Introduction

The mission of Clean Water Services (the District) is to safeguard the Tualatin River’s health and vitality, ensure the economic success of our region, and protect public health for over 600,000 residents and businesses in urban Washington County. The District’s past planning efforts have protected the Tualatin River, but anticipated growth and emerging challenges have necessitated a revised planning process to accomplish the District’s mission.

Instead of preparing separate East Basin Collection System and Durham Advanced Wastewater Treatment Facility (AWWTF) Plans, this current planning process combined these efforts into an integrated plan for the East Basin. This integrated planning effort allows for a consistent approach and set of planning data for both the East Basin collection system and the Durham AWWTF to meet the following future challenges:

- **Population Growth**
  - Infill of existing served areas (State Housing Bill 2001 allows single family residential zoning areas to densify).
  - Expansion of the collection system into the identified growth areas, including Beaverton, Tigard, King City, Sherwood, and Tualatin.
- **Uncertain Regulatory Environment**
  - Durham AWWTF permit conditions.
- **Infrastructure Age/Condition**
  - Fanno Creek Interceptor.
  - System-wide.
  - Durham AWWTF.
- **Wet Weather Capacity** (see Study Area Map on adjacent page)
  - Fanno Creek Interceptor.
  - Metzger Trunk.
  - Summer Creek Trunk.

The District established the following goals for the integrated plan (Plan):

1. Advance strategies to improve overall watershed health.
2. Be flexible and provide a framework for successful long-term implementation decisions.
3. Be a vision for the future.
4. Be cost effective.
5. Be resilient with respect to climate change and seismic risks.
A sound basis of planning is essential to making informed decisions that meet the District’s near and long-term treatment and collection system needs. The key elements updated in this Plan include: flows and loads, regulatory requirements and resiliency considerations.

**Flows and Loads**

The Durham service area population is projected to increase by 36 percent during the 20-year planning period at an annual growth rate of 1.8 percent according to the Portland State University Population Research Center. This population increase would result in projected flow and carbonaceous biochemical oxygen demand (cBOD) and total suspended solids (TSS) load increases of approximately the same magnitude. The projected wet weather flows were developed using the calibrated collection system model. Maximum hour wet weather flows are projected to increase by 30 percent during the next 20 years to 157 mgd.

**Regulatory Requirements**

The planning team worked closely with the District’s Regulatory Advisory Group to determine the likely future permit requirements. Two permit conditions that could change were identified, as summarized below.

- **Phosphorous.** Water quality modeling suggests that the Tualatin River is no longer as sensitive to phosphorus inputs as it once was. The District is working with Oregon Department of Environmental Quality (DEQ) to support an update of the phosphorus TMDL. Based on this uncertainty, two effluent total phosphorus (TP) scenarios were evaluated: (1) current summer limits of 0.11 mg/L TP and (2) relaxed summer limits of 0.5 mg/L TP.

- **Aluminum.** A water quality criteria for aluminum was promulgated by EPA in December 2020. Effluent data suggests that the District would be able to comply with the water quality criteria for aluminum with the use of the bioavailable test method (an option allowed for in the final rule). The District is working with DEQ on method establishment. For the purposes of facilities planning, the Plan presumes that the discharge from the Durham facility would be able to meet water quality criteria for aluminum with the continued use of alum for phosphorus removal.

Additionally, per- and polyfluoroalkyl substances (PFAS) are contaminants of increasing concern. The future of regulatory action on PFAS is uncertain, however it is likely that there may be future restrictions that could affect the land application of biosolids. Therefore, solids stabilization processes that destroy PFAS or the ability to be able to cost effectively add processes that could destroy PFAS were considered during the solids planning process.
This section highlights the following outcomes and features of this Plan that will guide the District in making key decisions and optimizing facilities:

- Planning for AWWTF site buildout for a clear vision of the future site needs.
- Optimizing operations and energy recovery at the AWWTF.
- Decision-making process.
- Creating a “Living” Plan to facilitate the District making efficient on-going and real-time updates to the Plan.

**Site Buildout Planning**

To provide an understanding of maximum site capacity, a site plan was developed that could accommodate the basin buildout flows and loads. This site planning effort identifies when key site planning decisions will need to be made such as whether secondary train 7 (required sometime after the planning period) will need to be built with intensification technology to extend both the capacity of the secondary and tertiary processes.

**Resiliency Considerations**

A key consideration of the planning effort is to assess seismic and climate change resiliency for both the collections system and AWWTF.

- **Climate Resiliency.** Information from the Oregon Climate Change Research Institute and the Climate Impacts Research Consortium was used to project the impacts of climate change through the planning period. This research found that by the end of the planning period (year 2040), climate change may increase the frequency of extreme events by about 10 percent. Because there is low to moderate confidence in these estimated climate changes, the planning team recommended performing a stress test by modeling a “climate sensitive” storm to identify system deficiencies and potential improvements.

- **Seismic Resiliency.** A seismic hazard assessment was conducted of the East Basin collection system and the Durham AWWTF. This assessment found that the majority of the East Basin collection system is located within seismic hazard zones while the majority of the Durham AWWTF is located in relatively low seismic hazard areas. Due to the extent of the collection system located in the seismic hazard zones, it is not feasible to improve all existing pipelines. However, all new or improved pipelines should be designed to address seismic hazards. Additionally, seismic considerations were included in the alternatives analysis for the collection system.

**Planning Outcomes**

The outcomes identified from the planning effort include:

**Buildout site planning** identified when key decisions will need to be made regarding expansion technologies.

**East Basin Design Storm and Climate Sensitivity Storms**

A stress test of the collection system using a “Climate Sensitive” storm modeled to increase the climate resiliency of the East Basin.
Operations Optimization at Durham AWWTF

Surge Basin Optimization

The District identified an opportunity to maximize plant capacity and improve effluent quality by reconfiguring their two surge basins, which equalize peak flows. By dedicating the large surge basin for primary effluent flow and the small surge basin for secondary effluent, the surge basin return flow is limited to just the large surge basin, which improves effluent quality. Additional modeling found that this operational mode resulted in minimal use of the wet weather outfall within the planning period.

Digester Loading Optimization

Using historically conservative assumptions for the thickened concentration of the primary and waste activated sludge, suggested that an anaerobic digester would be required within the next couple of years. Since the District is not currently out of anaerobic digester capacity based on historic solids residence times (SRT), the planning team worked with the District to identify operational targets for thickened sludge concentration that would defer the need for additional digestion capacity. Based on historic volatile solids reduction rates, this thicker feed concentration will yield a digester total solids concentration of around 3.5 percent, which is within the allowable range for these digesters. The District worked with operations staff to determine that the existing pumps could handle these higher feed concentrations. This optimization effort allowed the anaerobic digestion project to be deferred by 6 years, pushing the timing to the year 2027.

Energy Recovery Optimization at Durham AWWTF

FOG Loading Optimization

In 2015, the Brown Grease Receiving Facility came online, allowing Durham to accept fats oils and grease (FOG) and other high strength waste such as brown grease from waste haulers. This waste is processed in the anaerobic digesters and increases energy recovery through cogeneration. As part of the Plan, a scientific approach was taken to determining the optimum mixture of indigenous sludge and high strength waste based on the target protein, lipid and carbohydrate ratios in stable anaerobic digestion operation. This evaluation determined that for stable digestion, the high strength waste should be no greater than 30 percent of the total digester feed volatile solids loading. This finding is supported by the District staff operational experience and provides guidance to the District as to the target quantity of FOG.

Setting up for Renewable Natural Gas

While the District currently plans to continue using their cogeneration process through the year 2030, the Plan evaluated alternate end uses for the digester gas. One promising avenue for digester gas is to create renewable natural gas for pipeline injection. Due to the increasing EPA mandated volumes of renewable fuels that oil and gas manufacturers are required to purchase each year, pipeline injection of digester...
The planning team collaborated with the District to evaluate, score and select conveyance system improvements from multiple alternatives. The process was focused on integrating multiple perspectives in scoring and selecting system improvements. Conveyance, pumping and treatment, natural resources, and O&M staff were all involved in developing the scoring criteria, alternatives review and alternatives scoring. The following categories were used for scoring:

- Operations and maintenance requirements.
- Environmental impact, environmental enhancement opportunities, and permitting requirements.
- Public impact.
- Constructability risks.
- Easement and property acquisition requirements.
- Flexibility for timing of implementation and balancing of wet weather reduction with capacity upgrades.

An example output from the scoring process is shown in this graphic. The alternatives were ranked based on score with a higher score representing a preferential alternative.

District staff also considered life cycle costs for each alternative when selecting a preferred improvement for implementation. Life cycles cost estimates considered initial capital costs, replacement costs based on infrastructure design life, annual operations and maintenance costs, and annual energy costs. The graphic below provides an example of the annualized life cycle cost vs. score for a set of conveyance improvement alternatives.
**“Living” Plan**

One of the key objectives of this planning effort was to create a flexible, dynamic Plan that can be adapted based on actual growth, regulatory developments, and process performance. The objective was met by working with the District to develop the following tools to facilitate updating dynamic information and viewing the corresponding results:

- **Flows and Loads.** Excel based spreadsheet to update flows and loads and assess up to two alternate growth scenarios.
- **Process Model.** The updated flows and loads or alternate growth scenarios can be run through the District’s calibrated Sumo model to determine the impacts of these changes on the solids balance for the AWWTF. An interface was created to allow for a streamlined process to update the process models based on changes to influent flows and loads.
- **Process Capacity Spreadsheet.** The mass balance information is exported from the Sumo models and used to evaluate unit process capacity and the corresponding capacity trigger year. The Process Capacity Spreadsheet creates trigger plots for each unit process and creates capacity and trigger year outputs for the Power BI dashboard user interface.

- **Power BI Interface.** An interface was created using the Power BI program to synthesize information from each of the tools described above along with the District’s financial data into an easily assessable viewing platform. The Power BI dashboards display information on flows and loads, process capacity, and alternate growth scenarios, along with information on budgeted and actual spending for each of the District’s projects. The Power BI interface will automatically pull in the latest data from these sources and provides a dynamic and flexible implementation of the Plan. Although the Power BI dashboard was initially built based on information from Durham AWWTF, it is flexible to incorporate this same information from each of the District’s plants and the collection system.

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**Recommended Improvements**

Alternatives were developed to address deficiencies found within the collection system and the Durham AWWTF with respect to growth, changing regulations and infrastructure condition. These alternatives were evaluated based on the Plan’s goals to select recommended improvements for the 20-year planning period. The following section summarizes these recommended improvements for the collection system and for the Durham AWWTF.

**Recommended Conveyance System Improvements**

The conveyance system recommended improvements are divided into those addressing deficiencies in infrastructure condition and those addressing deficiencies in capacity as a result of growth within the collection system, expansion to new growth areas or increased wet weather flows.
Conveyance System Improvements – Condition and Wet Weather (within 10 years)

1. **Wet Weather Flow Reduction Program**
   - Targets rehabilitation in the local pipes and laterals to prolong life of infrastructure.
   - Collaboration with member cities to fund and implement (50/50).
   - Optimized balance of wet weather flow reduction with capacity improvements allows reduced improvement sizing to the Metzger Trunk and Fanno Wet Weather Pump Station.

2. **Fanno Creek Interceptor Rehabilitation**
   - Full length of Fanno Creek corridor (~8 miles).
   - Trenchless rehabilitation to minimize impact to creek corridor.
   - Reduces risk of pipeline structural failure and groundwater intrusion.

3. **Metzger Trunk Pipeline Upsizing**
   - Capacity improvement to reduce risk of sewer overflows.
   - Paired with wet weather flow reduction targets.
   - Opportunity to consider partnering opportunities for adjacent land access for environmental enhancement.
   - Trenchless construction under Metro transit line.

4. **Fanno Wet Weather Pump Station and Force Mains**
   - Reduces risk of sewer overflow in creek corridors during winter season.
   - Minimizes pipeline construction, environmental and public impact in Fanno Creek corridor including heavily used trailways.
   - Dual use system utilizes force mains for wet weather capacity in the winter and recycled water from treatment plant to new customers in summer also reducing temperature impact on Tualatin River.
   - Opportunity to collaborate location with city park improvements.
   - Adds resiliency in conveyance system for seismic risk.
Conveyance System Improvements – Growth (within 10 years)

The District engaged in a collaborative process with member cities to coordinate on master planning goals and timing of development.

1. **Beaverton, Tigard, King City**
   - Opportunity to collaborate with King City for new trunk through Beef Bend Planning Area.
   - Scholl’s County Estates, Meyers Farms, and Pleasant View pump stations to be decommissioned to offset construction of new local pump stations.
   - Tile Flats Pump Station to serve areas in Cooper Mountain.

2. **Sherwood**
   - Chicken Creek Pump station planned for western urban reserve expansion which will allow for decommissioning of trunk sewer through wildlife refuge.
   - Brookman Trunk extension serving Brookman and West Sherwood UGB expansions.

3. **Tualatin**
   - Local pump stations required to serve Basalt Creek and Southwest Tualatin.
   - New or upsized gravity trunks.

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**Conveyance System Improvements**

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<tr>
<th>2021 - 2040: Wet Weather Reduction Program (phased)</th>
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<tr>
<td>2022 - 2030: Fanno Creek Interceptor Rehab (phased)</td>
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<td>2023 - 2030: Multiple Pump Stations Basalt Creek and SW Tualatin</td>
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**Collection System Capital Projects**

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<td>Clean Water Services East Basin Master Plan June 2021</td>
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**Recommended I&I Reduction Areas**

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<td>Area impacts downstream infrastructure with projected future sewer overflow risk</td>
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**Recommended Area**

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<td>Development Area within UGB</td>
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**Urban Reserve (limited growth)**

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**Dual FMs**

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2021 – Secondary Expansion (Train 5)

✓ Capacity. A fifth secondary train consisting of an aeration basin and secondary clarifier has been constructed and was brought into service in May of 2021.

✓ Flexibility. This aeration basin is designed with the best industry knowledge for achieving stable biological phosphorus removal. The basin includes larger unaerated volumes and can operate in three different process configurations.

✓ Decreased chemicals. These improvements will provide a more stable biological phosphorus removal process, allowing the District to meet effluent limits with less chemical addition and increased struvite harvesting.

2023 – Thickening Expansion

✓ Low-cost thickening and WASSTRIP expansion: The District has completed the design of a mechanical WAS thickener to replace the current gravity thickening process. Additionally, the existing WASSTRIP process, which is currently housed in one gravity thickener, will be moved to a larger unused digester in the DC1 complex. This will provide a low-cost expansion of both the WAS thickening and the WASSTRIP processes. These projects will free up two gravity thickeners to provide additional primary sludge fermentation and thickening capacity at a relatively low cost.

✓ Reliable phosphorus removal. In addition, the District also completed a project to use waste heat from the cogeneration process to heat the primary sludge fermentation process. Increasing the temperature of the fermentation process allows for increased generation of volatile fatty acids which when added back to the secondary process, allow for a more stable biological phosphorus removal process.

2026 – Chemical Clarifier Optimization

✓ Improved phosphorus removal performance. Based on uncertainty in future effluent phosphorus limits, the Plan recommends two alternative paths forward. If future effluent limits remain unchanged, the District will construct the full planned modifications to the chemical clarifiers. However, if the effluent limits are more relaxed, the District can save costs by implementing only select modifications.

2027 – Anaerobic Digestion Expansion

✓ Capacity. An expansion to the District’s anaerobic digestion capacity will be required by 2027. The Plan conducted a robust evaluation of different digestion technologies, including considerations for producing Class A biosolids along with potential to destroy PFAS compounds. Since future solids regulations are unclear, the Plan recommends continuing with conventional anaerobic digestion.

2028 – Secondary Expansion (Train 6)

✓ Capacity. Towards the end of the planning period, an additional secondary train will be required to provide sufficient nitrification capacity during the dry weather season. In conjunction with this expansion, the primary effluent pump station will also need to be expanded to allow for increased peak flows to be conveyed to the secondary process.