute to overall plant inefficiency or failure to meet regulatory requirements.

LEGEND

- PROJECT C1A & C1B
- PROJECT C2
- PROJECT C3
- PROJECT C4
- PROJECT C5
- PROJECT C6
- PROJECT C7
- PROJECT C8
- UGB / CITY LIMITS



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www.tetratech.com

15350 SW Sequoia Parkway, Suite 220
Portland, OR 97224
(503) 684-9097

CITY OF CARLTON

WASTEWATER FACILITIES PLAN

PROPOSED CLAY PIPE
REPLACEMENT PROJECTS

Project No.:	135-13914-16001
Date:	SEPTEMBER 2017
Designed By:	NGN

Supplemental

FIG 6-1

Bar Measures 1 inch

12/10/2018 2:37:56 PM - P:\13914\135-13914-16001-03\CAD\SHEETFILES\SANITARY SEWER SYSTEM MAP.DWG - BENNETTDAGGETT, HUNTER

The higher-level-of-treatment alternative (mechanical treatment) was also rejected because no conditions were identified that required more advanced treatment; hence the increased cost of more advanced treatment (such as an extended aeration/activated sludge system or membrane bioreactor type system) cannot be justified by any need or requirement.

The regional option was also rejected. The regional options would include combining systems with Yamhill, Lafayette or McMinnville. The City of Yamhill and Lafayette facilities are too small to consider combining them with Carlton without major expansions. The City of McMinnville is large enough that combining with them might be feasible. However, all three communities are a substantial distance from Carlton. Yamhill is approximately 4 miles distance, Lafayette is over 8 miles distant, and the treatment plant at McMinnville is over 8 miles distant. The pump station and force main could be in the range of $10 million, plus the improvements to the treatment plants that would be required. Due to the costs these options are not considered feasible.

For these reasons, all the improvements described in the following sections represent the upgrade-existing-plant alternative; where multiple upgrade options were identified, an evaluation of each is provided. Upgrades to provide additional hydraulic capacity represent the most cost-effective solution to providing a facility that meets NPDES permitting requirements and the needs of the City for the planning period.

6.2.2 Headworks

Headworks facilities remove fine to coarse debris from wastewater flow to allow more efficient treatment by downstream treatment process units. Data on influent flow quantity and quality is typically collected at the headworks, using a flow meter and a sewage sampler. A flow meter was included as part of the main pump station upgrades in 2011. The existing headworks channel is undersized and it is recommended that the existing headworks be completely replaced. New headworks facilities that would be suitable for the Carlton treatment plant include the following:

- A mechanically cleaned fine screen to remove fine to coarse debris and a washer/compactor to remove the fecal matter from the screenings
- Reuse or replace manually cleaned coarse screen used only as a bypass
- A new sewage sampler

The headworks facilities would be sized for the design peak-hour flow and equipment would be selected to maximize energy efficiency. The estimated cost for the headworks modifications is $640,000; a concept level cost estimate is provided in Appendix D. Odor control facilities are not proposed for the headworks because odors have not been a problem at the existing headworks, and with automatic bagging of screenings provided with the new fine screen, odors will probably be reduced. The new headworks facilities will be constructed adjacent to the existing headworks channel to allow existing facilities to remain in operation during construction.

6.2.3 Lagoon Site

Lagoon Treatment

Aeration for the two primary lagoons is currently provided by the six original floating aerators installed in 1991. The aerators are at the end of their design life and are due for replacement. Permit exceedances for effluent BOD concentration and loading, particularly during high flow periods, indicate that additional aeration capacity is required as well. Aeration requirements were calculated for projected average and peak week BOD loads, as shown in Table 6-2. The existing aeration capacity of 12 hp is not adequate to meet even short-term average BOD loads; a significant increase in aeration capacity is required. For the 2037 design year, a total of 48.8 hp will be required to meet the aeration demand for peak week BOD loads.

Table 6-2. Total Aeration Requirements for Primary Lagoons

	Average		Peak-Week		Number of 3 HP Floating Aerators Required
	BOD (ppd)	Required Aeration Power (hp)	BOD (ppd)	Required Aeration Power (hp)	
2020	550	15.3	1,236	36.8	14 total (7 per lagoon)
2025	598	16.8	1,345	40.2	14 total (7 per lagoon)
2030	651	18.5	1,463	43.9	16 total (8 per lagoon)
2032	673	19.2	1,513	45.4	16 total (8 per lagoon)
2035	708	20.2	1,592	47.9	16 total (8 per lagoon)
2037	721	20.6	1,621	48.8	18 total (9 per lagoon)

For cost estimating purposes it has been assumed that new aerators will be 3-hp floating units generally comparable to the existing aerators. However, bottom-mounted coarse- or fine-bubble aerators supplied by blowers adjacent to the lagoons are also an option and may be preferable if the level of the aerated lagoons is highly variable. During design, alternatives systems will be reviewed but the overall aeration approach is not expected to change.

As shown in the table, some phasing is possible to minimize up-front costs. For cost estimating purposes, it was assumed that the first phase of aeration improvements would include 16 3-hp floating aerators at an estimated cost of $430,000 and would provide adequate capacity through 2030. A second phase installed in approximately 10 years would include two additional floating aerators, at an estimated cost of $60,000. Concept level cost estimates are provided in Appendix D.

A mixing zone study and reasonable potential analysis (Appendix G) was performed to determine if ammonia and pH would be constituents that needed to be addressed in the future. The evaluation indicates that neither pH nor ammonia have a reasonable potential to exceed water quality standards. Therefore, treatment for these are not considered further.

Lagoon Capacity

In October 2017, the City was required to obtain DEQ permission to discharge to the Yamhill River before the permitted discharge period in order to avoid an overflow following a period of heavy rain. Early discharges have become an increasingly common necessity, indicating that lagoon storage capacity is an issue that needs to be addressed.

The existing and required capacity of the lagoons was modeled using a water budget spreadsheet, which is included in Appendix F. In the spreadsheet, water enters the lagoons due to influent flow and rainwater, and leaves the lagoons due to evaporation and discharges (to the river during winter months, and to irrigation during the summer months). As was experienced in 2017, the water budget spreadsheet identifies the month of October as the most critical time for storage because during this month, river discharge is not yet allowed, irrigation needs and evaporation are minimal, and rainfall is much higher than the summer months.

Using the water budget spreadsheet, four approaches to maximize lagoon capacity and stay within permit limits were identified and analyzed:

- **Increase total lagoon volume**: Total volume can be increased by raising the dikes around the lagoons, adding a second storage lagoon, and/or dredging biosolids.
- **Manage lagoon levels to provide volume at critical times**: If lagoon levels are drawn down in the spring months while river discharge is allowed by permit, this “spare” volume can be used during the critical storage month of October. Aeration is typically not required during the summer months because

permit requirements during irrigation periods do not include an effluent BOD requirement; as a result, the primary and secondary lagoons can be drawn down to better manage treatment/storage capacity.

- **Increase effluent flow to river**: Flow to the river is limited by the total permitted BOD load limit of 92 pounds per day. To maximize flow, effluent BOD concentration must be reduced, requiring higher levels of treatment. This should be achievable since significant additional aeration capacity is being recommended as discussed in the prior section.
- **Increase irrigation volume**: Irrigation volume is primarily limited by the amount of land available, as well as the crops grown and the management of the irrigation systems. Management issues are discussed further in Section 6.2.7, but for the purposes of this analysis, it is assumed that only existing City-owned land is available and that grass-seed irrigated at recommended levels will be the main crop. The analysis shows that additional irrigation does not appear to be a viable option for maximizing lagoon capacity.

Analysis using the water budget spreadsheet indicates that meeting projected 2037 loading limits while also remaining within permit effluent limits will require a combination of all three viable options: increasing total lagoon volume, managing lagoon levels to maximize available storage, and maximizing effluent flow to the river by increasing BOD removal. Proposed methods for achieving each option are described below.

Increasing Total Lagoon Volume

While dredging is an option to recapture some of the volume lost to accumulating sludge, the total volume increase is not likely to be significant given that recent estimates of biosolids depth range from three to eight inches. In addition, it appears that the biosolids layer has not increased in depth since measurements were taken in 2007, which is a sign that the bacterial community in the lagoons has reached an equilibrium state. Removing too many biosolids may affect treatment performance, so other alternatives should be evaluated to improve storage capacity.

Raising the dikes that encompass the lagoons will increase storage. The simplest method of doing so is to add material at the top of the existing dike, but the raise in height is limited by the width of the berm that separates each treatment cell. The existing width is approximately 10 feet, and due to the design slope of the lagoons, the dikes can only be raised one foot while still maintaining a minimum width of 5 feet for the new top of berm. Raising the dikes further would require that additional material be added within the existing lagoons, thickening the walls and allowing a greater height.

A dike raise of one-foot around all three existing lagoons will increase the maximum storage by approximately 4.2 million gallons, an increase of about 16%. The water budget analysis indicates that this increase in volume will be adequate to meet the City's needs, so a greater dike raise was not considered further. The estimated cost for raising the dikes one-foot is $620,000; a concept level cost estimate is provided in Appendix D. This cost assumes that it will be possible to weld a new liner for the raised portion of the dike to the existing lagoon liners; however, without excavating the existing lagoon to determine its condition, it is not possible to be certain that this welding method will be feasible.

Another option to increase total volume is to construct a fourth lagoon, which would serve as a second storage lagoon. For initial analysis, it was assumed that the additional lagoon would be equal in size to the existing storage lagoon to allow for simple flow splitting between the two storage lagoons if needed during future upgrades. A new 3.8-acre lagoon with a depth of six feet deep would provide an additional volume of 7.7 million gallons. The new lagoon would be constructed using 80 mm high density polyethylene (HDPE) liner that will be tougher than the 20 mm PVC liners used in the existing lagoons, allowing the lagoon to be constructed without a covering of soil over the liner.

The water budget spreadsheet indicates that the new lagoon option is a less effective method of providing additional storage than raising the dikes. This is because the new lagoon would be constructed in an area currently

used for irrigation, reducing the total irrigation water usage in the summer. In addition, a new lagoon adds more surface area and thus more precipitation to the lagoon system, especially during the critical storage month of October. The estimated cost for adding a fourth lagoon is $1,320,000; a concept level cost estimate is provided in Appendix D.

Managing Lagoon Levels

The water budget spreadsheet assumes that water level in all lagoons will be drawn down at the end of the river discharge period (late April). The water level will be maintained at a relatively low level during the summer months, as irrigation and evaporation roughly balance influent flows. Drawing down the lagoons provides the necessary storage when net flow increases in October. Even with increased volume due to raised dikes or an additional lagoon, the water budget spreadsheet indicates that the lagoons will need to be drawn down to a depth of 2.0 feet to meet capacity requirement in 2037.

Managing the level of the lagoons is primarily a matter of operations rather than infrastructure. However, reducing the water level in the aerated lagoons will require that the new aerators or aeration diffusers be capable of accommodating large variations in water level. It is assumed that the aerators will be turned off when lagoon levels are at their lowest during late summer; during this period the shallow depth of the lagoons means that surface aeration should be adequate to meet the minimal treatment requirements during irrigation season.

Increasing Total Effluent Flow to River

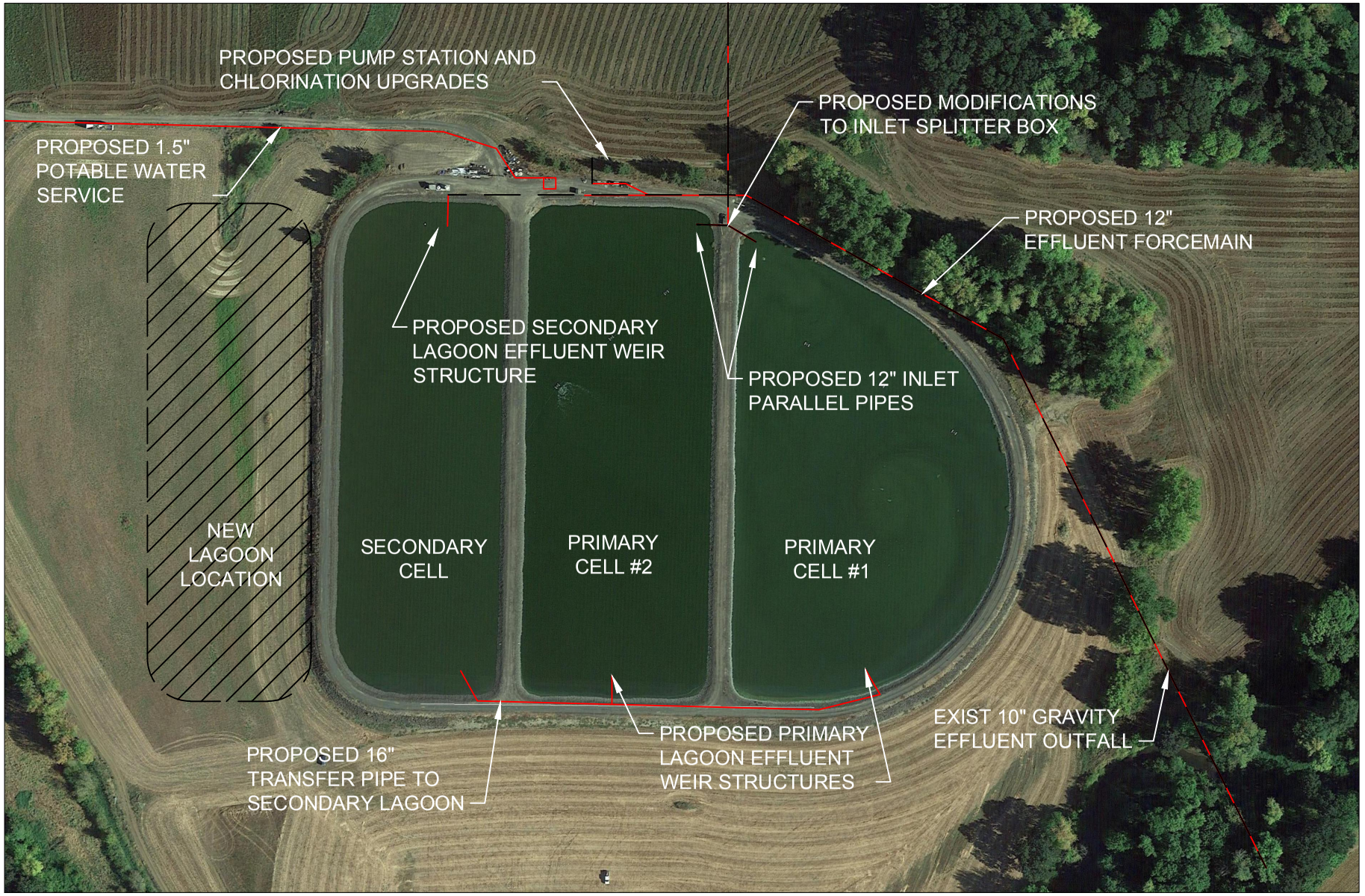
Total effluent flow during the winter months is determined by the effluent BOD concentration as a result of the permit limit on total BOD load. As a result, more effective biological treatment will be required. The water budget spreadsheet indicates that by 2037 effluent BOD concentrations below 12.0 mg/L will need to be maintained during winter months. Although this concentration is well below the average of 16.5 mg/L achieved in the last three years, the current system achieves comparable levels during months of relatively low flow, indicating that the system can achieve the lower concentrations consistently with adequate aeration capacity. Proposed increases in aeration capacity have been sized to achieve effluent BOD concentrations of less than 10 mg/L.

Lagoon Transfer Piping

With the increased capacity of the Main Pump Station, the existing 10-inch pipes from the inlet splitter box to the primary cells and from the primary cells to the secondary cell are insufficient to convey peak flows. Also, the lack of discharge weirs from all three cells limits the operator's ability to control water levels in the lagoons. Improvements to the lagoon transfer piping necessary to address these problems include construction of a new inlet splitter box, replacement of existing transfer pipes with 12-inch pipes from the inlet box to each primary cell, new discharge structures that provide level control, and new 16-inch transfer piping from the primary to secondary lagoons. Figure 6-2 shows the recommended piping improvements.

An estimated 710 feet of lagoon transfer piping will be replaced with new 16-inch transfer piping. Additional 16-inch transfer piping will be necessary if a new lagoon is built; costs for this piping is included in the cost of the additional lagoon project rather than the transfer piping project.

The existing influent splitter box was designed to handle 1.7 mgd, and the upgraded Main Pump Station is designed for a peak flow of 5.1 mgd. As a result, a new splitter box sized to accommodate flows from the upgraded pump station is required. The new splitter box will include gate mechanisms to selectively direct and control flows into either primary cell. This allows the operator to use the primary cells either in parallel or in series. The cost of a new splitter box, upgraded transfer piping, and outlet weir structures is estimated to be $410,000; a concept level cost estimate is provided in Appendix D.



TETRA TECH

www.tetratech.com

15350 SW Sequoia Pkwy, Ste 220
Portland, OR 97224
Tel 503.684.9097

City of Carlton

PROPOSED LAGOON TRANSFER PIPING IMPROVEMENTS

Project No.	135-13914-16001-03
Date:	DEC 2017
Designed By:	

FIGURE

FIG 6-2

Bar Measures 1 inch

Effluent Disinfection

Disinfection upgrades are necessary to meet regulatory requirements for future design flows. Upgrades to both the chlorination system, contact piping, and dechlorination system are all required. Chlorine effluent limits have been violated 39 times since 2011. This is an indication that the dechlorination system needs to be re-evaluated and upgraded to increase dosage, equipment size, or upgrade the dechlorination contact system.

The existing chlorine contact system is insufficient to meet projected treatment flows. DEQ guidelines state that the chlorine contact pipe length should be sized to provide 60 minutes of contact time at ADWF, 20 minutes at PDF, or 15 minutes at PHF, whichever results in the largest contact volume requirement. For this analysis, AWWF flow was used in place of ADWF to provide a more conservative estimate of required contact time. For PDF, flow data from the 2011-2016 DMRs indicate that peak effluent flows are typically significantly lower than peak influent flows at the City's WWTP, likely due to the large flow buffering capacity provided by the lagoons. As a result, peak effluent flow was estimated by combining influent maximum month wet weather flow, which simulates the buffering capacity of the lagoons by using a month of data, and the rainfall volume of a 5-year, 24-hour storm event. Storm volume was included to meet the OAR 3040-041-0009 requirement that no overflows shall result storm events of lower magnitude than a 5-year, 24-hour event.

As shown in Table 6-3, an additional 125 feet of 48-inch pipe is needed to provide the necessary chlorine contact volume for future design flows, bringing the total to 365 feet of disinfection piping. This additional piping can be located adjacent to the existing pipe, with the chlorine injection point and lagoon decant pipe connection relocated to the new upstream end of the chlorination pipe (see Figure 6-3).

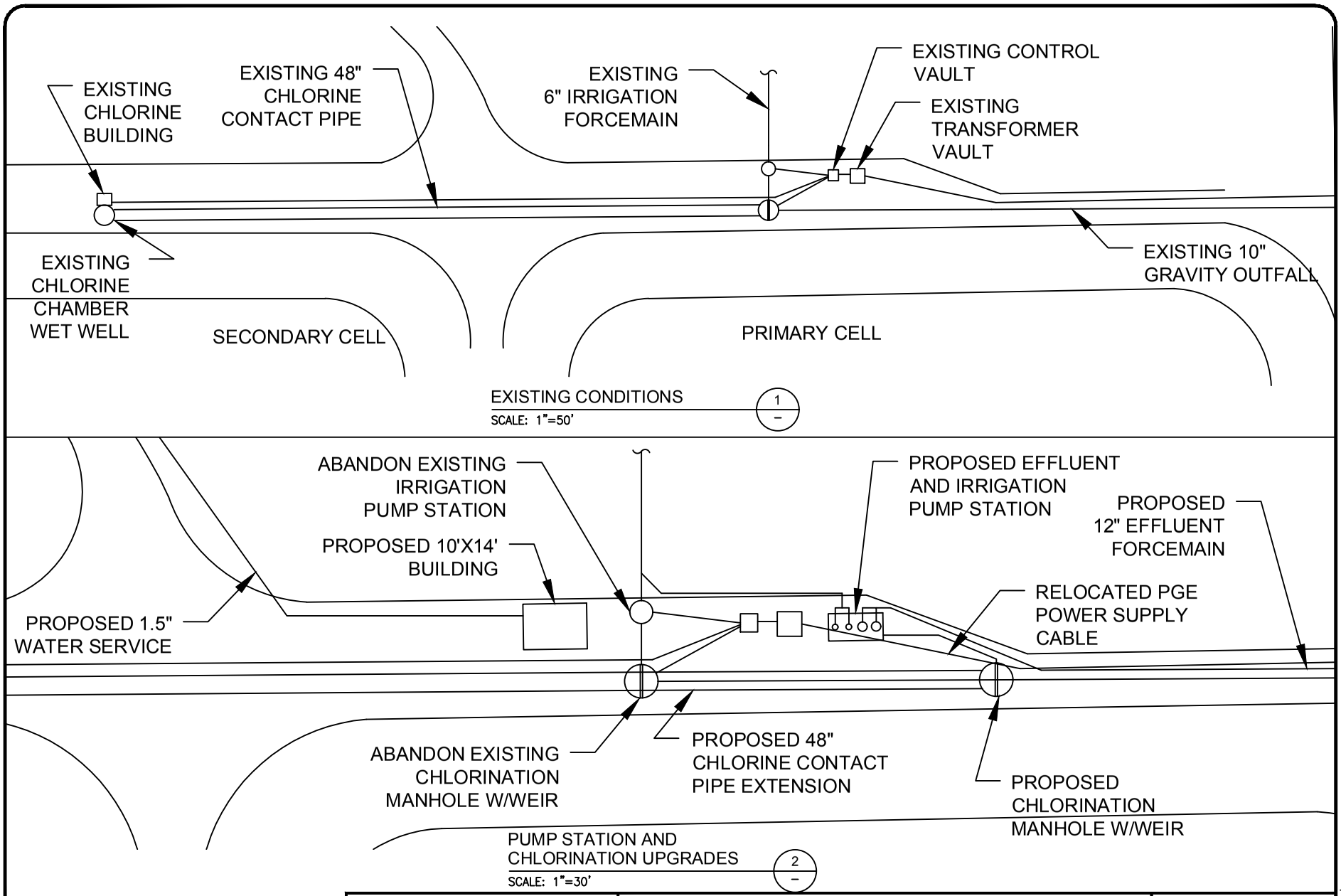
Table 6-3. Additional Chlorine Contact Chamber Requirements

	Projected Flow	Contact Time with Existing Facilities	Required Contact Time	Additional Contact Chamber Volume Required
Wet Weather Flows				
AWWF	0.59 mgd	47.5 minutes	60 minutes	3,300 gallons (35 feet of 4-foot-diameter pipe)
Peak Effluent Flow (MMWWF + 5-year, 24-hour rainfall)	2.42 mgd	15.0 minutes	20 minutes	11,750 gallons (125 feet of 4-foot-diameter pipe)

In addition, replacement of the gaseous chlorine disinfection equipment and sulfur dioxide dechlorination equipment is required. For cost estimating purposes it has been assumed that the new chlorination equipment will also use gaseous chlorine, but comparable systems using liquid sodium hypochlorite or chlorine tablets are also available and should be considered during the design process. The estimated cost to provide the required disinfection improvements, including providing a new chlorine mixer and replacing the weir manhole, is $230,000; a concept level cost estimate is provided in Appendix D.

Energy Efficiency

Lagoon wastewater treatment systems are inherently energy efficient compared to mechanical treatment plants as there is much less mechanical equipment that requires energy. Maintaining the treatment plant as a lagoon system keep the energy consumption low, and thus energy efficient. New equipment associated with the proposed aeration, effluent pump station and disinfection upgrades would be selected to maximize energy efficiency. It is standard procedure to require energy efficient motors for pumps, aerators and other mechanical devises, and it is anticipated that it will be required in the design for the upgrade.



TETRA TECH

www.tetratech.com

15350 SW Sequoia Pkwy, Ste 220
Portland, OR 97224
Tel 503.684.9097

City of Carlton

PROPOSED EFFLUENT DISINFECTION FACILITIES AND MAINTENANCE BUILDING

Project No.	135-13914-16001-03
Date:	DEC 2017
Designed By:	

FIGURE

FIG 6-3

Bar Measures 1 inch

6.2.4 Maintenance Building and Potable Water Supply

Treatment plant staff have indicated a need for a maintenance building with a potable water supply at the site of the treatment lagoons. Figure 6-3 shows the proposed location of a 10-by-14-foot building and 1.5-inch water service line. The estimated cost for the new building and water supply infrastructure is $440,000; a concept level cost estimate is provided in Appendix D.

6.2.5 Site Access

Access to the lagoon site has been temporarily cut off for periods of several days when the North Yamhill River floods its banks. This appears to occur several times each winter. The lagoon site is surrounded by floodplain and the access road was not constructed to an elevation that rises above the floodplain. Approximately 2,400 feet of the access road is below an elevation of 125 feet, which corresponds to the approximate 50-year flood elevation. In order to provide more reliable access to the treatment facility, it is recommended that the low portions of the access road be raised two feet to an elevation of 125 feet. The estimated cost for raising the access road is $400,000; a concept level cost estimate is provided in Appendix D.

6.2.6 Wet-Weather North Yamhill River Outfall

The existing 10-inch wet-weather gravity outfall pipe to the North Yamhill River has a capacity of 1.38 mgd when the river water surface remains below a top of bank elevation of 114.0 feet. In order to increase discharge when the river level exceeds that elevation, the irrigation system is used to pump additional effluent to the river. Use of the irrigation pumps for river discharge requires manual activation and a considerable amount of operator time. Even with the additional capacity provided by the irrigation pumping system, the wet-weather discharge system is undersized, as was evidenced during heavy rains in December 2005 and January 2006 when the lagoon freeboard was reduced to the point that the Main Pump Station had to be shut down and the lagoons bypassed. Based on this, the existing effluent outfall system is considered to be inadequate for peak storm events.

The current NPDES permit requires improvement of Outfall 001 (per NPDES Permit Number 101902) to improve mixing of the treated discharge with the receiving water, as the single existing diffuser is not effective. In addition, the current location of the wet-weather gravity Outfall 001 is at the bend of the North Yamhill River at river mile 8.1, causing susceptibility to erosion due to the changing course of the river around the bend.

Mixing Zone Study

A mixing zone study using CORMIX (an EPA-approved mixing zone model) was completed as part of the facility planning and is included in Appendix G. The results of the study indicate that a two-port diffuser will be sufficient to enhance the mixing to meet discharge permit requirements.

The mixing zone study considered the standard water quality parameters for a wastewater outfall including BOD, DO, and temperature. A reasonable potential analysis was also conducted for ammonia and pH.

Outfall Capacity Increase

It is recommended that the capacity of the wet-weather river outfall be increased to 2.42 mgd, to accommodate the maximum-month influent flow plus the rainfall from a 5-year, 24-hour storm onto the lagoons. EPA rules require that the treatment plant remain fully operational during a 25-year flood. The 2010 Federal Emergency Management Agency (FEMA) Flood Insurance Study for the North Yamhill River indicated that the flood elevations for a 10-year and 50-year flood at the proposed new location for the outfall of the treatment plant are 124.0 feet and 126.5 feet, respectively (a 25-year flood elevation is not included in the study). In order to ensure that the plant can remain operational during a 25-year flood, the outfall should be capable of discharging to the North Yamhill River for water surface elevations up to 126.5 feet.

In order to increase the capacity of the wet-weather outfall, pumped discharge with a pressure force main is needed. The existing gravity outfall will have to be replaced or a parallel pressure line will have to be constructed for use when the river elevation limits the use of the gravity outfall. Two options were identified for installing a pressurized outfall pipe to allow for pumped flow to the river:

- **Option 1—**Use pipe bursting to replace existing 10-inch PVC gravity sewer pipe with an 18-inch polyethylene pipe if existing outfall location is not to be abandoned.
- **Option 2—**Plug and abandon existing outfall pipe in place and install an 18-inch pressurized outfall pipe to the new outfall location. This option would allow gravity discharge during low-river conditions.

Both options allow discharge by gravity flow during low river conditions with automatic switchover to pumped flow during high river conditions; the advantage of Option 2 over Option 1 is that it accommodates relocation of the outfall.

Option 2 is recommended for increasing the river discharge capacity as it helps prevent further erosion and damage of the outfall in the river. In order to accommodate the maximum-month influent flow plus 5-year rainfall, the capacity of the new effluent pump station should be 2.42 mgd, or 1,694 gpm. Figure 6-2 shows the recommended new effluent force main; Figure 6-3 shows the recommended location for the new effluent pump station. The estimated cost for the new effluent pump station is $800,000, and the estimated cost for the new pressurized outfall and in-water installation of the two-port diffuser assembly is $810,000; a concept level cost estimate is provided in Appendix D.

In order to meet EPA Level I reliability/redundancy requirements, provisions for connection of a backup power generator to power the pumps in the event of a power outage will be necessary.

Outfall Relocation and Improvements

Relocating the outfall to a location in the straighter river alignment approximately 500 feet north along the river would make it less susceptible to erosion. The current NPDES permit requires improvement of Outfall 001 to improve mixing of the treated discharge with the receiving water. Thus, a new header in the river with two diffusers approximately 10 feet apart is recommended to enhance mixing and dilution of the ammonia in the treated effluent. See Appendix G for recommendations from the mixing zone study performed in August 2007.

6.2.7 Dry-Weather Reclaimed Wastewater Outfall

Use of reclaimed wastewater for crop irrigation allows the City to reduce its need for wastewater storage during the months when discharge to the Yamhill River is not allowed by permit. At present, reclaimed wastewater is currently applied to both City-owned agricultural land and adjacent land owned by a local farmer. Irrigation operations for these combined areas of land are managed by the farmer. This has caused problems for City personnel because the timing of irrigation water use is unpredictable and often inconvenient. In addition, the fields are being managed to maximize crop production rather than maximizing reclaimed wastewater use, which is the City's goal. It is recommended that the City focus only on irrigating the land it currently owns and either have City staff control irrigation timing and rates or ensure that anyone managing the land for the City is aware of the City's priorities.

The recommended crop for the City-owned land is grass seed. Grass seed has a relatively high water consumption rate while having low management requirements. Current irrigation operations are dictated by the farmer's need for irrigation, which varies significantly from year to year. Records for the last six years indicate that irrigation typically only occurs during two of the six dry-weather months. However, data published by Oregon State University's Water Resources Engineering Team list higher net irrigation rates for grass seed, indicating that it should be possible to apply additional reclaimed wastewater for irrigation. The City's permit requires "sound

irrigation practices" that prevent prolonged ponding, surface runoff, creation of odors or nuisance conditions, and overloading of nutrients and other pollutant parameters. It appears, based on the OSU data, that it is possible to apply additional reclaimed wastewater for irrigation without triggering these unacceptable conditions. The farmer currently managing irrigation for the City is likely using best practices that minimize water usage, such as irrigating at night to reduce water loss due to evaporation. However, in this case, these practices are resulting in undesirable outcomes for the City because water use is the goal rather than a consumptive use to be minimized. For this reason, City control of the irrigation is strongly recommended.

If irrigation on City land is to be fully controlled by the City, it is assumed that irrigation piping and equipment will need to be purchased. In addition, City staff have also asked that a woven wire fence and two security cameras be installed at the lagoon site to enhance security and prevent unauthorized changes to the irrigation equipment. The estimated cost for this equipment and security upgrades are $590,000; a concept level cost estimate is provided in Appendix D. Upgrades to the irrigation pumping system are included in the effluent pump station upgrade because the new pump station will include pumps for discharging both to the river and to the irrigation equipment.

6.2.8 Biosolids Removal

The primary treatment lagoons have been accumulating biosolids since their construction in 1991. Recent sludge depth measurements indicate that the thickness of the biosolids layer is 3 to 8 inches, which is not a significant increase from 2007 when the biosolids depth was last evaluated. With biosolids at this depth and the depth not appearing to increase, dredging and wasting of this material is not an immediate need. However, changes to the treatment process, lagoon volume and/or increased influent loading may result in greater biosolids accumulation. At this time, it is expected that the need to remove biosolids won't be necessary for at least 10 years.

The most cost-efficient approach will be to land-apply the biosolids onto City-owned effluent reuse areas, although additional land may also be required. Prior to sludge removal, a biosolids management plan will need to be developed and approved by DEQ, and this plan will evaluate possible methods of biosolids disposal, including land application locally, land application at a remote site, hauling liquid biosolids to another wastewater treatment plant, and hauling dewatered solids to a landfill. The estimated cost to prepare the biosolids management plan is $20,000. Without knowing if the City-owned land will provide enough space for land application, an estimated dredging and disposal cost of $820,000 has been estimated based on land application at a remote site. If the conclusions of the biosolids management plan support land application in Carlton, this cost is likely to be reduced. A concept level cost estimate is provided in Appendix D.

6.2.9 High Strength Users

Like many other communities in the region, the City is experiencing significant growth in businesses related to the wine industry. Many of these businesses discharge wastewater that is higher in strength than typical residential wastewater, meaning that it has higher levels of organic matter and requires additional treatment as a result. High strength wastewater is often characterized using biochemical oxygen demand (BOD) and is produced by such businesses as commercial kitchens, food packagers, and producers of beer and wine.

The data shows that the City has higher strength wastewater per capita than is usual, and this is likely due in least in part to the high strength users such as the wineries. This is part of the reason the treatment plant is at capacity and at times over capacity. The treatment improvements aimed at biological treatment are sized in part for these high strength users.

The City's Code includes language that allows limits to be placed on high strength wastewater, but to date the City has typically dealt with wineries and other high strength dischargers by working with them on an individual basis to remove solids (such as crushed grapes) from their waste stream before discharging to a City sewer.

The City's existing Code addresses high strength discharge briefly in Chapter 13.08.240.C.9.c, which prohibits "Unusual BOD, chemical oxygen demand, or chlorine requirements in such quantities as to constitute a significant load on the sewage treatment works".

It is recommended that the City begin to enact the limits that the code allows for high strength users. There are several steps involved with this that include the following:

- Development of an industrial user ordinance to set the general requirements for high strength users. This will also define what a high strength user is and what the quality and quantity limits are that must be met.
- As part of the industrial user ordinance, there should be a requirement for the industry to define the quality and quantity of their wastewater flow.
- Industrial user ordinances typically require that individual discharge permits be developed for each high strength user.
- Develop a rate structure for industrial users. This would need to have some flexibility in it to allow the City to respond to unusual pollutants. Often there is a rate for flow, BOD, and TSS.
- Require pretreatment at the industrial user facility to meet certain standards. Pretreatment may involve fine screens, biological treatment, pH adjustment and other methods as required. Part of the pretreatment system would also include monitoring of both quantity and quality of the wastewater discharge from the industrial facility.

There are existing winery facilities in the community that would fall under the pretreatment ordinance, and it is recommended that the City begin to work with these users to implement pretreatment. There are several steps to this process and it is suggested that it includes the following:

- Discussions with the users with regard to the coming requirements.
- Setting a reasonable time table for implementing the program that allows the existing users to respond in a responsible manner.
- Implement monitoring of the wastewater from the facilities. This should be done at least over a year's period to try to capture all the changes in the wastewater due to operations.
- Based upon the results of the monitoring, develop pretreatment requirements.
- Develop individual permits for each winery.

It is likely that there are some pretreatment requirements that can be implemented prior to the years monitoring data based upon known operational circumstances. This could include fine screening and pH adjustment.

6.2.10 Sustainability and Constructability

The proposed improvements utilize the simplest method of upgrading the wastewater facilities, which has a number of benefits with regard to sustainability:

- The energy consumption is much lower than other treatment plants that are mechanical in nature.
- There are less mechanical parts and equipment thus reducing the future maintenance and replacement requirements.
- The continued use of existing facilities, such as the lagoons, reduces the resources required for the improvements and makes good use of existing facilities.
- Replacement of clay pipe reduces the I/I in the system, which in the long-term reduces the capacity requirements of the system. This will reduce the expansion requirements of the treatment plant in the future.
- Replacement of the clay pipes will also reduce the pipe failures that sometimes leads to larger issues, such as sink holes.

There are constructability issues, but they are standard and can be addressed as part of design such as:

- Keeping the treatment plant operational while the improvements are completed.
- Constructing the outfall in the river.
- Replacing sanitary sewer pipe while keeping the system operational.

7. RECOMMENDED PLAN

7.1 PROJECT DESCRIPTION

The following improvements to the City's wastewater facilities are proposed to meet existing needs and provide for future development during the 20-year planning period:

- Ongoing replacement of clay sewer pipes in the collection system
- Upsizing of pumps at the Hawn Creek pump station to accommodate increased flows
- New headworks, including concrete channel and self-cleaning fine screen
- Lagoon aeration improvements:
  - Phase 1: replace existing aerators and provide adequate aeration capacity for projected 2028 loading in each primary lagoon
  - Phase 2: provide additional aeration capacity to meet projected 2038 loading in each primary lagoon
- Lagoon storage capacity improvements - Raise dikes around three existing lagoons by one-foot.
- Upsizing of the lagoon transfer piping, upsized splitter box, and the addition of lagoon level-control structures
- Expansion of the chlorine contact piping and replacement of chlorination/dechlorination equipment
- New maintenance building with potable water supply at lagoon site
- Raise access road to approximate 50-year flood elevation
- New effluent pump station to house two irrigation pumps and two high-river effluent pumps
- New 18-inch pressurized effluent pipe from effluent pump station to relocated outfall with two-port diffuser
- New irrigation equipment allowing City to directly manage irrigation of City-owned land adjacent to lagoons
- Biosolids management plan and dredging of biosolids from lagoons

7.2 DESIGN DATA

The recommended improvements were designed to accommodate wastewater flows and loads based on growth assumptions through 2037 (see Section 5.6). Table 7-1 and Table 7-2 summarize the resulting design data for the proposed collection system and treatment plant improvements, respectively.

Table 7-1. Design Data for Recommended Collection System Improvements

Design Parameter	Design Criteria
Clay Pipe Replacement	*See Table 6-1*
Hawn Creek Pump Station Upgrade	
Design Capacity	1,600 gpm (approximate, required capacity to be revisited when project is initiated)
Force Main	Use existing 2,770 linear feet of 6-inch steel force main and 3,865 linear feet of 8-inch PVC force main
Wet Well	Use existing 8-foot diameter wet well
Level Sensing	Use existing instrumentation

Table 7-2. Design Data for Recommended Treatment Plant Improvements

Design Parameter	Design Criteria
HEADWORKS—Screening	
Screen Type	Fine, rotary
Number	1
Peak Flow Capacity	5.1 mgd
Screenings Washing and Compaction	Yes
Bypass Screen	Manually cleaned coarse bar screen
LAGOON AERATION	
Phase 1 (near term)	16 replacement 3-hp aerators per lagoon
Phase 2 (before 2030)	2 additional 3-hp aerators per lagoon
LAGOON CAPACITY—Dike Raise	
Total Height Raise	1 foot
Minimum Berm Width After Raise	5 feet
Additional Volume	4.2 million gallons
Liner	20 mil PVC, welded to top of existing PVC line
LAGOON PIPING	
Splitter Box Dimensions	10.33 feet wide, 22 feet long, 8.5 feet deep
Overflow Piping	80 linear feet of 12-inch PVC pipe
Transfer Piping	710 linear feet of 16-inch PVC pipe
DISINFECTION	
Effluent Chlorination	
Type	Gaseous chlorination
Number of Chlorinators	1
Capacity, per Chlorinator	120 ppd
Feed Rate, Average	10 ppd
Feed Control	Flow-paced
Chlorine Contact	
Existing Facilities	48-inch diameter chlorine contact pipe
Additional Volume	11,750 gallons w/flash mixer
Additional Length of 48-Inch Pipe Required	125 feet
Minimum Contact Time, at AWWF (1.32 mgd)	60 minutes
Contact Time, at MMWWF plus Rainfall (2.44 mgd)	20 minutes
Effluent Dechlorination	
Type	Gaseous sulfur dioxide
Number of Sulfonators	1
Feed Control	Flow-paced

Design Parameter	Design Criteria
EFFLUENT DISPOSAL	
Wet Weather Outfall 001 (Discharge to the N. Yamhill River)	
Existing Gravity Discharge	10-inch
High-River Pumped Discharge	
Number of Pumps	Two submersible constant-speed pumps
Capacity	1,700 gpm each
Wet Well	6-by-10-foot precast concrete vault
Pressurized Outfall	18-inch pipe
Outfall Type	Two submerged duckbill-type diffusers
Dry Weather Outfall 002 (Reclaimed water use)	
Available Land Area, Design Year 2037	34.4 acres
Land Management	Irrigation equipment owned and operated by City
Irrigation Pumps	
Number and Type of Pumps	Two constant-speed submersible pumps
Capacity	300 gpm
Irrigation Main	6-inch pipe
Backup Power	Receptacle for Backup Power Generator

7.3 PROJECT COSTS

Concept level cost spreadsheets for the recommended improvements are included in Appendix D. These budget-level estimates are reliable to within 20 percent. The estimates include a 20-percent construction contingency and 25 percent for allied costs including engineering, legal, and administrative costs. All costs are presented in 2017 dollars (ENR Construction Cost Index = 10817.11).

7.3.1 Collection System Improvements

Collection system improvements consist of the Clay Pipe Replacement Program discussed in Chapter 6, in addition to pump replacement to increase capacity at Hawn Creek pump station in approximately 2024. The City has identified Projects C2 on Grant Street and Project C4 on West Main Street as high priorities due to condition issues. For planning purposes, it is recommended that the high priority projects be initiated in 2018 and the remaining improvements be spread over the remaining 20-year timeframe. Table 7-3 summarizes the proposed collection system improvements and estimated costs.

7.3.2 Treatment Facility Improvements

Near-Term

As the existing headworks, lagoons, and effluent disinfection and discharge facilities are all undersized for existing flows, it is recommended that the proposed improvements to these facilities be constructed in a single phase, with construction to begin in 2019. Only one lagoon capacity project is anticipated to be needed (dike raise or new lagoon); in order to provide a conservative estimate of total costs, the more expensive option (new lagoon) has been assumed as the selection. Acquisition of irrigation equipment should be included in the initial project to ensure that the irrigation system used for reclaimed water during the summer months is owned and controlled by the City. Table 7-4 summarizes the proposed improvements and estimated costs.

Table 7-3. Collection System Improvement Costs

Project	Cost
Clay Pipe Replacement Program	
C1A. 1,585 feet of 16-inch trunk main	$710,000
C1B. 741 feet of 8-inch pipe in Yamhill St and W. Garfield St.	$270,000
C2. 1,265 feet of 10-inch trunk main in Grant Street	$500,000
C3. 710 feet of 10-inch and 1,190 feet of 8-inch pipe in East Main Street	$680,000
C4. 320 feet of 6-inch, 430 feet of 8-inch, and 1,455 feet of 10-inch pipe in West Main Street	$840,000
C5. 1,400 feet of 6-inch and 790 feet of 8-inch pipe in South Pine and South Park Streets	$750,000
C6. 1,825 feet of 6–inch and 290 feet of 8-inch pipe in Kutch Street and vicinity	$700,000
C7. 1,625 feet of 6-inch pipe in West Jefferson Street, West Johnson Street and vicinity	$440,000
C8. 275 feet of 6-inch and 2,020 feet of 8-inch pipe in East Monroe Street and vicinity	$790,000
Subtotal	***$5,680,000***
Pump Stations	
P1. Hawn Creek Pump Station Pump Replacement	$210,000
Total	**$5,890,000**

Table 7-4. Near-Term Treatment Facility Improvement Costs

Project	Cost
T1. Headworks Upgrade	$640,000
T2A. Lagoon Aeration Improvements - Phase 1	$430,000
T3A. Lagoon Capacity Improvement - Raise Dikes	$620,000
T4. Lagoon Piping Improvements	$410,000
T5. Lagoon Disinfection Improvements	$230,000
T6. Miscellaneous Plant Improvements (Water/Electrical Service, Small Building)	$440,000
T7. Raise Access Road to Elevation 125.0' (Approximately 50-year Floodplain)	$400,000
T8. Effluent Pump Station	$800,000
T9. Effluent Force Main and River Outfall	$810,000
T10. Irrigation Piping and Equipment	$590,000
Total	**$5,370,000**

Long-Term

Improvements that are expected to be necessary within the 20-year planning period but are not required at this time include raising the elevation of the access road, the second phase of aeration improvements, and biosolids removals. These improvements should be anticipated for approximately 10 years in the future. Table 7-5 summarizes the long-term treatment plant improvements.

Table 7-5. Long-Term treatment Facility Improvement Costs

Project	Cost
T2B. Lagoon Aeration Improvements - Phase 2	$60,000
T11A. Biosolids Management Plan	$20,000
T11B. Dredging and Biosolids Land Application	$820,000
Total	**$900,000**

Annual Costs

The FY2017 estimated annual cost for administration and for O&M, approximately $405,000, will be the basis for ongoing annual costs, with adjustments for inflation. Should the City add staff the O&M budget would need to adjusted accordingly.

With the increase in complexity of the treatment plant, it is recommended that the City re-evaluate staffing and consider adding one staff.

Capital Improvement Plan (CIP)

The improvements have been combined into a capital improvement plan (CIP), as shown in Table 7-6.

Table 7-6. CIP

Project	Cost	Year	SDC Eligible
C4 Main Street 320 feet of 6-inch, 430 feet of 8-inch, and 1,455 feet of 10-inch pipe	$840,000	2020	No
Phase 1 Near Term WWTP (T2A, T3A, T4, T5, T8, T9, T10)	$3,890,000	2022	Yes
P1. Hawn Creek Pump Station Pump Replacement	$210,000	2024[a]	Yes
Phase 2 Near Term WWTP (T1, T6,T7) & C1A. 1,585 feet of 16-inch trunk main	$2,190,000	2027	Partially
T2B. Lagoon Aeration Improvements - Phase 2	$60,000	2028[b]	Yes
T11A & T11B. BMP & Dredging and Biosolids Land Application	$840,000	2028[c]	No
C1B & C2. 1,265 feet of 10-inch trunk main in Grant St, 741 feet of 8-inch pipe in Yamhill St and W. Garfield St.	$770,000	2030	No
C3. 710 feet of 10-inch and 1,190 feet of 8-inch pipe in East Main St	$680,000	2032	No
C5. 1,400 feet of 6-inch and 790 feet of 8-inch pipe in South Pine and South Park St	$750,000	2035	No
C6. 1,825 feet of 6–inch and 290 feet of 8-inch pipe in Kutch Street and vicinity	$700,000	2036	No
C7. 1,625 feet of 6-inch pipe in West Jefferson Street, West Johnson Street and vicinity	$440,000	2037	No
C8. 275 feet of 6-inch and 2,020 feet of 8-inch pipe in East Monroe Street and vicinity	$790,000	2038	No
Total	**$12,160,000**		

a. Actual timing of this upgrade will be based upon when development occurs. The City should consider an upgrade when the station reaches 80% capacity.
b. Actual timing will depend on the loading to the WWTP which will be dependent upon development.
c. This work will only be done as required. The City should measure the depth of the sludge in the lagoons yearly to determine when sludge needs to be removed. It has not been required yet, but with the change in treatment more sludge may accumulate.

7.4 SCHEDULE

The collection system improvements on Main Street need to be done in 2020 to meet the schedule for the ODOT Main Street improvements scheduled for construction in 2021. This project will also be coordinated with undergrounding the utilities on Main Street. The near-term treatment plant projects are necessary to meet current system demands and consequently should be constructed as soon as possible. The following are the key project milestones for the two improvement projects:

- Review of Draft Facilities Plan complete (DEQ and the City): February 2018
- Facilities Plan finalized: May 2018
- Begin design of C4: March 2018
- Coordinate with ODOT: March 2018 – March 2020
- Apply for construction funding: by May 2018
- Complete design of C4: December 2018

- Coordinate design with Utility undergrounding: July 2018 – July 2019
- Construction C4: October 2019 – May 2020
- Begin funding for phase 1 WWTP improvements: June 2018
- Begin design for phase 1 WWTP improvements: September 2019
- Bid out the project: September 2020
- Construction: December 2020 to March 2022

7.5 HIGH STRENGTH USERS

It is recommended that the City begin to address high strength users in order to reduce the biological load to the treatment plant. There are several steps involved with this that include the following:

- Development of an industrial user ordinance.
- Develop a rate structure for industrial users. This should consider flow, BOD, and TSS.
- Require pretreatment at the industrial user facilities.
- Incorporate addressing high strength users into the development review process.

There are existing winery facilities in the community that would be in this category of user, and it is recommended that the City begin to work with these users to implement pretreatment. There are several steps to this process and it is suggested that it includes the following:

- Implement monitoring of the wastewater from the facilities. This should be done at least over a year's period to try to capture all the changes in the wastewater due to operations.
- Based upon the results of the monitoring, develop pretreatment requirements.
- Develop individual permits for each winery.

The Oregon Association of Clean Water Agencies Pretreatment Committee distributes a Draft Sewer User Ordinance for use by municipalities wishing to update their own ordinances. The Draft Ordinance can be modified to meet the City's needs for details, such as local limits on specific pollutants. Instituting local limits would allow the City to require pretreatment for high strength wastewater without requiring a "prohibition" of a specific discharger's wastewater.

8. FUNDING

Wastewater system improvements may be financed by the City's wastewater user fees (rates), system development charges (SDCs), federal or state loan programs, grants, and bonds. No financial analysis or evaluation of rates and SDCs was conducted in this Facility Plan update. This chapter includes a brief summary of funding programs available to the City.

8.1 FUNDING SOURCES

If SDCs fund the growth-related improvements, the City will need to fund the improvements to meet existing needs with a combination of user rate revenue and funding from outside sources. The following is a summary of available local, state and federal funding sources for wastewater system improvements.

8.1.1 Local Funding Sources

Local funding sources for capital improvements other than SDCs and sewer user fees include various types of bonds, ad valorem taxes (property taxes), connection fees and sinking funds. Local bond funding typically used in Oregon includes general obligation bonds, revenue bonds and improvement bonds (typically used for local improvement districts). Ad valorem taxes provide a tax on all property within the jurisdiction, whether developed or not, and usually are based on assessed value.

Connection fees can only include the jurisdiction's actual cost associated with a connection and cannot cover capital improvement costs.

8.1.2 State and Federal Grant and Loan Programs

A number of state and federal grant and loan programs are available to help municipalities finance wastewater system improvements. The following are the primary sources of funding available for wastewater system financing:

- The Rural Development Administration (RD), a part of the U.S. Department of Agriculture
- The Oregon Economic and Community Development Department (OECDD), which administers the Special Public Works Fund (SPWF), the Water/Wastewater (W/W) Financing Program, the Community Development Block Grant (CDBG) program, and the Bond Bank Program
- The Oregon DEQ, which administers the Clean Water State Revolving Fund (CWSRF).

Under current programs, the City may qualify for grants available under the RD, W/W, or CDBG programs.

9. ENVIRONMENTAL ASSESSMENT

An environmental assessment was not included in the scope of work. A full environmental evaluation will be required if the project moves forward and should be done in accordance with the funding agency requirements.

Wastewater Facilities Plan

Appendix A. Flow Projections

City of Carlton Wastewater Facilities Plan

Flow Projections per DEQ Guidelines

		Flow (MGD)						BOD Per Capita Loading (ppd)				TSS Per Capita Loading (ppd)			
Year	Pop	ADWF 2-Year	AAF 2-Year	MMDWF 10-Year	MMWWF 5-Year	PDF 5-Year	PHF 5-Year	AAL 3-Year Avg	MML 3-Year Avg	PWL 3-Year Avg	PDL 3-Year Avg	AAL 3-Year Avg	MML 3-Year Avg	PWL 3-Year Avg	PDL 3-Year Avg
2017	2067	0.19	0.38	0.41	1.1	3.2	4.6	0.251	0.464	0.565	0.882	0.359	0.653	0.808	1.248

		Flow (MGD)						BOD Loading (ppd)				TSS Loading (ppd)			
Year	Pop	ADWF	AWWF	MMDWF	MMWWF	PDF	PHF	AAL	MML	PWL	PDL	AAL	MML	PWL	PDL
2020	2,247	0.21	0.73	0.45	1.16	3.28	4.70	564	1,043	1,270	1,982	807	1,467	1,816	2,804
2025	2,465	0.23	0.76	0.50	1.21	3.38	4.82	619	1,144	1,393	2,174	885	1,610	1,992	3,076
2030	2,669	0.26	0.79	0.54	1.25	3.46	4.93	670	1,238	1,508	2,354	958	1,743	2,157	3,331
2032	2,757	0.27	0.80	0.56	1.27	3.50	4.98	692	1,279	1,558	2,432	990	1,800	2,228	3,441
2035	2,890	0.28	0.82	0.59	1.30	3.56	5.05	725	1,341	1,633	2,549	1,038	1,887	2,335	3,607
2037	2,983	0.29	0.83	0.61	1.32	3.60	5.10	749	1,384	1,685	2,631	1,071	1,948	2,410	3,723

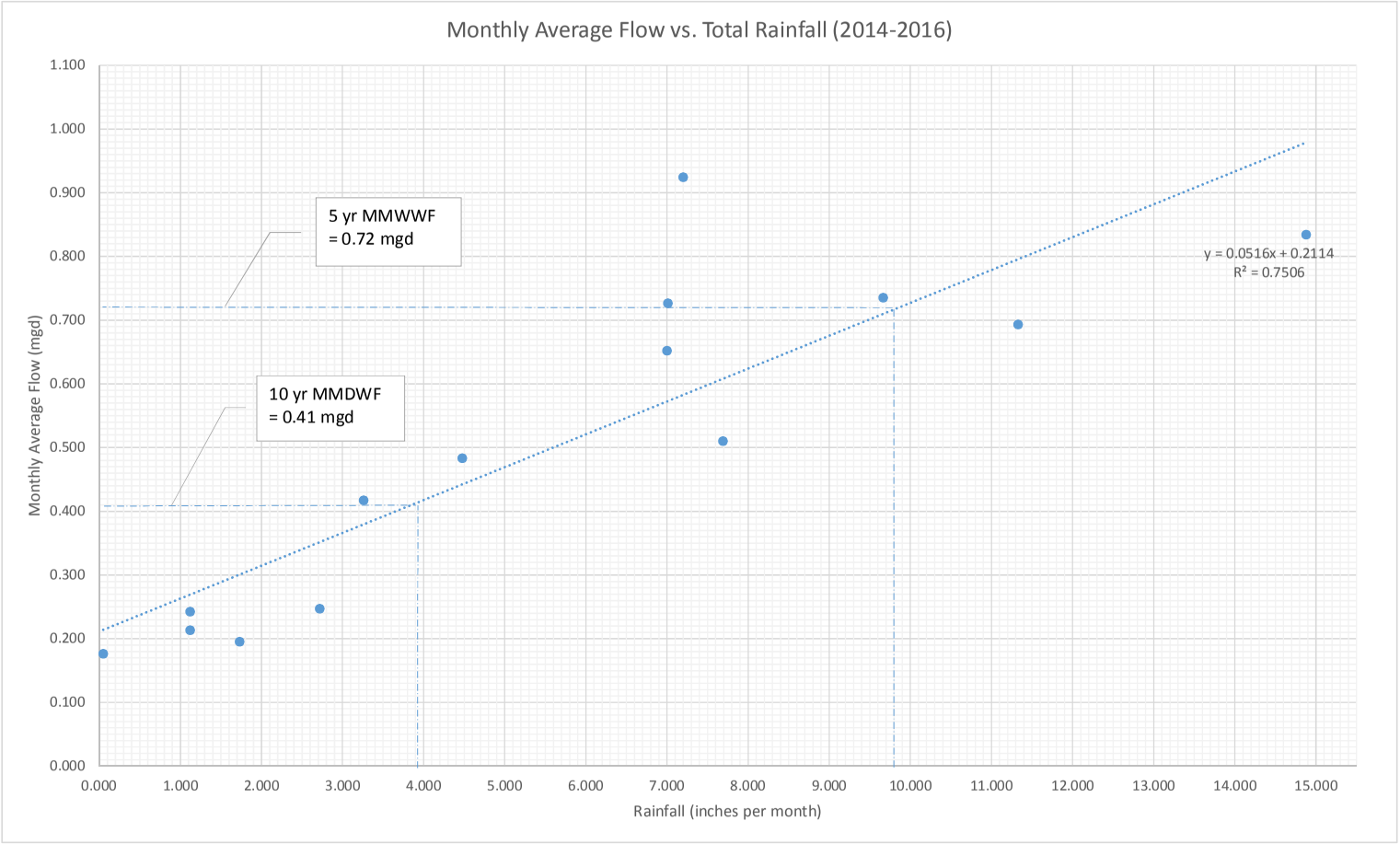
Notes:

1. Population projections based on Population Forecasts for Yamhill County 2011-2035 (PSU Population Research Center)
2. Flow projections per DEQ guidelines

City of Carlton Wastewater Facilities Plan

Flow Projections per DEQ Guidelines

To find 10 year MMDWF and 5 year MMWWF			
		Flow	Rainfall
Jan	2016	0.834	14.880
Feb	2016	0.510	7.690
March	2016	0.735	9.665
April	2016	0.247	2.720
May	2016	0.176	0.050
Jan	2015	0.483	4.475
Feb	2015	0.693	11.330
March	2015	0.924	7.200
April	2015	0.213	1.120
May	2015	0.195	1.730
Jan	2014		
Feb	2014	0.726	7.010
March	2014	0.652	7.000
April	2014	0.417	3.260
May	2014	0.242	1.120

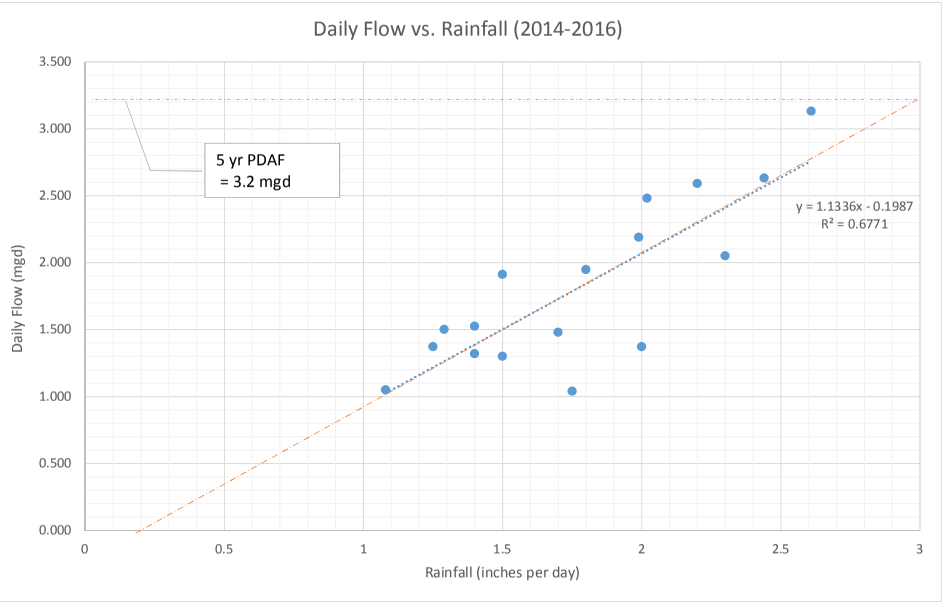


City of Carlton Wastewater Facilities Plan

Flow Projections per DEQ Guidelines

PDAF

Month	Day	Year	Flow (mgd)	Rainfall (in.)	Rainfall>1	Flow >1	Both Conditions met
2	12	2014	1.400	1.11	1	1	1
2	15	2014	1.720	1.13	1	1	1
3	5	2014	1.900	1.48	1	1	1
3	8	2014	1.411	1.11	1	1	1
4	23	2014	1.274	1.41	1	1	1
12	10	2014	1.470	1.18	1	1	1
12	20	2014	2.190	1.99	1	1	1
1	17	2015	2.590	2.2	1	1	1
2	8	2015	1.480	1.7	1	1	1
11	17	2015	1.300	1.5	1	1	1
11	18	2015	1.040	1.75	1	1	1
12	6	2015	1.948	1.8	1	1	1
12	7	2015	2.480	2.02	1	1	1
12	8	2015	2.630	2.44	1	1	1
12	12	2015	1.500	1.29	1	1	1
12	16	2015	1.050	1.08	1	1	1
12	17	2015	3.131	2.61	1	1	1
1	12	2016	2.050	2.3	1	1	1
1	22	2016	1.320	1.4	1	1	1
3	9	2016	1.913	1.5	1	1	1
3	12	2016	1.525	1.4	1	1	1
10	13	2016	1.372	2	1	1	1
10	14	2016	1.372	1.25	1	1	1
11	23	2016	1.981	1.58	1	1	1
11	24	2016	2.900	3.43	1	1	1



PHF

Year	Type	Flow	Probability
2	ADWF	0.19	87
2	AAF	0.38	50.000
10	AWWF	0.57	34.000
5	MMWWF	0.72	8.300
5	MDWWF	3.2	0.300
5	PHF	4.6	0.010

Graph on Two Cycle Probability Log Paper
Find PHF from trendline.

Wastewater Facilities Plan

Appendix B. NPDES Permit

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE PERMIT

Department of Environmental Quality
Western Region – Salem Office
750 Front Street NE, Suite 120, Salem, OR 97301-1039
Telephone: (503) 378-8240

Issued pursuant to ORS 468B.050 and The Federal Clean Water Act

ISSUED TO:

City of Carlton
191 E. Main St.
Carlton, OR 97111-9107

SOURCES COVERED BY THIS PERMIT:

Type of Waste	Outfall Number	Outfall Location
Treated Wastewater	001	R.M. 8.1
Recycled Water	002	irrigation

FACILITY TYPE AND LOCATION:

Stabilization Lagoons with Aeration
Carlton STP
1001 W. Grant St.
Carlton

Treatment System Class: Level II

Collection System Class: Level II

RECEIVING STREAM INFORMATION:

Basin: Willamette
Sub-Basin: Yamhill
Receiving Stream: North Yamhill River
LLID: 1231445452259 8.1 D
County: Yamhill

EPA REFERENCE NO: OR-002054-1

Issued in response to Application No. 971745 received 5/21/2009.

This permit is issued based on the land use findings in the permit record.

Zachary J. Loboy, Water Quality Manager
Western Region

9/20/2010
Date

PERMITTED ACTIVITIES

Until this permit expires or is modified or revoked, the permittee is authorized to construct, install, modify, or operate a wastewater collection, treatment, control and disposal system and discharge to public waters adequately treated wastewaters only from the authorized discharge point or points established in Schedule A and only in conformance with all the requirements, limitations, and conditions set forth in the attached schedules as follows:

Unless specifically authorized by this permit, by another NPDES or WPCF permit, or by Oregon Administrative Rule, any other direct or indirect discharge of waste is prohibited, including discharge to waters of the state or an underground injection control system.

SCHEDULE A

1. **Waste Discharge Limits not to be exceeded after permit issuance:**

a. Treated Effluent Outfall 001

(1) May 1 - October 31: No discharge to waters of the State

(2) November 1 - April 30:

Parameter	Average effluent concentration		Average effluent loading		
	Monthly	Weekly	Monthly	Weekly	Daily max.
BOD_5	30 mg/L	45 mg/L	92 lb/day	138 lb/day	184 lb/day
TSS	50 mg/L	80 mg/L	153 lb/day	229 lb/day	306 lb/day

* Average dry weather design flow to the facility equals 0.165 MGD. Mass load limits based on the projected design year 2010 daily average discharge flow of 0.367 MGD.

(3)

Other parameters (year-round)	Limits
E. coli Bacteria	May not exceed 126 organisms per 100 mL monthly geometric mean. No single sample may exceed 406 organisms per 100 mL. **(See Note A1).**
pH	Must be within the range of 6.0 - 9.0
BOD_5 and TSS Removal Efficiency	May not be less than 85% monthly average for BOD_5 and 65% monthly for TSS.
Total chlorine residual	May not exceed daily maximum concentration of 0.09 mg/L and monthly average of 0.04 mg/L **(see Note A2)**

2. **Mixing Zone**

No wastes may be discharged or activities conducted that cause or contribute to a violation of water quality standards in OAR 340-041 applicable to the Willamette basin except as provided for in OAR 340-045-0080 and the following regulatory mixing zone:

The regulatory mixing zone is that portion of the North Yamhill River contained within a 25-foot wide band centered on the point of discharge and extending from a point ten feet upstream of the point of discharge to a point 50 feet downstream from the point of discharge. The Zone of Immediate Dilution (ZID) is defined as that portion of the regulatory mixing zone that is within five feet of the point of discharge.

3. **Reclaimed Wastewater Outfall 002**

(1) No discharge to state waters is permitted. All recycled must be distributed on land, for dissipation by evapotranspiration and controlled seepage by following sound irrigation practices so as to prevent:

a. Prolonged ponding of treated, recycled water on the ground surface;

b. Surface runoff or subsurface drainage through drainage tile;

c. The creation of odors, fly and mosquito breeding, or other nuisance conditions;

d. The overloading of land with nutrients, organics, or other pollutant parameters; and,

e. Impairment of existing or potential beneficial uses of groundwater.

(2) Prior to land application of the recycled water, it must receive at least Class C treatment as defined in OAR 340-055 to:

(a) Reduce Total Coliform to a 7-day median of 23 organisms per 100 ml and a maximum of 240 organisms per 100 ml,

(3) Irrigation must conform to the irrigation management plan approved by DEQ.

4. Groundwater

No activities may be conducted that could cause an adverse impact on existing or potential beneficial uses of groundwater. All wastewater and process related water must be managed and disposed in a manner that will prevent a violation of the Groundwater Quality Protection Rules (OAR 340-040

5. Overflows

Raw sewage overflows are prohibited.

6. Yamhill TMDL

The Yamhill TMDL is currently in development. DEQ may modify this permit to comply with waste load allocations contained in the final Yamhill TMDL.

7. Mixing Zone Dilutions

DEQ will conduct Reasonable Potential Analyses for pH and ammonia based on dilutions reported in the mixing zone study required in Schedule D, condition 2. DEQ may modify this permit as appropriate based on the results of the analyses.

Notes:

A1. If a single sample exceeds 406 organisms per 100 ml, then five consecutive re-samples may be taken at four-hour intervals beginning within 72 hours after the original sample was taken. If the log mean of the five re-samples is less than or equal to 126 organisms per 100 ml, a violation shall not be triggered.

A2. When the total residual chlorine limit is lower than 0.10 mg/L, DEQ will use 0.10 mg/L as the compliance evaluation level (i.e. daily maximum concentrations below 0.10 mg/L will be considered in compliance with the limit).

SCHEDULE B

1. **Minimum Monitoring and Reporting Requirements**:

The permittee must monitor the parameters as specified below at the locations indicated. The laboratory used by the permittee to analyze samples must have a quality assurance/quality control (QA/QC) program to verify the accuracy of sample analysis. If QA/QC requirements are not met for any analysis, the results must be included in the report, but not used in calculations required by this permit. When possible, the permittee must re-sample in a timely manner for parameters failing the QA/QC requirements, analyze the samples, and report the results.

a. Influent

Influent flow is measured by a flow meter and Parshall flume located immediately after the headworks. Influent samples and measurements s are taken just before the main pump station. The composite sampler is located prior to the main pump station.

Parameter	Minimum Frequency	Sample Type
Total Flow (MGD)	Daily	Measurement
Flow Meter Calibration	Annually	Verification
BOD_5	1 per 2 Weeks	Composite
TSS	1 per 2 Weeks	Composite
pH	2 per Week	Grab

b. Treated Effluent Outfall 001

Flow is metered immediately before the dechlorination point. Effluent samples and measurements are taken from the manhole at the end of the chlorine contact chamber, immediately after dechlorination.

Parameter	Minimum Frequency	Sample Type
Total Flow (MGD)	Daily	Measurement
Flow Meter Calibration	Annual	Verification
BOD_5	1 per 2 Weeks	24 hr composite
TSS	1 per 2 Weeks	24 hr composite
Pounds Discharged (BOD_5 and TSS)	1 per 2 Weeks	Calculation
Average Percent Removed (BOD_5 and TSS)	Monthly	Calculation
pH	2 per Week	Grab
E. coli	1 per Week	Grab
Quantity Chlorine Used	Daily	Measurement
Total Chlorine Residual	Daily	Grab
Ammonia (**see Note B1**)	Monthly	Grab
Temperature	2 per week	Grab

c. Recycled Wastewater Outfall 002

Flow is measured at the irrigation pump at the north end of lagoon cell 2.

Parameter	Minimum Frequency	Sample Type
Quantity Irrigated (inches/acre)	Daily	Measurement
Flow Meter Calibration	Annually	Verification
Quantity Chlorine Used	Daily	Measurement
Total Chlorine Residual	Daily	Grab
pH	2/Week	Grab
Total Coliform	1 per Week	Grab

Nutrients (TKN, NO_2+NO_3-N, NH_3, Total P)	Quarterly	Grab

d. Lagoon

Parameter	Minimum Frequency	Sample Type
Sludge Depth	Once/permit cycle	Measurement
Water Level in Lagoons	Weekly	Measurement
Perimeter Inspection	Daily	Observation

e. Groundwater Monitoring

1. Groundwater monitoring must be conducted in the following monitoring wells:

Monitoring Well	**Well Designation**
Monitoring Well 1	MW-1A
Monitoring Well 2	MW-2
Monitoring Well 3	MW-3
Monitoring Well 4	MW-4

2. At a minimum, the permittee must monitor groundwater for the parameters at the frequencies as specified below:

Parameter	**Minimum Frequency**	**Sample Type**
Temperature	annual (in December)	Field measurement
pH	annual (in December)	Field measurement
Specific conductance	annual (in December)	Field measurement
Nitrate-N	annual (in December)	Grab
Ammonia-N	annual (in December)	Grab
TKN	annual (in December)	Grab
Fecal coliform	annual (in December)	Grab
Orthophosphate-P	annual (in December)	Grab
Water level	annual (in December)	Field measurement

3. Depth to water level measurements must be conducted in the following monitoring wells:

Monitoring Well	**Well Designation**
Monitoring Well 1	MW-1A
Monitoring Well 2	MW-2
Monitoring Well 3	MW-3
Monitoring Well 4	MW-4
Piezometer 1	P-1A
Piezometer 2	P-1B
Piezometer 3	P-2
Piezometer 4	P-3
Piezometer 5	P-4

4. Groundwater Reporting Requirements

(A) **Annual Data Analysis and Reporting**: An annual groundwater data analysis report must be submitted to DEQ with by January 30th of each year. The annual report must report the previous year sampling data and identify any trends and concentrations of concern in the monitoring results.

(B) **Groundwater Monitoring Resampling Requirements**: If monitoring indicates a significant increase (or decrease for pH) in the value of a monitored parameter, the permittee must immediately resample the monitoring well for that and other parameters deemed necessary by DEQ. If the resampling confirms a change in water quality, the permittee must report the results to DEQ within ten days of receipt of the laboratory data.

2. **Reporting Procedures:**

a. Monitoring results must be reported on approved forms. The reporting period is the calendar month. Reports must be submitted to the appropriate DEQ office by the 15th day of the following month.

b. State monitoring reports must identify the name, certificate classification, and grade level of each principal operator designated by the permittee as responsible for supervising the wastewater collection and treatment systems during the reporting period. Monitoring reports must also identify each system classification as found on page one of this permit.

c. Monitoring reports must also include a record of the quantity and method of use of all sludge removed from the treatment facility and a record of all applicable equipment breakdowns and bypassing.

3. **Report Submittals:**

a. The permittee must have in place a program to identify and reduce inflow and infiltration into the sewage collection system. An annual report must be submitted to the appropriate DEQ office by February 1 each year which details sewer collection maintenance activities that reduce inflow and infiltration. The report must state those activities that have been done in the previous year and those activities planned for the following year.

b. By no later than January 15 of each year, the permittee must submit to the appropriate DEQ office an annual report describing the effectiveness of the recycled water system to comply with approved recycled water use plan, the rules of Division 55, and the limits and conditions of this permit applicable to reuse of recycled water.

c. An annual groundwater report must be submitted to DEQ by February 15. The annual report must contain the analytical results of groundwater monitoring from the previous year, an analysis of these data, and reporting information identified in the approved Groundwater Monitoring Plan.

Notes:

B1. The permittee must monitor and report effluent ammonia at the frequency specified in Schedule B(1)b above until completion of the upgrade to outfall 001 required by Schedule D, condition 1.

SCHEDULE D

Special Conditions

1. The permittee must upgrade outfall 001 by extending the outfall into the main flow of the receiving stream and installing a multi-port diffuser as recommended in the Permit Evaluation Report within the next permit cycle.

2. After completion of the upgrade to outfall 001, the permittee must conduct and submit to DEQ a mixing zone study that complies with the requirements of the DEQ Internal Management Directive on Regulatory Mixing Zones. The study must be submitted as part of the application for the next renewal of the City's NPDES permit.

3. The permittee must meet the requirements for use of recycled water under Division 55, including the following:

   a. All recycled water must be managed in accordance with the approved Recycled Water Use Plan. No substantial changes may be made in the approved plan without written approval of DEQ.

   b. No recycled water may be released by the permittee to another person, as defined in Oregon Revised Statute (ORS) 468.005, for use unless there is a valid contract between the permittee and that person that meets the requirements of OAR 340-055-0015(9).

   c. The permittee must notify DEQ within 24 hours if it is determined that the treated effluent is being used in a manner not in compliance with OAR 340-055. When DEQ offices are closed, the permittee must report the incident of noncompliance to the Oregon Emergency Response System (Telephone Number 1-800-452-0311).

   d. No recycled water may be made available to a person proposing to recycle unless that person certifies in writing that they have read and understand the provisions in these rules. This written certification must be kept on file by the sewage treatment system owner and be made available to DEQ for inspection.

4. Six (6) months prior to the removal of accumulated solids from the lagoon, the permittee must submit to the DEQ a revised biosolids management plan developed in accordance with Oregon Administrative Rule 340-050-0031, "Biosolids and Domestic Septage Management Plans." The plan must be implemented by the permittee upon its approval by the DEQ.

5. The permittee must comply with Oregon Administrative Rules (OAR), Chapter 340, Division 49, "Regulations Pertaining To Certification of Wastewater System Operator Personnel" and accordingly:

   a. The permittee must have its wastewater system supervised by one or more operators who are certified in a classification and grade level (equal to or greater) that corresponds with the classification (collection and/or treatment) of the system to be supervised as specified on page one of this permit.

Note: A "supervisor" is defined as the person exercising authority for establishing and executing the specific practice and procedures of operating the system in accordance with the policies of the permittee and requirements of the waste discharge permit. "Supervise" means responsible for the technical operation of a system, which may affect its performance or the quality of the effluent produced. Supervisors are not required to be on-site at all times.

   b. The permittee's wastewater system may not be without supervision (as required by Special Condition 3.a. above) for more than thirty (30) days. During this period, and at any time that the supervisor is not available to respond on-site (i.e. vacation, sick leave or off-call), the permittee must make available another person who is certified in the proper classification and at grade level I or higher.

   c. The permittee is responsible for ensuring the wastewater system has a properly certified supervisor available at all times to respond on-site at the request of the permittee and to any other operator.

   d. The permittee must notify DEQ in writing within thirty (30) days of replacement or re-designation of certified operators responsible for supervising wastewater system operation. The notice must be filed with the Water Quality Division, Operator Certification Program, 400 East Scenic Drive, Suite 307, The

Dalles, OR 97058. This requirement is in addition to the reporting requirements contained under Schedule B of this permit.

e. Upon written request, DEQ may grant the permittee reasonable time, not to exceed 120 days, to obtain the services of a qualified person to supervise the wastewater system. The written request must include justification for the time needed, a schedule for recruiting and hiring, the date the system supervisor availability ceased, and the name of the alternate system supervisor(s) as required by 3.b. above.

6. Six (6) months prior to the removal of accumulated solids from the lagoon, the permittee must submit to the DEQ a revised biosolids management plan developed in accordance with Oregon Administrative Rule 340-050-0031, "Biosolids and Domestic Septage Management Plans." The plan must be implemented by the permittee upon its approval by the DEQ.

7. The permittee must notify the appropriate DEQ office in accordance with the response times noted in the General Conditions of this permit, of any malfunction so that corrective action can be coordinated between the permittee and DEQ.

8. All raw sewage discharges/overflows must be reported within 24 hours to DEQ via the Oregon Emergency Response System (OERS) at 800-452-0311. Additional reporting requirements are contained in Schedule F of this permit.

SCHEDULE F

NPDES GENERAL CONDITIONS – DOMESTIC FACILITIES

SECTION A. STANDARD CONDITIONS

1. Duty to Comply with Permit

The permittee must comply with all conditions of this permit. Failure to comply with any permit condition is a violation of Oregon Revised Statutes (ORS) 468B.025 and the federal Clean Water Act and is grounds for an enforcement action. Failure to comply is also grounds for the Department to terminate, modify and reissue, revoke, or deny renewal of a permit.

2. Penalties for Water Pollution and Permit Condition Violations

The permit is enforceable by DEQ or EPA, and in some circumstances also by third-parties under the citizen suit provisions 33 USC §1365. DEQ enforcement is generally based on provisions of state statutes and EQC rules, and EPA enforcement is generally based on provisions of federal statutes and EPA regulations.

ORS 468.140 allows the Department to impose civil penalties up to $10,000 per day for violation of a term, condition, or requirement of a permit. The federal Clean Water Act provides for civil penalties not to exceed $32,500 and administrative penalties not to exceed $11,000 per day for each violation of any condition or limitation of this permit.

Under ORS 468.943, unlawful water pollution, if committed by a person with criminal negligence, is punishable by a fine of up to $25,000, imprisonment for not more than one year, or both. Each day on which a violation occurs or continues is a separately punishable offense. The federal Clean Water Act provides for criminal penalties of not more than $50,000 per day of violation, or imprisonment of not more than 2 years, or both for second or subsequent negligent violations of this permit.

Under ORS 468.946, a person who knowingly discharges, places, or causes to be placed any waste into the waters of the state or in a location where the waste is likely to escape into the waters of the state is subject to a Class B felony punishable by a fine not to exceed $200,000 and up to 10 years in prison. The federal Clean Water Act provides for criminal penalties of $5,000 to $50,000 per day of violation, or imprisonment of not more than 3 years, or both for knowing violations of the permit. In the case of a second or subsequent conviction for knowing violation, a person shall be subject to criminal penalties of not more than $100,000 per day of violation, or imprisonment of not more than 6 years, or both.

3. Duty to Mitigate

The permittee must take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment. In addition, upon request of the Department, the permittee must correct any adverse impact on the environment or human health resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

4. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and have the permit renewed. The application must be submitted at least 180 days before the expiration date of this permit.

The Department may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date.

5. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:

a. Violation of any term, condition, or requirement of this permit, a rule, or a statute
b. Obtaining this permit by misrepresentation or failure to disclose fully all material facts
c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge
d. The permittee is identified as a Designated Management Agency or allocated a wasteload under a Total Maximum Daily Load (TMDL)
e. New information or regulations
f. Modification of compliance schedules
g. Requirements of permit reopener conditions
h. Correction of technical mistakes made in determining permit conditions
i. Determination that the permitted activity endangers human health or the environment
j. Other causes as specified in 40 CFR 122.62, 122.64, and 124.5
k. For communities with combined sewer overflows (CSOs):
   (1) To comply with any state or federal law regulation that addresses CSOs that is adopted or promulgated subsequent to the effective date of this permit
   (2) If new information, not available at the time of permit issuance, indicates that CSO controls imposed under this permit have failed to ensure attainment of water quality standards, including protection of designated uses
   (3) Resulting from implementation of the Permittee's Long-Term Control Plan and/or permit conditions related to CSOs.

The filing of a request by the permittee for a permit modification, revocation or reissuance, termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

6. Toxic Pollutants

The permittee must comply with any applicable effluent standards or prohibitions established under Oregon Administrative Rules (OAR) 340-041-0033 and 307(a) of the federal Clean Water Act for toxic pollutants, and with standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act, within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

7. Property Rights and Other Legal Requirements

The issuance of this permit does not convey any property rights of any sort, or any exclusive privilege, or authorize any injury to persons or property or invasion of any other private rights, or any infringement of federal, tribal, state, or local laws or regulations.

8. Permit References

Except for effluent standards or prohibitions established under Section 307(a) of the federal Clean Water Act and OAR 340-041-0033 for toxic pollutants, and standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act, all rules and statutes referred to in this permit are those in effect on the date this permit is issued.

9. Permit Fees

The permittee must pay the fees required by Oregon Administrative Rules.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

The permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the

conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems that are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Need to Halt or Reduce Activity Not a Defense

For industrial or commercial facilities, upon reduction, loss, or failure of the treatment facility, the permittee must, to the extent necessary to maintain compliance with its permit, control production or all discharges or both until the facility is restored or an alternative method of treatment is provided. This requirement applies, for example, when the primary source of power of the treatment facility fails or is reduced or lost. It is not a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Bypass of Treatment Facilities

a. Definitions

(1) "Bypass" means intentional diversion of waste streams from any portion of the treatment facility. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, provided the diversion is to allow essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs b. and c. of this section.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Prohibition of bypass.

(1) Bypass is prohibited and the Department may take enforcement action against a permittee for bypass unless:

i. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

ii. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventative maintenance; and

iii. The permittee submitted notices and requests as required under General Condition B.3.c.

(2) The Department may approve an anticipated bypass, after considering its adverse effects and any alternatives to bypassing, when the Department determines that it will meet the three conditions listed above in General Condition B.3.b.(1).

c. Notice and request for bypass.

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, a written notice must be submitted to the Department at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee must submit notice of an unanticipated bypass as required in General Condition D.5.

4. Upset

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operation error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of General Condition B.4.c are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
(1) An upset occurred and that the permittee can identify the causes(s) of the upset;
(2) The permitted facility was at the time being properly operated;
(3) The permittee submitted notice of the upset as required in General Condition D.5, hereof (24-hour notice); and,
(4) The permittee complied with any remedial measures required under General Condition A.3 hereof.

d. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

5. Treatment of Single Operational Upset

For purposes of this permit, A Single Operational Upset that leads to simultaneous violations of more than one pollutant parameter will be treated as a single violation. A single operational upset is an exceptional incident that causes simultaneous, unintentional, unknowing (not the result of a knowing act or omission), temporary noncompliance with more than one Clean Water Act effluent discharge pollutant parameter. A single operational upset does not include Clean Water Act violations involving discharge without a NPDES permit or noncompliance to the extent caused by improperly designed or inadequate treatment facilities. Each day of a single operational upset is a violation.

6. Overflows from Wastewater Conveyance Systems and Associated Pump Stations

a. Definitions
(1) "Overflow" means any spill, release or diversion of sewage including:
i. An overflow that results in a discharge to waters of the United States; and
ii. An overflow of wastewater, including a wastewater backup into a building (other than a backup caused solely by a blockage or other malfunction in a privately owned sewer or building lateral), even if that overflow does not reach waters of the United States.

b. Prohibition of overflows. Overflows are prohibited. The Department may exercise enforcement discretion regarding overflow events. In exercising its enforcement discretion, the Department may consider various factors, including the adequacy of the conveyance system's capacity and the magnitude, duration and return frequency of storm events.

c. Reporting required. All overflows must be reported orally to the Department within 24 hours from the time the permittee becomes aware of the overflow. Reporting procedures are described in more detail in General Condition D.5.

7. Public Notification of Effluent Violation or Overflow

If effluent limitations specified in this permit are exceeded or an overflow occurs that threatens public health, the permittee must take such steps as are necessary to alert the public, health agencies and other affected entities (e.g., public water systems) about the extent and nature of the discharge in accordance with the notification procedures developed under General Condition B.8. Such steps may include, but are not limited to, posting of the river at access points and other places, news releases, and paid announcements on radio and television.

8. Emergency Response and Public Notification Plan

The permittee must develop and implement an emergency response and public notification plan that identifies measures to protect public health from overflows, bypasses or upsets that may endanger public health. At a minimum the plan must include mechanisms to:

a. Ensure that the permittee is aware (to the greatest extent possible) of such events;
b. Ensure notification of appropriate personnel and ensure that they are immediately dispatched for investigation and response;

c. Ensure immediate notification to the public, health agencies, and other affected public entities (including public water systems). The overflow response plan must identify the public health and other officials who will receive immediate notification;
d. Ensure that appropriate personnel are aware of and follow the plan and are appropriately trained;
e. Provide emergency operations; and
f. Ensure that DEQ is notified of the public notification steps taken.

9. Removed Substances
Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters must be disposed of in such a manner as to prevent any pollutant from such materials from entering waters of the state, causing nuisance conditions, or creating a public health hazard.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling
Sampling and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples must be taken at the monitoring points specified in this permit, and shall be taken, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water, or substance. Monitoring points may not be changed without notification to and the approval of the Department.

2. Flow Measurements
Appropriate flow measurement devices and methods consistent with accepted scientific practices must be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices must be installed, calibrated and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected must be capable of measuring flows with a maximum deviation of less than ± 10 percent from true discharge rates throughout the range of expected discharge volumes.

3. Monitoring Procedures
Monitoring must be conducted according to test procedures approved under 40 CFR part 136, or in the case of sludge use and disposal, under 40 CFR part 503, unless other test procedures have been specified in this permit.

4. Penalties of Tampering
The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit may, upon conviction, be punished by a fine of not more than $10,000 per violation, imprisonment for not more than two years, or both. If a conviction of a person is for a violation committed after a first conviction of such person, punishment is a fine not more than $20,000 per day of violation, or by imprisonment of not more than four years, or both.

5. Reporting of Monitoring Results
Monitoring results must be summarized each month on a Discharge Monitoring Report form approved by the Department. The reports must be submitted monthly and are to be mailed, delivered or otherwise transmitted by the 15th day of the following month unless specifically approved otherwise in Schedule B of this permit.

6. Additional Monitoring by the Permittee
If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR part 136, or in the case of sludge use and disposal, under 40 CFR part 503, or as specified in this permit, the results of this monitoring must be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report. Such increased frequency must also be indicated. For a pollutant parameter that may be sampled more than once per day (e.g., Total Chlorine Residual), only the average daily value must be recorded unless otherwise specified in this permit.

7. Averaging of Measurements
Calculations for all limitations that require averaging of measurements must utilize an arithmetic mean, except for bacteria which shall be averaged as specified in this permit.

8. Retention of Records
Records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities shall be retained for a period of at least five years (or longer as required by 40 CFR part 503). Records of all monitoring information including all calibration and maintenance records, all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit and records of all data used to complete the application for this permit shall be retained for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the Department at any time.

9. Records Contents
Records of monitoring information must include:

a. The date, exact place, time, and methods of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) analyses were performed;
d. The individual(s) who performed the analyses;
e. The analytical techniques or methods used; and
f. The results of such analyses.

10. Inspection and Entry
The permittee must allow the Department or EPA upon the presentation of credentials to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit, and
d. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by state law, any substances or parameters at any location.

11. Confidentiality of Information
Any information relating to this permit that is submitted to or obtained by DEQ is available to the public unless classified as confidential by the Director of DEQ under ORS 468.095. The Permittee may request that information be classified as confidential if it is a trade secret as defined by that statute. The name and address of the permittee, permit applications, permits, effluent data, and information required by NPDES application forms under 40 CFR 122.21 will not be classified as confidential. 40 CFR 122.7(b).

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes
The permittee must comply with OAR chapter 340, division 52, "Review of Plans and Specifications" and 40 CFR Section 122.41(l) (1). Except where exempted under OAR chapter 340, division 52, no construction, installation, or modification involving disposal systems, treatment works, sewerage systems, or common sewers may be commenced until the plans and specifications are submitted to and approved by the Department. The permittee must give notice to the Department as soon as possible of any planned physical alternations or additions to the permitted facility.

2. Anticipated Noncompliance
The permittee must give advance notice to the Department of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements.

3. Transfers
This permit may be transferred to a new permittee provided the transferee acquires a property interest in the permitted activity and agrees in writing to fully comply with all the terms and conditions of the permit and the rules of the Commission. No permit may be transferred to a third party without prior written approval from the Department. The Department may require modification, revocation, and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under 40 CFR Section 122.61. The permittee must notify the Department when a transfer of property interest takes place.

4. Compliance Schedule
Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any compliance schedule of this permit must be submitted no later than 14 days following each schedule date. Any reports of noncompliance must include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements.

5. Twenty-Four Hour Reporting
The permittee must report any noncompliance that may endanger health or the environment. Any information must be provided orally (by telephone) to DEQ or to the Oregon Emergency Response System (1-800-452-0311) as specified below within 24 hours from the time the permittee becomes aware of the circumstances.

a. Overflows.

(1) Oral Reporting within 24 hours.
i. For overflows other than basement backups, the following information must be reported to the Oregon Emergency Response System (OERS) at 1-800-452-0311. For basement backups, this information should be reported directly to DEQ.
a) The location of the overflow;
b) The receiving water (if there is one);
c) An estimate of the volume of the overflow;
d) A description of the sewer system component from which the release occurred (e.g., manhole, constructed overflow pipe, crack in pipe); and
e) The estimated date and time when the overflow began and stopped or will be stopped.
ii. The following information must be reported to the Department's Regional office within 24 hours, or during normal business hours, whichever is first:
a) The OERS incident number (if applicable) along with a brief description of the event.

(2) Written reporting within 5 days.
i. The following information must be provided in writing to the Department's Regional office within 5 days of the time the permittee becomes aware of the overflow:
a) The OERS incident number (if applicable);
b) The cause or suspected cause of the overflow;
c) Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
d) Steps taken or planned to mitigate the impact(s) of the overflow and a schedule of major milestones for those steps; and
e) (for storm-related overflows) The rainfall intensity (inches/hour) and duration of the storm associated with the overflow.

The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

b. Other instances of noncompliance.
   (1) The following instances of noncompliance must be reported:
      i. Any unanticipated bypass that exceeds any effluent limitation in this permit;
      ii. Any upset that exceeds any effluent limitation in this permit;
      iii. Violation of maximum daily discharge limitation for any of the pollutants listed by the Department in this permit; and
      iv. Any noncompliance that may endanger human health or the environment.
   (2) During normal business hours, the Department's Regional office must be called. Outside of normal business hours, the Department must be contacted at 1-800-452-0311 (Oregon Emergency Response System).
   (3) A written submission must be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission must contain:
      i. A description of the noncompliance and its cause;
      ii. The period of noncompliance, including exact dates and times;
      iii. The estimated time noncompliance is expected to continue if it has not been corrected;
      iv. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance; and
      v. Public notification steps taken, pursuant to General Condition B.7
   (4) The Department may waive the written report on a case-by-case basis if the oral report has been received
   within 24 hours.

6. Other Noncompliance

The permittee must report all instances of noncompliance not reported under General Condition D.4 or D.5, at the time monitoring reports are submitted. The reports must contain:

a. A description of the noncompliance and its cause;
b. The period of noncompliance, including exact dates and times;
c. The estimated time noncompliance is expected to continue if it has not been corrected; and
d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

7. Duty to Provide Information

The permittee must furnish to the Department within a reasonable time any information that the Department may request to determine compliance with the permit or to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit. The permittee must also furnish to the Department, upon request, copies of records required to be kept by this permit.

Other Information: When the permittee becomes aware that it has failed to submit any relevant facts or has submitted incorrect information in a permit application or any report to the Department, it must promptly submit such facts or information.

8. Signatory Requirements

All applications, reports or information submitted to the Department must be signed and certified in accordance with 40 CFR Section 122.22.

9. Falsification of Information

Under ORS 468.953, any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, is subject to a Class C felony punishable by a fine not to exceed $100,000 per violation and up to 5 years in prison. Additionally, according to 40 CFR 122.41(k)(2),

any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a federal civil penalty not to exceed $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

10. Changes to Indirect Dischargers

The permittee must provide adequate notice to the Department of the following:

a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the Clean Water Act if it were directly discharging those pollutants and;

b. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

c. For the purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

SECTION E. DEFINITIONS

1. *BOD* means five-day biochemical oxygen demand.
2. *CBOD* means five day carbonaceous biochemical oxygen demand
3. *TSS* means total suspended solids.
4. "*Bacteria*" includes but is not limited to fecal coliform bacteria, total coliform bacteria, and E. coli bacteria.
5. *FC* means fecal coliform bacteria.
6. *Total residual chlorine* means combined chlorine forms plus free residual chlorine
7. *Technology based permit effluent limitations* means technology-based treatment requirements as defined in 40 CFR Section 125.3, and concentration and mass load effluent limitations that are based on minimum design criteria specified in OAR Chapter 340, Division 41.
8. *mg/l* means milligrams per liter.
9. *kg* means kilograms.
10. m^3/d means cubic meters per day.
11. *MGD* means million gallons per day.
12. 24-hour *Composite sample* means a sample formed by collecting and mixing discrete samples taken periodically and based on time or flow. The sample must be collected and stored in accordance with 40 CFR part 136.
13. *Grab sample* means an individual discrete sample collected over a period of time not to exceed 15 minutes.
14. *Quarter* means January through March, April through June, July through September, or October through December.
15. *Month* means calendar month.
16. *Week* means a calendar week of Sunday through Saturday.
17. *POTW* means a publicly owned treatment works

Wastewater Facilities Plan

Appendix C. OAR 340-055 Recycled Water Use

Department of Environmental Quality

Chapter 340

Division 55
RECYCLED WATER USE

340-055-0005
Purpose

These rules (OAR 340-055-0005 to 340-055-0030) prescribe requirements for the use of recycled water for beneficial purposes. The purpose of this division is to protect the environment and public health in the State of Oregon.

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.015 & 468B.020
History:
DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

340-055-0007
Policy

It is the policy of the Environmental Quality Commission to encourage the use of recycled water for domestic, agricultural, industrial, recreational, and other beneficial purposes in a manner which protects public health and the environment of the state. The use of recycled water for beneficial purposes will improve water quality by reducing discharge of treated effluent to surface waters, reduce the demand on drinking water sources for uses not requiring potable water, and may conserve stream flows by reducing withdrawal for out-of-stream use.

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.015
History:
DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

340-055-0010
Definitions

The following definitions apply to this division of rules:

(1) “Artificial Groundwater Recharge” means the intentional addition of water diverted from another source to a groundwater reservoir.

(2) "Beneficial Purpose" means a purpose where recycled water is utilized for a resource value, such as nutrient content or moisture, to increase productivity or to conserve other sources of water.

(3) “Department” means the Oregon Department of Environmental Quality.

(4) "Disinfected Wastewater" means wastewater that has been treated by a chemical, physical or biological process and meets the criteria if applicable to its classification for use as recycled water.

(5) “Filtered Wastewater” means an oxidized wastewater that meets the criteria defined in OAR 340-055-0012(7)(c).

(6) “Human Consumption” means water used for drinking, personal or oral hygiene, bathing, showering, cooking, or dishwashing.

(7) "Landscape Impoundment" means a body of water used for aesthetic purposes or other function that does not include public contact through activities such as boating, fishing, or body-contact recreation. Landscape impoundments include, but are not limited to, golf course water ponds or non-residential landscape ponds.

(8) "Nonrestricted Recreational Impoundment" means a constructed body of water for which there are no limitations on body-contact water recreation activities. Nonrestricted recreational impoundments include, but are not limited to, recreational lakes, water features accessible to the public, and public fishing ponds.

(9) "NPDES Permit" means a National Pollutant Discharge Elimination System permit as defined in OAR chapter 340, division 45.

(10) "Oxidized Wastewater" means a treated wastewater in which the organic matter is stabilized and nonputrescible, and which contains dissolved oxygen.

(11) "Person" means the United States and agencies thereof, any state, any individual, public or private corporation, political subdivision, governmental agency, municipality, copartnership, association, firm, trust estate, or any other legal entity.

(12) “Processed Food Crops” means those crops that undergo thermoprocessing sufficient to kill spores of Clostridium botulinum.

(13) “Recycled Water” means treated effluent from a wastewater treatment system which as a result of treatment is suitable for a direct beneficial purpose. Recycled water includes reclaimed water as defined in ORS 537.131.

(14) "Restricted Recreational Impoundment" means a constructed body of water that is limited to fishing, boating, and other non-body contact water recreation activities.

(15) “Sprinkler Irrigation” means the act of applying water by means of perforated pipes or nozzles operated under pressure so as to form a spray pattern.

(16) “Wastewater” or "Sewage" means the water-carried human or animal waste from residences, buildings, industrial establishments or other places, together with such groundwater infiltration and surface water as may be present. The admixture with sewage of wastes or industrial wastes shall also be considered “wastewater” within the meaning of this division.

(17) “Wastewater Treatment System” or "Sewage Treatment System" means an approved facility or equipment used to alter the quality of wastewater by physical, chemical or biological means or a combination thereof that reduces the tendency of the wastewater to degrade water quality or other environmental conditions.

(18) “Waters of the State” means lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon, and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or effect a junction with natural surface or underground waters) that are located wholly or partially within or bordering the state or within its jurisdiction.

(19) "WPCF Permit" means a Water Pollution Control Facilities permit as defined in OAR chapter 340, division 45.

(20) “Wetlands” means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.005, 468B.030 & 468B.050
History:
DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

340-055-0012
Recycled Water Quality Standards and Requirements

(1) Any person having control over the treatment or distribution or both of recycled water may distribute recycled water only for the beneficial purposes described in this rule, and must take all reasonable steps to ensure that the recycled water is used only in accordance with the standards and requirements of the rules of this division.

(2) Any person who uses recycled water may use recycled water only for the beneficial purposes described in this rule, and must comply with the standards and requirements of this rule and the rules of this division.

(3) The following requirements apply to nondisinfected recycled water.

(a) Beneficial Purposes. Nondisinfected recycled water may be used only for the following beneficial purposes and only if the rules of this division are met:

(A) Irrigation for growing fodder, fiber, seed crops not intended for human ingestion, or commercial timber; and

(B) Any beneficial purpose authorized in writing by the department pursuant to OAR 340-055-0016(6).

(b) Treatment. Nondisinfected recycled water must be an oxidized wastewater.

(c) Criteria. There are no disinfection criteria for nondisinfected recycled water.

(d) Monitoring. Monitoring must be in accordance with the wastewater treatment system owner's NPDES or WPCF permit.

(e) Setback Distances. There must be a minimum of 150 feet from the edge of the irrigation site to a water supply source used for human consumption. Other site specific setback distances for irrigation necessary to protect public health and the environment must be established in the recycled water use plan and must be met when irrigating.

(f) Access and Exposure. Public access to the irrigation site must be prevented.

(g) Site Management.

(A) Irrigation with recycled water is prohibited for 30 days before harvesting.

(B) Sprinkler irrigation is prohibited unless authorized in advance and in writing by the department based on demonstration that public health and the environment will be adequately protected from aerosols.

(4) The following requirements apply to Class D recycled water.

(a) Beneficial Purposes. Class D recycled water may be used only for the following beneficial purposes and only if the rules of this division are met:

(A) Any beneficial purpose defined in subsection (3)(a) of this rule;

(B) Irrigation of firewood, ornamental nursery stock, Christmas trees, sod, or pasture for animals; and

(C) Any beneficial purpose authorized in writing by the department pursuant to OAR 340-055-0016(6).

(b) Treatment. Class D recycled water must be an oxidized and disinfected wastewater that meets the numeric criteria in subsection (c) of this section.

(c) Criteria. Class D recycled water must not exceed a 30-day log mean of 126 E. coli organisms per 100 milliliters and 406 E. coli organisms per 100 milliliters in any single sample.

(d) Monitoring. Monitoring for E. coli organisms must occur once per week at a minimum.

(e) Setback Distances.

(A) Where an irrigation method is used to apply recycled water directly to the soil, there must be a minimum of 10 feet from the edge of the site used for irrigation and the site property line.

(B) Where sprinkler irrigation is used, there must be a minimum of 100 feet from the edge of the site used for irrigation and the site property line.

(C) There must be a minimum of 100 feet from the edge of an irrigation site to a water supply source used for human consumption.

(D) Where sprinkler irrigation is used, recycled water must not be sprayed within 70 feet of an area where food is prepared or served, or where a drinking fountain is located.

(f) Access and Exposure.

(A) Animals used for production of milk must be restricted from direct contact with the recycled water.

(B) When using recycled water for irrigation of sod, ornamental nursery stock, or Christmas trees, the personnel at the use area must be notified that the water used is recycled water and is not safe for drinking. The recycled water use plan must specify how notification will be provided.

(g) Site Management.

(A) When irrigating, signs must be posted around the perimeter of the irrigation site stating recycled water is used and is not safe for drinking.

(B) Irrigation of fodder, fiber, seed crops not intended for human ingestion, sod, commercial timber, firewood, ornamental nursery stock, or Christmas trees is prohibited for three days before harvesting.

(5) The following requirements apply to Class C recycled water.

(a) Beneficial Purposes. Class C recycled water may be used only for the following beneficial purposes and only if the rules of this division are met:

(A) Any beneficial purpose defined in subsection (4)(a) of this rule;

(B) Irrigation of processed food crops;

(C) Irrigation of orchards or vineyards if an irrigation method is used to apply recycled water directly to the soil;

(D) Landscape irrigation of golf courses, cemeteries, highway medians, or industrial or business campuses;

(E) Industrial, commercial, or construction uses limited to: industrial cooling, rock crushing, aggregate washing, mixing concrete, dust control, nonstructural fire fighting using aircraft, street sweeping, or sanitary sewer flushing;

(F) Water supply source for landscape impoundments; and

(G) Any beneficial purpose authorized in writing by the department pursuant to OAR 340-055-0016(6).

(b) Treatment. Class C recycled water must be an oxidized and disinfected wastewater that meets the numeric criteria in subsection (c) of this section.

(c) Criteria. Class C recycled water must not exceed a median of 23 total coliform organisms per 100 milliliters, based on results of the last seven days that analyses have been completed, and 240 total coliform organisms per 100 milliliters in any two consecutive samples.

(d) Monitoring. Monitoring for total coliform organisms must occur once per week at a minimum.

(e) Setback Distances.

(A) Where an irrigation method is used to apply recycled water directly to the soil, there must be a minimum of 10 feet from the edge of the site used for irrigation and the site property line.

(B) Where sprinkler irrigation is used, there must be a minimum of 70 feet from the edge of the site used for irrigation and the site property line.

(C) There must be a minimum of 100 feet from the edge of an irrigation site to a water supply source used for human consumption.

(D) Where sprinkler irrigation is used, recycled water must not be sprayed within 70 feet of an area where food is being prepared or served, or where a drinking fountain is located.

(f) Access and Exposure.

(A) When irrigating for a beneficial purpose defined in subsection (4)(a) of this rule, the access and exposure requirements defined in subsection (4)(f) of this rule must be met.

(B) During irrigation of a golf course, a cemetery, a highway median, or an industrial or business campus, the public must be restricted from direct contact with the recycled water.

(C) If aerosols are generated when using recycled water for an industrial, commercial, or construction purpose, the aerosols must not create a public health hazard.

(D) When using recycled water for an agricultural or horticultural purpose where sprinkler irrigation is used, or an industrial, commercial, or construction purpose, the public and personnel at the use area must be notified that the water used is recycled water and is not safe for drinking. The recycled water use plan must specify how notification will be provided.

(g) Site Management.

(A) When irrigating for a beneficial purpose defined in subsection (4)(a) of this rule, the site management requirements defined in subsection (4)(g) of this rule must be met.

(B) When using recycled water for a landscape impoundment or for irrigating a golf course, cemetery, highway median, or industrial or business campus, signs must be posted at the use area and be visible to the public. The signs must state that recycled water is used and is not safe for drinking.

(C) Irrigation of processed food crops is prohibited for three days before harvesting.

(D) When irrigating an orchard or vineyard, the edible portion of the crop must not contact the ground, and fruit or nuts may not be harvested off the ground.

(E) When using recycled water for a landscape impoundment, aerators or decorative fixtures that may generate aerosols are allowed only if authorized in writing by the department.

(6) The following requirements apply to Class B recycled water.

(a) Beneficial Purposes. Class B recycled water may be used only for the following beneficial purposes and only if the rules of this division are met:

(A) Any beneficial purpose defined in subsection (5)(a) of this rule;

(B) Stand-alone fire suppression systems in commercial and residential buildings, non-residential toilet or urinal flushing, or floor drain trap priming;

(C) Water supply source for restricted recreational impoundments; and

(D) Any beneficial purpose authorized in writing by the department pursuant to OAR 340-055-0016(6).

(b) Treatment. Class B recycled water must be an oxidized and disinfected wastewater that meets the numeric criteria in subsection (c) of this section.

(c) Criteria. Class B recycled water must not exceed a median of 2.2 total coliform organisms per 100 milliliters, based on results of the last seven days that analyses have been completed, and 23 total coliform organisms per 100 milliliters in any single sample.

(d) Monitoring. Monitoring for total coliform organisms must occur three times per week at a minimum.

(e) Setback Distances.

(A) Where an irrigation method is used to apply recycled water directly to the soil, there are no setback requirements.

(B) Where sprinkler irrigation is used, there must be a minimum of 10 feet from the edge of the site used for irrigation and the site property line.

(C) There must be a minimum of 50 feet from the edge of the irrigation site to a water supply source used for human consumption.

(D) Where sprinkler irrigation is used, recycled water must not be sprayed within 10 feet of an area where food is being prepared or served, or where a drinking fountain is located.

(f) Access and Exposure.

(A) During irrigation of a golf course, the public must be restricted from direct contact with the recycled water.

(B) If aerosols are generated when using recycled water for an industrial, commercial, or construction purpose, the aerosols must not create a public health hazard.

(C) When using recycled water for an agricultural or horticultural purpose where sprinkler irrigation is used, or an industrial, commercial, or construction purpose, the public and personnel at the use area must be notified that the water used is recycled water and is not safe for drinking. The recycled water use plan must specify how notification will be provided.

(g) Site Management.

(A) When irrigating for a beneficial purpose defined in subsection (4)(a) of this rule, the site management requirements defined in subsection (4)(g) of this rule must be met.

(B) When using recycled water for a landscape impoundment or for irrigating a golf course, cemetery, highway median, or industrial or business campus, signs must be posted at the use area and be visible to the public. The signs must state recycled water is used and is not safe for drinking.

(C) Irrigation of processed food crops is prohibited for three days before harvesting.

(D) When irrigating an orchard or vineyard, the edible portion of the crop must not contact the ground, and fruit or nuts may not be harvested off the ground.

(7) The following requirements apply to Class A recycled water.

(a) Beneficial Purposes. Class A recycled water may be used only for the following beneficial purposes and only if the rules of this division are met:

(A) Any beneficial purpose defined in subsection (6)(a) of this rule;

(B) Irrigation for any agricultural or horticultural use;

(C) Landscape irrigation of parks, playgrounds, school yards, residential landscapes, or other landscapes accessible to the public;

(D) Commercial car washing or fountains when the water is not intended for human consumption;

(E) Water supply source for nonrestricted recreational impoundments;

(F) Artificial groundwater recharge by surface infiltration methods or by subsurface injection in accordance with OAR chapter 340, division 44. Direct injection into an underground source of drinking water is prohibited unless allowed by OAR chapter 340, division 44; and

(G) Any beneficial purpose authorized in writing by the department pursuant to OAR 340-055-0016(6).

(b) Treatment. Class A recycled water must be an oxidized, filtered and disinfected wastewater that meets the numeric criteria in subsection (c) of this section are met.

(c) Criteria. Class A recycled water must not exceed the following criteria:

(A) Before disinfection, unless otherwise approved in writing by the department, the wastewater must be treated with a filtration process, and the turbidity must not exceed an average of 2 nephelometric turbidity units (NTU) within a 24-hour period, 5 NTU more than five percent of the time within a 24-hour period, and 10 NTU at any time, and

(B) After disinfection, Class A recycled water must not exceed a median of 2.2 total coliform organisms per 100 milliliters, based on results of the last seven days that analyses have been completed, and 23 total coliform organisms per 100 milliliters in any single sample.

(d) Monitoring.

(A) Monitoring for total coliform organisms must occur once per day at a minimum.

(B) Monitoring for turbidity must occur on an hourly basis at a minimum.

(e) Setback Distances. Where sprinkler irrigation is used, recycled water must not be sprayed onto an area where food is being prepared or served, or onto a drinking fountain.

(f) Access and Exposure. When using recycled water for an agricultural or horticultural purpose where spray irrigation is used, or an industrial, commercial, or construction purpose, the public and personnel at the use area must be notified that the water used is recycled water and is not safe for drinking. The recycled water use plan must specify how notification will be provided.

(g) Site Management. When using recycled water for a landscape impoundment, restricted recreational impoundment, nonrestricted recreational impoundment, or for irrigating a golf course, cemetery, highway median, industrial or business campus, park, playground, school yard, residential landscape, or other landscapes accessible to the public, signs must be posted at the use area or notification must be made to the public at the use area indicating recycled water is used and is not safe for drinking. The recycled water use plan must specify how notification will be provided.

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.030 & 468B.050
History:
Renumbered from 340-055-0015, DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

340-055-0013
Exempted Use of Recycled Water

Recycled water used by a wastewater treatment system owner for landscape irrigation or for in plant processes at a wastewater treatment system is exempt from the rules of this division if:

(1) The recycled water is an oxidized and disinfected wastewater;

(2) The recycled water is used at the wastewater treatment system site where it is generated or at an auxiliary wastewater or sludge treatment facility that is subject to the same NPDES or WPCF permit as the wastewater treatment system. Contiguous property to the parcel of land upon which the treatment system is located is considered the wastewater treatment system site if under the same ownership;

(3) Spray or drift or both from the use does not occur off the site; and

(4) Public access to the site is restricted.

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.050
History:
DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

340-055-0016

General Requirements for Permitting the Use of Recycled Water

(1) NPDES or WPCF permit. A wastewater treatment system owner may not provide any recycled water for use unless authorized by a NPDES or WPCF permit issued by the department pursuant to OAR chapter 340, division 045.

(2) Recycled water use plan.

(a) Except for use of recycled water authorized by a NPDES or WPCF permit, a wastewater treatment system owner may not provide any recycled water for distribution or use or both until a recycled water use plan meeting the requirements of OAR 340-055-0025 has been approved in writing by the department. Upon approval of the plan, the permittee must comply with the conditions of the plan.

(b) Before approving or modifying any plan for the use of Class C, Class D, or nondisinfected recycled water, the department will submit the proposed plan to the Oregon Department of Human Services for comment.

(c) For use of recycled water previously authorized under a NPDES or WPCF permit but without a department approved recycled water use plan, the wastewater treatment system owner must submit a recycled water use plan to the department within one year of the effective date of these rules.

(3) Land application on land zoned exclusive farm use. A recycled water use plan will not be approved for the land application of recycled water on land zoned exclusive farm use until the requirements of ORS 215.213(1)(bb) and 215.283(1)(y) for recycled water are met.

(4) Compliance with this division. When the rules of this division require a limitation or a condition or both that conflicts with a limitation or a condition or both in an existing permit, the existing permit controls until the permit is modified or renewed by the department. When the existing permit is modified or renewed, the permittee will be given a reasonable compliance schedule to achieve new requirements if necessary.

(5) Additional permit limitations and conditions. The department may include additional permit limitations or conditions or both if it determines or has reason to believe additional requirements for the use of recycled water are necessary to protect public health or the environment or both.

(6) Authorization of other recycled water uses. The department may authorize through a NPDES or WPCF permit a use of recycled water for a beneficial purpose not specified in this division. When the department considers the authorization, it may request information and include permit limitations or conditions or both necessary to assure protection of public health and the environment. The department will confer with the Oregon Department of Human Services before authorizing other uses of Class C, Class D, or nondisinfected recycled water under this section.

(7) Setback distances. The department may consider and approve, on a case-by-case basis, a setback distance other than what is required in this division. For a reduced setback distance, it must be demonstrated to the department that public health and the environment will be adequately protected. The recycled water use plan must include any approved alternative setback distance.

(8) Public outreach and sign posting. When the rules of this division require the posting of signs at a use area, the department may, on a case-by-case basis, approve an alternative method for public outreach where it considers the method will assure an equivalent degree of public protection.

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.030 & 468B.050
History:
Renumbered from 340-055-0015, DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

340-055-0017

Treatment and Use of Recycled Water

(1) Alternative treatment process. The department may approve in writing an alternative wastewater treatment process not specified in the rules of this division if it is demonstrated that the treatment is equivalent to and can achieve the recycled water criteria required for a specific beneficial purpose.

(2) Additional treatment. A person using recycled water from a wastewater treatment system may provide additional treatment for a different class of recycled water that is identified in this division. The wastewater treatment system owner providing the additional treatment is subject to the rules of this division and must have a NPDES or WPCF permit issued by the department.

(3) Blending recycled water. The department may approve on a case-by-case basis blending recycled water with other water if proposed by a wastewater treatment system owner. Before blending recycled water, the owner must obtain written authorization from the department. In obtaining authorization, the wastewater treatment system owner must submit to the department, at a minimum the following:

(a) An operations plan,

(b) A description of any additional treatment process,

(c) A description of blending volumes, and

(d) A range of final recycled water quality at the compliance point identified in the NPDES or WPCF permit.

(4) Water right. The rules of this division do not create a water right under ORS chapters 536, 537, 539 or 540. A person must contact the Oregon Water Resources Department to determine water right requirements for the use of recycled water.

(5) Prohibited use for human consumption. The use of recycled water for direct human consumption, regardless of the treatment class, is prohibited unless approved in writing by the Oregon Department of Human Services, and after public hearing, and it is so authorized by the Environmental Quality Commission.

(6) Prohibited use for a public pool. The use of recycled water as a source of supply for a public pool, spa, or bathhouse is prohibited unless authorized in writing by the department and with written approval from the Oregon Department of Human Services. Public pools are subject to the requirements of ORS 448 and the Oregon Department of Human Services administrative rules.

(7) Transporting recycled water. A vehicle used to transport or distribute recycled water must not be used to transport water for human consumption, unless authorized in writing by the department. The vehicle must be clearly identified with the words "nonpotable water" written in letters at least six inches high and displayed on each side and rear of the vehicle unless otherwise authorized by the department.

(8) Impoundments. Constructed landscape, and restricted and nonrestricted recreational impoundments approved for use under the rules of this division are not considered waters of the state for water quality purposes. Impoundments used for wastewater treatment are subject to ORS 215.213 and 215.283.

(9) Wetlands.

(a) The term "waters of the state" as provided in OAR 340-055-0012(18) includes, but is not limited to, the following wetlands and discharge to any of these wetlands requires a NPDES permit issued by the Department pursuant to OAR chapter 340, division 45:

(A) Enhanced or restored wetlands;

(B) Existing natural wetlands; and

(C) Wetlands created as mitigation for loss of wetlands under the Clean Water Act, Section 404.

(b) Wetlands constructed on non-wetland sites and managed for wastewater treatment are exempt from the rules of this division and are not considered waters of the state for water quality purposes.

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.030 & 468B.050
History:
Renumbered from 340-055-0015, DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

340-055-0020
Groundwater Quality Protection

Recycled water will not be authorized for use unless all groundwater quality protection requirements in OAR chapter 340, division 40 are met. The requirements in OAR chapter 340, division 40 are considered to be met if the wastewater treatment system owner demonstrates recycled water will be used or land applied in a manner and at a rate that minimizes the movement of contaminants to groundwater and does not adversely impact groundwater quality. If the use of recycled water occurs within a designated groundwater management area, the department may require additional conditions to be met.

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.150 - 468B.190
History:
DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

340-055-0022
Monitoring and Reporting

(1) The department will include in a NPDES or WPCF permit authorizing the use of recycled water, at a minimum, the monitoring requirements in OAR 340-055-0012.

(2) When chlorine or a chlorine compound is used as a disinfecting agent, the department may specify in the NPDES or WPCF permit a minimum chlorine residual concentration. When other disinfecting agents are used, the department may require additional monitoring requirements to assure adequate disinfection.

(3) The department will include in a NPDES or WPCF permit authorizing the use of recycled water, a requirement that the wastewater treatment system owner submit an annual report to the department describing the effectiveness of the system to comply with the approved recycled water use plan, the rules of this division, and the permit limits and conditions for recycled water.

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.030 & 468B.050
History:
Renumbered from 340-055-0015, DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

340-055-0025
Recycled Water Use Plan

(1) A recycled water use plan must describe how the wastewater treatment system owner will comply with the rules of this division and must include, but is not limited to, the following:

(a) A description of the wastewater treatment system, including treatment efficiency capability;

(b) A detailed description of the treatment methods that will be used to achieve a specific class of recycled water and for what beneficial purpose;

(c) The estimated quantity of recycled water to be provided by the wastewater treatment system owner to the user, and at what frequency and for what beneficial purpose;

(d) A description of contingency procedures that ensure the requirements of this division are met when recycled water is provided for use;

(e) Monitoring and sampling procedures;

(f) A maintenance plan that describes how the wastewater treatment system equipment and facility processes will be maintained and serviced;

(g) If notification is required by the rules of this division, a description of how the public and personnel at the use area will be notified; and

(h) A description of any measuring and reporting requirements identified by the Oregon Water Resources Department after consultation with that agency.

(2) If Class B, C, or D, or nondisinfected recycled water is to be used for irrigation, a recycled water use plan must also include, but is not limited to, the following:

(a) A description and identification of the land application site, including the zoned land use of the irrigation site and surrounding area, a site map with setbacks, and distances of nearest developed property from all boundaries of the irrigation site;

(b) A description of the irrigation system, including storage, distribution methods, application methods and rates, and shut off procedures;

(c) A description of the soils and crops or vegetation grown at the land application site;

(d) A description of site management practices including, but not limited to, the timing of application, methods used to mitigate potential aerosol drift, and if required by this division, posting of signs or public outreach; and

(e) If public access control or notification is required by this division, descriptions of public access control and how the public and personnel will be notified.

(3) If Class A recycled water is to be used for the beneficial purpose of artificial groundwater recharge, a recycled water use plan must also include, but is not limited to, the following:

(a) A groundwater monitoring plan in accordance with OAR 340-040-0030(2);

(b) A determination if the recharge will be to a drinking water protection area;

(c) A description of the soils and characteristics;

(d) The distance from the recharge area to the nearest point of withdrawal and the retention time in the aquifer until the time of withdrawal; and

(e) Verification from Oregon Water Resources Department that a request for authorization for this use has been initiated.

(4) Conditions contained in a department approved recycled water use plan are NPDES or WPCF permit requirements.

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.030 & 468B.050
History:
DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

340-055-0030
Operational Requirements for the Treatment and Distribution of Recycled Water

(1) Bypassing. The intentional diversion of wastewater from any unit process in the wastewater treatment system for a beneficial purpose is not allowed, unless with the unit process out of service the recycled water meets the criteria of this division for a specific class and beneficial purpose described in the recycled water use plan.

(2) Alarm devices. Alarm devices are required to provide warning of power loss and failure of process equipment essential to the proper operation of the wastewater treatment system and compliance with this division.

(3) Standby power. Unless otherwise approved in writing by the department, a wastewater treatment system providing recycled water for use must have sufficient standby power to fully operate all essential treatment processes. The department may grant an exception to this section only if the wastewater treatment system owner demonstrates that power failure will not result in inadequately treated water being provided for use and will not result in any violation of an NPDES or WPCF permit limit or condition or Oregon Administrative Rule.

(4) Redundancy. A wastewater treatment system that provides recycled water for use must have a sufficient level of redundant treatment facilities and monitoring equipment to prevent inadequately treated recycled water from being used or discharged to public waters.

(5) Distribution system requirements. Unless otherwise approved in writing by the department, all piping, valves, and other portions of the recycled water use system that is outside a building must be constructed and marked in a manner to prevent cross-connection with a potable water system. Unless otherwise approved in writing by the department or as required by the rules of this division, construction and marking must be consistent with sections (2), (3), (4), and (5) of the 1992 "Guidelines for the Distribution of Nonpotable Water" of the California-Nevada Section of the American Water Works Association.

(6) Cross-connection control. Connection between a potable water supply system and a recycled water distribution system is not authorized unless the connection is through an air gap separation approved by the department. A reduced pressure principle backflow prevention device may be used only when approved in writing by the department and the potable water system owner.

[Publications: Publications referenced are available from the agency.]

Statutory/Other Authority: ORS 468.020, 468.705 & 468.710
Statutes/Other Implemented: ORS 468B.030 & 468B.050
History:
DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 32-1990, f. & cert. ef. 8-15-90

Wastewater Facilities Plan

Appendix D. Detailed Cost Estimates

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Project Summary and Capital Improvements Plan

Project Summary			
Project No.	**Project Name**	**Project Cost**	**Priority**
C1A	16-inch trunk main	$710,000	Medium
C1B	8-inch pipe in Yamhill St and W. Garfield St.	$270,000	Medium
C2	10-inch trunk main in Grant Street	$500,000	High
C3	10-inch and 8-inch pipe in East Main Street	$680,000	Medium
C4	6-inch, 8-inch, and 10-inch pipe in West Main Street	$840,000	High
C5	6-inch and 8-inch pipe in South Pine and South Park Streets	$750,000	Medium
C6	6-inch and 8-inch pipe in Kutch Street and vicinity	$700,000	Medium
C7	6-inch pipe in West Jefferson Street, West Johnson Street and vicinity	$440,000	Medium
C8	6-inch and 8-inch pipe in East Monroe Street and vicinity	$790,000	Medium
P1	Hawn Creek Pump Station Pump Replacement	$210,000	Medium
T1	Headworks Upgrade	$640,000	High
T2A	Lagoon Aeration Improvements - Phase 1	$430,000	High
T2B	Lagoon Aeration Improvements - Phase 2	$60,000	Medium
T3A	Lagoon Capacity Improvement - Raise Dikes	$620,000	High
T3B	Lagoon Capacity Improvement - New Lagoon	$1,320,000	High
T4	Lagoon Piping Improvements	$410,000	High
T5	Lagoon Disinfection Improvements	$230,000	High
T6	Miscellaneous Plant Improvements (Water/Elec Service, Small Bldg)	$440,000	Medium
T7	Raise Access Road to Elev 125.0' (Approx 50-year Floodplain)	$400,000	Medium
T8	Effluent Pump Station	$800,000	High
T9	Effluent Force Main and River Outfall	$810,000	High
T10	Irrigation Piping and Equipment	$590,000	Medium
T11A	Biosolids Management Plan	$20,000	Low
T11B	Dredging and Biosolids Land Application	$820,000	Low

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Clay Sewer Pipe Replacement

Project C1A: 16" Clay Pipe

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$35,000	$35,000
16" Sanitary Sewer	1,585	LF	$180	$285,300
48" Sanitary Manholes	9	EA	$6,000	$54,000
Service Connections	20	EA	$2,000	$40,000
4" AC Restoration	1,200	SY	$40	$48,000
Traffic Control	1	LS	$4,000	$4,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$471,000**
Construction Contingencies (% of total)			20%	$94,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$141,000
Total Project Cost				**$710,000**

Project C1B: Selected High Priority Pipes

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$13,000	$13,000
8" Sanitary Sewer	741	LF	$130	$96,330
48" Sanitary Manholes	4	EA	$6,000	$24,000
Service Connections	5	EA	$2,000	$10,000
4" AC Restoration	600	SY	$40	$24,000
Traffic Control	1	LS	$4,000	$4,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$176,000**
Construction Contingencies (% of total)			20%	$35,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$53,000
Total Project Cost				**$270,000**

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Clay Sewer Pipe Replacement

Project C2: 10" Clay Pipe along Grant St

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$25,000	$25,000
10" Sanitary Sewer	1,265	LF	$140	$177,100
48" Sanitary Manholes	6	EA	$6,000	$36,000
Service Connections	25	EA	$2,000	$50,000
4" AC Restoration	900	SY	$40	$36,000
Traffic Control	1	LS	$4,000	$4,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$333,000**
Construction Contingencies (% of total)			20%	$67,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$100,000
Total Project Cost				**$500,000**

Project C3: 8" and 10" Clay Pipe along E. Main St.

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$33,000	$33,000
10" Sanitary Sewer	710	LF	$140	$99,400
8" Sanitary Sewer	1,190	LF	$130	$154,700
48" Sanitary Manholes	6	EA	$6,000	$36,000
Service Connections	32	EA	$2,000	$64,000
4" AC Restoration	1,300	SY	$40	$52,000
Traffic Control	1	LS	$4,000	$4,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$448,000**
Construction Contingencies (% of total)			20%	$90,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$135,000
Total Project Cost				**$680,000**

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Clay Sewer Pipe Replacement

Project C4: 6", 8" and 10" Clay Pipe along W. Main St.

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$41,000	$41,000
10" Sanitary Sewer	1,455	LF	$140	$203,700
8" Sanitary Sewer	430	LF	$130	$55,900
6" Sanitary Sewer	320	LF	$120	$38,400
48" Sanitary Manholes	10	EA	$6,000	$60,000
Service Connections	45	EA	$2,000	$90,000
4" AC Restoration	1,500	SY	$40	$60,000
Traffic Control	1	LS	$4,000	$4,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$557,000**
Construction Contingencies (% of total)			20%	$111,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$167,000
Total Project Cost				**$840,000**

Project C5: 6" and 8" Clay Pipe along S. Pine St and S. Park St.

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$37,000	$37,000
8" Sanitary Sewer	790	LF	$130	$102,700
6" Sanitary Sewer	1,400	LF	$120	$168,000
48" Sanitary Manholes	7	EA	$6,000	$42,000
Service Connections	43	EA	$2,000	$86,000
4" AC Restoration	1,400	SY	$40	$56,000
Traffic Control	1	LS	$4,000	$4,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$500,000**
Construction Contingencies (% of total)			20%	$100,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$150,000
Total Project Cost				**$750,000**

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Clay Sewer Pipe Replacement

Project C6: 6" and 8" Clay Pipe along Kutch St and vicinity

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$34,000	$34,000
8" Sanitary Sewer	290	LF	$130	$37,700
6" Sanitary Sewer	1,825	LF	$120	$219,000
48" Sanitary Manholes	7	EA	$6,000	$42,000
Service Connections	35	EA	$2,000	$70,000
4" AC Restoration	1,300	SY	$40	$52,000
Traffic Control	1	LS	$4,000	$4,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$463,000**
Construction Contingencies (% of total)			20%	$93,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$139,000
Total Project Cost				**$700,000**

Project C7: 6" Clay Pipe along W. Jefferson St, W. Johnson St and vicinity

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$22,000	$22,000
6" Sanitary Sewer	1,264	LF	$120	$151,680
48" Sanitary Manholes	6	EA	$6,000	$36,000
Service Connections	21	EA	$2,000	$42,000
4" AC Restoration	800	SY	$40	$32,000
Traffic Control	1	LS	$4,000	$4,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$292,000**
Construction Contingencies (% of total)			20%	$58,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$88,000
Total Project Cost				**$440,000**

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Clay Sewer Pipe Replacement

Project C8: 6" and 8" Clay Pipe along E. Monroe St and vicinity

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$39,000	$39,000
8" Sanitary Sewer	2,020	LF	$130	$262,600
6" Sanitary Sewer	275	LF	$120	$33,000
48" Sanitary Manholes	5	EA	$6,000	$30,000
Service Connections	45	EA	$2,000	$90,000
4" AC Restoration	1,500	SY	$40	$60,000
Traffic Control	1	LS	$4,000	$4,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$523,000**
Construction Contingencies (% of total)			20%	$105,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$157,000
Total Project Cost				**$790,000**

Total Clay Pipe Replacement Project Cost **$5,680,000**

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Pump Station Upgrades

Project P1: Hawn Creek Pump Station Pump Replacement

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$10,000	$10,000
Duplex Submersible Pumps, Installed	2	EA	$50,000	$100,000
Electrical/Instrumentation	1	LS	$25,000	$25,000
Construction Subtotal				**$135,000**
Construction Contingencies (% of total)			20%	$27,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$41,000
Total Project Cost				**$210,000**

Total Pump Station Upgrades Project Cost **$210,000**

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Treatment Plant Upgrades

Project T1: Headworks Upgrade

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$31,000	$31,000
Excavation	212	CY	$150	$31,800
Dewatering	1	MO	$25,000	$25,000
Hauling	326	CY	$10	$3,260
Shoring, Sheet Pile	1,235	SF	$20	$24,700
Backfill and Compaction, Imported Fill	114	CY	$80	$9,120
Gravel Fill under Structure	579	SF	$1	$440
Fine Screen	1	LS	$116,000	$116,000
Equipment Installation	1	LS	$23,000	$23,000
Coarse Screen (Manual)	1	LS	$10,000	$10,000
Pipe Penetration	2	EA	$2,000	$4,000
Concrete and Reinforcement	50	CY	$850	$42,500
Manhole, Precast 48"	1	EA	$5,000	$5,000
Stop Gates	3	EA	$1,500	$4,500
Sewage Sampler, Refrigerated, Automatic	1	EA	$4,000	$4,000
Bypass Pumping	1	LS	$10,000	$10,000
Misc. Grating/Handrail	1	LS	$15,000	$15,000
Site Piping/Site Work	5%	LS	$16,000	$16,000
Electrical/Instrumentation	15%	LS	$49,000	$49,000
Construction Subtotal				**$425,000**
Construction Contingencies (% of total)			20%	$85,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$128,000
Total Project Cost				**$640,000**

Project T2A: Lagoon Aeration Improvements - Phase 1

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$21,000	$21,000
3 HP Floating Aerators	16	EA	$10,000	$160,000
Aerator Installation	16	EA	$3,000	$48,000
Electrical	16	EA	$3,500	$56,000
Construction Subtotal				**$285,000**
Construction Contingencies (% of total)			20%	$57,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$86,000
Total Project Cost				**$430,000**

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Treatment Plant Upgrades

Project T2B: Lagoon Aeration Improvements - Phase 2

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$3,000	$3,000
3 HP Floating Aerators	2	EA	$10,000	$20,000
Aerator Installation	2	EA	$3,000	$6,000
Electrical	2	EA	$3,500	$7,000
Construction Subtotal				**$36,000**
Construction Contingencies (% of total)			20%	$7,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$11,000
Total Project Cost				**$60,000**

Project T3A: Lagoon Capacity Improvement - Raise Dikes

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$30,000	$30,000
Earthwork (Compaction)	5,187	CY	$3	$15,561
Fill Dirt, Hauling	5,187	CY	$50	$259,350
Liner (20 mil PVC Liner)	18,800	SF	$0.70	$13,160
Weld Existing Liner to Liner for Raised Portion	1	LS	$15,000	$15,000
Crushed Rock, 3/4" - 0	750	CY	$80	$60,000
Riprap 9"	500	CY	$28	$14,000
Construction Subtotal				**$408,000**
Construction Contingencies (% of total)			20%	$82,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$123,000
Total Project Cost				**$620,000**

Project T3B: Lagoon Capacity Improvement - New Lagoon

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$65,000	$65,000
Earthwork (Compaction)	10,350	CY	$3	$31,050
Fill Dirt, Hauling	10,350	CY	$50	$517,500
Liner (80 mil HDPE Liner)	203,000	SF	$1.20	$243,600
Crushed Rock, 3/4" - 0	235	CY	$80	$18,800
Construction Subtotal				**$876,000**
Construction Contingencies (% of total)			20%	$175,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$263,000
Total Project Cost				**$1,320,000**

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Treatment Plant Upgrades

Project T4: Lagoon Piping Improvements

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$20,000	$20,000
New Influent Splitter Box	38	CY	$600	$22,800
Existing Splitter Box Demo	1	LS	$6,000	$6,000
Aggregate Fill	11	CY	$80	$880
12-inch Canal Gates - Inlet Box to Cells 1 and 2	2	EA	$3,000	$6,000
12-inch Overflow Pipes - Inlet Box to Cells 1 and 2	80	LF	$150	$12,000
Overflow Pipes Outlet Protection	2	EA	$5,400	$10,800
Outlet Structures w/Weir	3	EA	$27,000	$81,000
16-inch Transfer Piping	710	LF	$150	$106,500
Existing Piping Demo	1	LS	$5,000	$5,000
Construction Subtotal				**$271,000**
Construction Contingencies (% of total)			20%	$54,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$81,000
Total Project Cost				**$410,000**

Project T5: Lagoon Disinfection Improvements

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$11,000	$11,000
Extend 48-inch Chlorine Contact Pipe	125	LF	$300	$37,500
Chlorination System	1	EA	$10,640	$10,640
SO2 Dechlorination System	1	EA	$10,640	$10,640
Install Cl Mixer	1	LS	$16,200	$16,200
Remove/Replace 72-inch Weir Manhole	1	LS	$34,000	$34,000
Electrical	1	LS	$30,000	$30,000
Construction Subtotal				**$150,000**
Construction Contingencies (% of total)			20%	$30,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$45,000
Total Project Cost				**$230,000**

Project T6: Miscellaneous Plant Improvements (Water/Elec Service, Small Bldg)

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$21,000	$21,000
1.5" Potable Water Service (from Meadowlark Rd)	3,200	LF	$30	$96,000
Backflow Preventer Assembly	1	LS	$3,000	$3,000
10' x 14' Prefab Building (Restroom/Storage)	1	LS	$60,000	$60,000
New Electrical Service (from Meadowlark Rd)	3,200	LF	$30	$96,000
Potable Water Lines, New Hose Bibbs	1	LS	$13,500	$13,500
Construction Subtotal				**$290,000**
Construction Contingencies (% of total)			20%	$58,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$87,000
Total Project Cost				**$440,000**

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Treatment Plant Upgrades

Project T7: Raise Access Road to Elev 125.0' (Approx 50-year Floodplain)

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$18,000	$18,000
8" Thick Crushed Rock Surfacing	890	CY	$80	$71,200
Aggregate Fill	2,670	CY	$50	$133,500
Swale Grading	240	LF	$10	$2,400
Triple 60" Culverts	30	LF	$680	$20,400
Construction Subtotal				**$246,000**
Construction Contingencies (% of total)			20%	$49,000
Engineering to Size Culverts	1	LS	$27,000	$27,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$74,000
Total Project Cost				**$400,000**

Project T8: Effluent Pump Station

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$39,000	$39,000
16-inch Pipe to Wet Well	110	LF	$180	$19,800
6' X 10' X 17' Deep Wet Well Vault	1	LS	$70,000	$70,000
Duplex 400 gpm Irrigation Pumps	2	EA	$70,000	$140,000
Duplex 1,700 gpm High River Discharge Pumps	2	EA	$45,000	$90,000
Wet Well Piping	1	LS	$20,000	$20,000
Valve Vault	1	LS	$30,000	$30,000
Valve Vault Mechanical	1	EA	$50,000	$50,000
Electrical/Instrumentation	1	LS	$60,000	$60,000
Gravity and Irrigation Pipe Connections	1	LS	$10,000	$10,000
Construction Subtotal				**$529,000**
Construction Contingencies (% of total)			20%	$106,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$159,000
Total Project Cost				**$800,000**

Project T9: Effluent Force Main and River Outfall

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$40,000	$40,000
Open Cut 18" PE Pipe and Trench Excavation, Pipe I	2,000	LF	$180	$360,000
Pipe Trench Bedding	2,000	LF	$28	$56,000
Clearing in Heavily Vegetated Area	0.9	Acre	$7,275	$6,402
Diffuser Assembly, Fabrication	1	EA	$5,800	$5,800
In-Water Excavation	28	CY	$200	$5,600
In-Water Backfill, Native	28	CY	$108	$3,024
Turbidity Curtain	150	LF	$15	$2,250
Crane and Crew for In-Water Work	5	Day	$1,775	$8,875
Backhoe and Crew for In-Water Work	5	Day	$2,125	$10,625
Diving Services, 3 person crew	5	Day	$5,000	$25,000
Surveying	112	Manhr	$118	$13,216
Sanitary Facilities	3	Mo	$200	$600
Construction Subtotal				**$538,000**
Construction Contingencies (% of total)			20%	$108,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$162,000
Total Project Cost				**$810,000**

City of Carlton
WASTEWATER FACILITIES MASTER PLAN UPDATE
Treatment Plant Upgrades

Project T10: Irrigation Piping and Equipment

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$29,000	$29,000
Connection to Outlet Structure	1	LS	$7,500	$7,500
Big Gun	2	LS	$65,000	$130,000
6-inch Irrigation Piping	2,000	LF	$75	$150,000
Irrigation Risers	17	EA	$3,000	$51,000
Woven Wire Fence around City Land	8,000	LF	$2	$16,000
Security Camera at Lagoons	2	EA	$2,000	$4,000
Construction Subtotal				**$388,000**
Construction Contingencies (% of total)			20%	$78,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$117,000
Total Project Cost				**$590,000**

Project T11B: Dredging and Biosolids Land Application

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$40,000	$40,000
Suction Hydraulic Dredging	683	Dry Ton	$350	$239,050
Haul to Heard Farms, south of Roseburg	252	Trips	$1,056	$266,112
Construction Subtotal				**$546,000**
Construction Contingencies (% of total)			20%	$109,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$164,000
Total Project Cost				**$820,000**

Wastewater Facilities Plan

Appendix E. Hydraulic Analysis Tabulation Spreadsheets

APPENDIX E.
HYDRAULIC ANALYSIS TABULATION SPREADSHEETS

Hydraulic analysis tabulation spreadsheets were used to estimate the hydraulic grade line of each trunk main. The full-flow gravity capacity and velocity of each pipe segment were calculated, based on the segment's material, slope, diameter, length and invert elevation at the upstream and downstream ends, and the elevation of manhole tops. Head losses for free-surface and pressure conditions were calculated using flows estimated in the hydrologic analysis.

The hydraulic analysis assumed a tailwater elevation (the water elevation at the downstream end of the system) equal to the overflow elevation at the treatment plant main pump station. From this starting elevation, the system's hydraulic grade line (the effective elevation of the water throughout the system) was determined using the invert elevations provided by the storm system inventory and the head losses calculated for each pipe. The method used to determine tailwater and headwater elevations for each pipe is shown in Figure E-1.

Headwater elevations determined by the hydraulic analysis were compared to the upstream top-of-manhole elevations for each pipe segment. If the headwater elevation was greater than the top of manhole elevation (indicating surcharging in the manhole and flooding over the manhole rim), the system was defined as under-capacity somewhere downstream of the flooded manhole. The manhole rims, inverts and pipeline lengths used in the analysis were obtained from a survey performed by LDC in September 2006 (the survey results are attached to the end of this appendix).

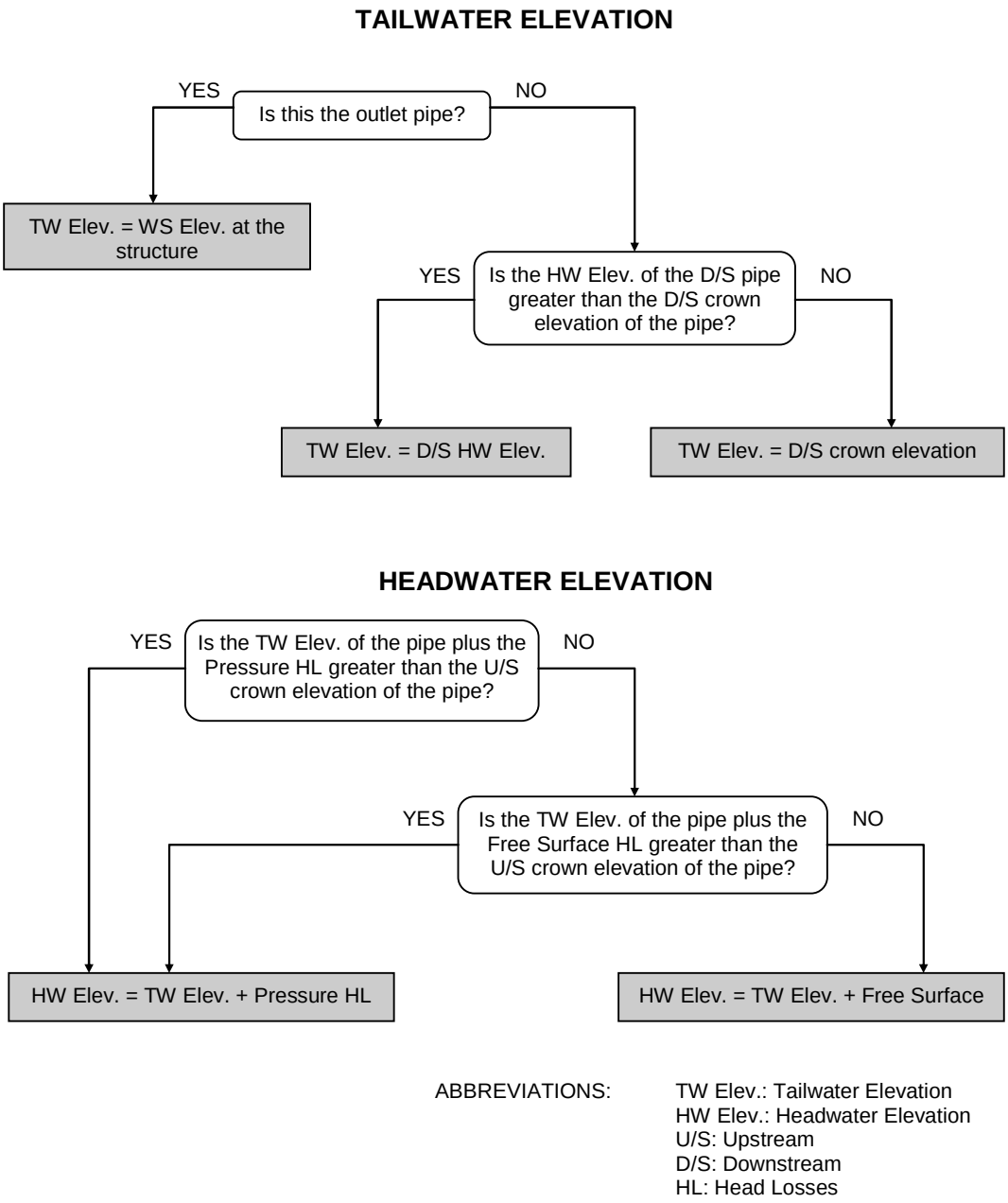


Figure E-1. Procedure for Determining Headwater and Tailwater Elevations

CITY OF CARLTON

ESTIMATED SANITARY FLOWS - 2017

System Labels					**System Inventory**										**Hydraulic Calculations**				
U/S Station	D/S Station	Design	Design	Design	Invert	Pipe	Pipe	Mannings	Full Flow	Full Flow	Length	Pipe Invert		Top of	TW	Head	Head	HW	Surch.
or MH	or MH	Discharge	Discharge	Velocity	Slope	Size	Mat'l		Capacity	Velocity		Elevations		U/S MH	Elev.	Loss	Loss	Elev.	or
No.	No.	Q	Q	Vf	S	D		n	Qf	Vf	L	U/S	D/S	Elev.		(grav.)	(pres.)		Flood
		(gpm)	(cfs)	(fps)	(%)	(in.)			(cfs)	(fps)	(ft.)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
1	2	3	4	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Monroe St																			
B8	B7	625	1.4	1.0	0.28	16	Clay	0.014	3.8	2.7	228.7	176.1	175.5	194.3	176.80	0.11	0.09	176.91	
B7	B9	1,384	3.1	2.2	0.29	16	Clay	0.014	3.8	2.7	350.7	175.4	174.4	187.4	175.70	0.77	0.66	176.47	
B9	B6	1,384	3.1	2.2	0.24	16	Clay	0.014	3.5	2.5	271.0	174.4	173.7	187.4	175.05	0.62	0.51	175.67	
B6	B5	1,384	3.1	2.2	0.18	16	Clay	0.014	3.0	2.2	160.0	173.7	173.4	175.8	174.76	0.41	0.30	175.06	**Surch.**
B5	B4	1,384	3.1	2.5	0.14	15	PVC	0.009	3.5	2.9	99.1	173.3	173.2	179.3	174.44	0.26	0.11	174.55	
B4	B3	1,384	3.1	2.5	0.21	15	PVC	0.009	4.2	3.5	102.2	173.1	172.9	180.9	174.13	0.26	0.11	174.24	
B3	B2	1,384	3.1	2.5	0.43	15	PVC	0.009	6.1	5.0	195.3	172.8	172.0	179.9	173.41	0.36	0.21	173.77	
B2	B1	1,869	4.2	3.4	0.05	15	PVC	0.009	2.0	1.6	130.1	172.0	171.9	188.7	173.15	0.53	0.26	173.41	**Surch.**
B1	A3	1,869	4.2	3.0	0.77	16	Clay	0.014	6.3	4.5	251.1	171.9	170.0	186.3	171.30	1.06	0.86	172.37	
Grant St																			
A9	A8	642	1.4	2.6	0.43	10	Clay	0.014	1.3	2.5	213.0	181.9	180.9	193.5	181.76	1.21	1.05	182.81	**Surch.**
A8	A7	642	1.4	2.6	0.56	10	Clay	0.014	1.5	2.8	269.9	180.9	179.4	189.0	180.24	1.49	1.33	181.74	
A7	A6	642	1.4	2.6	0.44	10	PVC	0.009	2.1	3.8	290.9	179.5	178.2	194.2	179.05	0.75	0.59	179.81	
A6	A5	642	1.4	2.6	0.52	10	PVC	0.009	2.3	4.2	291.2	178.1	176.6	186.2	177.47	0.75	0.59	178.23	
A5	A4	642	1.4	2.6	0.52	10	Clay	0.014	1.5	2.7	291.0	176.6	175.0	188.9	175.87	1.60	1.44	177.31	
A4	A3	642	1.4	2.6	1.70	10	Clay	0.014	2.7	4.9	291.6	174.8	169.8	193.8	170.64	1.60	1.44	172.24	
A3	A2	2,616	5.8	4.2	7.54	16	Clay	0.014	19.6	14.0	507.0	169.5	131.3	179.4	136.08	3.80	3.39	139.88	
A2	A1	2,812	6.3	3.5	0.51	18	PVC	0.009	10.9	6.2	47.0	131.2	131.0	137.4	136.00	0.37	0.08	136.08	**Surch.**
A1	Plant	2,812	6.3	4.5	1.33	16	PVC	0.009	12.8	9.2	1.5	131.0	131.0	136.0	136.50	0.47	0.00	136.50	**Flood**

CITY OF CARLTON

ESTIMATED SANITARY FLOWS - 2037

System Labels					**System Inventory**							**Hydraulic Calculations**						
U/S Station	D/S Station	Design	Design	Design	Invert	Pipe	Pipe	Mannings	Full Flow	Full Flow	Length	Pipe Invert		Top of	TW	Head	Head	HW	Surch.
or MH	or MH	Discharge	Discharge	Velocity	Slope	Size	Mat'l		Capacity	Velocity		Elevations		U/S MH	Elev.	Loss	Loss	Elev.	or
No.	No.	Q	Q	Vf	S	D		n	Qf	Vf	L	U/S	D/S	Elev.		(grav.)	(pres.)		Flood
		(gpm)	(cfs)	(fps)	(%)	(in.)			(cfs)	(fps)	(ft.)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
1	2	3	4	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Monroe St																			
B8	B7	649	1.4	1.0	0.28	16	Clay	0.014	3.8	2.7	228.7	176.1	175.5	194.3	176.87	0.12	0.09	176.99	
B7	B9	1,661	3.7	2.7	0.29	16	Clay	0.014	3.8	2.7	350.7	175.4	174.4	187.4	175.93	1.11	0.95	176.87	**Surch.**
B9	B6	1,661	3.7	2.7	0.24	16	Clay	0.014	3.5	2.5	271.0	174.4	173.7	187.4	175.19	0.89	0.73	175.93	**Surch.**
B6	B5	1,661	3.7	2.7	0.18	16	Clay	0.014	3.0	2.2	160.0	173.7	173.4	175.8	174.76	0.60	0.43	175.19	**Surch.**
B5	B4	1,661	3.7	2.7	0.14	16	PVC	0.009	4.2	3.0	99.1	173.3	173.2	179.3	174.52	0.27	0.11	174.63	
B4	B3	1,661	3.7	2.7	0.21	16	PVC	0.009	5.0	3.6	102.2	173.1	172.9	180.9	174.21	0.28	0.11	174.33	
B3	B2	1,661	3.7	2.7	0.43	16	PVC	0.009	7.3	5.2	195.3	172.8	172.0	179.9	173.48	0.38	0.22	173.86	
B2	B1	2,148	4.8	3.4	0.05	16	PVC	0.009	2.4	1.7	130.1	172.0	171.9	188.7	173.23	0.52	0.24	173.48	**Surch.**
B1	A3	2,148	4.8	3.4	0.77	16	Clay	0.014	6.3	4.5	251.1	171.9	170.0	186.3	171.30	1.41	1.13	172.71	
Grant St																			
A9	A8	707	1.6	2.9	0.43	10	Clay	0.014	1.3	2.5	213.0	181.9	180.9	193.5	181.86	1.47	1.28	183.14	**Surch.**
A8	A7	707	1.6	2.9	0.56	10	Clay	0.014	1.5	2.8	269.9	180.9	179.4	189.0	180.24	1.81	1.62	181.86	**Surch.**
A7	A6	707	1.6	2.9	0.44	10	PVC	0.009	2.1	3.8	290.9	179.5	178.2	194.2	179.05	0.91	0.72	179.97	
A6	A5	707	1.6	2.9	0.52	10	PVC	0.009	2.3	4.2	291.2	178.1	176.6	186.2	177.62	0.92	0.72	178.53	
A5	A4	707	1.6	2.9	0.52	10	Clay	0.014	1.5	2.7	291.0	176.6	175.0	188.9	175.87	1.94	1.74	177.62	
A4	A3	707	1.6	2.9	1.70	10	Clay	0.014	2.7	4.9	291.6	174.8	169.8	193.8	170.64	1.94	1.75	172.58	
A3	A2	2,960	6.6	4.7	7.54	16	Clay	0.014	19.6	14.0	507.0	169.5	131.3	179.4	133.19	4.86	4.34	138.05	
A2	A1	3,156	7.0	4.0	2.39	18	PVC	0.009	23.5	13.3	87.0	131.2	129.1	137.4	133.00	0.56	0.19	133.19	**Surch.**
A1	Plant	3,156	7.0	5.0	0.55	16	PVC	0.009	8.2	5.9	55.0	129.0	128.7	133.0	136.50	0.81	0.22	136.72	**Flood**

LDC
Design Group
a Parati company

20085 NW Tanasbourne Drive
Hillsboro, OR 97124
P 503.858.4242
F 503.645.5500
www.ldcdesign.com

CARLTON MANHOLES, SEPTEMBER 18, 2006

MANHOLE A1;
136.00' RIM
129.00' IE N 18"
129.14' IE W 18"

MANHOLE A2;
137.40' RIM
131.26' IE E 18"
131.22' IE NW 18"
131.91' IE SW 8"

MANHOLE A3;
179.37' RIM
169.97' IE N 18"
169.81' IE E 12"
169.47' IE W 18"

MANHOLE A4;
193.76 RIM
174.78' IE W 12"
175.04' IE E 12"

MANHOLE A5;
188.92' RIM
176.56' IE W 12"
176.64' IE E 12"

MANHOLE A6;
186.18' RIM
178.22' IE W 12"
178.14' IE E 12"

MANHOLE A7;
194.23' RIM
179.41' IE E 12"
179.49' IE W 12"

MANHOLE A8;
189.03' RIM
180.93 IE E AND W 12"

MANHOLE A9;
193.51' RIM
182.21' IE NE 8"
182.25' IE E 12"
182.17' IE S 8"
181.85' IE W 12"
181.91' IE SE 8"

MANHOLE B1;
186.30' RIM
172.00' IE N 18"
171.90 IE S 18"

MANHOLE B2;
188.68' RIM
171.98' IE N 15"
171.96' IE W 18"
177.38' IE S 10"

MANHOLE B3;
179.86' RIM
172.88' IE E 15"
172.82' IE S 15"

MANHOLE B4;
180.85' RIM
173.19' IE NE 15"
173.09' IE W 15"

MANHOLE B5;
179.33' RIM
173.43' IE N 15"
173.33' IE SW 15"

MANHOLE B6;
175.82' RIM
173.72' IE E AND S 15"

MANHOLE B7;
187.43' RIM
175.47 IE E 18"
175.37' IE W 18"

MANHOLE B8;
194.26' RIM
176.36' IE N 12"
176.12' IE W 18"
176.18' IE E 12"

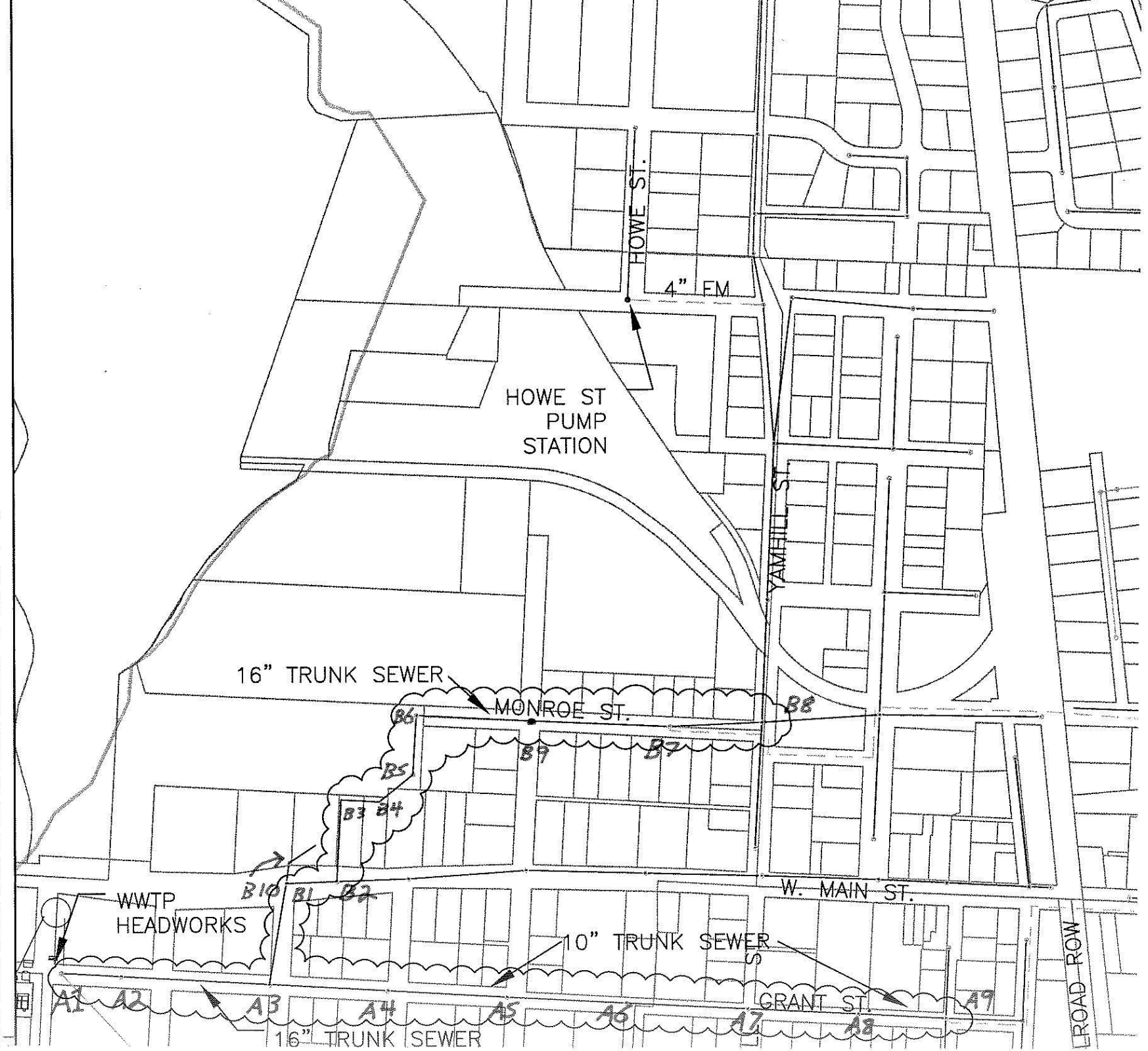
MANHOLE B9;
187.43' RIM
174.37' IE W AND E 15"
175.99' IE N 8"
178.89' IE S 8"

MANHOLE B10;
186.60' RIM
172.10' IE E 18"
171.90' IE S 18"

A1-A2=87.04'
A2-A3=507.00'
A3-A4=291.60'
A4-A5=291.04'
A5-A6=291.19'
A6-A7=290.86'
A7-A8=269.90'
A8-A9=212.98'

A3-B1=251.08'
B1-B10=9.60'

B1-B2=130.10'
B2-B3=195.26'
B3-B4=102.21'
B4-B5=99.10'
B5-B6=157.96'
B6-B9=270.97'
B9-B7=350.73'
B7-B8=228.68'



630018 Carlton\Figures\Fig 4.2.dwg Plot date: Aug 21, 2006-01:54:32pm CAD User: Rachel.Dvorsky.

Wastewater Facilities Plan

Appendix F. Water Balance Spreadsheets

City of Carlton - WWTP Facilities Plan Update
Water Balance: 2017

Assumptions				
AWWF Increase [1]	1.00	Effluent BOD Load [4]	92.0	lbs/day
ADWF Increase [1]	1.00	Effluent BOD Conc [4]	15.0	mg/L
Precip Increase [6]	1.00	Irrigation Acreage	34.4	acres
Evap Increase [7]	1.00	Additional Irrigation	0.0	in/day
		is equal to	0	GPD

Lagoon 1+2+3		
Lagoon Surface Area	12.8	acres
Depth at Start	1.5	ft
Max Depth	6.0	ft
Max Storage Volume	76.8	ac-ft

Month	Avg Daily Flow	Monthly Influent Flow		Monthly Precipitation [2]		Monthly Evaporation [3]		Monthly Discharge [4]		Monthly Base Irrigation [5]		Extra Irrigation (Soil capacity)		Net Flow	Volume Stored	Lagoon Depth	Status
	MG	MG	ac-ft	in	ac-ft	in	ac-ft	mgd	ac-ft	in	ac-ft	in	ac-ft	ac-ft	ac-ft	ft	
															19.2	1.5	Normal
May	0.204	6.3	19.4	0.97	1.03	5.15	-5.5	0.00	0.0	2.01	-5.8	0.0	0.0	9.2	28.4	2.2	Normal
Jun	0.162	4.9	14.9	1.60	1.71	6.01	-6.4	0.00	0.0	3.82	-11.0	0.0	0.0	-0.8	27.6	2.2	Normal
Jul	0.146	4.5	13.9	0.00	0.00	7.40	-7.9	0.00	0.0	6.42	-18.4	0.0	0.0	-12.4	19.2	1.5	Normal
Aug	0.134	4.1	12.7	0.29	0.31	6.78	-7.2	0.00	0.0	5.94	-17.0	0.0	0.0	-11.2	19.2	1.5	Normal
Sep	0.146	4.4	13.5	0.89	0.95	4.68	-5.0	0.00	0.0	4.25	-12.2	0.0	0.0	-2.8	19.2	1.5	Normal
Oct	0.337	10.5	32.1	8.91	9.50	2.39	-2.5	0.00	0.0	2.17	-6.2	0.0	0.0	32.8	52.0	4.1	Normal
Nov	0.472	14.2	43.5	8.04	8.57	1.05	-1.1	0.73	-67.6	0	0.0	0.0	0.0	-16.7	35.3	2.8	Normal
Dec	0.863	26.7	82.1	11.47	12.23	0.57	-0.6	0.73	-69.9	0	0.0	0.0	0.0	23.8	59.1	4.6	Normal
Jan	0.553	17.1	52.6	9.68	10.32	0.63	-0.7	0.73	-69.9	0	0.0	0.0	0.0	-7.7	51.5	4.0	Normal
Feb	0.643	18.0	55.3	8.68	9.26	1.18	-1.3	0.73	-63.1	0	0.0	0.0	0.0	0.1	51.6	4.0	Normal
Mar	0.770	23.9	73.3	7.96	8.49	2.29	-2.4	0.73	-69.9	0	0.0	0.0	0.0	9.4	61.0	4.8	Normal
Apr	0.292	8.8	26.9	2.37	2.52	3.31	-3.5	0.73	-67.6	0.59	-1.7	0.0	0.0	-43.4	19.2	1.5	Normal
Total	4.72	143	440	60.8	64.9	41.4	-44.2	4.41	-408	25.2	-72.2	0.0	0.0	-19.54	443	35	
												Maximum Volume Required			61.0	ac-ft	

Notes:

1) Projected monthly ADWF/AWWF based on annual ADWF/AWWF factor applied to each month. Projections per DEQ guidelines
2) Precipitation based on 2011-2016 DMR data from Carlton WWTP.
3) Evaporation based on historical means for N. Willamette Experiment Station, Oregon Climate Service, 1961-1990.
4) Discharge to N Yamhill assumed to be max based on BOD mass load permit limit of 92 lbs/day
5) Irrigation based on application rates for spring grass seed, Region 5, 19 out of 20 yrs, in "Oregon Crop Water Use and Irrigation Requirements", WRET, 1992.
6) Precipitation projection factor based on average of "Climate Change for Projected Precipitation", Climate Impacts Group, 2013.
7) Evaporation projection factor based on "Climate Change Projections for USFS lands in Oregon and Washington", Climate Impacts Group, 2011.

City of Carlton - WWTP Facilities Plan Update
Water Balance: 2025

Assumptions				
AWWF Increase [1]	1.27	Effluent BOD Load [4]	92.0	lbs/day
ADWF Increase [1]	1.23	Effluent BOD Conc [4]	12.0	mg/L
Precip Increase [6]	1.02	Irrigation Acreage	34.4	acres
Evap Increase [7]	1.01	Additional Irrigation	0.0	in/day
		is equal to	0	GPD

Lagoon 1+2+3		
Lagoon Surface Area	13.1	acres
Depth at Start	1.5	ft
Max Depth	7.0	ft
Max Storage Volume	91.7	ac-ft

Month	Avg Daily Flow	Monthly Influent Flow		Monthly Precipitation [2]		Monthly Evaporation [3]		Monthly Discharge [4]		Monthly Base Irrigation [5]		Extra Irrigation (Soil capacity)		Net Flow	Volume Stored	Lagoon Depth	Status
	MG	MG	ac-ft	in	ac-ft	in	ac-ft	mgd	ac-ft	in	ac-ft	in	ac-ft	ac-ft	ac-ft	ft	
															19.65	1.5	Normal
May	0.251	7.8	23.9	0.99	1.08	5.21	-5.7	0.00	0.0	2.01	-5.8	0.0	0.0	13.5	33.2	2.5	Normal
Jun	0.199	6.0	18.3	1.63	1.78	6.08	-6.6	0.00	0.0	3.82	-11.0	0.0	0.0	2.5	35.7	2.7	Normal
Jul	0.180	5.6	17.1	0.00	0.00	7.49	-8.2	0.00	0.0	6.42	-18.4	0.0	0.0	-9.5	26.2	2.0	Normal
Aug	0.164	5.1	15.6	0.30	0.33	6.86	-7.5	0.00	0.0	5.94	-17.0	0.0	0.0	-8.5	19.7	1.5	Normal
Sep	0.180	5.4	16.6	0.91	0.99	4.74	-5.2	0.00	0.0	4.25	-12.2	0.0	0.0	0.2	19.9	1.5	Normal
Oct	0.415	12.9	39.5	9.09	9.92	2.42	-2.6	0.00	0.0	2.17	-6.2	0.0	0.0	40.5	60.4	4.6	Normal
Nov	0.600	18.0	55.2	8.20	8.95	1.06	-1.2	0.92	-84.6	0	0.0	0.0	0.0	-21.5	38.9	3.0	Normal
Dec	1.096	34.0	104.2	11.70	12.77	0.58	-0.6	0.92	-87.4	0	0.0	0.0	0.0	29.0	67.9	5.2	Normal
Jan	0.702	21.8	66.8	9.87	10.78	0.64	-0.7	0.92	-87.4	0	0.0	0.0	0.0	-10.5	57.4	4.4	Normal
Feb	0.817	22.9	70.2	8.85	9.66	1.19	-1.3	0.92	-78.9	0	0.0	0.0	0.0	-0.4	57.0	4.3	Normal
Mar	0.978	30.3	93.1	8.11	8.86	2.32	-2.5	0.92	-87.4	0	0.0	0.0	0.0	12.0	69.0	5.3	Normal
Apr	0.371	11.1	34.2	2.41	2.64	3.35	-3.7	0.92	-84.6	0.59	-1.7	0.0	0.0	-53.1	19.7	1.5	Normal
Total	5.95	181	555	62.1	67.7	41.9	-45.8	5.51	-510	25.2	-72.2	0.0	0.0	-5.73	505	39	
												Maximum Volume Required			69.0	ac-ft	

Notes:

1) Projected monthly ADWF/AWWF based on annual ADWF/AWWF factor applied to each month. Projections per DEQ guidelines
2) Precipitation based on 2011-2016 DMR data from Carlton WWTP.
3) Evaporation based on historical means for N. Willamette Experiment Station, Oregon Climate Service, 1961-1990.
4) Discharge to N Yamhill assumed to be max based on BOD mass load permit limit of 92 lbs/day
5) Irrigation based on application rates for spring grass seed, Region 5, 19 out of 20 yrs, in "Oregon Crop Water Use and Irrigation Requirements", WRET, 1992.
6) Precipitation projection factor based on average of "Climate Change for Projected Precipitation", Climate Impacts Group, 2013.
7) Evaporation projection factor based on "Climate Change Projections for USFS lands in Oregon and Washington", Climate Impacts Group, 2011.

City of Carlton - WWTP Facilities Plan Update
Water Balance: 2032

Assumptions				
AWWF Increase [1]	1.34	Effluent BOD Load [4]	92.0	lbs/day
ADWF Increase [1]	1.40	Effluent BOD Conc [4]	11.2	mg/L
Precip Increase [6]	1.04	Irrigation Acreage	34.4	acres
Evap Increase [7]	1.02	Additional Irrigation	0.0	in/day
		is equal to	0	GPD

Lagoon 1+2+3		
Lagoon Surface Area	13.1	acres
Depth at Start	1.5	ft
Max Depth	7.0	ft
Max Storage Volume	91.7	ac-ft

Month	Avg Daily Flow	Monthly Influent Flow		Monthly Precipitation [2]		Monthly Evaporation [3]		Monthly Discharge [4]		Monthly Base Irrigation [5]		Extra Irrigation (Soil capacity)		Net Flow	Volume Stored	Lagoon Depth	Status
	MG	MG	ac-ft	in	ac-ft	in	ac-ft	mgd	ac-ft	in	ac-ft	in	ac-ft	ac-ft	ac-ft	ft	
															19.65	1.5	Normal
May	0.286	8.9	27.2	1.00	1.09	5.27	-5.7	0.00	0.0	2.01	-5.8	0.0	0.0	16.8	36.5	2.8	Normal
Jun	0.226	6.8	20.8	1.66	1.81	6.15	-6.7	0.00	0.0	3.82	-11.0	0.0	0.0	5.0	41.4	3.2	Normal
Jul	0.204	6.3	19.4	0.00	0.00	7.57	-8.3	0.00	0.0	6.42	-18.4	0.0	0.0	-7.2	34.2	2.6	Normal
Aug	0.187	5.8	17.8	0.30	0.33	6.93	-7.6	0.00	0.0	5.94	-17.0	0.0	0.0	-6.5	27.8	2.1	Normal
Sep	0.205	6.1	18.9	0.92	1.01	4.79	-5.2	0.00	0.0	4.25	-12.2	0.0	0.0	2.5	30.2	2.3	Normal
Oct	0.472	14.6	44.9	9.24	10.09	2.44	-2.7	0.00	0.0	2.17	-6.2	0.0	0.0	46.1	76.4	5.8	Normal
Nov	0.633	19.0	58.3	8.34	9.10	1.07	-1.2	0.98	-90.6	0	0.0	0.0	0.0	-24.4	52.0	4.0	Normal
Dec	1.156	35.8	110.0	11.90	12.99	0.58	-0.6	0.98	-93.6	0	0.0	0.0	0.0	28.7	80.7	6.2	Normal
Jan	0.741	23.0	70.5	10.04	10.96	0.64	-0.7	0.98	-93.6	0	0.0	0.0	0.0	-12.9	67.8	5.2	Normal
Feb	0.862	24.1	74.0	9.00	9.83	1.21	-1.3	0.98	-84.6	0	0.0	0.0	0.0	-2.0	65.8	5.0	Normal
Mar	1.032	32.0	98.2	8.25	9.01	2.34	-2.6	0.98	-93.6	0	0.0	0.0	0.0	11.1	76.9	5.9	Normal
Apr	0.392	11.8	36.1	2.46	2.68	3.38	-3.7	0.98	-90.6	0.59	-1.7	0.0	0.0	-57.2	19.7	1.5	Normal
Total	6.40	194	596	63.1	68.9	42.4	-46.3	5.90	-547	25.2	-72.2	0.0	0.0	-0.02	609	47	
												Maximum Volume Required			80.7	ac-ft	

Notes:

1) Projected monthly ADWF/AWWF based on annual ADWF/AWWF factor applied to each month. Projections per DEQ guidelines
2) Precipitation based on 2011-2016 DMR data from Carlton WWTP.
3) Evaporation based on historical means for N. Willamette Experiment Station, Oregon Climate Service, 1961-1990.
4) Discharge to N Yamhill assumed to be max based on BOD mass load permit limit of 92 lbs/day
5) Irrigation based on application rates for spring grass seed, Region 5, 19 out of 20 yrs, in "Oregon Crop Water Use and Irrigation Requirements", WRET, 1992.
6) Precipitation projection factor based on average of "Climate Change for Projected Precipitation", Climate Impacts Group, 2013.
7) Evaporation projection factor based on "Climate Change Projections for USFS lands in Oregon and Washington", Climate Impacts Group, 2011.

City of Carlton - WWTP Facilities Plan Update
Water Balance: 2037

Assumptions				
AWWF Increase [1]	1.39	Effluent BOD Load [4]	92.0	lbs/day
ADWF Increase [1]	1.53	Effluent BOD Conc [4]	10.5	mg/L
Precip Increase [6]	1.05	Irrigation Acreage	34.4	acres
Evap Increase [7]	1.03	Additional Irrigation	0.0	in/day
		is equal to	0	GPD

Lagoon 1+2+3		
Lagoon Surface Area	13.1	acres
Depth at Start	1.5	ft
Max Depth	7.0	ft
Max Storage Volume	91.7	ac-ft

Month	Avg Daily Flow	Monthly Influent Flow		Monthly Precipitation [2]		Monthly Evaporation [3]		Monthly Discharge [4]		Monthly Base Irrigation [5]		Extra Irrigation (Soil capacity)		Net Flow	Volume Stored	Lagoon Depth	Status
	MG	MG	ac-ft	in	ac-ft	in	ac-ft	mgd	ac-ft	in	ac-ft	in	ac-ft	ac-ft	ac-ft	ft	
															19.65	1.5	Normal
May	0.313	9.7	29.7	1.02	1.11	5.30	-5.8	0.00	0.0	2.01	-5.8	0.0	0.0	19.3	38.9	3.0	Normal
Jun	0.247	7.4	22.8	1.68	1.83	6.19	-6.8	0.00	0.0	3.82	-11.0	0.0	0.0	6.9	45.8	3.5	Normal
Jul	0.223	6.9	21.3	0.00	0.00	7.62	-8.3	0.00	0.0	6.42	-18.4	0.0	0.0	-5.5	40.4	3.1	Normal
Aug	0.205	6.3	19.5	0.31	0.34	6.98	-7.6	0.00	0.0	5.94	-17.0	0.0	0.0	-4.9	35.5	2.7	Normal
Sep	0.224	6.7	20.6	0.93	1.02	4.82	-5.3	0.00	0.0	4.25	-12.2	0.0	0.0	4.2	39.7	3.0	Normal
Oct	0.516	16.0	49.1	9.36	10.21	2.46	-2.7	0.00	0.0	2.17	-6.2	0.0	0.0	50.4	90.1	6.9	Normal
Nov	0.657	19.7	60.4	8.44	9.21	1.08	-1.2	1.05	-96.6	0	0.0	0.0	0.0	-28.2	62.0	4.7	Normal
Dec	1.199	37.2	114.1	12.04	13.15	0.59	-0.6	1.05	-99.9	0	0.0	0.0	0.0	26.7	88.7	6.8	Normal
Jan	0.768	23.8	73.1	10.16	11.09	0.65	-0.7	1.05	-99.9	0	0.0	0.0	0.0	-16.4	72.3	5.5	Normal
Feb	0.894	25.0	76.8	9.11	9.95	1.22	-1.3	1.05	-90.2	0	0.0	0.0	0.0	-4.8	67.6	5.2	Normal
Mar	1.071	33.2	101.9	8.35	9.12	2.36	-2.6	1.05	-99.9	0	0.0	0.0	0.0	8.6	76.1	5.8	Normal
Apr	0.406	12.2	37.4	2.49	2.71	3.41	-3.7	1.05	-96.6	0.59	-1.7	0.0	0.0	-61.9	19.7	1.5	Normal
Total	6.72	204	627	63.9	69.7	42.7	-46.6	6.30	-583	25.2	-72.2	0.0	0.0	-5.45	677	52	
												Maximum Volume Required			90.1	ac-ft	

Notes:

1) Projected monthly ADWF/AWWF based on annual ADWF/AWWF factor applied to each month. Projections per DEQ guidelines
2) Precipitation based on 2011-2016 DMR data from Carlton WWTP.
3) Evaporation based on historical means for N. Willamette Experiment Station, Oregon Climate Service, 1961-1990.
4) Discharge to N Yamhill assumed to be max based on BOD mass load permit limit of 92 lbs/day
5) Irrigation based on application rates for spring grass seed, Region 5, 19 out of 20 yrs, in "Oregon Crop Water Use and Irrigation Requirements", WRET, 1992.
6) Precipitation projection factor based on average of "Climate Change for Projected Precipitation", Climate Impacts Group, 2013.
7) Evaporation projection factor based on "Climate Change Projections for USFS lands in Oregon and Washington", Climate Impacts Group, 2011.

City of Carlton - WWTP Facilities Plan Update
Water Balance: 2037 (with 4th Lagoon)

Assumptions				
AWWF Increase [1]	1.39	Effluent BOD Load [4]	92.0	lbs/day
ADWF Increase [1]	1.53	Effluent BOD Conc [4]	10.3	mg/L
Precip Increase [6]	1.05	Irrigation Acreage	33.9	acres
Evap Increase [7]	1.03	Additional Irrigation	0.0	in/day
		is equal to	0	GPD

Lagoon 1+2+3 (+4)		
Size of New Lagoon	0.0	acres
Lagoon Surface Area	12.8	acres
Depth at Start	1.5	ft
Max Depth	6.0	ft
Max Storage Volume	76.8	ac-ft

Month	Avg Daily Flow	Monthly Influent Flow		Monthly Precipitation [2]		Monthly Evaporation [3]		Monthly Discharge [4]		Monthly Base Irrigation [5]		Extra Irrigation (Soil capacity)		Net Flow	Volume Stored	Lagoon Depth	Status
	MG	MG	ac-ft	in	ac-ft	in	ac-ft	mgd	ac-ft	in	ac-ft	in	ac-ft	ac-ft	ac-ft	ft	
															19.2	1.5	Normal
May	0.313	9.7	29.7	1.02	1.08	5.30	-5.7	0.00	0.0	2.01	-5.7	0.0	0.0	19.5	38.7	3.0	Normal
Jun	0.247	7.4	22.8	1.68	1.79	6.19	-6.6	0.00	0.0	3.82	-10.8	0.0	0.0	7.2	45.9	3.6	Normal
Jul	0.223	6.9	21.3	0.00	0.00	7.62	-8.1	0.00	0.0	6.42	-18.1	0.0	0.0	-5.0	40.8	3.2	Normal
Aug	0.205	6.3	19.5	0.31	0.33	6.98	-7.4	0.00	0.0	5.94	-16.8	0.0	0.0	-4.4	36.4	2.8	Normal
Sep	0.224	6.7	20.6	0.93	1.00	4.82	-5.1	0.00	0.0	4.25	-12.0	0.0	0.0	4.5	40.9	3.2	Normal
Oct	0.516	16.0	49.1	9.36	9.98	2.46	-2.6	0.00	0.0	2.17	-6.1	0.0	0.0	50.3	91.2	7.1	Overflow
Nov	0.657	19.7	60.4	8.44	9.00	1.08	-1.2	1.07	-98.5	0	0.0	0.0	0.0	-30.2	61.0	4.8	Normal
Dec	1.199	37.2	114.1	12.04	12.85	0.59	-0.6	1.07	-101.8	0	0.0	0.0	0.0	24.5	85.5	6.7	Overflow
Jan	0.768	23.8	73.1	10.16	10.84	0.65	-0.7	1.07	-101.8	0	0.0	0.0	0.0	-18.6	66.9	5.2	Normal
Feb	0.894	25.0	76.8	9.11	9.72	1.22	-1.3	1.07	-91.9	0	0.0	0.0	0.0	-6.7	60.2	4.7	Normal
Mar	1.071	33.2	101.9	8.35	8.91	2.36	-2.5	1.07	-101.8	0	0.0	0.0	0.0	6.5	66.7	5.2	Normal
Apr	0.406	12.2	37.4	2.49	2.65	3.41	-3.6	1.07	-98.5	0.59	-1.7	0.0	0.0	-63.7	19.2	1.5	Normal
Total	6.72	204	627	63.9	68.1	42.7	-45.5	6.42	-594	25.2	-71.2	0.0	0.0	-16.25	653	51	
												Maximum Volume Required			91.2	ac-ft	

Notes:

1) Projected monthly ADWF/AWWF based on annual ADWF/AWWF factor applied to each month. Projections per DEQ guidelines
2) Precipitation based on 2011-2016 DMR data from Carlton WWTP.
3) Evaporation based on historical means for N. Willamette Experiment Station, Oregon Climate Service, 1961-1990.
4) Discharge to N Yamhill assumed to be max based on BOD mass load permit limit of 92 lbs/day
5) Irrigation based on application rates for spring grass seed, Region 5, 19 out of 20 yrs, in "Oregon Crop Water Use and Irrigation Requirements", WRET, 1992.
6) Precipitation projection factor based on average of "Climate Change for Projected Precipitation", Climate Impacts Group, 2013.
7) Evaporation projection factor based on "Climate Change Projections for USFS lands in Oregon and Washington", Climate Impacts Group, 2011.

Wastewater Facilities Plan

Appendix G. Mixing Zone Study

DRAFT: CITY OF CARLTON MIXING ZONE STUDY

Prepared for:

The City of Carlton

191 E Main Street

Carlton, OR 97111

Project No. 1625001

August 17, 2017

CwM-H2O

Complete Water Management

1319 SE MLK Jr. Blvd, Suite 204, Portland, Oregon 97214

Complete Water Management | CwMH2O.com

Table of Contents

1 Introduction

This report presents the results of the Mixing Zone Study conducted by CwM H2O, LLC (CwM) for the City of Carlton, OR (Carlton) wastewater treatment plant (WWTP). The Carlton WWTP and river discharge outfall are located southwest of Carlton, Oregon off NW Meadowlake Road (see Figure 1). This mixing zone study was completed to support planning for WWTP upgrades and for Carlton's application for renewal of their National Pollutant Discharge Elimination System Permit (Permit) #101902 (DEQ, 2012a). The Permit allows for wasterwater discharge (discharge) from the WWTP to the North Yamhill River (receiving water) from November 1 to April 30.

This report is consistent with Oregon Department of Environmental Quality (DEQ) Mixing Zone Internal Management Directive (Mixing Zone IMD) (DEQ, 2013) and presents the following information to document the results of the mixing zone study:

- Background information on site conditions, including a description of the current Regulatory Mixing Zone (RMZ) and Zone of Immediate Dilution (ZID) in the Permit.
- Environmental mapping conducted by CwM, consisting of research into public information of natural resources. Environmental mapping is required to identify applicable beneficial uses for the receiving water and identify the sensitive ecological receptors potentially present in the area within or around the RMZ.
- Documentation of the modeling approach and results of the mixing zone analysis. The analysis included characterization of the data collected over the current permit cycle, including details on the outfall configuration, the wastewater discharge, and the receiving water. These data were utilized to determine the appropriate model parameters and assumptions for the mixing zone modeling analysis.

2 Site and Permit Conditions

The City of Carlton operates a domestic WWTP with an average dry weather design (ADWF) flow of 0.19 million gallons per day (mgd). Carlton's wastewater facilities include headworks, three facultative lagoons, a chlorine contact chamber, and two outfalls. The facility is permitted to discharge to the North Yamhill River via Outfall 001 from November 1 to April 30. From May 1 to October 31, the facility releases the treated wastewater to a contract farmer for application to agricultural lands via Outfall 002.

At River Mile (RM) 8.1, Carlton discharges treated wastewater to the river through Outfall 001[1]. Currently Outfall 001 is a 10-inch pipe that discharges to an embayment prior to reaching the main river channel (See Figure 2 and 3). The current permit requires improvement of the outfall to improve mixing of the discharge with the receiving water. The proposed improvements include extending the outfall into the main channel of the receiving water and installing a multiport diffuser. This mixing zone study focuses on Outfall 001 and assumes the improvements of outfall required by the permit have been completed. This mixing zone study does not address discharge via the existing 10-inch pipe nor Outfall 002.

[1] The coordinates of Outfall 001 are N 45° 17' 37" and W 123° 11' 11"

Carlton's Permit allows for mixing zones surrounding Outfall 001. A mixing zone is a region in which water quality standards may be temporarily suspended for wastewater discharge to surface water. This is allowed under Oregon Administrative Rule (OAR) 340-041-0053. The permit outlines two mixing zones within the river for discharge from Outfall 001:

- The Regulatory Mixing Zone (RMZ), where chronic water quality criteria may be suspended. The RMZ is the portion of the North Yamhill River contained within a 25-foot wide band centered on the point of discharge and extending ten feet upstream to 50 feet downstream from the point of discharge.
- The Zone of Immediate Dilution (ZID), where acute water quality criteria may be suspended. The ZID is defined as the portion of the RMZ within five feet of the point of discharge.

These mixing zones are designed to protect the overall integrity of the water body.

3 Environmental Mapping

This section presents the results of the environmental mapping conducted by CwM. The environmental mapping consisted of researching public data from natural resource agencies, such as the Oregon Fish and Wildlife Department, to identify areas near the RMZ that may be sensitive to impacts from discharge, including identification of critical resources and other beneficial uses of the water body receiving discharge. This evaluation included, and is limited to, review and summary of the:

- Beneficial uses for the receiving water and downstream water bodies as identified in OAR 340-041-0340.
- Review of the Oregon DEQ fish maps from OAR 340-041-0340, which identify fish use designations for the Willamette Basin (Figure 340A) and identify areas for salmon and steelhead spawning (Figure 340B).
- A review of species classified as threatened or endangered by the United States Fish & Wildlife Service (USFW) and species classified as "Sensitive Species" by the Oregon Fish & Wildlife Service (ODFW).
- Field mapping conducted on 1/26/2017. The field mapping focused on identifying the current distribution of surface water bodies (including drainage ditches) in the area upstream and downstream of the outfall.
- Examination of public data sources to identify features such as drinking water intakes, public recreational access points, and tributary streams to the North Yamhill River.

The findings of the environmental mapping are presented in Figure 4. The information from the agencies that provided the environmental data that support the basis of this assessment are provided in their original form in Appendix A.

3.1 Designated Uses

Carlton's Outfall 001 is located at approximately RM 8.1 of the North Yamhill River, a tributary of the Willamette River. Designated beneficial uses for the river include; public and private domestic water supply, industrial water supply, irrigation, livestock watering, fish and aquatic life, fishing, boating, wildlife

and hunting, recreation, aesthetic quality, hydro-power, and commercial navigation and transportation (OAR 340-041-0101, Table 340A).

3.2 Fish Distribution

CwM's analysis of fish distribution was completed through utilization of professional opinion and observations of the Oregon Department of Fish and Wildlife (ODFW), Figure 340A of OAR 340-041-0101, and fish distribution maps for the local area created from the Oregon Explorer Natural Resource Digital Library. These maps, included in Appendix A, show that the section of the North Yamhill River local to Outfall 001 is used for rearing of spring Chinook Salmon, rearing of winter Steelhead, and migration of Coho Salmon. In examination of the data, no redds were identified during mapping, confirming the professional opinion given previously by regional ODFW biologists (DEQ, 2009). No critical habitats were designated for this section of the North Yamhill River by the National Marine Fisheries Service (NMFS). Additionally, no physical structures that could potentially attract fish such a piers or woody debris were identified in the vicinity of Outfall 001.

3.3 Threatened or Endangered Species

The Oregon Department of Fish and Wildlife (ODFW) maintains a list of species that are threatened or endangered under Federal and Oregon State Endangered Species Fish Acts (ORS 496. 171-192). Fish species known to use the North Yamhill River in the vicinity of Outfall 001 that are listed as endangered or threatened were identified as follows:

- Coho Salmon – Threatened federal status; Endangered state status.
- Steelhead – Threatened federal status; No state status.
- Chinook Salmon – Threatened federal status; No state status.

Coho and Chinook Salmon generally migrate from freshwater into slackwater estuaries between March and July. Steelhead rearing occurs during the winter in the receiving water at the location of Outfall 001. Figure 4 presents the distribution of these species approximately ½ mile upstream and downstream of Outfall 001.

3.4 Sensitive Species

Fish classified as "Sensitive Species" under Oregon's Sensitive Species Rule (OAR 635-100-0040) were identified based on review of the current Sensitive Species List (ODFW, 2016). Fish listed for the Upper Willamette Species Management Unit (encompassing the North Yamhill River at Carlton) include Steelhead, Chinook Salmon, Bull Trout, Oregon Chub, the Western Brook Lamprey, and Western River Lamprey.

Amphibians listed as sensitive species within the Willamette Valley ecosystem within the vicinity of the outfall include the Clouded Salamander and Northern Red-legged Frog (See Figure 4) as specified by the ODFW Compass mapping tool (ODFW, 2017).

3.5 Commercial and Recreational Shellfish Areas

The Oregon Department of Agriculture (ODA) limits commercial shellfish harvest to ODA classified shellfish harvest areas as shown on the map included in Appendix A. No commercial shellfish harvesting occurs on the North Yamhill River. Additionally, there are no known recreational shellfish harvesting areas on the North Yamhill River.

3.6 Cold Water Refugia

As defined in OAR 340-041-0002, cold water refugia are portions of a water body where, or times during the daily temperature cycle when, the water temperature is at least 2 degrees Celsius colder than the daily maximum temperature of the adjacent mixed flow of the water body. Refugia include habitats and locations where sensitive cold-water species may find refuge when ambient aquatic temperatures are stressful. Often, these refugia are located at the confluence of rivers with colder tributaries.

In the area local to Outfall 001, CwM identified three unnamed streams from the National Hydrography Dataset provided by the United States Geological Survey (USGS, 2017). The first identified tributary is located 2,000 feet downstream of Outfall 001 and enters the North Yamhill River from the east. The second and third tributaries are located 3,000 feet downstream of Outfall 001 to the east and west. It is not known if these streams provide cold water refugia presently and all three of these cold water refugia were located outside of the mixing zone area.

3.7 303(d) Listing Status

Section 303(d) of the Clean Water Act requires each state to develop a list of water bodies that do not meet state surface water quality standards. The state is then required to complete a total maximum daily load (TMDL) program for water bodies on the 303(d) list. The Clean Water Act prohibits new or increased discharges until a TMDL has been established for 303(d) water bodies, unless the discharge does not contribute pollutants that cause the water body to violate water quality standards.

In area local to Outfall 001, the North Yamhill River is on the 303(d) list for temperature, bacteria, dissolved oxygen, and iron and/or manganese. Currently TMLDs for these constituents are in development.

No other National Pollution Discharge Elimination System (NPDES) dischargers were identified within a half mile upstream or downstream of Outfall 001.

3.8 Public Access

CwM found no boat ramps, docks, public beaches, or other public features were identified within a half mile upstream or downstream of Outfall 001. One park, Wennerberg Park, was identified approximately one mile upstream of Outfall 001. Additional public access areas are found at McMinnville, OR. McMinnville, is located at the confluence of the North and South Forks of the Yamhill River, is approximately 5 River Miles downstream of Outfall 001.

3.9 Drinking Water Intakes

No drinking water intakes were identified within the vicinity of Outfall 001 or within a half mile downstream of the outfall. Intake along the North Yamhill River is primarily for irrigation purposes.

4 Mixing Modeling and Results

This section provides a summary of the mixing zone modeling and results conducted to estimate the dilution factors within the ZID and RMZ. A detailed description of the modeling approach, model parameters, and how they were derived is presented in Appendix B. A summary of the modeling approach and results is presented in the following section.

The first aspect of the modeling was determining the "critical" period during which adverse impacts to the beneficial uses are most likely to be experienced. The second step was defining the scenarios for the modeling based on the Mixing Zone IMD relative to the critical period. Once the scenarios were established, the system was characterized for the parameters discussed above (e.g., channel dimensions and outfall configuration). Modeling of the system was then conducted based on the components' characteristics to estimate the dilution factors.

4.1 Determination of the Critical Period

For this mixing zone study, CwM determined the critical period to be when flows in the receiving water are at the lowest, and coinciding with the timeframe the Permit allows discharge to the receiving water (November 1st to April 30th). This critical discharge period is the period most likely to result in highest concentrations of constituents in the receiving water. For unidirectional rivers, this critical period typically corresponds to low flow conditions. The determination of the critical discharge period was made based on the month when flows are expected to be at a minimum, which is November.

4.2 Mixing Zone Scenarios

The Mixing Zone IMD outlines the general scenarios for which dilution should be calculated. The scenarios correspond to exposure conditions defined by both receiving water flows and discharge flows and are related to water quality criteria intended to protect the beneficial uses of the river. There are five receiving water flow rates recommended for modeling. The five receiving water flow rates are coupled with selected discharge rates to characterize a range of conditions from brief exposure of relatively high constituent concentrations to longer-term exposure of relatively lower constituent concentrations.

Additional to the discharge flow condition scenarios, CwM evaluated two general treatment plant flow rates, Present Day (2020) and Future (2037) for each of the five flow conditions for a combined total of 10 scenarios. The 2020 period scenarios are denoted by an (a), and the 2037 scenarios are denoted by a (b). A summary of the scenarios numbered in order of 2020 and 2037 are provided in Table 1.

4.3 Characterization of the System

Characterization of the system is provided in Appendix B to this report. As stated in Section 1, the permit requires a modification of the existing outfall to improve mixing of the discharge with the receiving water. The preliminary diffuser configuration, upon which this report is based, consists of a two-port diffuser with risers extending from a buried pipe and fitted with 10-inch one-way valves. The one-way valves allow for flow to discharge into the river, but close when there is no back pressure. Additionally, the valves vary in effective diameter based on the amount of backpressure such that discharge occurs at a higher velocity than a fixed open pipe diameter. These valves were modeled 10-feet apart and extend above the channel bottom by approximately one foot. A drawing of the preliminary configuration is provided in Figure 5.

4.4 Results

With the scenarios established and the system characterized, the modeling was conducted using CORMIX, an EPA-approved mixing zone model. The modeling produced estimates of several aspects of mixing of discharge within the receiving water. The primary result is the dilution factor. The dilution factor for each scenario is presented in Table 2.

The other aspects of the modeling outputs include general plume shape and dimensions and possible interactions with boundaries such as the river banks or the channel bed. In general, the plumes for the modeled scenarios demonstrate the following characteristics:

- Deflection and advection downstream of the diffuser in the river current;
- Full vertical mixing with the water column 5 feet downstream of the diffuser;
- Bank or bottom attachments were not predicted with the mixing zones of each scenario.

More detail regarding the plume dynamics and descriptions are provided in Appendix B.

5 Water Quality Assessment

This section presents the water quality assessment for two constituents in the discharge, ammonia and ph. The water quality assessment consisted of determining if there is reasonable potential for the discharge to result in exceedances of water quality criteria at the edge of the mixing zones for each constituent. The Reasonable Potential Analysis (RPA) (DEQ 2012) combines the maximum estimated (or maximum range) discharge concentration, the receiving water concentration, and the modeled dilution factors to determine if there is potential to exceed the water quality criterion at the edge of the mixing zone. If such potential exists, permit limits and waste load allocations may be assigned in the subsequent permit issuance.

Ammonia and pH were identified in the permit as constituents for which the RPA needed to be conducted when the Outfall 001 was improved. Using Carlton Discharge Monitoring Record (DMR) data for wastewater concentrations and DEQ ambient water quality data for the North Yamhill River as receiving water concentrations, mixing constituent concentrations were calculated at the edge of the mixing zones.

Neither ammonia nor pH was identified in the water quality assessment as having reasonable potential to exceed water quality standards. Table 3 presents the RPA for both constituents, providing the anticipated concentrations at the edge of the mixing zones and the applicable water quality criteria. Please see Appendix B, Section 5 for more detail on how the RPA were conducted for each constituent.

References

DEQ, 2010. National Pollutant Discharge Elimination System Waste Discharge Permit, Permit #101902. Oregon Department of Environmental Quality. 9/20/2010.

DEQ, 2012. Reasonable Potential Analysis Process for Toxic Pollutants Version 3.1. Oregon Department of Environmental Quality. 2/13/2012.

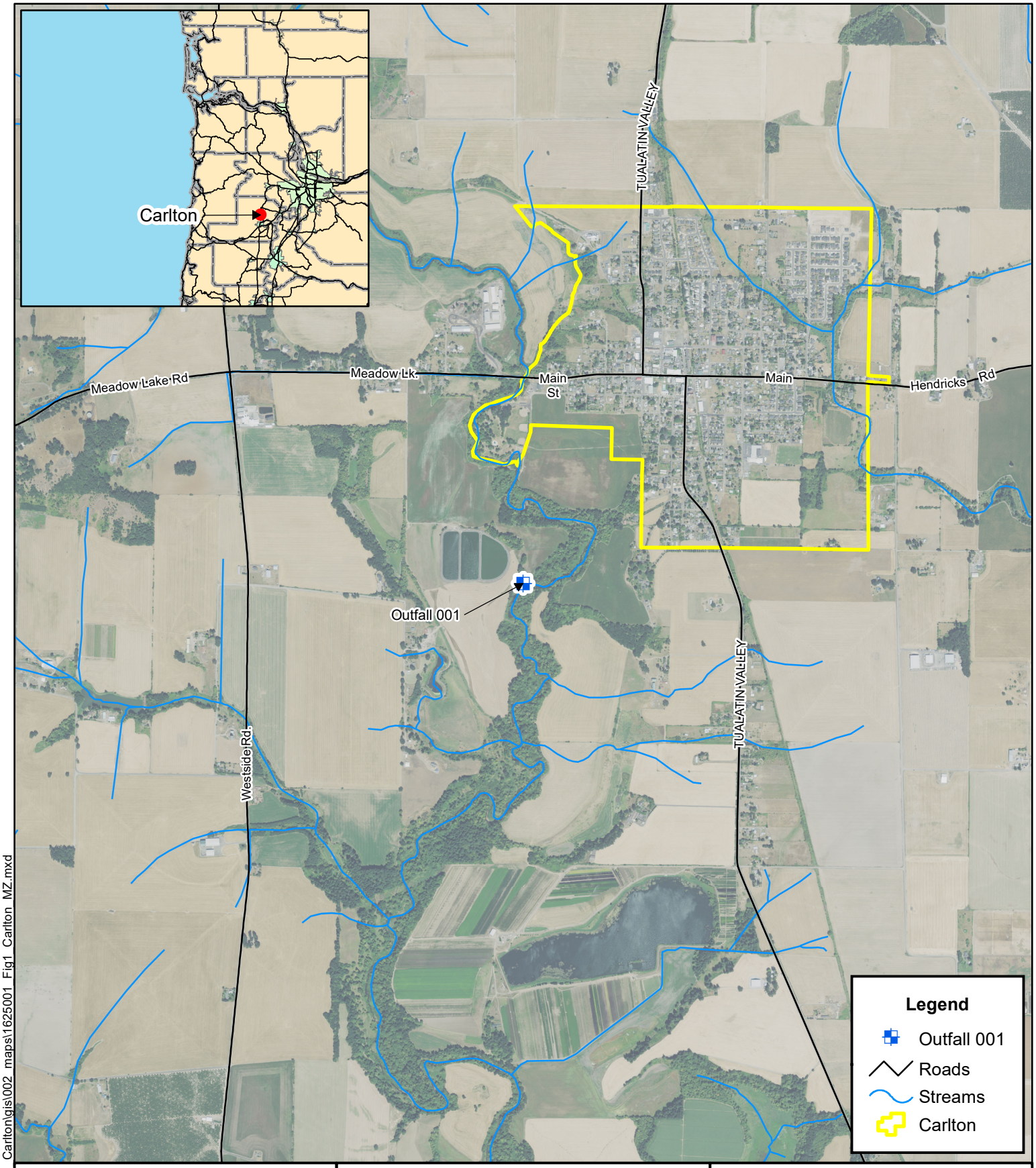
DEQ, 2013. Regulatory Mixing Zone Internal Management Directive, Part Two: Reviewing Mixing Zone Studies. Oregon Department of Environmental Quality. 6/10/2013.

ODFW, 2016. Sensitive Species List. Oregon Department of Fish & Wildlife. Mapping tool located at: http://www.dfw.state.or.us/wildlife/diversity/species/sensitive_species.asp

ODFW, 2017. Sensitive Species List. Oregon Department of Fish & Wildlife. Mapping tool located at: http://www.dfw.state.or.us/maps/compass/resources.asp

USGS, 2017. National Hydrography Dataset. United States Geologic Survey. https://nhd.usgs.gov/.

Figures



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CwM-H2O
Complete Water Management

1319 SE MLK Jr Blvd, Suite 204
Portland, Oregon 97214
(503) 954-1326

City of Carlton
Figure 1 - Site Location and Outfall

No.	Date	By	Revisions
1	08/04/17	RMS	DRAFT

N

1,000 0 1,000 2,000 ft

1 inch = 2,000 ft

Proj#: 1625001

City of Carlton
191 E. Main Street
Carlton, OR 97111

Figure 2. North Yamhill River and Outfall 001 from Upstream

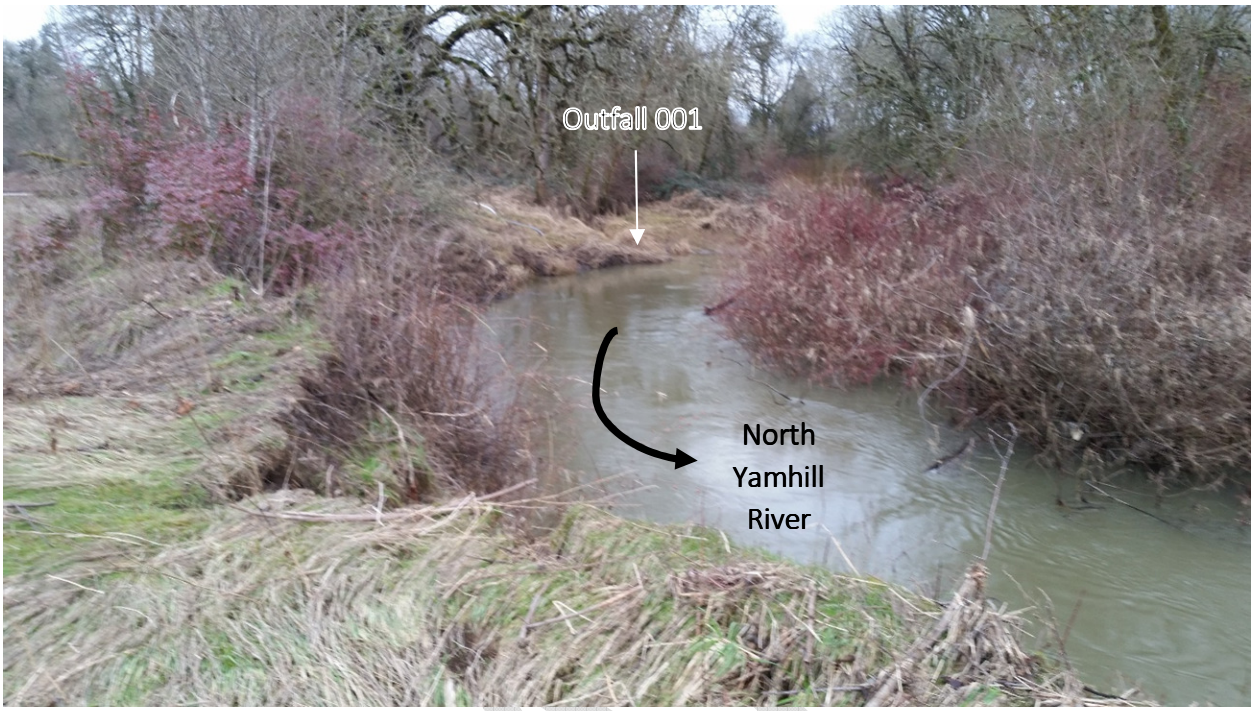
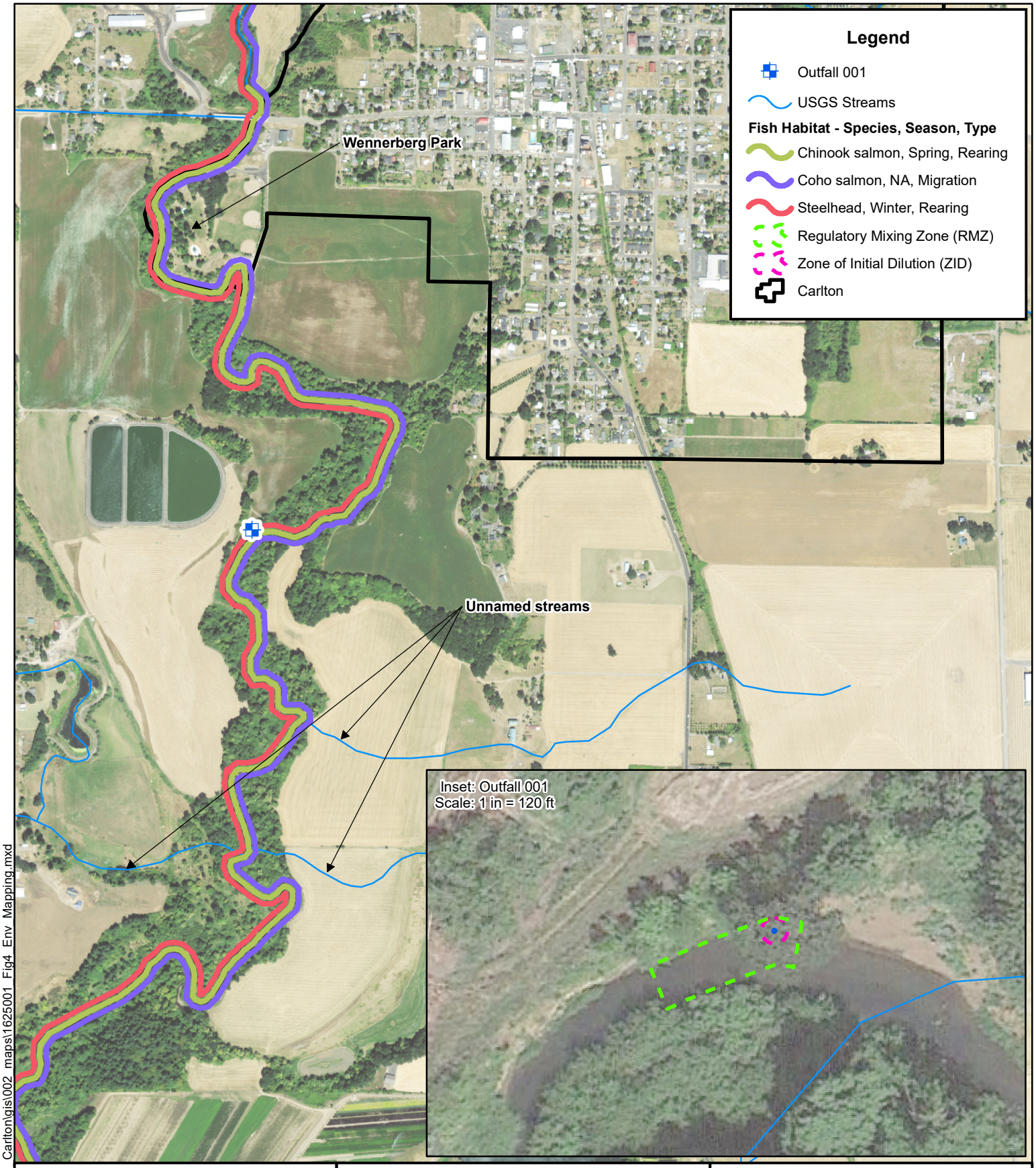


Figure 3. North Yamhill River and Outfall 001 from Downstream



C:\001_CwM_Projects\1625001_Carlton\gis\002_maps\1625001_Fig4_Env_Mapping.mxd

CwM-H2O
Complete Water Management

1319 SE MLK Jr Blvd, Suite 204
Portland, Oregon 97214
(503) 954-1326

City of Carlton
Figure 4 - Environmental Mapping

No.	Date	By	Revisions
1	08/04/17	RMS	DRAFT

N

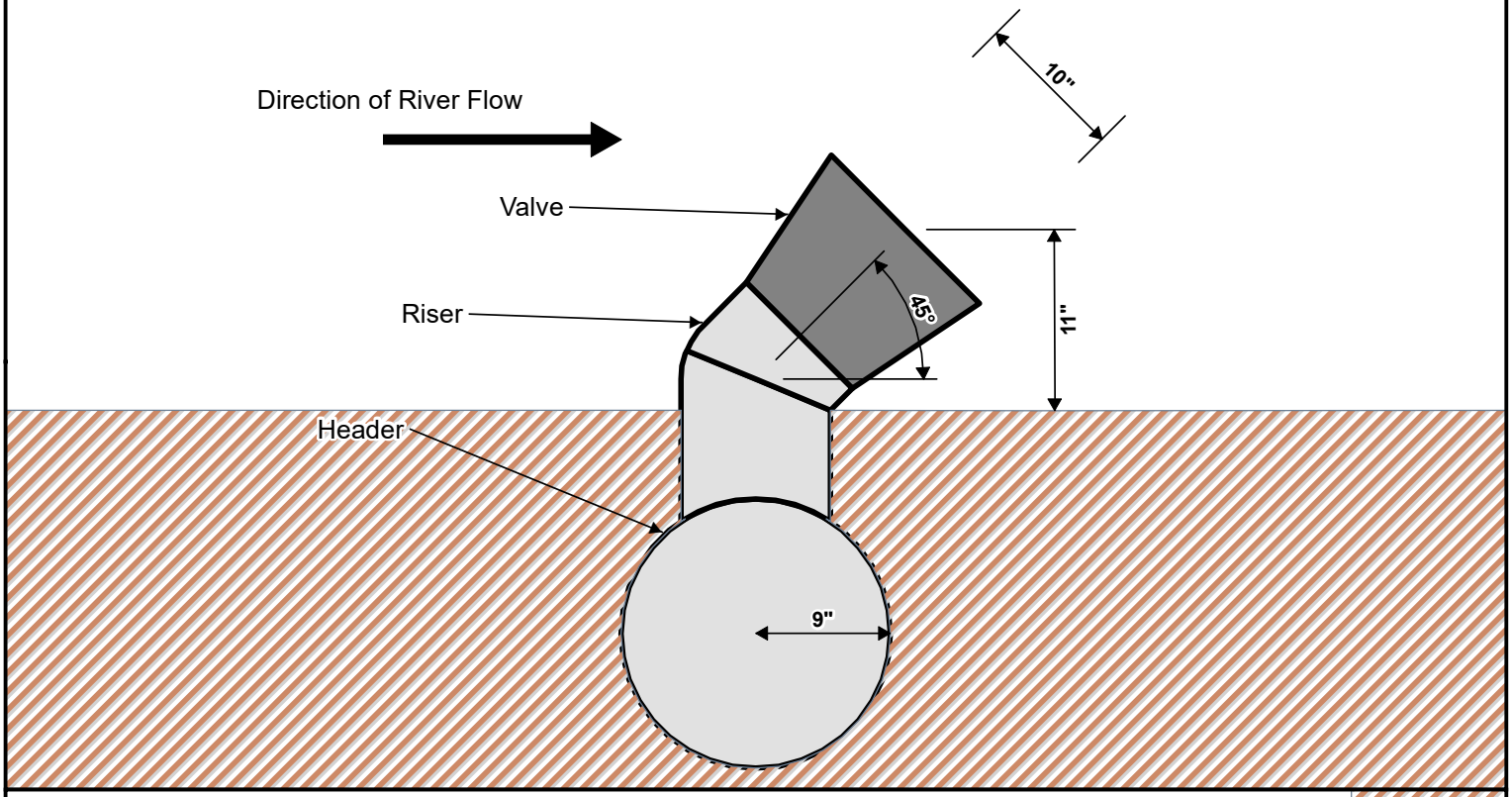
500 0 500 1,000 ft

1 inch = 1,000 ft

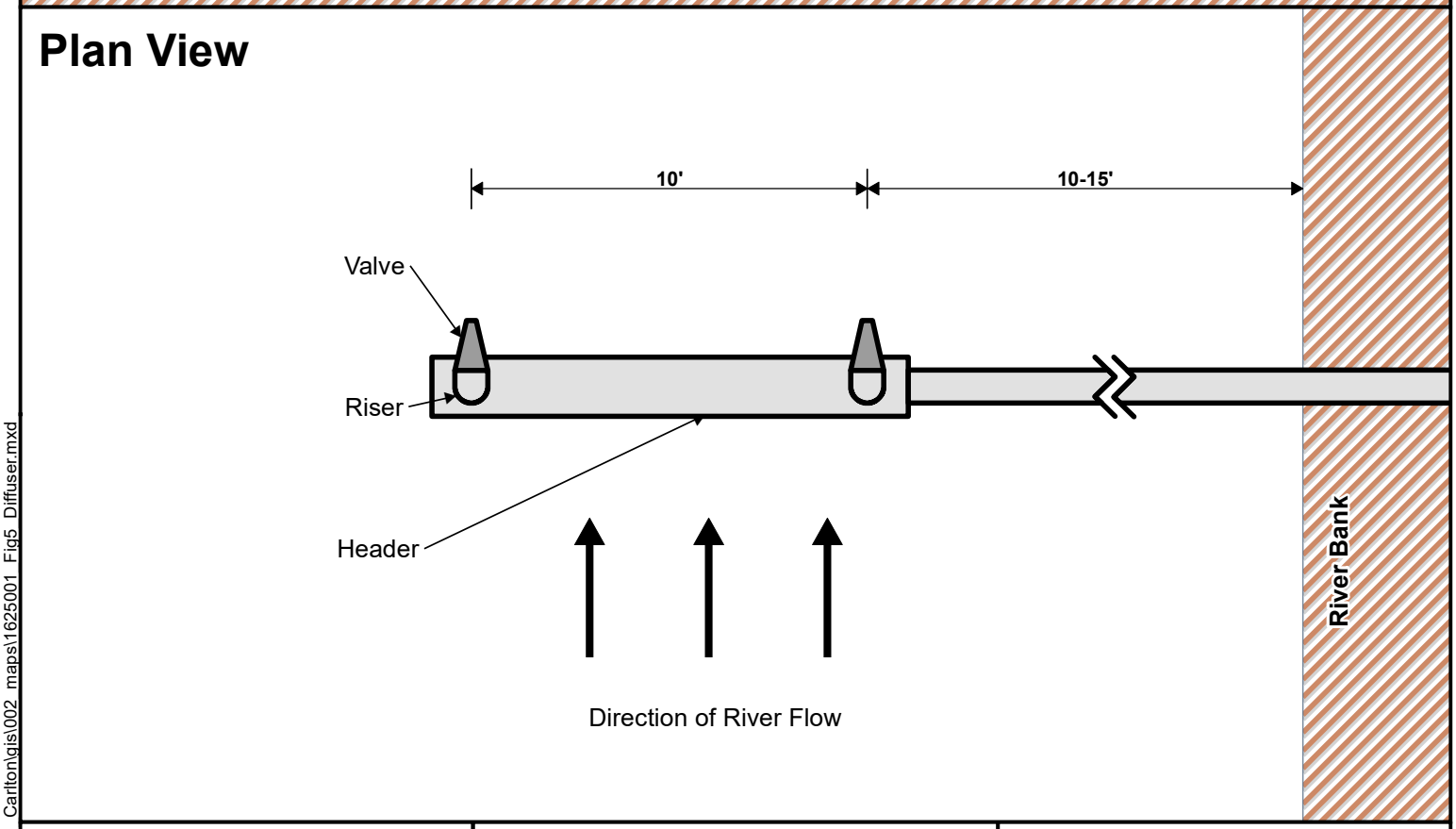
Proj#: 1625001

City of Carlton
191 E. Main Street
Carlton, OR 97111

Profile View



Plan View



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City of Carlton
Figure 5 - Conceptual Diffuser Dimensions

No.	Date	By	Revisions
1	08/04/17	RMS	DRAFT

N

Proj#: 1625001

City of Carlton
191 E. Main Street
Carlton, OR 97111

C:\001_CwM_Projects\1625001_Carlton\gis\002_maps\1625001_Fig5_Diffuser.mxd

Tables

Table 1. Mixing Zone Scenario Descriptions

Scenario	Description	Applicable Mixing Zone	Receiving Water Statistic	Flow Rate, 2020 in cfs	Discharge Statistic	Present (a) Flow Rate, 2020 in mgd	Future (b) Flow Rate, 2037 in mgd
1	Aquatic Life, Acute	ZID	1Q10[a]	22.9	PDF[d]	3.28	3.60
2	Aquatic Life, Chronic	RMZ	7Q10[b]	22.9	AWWF[e]	0.49	0.59
3	Human Health, Non-carcinogenic	RMZ	30Q5[c]	25.1	AWWF[e]	0.49	0.59
4	Human Health, Carcinogenic	RMZ	Harmonic Mean	130.7	AWWF[e]	0.49	0.59
5	Off-design Conditions	RMZ	7Q10[b]	106.0	AWWF[e]	0.49	0.59

[a] Minimum 1-day flow rate with a 10 percent chance of occurrence

[b] Minimum 7-day average flow rate with a 10 percent chance of occurrence

[c] Minimum 30-day average flow rate with a 20 percent change of recurrence

[d] Peak Daily Flow

[e] Average Wet Weather Flow

Table 2. Modeled Dilution Factors

Scenario	At Present (2020) WWTP Flow (a)	At Future (2037) WWTP Flow (b)
1 - Acute, Biological	5.1	4.9
2 - Chronic, Biological	33.3	27.8
3 - H. Health, Non-Carcinogenic	35.9	30.0
4 - H. Health, Carcinogenic	121.9	101.4
5 - Off-design	115.9	96.4

Table 3. Ammonia and pH Reasonable Potential Analysis

RPA Parameter	Ammonia		pH	
	Acute	Chronic	Lower pH	Upper pH
Applicable Mixing Zone (MZ)	ZID (@ 5')	RMZ (@ 50')	RMZ (@ 50')	RMZ (@ 50')
Concentration at the MZ Boundary	3.49	0.66	6.92	7.63
Water Quality Criterion (mg/L)	8.83	1.83	6.50	8.50
Reasonable Potential to Exceed WQ Criteria	NO	NO	NO	NO

Appendices

Appendix A – Agency Environmental Mapping Components

Table 340A

Designated Beneficial Uses
Willamette Basin
(340-041-0340)

Beneficial Uses	Willamette River Tributaries						Main Stem Willamette River			
	Clackamas River	Molalla River	Santiam River	McKenzie River	Tualatin River	All Other Streams & Tributaries	Mouth to Willamette Falls, Including Multnomah Channel	Willamette Falls to Newberg	Newberg to Salem	Salem to Coast Fork
Public Domestic Water Supply[1]	X	X	X	X	X	X	X	X	X	X
Private Domestic Water Supply[1]	X	X	X	X	X	X	X	X	X	X
Industrial Water Supply	X	X	X	X	X	X	X	X	X	X
Irrigation	X	X	X	X	X	X	X	X	X	X
Livestock Watering	X	X	X	X	X	X	X	X	X	X
Fish & Aquatic Life[2]	X	X	X	X	X	X	X	X	X	X
Wildlife & Hunting	X	X	X	X	X	X	X	X	X	X
Fishing	X	X	X	X	X	X	X	X	X	X
Boating	X	X	X	X	X	X	X	X	X	X
Water Contact Recreation	X	X	X	X	X	X	X[3]	X	X	X
Aesthetic Quality	X	X	X	X	X	X	X	X	X	X
Hydro Power	X	X	X	X	X	X	X	X		
Commercial Navigation & Transportation							X	X	X	

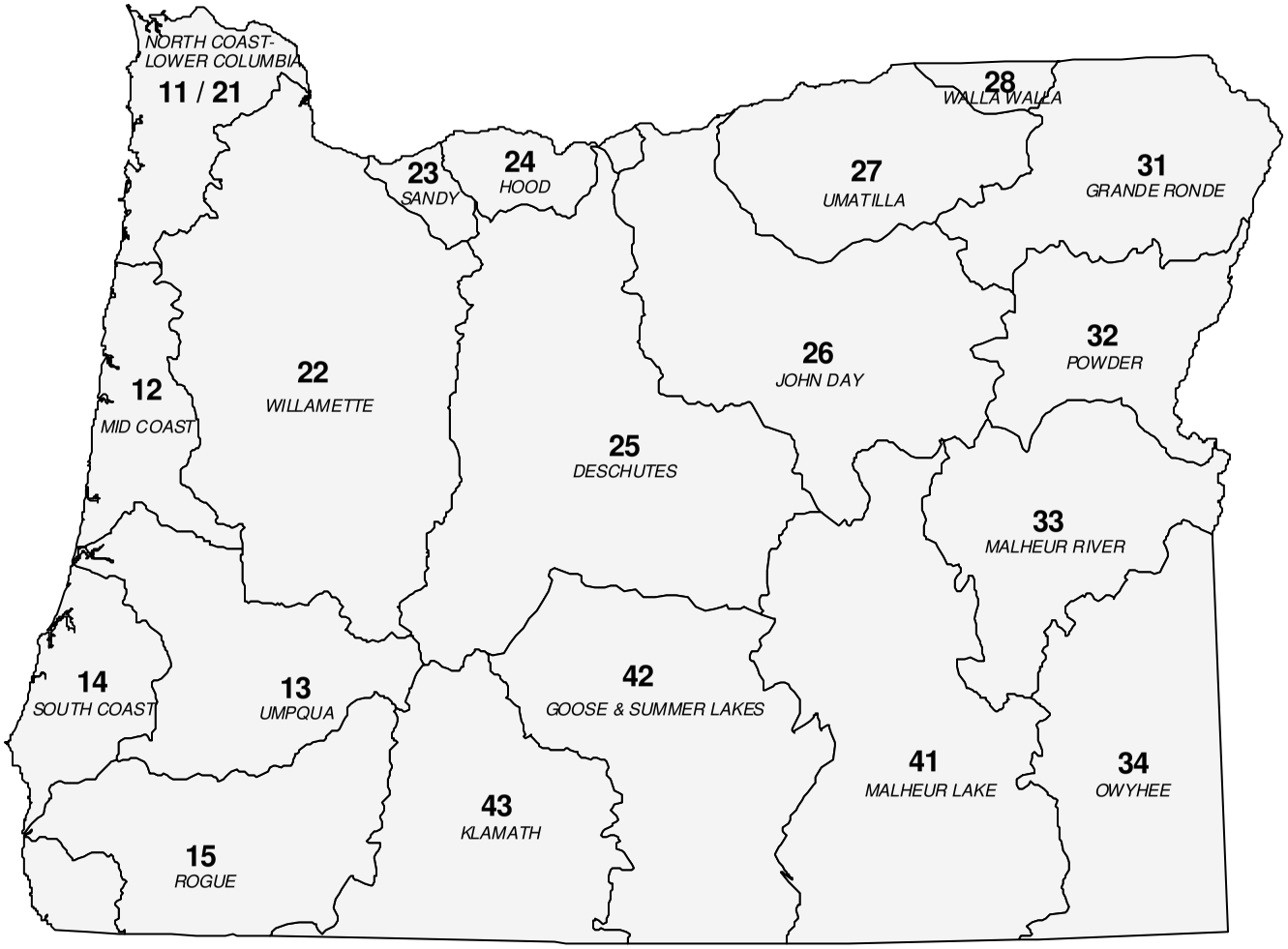
[1] With adequate pretreatment and natural quality that meets drinking water standards.

[2] See also Figures 340A and 340B for fish use designations for this basin.

[3] Not to conflict with commercial activities in Portland Harbor.

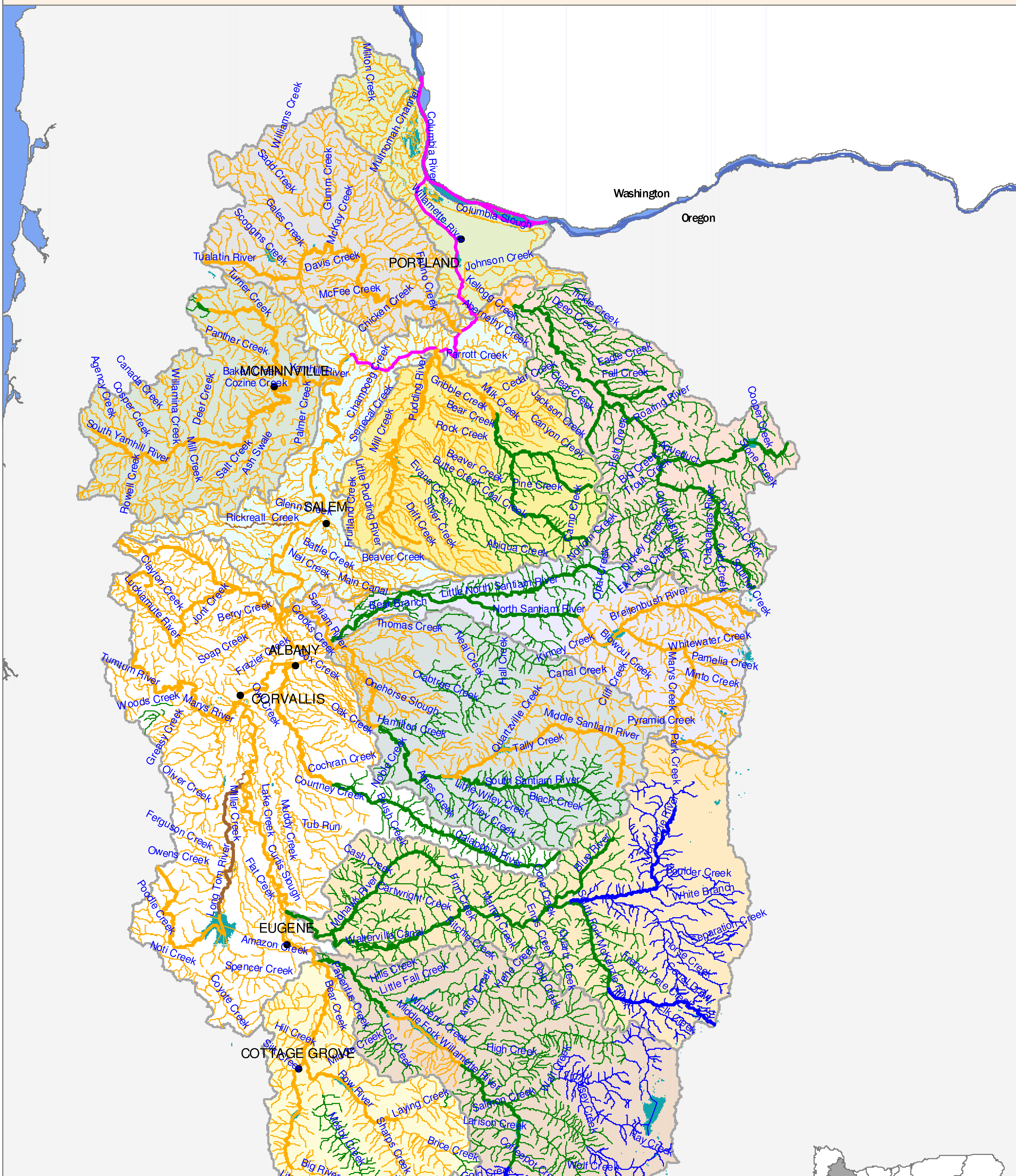
Table produced August, 2005

Figure 1: Oregon Basin Index Map



Basin Name	Basin #	OAR #
DESCHUTES	25	340-41-0130
GOOSE & SUMMER LKS	42	340-41-0140
GRANDE RONDE	31	340-41-0151
HOOD	24	340-41-0160
JOHN DAY	26	340-41-0170
KLAMATH	43	340-41-0180
MALHEUR LAKE	41	340-41-0190
MALHEUR RIVER	33	340-41-0201
MID COAST	12	340-41-0220
NORTH CST-LWR COL	11-21	340-41-0230
OWYHEE	34	340-41-0250
POWDER	32	340-41-0260
ROGUE	15	340-41-0271
SANDY	23	340-41-0286
SOUTH COAST	14	340-41-0300
UMATILLA	27	340-41-0310
UMPQUA	13	340-41-0320
WALLA WALLA	28	340-41-0330
WILLAMETTE	22	340-41-0340

*Figure 340A: Fish Use Designations**
Willamette Basin, Oregon



DEQ
State of Oregon Department of Environmental Quality
StreamNet

Legend

Designated Fish Use*:

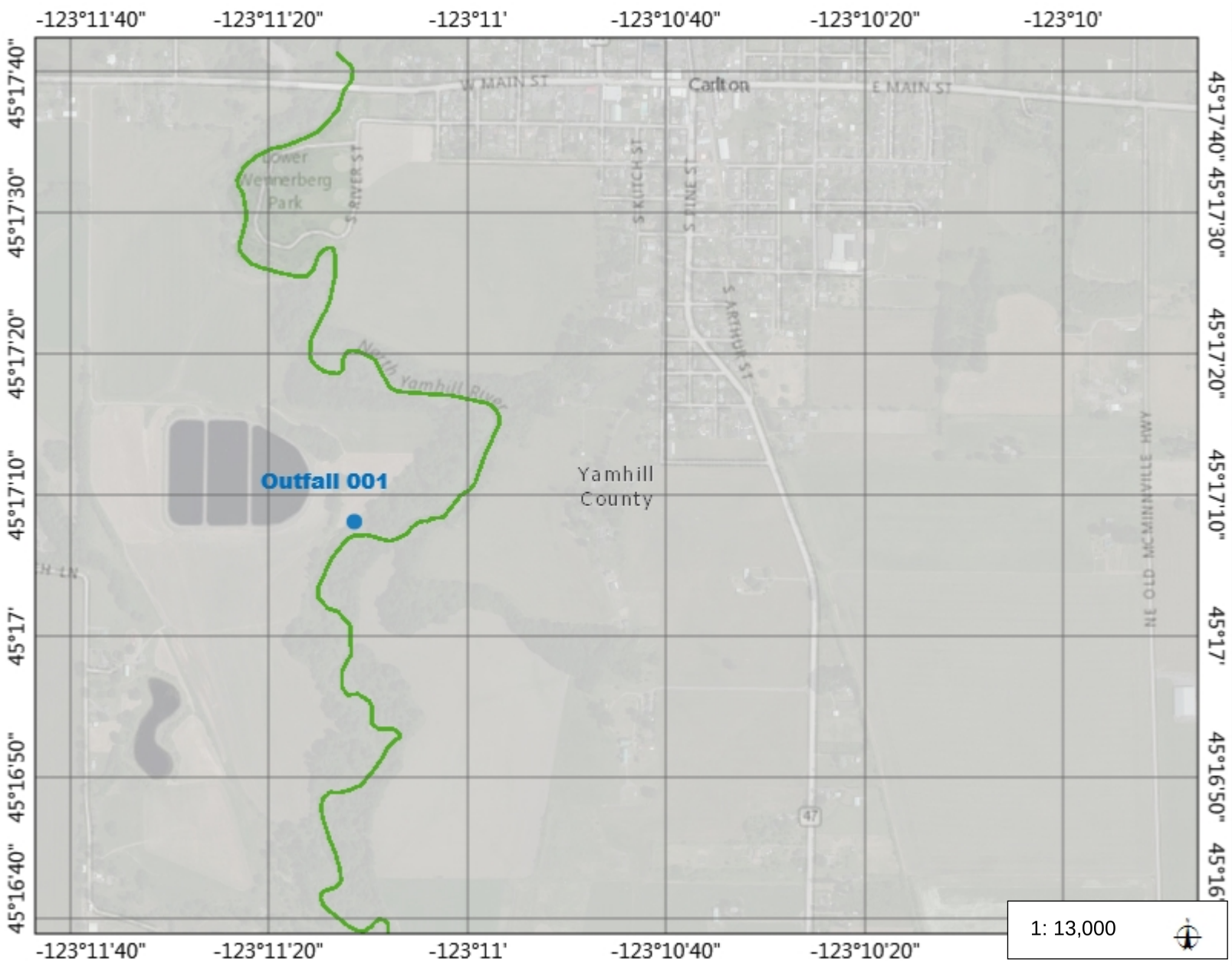
- Bull Trout Spawning & Juvenile Rearing
- Core Cold-Water Habitat
- Salmon & Trout** Rearing & Migration
- Salmon & Steelhead Migration Corridors
- Cool Water Species (no salmonid use)

Subbasins

- CLACKAMAS
- COAST FORK WILLAMETTE
- LOWER WILLAMETTE
- MCKENZIE
- MIDDLE FORK WILLAMETTE
- MIDDLE WILLAMETTE
- MOLALLA-PUDDING
- NORTH SANTIAM
- SOUTH SANTIAM
- TUALATIN
- UPPER WILLAMETTE
- YAMHILL

NOTES:
*Please see Figure 340B for Spawning Use Designations.
**Includes all salmon species, steelhead, rainbow, and cutthroat trout.
Major rivers shown in bolder lines.
Map produced November, 2003

Fish Distribution Mapping - Outfall 001



Legend

- County Boundaries (2007)

Spring Chinook Salmon Distribution (2014)

- Spawning
- Rearing
- Migration
- Unknown
- Historical

States & Provinces

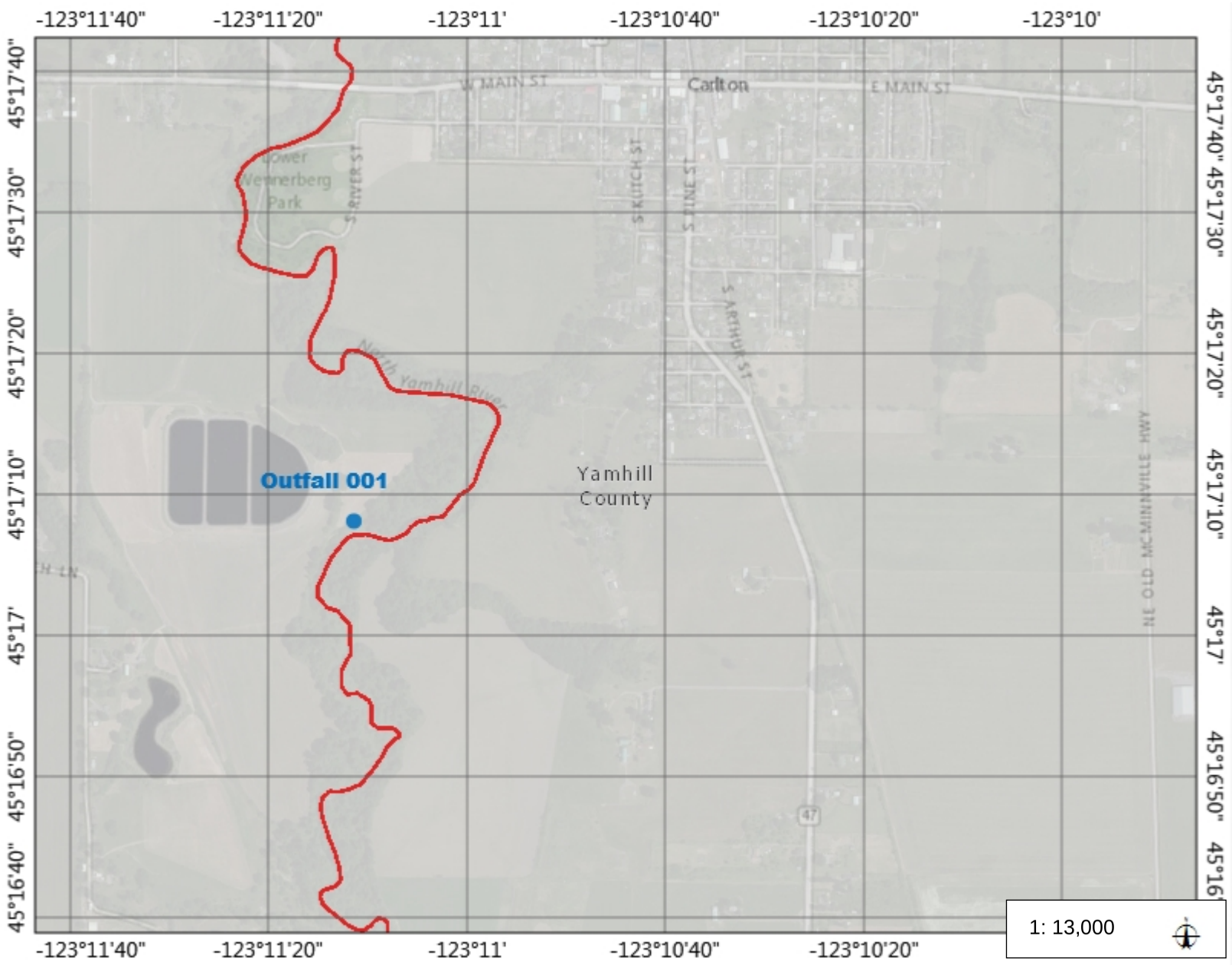
- Other States and Provinces
- Oregon

Notes

This map is a user generated static output from the Oregon Explorer Map Viewer (http://tools.oregonexplorer.info/oe_map_viewer/Viewer.html?Viewer=OE) and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Fish Distribution Mapping - Outfall 001



Legend

- County Boundaries (2007)
- Coho Salmon Distribution (2014)
  - Spawning
  - Rearing
  - Migration
  - Unknown
  - Historical
- States & Provinces
  - Other States and Provinces
  - Oregon

1: 13,000

Notes

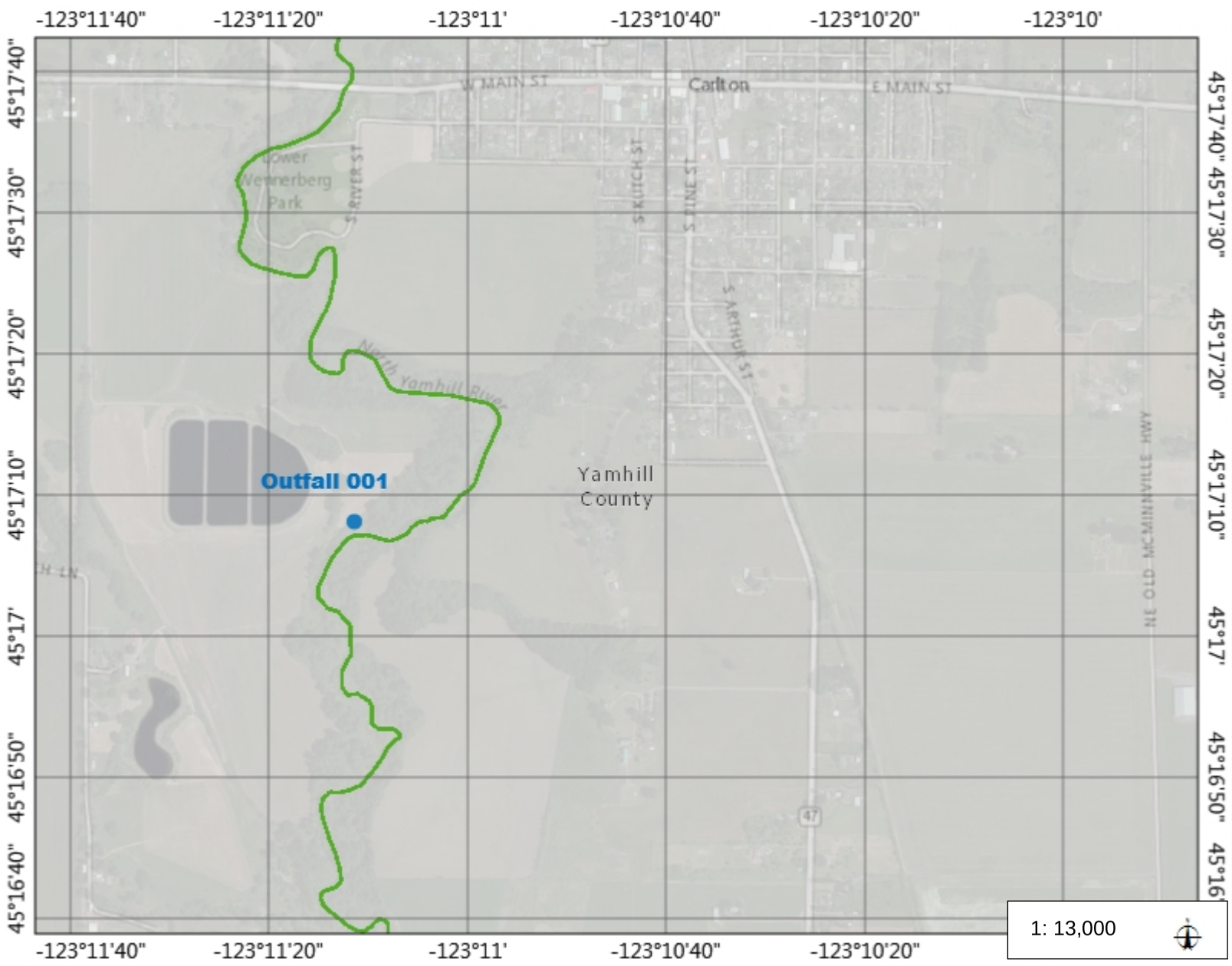
0.4 0 0.21 0.4 Miles

WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from the Oregon Explorer Map Viewer (http://tools.oregonexplorer.info/oe_map_viewer/Viewer.html?Viewer=OE) and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Fish Distribution Mapping - Outfall 001



Legend

- County Boundaries (2007)

Winter Steelhead Distribution (2014)

- Spawning
- Rearing
- Migration
- Unknown
- Historical

States & Provinces

- Other States and Provinces
- Oregon

1: 13,000

Notes

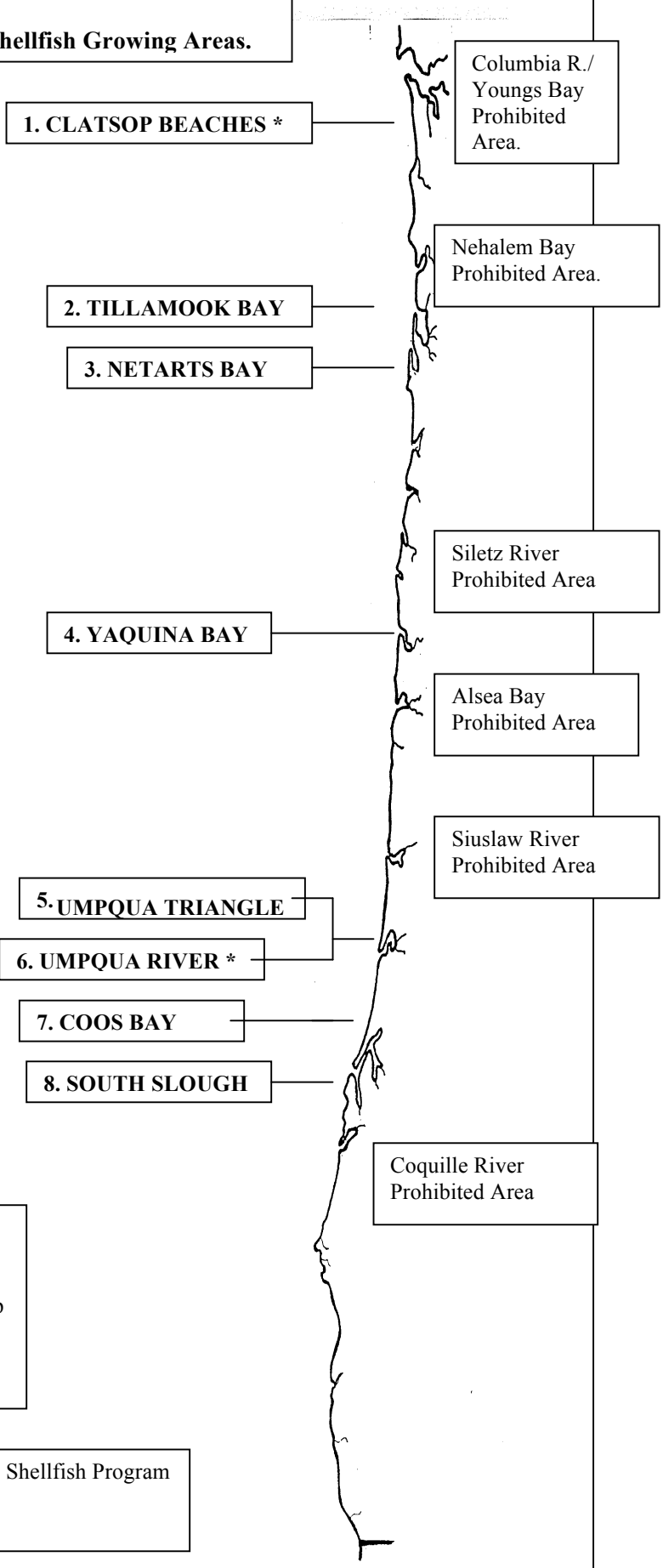
0.4 0 0.21 0.4 Miles

WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from the Oregon Explorer Map Viewer (http://tools.oregonexplorer.info/oe_map_viewer/Viewer.html?Viewer=OE) and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

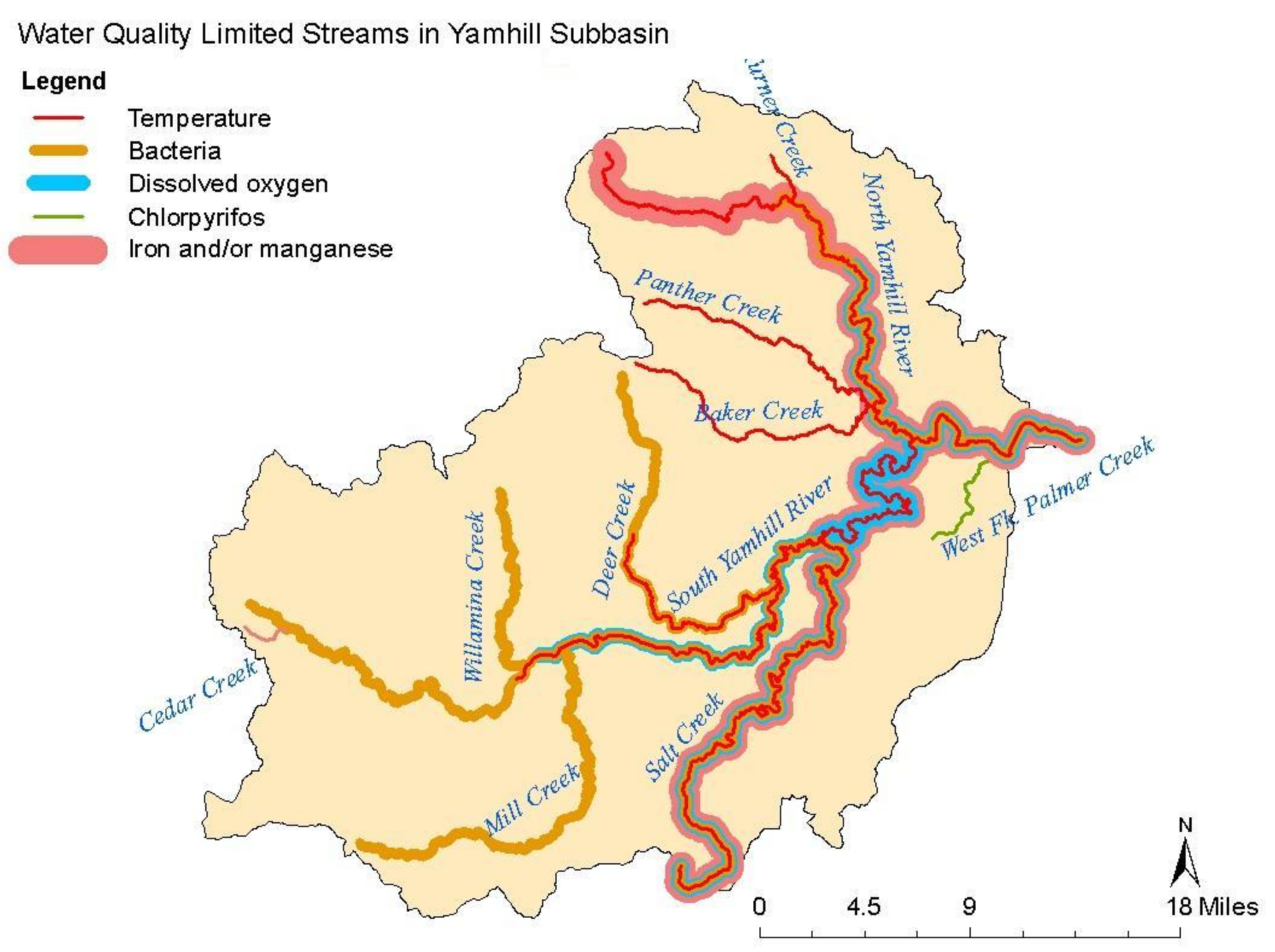
Oregon Department of Agriculture Shellfish Program
Classified Commercial Shellfish Growing Areas.



NOTE:
* Intra-State sales only.

All beaches except Clatsop Beaches prohibited for commercial harvest for human consumption.

Oregon Dept. Of Agriculture Shellfish Program
(503) 986-4720


Water Quality Limited Streams in Yamhill Subbasin
Legend
Temperature
Bacteria
Dissolved oxygen
Chlorpyrifos
Iron and/or manganese
Turner Creek
North Yamhill River
Panther Creek
Baker Creek
Deer Creek
South Yamhill River
West Fk. Palmer Creek
Willamina Creek
Cedar Creek
Salt Creek
Mill Creek
N
0
4.5
9
18 Miles

Appendix B – Carlton Mixing Zone Study – Technical Modeling Summary

DRAFT: CITY OF CARLTON MIXING ZONE STUDY

Technical Modeling Summary

Prepared for:

The City of Carlton

191 E Main Street

Carlton, OR 97111

Project No. 1625001

August 17, 2017

CwM-H2O
Complete Water Management

1319 SE MLK Jr. BLVD, Suite 204 Portland, Oregon 97214
Complete Water Management | cwmh2o.com

1 Introduction

This report summarizes the mixing zone modeling performed for the City of Carlton, Oregon (Carlton). CwM H2O, LLC (CwM) conducted these analyses in support of Carlton's wastewater treatment plant (WWTP) planning and permit renewal. The analyses address conditions within Carlton's National Pollutant Discharge Elimination System (NPDES) permit #101902 (Permit; DEQ, 2010). This report presents CwM's approach to developing the mixing zone model including the data collection, the assumptions used, and collation of the results.

Carlton is currently planning upgrades to plant facilities and treatment processes to their 0.19 million gallons per day[1] (mgd) wastewater treatment plant (WWTP). Projections for plant demand and performance have been made 20 years into the future to 2037. Part of the facility planning includes upgrading Carlton's outfall (Outfall 001) to the North Yamhill River. Currently the outfall discharges via a 10-inch pipe into an embayment slightly sheltered from the main current of the North Yamhill River (See Figure 1). The permit requires improvements to the existing outfall, including moving Outfall 001 into the main channel of the river and installing a multiport diffuser.

This study was conducted based on the construction of a new outfall to improve mixing. Carlton is also assessing options to relocate the outfall upstream, but within the designated River Mile (RM 8.1), to provide a more regular and deeper reach of river to discharge into. Assessment of the existing outfall consisting of the 10-inch pipe was not evaluated in this study.

This analysis conforms to the state of practice as outlined in the Oregon Department of Environmental Quality's (DEQ) Mixing Zone Internal Management Directive (IMD; DEQ 2013) with appropriate documentation and justification where alternative approaches were required. This study assumes an IMD Level 2 analysis because the available dilution from the proposed Outfall 001 at 25 percent of the critical flow is less than 20 (see IMD, page 9).

CwM's approach to the mixing zone analysis includes the following sections:

- Section 2 – Modeling Scenarios. Section 2 includes a description of the mixing zones, modeled discharge period and the selection of the scenarios.
- Section 3 – System Characterization. Section 3 includes discussion of the parameterization of the river, discharge and outfall;
- Section 4 – Modeling. Section 4 presents the results of the mixing zone modeling; and
- Section 5 – Potential Water Quality Impacts. Section 5 addresses the potential impacts to water quality resulting from the discharge relative to ammonia and pH.

2 Modeling Scenarios

The IMD guidelines propose conducting the assessment of five flow scenarios to determine the dilution achieved by the discharge from Outfall 001. Based on the IMD guidance, CwM completed the prescribed modeling scenarios to address environmental hazards to aquatic life and human health. This section identifies the mixing zones allowed under the current regulations, and, presents a discussion of the critical

[1] Average dry-weather flow for 2016 (ADWF)

time periods when exposure related to discharge could have the greatest potential impacts. The modeling scenarios selected are also discussed.

2.1 Mixing Zone Descriptions

Mixing zones are permitted under Oregon Administrative Rule (OAR) 340-041-0053. This rule defines the acceptable conditions, and areas under which, water quality standards may be temporarily suspended for wastewater discharge to surface water. The rule provides for the following mixing zones:

- Zone of Initial Dilution (ZID) – the area in which acute water quality criteria may be suspended. The ZID addresses potential short-term exposure to elevated constituent concentrations; and
- Regulatory Mixing Zone (RMZ) – The area in which chronic and human health criteria may be suspended. The RMZ addresses potential longer-term exposure to elevated discharge constituent concentrations.

These mixing zones are designed to protect the overall integrity of the water body.

The RMZ defined in the NPDES permit extends 10 feet upstream and 50 feet downstream of the Outfall 001. The width of the RMZ extends 25 feet into the river from the west bank. The ZID is defined as that portion of the allowable mixing zone that is within five feet of the point of discharge.

2.2 Critical Discharge Period

The critical discharge period is the time of year when discharge occurs that is mostly likely to result in highest concentrations of discharge constituents in the receiving water. For unidirectional rivers, like the North Yamhill River, this critical period typically corresponds to low flow conditions.

The WWTP is permitted to discharge to the North Yamhill River from November 1 to April 30. Based on the allowable discharge period, the determination of the critical discharge period was made based on the month when flows are expected to be at a minimum, which is November (USGS, 2017a).

2.3 Modeling Scenarios

CwM evaluated modeling scenarios for five river flow rates and two discharge flow rates for different WWTP configurations. The discharge flow rates are based on 1) the current discharge flow rate and configuration of the WWTP and 2) a future projected discharge flow rate for the year 2030.

The IMD outlines the general dilution scenarios that will frame the focus of the modeling. These scenarios account for the risk and duration of exposure. Additionally, the reference organisms (i.e., aquatic or human) also factor into the scenario definitions. These scenarios correspond to the following exposure conditions:

- Scenario 1: Aquatic Life, Acute – Short-term exposure within the ZID; based on minimum 1-day flow rates with a 10 percent chance of occurrence (i.e., 1Q10).
- Scenario 2: Aquatic Life, Chronic – Short-term exposure within the RMZ; based on minimum 7-day average flow rates with a 10 percent chance of occurrence (i.e., 7Q10).
- Scenario 3: Human Health, Non-carcinogenic – Longer-term human exposure within the RMZ; based on the minimum 30-day average flow rate with a 20 percent chance (or 1 in 5 years) of recurrence (i.e., 30Q5).

- Scenario 4: Human Health, Carcinogenic – Longer-term human exposure within the RMZ; based on the harmonic mean of flow rates during the critical period.
- Scenario 5: Off-design Conditions – Conditions not typically associated with low river flows, but could be important to evaluating discharge. This scenario presents the assessment of springtime conditions resulting in low river flows (i.e., April 7Q10) and low temperatures that mix with high discharge flow rates that exhibit high temperatures.

CwM evaluated five scenarios for river flow conditions for the present-day flow rates (2020) and for future built-out flow rates (2037). The two TTWP flow rates for 2020 and 2037 were evaluated for each of the five river flow conditions. The WWTP flow conditions are notated as follows in Table 1:

- Present – 2020 WWTP flow rates, denoted as part (a) of each scenario; and
- Future – 2037 WWTP build-out flow rates, denoted as part (b) of each scenario.

A summary of the scenarios numbered in order of Present and Future are provided in Table 1.

3 System Characteristics

This section presents the characteristics of the system including the receiving water and discharge conditions. The discharge conditions consist of the flow rates and outfall characteristics.

A site inspection was conducted by participants from Carlton, CwM, and Tetra Tech on 1/26/2017 to visually inspect the conditions and infrastructure. Flow in the South Yamhill River at McMinnville at the time of the inspection was approximately 1150 cfs at a stage of 16.1 feet. The South Yamhill River at the gage location drains a catchment of 522 square miles, approximately 4.5 times the aerial size of the North Yamhill River at Carlton. The weather was overcast, but not raining. Water in the North Yamhill River at the existing outfall was moving swiftly. Figure 2 shows a photograph of the river looking downstream from the location of the outfall.

3.1 River Dynamics

River dynamics influence the rate and degree of mixing and dilution that occur when waste water is discharged to a river. This section presents an overview of river flow rates, channel characteristics and the effects of temperature on density. Each of these factors are considered in the development of the mixing model.

3.1.1 North Yamhill Flows

The North Yamhill River at the location of the outfall drains approximately 114 square miles of catchment in the northern Willamette Valley. The North Yamhill River has its headwaters in the Oregon Coastal Range, and ultimately discharges to the Yamhill River where the North and South forks of the Yamhill river meet near McMinnville, Oregon.

The North Yamhill River catchment receives 63.9 inches of rain per year, spatially averaged. Approximately 60 percent of the catchment is forested, 30 percent cultivated as crop or hay, with the remaining 10 percent comprised of grass and developed land (USGS, 2017a).

The North Yamhill River experiences high flows during the winter and spring rainy months and low flows during the drier summer and fall months.

3.1.1.1 Flow estimates

The flow rate for the Aquatic Life, Chronic Exposure (Scenario 2), were estimated using the Oregon StreamStats GIS utility (USGS 2017a) developed by the U.S. Geologic Survey (USGS). This tool was created to estimate peak and low flow rates for stream and river reaches that do not have current or historically gaged flow data, as is the case with the North Yamhill at Carlton.

The StreamStats tool only provides 7Q10 (minimum 7-day average flow rates with a 10 percent chance of occurrence) estimates, so the low flow rates for Scenarios 1, 3 and 4 were estimated by scaling the 7Q10 from the StreamStats tool based on ratios of 1Q10, 7Q10, 30Q5, and harmonic mean values for a gaged section of the North Yamhill River at Pike, OR (USGS, 2017b). The station at Pike gaged flow data in the river for a period of 25 years from 1948 to 1972. The catchment upstream of the gage is 65 square miles.

To scale the 1Q10, 30Q5 and harmonic mean to the 7Q10, low flow statistics were calculated for the gaged reach of the North Yamhill and the ratio of those statistics to the 7Q10 were calculated. Then, the flow rates for the ungauged reach of the North Yamhill were estimated by multiplying the 7Q10 at Carlton by the ratios determined from the gaged reach at Pike.

To illustrate the process of estimating the 30Q5 for the ungauged North Yamhill reach at Carlton, the statistical values of 7Q10 and 30Q5 were estimated for the gaged reach at Pike at 11.4 cubic feet per second (cfs) and 12.5 cfs, respectively. The ratio of the 30Q5 to the 7Q10 for that gaged reach is 1.09. To determine the 30Q5 for the ungauged reach, the 7Q10 from the StreamStats tool for the reach at Carlton was multiplied by that ratio to estimate a 30Q5 flow of 25.1 cfs. The estimated flow rates for the are provided in Table 2. Column 3 provides the low flow statistics for the gaged reach of the North Yamhill, Column 4 the ratio of those statistics to the gaged 7Q10, and Column 5 provides the scaled low flow statistics for the ungauged reach at Carlton. CwM notes the 1Q10 and 7Q10s are identical.

The Off-Design scenario consists of the April 7Q10 as estimated by the StreamStats tool and therefore was not scaled by a ratio relative to the gaged reach flows because the StreamStats tool.

3.1.2 North Yamhill Bathymetry

Based on the flow rates estimated in the previous section, channel dimension and velocities were estimated. The mixing zone model used in the study, CORMIX, requires a schematized rectangular cross section which requires conforming an irregular (e.g., trapezoidal) cross section into a representative width and depth. The key aspect of this transformation is preservation of the velocity of the river. Therefore, the cross sections and water depths for the given flow were assumed to have the same cross-sectional area, with rectangular dimensions.

3.1.2.1 Channel characteristics – cross section

In October 2008, DEQ performed a preliminary mixing zone study to examine outfall performance in the field (DEQ, 2009). As part of that study, DEQ measured water depths (bathymetry) at regularly spaced intervals immediately upstream of the outfall. That bathymetry was used in this study to provide a

representative cross section as a basis for the assessment. The DEQ study was conducted 10/16/2008, when flows in the river are typically lower than those observed in November[2]. The bathymetry was collected only for the portions of the river that were inundated at that time. The lateral extents of the cross-section not measured by DEQ were augmented with elevation data from the Oregon DEM Framework sub-meter (<0.5 meters) digital elevation model (DOGAMI 2017). These datasets were combined to produce the cross section used in the modeling, shown in Figure 3.

DEQ also captured velocities at regular intervals within that cross section to estimate the flow rate at the time of the field study. That flow rate was estimated at 18.4 cfs.

3.1.2.2 Channel characteristics – longitudinal profile

Channel longitudinal profile was estimated using the previously mentioned LiDAR data. A reach of river approximately 500 feet upstream to 500 feet downstream of the outfall was selected for representative profile. Because the LiDAR data does not penetrate water surfaces, this profile represents the water surface elevation at the time of the LiDAR was flown. The channel shallow and the slope of the water surface is 0.0005 ft/ft, which likely represents water flowing under subcritical conditions. Hence the water surface slope is a sufficient approximation for the channel bed slope. CwM notes that in the process of developing the representative longitudinal section, a portion of the LiDAR data that showed a higher elevation mound was deleted from the analysis as is assumed this mound or peak represents a shoal or gravel bed and was not representative of the longitudinal section as a whole. The longitudinal profile is presented in Figure 4.

3.1.2.3 Channel Roughness

Using the 2008 DEQ cross sectional data and velocity measurements, and estimated longitudinal profile, CwM estimated the channel roughness, *n*, using Manning's Equation. The value of *n* was estimated to be 0.079. Literature values suggest a natural channel with pools, shoals and some emergent vegetation could have a maximum roughness of 0.05 to 0.06 (Chow, 1959).

Due to the discrepancy in these values, Manning's channel roughness will be varied for Scenarios 1(b) and 2(b) to determine the sensitivity of the model to this parameter. The values of *n* used will be 0.04 (average literature value) and 0.08 (the approximate estimated field value).

3.1.2.4 Schematized channel – velocity representations

The cross-sectional data, longitudinal profile and channel roughness were combined using Manning's Equation to estimate water levels in the river at the flows for the given scenarios. As mentioned previously, the goal of the channel schematization is to transform an irregular channel cross section into a rectangular cross section with the same cross-sectional area. This allows for the model to compute dilutions based on the same velocity in the river. These water surface elevations, channel dimensions, along with the corresponding velocities in the river are presented in Table 3 and shown in Figure 5 with representative rectangular cross section dimension.

[2] The October 7Q10 is 11.9 cfs, compared to the November 7Q10 at 22.9 cfs.

3.1.3 Temperature (Density)

Temperature is an important component of mixing dynamics because it, along with salinity, is a factor in the relative densities of the receiving water and discharge. The density differential between receiving water and discharge determines the buoyancy of the discharge. Large density differences can drive additional mixing when the discharge rises or falls in the receiving water column. Stratification within the water column can also affect mixing, creating barriers or layers where dilution is enhanced or retarded.

The North Yamhill River is a shallow, freshwater waterbody with no effective stratification due to typically uniform temperature in the water column. Therefore, temperature in the river was modeled as uniform throughout the water column for all of the scenarios. To characterize the temperature of the receiving water for the modeling, river data were sourced from the DEQ LASAR database for the North Yamhill River at the Poverty Road Bend monitoring location (DEQ, 2017). Two receiving water temperatures were applied in the model for the following scenarios. Those values are presented in Table 4.

- Average of Discharge Period (November – April) for Scenarios 1-4; and
- Month of April for the Off-design scenario, Scenario 5.

3.2 Discharge Characteristics

This section summarizes the characteristics of the discharge in terms of flow rates and temperatures. Outfall characteristics will be summarized in Section 3.3.

3.2.1 Discharge Flow Rates

Discharge flow rates were taken from the flow projections presented in the Carlton Facility Plan (Tetra Tech, 2017). As mentioned previously, two flow rates at each receiving water flow rate were modeled – Present day (2020) and Future projection (2037). The IMD recommends the use of particular treatment plant flow rates for each of the given scenarios. This study deviates from that guidance in the following ways with justification:

- Scenario 1, Aquatic Life, Acute– the suggested flow rate is the Average Dry Weather Flow[3] (ADWF) multiplied by a peaking factor (PF). This study uses the Peak Daily Flow (PDF) rate which has been provided in the Facility Plan. The PF between the ADWF and the PDF as presented in the Facility Plan is 12-15 depending on the project year (i.e., the PF is lower in 2037 than it is in 2020).
- Scenario 2, Aquatic Life, Chronic – the IMD suggested flow rate is the ADWF, however, the period of discharge occurs during the winter which is nominally the wet season in Oregon. Therefore, this study makes use of the Average Wet Weather Flow (AWWF). This is a conservative assumption because the AWWF is greater than the ADWF.
- Scenario 3, Human Health, Non-carcinogenic – the IMD recommends using the ADWF. This study uses the AWWF. This is a conservative assumption because the AWWF is greater than the ADWF.
- Scenario 4, Human Health, Carcinogenic – the IMD recommends using the Average Annual Flow (AAF). This study uses the AWWF. This is a conservative assumption because the AWWF is greater than the AAF.

[3] The IMD guidance uses the term Dry Weather Design Flow (DWDF) which is equivalent to the ADWF.

- Scenario 5, Off-design – This value assessed for this study for the off-design conditions is the AWWF.

Table 5 presents the modeled values discussed above.

3.2.2 Temperature (Density)

As mentioned previously, temperature can be an important factor in mixing dynamics. The IMD guidance suggests using temperatures based on statistical calculations of the historical discharge temperatures. The modeled temperatures as per the IMD guidance are presented in Table 6.

3.3 Outfall Description

Carlton's Outfall 001 is the only outfall that discharges to the North Yamhill River. This section evaluates the outfall assuming that Outfall 001 is moved from its current position to approximately the center of the river and improved with diffuser valves.

3.3.1 Outfall dimensions

A preliminary outfall configuration was developed assuming a 2-port diffuser with a buried header and exposed risers and valves extending above the river bottom approximately 1 foot. The developed diffuser configuration incorporates two risers each with a 10-inch one-way valve. One-way valves are designed to allow flow in one direction (outflow) and close due to hydrostatic pressure in the other direction (inflow). Jet velocities from one-way valves depend on the material stiffness, valve diameter and backpressure. The performance specifications and manufacturer's brochure are presented in Appendix C of the main report. The risers and valves are oriented downstream (in the direction of the river current) at an angle 45 degrees above the horizontal. Figure 6 presents the conceptual plan for the diffuser and Table 7 provides generalized diffuser dimensions for all scenarios.

CwM notes the diffuser was modeled as a 3 port because CORMIX will only model diffusers with three or more openings. This modification is appropriate and does not impact results because CORMIX models multi-port diffusers as a slot diffuser rather than discrete ports, so long as the jet velocity from three ports is modeled as the same as the two-port diffuser. This modification is accomplished by decreasing the port diameter of the 3-port diffuser relative to the 2-port diffuser. See the following section for port jet velocities and diameter modifications.

3.3.2 Discharge Velocities

The one-way valve flexes and contracts when discharging due to the stiffness of the material, the diameter of the valve, and the pressure behind the valve. The conceptual diffuser design for this mixing zone study used valve specification information based on a 10-inch Tideflex® Widebill valve. The port diameters and jet velocities of each scenario are presented in Table 8. As mentioned in the previous section, the diffuser was modeled as a three-port diffuser. In order to preserve the jet velocity of the discharge through three-ports, the diameter of the ports was reduced. Those diameters are also provided in Table 8.

4 Modeling

For this study, CORMIX 10.0G was selected as the modeling platform. CORMIX is the industry standard for mixing zone studies of this size and scope, and it is accepted by both the US Environmental Protection Agency (EPA) and Oregon DEQ. CORMIX is capable of modeling most outfall configurations. This model was selected because CORMIX:

- Incorporates physical bounds (shore, bed, and surface); and
- Contains as a module for modeling surface discharge from pipes and open channels.

In the section that follow the results from the modeling scenarios are discussed.

4.1 Mixing Zone Results

The parameters outlined in Section 3 were input to the model for the five scenarios coupled with 2 flow rates for a total of 10 modeled scenarios. Results are presented in the following formats:

- Dilution factors – the dilution factor is the fraction for a given control volume within the plume of the discharge and receiving water divided by the discharge. Mathematically expressed this is:

$$DF = \frac{Q_{dis} + Q_{rec}}{Q_{dis}}$$

  Where *DF* is the dilution factor, Q_{dis} is the volume of discharge in the control volume and Q_{rec} is the volume of receiving water in the control volume. For example, a dilution factor of 5 at a given location downstream indicates that there is one part discharge and four parts receiving water. Dilution factors are presented in Table 9.
- Plume classifications – CORMIX bases its dilution estimations on the type, or classification, of plume that results from the discharge, outfall and receiving water conditions. These plume classifications are descriptive of the type of mixing that occurs. The flow classifications for all of the scenarios is a co-flowing diffuser with a submerged positively buoyant discharge in a uniform layer (MU2). Plumes of this classification initially contract laterally due to acceleration of the receiving water flow surrounding the plume, while spreading vertically within the column. When the plume mixes with the full depth of water, the plume loses some momentum and begins to spread laterally. See Figure 7 and Figure 8 for plan and profiles of acute and chronic plumes (Scenarios 1 and 2), respectively. Plume dimensions for Scenarios 3-5 are similar to Scenario 2.
- Transition from near-field mixing to far-field mixing – Mixing occurs in two general phases – near-field and far-field mixing. Near-field mixing is generally the result of the momentum of the discharge and occurs within the immediate vicinity of the outfall. After the near field, the discharge loses its initial momentum and transitions to far-field mixing where the characteristics of the channel control the dilution.
    - For acute exposure scenarios, the transition from near-field to far-field mixing occurs at approximately 20 to 25 feet—outside of the ZID—due to the high discharge velocities.
    - For chronic, human health and off-design scenarios, the transition occurs at around 1.5 feet due to the lower discharge velocities from the pipe.

- Boundary interactions – All scenarios demonstrate full vertical mixing at around 5 feet downstream, but are not bottom attached. Scenarios 2 and 3 (chronic and non-carcinogenic) become bank attached in the modeling, however this is due to the way the channel is schematized (reduced width) in the model. Figure 8 shows the likely relationship of the plume boundary to the bank, indicated some buffer before interacting with the left bank.
- There were no modeled instabilities, recirculation eddies, stratification or upstream plume intrusions. This is characteristic of submerged positively buoyant plumes.
- Sensitivity Analysis – The dilution factors for Scenarios 1(b) and 2(b) when modeled at roughness factor of 0.04 are 4.9 and 24.3, respectively, changes of 0 and 12 percent less, respectively, than the dilution factors predicted at a roughness of 0.08. This sensitivity analysis indicates mixing is not as sensitive to the characteristics of the channel as much as the characteristics of the diffuser within the immediate vicinity of the outfall. Farther downstream the channel characteristics play an increasing role in the mixing of the discharge with the receiving water.

5 Potential Water Quality Impacts

This section summarizes potential water quality impacts from the discharge based on the dilution achieved as a result of the new diffuser. Mixing zones allow for water quality criteria to be temporarily suspended with in the mixing zone, but require that they are met at the edge of the prescribed mixing zone. The dilution factors are used determine constituent concentrations at the edge of either the ZID or RMZ. The acute water quality criteria apply at the edge of the ZID and the chronic water quality criteria apply at the edge of the RMZ. DEQ employs an evaluation process called reasonable potential analysis (RPA; DEQ, 2012) that determines the potential for a constituent within the discharge to exceed water quality criteria beyond the ZID or RMZ.

The permit states that ammonia and pH require RPA to determine the potential impacts and if permit modification is required. Monitoring for ammonia and pH are required by permit, however, there are no permit limits for ammonia in the current permit. The permitted range of pH for discharge is from 6.0 to 9.0.

5.1 Ammonia RPA

Ammonia toxicity analysis in the RPA is based on the "mixed" discharge and receiving water ammonia concentrations at the edge of the ZID and RMZ.

The RPA works along this general flow path:

- Estimate the maximum possible concentration for each constituent of the discharge based on the historical discharge water quality data. This estimated maximum concentration incorporates the maximum observed concentration, the number of samples in the dataset, and the variability of the data (using the coefficient of variation). These numbers are combined to set a factor of safety by which the maximum observed value is multiplied.
- Calculate the "mixed" concentration of the constituent at the edge of the ZID and the RMZ using the estimated maximum concentration and the receiving water concentration. This step uses a mass balance approach based on the dilution factor achieved at the edge of the ZID and RMZ.

- Calculate the water quality criteria of the constituent. Ammonia criteria are site dependent and factor in the water quality parameters of temperature, pH and alkalinity. The RPA uses statistical representations for each dataset. For example, for temperature, pH and alkalinity of the discharge the 90th percentile values within the datasets are used, whereas the alkalinity of the receiving water is based on the 10th percentile value.
- Compare the mixed concentration of the constituent to the water quality criteria.

Table 10 provides the water quality values of the receiving water and discharge as well as the statistical representation used in the RPA. For receiving water quality data, LASAR data from the Poverty Road Bend were used. Discharge values of ammonia, pH and temperature were calculated from the Carlton Discharge Monitoring Reports dating back to 2011. The discharge alkalinity value was based on the DEQ mixing zone study conducted in 2008.

Using the values presented in Table 10 and the methodology outlined above, the reasonable potential for the Carlton discharge to exceed acute and water quality criteria for ammonia were estimated. The RPA as determined by the using the values presented in this study are provided in Table 11.

5.2 pH RPA

Reasonable potential analysis for pH follows a similar flow path and combines the same water quality constituents (temperature, pH and alkalinity) as ammonia to determine the potential to exceed the water quality criterion. The pH RPA, however, involves examining the pH relative to the range of the criterion for the RMZ. That is, the RPA considers whether the discharge has the potential to result in a mixed pH that is lower than the low criterion value or higher than the high criterion value. The pH criterion range for the Willamette Basin is 6.5 to 8.5.

Table 12 presents the RPA for pH, demonstrating no reasonable potential for the mixed pH at the mixing zone to be outside of the criterion range.

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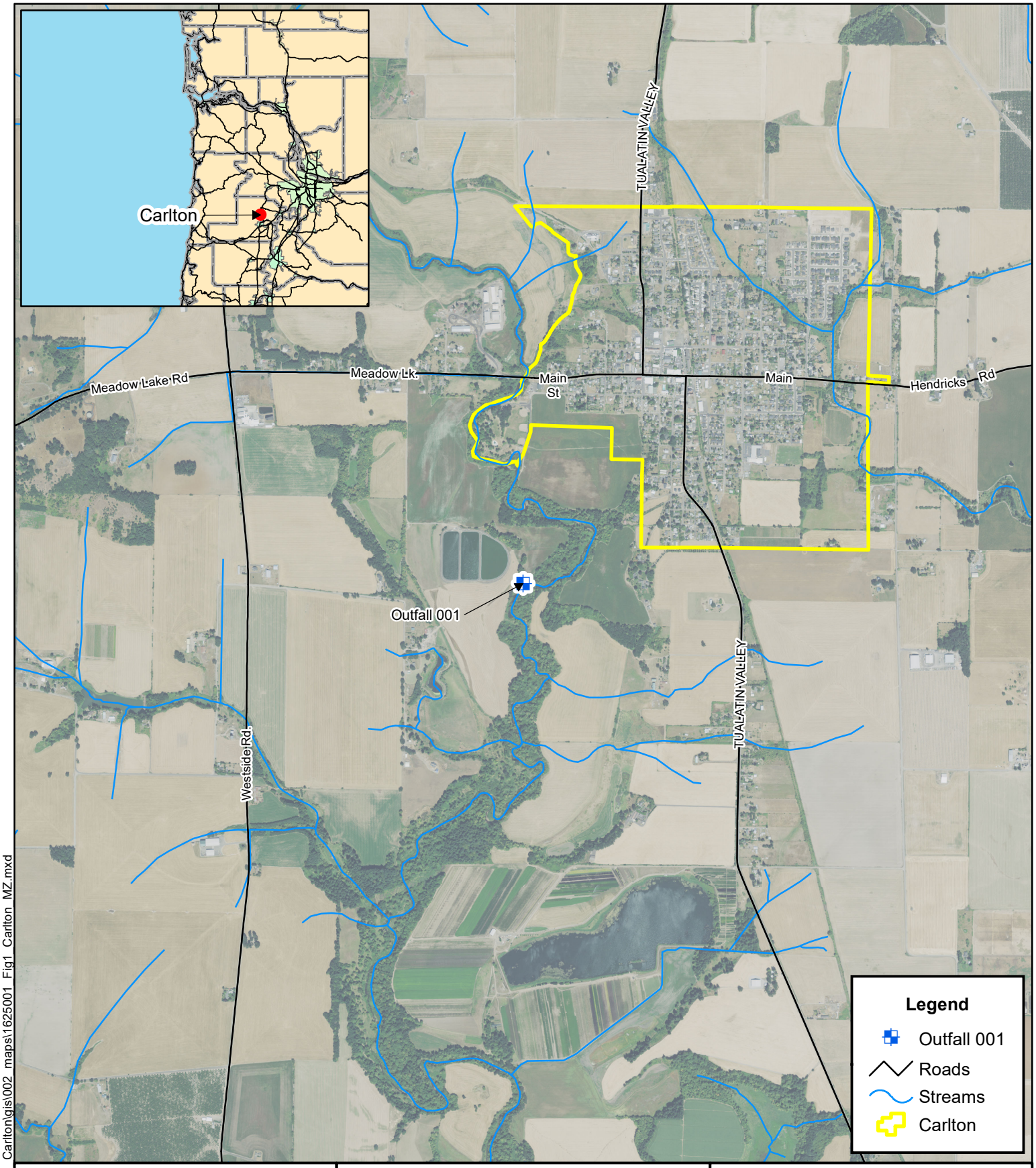
Figures



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City of Carlton
Figure 1 - Site Location and Outfall

No.	Date	By	Revisions
1	08/04/17	RMS	DRAFT

N

1,000 0 1,000 2,000 ft

1 inch = 2,000 ft

Proj#: 1625001

City of Carlton
191 E. Main Street
Carlton, OR 97111

Figure 2. North Yamhill River at Outfall 001

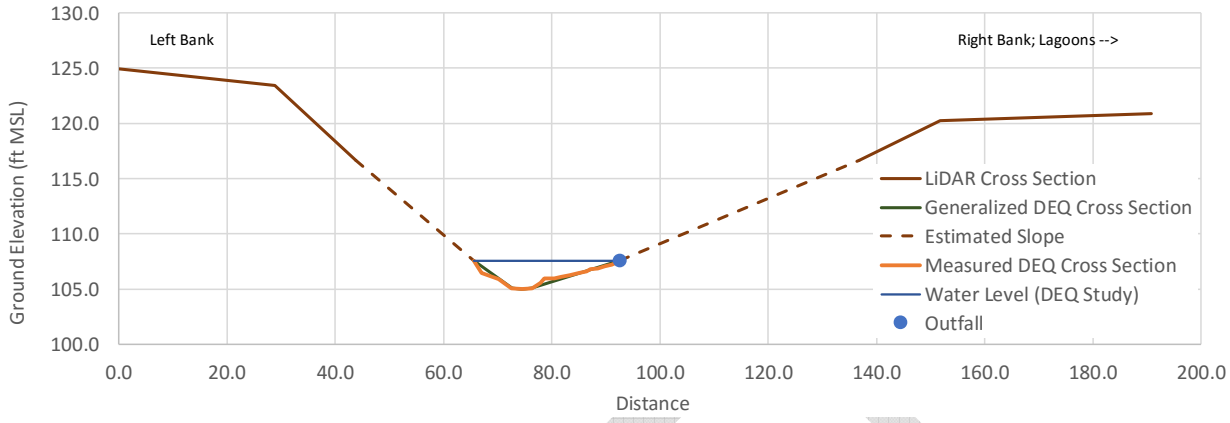


Figure 3. North Yamhill River indicative cross section at Outfall 001

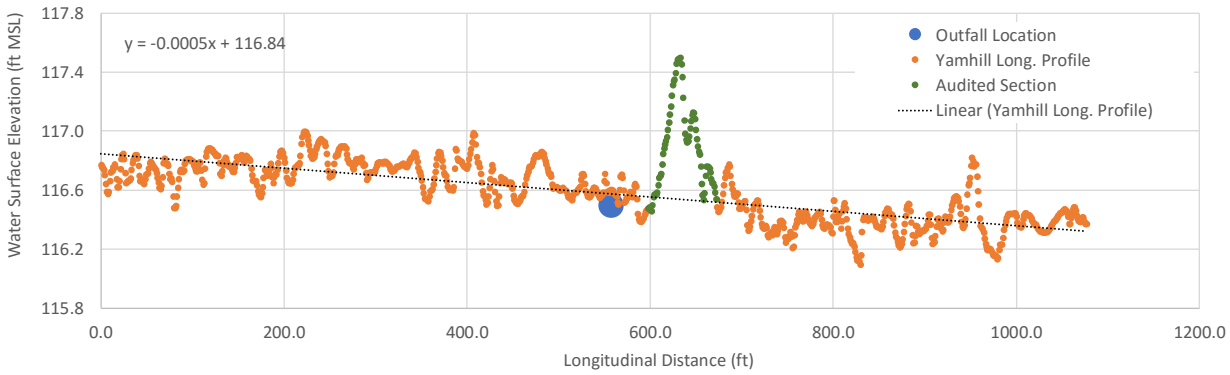


Figure 4. North Yamhill River longitudinal profile at Outfall 001

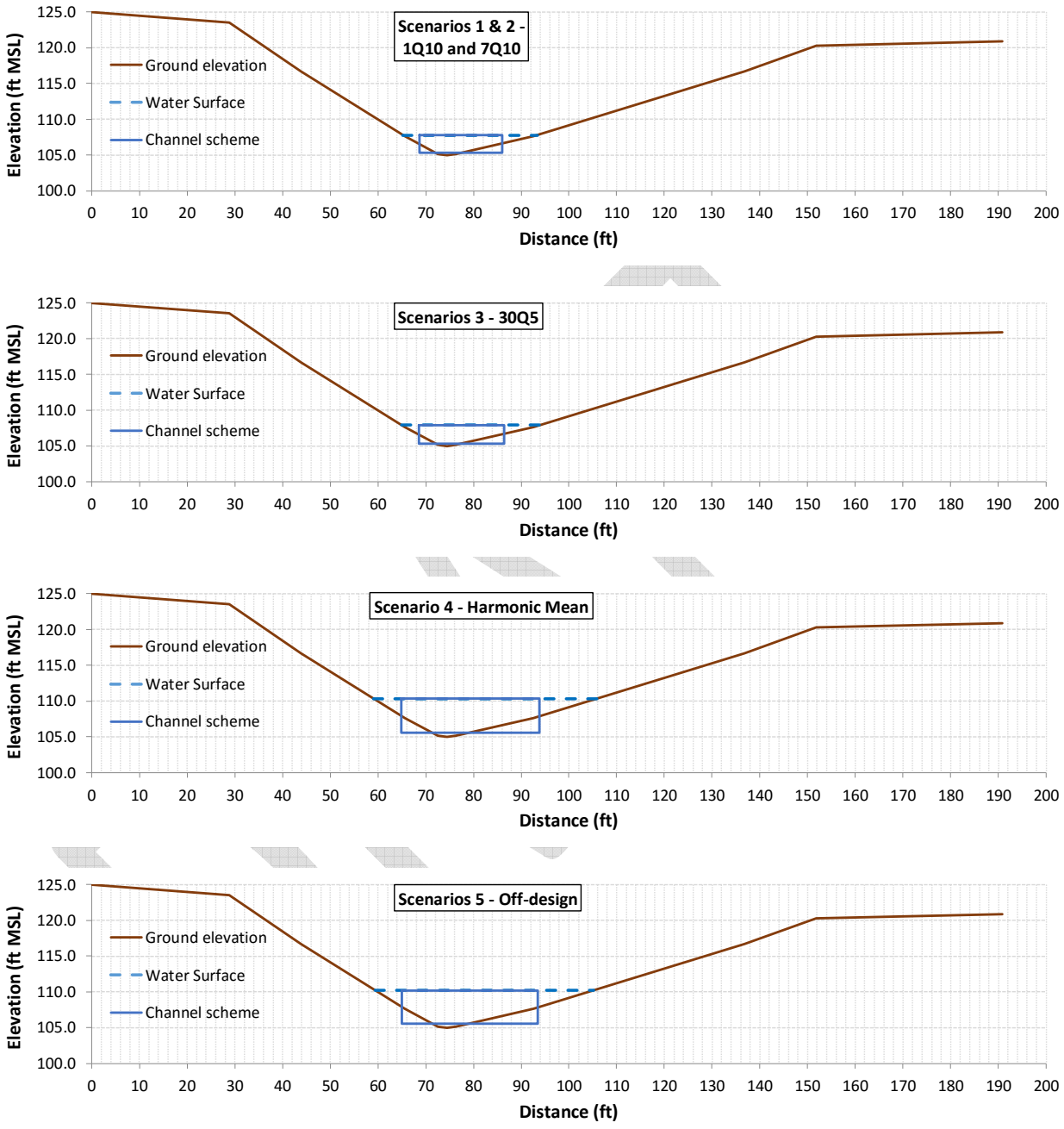
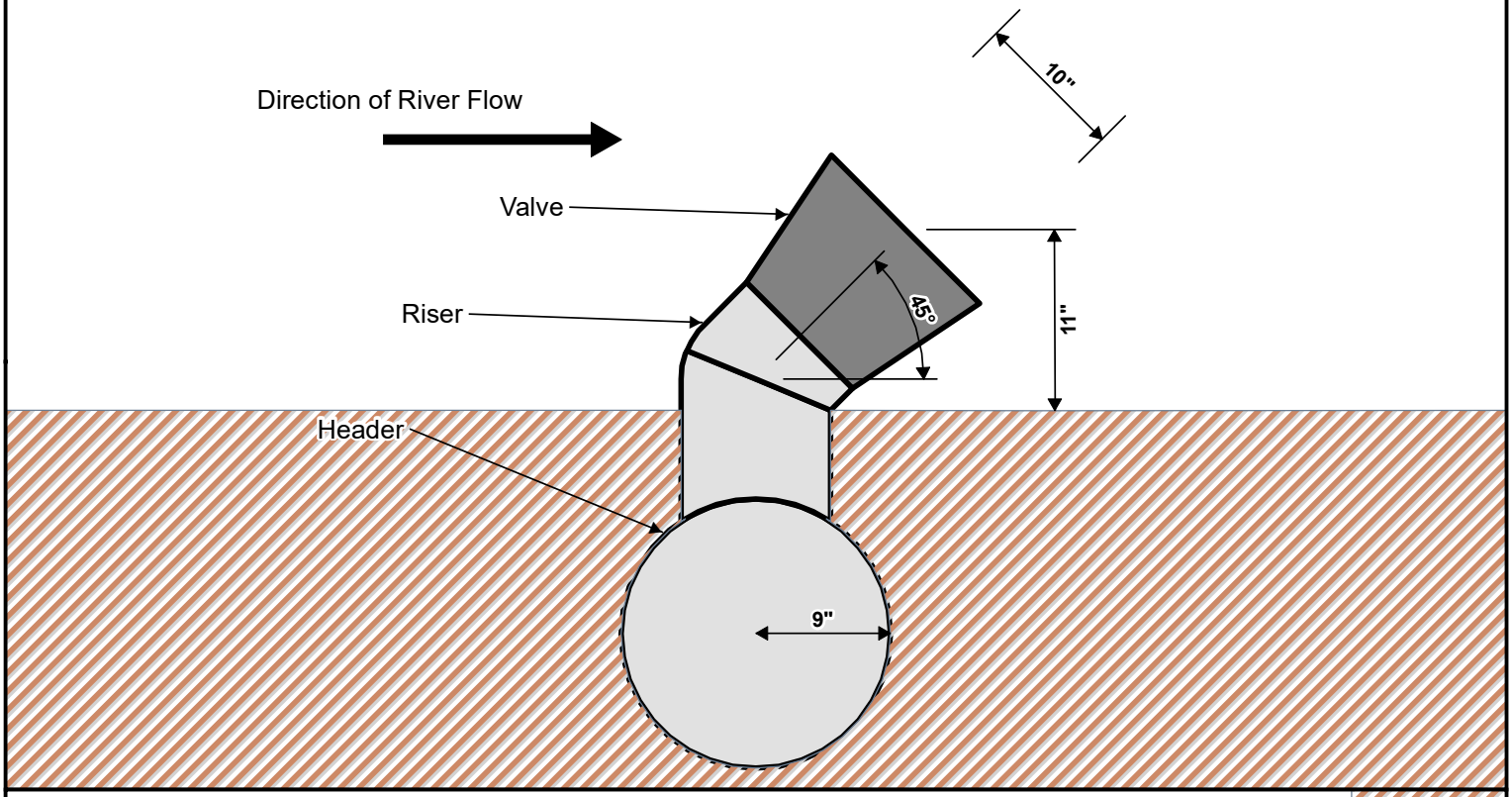
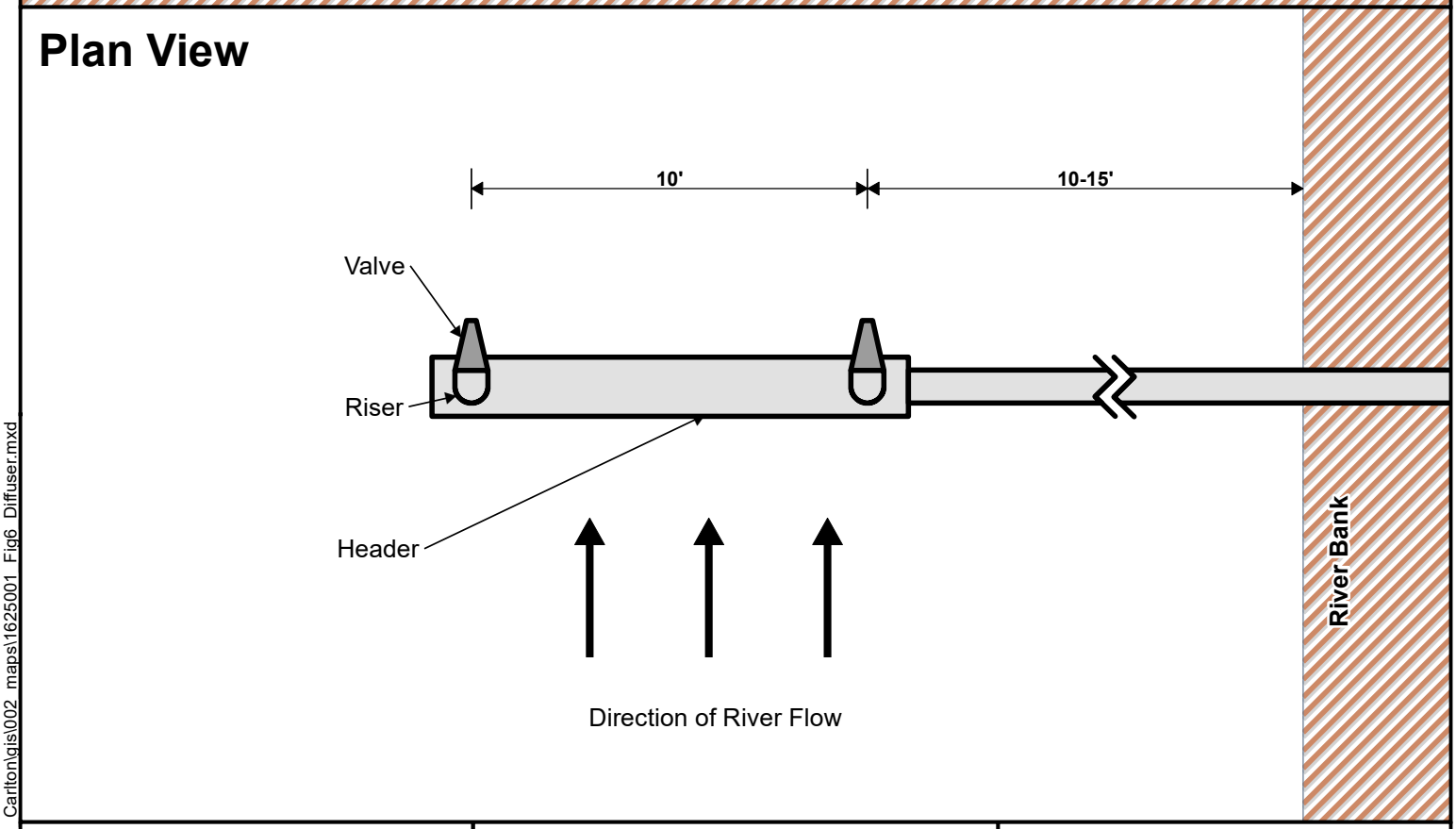


Figure 5. Rectangular scheme river channel dimensions

Profile View



Plan View



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City of Carlton
Figure 6 - Conceptual Diffuser Dimensions

No.	Date	By	Revisions
1	08/13/17	RMS	DRAFT

N

Proj#: 1625001

City of Carlton
191 E. Main Street
Carlton, OR 97111

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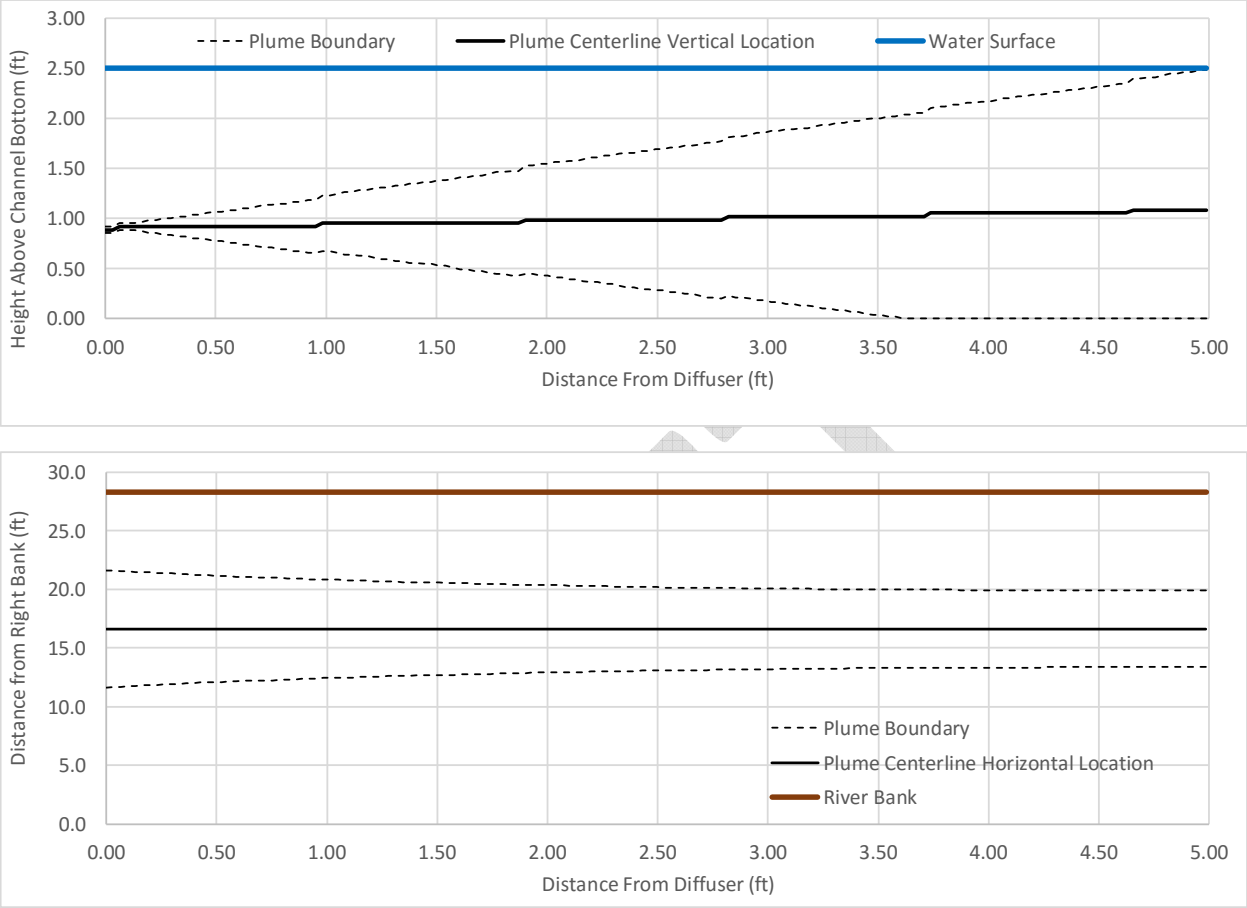

Figure 7. Scenario 1 – acute, aquatic exposure plume dimensions, profile (top) and plan (bottom) views

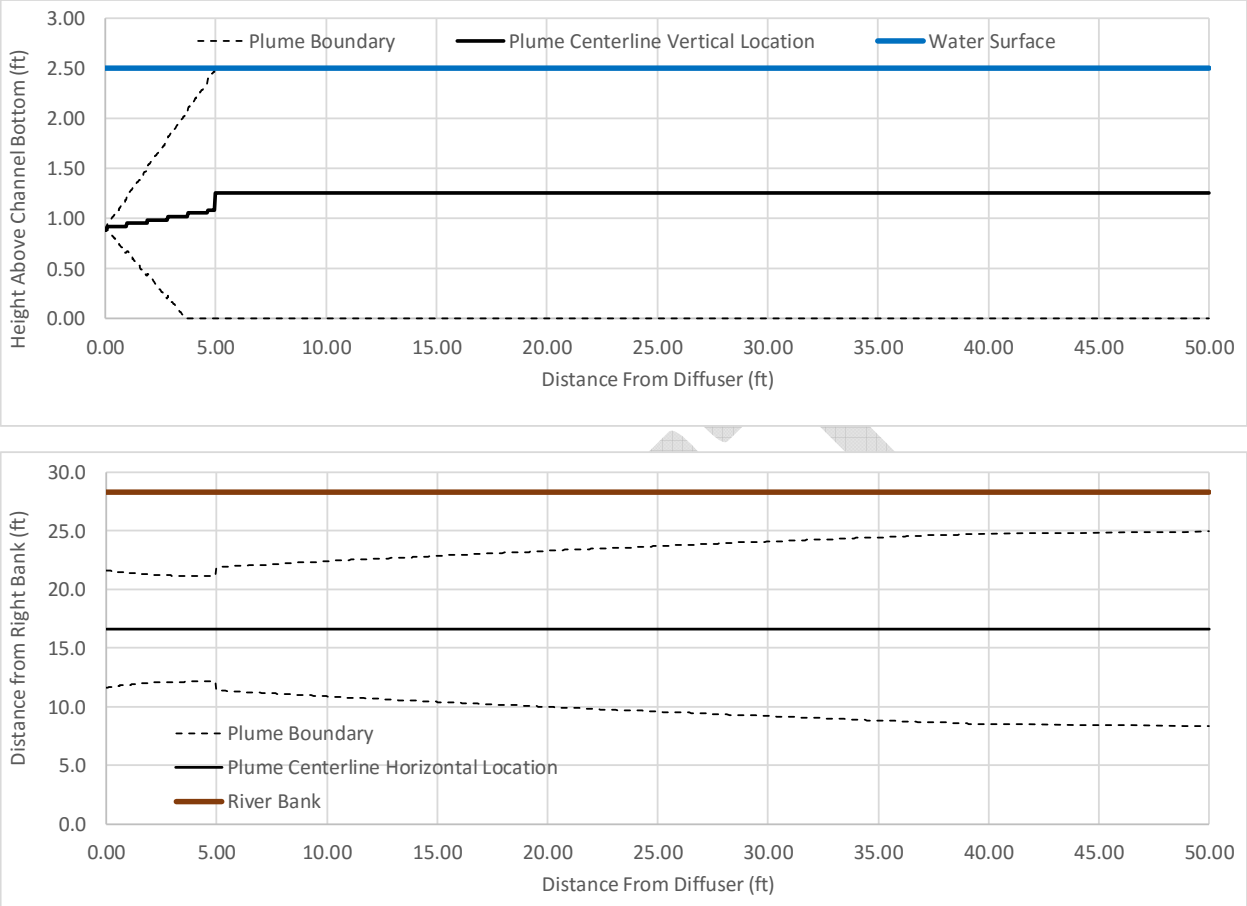

Figure 8. Scenario 2 – chronic, aquatic exposure plume dimensions, profile (top) and plan (bottom) views

Appendix C – Tideflex® Widebill Valve Brochure and Performance Specifications

Technical Data

Tideflex® Widebill Effluent Diffuser

Features & Benefits

- **Less expensive than standard duck bill check valve**
- **Improved dilution**
- **No need to oversize in order to reduce headloss**
- **No additional headloss at peak flow**

Materials of Construction

- **Available in Buna-N, Neoprene, EPDM**

A 4" Tideflex Widebill Diffuser (left) next to a standard 4" Tideflex Diffuser (right).

Tideflex Widebill Effluent Diffuser Valves are an innovative choice for effluent diffuser systems. The newly patented "widebill" check valve design has several unique benefits, the most significant being cost savings. Widebill Tideflex Diffusers are less expensive than a standard duck bill check valve. Also, the all-elastomer construction is flexible and non-fouling, making them suited for long-term, maintenance free service.

Other major benefits of the Tideflex Widebill Effluent Diffuser include:

- Elliptical Jet has greater width/depth ratio yielding better dilution.
- Enhanced jet velocity at flows below peak flow for improved dilution.
- No need to oversize Tideflex Diffusers to reduce headloss.
- No additional headloss at peak flow (same headloss as fixed-diamter port/riser).
- Widebill diffusers open to and beyond nominal pipe diameter at peak flow.
- Easily retrofit to existing diffusers without oversizing Tideflex.
- Smaller diameter risers also compound the cost savings.

WIDE BILL TIDEFLEX DIFFUSER (TFW) SYSTEM DATA ANALYSIS

MEDIA: Effluent

Density or Spec. Gravity: [ ] lb/ft^3; [1]

FLOW RANGE:

0.2	MGD =	139	gpm
0.3	MGD =	208	gpm
5	MGD =	3472	gpm

AVAILABLE HEADLOSS@ DIFFUSER: Minimum [ ] feet; Design [ ] feet; Maximum [ ] feet

MAX. BACKPRESSURE: [ ] feet

DATE: 10-Jul-2017

CLIENT: City of Carlton, OR

CONTACT:

ENGINEER: CwM H2O

CONTACT: Ryan Shojinaga

PROJECT: Carlton WWTP Outfall Diffuser

REP: Antec

CONTACT: Matthew Davidson

* TFW SIZE (IN)	* HYDRAULIC CODE
10	**2224**

* Wide Bill Tideflex Diffuser

		PER WIDE BILLTIDEFLEX DIFFUSER			
*** TOTAL QUANTITY**	TOTAL FLOW (gpm)	FLOW (gpm)	**JET VELOCITY (fps)**	**HEADLOSS (feet)**	EFFECTIVE DIAMETER (in)
2	138.9	69.4	1.4	0.0	4.5
	208.3	104.2	1.7	0.0	4.9
	3472.2	1736.1	7.3	0.8	9.8

FIXED ORIFICE DIA. * Cd = 1

		PER FIXED ORIFICE				
10.00	**2**	138.9	69.4	**0.3**	**0.0**	10.0
		208.3	104.2	**0.4**	**0.0**	10.0
		3472.2	1736.1	**7.1**	**0.8**	10.0