



INTEGRATED PLAN

SUBMITTED TO
OREGON DEPARTMENT OF
ENVIRONMENTAL QUALITY



NOVEMBER 2020



CleanWater Services
1970-2020

Contents

Executive Summary	vii
1 Introduction.....	1
2 Tualatin River Watershed and District Objectives	6
2.1 Tualatin River Watershed	6
2.2 Clean Water Services	8
2.3 Objectives	8
3 Current Activities Protecting Public Health and Enhancing Watershed Health.....	10
3.1 Wastewater Collection	10
3.1.1 Description of Collection System	10
3.1.2 Collection System Operational Strategy	10
3.1.3 Capacity	11
3.1.4 Management.....	12
3.1.5 Operation and Maintenance	12
3.2 Wastewater Treatment	13
3.2.1 Description of the WWTFs.....	13
3.2.2 Pretreatment	15
3.2.3 Resource Recovery	15
3.2.4 Planning and Management.....	17
3.3 Stormwater Management	18
3.3.1 Illicit Discharge Detection and Elimination	18
3.3.2 Construction Site Runoff Control	18
3.3.3 Industrial and Commercial Facilities	18
3.3.4 Stormwater Facilities Operation and Maintenance Activities	19
3.3.5 Education and Outreach.....	19
3.3.6 Pollution Prevention for Municipal Operations	19
3.3.7 Post-Construction Site Runoff and Retrofit Programs	19
3.3.8 Public Involvement and Participation	19
3.4 Watershed Enhancement Program.....	20
3.4.1 Thermal Load Management Activities	20
3.4.2 Water Quality Credit Trading Program	21
3.4.3 Other Watershed Enhancement Activities	23
3.5 Research and Innovation.....	24
3.6 Tualatin Basin Dam Safety and Water Supply Joint Project	24
3.7 Public Education and Outreach.....	25
3.7.1 Public Involvement	29
3.7.2 Education	29

3.8	Watershed Monitoring Program	29
3.8.1	Flow Monitoring	30
3.8.2	Continuous Water Quality Monitoring	30
3.8.3	Ambient Water Quality Monitoring using Discrete Samples	30
3.8.4	Macroinvertebrate Monitoring.....	33
3.8.5	Project Monitoring	33
3.8.6	Anticipated Scope of Watershed Monitoring Program.....	34
4	Effectiveness of Actions in Meeting Objectives.....	35
4.1	Water Quality Improvements.....	35
4.2	Watershed Enhancement Program.....	36
4.2.1	Community Benefits	38
4.3	Research and Innovation.....	39
4.3.1	Improved Reliability of Biological Phosphorus Removal Process.....	39
4.3.2	Vertical Flow Wetlands for NTS	40
4.3.3	Improve Measurement and Understanding of Inhibition.....	40
4.3.4	Reduction of Disinfection Byproducts at Rock Creek and Durham WWTFs	40
4.4	Public Education and Outreach.....	40
5	Challenges the District Faces.....	41
5.1	Growth	41
5.2	Replacing Aging Infrastructure.....	41
5.3	Regulatory Challenges	43
5.3.1	Wastewater Collection	43
5.3.2	Highly Managed River System	43
5.3.3	Legacy and Current Use Chemicals.....	44
5.3.4	Tualatin River Water Quality.....	44
5.3.5	Tualatin River Temperature TMDL.....	46
5.3.6	Land Application of Biosolids	46
5.3.7	Stormwater Management	47
5.4	Water Resource Limitations	47
5.5	Climate Change Impacts	48
5.6	Ratepayer Considerations	49
6	Strategies to Address Challenges.....	50
6.1	Wastewater Collection	50
6.1.1	Strategy: Continue Utilizing CMOM-Based Approach.....	50
6.2	Wastewater Treatment	51
6.2.1	Strategy: Update Phosphorus TMDL for the Tualatin River.....	52
6.2.2	Strategy: Update Temperature TMDL for the Tualatin River	53
6.2.3	Strategy: Update TSS and CBOD ₅ Limits at Forest Grove WWTF and NTS Based on Equivalent Control Provided by NTS	53
6.2.4	Strategy: Define Permitting Framework for Highly Managed Streams	57
6.2.5	Strategy: Discharge Year-round from Hillsboro WWTF and NTS	57

6.2.6	Strategy: Discharge water into the TVID irrigation system	60
6.2.7	Strategy: Expand Recycled Water Use Program	60
6.2.8	Strategy: Expand Resource Recovery.....	61
6.3	Stormwater Management	61
6.3.1	Strategy: Continue to Implement Program to Protect and Enhance Riparian Areas	61
6.3.2	Hydromodification Strategy.....	62
6.3.3	Retrofit Strategy.....	63
6.4	Watershed Enhancement Program.....	63
6.4.1	Strategy: Continue to Implement Water Quality Trading Program.....	64
6.4.2	Additional Strategies.....	64
6.5	Tualatin Basin Dam Safety and Water Supply Joint Project	68
6.6	Pollution Prevention.....	68
6.7	Embracing Technology and Innovation.....	69
6.8	Public Education and Outreach.....	70
7	Public Outreach and Stakeholder Involvement.....	71
8	Adaptive Management.....	72
9	Regulatory Support	73
10	References.....	74

Tables

Table 1.	Summary of Ambient Water Quality Monitoring Program	32
Table 2.	Summary of Macroinvertebrate Monitoring	33
Table 3.	CBOD ₅ , TSS, Nutrient and Metals Reductions at Forest Grove NTS (2020 data)	55
Table 4.	Proposed TSS and CBOD ₅ Effluent Limits for Forest Grove WWTS During Low River Flow Conditions	56
Table 5.	Anticipated Effluent Quality for Discharge from Hillsboro NTS	59

Figures

Figure ES-1.	Clean Water Services Initiative Implementation Schedule	viii
Figure 1-1.	District Organizational Chart.....	5
Figure 2-1.	Watershed Location Map.....	6
Figure 2-2.	Tualatin River Watershed and Location of CWS Treatment Facilities	7
Figure 3-1.	Hagg Lake Storage Trends, 1980-2019	25
Figure 3-2.	Customer Awareness and Satisfaction Survey (January 2017)	26
Figure 3-3.	Ambient Water Quality Monitoring sites	31
Figure 4-1.	Riparian Planting Projects (2004 – 2019).....	36
Figure 4-2.	Flow Enhancement in Tualatin River Watershed	37
Figure 4-3.	Water Quality Credit Trading Program Benefits.....	38
Figure 4-4.	Community Benefits of Tree for All Program.....	39
Figure 5-1.	Rock Creek AWWTF Base Flow Projections	41
Figure 5-2.	Key Water Quality Parameters in the Lower Tualatin River from August-October 1988-2019	45
Figure 5-3.	Hagg Lake (Scoggins Reservoir) Storage by Water Year (2001-2020)	48
Figure 6-1.	CBOD ₅ Concentrations at the Forest Grove WWTF and NTS Effluent	54
Figure 6-2.	TSS Concentrations at the Forest Grove WWTF and NTS Effluent.....	54
Figure 6-3.	Hillsboro NTS Area	58
Figure 8-1.	Adaptive Management Cycle.....	72
Figure 9-1.	Clean Water Services Strategy Implementation Schedule.....	73

Acronyms and Abbreviations

AWEP	Agricultural Water Enhancement Program
AWWTF	Advanced Wastewater Treatment Facility
BMP	best management practice
BOD	biochemical oxygen demand
C	Celsius
cfs	cubic feet per second
CMOM	Capacity, Management, Operation, and Maintenance
CWA	Clean Water Act
District	Clean Water Services
ECREP	Enhanced Conservation Reserve Enhancement Program
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
F	Fahrenheit
ft	Feet
ft/mi	feet per mile
GIS	geographic information system
IDDE	Illicit Discharge Detection and Elimination
I/I	infiltration and inflow
IP	Integrated Plan
LIDA	Low Impact Development Approaches
mgd	million gallons per day
mg/L	milligrams per liter
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NTS	natural treatment system
O&M	operation and maintenance
OAR	Oregon Administrative Rule
ODEQ	Oregon Department of Environmental Quality
OWRD	Oregon Water Resources Department
PFAS	per- and polyfluoro alkyl substances
RM	River Mile
SSO	sanitary sewer overflow
SWMP	Stormwater Management Plan
TFA	Tree for All
TLMP	Thermal Load Management Plan
TMDL	Total Maximum Daily Load
TSS	total suspended solids

TSWCD	Tualatin Soil and Water Conservation District
TVID	Tualatin Valley Irrigation District
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VEGBAC	Vegetated Buffer Areas for Conservation
WASSTRIP	Waste Activated Sludge Stripping to Remove Internal Phosphorus
WWTF	Wastewater Treatment Facility

Executive Summary

Everything we do at Clean Water Services (District) aims to protect public health while enhancing the natural environment of the Tualatin River Watershed. Combining science and nature, we work in partnership with others to safeguard the river's health and vitality, ensure the economic success of our region, and protect public health for more than 600,000 residents and businesses in urban Washington County.

The District provides wastewater, stormwater, watershed enhancement and related water resource management services in Washington County and small portions of Clackamas and Multnomah counties in the Tualatin River Watershed. Proper administration of these services requires the District to manage a significant number of assets including four wastewater treatment facilities, 43 pump stations, more than 850 miles of sanitary sewer lines and 530 miles of storm sewer infrastructure.

The District faces challenges from a growing service area, aging infrastructure needs, increasingly complex regulatory drivers, water resource limitations, evolving climate change impacts, and keeping rates affordable across a range of social and economic strata. The goal of the District's Integrated Plan is to establish a long-term permitting strategy to prioritize and schedule actions well into the future to help address these challenges. The long-term strategy will also enable the District to anticipate regulatory needs, develop implementable project and program schedules and continue to maintain compliance.

The District believes that strategic planning and interaction with the Oregon Department of Environmental Quality (ODEQ) is necessary to collaboratively develop and implement approaches that protect human health, improve watershed health and resiliency, meet regulatory requirements, and maintain a sustainable rate structure for all customers. The District is encouraged by the strong working relationship with ODEQ and is committed to the ongoing communication and adaptive management elements of the Integrated Plan. Under this approach, the District will work with ODEQ to prioritize and schedule District actions well into the future to address regional challenges.

The Integrated Plan includes 20 initiatives in seven program areas for near-term (one to five years), mid-term (six to 10 years) and longer-term (11 to 20 years) planning. Figure ES-1 outlines each initiative and the estimated timeframe for implementation.

PROGRAM	INITIATIVES	2020-2025	2026-2030	2031-2040
Wastewater Collection	Facilitate CMOM-based approach: Continue to work with District to facilitate ongoing implementation of a CMOM-based approach for collection system management			
Wastewater Treatment	Update total phosphorus TMDL: Update TMDL for Total Phosphorus to enable the use of biological processes for phosphorus control & meet anticipated aluminum criteria			
	Expand recycled water use: Enable an expanded recycled water use program for restoration of ecological & wetland function in the watershed			
	Update temperature TMDL: Update TMDL for Temperature to be consistent with current standards			
	Discharge to irrigation system: Incorporate discharge of water into an irrigation distribution system			
	Define Forest Grove equivalent treatment: Define treatment provided by Forest Grove WWTF & NTS as equivalent to basin standards			
	Include Hillsboro NTS: Include natural treatment system at Hillsboro WWTF			
	Recover resources from wastewater: Continued support of District's efforts to recover resources from wastewater			
Stormwater Management	Highly managed river system: Work with District to define permitting framework for highly managed river systems			
	Continue to implement MS4 program			
	Continue to implement riparian protection & enhancement program			
	Continue to implement sub-basin strategies: Continue support of sub-basin strategies as a holistic method to manage stormwater & enhance watershed health			
Watershed Enhancement	Continue to implement retrofit program			
	Expand water quality trading program: Support District's expansion of the water quality trading program			
	Update riparian shade crediting protocol			
Pollution Prevention	Continue work on Tualatin Joint Project			
	Support pollution prevention approach: Support pollution prevention approach for legacy & current use chemicals associated with broad societal use			
Research & Development	Continue to incorporate technology & innovation			
	Optimize monitoring frequencies at WWTFs: Develop procedures to reduce influent & effluent monitoring frequencies for TSS, CBOD & nutrients at WWTFs			
Public Education & Outreach	Continue implementing education & outreach program			

Introduction

Clean Water Services (District) provides wastewater, stormwater, watershed enhancement and related water resource management services for over 600,000 residents and businesses in Washington County and small portions of Clackamas and Multnomah counties in the Tualatin River watershed. The District owns and operates four water resource recovery facilities and 43 pump stations and manages more than 850 miles of sanitary sewer lines and 530 miles of storm sewer infrastructure.

The District is committed to providing effective and affordable services that protect public health and the environment, meet customer expectations and support long-term community planning efforts.

The District faces challenges from a growing service area, aging infrastructure needs, increasingly complex regulatory drivers, water resource limitations, evolving climate change impacts and keeping rates affordable across a range of social and economic strata. The goal of the District's Integrated Plan (IP) is to establish a long-term permitting strategy to prioritize and schedule actions well into the future to help address these challenges. The long-term strategy will also enable the District to anticipate regulatory needs, develop implementable project and program schedules and continue to maintain compliance.

The District believes that strategic planning and interaction with the Oregon Department of Environmental Quality (ODEQ) is necessary to collaboratively develop and implement approaches that protect human health, improve watershed health and resiliency, meet regulatory requirements, and maintain a sustainable rate structure for all customers.

In 2011, the U.S. Environmental Protection Agency (EPA) recognized that when afforded the flexibility to balance demands on asset improvements, municipalities could more efficiently use their resources to make important, cost-effective environmental improvements that align with community priorities (Stoner and Giles 2011). To support communities in these efforts, EPA released the *Integrated Municipal Stormwater and Wastewater Planning Approach Framework* (Framework; Stoner and Giles 2012). The president signed the Water Infrastructure Improvement Act of 2018 in January 2019 (EPA 2019a), which codifies the EPA's Framework and includes several provisions that facilitate using integrated planning to meet Clean Water Act (CWA) requirements.

An IP uses existing federal and state regulations and policies to sequence wastewater and stormwater projects in a way that allows the highest priority environmental projects to occur first and encourages innovative solutions. An IP does not remove obligations to comply with the CWA, nor does it lower existing regulatory or permitting standards, but rather recognizes the flexibilities in the CWA for the appropriate sequencing and scheduling of work. It should be noted that the District is not using an IP solely as a compliance strategy; rather it is striving to implement innovative solutions that improve overall watershed health and achieve greater outcomes than compliance alone.

EPA's Framework outlines a process that allows municipalities to meet human health and water quality objectives by using existing CWA flexibilities to appropriately prioritize and schedule asset improvements according to a community's needs and financial capability. It also makes it clear that local governments may pursue integrated planning to prioritize their water management and compliance obligations, as well as water reuse, water recycling, green infrastructure and other innovative projects, over a long-term planning period.

In their Framework, EPA anticipates that IPs will address the following six elements:

- **Element 1:** A description of the water quality, human health and regulatory issues to be addressed.
- **Element 2:** A description of existing wastewater and stormwater systems under consideration and summary information describing the systems' current performance.
- **Element 3:** A process that opens and maintains channels of communication with relevant community stakeholders to provide full consideration of others' views during the planning process and implementation of the plan.
- **Element 4:** A process for identifying, evaluating and selecting alternatives and proposing implementation schedules.
- **Element 5:** A process for evaluating the performance of projects identified.
- **Element 6:** An adaptive management process for making improvements to the plan.

The District is not developing an IP in response to regulatory agency enforcement actions. Instead, the District foresees greater challenges and seeks to start an IP now to proactively address these issues. The District views the IP as a planning tool to prioritize activities that more effectively address infrastructure needs, enhance watershed health, and anticipate and meet regulatory requirements in a cost-effective, sustainable manner.

This IP is to be part of the District's permit renewal application, to provide a framework for upcoming and subsequent National Pollutant Discharge Elimination System (NPDES) permit development. The District views the IP as a tool to:

- Define comprehensive goals for the watershed.
- Identify current actions and future strategies to meet watershed goals.
- Coordinate various planning efforts (i.e., wastewater treatment facility plans, collection system master plans, stormwater planning activities and natural system planning activities).
- Establish its long-term permitting strategy to guide investments in infrastructure and watershed enhancement activities in a predictable, systematic, sustainable manner.

- Succinctly communicate goals and strategies to protect public health and enhance watershed health.

To that end, and to address the six elements noted in EPA's framework, the scope of this IP is broken into sections that:

- Define the District's objectives.
- Identify current activities the District undertakes to protect public health and enhance watershed health.
- Evaluate the District's effectiveness at meeting those objectives.
- Identify the challenges the District faces.
- Propose strategies and request regulatory support for developing a pathway to implement the strategies.
- Identify stakeholder involvement necessary to effectively set priorities.
- Define how adaptive management will be used through updates to this plan.

The District seeks to establish a partnership with ODEQ to implement this IP and anticipates working with ODEQ to implement activities that are prioritized and focused on protecting and improving water quality and watershed health on a long-term and sustainable basis. The District is committed to the ongoing communication and adaptive management elements of the plan so both partners are aware of current and planned critical activities. These efforts will lay a foundation that will inform future permitting discussions, help anticipate and address potential compliance issues, and establish strategies to continue to protect and enhance public health and the environment. ODEQ will be more informed of what to expect, how much time will be needed for potential compliance schedules, and how other regulatory approaches might be deployed for challenging emerging parameters of concern (e.g., appropriate use of pollutant minimization and prevention planning).

The District is well situated to follow an integrated planning framework. Having worked closely with the ODEQ to implement the nation's first watershed-based NPDES permit, the District looks to build on that partnership and continue to identify and implement strategies that address future regulatory opportunities and hurdles. The District's innovative approach to problem-solving has earned Clean Water Services national and international recognition by the Utility of the Future Today program and Leading Utilities of the World network. Clean Water Services has leveraged its enhanced biological nutrient removal processes becoming the first utility to partner with Ostara Nutrient Recovery Technologies, Inc. (Ostara) to transform recovered nitrogen and phosphorus into granular fertilizers. The District has incorporated the Fernhill Natural Treatment System as an ecological bridge between its Forest Grove Wastewater Treatment Facility (WWTF) and the watershed to reduce effluent temperature and provide additional treatment prior to discharge to the Tualatin River. The District has also implemented a Thermal Load Management Plan (TLMP), using flow enhancement and riparian planting activities to offset the thermal loads from the District's WWTFs. Through 2019, Clean Water Services has enhanced more than 73 river and tributary miles and released an average of 35 cubic feet per second (cfs) of

stored water to enhance watershed health. This approach has resulted in a sustainable and cost-effective solution for managing thermal loads while improving ecological health and stream resiliency. The District has worked closely with ODEQ to develop and implement these innovative and groundbreaking strategies.

The District also benefits from having the service district boundary fall within the boundary of the Tualatin River Watershed, which aligns closely with the county boundary. This allows for countywide environmental decisions to affect the entire watershed. Conversely, the District's implementation of watershed enhancement strategies will be concentrated within Washington County, which can facilitate more streamlined communication with stakeholders and lead to more efficient decision-making and faster implementation.

The District has developed and sustained strategic transformational partnerships across the region to accomplish more than any one organization could alone. The enduring organizational partnerships go beyond the exchange of money and written agreements. They are transformational in that they are characterized by an alignment of missions, staff, volunteers and activities that make it possible to work at a much larger scale. For example, the Tree for All (TFA) program is one of the nation's largest and most successful landscape conservation programs, working with nearly 40 partners from public, private and nonprofit sections to join forces and plant more than 11 million native trees and shrubs to improve watershed health.

The District also has implemented a comprehensive, watershed-based monitoring program that includes stream flow monitoring, instream water quality (discrete and continuous), and macroinvertebrate and physical habitat monitoring. This program allows the District to track the health of the watershed over time and use the historical baselines to evaluate the effectiveness of newly implemented program components to support adaptive management practices.

The District also has a long history of sustained compliance at all four of its WWTFs. These complex facilities have some of the most stringent permit requirements in the country, requiring coordinated, innovative and skilled planning and operations. For more than the past 10 years, every one of the District's four facilities has been recognized with the National Association of Clean Water Agencies Peak Performance Award for excellence in permit compliance in the Gold or Platinum category. Gold signifies no permit violations over the calendar year; Platinum denotes no permit violations over five consecutive years.

The District's organizational structure includes dedicated departments for water resource recovery operations and services, utility operations and services, regulatory affairs, and natural systems enhancement and stewardship (Figure 1-1). Clean Water Services has become an industry leader recognized for pioneering smart, practical solutions for sustainability of the community and the Tualatin River Watershed. It is the District's focus and expertise in each of these areas that will support a successful and comprehensive implementation of the IP, allowing the District to innovate with new strategies to further protect public health and enhance the health of the Tualatin River Watershed.

Figure 1-1. District Organizational Chart

2 Tualatin River Watershed and District Objectives

This section includes brief descriptions of the Tualatin River Watershed and Clean Water Services and summarizes the District's overall objectives.

2.1 Tualatin River Watershed

The 712-square-mile Tualatin River Watershed is a sub-basin of the Willamette River and situated in the northwest corner of Oregon (Figure 2-1). The headwaters are in the Coast Range and flow in a generally easterly direction to the confluence with the Willamette River.

Figure 2-1. Watershed Location Map



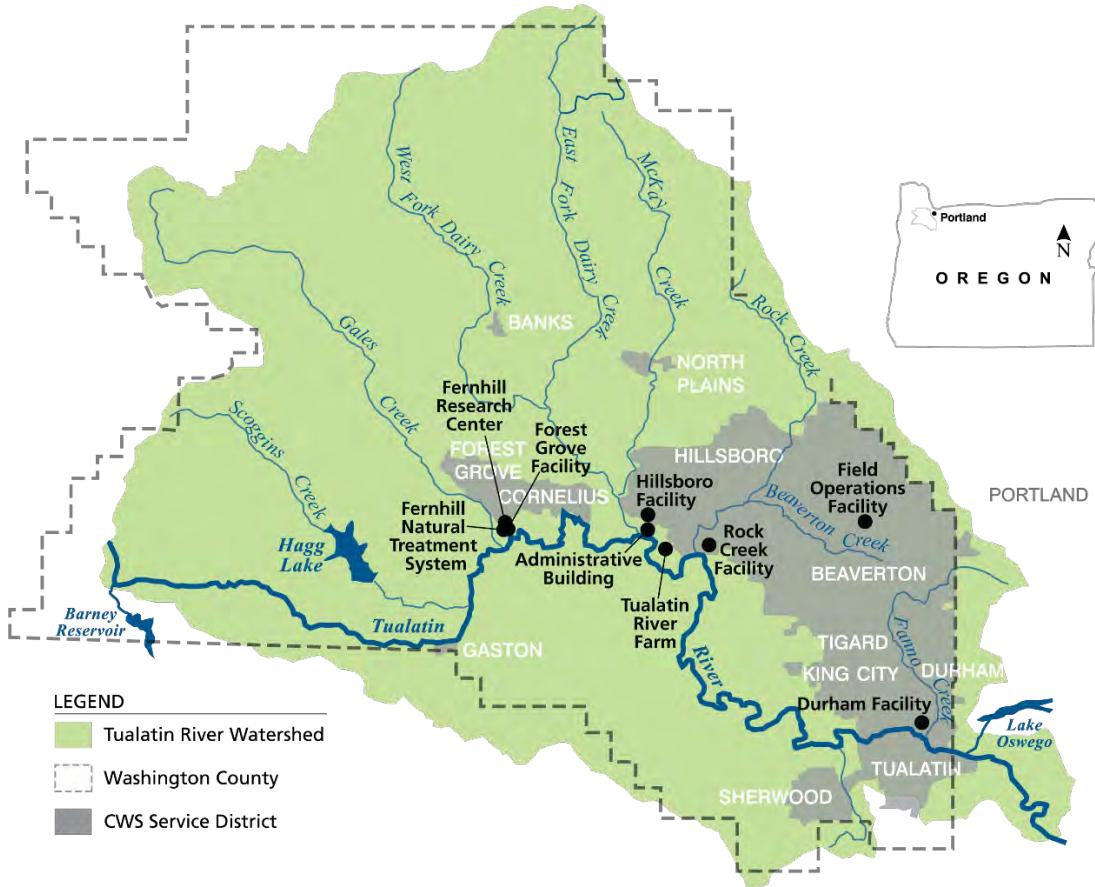
The Tualatin River is about 80 miles long and changes dramatically from its headwaters to its mouth. The mountain or headwater reach (upstream of River Mile [RM] 55) is narrow (about 15 feet [ft]) and steep with an average slope of about 74 ft per mile (ft/mi). The meander reach (RM 55–33) is wider with an average slope of about 1.3 ft/mi. The reservoir reach (RM 33–3.4) is wide (up to 150 ft), has an estimated slope of only 0.08 ft/mi and includes several deep pools. Travel times through the reservoir reach are long with the slower water current causing this reach to act much like a lake. In the riffle reach (RM 3.4–0), the Tualatin River flows through a short reservoir section and then drops into a narrow gorge near the City of West Linn before it enters the Willamette River just upstream of the Willamette Falls. The average slope in this reach is 10 ft/mi (Clean Water Services 2020a).

Major tributaries to the Tualatin River include Scoggins Creek, Gales Creek, Dairy Creek (which includes East Fork Dairy Creek, West Fork Dairy Creek and McKay Creek), Rock Creek (which includes Beaverton Creek), Chicken Creek and Fanno Creek (Figure 2-2).

The Tualatin River Watershed supports a wide range of land uses including forestry, agriculture and urban. The headwaters of the Tualatin River Watershed are forested. Agricultural activities become prevalent in the upper and middle portion of the

watershed as the river flattens out. The urban section is mostly in the middle and lower portion of the watershed. The Tualatin River Watershed includes the cities of Banks, Beaverton, Cornelius, Durham, Forest Grove, Gaston, Hillsboro, King City, Lake Oswego, North Plains, Sherwood, Tigard, Tualatin, West Linn and portions of Portland (Figure 2-2). The Tualatin River is the primary source of municipal drinking water in urban Washington County and is used by agricultural producers for irrigation.

Figure 2-2. Tualatin River Watershed and Location of CWS Treatment Facilities



The urban area, which makes up approximately 26 percent of the basin, has experienced steady growth over the last 30 years. Agricultural land use makes up approximately 35 percent of the basin with forestry making up the remaining 39 percent. Approximately 92 percent of the basin is privately owned; state and federal lands make up the remaining 8 percent (ODEQ 2001).

The sub-basin climate is characterized by mild, wet winters and warm, dry summers. The area experiences little, if any, snow accumulation. Temperature and precipitation are directly affected by air masses moving inland from the Pacific Ocean. Rainfall ranges from 110 inches on the western slope of the Coast Range to 35-40 inches in the southeastern area. The peak months for rainfall are November through February while the driest months, based on the percentage of precipitation occurring, are generally June through October. Municipal and agricultural demand for water peaks

during the driest months of the year (i.e., July-September), when air temperatures are highest and instream flows are low.

2.2 Clean Water Services

Clean Water Services is a county service district that provides wastewater, stormwater and watershed enhancement services in the Tualatin Basin Watershed. There are 12 cities in the service area — Banks, Beaverton, Cornelius, Durham, Forest Grove, Gaston, Hillsboro, King City, North Plains, Sherwood, Tigard, Tualatin — and Washington County. The cities and the county work together with the District to operate the collection system; the District owns and operates the four WWTFs in the Tualatin River basin (Sections 3.1.1 and 3.2.1, Figure 2-2):

- Forest Grove WWTF
- Hillsboro WWTF
- Rock Creek Advanced Wastewater Treatment Facility (AWWTF)
- Durham AWWTF

The treatment facilities and the municipal separate storm sewer system are permitted by the ODEQ under the District's watershed-based 2016 NPDES permit (Section 3.3).

Rock Creek and Durham are referred to as AWWTFs because they provide a higher level of treatment, with phosphorus removal and tertiary filtration, than Forest Grove and Hillsboro. The term WWTF is used when referring to both WWTFs and AWWTFs. In Figure 2-2, the gray area denotes the wastewater service area, which is similar to the District's MS4 service boundary, with the exception of Gaston, which is not within the designated MS4 program area.

2.3 Objectives

Clean Water Services aims to protect public health while enhancing the natural environment of the Tualatin River Watershed. To focus its efforts and guide its actions, the District has identified the following objectives:

- **Protect public health:** Clean Water Services provides services to protect public health and the environment and implements innovative technologies to meet those objectives.
- **Protect and enhance watershed health:** The District implements a landscape conservation strategy approach that is integrated with infrastructure projects.
- **Protect and maintain public infrastructure:** The District continues to maintain, upgrade and expand its assets to provide reliable and resilient infrastructure, investing in conveyance and treatment systems, stormwater management operations, and key long-term dam safety improvements.

- **Provide infrastructure for anticipated growth in the basin:** Clean Water Services' just-in-time approach to infrastructure relies on timely planning and ongoing investments to construct and upgrade facilities to meet near-term anticipated growth in its service area. This approach ensures effective and efficient treatment and cost-effective services that provide a sustainable rate structure for the community.
- **Expand resource recovery:** Through research and innovation, the District has pivoted from a wastewater treatment utility to one of resource recovery creating clean water for a variety of beneficial uses, producing renewable energy and recovering key nutrients.
- **Ensure ability to comply with CWA regulations:** Historically, Clean Water Services has consistently met the stringent regulatory requirements in its NPDES permits, winning annual National Association of Clean Water Agencies awards for excellence in permit compliance. The District strives to act proactively and continues to find innovative solutions to cost-effectively meet future regulatory requirements.
- **Strengthen watershed resiliency:** The District pioneered integrated water resource management using a One Water approach to address complex challenges related to water quality, hydromodification, resilient infrastructure, flow restoration and long-term water supply. The District seeks to actively integrate ecosystem enhancement activities with infrastructure improvements to improve watershed health and water quality and provide resilience in the face of growth and climate change.

In the work being done to meet these objectives, the District must continue to honor the people of the community and region, embedding diversity, equity, inclusion and justice, not only into conducting daily business operations, but also in its approach to the challenges ahead. By continuing to work innovatively and anticipating and addressing issues proactively, the District will be positioned for sustainable success, as it continues to bring the most cost-effective benefits to the community.

3 Current Activities Protecting Public Health and Enhancing Watershed Health

Since its inception in 1970, the District has made it its mission to provide cost-effective services and environmentally sensitive management of water resources to protect public health and enhance the environment and quality of life in the Tualatin River Watershed.

3.1 Wastewater Collection

3.1.1 Description of Collection System

The collection system includes 43 pump stations, approximately 1,850 miles of sanitary sewer line, 65 miles of force main, and about 46,700 sanitary sewer manholes. Pipes range from 4 inches to 84 inches in diameter. The age of the system generally corresponds to the time of incorporation of each of the jurisdictions.

Portions of the Hillsboro and Forest Grove systems date to the late 1800s; other areas are less than 10 years old. Major interceptors were constructed in the 1970s when the Rock Creek and Durham AWTFs were built.

The District has intergovernmental agreements (IGA) with each of the 12 cities in its service area and Washington County that articulate the division of responsibilities and Performance Standards for managing, operating and maintaining the collection system. The IGAs also outline the division of rate and System Development Charge revenues and financing of capital improvements.

Generally, the seven larger cities in the service area — Beaverton, Cornelius, Forest Grove, Hillsboro, Sherwood, Tigard and Tualatin — operate and maintain gravity sanitary lines smaller than 24 inches in diameter within their city limits. The District is responsible for all gravity lines 24 inches and larger and all pump stations and force mains. The District is responsible for operating and maintaining all sanitary infrastructure in unincorporated Washington County and in the smaller cities — Gaston, Banks, Durham, King City and North Plains.

Through implementation of the IGAs and associated Performance Standards, the District ensures the collection system has the necessary capacity, and is well managed, operated and maintained to transmit flows to the WWTFs.

3.1.2 Collection System Operational Strategy

The EPA considers criteria for Capacity, Management, Operation and Maintenance (CMOM) to evaluate a collection system. According to the EPA, the CMOM approach helps operators sustain a high level of service to customers and comply with regulatory requirements. The District incorporated CMOM-related elements into its collection system program and based its Performance Standards on CMOM principles. The goal of the District's collection system operational strategy is to protect water quality by proactively improving and maintaining the system to minimize risk of dry and wet weather overflows and efficiently managing and providing wastewater infrastructure in growth areas to support redevelopment.

3.1.3 Capacity

The District regularly updates its Sanitary Sewer Master Plan (Master Plan). The Master Plan has a 20-year planning horizon that is separated into five-year increments and a build-out scenario. As part of each update, the District works with the land use authorities to project population increases and potential service area expansions.

Clean Water Services uses this information and data from its system of sanitary sewer monitors to model existing and future flow conditions in the sanitary sewer system and identify locations where the existing pipe or pump station capacity might not be adequate. For each location identified, a ranking system is used to determine the risk of overflow and priority for addressing the capacity deficiency. The ranking takes into account opportunities to combine sewer improvements with other infrastructure replacements or redevelopment, maintenance needs, structural repair needs and basin infiltration and inflow (I/I) rehabilitation. Prioritization is dynamic. Cost estimates for improvements and future extensions of the collection system are documented to serve as a guide for annual capital improvement planning.

The District generally employs a just-in-time capital improvement delivery model. Once the Master Plan is updated, the District monitors the need to trigger projects through its system of permanent sanitary sewer flow monitors. Data from these sites are sent to District field operations and engineering staff in near real-time for analysis. The District also has a fleet of portable flow monitors that is used for more targeted sub-basin monitoring and project design.

The District has a long history of effective I/I reduction and uses I/I reduction and system rehabilitation as a tool in preserving collection system capacity. Sewer sub-basins are ranked based on I/I levels; basins with excessive I/I are prioritized for rehabilitation. I/I reduction is also used to defer or reduce downstream collection system and treatment plant improvements. The District, its partner cities and Washington County spend approximately \$4 million annually in I/I reduction and system rehabilitation efforts throughout the entire collection system.

The District realizes significant cost savings by comprehensively rehabilitating both public and private components of the sanitary sewer system. All ratepayers share the benefits of reduced I/I, which include decreased treatment costs, decreased risk of sanitary sewer overflows, and reduced capital expenditures for collection system and treatment plant upgrades and expansions.

The District or respective city is responsible for structural maintenance on the portion of sewer laterals within the public right-of-way. Structural maintenance of the portion of sewer laterals on private property is the responsibility of property owners served by the sewer lateral, except when the property is within a designated rehabilitation project area. The District offers to perform necessary structural maintenance at no cost to the property owner if a structural defect is found in any part of the lateral during a public or private inspection. Property owners are responsible for preventative and corrective maintenance activities such as inspection, blockage removal and cleaning required to preserve or restore functional operation and the free-flowing condition of sewer laterals.

3.1.4 Management

Clean Water Services has a robust program to maintain existing infrastructure. The Performance Standards for the sanitary system specifies areas of responsibility for the District, the cities in its service area, and Washington County. The Performance Standards detail maintenance frequency and measurement criteria for activities such as line cleaning, manhole maintenance and repairs, root control, TV inspections, and emergency response. These standards provide consistency across the entire service area and are designed to maintain the collection system efficiently and cost-effectively, identify and address potential issues in a timely manner, and minimize the risk of overflows due to inadequate capacity, maintenance or structural deficiencies.

Clean Water Services holds monthly technical meetings, quarterly operations meetings and annual overall program meetings with jurisdictions in the service area. These meetings are used to convey new requirements; monitor performance; assess resource needs; plan capital improvements; and share technical, policy and operational information.

Reporting data criteria is defined for all Performance Standards and each jurisdiction is required to have a maintenance management system that enables them to track and report their performance. The Systems Delivery Planning Group oversees performance for the District and each jurisdiction.

The District, the cities in its service area, and Washington County maintain 24-hour customer response systems and adhere to a consistent set of standard sanitary sewer overflow (SSO) response and reporting protocols. The District provides annual training to all field response and inspection staff in proper response, sampling, site management, reporting and clean-up procedures.

3.1.5 Operation and Maintenance

Clean Water Services uses operation and maintenance (O&M) practices that are consistent with the EPA's recommended approach including inspecting and testing the sewer system to track condition and identify potential problems; periodic cleaning and flushing; working with customers to reduce pollutant loads delivered to the treatment plants; and establishing procedures for notifying the public in the event of an SSO.

For day-to-day operations and during wet weather events, staff monitors the system status through a geographic information system (GIS) portal in near real time. Key monitors are programmed to send text messages when water levels in the sewer exceed pre-established thresholds. The District also uses real-time data and early warnings to allow crews to redirect flow, move flow using vactor trucks, contain overflows, or minimize the risk or potential effects of an overflow. Crews can also stop flows in some sectors of the system. The 43 pump stations are also telemetered and monitored by District staff. The system includes alerts, alarms and some remote operation capability.

The District's maintenance management information system, Lucity, is synchronized with the District's GIS. Known assets are given a unique identification number,

mapped in GIS, and incorporated into the electronic work order system. The District's GIS includes all known assets within the entire Clean Water Services service area. The District updates the systemwide GIS based on quarterly O&M performance reports provided by Washington County and the cities in the service district.

The Performance Standards include requirements for inspection, acceptance and mapping of new construction. Upon acceptance, new system assets are added to the GIS and put on work orders for routine maintenance in accordance with the Performance Standards.

3.2 Wastewater Treatment

The District's four WWTFs provide clean water that supplements flows in the Tualatin River and is used as recycled water. The effluent from the WWTFs represents a large fraction of the river's flow; sometimes more than a third during the dry season. The WWTFs also recover key nutrients in the form of fertilizer and generate electricity from biogas.

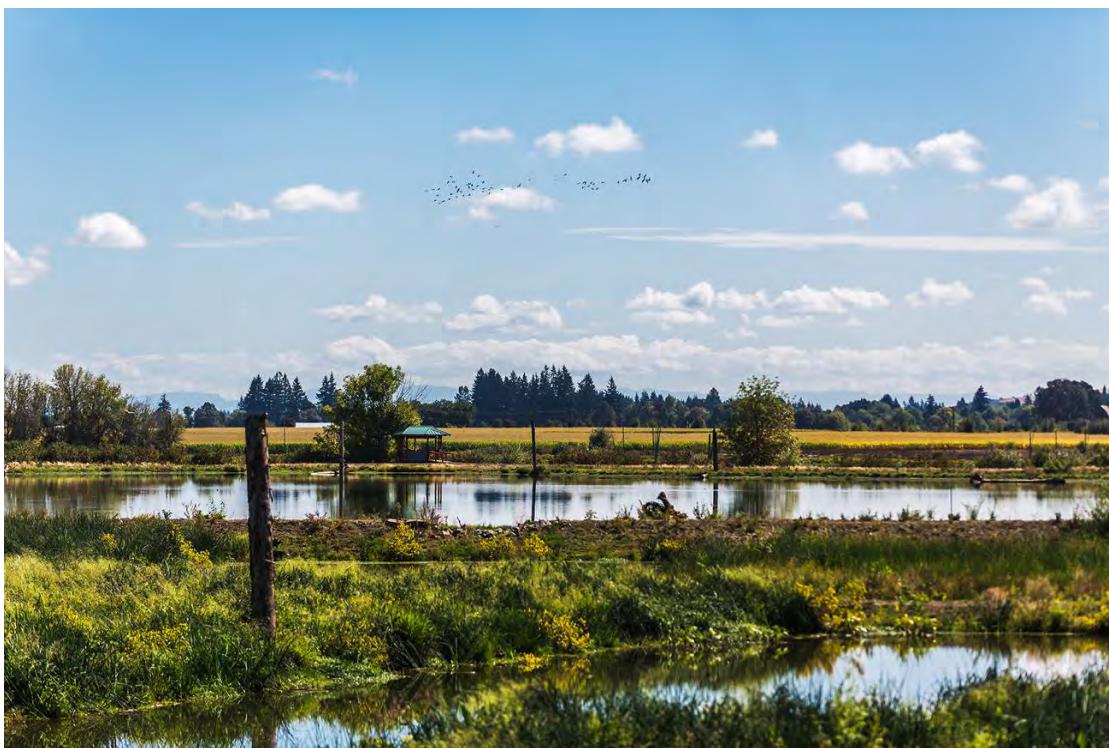
3.2.1 Description of the WWTFs

The Rock Creek and Durham AWWTFs discharge to the Tualatin River year-round. The Rock Creek AWWTF has an average dry weather design flow of 46.4 million gallons per day (mgd) and average wet weather design flow of 68.4 mgd (ODEQ 2016). The Durham AWWTF has an average dry weather design flow of 25.7 mgd and average wet weather design flow of 42 mgd (ODEQ 2016). Treatment processes include preliminary treatment followed by primary clarification, conventional activated sludge systems configured for nitrification and enhanced biological phosphorus removal, tertiary treatment for additional phosphorus and total suspended solids (TSS) removal, chlorine contact basins for disinfection, and dechlorination, prior to discharging to the river. The Rock Creek and Durham AWWTFs produce high quality effluent to meet permit limits and protect water quality of the Tualatin River.



▲ Rock Creek AWWTF

The Forest Grove and Hillsboro WWTFs are considerably smaller. The Forest Grove WWTF has a dry weather design flow of 6.3 mgd and both facilities have an average wet weather design flow of 7.8 mgd (ODEQ 2016). Both of the smaller treatment plants utilize conventional activated sludge secondary treatment processes and ultraviolet disinfection systems. During the dry season, Hillsboro does not discharge to the Tualatin River, but pumps primary effluent to the Forest Grove WWTF. The Forest Grove WWTF treats wastewater from the Forest Grove and Hillsboro service areas before directing effluent through the 95-acre Fernhill natural treatment system (NTS) for additional treatment prior to discharging to the Tualatin River. Both facilities discharge through their respective outfalls during the wet season.



▲ Forest Grove NTS

3.2.2 Pretreatment

The District regulates all significant industrial user discharges into the sanitary sewer system as part of its ODEQ-approved industrial pretreatment program. The program protects infrastructure investments, public and worker health and safety, biological processes at the WWTFs, Tualatin River water quality, and enables the beneficial use of biosolids.

3.2.3 Resource Recovery

The Durham and Rock Creek AWWTFs incorporate innovative treatment processes to recover resources and optimize performance. The Durham AWWTF produces Class A recycled water that is used May through October at golf courses, parks and athletic fields. In 2019, Durham AWWTF produced 57.1 million gallons of Class A recycled water, which results in a direct reduction in thermal load discharged by the facility to the Tualatin River.

In 2015, the District obtained regulatory approval from ODEQ and the Oregon Health Authority to purify 100 percent effluent for limited use by home brewers for a Pure Water Brew competition. Clean Water Services worked with consultants to design and build a pilot-scale high purity water treatment system enclosed in a customized trailer. The result is a mobile showcase of leading edge water purification technology – the Pure Water Wagon. The Pure Water Wagon provides a powerful community outreach tool to raise awareness of the District's wastewater programs and promote water quality and watershed stewardship. In July 2019, the District expanded the beneficial use to include commercial brewers and distillers who provide opportunity for greater control and capacity when producing alcoholic beverages.



▲ **Pure Water Brew Tasting**

Both the Rock Creek and Durham facilities recover nutrients from the waste streams to produce sustainable commercial fertilizer, while preventing nutrient-rich streams from being recycled to the head of the plants. In 2009, the District partnered with Ostara to implement the first municipal, full-scale struvite recovery system in the country, which efficiently precipitates phosphorus, ammonia and magnesium from waste streams to produce struvite fertilizer granules. In 2012, the District opened its second nutrient recovery facility at the Rock Creek AWWTF, which at the time was the world's largest municipal nutrient recovery facility.



▲ Durham AWWTF Ostara Reactors

The District also produces Class B biosolids used for land application. The Hillsboro and Forest Grove WWTFs transfer their solids to Rock Creek AWWTF for treatment. The Rock Creek and Durham AWWTFs thicken, anaerobically digest and dewater more than 31 dry tons of nutrient-rich organic material each day to produce biosolids that are used as soil amendment at local farms and rangeland across Eastern Oregon and the Willamette Valley.

The Durham and Rock Creek facilities implemented cogeneration systems that take the methane gas created during the anaerobic breakdown of organic material in the facilities' digesters and produce electricity and heat for process and space heating. Through cogeneration, some electrical energy needs are met (30 percent at the Rock Creek facility and about 60 percent at the Durham facility), while offsetting about 70 percent of the natural gas needed for heating. Energy production at the Durham facility is enhanced using more than 150,000 gallons of fats, oils and grease, delivered weekly from local restaurants. In the past, this substantial energy source was disposed of in landfills, but it is increasingly being used as feedstock to produce energy. The addition of fats, oils and grease has doubled the amount of digester gas produced at Durham, while providing a valuable service to local restaurants.

3.2.4 Planning and Management

The District uses the just-in-time capital improvement delivery model at the treatment facilities and schedules ongoing incremental investments in facility improvements and expansions. The approach is similar to its management approach with the collection system, which allows the District to take advantage of state-of-the-art treatment technologies without significantly overdesigning systems. The District

provides appropriate capacity where and when needed to accommodate growth in the service area and ongoing effective treatment that stays current with stringent regulatory requirements while maintaining a sustainable rate structure.

The District's proactive approach to planning extends to regulatory drivers. The District anticipates regulatory issues, conducts monitoring to gather necessary information, and takes actions to address them. This approach enables a thorough assessment of alternatives and the selection and implementation of environmentally sustainable, cost-effective alternatives in a timely manner.

3.3 Stormwater Management

The District's Stormwater Management Plan (SWMP) was incorporated into its NPDES permit issued April 2016 (ODEQ 2016). The SWMP and NPDES permit requirements constitute the Maximum Extent Practicable requirement that the District must meet in reducing the discharge of pollutants from the Municipal Separate Storm Sewer System (MS4). The District works with its co-implementers — Washington County and all the cities in its service district except Gaston, which is outside the MS4 area — to apply the applicable provisions of the SWMP. The SWMP groups stormwater best management practices (BMPs) into the following eight categories, aligned with permit requirements, which the District and co-implementers utilize to execute the MS4 program.

3.3.1 Illicit Discharge Detection and Elimination

The District and co-implementers implement an Illicit Discharge Detection and Elimination (IDDE) program to prevent, detect and eliminate illicit discharges to the MS4. The IDDE program includes an ordinance prohibiting illicit discharges, written enforcement response plan, dry weather field screening program, geographic information tracking system, and spill prevention and response actions. The IDDE program covers accidental and intentional discharges of wastes to the MS4, sanitary-to-storm cross connections and discharges from industrial facilities and construction sites.

3.3.2 Construction Site Runoff Control

The District and co-implementers carry out a construction site stormwater program that includes permitting, education, outreach, inspection and enforcement. District or city staff review Erosion Prevention and Sediment Control Plans to ensure that appropriate BMPs are included and perform regular site inspections to confirm that the BMPs and other measures are being implemented. Inspectors follow an escalating enforcement response procedure to bring sites into compliance. The District provides annual training to its staff.

3.3.3 Industrial and Commercial Facilities

The District acts as ODEQ's agent administering the industrial stormwater program (1200-Z NPDES general permits) under a Memorandum of Agreement with ODEQ for the entire MS4 service area. In implementing this program, the District identifies facilities that require an industrial stormwater permit, reviews permit application

materials (i.e., stormwater pollution control plan), conducts inspections, reviews discharge monitoring reports, solicits voluntary compliance from permittees, and escalates enforcement to ODEQ for compliance cases that require formal enforcement. The District also responds to site-specific information that indicates an industrial or commercial facility may contribute a significant pollutant load to the MS4.

3.3.4 Stormwater Facilities Operation and Maintenance Activities

The District and co-implementers carry out a comprehensive O&M program that includes catch basin and water quality manhole cleaning, vegetated and proprietary water quality facility maintenance, and private water quality facility inspection.

3.3.5 Education and Outreach

The District and co-implementers employ a public education and outreach program that informs and educates the public, business and industry representatives, and government staff about the causes of stormwater pollution, its effects on local streams and rivers, and the need for stormwater management. These BMP elements specify actions to protect water quality, reduce pollutant discharges from the MS4, and promote the health of the Tualatin River Watershed. The District and co-implementers train their employees involved in MS4-related activities, such as illicit discharge response, construction site inspection and water quality facility design.

3.3.6 Pollution Prevention for Municipal Operations

The District and co-implementers reduce pollutant discharge to the MS4 from municipal operations by sweeping urban streets, implementing an integrated pest management program, managing their municipal yards, limiting infiltration from the sanitary sewers, controlling releases from firefighting training activities, and retrofitting outfalls and catch basins to remove pollutants.

3.3.7 Post-Construction Site Runoff and Retrofit Programs

The District and co-implementers carry out a program to control the quality and quantity of stormwater runoff from developed sites. Through its *Design and Construction Standards*, the District requires development projects to treat stormwater runoff and control flow. The District's retrofit program addresses stormwater runoff from previously developed sites (Section 6.3.3). The District also implements a riparian protection and enhancement program that requires vegetated corridors be maintained or enhanced when new development occurs around Water Quality Sensitive Areas (Sections 3.4.2, 3.4.3, and 6.3.1).

3.3.8 Public Involvement and Participation

The District provides opportunities for the public to participate in the development, implementation, and modification of the District's stormwater management program. The Clean Water Services Advisory Commission meets regularly to provide the opportunity to gain input from stakeholders on District policies and programs (Section 7).

3.4 Watershed Enhancement Program

The District and its partners implement watershed enhancement activities throughout the Tualatin River Watershed including stream flow enhancement, riparian and stream restoration, wetland enhancement, upland activities in agricultural areas, and community planting projects. These activities provide a wealth of benefits, including ecological and societal benefits, implemented through partnerships with governmental and nongovernmental organizations. Many of these activities also help offset the thermal load inputs to the Tualatin River from the District's WWTFs and are part of the District's water quality trading program.

3.4.1 Thermal Load Management Activities

The District uses its recycled water program, the Forest Grove NTS, improvements at the wastewater treatment facilities, and source control activities to reduce the thermal load discharged by the WWTFs to the river. These methods are summarized in the following sections. The water quality credit trading program, which includes flow enhancement and riparian planting activities, is used to offset the remaining thermal load from the WWTFs.

SOURCE CONTROL

The District regulates all significant industrial user discharges into the sanitary sewer system as part of its ODEQ-approved industrial pretreatment program. Two significant industrial user dischargers installed cooling systems at their facilities to reduce thermal load to the WWTFs.

WASTEWATER TREATMENT FACILITY IMPROVEMENT

The District has implemented projects to reduce thermal loads discharged from the Rock Creek, Durham and Forest Grove WWTFs. The District covered primary clarifiers at the treatment plants to reduce solar loading. A cogeneration facility was constructed at Durham that included air cooled radiators to dissipate excess heat to the atmosphere and avoid discharging excess heat to the treatment facility effluent. Several other projects at Durham expand the utilization of heat recovered from the operation of the cogeneration facility and displace natural gas usage. The District also upgraded a water cooled chiller at Durham that uses plant effluent to absorb the rejected heat from an office building with high efficiency air cooled condensing units.

FOREST GROVE NATURAL TREATMENT SYSTEM

In 2017, the District began discharging treated effluent from the Forest Grove WWTF through the 95-acre NTS in Forest Grove for further treatment prior to discharge to the Tualatin River.

Average temperatures at the Forest Grove NTS are typically cooler than the temperatures at the Rock Creek facility. With the reduction in flow due to infiltration and evapotranspiration, and the cooler effluent temperatures, thermal loads from the Forest Grove NTS are substantially lower than those that otherwise would be discharged at Rock Creek AWWTF.

RECYCLED WATER PROGRAM

The District produces an average of 60 million gallons of Class A recycled water annually at the Durham facility to irrigate golf courses, parks and athletic fields. Implementation of the recycled water use program results in a direct reduction in thermal load to the Tualatin River.

3.4.2 Water Quality Credit Trading Program

The District's NPDES permit includes thermal load limits for the Rock Creek, Durham and Forest Grove WWTFs based on the 2001 Temperature Total Maximum Daily Load (TMDL) for the Tualatin River. The permit allows the District to offset the thermal loads from the Rock Creek, Durham and Forest Grove facilities by implementing a water quality credit trading program for temperature. The program includes flow enhancement and riparian planting activities. The Thermal Load Management Plan documents the District's approach for offsetting the thermal load and specifies its methodology for calculating thermal credits associated with the riparian planting and flow enhancement programs. The District also submits a Water Quality Credit Trading Report to ODEQ annually that summarizes the thermal load management activities conducted over the previous year.

FLOW ENHANCEMENT

Annually, the District has 12,618 acre-feet of available stored water in Scoggins Reservoir (Hagg Lake) and 1,654 acre-feet in Barney Reservoir. The District coordinates with the Joint Water Commission, which provides drinking water to several cities in Washington County including Hillsboro, Beaverton and Forest Grove; Oregon Water Resources Department (OWRD) District 18 Watermaster; Tualatin Valley Irrigation District (TVID); and other agencies to manage stream flows in the mainstem Tualatin River and select tributaries. The District typically releases stored water from June to October until the onset of fall rains.

The District releases stored water during the summer and fall low-flow period to meet the following objectives:

- **Offset thermal load from the WWTFs:** The NPDES permit allows the District to offset a portion of the thermal load discharged from the Rock Creek, Durham and Forest Grove treatment facilities by releasing stored water from Hagg Lake. Stored water releases in July and August form the basis for the flow enhancement credit. The remainder of the WWTFs' thermal load is offset by thermal credits generated from planting riparian areas.
- **Maintain minimum stream flows in the Tualatin River:** The District uses its stored water releases to maintain minimum stream flows above each WWTF during summer and fall low-flow periods.
- **Provide sustainable base flows in the upper Tualatin River:** During the summer and fall low-flow periods, the District's stored water releases from Hagg Lake and Barney Reservoir account for a large portion of the flow in the Tualatin River in the 15-mile stretch between the Springhill Pump Plant (where water is withdrawn for municipal and irrigation uses) and Highway 219 (where Dairy Creek enters the Tualatin River). The stored water releases

provide sustainable base flows that offer habitat for aquatic life and result in cooler river temperatures and higher dissolved oxygen levels.

- Enhance stream flow in key tributaries: The District coordinates with the TVID and local farmers to release stored water into Gales Creek, East Fork Dairy Creek, West Fork Dairy Creek and McKay Creek. Monitoring shows that the stored water releases in tributaries improves water quality by increasing dissolved oxygen levels and lowering stream temperatures.
- Improve dissolved oxygen levels and enhance overall water quality in the lower Tualatin River: The District's stored water releases help to offset sediment oxygen demand and maintain higher dissolved oxygen levels in the lower Tualatin River. This enhances water quality in the lower Tualatin River and provides operational flexibility for the WWTFs.

RIPARIAN PLANTING

The District's riparian planting program consists of a Capital Program in urban areas and a Landowner Incentive Program in rural areas.

Within urban areas, the District partners with cities, Washington County, Metro (an elected regional government that serves the Portland metropolitan area), Tualatin Hills Park and Recreation District, and other organizations to plant trees and shrubs on public and private property. Through these local government partnerships, the District is able to access property for planting and restoration. In return, the property owner receives planning, planting materials and long-term stewardship of their sites.

Riparian planting projects implemented under the District's Capital Program mostly occur on public lands where large-scale restoration opportunities are available and multiple water quality and ecological benefits can be achieved. Project activities under this program include securing easements or stewardship agreements with property owners, site preparation activities, invasive species management, re-vegetation, monitoring and maintenance.

In rural areas, the District's riparian planting program is primarily focused on agricultural land along streams and developing partnerships through the local Tualatin Soil and Water Conservation District (TSWCD). The District works with the TSWCD, the U.S. Department of Agriculture's (USDA) Natural Resource Conservation Service (NRCS) and USDA's Farm Service Agency to provide incentives for enrolling landowners in an enhanced version of the USDA's Conservation Reserve Enhancement Program (labeled ECREP). The ECREP has provided an opportunity to leverage local and federal programs and greatly increased the acceptance and implementation of restoration programs at the local level. The Vegetated Buffer Areas for Conservation (VEGBAC) is a locally designed program that provides incentives for rural landowners to plant native trees and shrubs in stream buffer areas. VEGBAC offers a restoration alternative to landowners who either do not qualify for ECREP or prefer more flexibility over higher benefits. Riparian planting projects implemented in rural areas primarily consist of site preparation, re-vegetation, invasive species management, monitoring and maintenance.

3.4.3 Other Watershed Enhancement Activities

The District conducts additional watershed enhancement activities including stream enhancement, irrigation efficiency and nutrient management in urban and rural areas.

STREAM ENHANCEMENT

The District conducts stream enhancement activities on a site-specific basis at a number of project sites to improve a broader range of ecosystem functions. These activities include channel reconfiguration, large wood placement, gravel-boulder placement and off-channel habitat creation.



▲ Habitat Creation and Stream Enhancement at PCC

UPLAND AGRICULTURAL PROGRAMS

The District collaborates with agencies to enroll farmers in programs that implement irrigation efficiency, nutrient management and other practices. The Agricultural Water Enhancement Program (AWEPP) is administered by the NRCS and provides incentives for farmers in the upper Tualatin River Watershed to implement practices that reduce nutrients, sediment and pesticide runoff to surface waters; increase streamflow by improving irrigation efficiency; and reduce stream temperature by providing riparian shade. The NRCS provides cost-sharing incentives via AWEPP for practices such as nutrient management, drip irrigation, filter strips, no-till farming practices and tree/shrub establishment. The Environmental Quality Incentive Program (EQIP) is also administered by the NRCS and provides assistance to growers and landowners who want to implement conservation practices including tree planting, drip irrigation, soil moisture sensors, fish screens, pest consultants and erosion control on their properties. EQIP and AWEPP are typically paired with the District's VEGBAC program.

COMMUNITY PLANTING PROJECTS

The Tree for All program recognizes the importance of community values including connected habitat and biodiversity, recreation and human health, sustainable urban rural economies, watershed resiliency and the District's One Water concept. TFA catalyzes coordination among diverse urban and rural partners. Cities, farmers, governmental organizations, nonprofit organizations, volunteers, industry and others with similar restoration goals develop shared programs that amplify ecological benefits. This community-driven approach has helped build a green economy; leveraged funding from multiple sources; improved habitat for fish, birds and other wildlife; increased climate change resilience and carbon sequestration; and developed the social capital needed to ensure long-term stewardship of enhanced areas.

3.5 Research and Innovation

The District has developed a robust research program to advance its effectiveness and productivity and reduce operational and capital costs. The District has identified a need to adopt new and innovative processes and technologies to support its core mission, which can only be addressed through a targeted internal research and innovation program. Innovation and the early adoption of technology are key to the just-in-time capital improvement delivery model and allow the District to provide better outcomes and successfully manage costs. This District program directly aligns with the 2012 IP Framework's call to incorporate innovative measures and technologies for sustainable infrastructure planning and implementation.

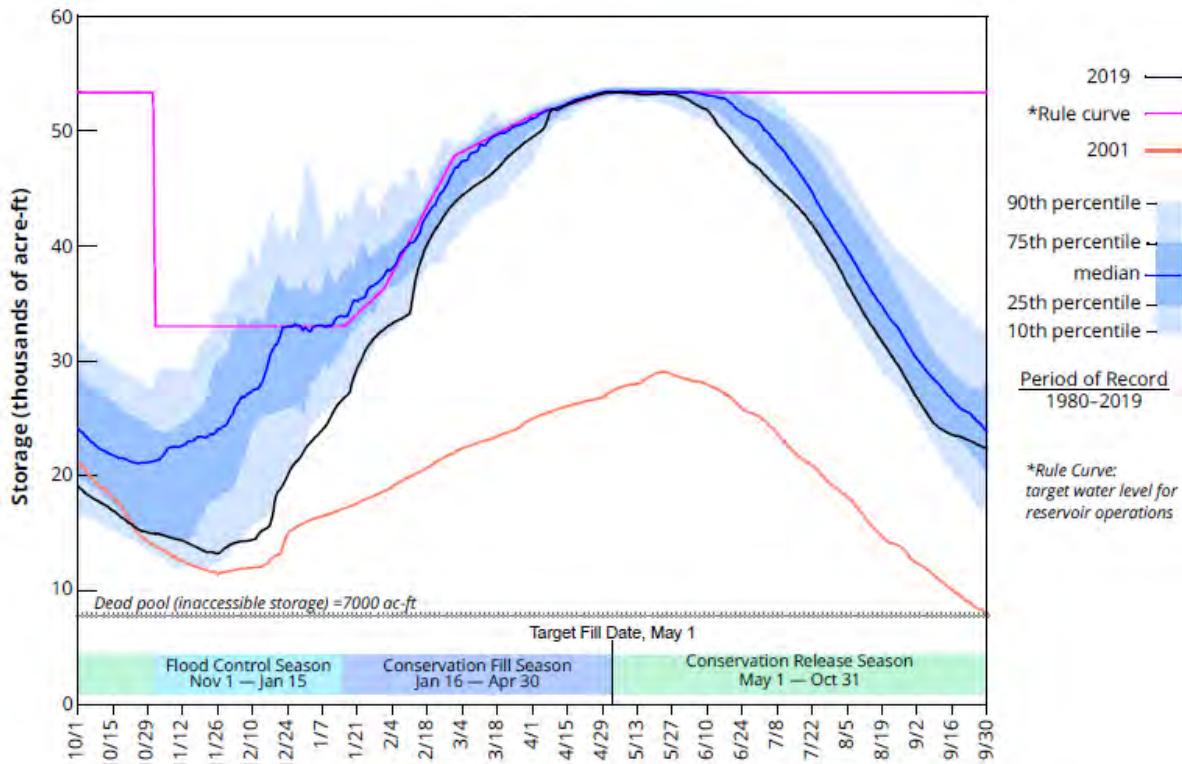
The research program is divided into specific areas related to foundational, strategic and aspirational needs. Foundational needs are related to day-to-day operations and typically involve small, highly effective changes that result in greater efficiencies, lower costs, improved productivity or greater safety. Often foundational improvements can result in marketable products or transferable procedures. As defined here, strategic research typically involves process changes or the optimization of impacts from large infrastructure projects. This research can result in improvement of procedures and operation. Aspirational research addresses long-term needs and is focused on changes the District may adopt in 10 to 20 years that have the potential for large benefits. Many of these projects can be classified as cutting edge or game changing.

3.6 Tualatin Basin Dam Safety and Water Supply Joint Project

Hagg Lake is the centerpiece of Washington County's water supply, providing drinking water and irrigation for 17,000 acres of cropland. The District has water rights to approximately 24 percent of Hagg Lake (as well as 10 percent of Barney Reservoir), which the District uses for flow enhancement of the Tualatin River and its key tributaries to support critical fish and wildlife habitat during low river flow conditions and offset thermal loads from the District's WWTFs. The District is currently able to offset these thermal loads with flow enhancement thermal credits and riparian shading thermal credits. Over the past 10 years the District has released an average of 80 percent of its available allocation each year with some years requiring release of nearly all allocated storage in Hagg Lake. With the anticipated

growth in its service population (Section 5.1), periodic droughts, and greater potential for sustained and recurring droughts in the future (Section 6.3.3) that have the potential to severely limit annual storage reserves (see year 2001 storage trend in Figure 3-1), there is a need to address the threat of future water shortages.

Figure 3-1. Hagg Lake Storage Trends, 1980-2019



Additionally, the U. S. Bureau of Reclamation, which owns and operates Scoggins Dam, is considering a seismic retrofit to the facility as part of a Safety of Dams project. Clean Water Services is working with the U.S. Bureau of Reclamation and local partners to evaluate three options that would reduce seismic risks and potentially secure additional water storage for the District. Final design and construction of the dam modification or a new dam is expected to take place over the next 10 to 20 years.

3.7 Public Education and Outreach

The District considers public engagement an important element of providing sustainable wastewater, stormwater and watershed management services and has built an industry-leading engagement program. This program aligns directly with one of the key elements in the 2012 IP Framework. District staff members engage audiences in capital projects, facility expansions and major District initiatives; build transformational partnerships with the education community and key watershed stakeholder groups; and manage the District's corporate communications, employee engagement, public involvement and student education strategies.

A Strategic Communication Plan, Student Education Strategy and public involvement plans guide the education and outreach program with clear messages and engaging strategies that are consistent with the District's mission, vision, values and promise. These documents reflect the goals of Clean Water Services as established by the District's Board of Directors and organizational leadership, thus underscoring the idea of an organization with a common purpose: public health, environmental protection and value for ratepayers and stakeholders.

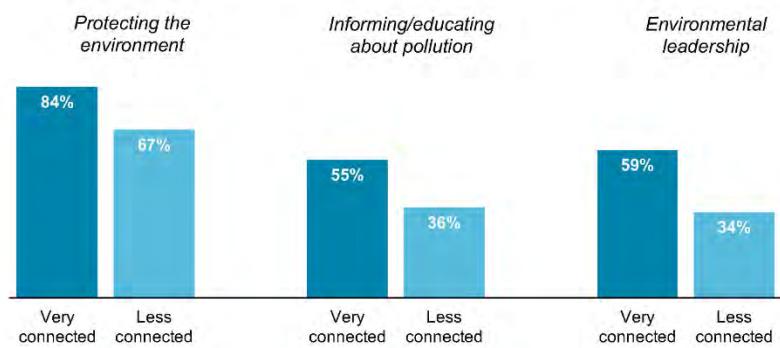
The Strategic Communications Plan guides broad outreach programs and key messages. The communication strategy is based on customer values and provides easy-to-understand information and practical behavior change actions that build support for Clean Water Services while nurturing a thriving community.

The District's Student Education Strategy identifies goals to help students and educators understand the interrelated parts of the natural world and how individual activities can make a difference in the health of the watershed.

The District has a robust public awareness research and engagement strategy that taps into community opinions and values and identifies challenges and opportunities. The District then develops objectives, key performance indicators and delivery mechanisms tailored for different audiences. Clean Water Services has conducted a Customer Awareness and Satisfaction Survey every other year since 1988. The survey measures awareness of Clean Water Services and its programs, value of services and community connection to the Tualatin River and its tributaries. These surveys shows that customers who are more connected to their local water body are more supportive of Clean Water Services' work (Figure 3-2).

Figure 3-2. Customer Awareness and Satisfaction Survey (January 2017)

Customers who are “very connected” to the river are more likely to view CWS’s environmental investments are “very important.”



DHM RESEARCH | CWS CUSTOMER AWARENESS AND SATISFACTION | JANUARY 2017

In fall 2018, the District participated in a regional Growing Up survey that examined the demographics of the service district, customer values and needs. The survey was not specific to water, but it offered interesting insights to a community in change and the District will use the information to create more effective outreach campaigns.

Clean Water Services targets specialty audiences to communicate specific objectives. With its community partners, the District provides public educational programs and materials to foster water quality protection such as Canines for Clean Water, Gardening with Native Plants, The Stream Care Guide, and River Rangers. These programs and materials teach proper disposal of hazardous wastes, water-friendly and chemical-free gardening, pet waste cleanup, and riparian protection.

The District installed signage at every stormwater treatment facility that explains the function of the facility in protecting water quality. In addition, Clean Water Services has cosponsored SOLVE cleanup efforts; provided storm drain markers to volunteers to deter illicit discharges; conducted behavior change campaigns about proper disposal of household fats, oils, grease and nonflushable wipes; and published information about littering, illegal dumping and water quality on its website, in billing inserts, in the Clean Water Connection electronic newsletter and in city newsletters.



▲ Stormwater Treatment Facility Signage



▲ **Storm Drain Marker**

Wipes clog pipes!

Many household cleaning products are labeled and marketed as "disposable" but that doesn't mean you should flush them down the toilet. Items include:

- disinfecting wipes
- baby wipes
- mop refills
- paper towels
- towelettes

These products **don't dissolve** once they are flushed; they clog private pipes that cause expensive and time consuming repairs for homeowners. On a larger scale, these products also get tangled up and stuck in public sewer pipes and pump station equipment leading to unpleasant sewer backups. Save yourself and your wastewater utility from a pain in the drain; put wipes, rags and towels in the trash, not the toilet.

503.681.3600
cleanwaterservices.org

Celebrating 50 Years

CleanWater Services

▲ **Nonflushable Wipes Informational Postcards**

Clean Water Services works with ODEQ, Metro and other Oregon municipalities as part of a Pollution Prevention Outreach team to implement the EcoBiz program, which certifies businesses such as landscapers and automotive shops that voluntarily meet statewide standards.

The District employs a multitude of communication options including photography, videos, graphics, social media, radio and TV spots, press kits, fact sheets, media advisories, classroom presentations, industry events, public events and newsletters.

3.7.1 Public Involvement

Clean Water Services obtains input on its outreach efforts from a variety of sources and uses that information to update and refine its messages. The District uses a documented stakeholder engagement process to ensure project and policy decisions are made with appropriate input. Including stakeholders throughout the decision-making process builds credibility and support. Clean Water Services receives input and guidance on policies and programs from its Board of Directors. The District also gets input from the Clean Water Services Advisory Commission, which holds monthly meetings that are open to the public. The commission's 15 members are appointed by the Board of Directors to represent neighborhood, business, development, environmental and agricultural interests.

3.7.2 Education

Well-planned education programming fosters learning that can change how people think, act and make decisions. Education is an integral component to increasing awareness, sharing information and promoting behavior that improves watershed health and sustainable water resources management. Through classroom and field-based education programs and stewardship opportunities, the District and its partners deliver information and practical tools to promote the health of the Tualatin River Watershed and bring real-world application to classroom learning. During the 2019-2020 school year, more than 6,000 students participated in programs sponsored by the District. One of Clean Water Services' programs, River Rangers, engaged over 1,600 elementary school students at 22 schools, educating young students and inspiring them to take action to support a healthy watershed.

In 2017, Clean Water Services launched the Paseos Verdes Watershed Health Walk program to connect historically underserved community members to natural areas in the Tualatin River Watershed through guided bilingual nature walks. The program is based on the idea that connecting the community with nature is good for the watershed and good for human health and wellness. The walks engage families to learn about watershed health, water management and wildlife while having fun in a safe environment. The goal of these experiences is to foster environmental stewardship and provide the well-documented health benefits that come from being active in the outdoors.

3.8 Watershed Monitoring Program

The District conducts a comprehensive, watershed-based monitoring program that includes stream flow monitoring, continuous water quality monitoring, ambient water quality monitoring using discrete samples, macroinvertebrate monitoring, physical conditions monitoring and project-oriented monitoring. The District's monitoring program provides a strong foundational element that builds into the IP's adaptive management strategy by providing timely feedback on water quality improvements linked to program and project implementation. The following is a brief description of each element of the program.

3.8.1 Flow Monitoring

The District partners with the U.S. Geological Survey (USGS), OWRD District 18, and others to monitor stream flow at more than 20 locations in the Tualatin River Watershed using continuous recording devices. Stream flow data are collected every 15 minutes and much of this information is available on a near-real-time basis on the USGS and OWRD websites: <http://or.water.usgs.gov/tualatin/monitors/> and http://apps.wrd.state.or.us/apps/sw/hydro_near_real_time/Default.aspx.

Stream flow data are published annually in the Tualatin Basin Flow Management Committee Annual Report. These reports are available on the District 18 Watermaster's website:

<http://www.co.washington.or.us/Watermaster/SurfaceWater/tualatin-river-flow-technical-committee-annual-report.cfm>.

3.8.2 Continuous Water Quality Monitoring

The District and USGS jointly fund the operation of continuous water quality monitoring devices in the watershed. These devices are deployed in key tributaries and the mainstem Tualatin River at Scoggins Creek, Gales Creek, Wapato Creek, Rock Creek, Chicken Creek, Tualatin River at Dilley, Tualatin River at Hwy 219, Tualatin River at Scholls, and Tualatin River at Oswego Dam. Water quality parameters including temperature, dissolved oxygen, turbidity, specific conductance, chlorophyll and Phycocyanin (at select locations), and pH are monitored hourly and the data available in near-real time on the USGS website:

<http://or.water.usgs.gov/tualatin/monitors/>

Data are used to determine water quality based effluent limits for ammonia at the District's WWTFs, provide long-term status and trend data, and respond to potential water quality problems.

3.8.3 Ambient Water Quality Monitoring using Discrete Samples

The District's ambient water quality monitoring program consists of monitoring field parameters (temperature, dissolved oxygen, pH, turbidity and specific conductance), major ions, nutrients, chlorophyll, total organic carbon, solids, pathogen indicators and metals. The District monitors more than 20 locations on the mainstem Tualatin River and major tributaries twice per month.

Figure 3-3 shows the location of the District's ambient water quality monitoring sites.

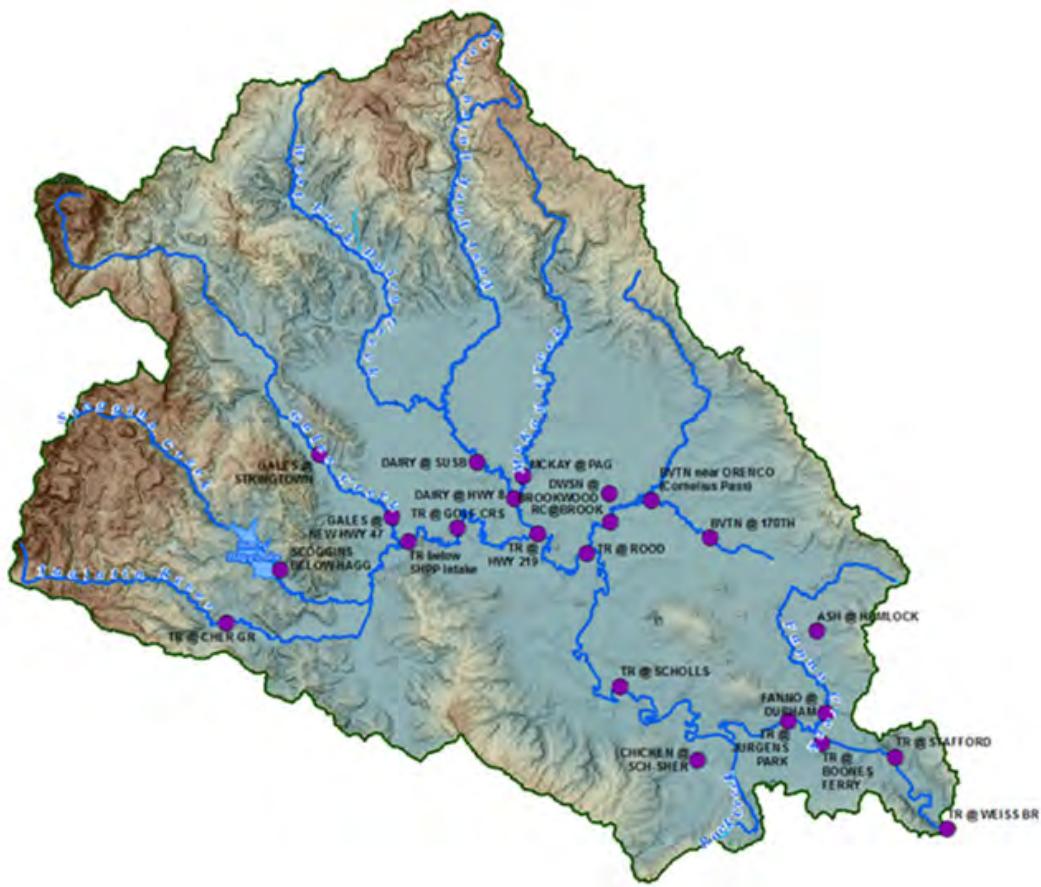
Figure 3-3. Ambient Water Quality Monitoring sites

Table 1 presents a summary of the District's discrete ambient monitoring program. It includes the monitoring sites, location, description, parameters and frequency.

Table 1. Summary of Ambient Water Quality Monitoring Program

SITE LIST			Location Description										PARAMETERS																				
LOC COD	Location	River Mile	Description	Continuous Water Quality Data Site?		Continuous Flow Data Site?		Time	Sample Depth	Temperature	Dissolved Oxygen	DO % SAT	pH	Specific Conductance	Turbidity	Total Solids	TDS	TSS	NH3-N	NO2 + NO3-N	TKN	T-PO4-P	S-OPO4-P	Alkalinity	NPOC for TOC	Chloride	E. coli	Chlorophyll - a Corrected	Chlorophyll - a Uncorrected	NPDES Permit Monitoring	Mercury (Total & Dissolved)	Hardness	Metals (Total & Dissolved)
				N	Y	N	N																										
MAINSTEM TUALATIN RIVER																																	
3701002	Tualatin River @ Weiss Bridge	0.2	Representative of conditions below Oswego Dam	N	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
3701054	Tualatin River @ Stafford Road	5.4	Lower section of reservoir below Lake Oswego diversion	N	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
3701087	Tualatin River @ Boones Ferry	8.7	Downstream of Durham AWTF and Fanno Creek; DEQ monitors at this location	N	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S						
3701106	Tualatin River @ Jurgens Park	10.6	Upstream monitoring site for Durham AWTF	N	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Q						
3701271	Tualatin River @ Scholls	27.1	Upper section of the reservoir, Downstream of Rock Creek AWTF	Y	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S	X						
3701391	Tualatin River @ Rood Bridge Road	39.1	Upstream of Rock Creek AWTF; Downstream of Hillboro WWTF	N	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Q						
3701450	Tualatin River @ Hwy 219	45.0	Upstream of Hillsboro WWTF (Jackson Bottom)/Downstream of Forest Grove WWT	Y	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S	S						
3701528	Tualatin River @ Golf Course Road	52.8	Downstream of Forest Grove WWTF	N	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S						
3701580	Tualatin River @ Fernhill Bridge	58.0	Upstream of Forest Grove WWTF; below Springhill intake	N	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	Q						
3701715	Tualatin River @ Cherry Grove	71.5	Upper river monitoring location; representative of background conditions	N	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
TRIBUTARIES																																	
3805050	Scoggins Creek below Dam	5.0	Below release from Hagg Lake	Y	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S							
3810015	Gales Creek @ New Hwy 47	1.5	Near mouth of Gales Creek	Y	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S							
3810070	Gales Creek @ Stringtown Road	7.0	Representative of water quality entering CWS service area	N	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S							
3815021	Dairy Creek @ Hwy 8	2.1	Near mouth of Dairy Creek	N	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S							
3815058	Dairy Creek @ Susbauer Road	5.8	Representative of water quality entering CWS service area	N	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
3816010	McKay Creek @ Padgett Road	1.0	Near mouth of McKay Creek	N	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S							
3820022	Rock Creek @ Brookwood	2.2	Near mouth of Rock Creek	Y	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S							
3821012	Beaverton Creek @ Cornelius Pass	1.2	Near mouth of Beaverton Creek	N	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S							
3821050	Beaverton Creek @ 170th	5.0	Location of USGS continuous recording device	Y	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
3835020	Chicken Creek @ Scholls-Sherwood	2.0	Near mouth of Chicken Creek above TR Wildlife Refuge	N	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S							
3840012	Fanno Creek @ Durham Road	1.2	Near mouth of Fanno Creek	Y	Y	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S							
3845014	Ash Creek @ Hemlock	1.4	Representative of SW Portland water quality	N	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
3850006	Dawson Creek @ Brookwood	0.6	Near mouth of Dawson Creek	N	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	S							
NOTES																																	
X = twice per month; Q=Quarterly; S=Semi-annually																																	

Provided by Clean Water Services

3.8.4 Macroinvertebrate Monitoring

Macroinvertebrate monitoring is conducted to assess the condition of biological communities and ascertain longer-term trends. The District also conducts physical habitat conditions monitoring, which includes wetted width, bank condition (eroding and undercut), percent canopy cover and large wood rating. Since 2000, the District has conducted regular macroinvertebrate monitoring surveys in the watershed. Table 2 provides a summary of each survey.

Table 2. Summary of Macroinvertebrate Monitoring

Year	Objective	Sites
2000	Assess biological conditions of area streams	44
2001	Assess biological condition of area streams and identify relationships between environmental gradients and biological conditions	63
2005	Assess current biological conditions of area streams	63
2007	Assess current biological conditions of area streams	20
2009	Identify least disturbed low gradient and characterize benthic communities in these reaches	13
2009	Quantify differences in benthic assemblages between riffles and glides, and determine effects of instream and land use conditions in these differences	17
2010	Assess current biological conditions of area streams and ascertain longer-term trends (2000-10)	33
2013	Assess current biological conditions of area streams and ascertain longer-term trends (2000-13)	13
2015	Assess current biological conditions of area streams and ascertain longer-term trends (2000-15)	13
2018	Assess current biological conditions of area streams and ascertain longer-term trends (2000-18)	15

Source: 2018 Tualatin River Macroinvertebrate Assessment, Cole Ecological, Inc., May 2019

The 2018 macroinvertebrate monitoring survey included 15 stream reaches with five higher-gradient reaches and 10 lower-gradient reaches. Of the 15 stream reaches, 13 reaches were included to continue longer-term monitoring of biological conditions in sampled waterbodies; two new reaches were sampled for the first time in association with District's stream enhancement activities. A reach summary was prepared for each project site and includes the physical conditions, riparian conditions, photographs, water quality data collected during the macroinvertebrate monitoring and a summary of the macroinvertebrate scores. The results of the 2018 macroinvertebrate monitoring will be submitted to ODEQ with the NPDES permit renewal application.

3.8.5 Project Monitoring

The District conducts project-based monitoring to assess the effectiveness and evaluate the benefits of projects. Monitoring may include hydrologic parameters (stream flow, stage), geomorphology (channel cross sections, stability), vegetation monitoring (native woody plant density, canopy cover, plant diversity), and wildlife surveys (amphibian survey, avian survey, dragonfly/damselfly).

The District is evaluating metrics to assess effectiveness and benefits of projects including erosion potential, system storage, energy dissipation, stream power and sediment dynamics. Depending on the project, the District will assess conditions associated with the metrics before and after project work to gauge project effectiveness.

3.8.6 Anticipated Scope of Watershed Monitoring Program

The District plans to continue implementing the monitoring program to inform and assess the effectiveness of management activities. The number of monitoring sites, their location, and/or parameters may be modified to address specific needs, but the general elements of the monitoring programs will be maintained.

4 Effectiveness of Actions in Meeting Objectives

4.1 Water Quality Improvements

The strategies employed by the District in the wastewater collection, wastewater treatment, stormwater management and watershed enhancement programs have been successful in protecting public health and the environment.

For wastewater collection systems, one of the key performance indicators is the number of SSOs per 100 miles of sewer pipe per year. Over the past five years (2015-2019), the District has averaged less than one SSO event per 100 miles of sewer main per year, indicative of a high performing collection system. Primary causes of overflows are typically due to vandalism and damage during construction projects from failure to accurately locate the pipe.

Improvements at the WWTFs have led to direct improvements in water quality in the Tualatin River. Figure 5-2 (Section 5.3.4) shows that algal biomass (measured as concentrations of chlorophyll in the water column) have decreased over the past two decades to concentrations generally below 10 ug/L — routinely below the goal of a three-month average of 15 ug/L — and pH excursions in the river have been eliminated in recent years. Algae levels and pH excursions were the primary impairment parameters associated with the phosphorus TMDL. The District has also been successful in reducing ammonia loads to the river, which also benefits dissolved oxygen concentrations in the river. (Ammonia was the primary parameter for the dissolved oxygen TMDL.)

The effectiveness of the stormwater program can be demonstrated by looking at water quality trends in the Tualatin River tributaries. The District's ambient monitoring program includes regular sampling on the major tributaries of the Tualatin River. As part of its 2020 Stormwater Annual Report, the District conducted a trend analyses for metals, nutrients and suspended solids using data collected over the past 10 years. Monitoring data were evaluated by computing the values and reporting the statistical significance of the Seasonal Kendall *tau* correlation coefficient, a nonparametric procedure that is used to determine whether values tend to increase or decrease monotonically (i.e., gradual rather than abrupt changes over time that may or may not be linear). All evaluations used a statistical significance level (α) of 0.05. For trends determined to be significant, the estimated probability that a trend is actually present and not arising due to chance is at least 95 percent. The six sample locations and 10 pollutant parameters provided 60 datasets for trend analyses. Three separate trend analyses were performed for each of these datasets: one for the summer data (samples collected from May through October), one for the winter data (samples collected from November through April), and an overall test for the entire year. In all, there were 179 trend analyses completed.

Of the 179 trend analyses, 74 were statistically significant at $\alpha = 0.05$. Of these significant trends, 61 were negative (indicating decreasing pollutant concentrations) and 13 were positive (indicating increasing pollutant concentrations). The positive trends were related to nutrients (primarily ortho-phosphate); although statistically

significant at alpha 0.05, the magnitude of the positive trends was not large. A more detailed review of the data is needed to draw inference from the apparent trend. Once confirmed, the District will use this information to implement strategies and outreach efforts through its adaptive management program.

4.2 Watershed Enhancement Program

Since the establishment of the water quality credit trading program in 2004 through 2020, the District has implemented 161 riparian planting projects along streams in the Tualatin River Watershed generating 520 million kcal/day of thermal credit. The District typically releases about 35 cfs of stored water into the mainstem Tualatin River and key tributaries to enhance stream flows and improve overall water quality. Figure 4-1 and Figure 4-2 show the geographic scale of the District's riparian planting projects and flow enhancement program. With its water quality credit trading program, the District has successfully offset the thermal load from its WWTFs with credits generated from flow enhancement and riparian planting activities.

Figure 4-1. Riparian Planting Projects (2004 – 2019)

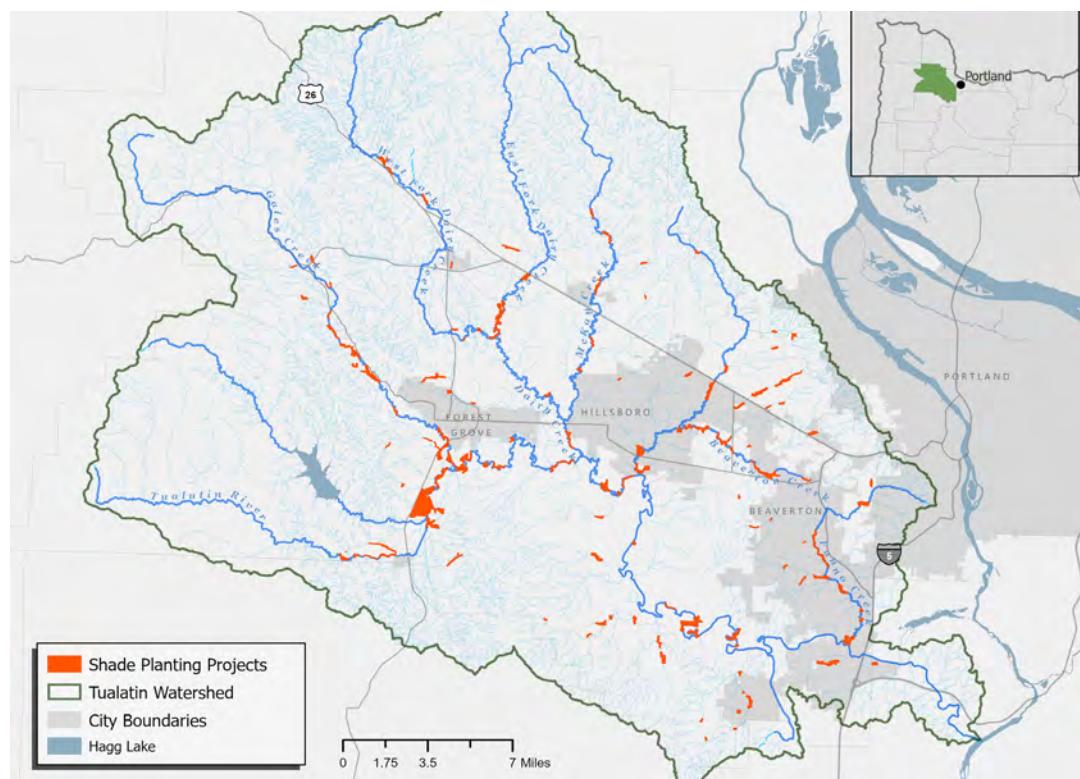
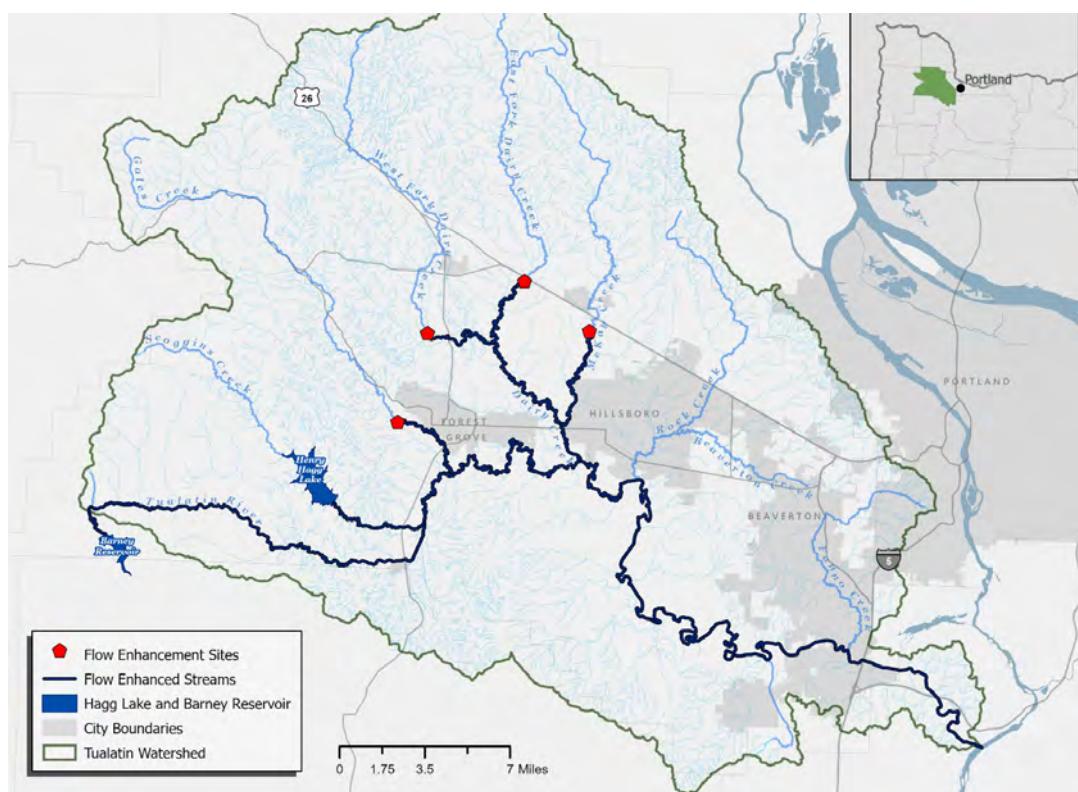


Figure 4-2. Flow Enhancement in Tualatin River Watershed

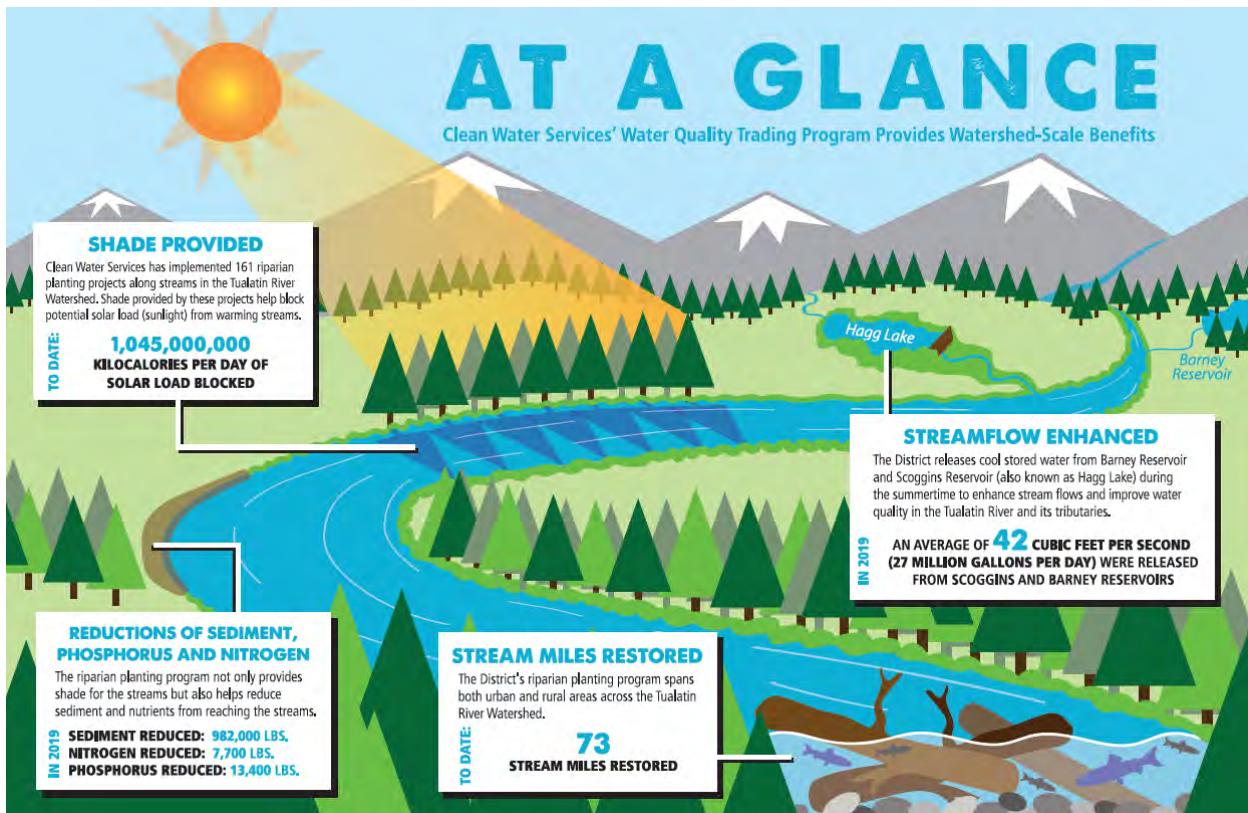
The District's water quality credit trading program provides numerous ecosystem benefits beyond temperature benefits. Ecosystem benefits include floodplain roughness, bank stabilization, peak flow attenuation, habitat creation, and improved stream and riparian corridor functions. Additional benefits include greater aquatic and terrestrial plant and animal species diversity, more filtered stormwater runoff, and improved water quality. The increased complexity of structure and diversity of restored riparian forests, forested wetlands, and scrub-shrub wetlands support many important ecosystem functions for the aquatic environment. One example is the colonization of some stream reaches by beavers, a keystone species for stream function in the watershed. By raising the water table, beavers promote floodplain wetlands with enhanced plant, animal, and geomorphic diversity compared with the original simplified stream channel.

The District has quantified the water quality benefits associated with sediment and nutrient reduction from the riparian planting program. The 161 riparian planting projects currently enrolled in the District's water quality trading program are estimated to remove approximately 982,000 pounds of sediment, 7,700 pounds of total nitrogen, and 13,400 pounds of phosphorus each year that would otherwise be released into streams in the Tualatin Basin (Figure 4-3). These estimated load reductions are based on a 2014 study on nutrient and sediment removal rates for stream restoration projects in the Chesapeake Bay (Schueler 2013).

The District's release of stored water also provides multiple ecosystem benefits. The stored water used for flow enhancement provides cooling effects, provides buffers

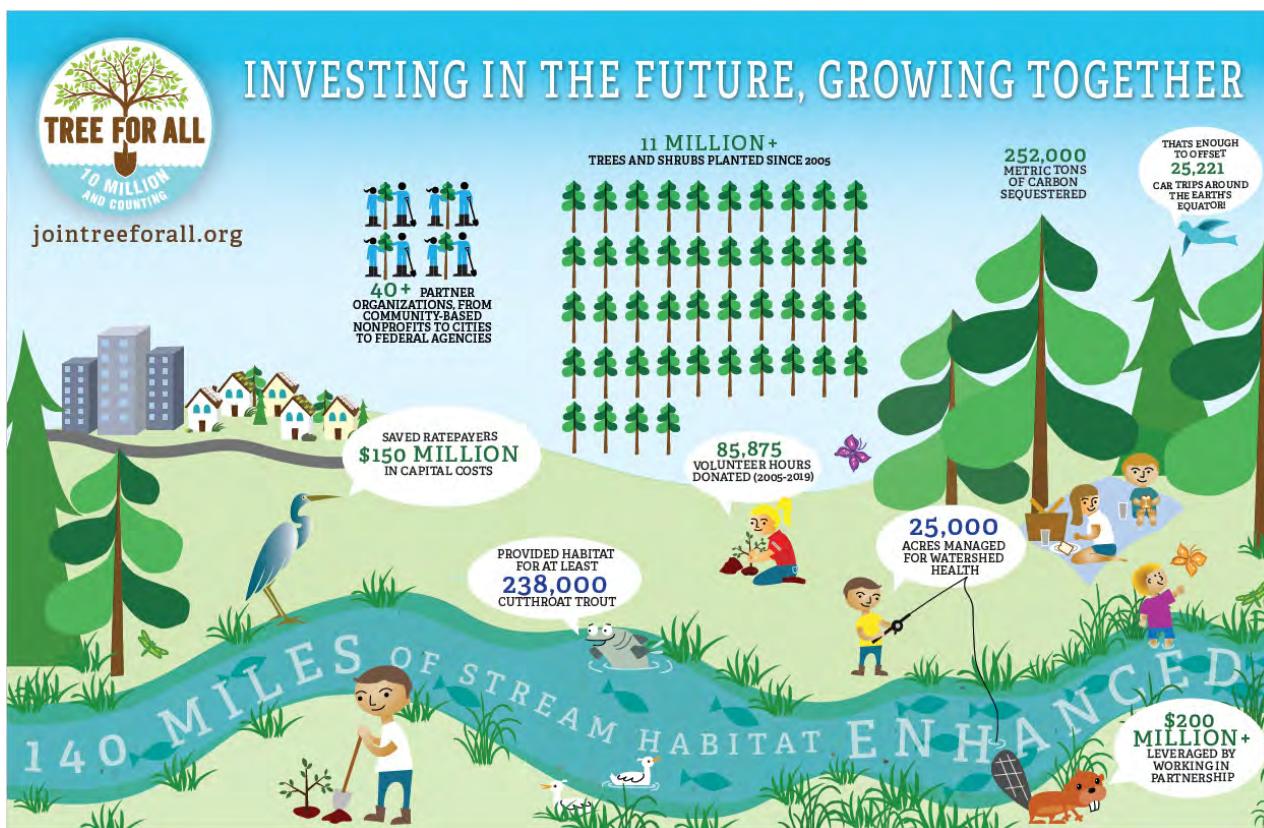
against temperature changes and improved overall water quality to support aquatic life. The District's releases of stored water also sustain base flows in the upper Tualatin River. The release of stored water and highly treated discharges from the District's Rock Creek, Durham, and Forest Grove facilities and NTS, provide a sustainable base flow to the mainstem Tualatin River during the dry season.

Figure 4-3. Water Quality Credit Trading Program Benefits



4.2.1 Community Benefits

Under the TFA program, diverse partners work toward a shared vision of a healthier watershed. Since 2005, TFA partners have managed more than 30,000 acres for watershed protection and restoration and planted more than 11 million native plants (Figure 4-4).

Figure 4-4. Community Benefits of Tree for All Program

4.3 Research and Innovation

The District takes great pride in its commitment to innovation. The District believes that its success is strongly dependent on the rapid implementation of innovative practices at all levels of the organization. Specific areas are described below that illustrate the success of innovation commitments.

4.3.1 Improved Reliability of Biological Phosphorus Removal Process

The biological phosphorus removal processes at the Durham and Rock Creek facilities have resulted in about 40-60 percent reduction in effluent phosphorus and allowed greater recovery of phosphorus in the WASSTRIP/Ostara processes. However, summer effluent limits for total phosphorus have only been achieved with tertiary alum (aluminum sulfate) addition. District research over the past five years has focused on improving the biological phosphorus removal process. The research has resulted in improved source control for reduction of influent nitrates and oxygen, addition of volatile fatty acids to support phosphate accumulating organism growth, maintenance, and monitoring of populations, and control of sludge recycle rates and solids retention times. In 2020, the District was able to achieve target phosphorus concentrations at both the Rock Creek and Durham AWTFs without adding alum during the tertiary stage of the treatment process. Eliminating alum reduces the discharge of aluminum; increases phosphorus recovery in the Ostara project; reduces carbon, energy and ecological footprint; and substantially reduces chemical costs.

4.3.2 Vertical Flow Wetlands for NTS

The vertical flow wetlands at Forest Grove were developed during a three-year research project. The research resulted in the design parameters for the vertical flow wetlands including hydraulic detention time, recycle rates, and rock media selection and sizing. Under full-scale operation, the vertical flow wetlands results in 70 to 90 percent nitrification effectiveness. This is achieved in a fill-and-draw operating mode with no external aeration. This technology potentially has wide scale application for small WWTFs to achieve ammonia removal with high stability and low costs.

4.3.3 Improve Measurement and Understanding of Inhibition

Discharges from industrial sources have the potential to affect the biological processes at the District's WWTFs. The District establishes local limits for industrial sources to protect the biological processes at the WWTFs, protect water quality, protect health and safety, and ensure beneficial use of biosolids. Inhibition thresholds define concentrations of pollutants such as metals that adversely affect biological processes in the treatment facility. Available guidance for many of these inhibition values is based on a limited number of studies, some of which are several decades old. Additionally, the range of threshold values can vary by an order of magnitude or more.

The District's research (*Inhibition Measurements to Support Local Limits Regulation*) has focused on developing rapid methods of inhibition monitoring to allow improved understanding of inhibitory response to activated sludge from its facilities. This research has resulted in specific determination of inhibitory concentrations for copper and zinc for both heterotrophic oxidation and nitrification that can be directly applied to the development of local limits for industrial sources.

4.3.4 Reduction of Disinfection Byproducts at Rock Creek and Durham WWTFs

This project continues the development and implementation of ammonia addition before chlorination to reduce the production of disinfection byproducts, particularly trihalomethanes. The project identified that the addition of low doses of ammonia to produce chloramines successfully reduces disinfection byproduct formation and ensures compliance with water quality criteria.

4.4 Public Education and Outreach

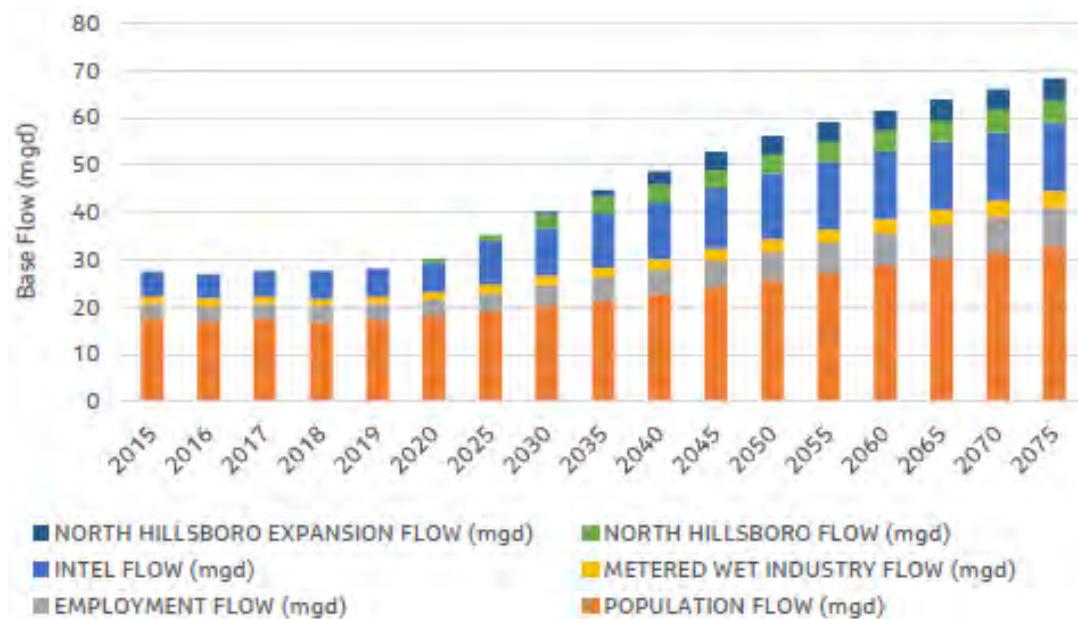
The District assesses the effectiveness of its public engagement and education programs by collecting data on program effectiveness, analyzing the data to determine the effectiveness of educational and behavioral change efforts, identifying programmatic changes to improve outcomes, and implementing those improvements. Outreach materials and engagement strategies are created or updated based on results of the ongoing feedback.

5 Challenges the District Faces

5.1 Growth

The District's service population is projected to double by 2075 based on population and employment forecasts (Jacobs 2020). This continued residential, commercial and industrial growth in the region is expected to increase flows to the WWTFs in a similar fashion, with base flows approximately doubling by 2075. The Rock Creek AWWTF is expected to see the largest percent increase in future flows due to most of the industrial expansion affecting the Rock Creek treatment basin (Figure 5-1). The District will need to continue to provide infrastructure to keep pace with the region's growth, while maintaining its high level of treatment, continuing compliance with regulatory requirements, and providing cost effective services to ratepayers.

Figure 5-1. Rock Creek AWWTF Base Flow Projections



5.2 Replacing Aging Infrastructure

The District has wastewater and stormwater collection system and treatment system assets of varying ages across the watershed that require regular investments in rehabilitation and replacements as they reach the end of their useful life. The collection system includes 43 pump stations, approximately 1,850 miles of sanitary sewer line, 65 miles of force main and about 46,700 sanitary sewer manholes. The age of the system generally corresponds to the time of incorporation of each of the jurisdictions. Portions of the Hillsboro and Forest Grove systems date to the late 1800s, while there are large areas of recent growth expansion that are less than 10 years old. Major interceptors were constructed in the 1970s when the Rock Creek and Durham WWTFs were built. These two larger WWTFs have had major upgrades and expansions occurring periodically since the 1990s. The Hillsboro and Forest Grove WWTFs have also undergone major upgrades over the past 25 years,

transforming large portions of the treatment plants to treat current wastewater flows and meet changing regulatory requirements.



▲ Field Operations staff replacing section of collection system piping



▲ Field Operations crew entering a manhole

The District heavily invests in upgrades to aging infrastructure throughout its wastewater collection and treatment systems and expects the necessary level of

investment to continue to rise in the foreseeable future. Some of the earliest stormwater treatment facilities were built in the early 1990s in response to TMDL implementation plans, predating the MS4 program, and will potentially also require financial investments for upgrades or retrofits in the coming years. These stormwater facility improvements provide ongoing opportunity to further integrate green stormwater solutions into the existing systems.

While the District will need to replace aging infrastructure, many of the replacements and upgrades could be efficiently co-implemented with other improvements such as enhancements to address water quality improvements to meet new regulation requirements. The District would like to work with ODEQ via this integrated planning process to better understand regulatory priorities to implement infrastructure upgrades and replacements to benefit key regulatory pursuits on a schedule that is cost effective for the District (Section 9).

5.3 Regulatory Challenges

The District faces a number of challenges with the continued operation and management of the wastewater collection and treatment system under the current regulatory framework. These are discussed below.

5.3.1 Wastewater Collection

The District will continue its CMOM-based approach for managing and maintaining the collection system to minimize overflows. It is expected that the precipitation events as a result of climate change will be of greater intensity, which will place additional burden on the wastewater collection system, its operation and maintenance, and efforts to minimize I/I. Developing a cohesive wet weather strategy with ODEQ will be critical for the District and other municipal collections systems in Oregon (Sections 6.1.1).

5.3.2 Highly Managed River System

During typically low flow periods for the Tualatin River (late summer, early fall), the District's WWTF discharges often represent a substantial proportion of river flow. Together with the stored water releases from Hagg Lake and Barney Reservoir, the WWTF discharges provide sustainable base flows and aquatic life habitat in the Tualatin River Watershed. Previous water quality modeling and current efforts indicated that if the District were to cease WWTF discharges to the river during these periods, the overall water quality and aquatic habitat suitability would be substantially diminished. Rather than pumping the WWTF effluent out of the basin the District has focused on providing an enhanced level of treatment while also working to manage instream flows to improve water quality and beneficial uses. The net environmental enhancements of highly treated municipal wastewater discharged to streams and rivers is recognized and documented as beneficial in many of these situations. However, the regulatory structure is often difficult to navigate to recognize these benefits and continue to permit these discharges (Section 6.2.4). These circumstances are not unique to the District and Tualatin River Watershed. There are similar

conditions in other receiving waters in Oregon and in numerous watersheds throughout the arid west.

5.3.3 Legacy and Current Use Chemicals

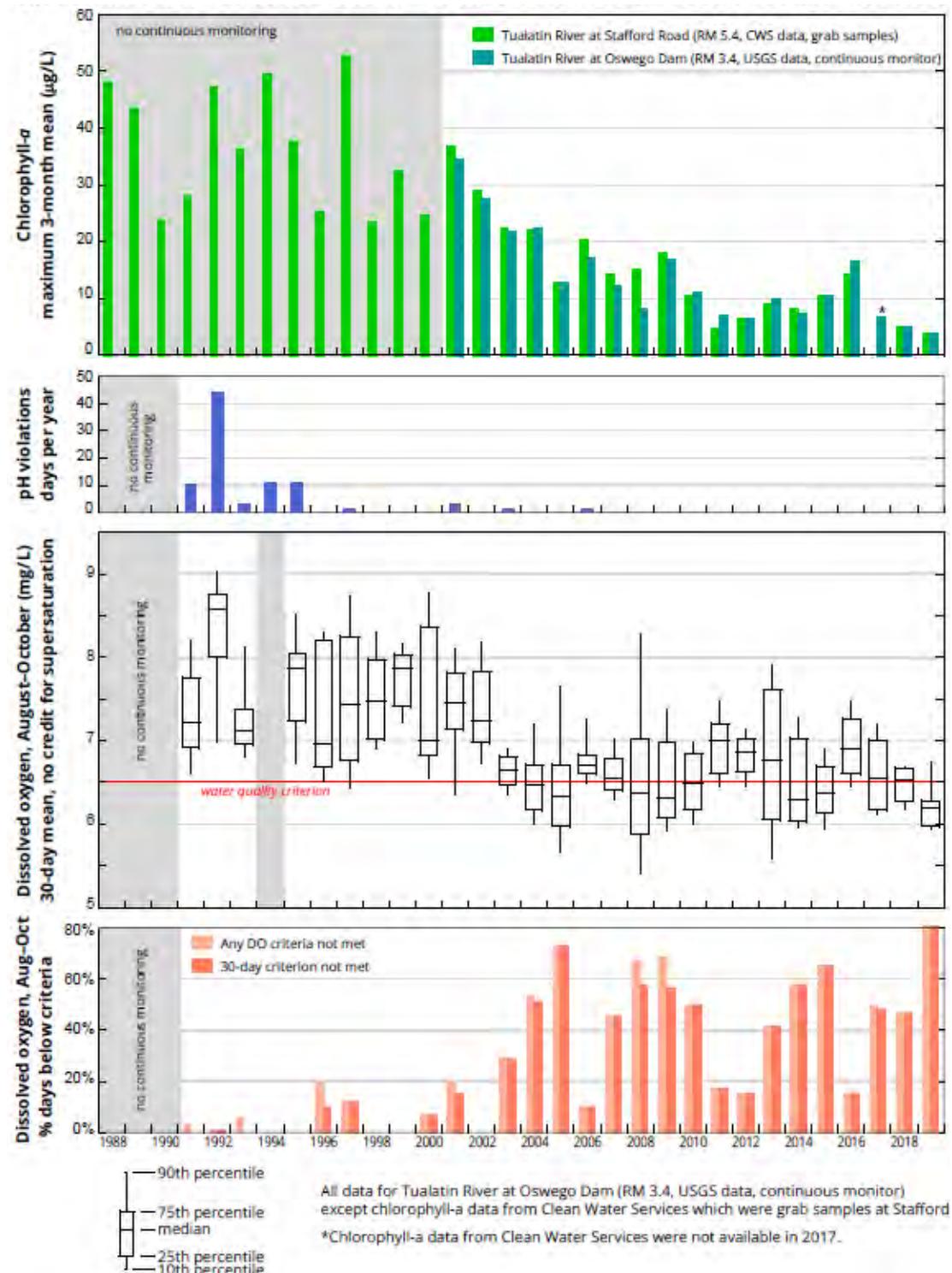
There are a number of legacy and current use chemicals associated with societal use that do not lend themselves to the traditional approaches prescribed under the Clean Water Act. These include legacy pesticides, PCBs, mercury, per- and polyfluoro alkyl substance (PFAS), pharmaceuticals and personal care products. These pollutants tend to be ubiquitous due to societal uses and present unique challenges to the District and other municipal wastewater utilities. Many of these pollutants are present at low levels and feasible, cost-effective wastewater treatment processes are not available to remove or substantially reduce them. Additionally, because of widespread use, they are not effectively controlled by the requirements of the federally mandated industrial pretreatment program. A pollution prevention-based approach modeled on the District's and other successful pollution prevention strategies would be more effective, better for the environment (i.e., does not result in a waste that then has to be disposed), less energy intensive and more cost-effective.

5.3.4 Tualatin River Water Quality

The environmental consequences of urbanization, including stream water quality and ecological health, have been the focus of research and management strategy development for several decades. A comprehensive description of these effects has been provided by the USGS for nine highly urbanized areas of the U.S., including Portland (Coles et al. 2012). Highly urbanized areas, such as those served by the District and the rest of the Portland area, share common and complex challenges from multiple stressors that span regional, watershed and stream-reach scales. One of the key findings of the 2012 USGS study is that “no single factor related to stream hydrology, habitat, or chemistry was universally important in explaining responses of the biological communities to urban development.” The District's extensive monitoring, research and modeling of the Tualatin watershed affirms this reality for urbanized portions of tributaries and the mainstem river. For example, various pollutants and stressors, involving both dry and wet weather conditions, influence the complex dissolved oxygen regime in the lower river. Other pollutants may be primarily introduced to the ecosystem not through wastewater discharges, but via atmospheric deposition from sources outside the watershed.

Algal production is a key source of dissolved oxygen in the lower Tualatin River. The reduction in algal activity since the 1990s has resulted in lower dissolved oxygen levels (Figure 5-2). The lower Tualatin River would benefit from additional algal activity to improve dissolved oxygen levels. However, control strategies must continue to ensure that the algal activity cannot occur at a level that would cause nuisance algal conditions and exceedances of the pH water quality criteria. The District has sought to optimize the balance of algal productivity and dissolved oxygen through flow control, preserving instream water rights, managing stored water releases and nutrient control. The dynamic nature of this approach remains a challenge in this complex and highly managed river system.

Figure 5-2. Key Water Quality Parameters in the Lower Tualatin River from August-October 1988-2019



Source: Clean Water Services (2020a)

The Tualatin River and tributaries have historically been listed as impaired for aquatic life uses due to excursions in the water quality criteria for dissolved oxygen, pH,

bacteria and temperature. ODEQ has developed TMDLs for these parameters; treatment controls and management practices have been implemented to improve water quality. Recent assessments by ODEQ have identified the Tualatin River as not meeting water quality criteria (i.e., water quality limited) for iron, copper and biocriteria. Tualatin River tributaries are listed as being water quality limited for iron and biocriteria; some of the urban tributaries have additional listings for copper, chromium and tetrochloroethylene (Fanno Creek only).

5.3.5 Tualatin River Temperature TMDL

The temperature TMDL for the Tualatin River was developed in 2001 and predates current temperature criteria and water quality trading rules. Additionally, the 2001 TMDL does not include the broad scope of watershed enhancement strategies that the District implements to offset thermal loads from the WWTFs. An updated TMDL would reflect the current temperature criteria and watershed enhancement strategies being implemented by the District.

5.3.6 Land Application of Biosolids

As previously discussed, the District produces Class B biosolids and land applies them for beneficial use. Environmental effects of emerging contaminants such as PFAS are a growing concern in the U.S., including accumulation in municipal biosolids. PFAS are a group of manufactured chemicals used in a variety of industries that are pervasive throughout the environment and represent a growing health concern. Early in 2019, EPA issued a PFAS Action Plan but to date has not taken specific regulatory action (EPA 2019b). Some states' environmental agencies are exploring biosolids regulations. These actions have the potential to disrupt the District's biosolids management options.



▲ Biosolids Land Application

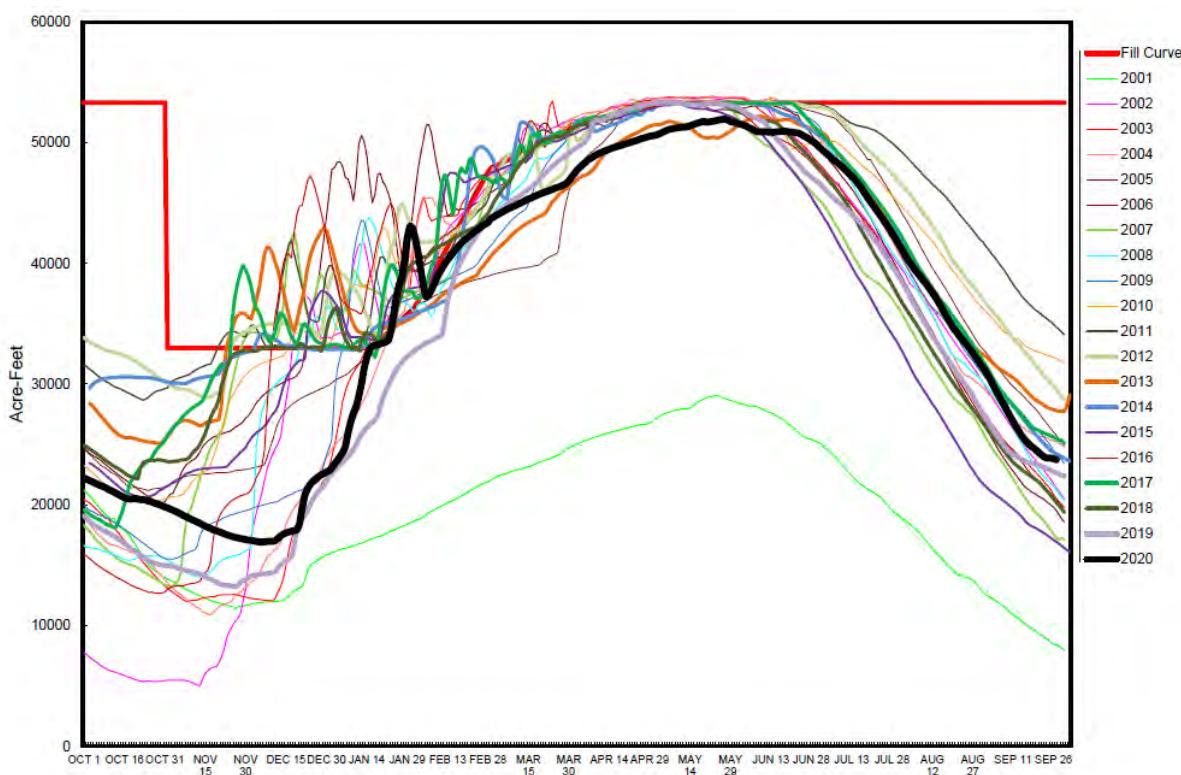
5.3.7 Stormwater Management

Human activities have substantially altered the Tualatin Basin from its natural state through eradicating beaver, clearing forests, draining meadows, rechanneling streams, filling wetlands and removing large wood from streams. Urbanization replaced natural landscapes and agricultural land with impervious surfaces, while stormwater systems replaced natural drainages. These changes to the watershed altered the basin's hydrology, disconnected the river from its floodplains, impacted riparian vegetation and habitat and reduced stream complexity.

Additionally, much of the District's stormwater system was built before implementation of the MS4 program. As such, large portions of the District's service area do not provide treatment of stormwater runoff. Furthermore, climate change impacts, which are expected to result in longer, drier summers and more intense rain events, will further exacerbate watershed health. A comprehensive strategy that includes the implementation of stormwater management practices to reduce pollutants in upland areas and coordinated action in the riparian stream corridor is necessary to enhance stream function, provide resiliency in response to climate change, and improve water quality.

5.4 Water Resource Limitations

The water resource demands in Washington County are split between municipal use, irrigation, river flow augmentation and water for Lake Oswego. A portion of these are met each year through natural flow, but demands during the dry season are mostly met using stored water releases from Hagg Lake and Barney Reservoir (Sections 3.4.2 and 3.6). Increases in population (Section 5.1) and changes in climate conditions have stressed the water resources in the watershed, especially in recent years. For example, 2019 set the record for the longest period of regulation of flows on the Tualatin River (Clean Water Services 2020a). The fill reliability of the reservoirs has also been somewhat lower in recent years. In 2013 and 2020, Hagg Lake did not fill to capacity (Figure 5-3). Barney Reservoir filled to only 97.6 percent of its capacity in 2019 (Clean Water Services 2020a). While the supply of water in the watershed currently meets the demands in most average years, the demands can exceed or nearly exceed the capacity in warmer, drier years. In 2001, for example, Hagg Lake volume was extremely low, and all water uses faced curtailed availability. In 2015, TVID and Clean Water Services used nearly all of their available water (Clean Water Services 2020a). Climate change (Section 5.5) is anticipated to increase the number of dry, hot summers, increasing the demands placed on the existing water supply and potentially increasing temperatures in the river.

Figure 5-3. Hagg Lake (Scoggins Reservoir) Storage by Water Year (2001-2020)

The population of Washington County is projected to grow considerably over the next 50 years. To meet this additional demand, the Tualatin Valley Water District, City of Hillsboro, and City of Beaverton are partnering to develop the Willamette Water Supply Project, which will withdraw water from the Willamette River near Wilsonville and pump it through a long pipeline to users in the Tualatin River Watershed (<http://www.ourreliablewater.org/wordpress/wp-content/uploads/2019/11/Willamette-Water-Supply-Program-Intro-Fact-Sheet-11-11-19.pdf>). The projected population growth will increase effluent flows to the Tualatin River. The District's WWTF discharges already represent a substantial proportion of the river flow and increased flows from the WWTFs could further affect existing water resources. In addition, the water at the new withdrawal location in the Willamette River is warmer in the summer than the water currently withdrawn at the Springhill Pumping Plant. While the magnitude and timing of the effect on WWTF effluent temperatures is unknown because of the many other factors affecting effluent temperature, there is potential that this higher temperature source water could increase the temperature of the effluent.

5.5 Climate Change Impacts

The future impacts of global warming have been studied extensively for the past 50 years at scales from local to worldwide. Human activities are likely to have increased the average temperature in the Pacific Northwest by 1.5 degree Fahrenheit (F) during the 20th century and such increases are expected to continue in the 21st century (Hamlet et al. 2001). The District's operations are deeply intertwined

with the water cycle that likely will be affected by global warming. Several potential impacts on the District's operation and its ability to meet its regulatory requirements are described below.

The District's ability to meet its thermal offset requirements in the Tualatin River and to maintain minimum summer flows is dependent on stored water from Hagg Lake and Barney Reservoir. In addition to maintaining minimum flows in the Tualatin River, the 14,200 acre-feet of stored water from the two reservoirs are used to offset about two-thirds of the thermal loads from the WWTFs and are essential for maintaining the ecology of the mainstem Tualatin River. The system is highly dependent on filling both Hagg Lake and Barney Reservoir, which may be threatened by years with below average rainfall or drought.

Hagg Lake and Barney Reservoir are filled mostly by rainfall, which is not expected to be radically diminished by climate change within this region. Neither system depends on snow packs for winter storage, as a significant portion of the rain that fills the lake and reservoir comes from major south Pacific storms. Total precipitation is not expected to dramatically change, but the rainfall pattern is expected to be different. The Pacific Northwest can anticipate longer, drier, warmer summers and precipitation events that are shorter but of greater intensity. This weather pattern will further tax the available water resources in the basin. Changing rainfall patterns will impact stream stability and influence the design requirements for collection, conveyance, and stormwater systems. These changes necessitate the integration of stream enhancement, stormwater design and upland controls to ensure the protection and recovery of stressed stream systems.

5.6 Ratepayer Considerations

Clean Water Services has developed a robust financial management approach for expenses, rate and revenue predictability, and service enhancements. The utility considers issues such as future demand, research and development, capital investment needs, and regulatory costs. The District has sought operational efficiencies and improvements for financial, community and environmental benefit, while keeping rates and fees at an affordable level. Reasonable and predictable rate increases are vital to the long-term financial health of Clean Water Services. The District honors the people of the community and region and factors diversity, equity, inclusion and justice into rate discussions. To ensure future rates are manageable across social and economic strata, it is imperative for the District to conduct long-term planning and prioritization of strategies to guide future investments.

6 Strategies to Address Challenges

The District will continue to pursue strategies that protect public health, enhance watershed health, use green infrastructure and sustainable treatment processes, recover resources, and generate energy.

6.1 Wastewater Collection

The large, complex collection system is managed by Clean Water Services, the cities in its service area and Washington County. The District plans to strengthen these partnerships to protect public health while enhancing the natural environment of the Tualatin River Watershed — common objectives for all the entities. The District also will emphasize effective communication with its partners during planning, design, construction and O&M of the system.

6.1.1 Strategy: Continue Utilizing CMOM-Based Approach

The District, the 12 cities in the service area and Washington County will continue to implement a CMOM-based approach to ensure adequate capacity, operate and manage the system to minimize overflows to the extent feasible, and provide continued comprehensive maintenance to protect and lengthen the useful life of the public infrastructure investments. The District is also exploring other strategies such as in-line storage to fully utilize the capabilities of the wastewater collection system and further minimize the potential for overflows.

CAPACITY

The District will continue its sanitary sewer flow monitoring to regularly evaluate the needs across the collection system and implement planned projects as required. These projects, sourced from the Sanitary Sewer Master Plan, are developed from updated population growth forecasts and projected flow conditions at locations throughout the collection system. The District is committed to regular master planning to ensure planning aligns with current growth projections and forecasted flows and provide capacity assessments that identify necessary imminent improvements.

The District will continue to implement a robust I/I reduction and system rehabilitation program that includes the repair of private laterals to preserve collection system capacity and minimize potential for overflows.

OPERATION AND MANAGEMENT

The District will continue using real-time rainfall and flow monitoring systems to assess current system limitations and inform operational strategies and systemwide improvements. The District is also evaluating a few potential storage and flow diversion strategies to mitigate I/I and SSOs during high flow events. This includes potential storage options within the collection system and at WWTFs (i.e., surge basins at Durham AWWTF), and the continued use of the twin, 24-inch pipelines to convey water from the Forest Grove and Hillsboro WWTFs to the Rock Creek AWWTF during high flow events.

MAINTENANCE

The District will continue to work with jurisdictions in its service area to keep the collection system dependable and resilient and to minimize overflows. Crews from the District, cities and Washington County will perform comprehensive maintenance work – pipe inspections, line cleanings, root control activities, routine repairs and emergency response activities – on a regular basis. This approach will help the District protect and lengthen the useful life of its public infrastructure investments and protect watershed health.

The District will continue to work with ODEQ, EPA and state and national organizations to develop a comprehensive wet weather strategy, which includes a CMOM-based approach as a central tenet.

► **DISTRICT REQUEST:** Continue to work with District to facilitate ongoing implementation of a CMOM-based approach for collection system management

6.2 Wastewater Treatment

As technology advances and the District works toward implementing sustainable practices, wastewater can no longer be considered a waste to be disposed of, but rather a valuable resource. Clean Water Services is home to North America's first municipal nutrient recovery facility, Oregon's largest water reuse program, and a leading renewable energy program. As the District continues to provide a high level of treatment to protect and enhance watershed health, it is also pursuing a significant expansion of its recycled water program to expand opportunities for ecological restoration, wetland recovery and irrigation water supply that will further enhance watershed health, address water resources limitations and help combat climate change impacts. Throughout its treatment facilities, the District continues to emphasize the use of sustainable and natural treatment technologies to meet objectives and is committed to continuing to implement strategies that enhance resource recovery capabilities.

Facilities planning can be difficult to align with permit cycles, so Clean Water Services takes a just-in-time approach to optimize its investments. The District constructs facilities to meet near-term anticipated growth in the service area, incorporate technology on an ongoing basis, ensure effective treatment and compliance, and maintain a sustainable rate structure.

The District will evaluate treatment alternatives and strategies through a lens that goes beyond compliance, looking at more holistic impacts to the environment, including carbon and environmental footprints. This approach more fully recognizes the benefit to the watershed and often can be more cost-effectively implemented when compared to traditional compliance approaches. The District will need ODEQ's support in developing regulatory pathways to support these comprehensive approaches to wastewater treatment.

6.2.1 Strategy: Update Phosphorus TMDL for the Tualatin River

The phosphorus TMDL for the Tualatin River, which was developed in 1988 and updated in 2001 and 2012, establishes wasteload allocations for the District's WWTFs. Clean Water Services relies on a combination of biological processes and alum to meet the effluent limits for total phosphorus in its watershed-based NPDES permit. EPA is finalizing the water quality criteria for aluminum that, when established, may prevent the District from using alum to the extent currently used in treatment processes for phosphorus removal.

Consistent with the 1988 TMDL, data suggest that the Tualatin River is no longer as sensitive to phosphorus inputs as when the TMDL was originally established as a result of reduced residence time from increased flows and removal of flashboards by the Lake Oswego Corporation to divert water into the Oswego Canal. This information demonstrates the importance of both water management and nutrient control in addressing water quality issues.

Clean Water Services has worked with Portland State University to update a CE-QUAL-W2 water quality model for the Tualatin River. The model was originally developed by Portland State University and later refined and updated by USGS. It was recently updated to the current version and calibrated by the District for a three-year period (2013-2015). Initial modeling results confirm that the Tualatin River is not as sensitive to phosphorus inputs as it once was.

To further support the TMDL update, Clean Water Services gathered additional information in 2019 and 2020 regarding phosphorus fractionation in the treatment plant effluent and the Tualatin River, and algal biomass in the Forest Grove NTS. These data were not available for the 2013-2015 calibration period. Additionally, Clean Water Services assessed the performance of the WWTFs in removing total phosphorus primarily with biological processes and no tertiary alum addition. Clean Water Services also conducted enhanced ambient monitoring to assess the effects of this treatment strategy on water quality in the Tualatin River.

The study consisted of monitoring the effluent from the Rock Creek AWWTF, Durham AWWTF and Forest Grove NTS for phosphorus fractions, nitrogen species, TSS, chemical oxygen demand, alkalinity, chlorophyll-a and field parameters (pH, conductivity, temperature and dissolved oxygen). Monitoring was also conducted at several locations on the Tualatin River for these parameters. Clean Water Services coordinated with the USGS to monitor the Forest Grove NTS effluent and several Tualatin River locations for algae as part of a separate study.

The study was successful in defining the capabilities of the WWTFs in removing total phosphorus using biological processes and no tertiary alum addition. The study also demonstrated that this treatment strategy does not negatively impact water quality in the Tualatin River for the conditions encountered during the study. Clean Water Services will submit a technical report to ODEQ that captures the results of the phosphorus study and water quality modeling to support an update to the Tualatin River Phosphorus TMDL.

- **DISTRICT REQUEST:** Update TMDL for Total Phosphorus to enable the use of biological processes for phosphorus control and meet anticipated aluminum criteria

6.2.2 Strategy: Update Temperature TMDL for the Tualatin River

The 2001 temperature TMDL for the Tualatin River predates the current temperature criteria and does not include the broad scope of watershed enhancement strategies that the District implements to offset thermal loads from the WWTFs. ODEQ should update the Tualatin Temperature TMDL to reflect the current temperature criteria and associated TMDL approach that ODEQ currently uses, and also support the watershed enhancement strategies being implemented by the District. The District recognizes that ODEQ has an established schedule for updating mainstem and tributary temperature TMDLs in the Willamette. The District will coordinate with ODEQ to define the time frame for updating the Tualatin temperature TMDL.

- **DISTRICT REQUEST:** Update TMDL for Temperature to be consistent with current standards

6.2.3 Strategy: Update TSS and CBOD₅ Limits at Forest Grove WWTF and NTS Based on Equivalent Control Provided by NTS

ODEQ authorized dry-season discharges from the Forest Grove WWTF in the 2016 NPDES permit, which includes effluent limits for CBOD₅, TSS, E. coli bacteria, pH, phosphorus, ammonia, temperature and dissolved oxygen. Compliance with effluent limits for most parameters is at the Forest Grove WWTF; compliance with temperature and dissolved oxygen limits is at the discharge from the NTS.

BASIN STANDARDS

The effluent limits for CBOD₅ and TSS that apply at the Forest Grove WWTF are based on basin standards in the Oregon Administrative Rules (OAR 340-041-0345). See excerpt below:

(b) Main stem Tualatin River from mouth to Gaston (river mile 0 to 65):

(A) During periods of low stream flows (approximately May 1 to October 31): Treatment resulting in monthly average effluent concentrations not to exceed 10 mg/L of BOD and 10 mg/L of SS or equivalent control;

(B) During the period of high stream flows (approximately November 1 to April 30): Treatment resulting in monthly average effluent concentrations not to exceed 20 mg/L of BOD and 20 mg/L of SS or equivalent control.

The basin standards in the administrative rules are technology targets based on the use of conventional treatment technology. For the dry season (i.e., periods of low stream flows as specified in the OARs), the basin standards specify that the level of control as “treatment resulting in monthly average concentrations of 10 mg/L BOD and suspended solids (SS) *or equivalent control* (emphasis added).” Note that

10 mg/L BOD is deemed equivalent to 10 mg/L CBOD₅ per ODEQ policy. To consistently meet CBOD₅ and TSS limits during the dry season, the District likely would need to install filtration technology at the Forest Grove WWTF. This approach does not recognize the additional treatment and ecological buffer provided by the 95-acre NTS.

The District began operating the NTS in 2017. Over the past three years, the District has integrated this treatment technology with the Forest Grove WWTF, and assessed the capabilities of the entire system. Effluent data gathered in 2020 demonstrates that the Forest Grove WWTF and NTS provide treatment equivalent to basin standards. Figure 6-1 and Figure 6-2 show CBOD₅ and TSS concentrations in the Forest Grove WWTF and the NTS.

Figure 6-1. CBOD₅ Concentrations at the Forest Grove WWTF and NTS Effluent

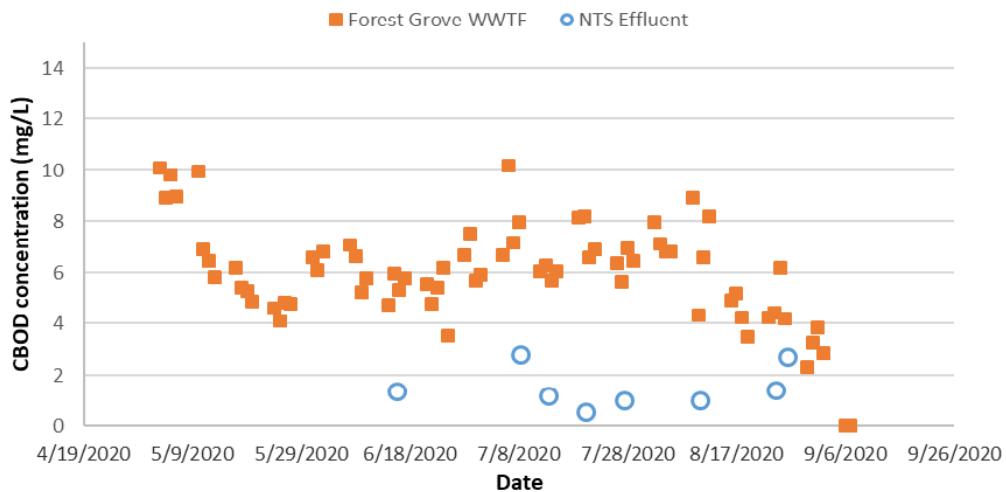
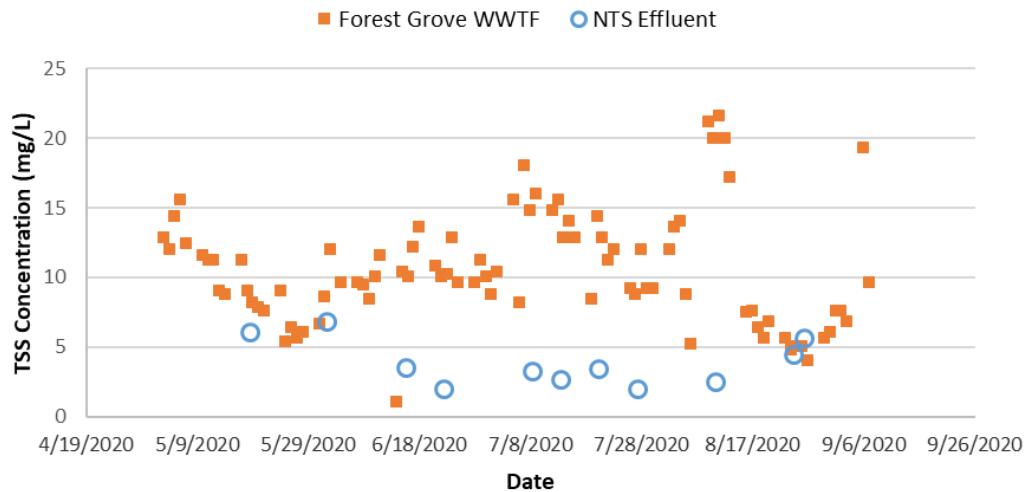


Figure 6-2. TSS Concentrations at the Forest Grove WWTF and NTS Effluent



At the Forest Grove WWTF, CBOD₅ concentrations range from about 4 mg/L to 10 mg/L and TSS concentrations range from about 5 mg/L to 20 mg/L. As a result of the additional treatment in the NTS, CBOD₅ concentrations in the NTS effluent ranges from 1 mg/L to 2.7 mg/L and TSS concentrations range from 2 mg/L to 6.8 mg/L and meet basin standards.

Additionally, the NTS is very effective at reducing ammonia, nitrates, phosphorus and metals. Table 3 provides a summary of the reductions achieved at the Forest Grove NTS for CBOD₅, TSS, nutrients and metals.

Table 3. CBOD₅, TSS, Nutrient and Metals Reductions at Forest Grove NTS (2020 data)

Parameter	FG WWTF Effluent to NTS	FG NTS Effluent to River	% Reduction
CBOD ₅	6.1 mg/L	1.5 mg/L	75%
TSS	10.5 mg/L	3.8 mg/L	64%
Ammonia	1.0 mg/L	0.14 mg/L	86%
Nitrates	10.4 mg/L	0.11 mg/L	99%
Total Phosphorus	1.5 mg/L	0.36 mg/L	76%
Copper*	9.3 µg/L	2.2 µg/L	76%
Zinc*	53.7 µg/L	3.9 µg/L	93%

*2017-20 data

On average, CBOD₅ and TSS were reduced by 75 and 64 percent, respectively in the NTS. As a result of the long detention time (about 5 days) and additional treatment provided by the NTS, the TSS and CBOD₅ concentrations discharged from the Forest Grove WWTF to the NTS do not affect the discharge quality of the water being released from the NTS to the Tualatin River. Substantial reduction in ammonia, nitrates, phosphorus and metals was also observed in the NTS.

Additionally, the TSS and CBOD₅ in the discharge from NTS is not the same as the TSS and CBOD₅ from the WWTF. The TSS and CBOD₅ in the effluent are degraded in the NTS through natural processes. The NTS discharge contains CBOD₅ and TSS mostly from algae, plants, wildlife and other natural sources. EPA's Wastewater Technology Fact Sheet for Free Water Surface Wetlands (September 2000) states the following:

Wetland systems are living ecosystems. The life and death cycles of the biota produce residuals which can be measured as BOD, TSS, nitrogen, phosphorus and fecal coliforms. As a result, regardless of the size of the wetland or the characteristics of the influent, there will always be a residual background concentration of these materials in wetland systems.

The EPA fact sheet goes on to state that a lightly loaded free water surface wetland can achieve background levels associated with natural processes in the range of 1-10 mg/L BOD and 1-6 mg/L TSS. The data above suggests that the performance of the Forest Grove NTS is providing treatment to achieve the background concentrations expected from these natural systems. Establishing effluent limits for CBOD₅ and TSS at the NTS discharge would be problematic as natural systems can have variable effluent quality due to natural processes, background levels can account

for a large portion of the CBOD_5 and TSS concentrations in the effluent, and engineered controls would not be available to ensure that the discharge consistently meets effluent limits.

Installing filtration technology at the Forest Grove WWTF to meet a 10 mg/L TSS limit and 10 mg/L CBOD_5 before discharging to the NTS will not improve the effluent quality from the NTS to the Tualatin River. Because effluent quality of the NTS discharge to the Tualatin River is not affected, there would be no impact to water quality in the Tualatin River. Thus, installation of filtration technology is an unnecessary and poor use of limited resources.

EQUIVALENT CONTROL

The application of TSS and CBOD_5 basin standards is not meaningful at Forest Grove where there is a 95-acre NTS that follows the conventional wastewater treatment facility. The OARs allow for flexibility in implementing the basin standards and include language that enables ODEQ to define “equivalent control.” BOD and TSS removal equations for wetland treatment systems suggest that effluent BOD and TSS concentration assuming a 20 mg/L influent BOD and TSS concentration would be less than 10 mg/L.

The District, in partnership with Oregon State University, is studying the Forest Grove WWTF and NTS effluents to assess the constituents that form the TSS and CBOD_5 tests. The information from this study provides a metric for comparing the characteristics of the TSS and CBOD_5 in the WWTF to the effluent of the NTS. The District will present the results of this study in a technical report to ODEQ.

DEQ should use the flexibility that is provided in the OARs to authorize that the additional treatment and environmental buffer provided by the 95-acre NTS serves as equivalent control. Clean Water Services will submit a technical report on this topic and request that the following TSS and CBOD_5 limits be established at the Forest Grove WWTF during low river flow conditions (Table 4).

Table 4. Proposed TSS and CBOD_5 Effluent Limits for Forest Grove WWTS During Low River Flow Conditions

River Flow Condition	Parameter	Average Effluent Concentrations (mg/L)	
		Monthly	Weekly
Low River Flow	CBOD_5	15	25
	TSS	20	30

- **DISTRICT REQUEST:** Define treatment provided by Forest Grove WWTF and NTS as equivalent to basin standards

6.2.4 Strategy: Define Permitting Framework for Highly Managed Streams

As discussed in Section 3.2, the District's WWTF discharges represent a substantial proportion of flow in the Tualatin River during the late summer and early fall. The net environmental enhancements of highly treated municipal wastewater discharged to streams and rivers are documented as beneficial in many of these situations.

However, the regulatory framework for continuing to permit such discharges is challenging. The District anticipates working with ODEQ to continue to define a permitting framework for highly managed systems, such as the Tualatin River, accounting for the ecosystem services provided by this water resource recycling strategy.

- **DISTRICT REQUEST:** Work with District to define permitting framework for highly managed river systems

6.2.5 Strategy: Discharge Year-round from Hillsboro WWTF and NTS

The Hillsboro WWTF discharges to the Tualatin River only during the wet season. During the dry season (generally May to October), raw influent from the Hillsboro WWTF is pumped either to the Rock Creek AWWTF or the Forest Grove WWTF and NTS for treatment and discharge. The District is planning to construct an NTS at Hillsboro. The Hillsboro NTS project would convert existing land at Clean Water Services' Davis Tool property site near the Hillsboro WWTF into wetlands by constructing a conveyance and distribution network in adjoining agricultural land and planting wetland vegetation. Treated WWTF effluent could flow by gravity or be pumped to the NTS via a new pipeline. Treatment wetlands would be constructed on 30 acres of upland area at the Davis Tool portion of the site west of Highway 219. An additional 120 acres on the Davis Tool portion of the site will be restored to natural wetland functions with water conveyed east of Highway 219 to the existing 14-acre Pintail Pond that will be converted to a treatment wetland. Pintail Pond is connected to the existing outfalls to the Tualatin River. The total NTS area for the Hillsboro site is 164 acres (Figure 6-3).

After construction of the Hillsboro NTS, wastewater from the Hillsboro service area will be treated at the Hillsboro WWTF, directed through the 164-acre NTS, and discharged to the Tualatin River through the existing Hillsboro WWTF outfalls (H001A & H001B). The fully treated and disinfected secondary effluent from the Hillsboro WWTF will be the source water for the NTS and receive additional treatment in the NTS prior to Tualatin River discharge. The restored natural wetlands at Davis Tool and the Pintail treatment wetlands will provide additional water quality benefits via further removal of conventional pollutants that are applicable to the mainstem Tualatin River TMDLs (i.e., phosphorus, ammonia and temperature). In addition to improving water quality, the NTS provides wetland habitat, recreational benefits and ecological conditioning of the water prior to Tualatin River discharge.

Figure 6-3. Hillsboro NTS Area

WATER BALANCE

Anticipated flows to the Hillsboro WWTF will be about 4.5 mgd of which 4.0 mgd will be conveyed to the Hillsboro NTS for further treatment and discharge; the remaining water would be used as carrier water to convey solids from the Hillsboro WWTF to the Rock Creek AWWTF. Evapotranspiration and other losses are estimated to reduce effluent flow by 15 percent, averaging 3.4 mgd during the dry season.

THERMAL LOADS

Temperature modeling conducted as part of the initial design of the Hillsboro NTS shows there could be substantial cooling across the NTS. With the reduction in flow from evapotranspiration and infiltration and the cooler effluent temperatures, the District expects that thermal loads from the Hillsboro NTS will be substantially lower than those that otherwise would be discharged at Rock Creek AWWTF. As part of a technical report to support the permitting of a natural treatment system at Hillsboro, the District will provide supporting information to quantify the benefits of the anticipated temperature and thermal load reduction at the Hillsboro NTS.

ANTICIPATED EFFLUENT QUALITY

In addition to temperature, the District's experience with the Forest Grove WWTF and NTS demonstrates that substantial reduction in nutrients and metals would occur in the NTS. Table 5 provides a summary of the anticipated effluent quality for the discharge from the Hillsboro NTS.

Table 5. Anticipated Effluent Quality for Discharge from Hillsboro NTS

Parameter	NTS Effluent to River
Ammonia	<0.5 mg/L
Nitrite + Nitrate	<0.5 mg/L
Total Phosphorus	<0.5 mg/L
Copper	<5 µg/L
Zinc	<5 µg/L

In 2012, the Tualatin TMDL was updated to incorporate dry season discharges from the Forest Grove and Hillsboro facilities into the ammonia bubble for the Rock Creek facility. The 2012 TMDL also included dry season discharges from the Forest Grove and Hillsboro facilities into a bubbled allocation for total phosphorus with the Rock Creek AWWTF. As such, no changes in the dissolved oxygen and phosphorus TMDLs are necessary to permit the discharge from the Hillsboro WWTF and NTS.

The Hillsboro WWTF and the treatment wetlands will be able to provide effluent quality suitable to meet water quality criteria. Additional water quality analysis will be conducted as part of the permitting process for the discharge from the Hillsboro NTS to demonstrate compliance with water quality criteria.

Part of the proposed Hillsboro NTS site is defined as jurisdictional wetlands and the District anticipates permitting will require concerted effort. The District will work with U.S Army Corp of Engineers, Oregon Division of State Lands and ODEQ on these issues. The District will submit a technical report to ODEQ to support an NTS at Hillsboro. The District will work with ODEQ to streamline the approach for permitting such systems based on its experience at the Forest Grove NTS, including where compliance is determined and how effluent limits are established and expressed (e.g., defining averaging periods for limits that recognize the variability in natural systems).

- **DISTRICT REQUEST:** Include natural treatment system at Hillsboro WWTF in a future NPDES permit

6.2.6 Strategy: Discharge water into the TVID irrigation system

The District is considering distributing treated water to customers through the TVID distribution system. The Spring Hill Pumping Plant is the largest diversion facility on the river. It is owned by the U.S. Bureau of Reclamation and operated jointly by TVID and the Joint Water Commission. TVID delivers water to about 12,000 acres of irrigated cropland via a pressure pipeline. The District would construct a pipeline to deliver up to 10 mgd of treated water from its Rock Creek or Forest Grove WWTFs to the Springhill Pump Plant. This strategy provides access to large-scale irrigation opportunities at a much lower capital cost. The District will work with ODEQ to define an appropriate regulatory mechanism to incorporate this strategy into the NPDES permit.

► **DISTRICT REQUEST:** Incorporate discharge of water into an irrigation distribution system in a future NPDES permit

6.2.7 Strategy: Expand Recycled Water Use Program

The District plans to expand the recycled water use program and broaden its benefit in enhancing not only healthy turf and crops, but also providing complex ecological benefits. Currently only the Durham AWWTF produces Class A recycled water, but the District intends to start producing recycled water at the Rock Creek and Forest Grove facilities. Alternatively, recycled water from the Rock Creek facility could be routed to the Forest Grove facility for distribution. The District is pursuing urban, rural and wetland enhancement opportunities as described in the following sections. The goal of the expanded recycled water use program is to provide a viable source of water for irrigation and ecological restoration and reduce thermal inputs to the Tualatin River in a cost-effective manner.

PROVIDE ECOLOGICAL RESTORATION

In expanding its recycled water use program, the District will provide additional ecological benefits through the ecological restoration of native plants. The District is proposing to land apply recycled water at agronomic rates at several sites during the next permit cycle for ecological restoration. The land application sites will be managed as a complex assemblage of native herbaceous grasses and shrub species. With this approach, the District will also be able to harvest and use native grass seed stock at these sites for other restoration projects.

RESTORE WETLAND FUNCTION

The District plans to utilize recycled water to restore degraded wetlands where the hydrology has been impaired by historical agricultural activities.

The District's Fernhill NTS is a powerful demonstration of the multiple benefits of restoring wetland function and providing ecological restoration at a site historically degraded by agricultural practices. The treatment wetlands at Fernhill serve as an ecological bridge between the treatment facility and the watershed. They are also a popular regional destination and a showcase of the ecological and social benefits of restored wetlands. The District envisions opportunities for restoration of natural wetlands that would provide an even fuller range of ecological and economic

benefits. The District anticipates that the permitting and application of recycled water to restore wetland hydrology and function will require concerted effort and collaboration with ODEQ to implement the necessary policy changes.

- **DISTRICT REQUEST:** Enable an expanded recycled water use program for restoration of ecological and wetland function in the watershed

6.2.8 Strategy: Expand Resource Recovery

Through research and innovation, the District recovers key resources in the form of clean water, fertilizer and renewable energy and strives to minimize its carbon footprint.

The District plans to continue utilizing the methane its anaerobic digesters produce to create heat and electricity. As renewable energy production increases from cogeneration facilities and solar energy systems, the District will be moving toward its goal of energy independence.

With the patented WASSTRIP process and Ostara fertilizer production facilities, the District will continue to sustainably recover phosphorus and ammonia.

- **DISTRICT REQUEST:** Continued support of District's efforts to recover resources from wastewater

6.3 Stormwater Management

The District utilizes a comprehensive set of management practices to reduce pollutants in upland areas to the maximum extent practicable and coordinated action in the riparian stream corridor to enhance overall watershed health.

The District and co-implementers will continue to implement stormwater management programs for illicit discharge detection and elimination, construction site runoff controls, industrial and commercial stormwater, Operation and Maintenance, public education and outreach, pollution prevention, and post construction site runoff to reduce pollutants to the maximum extent practicable.

6.3.1 Strategy: Continue to Implement Program to Protect and Enhance Riparian Areas

The District's riparian corridor protection and enhancement program requires development activities to provide vegetated corridors around Water Quality Sensitive Areas such as streams and wetlands. Vegetated corridors can range from 15 to 200 feet wide. Most often, vegetated corridors extend 50 feet from the edge of the Water Quality Sensitive Area. Enhancement of vegetated corridor on the site is required with development and can include removing invasive plant species and planting native trees and shrubs.

6.3.2 Hydromodification Strategy

Use of innovative green strategies is a key aspect of EPA's IP Framework, which is incorporated into the CWA via the Water Infrastructure Improvement Act (EPA 2019a). ODEQ's support of the District's IP, including long-term sub-basin strategies and associated green infrastructure aspects, will enhance opportunities for watershed health improvements across multiple NPDES permit cycles.

The District believes that controlling runoff into a degraded stream through traditional detention methods will not restore the hydraulic function of a stream. Many streams that are brought into the District service area are already degraded due to previous agricultural practices including channelization, draining and ditching. Simply controlling runoff through traditional detention methods in upland areas will not improve watershed health, enhance stream function, provide resiliency in response to climate change or improve water quality. The District has developed a comprehensive strategy to improve watershed health. This strategy considers the risk of hydromodification posed by a development project and integrates upland controls such as Low Impact Development Approaches (LIDA), water quality treatment, real-time controls and engineered detention with instream and riparian corridor enhancement actions to increase overall corridor resilience through improved habitat complexity and connectivity. Examples of LIDA are tree retention, porous pavement, curbside treatment facilities, green roofs and vegetated water quality facilities.

The District's hydromodification strategy includes the Base Strategy and multiple sub-basin strategies, which are implemented through the District's *Design and Construction Standards* (Clean Water Services 2019). The Base Strategy consists of upland controls and the sub-basin strategy includes upland controls and instream actions.

The sub-basin strategies will consider each sub-basin as a system, taking into account multiple factors and their interactions to develop a set of approaches (e.g., LIDA, detention, water quality treatment, instream enhancement, real-time controls) uniquely integrated to achieve a resilient stream condition. The District will prioritize sub-basins based on their relative hydromodification risk. For example, basins within the Urban Growth Boundary expansion areas where the pace of current development activity is high or where there are existing issues will be prioritized over sub-basins with little development activity or where stream channels are stable. Until a strategy is established for a particular sub-basin, the District will apply the Base Strategy.

Both strategies allow for application of multiple approaches — singly or in combination — to address hydromodification. Approaches include LIDA, conventional detention facilities, water quality treatment, stream corridor improvements and payment of fee-in-lieu.

The District has successfully implemented pilot projects that utilize an integrated approach to implement projects in upland areas and the stream corridor. These include projects in North Bethany and Abbey Creek. These approaches included upland controls such as LIDA, and water quality treatment facilities and stream corridor enhancements that have resulted in broad ecological benefits including

improved riparian and stream function, stream resilience, floodplain connection and improved habitat. These are much more complex efforts than simply requiring upland detention, but they have resulted in greater outcomes — more resilient streams, enhanced riparian corridors and improved ecological conditions.

This integrated and adaptable hydromodification strategy developed by the District is intended to further the watershed-scale goals by controlling runoff from new and redeveloped areas and restoring hydrologic functions in a broader landscape conservation context. In combination with the District's retrofit strategy, the hydromodification strategy will also address impacts to stream corridors from past development and land use activities that affect water quality.

6.3.3 Retrofit Strategy

The District's retrofit strategy also takes an integrated approach to enhance watershed health. Recognizing that watersheds in the District's service areas are mostly developed, the District's retrofit strategy focuses on taking action in the upland areas and stream corridor to improve water quality, increase storage in the watershed, reduce erosive energy associated with stormwater runoff, restore floodplain connectivity and riparian vegetation, and improve watershed health and resiliency. The District seeks opportunities to retrofit existing infrastructure to store water and reduce instream energy and direct connection to surface waters to address potential hydromodification effects. Additionally, the District's retrofit strategy focuses on providing stormwater treatment in areas that have potential for high pollutant loads (e.g., high traffic corridors, industrial/commercial areas, parking lots), reducing the energy of stormwater discharges and improving water quality through implementing outfall cutbacks and retrofits, and enhancing existing water quality facilities to improve water quality treatment and increased storage in the system.

The retrofit actions in upland areas are coordinated with actions in the stream corridor. The goals and strategies of the work in the stream corridor are to reduce erosive forces and improve stream resilience through energy dissipation and grade control. A wide range of actions are employed including planting riparian vegetation; reconnecting floodplains; restoring wetlands; re-meandering stream channels; adding stream complexity with the addition of large wood, grade-control structures and off-channel storage and habitat; and promoting beaver activity. These actions are geared toward restoring the stream's resilience to variable flow conditions and will provide more resilient solutions to potential impacts associated with climate change.

► **DISTRICT REQUEST:** Continue support of sub-basin strategies as a holistic method to manage stormwater and enhance watershed health

6.4 Watershed Enhancement Program

Many factors influencing the health of the river are beyond the realm of influence of a public utility, but the District's water quality trading program allows the District to serve as a catalyst to achieve broader watershed health outcomes with its watershed partners, including those in forestry, agriculture, and urban areas. The District, in

cooperation with its partners, implements a landscape conservation strategy to improve ecological conditions across the watershed, not just in the urban areas. This collective impact approach creates superior ecological and community outcomes than otherwise would be unattainable for any one entity.

By coordinating conservation and restoration efforts and combining resources, the District is able to work across land uses and jurisdictions at a range of scales to increase effective, efficient outcomes for watershed health. This approach creates connections between watershed partners' efforts based on their core businesses and values. It uses cross-boundary thinking to overcome the artificial jurisdictional boundaries (e.g., city and county lines, various district boundaries) imposed on the ecological landscape that impede watershed health. Unlike conventional water resources management, this approach emphasizes the connections between community and economic influences and environmental influences on public policies, programs, and projects. By producing not only positive ecological outcomes but tangible community benefits, the District is able to build support for these types of collaborative relationships and create greater awareness of the importance of valuable natural resources.

The District's landscape conservation approach as it applies to the Water Quality Trading program is discussed below.

6.4.1 Strategy: Continue to Implement Water Quality Trading Program

The District's implementation strategy to comply with the thermal load limits in the NPDES permit consists of reducing thermal loads from the WWTFs, enhancing stream flow in the mainstem Tualatin River and key tributaries, and restoring riparian areas in the urban and rural portions of the watershed. This strategy has been effective in offsetting thermal loads from the WWTFs over the past 16 years.

The District's water quality trading program provides multiple ecosystem benefits. The stored water releases provide cooling effects, buffer against temperature changes, and improve overall water quality to support aquatic life. The District's riparian planting program improves stream functions such as floodplain roughness, bank stabilization, peak flow attenuation and habitat creation; increases diversity of aquatic and terrestrial plant and animal species; filters stormwater runoff; and improves water quality.

The District will continue to implement these strategies.

6.4.2 Additional Strategies

The District is exploring additional strategies to further reduce thermal loads from the WWTFs and generate additional thermal credits to continue to offset thermal loads at the WWTFs associated with future growth. These strategies are discussed below.

THERMAL LOAD REDUCTION STRATEGIES

The primary strategies for reducing thermal loads are source control, technology-based solutions and recycled water use.

Two significant industrial users in the District's service area have implemented cooling systems to reduce thermal loads into the wastewater collection system. However, additional opportunities are limited to further reduce thermal loads from large industrial users. The District will continue to regularly evaluate discharge characteristics of its larger industrial users to determine if technology controls are necessary to reduce thermal loads.

The District has taken measures to reduce temperature increase across the Durham AWWTF by covering primary clarifiers, constructing a cogeneration facility at the treatment plant and replacing a water-cooled chiller. The District is exploring additional strategies to further reduce temperature and thermal loads from the WWTFs. These include installing heat pumps and/or cooling towers if necessary to meet the 25 C temperature limit.

As discussed in Section 6.2, strategies for wastewater treatment, the District wants to significantly expand its recycled water use program and is pursuing urban, rural and wetland enhancement opportunities. Implementing these strategies will result in a direct reduction in thermal load to the Tualatin River.

THERMAL CREDITING STRATEGIES

The District is exploring additional thermal crediting strategies to continue to offset thermal loads at the WWTFs associated with future growth. These include water resource-oriented strategies and enhancements to the riparian planting program.

Water Resource-Oriented Strategies

Instream Lease

The District, through its partners, implements a program where landowners have the option to lease water rights for instream use. The District and its partners handle transaction costs and landowner payments of leasing water rights for instream use. To date, applications for 33 instream leases have been processed, which restored a total of 1.8 cfs for instream use.

Most significantly, the District recently converted a 1928 water right for the Wapato Irrigation District for instream use. The U.S. Fish & Wildlife Service and TVID are the lessors of the water right and the District is the lessee. The District coordinates with the OWRD District 18 Watermaster's office to protect these instream flows, which will serve to increase the base flow in the Tualatin River and its tributaries. Currently, the District's water quality trading program does not include incorporating thermal credits from the lease of water rights for instream use. The District plans to update the TLMP to include a crediting mechanism for this activity.

Stored Water Releases from Barney Reservoir

The District has 1,654 acre-feet of stored water in Barney Reservoir. The District releases water from Barney Reservoir in September and October. Because of the timing of the releases, the stored water releases are currently not used for thermal credit generation. The District can release the water throughout the summer when the river is water quality limited and generate thermal credits. The District plans to update the TLMP to include a crediting mechanism for this activity.

Exchange Forest Grove NTS Discharge for Stored Water in Hagg Lake

The TVID releases stored water from Hagg Lake for use by its patrons. Most of the water is withdrawn at the Springhill Pump Plant and distributed through a pressure pipeline. Some TVID users located downstream of the Springhill Pump Plant take water directly from the Tualatin River. To supply these users, TVID releases additional stored water from Hagg Lake. The District's discharge from the Forest Grove NTS can be used to partially meet the needs of the direct river users below the Springhill Pump Plant. The District would be able exchange the water that direct river users withdraw from the Tualatin River for an equivalent amount of TVID stored water in Hagg Lake. Based on the estimated discharge from the Forest Grove NTS, an estimated 1,225 acre-feet (4 mgd for 100 days) of Forest Grove NTS effluent would be available for direct river users. The mechanism is already in place in the TLMP to enable the District to obtain thermal credits for this strategy once implemented.

Access to Unused Stored Water in Hagg Lake

The TVID has 27,022 acre-feet of stored water in Hagg Lake. TVID typically has a substantial amount of stored water left in Hagg Lake at the end of the irrigation season; averaging 9,800 acre-feet of remaining stored water from 2016 to 2019. The District is pursuing an agreement with TVID to obtain a portion of the remaining stored water for its use. The agreement would provide the District access to 2,500 acre-feet of additional stored water. The mechanism is already in place in the TLMP to enable the District to obtain thermal credits for this strategy.

Expanded Recycled Water Use Program with TVID Exchange

As discussed in Section 6.2.6, the District is considering distributing treated water to the TVID distribution system, which would provide access to large-scale irrigation opportunities at a much lower capital cost. Another benefit of this approach is that the treated water added to the TVID irrigation system may be exchanged for an equivalent amount of TVID stored water in Hagg Lake. Depending on the scale of the program, the exchange with TVID could provide 1,500 acre-feet (5 mgd for 100 days) to 3,000 acre-feet (10 mgd for 100 days) of stored water. The mechanism is already in place in the TLMP to enable the District to obtain thermal credits for this strategy once implemented.

Riparian Planting Strategy

As discussed in Section 3.4.2, the District's riparian planting program consists of a Capital Program and a Land Owner Incentive Program. The District's TLMP specifies a 2-to-1 trading ratio for calculating credit for shade which means that the thermal credit for shade is equal to 50 percent of the environmental benefit.

The trading ratio was established in 2004 and based on the time necessary for the vegetation to mature and provide effective shade (estimated to be 20 years), and uncertainty regarding the success of the riparian planting projects. The District implements a robust maintenance and management program, which has significantly reduced uncertainty associated with the success of riparian planting projects. Additionally, the District focuses most of its riparian planting efforts on smaller streams where effective shade is generated much faster than the time frame used in developing the original trading ratio. Furthermore, the District conducts additional

enhancement activities such as channel reconfiguration, large wood placement, gravel-boulder placement and off-channel habitat creation at some project sites to improve a broader range of ecosystem functions. Given the District's focus on smaller streams, greater certainty of project success and the additional stream enhancement activities, the trading ratio should be revised. The District will provide information to support the application of a lower trading ratio for riparian planting projects.

OTHER WATERSHED ENHANCEMENT STRATEGIES

Community Planting Projects (TFA program)

The TFA program is one of the largest and most successful landscape conservation programs in the United States. Partners in the program help support a broad set of community values such as economic vitality, biodiversity, habitat connectivity, climate change resiliency, human health, recreation and a One Water philosophy. The District will continue to implement this program.

Upland Agriculture Programs (Irrigation Efficiency, Nutrient Management)

As previously discussed, the District supports implementation of complimentary programs used to maximize water quality and ecological benefits including the AWEP and EQIP. These programs provide incentives for farmers to implement irrigation efficiency, nutrient management, erosion control and other practices. The District will continue to implement this program.

- **DISTRICT REQUEST:** Support the District's expansion of its Water Quality Trading Program and update the trading ratio for riparian projects

The District will seek ODEQ support as it updates its Water Quality Trading Program to incorporate additional strategies including stored water releases from Barney Reservoir and instream leases. The District will also work with ODEQ to define an appropriate trading ratio where stream enhancement activities are conducted as part of a riparian planting project.

6.5 Tualatin Basin Dam Safety and Water Supply Joint Project

As mentioned in Section 3.6, the Tualatin Basin Dam Safety and Water Supply Joint Project plans to address the seismically at-risk dam while potentially providing additional water storage. Two of the three options being explored as part of the retrofit plan will increase the water storage capacity of Hagg Lake by 21,000 to 50,000 acre-feet. This may require amending or revising state-issued Clean Water Act Section 401 water quality certifications of federal permits and licenses associated with the project that affect the District's flow augmentation program. Applicable federal permits might include CWA Section 404 permits for dredge and fill activities and wetlands protections, and U.S. Army Corps of Engineers permits for construction in a waterway.



▲ Hagg Lake

6.6 Pollution Prevention

As discussed in Section 5.3.3, there are a number of legacy and current use chemicals associated with societal use that do not lend themselves to the traditional approaches such as source control and treatment. A different approach that emphasizes pollution prevention would be more effective.

Mercury represents an instructive example of the need for and benefits of a pollution prevention approach. The District has implemented pollution prevention approaches for mercury for nearly 20 years. These include targeted outreach to industry, dental offices, schools and medical facilities. These practices have been effective in reducing influent and effluent mercury concentrations at the WWTFs. ODEQ has also supported this strategy in its recent update to the Willamette River mercury TMDL, which requires development and implementation of a mercury minimization plan to reduce mercury levels from WWTFs.

The District believes the pollution prevention/minimization approach is an appropriate strategy for chemicals associated with societal use. Increasing public awareness, promoting product substitution and a national conversation regarding chemical life cycle analysis (cradle to grave) for these types of chemicals are critical. These approaches tend to be better for the environment (i.e., do not result in a waste that then has to be disposed), are less energy intensive and more cost effective.

ODEQ should support implementation of pollution prevention and minimization strategies to address pollutants such as legacy chemicals, PFAS, pharmaceuticals, personal care products and other pollutants associated with societal use.

- **DISTRICT REQUEST:** Support pollution prevention approach for legacy and current use chemicals associated with broad societal use

6.7 Embracing Technology and Innovation

The District is investing in innovation to meet challenges such as meeting the needs of the growing region, taking care of aging infrastructure, adapting to changing weather patterns, managing risk and vulnerability, increasing regulatory requirements, and learning to live with economic uncertainty. Each of these issues can be addressed by application of new technology and innovation, social adaptation and economic responses.

Embracing innovation allows more options to meet all requirements of the NPDES permit. Such innovation provides a greater number of tools, improved data and models to support alternative operations, and greater resiliency to avoid unforeseen issues.

The District uses real-time devices in its treatment facilities, throughout the collection system and in the Tualatin River and its tributaries. With the District's use of online process monitoring, it has access to real-time data that enables operations staff to control and optimize processes while providing staff the ability to track performance on a real-time basis. Operational monitoring and compliance assessment historically required sampling to acquire water quality data. Online water quality monitoring instrumentation provides the District more water quality data without sampling multiple days each week.

Innovation calls out for new approaches related to regulation. Most regulatory laws are nearly 50 years old. The regulatory goals remain the same, but new tools have changed the approach. Two policy/regulatory examples may be applicable here. EPA's Technical Support Document provides technical analyses related to the number of samples, how that number factors into statistical derivation of permit limits and sampling frequencies for compliance purposes (EPA 1991). The Technical Support Document does not specifically address online and real-time monitoring or how it can be used to supplement or partially replace traditional compliance sampling and analyses, but provides guidance on statistical analyses for comparative evaluations. EPA's regulations and guidance for Alternative Test Methods (EPA 2018) is another example that pertains to organic and inorganic parameters, and the

process for approval of alternatives to a “method-defined analyte” such as BOD and TSS. The District requests ODEQ’s support to identify alternative statistical or test procedures that can be used to identify sampling frequencies for traditional analyses of TSS, CBOD, total phosphorus and ammonia that ensure compliance, recognize the support for continuous monitoring and reduce excess or redundant sampling requirements.

► **DISTRICT REQUEST:** Optimize monitoring frequencies for TSS, CBOD and nutrients at WWTFs

6.8 Public Education and Outreach

The District must engage the public to achieve its watershed goals. It will continue to cultivate a community that is more connected to its local streams and rivers and supportive of enhancing the watershed’s health. Key tools of the District’s successful public education and outreach program are its:

- **Strategic Communication Plan**, which provides easy-to-understand information and practical tools and behavior changes that improve watershed health and promote sustainable resource management.
- **Student Education Strategy**, which fosters learning in classroom and field-based programs focused on the interconnected nature of the built environment and natural world.
- Educating today’s students builds support for informed watershed management now and in the future.

It is also vital to engage with stakeholders to build credibility within the community and further collaborative partnerships. Stakeholders view building collaborative partnerships as the District’s top priority and the District will continue to bring partners together to manage and enhance the Tualatin River Watershed. The District will also continue to use its robust stakeholder engagement process to request input and guidance from the District’s Board of Directors and the Clean Water Services Advisory Commission, ensuring project and policy decisions are made with an appropriate level of input.

Public Outreach and Stakeholder Involvement

The IP captures strategies and approaches from other District planning efforts, each with their own outreach and stakeholder involvement components (Section 3.7.1).

The draft IP will be presented to:

- District's Board of Directors
- Washington County and the 12 cities in the District service area
- Clean Water Advisory Commission, which includes industry and environmental representatives appointed by the District's Board of Directors

The plan will also be posted on the Clean Water Services website.

As the District-defined strategies are further developed and before they are incorporated into the NPDES permit, they will undergo public review and comment.



▲ Public Outreach Event



▲ Plant tour at Durham AWWTF

8 Adaptive Management

EPA's Integrated Planning Framework recognizes that adaptive management strategies are key to successful integrated planning. This means monitoring and evaluating projects and practices as work proceeds, and adapting or revising plans and designs as new information is developed. These changes are then implemented and the cycle starts again with monitoring and reevaluation of the revised approach (Figure 8-1). Adaptive management activities will be key to refining the forecasted timing and cost of program improvements as the District implements the IP over time.

Figure 8-1. Adaptive Management Cycle



The District plans to reevaluate and update the IP every five years or so based on future NPDES permit cycles, greater system understanding, results of program and project implementation, and updated benefit evaluations.

The District intends to implement a long-term performance monitoring approach that measures both the environmental and programmatic improvements that result from IP implementation. The District will link specific performance metrics to the project evaluation criteria and use the

results to adjust or enhance the program. Performance measures include tracking the District's level of service goals and key performance indicators for the collection and treatment systems, reviewing effluent monitoring and other publicly available receiving stream data to characterize water quality improvements, and creating management controls to facilitate project execution and reliably achieve major project milestones.

The District continues to develop and improve level of service goals and key performance indicators for facilities, collection system performance and environmental conditions. The District also tracks inspection and maintenance productivity and uses these measures to prioritize resources to meet operational goals. The District closely tracks system upgrade efforts and prioritizes these efforts based on the risk associated with each pipe. The District conducts pre- and post-renewal flow monitoring to track the effectiveness of I/I reduction efforts and adjust program strategies accordingly.

The District will measure IP success based on its ability to achieve milestones and actions. At the end of the first five-year period, the District will determine if actions were completed and make necessary changes to satisfy infrastructure demands and meet CWA obligations.

9 Regulatory Support

The District seeks regulatory support to implement activities that protect and improve water quality and watershed health on a long-term and sustainable basis, goals shared by ODEQ.

The District wants to look ahead, well beyond five-year cycle permits. This IP provides a framework to partner with ODEQ over multiple permit cycles, near- and long-term, as described in Sections 1 and 2.

This partnership, including the ongoing communication and adaptive management elements of the IP, will inform permitting discussions, anticipate and address potential compliance issues, and establish strategies to protect and enhance public health and the environment.

The District has developed a schedule to implement the strategies discussed in previous sections. The strategies will be implemented over a 20-year planning period, assigned to one or more of the five-year permit cycles shown in Figure 9-1.

Figure 9-1. Clean Water Services Strategy Implementation Schedule



In 2013, ODEQ developed an integrated planning document based on the 2012 EPA IP Framework. The District expects EPA's support for integrated planning as part of an NPDES permit and anticipates entering into an agreement with ODEQ to forge a partnership to achieve its watershed objectives.

10 References

Clean Water Services (District)

2020a Tualatin River Flow Management Technical Committee 2019 Annual Report.

2020b Appendix D: Water Quality Improvements or Degradation from Stormwater Annual Report. In progress.

Cole Ecological, Inc.

2019 2018 Tualatin River Macroinvertebrate Assessment. May 2019.

Coles, James F., Gerard McMahon, Amanda H. Bell, Larry R. Brown, Faith A. Fitzpatrick, Barbara C. Cudde Eikenberry, Michael D. Woodside, Thomas F. Cuffney, Wade L. Bryant (USGS), Karen Cappiella, Lisa Fraley-McNeal, and William P. Stack

2012 Effects of Urban Development on Stream Ecosystems in Nine Metropolitan Study Areas Across the United States. U.S. Geological Survey Circular 1373. 2012. November 2012.

Oregon Department of Environmental Quality (ODEQ)

2001 Tualatin Sub-basin Total Maximum Daily Load (TMDL). August 2001.

2012 Tualatin Subbasin Total Maximum Daily Load (TMDL) and Water Quality Management Plan. ODEQ 11-WQ-036. August 2012.

2013 DEQ's Proposed Strategy for Implementing EPA's Integrated Approach Memorandum. February 7, 2013.

2016 National Pollutant Discharge Elimination System Watershed-Based Waste Discharge Permit #101141, 101142, 101143, 101144, and MS4. Issued by Oregon Department of Environmental Quality on May 31, 2016.

Hamlet, A. F., Fluharty, D., Lettenmaier, D. P., Mantua, N., Miles, E., Mote, P., and Binder, L.W.

2001 Effects of Climate Change on Water Resources in the Pacific Northwest: Impacts and Policy Implications, JISAO Climate Impacts Group, University of Washington, WA.

Jacobs

2020 Base Flow Projections for Clean Water Services Memorandum for East and West Basin Facility Plans Project. June 3, 2020.

Schueler, T., Stack, B.

2013 Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. Chesapeake Stormwater Network and Center for Watershed Protection, Ellicott City, MD. Pages 1-131.

http://www.chesapeakebay.net/documents/Final_CBP_Approved_Stream_Restoration_Panel_report_LONG_with_appendices_A-G_02062014.pdf

Stoner, N. and C. Giles.

2011 Achieving Water Quality through Integrated Municipal Stormwater and Wastewater Plans. October 27, 2011. Washington DC.

2012 Integrated Municipal Stormwater and Wastewater Planning Approach Framework. June 5, 2012. Washington DC.

U.S. Environmental Protection Agency

1991 Technical Support Document for Water Quality-based Toxics Control. EPA/505/2-90-001. March 1991.

2000 Wastewater Technology Fact Sheet for Free Water Surface Wetlands. September 2000.

2012 Integrated Municipal Stormwater and Wastewater Planning Approach Framework. May 2012.

2018 Protocol for Review and Validation of Alternate Test Procedures for Regulated Organic and Inorganic Analytes in Wastewater Under EPA's Alternate Test Procedure Program. February 2018.

2019a Water Infrastructure Improvement Act of 2018. January 2019.

2019b EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan. EPA Publication #823R18004. February 2019.

2020 EPA PFAS Action Plan: Program Update. EPA Publication #100K20002. February 2020.