FINAL REPORT

Wastewater Treatment Plant Master Plan Update 2017

Prepared for

City of Gresham

October 2017

Executive Summary

ES.1 Introduction

The City of Gresham, Oregon, Wastewater Treatment Plant (WWTP) is located between Interstate 84 and the Columbia River about 12 miles east of downtown Portland. It was originally built in 1954 and major improvements were made in 1970, 1979, 1987, and 2001. The facility is currently undergoing additional process upgrades to improve efficiency and performance.

The WWTP receives wastewater from incorporated areas of Gresham, Wood Village, and Fairview. The Gresham WWTP has two liquid stream treatment trains, the Upper (south) Plant, which was constructed in 2001, and the Lower (north) Plant, which was the original plant. Each train treats wastewater using a combination of screening, grit removal, primary clarification, activated sludge process, and liquid chlorination and dechlorination prior to discharge of treated effluent in the Columbia River. Solids removed from the liquid stream are treated and hauled offsite for land application. Figure ES-1 shows the existing site layout.

Figure ES-1. Gresham WWTP Existing Site Layout

ES.1.1 2017 Master Plan Update

This 2017 Master Plan Update builds on the previous work conducted as part of the 2004 Master Plan Update, the 2011 Master Plan Update, and the 2014 Solids Process Improvement Predesign Report. It identifies studies and capital projects that need to be conducted and/or implemented at the WWTP within the next 5 years while anticipating projected growth in the service area over the next 20 years and evolving regulatory requirements.

Key tasks completed as part of the Master Plan (MP) update included:

- Evaluation and updating of flow and load projections
- Development of a liquids treatment plan that has the flexibility to adapt to a variety of potential regulatory scenarios
- Evaluation of alternatives to allow the City to defer construction of a third anaerobic digester
- Investigation of how to achieve a Class A biosolids program if the City opts to pursue this goal within the next 5 years (i.e., before the next MP update)
- Assessment of options for using excess biogas and/or the heat generated from the existing combined heat and power system
- Modifications needed to the capital improvement plan to reflect the results of this update

ES.1.2 WWTP Improvements Since the 2011 Update

The 2011 Master Plan called for constructing a fats, oils, and grease (FOG) receiving station and cogeneration expansion improvements, which are complete and in service. The FOG receiving station was expanded in 2014.

The City has also proceeded with the Solids Process Improvements project, which is currently being implemented. The project includes:

- Adding the ability to thicken primary sludge with waste activated sludge (WAS) on the existing gravity belt thickeners
- Repair of the cover seal on the primary digester
- Modifications to enable parallel feed to the digesters including associated pressure and level instrumentation
- Larger overflow and pressure relief hatches to help mitigate foaming/rapid rise events and other safety improvements
- Installing larger piping to accommodate additional biogas generation
- Refurbishment of the belt filter presses (BFPs)

ES.2 Existing Conditions

Data on the existing conditions at the WWTP and historical flows and loads were collected and analyzed to determine per capita and peaking factor values, which are necessary to assess the current capacity of major unit processes. The historical flow and load analysis was used, along with population projections, to project future flows and loads so that the City can plan for future expansion of the WWTP. Per capita and peaking factors are used to estimate future flow and load conditions and are based on analyses of historical data. In general as shown by the dry season average residential/commercial (or non-industrial) per capita flows from 2005 to 2016 (Figure ES-2), the per capita and peaking factor values have been decreasing before and during the range of historical data analysis that was conducted for this study, 2011/2012 wet season through 2016 dry season.

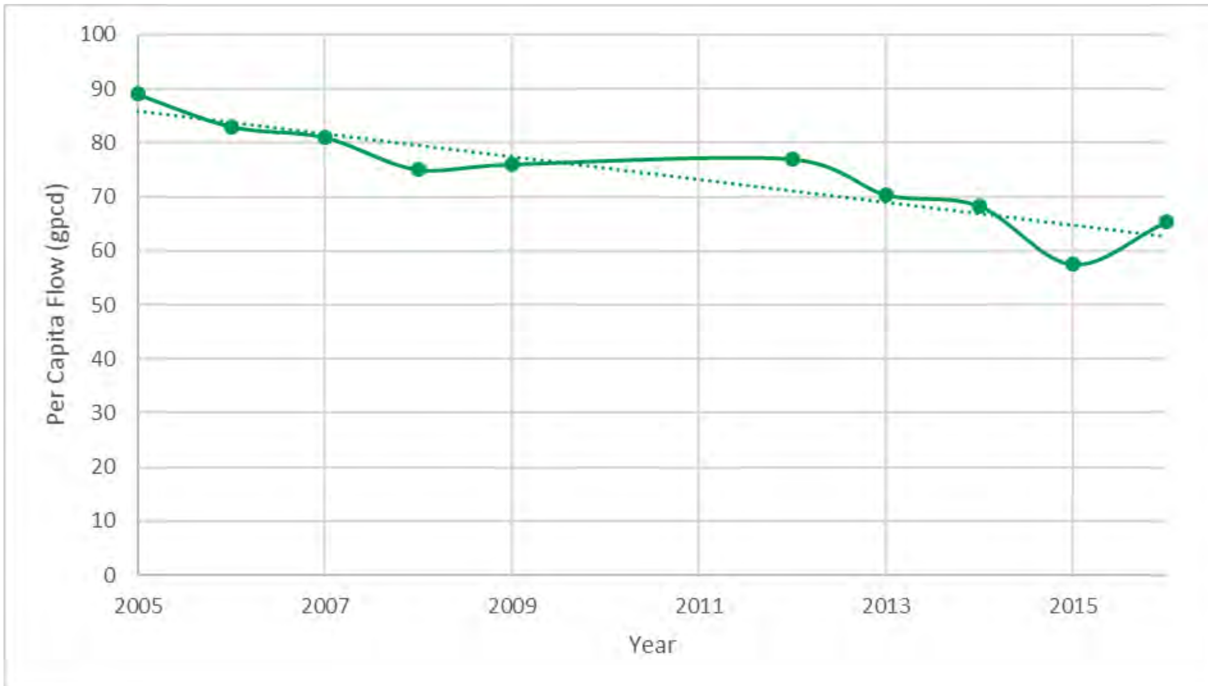

Figure ES-2. Dry Season Average Per Capital Flow (Residential/Commercial or Non-Industrial Portion)

The existing capacities of each major unit process at the Gresham WWTP were reviewed. The 2004 Master Plan, 2011 Master Plan, and input from plant staff were reviewed to determine physical process sizing and identify previously assumed design criteria. Design criteria were updated to CH2M and industry standards, where applicable, as justified by plant performance over the last 5 years. Plant data from the 2011/2013 wet season to the 2016 dry season were reviewed for influent characterization, plant operation conditions, and unit plant performances. After review of the historical data, May 2016 was selected as being the most representative of steady plant operation and was used to calibrate CH2M's proprietary whole plant process simulator model Pro2D2. The calibrated model was used to develop an overall plant capacity by increasing the plant flows and loads until preselected design criteria levels were exceeded. From the model, the capacity of the existing plant was determined to be 28.5 million gallons per day (mgd) based on wet season maximum month influent loading characteristics. The capacity is limited by secondary clarifier hydraulic overflow rates. Capacity is based on wet season because it is considered to be more limiting; nitrification is not currently required in either wet or dry season, and therefore a 3-day solids retention time (SRT) was assumed in both wet and dry seasons to meet effluent permit requirements. The projected plant influent biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations are within a few percentage points for wet season and dry season maximum month conditions, while the influent ammonia concentrations are higher in wet season than dry season. Thus, the wet season maximum month influent condition will limit the plant capacity, due to its significantly higher flows and low influent temperature, which result in a slower biological degradation and higher sludge yields. Historical data also confirmed higher digester feed solids in wet season than in dry season.

Digester capacity is currently limited by hydraulic loading, solids loading and lack of tank redundancy and can be increased significantly if the existing two digesters can be operated in parallel instead of in series to relieve solids loading and if co-thickening is utilized, which relieves hydraulic loading limitations. Improvements at the WWTP are underway that will enable operation in these modes; however, neither of these approaches address the lack of redundancy associated with the anaerobic digestion unit process. Table ES-1 summarizes the unit process analysis for the Gresham WWTP.

Table ES-1. Summary of Unit Process Capacity Analysis for the Gresham WWTP

Unit Process	Criteria/Limiting Factor	Unit Process Capacity (firm/all units in service)
Influent screens	Pass peak flow	52.5 mgd[a]
Grit removal	Pass peak flow	76 mgd[b]
Primary clarification	1,200 gpd/ft^2 SOR at WSMM 3,000 gpd/ft^2 SOR at WSPH (as well as maximum daily flow data and an assumed 1.4 PH:MD flow peaking factor)	14.9 mgd/32.1 mgd 37.4/80.2 mgd
Aeration basins	3-day SRT at WSMM 2,000 to 5,000 mg/L MLSS at WSMM	28.5 mgd[c]
Secondary clarification	700 gpd/ft^2 SOR at WSMM 1,200 gpd/ft^2 SOR at WSMD peak day SLR < 80% limiting SLR	28.5 mgd[c]
	Peak day and hour hydraulic capacity of secondary treatment	54mgd/58 mgd
Chlorine contact basins	20-minute HRT at WSMD 30-minute HRT at DSA	21.25 mgd/42.5 mgd 14.2 mgd/28.4 mgd
WAS thickening	1,000 dry lb solids/hr/meter SLR 100 gpm/meter HLR	68,000/88,000 ppd[d] 408,000/528,000 gpd[d]
Anaerobic digestion	0.50 lb COD/VS-day at 14-day maximum loading 15-day SRT at 14-day maximum flow 0.25 lb VSS/ft^3-day at 14-day maximum loading	Not applicable/84,000 ppd Not applicable/67,700 gpd Not applicable/33,900 gpd
Digested sludge dewatering	600 dry lb solids/hour/meter SLR 75 gpm per meter HLR	12,000/24,000 ppd[e]
	Operated 10 hours per day, 7 days per week	90,000/180,000 gpd[e]
Biosolids (dewatered sludge) storage	60 days of storage 14.5% average cake solids in wet season 1.07 cake specific gravity	14,600 gpd/18,500 ppd

[a] Only firm capacity is presented; plant cannot hydraulically pass the flow associated the rated capacities of each screen if all are in service.
[b] There is only one circular grit chamber in each the lower and Upper Plant; capacity values presented are total as there is no redundant unit
[c] Capacity determined from Pro2D modeling. Aeration basin capacity assessment: assumes all three Lower Plant and one Upper Plant basins are always in service so firm capacity (with one unit out of service) is not assessed. Similarly, for the secondary clarifiers: assumed all three units in the Lower Plant and one unit in the Upper Plant are always in service.
[d] As currently operated: one unit 24 hours per day and two units 10 hour per day, all three 7 days per week.
[e] As currently operated 10 hours per day, 7 days per week.

COD/VS-day = chemical oxygen demand per volatile solids per day
DSA = dry season average
DSMM = dry season maximum month
ft^2 = square foot
gpd = gallons per day
gpm = gallons per minute
HLR = hydraulic loading rate
HRT = hydraulic retention time
lb = pounds
mg/L = milligrams per liter
MLSS = mixed liquor suspended solids
PH:MD = peak hour: maximum day
ppd = pounds per day
SLR = solids loading rate
SOR = surface overflow rate
VSS/ft^3/day = volatile suspended solids per cubic foot per day
WSMD = wet season maximum day
WSMM = wet season maximum month
WSPH = wet season peak hour

ES.3 Planning Criteria and Discharge Considerations

Flow and load projections were developed for the period between 2017 and 2036. These projections will be used to assist in planning future improvements and expansions. Figure ES-3 summarizes the projections for flow, 5-day BOD, TSS, and ammonia for the wet season maximum month. The last 5 years of data, which were analyzed and used to develop future projections, are also presented in Figure ES-3. The flow and load projections include domestic (residential and light commercial) and existing industrial sources.

Summary of 2036 flows and loads:

- Based on a population of 145,959
- Peak hour flow: 47.8 mgd
- Dry season maximum month
  - BOD: 28,101 ppd
  - TSS: 27,235 ppd
  - Ammonia: 3,532 ppd

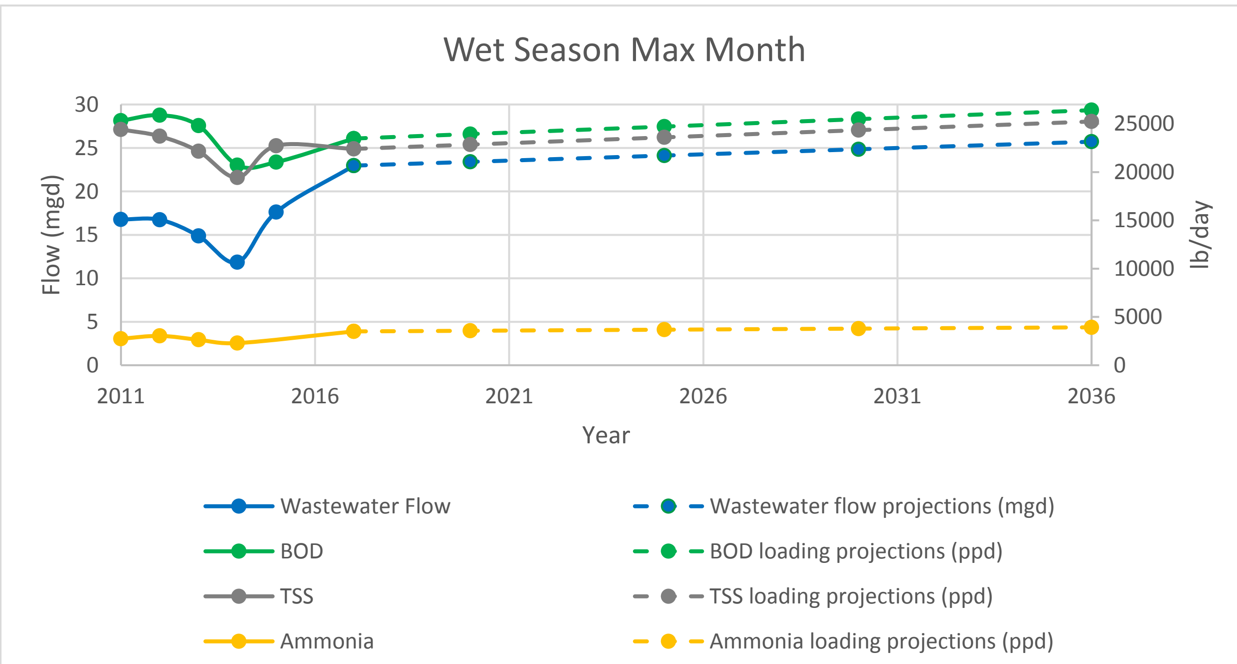

Figure ES-3. Summary of Flow and Load Projections

"Buildout" (2040) population for Gresham was estimated at 185,801 people according to the TAZ Potential Buildout method, which is based on current zoning and a density of 2.69 people per household. While this master planning effort focuses on the next 20 years, the buildout population is used to determine if the current WWTP site is sufficient to serve anticipated treatment needs beyond the 20-year horizon.

Gresham currently meets all discharge requirements identified in its National Pollutant Discharge Elimination System (NPDES) permit, which was renewed in August 2014 and expires in July 2019. Gresham has infrequently had issues with mass load permit compliance in the past during storm events, but typically the WWTP has consistently met BOD, TSS, *E. coli*, and pH requirements.

Discharge requirements for ammonia may become critical for future operation and planning. Ammonia limits do not currently exist in Gresham's NPDES permit, but the Oregon Department of Environmental Quality (DEQ) adopted more stringent ammonia water quality toxicity criteria in 2015, which will lower allowable ammonia discharge concentrations for Gresham. Therefore, the City needs to take reasonable operational and management measures now to reduce effluent ammonia concentrations to reduce the likelihood of triggering a "reasonable potential to exceed" these new, more stringent criteria. However, even if efforts are undertaken to reduce effluent ammonia levels between now and when permit renewal is undertaken, seasonal effluent ammonia limits may be included in the next NPDES permit renewal. To reduce the likelihood (or at least the severity) of future ammonia limits, nitrification of a portion of the flow during the dry season and some ammonia reductions in the wet season would most likely be required, depending on the ammonia criteria calculated and effluent ammonia data applied. A suite of options was evaluated as part of this MP update, including nitrification in the upper plant, treatment of dewatering filtrate recycle, and post aerobic digestion.

Gresham's biosolids management program complies with all local, state, and federal requirements. While there are no immediate regulatory drivers that would require the City to change the current biosolids program, the City is always looking for ways to continue to improve and enhance the program. Currently, major regulatory changes that would drive the City to change current solids processing and biosolids beneficial reuse practices are not foreseen. In the near term, digestion capacity/redundancy and storage of digested and dewatered biosolids are some of the more critical issues for Gresham.

The City may wish to modify its local land application program by producing biosolids with even lower pathogen levels (exceptional quality/Class A) than currently attained, by identifying additional land application sites including those located in eastern Oregon, or by converting to a product-based program (such as a soil amendment product) through advanced processing/treatment, e.g., composting.

Considering all of these issues, the City will:

- Continue to identify and implement cost-effective incremental improvements to defer construction of a third anaerobic digester without curtailing FOG/high-strength waste receiving if possible.
- Evaluate alternatives that will directly or indirectly provide more storage for dewatered biosolids, e.g., by constructing more storage or by optimizing BFP dewatering to obtain higher percent cake solids.
- Develop a long-term plan for modifying existing facilities to produce exceptional quality/Class A biosolids.
- Reserve space in the buildout site plan for advanced biosolids processing, such as composting.

ES.4 Alternatives Analysis

The WWTP unit process evaluation showed that under the current operating approach, no additional units are needed during the planning period (through 2036) for screening, grit removal, primary clarification, chlorine contact basin, WAS thickening, anaerobic digestion, and digested sludge dewatering. Aside from redundancy requirements, no additional capacity is needed during the planning period in secondary treatment and solids stabilization. Therefore, the alternatives analysis focused on evaluating options to address the following:

- Compliance with new permit limits on effluent ammonia
- The capacity of the gravity belt thickeners (GBTs) after the WWTP begins operating in co-thickening mode

- Improvements in the reliability and performance of anaerobic digestion, focusing on:
  - The ability to continue and potentially further expand acceptance of external high-strength waste
  - Digestion redundancy
  - Attaining Class A biosolids
  - Reducing the volume of generated biosolids
- Determining additional cake storage needs, if any, for each of the considered anaerobic digestion alternatives.

ES.4.1 Secondary Treatment

The most probable future ammonia effluent permit limits in the dry season (May through October) were estimated at 39 mg/L (30-day average) and 40 mg/L (daily maximum) assuming a Columbia River pH of 8.2. The worst-case limits for this same dry season scenario were estimated at 24 mg/L (30-day average) and 23 mg/L (daily maximum) and were based on a Columbia River pH of 8.5. For this alternative analysis, it was assumed that the effluent performance would need to attain 25 percent less than these estimated permit limit values.

The following alternatives were evaluated for complying with these future anticipated effluent ammonia limits:

- Alternative 1 – Nitrify Upper Plant
  - 1a – Plug Flow Operation
  - 1b – Step Feed Operation
  - 1c – Step Feed Operation with Seeding Lower Plant with Upper Plant Sludge
- Alternative 2 – Chemically Enhanced Primary Treatment (CEPT)
  - 2a – CEPT in Upper and Lower Plants
  - 2b – CEPT in Upper and Lower Plants - Upper Plant WAS to Lower Plant
- Alternative 3 – Post-Aerobic Digestion
- Alternative 4 – Sidestream Treatment of BFP Filtrate
- Alternative 5 – Integrated Fixed-Film Activated Sludge
- Alternative 6 – Granular Activated Sludge

Alternative 2 – Chemically Enhanced Primary Treatment was eliminated because it is not anticipated that such a high level of ammonia removal will be needed and because it requires the use of chemical addition that would increase biosolids production. Alternative 3 – Post-Aerobic Digestion was eliminated because it does not ensure compliance with the anticipated effluent ammonia limits and because of the significant costs to implement it. Alternative 4 – Sidestream Treatment of BFP Filtrate was eliminated because it does not ensure compliance with the anticipated effluent ammonia limits and because of the significant costs to implement. Alternative 5 – Integrated Fixed-Film Activated Sludge was eliminated because it is not anticipated that such a high level of ammonia removal will be needed and because of the significant costs to implement it. Alternative 6 – Granular Activated Sludge was eliminated because it is not anticipated that such a high level of ammonia removal will be needed and because granular activated sludge is still an emerging technology. Of the remaining options, Alternative 1b – Nitrify Upper Plant – Step Feed is recommended. Alternative 1b is preferred over 1a – Nitrify Upper Plant – Plug Flow, which requires construction of Secondary Clarifier No. 5 to address solids loading constraints (as opposed to just providing secondary clarification redundancy for Alternative 1b) and Alternative 1c –

Nitrify Upper Plant – Step Feed with Upper Plant WAS to Lower Plant, which provides increased effluent ammonia reduction that is not anticipated to be required.

To ensure that this operational approach can be executed reliably, it is recommended that the City construct a second secondary clarifier for the Upper Plant for increased redundancy and install a fourth blower (for a firm capacity of 15,900 standard cubic feet per minute (scfm) increased from 10,600 scfm currently) by 2020 in the Upper Plant blower building to ensure that 2020 maximum day peak diurnal airflows of 12,800 scfm can be provided with one unit out of service.

Projects and activities that should continue to be considered to further enhance the ability of the Gresham WWTP to comply with future, potentially more stringent effluent ammonia limits include modifying the existing diffuser to increase dilution in the Columbia River, constructing a post-aerobic digestion system or sidestream treatment system to remove recycled ammonia from the solids train, and installing integrated fixed-film activated sludge or a granular active sludge system to nitrify the Lower Plant.

ES.4.2 Evaluation of Digestion Alternatives

Solids treatment processes receive primary sludge and WAS from the Upper and Lower Plant processes. There is only one solids treatment train. Table ES-2 summarizes the additional liquids processes needed by 2025 and 2040 (buildout).

Table ES-2. Solids Treatment Units

	Total Units		
Unit Process	**Existing**	**2036**	**Comments**
Thickening (GBTs)	3	3	Currently 1 unit operates 24 hours per day and 2 units operate 10 hours per day, 7 days per week; increased daily hours of operation required in 2036
Digestion	2	2	No redundancy
Dewatering (BFPs)	2	2	
Biosolids Storage	9	Approximately 3 additional bays	At 14.5% cake solids and 367 cubic yards/bay, the number of additional bays will depend on long-term digestion approach implemented

Initially, the primary driver for the solids evaluation was to defer construction of a third digester tank. However, the capacity assessment concluded that with primary sludge and WAS co-thickening coupled with parallel digester operation, the 2036 projections and the current external high-strength waste loadings could be accommodated without the new tank. This scenario provides no redundancy in case of a process outage. Desirable attributes for the selected anaerobic digestion approach were defined as solutions that would provide:

- Solids stabilization reliability and redundancy
- Ease of operation (limit level of complexity)
- An exceptional quality/Class A biosolids product
- Energy efficiency or generation (i.e., biogas) providing sufficient heat for digestion and continuing net positive energy production
- A reduced quantity of generated biosolids (primarily a volume/truck trip issue)

The evaluation of digestion alternatives started with a preliminary screening of selected solids technologies that included the following:

- Conventional mesophilic digestion
- Anaerobic thermophilic digestion
- High-solids mesophilic digestion (Omnivore)

- Thermal hydrolysis process
- Post-aerobic digestion

The following four digester alternatives were selected for further quantitative evaluation because they would provide the most advantages identified in the alternatives above:

- Alternative 1 – Mesophilic Anaerobic Digestion
- Alternative 2 – Class B Anaerobic Thermophilic Digestion
- Alternative 3 – High-Solids Mesophilic Digestion (Omnivore by Anaergia)
- Alternative 4 – Thermal Hydrolysis

A quantitative non-monetary weighted scoring was combined with a weighted life-cycle score to generate an overall score for each of the alternatives. Based on these resulting scores, Alternative 4 – Thermal Hydrolysis ranked the highest, followed by Alternative 3 – High Solids Mesophilic, and then Alternative 2 – Class B Thermophilic. Alternative 1 – Mesophilic Digestion ranked fourth based on these results.

Therefore, the solids treatment recommendation is to complete the modifications that will enable co-thickening and parallel operation of the existing two digesters, and to obtain operating data so that the performance assumptions contained in Chapters 2 and 4 can be validated. Selection and implementation of digestion upgrades (Alternatives 1 through 4) should be deferred until the next WWTP MP Update, if possible.

ES.5 Biogas Production and Alternatives

The City of Gresham WWTP is an energy net-zero facility. It produces its electrical needs onsite by operating two internal combustion cogeneration (cogen) engines using biogas generated by the anaerobic digesters and by purchasing electricity from a third-party that generates electricity onsite with a solar photovoltaic array. Surplus electricity that is generated onsite is fed back onto the Portland General Electric electrical grid.

Biogas produced at the two anaerobic digesters is combusted onsite in one of three ways: (1) as fuel for the cogen units to produce heat and power, (2) as fuel for the boiler to produce heat in the event that one or both engines are out-of-service, and (3) as excess biogas burned in the waste biogas flare. The primary use for the biogas is as fuel for the cogeneration engines. The heat generated by the cogen engines is used onsite to heat the administration building and anaerobic digesters, the solids building, the lower headworks, and the thickener building.

A FOG receiving station was constructed in 2012 and expanded in 2014. FOG is produced by restaurants and food processors, collected from grease traps, and trucked to the FOG receiving station. It is injected directly into the anaerobic digesters to produce additional biogas. The City has a total of 30,000 gallons of FOG receiving tankage.

On average, the City produces approximately 300,000 standard cubic feet per day (scfd) of biogas from its anaerobic digesters, of which over 60,000 scfd is flared. There was a 9 percent increase in biogas production between 2015 and 2016, likely the result of receiving more FOG in 2016 than 2015.

The City is interested in developing new revenue streams from the excess biogas and/or heat generated onsite. Options included:

- Sell excess biogas (or heat generated from this biogas) to a nearby industrial user
- Use excess heat for additional building spaces onsite
- Sell excess biogas as renewable natural gas (pipeline injection)
- Use excess electricity to fuel electric vehicles
- Use microturbines to produce additional electricity

ES.5.1 Recommended Plan

In the short term (within the next 5 years), the City will use the excess heat generated onsite for building spaces such as the maintenance building. The City will continue to consider heating additional building spaces onsite including the lower plant blower building, the disinfection buildings, and the floor of the new decant facility.

In the long term, the City will study the life-cycle assessment costs to convert biogas to renewable natural gas. It may also evaluate the possibility of converting all biogas to renewable natural gas and buying natural gas for onsite needs. The City would be able to obtain Renewable Identification Numbers (RINs) for all the renewable natural gas sold to Northwest Natural or Williams, and could also consider if the economics at that time warrant operating the cogens using the purchased natural gas, primarily to retain net positive electricity use at the WWTP. The benefit of selling renewable natural gas is significantly diminished if the RIN program is not renewed past 2022 and if market prices for natural gas remain at or near current levels.

The City will also continue discussions with local industries to explore the option of selling excess biogas and/or excess heat. Depending on the amount of excess heat or biogas in the future, this could be a low-cost option to sell excess biogas and heat that is now currently wasted.

ES.6 Recommended Improvements

The recommended projects and associated costs and phasing plan through year 2036 are listed in Table ES-3. Figure ES-4 shows the site plan through 2036; Figure ES-4 also shows the additional wastewater treatment facilities needed to provide service for the buildout population of 185,801, and shows that the site has sufficient land for this purpose. Major projects/improvements are based on ensuring process capacity projections and meeting regulatory requirements. They also include general improvements identified through operator and staff comments. Project costs are order-of-magnitude estimates in 2017 dollars. The project costs include construction costs, a 30 percent construction contingency, and 25 percent for engineering, legal, and administrative costs. Capital improvement project summary sheets for each of the projects are included in the appendix to the MP.

Table ES-3. Costs and Phasing of Recommended Improvements through 2036

Project	Description	Driver	Cost	Phasing
Near Term (0-5 years)				
Nitrification of the upper plant	Nitrify upper plant during the dry season. Improve diffusers in upper plant aeration basins.	Effluent discharge concentration regulatory limits	$252,000	2018 2018-2019
Mixing Zone Study	Effluent mixing zone study.	Effluent discharge concentration regulatory limits	$100,000	2018
Outfall Diffuser Improvements	Extend and improve outfall diffuser.	Effluent discharge concentration regulatory limits	$1,436,000	2019-20
Columbia River Study	Water quality monitoring study (pH, copper, alkalinity, and hardness) of Columbia River.	Effluent discharge concentration regulatory limits	$30,000	2017-18
Digester and Biogas Improvements	Operate digesters in parallel with co-thickening. Digester solids and biogas improvements.	Digester capacity	-	Improvements currently in progress
Intermediate Term (5-10 years)				
Fifth Secondary Clarifier Fourth Upper Plant Blower	Add 2nd upper plant secondary clarifier & secondary scum improvements. Add a 4th blower to upper plant blower building	Redundancy and more reliable nitrification operation	$7,192,000 $559,000	2020-2022
Influent Diversion Automation	Automate influent diversion structure.	Lack of automated control for flow split	$151,000	2022
Disinfection Automation	Automate disinfection chemical feed systems.	Lack of automated control when hydraulic residence time design criteria is exceeded	$151,000	2027
Alternative Biogas Utilization	Alternative biogas handling/utilization (clean biogas for injection into high pressure natural gas line).	Improved return on biogas	$1,000,000	2026-2027
Septage Receiving Facility	Construct septage receiving station at WWTP.	Generate additional revenue and support local businesses	$1,660,000	2028-2029
Additional Cake Storage	Construct 3 additional cake storage bays.	Maintain 60 days of storage in the wet season	$2,895,000	2023-2025
Long Term (10+ years)				
Digestion Capacity Improvements	Anaerobic digester stabilization improvements (assuming conversion to Class A program is not pursued in the near-term). Technology selection to be reevaluated at the next MP update.	Digestion capacity/redundancy	$10,300,000	2022-2025
North Access Bridge	Construction of a bridge over the Columbia Slough to the north of the existing plant for use of additional land for future projects.	Use of land north of WWTP	$582,000	2030-31

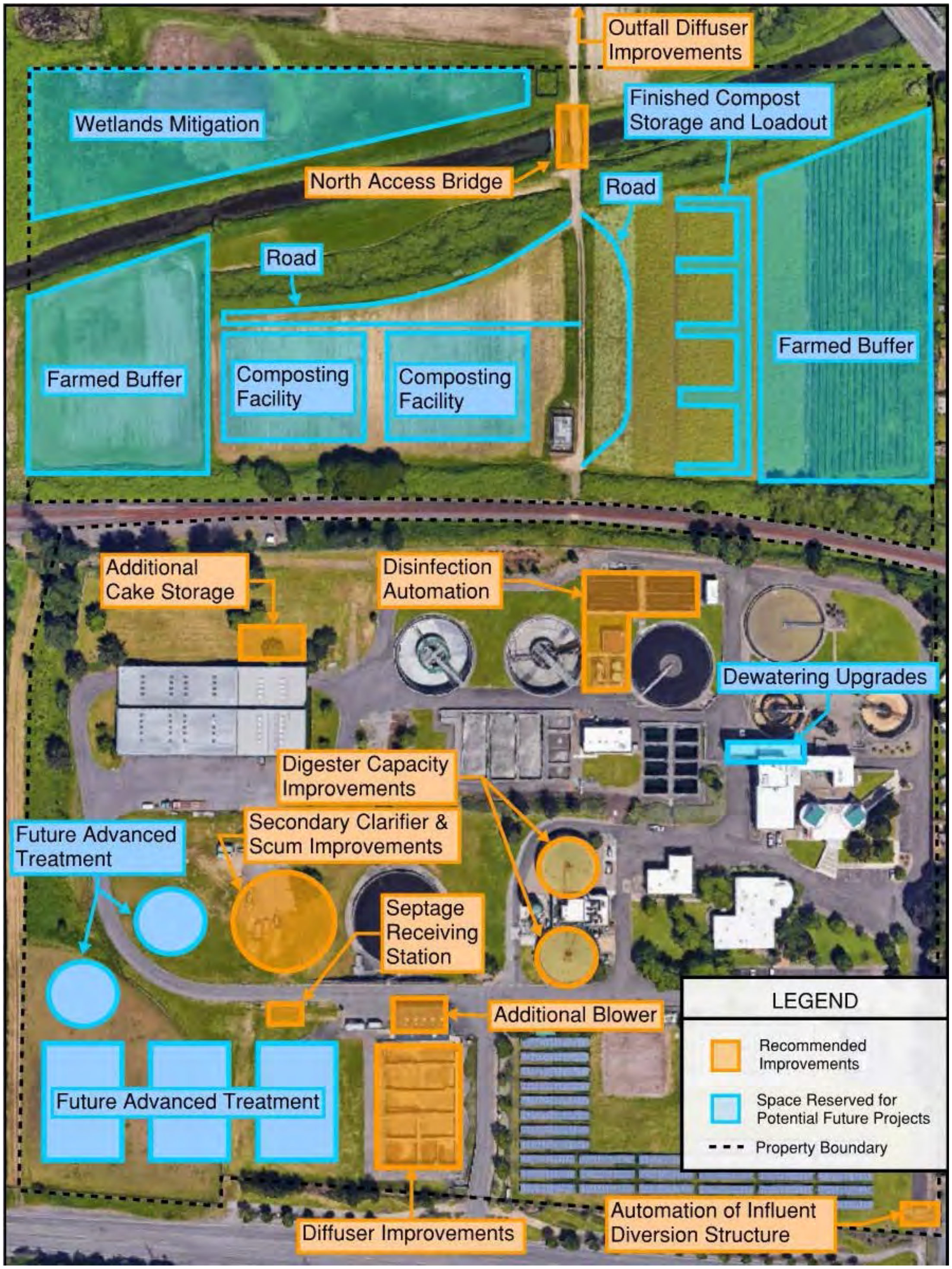

Figure ES-4. Recommended Improvements Plan

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Acronyms and Abbreviations

7Q10 flow	lowest 7-day average flow based on 10-year return interval
°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	micrograms per liter
ACWA	Oregon Association of Clean Water Agencies
Ag	silver
As	arsenic
ATD	anaerobic thermophilic digestion
BFP	belt filter press
BLM	Biotic Ligand Model
BOD	biochemical oxygen demand
BOD_5	5-day biochemical oxygen demand
Btu	British thermal units
CBOD	carbonaceous biochemical oxygen demand
Cd	cadmium
CFR	Code of Federal Regulations
CEPT	chemically enhanced primary treatment
CH2M	CH2M HILL Engineers, Inc.
CIP	capital improvement plan
City	City of Gresham
CMOM	Capacity, Management, Operation, and Maintenance
COD	chemical oxygen demand
COD/VS-day	chemical oxygen demand per volatile solids per day
cogen	cogeneration
Cr	chromium
Cu	copper
CWPTC	Construction Waste Processing and Transfer Center
DDT	dichlorodiphenyltrichlorethane
DEQ	Oregon Department of Environmental Quality
DO	dissolved oxygen
DSA	dry season average
DSMM	dry season maximum month
EPA	U.S. Environmental Protection Agency

FOG	fats, oils, and grease
ft^2	square foot (feet)
GBT	gravity belt thickener
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
Hg	mercury
HLR	hydraulic loading rate
hp	horsepower
HRT	hydraulic retention time
HSM	high-solids mesophilic
IFAS	integrated fixed-film activated sludge
I/I	infiltration and inflow
kcal	kilocalories
kW	kilowatts
kWh	kilowatt hours
kWh/d	kilowatt hours per day
lb	pounds
LMM	linear motion mixer
MAD	mesophilic anaerobic digestion
MG	million gallons
mg/L	milligrams per liter
mgd	million gallons per day
MJ/d	megajoules per day
mL	milliliters
MLSS	mixed liquor suspended solids
MMBH	million Btu per hour
MMP	Mercury Minimization Plan
MP	Master Plan
MW	megawatts
N/A	not applicable
ND	nondetectable
NH_3	ammonia
Ni	nickel
NOAA-NMFS	National Oceanic and Atmospheric Administration National Marine Fisheries Service

NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity units
OAR	Oregon Administrative Rules
O&M	operation and maintenance
PAD	post-aerobic digestion
Pb	lead
PCB	polychlorinated biphenyl
PGE	Portland General Electric
PH:MD	peak hour:maximum day ratio
ppcd	pounds per capita per day
ppd	pounds per day
PS	primary sludge
RAS	return activated sludge
RCNG	renewable compressed natural gas
RFS	Renewable Fuel Standard
RIN	Renewable Identification Number
RM	River Mile
RMZ	regulatory mixing zone
RMZ-IMD	Regulatory Mixing Zone Internal Management Directive
RPA	reasonable potential analysis
RPA-IMD	Reasonable Potential Analysis Process for Toxic Pollutants Internal Management Directive
SCADA	supervisory control and data acquisition
scf	standard cubic foot
scfd	standard cubic feet per day
scfm	standard cubic feet per minute
SCODSLR	specific chemical oxygen demand solids loading rate
Se	selenium
SLR	solids loading rate
SOR	surface overflow rate
SRT	solids retention time
SSO	sanitary sewer overflow
SVI	sludge volume index
SVSLR	specific volatile solids loading rate
SWMM	Storm Water Management Model

TAZ	traffic analysis zone
TDS	total dissolved solids
TH	thermal hydrolysis
THLA	total heat load allocation
TMDL	total maximum daily load
TS	total solids
TSS	total suspended solids
VFD	variable-frequency drive
VS	volatile solids
VSLR	volatile solids loading rate
VSR	volatile solids reduction
VSS	volatile suspended solids
VSS/ft^3-day	volatile suspended solids per cubic foot per day
v/v	volume/volume
WAS	waste activated sludge
WET	whole effluent toxicity
WSMD	wet season maximum day
WSMM	wet season maximum month
WSPH	wet season peak hour
WWTP	wastewater treatment plant
yd^3	cubic yard(s)
Zn	zinc
ZID	zone of initial dilution

CHAPTER 1

Introduction

This chapter provides a general overview of the goals, objectives, and scope of work related to the Master Plan Update for the City of Gresham's Wastewater Treatment Plant (WWTP). It also provides a review and status update of the recommended projects from the 2011 Master Plan (MP) Update (Carollo, 2011).

1.1 Background

The City of Gresham WWTP is located about 12 miles east of downtown Portland, Oregon, between Interstate 84 and the Columbia River. It was originally built in 1954 and major improvements were made in 1970, 1979, 1987, and 2001. The facility is currently undergoing additional process upgrades to improve efficiency and performance. Figure 1-1 shows the site layout.

Figure 1-1. Gresham WWTP Existing Site Layout

The WWTP receives domestic, commercial, and industrial wastewater from incorporated areas of Gresham, Wood Village, and Fairview. The Gresham WWTP has two influent treatment trains, the Upper (South) Plant (which was constructed in 2001), and the Lower (North) Plant, which was the original plant. Each train treats wastewater using a combination of screening, grit removal, primary clarification, activated sludge process, and liquid chlorination and dechlorination prior to discharge of treated effluent in the Columbia River through a National Pollutant Discharge Elimination System (NPDES) permitted outfall. Solids removed from the influent are treated using gravity belt thickeners (GBTs), anaerobic digesters, and belt filter presses (BFPs) prior to being hauled offsite for land application.

The 2011 MP Update called for constructing a fats, oils, and grease (FOG) receiving station and cogeneration (cogen) expansion improvements, which have been put in service. Also, Gresham has proceeded with the Solids Process Improvements Project (currently being implemented), which includes:

- Adding the ability to thicken primary sludge (PS) with the waste activated sludge (WAS) on the existing GBTs
- Repairing the cover seal on the primary digester
- Providing modifications to enable parallel feed to the digesters, including associated pressure and level instrumentation
- Providing larger overflow and pressure relief hatches to help mitigate foaming/rapid rise events and other safety improvements
- Installing larger piping to accommodate additional biogas generation
- Refurbishing the BFPs

The City is also considering implementing changes to the existing digester system that would enable operation at thermophilic temperatures with the objective of increasing digestion capacity and potentially improving dewatering performance.

1.2 Goal of the Master Plan Update

The goal of this 2017 MP Update was to build on the previous work conducted as part of the 2004 Master Plan Update (CH2M HILL, 2004), the 2011 Master Plan Update, and the *Solids Process Improvement Predesign Report* (Brown and Caldwell, 2014a) to identify studies and capital projects that need to be conducted and/or implemented at the WWTP within the next 5 years, while anticipating projected growth in the service area over the next 20 years and evolving regulatory requirements. This updated Master Plan addresses WWTP planning needs through 2036.

1.3 Scope of the Update

The City of Gresham retained CH2M HILL Engineers, Inc. (CH2M) to prepare the 2017 MP update. The scope included:

- Reviewing and updating the 2011 MP recommendations
- Reviewing the City's current solids handling and work conducted since the completion of the 2011 MP, including the *Solids Process Improvement Predesign Report* and the Solids Process Improvements Preliminary Design and Ten Percent Design Technical Memorandum (Brown and Caldwell, 2014b)
- Reviewing the current plan for increasing capacity of the City's digesters and improving dewatering performance

Key tasks completed as part of the MP update included:

- Evaluation and updating of prior flow and load projection
- Development of a liquids treatment plan that has the flexibility to adapt to a variety of potential regulatory scenarios
- Evaluation of alternatives to allow the City to defer construction of a third anaerobic digester
- Investigation of how to achieve a Class A biosolids program if the City opts to pursue this goal within the next 5 years (i.e., before the next Master Plan update)

- Assessment of options for using excess biogas and/or the heat generated from the existing combined heat and power system
- Modifications needed to the capital improvement plan to reflect the results of this update

1.4 Review of 2011 Master Plan Update

A status review of the projects that were recommended in the 2011 Master Plan Update is presented in Table 1-1. The FOG Receiving Phase 2 and Cogeneration Upgrades Project went online in 2015 and is a key part of Gresham WWTP attaining net positive electricity production for the last 2 years.

Table 1-1. Review of Projects from 2011 Master Plan Update

2011 WWTP Master Plan Project Name	2011 WWTP Master Plan Project Description	2011 WWTP Master Plan Estimated Project Cost (2011 dollars)	Estimated Date Needed Online (from 2011 WWTP MP Update)	Status (as of July, 2017)
FOG Receiving Phase 2 and Cogeneration Upgrades	Expansion of the FOG receiving stations, addition of cogen capacity, upgrades to the electrical distribution system	$4,600,000	Summer 2012	Project completed 2015.
WASAC Pilot Testing	Modifications to Aeration Basin 1 to allow for the testing of the WASAC process	$320,000	Winter 2011	City opted to not pursue this project.
WASAC Full-Scale Implementation	Modifications necessary for maximizing the operations and maintenance costs for WASAC	$300,000	Winter 2012	City opted to not pursue this project.
Secondary Scum Improvements	Piping to take secondary scum directly to the digesters to reduce growth of poorly settling bacteria in the Upper Plant	$400,000	2013	Project not initiated.
Flow Split Automation	Automation of the gates in the influent diversion structure to optimize flow split between the Upper and Lower Plants to realize the full capacity of the Lower Plant	$80,000	2020	Future project, not yet initiated.
Preliminary Treatment Upgrades	Adding passive bypass of manually cleaned bar rack to both headworks facilities to provide firm capacity of 76 mgd, which was projected to be adequate through buildout (2011 MP Update estimated wet season peak hour flow at buildout to be 65 mgd)	$400,000	2027	Future project, not yet initiated.
Disinfection Expansion[a]	Increasing disinfection by either adding ultraviolet disinfection or constructing an additional chlorine contact basin	$1,400,000	2027	Future project, not yet initiated.
Digester 3 Addition[a]	Construction of a third digester similar in size to Digester 1	$5,000,000	2030	Future project, not yet initiated.
Dewatering Upgrades	Installation of a screwpress in the existing solids processing building and upgrading dewatered sludge load-out facility	$2,700,000	2016	City opted to not pursue this project; continuing to utilize BFPs for solids dewatering.

Table 1-1. Review of Projects from 2011 Master Plan Update

2011 WWTP Master Plan Project Name	2011 WWTP Master Plan Project Description	2011 WWTP Master Plan Estimated Project Cost (2011 dollars)	Estimated Date Needed Online (from 2011 WWTP MP Update)	Status (as of July, 2017)
Screening and Compactor Replacement	Replacing existing screens with finer screens to alleviate ragging issues throughout the plant	$1,400,000	2029	City opted to proceed with screen replacement project; see text below for description of project completed in 2017.
Secondary Clarifier 5 Addition	Adding a secondary clarifier to the Upper Plant similar in size to Secondary Clarifier 4	$6,400,000	2025	Future project, not yet initiated.
Class A Solids Upgrades	Evaluating Class A solids processing technologies, including composting and the Therma-Flite Bio-Scru, and constructing the recommended technology	$3,900,000	2025	Evaluation and testing of technologies was conducted subsequent to the 2011 Master Plan; see text below for further discussion.

[a] While CH2M has not conducted a detailed review of the cost estimates relative to the project scope description, it appears that the estimated costs for this project may be insufficient for the scope and scale of the project.

The 2011 MP Update identified a Screening and Compactor Replacement Project to replace existing screens with finer screens to alleviate ragging issues throughout the plant. The 2011 MP Update slated this project to be online in 2029. However, because of wear issues the City proceeded with a project to upgrade the preliminary screening in the Lower Plant. In 2017, construction was completed on the replacement of the existing pair of 6-foot-wide bar screens in the Lower Plant. The original bar screens were installed in 1992 and 1997 following the 1987 plant expansion. The new multi-rake 1/4-inch screens replaced the existing climber screens, where one side was 3/8-inch and the other 1/2-inch. Washer compactors were also replaced. The peak capacity of each new bar screen is 22.5 mgd with 40 percent blinding.

The 2011 MP Update identified projects to install a dewatering screw press to increase cake solids performance and to evaluate composting and a Therma-Flite Bio Scru dryer for achieving Class A biosolids. The Solids Process Improvement Predesign Report (Brown and Caldwell, 2014a) built on the 2011 Master Plan work and focused on solids dewatering performance, providing additional digestion capacity, and evaluating Class A options for the future.

The dewatered cake performance at the WWTP has generally trended downward from 16 percent at startup to 14.5 percent currently, which is lower than average industry performance. Polymer usage was reported to range from 14 to 24 pounds per dry ton, which is typical for this application. The poor dewatering performance was primarily attributed to a high WAS/primary sludge ratio of 65/35 resulting from plant influent characteristics. To determine which dewatering technologies to further evaluate onsite, pilot testing or offsite bench testing was conducted on BFP, centrifuge, screw press, and rotary press units. All vendors reported that the sludge was difficult to dewater. Based on these results, BFP (base case), screw press, and centrifuge technologies were evaluated in more detail.

The benefit of the increase in cake concentrations from a screw press (pilot unit performance ranged from 18 to 20 percent cake versus the existing BFP at 14.5 percent) was in large part offset by the expense of additional polymer use (30 to 45 pounds per dry ton of solids processed). The screw press results varied between each test and manufacturer and one manufacturer did not recommend using a screw press at Gresham due to low solids capture rates. For these reasons, the City opted to not pursue a project to install a screw press (as was recommended in the 2011 Master Plan) and instead opted to retain the base case BFP dewatering.

Also as part of the 2014 work, the following advanced treatment alternatives were evaluated with the intent (in part) to avoid construction of a third digester:

- Thermal hydrolysis
- Thermophilic digestion (both Class B and Class A configurations)
- Class A belt drying

The lowest net present value options were Class A thermal hydrolysis followed by Class B thermophilic digestion. The City has proceeded with a 10 percent design to convert the existing mesophilic digesters to thermophilic. One of the objectives of this 2017 Master Plan Update is to review that direction and to assess if there are any additional technological and/or operating options that the City should consider for evaluation.

Although the 2014 evaluation of advanced treatment alternatives did not explicitly look at Therma-Flite Bio Scru drying, the 2017 Master Plan Update did not further evaluate that approach for several reasons. First, the results from 2014 study estimated that only approximately 40 percent of Gresham's WWTP solids could be dried from biogas-produced heat. Gresham's 2011 Internal Operation & Facilities Sustainability Plan has stated goals of 80 percent reduction in City greenhouse gas emissions by 2050 and 100 percent renewable energy by 2030. Purchasing natural gas for drying the remaining portion of the biosolids would not be consistent with achieving these goals. Second, the economic evaluation from the 2014 study found that drying had relatively high initial cost and the highest net present value costs. This evaluation did not take into consideration that the Class A drying solution, while it would eliminate the need to construct additional cake storage, would not address additional digestion capacity needs.

Composting was not considered and can be retained as a potential long-term option for Gresham although it does not address digestion capacity/redundancy needs.

CHAPTER 2

Existing Conditions

2.1 Summary

Data on the existing conditions at the WWTP and historical flows and loads (previous 5 years) were collected and analyzed to determine per capita and peaking factor values, which are necessary to assess the current capacity of major unit processes. The historical flow and load analysis was used, along with population projections, to project future flows and loads (Chapter 3) so that the City can plan for future expansion of the WWTP. The continuing downward trend of per capita flow is illustrated in Figure 2-1.

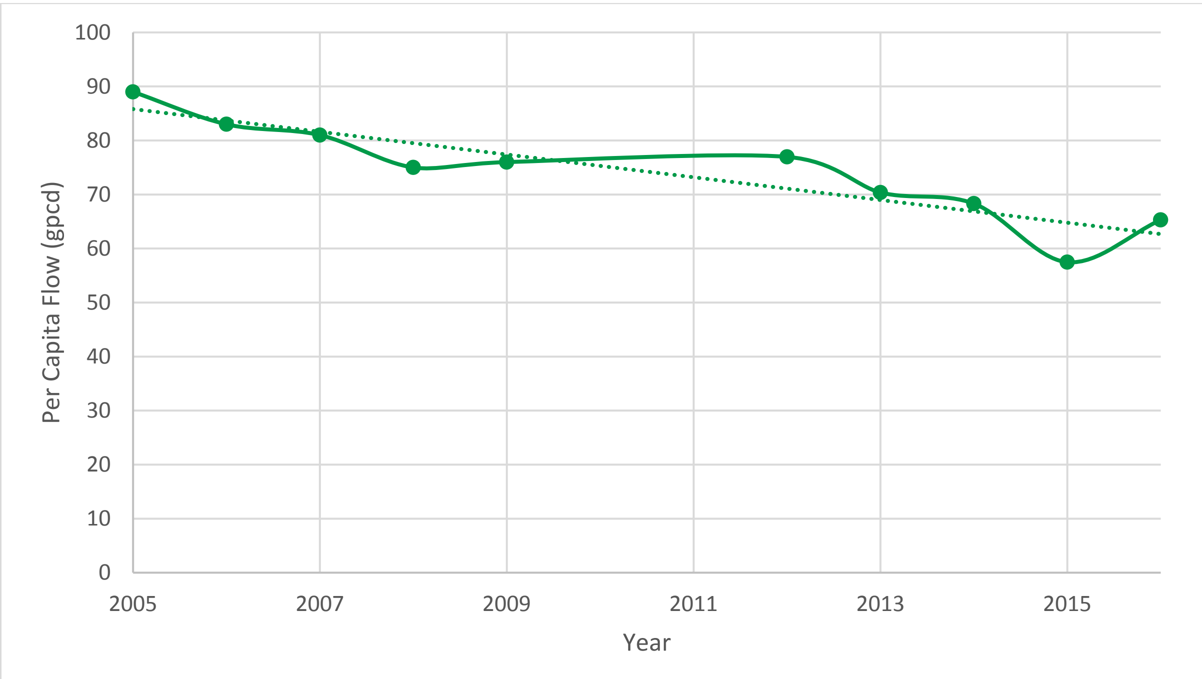

Figure 2-1. Average Dry Season Non-Industrial Per Capita Flow

Historical domestic (residential and light commercial) flow and load per capita and peaking factor values used in this MP Update are presented in Table 2-1.

Table 2-1. Selected Domestic Per Capita and Peaking Factor Values

Per Capita Values		
Parameter	***Dry Season Value***	***Wet Season Value***
Flow (gpcd)	80	100
BOD (ppcd)	0.18	0.17
TSS (ppcd)	0.17	0.17
NH_3 (ppcd)	0.020	0.020

Table 2-1. Selected Domestic Per Capita and Peaking Factor Values

	Peaking Factor Values[a]			
Flow Condition	***Flow***	***BOD***	***TSS***	***NH_3***
Annual average	1.2	1.0	1.0	1.0
Dry season average	1.0	1.0	1.0	1.0
Dry season maximum month	1.3	1.1	1.1	1.2
Dry season maximum week	1.5	1.3	1.4	1.4
Dry season maximum day	1.7	1.7	2.0	1.4
Wet season average	1.4	1.0	1.0	1.0
Wet season maximum month	1.7	1.1	1.1	1.3
Wet season maximum week	2.3	1.4	1.3	1.5
Wet season maximum day	2.8	1.8	1.7	1.5
Wet season peak hour	4.1	-	-	-

[a] Dry season (May 1 through October 31) peaking factors are relative to dry season average. Wet season (November 1 through April 30) peaking factors are relative to dry season average.
BOD = biochemical oxygen demand
gpcd = gallons per capita per day
NH_3 = ammonia
ppcd = pounds per capita per day
TSS = total suspended solids

Based on output from CH2M's Pro2D process model of the WWTP, the overall plant capacity is 28.5 million gallons per day (mgd) at wet season maximum month conditions. The capacity is limited by secondary clarifier hydraulic overflow rates. The peak day and hour hydraulic capacity of secondary treatment, although not evaluated as part of this study, has been previously established at 54 mgd and 58 mgd, respectively. Table 2-2 summarizes the unit process analysis for the Gresham WWTP.

Table 2-2. Summary of Unit Process Capacity Analysis for the Gresham WWTP

Unit Process	Criteria/Limiting Factor	Unit Process Capacity (firm/all units in service)
Influent screens	Pass peak flow	52.5 mgd[a]
Grit removal	Pass peak flow	76 mgd[b]
Primary clarification	1,200 gpd/ft^2 SOR WSMM 3,000 gpd/ft^2 SOR WSPH (as well as maximum daily flow data and an assumed 1.4 PH:MD flow peaking factor)	14.9 mgd/32.1 mgd 37.4/80.2 mgd
Aeration basins	3-day SRT @ WSMM 2,000 to 5,000 mg/L MLSS @ WSMM	28.5 mgd[c]
Secondary clarification	700 gpd/ft^2 SOR at WSMM 1,200 gpd/ft^2 SOR at WSMD peak day SLR < 80% limiting SLR	28.5 mgd[c]
	Peak day and hour hydraulic capacity of secondary treatment	54 mgd/58 mgd[d]
Chlorine contact basins	20-minute HRT, WSMD 30-minute HRT, DSA	21.25 mgd/42.5 mgd 14.2 mgd/28.4 mgd
WAS thickening	1,000 dry lb solids/hr/meter SLR 100 gpm/meter HLR	68,000/88,000 ppd[e] 408,000/528,000 gpd[e]
Anaerobic digestion	0.50 lb COD/VS-day at 14-day maximum loading 15-day SRT at 14-day maximum flow 0.25 lb VSS/ft^3-day at 14-day maximum loading	Not applicable/84,000 ppd Not applicable/67,700 gpd Not applicable/33,900 gpd
Digested sludge dewatering	600 dry lb solids/hour/meter SLR 75 gpm per meter HLR	12,000/24,000 ppd[f]
	Operated 10 hours per day, 7 days per week	90,000/180,000 gpd[f]
Biosolids (dewatered sludge) storage	60 days of storage 14.5% average cake solids in wet season 1.07 cake specific gravity	14,600 gpd 18,500 ppd – CH2M to verify volume of cake storage bays

[a] Only firm capacity is presented; plant cannot hydraulically pass the flow associated the rated capacities of each screen if all are in service.
[b] There is only one circular grit chamber in each the lower and Upper Plant; capacity values presented are total as there is no redundant unit
[c] Capacity determined from Pro2D modeling. Aeration basin capacity assessment: assumes all three Lower Plant and one Upper Plant basins are always in service so firm capacity (with one unit out of service) is not assessed. Similarly, for the secondary clarifiers: assumed all three units in the Lower Plant and one unit in the Upper Plant are always in service.
[d] Peak hour capacity based on 34 mgd Lower Plant and 24 mgd Upper Plant per 2001 Expansion Drawings; 75 mgd Lower Plant and 24 mgd Upper Plant per Plant Hydraulic Capacity Analysis 2011 WWTP Master Plan Update.
[e] As currently operated: one unit 24 hours per day and two units 10 hour per day, all three 7 days per week.
[f] As currently operated 10 hours per day, 7 days per week.

COD/VS-day = chemical oxygen demand per volatile solids per day
DSA = dry season average
DSMM = dry season maximum month
ft^2 = square foot
gpd = gallons per day
gpm = gallons per minute
HLR = hydraulic loading rate
HRT = hydraulic retention time
lb = pounds
mg/L = milligrams per liter
MLSS = mixed liquor suspended solids
PH:MD = peak hour:maximum day
ppd = pounds per day
SLR = solids loading rate
SOR = surface overflow rate
SRT = solids retention time
VSS/ft^3/day = volatile suspended solids per cubic foot per day
WSMD = wet season maximum day
WSMM = wet season maximum month
WSPH = wet season peak hour

2.2 Introduction

This chapter develops flows and loads per capita, peaking factor values, and capacity of the current wastewater treatment processes. Per capita and peaking factor values are used with population projections to predict future flows and loads (Chapter 3). Analysis of existing unit processes helps to determine existing overall plant capacity and, when compared with projected flows and loads, to identify any processes in need of additional capacity. These values also support the alternatives evaluations (Chapters 4 and 5) and recommended capital improvements (Chapter 6) conducted as part of the MP Update.

2.3 Flows and Loads

Per capita and peaking factors are used to estimate future peak flow conditions and are based on analyses of historical average and peak flow and load data. The purpose of analyzing recent historical data is to assist with developing a rational basis for future flow and load projections.

2.3.1 Historical Flows and Loads

Data from November 1, 2011, through October 31, 2016, were analyzed. Parameters evaluated consist of average daily values for flow, BOD, TSS, and ammonia. Data analysis was separated into dry season (May 1 through October 31) and wet season (November 1 through April 30), which aligns with the two sets of effluent requirements specified in Gresham's NPDES discharge permit for these two seasons. See Attachment 2-C for a copy of the current NPDES permit number 102523. Wet season data for November 1 through December 31 were used with data from January 1 through April 30 of the following year due to the range of data provided. Historical service area populations used in this analysis were provided by the City.

Influent to the Gresham WWTP consists of domestic, commercial, and industrial wastewater as well as seasonal infiltration and inflow. Influent flow data are compiled in Table 2-A-1 (provided in Attachment 2-A). There are two major industrial contributors to the Gresham WWTP, ON Semiconductor and Microchip, both microelectronics manufacturers. Because the flows and loads from these two dischargers (see Table 2-A-2) are not anticipated to be linked to increases in general service area population growth, they are subtracted from the total influent flows and loadings to obtain a domestic/commercial subtotal (see Table 2-A-3). It is assumed that commercial sources and the remaining industrial users will grow in similar proportion to the service area population. The resulting historical domestic/commercial influent flows and loads can then be used to determine per capita and peaking factor values that are representative of the domestic/commercial sources.

2.3.2 Derivation of Recommended Per Capita and Peaking Factor Values

Per capita and peaking factors for flow, BOD, TSS, and ammonia were determined using data from November 1, 2011, through October 31, 2016, as shown in Tables 2-A-4, 2-A-5, 2-A-6, and 2-A-7, respectively. They were compared with values provided in the 2004 Master Plan and the 2011 Master Plan Update. Upon comparison, some values were slightly adjusted. Because ammonia testing was performed less frequently than monitoring and testing for flow, BOD, and TSS, more conservative values were selected for ammonia.

Separate dry and wet values for both per capita and peaking factors were developed. Peaking factors for a specific condition are determined by dividing the maximum month, maximum week, maximum day, or peak hour (wet season flow only) values by the dry season average value.

The recommended per capita values and peaking factors highlighted in Tables 2-A-4, 2-A-5, 2-A-6, and 2-A-7 were selected to represent a reasonable expectation of future values without being overly conservative. A comparison between the recommended per capita and peaking factors and previously used values from the 2004 Master Plan and the 2011 Master Plan (see Tables 2-A-8 and 2-A-9 for the per capita and peaking factors, respectively) indicate that these recommended values are reasonable.

Wet season peak hour flows were evaluated using two methods: collection system modeling and recent historical influent data. Peak-hour flows were obtained from the 2012 *Wastewater Collection System Master Plan* (MSA, 2012) model output. The collection system plan used EPA's Storm Water Management Model (SWMM) to simulate the system's response to the 5-year, 24-hour storm event, which resulted in a 38.3-mgd peak hour flow. Historical peak flow data from October 13, 2014, through December 31, 2016, (Gresham did not record these data until October 2014) were also evaluated. The maximum peak hour flows recorded for each of these three wet seasons were 25.5, 47.8, and 19.1 mgd for the 2014/15, 2015/16, and the first part of the 2016/17 wet season, respectively.

It is important to select a value that will adequately represent anticipated WWTP influent flows up to a 24-hour, 5-year event without being overly conservative. This ensures that unit processes that are limited by peak flows are not unnecessarily overbuilt. The peaking factor of 4.1 as calculated based off of the SWMM peak hour flow of 38.3 mgd appears to provide the appropriate level of conservativeness and is therefore recommended. The 47.8 mgd recorded in December 2015 occurred when there was 4.06 inches of rain in a 24-hour period, which is significantly more than the 3.2 inches that defines the 5-year, 24-hour storm for Gresham.

2.4 Plant Capacity Analysis

The existing capacities of each major unit process at the Gresham WWTP were reviewed. The 2004 Master Plan, 2011 Master Plan, and input from plant staff were reviewed to determine physical process sizing and identify previously assumed design criteria. Design criteria were updated to CH2M and industry standards where applicable. Plant data from 2011 to 2016 were reviewed for influent characterization, plant operation conditions, and unit plant performances. The most recent plant data (May 2016) for steady plant operation were used to calibrate CH2M's proprietary whole plant process simulator model Pro2D2. The calibrated model was used to develop an overall plant capacity by increasing the plant flows and loads. From the model, the capacity of the existing plant was determined to be 28.5 mgd based on wet season maximum month influent loading characteristics. Capacity is based on wet season because it is considered to be more limiting; nitrification is not currently required in either wet or dry season, and therefore a 3-day SRT was assumed in both wet and dry seasons to meet effluent permit requirements. The projected plant influent BOD and TSS concentrations are within a few percentage points for wet season and dry season maximum month conditions, while the influent ammonia concentrations are higher in wet season than dry season. Thus, the wet season maximum month influent condition will limit the plant capacity, due to its significantly higher flows and low influent temperature, which result in a slower biological degradation and higher sludge yields. Historical data also confirmed higher digester feed solids in wet season than in dry season.

Assumptions and configurations used in the model were:

- Capacity is based on limiting conditions (wet season flows and loads) except for blowers, where it is assumed that some nitrification will occur during summer months, increasing aeration basin air demands.
- SRT is 3 days year-round.
- No mixed liquor recycle.
- Return activated sludge (RAS) is 50 percent of influent flow.
- Sludge volume index (SVI) is 150 mg/L.

- Primary sludge data are used to calibrate the model with regard to primary clarifier removals instead of primary effluent data, because unrealistically high primary clarifier removals would have resulted otherwise, likely due to unrepresentative primary effluent sampling. The low primary effluent strength data would not allow mass balances closure around the secondary process and digesters within reason.
- Biosolids processing recycles are sent to the Lower Plant aeration basin influent splitter box.
- Plant influent characteristics are comparable for Upper and Lower Plants based on similar influent strength recorded between the two plants, even with a flow split of approximately 60 percent to the Upper Plant and 40 percent to the Lower Plant. Therefore, it is not warranted to track the influent loading projections separately for this study.
- Influent concentrations used to establish wet season capacity are based on average WSMM values from 2011 through 2016. Resultant concentrations are 124 mg/L for BOD, 118 mg/L for TSS, and 18 mg/L for NH_3.

Tables 2-B-1 and 2-B-2 in Attachment B summarize the capacities of the liquids and solids processes. Actual 2016 flow or load data and maximum flow or load data over the study period (2011-2016) are shown in these tables where appropriate for comparison.

2.4.1 General Plant Description

The Gresham WWTP employs a suspended media activated sludge process. The WWTP receives domestic, commercial, and industrial wastewater from incorporated areas of Gresham, Wood Village, and Fairview. With the exception of disinfection, liquids treatment is done through separate Upper Plant and Lower Plant process trains. Solids for both plants are processed together. The Lower Plant can receive overflow from the Upper Plant and has three dedicated influent lines (Fairview Trunk, 185th Pump Station, and Interlachen Pump Station). As currently configured, flow from these lines cannot be routed to the Upper Plant.

The major components of the existing treatment facilities include:

- Screening
- Grit removal
- Primary clarification
- Secondary treatment aeration tanks
- Secondary clarification
- Sodium hypochlorite disinfection followed by sodium bisulfite dechlorination
- WAS thickening through GBTs
- Anaerobic digestion
- Digested sludge dewatering through BFPs
- Biosolids storage and beneficial reuse by local land application

There have been no major capacity modifications since the 2011 Master Plan Update to the Gresham WWTP. Improvement projects that have been constructed since 2011 include a cogen expansion (2015), solids process improvements and lower blower building refurbishment (2016), and Lower Plant headworks screen replacement (2017). The FOG Receiving Station received its first load of FOG on August 29, 2012. The FOG Receiving Station Expansion project became operational on May 26, 2014.

The solids process improvements and lower blower building refurbishment in 2015 included changing the RAS and WAS pumps in the basement of the blower building and modifying the GBT system to further enable co-thickening of PS with WAS. Replacement of three thickened sludge pumps in the solids building is currently being completed so that co-thickening can effectively be placed in service.

It is not anticipated that these projects have changed the capacity or capability of major unit processes except for a slight decrease in the hydraulic capacity of the Lower Plant influent screening and an anticipated increase in capacity of the anaerobic digesters with co-thickening and parallel digester operations. Therefore, this capacity assessment focuses on secondary treatment and digester capacity to quantify the benefits of co-thickening and parallel operations and to quantify the hydraulic throughput capacity of the influent screens to account for the finer screen size opening.

2.4.2 Preliminary Treatment

2.4.2.1 Influent Screens

Two mechanical fine screens are located in each of the lower and upper headworks building. The lower screens were replaced in early 2017 to have 1/4-inch screen openings. Each screen is rated at a wet season peak flow capacity of 25.5 mgd assuming 40 percent blinding (refer to the design data table and hydraulic profile from Project No CIP 319700, WWTP Lower Bar Screen Replacement, Brown and Caldwell, 2016). The resulting firm capacity (one unit out of service) is 25.5 mgd for the Lower Plant.

The Upper Plant has two screens rated at 30 mgd, each (refer to design data table and hydraulic profile from Project No CIP 319700, WWTP Lower Bar Screen Replacement). The upper screens have ⅜-inch screen openings and a firm wet season peak flow capacity of 30 mgd.

The total firm capacity is therefore 52.5 mgd if one unit is out in both the Upper and Lower Plants.

Screenings collected from the lower and upper screens are conveyed to the lower and upper screenings washer/compaction systems. From the washer/compactors the debris is deposited in the grit hopper for offsite disposal.

2.4.2.2 Grit Removal

The grit removal systems for the Lower and Upper Plant are similar vortex grit chamber systems. The lower system consists of one 20-foot-diameter grit chamber/collector, two grit pumps, and a grit classifier. Removed grit is deposited in the lower headworks grit hopper. Wet season peak capacity of the lower system is 38 mgd. The upper grit removal system consists of a 20-foot-diameter grit chamber/collector, two grit pumps, a grit cyclone, and a grit classifier. Removed grit is deposited in the grit hopper. Wet season peak capacity of the upper system is 38 mgd. Therefore, the total plant capacity is 76 mgd without redundancy.

2.4.3 Primary Clarifiers

The Lower Plant has three circular primary clarifiers: two 70-foot-diameter units (No. 1 and No. 2) and one 110-foot-diameter unit (No. 3). Influent flow to the clarifiers is metered by three Parshall flumes. If all three units are online, the flow is split equally between the two smaller clarifiers and one larger clarifier. Under current operating conditions the three lower clarifiers have only very rarely been in service at the same time. Typically, in the wet season, Clarifier No. 3 is the only clarifier online, and in the dry season just one of the smaller ones is online.

The Upper Plant has two side-by-side, rectangular clarifiers that are 140 feet long by 34 feet wide. Since going into service in 2001, both clarifiers typically are in operation during the wet season and during the dry season. During the dry season, one may be brought offline if there is a need for maintenance, and sometimes one is taken offline if flows are low, but quite often both clarifiers are operating in the dry season.

2.4.3.1 Hydraulic Loading/Capacity

Typical SOR design criteria for primary clarification are 1,200 and 3,000 gpd/ft^2 for WSMM and WSPH flow conditions, respectively. Applying these criteria, the capacities of the lower and upper primary clarifiers are:

Lower clarifiers (all units in service):	20.6 mgd at 1,200 gpd/ft^2 SOR at WSMM 51.6 mgd at 3,000 gpd/ft^2 SOR at WSPH
Upper clarifiers (all units in service):	11.4 mgd at 1,200 gpd/ft^2 SOR at WSMM 28.6 mgd at 3,000 gpd/ft^2 SOR at WSPH
Total hydraulic capacity:	32.1 mgd at 1,200 gpd/ft^2 SOR at WSMM 80.2 mgd at 3,000 gpd/ft^2 SOR at WSPH

2.4.4 Aeration Basins

The Lower Plant has three aeration basins (Nos. 1, 2, and 3), with two cells (A and B) in each basin. Basins Nos. 2 and 3 are connected hydraulically through open wall ports. Normal operation in the Lower Plant is aerobic plug flow. Basin No. 1 can only run in parallel plug flow, while Basins Nos. 2 and 3 are normally operated in series but can run in parallel. Due to the multiple cell arrangement of Basins Nos. 2 and 3, they can be operated in several modes: plug flow, contact stabilization, step feed, and anoxic selection. The basins have two influent flow streams, RAS and primary effluent. RAS is introduced directly into the aeration basins, while primary effluent is split between Basin No. 1 and Basins Nos. 2 and 3 in an influent splitter box.

The Upper Plant has one aeration basin (No. 4) divided into eight separate cells (A through H). Cells A and B are hydraulically connected through open wall ports. Cells C through H are connected through gates in the cell walls, allowing for the basins to be hydraulically open or isolated. The basin can be operated in plug flow, contact stabilization, step feed, and biological nutrient removal modes. The basin receives primary effluent and RAS flows. The basin is also equipped with a mixed liquor recycle loop that pumps mixed liquor from the effluent channel of the basin into cells D and E.

2.4.4.1 Aeration Basin Volume/Capacity

Aeration Basin No. 1 has a volume of 0.77 million gallons (MG). Basins Nos. 2 and 3 have a volume of 0.79 MG each. Aeration Basin No. 4 in the Upper Plant has a total volume of 2.0 MG.

Using design criteria of 3-day SRT, a mixed liquor concentration of 2,000 to 5,000 mg/L, and plug-flow operation gives the following wet season maximum month (WSMM) capacity:

Lower Plant (Basins Nos. 1, 2, and 3):	19.2 mgd
Upper Plant (Basin No. 4):	9.3 mgd
Total Capacity:	28.5 mgd

The Upper Plant aeration basin capacity is limited to 9.3 mgd because there is only one secondary clarifier, even though it has similar aeration basin volume compared to the Lower Plant.

The peak hydraulic capacity of secondary treatment, although not evaluated as part of this study, has been previously established as follows:

- 58 mgd (34 mgd Lower Plant and 24 mgd Upper Plant) per the 2001 Expansion Design Drawings (Design Data – 2, Sheet G12)
- 34 mgd Lower Plant and 24 Upper Plant per 2001 Expansion Drawings; 75 mgd Lower Plant and 24 mgd Upper Plant per Plant Hydraulic Capacity Analysis 2011 WWTP Master Plan Update

2.4.4.2 Aeration Blower Capacity

The Lower Plant aeration system is comprised of the following components:

- Four 100-horsepower (hp) multi-stage blowers rated at 1,600 standard cubic feet per minute (scfm) each
- Two 100-hp high-speed turbo blowers rated at 2,200 scfm each
- Six variable-frequency drive (VFD) units
- Dissolved oxygen feedback control loop

The Upper Plant aeration system is comprised of the following components:

- Three 300-hp Turblex single-stage centrifugal blowers rated at 5,300 scfm each
- Dissolved oxygen (DO) feedback control loop

The capacities of the Lower and Upper Plant aeration systems, as compared to 2002 dry season maximum day air requirements, are:

Lower Plant (8,000 scfm required):	10,800 scfm available; 8,600 scfm firm
Upper Plant (10,600 scfm required):	15,900 scfm available; 10,600 scfm firm
Total (18,600 scfm required):	26,700 scfm available; 19,200 scfm firm

2.4.5 Secondary Clarifiers

The Lower Plant contains three secondary clarifiers. One (No. 1) has a sidewall depth of 12 feet and a diameter of 110 feet, and two (Nos. 2 and 3) have a sidewall depth of 16 feet and a diameter of 110 feet. The clarifiers receive mixed liquor from Aeration Basins Nos. 1, 2, and 3.

The Upper Plant contains one secondary clarifier (No. 4) with a 20-foot sidewall depth and 130-foot diameter. Clarifier No. 4 receives mixed liquor from Aeration Basin No. 4.

2.4.5.1 Loading Criteria

SORs are one of two criteria used in design and analysis of secondary clarification systems. For the WSMM plant capacity analysis, a design criterion of 700 gpd/ft^2 was used.

The other commonly used design criteria is SLR. Typically, SLR values are within the range of 15 to 30 ppd/ft^2. For the WSMM plant capacity analysis, a SLR design criterion of 25 ppd/ft^2 was used.

2.4.5.2 Secondary Clarifier Capacity

Based on the design criteria listed above, the overall capacity of the secondary clarification system is 28.5 mgd (WSMM). The capacity of the single Upper Plant secondary clarifier is 9.3 mgd (WSMM) and is limited by the hydraulic overflow rate. The capacity of the three Lower Plant secondary clarifiers is 19.2 mgd (WSMM) and is solids loading limited.

2.4.6 Disinfection – Chlorine Contact Basins

Two chlorine contact basins provide combined effluent disinfection for both the lower and upper flow streams. Liquid sodium hypochlorite is applied at either the chlorine mixing chamber or at the secondary clarifier effluent weirs. Once applied, flow is detained within the contact basins for the time required to disinfect. Chlorine is removed from the plant effluent through the addition of sodium bisulfite solution. Sodium bisulfite is added just upstream of the effluent Parshall flumes.

2.4.6.1 Capacity

Each of the basins has a volume of 295,000 gallons. Typical Oregon Department of Environmental Quality (DEQ) criteria state that the required hydraulic detention times be 20 and 60 minutes for wet season maximum day and dry season average day conditions, respectively. Based on these criteria the average and maximum day capacities of the basins are:

Dry Season Average Day (60-minute HRT): 14.2 mgd (firm capacity; one tank out of service)

Wet Season Maximum Day (20-minute HRT): 42.5 mgd (both tanks in service)

If flows exceed 42.5 mgd with both tanks in service, the hypochlorite and bisulfite dosages can be increased manually. Currently, the plant does not have sufficient monitoring and controls to automatically increase the chemical dosages for flows over 42.5 mgd.

2.4.7 Waste Activated Sludge Thickening

Three 2-meter GBTs manufactured by Enviroquip are located in the solids building. The GBTs thicken WAS from the upper and lower secondary clarifiers from approximately 0.5 percent to 4 percent dry solids prior to WAS entering the digesters. Polymer is added to the WAS prior to entering the GBTs to help form a sludge floc that can support itself during the drainage procedure without breaking apart and losing solids to the filtrate. Currently, two units are operated 10 hours/day and 1 unit 24 hours/day. All units operate 7 days/week. In addition, Gresham currently has a project to add co-thickening operations to the plant.

The solids loading capacity of the GBTs, based on a capacity of 1,000 dry lb/hour, is 88,000 lb/day with all units in service and 68,000 lb/day with one unit out of service (one unit operating 24 hours per day and the second unit operating 10 hours per day).

The hydraulic capacity of the GBTs, based on a capacity of 100 gpm, is 528,000 gpd with all units in service and 408,000 gpd with one unit out of service (one unit operating 24 hours per day and the second unit operating 10 hours per day.

The GBT capacity when operating co-thickening is discussed in Chapter 4.

2.4.8 Anaerobic Digestion

The plant contains two concrete anaerobic digesters, operated as high-rate, complete mix systems. The primary digester is 80 feet in diameter and has a 27-foot sidewall depth, a fixed cover, and an active digester volume of 1.015 MG. The secondary digester is 80 feet in diameter and has a 27-foot sidewall depth, a floating cover, and an active digester volume of 1.015 MG (if no volume is allocated for gas or sludge storage). Both tanks are mixed using a 20-hp linear motion mixer (LMM), each with a VFD so that the speed can be increased to provide additional mixing energy during periods of high-strength waste and/or FOG addition. The design criterion for the LMMs is to provide digester mixing for a solids concentration of up to 3 percent and 4 percent (average) for the external high-strength waste/FOG. The disks are 96 inches in diameter and have a 16-inch stroke length with a stroke rate of 30 cycles per minutes. Typical co-thickening performance ranges from 5 to 8 percent solids. For example, the Central Marin Sanitation Agency Treatment Plant Initial Analysis of Co-Thickening Primary and Secondary Solids, conducted by Paul Pitt (January 2013) produced 5 to 7.8 percent and 6.4 percent on average. Therefore, 6.5 percent solids was assumed as a reasonable assumption for co-thickening PS and WAS at Gresham. With a 6.5 percent feed to the digesters, the estimated average digester concentration is 3.25 percent, which would exceed the design criteria of 3 percent originally established for the LMMs. Ovivo, the LMM manufacturer, was contacted and they indicated that the existing mixers should be able to sufficiently mix the digesters at solids concentrations well above 3 percent (i.e., all the way up to 5 to 6 percent solids in the digesters).

Both tanks are heated using a pump recirculation system with a concentric-tube counter-flow type heat exchanger. Heat recovered from the two cogen engines is used to heat the supply warm water and a backup boiler is used if the engines are out of service. Mixing and heating capacity and effectiveness is assumed to be similar between the two tanks. Typically, most anaerobic sludge digestion occurs in the primary digester when the tanks are operated in series. For the purposes of conducting this capacity analysis, the volatile solids reduction (VSR) rates are assumed to be equal in both tanks. Analysis of plant data indicated strong VSR performance. The VSR ranged from 66 to 70 percent depending on whether the average monthly, maximum monthly, or 14-day peak value is used. These values were calculated using the BFP feed data to close the mass balance as this provided a more consistent VSR estimate compared to using the VSS digester feed data to close the mass balance. Typical performance for mesophilic anaerobic digestion ranges from 50 to 65 percent, indicating that the Gresham digesters are performing very well. The Pro2D2 process model utilized 55 percent VSR for PS/WAS and 90 percent VSR for external FOG/high-strength waste, resulting in an aggregate overall VSR of 63 percent, which provides an appropriate level of conservativeness to this analysis.

Since August 2012, FOG has been received and fed directly into the primary digester. In 2015 a second cogen internal combustion engine was installed so that the additional biogas could be converted into electricity and heat. A main focus of this capacity evaluation is to determine if and how much the FOG addition needs to be curtailed to avoid or defer construction of a third digester.

Accepted industry design principles for mesophilic anaerobic digestion (Metcalf and Eddy, 2004) suggest limiting volatile solids (VS) loading rates to between 0.1 and 0.3 lb VS/ft^3-day. In CH2M's experience, anaerobic digesters operating efficiently can achieve loading rates up to 0.4 lb VS/ft^3-day. The volatile solids loading rate (VSLR) used at the Gresham WWTP between 2011 and 2016 was 0.27 lb VS/ft^3-day (14-day peak condition), which is near the maximum end of the typical range. Further demonstration testing could be performed to justify a higher VSLR. A VSLR of 0.15 lb VS/ft^3-day was carried through the analysis as verification.

Similarly, common design practices and regulations governing other areas of the country (i.e., 10-States Design Standards) indicate that a minimum of a 15-day SRT should be provided for most loading scenarios. SRT can be reduced to 10 days for short periods without significant impact on digester performance. The SRT at the Gresham WWTP between 2011 and 2016 was 22 days (14-day peak condition). This evaluation uses a minimum allowable SRT of 15 days to assess the available capacity.

As an additional verification, CH2M used the specific volatile solids loading rate (SVSLR) to also assess the capacity of the existing digesters. The SVSLR is an important loading parameter because it accounts for the balance of energy across the digester by assessing the ratio of the volatile solids concentration in the feed to the concentration of anaerobic bacteria (represented by volatile solids) in the reactor. SVSLR creates a more detailed understanding of digester loading. Furthermore, for facilities that accept external high-strength waste and/or FOG, COD is a better parameter to use for the feed concentration to more accurately account for the variation in specific loading rate or energy supply in the various feed stocks. Gresham does not typically monitor digester feed for COD; however, based on our database from other facilities, the following VS to COD conversion ratios are utilized:

- Gresham PS/WAS sludges: 1.52 COD:VS ratio
- External FOG/High-Strength Waste: 2.9 COD:VS ratio

The calculated specific COD solids loading rate (SCODSLR) at the Gresham WWTP between 2011 and 2016 was 0.5 lb COD_{Feed}/lb $VS_{Digester}$-day (14-day peak condition); the SCODSLR used to assess capacity is also 0.5 lb COD_{Feed}/lb $VS_{Digester}$-day.

The digester capacity was evaluated using all three metrics: VSLR, SRT, and SVSLR, utilizing the digester loading projections through 2036. FOG/high-strength waste in 2016 is used in this analysis and was the following, which represents 44 percent of the total COD feed and 23 percent of the total VSS feed:

- Annual average: 8,700 lb VSS/day
- Maximum month: 11,300 lb VSS/day
- 14-day Peak: 11,500 lb VSS/day

Table 2-3 summarizes the historical FOG feed data. Note the mass loadings and VS concentrations of the FOG increased significantly in the last 3 years, peaking in year 2016. FOG feed in 2016 is expected to be representative of the future conditions and thus was used in the analysis.

Table 2-3. Historical FOG Feed and Characteristics

	2012	2013	2014	2015	2016
Annual Average Day FOG VS, lb/day	1,500	3,100	5,200	6,800	8,700
Max. Month FOG VS, lb/day	2,300	5,300	6,800	8,800	11,300
14-day Peak FOG VS, lb/day	2,800	6,400	7,700	10,300	11,500
Annual Average Day FOG Feed, gpd[a]	4,800	7,500	8,600	10,800	11,600
Max. Month FOG Feed, gpd[a]	6,700	10,100	10,900	12,300	13,900
14-day Peak FOG Feed, gpd[a]	7,100	10,700	11,700	13,600	14,700
Average FOG VS Fraction, %	93.8	91.4	95.3	93.8	92.2
Average FOG TS Concentration, %	4.4	5.3	7.8	8.1	9.7

[a] Calculated based on plant data on FOG feed solids quantities, solids content, and FOG mixture density estimated using the solids content and 7.69 lb/gal solids density, assuming the solids contained in FOG is mostly corn oil.
TS = total solids

The following three capacity scenarios were evaluated:

- Scenario 1: Current operation; digesters operated in series and no co-thickening of PS/WAS (average TS concentration of 2.2 percent in the digesters)
- Scenario 2: Digesters operated in series with co-thickening of PS/WAS (6.5 percent TS feed; 3.2 percent in the digesters)
- Scenario 3: Digesters operated in parallel, no co-thickening
- Scenario 4: Digesters operated in parallel with co-thickening of PS/WAS (6.5 percent TS feed; 3.2 percent in the digesters)

2.4.8.1 Scenario 1: Current Operation; Digesters Operated in Series and No Co-thickening of PS/WAS (Average TS Concentration of 2.2 Percent in the Digesters)

Digester capacity under current operations is:

- VS loading (0.25 lb VSS/ft^3-day at 14-day max loading): 33,900 lb VS/day
- SRT (15-day SRT at 14-day max flow): 67,700 gpd
- SCODSLR (0.50 lb COD/VS-day at 14-day max loading): 84,000 lb COD/VS-day

Table 2-4 presents the amount of FOG that can be received and remain within the design criteria assumptions. Table 2-4 also presents the year the capacity is reached with no FOG addition. Capacity is significantly reduced due to series operation and no co-thickening.

Table 2-4. Allowed FOG Loads and Max Capacity in Scenario 1: Current Operation - Digesters Operated in Series and No Co-Thickening of PS/WAS

FOG Loading Allowed		2016	2017	2020	2024	2030	2036	Year Capacity Reached (w/o FOG)
Annual Average Day	lb VSS/d	4,300	2,000	1,100	0	0	0	2024
	gpd	5,700	2,600	1,400	0	0	0	
Max Month	lb VSS/d	0	0	0	0	0	0	<2016
	gpd	0	0	0	0	0	0	
14-Day Peak	lb VSS/d	0	0	0	0	0	0	<2016
	gpd	0	0	0	0	0	0	

Hydraulic capacity is sufficient with both tanks in service but with one digester out of service, the hydraulic capacity is already exceeded as shown in Figure 2-2.

As shown in Figure 2-3, the SCODSLR is exceeded except under the annual average loading condition if FOG is received, and is not exceeded with no FOG addition.

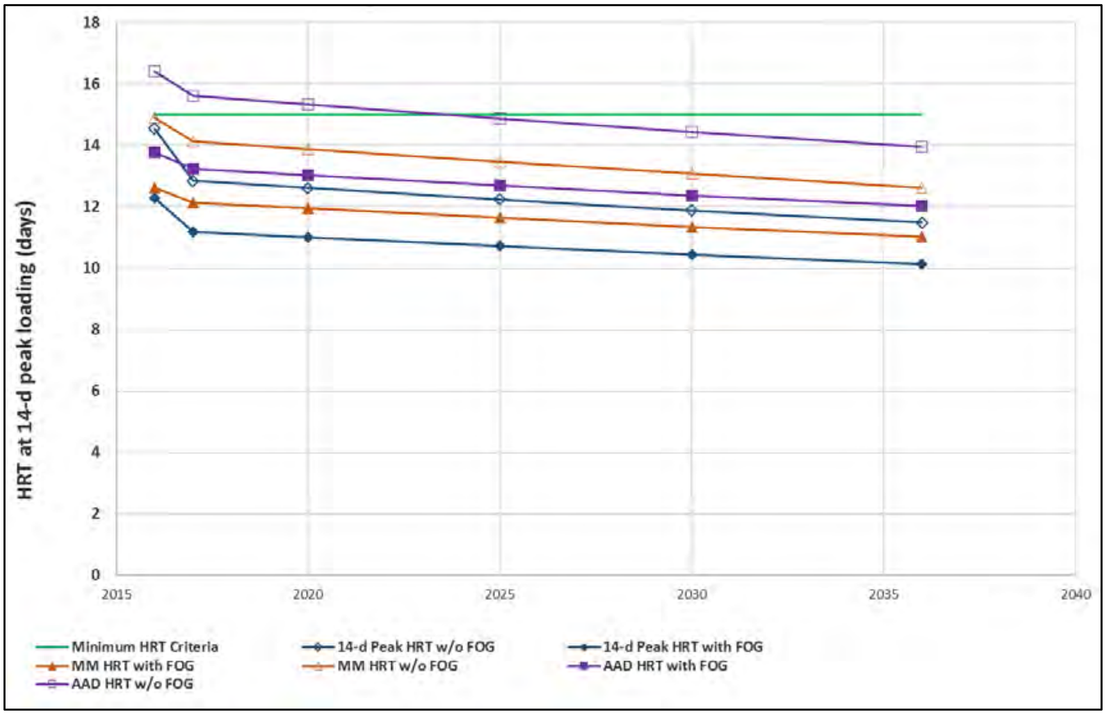

Figure 2-2. Digester Hydraulic Retention Scenario 1: Current Operation with One Digester Offline for Maintenance

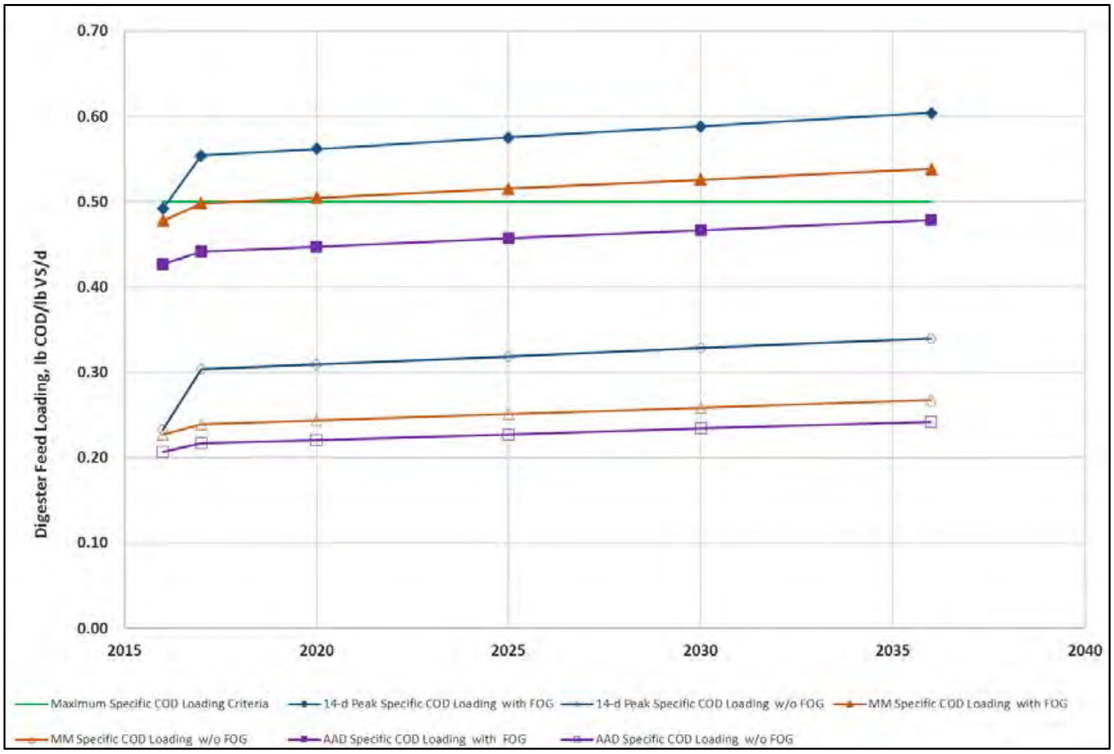

Figure 2-3. Specific COD Loading Digester Capacity for Scenario 1: Current Operation

2.4.8.2 Scenario 2: Digesters Operated in Series with Co-thickening of PS/WAS (6.5 Percent TS Feed)

Table 2-5 presents the amount of FOG that can be received and remain within the design criteria assumptions under Scenario 2: Digesters Operated in Series with Co-thickening. Table 2-5 also presents the year the capacity is reached with no FOG addition.

Table 2-5. Allowed FOG Loads and Year Capacity Reached in Scenario 2: Digesters Operated in Series with Co-thickening of PS/WAS (6.5 percent TS feed)

FOG loading allowed		2016	2017	2020	2024	2030	2036	Year Capacity Reached (w/o FOG)
Annual Average Day	lb VSS/d	8,700	8,700	8,700	8,700	8,700	8,700	> 2036
	gpd	11,600	11,600	11,600	11,600	11,600	11,600	
Max Month	lb VSS/d	11,300	10,800	10,000	8,600	7,200	5,500	> 2036
	gpd	13,900	13,300	12,300	10,600	8,900	6,800	
14-Day Peak	lb VSS/d	11,500	6,100	5,300	3,800	2,300	600	2036 (approximately)
	gpd	11,500	7,900	6,700	4,900	3,000	800	

Under Scenario 2, hydraulic capacity is sufficient with both tanks in service, but with one digester out of service the hydraulic capacity is exceeded under the maximum 14-day and maximum month loadings with FOG as shown in Figure 2-4.

As shown in Figure 2-5, the SCODSLR is not exceeded even with FOG addition as long as co-thickening is operated. These results indicate that the VS loading criterion of 0.25 lb VSS/ft^3-day at 14-day max loading is more conservative than the SCODSLR criterion (0.50 lb COD/VS-day at 14-day maximum loading) because as indicated in Table 2-5, FOG addition has to begin to be curtailed beginning in 2020 based on VS loading.

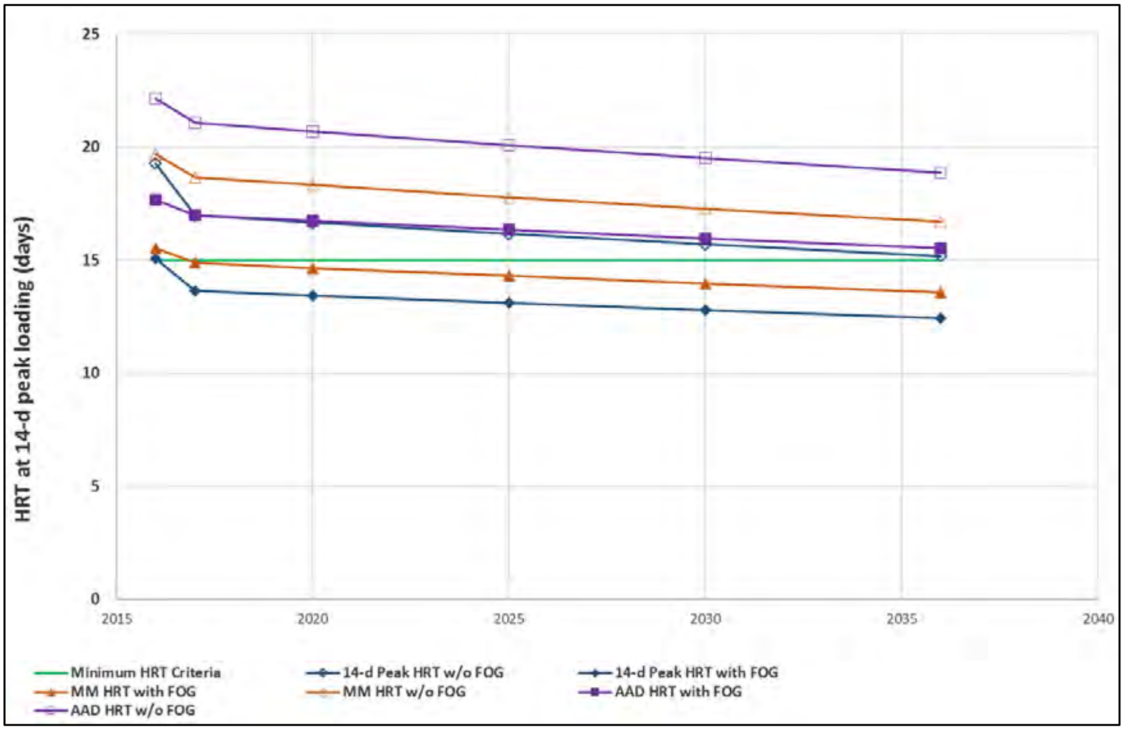

Figure 2-4. HRT Digester Capacity for Scenario 2: Digesters Operated in Series with Co-thickening and One Digester Offline for Maintenance

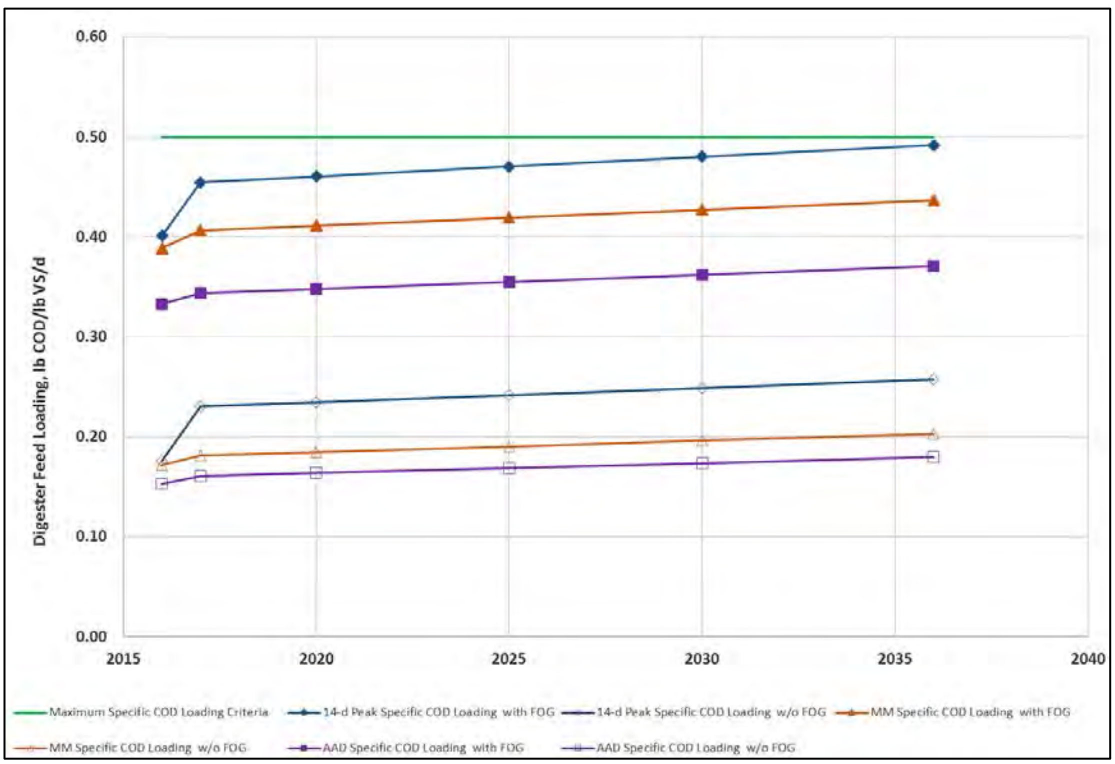

Figure 2-5. Specific Loading Digester Capacity for Scenario 2: Digesters Operated in Series with Co-thickening

2.4.8.3 Scenario 3: Digesters Operated in Parallel, No Co-thickening

Table 2-6 indicates FOG (2016 levels) can continue to be received through 2036 if parallel operation of the digesters is conducted.

Table 2-6. Allowed FOG Loads and Year Capacity Reached in Scenario 3: Digesters Operated in Parallel, No Co-thickening

FOG Loading Allowed		2016	2017	2020	2024	2030	2036	Year Capacity Reached (w/o FOG)
Annual Average Day	lb VSS/d	8,700	8,700	8,700	8,700	8,700	8,700	> 2036
	gpd	11,600	11,600	11,600	11,600	11,600	11,600	
Max Month	lb VSS/d	11,300	11,300	11,300	11,300	11,300	11,300	> 2036
	gpd	13,900	13,900	13,900	13,900	13,900	13,900	
14-Day Peak	lb VSS/d	11,500	11,500	11,500	11,500	11,500	11,500	>2036
	gpd	14,700	14,700	14,700	14,700	14,700	14,700	

With the digesters operated in parallel, the hydraulic capacity is not exceeded during the study period as illustrated in Figure 2-6. Likewise, with the digesters operated in parallel the SCODSLR under Scenario 3 is not exceeded during the study period as illustrated in Figure 2-7.

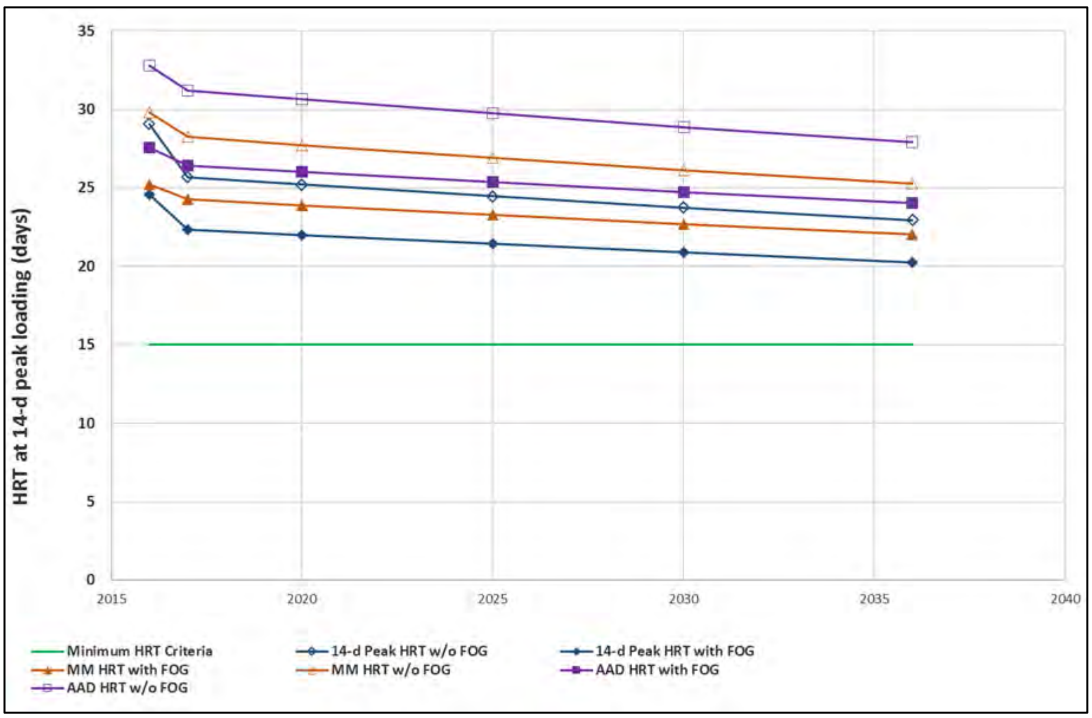

Figure 2-6. HRT Digester Capacity for Scenario 3: Operation in Parallel and No Co-thickening

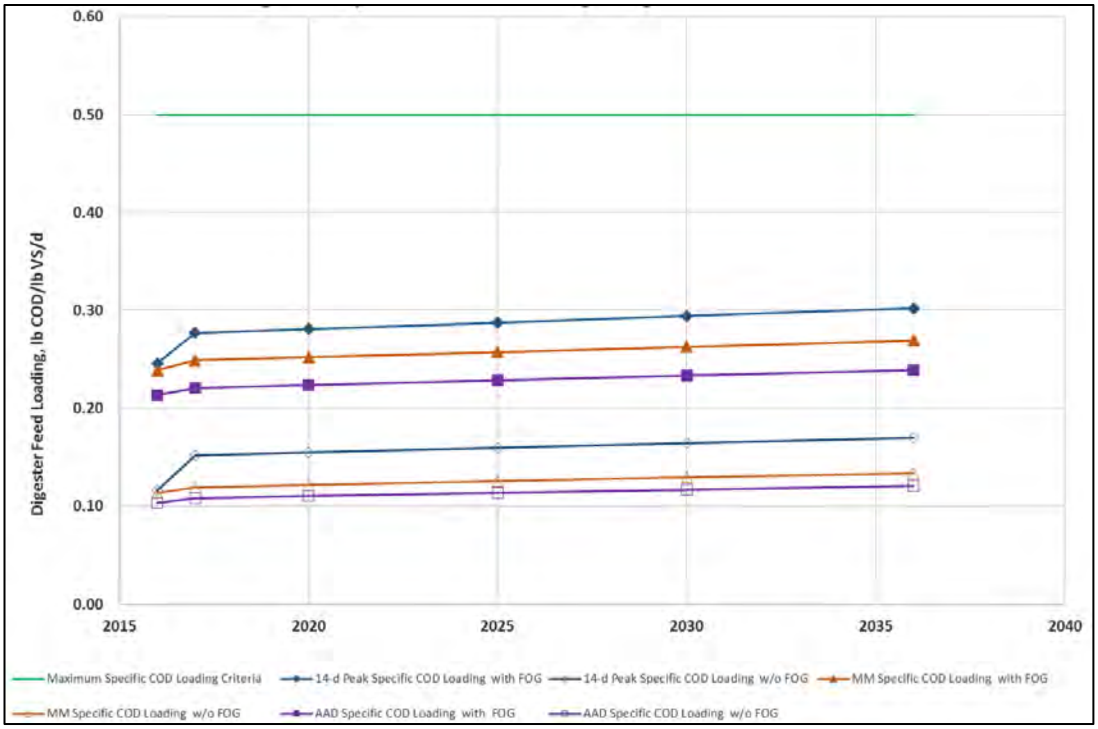

Figure 2-7. Specific Loading Digester Capacity for Scenario 3: Parallel Operation and No Co-thickening

2.4.8.4 Scenario 4: Digesters Operated in Parallel with Co-thickening

Similar to Scenario 3, FOG (2016 levels) can continue to be received through 2036 if parallel operation of the digesters with co-thickening is conducted.

2.4.9 Digested Sludge Dewatering

Two 2-meter BFPs manufactured by Ashbrook-Simon-Hartley are located in the solids building. Based on plant data, the BFPs concentrate digested sludge to approximately 14.5 percent dry solids. The system is designed to operate continuously with minimal operator attention. However, the belts are currently operated 8 to 10 hours a day, 7 days a week, and require more than minimal operator attention. For this capacity assessment, it was assumed that the BFPs can be operated 10 hours per day. Bypass of the BFPs is available for liquid disposal of the sludge. This allows operating flexibility for different sludge disposal methods and sites.

The current capacities of the BFPs are:

- Solids loading (assuming a loading rate of 600 dry lb per hour per meter or 1,200 dry lb per hour per unit):
  - 12,000 lb/day with one BFP in service
  - 24,000 lb/day with both BFPs in service
- Hydraulic loading (assuming a hydraulic loading rate of 75 gpm per meter or 150 gpm per unit):
  - 90,000 gpd with one BFP in service
  - 180,000 gpd with both BFPs in service

2.4.10 Biosolids Storage

The biosolids storage building receives dewatered sludge from the BFPs and has a capacity of 3,300 cubic yards (yd^3). Based on a dewatered sludge concentration of 14.5 percent solids, at current 2016 maximum month solids production (15,756 lb/day) the building can store solids for approximately 55 days, which is less than the desired 60-day storage design criterion. Using the 60-day criterion and assuming a 14.5 percent cake solids, the design rating of the storage building is:

- Dewatered digested solids flow: 11,110 gpd
- Dewatered digested solids load: 14,384 lb/day

Chapter 4 evaluates biosolids cake storage under different solids stabilization approaches (focusing on anaerobic digestion options) as well as assessing the impact of the Orege SLG sludge conditioning system on cake solids and hence cake storage needs.

Attachment 2-A
Historical Flow and Load Data

Table 2-A-1

Historical Total Influent Wastewater Flows and Loads

Year	Population	Condition	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	Ammonia-N (lb/d)
2011/2012	122,662	Annual Average	12.15	22,608	22,503	2,408
		Dry Season Average	10.87	24,053	24,090	2,428
		Dry Season Max Month	12.22	25,793	27,322	2,797
		Dry Season Max Week	14.48	28,899	32,800	N/A
		Dry Season Max Day	16.13	33,871	56,999	3,130
		Wet Season Average	13.42	21,164	20,916	2,388
		Wet Season Max Month	16.77	25,319	24,417	2,747
		Wet Season Max Week	21.79	29,624	31,464	N/A
		Wet Season Max Day	29.07	37,014	40,178	3,571
2012/2013	123,314	Annual Average	11.67	22,688	21,733	2,417
		Dry Season Average	10.11	22,892	21,626	2,369
		Dry Season Max Month	11.01	24,273	24,800	2,796
		Dry Season Max Week	13.50	26,814	31,993	N/A
		Dry Season Max Day	14.80	35,096	46,152	3,456
		Wet Season Average	13.22	22,484	21,840	2,465
		Wet Season Max Month	16.74	25,895	23,714	3,039
		Wet Season Max Week	20.63	32,441	27,569	N/A
		Wet Season Max Day	24.83	44,188	33,329	3,663
2013/2014	124,144	Annual Average	11.26	22,473	20,443	2,483
		Dry Season Average	9.91	21,964	20,094	2,409
		Dry Season Max Month	11.35	23,821	21,587	2,529
		Dry Season Max Week	13.18	29,990	25,510	N/A
		Dry Season Max Day	15.16	36,856	29,869	2,797
		Wet Season Average	12.61	22,983	20,791	2,521
		Wet Season Max Month	14.87	24,809	22,154	2,642
		Wet Season Max Week	18.27	27,677	25,512	N/A
		Wet Season Max Day	19.79	30,467	30,482	3,178
2014/2015	124,662	Annual Average	9.87	19,685	19,283	2,217
		Dry Season Average	8.60	20,324	20,172	2,308
		Dry Season Max Month	13.65	23,360	22,112	2,694
		Dry Season Max Week	15.09	25,545	28,705	N/A
		Dry Season Max Day	16.71	35,806	37,362	2,824
		Wet Season Average	11.15	19,153	18,542	2,149
		Wet Season Max Month	11.85	20,715	19,437	2,291
		Wet Season Max Week	15.01	25,905	26,016	N/A
		Wet Season Max Day	20.70	31,201	30,899	2,900
2015/2016	125,514	Annual Average	11.32	20,068	20,222	2,587
		Dry Season Average	9.62	20,744	20,685	2,587
		Dry Season Max Month	11.66	22,608	23,106	2,587
		Dry Season Max Week	14.02	27,221	26,953	N/A
		Dry Season Max Day	15.57	38,841	48,636	2,587
		Wet Season Average	13.02	19,392	19,758	0
		Wet Season Max Month	17.62	21,028	22,730	0
		Wet Season Max Week	24.43	24,141	29,430	N/A
		Wet Season Max Day	29.10	30,991	49,453	0
Average		Annual Average	11.25	21,505	20,837	2,422
		Dry Season Average	9.82	21,995	21,333	2,420
		Dry Season Max Month	11.98	23,971	23,786	2,680
		Dry Season Max Week	14.05	27,694	29,192	N/A
		Dry Season Max Day	15.67	36,094	43,804	2,959
		Wet Season Average	12.69	21,035	20,369	2,381
		Wet Season Max Month	15.57	23,553	22,491	2,680
		Wet Season Max Week	20.02	27,957	27,998	N/A
		Wet Season Max Day	24.70	34,772	36,868	3,328

Table 2-A-2
Industrial Wastewater Flow and Loads

Condition	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	Ammonia-N (lb/d)
Average Flow	1.48	538	257	195
Maximum Month	1.48	538	257	195
Maximum Week	1.68	894	483	455
Maximum Day	1.68	894	483	455

Table 2-A-3
Historical Domestic/Commercial Flows and Loads

Year	Population	Condition	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	Ammonia-N (lb/d)
2011/2012	122,662	Annual Average	10.66	22,071	22,246	2,213
		Dry Season Average	9.38	23,515	23,833	2,233
		Dry Season Max Month	10.73	25,255	27,065	2,602
		Dry Season Max Week	12.80	28,005	32,318	N/A
		Dry Season Max Day	14.45	32,977	56,516	2,675
		Wet Season Average	11.94	20,626	20,660	2,193
		Wet Season Max Month	15.28	24,782	24,161	2,551
		Wet Season Max Week	20.11	28,730	30,981	N/A
		Wet Season Max Day	27.38	36,121	39,695	3,116
2012/2013	123,314	Annual Average	10.18	22,150	21,476	2,222
		Dry Season Average	8.62	22,354	21,369	2,173
		Dry Season Max Month	9.52	23,736	24,544	2,601
		Dry Season Max Week	11.81	25,921	31,511	N/A
		Dry Season Max Day	13.12	34,202	45,669	3,001
		Wet Season Average	11.74	21,947	21,583	2,270
		Wet Season Max Month	15.26	25,357	23,458	2,844
		Wet Season Max Week	18.95	31,547	27,086	N/A
		Wet Season Max Day	23.15	43,294	32,847	3,208
2013/2014	124,144	Annual Average	9.78	21,936	20,186	2,288
		Dry Season Average	8.43	21,426	19,838	2,213
		Dry Season Max Month	9.87	23,283	21,331	2,334
		Dry Season Max Week	11.49	29,097	25,027	N/A
		Dry Season Max Day	13.48	35,963	29,386	2,342
		Wet Season Average	11.13	22,446	20,534	2,326
		Wet Season Max Month	13.39	24,272	21,897	2,447
		Wet Season Max Week	16.59	26,784	25,030	N/A
		Wet Season Max Day	18.11	29,573	29,999	2,723
2014/2015	124,662	Annual Average	8.39	19,148	19,026	2,022
		Dry Season Average	7.12	19,786	19,915	2,113
		Dry Season Max Month	12.16	22,823	21,856	2,498
		Dry Season Max Week	13.41	24,651	28,222	N/A
		Dry Season Max Day	15.03	34,913	36,879	2,368
		Wet Season Average	9.66	18,615	18,285	1,954
		Wet Season Max Month	10.36	20,177	19,180	2,095
		Wet Season Max Week	13.32	25,011	25,534	N/A
		Wet Season Max Day	19.02	30,307	30,417	2,445
2015/2016	125,514	Annual Average	9.84	19,531	19,965	2,391
		Dry Season Average	8.14	20,207	20,428	2,391
		Dry Season Max Month	10.17	22,070	22,850	2,391
		Dry Season Max Week	12.34	26,328	26,470	N/A
		Dry Season Max Day	13.88	37,947	48,154	2,131
		Wet Season Average	11.54	18,855	19,502	0
		Wet Season Max Month	16.14	20,491	22,474	0
		Wet Season Max Week	22.75	23,247	28,948	N/A
		Wet Season Max Day	27.42	30,097	48,970	0
Average		Annual Average	9.77	20,967	20,580	2,227
		Dry Season Average	8.34	21,458	21,077	2,225
		Dry Season Max Month	10.49	23,433	23,529	2,485
		Dry Season Max Week	12.37	26,800	28,710	N/A
		Dry Season Max Day	13.99	35,200	43,321	2,503
		Wet Season Average	11.20	20,498	20,113	2,186
		Wet Season Max Month	14.09	23,016	22,234	2,484
		Wet Season Max Week	18.34	27,064	27,516	N/A
		Wet Season Max Day	23.01	33,878	36,386	2,873

Table 2-A-4

Flow Per Capita and Peaking Factor Derivation

Dry Season Analysis (May 1 through October 31)

Historial Population		
Year	Population	Flow (gpcd)
2012	122,662	76
2013	123,314	70
2014	124,144	68
2015	124,662	57
2016	125,514	65
	Average:	67

Historical Dry Season Flows (mgd)			
Average	Maximum Month	Maximum Week	Maximum Day
9.38	10.73	12.80	14.45
8.62	9.52	11.81	13.12
8.43	9.87	11.49	13.48
7.12	12.16	13.41	15.03
8.14	10.17	12.34	13.88

Historical Peaking Factors from Average			
Maximum Month	Maximum Week	Maximum Day	
1.14	1.36	1.54	
1.10	1.37	1.52	
1.17	1.36	1.60	
1.71	1.88	2.11	
1.25	1.52	1.71	
1.28	1.50	1.70	Average
1.71	1.88	2.11	Maximum
1.3	**1.5**	**1.7**	**Selected Values**

Selected DS Per Capita Flow:	**79**	**gpcd**

Wet Season Analysis (November 1 through April 30)

Historical Population		
Year	Population	Flow (gpcd)
2011/2012	122,662	97
2012/2013	123,314	95
2013/2014	124,144	90
2014/2015	124,662	78
2015/2016	125,514	92
	Average:	90

Historical Wet Season Flows (mgd)				
Average	Maximum Month	Maximum Week	Maximum Day	Peak Hour
11.94	15.28	20.11	27.38	38.30
11.74	15.26	18.95	23.15	
11.13	13.39	16.59	18.11	
9.66	10.36	13.32	19.02	
11.54	16.14	22.75	27.42	

Historical Peaking Factors from Average			
Maximum Month	Maximum Week	Maximum Day	Peak Hour
1.63	2.14	2.92	4.08
1.77	2.20	2.68	
1.59	1.97	2.15	
1.46	1.87	2.67	
1.98	2.79	3.37	
1.69	2.20	2.76	Average
1.98	2.79	3.37	Maximum
1.4	**2.3**	**2.8**	**Selected Values**

Selected WS Per Capita Flow:	**100**	**gpcd**

Table 2-A-5

BOD Per Capita and Peaking Factor Derivation

Dry Season Analysis (May 1 through October 31)

Historial Population		
Year	Population	BOD (ppcd)
2012	122,662	0.19
2013	123,314	0.18
2014	124,144	0.17
2015	124,662	0.16
2016	125,514	0.16
	Average:	0.17

Historical Dry Season BOD (ppd)			
Average	Maximum Month	Maximum Week	Maximum Day
23,515	25,255	28,005	32,977
22,354	23,736	25,921	34,202
21,426	23,283	29,097	35,963
19,786	22,823	24,651	34,913
20,207	22,070	26,328	37,947

Historical Peaking Factors from Average			
Maximum Month	Maximum Week	Maximum Day	
1.07	1.19	1.40	
1.06	1.16	1.53	
1.09	1.36	1.68	
1.15	1.25	1.76	
1.09	1.30	1.88	
1.09	1.25	1.65	Average
1.15	1.36	1.88	Maximum
1.1	**1.3**	**1.7**	**Selected Values**

Selected DS Per Capita BOD:	**0.18**	**ppcd**

Wet Season Analysis (November 1 through April 30)

Historical Population		
Year	Population	BOD (ppcd)
2011/2012	122,662	0.17
2012/2013	123,314	0.18
2013/2014	124,144	0.18
2014/2015	124,662	0.15
2015/2016	125,514	0.15
	Average:	0.17

Historical Wet Season BOD (ppd)				
Average	Maximum Month	Maximum Week	Maximum Day	Peak Hour
20,626	24,782	28,730	36,121	
21,947	25,357	31,547	43,294	
22,446	24,272	26,784	29,573	
18,615	20,177	25,011	30,307	
18,855	20,491	23,247	30,097	

Historical Peaking Factors from Average			
Maximum Month	Maximum Week	Maximum Day	Peak Hour
1.05	1.22	1.54	
1.13	1.41	1.94	
1.13	1.25	1.38	
1.02	1.26	1.53	
1.01	1.15	1.49	
1.07	1.26	1.57	Average
1.13	1.41	1.94	Maximum
1.1	**1.4**	**1.8**	**Selected Values**

Selected WS Per Capita BOD:	**0.17**	**gpcd**

Table 2-A-6

TSS Per Capita and Peaking Factor Derivation

Dry Season Analysis (May 1 through October 31)

Historial Population		
Year	Population	TSS (ppcd)
2012	122,662	0.19
2013	123,314	0.17
2014	124,144	0.16
2015	124,662	0.16
2016	125,514	0.16
	Average:	0.17

Historical Dry Season TSS (ppd)			
Average	Maximum Month	Maximum Week	Maximum Day
23,833	27,065	32,318	56,516
21,369	24,544	31,511	45,669
19,838	21,331	25,027	29,386
19,915	21,856	28,222	36,879
20,428	22,850	26,470	48,154

Historical Peaking Factors from Average			
Maximum Month	Maximum Week	Maximum Day	
1.14	1.36	2.37	
1.15	1.47	2.14	
1.08	1.26	1.48	
1.10	1.42	1.85	
1.12	1.30	2.36	
1.12	1.36	2.04	Average
1.15	1.47	2.37	Maximum
1.1	**1.4**	**2.0**	**Selected Values**

Selected DS Per Capita TSS:	**0.17**	**ppcd**

Wet Season Analysis (November 1 through April 30)

Historical Population		
Year	Population	TSS (ppcd)
2011/2012	122,662	0.17
2012/2013	123,314	0.18
2013/2014	124,144	0.17
2014/2015	124,662	0.15
2015/2016	125,514	0.16
	Average:	0.16

Historical Wet Season TSS				
Average	Maximum Month	Maximum Week	Maximum Day	Peak Hour
20,660	24,161	30,981	39,695	
21,583	23,458	27,086	32,847	
20,534	21,897	25,030	29,999	
18,285	19,180	25,534	30,417	
19,502	22,474	28,948	48,970	

Historical Peaking Factors from Average				
Maximum Month	Maximum Week	Maximum Day	Peak Hour	
1.01	1.30	1.67		
1.10	1.27	1.54		
1.10	1.26	1.51		
0.96	1.28	1.53		
1.10	1.42	2.40		
1.06	1.31	1.73		Average
1.10	1.42	2.40		Maximum
1.1	**1.3**	**1.7**		**Selected Values**

Selected WS Per Capita TSS:	**0.17**	**gpcd**

Table 2-A-7

Ammonia Per Capita and Peaking Factor Derivation

Dry Season Analysis (May 1 through October 31)

Historial Population		
Year	Population	NH_3 (ppcd)
2012	122,662	0.018
2013	123,314	0.018
2014	124,144	0.018
2015	124,662	0.017
2016	125,514	0.019
	Average:	0.018

Historical Dry Season Ammonia (ppd)			
Average	Maximum Month	Maximum Week	Maximum Day
2,233	2,602	-	2,675
2,173	2,601	-	3,001
2,213	2,334	-	2,342
2,113	2,498	-	2,368
2,391	2,391	-	2,131

Historical Peaking Factors from Average			
Maximum Month	Maximum Week	Maximum Day	
1.17	-	1.20	
1.20	-	1.38	
1.05	-	1.06	
1.18	-	1.12	
1.00	-	0.89	
1.12	-	1.13	Average
1.20	-	1.38	Maximum
1.2	**1.4**	**1.4**	**Selected Values**

Selected DS Per Capita Ammonia:	**0.020**	**ppcd**

Wet Season Analysis (November 1 through April 30)

Historical Population		
Year	Population	NH_3 (ppcd)
2011/2012	122,662	0.018
2012/2013	123,314	0.018
2013/2014	124,144	0.019
2014/2015	124,662	0.016
2015/2016	125,514	-
	Average:	0.018

Historical Wet Season Ammonia				
Average	Maximum Month	Maximum Week	Maximum Day	Peak Hour
2,193	2,551	-	3,116	
2,270	2,844	-	3,208	
2,326	2,447	-	2,723	
1,954	2,095	-	2,445	
-	-	-	-	

Historical Peaking Factors from Average				
Maximum Month	Maximum Week	Maximum Day	Peak Hour	
1.14	-	1.40		
1.31	-	1.48		
1.11	-	1.23		
0.99	-	1.16		
0.00	-	0.00		
0.91	-	1.05		Average
1.31	-	1.48		Maximum
1.3	**1.5**	**1.5**		**Selected Values**

Selected WS Per Capita Ammonia:	**0.020**	**gpcd**

Attachment 2-B
Unit Process Capacity Assessment Data

Table 2-B-1. Liquids Process Capacity Summary

Unit Process	Criteria	Limiting Factor	Existing Process Capacity			2016 Flows (2015/16 wet season)	Highest Flow During Study Period (2011-2016-)
			Lower (Firm/Installed)	Upper (Firm/Installed)	Total (Firm/Installed - Except as Noted otherwise)		
Influent Screens	Pass Peak Flow	Peak Hour Flow	22.5/45[1] mgd	30/60[1] mgd	52.5 mgd/-[1]	47.8	38.3 mgd WSPH*
Grit Removal	Pass Peak Flow	Peak Hour Flow	38 mgd[2]	38mgd[2]	76 mgd[2]	47.8	38.3 mgd WSPH*
Primary Clarifiers	1200 gal/day-ft^2 SOR WSMM	WSMM Flow	9.2/20.6 mgd	5.7/11.4 mgd	14.9/32 mgd	17.6 mgd	17.6 mgd
	3000 gal/day-ft^2 SOR WSPH		23.1/51.6 mgd	14.3/28.6 mgd	37.4/80.2 mgd	47.8 mgd	29.1 mgd
Aeration Basins	3-day SRT at WSMM 2000-5000 mg/L MLSS at WSMM	Solids Retention	19.2 mgd[3]	9.3 mgd[3]	28.5 mgd	14.9 mgd	17.9 mgd
Secondary Clarifiers	700 gpd/ft^2 SOR at WSMM; 25 lb/day-ft^2 SLR at WSMM	SOR at Upper Plant; SLR at Lower Plant	19.2 mgd[3]	9.3 mgd[3]	28.5 mgd	14.9 mgd	17.9 mgd
Chlorine Contact Basins	20 min HRT at WSMD (Both tanks in service) 30 min HRT at DSA (One tank in service)		-	-	42.5 mgd 14.2 mgd	29.1 mgd WSMD 9.6 mgd DSA	29.1 mgd WSMD 10.9 mgd DSA

SOR = surface overflow rate
SRT = solids retention time
SLR = solids loading rate
HRT = hydraulic retention time
MLSS = mixed liquor suspended solids

DSA = dry season average
WSMM = wet season maximum month
WSMD = wet season maximum day
WSPH = wet season peak hour

1. Lower Plant: Two screens, 22.5 mgd capacity (each) at 40% blinding; Upper Plant: Two screens at 30 mgd (each). Ref. Design data table and hydraulic profile from Project No CIP 319700, WWTP Lower Bar Screen Replacement. Only firm capacity is presented; plant cannot hydraulically pass the flow associated the rated capacities of each screen if all are in service.
2. There is only one circular grit chamber in each the lower and Upper Plant; capacity values presented are total as there is no redundant unit.
3. Aeration basin capacity assessment: assumes all three Lower Plant and one Upper Plant basins are always in service so firm capacity (with one unit out of service) is not assessed. Similarly, for the secondary clarifiers: assumed all three units in the Lower Plant and one unit in the Upper Plant are always in service.

* 38.3 mgd represents the WSPH under a 5-year, 24-hour storm condition; the actual WSPH flow was 47.8 mgd which occurred in December 2015 during a rain event which was significantly more severe than the 5-year, 24-hour storm condition.

Table 2-B-2. Solids Process Capacity Summary

Unit Process	Criteria	Limiting Factor	Total Process Capacity: Current Operation - Series Operation and no PS/WA Co-thickening (firm/installed)	Total Process Capacity: Parallel Digester Operation	2016 Loads/Flow (maximum month)[a]	Loads/Capacity at WSMM Plant Capacity of 28.5 mgd
WAS Thickening	1,000 dry lb solids/hour/ meter SLR	Solids Loading	30,000 ppd	72,000 ppd (24 hours per day operation)	23,149 ppd	39,049 ppd
	100 gpm/meter HLR	Hydraulic Loading	360,000 gpd	864,000 gpd (24 hours per day operation)	401,429 gpd	503,563 gpd
	Currently operates 10 hours/day, 7 days/week					
Anaerobic Digestion	0.5 lb COD/VS-day at 14-day maximum loading[b]		84,000 lb COD/day	168,000 lb COD/day	65,700 lb COD/day at 14-day maximum	68,500 lb COD/day
	15-day SRT at 14-day maximum flow	Hydraulic Loading	67,700 gpd	135,300 gpd	82,700 gpd at 14-day maximum	80,100 gpd
	0.25 lb VSS/ft^3-day at 14-day maximum loading		33,900 lb VSS/day	68,000 lb VSS/day	33,000 lb VSS/day	36,400 lb VSS/day
Digested Sludge Dewatering	2,400 dry lb solids/hour SLR	Hydraulic Loading	12,000/24,000 ppd	28,800/57,600 ppd (24 hours per day operation)	15,500 ppd	19,900 ppd
	150 gpm HLR[c]		90,000/180,000 gpd	216,000/432,000 gpd (24 hours per day operation)	80,800 gpd	80,100 gpd
	Currently operates 10 hours/day, 7 days/week					
Biosolids Storage	60 days of storage		11,110 gpd	-	11,200 gpd at wet season average	14,600 gpd
	14.5% average cake solids in wet season		14,400 ppd		14,400 ppd at wet season average	18,500 ppd
	1.07 cake specific gravity					

[a] Unless otherwise noted.

[b] Based on 3.2% maximum digester TSS (co-thickening in operation), 62% digester volatile solids, and digester feedstock COD to VSS ratios of 1.52 for sludge and 2.90 for FOG according to Pro2D2 modeling results.

[c] Based on the maximum of 154 gpm/belt recorded from 2011 to 2016, at which the belt filter press showed an acceptable dewatering performance.

SRT = solids retention time
SLR = solids loading rate
HLR = hydraulic loading rate
VSS = volatile suspended solids
ppd = pounds per day
gpd = gallons per day
WSMM = wet season maximum month
DSA = dry season average

Attachment 2-C
NPDES Permit

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
WASTE DISCHARGE PERMIT

Oregon Department of Environmental Quality
Northwest Region – Portland Office
2020 SW 4th Ave. Suite 400
Telephone: 503-229-5263
Issued pursuant to ORS 468B.050 and The Federal Water Pollution Control Act (The Clean Water Act)

ISSUED TO:

CITY OF GRESHAM
1333 N.W. Eastman Parkway
Gresham, OR 97030

SOURCES COVERED BY THIS PERMIT:

Type of Waste	Outfall Number	Location
Treated Wastewater	001	114.9
Recycled Water	099	Reuse
Biosolids		Specified in Land Application Plan

FACILITY TYPE AND LOCATION:

Activated Sludge
GRESHAM WWTP
20015 NE SANDY BLVD
Portland, Oregon 97230

RECEIVING STREAM INFORMATION:

WRD Basin: Willamette
USGS *Subbasin: Lower Columbia / Willamette*
Receiving Stream: Columbia River Main Stream
LLID: 1240483462464 117.5 D
Lat/Long: 45° 33'32.75" N 122° 27'31.06" W
County: Multnomah

Treatment System Class Level: IV
Collection System Class Level: IV

EPA REFERENCE # OR0026131
Issued in response to application #962558 received Nov.16, 2012, and based on the land use compatibility statement in the permit record.

Tiffany Yelton-Bram Manager WQ-DEQ-NWR	June 30, 2014 Signature Date	August 1, 2014 Effective Date

PERMITTED ACTIVITIES

Until this permit expires or is modified or revoked, the permittee is authorized to:
1) Operate a wastewater collection, treatment, control and disposal system; and
2) Discharge treated wastewater to waters of the state only from the authorized discharge point or points in Schedule A in conformance with the requirements, limits, and conditions set forth in this permit.

Unless specifically authorized by this permit, by another NPDES or WPCF permit, or by Oregon statute or administrative rule, any other direct or indirect discharge of pollutants to waters of the state is prohibited.

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SCHEDULE A
Waste Discharge Limits

1. **Treated Effluent Outfall 001**
   a. BOD$_5$, and TSS
      i. May 1 – October 31:

Table A1: BOD$_5$ and TSS Limits May - Oct

Parameter	Average Effluent Concentrations, mg/L		Monthly Average lbs/day	Weekly Average lbs/day	Daily Maximum lbs
	Monthly	Weekly			
BOD$_5$	20 mg/L	30 mg/L	2502	3753	5004
TSS	20 mg/L	30 mg/L	2502	3753	5004

Other Parameters	Limitation
Excess Thermal load	7-day moving average of daily maximum excess thermal load shall not exceed 436x 10^6 Kcal/day The monthly average shall not exceed 231 x 10^6 Kcal/day

Notes
a. The thermal load limit was calculated using the maximum week and maximum month dry weather design flows and the maximum 7-day moving average effluent temperature and the monthly average of the daily 7-day moving average temperatures respectively. Upon approval of a Total Maximum Daily Load for temperature for this sub-basin, this permit may be re-opened and new temperature and/or thermal load limits assigned.

ii. November 1 – April 30: During this time period the permittee must comply with the limits in the following table:

Table A2: BOD$_5$ and TSS Limits Nov-April

Parameter	Average Effluent Concentrations, mg/L		Monthly Average lbs/day	Weekly Average lbs/day	Daily Maximum Lbs
	Monthly	Weekly			
BOD$_5$	30 mg/L	45 mg/L	6255	9380	12510
TSS	30 mg/L	45 mg/L	6255	9380	12510

iii. Additional information for the limits in Tables A1 and A2 above.
   1) Average dry weather design flow to the facility equals 15 MGD. Summer mass load limits based upon average dry weather design flow to the facility equaling 15 MGD. Winter mass load limits based upon average wet weather design flow to the facility equaling 25 MGD. The daily mass load limit is suspended on any day in which the flow to the treatment facility exceeds 30 MGD (twice the design average dry weather flow).

b. Additional Parameters. Permittee must comply with the limits in the following table (year round except as noted):

Table A3: Limits for Additional Parameters

Year-round (except as noted)	Limits
BOD_5 and TSS Removal Efficiency (see Note a.)	May not be less than 85% monthly average for BOD_5 and TSS
E. coli Bacteria (see Note b.)	Monthly log mean may not exceed 126 organisms per 100 ml. No single sample may exceed 406 organisms per 100 ml.
pH	May not be outside the range of 6.0 to 8.5 S.U.
Total Residual Chlorine	Monthly average concentration may not exceed 0.14 mg/L. Daily maximum concentration may not exceed 0.36 mg/L.

Notes

a. When monthly average flows exceed 25 MGD, the percent removal rate will be no less than 75 percent.
b. No single *E. coli* sample may exceed 406 organisms per 100 mL; however, DEQ will not cite a violation of this limit if the permittee takes at least 5 consecutive re-samples at 4 hour intervals beginning within 28 hours after the original sample was taken and the log mean of the 5 re-samples is less than or equal to 126 *E. coli* organisms/100 mL.

2. Regulatory Mixing Zone

Pursuant to OAR 340-041-0053, the permittee is granted a regulatory mixing zone as described below:

The regulatory mixing zone is that portion of the Columbia River from the outfall to a point 200 feet downstream from the outfall. The Zone of Immediate Dilution (ZID) is defined as that portion of the regulatory mixing zone that is within 20 feet of the point of discharge.

3. Groundwater Protection

The permittee may not conduct any activities that could cause an adverse impact on existing or potential beneficial uses of groundwater. All wastewater and process related residuals must be managed and disposed of in a manner that will prevent a violation of the Groundwater Quality Protection Rules (OAR Chapter 340, Division 40).

4. Use of Recycled Water

The permittee is authorized to distribute recycled water if it is:

a. Treated and used according to the criteria listed in Table A4.
b. Managed in accordance with its DEQ-approved Recycled Water Use Plan unless exempt as provided in Schedule D, condition 4.
c. Used in a manner and applied at a rate that does not have the potential to adversely impact groundwater quality.
d. Applied at a rate and in accordance with site management practices that ensure continued agricultural, horticultural, or silvicultural production and does not reduce the productivity of the site.
e. Irrigated using sound irrigation practices to prevent:
    i. Offsite surface runoff or subsurface drainage through drainage tile;
    ii. Creation of odors, fly and mosquito breeding, or other nuisance conditions; and
    iii. Overloading of land with nutrients, organics, or other pollutants.

Table A4: Recycled Water Limits

Class	Level of Treatment (after disinfection unless otherwise specified)	Beneficial Uses
C	Class C recycled water must be oxidized and disinfected. Total coliform may not exceed: • A median of 23 total coliform organisms per 100 mL, based on results of the last 7 days that analyses have been completed. • 240 total coliform organisms per 100 mL in any two consecutive samples.	Class C recycled water may be used for: • Class D and nondisinfected uses. • Irrigation of processed food crops; irrigation of orchards or vineyards if an irrigation method is used to apply recycled water directly to the soil. • Landscape irrigation of golf courses, cemeteries, highway medians, or industrial or business campuses. • Industrial, commercial, or construction uses limited to: industrial cooling, rock crushing, aggregate washing, mixing concrete, dust control, nonstructural fire fighting using aircraft, street sweeping, or sanitary sewer flushing.

5. Biosolids

The permittee may land apply biosolids or provide biosolids for sale or distribution, subject to the following conditions:

a. The permittee must manage biosolids in accordance with its DEQ-approved Biosolids Management Plan and Land Application Plan.

b. Except when used for land reclamation and approved by DEQ, biosolids must be applied at or below the agronomic rate required for maximum crop yield.

c. The permittee must obtain written site authorization from DEQ for each land application site prior to land application (see Schedule D, Condition 6) and follow the site-specific management conditions in the DEQ-issued site authorization letter.

d. Biosolids must meet one of the pathogen reduction standards under 40 CFR §503.32 and one of the vector attraction reduction standards under 40 CFR §503.33.

e. Pollutants in biosolids may not exceed the ceiling concentrations shown in Table A5 below. Biosolids exceeding the pollutant concentrations in Table A5 must be applied at a rate that does not exceed the corresponding cumulative pollutant loading rates.

Table A5: Biosolids Limits

Pollutant	Ceiling concentrations[1] (mg/kg)	Pollutant concentrations[1] (mg/kg)	Cumulative pollutant loading rates[1] (kg/ha)
Arsenic	75	41	41
Cadmium	85	39	39
Copper	4300	1500	1500
Lead	840	300	300
Mercury	57	17	17
Molybdenum	75	N/A	N/A
Nickel	420	420	420
Selenium	100	100	100
Zinc	7500	2800	2800

Note:

1. Biosolids pollutant limits are described in 40 CFR Part 503.13, which uses the terms *ceiling concentrations*, *pollutant concentrations*, and *cumulative pollutant loading rates*. Biosolids containing pollutants in excess of the ceiling concentrations may not be applied to the land. Biosolids containing pollutants in excess of the pollutant concentrations, but below the ceiling concentrations, may be applied to the land; however, the total quantity of biosolids applied may not exceed the cumulative pollutant loading rates.

SCHEDULE B
Minimum Monitoring and Reporting Requirements

1. Monitoring and Reporting Protocols

a. Sampling, Test Methods, and Laboratory Quality Assurance and Quality Control (QA/QC)
For all test methods used, the analyses must meet the quantitation limits specified in this schedule, unless the pollutant concentration of the sample can be quantified using a higher analytical threshold. If the permit holder demonstrates, in accordance with the methodology in 40 CFR Part 136, that a higher quantitation limit is needed due to matrix interference, DEQ may approve the change. DEQ's approval must be in writing. The permit holder may also request permission to use a different test method if the one listed in the permit is obsolete, or if a method with comparable or greater accuracy has been identified. As with changes to Quantitation Limits (QLs), DEQ's approval must be in writing. Regarding QA/QC, the permittee must develop and implement a written QA/QC program to verify the accuracy of sample analyses as specified in 40 CFR part 136. The QA/QC program must conform to the requirements of 40 CFR Part 136.7. For further instruction on proper sampling techniques, test methods and the use of laboratories with QA/QC procedures, see Schedule F, Sections B.1 and C.

b. Re-analysis and Re-sampling if QA/QC Requirements Not Met
If QA/QC requirements are not met any analysis, the results must be included in reports, but not used in calculations required by this permit. The permittee must re-analyze the sample if QA/QC requirements are not met. If the sample cannot be re-analyzed, the permittee must re-sample and analyze at the earliest opportunity.

c. Significant Figures and Rounding Conventions
The permittee must report the same number of significant digits as the permit limit for a given parameter. Regardless of the rounding conventions used by the permittee (such as, rounding 5 up for the calculated results or, in the case of laboratory results, rounding 5 to the nearest even number), the permittee must use the convention consistently, and must ensure that laboratories employed by the permittee use the same convention[1].

d. Reporting of Detection Levels and Quantitation Limits
When reporting sampling results, the permittee must record the laboratory detection level and quantitation limit as defined below for each analyte except BOD, TSS, E. coli, pH and total residual chlorine.
   i. Detection Level (DL): The Method Detection Limit (MDL) or Limit of Detection (LOD) and derived using 40 CFR §136 Appendix B; and
   ii. Quantitation Limit (QL): The Method Reporting Limit (MRL) or Limit of Quantitation (LOQ). It is the lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration for the analyte. It is equivalent to the concentration of the lowest calibration standard assuming that all method-specified sample weights, volumes, and cleanup procedures have been employed.

e. Reporting Sample Results
The permittee must follow the procedures listed below when reporting sampling results.
   i. If a sample result is below the DL, report the result as less than the specified DL. For example, if the DL is 1.0 µg/L and the result is non-detect, report "<1.0 µg/L" on the discharge monitoring report (DMR).

ii. If a sample result is above the DL but below the QL, report the result as the DL preceded by DEQ's data code "e". For example, if the DL is 1.0 µg/l, the QL is 3.0 µg/L, and the result is estimated to be between the DL and QL, report "e1.0 µg/L" on the DMR.

iii. If a sample result does not meet QA/QC requirements, the result must be included in the DMR along with a notation but must not be used in any calculation required by this permit.

These requirements do not apply to the following parameters: BOD, TSS, E. coli, pH and total residual chlorine.

f. Calculating and Reporting Mass Loads

The permittee must follow the procedures listed below when calculating and reporting mass loads.
Sample calculation:
Flow (MGD) X Concentration (mg/L) X 8.34 = Pounds per day

g. Daily Maximum Excess Thermal Load

The daily maximum excess thermal load may be calculated using the daily maximum temperature and the total discharge flow for the day. The 7-day average of daily maximum thermal load is a moving average of the daily maximum thermal loads. Excess thermal loads must be calculated using the formula. If the calculation results in a thermal load value less than zero, the results must be recorded as zero. Individual values of zero must be used in calculating the average values.

$$ETL = \Delta T * Q * 2.447 \text{ (million kcals/day °C)}$$

Where:
ETL = Excess thermal load (10^6 Kcal/day)
ΔT = 7-day average of daily maximum effluent temperature (°C) minus criterion (20°C from May 1 through Oct 31)
Q = Discharge flow (cfs)
2.447 (million kcals/day °C) = conversion from Kcals/Kg water/ second to mill Kcals/day

2. Influent Monitoring and Reporting Requirements

The permittee must monitor influent grab samples for both upper and lower plants just upstream of the bar screens and report results in accordance with the table below. Influent composite samples are to be taken between the bar screens and the Parshall flumes.

Table B1: Influent Monitoring

Item or Parameter	Time Period	Minimum Frequency	Sample Type/Action	Report
Total Flow (MGD)	Year-round	Daily	Measurement by totalizing meter	1. Daily values 2. Monthly total 3. Monthly average
Flow Meter Calibration	Year-round	Quarterly	Verification	1. Report that calibration was completed with date. 2. Keep records on site
BOD_5 and TSS (mg/L)	Year-round	3/Week	24-hour composite	1. Daily values 2. Monthly average
pH (S.U.)	Year-round	2 / Week	Grab	Values

Temperature °C	Year-round	Continuous	Measurement	1. Continuous log will be kept on site 2. Daily average
Daily Max Temperature °C	Year-round	Continuous	Calculation	1. Daily one hour maxmimum

3. **Compliance Effluent Monitoring and Reporting**
The permittee must monitor effluent for Outfall 001. Effluent grab and composite samples can either be taken from within the effluent flow channel (between the chlorine contact basin weirs and the outfalls) or within the downstream flow measurement Structure (just north of the WWTP fence line and railroad tracks) and before discharge to the outfalls and report results in accordance with the table below:

Table B2: Effluent Monitoring

Item or Parameter	Time Period	Minimum Frequency	Sample Type/Required Action	Report
Total Flow (MGD)	Year-round	Daily	Measurement by totalizing meter	1. Daily values 2. Monthly total 3. Minimum 4. Maximum 5. Monthly average 6. Weekly average
BOD_5 and TSS (mg/L)	Year-round	3/Week	24-hour composite	1. Daily values 2. Monthly total 3. Minimum 4. Maximum 5. Monthly average 6. Weekly average
BOD_5 and TSS Mass Load (lb/day)	Year-round		Calculation	1. Daily values 2. Monthly total 3. Minimum 4. Maximum 5. Monthly average
BOD_5 and TSS Percent Removal (%)	Year-round	Monthly	Calculation	Monthly average
pH (S.U.)	Year-round	Daily	Grab	1. Daily values 2. Maximum daily value 3. Minimum daily value
Temperature (degrees Celsius)	May-Oct	Daily	Continuous	1. Daily Maximum 2. Daily Average
Excess Thermal Load (Mkcal/day)	May-Oct	Daily	Calculation	Maximum Excess Thermal Load Using Daily maximum Temperature
Excess Thermal Load (Mkcal/day)	May-Oct	Monthly	Calculation	1. Daily Maximum Temperature Daily values as a rolling seven-day average 2. Monthly Average Excess Thermal Load Limit
E. coli (MPN/100mL depending on method)	Year-round	3/Week	Grab	1. Daily values 2. Monthly max 3. Monthly log-average
Quantity Chlorine Used (Gallons)	Year-round	Daily	Measurement	1. Daily values 2. Monthly average

Item or Parameter	Time Period	Minimum Frequency	Sample Type/Required Action	Report
Total Residual Chlorine (mg/L)	Year-round	Daily	Grab	1. Daily values 2. Maximum daily value 3. Monthly average

4. ***Pretreatment Monitoring***
The permit holder must monitor both influent and effluent according to the table below and report the results on an annual basis.

Table B3: Pretreatment Monitoring

Pollutant	CAS[a]	QL	Minimum Frequency	Sample Type	Report
Arsenic (total)[b]	7440382	0.50	Quarterly on 3 consecutive days between Monday and Friday, inclusive.	24-hour composite	Daily values
Cadmium[b]	7440439	0.10			
Chromium (total)[b]	7440473	0.40			
Copper[b]	7440508	10			
Lead[b]	7439921	5			
Mercury[b]	7439976	0.01			
Molybdenum[b]	7439987	10			
Nickel[b]	7440020	10			
Selenium[b]	7782492	2.0			
Silver[b]	7440224	1.0			
Zinc[b]	7440666	5.0			
Cyanide (Total)[c]	57125	5.0			

a. Chemical Abstract Service.
b. All metals must be analyzed for total recoverable concentration unless otherwise specified.
c. When sampling for Cyanide, at least six discrete grab samples must be collected over the operating day with samples collected no less than one hour apart. The aliquot must be at least 100 mL and collected and composited into a larger container that has been preserved with sodium hydroxide to insure sample integrity.

5. **Effluent Toxics Characterization Monitoring**
The permittee must analyze effluent samples for the parameters listed in tables B3-B7 above and below. Effluent composite samples can either be taken from within the effluent flow channel (between the chlorine contact basin weirs and the outfalls) or within the downstream flow measurement Structure (just north of the WWTP fence line and railroad tracks) and before discharge to the outfalls.
Samples must be taken and analyzed October 2014, April 2015, October 2015, and April 2016. Samples must be 24 hour composites except as noted in Tables B3 and B4 for Free Cyanide, Total Phenolic Compounds and Volatile Organic Compounds.

Table B4: Metals, Cyanide, Total Phenols, Nitrates, Ammonia and Hardness

(µg/L unless otherwise specified)

Pollutant[a]	CAS[b]	QL	Pollutant	CAS	QL
Antimony	7440360	0.10	Mercury	7439976	0.005[2]
Arsenic (total)[c]	7440382	0.50	Nickel	7440020	10
Arsenic (Inorganic)[c]	7440382	1.0	Selenium	7782492	2.0
Arsenic III[c]	22541544	50	Silver	7440224	1.0
Beryllium	7440417	0.10	Thallium	7440280	0.10
Cadmium	7440439	0.10	Zinc	7440666	5.0
Chromium (total)	7440473	0.40	Cyanide (Free)[e]	57125	10
Chromium III[d]	16065831	10	Cyanide (Total)[e]	57125	5.0
Chromium VI[d]	18540299	10	Total Phenolic Compounds[f]		5.0
Copper	7440508	10	Nitrates-Nitrite	14797558	100
Iron	7439896	100	Ammonia	7664417	1000
Lead	7439921	5	Hardness (Total as CaCO3)		

a. All metals must be analyzed for total recoverable concentration unless otherwise specified.
b. Chemical Abstract Service
c. If the result for Total Arsenic does not exceed 1.0 µg/L, it is not necessary to monitor for Inorganic Arsenic and Arsenic III. Otherwise, Method 1632A must be used for monitor for Inorganic Arsenic and Arsenic III.
d. If the result for Total Chromium does not exceed 10 µg/L, then it is not necessary to monitor for Chromium III and Chromium VI.
e. When sampling for Cyanide, at least six discrete grab samples must be collected over the operating day with samples collected no less than one hour apart. The aliquot must be at least 100 mL and collected and composited into a larger container that has been preserved with sodium hydroxide to insure sample integrity. If the result for Total Cyanide does not exceed 5.0 µg/L, it is not necessary to test for free cyanide.
f. When sampling for Total Phenolic Compounds, at least six discrete grab samples must be collected over the operating day with samples collected no less than one hour apart. "Total Phenolic Compounds" is identified as Phenols in 40 CFR Part 136.3, Table 1B.

Table B5: Volatile Organic Compounds

(µg/L unless otherwise specified)

Pollutant[a]	CAS	QL	Pollutant[a]	CAS	QL
Acrolein	107028	5.0	1,1-dichloroethylene[e]	75354	0.50
acrylonitrile	107131	5.0	1,2-dichloropropane	78875	0.50
Benzene	71432	0.50	1,3-dichloropropylene[f]	542756	0.50
bromoform	75252	0.50	Ethylbenzene	100414	0.50
carbon tetrachloride	56235	0.50	methyl bromide[g]	74839	0.50
chlorobenzene	108907	0.50	methyl chloride[h]	74873	0.50
Chlorodibromomethane[b]	124481	0.50	methylene chloride	75092	0.50
chloroethane	75003	0.50	1,1,2,2-tetrachloroethane	79345	0.50
2-chloroethylvinyl ether	110758	5.0	tetrachloroethylene[i]	127184	0.50
chloroform	67663	0.50	Toluene	108883	0.50
dichlorobromomethane[c]	75274	0.50	1,1,1-trichloroethane	71556	0.50
1,1-dichloroethane	75343	0.50	1,1,2-trichloroethane	79005	0.50
1,2-dichloroethane	107062	0.50	Trichloroethylene[j]	79016	0.50
1,2-trans-dichloroethylene[d]	156605	0.50	vinyl chloride	75014	0.50

a. Permit holders with lagoon facilities that have retention times in excess of 24 hours may collect a single sample over the operating day. Permit holders with other types of facilities must collect six discrete samples[3] (not less than 40 mL) over the operating day at intervals of at least one hour. The samples may be analyzed separately or composited. If analyzed separately, the analytical results for all samples must be averaged for reporting purposes. If composited, they must be

Pollutant[a]	CAS	QL	Pollutant[a]	CAS	QL

proportionally composited in the laboratory at the time of analysis and this must be done in a manner that maintains the integrity of the samples and prevents the loss of volatile analytes. The quantitation limits listed above remain in effect for composite samples.

b. Chlorodibromomethane is identified as dibromochloromethane in 40 CFR Part 136.3, Table 1C.
c. Dichlorobromomethane is identified as Bromodichloromethane in 40 CFR Part 136.3, Table 1C.
d. 1,2-trans-dichloroethylene is identified as trans-1,2-dichloroethene in 40 CFR Part 136.3, Table 1C.
e. 1,1-dichloroethylene is identified as 1,1-dichloroethene in 40 CFR Part 136.3, Table 1C..
f. 1,3-dichloropropylene consists of both cis-1,3-dichloropropene and trans-1,3-dichloropropene. Both should be reported individually.
g. Methyl bromide is identified as Bromomethane in 40 CFR Part 136.3, Table 1C.
h. Methyl chloride is identified as chloromethane in 40 CFR Part 136.3, Table 1C.
i. Tetrachloroethylene is identified as trichloroethene in 40 CFR Part 136.3, Table 1C.
j. Trichloroethylene is identified as trichloroethene in 40 CFR Part 136.3, Table 1C.

Table B6: Acid-Extractable Compounds
(µg/L unless otherwise specified)

Pollutant	CAS	QL[a]	Pollutant	CAS	QL[a]
p-chloro-m-cresol	59507	1.0	2-nitrophenol	88755	2.0
2-chlorophenol	95578	1.0	4-nitrophenol	100027	5.0
2,4-dichlorophenol	120832	1.0	pentachlorophenol	87865	2.0
2,4-dimethylphenol	105679	5.0	Phenol	108952	1.0
4,6-dinitro-o-cresol[c]	534521	2.0	2,4,5-trichlorophenol[d]	95954	2.0
2,4-dinitrophenol	51285	5.0	2,4,6-trichlorophenol	88062	1.0

a. Some QLs may need methods with modification allowed in 40 CFR Part 136.6 or EPA's **Solutions for Analytical Chemistry Problems w/Clean Water Methods, March 2007. (url: <u>http://water.epa.gov/scitech/methods/cwa/atp/upload/2008_02_06_methods_pumpkin.pdf</u>)**
b. p-chloro-m-cresol is identified as 4-Chloro-3-methylphenol in 40 CFR Part 136.3, Table 1C.
c. 4,6-dinitro-o-cresol is identified as 2-Methyl-4,6-dinitrophenol in 40 CFR Part 136.3, Table 1C.
d. To monitor for 2,4,5-trichlorophenol, use EPA Method 625.

Table B7: Base-Neutral Compounds
(µg/L unless otherwise specified)

Pollutant	CAS	QL[a]	Pollutant	CAS	QL
acenaphthene	83329	1.0	3,3-Dichlorobenzidine	91941	1.0
acenaphthylene	208968	1.0	diethyl phthalate	84662	1.0
anthracene	120127	1.0	dimethyl phthalate	131113	1.0
benzidine	92875	10	2,4-dinitrotoluene	121142	1.0
benzo(a)anthracene	56553	1.0	2,6-dinitrotoluene	606202	1.0
benzo(a)pyrene	50328	1.0	1,2-diphenylhydrazine[d]	122667	5.0
3,4-benzofluoranthene[b]	205992	1.0	fluoranthene	206440	2.0
benzo(ghi)perylene	191242	1.0	fluorene	86737	1.0
benzo(k)fluoranthene	207089	1.0	hexachlorobenzene	118741	1.0
bis(2-chloroethoxy)methane	111911	2.0	hexachlorobutadiene	87683	2.0
bis(2-chloroethyl)ether	111444	1.0	hexachlorocyclopentadiene	77474	2.0
bis(2-chloroisopropyl)ether[c]	108601	2.0	hexachloroethane	67721	2.0
bis (2-ethylhexyl)phthalate	117817	1.0	indeno(1,2,3-cd)pyrene	193395	1.0
4-bromophenyl phenyl ether	101553	1.0	isophorone	78591	10
butylbenzyl phthalate	85687	1.0	napthalene	91203	1.0
2-chloronaphthalene	91587	1.0	nitrobenzene	98953	1.0
4-chlorophenyl phenyl ether	7005723	1.0	N-nitrosodimethylamine	62759	1.0
chrysene	218019	1.0	N-nitrosodi-n-propylamine	621647	2.0
di-n-butyl phthalate	84742	1.0	N-nitrosodiphenylamine	86306	1.0
di-n-octyl phthalate	117840	1.0	Pentachlorobenzene[e]	608935	10
dibenzo(a,h)anthracene	53703	1.0	phenanthrene	85018	1.0
1,2-Dichlorobenzene (o)	95501	0.50	pyrene	129000	1.0
1,3-Dichlorobenzene (m)	541731	0.50	1,2,4-trichlorobenzene	120821	5.0
1,4-Dichlorobenzene (p)	106467	0.50	Tetrachlorobenzene,1,2,4,5[e]	95943	1.0

a. Some QLs may need methods with modification allowed in 40 CFR Part 136.6 or EPA's *Solutions for Analytical chemistry Problems w/Clean Water Methods, March 2007.*
b. 3,4-benzofluoranthene is listed as Benzo(b)fluoranthene in 40 CFR Part 136.
c. Bis(2-chloroisopropyl)ether is listed as 2,2'-oxybis(2-chloro-propane in 40 CFR Part 136.
d. 1,2-diphenylhydrazine is difficult to analyze given its rapid decomposition rate in water. Azobenzene (a decomposition product of 1,2-diphenylhydrazine), should be analyzed as an estimate of this chemical.[4]
e. To analyze for Pentachlorobenzene and Tetrachlorobenzene 1,2,4,5, use EPA 625.

6. Ambient and Additional Effluent Characterization Monitoring

DEQ will evaluate the results of monitoring required under Schedule B condition 5: Effluent Toxics Characterization Monitoring to determine whether the permittee will be required to conduct additional ambient water quality and/or effluent monitoring. DEQ will notify the permittee of its determination through a written "Monitoring Action Letter."

a. Sampling Plan

If additional monitoring is needed, the permittee must submit a sample and analysis plan to DEQ for approval within 3 months of receipt of the DEQ Monitoring Action Letter. The sampling plan must include the following:

i. Characterization of ambient water quality for any pollutants identified as having the reasonable potential to exceed the water quality criterion at the point of discharge. .

ii. If, after permit issuance, the EQC adopts water quality standards for a new parameter or parameters, characterization of effluent and ambient water quality for the new pollutant parameter(s).

iii. If, after permit issuance, the receiving stream is listed as impaired on DEQ's 303(d) list for a new parameter or parameters, characterization of effluent and, if necessary, ambient water quality for the newly listed pollutant parameter(s).
iv. Sampling locations for receiving water must be located as far upstream from outfall location as necessary to insure that samples contain no effluent.
v. Timing of sampling must coincide with the critical period.

b. Implementation
The permittee must implement the approved plan within 12 months of approval.

7. Whole Effluent Toxicity (WET) Testing Requirements
The permittee must monitor final effluent for whole effluent toxicity as described below using the testing protocols specified in Schedule D, condition 9, Whole Effluent Toxicity Testing for Freshwater.

Effluent grab and composite samples can either be taken from within the effluent flow channel (between the chlorine contact basin weirs and the outfalls) or within the downstream flow measurement Structure (just north of the WWTP fence line and railroad tracks) and before discharge to the outfalls.

Table B8: WET Test Monitoring

<table>
<tr><th>Parameter</th><th>Minimum Frequency</th><th>Sample Type/Location</th></tr>
<tr><td>Acute toxicity</td><td rowspan="2">The permit holder must monitor 4 times over the permit cycle with each sample collected during a different quarter. All four samples may be collected in the first year of the permit or they may be collected during a different quarter each year over 4 years (i.e., Year 1, Qtr 1)

When possible, conduct WET testing concurrent with Effluent Toxics Characterization Monitoring as described in Schedule B, Condition 9.

If 4 consecutive tests show no toxicity at the acute (ZID) and the chronic (RMZ) dilutions, no further testing is required. Otherwise, the permittee must re-test and if necessary evaluate the cause of toxicity as described in Schedule D, Condition 9.</td><td>For acute toxicity: Grab or 24-hour Composite sample</td></tr>
<tr><td>Chronic toxicity</td><td>For chronic toxicity: 24-hr composite sample</td></tr>
</table>

8. Recycled Water Monitoring Requirements: Outfall 099
The permittee must monitor recycled water as listed below. The samples must be representative of the recycled water delivered for beneficial reuse at the location identified in the Recycled Water Use Plan.

Table B9: Recycled Water Monitoring

Item or Parameter	Minimum Frequency	Sample Type/Required Action
Total Flow (MGD) or Quantity Irrigated (inches/acre)	Daily	Measurement
Flow Meter Calibration[5]	Annually	Verification
Quantity Chlorine Used (lbs)	Daily	Measurement
Chlorine, Total Residual (mg/L)	Daily	Grab

Item or Parameter	Minimum Frequency	Sample Type/Required Action
pH	2/Week	Grab
E. coli	Weekly (Class D)	Grab
Nutrients (TKN, NO2+NO3-N, NH3, Total Phosphorus[6])	Quarterly	Grab

9. Biosolids Monitoring Requirements

The permittee must monitor biosolids land applied or produced for sale or distribution as listed below. The samples must be representative of the quality and quantity of biosolids generated and undergo the same treatment process used to prepare the biosolids.

Table B10: Biosolids Monitoring

Item or Parameter	Minimum Frequency	Sample Type
Nutrient and conventional parameters[7] (% dry weight unless otherwise specified): 1) Total Kjeldahl Nitrogen (TKN) 2) Nitrate-Nitrogen (NO_3-N) 3) Ammonium Nitrogen (NH_4-N) 4) Total Phosphorus (P) 5) Potassium (K) 6) pH (S.U.) 7) Total Solids 8) Volatile Solids	As described in the DEQ-approved Biosolids Management Plan, but not less than the frequency in Table B10.	As described in the DEQ-approved Biosolids Management Plan
Pollutants: As, Cd, Cu, Hg, Pb, Mo, Ni, Se, Zn, mg/kg dry weight	As described in the DEQ-approved Biosolids Management Plan, but not less than the frequency in Table B10.	As described in the DEQ-approved Biosolids Management Plan
Pathogen reduction	As described in the DEQ-approved Biosolids Management Plan, but not less than the frequency in Table B10.	As described in the DEQ-approved Biosolids Management Plan
Vector attraction reduction	As described in the DEQ-approved Biosolids Management Plan, but not less than the frequency in Table B10.	As described in the DEQ-approved Biosolids Management Plan
Record of biosolids land application: date, quantity, location.	Each event	Record the date, quantity, and location of biosolids land applied on site location map or equivalent electronic system, such as GIS.

Table B11: Biosolids Minimum Monitoring Frequency

Quantity of biosolids land applied or produced for sale or distrubition per calendar year		Minimum Sampling Frequency
(dry metric tons)	(dry U.S. tons)	
Less than 290	Less than 320	Once per year
290 to 1,500	320 to 1,653	Once per quarter (4x/year)
1500 to 15,000	1,653 to 16,535	Once per 60 days (6x/year)
15,000 or more	16,535 or more	Once per month (12x/year)

10. Permit Application Monitoring Requirements

The following information is provided for the convenience of the permit holder and does not represent a requirement under the current permit. The renewal application for this permit requires 3 scans for the parameters listed in the table below. This data may be collected up to 4.5 years in advance of submittal of the renewal application. DEQ recognizes that some facilities may find it difficult to collect 3 scans that are representative of the seasonal variation in the discharge from each outfall, and is therefore calling attention to this permit application requirement of the permit application within this permit.

Table B12: Effluent Monitoring Required for NPDES Permit Application

Parameter
Ammonia (as N)
Chlorine (Total Residual, TRC)
Dissolved Oxygen
Total Kjeldahl Nitrogen (TKN)
Nitrate Plus Nitrite Nitrogen
Oil and Grease

11. Minimum Reporting Requirements
The permittee must report monitoring results as listed below.

Table B13: Reporting Requirements and Due Dates

Reporting Requirement	Frequency	Due Date	Report Form (unless otherwise specified in writing)	Submit To:
1. Table B1: Influent Monitoring 2. Table B2: Effluent Monitoring	Monthly	15th day following the completed monitoring period	DEQ-approved discharge monitoring report (DMR) form, electronic and hard copy (see Notes a. and b.)	• DEQ Regional Office • DEQ Water Quality Division, OIS
Table B3: Pretreatment Report	Annually	March 31st	Report	DEQ Pretreatment Coordinator
Tables B4 – B7: Effluent Toxics Characterization	Once (see Note c.)	According to Schedule B (5)	• DEQ - approved electronic summary template • 1 hard copy	DEQ Regional Office
Condition B.6: Ambient and Additional Effluent Toxics Characterization Data	Once (see Note c.)	If required, within one year of completion of Effluent Toxics Characterization	• 1 hard copy • Data in electronic format (see RPA spreadsheet) to upload to LASAR	DEQ Regional Office
Table B8: WET Test Monitoring	See Table B8	Within the month following the performance of the test.	1 hard copy	DEQ Regional Office

Reporting Requirement	Frequency	Due Date	Report Form (unless otherwise specified in writing)	Submit To:
1. Recycled water annual report describing effectiveness of recycled water system in complying with the DEQ-approved recycled water use plan, OAR 340-055, and this permit. (see Schedule D for more detail) 2. Table B9: Recycled Water Monitoring	Annually	January31	2 hard copies	One each to: • DEQ Regional Office • DEQ Water Reuse Program Coordinator
Wastewater solids annual report describing quality, quantity, and use or disposal of wastewater solids generated at the facility.	Annually	February 19	2 hard copies	One each to: • DEQ Regional Office • DEQ Biosolids Program Coordinator
1. Biosolids land application annual report describing solids handling activities for the previous year and includes the information described in OAR 340-050-0035(6)(a)-(e). 2. Table B9: Recycled Water Monitoring	Annually	February 19	Class I facilities, POTWs with design flows ≥1 mgd and POTWs serving ≥10,000 people: 3 hard copies	One each to: • DEQ Regional Office • DEQ Biosolids Program Coordinator • EPA Region 10
Inflow and infiltration report (see Schedule D, Section 1 for description)	Annually	February 19th	1 hard copy	DEQ Regional Office
Mercury Minimization Plan (see Schedule D, Section 12 for description)	One time	Within 24 months of permit effective date	1 hard copy	DEQ Regional Office

Notes:

a. Name, certificate classification, and grade level of each responsible principal operator as well as identification of each system classification must be included on DMRs.

b. Equipment breakdowns and bypass events must be noted on DMRs.

c. Though the overall characterization only needs to be performed once during the permit cycle, a particular characterization may include multiple sampling events.

SCHEDULE C
Compliance Schedule

There are no compliance schedules associated with this permit.

SCHEDULE D
Special Conditions

1. Inflow and Infiltration

An annual inflow and infiltration report must be submitted to DEQ as directed in Schedule B. The report must include the following:

a. Details of activities performed in the previous year to identify and reduce inflow and infiltration.
b. Details of activities planned for the following year to identify and reduce inflow and infiltration.
c. A summary of sanitary sewer overflows that occurred during the previous year.

2. Emergency Response and Public Notification Plan

The permittee must develop and maintain an Emergency Response and Public Notification Plan (the Plan) per Schedule F, Section B, and Conditions 7 & 8. The permit holder must develop the plan within six months of permit issuance and update the Plan annually to ensure that telephone and email contact information for applicable public agencies are current and accurate. An updated copy of the plan must be kept on file at the wastewater treatment facility for Department review. The latest plan revision date must be listed on the Plan cover along with the reviewer's initials or signature.

3. Recycled Water Use Plan

In order to distribute recycled water for reuse, the permittee must have and maintain a DEQ-approved Recycled Water Use Plan meeting the requirements in OAR 340-055-0025. The permittee must submit substantial modifications to an existing plan to DEQ for approval at least 60 days prior to making the proposed changes. Conditions in the plan are enforceable requirements under this permit.

4. Exempt Wastewater Reuse at the Treatment System

The permittee is exempt from the recycled water use requirements in OAR 340-055 when recycled water is used at the wastewater treatment system for landscape irrigation or for in-plant processes at a wastewater treatment system and all of the following conditions are met:

i. The recycled water is an oxidized and disinfected wastewater.
ii. The recycled water is used at the wastewater treatment system site where it is generated or at an auxiliary wastewater or sludge treatment facility that is subject to the same NPDES or WPCF permit as the wastewater treatment system. Contiguous property to the parcel of land upon which the treatment system is located is considered the wastewater treatment system site if under the same ownership.
iii. Spray or drift or both from the use does not occur off the site.
iv. Public access to the site is restricted.

5. Biosolids Management Plan

The permittee must maintain a Biosolids Management Plan meeting the requirements in OAR 340-050-0031(5). The permittee must keep the plan updated and submit substantial modifications to an existing plan to DEQ for approval at least 60 days prior to making the proposed changes. Conditions in the plan are enforceable requirements under this permit.

6. Land Application Plan

a. <u>Plan Contents</u>

The permittee must maintain a land application plan that contains the information listed below. The land application plan may be incorporated into the Biosolids Management Plan.

i. All known DEQ-approved sites that will receive biosolids while the permit is effective.
ii. The geographic location, identified by county or smaller unit, of new sites which are not specifically listed at the time of permit application.

iii. Criteria that will be used in the selection of new sites.
iv. Management practices that will be implemented at new sites authorized by the DEQ.
v. Procedures for notifying property owners adjacent to proposed sites of the proposed activity prior to the start of application[8].

b. Site Authorization
The permittee must obtain written authorization from DEQ for each land application site prior to its use. Conditions in site authorizations are enforceable requirements under this permit[9]. The permittee may land apply biosolids to a DEQ-approved site only as described in the site authorization, while this permit is effective and with the written approval of the property owner. DEQ may modify or revoke a site authorization following the procedures for a permit modification described in OAR 340-045-0055.

c. Public Participation
i. No DEQ-initiated public notice is required for continued use of sites identified in the DEQ-approved land application plan.
ii. For new sites that fail to meet the site selection criteria in the land application plan or that are deemed by DEQ to be sensitive with respect to residential housing, runoff potential, or threat to groundwater, DEQ will provide an opportunity for public comment as directed by OAR 340-050-0015(10)[10].
iii. For all other new sites, the permittee must provide for public participation following procedures in its DEQ-approved land application plan.

7. Wastewater Solids Transfers

a. *Within state.* The permittee may transfer wastewater solids including Class A and Class B biosolids, to another facility permitted to process or dispose of wastewater solids, including but not limited to: another wastewater treatment facility, landfill, or incinerator. The permittee must monitor, report, and dispose of solids as required under the permit of the receiving facility.
b. *Out of state.* If wastewater solids, including Class A and Class B biosolids, are transferred out of state for use or disposal, the permittee must obtain written authorization from DEQ, meet Oregon requirements for the use or disposal of wastewater solids, notify in writing the receiving state of the proposed use or disposal of wastewater solids, and satisfy the requirements of the receiving state.

8. Hauled Waste Control

a. The permittee may accept hauled wastes at discharge points designated by the POTW after receiving written DEQ approval of a hauled waste control plan. Hauled wastes may include wastewater solids from another wastewater treatment facility, septage, grease trap wastes, portable and chemical toilet wastes, landfill leachate, groundwater remediation wastewaters and commercial/industrial wastewaters. Wastewater solids from out-of-state facilities must not exceed the ceiling concentration limits in Schedule A, Table A5: Biosolids Limits.
b. The City of Gresham wastewater treatment facility accepts hauled waste currently as an integral part of methane production at the facility. The concept and application of received hauled waste for methane production has been reviewed and approved by DEQ, although not written down as a Hauled Waste Control Plan as such. The City has six months from the effective date of this renewed permit to submit a Hauled Waste Control Plan and may continue to accept hauled waste for the purpose of methane production until and after such a plan is submitted and approved.

9. Whole Effluent Toxicity Testing for Freshwater

a. The permit holder must conduct whole effluent toxicity (WET) tests as specified here and in Schedule B of this permit.

b. Acute Toxicity Testing - Organisms and Protocols
   i. The permittee must conduct 48-hour static renewal tests with *Ceriodaphnia dubia* (water flea) and 96-hour static renewal tests with *Pimephales promelas* (fathead minnow).
   ii. All test methods and procedures must be in accordance with Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, EPA-821-R-02-012, October 2002. Any deviation of the bioassay procedures outlined in this method must be submitted in writing to DEQ for review and approval prior to use.
   iii. Treatments to the final effluent samples (for example, dechlorination), except those included as part of the methodology, may not be performed by the laboratory unless approved by DEQ prior to analysis.
   iv. Unless otherwise approved by DEQ in writing, acute tests must be conducted on a control (0%) and the following dilution series: 1%, 5%, 15%, 30%, and 100%.
   v. An acute WET test will be considered to show toxicity if there is a statistically significant difference in survival between the control and 5 percent effluent.

c. Chronic Toxicity Testing - Organisms and Protocols
   i. The permittee must conduct tests with *Ceriodaphnia dubia* (water flea) for reproduction and survival test endpoint, *Pimephales promelas* (fathead minnow) for growth and survival test endpoint, and *Raphidocelis subcapitata* (green alga formerly known as *Selanastrum capricornutum*) for growth test endpoint.
   ii. All test methods and procedures must be in accordance with Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition, EPA-821-R-02-013, October 2002. Any deviation of the bioassay procedures outlined in this method must be submitted in writing to DEQ for review and approval prior to use.
   iii. Treatments to the final effluent samples (for example, dechlorination), except those included as part of the methodology, may not be performed by the laboratory unless approved by DEQ prior to analysis.
   iv. Unless otherwise approved by DEQ in writing, chronic tests must be conducted on a control (0%) and the following dilution series: 1%, 5%, 15%, 30%, and 100%.
   v. A chronic WET test will be considered to show toxicity if the IC_{25} (25% inhibition concentration) occurs at dilutions equal to or less than the dilution that is known to occur at the edge of the mixing zone, that is, $IC_{25} \leq 1\%$.

d. Dual End-Point Tests
   i. WET tests may be dual end-point tests in which both acute and chronic end-points can be determined from the results of a single chronic test. The acute end-point will be based on 48-hours for the *Ceriodaphnia dubia* (water flea) and 96-hours for the *Pimephales promelas* (fathead minnow).
   ii. All test methods and procedures must be in accordance with Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition, EPA-821-R-02-013, October 2002. Any deviation of the bioassay procedures outlined in this method must be submitted in writing to DEQ for review and approval prior to use.
   iii. Unless otherwise approved by DEQ in writing, tests run as dual end-point tests must be conducted on a control (0%) and the following dilution series: 1%, 5%, 15%, 30%, and 100%.
   iv. Toxicity determinations for dual end-point tests must correspond to the acute and chronic tests described in conditions 9.b.v and 9.c.v above.

e. Evaluation of Causes and Exceedances
   i. If any test exhibits toxicity as described in conditions 9.a.v and 9.c.v above, the permittee must conduct another toxicity test using the same species and DEQ-approved methodology within two weeks unless otherwise approved by DEQ.
   ii. If two consecutive WET test results indicate acute or chronic toxicity as described in conditions 9.b.v and 9.c.v above, the permittee must immediately notify DEQ of the results. DEQ will work with the permittee to determine the appropriate course of action to evaluate and address the toxicity.

f. Quality Assurance and Reporting
   i. Quality assurance criteria, statistical analyses, and data reporting for the WET tests must be in accordance with the EPA documents stated in this condition.
   ii. A bioassay laboratory report for each test must be prepared according to the EPA method documents referenced in this Schedule. The report must include all QA/QC documentation, statistical analysis for each test performed, standard reference toxicant test (SRT) conducted on each species required for the toxicity tests, and completed Chain of Custody forms for the samples including time of sample collection and receipt. Reports must be submitted to DEQ within 45 days of test completion.
   iii. The report must include all endpoints measured in the test: NOEC, LOEC, and IC_{25}.
   iv. The permittee must make available to DEQ upon request the written standard operating procedures they, or the laboratory performing the WET tests, use for all toxicity tests required by DEQ.

g. Reopener

DEQ may reopen and modify this permit to include new limits, monitoring requirements, and/or conditions as determined by DEQ to be appropriate, and in accordance with procedures outlined in OAR Chapter 340, Division 45 if:
   i. WET testing data indicate acute and/or chronic toxicity.
   ii. The facility undergoes any process changes.
   iii. Discharge monitoring data indicate a change in the reasonable potential to cause or contribute to an exceedance of a water quality standard

10. *Operator Certification*

a. Definitions
   i. "Supervise" means to have full and active responsibility for the daily on site technical operation of a wastewater treatment system or wastewater collection system.
   ii. "Supervisor" or "designated operator", means the operator delegated authority by the permittee for establishing and executing the specific practice and procedures for operating the wastewater treatment system or wastewater collection system in accordance with the policies of the owner of the system and any permit requirements.
   iii. "Shift Supervisor" means the operator delegated authority by the permittee for executing the specific practice and procedures for operating the wastewater treatment system or wastewater collection system when the system is operated on more than one daily shift.
   iv. "System" includes both the collection system and the treatment systems.

b. The permittee must comply with OAR Chapter 340, Division 49, "Regulations Pertaining to Certification of Wastewater System Operator Personnel" and designate a supervisor whose certification corresponds with the classification of the collection and/or treatment system as specified on p. 1 of this permit.

c. The permittee must have its system supervised full-time by one or more operators who hold a valid certificate for the type of wastewater treatment or wastewater collection system, and at a grade equal to or greater than the wastewater system's classification as specified on p. 1 one of this permit.

d. The permittee's wastewater system may not be without the designated supervisor for more than 30 days. During this period, there must be another person available to supervise who is certified at no more than one grade lower than the classification of the wastewater system. The permittee must delegate authority to this operator to supervise the operation of the system.

e. If the wastewater system has more than one daily shift, the permittee must have another properly certified operator available to supervise operation of the system. Each shift supervisor, if any, must be certified at no more than one grade lower than the system classification.

f. The permittee is not required to have a supervisor on site at all times; however, the supervisor must be available to the permittee and operator at all times.

g. The permittee must notify DEQ in writing of the name of the system supervisor. The permittee may replace or re-designate the system supervisor with another properly certified operator at any time and must notify DEQ in writing within 30 days of replacement or re-designation of operator in charge. As of this writing, the notice of replacement or re-designation must be sent to Water Quality Division, Operator Certification Program, 2020 SW 4th Avenue, Suite 400, Portland, OR 97201.

h. Upon written request, DEQ may grant the permittee reasonable time, not to exceed 120 days, to obtain the services of a qualified person to supervise the wastewater system.[11] The written request must include a justification for the time needed, schedule for recruiting and hiring, date the system supervisor availability ceased, and name of the alternate system supervisor as required by above.

11. Mercury Minimization Plan

Within 24 months of the permit effective date, the permittee must develop and submit for approval an MMP (Mercury Minimization Plan) tailored to the facility's potential to discharge mercury. At a minimum, the MMP must include the following:

a. Identification and evaluation of current and potential mercury (both methyl mercury, known as MeHg, and total mercury) sources
b. Identification and evaluations of conditions (i.e. anaerobic conditions) that contribute to the methylation of elemental mercury in the collection and treatment systems
c. Identification of large industrial, commercial and residential sources that could contribute significant mercury loads to the POTW
d. If applicable, a Monitoring Plan that will identify current or potential sources of mercury
e. An Action Plan that will:
   i. Identify potential methods for reducing or eliminating mercury. This may include but is not limited to assigning limits to potential industrial and commercial sources of mercury to a collection system or requiring BMPs such as:
      1) material substitution
      2) material recovery
      3) spill control and collection
      4) waste recycling
      5) process modifications
      6) proper housekeeping and laboratory use and disposal practices, and
      7) public education

ii. Identify potential methods for reducing or eliminating conditions that contribute to the methylation of elemental mercury.

The permittee must begin implementation of the plan within one month of DEQ approval of the plan. If it is determined that the conditions in the approved MMP are effective in reducing levels of mercury or if a water column criteria for mercury is developed, the DEQ may reopen the permit to modify the permit conditions. Any minimization plan activities undertaken or additions to permit conditions must be consistent with the State's Anti-Degradation Rule (OAR 340-041-0004).

SCHEDULE E
Pretreatment Activities

1. **Program Administration**
The permittee must conduct and enforce its Pretreatment Program, as approved by DEQ, and comply with the General Pretreatment Regulations (40 CFR part 403). The permittee must secure and maintain sufficient resources and qualified personnel to carry out the program implementation procedures described in this permit as required by 40 CFR § 403.8(f)(3).

2. **Legal Authorities**
The permittee must adopt all legal authority necessary to fully implement its approved pretreatment program and to comply with all applicable state and federal pretreatment regulations. The permittee must also establish, where necessary, contracts or agreements with contributing jurisdictions to ensure compliance with pretreatment requirements by industrial users within these jurisdictions. These contracts or agreements must identify the agency responsible for all implementation and enforcement activities to be performed in the contributing jurisdictions. Regardless of jurisdictional situation, the permittee is responsible for ensuring that all aspects of the pretreatment program are fully implemented and enforced.

3. **Industrial Waste Survey**
The permittee must update its inventory of industrial users at a frequency and diligence adequate to ensure proper identification of industrial users subject to pretreatment standards, but no less than once per year. The permittee must notify these industrial users of applicable pretreatment standards in accordance with 40 CFR § 403.8(f)(2)(iii).

4. **National Pretreatment Standards**
The permittee must enforce categorical pretreatment standards promulgated pursuant to section 307(b) and (c) of the Act, prohibited discharge standards as set forth in 40 CFR § 403.5(a) and (b), or local limits developed by the permittee in accordance with 40 CFR § 403.5(c), whichever are more stringent, or are applicable to any non-domestic source regulated under section 307(b), (c), or (d) of the Act.

5. **Local Limits**
The permittee must perform a technical evaluation of the need to revise local limits within 18 months after permit re-issuance unless DEQ authorizes or requires, in writing, an alternate time frame. Locally derived discharge limits must be defined as pretreatment standards under section 307(d) of the Act and must conform to 40 CFR § 403.5(c) and § 403.8(f)(4). Technically based local limits must be developed in accordance with the procedures established by DEQ and the EPA's Local Limits Guidance.

6. **Control Mechanisms**
The permittee must issue an individual control mechanism to all Significant Industrial Users except where the permittee may, at its discretion, issue a general control mechanism as defined by 40 CFR § 403.8(f)(1)(iii); or certification in lieu of a control mechanism for Non-Significant Categorical Industrial Users (NSCIUs) as defined by 40 CFR § 403.3(v)(2), and Non-Discharging Categorical Industrial Users (NDCIUs). All individual and general control mechanisms must be enforceable and contain, at a minimum, the requirements identified in 40 CFR § 403.8(f)(1)(iii)(B); and, may contain equivalent concentration and mass based effluent limits where appropriate under 40 CFR § 403.6(c)(5) and (6). Unless a more stringent definition has been adopted by the permittee, the definition of Significant Industrial User must be as stated in 40 CFR § 403.3(v).

7. Compliance Monitoring

a. Industrial User Sampling and Inspection

The permittee must randomly sample and analyze the effluent from Industrial Users at a frequency commensurate with the character, consistency, and volume of the discharge and conduct surveillance activities in order to identify, independent of information supplied by Industrial Users, occasional and continuing noncompliance with Pretreatment Standards. The permittee must conduct a complete facility inspection; and, sample the effluent from each Significant Industrial User at least once a year at a minimum, unless otherwise specified below:

i. Where the permittee has authorized the Industrial User subject to a categorical Pretreatment Standard to forego sampling of a pollutant regulated by a categorical Pretreatment Standard in accordance with 40 CFR § 403.12(e)(2), the permittee must sample for the waived pollutant(s) at least once during the term of the Categorical Industrial User's control mechanism. In the event that the permittee subsequently determines that a waived pollutant is present or is expected to be present in the Industrial User's wastewater based on changes that occur in the User's operations, the permittee must immediately begin at least annual effluent monitoring of the User's Discharge and inspection.

ii. Where the permittee has determined that an Industrial User meets the criteria for classification as a Non-Significant Categorical Industrial User, the permittee must evaluate, at least once per year, whether an Industrial User continues to meet the criteria in 40 CFR § 403.3(v)(2).

iii. In the case of Industrial Users subject to reduced reporting requirements under 40 CFR § 403.12(e)(3), the permittee must randomly sample and analyze the effluent from Industrial Users and conduct inspections at least once every two years. If the Industrial User no longer meets the conditions for reduced reporting in 40 CFR § 403.12(e)(3), the permittee must immediately begin sampling and inspecting the Industrial User at least once a year.

b. Industrial User Self Monitoring and Other Reports

The permittee must receive and analyze self-monitoring and other reports submitted by industrial users as required by 40 CFR § 403.8(f)(2)(iv) and § 403.12(b),(d),(e),(g) and (h). Significant Industrial User reports must include Best Management Practice (BMP) compliance information per 40 CFR § 403.12(b), (e), (h), where appropriate.

c. Industrial User Monitoring in Lieu of Self-Monitoring

Where the permittee elects to conduct monitoring of an industrial user in lieu of requiring self-monitoring, the permittee must gather all information which would otherwise have been submitted by the user. The permittee must also perform the sampling and analyses in accordance with the protocols established for the user and must follow the requirements in 40 CFR § 403.12(g)(2) if repeat sampling is required as the result of any sampling violation(s).

d. Sample Collection and Analysis

Sample collection and analysis, and the gathering of other compliance data, must be performed with sufficient care to produce evidence admissible in enforcement proceedings or in judicial actions. Unless specified otherwise by the Director in writing, all sampling and analyses must be performed in accordance with 40 CFR part 136 or 40 CFR part 503 for biosolids analytes.

8. Slug Control Plans

The permittee must evaluate whether each Significant Industrial User needs a slug control plan or other action to control slug discharges. Industrial Users identified as significant after October 14, 2005, must be evaluated within 1 year of being designated a Significant Industrial User. A slug discharge is any discharge of a non-routine, episodic nature, including but not limited to an accidental spill or a non-customary batch discharge that has a reasonable potential to cause interference or pass through or in any other way violate the permittee's regulations, local limits, or conditions of this permit. The results of such activities must be available to DEQ upon request. The permittee must require Significant Industrial Users to immediately notify the permittee of any changes at its facility affecting potential for a slug discharge. If the permittee determines that a slug control plan is needed, the requirements to control slug discharges must be incorporated into the Significant Industrial User's control mechanism and the slug plan must contain, at a minimum, the following elements:

a. Description of discharge practices, including non-routine batch discharges;
b. Description of stored chemicals;
c. Procedures for immediately notifying the permittee of slug discharges, including any discharge that would violate a prohibition under 40 CFR § 403.5(b) with procedures for follow-up written notification within five days; and
d. If necessary, procedures to prevent adverse impact from accidental spills, including inspection and maintenance of storage areas, handling and transfer of materials, loading and unloading operations, control of plant site run-off, worker training, building of containment structures or equipment, measures for containing toxic organic pollutants (including solvents), and/or measures and equipment for emergency response.

9. Enforcement

The permittee must identify all violations of the industrial user's permit or local ordinance. The permittee must investigate all such instances of industrial user noncompliance and take all necessary steps to return users to compliance. The permittee's enforcement actions must follow its approved legal authorities (for example, ordinances) and Enforcement Response Plan developed in accordance with 40 CFR § 403.8(f)(5).

10. Public Notice of Significant Noncompliance

The permittee must publish annual notification in a newspaper(s) of general circulation that provides meaningful public notice within the jurisdiction(s) served by the permittee of industrial users which, at any time during the previous 12 months, were in significant noncompliance with applicable pretreatment requirements. For the purposes of this requirement, an industrial user is in significant noncompliance if it meets one or more of the criteria listed in 40 CFR § 403.8(f)(2)(viii).

11. Data and Information Management

The permittee must develop and maintain a data management system designed to track the status of the industrial user inventory, discharge characteristics, and compliance. In accordance with 40 CFR § 403.12(o), the permittee must retain all records relating to pretreatment program activities for a minimum of 3 years and make such records available to DEQ and EPA upon request. The permittee must also provide public access to information considered effluent data under 40 CFR part 2.

12. Annual Pretreatment Program Report

The permittee must submit a complete report to DEQ on or before March 31 that describes the pretreatment program activities during the previous calendar year pursuant to 40 CFR § 403.12(i). For guidance on the contact and format of this report, contact DEQ's pretreatment coordinator. Reports submitted to DEQ regarding pretreatment must be signed by a principal executive officer, ranking elected official or other duly authorized employee if such employee is for overall operation of the POTW[12].

13. Pretreatment Program Modifications

The permittee must submit in writing to DEQ a statement of the basis for any proposed modification of its approved program and a description of the proposed modification in accordance with 40 CFR § 403.18. No substantial program modifications may be implemented by the delegated program prior to receiving written authorization from DEQ. This Schedule incorporates, by reference, all substantial and non-substantial pretreatment program modifications approved by DEQ prior to NPDES permit re-issuance.

14. Implementation of 2005 EPA Streamlining Amendments to 40 CFR Part 403

The permittee must complete implementation of the required portions of the 2005 EPA streamlining amendments within 12 months after the permit reissuance unless DEQ authorizes or requires in writing an alternate time frame.

SCHEDULE F
General Conditions
SCHEDULE F
NPDES GENERAL CONDITIONS – DOMESTIC FACILITIES

SECTION A. STANDARD CONDITIONS

A1. Duty to Comply with Permit

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

A2. Penalties for Water Pollution and Permit Condition Violations

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

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

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

Under ORS 468.946, a person who knowingly discharges, places, or causes to be placed any waste into the waters of the state or in a location where the waste is likely to escape into the waters of the state is subject to a Class B felony punishable by a fine not to exceed $250,000 and up to 10 years in prison per ORS chapter 161. The federal Clean Water Act provides for criminal penalties of $5,000 to $50,000 per day of violation, or imprisonment of not more than 3 years, or both for knowing violations of the permit. In the case of a second or subsequent conviction for knowing violation, a person is subject to criminal penalties of not more than $100,000 per day of violation, or imprisonment of not more than 6 years, or both.

A3. Duty to Mitigate

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

A4. Duty to Reapply

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

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

A5. Permit Actions

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

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

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

A6. Toxic Pollutants

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

A7. Property Rights and Other Legal Requirements

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

A8. Permit References

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

A9. Permit Fees

The permittee must pay the fees required by OAR.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

B1. Proper Operation and Maintenance

The permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems that are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

B2. Need to Halt or Reduce Activity Not a Defense

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

B3. Bypass of Treatment Facilities

a. Definitions
   (1) "Bypass" means intentional diversion of waste streams from any portion of the treatment facility. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, provided the diversion is to allow essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs b and c of this section.
   (2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.
b. Prohibition of bypass.
   (1) Bypass is prohibited and DEQ may take enforcement action against a permittee for bypass unless:
      i. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
      ii. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventative maintenance; and
      iii. The permittee submitted notices and requests as required under General Condition B3.c.
   (2) DEQ may approve an anticipated bypass, after considering its adverse effects and any alternatives to bypassing, if DEQ determines that it will meet the three conditions listed above in General Condition B3.b.(1).
c. Notice and request for bypass.
   (1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, a written notice must be submitted to DEQ at least ten days before the date of the bypass.
   (2) Unanticipated bypass. The permittee must submit notice of an unanticipated bypass as required in General Condition D5.

B4. Upset

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operation error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.
b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of General Condition B4.c are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
   (1) An upset occurred and that the permittee can identify the causes(s) of the upset;
   (2) The permitted facility was at the time being properly operated;
   (3) The permittee submitted notice of the upset as required in General Condition D5, hereof (24-hour notice); and
   (4) The permittee complied with any remedial measures required under General Condition A3 hereof.
d. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

B5. Treatment of Single Operational Upset

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

B6. Overflows from Wastewater Conveyance Systems and Associated Pump Stations

a. Definition. "Overflow" means any spill, release or diversion of sewage including:
   (1) An overflow that results in a discharge to waters of the United States; and
   (2) An overflow of wastewater, including a wastewater backup into a building (other than a backup caused solely by a blockage or other malfunction in a privately owned sewer or building lateral), even if that overflow does not reach waters of the United States.
b. Reporting required. All overflows must be reported orally to DEQ within 24 hours from the time the permittee becomes aware of the overflow. Reporting procedures are described in more detail in General Condition D5.

B7. Public Notification of Effluent Violation or Overflow

If effluent limitations specified in this permit are exceeded or an overflow occurs that threatens public health, the permittee must take such steps as are necessary to alert the public, health agencies and other affected entities (for example, public water systems) about the extent and nature of the discharge in accordance with the notification procedures developed under General Condition B8. Such steps may include, but are not limited to, posting of the river at access points and other places, news releases, and paid announcements on radio and television.

B8. Emergency Response and Public Notification Plan

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

a. Ensure that the permittee is aware (to the greatest extent possible) of such events;
b. Ensure notification of appropriate personnel and ensure that they are immediately dispatched for investigation and response;
c. Ensure immediate notification to the public, health agencies, and other affected public entities (including public water systems). The overflow response plan must identify the public health and other officials who will receive immediate notification;
d. Ensure that appropriate personnel are aware of and follow the plan and are appropriately trained;
e. Provide emergency operations; and
f. Ensure that DEQ is notified of the public notification steps taken.

B9. Removed Substances
Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters must be disposed of in such a manner as to prevent any pollutant from such materials from entering waters of the state, causing nuisance conditions, or creating a public health hazard.

SECTION C. MONITORING AND RECORDS

C1. Representative Sampling
Sampling and measurements taken as required herein must be representative of the volume and nature of the monitored discharge. All samples must be taken at the monitoring points specified in this permit, and must be taken, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water, or substance. Monitoring points must not be changed without notification to and the approval of DEQ.

C2. Flow Measurements
Appropriate flow measurement devices and methods consistent with accepted scientific practices must be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices must be installed, calibrated and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected must be capable of measuring flows with a maximum deviation of less than ± 10 percent from true discharge rates throughout the range of expected discharge volumes.

C3. Monitoring Procedures
Monitoring must be conducted according to test procedures approved under 40 CFR part 136 or, in the case of sludge use and disposal, approved under 40 CFR part 503 unless other test procedures have been specified in this permit.

C4. Penalties of Tampering
The federal Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit may, upon conviction, be punished by a fine of not more than $10,000 per violation, imprisonment for not more than two years, or both. If a conviction of a person is for a violation committed after a first conviction of such person, punishment is a fine not more than $20,000 per day of violation, or by imprisonment of not more than four years, or both.

C5. Reporting of Monitoring Results
Monitoring results must be summarized each month on a discharge monitoring report form approved by DEQ. The reports must be submitted monthly and are to be mailed, delivered or otherwise transmitted by the 15th day of the following month unless specifically approved otherwise in Schedule B of this permit.

C6. Additional Monitoring by the Permittee
If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR part 136 or, in the case of sludge use and disposal, approved under 40 CFR part 503, or as specified in this permit, the results of this monitoring must be included in the calculation and reporting of the data submitted in the discharge monitoring report. Such increased frequency must also be indicated. For a pollutant parameter that may be sampled more than once per day (for example, total residual chlorine), only the average daily value must be recorded unless otherwise specified in this permit.

C7. Averaging of Measurements
Calculations for all limitations that require averaging of measurements must utilize an arithmetic mean, except for bacteria which must be averaged as specified in this permit.

C8. Retention of Records
Records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities must be retained for a period of at least 5 years (or longer as required by 40 CFR part 503).

Records of all monitoring information including all calibration and maintenance records, all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit and records of all data used to complete the application for this permit must be retained for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of DEQ at any time.

C9. Records Contents

Records of monitoring information must include:

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

C10. Inspection and Entry

The permittee must allow DEQ or EPA upon the presentation of credentials to:

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

C11. Confidentiality of Information

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

SECTION D. REPORTING REQUIREMENTS

D1. Planned Changes

The permittee must comply with OAR 340-052, "Review of Plans and Specifications" and 40 CFR § 122.41(l)(1). Except where exempted under OAR 340-052, no construction, installation, or modification involving disposal systems, treatment works, sewerage systems, or common sewers may be commenced until the plans and specifications are submitted to and approved by DEQ. The permittee must give notice to DEQ as soon as possible of any planned physical alternations or additions to the permitted facility.

D2. Anticipated Noncompliance

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

D3. Transfers

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

D4. Compliance Schedule

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

D5. Twenty-Four Hour Reporting

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

a. Overflows.
   (1) Oral Reporting within 24 hours.
      i. For overflows other than basement backups, the following information must be reported to the Oregon Emergency Response System (OERS) at 1-800-452-0311. For basement backups, this information should be reported directly to the DEQ regional office.
         (a) The location of the overflow;
         (b) The receiving water (if there is one);
         (c) An estimate of the volume of the overflow;
         (d) A description of the sewer system component from which the release occurred (for example, manhole, constructed overflow pipe, crack in pipe); and
         (e) The estimated date and time when the overflow began and stopped or will be stopped.
      ii. The following information must be reported to the DEQ regional office within 24 hours, or during normal business hours, whichever is earlier:
         (a) The OERS incident number (if applicable); and
         (b) A brief description of the event.
   (2) Written reporting within 5 days.
      i. The following information must be provided in writing to the DEQ regional office within 5 days of the time the permittee becomes aware of the overflow:
         (a) The OERS incident number (if applicable);
         (b) The cause or suspected cause of the overflow;
         (c) Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
         (d) Steps taken or planned to mitigate the impact(s) of the overflow and a schedule of major milestones for those steps; and
         (e) For storm-related overflows, the rainfall intensity (inches/hour) and duration of the storm associated with the overflow.

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

iv. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance; and
v. Public notification steps taken, pursuant to General Condition B7.

(4) DEQ may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

D6. Other Noncompliance

The permittee must report all instances of noncompliance not reported under General Condition D4 or D5 at the time monitoring reports are submitted. The reports must contain:

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

D7. Duty to Provide Information

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

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

D8. Signatory Requirements

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

D9. Falsification of Information

Under ORS 468.953, any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, is subject to a Class C felony punishable by a fine not to exceed $125,000 per violation and up to 5 years in prison per ORS chapter 161. Additionally, according to 40 CFR § 122.41(k)(2), any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit including monitoring reports or reports of compliance or non-compliance will, upon conviction, be punished by a federal civil penalty not to exceed $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

D10. Changes to Indirect Dischargers

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

a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of the federal Clean Water Act if it were directly discharging those pollutants and;
b. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.
c. For the purposes of this paragraph, adequate notice must include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

SECTION E. DEFINITIONS

E1. *BOD* or BOD_5 means five-day biochemical oxygen demand.
E2. *CBOD* or $CBOD_5$ means five-day carbonaceous biochemical oxygen demand.
E3. *TSS* means total suspended solids.

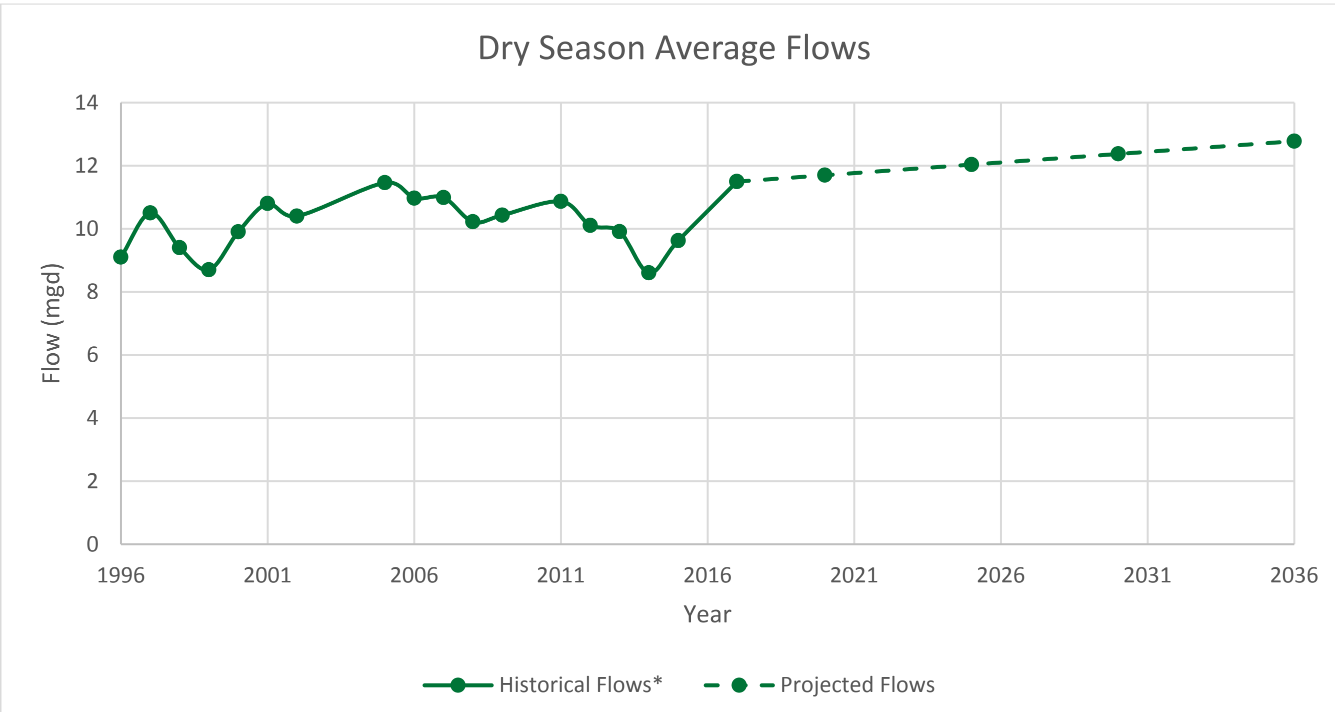
E4. *Bacteria* means but is not limited to fecal coliform bacteria, total coliform bacteria, *Escherichia coli* (*E. coli*) bacteria, and *Enterococcus* bacteria.
E5. *FC* means fecal coliform bacteria.
E6. *Total residual chlorine* means combined chlorine forms plus free residual chlorine
E7. *Technology based permit effluent limitations* means technology-based treatment requirements as defined in 40 CFR § 125.3, and concentration and mass load effluent limitations that are based on minimum design criteria specified in OAR 340-041.
E8. *mg/l* means milligrams per liter.
E9. *μg/l* means microgram per liter.
E10. *kg* means kilograms.
E11. m^3/d means cubic meters per day.
E12. *MGD* means million gallons per day.
E13. *Average monthly effluent limitation* as defined at 40 CFR § 122.2 means the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.
E14. *Average weekly effluent limitation* as defined at 40 CFR § 122.2 means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.
E15. *Daily discharge* as defined at 40 CFR § 122.2 means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the daily discharge must be calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the daily discharge must be calculated as the average measurement of the pollutant over the day.
E16. *24-hour composite sample* means a sample formed by collecting and mixing discrete samples taken periodically and based on time or flow. The sample must be collected and stored in accordance with 40 CFR part 136.
E17. *Grab sample* means an individual discrete sample collected over a period of time not to exceed 15 minutes.
E18. *Quarter* means January through March, April through June, July through September, or October through December.
E19. *Month* means calendar month.
E20. *Week* means a calendar week of Sunday through Saturday.
E21. *POTW* means a publicly-owned treatment works.

CHAPTER 3

Planning Criteria and Discharge Considerations

3.1 Summary

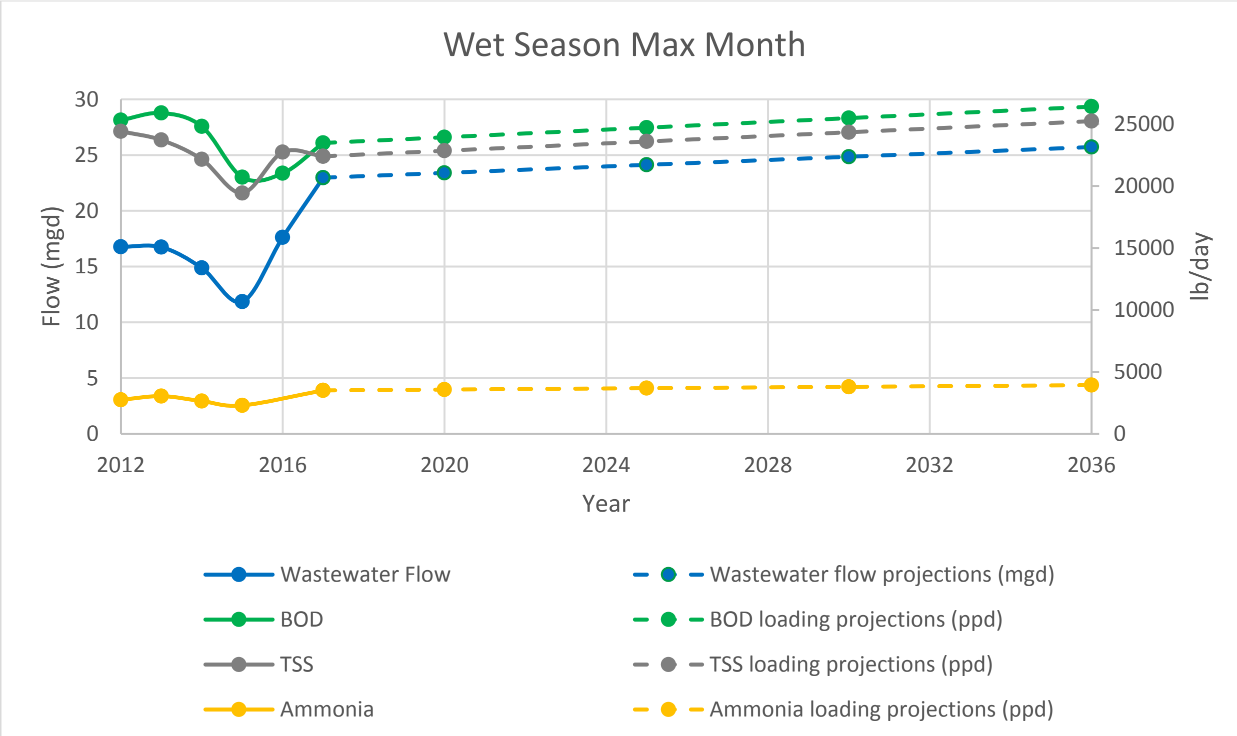
Flow and load projections for the period between 2017 and 2036 were developed for the Gresham WWTP. These projections will be used to assist in planning future improvements and expansions at the treatment plant. Figure 3-1 shows historical dry season average flows at the Gresham WWTP from 1996 through the planning period of the 2017 Master Plan.



*1996-2002 from 2004 MP, 2005-2009 from 2011 MP, 2012-2036 from 2017 MP

Figure 3-1. Summary of Historical and Projected Flows

Figure 3-2 summarizes the projections for flow, 5-day biochemical oxygen demand (BOD5), TSS, and ammonia. The last 5 years of data, which were analyzed and used to develop future projections, are also presented in Figure 3-2. The flow and load projections in Figure 3-2 include domestic (residential and light commercial) and existing industrial sources.



*No data provided for 2015/2016 wet season

Figure 3-2. Summary of Flow and Load Projections

Gresham currently meets all discharge requirements identified in its NPDES permit, which was renewed in August 2014 (DEQ, 2014b) and expires in July 2019. Gresham has infrequently had issues with mass load permit compliance in the past during a storm events, but typically the WWTP has consistently met BOD, TSS, *E. coli*, and pH requirements. Discharge requirements for ammonia may become critical for future operation and planning. Gresham's NPDES permit does not currently have ammonia limits, but DEQ adopted more stringent ammonia water quality toxicity criteria in 2015, which will lower allowable ammonia discharge concentrations. Therefore, the City should take reasonable operational and management measures now to reduce effluent ammonia concentrations to reduce the likelihood of triggering a reasonable potential to exceed these new, more stringent criteria. However, even if efforts are undertaken to reduce effluent ammonia levels between now and when permit renewal is undertaken, seasonal effluent ammonia limits in the next NPDES permit renewal may still be inevitable. To avoid an ammonia limit in future permits, nitrification of a portion of the flow during the dry season and some ammonia reductions in the wet season would most likely be required, depending on the ammonia criteria calculated and effluent ammonia data applied. Derivation of the ammonia criteria depends on the values assumed for the receiving water (Columbia River) pH and temperature. A suite of options was evaluated as part of the alternatives evaluation portion of this MP update, including industrial pretreatment, nitrification in the Upper Plant, treatment of dewatering filtrate recycle, post-aerobic digestion (PAD), and outfall modifications to increase dilutions.

Gresham's biosolids management program complies with all local, state, and federal requirements. While there are no immediate regulatory drivers that would require the City to change the current biosolids program, the City is always looking for ways to continue to improve and enhance the program. Major regulatory changes that would drive the City to change current solids processing and biosolids beneficial reuse practices are not foreseen. However, public opinion may directly or indirectly compel the City to modify its local land application program by producing biosolids with even lower pathogen levels (exceptional quality/Class A) than currently attained, identifying additional land application sites (including those located in eastern Oregon), or converting to a product-based program such as a soil amendment through advanced processing/treatment (e.g., composting). In the near term, digestion capacity/redundancy and storage of digested and dewatered biosolids is one of the more critical issues for Gresham. Considering all of these issues, it is recommended that the City do the following:

- Continue identification and implementation of cost-effective incremental improvements to defer construction of a third anaerobic digester without curtailing FOG/high-strength waste receiving if possible..
- Evaluate alternatives that will provide more storage for dewatered biosolids either directly (construct more onsite or offsite storage) or indirectly (optimize BFP dewatering to obtain a higher percent cake solids).
- Develop a long-term plan for modifying existing facilities to produce exceptional quality/Class A biosolids.
- Continue to reserve space in the buildout site plan for advanced biosolids processing such as composting.

The City recently conducted a solids study described in the *Solids Process Improvements Predesign Report* (Brown and Caldwell, 2014a). This 2017 WWTP Master Plan Update incorporates its findings and conclusions. Chapter 4 Alternatives Analysis discusses biosolids issues in more detail.

3.2 Introduction

This section documents the key elements associated with planning at the Gresham WWTP including flow and load projections, and effluent discharge criteria over the course of the MP study period, which is defined to be through the year 2036 (20-year planning horizon). Current and potential future effluent discharge requirements are evaluated. The impact of future regulations on the operation of the plant is also discussed.

3.3 Population, Flow, and Load Projections

3.3.1 Population Projections

Future population estimates were made using historical population data for 2010 through 2015 provided by the City of Gresham and the 2040 population projections from the *2015–2040 TAZ Growth Forecast Distribution* for the Gresham, Fairview, Wood Village regions, and future Springwater and Pleasant Valley Concept Plan developments. See Attachment 3-A for a description of the nine-step methodology that Metro used to create 2040 traffic analysis zone (TAZ) data.

3.3.1.1 Historical Population Summaries

To calculate per capita wastewater flows and loadings, historical population information was correlated with the historical wastewater flow and loading data in Chapter 2. These per capita flow and loading data were then used in conjunction with population projections to estimate future domestic wastewater flows and loadings.

Historical population data for the years 2010 through 2015 were provided by the City of Gresham Urban Planning and Development Department as detailed in Table 3-1.

Table 3-1. Historical Population Data

Year	Gresham Population	Fairview Population	Wood Village Population	Springwater Annexation Area TAZ ID 476, 475	Pleasant Valley Annexation Area TAZ ID 469, 470	Total
2010	105,594	8,920	3,878	465	269	119,126
2011	107,549	9,039	3,929	**474**	**275**	121,267
2012	108,794	9,144	3,959	**484**	**281**	122,662
2013	109,371	9,189	3,973	**493**	**288**	123,314
2014	110,109	9,243	3,996	**503**	**294**	124,144
2015	110,553	9,280	4,017	512	300	124,662

Note: **Bold** values are interpolated from 2010 and 2015 TAZ data.

3.3.1.2 Population Projection Summaries

Table 3-2 summarizes the population projections in the Gresham WWTP service area. The population projected includes the existing areas served by the Gresham WWTP and the future Springwater and Pleasant Valley Concept Plan developments per TAZ estimates for 2010, 2015, and 2040. The service area is comprised of City of Gresham, City of Fairview, and City of Wood Village. Using the historical data for 2015 and Metro TAZ population projections for 2040, population projections for 2016, 2017, 2020, and each multiple of 5 years from 2020 to 2036 were determined by linear interpolation.

Table 3-2. Population Projections

Year	Gresham Population	Fairview Population	Wood Village Population	Springwater Annexation Area TAZ ID 476, 475	Pleasant Valley Annexation Area TAZ ID 469, 470	Total
2016	111,257	9,320	4,076	538	323	125,514
2017	111,961	9,360	4,135	565	346	126,366
2020	114,072	9,481	4,311	643	414	128,921
2025	117,591	9,681	4,606	775	528	133,181
2030	121,109	9,882	4,900	906	643	137,440
2036	125,332	10,123	5,253	1,064	780	142,551
2040	128,147	10,283	5,489	1,169	871	145,959

See Figures 3-3, 3-4, and 3-5, for areas included in the City of Gresham wastewater treatment plant service area and TAZ boundaries for population forecasts. The City of Gresham used the Metro TAZ data selected polygons that have their centroid in the selected geography, including the Kelley Creek Headwaters Plan Area section and using the current city limits for calculations. TAZ 619 straddles Wood Village and Fairview and this lot was calculated for Wood Village. TAZ 472 was included in the Gresham count, even though the centroid was just off the center.

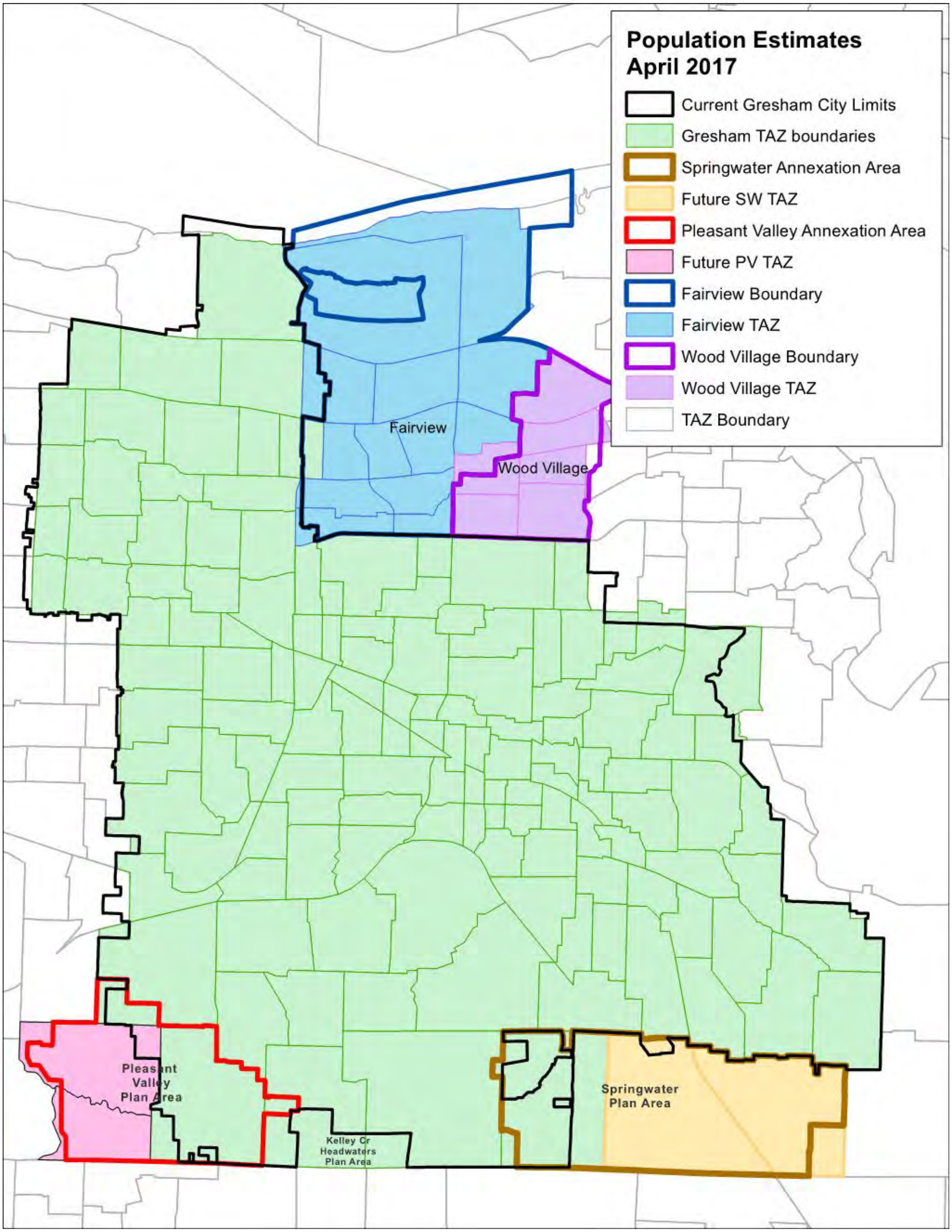


Figure 3-3. Gresham Service Area

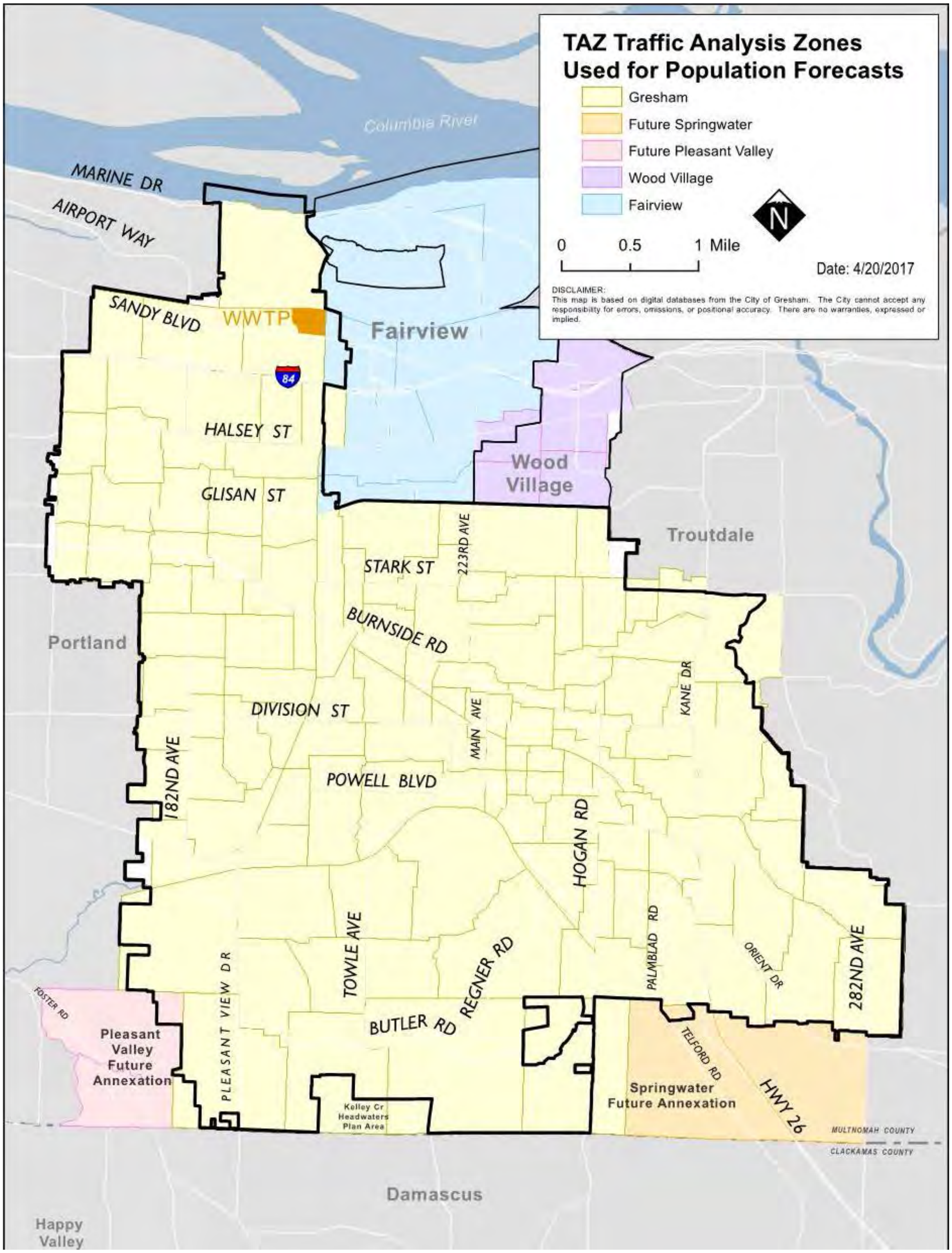


Figure 3-4. TAZ Traffic Analysis Zones Used for Population Forecasts

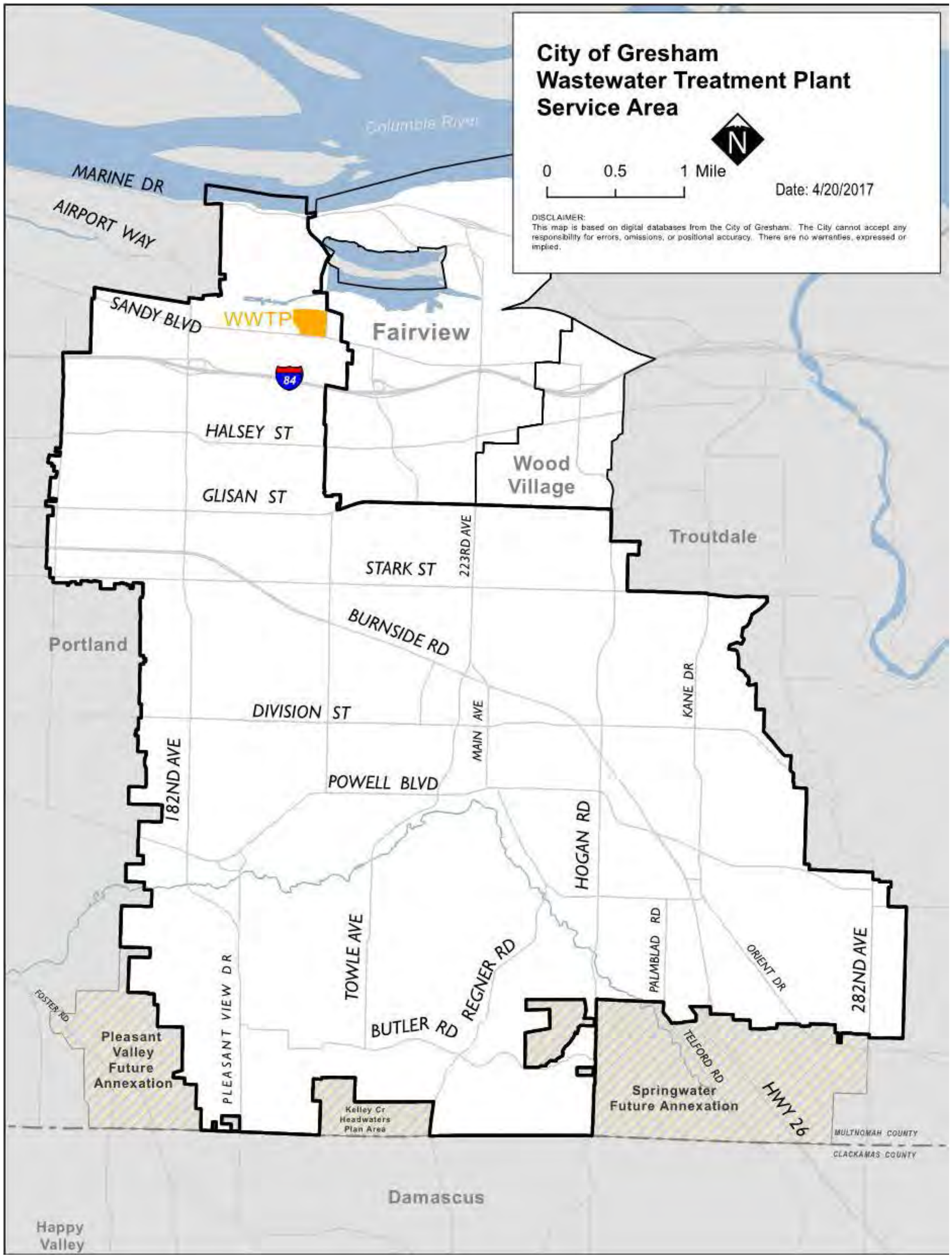


Figure 3-5. Wastewater Treatment Plant Service Area

Figure 3-6 is a representation of actual population from 2010 through 2015 and projected population from 2016 through 2040. Population projections from the 2011 *City of Gresham Wastewater Treatment Plant Master Plan Update* (Carollo, 2011) are included for reference.

Final buildout population for Gresham is 185,801 people per TAZ Potential Buildout, a method based on current zoning and a density of 2.69 people per household. See Attachment 3-E for population information. While this master planning effort focuses on the next 20 years, the buildout population will be utilized to confirm that the current WWTP site is sufficient to serve anticipated treatment needs.

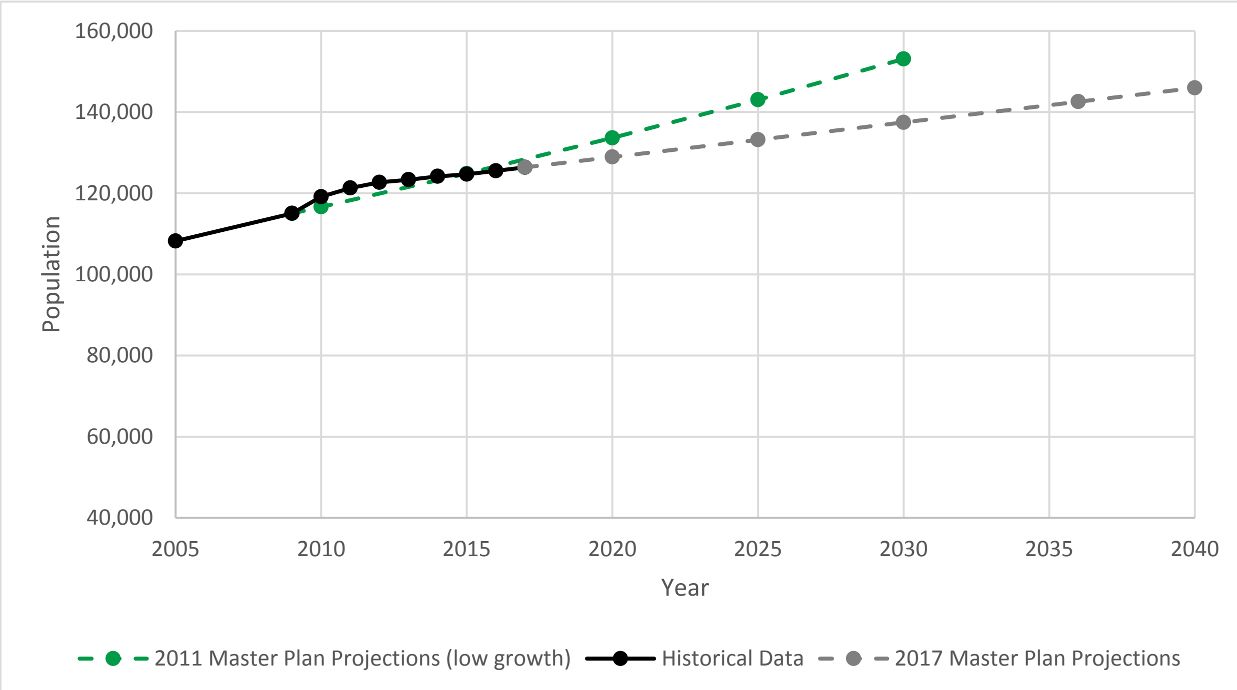


Figure 3-6. Population Projections for Gresham WWTP Service Area

3.3.1.3 Population Growth Summary

As seen in Figure 3-6, the population projections from the 2011 MP Update are higher than the projections developed in this update. Population projection differences between the 2011 Master Plan and this report are due to updated population projections. Table 3-3 presents a summary of population growth statistics over the study period, using 2015 as the base year and base case growth.

Table 3-3. Population Growth Data

Year	Percent Increase (%)	Annualized Average (%)	Total Increase
2025	6.4	0.64	8,519
2040	17.1	0.68	21,297

Note: The statistics in this table were calculated using 2015 as the base year.

3.3.2 Wastewater Flow and Load Projections

Wastewater flows and loadings were projected for the years 2016 and 2017, and at 5-year intervals from 2020 to the year 2036 for domestic and industrial sources. Years represent the wet season into the following year; for example, the 2020 projection represents the 2020/2021 wet season. Average, maximum month, maximum week, and maximum day flows and loads are determined for both dry and wet seasons. Peak-hour flows have been determined for wet season months, and the projections have been made for the growth conditions assuming that industrial contributions will remain similar to existing and that domestic (residential, commercial/light industrial) contributions will continue to increase within the existing served areas proportional to the population projections. It was assumed that industrial contributions will remain the same because historical data have not shown significant growth in the industrial contributions.

3.3.2.1 Domestic Wastewater Flow and Loading Projections

The domestic wastewater projections are estimated based on population projections and the selected per capita and peaking factors identified Chapter 2. Methodology for determining average, maximum month, maximum week, maximum day, and peak hour values are listed below and refer to both flows and loadings:

- **Dry season average**—Determined by multiplying the selected dry per capita value by the projected population for 2017, 2020, 2025, 2030, and 2036.
- **Wet season average**—Determined by multiplying the selected wet per capita value by the projected population for 2017, 2020, 2025, 2030, and 2036.
- **Maximum month**—Determined by multiplying the future dry or wet season averages for a given year by the selected maximum month peaking factor.
- **Maximum week**—Determined by multiplying the future dry or wet season averages for a given year by the selected maximum week peaking factor.
- **Maximum day**—Determined by multiplying the future dry or wet season averages for a given year by the selected maximum day peaking factor.
- **Peak hour flow**—Determined by multiplying the wet season average for a given year by the selected peak hour peaking factor.

3.3.2.2 Industrial Wastewater Flow and Loading Projections

Industrial flow and loading projections are based on two major contributing industrial sources: ON Semiconductor and Microchip Technology Inc. Data from these two sources were analyzed for the period from 2011 through 2016 to determine average values for dry and wet season average and maximum month conditions. Daily average conditions are considered representative of maximum month values, and daily maximum conditions are considered representative of maximum week values due to the generally steady operations within industrial facilities.

For the industrial projections, the average values determined for the dry and wet season average and maximum month flows and loads were kept the same through the study period. This is based on the current assumption that operations at the two main industrial contributors will remain at similar levels in the future.

Table 3-B-2 (provided in Attachment 3-B) summarizes the flows and loadings for 2017, 2020, 2025, 2030, and 2036. The flows and loadings projections have been determined by multiplying the per capita values for each parameter (i.e., flow, BOD, TSS, or ammonia) by the population projection for the respective year and then applying the appropriate peaking factor (e.g., WSMM, WSMD, DSMM, etc.). An example calculation is included in Table 3-B-2.

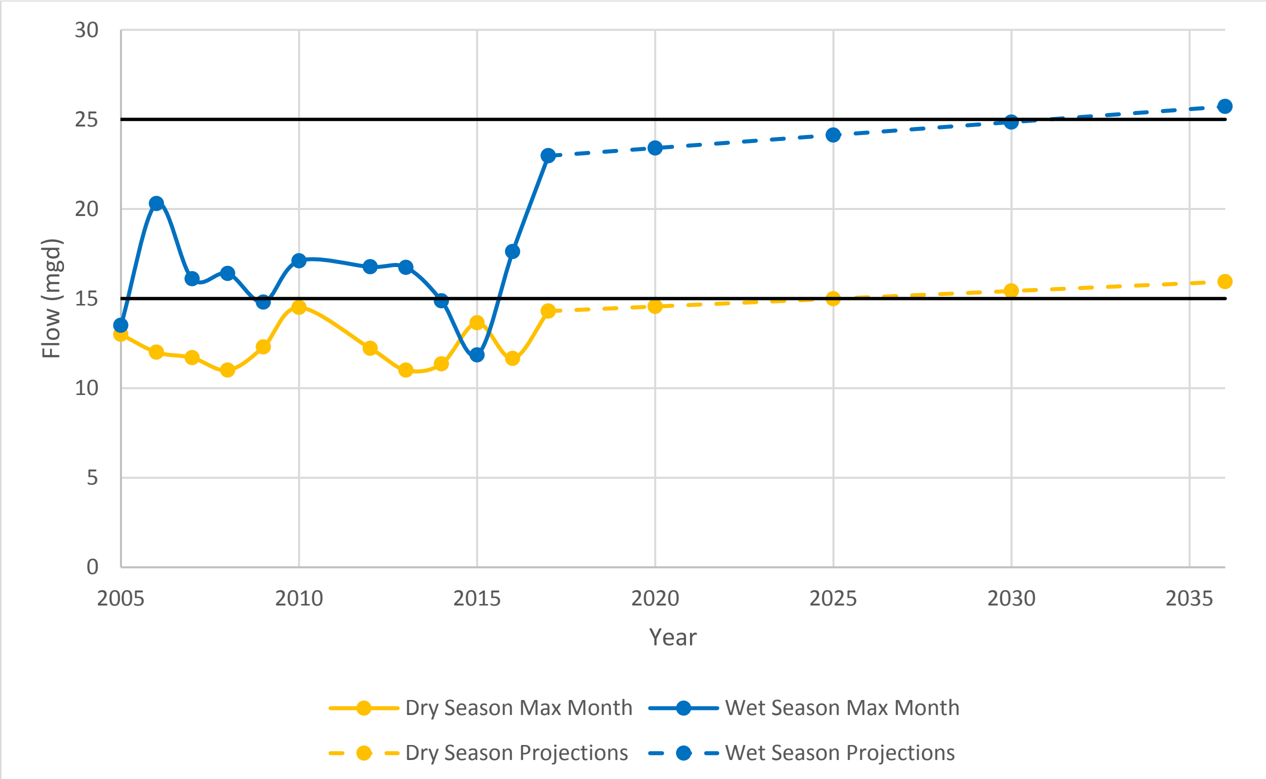
3.3.2.3 Wastewater Flow and Loading Projections Results

Table 3-4 presents projected base case flows and loadings for both dry and wet seasons. The flow and load projections are comprised of domestic (residential and commercial) and existing industrial sources. These flow and load projections do not include FOG. Table 3-B-1 details the individual flows and loadings for domestic and industrial sources.

Table 3-4. Summary of Flow and Load Projections

Item	Peaking Factor	Year 2017	2020	2025	2030	2036
Estimated population		126,366	128,921	133,181	137,440	142,551
Wastewater flow projections (mgd)						
Dry season average	1.0	11.5	11.7	12.0	12.4	12.8
Dry season maximum month	1.3	14.3	14.6	15.0	15.4	15.9
Dry season maximum day	1.7	19.1	19.5	20.0	20.6	21.3
Wet season average	1.4	18.7	19.0	19.6	20.2	20.9
Wet season maximum month	1.7	23.0	23.4	24.1	24.8	25.7
Wet season maximum day	2.8	37.4	38.2	39.4	40.6	42.0
Peak hour	4.1	42.5	43.3	44.7	46.1	47.8
BOD loading projections (ppd)						
Dry season average	1.0	22,954	23,407	24,163	24,918	25,825
Dry season maximum month	1.1	24,971	25,465	26,289	27,112	28,101
Wet season average	1.0	21,116	21,532	22,225	22,919	23,751
Wet season maximum month	1.1	23,474	23,937	24,710	25,484	26,411
TSS loading projections (ppd)						
Dry season average	1.0	21,998	22,437	23,170	23,903	24,782
Dry season maximum month	1.1	24,172	24,655	25,462	26,268	27,235
Wet season average	1.0	20,312	20,717	21,393	22,069	22,881
Wet season maximum month	1.1	22,401	22,849	23,595	24,342	25,237
Ammonia loading projections (ppd)						
Dry season average	1.0	2,660	2,710	2,793	2,876	2,976
Dry season maximum month	1.2	3,153	3,213	3,312	3,412	3,532
Wet season average	1.0	2,723	2,774	2,859	2,944	3,046
Wet season maximum month	1.3	3,502	3,569	3,681	3,792	3,926

The projections are shown graphically in Figures 3-7 through 3-10. Figure 3-7 illustrates the dry and wet season maximum month projections for 2017 through 2036. Also shown in Figure 3-7 are the treatment plant design flows for the dry (15-mgd) and wet (25-mgd) season. Peak hour flow projections are shown in Figure 3-8. Dry and wet season maximum month BOD and TSS loading projections are illustrated in Figure 3-9 and Figure 3-10, respectively.



*2005-2010 data from Table ES.3 and Table 3 in the 2011 Master Plan

Figure 3-7. Dry and Wet Season Maximum Month Flow Projections

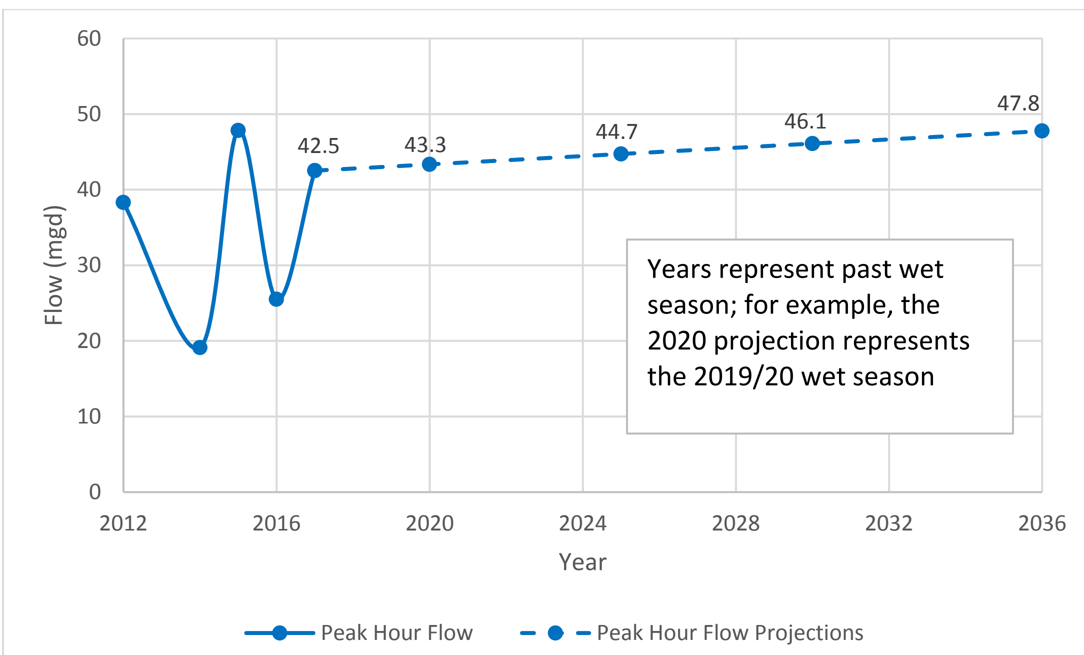


Figure 3-8. Peak Hour Flow Projections

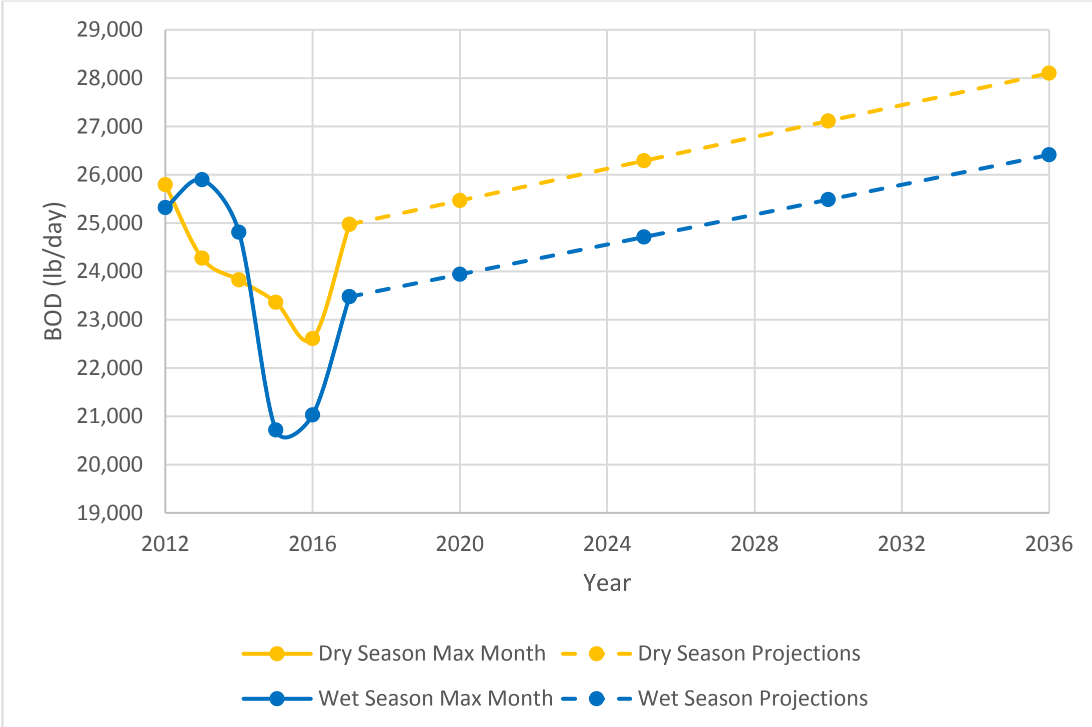


Figure 3-9. Dry and Wet Season Maximum Month BOD Loading Projections

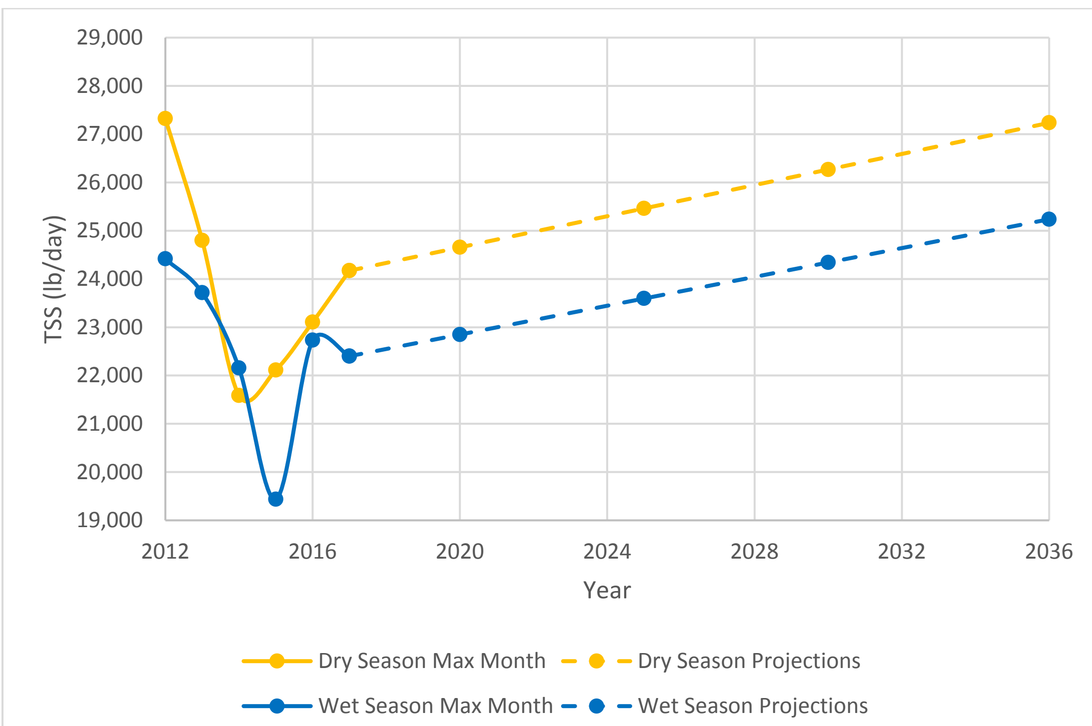


Figure 3-10. Dry and Wet Season Maximum Month TSS Loading Projections

Peak hour flow projections developed in this MP Update are significantly lower than those developed previously. As shown in Table 3-4, the peak hour flows in 2030 and 2036 are estimated to be 46.1 and 47.8 mgd, respectively. The 1997 Wastewater Facilities Plan estimated peak hour flows for 2030 and 2040 (not developed for 2036) were 85.4 and 99.6 mgd, respectively. These reductions are reflective of significantly reduced base flows that have resulted from water conservation and more concentrated influent wastewater characteristics as well as significantly reduced infiltration and inflow (I/I) due to the City's I/I abatement efforts.

Maximum month wastewater influent concentrations associated with the projections are as follows:

- BOD:
  - Dry Season: 228.5 mg/L
  - Wet Season: 127.9 mg/L
- TSS:
  - Dry Season: 223.7 mg/L
  - Wet Season: 123.5 mg/L

It is assumed that these concentration levels remain constant through the study period. These values are calculated by dividing the maximum month loads by the maximum month flows for the domestic and commercial contributions (not including the industrial contribution).

3.4 Water Quality/Liquids Treatment

The federal Clean Water Act requires discharges of wastewaters to State waters to operate under the conditions of an NPDES permit. DEQ issued a renewed NPDES permit for the City of Gresham's WWTP on August 1, 2014. The current NPDES Permit (No. 102523) expires July 31, 2019.

3.4.1 Existing Discharge Permit Requirements

The discharge limits and requirements for Gresham's current NPDES permit are summarized in Table 3-5.

Table 3-5. Existing Discharge Requirements and Limitations for the Gresham WWTP (Treated Effluent Outfall 001)

Dry Season - May 1 – October 31					
	Average Effluent Concentrations (mg/L)				
Parameter	**Monthly**	**Weekly**	**Monthly[a] Average (ppd)**	**Weekly[a] Average (ppd)**	**Daily[a] Maximum (lb)**
BOD_5	20	30	2,502	3,753	5,004
TSS	20	30	2,502	3,753	5,004
Other Parameters			Limitation		
Excess Thermal Load			7-day moving average of daily maximum excess thermal load shall not exceed 436 x 10^6 Kilocalories per day The monthly average shall not exceed 231 x 10^6 Kilocalories per day		

Note regarding excess thermal load limit: The thermal load limit was calculated using the maximum week and maximum month dry weather design flows, the maximum 7-day moving average effluent temperature, and the monthly average of the daily 7-day moving average temperatures. Upon approval of a TMDL for temperature for this sub-basin, the permit may be re-opened and new limits set.

Table 3-5. Existing Discharge Requirements and Limitations for the Gresham WWTP (Treated Effluent Outfall 001)

Wet Season - November 1 – April 30

Parameter	Average Effluent Concentrations (mg/L)		Monthly[a] Average (ppd)	Weekly[a] Average (ppd)	Daily[a] Maximum (lb)
	Monthly	Weekly			
BOD_5	30	45	6,255	9,380	12,510
TSS	30	45	6,255	9,380	12,510

Additional information applicable to both dry and wet season limits: Average dry weather design flow to the facility equals 15 mgd. Dry season mass load limits based upon average dry weather design flow to the facility equal 15 mgd. Wet season mass load limits based upon average wet season design flow to the facility equal 25 mgd. The daily mass load limit is suspended on any day in which the flow to the treatment facility exceeds 30 mgd (twice the design average dry season flow).

Year-round

Parameter	Limits
BOD_5 and TSS Removal Efficiency (see Note 1.)	Shall not be less than 85% monthly average for BOD_5 and TSS. (When monthly average flows exceed 25 mgd, percent removal rate will be no less than 75 percent.)
E. coli Bacteria (see Note 2.)	Not exceed 126 organisms per 100-mL monthly log (geometric) mean. No single sample exceed 406 organisms per 100 mL.
pH	Range of 6.0 – 8.5.
Total Residual Chlorine	Shall not exceed a monthly average of 0.14 mg/L and maximum daily limit of 0.36 mg/L.

Notes regarding year-round limits

1. Specific conditions for Outfall 002 through 011 have been removed from Schedule A of the NPDES permit. Schedule F, Section B6 of the permit addresses overflows from wastewater conveyance systems and associated pump stations.
2. Total coliform shall not exceed a 7-day median of 23 organisms per 100 mL with no two consecutive samples to exceed 240 organisms per 100 mL.

[a] Summer mass load limits based upon 15 mgd. Winter mass load limits based upon average wet season design flow to the facility equaling 25 mgd. The daily mass load limit is suspended on any day in which the flow to the treatment facility exceeds 30 mgd (twice the design average dry season flow).

kcal/day = kilocalories per day; mL = milliliters; OAR = Oregon Administrative Rules; TMDL = total maximum daily load

The treated effluent discharge has mass load and concentration limits for BOD_5 and TSS established for the dry season (May 1 - October 31) and the wet season (November 1 - April 30). These current mass load limits are the same as previous NPDES permits and are based on the basin standards for the Willamette Basin. The permit allows the daily mass load limits to be suspended on any day that the influent flow exceeds 30 mgd (or twice the design average dry season flow). The permit requires 85 percent removal of BOD_5 and TSS; this requirement is reduced to 75 percent when monthly average flows exceed 25 mgd. This suspension of the 85 percent removal requirement is necessary because of the less concentrated influent wastewater when plant inflows exceed 25 mgd.

The current permit no longer addresses effluent blending or selective treatment operation methods that are used by the Gresham WWTP when plant flows exceed the secondary treatment maximum day hydraulic capacity of 54 mgd. Under these conditions, a portion of the primary effluent flow is directed to the chlorine contact basins to mix with secondary effluent for disinfection. Based on the 2036 wet season peak hour projection of 47.8 mgd, it is not anticipated that Gresham will need to utilize this blending mode of operation.

Treated effluent also includes limits for bacteria (*E. coli*), pH, total residual chlorine, and excess thermal loads (during May 1 - Oct. 31). Gresham's WWTP dechlorinates the final effluent to control residual chlorine concentrations in the discharge. Excess thermal load limits are discussed in detail later in this section.

The untreated emergency sanitary sewer overflows from Outfalls 002 through 011 have been removed from Schedule A of the NPDES permit. Section B6 in Schedule F of the permit addresses overflows from wastewater conveyance systems and associated pump stations.

The third category of discharge addressed in the NPDES permit is recycled water. Currently, Gresham does not have a plan for the use of recycled water and no recycled water use is permitted, except on the treatment plant site, without meeting specific permit conditions and providing a specific plan for its use. The permit specifies that prior to any use of recycled water it must receive at least Level II treatment to achieve Class C as defined in OAR 340-55 and meet specific bacteria limits. Current effluent total coliform levels are greater than 1,000 organisms per 100 mL, which exceeds the Class C criterion of 23 organisms per 100 mL (median 7-day) and 240 organisms per 100 mL in any two consecutive samples. An increased applied sodium hypochlorite dose and/or additional contact time would be necessary to meet this standard.

3.4.2 Review of Water Quality Regulations and Discharge Permit Requirements

A detailed review and evaluation of current and potential future water quality regulations and potential treatment, discharge, and permit impacts that could result from changing regulations and changing effluent discharge flows and concentrations is presented in Table 3-6. This table also includes operation and management suggestions that may help alleviate or mitigate potential treatment, discharge, and permit impacts. Current and potential water quality, treatment, discharge, and permit issues presented in Table 3-6 are discussed below.

3.4.2.1 Statewide Standards and Criteria

OAR 340-041 specify the water quality standards for the state waters including policies, state-wide narrative and numeric water quality criteria, and basin-specific designated beneficial uses and water quality standards and policies. The Oregon Water Quality Standards (OAR Chapter 340, Division 41) include narrative and numerical receiving water quality standards. These standards address many water quality parameters, including DO, temperature, toxicity, turbidity, pH, coliform bacteria and other bacterial sources, dissolved gases, deleterious plant growths, deleterious effects on fish and shellfish, taste and odor, settleable solids deposition, discolorations or floating material, aesthetic water conditions, radioisotope concentrations, TDS, and toxic substances.

The City of Gresham WWTP discharges wastewater to the Columbia River at RM 114.9, according to the NPDES permit. The following sections discuss the Gresham WWTP's potential discharge effects on Columbia River water quality, which were evaluated using wastewater data and available ambient receiving water data for the Columbia River.

3.4.2.2 Temperature

Oregon's current temperature standard was adopted by the Oregon Environmental Quality Commission in December 2003. The EPA approved much of the standard in March 2004, and approved additional provisions in March 2010. DEQ revised the standard in February 2007 in response to EPA's disapproval of the 2003 narrative criteria for cool water species, natural lakes, and oceans and bays. EPA approved the revised narratives in February 2011. As a result of a lawsuit in federal District Court brought by Northwest Environmental Advocates, the Oregon temperature standards were remanded to EPA for revision. On August 8, 2013, EPA disapproved the natural conditions criterion contained in Oregon's water quality standard for temperature. EPA also disapproved the general natural conditions criterion contained in Oregon's statewide narrative criteria, which applied to other naturally occurring substances and conditions of water.

Table 3-6. Review and Evaluation of Current and Future Water Quality Regulations and Potential Future Permit Issues

Water Quality Standards and Treatment Plant Rules	Treatment & Discharge Impacts	Permit Impact	Source Control	Alternative Disposal/Reuse
Design Flows				
As plant influent flows increase and treatment plant improvements expand capacity of the facility's design flows, then the updated plant design flows may result in a change to mass limits and dilution ratios. The average dry season design flow is 15 mgd, and the average wet season design flow is 25 mgd.	N/A	Potential for change in permit effluent limitation. Changes to the design flows will need to be approved by DEQ. A change to the average dry season design flow could result in changes to permit dilution factors and possible water-quality-based effluent limits. Changes to average dry season and/or average wet season design flows will result in a review of how to approach mass limits.	N/A	N/A
BOD_5 and TSS Mass Limits				
Mass limits in current permit are specified for dry season (May 1 - October 31) and wet season (November 1 - April 30) seasonal flows. The dry season mass limits are based on the average dry season design flow (15 mgd), and the wet season mass limits are based on average wet season design flow (25 mgd). Daily mass limits are suspended when daily flow to the treatment plant exceeds twice the average dry season design flow (i.e., 30 mgd).	Increases in plant flows above the design flows would result in the necessity to discharge BOD_5 and TSS at concentrations below the concentrations listed in the permit.	Requesting a mass load increase is not anticipated. However, plant improvements that result in an increase in the design average dry or wet season flows could provide justification for requesting an increase in permitted mass limits of BOD_5 and TSS. Requests for an increase in mass limits typically require Environmental Quality Commission approval according to OAR 340-41-0120. The most recent permit did not include increases in the mass load limits. DEQ continues to consider revisiting the waiver of daily mass load limits, which is an issue that the City should continue to track.	N/A	N/A
85% Removal				
The current permit contains language in Schedule A indicating that a minimum of 75% removal is the requirement when monthly average flows exceed 25 mgd.	The plant uses selective treatment (or split flow) when flows exceed the maximum day hydraulic capacity (54 mgd). Reduced wet season peak hour projections indicate a decreased frequency when 54 mgd will be exceeded moving forward.	Current permit specifies seasonal effluent concentration and mass limits, as well as an allowance for less than 85% removal when the monthly average flows exceed 25 mgd. This approach needs to be maintained in future permits.	N/A	N/A

Table 3-6. Review and Evaluation of Current and Future Water Quality Regulations and Potential Future Permit Issues

Water Quality Standards and Treatment Plant Rules	Treatment & Discharge Impacts	Permit Impact	Source Control	Alternative Disposal/Reuse
Blending				
Also known as split flow or selective treatment, this refers to the practice of diverting flow around a treatment component (usually secondary treatment) during high flows. The Gresham treatment facility was designed to operate utilizing blending when flow exceeds the peak day capacity of secondary treatment system (54 mgd). The practice is not acknowledged in the NPDES permit or the fact sheet (DEQ, 2014a). Blending is not expressly prohibited in the Clean Water Act, but EPA's practice on blending has often been to prohibit it in separate sewer systems.[a]	The lack of clear regulatory direction on blending makes the legality of the future use of blending at the treatment facility unclear. The treatment facility's existing secondary treatment capacity, however, is currently sufficient to treat observed peak wet season flows, so blending is rarely needed. Flow projections indicate that wet season peak day flows will not exceed the secondary treatment capacity during the study period. However, ability to utilize this peak flow management approach should be retained.	There is no need for changing the permit language at this time as the regulatory framework remains uncertain. The City should follow legal developments with the Eighth Circuit Court panel's decision as the blending prohibition remains an active legal battleground. If the legality of blending becomes clearly established, corresponding language should be included in the NPDES permit, even though the use of blending is anticipated to be very rare, either at the next scheduled renewal or if the permit is opened for another reason.	N/A	N/A
Sanitary Sewer Overflow/Capacity, Management, Operation, and Maintenance Oregon's current SSO rules are embedded in the bacteria water quality standard, which prohibits overflows from less than a 1-in-5-year 24-hour winter (November 1 - May 21) storm, and from a less than 1-in-10-year 24-hour summer (May 22 - October 31) storm. EPA considers SSOs as point source discharges and prohibits them like other points source discharges from separate sewer systems unless authorized by an NPDES permit. Generally, EPA has not allowed SSOs to be permitted. Conflicts between state SSO rules and federal SSO rules are not unusual. EPA was ready to publish a draft national SSO policy in early 2001, but it was withdrawn for further review and has remained withdrawn since that time. There is no estimated timetable for when it might be published.	Collection system management practices and I/I reduction efforts have reduced the potential for SSOs. Federal standard of no allowable overflows independent of the storm size versus Oregon's approach is resolved for the time being utilizing enforcement discretion approach.	Specific allowance of and reference to pump station overflow discharges were removed in the 2014 NPDES permit. The Gresham permit addresses emergency overflows in Schedule F, Section B.3. Bypass of treatment is prohibited under all circumstances except extreme events. Changes to federal regulations for SSOs or CMOM requirements will be permit issues.	N/A	N/A

Table 3-6. Review and Evaluation of Current and Future Water Quality Regulations and Potential Future Permit Issues

Water Quality Standards and Treatment Plant Rules	Treatment & Discharge Impacts	Permit Impact	Source Control	Alternative Disposal/Reuse
Bacteria and Total Residual Chlorine				
The indicator organism was changed in prior permit renewal to *E. coli* bacteria. WWTP has been in compliance with new limitation using chlorination and dechlorination. EPA is developing Clean Water Act §304(a) Recreational Water Quality Criteria for coliphage, a viral indicator, to ensure public health protection when recreating in water bodies that may be affected by human fecal contamination. EPA is expected to publish draft water quality criteria for coliphage in coming years.	Alternative disinfection may be investigated as part of future treatment plant improvements, as necessary. When EPA promulgates final water quality criteria for coliphage, these would translate to effluent limits and treatment requirements.	Current permit allows for daily maximum total residual chlorine of 0.36 mg/L and monthly average of 0.14 mg/L. These effluent limits allow for minimal residual chlorine in the effluent, which will help avoid regrowth in the outfall. Water quality criteria for coliphage could lead to new effluent limits and treatment requirements for coliphage.	N/A	N/A
Temperature				
The regulatory environment for temperature discharges is continually evolving in Oregon. In accordance with DEQ requirements, a Temperature Management Plan for the facility was submitted to DEQ and approved in 2001. In 2003, EPA Region 10 released temperature guidance for Pacific Northwest states and EPA published a Preliminary Draft Temperature TMDL for Columbia and Snake Rivers (EPA, 2003). The draft TMDL has not advanced, and in 2016 two groups filed notice of intent to sue EPA for this inaction. In 2003, DEQ published revised temperature standards and in 2006 published a Temperature TMDL for the Willamette River basin. In 2013—in response to a legal challenge—EPA disapproved a portion of Oregon's temperature standards. DEQ proposed revised temperature standards and in 2015 NOAA-NMFS issued a Biological Opinion concluding the revised temperature standards would result in damage to Endangered Species Act species. Future revisions to Oregon's temperature standards will be forthcoming and these may lower the biologically based temperature standards in the Columbia River.	Temperature limitations and control measures should be considered in any treatment plant expansion design alternatives analysis. This is in keeping with the current Temperature Management Plan for the facility, and will serve to abate impacts of future temperature standards and TMDLs. The current permit requires continuous temperature monitoring to provide data that may be used to revise the excess thermal load limits in the NPDES permit. EPA's Temperature Guidance and DEQ revisions to the state temperature standards may lead to revised thermal load limits or new discharge temperature limits during seasonal periods when threatened or endangered fish species are present near the discharge.	Potential for change in permit effluent limitation. Excess thermal load limits in the current NPDES permit are based on dry season design flows for the permit life and effluent temperature from monitoring data collected during the previous permit. The excess thermal load limits in the current NPDES permit were assigned as an antidegradation placeholder. Excess thermal load limits after a temperature TMDL is established may result in thermal load allocation changes, and DEQ could continue the more restrictive pre-TMDL thermal limits into subsequent permits because of anti-backsliding requirements. This is under review at DEQ. If necessary, this should be reviewed by legal counsel, and may result in permit negotiation.	Sewer system regulations need to contain restrictions on temperature for industrial and commercial dischargers based on potential to impact treatment efficiency. The Temperature Management Plan for the facility includes continued evaluation of potential heat source reductions both in the influent and treatment processes.	Any reuse or alternative disposal of treated wastewater will reduce the thermal load of discharges to the river.

Table 3-6. Review and Evaluation of Current and Future Water Quality Regulations and Potential Future Permit Issues

Water Quality Standards and Treatment Plant Rules	Treatment & Discharge Impacts	Permit Impact	Source Control	Alternative Disposal/Reuse
Oregon water quality standards include biologically based temperature standards and thermal plume limitations under the mixing zone section. The current NPDES permit was issued with dry season (May-October) thermal load limitations that are based on the dry season design maximum week and maximum month flows and the maximum 7-day moving average effluent temperature and monthly average of 7-day moving average temperatures. Alternate flows have been used by DEQ in developing other permits. The calculation method for the thermal load limit is under review by DEQ, and may be changed in the future once legal challenges are settled. Upon approval of a temperature TMDL for the Columbia River basin, new thermal load limits will likely be assigned; however, the timing for this action is uncertain.				
Toxicity				
NPDES permit contains whole effluent toxicity (WET) testing requirements. No current problems with compliance with toxicity requirements in the permit.	WET testing has not shown any compliance problems with the toxicity requirements in the permit based on current dilution factors used in WET testing.	Any future reductions in approved mixing zone dilution factors, if applicable, could affect toxicity compliance.	Could be source control issue if a future effluent toxicity situation requires identification and removal of a toxicity source.	N/A
Ammonia				
In 2015, Oregon replaced ammonia water quality criteria (based on EPA, 1986) with new ammonia criteria (based on EPA, 2013). These 2015 ammonia criteria calculate a 1-hour maximum (acute criterion), 30-day average (chronic criterion), and a 4-day maximum (chronic criterion) based on river pH and temperature and assume that freshwater mussels and salmonids are present at the discharge site.	Existing effluent ammonia levels and new Oregon ammonia criteria will require ammonia reduction treatment technologies and/or outfall diffuser improvements to increase dilutions under critical conditions—assuming river pH values used to calculate the ammonia criteria are 8.2 or higher	No changes to existing NPDES permit; however, effluent limits in next permit (2019) are probable even if effluent ammonia levels are reduced and/or outfall diffuser is modified to increase dilution. (Refer to Mixing Zones and Dilution Factor topics below.)	Pretreatment program staff may evaluate whether a local limit for ammonia would be beneficial to limit the industrial ammonia loads.	Use of the reclaimed water (Outfall 099) for seasonal irrigation or other uses would reduce ammonia loads for 001 discharge, but

Table 3-6. Review and Evaluation of Current and Future Water Quality Regulations and Potential Future Permit Issues

Water Quality Standards and Treatment Plant Rules	Treatment & Discharge Impacts	Permit Impact	Source Control	Alternative Disposal/Reuse
	in the dry and wet seasons. Updated outfall dilution factors will be needed for the next NPDES permit renewal in 2019.			not concentrations.
Mercury				
The Columbia River reach where the Gresham WWTP discharges is not listed on Oregon's 2012 303(d) impaired waters list for mercury in water, sediment, or fish tissue. However, downstream river reaches are listed, as is the lower Willamette River. A TMDL for mercury in the Willamette River was completed in 2006 and DEQ has implemented mercury source tracking and controls in NPDES permits, including the Gresham permit.	The TMDL for the lower Willamette River has resulted in DEQ implementing mercury source tracking and controls in NPDES permits. The current NPDES permit includes requirements for Gresham to develop, obtain DEQ approval, and implement a Mercury Minimization Plan (MMP). Gresham is implementing an approved MMP.	Potential for new permit effluent limitation if the MMP is not effective at reducing or controlling mercury sources. The MMP will likely need to be updated as part of the permit renewal process to comply with current DEQ guidance, which was not available when the current plan was written.	The City of Gresham has a well-designed and implemented pretreatment program. Effluent sampling using ultra-clean methods for mercury have shown Hg levels well below acute or chronic criteria.	N/A
Metals				
Current effluent and biosolids metals concentrations are well below any regulatory thresholds. Some recent changes have been promulgated to Oregon water quality criteria for metals, specifically, cadmium, copper, and selenium. In 2016, Oregon revised the copper criteria from hardness-based to criteria based on EPA's Biotic Ligand Model (BLM). In addition, DEQ has revised metals criteria such that some are total recoverable (As, Cr, Hg, Se) and some are now dissolved (Cd, Cu, Pb, Ni, Ag, and Zn).	Continuation of low influent and effluent metals, as well as maintaining the outfall diffuser operation for optimal dilution factors, will avoid the need for effluent metals limits.	Implementation of the BLM for calculating copper criteria will require as much as 2 years of monthly effluent and river sample collections for analysis of 11 parameters required for the BLM input. Effluent metals should not become an issue in the future given the outfall dilutions, but site-specific criteria could be developed if needed to forestall effluent metals limits. Background river arsenic and aluminum concentrations could become issues with human health criteria compliance. Effluent aluminum is not typically tested in WWTPs.	Metals are regulated in industrial discharges through local limits and categorical industrial limits. Most metals local limits are driven by biosolids quality goal adopted by Gresham.	N/A

Table 3-6. Review and Evaluation of Current and Future Water Quality Regulations and Potential Future Permit Issues

Water Quality Standards and Treatment Plant Rules	Treatment & Discharge Impacts	Permit Impact	Source Control	Alternative Disposal/Reuse
Arsenic				
Columbia River below RM 98 is listed in Oregon's 2012 303(d) list for exceeding the arsenic human health criterion for "water and fish ingestion." Gresham WWTP discharges into the Columbia River at RM 114.9. This listing could eventually lead to the development of a TMDL for arsenic unless a state-wide variance is implemented. The arsenic concentrations in the river are attributed to the volcanic basalt rocks in the Columbia and Snake River drainages and they are ubiquitous in the background waters. Oregon has arsenic human health criteria of 2.1 µg/L based on inorganic arsenic (based on 10^{-5} risk level) and EPA could disapprove and require 10^{-6} risk level (0.21 µg/L criteria) or implement EPA human health criteria of 0.018 µg/L total arsenic.	Effluent monitoring at lower detection limits is required to define compliance with arsenic criteria.	Potential for new permit effluent limitation. Could be future effluent limitation for arsenic based on TMDL, if discharge concentrations exceed the City's drinking water source concentrations.	Could be future source control issue. Topic for engagement with Oregon Association of Clean Water Agencies.	N/A
Dissolved Oxygen				
The Columbia River reach where Gresham discharges is not included in the 2012 303(d) list for DO; however, the reach downstream of the Willamette River confluence (RM 98) is listed. DEQ's antidegradation review in the 2014 permit renewal did not show any potential DO impacts of Gresham's discharge under critical conditions.	Could be a future treatment issue if DO criteria are exceeded in the river reach where Gresham discharges if the river is listed (Category 5) in the future. This could be addressed with ammonia treatment or could require advanced treatment for removals of CBOD, phosphorus, and ammonia.	Potential future summer season permit limits for CBOD, phosphorus, and ammonia if DO criteria are exceeded in the river reach where Gresham discharges (303d listing).	N/A	N/A
River pH				
The Columbia River reach where Gresham discharges is listed in 2012 303(d) list as Category 5 for exceeding pH in the fall, winter, and spring. In the 2014 permit renewal, DEQ evaluated potential pH impacts of Gresham's discharge under critical conditions and changed the effluent pH range to 6.0 to 8.5 since the river pH	Could become a treatment issue if pH excursions continue in the river and if DO criteria are exceeded in the river reach where Gresham discharges. Once DEQ develops a TMDL for pH in the Columbia River, this could affect treatment for	Potential future permit limits for ammonia (possibly phosphorus and CBOD as well) if pH criteria excursions continue in the river reach where Gresham discharges.	N/A	N/A

Table 3-6. Review and Evaluation of Current and Future Water Quality Regulations and Potential Future Permit Issues

Water Quality Standards and Treatment Plant Rules	Treatment & Discharge Impacts	Permit Impact	Source Control	Alternative Disposal/Reuse
criterion is 7.0 to 8.5. As a Category 5 listing, DEQ will need to develop a pH TMDL for the Columbia River RM 98 to 142.	removal of ammonia since river pH determines ammonia criteria and effluent ammonia limits.			
Phosphorus				
Refer to Dissolved Oxygen and River pH sections in this table. Future or continued 303(d) listings of the river reach and downstream of the Gresham discharge for DO and pH may result in nutrient controls on point sources.	DEQ included phosphorus monitoring of the effluent in the 2002 permit and removed this requirement from the 2014 permit.	In the 2002 permit Fact Sheet, DEQ evaluated potential phosphorus impacts of Gresham's discharge on river pH under critical spring conditions, which showed no measurable effect.	N/A	N/A
Turbidity				
Oregon's water quality standard for turbidity has been under periodic review by DEQ for over 10 years, and a new standard may be proposed in the next 5 years. Gresham's effluent discharge complies with the current standard, which is based on a 10 percent allowable increase in turbidity above background values.	Not a potential future treatment issue.	Not a potential future permit issue.	N/A	N/A
Total Dissolved Solids				
The TDS standard in the Columbia River at RM 114.9 (where the WWTP outfall discharges) is 500 mg/L. No current compliance issues.	Not a potential future treatment issue.	Not a potential future permit issue.	TDS can be an issue in discharge permit development for high-flow high-tech industries.	N/A
Dioxins and Furans				
The lower Columbia River was listed in 1980s for 2,3,7,8-TCDD (dioxin) and EPA approved a TMDL in 1991. Gresham's WWTP is not a load contributor.	Not a potential future treatment issue.	Potential future permit issue.	Could be future source control issue.	N/A
Emerging Issues				
Increasing attention is being paid to the presence of pharmaceuticals, hormones, and other organic contaminants such as caffeine, insect repellant, and fire retardant in treated wastewater discharges. The effects of these compounds in	N/A	N/A	N/A	N/A

Table 3-6. Review and Evaluation of Current and Future Water Quality Regulations and Potential Future Permit Issues

Water Quality Standards and Treatment Plant Rules	Treatment & Discharge Impacts	Permit Impact	Source Control	Alternative Disposal/Reuse
receiving waters is not well known; however, fisheries effects from hormones has been documented in research. Another emerging issue is the increasing resistance of pathogens to antibiotics. A corresponding resistance of water-borne pathogens to chlorine, perhaps because of over-usage of chlorine disinfectants, has not been investigated.				
Dilution Factors for Outfall Discharges				
In 2012, DEQ published a *Regulatory Mixing Zone Internal Management Directive* (RMZ-IMD) to provide specific guidance to permit writers and dischargers on procedures and requirements to analyze and document dilution factors used in NPDES permits. DEQ is requiring every discharger to update outfall mixing studies in accordance with the RMZ-IMD to allow NPDES permit renewals. The RMZ-IMD specifies the use of flux-average dilution factor for chronic conditions at the regulatory mixing zone (RMZ) and centerline dilution for acute conditions at the zone of initial dilution (ZID). The application of centerline dilutions at the ZID is a change from past practices and results in lower dilutions. Four key factors contribute to calculation of the treatment facility's allowable dilutions that are used in the NPDES permit development: the Columbia River low river flows, the outfall diffuser port configuration and depth, Gresham WWTP effluent flows and temperatures, and dilution modeling analyses. A change to any of these factors can result in a change to the allowable dilutions, with corresponding changes to future water-quality-based effluent limitations.	Any changes to the dilution factors in the NPDES permit can result in changes to the need for water-quality-based effluent limits (e.g., ammonia) that result in the need for treatment additions (e.g., nitrification).	Potential for change in permit effluent limitation. Changes to the dilution ratios in the NPDES permit will occur as a result of effluent flow increases. Dilution ratio changes may lead to water-quality-based effluent limits (e.g., ammonia). Gresham needs to manage and plan the future outfall diffuser operation and improvements to optimize the dilution performance and minimize need for treatment changes.	N/A	N/A

Table 3-6. Review and Evaluation of Current and Future Water Quality Regulations and Potential Future Permit Issues

Water Quality Standards and Treatment Plant Rules	Treatment & Discharge Impacts	Permit Impact	Source Control	Alternative Disposal/Reuse
Columbia River Low Flow				
Recent years with less than normal precipitation may result in a change to the river 7Q10 flow statistic (lowest 7-day average flow based on 10-year return interval). This flow is one of the key factors that determine the allowable dilution factors at the edge of the mixing zones.	N/A	Potential for change in permit effluent limitation. Any changes to the Columbia River 7Q10 and the volume of river flow and water depths in the McGuire Island channel (where the Gresham discharge is located) will result in changes to the calculated allowable dilutions at the mixing zone boundaries, and, therefore, changes to water-quality-based effluent limitations.	N/A	N/A
Mixing Zone and Dilution Studies				
Following installation of the outfall extension and diffuser in 1996, the *Gresham WWTP Outfall Final Report* (Brown and Caldwell) was submitted to DEQ in April 1998. No field verification of the diffuser performance was conducted. DEQ's RMZ-IMD defines the procedures and requirements to analyze and document dilution factors used in NPDES permits. DEQ now requires every discharger to update outfall mixing studies in accordance with the RMZ-IMD to allow NPDES permit renewals.	Any changes to the dilution factors in the NPDES permit can result in changes to the need for water-quality-based effluent limits (e.g., ammonia) that result in the need for treatment additions (e.g., nitrification).	Potential for change in permit effluent limitation. An updated mixing study will be required by DEQ prior to the next NPDES permit renewal application in December 2018. This study will result in a new calibrated dilution model for critical conditions that defines the allowable acute and chronic dilution factors used for water-quality-based effluent limits. Gresham should evaluate and plan outfall diffuser operation and improvements to optimize the dilution performance.	N/A	N/A
Reasonable Potential Analysis for Water Quality Compliance				
In 2012, DEQ published a Reasonable Potential Analysis Process for Toxic Pollutants Internal Management Directive (RPA-IMD) to provide specific guidance to permit writers and dischargers on procedures and requirements to analyze effluent and background river chemistry and how to use these data in NPDES permit development (in accordance with the Clean Water Act). DEQ is requiring every discharger to provide sufficient quality and quantity of data on	Elevated effluent chemistry results (i.e., ammonia), elevated river chemistry results (including pH), and reductions in outfall dilution factors can cause the RPA to determine that water-quality-based effluent limitations are required in the NPDES permit. Changes in the requirement for water-quality-based effluent limits (e.g., ammonia) would result in the need	Potential for change in permit effluent limitation. Changes to the RPA used in the NPDES permit development could result in water-quality-based effluent limits that would result in the need for treatment additions (e.g., nitrification). Gresham needs to manage effluent chemistry and plan the future outfall diffuser operation and improvements to	N/A	N/A

Table 3-6. Review and Evaluation of Current and Future Water Quality Regulations and Potential Future Permit Issues

Water Quality Standards and Treatment Plant Rules	Treatment & Discharge Impacts	Permit Impact	Source Control	Alternative Disposal/Reuse
effluent and background river chemistry (in accordance with the RPA-IMD) to allow NPDES permit renewals. Results of the reasonable potential analysis (RPA) depend on effluent chemistry data, river chemistry data, and outfall dilution factors, and the RPA determines if water-quality-based effluent limitations are required in the NPDES permit.	for treatment additions (e.g., nitrification).	optimize the dilution performance and minimize need for treatment changes.		

[a] In March 2013, an Eighth Circuit Court panel ruled (*Iowa League of Cities v. EPA*) that the blending prohibition is beyond EPA's statutory authority. EPA decided not to appeal the ruling, meaning the ruling only applies to states within the Eighth Circuit. An industry consortium filed a lawsuit against EPA in the U.S. Court of Appeals for the District of Columbia Circuit arguing that the Eighth Circuit Court's ruling should apply to the entire country. In February 2017, the three-judge panel ruled that it lacked jurisdiction to consider the case, meaning blending will continue to only be explicitly allowed within the Eighth Circuit states.

µg/L = micrograms per liter; Ag = silver; As = arsenic; BLM = Biotic Ligand Model; CBOD = carbonaceous biochemical oxygen demand; Cd = cadmium; CMOM = Capacity, Management, Operation, and Maintenance; Cr = chromium; Cu = copper; EPA = U.S. Environmental Protection Agency; Hg = mercury; MMP = Mercury Minimization Plan; N/A = not applicable; Ni = nickel; NOAA-NMFS = National Oceanic and Atmospheric Administration National Marine Fisheries Service; Pb = lead; RM = River Mile; RMZ = regulatory mixing zone; RMZ-IMD = Regulatory Mixing Zone Internal Management Directive; RPA = reasonable potential analysis; RPA-IMD = Reasonable Potential Analysis Process for Toxic Pollutants Internal Management Directive; Se = selenium; SSO = sanitary sewer overflow; TDS = total dissolved solids; WET = whole effluent toxicity; Zn = zinc; ZID = zone of initial dilution.

At this time, the Oregon standards (as approved by EPA) continue to be in effect until revised. Given this uncertainty, it is clear that Oregon's temperature standards will change, although the final impact of these changes on the Gresham discharge site in the Columbia River is unknown. DEQ is preparing revisions to the temperature standard with oversight by EPA Region 10 and NOAA-NMFS. DEQ has not defined a schedule for new standards.

The temperature standards (OAR 340-041-0028) include narrative and numeric criteria. The numeric criteria are as follows: "Numeric temperature criteria are measured as the 7-day moving average of the daily maximum temperatures. If there is insufficient data to establish a 7-day moving average of maximum temperatures, the numeric criteria shall be applied as an instantaneous maximum. The measurements shall be made using a sampling protocol appropriate to indicate impact to the beneficial uses." The numeric criterion applicable to the Columbia River at RM 114.9 is a 7-day average maximum temperature of 68 degrees Fahrenheit (°F) (20 degrees Celsius [°C]). No effluent temperature limits are necessary for the Gresham WWTP since the discharge temperature meets the temperature standard based on DEQ's temperature analysis in Section 5.3 of the 2014 NPDES Permit Evaluation Report (DEQ 2014a), which requires the discharge to not exceed a 0.3°F temperature change at the mixing zone boundary.

The water quality standards include temperature thermal plume limitations under the mixing zone standards. The temperature thermal plume limitations associated with mixing zones are identified at paragraphs (A) through (D) of OAR-340-041-0053(2)(d). These additional temperature limits apply within the mixing zone boundaries as follows:

- **Paragraph [A]: Impairment of an active salmonid spawning area where redds are located or likely to be located**—prevented or minimized by limiting potential fish exposure to temperatures of 13.0°C or less for salmon and steelhead
- **Paragraph [B]: Acute Impairment or Instantaneous Lethality**—prevented by limiting potential fish exposure to temperatures of 32.0°C or more to less than 2 seconds
- **Paragraph [C]: Thermal Shock**—prevented or minimized by limiting potential fish exposure to temperatures of 25.0°C or more to less than 5 percent of the cross-section of 100 percent of the 7Q10 low flow of the water body
- **Paragraph [D]: Migration Blockage**—unless the ambient temperature is 21.0°C or greater, migration blockage is prevented or minimized by limiting potential fish exposure to temperatures of 21.0°C or more to less than 25 percent of the cross section of 100 percent of the 7Q10 low flow of the water body

Paragraph [A] of the thermal plume limitations does not apply because there is no active salmonid spawning or suitable conditions for spawning in the Gresham WWTP mixing zone that would be affected by the discharge. The Gresham wastewater will not contribute any excess thermal load to the river because the wastewater discharge temperature (23.0°C maximum) is less than the temperatures allowed in the river by paragraphs [B] and [C] of the thermal plume limitations, and the diffuser occupies only 15 percent of the McGuire Island channel at low river stage—so less than the 25 percent cited in paragraph [D].

The 2001 permit renewal fact sheet (DEQ, 2001a) stated that the Columbia River is listed on the DEQ's 2012 303(d) List for temperature from the Willamette River (RM 98) to the Bonneville Dam (RM 142) during the summer season. Gresham's WWTP discharges to this reach of the river and DEQ established excess thermal load limits in the NPDES permit. The excess thermal load limits in the current NPDES permit are based on the dry season design average flow (15 mgd) for the average monthly limit and the maximum week dry season design flow (25 mgd), as well as the calculated maximum 7-day average (24.6°C) and monthly average (23°C) effluent temperatures. The excess thermal load limits in the current NPDES permit for May 1 through October 31 are a 7-day moving average of daily maximum excess thermal load not to exceed 436 million kcal per day, and a monthly average not to exceed 231 million kcal per day.

In addition, EPA issued a preliminary draft temperature TMDL for the Columbia River in 2003 that included a draft total heat load allocation (THLA) of 106.7 megawatts (MW) (8,740 million British thermal units [Btu]/day) for the Gresham WWTP. This draft THLA is based on the total flow and effluent temperature, rather than the flow and excess temperature (above the applicable criterion). EPA's THLA for the Gresham WWTP was based on an effluent dry season design flow of 25 mgd and an effluent temperature of 23°C. Using the projected worst-case conditions, the Gresham WWTP has the potential to exceed this draft THLA with a dry season flow of 23.8 mgd and temperature of 24.5°C.

It is also important to understand that EPA has proposed draft individual source and group allocations for municipal dischargers along river reaches. The Gresham WWTP is located within the Columbia River reach defined as RM 142 (Bonneville) to River Mile 112 (upstream of Vancouver). The draft group allocation for this reach is 163.3 MW (13,400 million Btu/day). Within this reach, the Fort James Camas Mill has a separate allocation of 338 MW (27,700 million Btu/day). Once the temperature TMDL is back in process at EPA, Gresham will want to evaluate potential seasonal effluent load allocation trading as a means to secure future THLA allocation for growth. Similarly, allocation trading may also be evaluated if standards change in the future. The draft TMDL is expected to be revised and reissued in the next 5 years, which should lead to legal challenges.

3.4.2.3 Toxic Substances

OAR 340-041-0033 prohibits the discharge of toxic pollutants in amounts that may be harmful to beneficial uses. In addition, OAR 340-041-0033, Tables 30, 31, and 40, establish numeric criteria for toxic pollutants. Evaluations of the Gresham WWTP wastewater discharge chemical compositions were conducted for this MP update. The effluent constituents of potential concern are ammonia, metals, and some organic chemicals. Ammonia and metals are discussed below; organics were not detected and therefore are not discussed.

3.4.2.4 Ammonia

The Gresham NPDES permit does not include effluent limits for ammonia since the WWTP outfall diffuser provides high dilutions in the river and the 2014 permit renewal applied Oregon's water quality criteria for ammonia based on the EPA's ambient water quality criteria (1986). In 2015, Oregon replaced its ammonia water quality criteria with new ammonia criteria (based on EPA, 2013). These 2015 ammonia criteria calculate a 1-hour maximum (acute criteria), 30-day average (chronic criteria), and a 4-day maximum (chronic criteria) based on river pH and temperature and assume that freshwater mussels and salmonids are present at the discharge site.

Five years (November 2011 through December 2016) of effluent ammonia measurements for the Gresham WWTP have been evaluated. Figure 3-C-1 in Attachment C graphically illustrates the probability distribution of these 5 years of 268 effluent ammonia measurements. This plot shows that the 50th percentile and 95th percentile of the effluent ammonia database are 31.7 mg/L and 42.3 mg/L, respectively. The maximum day effluent ammonia concentrations are 46.1 mg/L (wet season) and 53.3 mg/L (dry season). The dry season maximum (reported for October 7, 2014) may be an outlier ammonia value, but it has been applied as a conservative representation of dry season maximum effluent in the screening reasonable potential evaluation.

Table 3-C-1 in Attachment C provides the screening evaluation of the Gresham WWTP discharge compliance with the acute and chronic ammonia criteria under critical seasonal receiving water conditions. This screening evaluation of dilutions required to meet seasonal ammonia criteria includes dry season ammonia criteria derived using ambient river pH values ranging from 8.0 to 8.5, and wet season ammonia criteria derived using ambient river pH values of 8.0 and 8.5. This evaluation shows that ammonia criteria based on dry season river pH values of 8.1 and greater (and based on wet season

river pH values of 8.4) would require acute and chronic dilutions greater than currently provided by the Gresham outfall diffuser. Oregon DEQ has defined the dilution factors applied in the NPDES permit for the Gresham discharge as 19 at the zone of initial dilution (ZID) and 84 at the regulatory mixing zone (RMZ). Table 3-C-1 shows the input and output values of the reasonable potential analysis screening evaluation.

Table 3-7 summarizes calculated potential monthly average (30-day) and daily maximum effluent ammonia concentrations limits (dry and wet season) based on DEQ's new ammonia criteria (derived for plausible and worst-case river pH and temperatures), based on the existing acute and chronic dilution factors. This screening-level evaluation of dry and wet season compliance with potential plausible and worst-case monthly average (30-day) and daily maximum effluent ammonia limits (dry and wet season) indicates the following (refer to Table 3-7):

- Plausible ammonia criteria could necessitate some nitrification treatment in dry season to reduce maximum ammonia concentrations, but would not be needed in the wet season.
- Worst-case ammonia criteria would necessitate nitrification treatment in dry season to reduce average and maximum ammonia concentrations, and some nitrification treatment would be needed in wet season to reduce maximum ammonia concentrations.

Near-term and future planning needs include diffuser performance, operation, and maintenance inspections and followup to support the key role of dilution in meeting the ammonia criteria. In addition, treatment plant operational measures need to be evaluated to optimize ammonia removal during critical periods without use of full nitrification. These measures together could forestall the requirement of effluent ammonia limits in the next NPDES permit and/or could assist in meeting future permit limits. Figure 3-11 is a probability distribution of effluent ammonia data from 2011 through 2016 and includes the estimated dry season maximum day and dry season 30-day average permit limits and these estimated limits with a 25 percent safety factor.

Table 3-7. Summary of Calculated Potential Effluent Ammonia Limits and Compliance Outcome Based on Existing Discharge Concentrations[a] and DEQ Ammonia Criteria

Scenario	Water Quality Criteria (acute & chronic)	River pH & Temperature	Estimated 30-day Effluent Limit[c] (mg/L)	Estimated Daily Maximum Effluent Limit[d] (mg/L)	Does Existing Effluent Average & Maximum Meet Required Limit?[b]	Outcome
Dry Season (May –October)						
Plausible Case	1.7 mg/L & 0.40 mg/L	8.2 & 23.0°C	39	40	Yes/No	Some nitrification needed
Worst Case	1.2 mg/L & 0.29 mg/L	8.5 & 23.0°C	24	23	No/No	Nitrification required
Wet Season (November – April)						
Plausible Case	2.5 mg/L & 0.53 mg/L	8.4 & 16.0°C	45	48	Yes/Yes	No nitrification needed
Worst Case	2.1 mg/L & 0.45 mg/L	8.5 & 16.0°C	38	40	Yes/No	Some nitrification needed

[a] Based on current acute dilution factor of 19 at the ZID, and chronic dilution factor of 84 at the mixing zone boundary.

[b] Based on maximum day dry and wet season effluent ammonia values of 53.3 mg/L and 46.1 mg/L, respectively, and monthly average dry and wet season effluent ammonia values of 35.1 mg/L and 28.2 mg/L, respectively.

[c] Monthly average effluent concentration correlates to chronic aquatic life criteria compliance.

[d] Daily maximum concentration correlates to acute aquatic life criteria compliance.

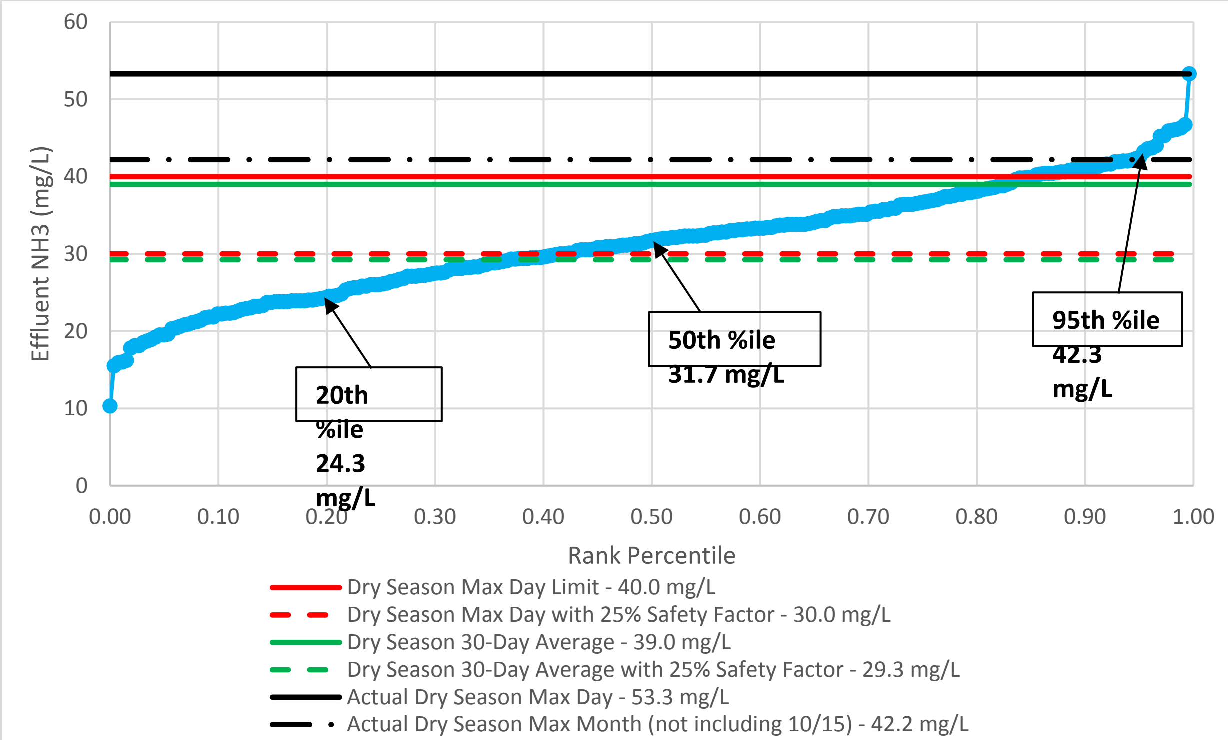


Figure 3-11. Probability Distribution of Gresham Ammonia Measurements (2011-2016)

3.4.2.5 Metals

The current Gresham NPDES permit does not include effluent limits for any metals. Gresham has provided clean sampling results for all potential target metals, and these results have demonstrated that Gresham's discharge does not have a reasonable potential to exceed water quality criteria for any metals. The current NPDES permit requires quarterly monitoring for arsenic, cadmium, copper, chromium, lead, mercury, molybdenum, nickel, selenium, silver, and zinc. Metals and organic chemicals are regulated under Gresham's industrial pretreatment program. Gresham has developed local limits for several metals of concern. Local limits are based on the most restrictive of the following criteria: protection of water quality, protection of biosolids quality, process inhibition/interference, and worker health and safety.

Most of Oregon's current water quality criteria for toxic pollutants are based on values recommended by EPA's *Quality Criteria for Water* published in 1986. Since that time, EPA has published several updates of its criteria. As part of its triennial review process, DEQ has revised water quality standards to reflect the updated criteria published by EPA. Some recent changes have been promulgated to Oregon water quality criteria for metals—specifically cadmium, copper, and selenium. In addition, DEQ has revised metals criteria such that some are total recoverable metals criteria (As, Cr, Hg, Se) and some are now dissolved metals criteria (Cd, Cu, Pb, Ni, Ag, and Zn).

In 2016, Oregon revised the copper criteria from hardness-based to criteria that are based on EPA's Biotic Ligand Model (BLM). Implementation of the BLM for calculating copper criteria will require as much as 2 years of monthly effluent and river sample collections for analysis of 11 parameters required for the BLM input. DEQ will be requesting these BLM data collections in letters to dischargers in 2017.

Table 3-C-2 in Attachment C provides a screening evaluation of the Gresham WWTP discharge compliance with the acute and chronic metals criteria based on maximum effluent metals concentrations. This evaluation shows that effluent copper (using hardness-based criteria) requires dilutions for compliance of 2 at the ZID and 3 at the RMZ, and the dilution factors in the NPDES permit are 19 and 84. Effluent metals should not become an issue in the future given the outfall dilutions and

low effluent metals concentrations. Background river arsenic and aluminum concentrations could become issues with human health criteria compliance. Effluent aluminum is not typically tested in WWTPs.

DEQ's RPA worksheets for aquatic life protection and human health protection have been completed and these are provided in Tables 3-C-3 and 3-C-4 in Attachment C. The RPA worksheets use the NPDES permit dilution factors, the maximum effluent concentrations (effluent data for November 2011 to December 2016), and the background Columbia River concentrations (from Washington State Department of Ecology's 2008 river sampling). Two sets of RPA worksheets have been prepared, one for aquatic toxicity criteria and one for human health criteria. These RPA tables document that the Gresham WWTP wastewater discharge into the Columbia River has no reasonable potential to cause or contribute to violations of ambient water quality criteria at the ZID and RMZ boundaries.

3.4.2.6 Dissolved Oxygen

The applicable water quality standard for DO (OAR 340-041-0016(2)) states: "For water bodies identified by the Department [DEQ] as providing cool-water aquatic life, the dissolved oxygen shall not be less than 6.5 mg/L as an absolute minimum. When the Department determines that adequate information exists, the dissolved oxygen may not fall below 6.5 mg/L as a 30-day mean minimum, 5.0 mg/L as a 7-day minimum mean, and not fall below 4.0 mg/L as an absolute minimum." The cool-water aquatic life criterion applies year-round.

The wastewater influence on the receiving waters can be identified as immediate DO demand that occurs during the dilution process in the river. The immediate DO demand was calculated using a mass balance equation and the methods outlined in the Section 301(h) Technical Support Document (EPA, 1991). Receiving water DO concentrations at the completion of wastewater dilution were predicted applying the NPDES permit dilution factor at the RMZ. This screening analysis included the following conservative assumptions: effluent DO of 5.0 mg/L, ambient DO concentration of 6.6 mg/L, and a minimum dilution factor of 84.

Thus, using the mass balance equation, where $DO_{ambient}$ is the dissolved oxygen of the river, $DO_{effluent}$ is the dissolved oxygen of the facility wastewater, $DO_{mixture}$ is the dissolved oxygen at the edge of the RMZ, Q_o is the initial flow (Q_o), and $Q_{entrain}$ is the entrained flow:

$$Q_o * (DO_{effluent}) + Q_{entrain} * (DO_{ambient}) = (Q_o + Q_{entrain}) * (DO_{mixture})$$

With a predicted minimum RMZ dilution factor of 84 at 7Q10, Q_o = 1 (by definition), and $Q_{entrain}$ = 83, solving the equation for $DO_{mixture}$ yields:

$$\frac{1*(5.0)+83*(6.6)}{84} = 6.58$$

The calculated worst-case decrease in DO is the difference between the DO concentration of the effluent and ambient ($DO_{mixture}$) and the ambient DO ($DO_{ambient}$), or (6.6 mg/L)-(6.58 mg/L) = 0.02 mg/L DO. Pursuant to OAR 340-041-0004(9)(a)(D)(iii), a reduction in DO of less than 0.1 mg/L is allowed even in waterbodies that do not meet the applicable DO criterion. The Columbia River at the Gresham discharge site does meet the DO criterion and is not listed for impairment. This evaluation demonstrates that the Gresham WWTP discharge to the Columbia River does not cause a violation of the DO criterion.

3.4.2.7 pH

The pH limits for the Gresham WWTP are 6.0 to 8.5 standard units, as defined in the current NPDES permit. The applicable pH standard for the Columbia River basin (OAR 340-041-0104) is between 7.0 and 8.5. Based on an analysis of the minimum and maximum pH in the Gresham WWTP discharge (6.6 to

7.8), assuming a background river pH range of 7.9 to 8.4, and using EPA's PHMIX2 program, the resulting worst-case pH at the RMZ boundary would not be less than 7.6 or above 8.36. The Gresham WWTP discharge does not cause or contribute to a violation of this criterion.

3.4.2.8 Turbidity

The turbidity criterion allows up to a 10 percent increase in stream turbidity, "as measured relative to a control point immediately upstream of the turbidity causing activity," OAR 340-041-0036. Receiving water turbidity data for the Columbia River near the Gresham WWTP discharge site are limited to sporadic measurements at DEQ and other water quality sampling sites upriver. These sporadic readings range from 2 to 34 nephelometric turbidity units (NTU) over the last 20 years, and the range of values is seasonal and depends on runoff conditions. Gresham WWTP does not monitor effluent turbidity, but typical secondary effluent turbidity values at other WWTPs range from 5 to 15 NTU. Applying the seasonal minimum dilution factor at the RMZ (84), the mixed river and Gresham WWTP wastewater turbidity at the RMZ does not exceed the criterion, even with background river water at 2 NTU.

3.4.2.9 Bacteria Pollution

The numeric and narrative bacterial standards are set forth in OAR 340-041-0009. The Gresham WWTP wastewater is disinfected with liquid sodium hypochlorite and then dechlorinated with sodium bisulfite prior to discharge. The NPDES permit requires the Gresham WWTP wastewater to meet a monthly log mean of 126 *E. coli* organisms per 100 mL and no single sample above 406 *E. coli* organisms per 100 mL, which is the same as the applicable water quality criterion**.** This evaluation demonstrates that the Gresham WWTP discharge to the Columbia River does not cause a violation of the bacteria pollution criteria.

3.4.2.10 Total Dissolved Solids

OAR 340-041-0104(2)(b) establishes a guideline TDS criterion of 500 mg/L in the lower Columbia River basin from the mouth to RM 120. The Gresham WWTP does not routinely monitor TDS, but the discharge does not cause the river outside the mixing zone to exceed the 500 mg/L criterion, based on available information.

3.4.2.11 Acute and Chronic Toxicity

The Gresham WWTP effluent is routinely tested for chronic and acute dual-endpoint bioassays using three aquatic species, and the effluent has not shown any acute or chronic toxicity in these tests. Therefore, the Gresham WWTP discharge is not anticipated to cause or contribute to acute or chronic toxicity in the Columbia River.

3.4.2.12 Liberation of Dissolved Gases

OAR 340-041-0031(1) provides that waters of the state "will be free from dissolved gases…in sufficient quantities to cause objectionable odors or to be deleterious to fish or other aquatic life, navigation, recreation, or other reasonable uses." The Gresham WWTP wastewater discharge will not release dissolved gases such as hydrogen sulfide, carbon dioxide, or other gases that would cause or contribute to a violation of this criterion in the Columbia River. The numeric criterion in OAR 340-041-0031(2) limits dissolved gases to less than 110 percent of saturation. The Gresham WWTP wastewater discharges to Columbia River will contain DO as the only significant gas, and the discharge will not exceed 100 percent saturation for dissolved gases.

3.4.2.13 Development of Fungi

OAR 340-041-0007(10) prohibits the development of fungi or other growths that are harmful to beneficial uses. The Gresham WWTP wastewater discharge has limited nutrients (nitrogen or phosphorus compounds) that are rapidly diluted in the mixing zone and downstream in the river. The Gresham WWTP discharge has not led to the development of fungi or other growths on the riverbed.

The photos taken during the internal inspection of the Gresham WWTP outfall diffuser in October 2016 do not show fungi or other growths on the pipe walls.

3.4.2.14 Bottom or Sludge Deposits

OAR 340-041-0007(12) prohibits the formation of appreciable bottom or sludge deposits that are harmful to beneficial uses. Because of the high quality of the Gresham WWTP effluent, outfall dilution characteristics, and river currents, the wastewater discharge does not cause or contribute to the development of bottom or sludge deposits. Due to the ambient currents at the outfall diffuser site, any suspended solids discharged through the outfall are transported rapidly downstream and dispersed.

3.4.2.15 Discoloration, Scum, Oily Slick

OAR 340-041-0007(13) prohibits "[o]bjectionable discoloration, scum, oily slick, or floating solids, or coating of aquatic life with oil films." The Gresham WWTP wastewater discharge plume does not increase receiving water color. The wastewater discharge does not release substances that create scum or an oily slick in either the mixing zone or at down-current areas.

3.4.2.16 Creation of Tastes or Odors

OAR 340-041-0007(11) prohibits the creation of tastes or odors or toxic or other conditions that could deleteriously affect fish or shellfish or the potability of drinking water. Gresham WWTP wastewater does not have any constituents that create odor or taste impairments in drinking water or fish and shellfish. Moreover, the discharge will, as discussed above, continue to meet all applicable criteria for toxic pollutants.

3.4.2.17 Aesthetic Conditions

OAR 340-041-0007(14) prohibits "aesthetic conditions offensive to the human senses of sight, taste, smell, or touch." The wastewater discharge will not release substances that create such water quality problems in either the mixing zone or down-current areas. The wastewater plume can reach the surface depending on the ambient current speeds, but the Gresham WWTP wastewater does not create any surface discolorations, foam, or other unwanted aesthetic conditions.

3.4.2.18 Antidegradation Review

Oregon’s antidegradation rule provides that waterbodies “may not be further degraded” except as authorized by the rule (OAR 340-041-0004(7)). DEQ has interpreted “degradation” as a “measurable change in water quality away from conditions unimpacted by anthropogenic sources (outside the mixing zone, if existing)” (*Antidegradation Policy Implementation Internal Management Directive for NPDES Permits and Section 401 Water Quality Certifications* [Antidegradation Policy IMD]; DEQ, 2001a). DEQ developed an antidegradation review in the 2014 Permit Evaluation Report that concluded that the Gresham WWTP discharge complies with Oregon’s antidegradation policy.

The following analysis demonstrates that the Gresham WWTP discharge does not cause a measurable change in water quality in the Columbia River outside of the defined mixing zone, and, therefore, it will not degrade the quality of the river.

For temperature and DO, a “measurable change” is defined by rule. With respect to temperature, OAR 340-041-0004(3)(c) provides that “[i]nsignificant temperature increases authorized under OAR 340-041-0028(11) and (12) are not considered a reduction in water quality.” As discussed under the Temperature section above, the Gresham WWTP discharge can result in a temperature increase in the Columbia River of less than 0.3°C during the year. These temperature effects are insignificant pursuant to OAR 340-041-0028(12)(b)(A) and (B).

With respect to DO, OAR 340-041-0004(3)(d) provides: “Up to a 0.1 mg/L decrease in DO from the upstream end of a stream reach to the downstream end of the reach is not considered a reduction in water quality so long as it has no adverse effects on threatened or endangered species." As discussed above under the Dissolved Oxygen section, a conservative analysis demonstrates that the discharge does not cause or contribute to a violation of applicable DO criteria or reduce DO concentrations in the river by more than 0.1 mg/L under critical stream flow conditions. Moreover, because the DO criteria were developed to protect threatened and endangered salmonids, the Gresham WWTP discharge does not have an adverse effect on these or other listed species. The Gresham WWTP discharge does not degrade the quality of the Columbia River with respect to its temperature, pH, DO, and metals concentrations.

For constituents other than temperature and DO, a "measurable change" in water quality is defined on a case-by-case basis using best professional judgment (DEQ, 2001a). Among the list of considerations that the Antidegradation Policy IMD identifies for evaluating whether a discharge will cause a "measureable change" in water quality is the "percent reduction in assimilative capacity." In the context of antidegradation review, the assimilative capacity of a waterbody is the difference between the applicable water quality criterion for a constituent and the ambient concentration of that constituent. Assimilative capacity is a particularly useful evaluation tool because it allows consideration not only of the relative change in water quality that a discharge will cause, but also the significance of that change with respect to the protection of beneficial uses and potential constraints on future economic development that may require discharges to the river. The tables provided in Attachment 3-C document the mixed effluent and river concentrations at the RMZ boundary, and when these are compared to the acute and chronic water quality criteria, they all are well below the criteria—indicating that the effect of the Gresham WWTP discharge on the assimilative capacity of the river is insignificant.

3.4.2.19 Other Parameters and Issues

Table 3-6 above provides additional review and evaluation of emerging effluent constituent issues, mixing zone and dilution issues, as well as the application of the RPA-IMD in NPDES permitting.

3.4.2.20 303(d) Listings in River

The Columbia River in the vicinity of Gresham's discharge has been included in DEQ's 2012 303(d) listing for the following parameters:

- Temperature during the summer season
- Dichlorodiphenyltrichlorethane (DDT) and metabolites in fish tissue
- Polychlorinated biphenyls (PCBs) in fish tissue
- pH in fall, winter, and spring seasons

These 303(d) listed parameters and others water quality parameters have been evaluated in Table 3-6 and the preceding subsections. The Gresham WWTP discharge does not contribute DDT, DDT metabolites, and PCBs in the discharge to the river. This evaluation shows that the City of Gresham's discharge does not significantly contribute to the impairment or degradation of water quality in the Columbia River.

3.4.2.21 Columbia River Basin Specific Water Quality Criteria

OAR 340-041 specifies the water quality standards for the state waters including policies, state-wide and basin-specific criteria, and designated beneficial uses. The Gresham WWTP discharges wastewater to the Columbia River at RM 114.9. The designated beneficial uses for the Columbia River in the vicinity of the Gresham WWTP outfall are provided in Table 101A (OAR 340-041-0101) and these include: public and private domestic water supply, industrial water supply, irrigation use, livestock watering, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, hydropower, commercial navigation and transportation, and aesthetic quality. In addition, Table 101B (OAR 340-041-0101), Fish Use Designations for Columbia Basin, lists the main stem Columbia River as a salmon and steelhead migration corridor.

The water quality standards and policies for the main stem Columbia River (OAR 340-041-0104) include: pH, TDS, total dissolved gas, as well as minimum design criteria for treatment and control of sewage wastes. A review of the Gresham WWTP discharge water quality versus the water quality standards for pH, total dissolved solids, total dissolved gas was presented in preceding subsections. The NPDES permit for the Gresham WWTP requires the facility to comply with the minimum design criteria for treatment and control of sewage wastes.

3.4.2.22 Design Flows and Mass Limits

Growth in the plant design flows and the effect on mass limits are linked. Specific treatment plant expansions must be approved by DEQ, and such design flow changes directly impact the allowable dilution ratios used in the NPDES permit. If higher mass load limits are requested for future Gresham NPDES permits, DEQ must establish findings as specified in OAR 340-41-026(3) and the Environmental Quality Commission needs to approve the higher mass loads.

Based on flow and load projections, the required effluent concentrations will continue to decrease if current mass limits remain unchanged. However, the flow and load projections for the WWTP through 2036 do not decrease the allowable discharge levels to an extent that would require tertiary treatment or other advanced treatment. This MP update therefore does not evaluate alternatives for providing future tertiary treatment; however, the WWTP site plan will continue to reserve space for tertiary/advanced treatment in case it is needed in the future.

Waiver of Daily Mass Load Limits

The current NPDES permit includes a waiver of the daily mass load limit for BOD_5 and TSS when flows exceed twice the 15-mgd dry season design flow for the facility (30 mgd). For existing facilities (i.e., those constructed before 1992), OAR 340-41-120(9)(a) states that the daily mass load limit would not apply for BOD_5 and TSS on any day where flows exceed the lesser of either the secondary hydraulic capacity of the facility or twice the design average dry season flow.

For new or expanded treatment plants (those constructed or expanded after 1992), OAR 340-41-120(9)(b) states that mass load limits will be calculated based on the proposed treatment facilities' capabilities. Similarly, the guidance states that the daily mass load limits should be based on the expected effluent quality and effluent flow from a 2-year, 24-hour storm event. Since mass loads are based on the treatment facilities' capabilities, the daily mass load limit waiver is not included for facilities constructed or expanded after 1992. The approach for new or expanded facilities in OAR 340-41-120(9)(b) was not used by DEQ for the Gresham WWTP.

This review assumes that the future NPDES permits will continue to include a waiver of the daily mass load limits for BOD_5 and TSS when flows exceed twice the dry season design flow of the facility. If the daily mass load limit waiver is not included, then Gresham will need to work with DEQ to incorporate mass load limits that address peak flow conditions.

85 Percent Removal

The NPDES permit currently includes an 85 percent removal efficiency requirement for BOD_5 and TSS as a monthly average. The NPDES permit also allows Gresham a 75 percent removal efficiency for BOD_5 and TSS when monthly average flow exceeds 25 mgd. Gresham has demonstrated that the criteria set forth in the federal regulations (40 Code of Federal Regulations [CFR] 133), which allow for a removal efficiency less than 85 percent, are met. These conditions will need to be met if future mass limit increases are requested and the NPDES permit is reissued. To qualify for a lower removal efficiency, the federal regulations require that:

1. The treatment works is consistently meeting, or will consistently meet, its permit effluent concentration limits but its percent removal requirements cannot be met due to less concentrated influent wastewater,

2. The treatment works would have to achieve significantly more stringent limitations than would otherwise be required by the concentration-based standards to meet the percent removal requirements, and
3. The less concentrated influent wastewater is not the result of excessive I/I.

3.4.2.23 Selective Treatment or Blending

The Gresham WWTP was designed to operate using selective treatment or blending when flow exceeds the maximum day hydraulic capacity of the secondary system (54 mgd) whereby flows greater than this level receive primary treatment and are routed directly to the chlorine contact basins to mix with secondary effluent for disinfection. This practice is not acknowledged in the NPDES permit. EPA issued two draft policies regarding treatment of peak flows at WWTPs in 2003 and 2005. The 2003 draft policy allowed for blending under certain conditions. In 2005, EPA abandoned the 2003 proposal and issued another draft policy, citing confusion regarding the regulatory status of peak wet season diversion around secondary treatment units and stating the diversions were only intermittently treated as bypasses. The 2005 draft policy proposed that the 40 CFR 122.41(m) bypass regulation be used for peak wet season diversions for publicly owned treatment works serving separate sewer systems where the bypass is recombined with flow from the secondary treatment units. A peak wet season diversion would only be allowed if there were no feasible alternatives. The 2005 draft policy was never finalized, but EPA began applying the 2005 draft policy through letters to various municipalities. The Iowa League of Cities sued EPA (*Iowa League of Cities v. EPA*) in the Eighth Circuit Court for using letters to promulgate new rules as being in violation of Administrative Procedures Act's notice and comment requirements and also in conflict with the Clean Water Act. In March 2013, an Eighth Circuit Court panel ruled in favor of the Iowa League of Cities that EPA was promulgating new rules through letters, and further ruled that the blending prohibition is beyond EPA's statutory authority. That is, EPA cannot regulate processes within the treatment plant, but only the effluent limits at the discharge point. EPA decided not to appeal the ruling, meaning the ruling only applies to states within the Eighth Circuit. An industry consortium (Center for Regulator Reasonableness) filed a lawsuit against EPA in the U.S. Court of Appeals for the District of Columbia Circuit, arguing that the Eighth Circuit Court's ruling should apply to the entire country. In February 2017, the three-judge panel ruled that it lacked jurisdiction to consider the case, meaning blending will continue to only be explicitly allowed within the Eighth Circuit. The lack of clear regulatory direction on blending makes the legality of the future use of blending at the treatment facility unclear. The treatment facility's existing secondary treatment capacity, however, is currently sufficient to treat wet season flows, so blending is not needed. Based on projected flows in this 2017 Master Plan Update, the secondary treatment capacity will continue to be sufficient to avoid or at least significantly curtail the use of blending through the study period (until 2036). However, the City should continue to monitor regulatory developments. If regulatory clarity is attained, it may be prudent to include specific language to address blending in future NPDES permits.

3.4.2.24 Sanitary Sewer Overflows

The City has averaged two sanitary sewer overflows per year over the last 5 years. As shown in Table 3-8, none of these overflows were capacity or storm related. The majority of these issues were related to a force main break, which has since been addressed.

Table 3-8. NPDES Permit Enforcement Action Summary

Event Date	Event Description	Responsible Party	DEQ/EPA Enforcement	Document Date	Document No.	Fine	Comment
WWTP and Pump Station Events							
08/19/2006	Missed pH Sample	Veolia	MAO	10/11/2007	WQ/M-NWR-07-135	$2,000.00	
10/20/2006	Missed Bioassay Retest	Veolia	Warning Letter	01/09/2007	WL-NWR-WQ-07-0007	-	
04/21/2008	Biosolids Misapplication	Veolia	Warning Letter	04/28/2008	NWR-2008-0034-WL	-	
08/21/2009	Biosolids Misapplication	Veolia	Warning Letter	09/21/2009	NWR-WQ-2009-0100-WL	-	
09/30/2009	Operation Status of 1A and AB Aearation Basins and Reporting of Basement backups	Veolia and City	EPA Warning Letter	09/30/2009	NA	-	
06/23/2010	Test for Priority Pollutants	City	Department Order	06/23/2010	WQ/M-NWR-10-106	-	Oregon SB 737 requirement
04/14/2011	Biosolids Misapplication	Veolia	DEQ Warning Letter	04/19/2011	NWR-WQ-2011-0032-WL	-	
July, 2011	Permit Limit Exceedances, numerous	Veolia	DEQ Warning Letter	10/19/2011	WL-NWR-WQ-11-0075	-	
August, 2011	Permit Limit Exceedances, TSS pounds	Veolia	DEQ Warning Letter	01/25/2013	WL-NWR-WQ-2013-0004	-	
October, 2011	Permit Limit Exceedances, BOD Concentration	Veolia	DEQ Warning Letter	01/25/2013	WL-NWR-WQ-2013-0004	-	
01/08/2015	Permit Limit Exceedance, TSS pounds	Veolia	No Response				
11/12/2017	185th PS Dry Well SSO	Veolia	Pre-Enforcement Notice	01/12/2017	2016-PEN-2141	-	
			Warning Letter	05/16/2017	2017-WL-2553	-	
Collection System SSO Events							
03/21/2011	185th PS Force Main break	City	DEQ Warning Letter	06/23/2010	WL-NWR-WQ-11-0037	-	
09/27/2011	185th PS Force Main break	City	DEQ Warning Letter	10/19/2011	WL-NWR-WQ-11-0075	-	
11/21/2011	185th PS Force Main break	City	Pre-Enforcement Notice	02/05/2013	PEN-NWR-WQ-13-0018	-	
01/22/2012	185th PS Force Main break	City	Pre-Enforcement Notice	02/05/2013	PEN-NWR-WQ-13-0019	-	
			MAO	09/12/2013	WQ/M-NWR-13-023	$1,520.00	Supplemental Environmental Project

Schedule F, Section B3 of the 2014 Gresham NPDES permit specifies the following:

> b. Prohibition of bypass.
>
> (1) Bypass is prohibited and DEQ may take enforcement action against a permittee for bypass unless:
>
> i. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
>
> ii. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventative maintenance; and
>
> iii. The permittee submitted notices and requests as required under General Condition B3.c.
>
> (2) DEQ may approve an anticipated bypass, after considering its adverse effects and any alternatives to bypassing, if DEQ determines that it will meet the three conditions listed above in General Condition B3.b.(l).

The City’s 10 pump station overflow outfalls listed in the 2002 NPDES permit were removed in the 2014 NPDES permit, which has been DEQ’s permit renewal approach based on EPA guidance.

Also, the City is taking steps to reduce the likelihood of future overflows including:

- Pump stations:
  - Monitoring pump runs times to identify any operating anomalies.
  - High wet well alarm callouts at all pump stations.
  - Installation of bypass pumping connections in force main valve vaults at larger pump stations.
  - Permanent backup power for large pump stations and portable backup power for remaining pump stations.
  - All pump stations now are compatible such that portable backup power generators can be utilized if needed.
- Collection/conveyance system management:
  - Fats, Oils, and Grease Monitoring Program: Excess FOG in the collection system obstructs flow and leads to sanitary sewer overflows (SSOs), which expose the public and environment to disease organisms and pollutants. SSOs are prohibited by the federal Clean Water Act and the City of Gresham’s NPDES permit, and the City can receive enforcement penalties and fines from DEQ. To control these issues through enforcement and technical assistance, the Fats, Oils, and Grease Program was created. Excess FOG in wastewater discharged from commercial establishments, such as food service establishments and multi-family complexes, adhere to sewer pipe walls, restricting flow. To control this, best management practices are implemented along with requirements for businesses to install pretreatment. These pretreatment devices are monitored and routinely serviced to ensure the City’s infrastructure is safeguarded. The City of Gresham Wastewater Division is offering grants (not to exceed $5,000) to Gresham food service establishments retrofitting their business with an approved grease interceptor. The purpose of the program is to reduce impacts of FOG discharged from food service establishments to the sanitary sewer system.
  - Preliminary monitoring for asset management prioritization. Inspect with closed circuit television and clean the entire system over a 3- to 5-year period. Identify issues such as grease buildup, bellies in gravity lines, and/or poorly operating manholes.

- Increase cleaning frequency for identified problem areas (either 3-, 6-, or 9-month interval) to further refine prioritized asset management list.
- In parallel, use calibrated computer model of collection system to identify capacity bottlenecks.
- Through the Capital Improvement Program, replace one to two pipes per year of troubled areas through an engineering solution based on these asset management and capacity assessment efforts.

3.5 Solids Treatment

Gresham's biosolids management program complies with local, state, and federal requirements. While there are no immediate regulatory drivers that would require the City to change the current biosolids program, the City is always looking for ways to continue to improve and enhance the program. There is significant ongoing research assessing the potential health and environmental impacts of persistent compounds and/or micro- and nano-constituents of emerging concern, but there are no major regulatory changes imminent that would drive the City to change current solids processing and biosolids beneficial reuse practices.

The general industry trend is towards the production of Class A biosolids, which, coupled with lower metals concentrations (which Gresham already meets and is anticipated to meet with continued execution of the industrial pretreatment program), allows a publicly owned treatment works to produce an exceptional quality product with a reduced regulatory/monitoring burden. Exceptional quality biosolids typically have improved public acceptance over non-exceptional quality/Class B products. EPA notes that no significant public controversies have arisen around programs that manage biosolids as a Class A/exceptional quality product. Some of the most common reasons to produce Class A biosolids include:

- Improved public perception, particularly if exceptional quality status is achieved.
- Increased number and types of application sites available for Class A products (i.e., biosolids could be more readily used on rangeland, turf farms, and in the nursery industry).
- Reduced application site management burden for Class A products.
- Concern over increased future regulatory burden for Class B biosolids.

In some U.S. locations, such as the Central Valley of California, counties or other local jurisdictions have implemented land use or public health regulations intended to control or discourage the import of biosolids from other areas. Regulations have involved fees imposed on biosolids land application sites, increased treatment requirements beyond the 40 CFR Part 503 regulations, and site management restrictions. These situations have typically arisen when a community became concerned that it could become a "dumping ground" for large quantities of biosolids from another entity.

For Gresham, public opinion may eventually directly or indirectly compel the City to modify its local land application program either by producing biosolids with even lower pathogen levels (exceptional quality/Class A) than currently attained, identifying additional land application sites including those located in eastern Oregon, or converting to a product-based program such as a soil amendment through advanced processing/treatment (e.g., composting).

In the near term, digestion capacity/redundancy and storage of digested and dewatered biosolids is one of the more critical issues for Gresham. Considering all of these issues, it is recommended that the City do the following:

- Continue to identify and implement cost-effective incremental improvements to defer construction of a third anaerobic digester without curtailing FOG/high-strength waste receiving if possible.

- Evaluate alternatives that will provide more storage for dewatered biosolids either directly (constructing more onsite or offsite storage) or indirectly (optimizing BFP dewatering to obtain a higher percent cake solids).
- Develop a long-term plan for modifying existing facilities to produce exceptional quality/Class A biosolids.
- Continue to reserve space in the buildout site plan for advanced biosolids processing such as composting.

The City recently conducted an evaluation of solids process improvements (Brown and Caldwell, 2014a). This 2017 WWTP Master Plan Update incorporates its findings and conclusions. Chapter 4, Alternatives Analysis, discusses these issues in more detail.

3.6 Conclusions and Recommendations

The conclusions and recommendations of this analysis are summarized separately below for water quality/liquids treatment and biosolids.

3.6.1 Water Quality/Liquids Treatment

Gresham currently meets all discharge requirements identified in its NPDES permit, which was renewed in August 2014 and expires in July 2019. However, several evolving issues need to be monitored until the next permit application is submitted. Conclusions and recommendations in the area of water quality/liquids treatment are as follows:

- **Ammonia**. Gresham's NPDES permit does not currently limit ammonia; however, it is likely that limits (based on the last 5 years of effluent ammonia data) will be included in the next permit cycle (see Table 3-7) because DEQ adopted more stringent ammonia water quality toxicity criteria in 2015. Therefore, the City should take reasonable operational and management measures now to reduce effluent ammonia concentrations, to reduce the likelihood of triggering a reasonable potential to exceed these new more stringent criteria. However, even if efforts are undertaken to reduce effluent ammonia levels between now and when permit renewal is undertaken, seasonal effluent ammonia limits in the next NPDES permit renewal may still be inevitable. Derivation of the ammonia criteria depends on the values assumed for the receiving water (Columbia River) pH and temperature. A suite of options was evaluated as part of the alternatives evaluation portion of this MP update, including industrial pretreatment, nitrification in the Upper Plant, treatment of dewatering filtrate recycle, PAD, and outfall modifications to increase dilutions.
- **pH**. The City should consider collecting Columbia River pH data to facilitate permit negotiations in 2018-2019.
- **Evolving/Developing Issues**. Numerous issues remain in a state of regulatory uncertainty including peak flow blending, SSOs, temperature/thermal load limitations, and constituents of emerging concern. These issues should continue to be monitored by the City in concert with Oregon Association of Clean Water Agencies (ACWA).

3.6.2 Solids Treatment

Gresham's biosolids management program complies with all local, state, and federal requirements. While there are no immediate regulatory drivers that would require the City to change the current biosolids program, the City wishes to continually improve and enhance the program.. Public opinion may directly or indirectly compel the City to modify its local land application program either by producing biosolids with even lower pathogen levels (exceptional quality/Class A) than currently attained, identifying additional land application sites (including those located in eastern Oregon), or converting to a product-based program such as a soil amendment through advanced processing/treatment (e.g., composting). In the near term, digestion capacity/redundancy and storage of digested and dewatered biosolids is one of the more critical issues for Gresham. Considering all of these issues, it is recommended that the City do the following:

- Continue to identify and implement cost-effective incremental improvements to defer construction of a third anaerobic digester without curtailing FOG/high-strength waste receiving if possible..
- Evaluate alternatives that will provide more storage for dewatered biosolids either directly (constructing more onsite or offsite storage) or indirectly (optimizing BFP dewatering to obtain a higher percent cake solids).
- Develop a long-term plan for modifying existing facilities to produce exceptional quality/Class A biosolids.
- Continue to reserve space in the buildout site plan for advanced biosolids processing such as composting.

Attachment 3-A
Metro’s Nine-step Methodology to Create 2040 Traffic Analysis Zone Data

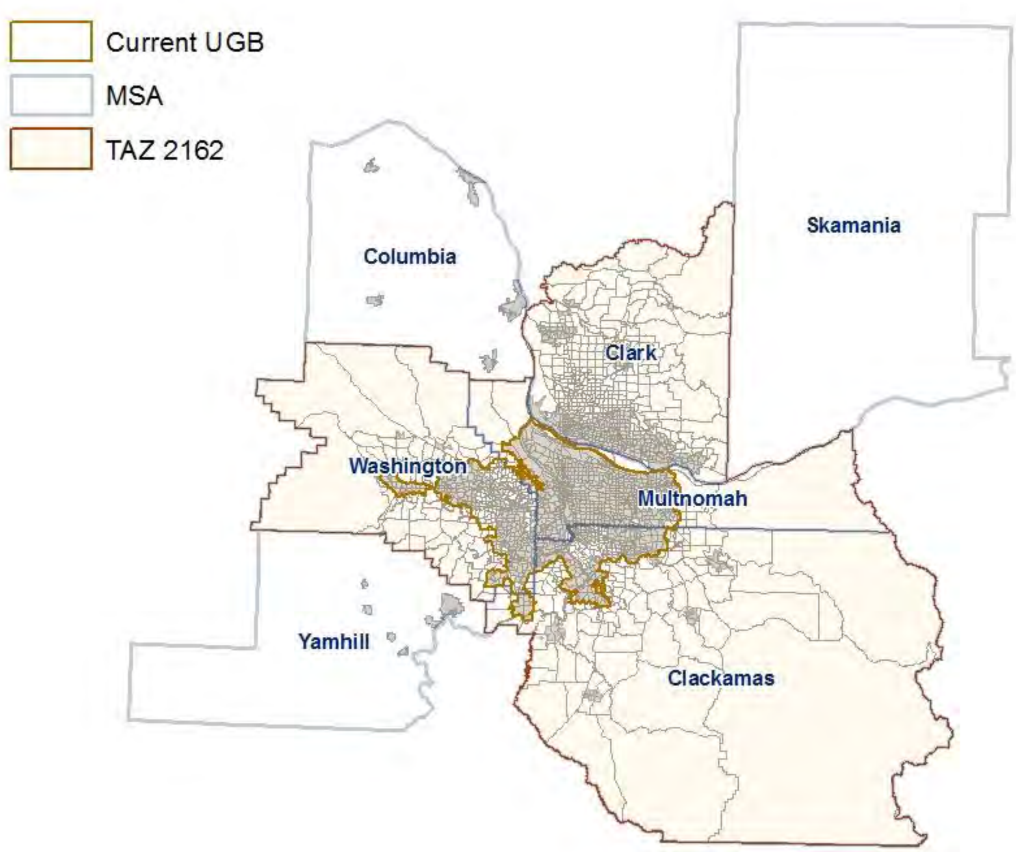
City-level Forecast Methodology and FAQ

Summary level tabulation of the 2015-2040 TAZ Growth Forecast Distribution (May 2016)

What is a TAZ?

A traffic analysis zone (TAZ) is the unit of geography used in conventional transportation planning models. A TAZ can be thought of as a concentration of people and jobs with specific access to the transportation system. TAZs vary in spatial extent, ranging from vary small zones in more dense, urban parts of the region to increasingly larger zones as one moves to the suburbs and less densely populated exurban and rural locations. TAZ area varies so that all TAZs in the modeled space have populations in the same order of magnitude, a condition that generally results in more robust transport model findings. The population contained within a TAZ generally ranges from 1,000 to 3,000 people.

TAZs are unique geographic constructs whose boundaries are set based on the transport network rather than political (such as city limits or other political districts). The one exception to this rule is county boundaries, to which TAZ boundaries align.



How many TAZs are there?

There are 2,162 zones in the Metro TAZ system. The four-county region is represented by the first 2,147 zones. The remaining zones cover parts of Columbia, Marion and Yamhill counties.

What's a TAZ Growth Forecast Distribution?

Oregon law requires Metro to forecast population and employment growth for the Portland region for the next 20 years. This forecasted growth is allocated throughout the region using the TAZ geographic unit as the basis for that allocation to support transport modeling and planning. This resulting allocation of future growth to each of the 2,162 TAZs in the region is known as the TAZ growth distribution forecast and it provides the linkage between growth and land use planning within the region.

The Metro forecast includes population, household, and employment data as well as other socio-economic data useful in modeling and forecasting traffic demand in the region.

How is the TAZ Growth Forecast Distribution developed?

The TAZ Growth Forecast Distribution is a joint effort between Metro and the local governments within the UGB.

Metro provides a preliminary estimate of TAZ growth allocations that incorporate growth management and transportation forecast inputs such as:

- A jurisdiction-reviewed buildable land inventory
- A regionally accepted regional forecast
- Best available inputs from the regional transport model
- Current regional land use policies and local zoning codes and regulations.

Local jurisdictions then review this preliminary growth distribution and work with Metro to refine the allocations to TAZs within their jurisdiction based on their knowledge of local trends and socio-economic conditions. The result is coordinated regional Growth Forecast Distribution at the TAZ geography level.

If it is developed at the TAZ level, why is the Growth Forecast Distribution adopted as city-level estimates?

Metro is required by state law (ORS 195.036) to adopt a population forecast for the region that must also be distributed to each city for local planning purposes. The transport models need the TAZ product.

Why are city population forecast figures lower under this new approach for most cities?

This former approach tended to over-estimate city-level population because whole TAZ's were assigned to cities. Many of these assigned TAZ's overlapped the city limit and unincorporated county areas. At the expense of these areas, what previously got counted as city numbers in fact should have been apportioned part to the city and the other part of the TAZ to unincorporated counties. This new approach more accurately apportions current population to city limits.

What detailed methodology is used to convert the 2015-40 TAZ Growth Forecast Distribution into summary city-level estimates?

Because TAZs do not coincide with city boundaries, Metro developed a method of apportioning TAZ-level growth projections of population, households and employment into city-level estimates.

Step 1: Identify available annual city-level estimates of population, households, and employment

- Population (2015): City population estimates from PSU Population Research Center
- Household (2014): 2014 Census ACS 5-year city estimates of households
- Employment (2013): Metro Research Center geocodes of "tax lot" level covered employment data (i.e., QCEW) tabulated up to city-level estimates

Step 2: Impute all data to a 2015 base-year

- Population – imputation unnecessary as PSU has released 2015 city estimates
- Household – impute 2015 household estimates by deriving 2014 household size (2014 ACS city-level household and population data); adjust this 2014 household size to 2015 and divide into 2015 PSU population estimates to get base-year city household estimates
- Employment – using 2013 employment data geocoded to tax lots, sum employment "points" to TAZ's; adjust the 2013 TAZ job estimates to year 2015 by proportionally re-weighting the TAZ employment; based on county employment estimates now available for year 2015 for Clackamas, Multnomah and Washington.

Step 3: Tabulate reviewed 2015-2040 TAZ growth distribution figures (2015 and 2040) by city.

- Pre-assign individual TAZ's to individual cities or an unincorporated county designation.
- Identify TAZ's as inside or outside the Metro UGB.
- Assign whole TAZ's to a city or county; or inside or outside the UGB. Make no proportional allocations.
- Tabulate households and employment by these place names (i.e., cities and counties). Include cities and unincorporated areas inside and outside the Metro UGB in this tabulation.

Step 4: Calculate the share of households (and employment) in unincorporated Clackamas, Multnomah and Washington counties residing inside the Metro UGB and outside the UGB.

Note: This step is required by ORS 195.033 (Area Population Forecasts) to delineate the outlook of 2040 population (also household and employment) growth inside the Metro UGB.

At this point, the methodology for estimating city-level households and population projections diverges from how city employment is projected.

Forecasting city population and household:

Step 5: Compute 2015 TAZ-derived city population estimates from the growth distribution

- From step 3, multiply 2015 households tabulated by city (i.e., reviewed TAZ forecast distribution) by 2015 household sizes calculated in step 2.

Step 6: Compute 2040 TAZ-derived city population forecast from the growth distribution

- From step 3, multiply 2040 households tabulated by city (i.e., reviewed TAZ forecast distribution) by 2040 household sizes calculated. (compute 2040 city household sizes by iterative adjustment of 2015 city household sizes subject to expected regionwide decline in persons per household; stop iterations when the necessary condition of matching the 2040 population forecast inferred from the 2040 population forecast).

Step 7: Reconcile differences between the 2015 TAZ-derived city population figures computed in step 5 and the PSU 2015 population estimates (found in step 2)

- Take these differences and sum them by county and by inside vs. outside the Metro UGB
- Add these adjustment numbers to the appropriate unincorporated county estimates (from step 4)

The step reconciles the TAZ-derived 2015 population estimates with the 2015 population estimates released by PSU. The total Tri-county population is 1,745,385 residents in Clackamas, Multnomah and Washington according to PSU's 2015 estimates.

Step 8: 2040 city population forecast – pivoting from PSU's 2015 city population estimates project the growth in 2040.

- From step 5 and step 6, calculate the 2040 rate of population growth implied by the TAZ-derived population figures, which are based on the reviewed 2015-40 TAZ household growth distribution.
- Multiply the rate of population growth and the 2015 city population figures from PSU.
- Iteratively re-balance this city-level 2040 population forecasts such that the sum of population growth in 2040 matches up with the population growth forecasted from the reviewed TAZ distribution for the counties.

Step 9: 2040 city household forecast – pivot from Metro's 2015 city household estimates which are derived from Census ACS 5-year (2014) data and PSU 2015 population estimates

- From step 2, multiply 2015 city household estimatesby 2040 household size estimates to arrive at 2040 city household forecasts
- 2040 household sizes derive from implied household sizes computed from TAZ derived population (step 6) and household (step 3), and adjusted iteratively to match county control totals given by the reviewed TAZ forecast distribution.

Forecasting city employment:

Step 10: 2040 city employment forecast – pivoting from Metro's employment geocode

- From step 2, derive 2015 city employment estimates from a geocode of 2013 QCEW covered employment data to tax lots. Summarize these points and proportionally re-weight to sum to updated 2015 county control totals (2015 county employment data sourced from the Oregon Employment Department / BLS estimates).

	2015 Employment (OR Empl. Dept)
Clackamas	149,200
Multnomah	486,300
Washington	274,800
Tri-county TOTAL	910,300

- From step 3, calculate the city growth rate derived from 2015-40 TAZ growth distribution forecast. Multiply this calculated growth rate and the 2015 city employment estimates (found in step 2) to arrive at 2040 employment projections. Adjust iteratively the employment projections such that the 2040 figures sum to match county control totals. County control totals are given by the 2040 TAZ growth distribution forecasts.

	2040 Employment (TAZ forecast)
Clackamas	231,003
Multnomah	644,623
Washington	413,426
Tri-county TOTAL	1,289,052

Attachment 3-B
Flow and Load Projection Data

Table 3-B-1
Base Case Flow and Load Projections

Year	Population Projection	Parameter	Condition	Per Capita (gpcd or ppcd)	Peaking Factor	Domestic (mgd)	+	Industrial (mgd)	=	Total (mgd)
2017	126,366	Flow (mgd)	Dry Season							
			Average	79	1.0	10.0		1.48		11.5
			Max Month		1.3	12.8		1.48		14.3
			Max Week		1.5	15.4		1.68		17.1
			Max Day		1.7	17.4		1.68		19.1
2017/18			Wet Season							
			Average	100	1.4	17.2		1.48		18.7
			Max Month		1.7	21.5		1.48		23.0
			Max Week		2.3	28.4		1.68		30.1
			Max Day		2.8	35.8		1.68		37.4
			Peak Hour		4.1	40.8		1.68		42.5
		BOD (ppd)	Dry Season							
			Average	0.18	1.0	22,416		538		22,954
			Max Month		1.1	24,434		538		24,971
			Max Week		1.3	28,244		894		29,138
			Max Day		1.7	36,987		894		37,880
			Wet Season	0.17						
			Average		1.0	20,578		538		21,116
			Max Month		1.1	22,936		538		23,474
			Max Week		1.4	30,010		894		30,903
			Max Day		1.8	37,512		894		38,406
		TSS (ppd)	Dry Season							
			Average	0.17	1.0	21,741		257		21,998
			Max Month		1.1	23,915		257		24,172
			Max Week		1.4	29,785		483		30,268
			Max Day		2.0	42,395		483		42,877
			Wet Season							
			Average	0.17	1.0	20,055		257		20,312
			Max Month		1.1	22,144		257		22,401
			Max Week		1.3	27,367		483		27,850
			Max Day		1.7	36,141		483		36,624
		NH3 (ppd)	Dry Season							
			Average	0.020	1.0	2,465		195		2,660
			Max Month		1.2	2,958		195		3,153
			Max Week		1.4	3,451		455		3,906
			Max Day		1.4	3,451		455		3,906
			Wet Season							0
			Average	0.020	1.0	2,527		195		2,723
			Max Month		1.3	3,307		195		3,502
			Max Week		1.5	3,791		455		4,246
			Max Day		1.5	3,791		455		4,246

Year	Population Projection	Parameter	Condition	Per Capita (gpcd or ppcd)	Peaking Factor	Domestic (mgd)	+	Industrial (mgd)	=	Total (mgd)
2020	128,921	Flow (mgd)	Dry Season							
			Average	79	1.0	10.2		1.48		11.7
			Max Month		1.3	13.1		1.48		14.6
			Max Week		1.5	15.7		1.68		17.4
			Max Day		1.7	17.8		1.68		19.5
2020/21			Wet Season							
			Average	100	1.4	17.5		1.48		19.0
			Max Month		1.7	21.9		1.48		23.4
			Max Week		2.3	29.0		1.68		30.7
			Max Day		2.8	36.5		1.68		38.2
			Peak Hour		4.1	41.7		1.68		43.3
		BOD (ppd)	Dry Season							
			Average	0.18	1.0	22,869		538		23,407
			Max Month		1.1	24,928		538		25,465
			Max Week		1.3	28,816		894		29,709
			Max Day		1.7	37,735		894		38,628
			Wet Season	0.17						
			Average		1.0	20,994		538		21,532
			Max Month		1.1	23,400		538		23,937
			Max Week		1.4	30,617		894		31,510
			Max Day		1.8	38,271		894		39,164
		TSS (ppd)	Dry Season							
			Average	0.17	1.0	22,181		257		22,437
			Max Month		1.1	24,399		257		24,655
			Max Week		1.4	30,387		483		30,870
			Max Day		2.0	43,252		483		43,735
			Wet Season							
			Average	0.17	1.0	20,461		257		20,717
			Max Month		1.1	22,592		257		22,849
			Max Week		1.3	27,920		483		28,403
			Max Day		1.7	36,872		483		37,355
		NH3 (ppd)	Dry Season							
			Average	0.020	1.0	2,515		195		2,710
			Max Month		1.2	3,017		195		3,213
			Max Week		1.4	3,520		455		3,976
			Max Day		1.4	3,520		455		3,976
			Wet Season							0
			Average	0.020	1.0	2,578		195		2,774
			Max Month		1.3	3,374		195		3,569
			Max Week		1.5	3,868		455		4,323
			Max Day		1.5	3,868		455		4,323

Year	Population Projection	Parameter	Condition	Per Capita (gpcd or ppcd)	Peaking Factor	Domestic (mgd)	+	Industrial (mgd)	=	Total (mgd)
2025	133,181	Flow (mgd)	Dry Season							
			Average	79	1.0	10.5		1.48		12.0
			Max Month		1.3	13.5		1.48		15.0
			Max Week		1.5	16.2		1.68		17.9
			Max Day		1.7	18.4		1.68		20.0
2025/26			Wet Season							
			Average	100	1.4	18.1		1.48		19.6
			Max Month		1.7	22.6		1.48		24.1
			Max Week		2.3	30.0		1.68		31.6
			Max Day		2.8	37.7		1.68		39.4
			Peak Hour		4.1	43.0		1.68		44.7
		BOD (ppd)	Dry Season							
			Average	0.18	1.0	23,625		538		24,163
			Max Month		1.1	25,751		538		26,289
			Max Week		1.3	29,768		894		30,661
			Max Day		1.7	38,981		894		39,875
			Wet Season	0.17						
			Average		1.0	21,688		538		22,225
			Max Month		1.1	24,173		538		24,710
			Max Week		1.4	31,628		894		32,522
			Max Day		1.8	39,535		894		40,429
		TSS (ppd)	Dry Season							
			Average	0.17	1.0	22,913		257		23,170
			Max Month		1.1	25,205		257		25,462
			Max Week		1.4	31,391		483		31,874
			Max Day		2.0	44,681		483		45,164
			Wet Season							
			Average	0.17	1.0	21,137		257		21,393
			Max Month		1.1	23,339		257		23,595
			Max Week		1.3	28,843		483		29,325
			Max Day		1.7	38,090		483		38,573
		NH3 (ppd)	Dry Season							
			Average	0.020	1.0	2,598		195		2,793
			Max Month		1.2	3,117		195		3,312
			Max Week		1.4	3,637		455		4,092
			Max Day		1.4	3,637		455		4,092
			Wet Season							0
			Average	0.020	1.0	2,664		195		2,859
			Max Month		1.3	3,485		195		3,681
			Max Week		1.5	3,995		455		4,451
			Max Day		1.5	3,995		455		4,451

Year	Population Projection	Parameter	Condition	Per Capita (gpcd or ppcd)	Peaking Factor	Domestic (mgd)	+	Industrial (mgd)	=	Total (mgd)
2030	137,440	Flow (mgd)	Dry Season							
			Average	79	1.0	10.9		1.48		12.4
			Max Month		1.3	13.9		1.48		15.4
			Max Week		1.5	16.8		1.68		18.4
2030/31			Max Day		1.7	18.9		1.68		20.6
			Wet Season							
			Average	100	1.4	18.7		1.48		20.2
			Max Month		1.7	23.4		1.48		24.8
			Max Week		2.3	30.9		1.68		32.6
			Max Day		2.8	38.9		1.68		40.6
			Peak Hour		4.1	44.4		1.68		46.1
		BOD (ppd)	Dry Season							
			Average	0.18	1.0	24,381		538		24,918
			Max Month		1.1	26,575		538		27,112
			Max Week		1.3	30,720		894		31,613
			Max Day		1.7	40,228		894		41,122
			Wet Season	0.17						
			Average		1.0	22,381		538		22,919
			Max Month		1.1	24,946		538		25,484
			Max Week		1.4	32,640		894		33,533
			Max Day		1.8	40,799		894		41,693
		TSS (ppd)	Dry Season							
			Average	0.17	1.0	23,646		257		23,903
			Max Month		1.1	26,011		257		26,268
			Max Week		1.4	32,395		483		32,878
			Max Day		2.0	46,110		483		46,593
			Wet Season							
			Average	0.17	1.0	21,813		257		22,069
			Max Month		1.1	24,085		257		24,342
			Max Week		1.3	29,765		483		30,248
			Max Day		1.7	39,308		483		39,791
		NH3 (ppd)	Dry Season							
			Average	0.020	1.0	2,681		195		2,876
			Max Month		1.2	3,217		195		3,412
			Max Week		1.4	3,753		455		4,208
			Max Day		1.4	3,753		455		4,208
			Wet Season							0
			Average	0.020	1.0	2,749		195		2,944
			Max Month		1.3	3,597		195		3,792
			Max Week		1.5	4,123		455		4,578
			Max Day		1.5	4,123		455		4,578

Year	Population Projection	Parameter	Condition	Per Capita (gpcd or ppcd)	Peaking Factor	Domestic (mgd)	+	Industrial (mgd)	=	Total (mgd)
2036	142,551	Flow (mgd)	Dry Season							
			Average	79	1.0	11.3		1.48		12.8
			Max Month		1.3	14.5		1.48		15.9
			Max Week		1.5	17.4		1.68		19.1
			Max Day		1.7	19.6		1.68		21.3
2036/37			Wet Season							
			Average	100	1.4	19.4		1.48		20.9
			Max Month		1.7	24.2		1.48		25.7
			Max Week		2.3	32.1		1.68		33.8
			Max Day		2.8	40.3		1.68		42.0
			Peak Hour		4.1	46.1		1.68		47.8
		BOD (ppd)	Dry Season							
			Average	0.18	1.0	25,287		538		25,825
			Max Month		1.1	27,563		538		28,101
			Max Week		1.3	31,862		894		32,756
			Max Day		1.7	41,724		894		42,618
			Wet Season	0.17						
			Average		1.0	23,214		538		23,751
			Max Month		1.1	25,874		538		26,411
			Max Week		1.4	33,853		894		34,747
			Max Day		1.8	42,317		894		43,210
		TSS (ppd)	Dry Season							
			Average	0.17	1.0	24,526		257		24,782
			Max Month		1.1	26,978		257		27,235
			Max Week		1.4	33,600		483		34,083
			Max Day		2.0	47,825		483		48,308
			Wet Season							
			Average	0.17	1.0	22,624		257		22,881
			Max Month		1.1	24,981		257		25,237
			Max Week		1.3	30,872		483		31,355
			Max Day		1.7	40,770		483		41,253
		NH3 (ppd)	Dry Season							
			Average	0.020	1.0	2,780		195		2,976
			Max Month		1.2	3,337		195		3,532
			Max Week		1.4	3,893		455		4,348
			Max Day		1.4	3,893		455		4,348
			Wet Season							0
			Average	0.020	1.0	2,851		195		3,046
			Max Month		1.3	3,731		195		3,926
			Max Week		1.5	4,277		455		4,732
			Max Day		1.5	4,277		455		4,732

Attachment 3-C
Water Quality Analysis Data

Table 3-C-1

Screening-Level Evaluation of Dilutions Required for Compliance with Oregon's Ammonia Criteria for the Gresham WWTP Discharge to the Columbia River - Dry & Wet Seasons

									NPDES Permit Acute Dilution Factor = 19	NPDES Permit Chronic Dilution Factor = 84	
		Water Quality Criteria a									
Cases No.	Parameters	Acute (mg/l) b	Chronic (mg/l) c	No. of Samples	Maximum Effluent Concentration (mg/l) e	Multiplier Factor (99% C.L. and 95% Prob.) d	Average Effluent Concentration (mg/l)	Background Concentration (90th-% EST.) (mg/L)	Minimum Dilution Factors Needed to Meet Acute Water Quality Criteria at ZID	Minimum Dilution Factors Needed to Meet Chronic Water Quality Criteria at RMZ	Does Permit Dilution Factor Meet Required Dilution?
Dry Season (May - October)											
1 (River pH = 8.0; Temp.= 23.0 C)	Ammonia (Total NH3)	3.0		122	53.3	1.0	35.1	0.05	**18**		Yes
	Dry Season (May-October) - 30 day Avg.		0.64							**83**	Yes
	Highest 4-day Average Limit		1.6							**33**	Yes
2 (River pH = 8.2; Temp.= 23.0 C)	Ammonia (Total NH3)	2.1		122	53.3	1.0	35.1	0.05	**25**		No
	Dry Season (May-October) - 30 day		0.47							**114**	No
	Highest 4-day Average Limit		1.2							**44**	Yes
3 (River pH = 8.4; Temp.= 23.0 C)	Ammonia (Total NH3)	1.4		122	53.3	1.0	35.1	0.05	**38**		No
	Dry Season (May-October) - 30 day		0.34							**157**	No
	Highest 4-day Average Limit		0.9							**59**	Yes
4 (River pH = 8.5; Temp.= 23.0 C)	Ammonia (Total NH3)	1.2		122	53.3	1.0	35.1	0.05	**44**		No
	Dry Season (May-October) - 30 day		0.29							**184**	No
	Highest 4-day Average Limit		0.7							**76**	Yes
Wet Season (November - April)											
5 (River pH = 8.0; Temp.= 16.0 C)	Ammonia (Total NH3)	5.4		146	46.1	1.0	28.2	0.05	**9**		Yes
	Wet Season (Nov.-April) - 30 day		1.0							**46**	Yes
	Highest 4-day Average Limit		2.5							**18**	Yes
6 (River pH = 8.5; Temp.= 16.0 C)	Ammonia (Total NH3)	2.1		146	46.1	1.0	28.2	0.05	**22**		No
	Wet Season (Nov.-April) - 30 day		0.45							**103**	No
	Highest 4-day Average Limit		1.1							**41**	Yes

Notes:

a Ammonia criteria calculated using 2016 DEQ ammonia criteria; based on dry season river temperature of 23.0 deg. C and pH range of 8.0 to 8.5; and wet season river temperature of 16.0 deg. C and pH range of 8.0 to 8.5.

b The freshwater acute criteria is a 1-hour average concentration not to be exceeded more than once every three years on the average.

c The freshwater chronic criteria is a 4-day average concentration not to be exceeded more than once every three years on the average.

d The reasonable potential multiplying factor assumes a coefficient of variation of 0.6, based on guidance on Table 3-2 (p.57) in the Technical Support Document (EPA, 1991).

e Concentrations of total ammonia were based on effluent total ammonia concentrations in the City of Gresham Effluent Monitoring Database for November 2011 through December 2016.

Table 3-C-2

Screening Evaluation of Dilutions Required for Effluent Metals Compliance with State Water Quality Standards for the Gresham WWTP Discharge to the Columbia River

Parameter	Water Quality Criteria a		No. of Samples	Maximum Effluent Concentration (ug/l) d	Multiplier Factor (99% C.L. and 95% PROB) e	RPA Estimated Maximum Effluent Conc. (ug/l)	Background Concentration (90th-%) (ug/L) f	Minimum Dilution Needed to Meet Acute Water Quality Criteria at ZID	Minimum Dilution Needed to Meet Chronic Water Quality Criteria at RMZ
	Acute (ug/l) b	Chronic (ug/l) c							
Arsenic (total)	360	150	36	1.4	1.3	1.8	1.07	0	0
Cadmium (total/diss)	1.9	0.2	48	0.070	1.2	0.1	0.1	0	1.1
Chromium (dissolved)	1055	51	45	2.5	1.2	3.0	0.44	0	0
Copper ** (total)	9.6	6.8	47	15.2	1.2	18.2	0.84	2.0	2.8
Lead (dissolved)	35.5	1.4	36	0.4	1.3	0.5	0.07	0	0.4
Mercury (total)	2.4	0.012	48	0.011	1.2	0.0132	0.004	0	1.4
Nickel (dissolved)	269	30.2	43	10.1	1.2	12.1	0.76	0	0
Selenium (total)	13	4.6	29	1.2	1.4	1.7	1	0	1
Silver (dissolved)	1.2	0.1	37	0.14	1.3	0.2	0.05	0	2
Zinc (dissolved)	68.8	69.3	48	42.6	1.2	51.1	3.57	0.8	0.8
Cyanide (free)	22.0	5.2	36	20	1.3	26.0	0	1.2	5.0

Note:

** DEQ revised 2016 Standards implement the Biotic Ligand Model for calculation of acute and chronic copper criteria - and this model requires collections of effluent and river water chemistry over at least one year as model input. The copper dilution requirements in this RPA are calculated based on effluent and river hardness.

a Freshwater acute & chronic criteria from OAR 340-041 (November 2016) Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon.

b The freshwater acute criteria is a 1-hour average concentration not to be exceeded more than once every three years on the average, with the exception of silver, which is an instantaneous concentration not to be exceeded at any time. Hardness dependent metals criteria based on mixed (DF=19) hardness of 52 mg/L using effluent hardness (42 mg/L) and river hardness (52.5 mg/L).

c The freshwater chronic criteria is a 4-day average concentration not to be exceeded more than once every three years on the average. Hardness dependent metals criteria based on mixed (DF=84) hardness of 52 mg/L using effluent hardness (42 mg/L) and river hardness (52.5 mg/L).

d The maximum effluent concentration is based on total recoverable metals concentrations collected November 2011 - December 2016 at the Gresham WWTP.

e The reasonable potential multiplying factor assumes a coefficient of variation of 0.6, based on guidance on Table 3-2 (p.57) in the Technical Support Document (EPA, 1991).

f Background receiving water data from Ecology river sampling upstream Columbia River in 2008.

Table 3-C-3. Reasonable Potential Analysis - Aquatic Toxicity - Domestic Facility

RPA Run Information	
Facility Name:	Gresham WWTP
DEQ File Number:	35173
Permit Writer Name:	
Outfall Number:	1
Date of RPA Run:	1/30/2017
RPA Run Notes:	
KEY:	-- Intermediate calc.s
* Enter data here	-- Calculated results

Please complete the following General Facility Information

1. Do I have dilution values from a mixing zone study? (Y/N)		Y
2. Is the receiving waterbody fresh water? (Y/N)		Y
3. If answered "N" to *Question 1*, then fill in the following table		
Eff. Flow Rate	MGD	12.1
Stream Flow: 7Q10	CFS	*
Stream Flow: 1Q10	CFS	*
% dilution at ZID	%	10%
% dilution at MZ	%	25%
Calculated dilution Factors		
Dilution @ ZID		na
Dilution @ MZ		na

4. If answered "Y" to *Question 1*, then fill in dilution factors from mixing zone study		
Dilution @ ZID (from study)		19
Dilution @ MZ (from study)		84
5. Please enter *Water Hardness Data* below to reflect critical conditions (values from 25 to 400 mg/l)		
Effluent	mg/L $CaCO_3$	42
Up-stream	mg/L $CaCO_3$	52.5
ZID boundary	mg/L $CaCO_3$	52
MZ boundary	mg/L $CaCO_3$	52
6. Please enter statistical *Confidence* and *Probablity* values (note: defaults already entered)		
Maximum Effluent Conc. %'ile	%'ile	95%
Confidence Level	%'ile	99%

Determine Monitoring Reqs.		Identify Pollutants of Concern					Determine In-Stream Conc.			Determine Reasonable Potential			
Pollutant Parameter	RPA Evaluation Required?	# of Samples	Highest Effluent Conc.	Coefficent of Variation	Est. Maximum Effluent Conc.	RP at end of pipe?	Ambient Conc.	Max Total Conc. at ZID	Max Total Conc. at RMZ	WQ CRITERIA 1 Hour (CMC)	WQ CRITERIA 4 Day (CCC)	Is there Reasonable Potential to Exceed? (Yes/No)	
	(Yes/No)		µg/l	Default=0.6	µg/l	(Yes/No)	µg/l	µg/l	µg/l	µg/l	µg/l	Acute	Chronic
Table 1 Effluent Parameters for all POTWs w/a Flow > 0.1 MGD													
Table 2 Effluent Parameters for Selected POTWs													
Hardness (Total as CaCO3)	Yes	Must be collected for metals criteria calculation. Submit data to the fields at the top of the spreadsheet											
Table 2: Metals (total recoverable), cyanide and totoal phenols								Use total data for dissolved criteria? (yes/no)					Yes
Arsenic (total recoverable)	Yes	36	1.4	No Water Quality Criteria			1.07						
Arsenic (total inorganic +	*	36	1.4	0.60	1.82	No	1.07	1.11	1.08	340.0	150.0	NO	NO
Cadmium (total recoverable)	Yes	48	0.07	0.60	0.08	No	0.10	0.10	0.10	1.9	--	NO	--
Cadmium (dissolved)	*	48	0.07	0.60	0.08	No	0.10	0.10	0.10	--	0.2	--	NO
Chromium (total recoverable)	Yes	45	2.5	No Water Quality Criteria			0.50						
Chromium (dissolved)	*	45	2.5	Only for use in Tier 2			0.44						
Chromium III (dissolved)	*	45	2.5	0.60	3.00	No	0.00	0.16	0.04	1054.5	50.7	NO	NO
Chromium VI (dissolved)	*	45	2.5	0.60	3.00	No	0.00	0.16	0.04	16.0	11.0	NO	NO
Copper (total recoverable)	Yes	47	15.2	0.60	18.24	Yes	1.19	2.09	1.39	9.6	6.8	NO	NO
Copper (dissolved)	*	47	15.2	0.60	18.24	--	0.84	1.76	1.05	--	--	--	--
Iron (total recoverable)	Yes	47	201	0.60	241.20	No	0.00	12.69	2.87	--	1000	--	NO
Lead (total recoverable)	Yes	36	0.4	No Water Quality Criteria			0.28						
Lead (dissolved)	*	36	0.4	0.60	0.52	No	0.07	0.09	0.08	35.5	1.4	NO	NO
Mercury (total)	Yes	48	0.011	0.60	0.01	Yes	0.004	0.004	0.004	2.4	0.012	NO	NO
Nickel (total recoverable)	Yes	43	10.1	No Water Quality Criteria			0.92						
Nickel (dissolved)	*	43	10.1	0.60	12.12	No	0.76	1.36	0.90	269.6	30.2	NO	NO

Table 3-C-3. Reasonable Potential Analysis - Aquatic Toxicity - Domestic Facility

Determine Monitoring Reqs.		Identify Pollutants of Concern					Determine In-Stream Conc.			Determine Reasonable Potential			
Pollutant Parameter	RPA Evaluation Required?	# of Samples	Highest Effluent Conc.	Coefficent of Variation	Est. Maximum Effluent Conc.	RP at end of pipe?	Ambient Conc.	Max Total Conc. at ZID	Max Total Conc. at RMZ	WQ CRITERIA 1 Hour (CMC)	WQ CRITERIA 4 Day (CCC)	Is there Reasonable Potential to Exceed? (Yes/No) Acute	Is there Reasonable Potential to Exceed? (Yes/No) Chronic
	(Yes/No)		µg/l	Default=0.6	µg/l	(Yes/No)	µg/l	µg/l	µg/l	µg/l	µg/l	Acute	Chronic
Selenium (total recoverable)	Yes	29	1.2		No Water Quality Criteria		0.00						
Selenium (selenate+selenite,	*	29	1.2	0.60	1.68	No	0.00	0.09	0.02	13.0	4.6	NO	NO
Silver (total recoverable)	Yes	37	0.139		No Water Quality Criteria		0.10						
Silver (dissolved)	*	37	0.139	0.60	0.18	Yes	0.05	0.06	0.05	1.2	0.1	NO	NO
Zinc (total recoverable)	Yes	48	42.6		No Water Quality Criteria		5.54						
Zinc (dissolved)	*	48	42.6	0.60	51.12	No	3.57	6.07	4.14	68.8	69.3	NO	NO
Cyanide (total)	Yes	36	20		No Water Quality Criteria		0.00						
Cyanide (free)	*	36	20	0.60	26.00	Yes	0.00	1.37	0.31	22.0	5.2	NO	NO
Table 2: Volatile organic compounds													
Table 2: Acid-extractable compounds													
Pentachlorophenol	Yes	4	0.66	0.60	2.11	No	0.00	0.11	0.03	pH Data	pH Data	--	--
Table 2: Base-neutral compounds													
Table 3: Pesticides & PCBs													
Aldrin	*	--	--	0.60	--	--	*	--	--	3.0	--	--	--
BHC Gamma (Lindane)	*	--	--	0.60	--	--	*	--	--	1.0	0.1	--	--
Chlordane	*	--	--	0.60	--	--	*	--	--	2.4	0.0	--	--
Chlorpyrifos	*	--	--	0.60	--	--	*	--	--	0.1	0.0	--	--
Demeton	*	--	--	0.60	--	--	*	--	--	--	0.1	--	--
DDT 4,4'	*	--	--	0.60	--	--	*	--	--	1.1	0.0	--	--
Dieldrin	*	--	--	0.60	--	--	*	--	--	0.2	0.1	--	--
Endosulfan Alpha	No	--	--	0.60	--	--	*	--	--	0.2	0.1	--	--
Endosulfan Beta	No	--	--	0.60	--	--	*	--	--	0.2	0.1	--	--
Endosulfan	*	--	--	0.60	--	--	*	--	--	0.2	0.1	--	--
Endrin	*	--	--	0.60	--	--	*	--	--	0.1	0.0	--	--
Guthion	*	--	--	0.60	--	--	*	--	--	--	0.0	--	--
Heptachlor	*	--	--	0.60	--	--	*	--	--	0.5	0.0	--	--
Heptachlor Epoxide	*	--	--	0.60	--	--	*	--	--	0.5	0.0	--	--
Malathion	*	--	--	0.60	--	--	*	--	--	--	0.1	--	--
Methoxychlor	*	--	--	0.60	--	--	*	--	--	--	0.0	--	--
Mirex	*	--	--	0.60	--	--	*	--	--	--	0.0	--	--
Parathion	*	--	--	0.60	--	--	*	--	--	0.1	0.0	--	--
Toxaphene	*	--	--	0.60	--	--	*	--	--	0.7	0.0	--	--
Total PCBs	*	--	--	0.60	--	--	*	--	--	2.0	0.0	--	--
PCB- Aroclor 1016	No	--	--		No Water Quality Criteria		*						
PCB- Aroclor 1221	No	--	--		No Water Quality Criteria		*						
PCB- Aroclor 1232	No	--	--		No Water Quality Criteria		*						
PCB- Aroclor 1242	No	--	--		No Water Quality Criteria		*						
PCB- Aroclor 1248	No	--	--		No Water Quality Criteria		*						
PCB- Aroclor 1254	No	--	--		No Water Quality Criteria		*						
PCB- Aroclor 1260	No	--	--		No Water Quality Criteria		*						

Table 3-C-3. Reasonable Potential Analysis - Aquatic Toxicity - Domestic Facility

Determine Monitoring Reqs.		Identify Pollutants of Concern					Determine In-Stream Conc.			Determine Reasonable Potential			
Pollutant Parameter	RPA Evaluation Required?	# of Samples	Highest Effluent Conc.	Coefficent of Variation	Est. Maximum Effluent Conc.	RP at end of pipe?	Ambient Conc.	Max Total Conc. at ZID	Max Total Conc. at RMZ	WQ CRITERIA 1 Hour (CMC)	WQ CRITERIA 4 Day (CCC)	Is there Reasonable Potential to Exceed? (Yes/No) Acute	Chronic
	(Yes/No)		µg/l	Default=0.6	µg/l	(Yes/No)	µg/l	µg/l	µg/l	µg/l	µg/l	Acute	Chronic
Other parameters with state water quality criteria													
Sulfide Hydrogen Sulfide	*	--	--	0.60	--	--	*	--	--	--	2.0	--	--
Phosphorus, Elemental	*	--	--	0.60	--	--	*	--	--	--	--	--	--

Table 3-C-4. Reasonable Potential Analysis - Human Health - Domestic Facility

RPA Run Information	
Facility Name:	Gresham WWTP
DEQ File Number:	35173
Permit Writer Name:	0
Outfall Number:	1
Date of RPA Run:	1/30/2017
RPA Run Notes:	

Please complete the following General Facility Information

1. Do I have dilution value from a mixing zone study? (Y/N)		Y
2. Is the receiving waterbody fresh water? (Y/N)		Y
3. If answered "N" to *Question 1*, then fill in the following table		
Eff. Flow Rate	MGD	12.1
Stream Flow: Harmonic Mean	CFS	*
Stream FLow: 30Q5	CFS	*
% dilution at MZ	%	25%
Calculated dilution factors		
Dilution @ Harmonic Mean Flow		na
Dilution @ 30Q5		na

4. If answered "Y" to *Question 1*, then fill in dilution factors from mixing zone study		
Dilution @ RMZ under harmonic mean flow		84
Dilution @ RMZ under 30Q5 flow		84
5. Please enter statistical *Confidence* and *Probablity* values (note: defaults already entered)		
Max. Effluent Conc. %'ile	% 'ile	95%
Confidence Level	% 'ile	95%

Determine Monitoring Reqs.			Identify Pollutants of Concern					In-stream Conc.		Determine Reasonable Potential			
Pollutant Parameter	Carcinogen Status	Evaluation required?	# of Samples	Effluent Conc.	Coefficent of Variation	Est. Maximum Effluent Conc.	RP at end of pipe?	Ambient Conc.	Max Total Conc. at RMZ	WQ Criteria: Water + Fish	WQ Criteria: Fish	Is there Reasonable Potential to Exceed? (Yes/No): Water + Fish	Is there Reasonable Potential to Exceed? (Yes/No): Fish
Pollutant Type	(Y/N)	(Yes/No)		µg/l	default=0.6	µg/l	(Yes/No)	µg/l	µg/l	µg/l	µg/l	Water + Fish	Fish
Table 1 Effluent Parameters for all POTWs w/a Flow > 0.1 MGD													
Nitrates-Nitrite	N	Yes	6	####	0.60	364.09	No	*	--	10000	na	--	--
Table 2 Effluent Parameters for Selected POTWs													
Table 2: Metals (total recoverable), cyanide and totoal phenols													
Antimony (total recoverable)	N	Yes	36	0.36	0.60	0.41	No	0.00	0.0049	5.1	64	NO	NO
Arsenic (total recoverable)	Y	Yes	36	0.31	No Human Health Water Quality Criteria			0.86					
Arsenic (total inorganic)	Y	*	36	0.31	0.60	0.35	No	0.86	0.8540	2.1	2.1	NO	NO
Copper (total recoverable)	N	Yes	36	15.20	0.60	17.35	No	1.05	1.2441	1300	na	NO	--
Mercury (total)	N	Yes	36	0.011	No Human Health Water Quality Criteria			0.00					
Methyl Mercury	N	*	36	0.01	--	--	MMP Req'd	na	na	na	.040 mg/kg	MMP Req'd	MMP Req'd
Nickel (total recoverable)	N	Yes	36	5.98	0.60	6.83	No	0.82	0.8915	140	170	NO	NO
Selenium (total recoverable)	N	Yes	36	0.8	0.60	0.91	No	0.00	0.0109	120	420	NO	NO
Thallium (total recoverable)	N	Yes	36	0.11	0.60	0.13	Yes	0.00	0.0015	0.043	0.047	NO	NO
Zinc (total recoverable)	N	Yes	36	41.9	0.60	47.83	No	5.23	5.7372	2100	2600	NO	NO
Cyanide (total)	N	Yes	36	20	0.60	22.83	No	0.00	0.2718	130	130	NO	NO
Table 2: Volatile organic compounds													
Acrolein	N	Yes	4	nd	0.60	--	Non-Det.	*	--	0.88	0.93	--	--
Acrylonitrile	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.018	0.025	--	--

Table 3-C-4. Reasonable Potential Analysis - Human Health - Domestic Facility

Determine Monitoring Reqs.			Identify Pollutants of Concern					In-stream Conc.		Determine Reasonable Potential			
Pollutant Parameter	Carcinogen Status	Evaluation required?	# of Samples	Effluent Conc.	Coefficent of Variation	Est. Maximum Effluent Conc.	RP at end of pipe?	Ambient Conc.	Max Total Conc. at RMZ	WQ Criteria: Water + Fish	WQ Criteria: Fish	Is there Reasonable Potential to Exceed? (Yes/No)	
Pollutant Type	(Y/N)	(Yes/No)		µg/l	default=0.6	µg/l	(Yes/No)	µg/l	µg/l	µg/l	µg/l	Water + Fish	Fish
Benzene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.44	1.4	--	--
Bromoform	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	3.3	14	--	--
Carbon Tetrachloride	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.1	0.16	--	--
Chlorobenzene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	74	160	--	--
Chlorodibromomethane	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.31	1.3	--	--
Chloroform	N	Yes	4	1.60	0.60	4.14	No	0.00	0.0492	260	1100	NO	NO
Dichlorobromomethane	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.42	1.7	--	--
1,2-dichloroethane	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.35	3.7	--	--
1,2-trans-dichloroethylene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	120	1000	--	--
1,1-dichloroethylene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	230	710	--	--
1,2-dichloropropane	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.38	1.5	--	--
1,3-dichloropropene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.3	2.1	--	--
Ethylbenzene	N	Yes	4	0.10	0.60	0.26	No	0.00	0.0031	160	210	NO	NO
Methyl Bromide	N	Yes	4	nd	0.60	--	Non-Det.	*	--	37	150	--	--
Methylene Chloride	Y	Yes	4	--	0.60	--	--	*	--	4.3	59	--	--
1,1,2,2-tetrachloroethane	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.12	0.4	--	--
Tetrachloroethylene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.24	0.33	--	--
Toluene	N	Yes	4	0.36	0.60	0.93	No	0.00	0.0111	720	1500	NO	NO
1,1,2-trichloroethane	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.44	1.6	--	--
Trichloroethylene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	1.4	3	--	--
Vinyl Chloride	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.023	0.24	--	--
Table 2: Acid-extractable compounds													
2-chlorophenol	N	Yes	4	nd	0.60	--	Non-Det.	*	--	14	15	--	--
2,4-dichlorophenol	N	Yes	4	0.17	0.60	0.44	No	0.00	0.0052	23	29	NO	NO
2,4-dimethylphenol	N	Yes	4	nd	0.60	--	Non-Det.	*	--	76	85	--	--
Methyl-4,6-dinitrophenol	N	Yes	4	nd	0.60	--	Non-Det.	*	--	9.2	28	--	--
2,4-dinitrophenol	N	Yes	4	nd	0.60	--	Non-Det.	*	--	62	530	--	--
Pentachlorophenol	Y	Yes	4	0.24	0.60	0.62	Yes	0.00	0.0074	0.15	0.3	NO	NO
Phenol	N	Yes	4	4.40	0.60	11.38	No	0.00	0.1354	9400	86000	NO	NO
2,4,5-trichlorophenol	N	Yes	4	nd	0.60	--	Non-Det.	*	--	330	360	--	--
2,4,6-trichlorophenol	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.23	0.24	--	--
Table 2: Base-neutral compounds													
Acenaphthene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	95	99	--	--
Anthracene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	2900	4000	--	--
Azobenzene	na	Yes	4	nd	No Human Health Water Quality Criteria			*					
Benzidine	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	1.8E-05	2E-05	--	--
Benzo(a)anthracene	Y	Yes	4		0.60	--	--	*	--	0.0013	0.0018	--	--
Benzo(a)pyrene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.0013	0.0018	--	--
Benzo(b)fluoranthene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.0013	0.0018	--	--
Benzo(k)fluoranthene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.0013	0.0018	--	--

Table 3-C-4. Reasonable Potential Analysis - Human Health - Domestic Facility

Determine Monitoring Reqs.			Identify Pollutants of Concern					In-stream Conc.		Determine Reasonable Potential			
Pollutant Parameter	Carcinogen Status	Evaluation required?	# of Samples	Effluent Conc.	Coefficent of Variation	Est. Maximum Effluent Conc.	RP at end of pipe?	Ambient Conc.	Max Total Conc. at RMZ	WQ Criteria Water + Fish	WQ Criteria Fish	Is there Reasonable Potential to Exceed? (Yes/No) Water + Fish	Is there Reasonable Potential to Exceed? (Yes/No) Fish
Pollutant Type	(Y/N)	(Yes/No)		µg/l	default=0.6	µg/l	(Yes/No)	µg/l	µg/l	µg/l	µg/l	Water + Fish	Fish
Bis(2-chloroethyl)ether	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.02	0.053	--	--
Bis(2-chloroisopropyl)ether	N	Yes	4	nd	0.60	--	Non-Det.	*	--	1200	6500	--	--
Bis (2-ethylhexyl)phthalate	Y	Yes	4	0.74	0.60	1.91	Yes	0.00	0.0228	0.2	0.22	NO	NO
Butylbenzyl phthalate	N	Yes	4	0.26	0.60	0.67	No	0.00	0.0080	190	190	NO	NO
2-chloronaphthalene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	150	160	--	--
Chrysene	Y	Yes	4		0.60	--	--	*	--	0.0013	0.0018	--	--
Di-n-butyl phthalate	N	Yes	4	0.50	0.60	1.29	No	0.00	0.0154	400	450	NO	NO
Dibenzo(a,h)anthracene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.0013	0.0018	--	--
1,2-Dichlorobenzene (o)	N	Yes	4	0.04	0.60	0.10	No	0.00	0.0012	110	130	NO	NO
1,3-Dichlorobenzene (m)	N	Yes	4	nd	0.60	--	Non-Det.	*	--	80	96	--	--
1,4-Dichlorobenzene (p)	N	Yes	4		0.60	--	--	*	--	16	19	--	--
3,3-Dichlorobenzidine	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.0027	0.0028	--	--
Diethyl phthalate	N	Yes	4	0.91	0.60	2.35	No	0.00	0.0280	3800	4400	NO	NO
Dimethyl phthalate	N	Yes	4	0.10	0.60	0.26	No	0.00	0.0031	84000	110000	NO	NO
2,4-dinitrotoluene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.084	0.34	--	--
1,2-diphenylhydrazine	Y	No	4	nd	0.60	--	Non-Det.	*	--	0.014	0.02	--	--
Fluoranthene	N	Yes	4	0.04	0.60	0.11	No	0.00	0.0013	14	14	NO	NO
Fluorene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	390	530	--	--
Hexachlorobenzene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	2.9E-05	3E-05	--	--
Hexachlorobutadiene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.36	1.8	--	--
Hexachlorocyclopentadiene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	30	110	--	--
Hexachloroethane	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.29	0.33	--	--
Indeno(1,2,3-cd)pyrene	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.0013	0.0018	--	--
Isophorone	N	Yes	4	0.06	0.60	0.16	No	0.00	0.0018	27	96	NO	NO
Nitrobenzene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	14	69	--	--
N-nitrosodimethylamine	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.00068	0.3	--	--
N-nitrosodi-n-propylamine	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.0046	0.051	--	--
N-nitrosodiphenylamine	Y	Yes	4	nd	0.60	--	Non-Det.	*	--	0.55	0.6	--	--
Pentachlorobenzene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	0.15	0.15	--	--
Pyrene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	290	400	--	--
1,2,4-trichlorobenzene	N	Yes	4	nd	0.60	--	Non-Det.	*	--	6.4	7	--	--
Tetrachlorobenzene,1,2,4,5	N	Yes	4	nd	0.60	--	Non-Det.	*	--	0.11	0.11	--	--
Table 3: Pesticides & PCBs													
Aldrin	Y	*	--	--	0.60	--	--	*	--	5E-06	5E-06	--	--
BHC-Technical	Y	No	--	--	0.60	--	--	*	--	0.0014	0.0015	--	--
BHC Alpha	Y	No	--	--	0.60	--	--	*	--	0.00045	0.0005	--	--
BHC Beta	Y	No	--	--	0.60	--	--	*	--	0.0016	0.0017	--	--
BHC-delta		No	--	--	No Water Quality Criteria			*					
BHC Gamma (Lindane)	N	*	--	--	0.60	--	--	*	--	0.17	0.18	--	--

Table 3-C-4. Reasonable Potential Analysis - Human Health - Domestic Facility

Determine Monitoring Reqs.			Identify Pollutants of Concern					In-stream Conc.		Determine Reasonable Potential			
Pollutant Parameter	Carcinogen Status	Evaluation required?	# of Samples	Effluent Conc.	Coefficent of Variation	Est. Maximum Effluent Conc.	RP at end of pipe?	Ambient Conc.	Max Total Conc. at RMZ	WQ Criteria Water + Fish	WQ Criteria Fish	Is there Reasonable Potential to Exceed? (Yes/No)	
Pollutant Type	(Y/N)	(Yes/No)		µg/l	default=0.6	µg/l	(Yes/No)	µg/l	µg/l	µg/l	µg/l	Water + Fish	Fish
Chlordane	Y	*	--	--	0.60	--	--	*	--	8.1E-05	8E-05	--	--
DDD 4,4'	Y	*	--	--	0.60	--	--	*	--	3.1E-05	3E-05	--	--
DDE 4,4'	Y	*	--	--	0.60	--	--	*	--	2.2E-05	2E-05	--	--
DDT 4,4'	Y	*	--	--	0.60	--	--	*	--	2.2E-05	2E-05	--	--
Dieldrin	Y	*	--	--	0.60	--	--	*	--	5.3E-06	5E-06	--	--
Endosulfan Alpha	N	No	--	--	0.60	--	--	*	--	8.5	8.9	--	--
Endosulfan Beta	N	No	--	--	0.60	--	--	*	--	8.5	8.9	--	--
Endosulfan Sulfate	N	*	--	--	0.60	--	--	*	--	8.5	8.9	--	--
Endrin	N	*	--	--	0.60	--	--	*	--	0.024	0.024	--	--
Endrin Aldehyde	N	*	--	--	0.60	--	--	*	--	0.03	0.03	--	--
Heptachlor	Y	*	--	--	0.60	--	--	*	--	7.9E-06	8E-06	--	--
Heptachlor Epoxide	Y	*	--	--	0.60	--	--	*	--	3.9E-06	4E-06	--	--
Methoxychlor	N	*	--	--	0.60	--	--	*	--	100	na	--	--
Toxaphene	Y	*	--	--	0.60	--	--	*	--	2.8E-05	3E-05	--	--
Total PCBs	Y	No	--	--	0.60	--	--	*	--	6.4E-06	6E-06	--	--
PCB- Aroclor 1016	Y	No	--	--	No Water Quality Criteria			*					
PCB- Aroclor 1221	Y	No	--	--	No Water Quality Criteria			*					
PCB- Aroclor 1232	Y	No	--	--	No Water Quality Criteria			*					
PCB- Aroclor 1242	Y	No	--	--	No Water Quality Criteria			*					
PCB- Aroclor 1248	Y	No	--	--	No Water Quality Criteria			*					
PCB- Aroclor 1254	Y	No	--	--	No Water Quality Criteria			*					
PCB- Aroclor 1260	Y	No	--	--	No Water Quality Criteria			*					
Other parameters with state water quality criteria													
Barium (total recoverable)	N	*	--	--	0.60	--	--	*	--	1000	na	--	--
Manganese (total	N	*	--	--	0.60	--	--	*	--	Withdrawn	100	--	--
Chlorophenoxy Herbicide (2,4,5,-TP)	N	*	--	--	0.60	--	--	*	--	10	na	--	--
Chlorophenoxy Herbicide (2,4,-D)	N	*	--	--	0.60	--	--	*	--	100	na	--	--
Dioxin (2,3,7,8-TCDD)	Y	*	--	--	0.60	--	--	*	--	5.1E-10	5E-10	--	--
Nitrosodibutylamine, N	Y	*	--	--	0.60	--	--	*	--	0.005	0.022	--	--
Nitrosodiethylamine, N	Y	*	--	--	0.60	--	--	*	--	0.00079	0.046	--	--
Nitrosopyrrolidine, N	Y	*	--	--	0.60	--	--	*	--	0.016	3.4	--	--

Attachment 3-D
DEQ Guidance on SB212

2001 Land Application Laws &
DEQ's Procedure for Proposals to Land Apply Reclaimed Water, Industrial Process Water, and Biosolids on Exclusive Farm Use (EFU) Lands

State of Oregon
Department of Environmental Quality

Water Quality Division
811 SW 6th Avenue
Portland, OR 97204
Phone: (503) 229-5696
(800) 452-4011
Fax: (503) 229-5850
Contact: Mark Cullington or Roberta Young
www.deq.state.or.us

Purpose: This document is intended to provide information on the 2001 Legislative Act relating to land application practices and land use regulations (Senate Bill 212), and also describes the steps that the Department of Environmental Quality (DEQ) uses to process land application proposals in compliance with this Act.

History and Benefits of Land Application: The land application of organic residuals and reuse of wastewater (reclaimed water) has been practiced in Oregon and nationally for decades. When done in accordance with appropriate environmental regulations and guidance, land application is beneficial for a number of reasons. Biosolids contain soil amendment properties as well as important nutrients that can improve crop production. Reclaimed water and industrial process water can provide nutrient benefits and reduce the demand for irrigation water from ground or surface water sources. The use of reclaimed water can also reduce the demand for potable water supplies, which can be used instead for drinking water and instream flow protection. Water quality and water availability continue to be serious issues confronting growing communities in Oregon. Finding appropriate uses for reclaimed water, industrial process water, and biosolids are necessary options for many communities in their efforts to comply with federal and state water quality laws. The practice of land application presents important conservation potential and helps extend existing water supplies. Organic residuals and wastewater that were once considered waste products to be disposed, are now valuable resources.

Until the passage of the 2001 legislation, there was considerable uncertainty regarding the land use requirements for land application on EFU zoned lands. Questions existed about whether particular land application activities were farm uses, utility facilities or something else. In 1999, Jackson County approved the City of Ashland's land application proposal as a farm use without making a formal land use decision, and signed-off accordingly on DEQ's Land Use Compatibility Statement (LUCS). This decision was appealed by a citizen group to the Land Use Board of Appeals (LUBA). LUBA concluded that the County's decision constituted a "land use decision" under ORS 197.015 (10)(b)(A) and that the County failed to provide public notice and an opportunity for hearing. LUBA also determined that under current law in this case, and using the appropriate decision-making process, land application may be determined a farm use or a utility facility use. The City appealed the decision to the Court of Appeals. The Department of Land Conservation and Development (DLCD), Department of Agriculture (ODA) and DEQ submitted an amicus brief, which supported the position that county notice and opportunity for hearing should be required for land application activities. The Court of Appeals upheld LUBA's decision on this point. In another case, Cox v. Polk County, the Court of Appeals reversed LUBA's decision that the proposed land application was a utility facility, however let stand the county and LUBA's determination that the proposed use was a farm use.

The Ashland court case triggered a mediation that involved the affected agencies and interested parties. Key issues identified in the mediation process included:

- The lack of direct reference to land application as an allowable use in the EFU statutes (ORS 215); and, uncertainty over whether such activities were a "farm use" or a "utility facility".
- Land application practices and regulations and related public health and safety issues.
- The implications of city ownership of EFU land and land application practices on available EFU land in the State, particularly on lands adjacent to Urban Growth Boundaries.

Legislative Remedy: In 2001, the Legislature approved Senate Bill 212, amending ORS 215.213 and 215.283. Highlights of the Act include:

- Subject to issuance of a permit or approval by DEQ, land application of industrial process water, reclaimed water and biosolids is an allowed use on EFU zoned land. Because land application is listed as an allowed use in ORS 215.213(1), counties may not impose additional land use restrictions or conditions on land application practices, beyond those specified in the statute.
- Other facilities or uses on the same EFU tract are included in the allowed use if they are accessory to and reasonably needed for land application to occur on the proposed site. The Act also disallows certain uses, e.g. utility facility service lines.
- Before a county land use decision is made on a land application proposal, the applicant responds in writing to public comments received by the county that identify alternative sites or methods for managing the industrial process water, reclaimed water or biosolids. The applicant's response describes how the alternative sites or methods were considered and why they were not selected. The land use decision can not be remanded or reversed, unless the applicant fails to provide a written response when required.
- DEQ is required to determine, through its review and approval process, that the practice of land application will not reduce the productivity of the subject land.
- Land application of biosolids is exempt under the Act when transported by vehicle to EFU land (a DEQ LUCS is not required).
- Land application of materials that are not described in the Act are not subject to the Act's provisions, e.g. confined animal feeding operation wastes.
- Land division, for purposes of land application, is not allowed in EFU zones.
- Restrictions apply in changing the use of land where land application practices has occurred.

Process for Land Application Proposals: As the State Agency that issues environmental approval for land application practices, DEQ has consulted with the DLCD, ODA, and Department of Human Services (DHS) to ensure that its process meets the intent of the new Act. The following steps described below apply to:

- New land application proposals (except those involving vehicle transport of biosolids).
- Significant modifications to permits, approvals and permit renewals, e.g. use of additional lands.

1. The applicant obtains the required DEQ application and LUCS forms, and submits the LUCS to the county planning office for its review and approval.
2. The county conducts its land use review process in accordance with the requirements under the Act.

3. The county completes the LUCS form and returns it to the applicant with the attached findings:
   - The proposed activity constitutes land application for purposes of agricultural, horticultural, silviculture production, or for irrigation in connection with a use allowable in EFU zoned land under ORS 215.
   - Any proposed facilities necessary for the land application practice to occur on the subject site are accessory to and reasonably necessary as allowed by the Act.
   - Approval of the LUCS is subject to DEQ's issuance of the necessary environmental approvals or permits.
4. The applicant submits the DEQ application and approved LUCS to DEQ for processing. DEQ processes the application and conducts a technical review in accordance with its rules. The review, depending on what material is applied to the land, may include the following:
   - Pollutant and nutrient testing
   - Determination of agronomic rate
   - Determination of agronomic or pollutant loading
   - Determination of water assimilation capacity
   - Site assessment and evaluation
   - Crop type and cropping system
   - Application methods and equipment requirements
   - Site access and harvest restrictions
   - Monitoring requirements
   - A written determination that the land application activity will not reduce the productivity of the land in question.
5. DEQ submits all Reclaimed Water Reuse Plans to the DHS for comment (OAR 340-055-0015(2)), and consults with DHS on any effluent quality limitations (OAR 340-055-0015(4)).
6. Applicants intending to land apply reclaimed water are required to submit a "Registration of Reclaimed Water Use" form (http://www1.wrd.state.or.us/pdfs/reclaimform96.pdf) to the Water Resources Department (ORS 537.131, 537.132 and 537.610(h)). Either agency can supply applicants with this form, however it requires a DEQ signature.
7. DEQ issues an approval or denial to the applicant, and provides a copy to the county planning office.

In situations where a LUCS is denied or appealed:

1. When DEQ receives a county-denied LUCS, the applicant is informed that DEQ can not process the application until county approval is provided.
2. If a county land use decision is appealed after DEQ receives an approved LUCS, DEQ's policy is to process the application unless ordered otherwise by a court stay or invalidation of the county decision. A county may withdraw or modify its LUCS decision before the permit is issued.
3. If a county-approved LUCS is successfully appealed after DEQ issues a permit, DEQ may revoke or suspend the permit, or delay its decision until the appeals process is exhausted. In making its decision, DEQ consults closely with the applicant and county government.

Attachment 3-E
City of Gresham TAZ Population Projections

Table 3-E. City of Gresham TAZ Population Projections

	Gresham Population	Fairview Population	Wood Village Population	Springwater Annexation Area TAZ ID 476, 475	Pleasant Valley Annexation Area TAZ ID 469, 470	Total
US Census Estimates						
2010 Census Est	105,594	8,920	3,878			
2011 Census Est	107,549	9,039	3,929			
2012 Census Est	108,794	9,144	3,959			
2013 Census Est	109,371	9,189	3,973			
2014 Census Est	110,109	9,243	3,996			
2015 Census Est	110,553	9,280	4,017			
2016 Census Est	N/A	N/A	N/A			
2010 Ave HH size	2.69	2.51	3.11			
TAZ Estimates						
TAZ 2010 Estimate	103,798	9,141	4,880	465	269	
TAZ 2015 Estimate	112,892	9,722	5,128	512	300	
TAZ 2040 Estimate	128,147	10,283	5,489	1169	871	
TAZ HH 2010 Estimate	38,049	3,631	1,539	185	107	
TAZ HH 2015 Estimate	39,155	3,655	1,530	193	113	
TAZ HH 2040 Estimate	47,567	4,132	1,751	471	351	
Ave People per HH 2010	2.73	2.52	3.17	2.51	2.51	
Ave People per HH 2015	2.88	2.66	3.35	2.65	2.65	
Ave People per HH 2040	2.69	2.49	3.13	2.48	2.48	
TAZ Potential Buildout by HH	55,491	5,088	2,193	1,351	4,480.0	
HH * Average Buildout 2040	149,495	12,662	6,875	3,353	11,117	183,501

Notes:

2011-2015 are estimates from the US Census see:

\\Gresham.gov\cog\Inter-Departmental\MapsAndData\Projects\2017\01\25336\DerivedData\PEP_2015_PEPANNRES.xls

N/A = Non Applicable

2040 GIS Notes:

Used Metro TAZ data selected polygons that have their centroid in the selected geography, include KCHW (Kelly Creek Headwaters Plan Area) section.

Used the current city limits for calculations.

Note TAZ zone 619 straddles Wood Village and Fairview this lot was calculated for Wood Villge

Added TAZ 472 to Gresham count, the centroid was just off the center

CHAPTER 4

Alternatives Analysis

4.1 Summary

This alternatives analysis focused on evaluating options to address the following needs that were identified in Chapter 2, Existing Conditions, and Chapter 3, Planning Criteria and Discharge Considerations:

- An anticipated effluent ammonia permit limit
- Assessing the capacity of the GBTs after the WWTP begins operating in co-thickening mode
- Improving the reliability and performance of anaerobic digestion focusing on:
  - Ability to continue and potentially further expand acceptance of external high-strength waste
  - Digestion redundancy
  - Attaining Class A biosolids
  - Reducing the volume of biosolids that is beneficially reused
- Determining additional cake storage needs, if any, for each the considered anaerobic digestion alternatives

Resulting recommendations are either near-term (to occur within 5 years), intermediate-term (to occur within 5 to 10 years), or long-term (to occur greater than 10 years) projects. Near-term operational changes or projects include the following:

- Nitrify Upper Plant during the dry season:
- Improve diffusers in Upper Plant aeration basins
- Add a fourth blower or upgrade existing Upper Plant blowers
- Conduct effluent mixing zone study
- Conduct Columbia River water quality monitoring study for pH, copper, alkalinity, and hardness as required by DEQ and associated with NPDES permit renewal
- Operate digesters in parallel with co-thickening (improvements to better enable operation of the WWTP in this manner are currently in progress)
- Implement digester solids and biogas improvements (these improvements are currently in progress and include repairing the cover seal on the primary digester, providing modifications to enable parallel feed to the digesters including associated pressure and level instrumentation, providing larger overflow and pressure relief hatches to help mitigate foaming/rapid-rise events and other safety improvements, installing larger piping to accommodate additional biogas generation, and refurbishing the BFPs.
- Implement dewatering performance improvements (for example, piloting of the Orege SLG pretreatment of BFP feed sludge, which if demonstrated to be effective at sufficiently increasing cake solids and/or reducing polymer use will be made permanent)
- Conversion to Class A biosolids program if City deems necessary to respond to community expectations within the next 5 years (placeholder budget has been established assuming use of thermal hydrolysis; technology to be further analyzed and determined during predesign if conversion to Class A is deemed necessary)

Intermediate-term projects include the following:

- Add new Upper Plant secondary clarifier for redundancy and more reliable nitrification operation
- Automate influent diversion structure
- Construct septage receiving station

Long-term projects include the following:

- Make further anaerobic digester stabilization improvements if conversion to Class A program is not pursued in the near term. The technology selection should be reevaluated during the next WWTP MP Update. For this MP Update, the costs to upgrade to Class B thermophilic digestion is used as the basis for the budget placeholder.
- Evaluate alternative biogas handling/utilization (i.e., clean biogas for injection into high-pressure natural gas line).
- Construct a bridge over Columbia Slough to provide better access for biosolids trucks to the property to the north if future projects such as biosolids composting or solar drying are determined to be needed.

Specific project phasing of future unit processes is addressed in Chapter 6, Recommended Improvements."

4.2 Introduction

The purpose of this chapter is to document the alternatives analysis of liquids and solids treatment processes improvements to accommodate projected growth, meet current and future anticipated regulatory requirements, and provide an enhanced level of service. Figure 4-1 shows the Gresham WWTP existing site layout.

Figure 4-1. Gresham WWTP Existing Site Layout

In Chapter 2, Existing Conditions, a unit process evaluation was completed that indicated that under the current operating approach, no additional units are needed during the planning period (through 2036) for screening, grit removal, primary clarification, chlorine contact basin, waste-activated sludge (WAS) thickening, anaerobic digestion, and digested sludge dewatering, as shown in Table 4-1. Furthermore, aside from redundancy requirements, no additional capacity is needed during the planning period in secondary treatment and solids stabilization assuming the current permit requirements remain unchanged. Chapter 3, Planning Criteria and Discharge Considerations, concluded that the City should take measures to lower current effluent ammonia concentrations to reduce the likelihood of receiving a permit limit from DEQ during NPDES permit renewal.

Table 4-1. Summary of Improvements to Provide Capacity

	Recommended Improvements		
Unit Process	**Next 5 years (2022)**	**2036**	**Comments**
Liquids			
Influent Screens	None	None	
Grit Removal	None	None	No redundancy.
Primary Clarifiers	None	None	
Aeration Basins	Upper Plant modifications so that dry season nitrification is possible at design condition	None	A new Upper Plant aeration basin may be required if an ammonia discharge limit more stringent than anticipated is established.
Secondary Clarifiers	One new for Upper Plant	None	Primarily for redundancy but also to more reliability during dry season nitrification.
Disinfection	None	None	Defer additional contact basins or conversion to ultraviolet light by increasing sodium hypochlorite dosage during peak flow events.
Effluent Discharge Parshall Flume	None	None	
Solids			
Thickening (GBTs)	None	None[a]	
Digestion	None (but without redundancy)	None	No redundancy; DSMM is limiting condition.
Dewatering (BFPs)	None[b]	None	With both units operating, no additional units required under current operating approach (10 hours per day; 7 days per week); with one unit out, would need to operate the remaining unit approximately 12.5 hours per day to address solids loading limitation.
Biosolids Storage	None	Approximately 3 additional bays	Number of additional bays and phasing will depend on long-term digestion approach ultimately selected.

[a] Existing GBTs will have exceeded their useful design life and will need to be refurbished/replaced (and then again approximately every 10 years).
[b] Refurbishment/replacement of existing BFP units (approximately every 10 years).
DSMM = dry season maximum month

4.3 Alternatives Analysis

Each major unit process was reviewed for this MP Update. The alternatives analysis described below focused on evaluating options to address the needs identified in Chapter 2, Existing Conditions, and Chapter 3, Planning Criteria and Discharge Considerations. These include:

- An anticipated effluent ammonia permit limit
- Assessing the capacity of the GBTs after the WWTP begins operating in co-thickening mode
- Improving the reliability and performance of anaerobic digestion focusing on:
  - Ability to continue and potentially further expand acceptance of external high-strength waste
  - Digestion redundancy
  - Attaining Class A biosolids
  - Reducing the volume of biosolids that is beneficially reused
- Determining additional cake storage needs, if any, for each the considered anaerobic digestion alternatives

4.3.1 Influent Diversion Structure

The existing influent diversion structure processes approximately 95 percent of flows and is designed to send 60 percent of flow to the Upper Plant and 40 percent of flow to the Lower Plant. All flow that does not pass through the influent diversion structure enters the Lower Plant. This includes flow that is piped directly to the Lower Plant from the Fairview Trunk, 185th Pump Station, and Interlachen Pump Station. Flow is split with two manual gates that are not used very often. As noted in the 2011 MP Update, it is recommended that the gates at the influent diversion structure be automated to control flow to the Upper and Lower Plants.

4.3.2 Septage Receiving Facility

This subsection provides a preliminary assessment of whether the City should further investigate developing a septage receiving program. Haulers periodically pump out septage from onsite septic tank/drain field systems, so there is a demand in the region for locations where the haulers can empty their trucks. Portable chemical toilet waste could also be accepted as part of this program.

In 2013 the Biosolids & Recycled Water Committee of ACWA conducted a septage survey (ACWA, 2013). The survey was sent electronically in January 2013 to each ACWA member organization and 46 responses were returned. Survey responses are summarized as follows:

- 21 wastewater utilities responding indicated that they accepted septage; septage flow ranged from negligible to 0.6 percent of the total plant flow, with 0.08 percent being the average for all 21 respondents.
- 55 percent of the septage receiving programs also accepted chemical toilet waste.
- 14 percent of the programs also accepted grease trap waste.
- 70 percent discharged the septage to the headworks; the remaining 30 percent discharged the septage to a main line before the wastewater facility.
- 96 percent treated the septage at the wastewater facility; 4 percent utilized a separate treatment process.
- 37.5 percent employed screening equipment prior to discharge to the wastewater facility; 62.5 percent relied on the headworks screening equipment.

- 20 percent of the programs did not add chemicals to enhance treatment of the septage; one facility pretreated the septage with chlorine dioxide.
- 11 percent used flow equalization/metering; 89 percent discharged to the wastewater facility in batches.
- The survey respondents charged the septage haulers 7 to 15 cents per gallons (10 cents on average); additional miscellaneous program fees include out-of-county surcharge fees, lab test fees, initial and/or ongoing annual permitting fees, and pollutant strength loading surcharge fees.

In the vicinity of Gresham, only the Tri-City Water Pollution Control Plant and Kellogg Creek Water Pollution Control Plant (only if generated in the City of Milwaukie) accept septage in Oregon. Both plants are managed by Clackamas County Water Environment Services. Facilities in the cities of Portland (Columbia Boulevard and Tryon Creek facilities), Oak Lodge, and Troutdale do not accept septage. Vancouver's Westside plant also accepts septage across the Columbia River.

The City of Salem recently commissioned a new Construction Waste Processing and Transfer Center (CWPTC). A significant element of the CWPTC is a septage receiving facility that replaced the existing facility (which was located at the City's Public Works compound). A key aspect that the City wanted to retain was locating the septage receiving station remotely to enable the waste to be blended with the raw sewage prior to the Willow Lake Water Pollution Control Facility and allow for a time delay if any illicit and/or hazardous discharges needed to be retained or diverted.

The new Salem septage receiving facility features a two-stall facility to accommodate the septic truck traffic volume experienced at the City's current septage receiving facility. Haulers that used the facility at Public Works indicated a desire to use larger trucks carrying 5,500–6,000 gallons (up to 10,000 gallons) rather than standard trucks (2,000–3,000 gallons). The new facility can accommodate these larger trucks and the driveway to this septage receiving facility provides ample room for parking up to three double-trailer septage trucks to accommodate busy times. Controls for the facility function similarly to those at the Public Works facility, with a key pad to control access, identify haulers, and activate screening equipment and flowmeters to measure discharge so that haulers are charged accurately. The discharge is also monitored for high pH, low pH, and volatile organic compounds; equipment automatically shuts down if standards are exceeded. The facility is designed to typically operate unmanned with connections to the City's supervisory control and data acquisition (SCADA) system to allow remote monitoring. The facility is inspected daily by operations staff and equipment requires periodic maintenance by staff assigned to the CWPTC.

Salem's septage receiving building is an approximately 6,000-square-foot, pre-engineered steel structure that is intended to be a drive-through facility. In addition to providing two bays for septage haulers, the facility is slated to include a restroom for use by drivers. Between the two bays is an enclosed and odor-controlled area that houses the grinder/screening equipment. The facility includes a rock trap to alleviate maintenance problems. The removed large debris is cleaned and discharged into a large roll-off dumpster. Personnel access to this enclosed area is from an exterior double door. Roll-off access is provided via a garage door to allow easy removal and replacement of the dumpster.

Averaging the Salem bid tab amounts from the three lowest respondents, the costs directly attributable to the septage receiving facility total approximately $980,000 (construction cost only). The City expects to pay for the facility through the hauler tipping fees (approximately 10 cents per gallon) in less than 10 years.

Gresham's septage facility could be located to the west of the Upper Plant aeration basin along the road that provides access to the biosolids storage bays. The total project costs for a Gresham facility similar to the recently constructed Salem facility would cost $1,200,000 (minus 30%) to $2,600,000 (plus 50%) with a median cost of $1,700,000.

Benefits of a septage receiving program include an additional revenue source from the tipping fees (the City would probably charge approximately 10 cents per gallon) and a community service that may decrease the likelihood of illicit dumping into City manholes or elsewhere.

One potential disadvantage is the risk of receiving illicit discharges at the receiving facility that could adversely impact the WWTP process, cause effluent permit violations, and/or adversely impact the biosolids land application program. Other disadvantages include the effort and cost required to develop and manage the program, and increased use of WWTP capacity.

Based on the average values from the 2013 ACWA survey, septage would be 0.08 percent of the total Gresham WWTP influent and would have a negligible impact on hydraulic capacity. From an organic loading standpoint, assuming the average values from the 2013 ACWA study, septage would provide about 4 percent of the total BOD/TSS load. Due to future concerns of effluent ammonia permit limits, ammonia loadings would have to be monitored closely.

Possible locations for a septage receiving facility include south of the Upper Plant headworks (the southeast corner of the site), the northeast corner of the site, west of the Upper Plant aeration basin and offsite. Security cameras could be installed for monitoring activity at the facility. Locating the facility on the east side of the site is ideal in terms of minimizing pumping/piping distances for feeding into either the Upper or Lower Plant headworks. However, due to noise and odor concerns with the neighbors to the east and because of minimal transit time for illicit discharges, these locations are not recommended. West of the Upper Plant aeration basin provides good access for the haulers away from the core of the WWTP. This location was used as a placeholder for the purposes of this preliminary assessment. While an offsite location has the benefits of providing additional transit time for dilution as well as to detect illicit discharges and contain or divert those flows if necessary, identifying a location that would be acceptable to the community and the haulers (in term of accessibility) may be challenging.

Gresham's septage receiving program would include:

- Modifying the City's industrial pretreatment program to include the septage receiving program
- Developing sampling requirements (e.g., pH, BOD, TSS, ammonia) and planning for potential illicit discharges (e.g., holding times)
- Reaching out to septage haulers in the area to assess their interest and their price point for bringing the material to Gresham
- Developing a security plan for the facility.

A septage receiving program is a potential new revenue source for Gresham WWTP. If Gresham wishes to pursue it, a more detailed, site-specific study should be undertaken that includes a facility siting evaluation, an economic feasibility assessment, and the programmatic components outlined above. In the meantime, a placeholder project budget for a septage receiving facility is included in the recommended plan presented in Chapter 6.

4.3.3 Preliminary Treatment

For preliminary treatment capacity analysis, it was assumed that influent flow was split 33 percent to the Upper Plant and 67 percent to the Lower Plant because the Upper Plant capacity is limited by the secondary clarifier (SC4) surface overflow rate design criteria limitations under peak flow conditions (see secondary clarifier capacity assessment in Section 2.4.5).

4.3.3.1 Influent Screens and Grit Removal

No additional capacity is needed for influent screens and grit removal during the planning period. The 2011 MP Update identified the need to add a passive bypass screenings channel to provide redundancy for the projected wet season peak hour flows (59 mgd in 2030).

This MP Update estimates the wet season peak hour flow in 2036 to be 47.5 mgd (see flow and load projections in Chapter 3). Based on this lower peak flow projection, the passive bypass screenings channel would not be necessary as the existing firm capacity of influent screening is 55.5 mgd (see Chapter 2).

4.3.4 Primary Treatment

4.3.4.1 Primary Clarifiers

As documented in Chapter 2, no additional capacity is needed for primary clarification.

4.3.5 Secondary Treatment

In Chapter 3, Planning Criteria and Discharge Considerations, the most probable future ammonia effluent permit limits in the dry season (May through October) were estimated at 39 mg/L (30-day average) and 40 mg/L (daily maximum). These values are based on a Columbia River pH of 8.2. The worst-case limits for this same dry season scenario were estimated at 24 mg/L (30-day average) and 23 mg/L (daily maximum) and were based on a Columbia River pH of 8.5. For this alternative analysis, it was assumed that the effluent performance would need to attain 25 percent less than these estimated permit limit values as shown in Table 4-2.

Table 4-2. Effluent Ammonia Limits Utilized for Alternative Analysis

Dry Season Permit Condition	Most Probable Estimated Effluent Ammonia Limit Based on Columbia River pH of 8.2 (with 25% safety factor applied)	Worst Case Estimated Effluent Ammonia Limit Based on Columbia River pH of 8.5 (with 25% safety factor applied)
Monthly Average	39 mg/L (29.3 mg/L)	24 mg/L (18 mg/L)
Maximum Day	40 mg/L (30 mg/L)	23 mg/L (17.25 mg/L)

Based on the capacity analysis in Chapter 2, Existing Conditions, the Lower Plant is limited by aeration basin volume and the Upper Plant is limited by secondary clarification. Therefore, the analysis focused on nitrifying in the Upper Plant instead of in the Lower Plant because additional aeration basin capacity in the Upper Plant is better suited to support a longer SRT needed for nitrification.

The following alternatives were evaluated for complying with these future anticipated effluent ammonia limits:

- Alternative 1 – Nitrify Upper Plant
  - 1a – Plug Flow Operation
  - 1b – Step Feed Operation
  - 1c – Step Feed Operation with Seeding Lower Plant with Upper Plant Sludge
- Alternative 2 – Chemically Enhanced Primary Treatment (CEPT)
  - 2a – CEPT in Upper and Lower Plants
  - 2b – CEPT in Upper and Lower Plants - Upper Plant WAS to Lower Plant
- Alternative 3 – Post-Aerobic Digestion
- Alternative 4 – Sidestream Treatment of BFP Filtrate

- Alternative 5 – Integrated Fixed-Film Activated Sludge
- Alternative 6 – Granular Activated Sludge

4.3.5.1 Alternative 1a/1b – Nitrify Upper Plant (Either Plug Flow or Step Feed Operation)

The first alternative for reducing the dry season ammonia effluent at the Gresham WWTP is increasing the SRT in the Upper Plant during the dry season. Autotrophic bacterial species that oxidize ammonia grow significantly slower than heterotrophic bacteria that consume BOD. Increasing the SRT to approximately 6 days from 2 to 3 days will provide sufficient time to sustain a population of autotrophic ammonia-oxidizing bacteria even at the lowest expected dry season water temperatures of 17°C in the shoulder months (May and October). Both the Upper and Lower Plants are currently operated at an SRT of 3 days or less, and these short SRTs have not provided sufficient time for the ammonia-oxidizing bacteria to thrive in the biological reactors at either plant. While the Lower Plant does not have sufficient volume to support a 6-day SRT, sufficient capacity is available in the aeration basin at the Upper Plant.

Nitrification at the Upper Plant was modeled at 2036 DSMM conditions with a 6-day SRT in both plug flow and step-feed configurations. 2036 dry season max month influent conditions were defined in Attachment 3-B from Chapter 3 as 15.8 mgd flow, 27,921 lb/day BOD, 27,059 lb/day of TSS, and 3,510 lb/day of ammonia. Approximately 59 percent of flow (9.3 mgd) was routed to the Upper Plant while the remaining 41 percent (6.5 mgd) was routed to the Lower Plant. The Upper Plant flow was limited to 9.3 mgd because that was the WSMM capacity as limited by secondary clarifier surface overflow rate design criteria. Operating the Upper Plant aeration basin in plug flow resulted in essentially the same ammonia effluent from both the Upper Plant and the combined plant effluent when operating in step-feed configuration. Ammonia effluent results from the model for the two modes of operation are shown in Table 4-3. The slight difference in the Lower Plant effluent ammonia is a result of changes in the composition of the recycle streams routed to the Lower Plant aeration basins, and is not due to any modeled operational change at the Lower Plant.

Table 4-3. Ammonia Effluent from Nitrifying the Upper Plant

2036 DSMM Condition	Upper Plant	Lower Plant	Combined Effluent
Plug Flow	0.4 mg/L	20.6 mg/L	9.0 mg/L
Step Feed	0.7 mg/L	20.7 mg/L	9.3 mg/L

Blowers

The plant model predicts a total daily average aeration demand in the Upper Plant of approximately 10,200 and 11,100 scfm at 2020 and 2036 max month conditions, respectively. This demand is significantly lower than the total blower capacity of 15,900 scfm currently installed at the plant, but is greater than the firm capacity of 10,600 scfm. CH2M also simulated the air demand at peak hour assuming that the DO concentration is 1.0 mg/L on peak day. The peak hour air demands are 12,700 and 13,800 scfm at 2020 and 2036 conditions, respectively. Table 4-4 summarizes these estimated aeration demands during the dry season at two significant loading conditions.

Table 4-4. Upper Plant Airflow Demands, scfm

Dry Season Flow Condition	Airflow Required	Existing Capacity (firm/total)
2020		
2020 Max Month Average Airflow Requirement	10,200	10,600/15,900
2020 Max Day Peak Diurnal Airflow Requirement	12,700	

Table 4-4. Upper Plant Airflow Demands, scfm

Dry Season Flow Condition	Airflow Required	Existing Capacity (firm/total)
2036		
2036 Max Month Average Airflow Requirement	11,100	10,600/15,900
2036 Max Day Peak Diurnal Airflow Requirement	13,800	

CH2M recommends installing an additional blower in the blower building to increase the total firm aeration capacity of the Upper Plant to 15,900 scfm so that redundancy is provided at peak hour air demands.

Diffusers

The number of fine bubble diffusers installed in the Upper Plant varies by cell, and was designed with a specific taper set at specific step-feed points. However, the drop-off in number of diffusers from Cell C to the similarly sized cells D and E is too great, as shown in Table 4-5. Cells A and B are typically operated as anaerobic/anoxic selectors with the mixers turned on but no airflow to the diffusers. Fine bubble diffusers generally should not be operated above 4 scfm/diffuser on a continuous basis, or above 5 scfm/diffuser at peak conditions. It is recommended that the diffuser grids in cells D and E be replaced, as both cells will have airflows well above 4 scfm/diffuser at 2036 max month conditions.

Table 4-5. Airflow Per Diffuser in the Upper Plant

Cell	A	B	C	D	E	F	G	H	Total
Number of Diffusers	540	450	880	296	296	924	480	352	3,228[a]
Airflow Rate, scfm	0	0	2,811	1,583	1,368	2,526	1,652	1,171	11,110
Airflow Rate per Diffuser, scfm	0	0	3.19	5.35	4.62	2.73	3.44	3.33	N/A

[a] Total number of diffusers including Cells A and B is 4,218; 3,228 is the total of Cells C through H, which are the cells that typically receive air.

Mixing

The Upper Plant was modeled with three active step-feed points in cells A, C, and F. These feed points were chosen because they correspond with the zones that have the highest diffuser density. The feed points into Zones A and C work well in the current plant configuration. However, the feed point into Cell F is close to the feed point into Cell G. Without additional mixing, the raw influent into Cell F will proceed very quickly into Cell G as shown in Figure 4-2, and will not appropriately utilize the installed treatment capacity in Cell F. Two additional submersible mixers are recommended to create a racetrack type mixing flow pattern inside this cell so that the influent flow at the step-feed point is mixed throughout the volume of Cell F.

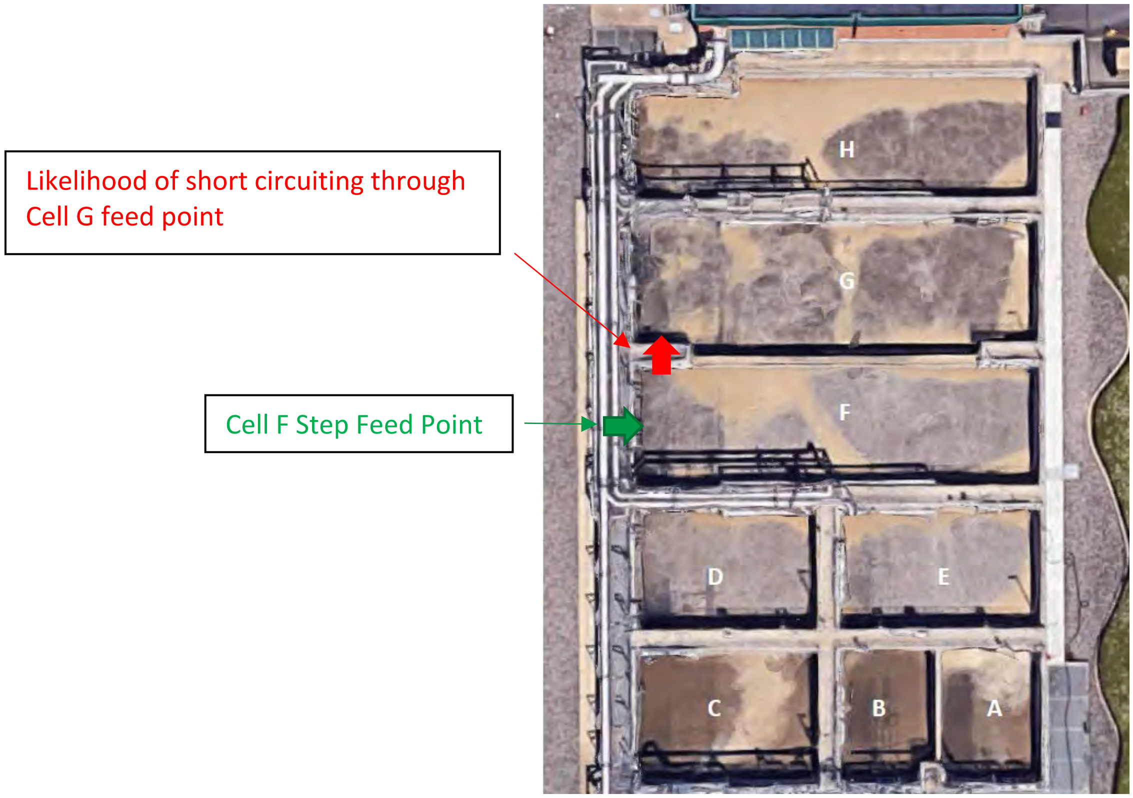


Figure 4-2. Upper Plant Aeration Basin Cells

Secondary Clarifiers

Solids from the Upper Plant aeration basin are settled by a single 130-foot-diameter clarifier. A state point analysis on the Upper Plant secondary clarifier indicates that the clarifier would be overloaded at the peak diurnal condition in 2026 when operating in plug flow mode. Operating the Upper Plant as a step-feed reactor allows the MLSS to drop over the length of the reactor. Figure 4-3 depicts how the MLSS concentration varies along the reactor, with the flow split equally in thirds to reactors A, C, and G.

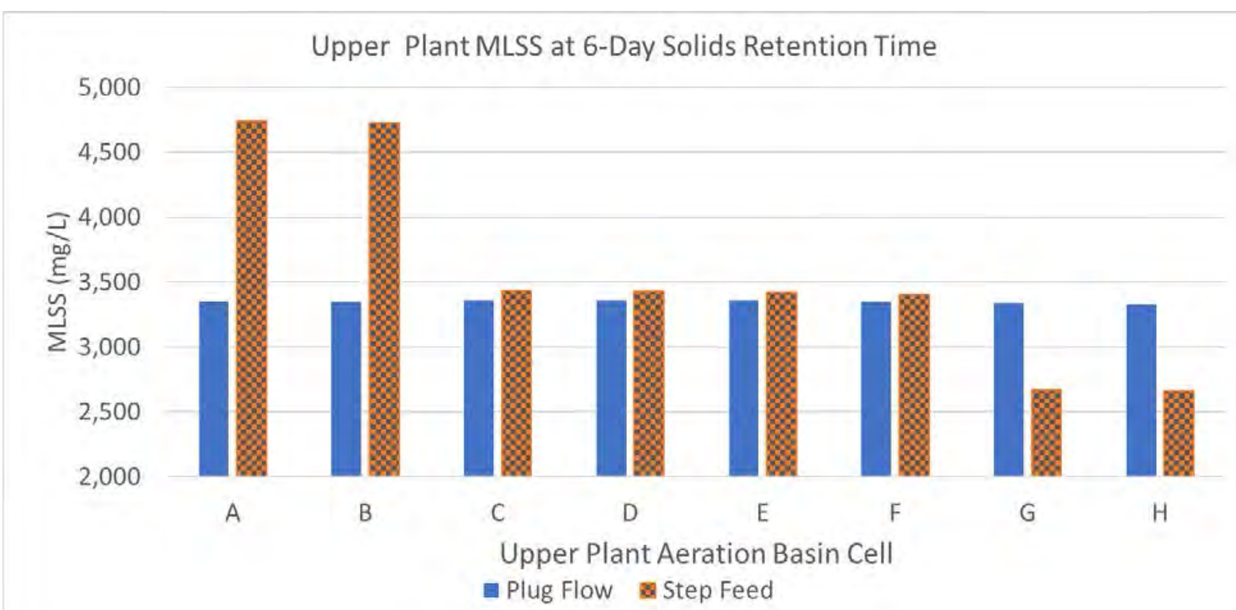


Figure 4-3. Comparison of MLSS Concentrations in Upper Plant at Dry Season Maximum Month

The reduced MLSS in the far downstream reactor H would result in a 20 percent reduced solids loading to the secondary clarifier. Per the state point analysis, reducing the solids loading to the clarifier results in the clarifier staying under the peak solids flux rate at an assumed SVI of 180 as shown in Figures 4-4 and 4-5.

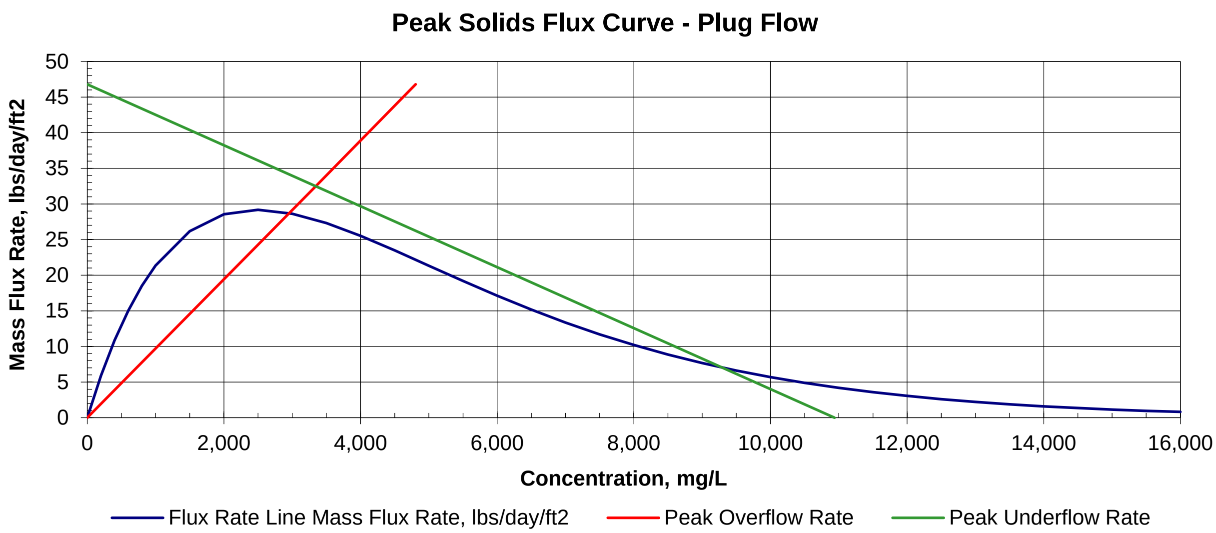


Figure 4-4. Clarifier State Point Analysis at Peak 2036 Conditions – Plug Flow

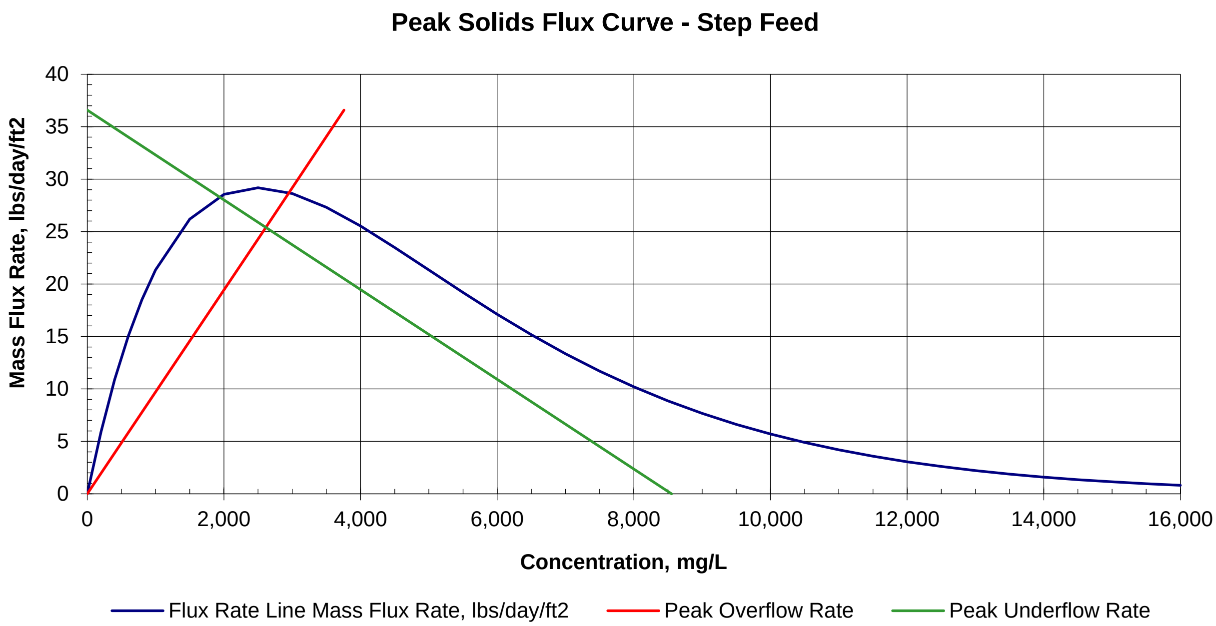


Figure 4-5. Clarifier State Point Analysis at Peak 2036 Conditions – Step Feed

While this clarifier has sufficient capacity in step-feed conditions to settle the MLSS of 2,600 mg/L at the 15.8-mgd 2036 max month conditions, there are no redundant units. If the Upper Plant secondary clarifier is out of service during the dry season, the entire Upper Plant is required to shut down. As there is not sufficient aeration basin capacity to nitrify in the Lower Plant, shutting down the Upper Plant is likely to result in the Gresham WWTP exceeding future effluent ammonia limits. An additional secondary clarifier in the Upper Plant should be constructed to provide redundancy and additional reliability in meeting future anticipated ammonia permit limits.

4.3.5.2 Alternative 1c – Nitrify Upper Plant in Step-Feed Mode and Seed Lower Plant with Upper Plant Sludge

Like Alternative 1b above, this sub-alternative would accomplish nitrification in the Upper Plant by maintaining a 6-day SRT and operating the reactor in step-feed mode. The difference is that the WAS flow from the Upper Plant would be rerouted to flow directly into the Lower Plant, rather than flow to the GBTs. The impacts of this alternative differ from 1b in the Lower Plant only. The infrastructure recommendations at the Upper Plant remain unchanged.

Relocating the WAS feed from the Upper Plant to the Lower Plant can be accomplished by constructing a line connecting the Upper Plant WAS to the GBT filtrate drain line.

Nitrification Impacts

Wasting the Upper Plant WAS directly to the Lower Plant would seed the Lower Plant with a small population of ammonia-oxidizing bacteria even though the Lower Plant is operating at an SRT that is too short to sustain a population of nitrifying bacteria. The result of this seeding would be that a greater proportion of the ammonia entering the Lower Plant is nitrified, resulting in a reduced ammonia effluent from the plant when compared with sending the Upper Plant sludge directly to the solids train. The impacts of rerouting this WAS stream can be seen in Table 4-6.

Table 4-6. Ammonia Effluent When Seeding Lower Plant with Upper Plant Sludge

2036 DSMM Condition	Upper Plant	Lower Plant	Combined Effluent
Upper Plant WAS to Solids Train	0.7 mg/L	20.7 mg/L	9.3 mg/L
Upper Plant WAS to Lower Plant	0.7 mg/L	8.2 mg/L	3.9 mg/L

Other Operational Changes

Rerouting the Upper Plant WAS to the Lower Plant would result in a significantly higher solids influent to the Lower Plant, an increased sludge wasting rate, and reduced overall SRT to account for the additional solids. CH2M reduced the SRT in the Lower Plant from 3 days to 2 days in the process model to retain a roughly constant solids inventory in the Lower Plant aeration basins. The sludge wasting rate in the Lower Plant increased from approximately 270,000 gpd when the Upper Plant WAS was sent to the GBTs to approximately 430,000 gpd when the Upper Plant WAS was routed to the Lower Plant aeration basins.

The addition of the Upper Plant sludge would also increase the required airflow rates in the Lower Plant from approximately 4,900 scfm to 5,900 scfm. The current firm blower capacity in the Lower Plant is approximately 8,000 scfm, which should be sufficient for the increased aeration demands.

4.3.5.3 Alternative 2 – Chemically Enhanced Primary Treatment (CEPT)

CEPT can be combined with Alternative 1, nitrifying the Upper Plant. Utilizing CEPT allows both the Upper and Lower Plants to be operated at a much longer SRT in the aeration basins as a result of removing additional influent solids via the primary clarifiers. The existing primary clarifiers are estimated to historically remove 50 percent of the influent solids, while solids removal with CEPT is estimated to increase to 85 percent. Reducing the influent solids while maintaining the same solids inventory in the aeration basins will increase the SRT.

The increased primary solids production may impair the ability of the existing primary clarifiers to maintain a thick sludge blanket and still achieve efficient TSS removal. It may be advantageous to remove primary solids at higher flow rates and at a lower solids concentration in existing clarifiers where it is already difficult to build up a sludge blanket. In these cases, the CEPT solids could be sent to an external gravity thickener, where 5 to 6 percent thickened solids could be achieved.

The increased solids removal would allow the Upper Plant to be operated at a 12-day SRT and the Lower Plant at a 5-day SRT when the Upper Plant solids are sent directly to the GBTs, without increasing the solids inventory in either aeration basin. This compares with operating the two plants at 6 and 3 days SRT, respectively, in Alternative 1.

The ammonia effluent impacts of the two alternatives are shown in Table 4-7.

Table 4-7. Ammonia Effluent with CEPT

2036 DSMM Condition	Upper Plant	Lower Plant	Combined Effluent
Upper Plant WAS to Solids Train	0.1 mg/L	3.4 mg/L	1.5 mg/L
Upper Plant WAS to Lower Plant	0.1 mg/L	2.2 mg/L	1.0 mg/L

The benefit of using CEPT in the Upper Plant is marginal, as the 6-day SRT in the previous option was already sufficient to achieve low levels of effluent ammonia. However, utilizing CEPT in the Lower Plant allows the effluent ammonia from that plant to drop from 21.0 mg/L to 3.4 mg/L, nitrifying in the Lower Plant as well. Relocating the WAS when utilizing CEPT further augments the population of ammonia-oxidizing bacteria in the Lower Plant, leading to lower effluent ammonia levels, but the impact is small. As such, relocating the WAS while utilizing CEPT is not recommended.

Operational Changes

A CEPT system would reduce the influent BOD to the downstream biological reactor in addition to the TSS, with the BOD reduction across the primary clarifiers increasing from 30 percent to an estimated 64 percent with a CEPT system. The reduction in BOD would lower the air required for BOD oxidation in both the Upper and Lower Plants. In the Lower Plant, additional air would be required for nitrification. The result is a decrease in the Upper Plant air demands when compared to Alternative 1, but a net increase in the air demand in the Lower Plant due to nitrification.

When compared to the Alternative 1, the CEPT alternative has two additional significant benefits beyond the lower ammonia levels. The reduced air demand in the Upper Plant resulting from the additional BOD removal means there would be no need to add an additional blower or to add additional diffusers. The projected Upper Plant airflow during max month conditions is 6,800 scfm, with a peak hour flow projected at 8,500 scfm. Both values are below the currently installed firm capacity of 10,600 scfm, so additional blower capacity is not needed to maintain redundancy.

As shown in Table 4-8, all diffuser zones are below 4 scfm per diffuser (the limiting air flow rate criterion on a continuous basis) at 2036 max month conditions when utilizing CEPT, and diffuser system expansion is not required if the City chooses to utilize a CEPT system.

Table 4-8. Airflow Per Diffuser in the Upper Plant with CEPT

Cell	A	B	C	D	E	F	G	H	Total
Diffusers	540	450	880	296	296	924	480	352	3,228[a]
Airflow Rate, scfm	0	0	1,710	1,167	945	1,740	857	414	6,834
Airflow Rate per Diffuser, scfm	0	0	1.9	3.9	3.2	1.9	1.8	1.2	N/A

[a] Total number of diffusers including Cells A and B is 4,218; 3,228 is the total of Cells C through H, which are the cells that typically receive air.

4.3.5.4 Alternative 3 – Post-Aerobic Digestion

A third alternative to reduce the effluent ammonia at the Gresham WWTP involves constructing a post-aerobic digester in the solids train. A post-aerobic digester would reduce the ammonia load in the Lower Plant. The 2036 max month conditions include 3,510 lb/day of ammonia in the influent to the WWTP and 738 lb/day returned to the Lower Plant in the BFP recycle stream. Installing a PAD system is projected to remove approximately 98 percent of the ammonia present in the BFP recycle stream and result in an approximately 17 percent net decrease in ammonia sent to aeration basins. This decrease would decrease the effluent ammonia to the treatment plant by a similar magnitude.

In addition to ammonia removal, data from a CH2M PAD installation demonstrates increased VSR of 30 to 40 percent in the post-aerobic digester after typical VSR of over 60 percent in the anaerobic digester, resulting in a total increase in VSR of at least 80 percent in the overall digestion system. Energy costs of PAD aeration are significant, but will be more than offset by the savings in final biosolids disposal costs due to the additional total solids destruction.

A PAD system involves significant capital costs and will not assist the City in treating peak ammonia influents, as the system reduces return ammonia loads rather than treating ammonia present in the influent. PAD could be an effective complement to Alternative 1, especially as the return ammonia is sent directly to the Lower Plant where it is less likely to be treated under the Nitrify Upper Plant scenario, if a more stringent effluent ammonia limit is required by DEQ relative to what is presented in Table 4-2.

4.3.5.5 Alternative 4 – Sidestream Treatment of BFP Filtrate

Similar to a PAD system, sidestream treatment of the BFP filtrate flow can result in near complete ammonia removal in the sidestream, resulting in an overall influent ammonia reduction of approximately 17 percent to the aeration basins. There are many possible ammonia removal process configurations, including nitrification/denitrification systems and Annamox-based ammonia removal.

Any of these systems would require significant capital costs and would not directly treat influent ammonia peaks. Installing one of these systems would, similar to PAD, be a helpful complement to the Alternative 1 Nitrify Upper Plant scenario by reducing the ammonia influent to the Lower Plant, but it is not suitable as a standalone solution to reduce the ammonia in effluent at the Gresham WWTP.

4.3.5.6 Alternative 5 – Integrated Fixed-Film Activated Sludge

An integrated fixed-film activated sludge (IFAS) system is a potential solution to reduce effluent ammonia levels. The introduction of suspended media into the activated sludge systems would allow treatment trains to operate at longer overall SRTs than would be possible when using only suspended biomass by allowing the growth of biomass directly onto the media that will not be carried over into the clarifier. The Upper Plant has sufficient volume to nitrify without adding media, rendering IFAS unnecessary in the Upper Plant at present. However, IFAS would allow the Lower Plant to fully nitrify as well, and should be considered as a viable alternative if nitrification is needed or desired in the Lower Plant. In addition, it is possible that installing an IFAS system in the Lower Plant would allow 100 percent of the plant flow to be treated and nitrified with the Upper Plant offline.

4.3.5.7 Alternative 6 – Granular Activated Sludge

Granular activated sludge systems are newer to the industry and work by selectively retaining higher-density biomass in the return sludge line, which is typically achieved with a hydrocyclone. The hydrocyclone wastes lower-density, slower-settling biomass out of the top of the cyclone while the higher density biomass is retained. Over time, rapidly settling granules will develop in the mixed liquor of the aeration basins. These granules allow a treatment plant to operate at a higher SRT than would be possible in a typical aeration basin, and also significantly increase the SVI of the sludge. The higher SRT allows granular systems to nitrify in reduced aeration basin volumes, and would be an appropriate alternative to pursue if complete nitrification in the Lower Plant is needed or desired in the future.

4.3.5.8 Secondary Treatment Conclusion

Table 4-9 summarizes the alternatives evaluated to comply with the anticipated effluent ammonia limit.

Table 4-9. Summary of Liquids Alternatives

Alternative	Combined Effluent Ammonia Concentration
No Action	23.6 mg/L[a]
Alt. 1a – Nitrify Upper Plant – Plug Flow	9.0 mg/L
Alt. 1b – Nitrify Upper Plant – Step Feed	9.3 mg/L
Alt. 1c – Nitrify Upper Plant- Step Feed – Upper Plant WAS to Lower Plant	3.9 mg/L
Alt. 2a – CEPT in Upper and Lower Plants	1.5 mg/L
Alt. 2b – CEPT in Upper and Lower Plants - Upper Plant WAS to Lower Plant	1.0 mg/L
Alt. 3 – Post-Aerobic Digestion	17% reduction in ammonia load to Lower Plant
Alt. 4 – Sidestream Treatment of BFP Filtrate	17% reduction in ammonia load to Lower Plant
Alt. 5 – Integrated Fixed-Film Activated Sludge	Complete nitrification possible
Alt. 6 – Granular Activated Sludge	Complete nitrification possible

[a] Although the “No Action” effluent ammonia concentration is estimated to be 23.6 mg/L, which is lower than the targeted effluent performance of 29.3 mg/L (monthly average) and 30 mg/L (maximum day), it is too close to these effluent targets to reliably ensure permit compliance.

Advantages and disadvantages for these alternatives are presented in Table 4-10.

Table 4-10. Summary of Liquids Alternatives

Alternative	Initial Cost	Energy Use	Chemical Use	Compliance with Potential Future Ammonia Limits
No Action	None.	No impact	None	Insufficient[a]
Alt. 1a – Nitrify Upper Plant – Plug Flow	Significant cost of Secondary Clarifier 5. Additional Upper Plant aeration basin diffusers and 4th blower for redundancy.	Increase (see Figure 4-6)	None	Meets most probable and worst-case ammonia limits
Alt. 1b – Nitrify Upper Plant – Step Feed	Secondary clarifier No. 5 recommended to provide redundancy.	Increase (see Figure 4-6)	None	Same as Alt. 1a
Alt. 1c – Nitrify Upper Plant- Step Feed – Upper Plant WAS to Lower Plant	Same as Alt. 1b.	Slight increase over Alt. 1b due to increased Lower Plant aeration basin air WAS pumping	None	Meets much more stringent ammonia limit than is anticipated
Alt. 2a – CEPT in Upper and Lower Plants and Alt. 2b – CEPT in Upper and Lower Plants with Upper Plant WAS to Lower Plant	Diffusers and 4th blower not required. Potentially would need to construct gravity thickening for primary sludge.	Reduced – less aeration basin air	Chemical addition required	Meets much more stringent ammonia limit than is anticipated
Alt. 3 – Post-Aerobic Digestion	Significant.	Increase for aeration of post-aerobic digester (but cost offset due to reduced biosolids production)	None	Increase frequency of meeting most probable limit

Alternative	Initial Cost	Energy Use	Chemical Use	Compliance with Potential Future Ammonia Limits
Alt. 4 – Sidestream Treatment of BFP Filtrate	Significant.	Minimal impact (increase for sidestream reactor offset by reduction of ammonia load to mainstream liquids treatment)	None	Increase frequency of meeting most probable limit
Alt. 5 – Integrated Fixed-Film Activated Sludge	Significant.	No impact	None	Meets much more stringent ammonia limit than is anticipated
Alt. 6 – Granular Activated Sludge	Moderate.	Moderate increase associated with operating hydrocyclone	None	Meets much more stringent ammonia limit than is anticipated

[a] Although the "No Action" effluent ammonia concentration is estimated to be 23.6 mg/L. which is lower than the targeted effluent performance of 29.3 mg/L (monthly average) and 30 mg/L (maximum day), it is too close to these effluent targets to reliably ensure permit compliance.

Alternative 2 – Chemically Enhanced Primary Treatment was eliminated because it is not anticipated that such a high level of ammonia removal will be needed and because it requires the use of chemical addition that would increase biosolids production.

Alternative 3 – Post-Aerobic Digestion was eliminated because it does not ensure compliance with the anticipated effluent ammonia limits and because of the significant costs to implement it.

Alternative 4 – Sidestream Treatment of BFP Filtrate was eliminated because it does not ensure compliance with the anticipated effluent ammonia limits and because of the significant costs to implement.

Alternative 5 – Integrated Fixed-Film Activated Sludge was eliminated because it is not anticipated that such a high level of ammonia removal will be needed and because of the significant costs to implement it.

Alternative 6 – Granular Activated Sludge was eliminated because it is not anticipated that such a high level of ammonia removal will be needed and because granular activated sludge is still an emerging technology.

Of the remaining options, Alternative 1b – Nitrify Upper Plant – Step Feed is recommended. Alternative 1b is preferred over 1a – Nitrify Upper Plant – Plug Flow, which requires Secondary Clarifier No. 4 to address solids loading constraints (as opposed to just providing secondary clarification redundancy for Alternative 1b) and Alternative 1c – Nitrify Upper Plant – Step Feed with Upper Plant WAS to Lower Plant, which provides increased effluent ammonia reduction that is not anticipated to be required.

The effluent ammonia benefit and impact to electricity use and biosolids production associated with Alternative 1b is shown in Figure 4-6.

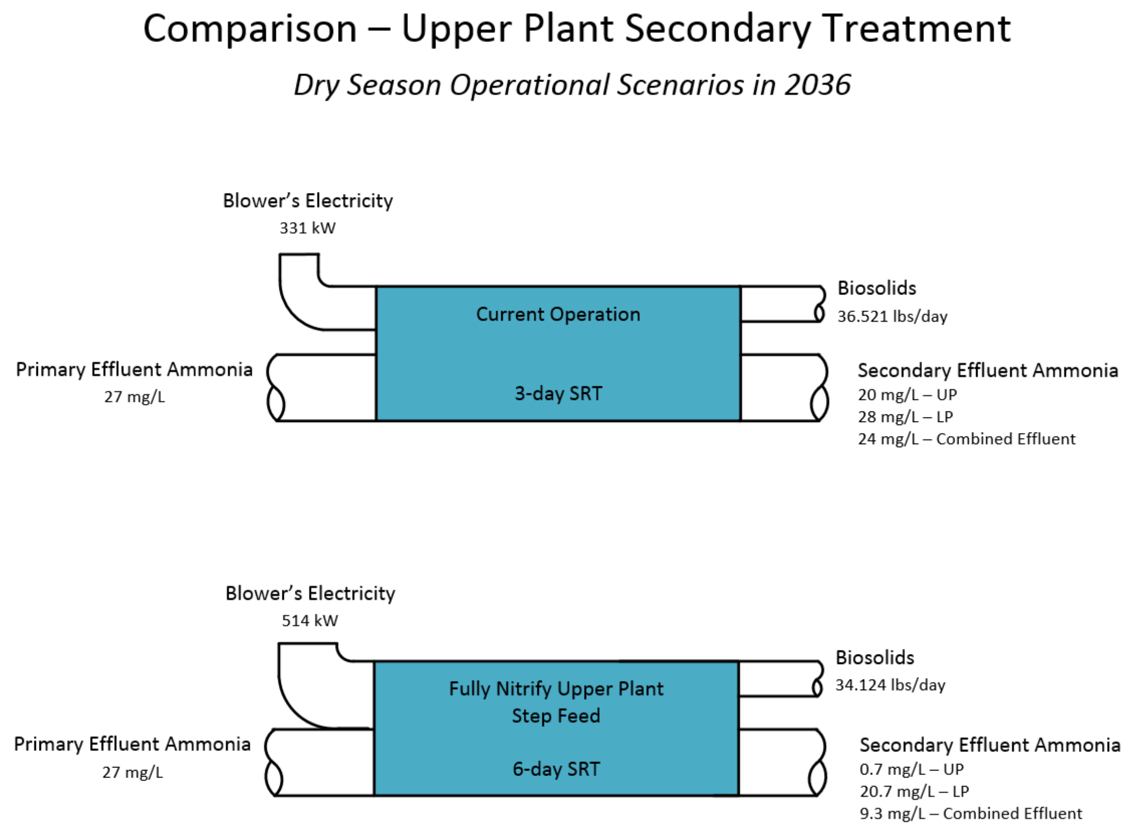


Figure 4-6. Resource Benefits and Impacts Associated with Upper Plant Nitrification

To ensure that this operational approach can be executed reliably, it is recommended that the City construct a second secondary clarifier for the Upper Plant for increased redundancy and install a fourth blower (for a firm capacity of 15,900 scfm increased from 10,600 scfm currently) by 2020 in the Upper Plant blower building to ensure that 2020 maximum day peak diurnal airflows of 12,800 scfm can be provided with one unit out of service.

Projects and activities that should continue to be considered to further enhance the ability of the Gresham WWTP to comply with future, potentially more stringent effluent ammonia limits include modifying the existing diffuser to increase dilution in the Columbia River, constructing a PAD system or sidestream treatment system to remove recycled ammonia from the solids train, and installing IFAS or a granular active sludge system to nitrify the Lower Plant.

4.3.6 Disinfection

No additional capacity is needed for disinfection during the planning period. However, during peak flow events the applied sodium hypochlorite dose may need to be increased to mitigate the impact of reduced contact times. Automation should be added so that the increase in applied dose during these events does not have to be done manually.

4.3.7 Solids Treatment

Solids treatment processes receive primary sludge and WAS from the Upper and Lower Plant processes. There is only one solids treatment train. Table 4-11 summarizes the additional liquids processes needed by 2025 and 2040 (buildout).

Table 4-11. Solids Treatment Units

Unit Process	Total Units: Existing	Total Units: 2036	Comments
Thickening (GBTs)	3	3	Currently 1 unit operates 24 hours per day and 2 units operate 10 hours per day, 7 days per week; increased daily hours of operation required in 2036
Digestion	2	2	No redundancy
Dewatering (BFPs)	2	2	
Biosolids Storage	9	Approximately 3 additional bays	At 14.5% cake solids and 367 yd^3/bay, the number of additional bays will depend on long-term digestion approach implemented

4.3.7.1 Waste Activated Sludge Thickening

The GBTs currently used to thicken WAS with all units operating (one unit at 24 hours per day and two units at 10 hours per day, 7 days per week) have sufficient solids loading capacity but insufficient hydraulic loading capacity through the planning period. Published criteria per Water Environment Federation Manual of Practice 8, Chapter 23-5.2 (Water Environment Federation, 2012) states a hydraulic loading rate of 100 to 250 gpm per meter, and the City is using 100 gallons per hour per meter, which is more conservative. Meeting capacity requirements with redundancy is possible if the daily hours of operation for the two units that are only operated 10 hours per day are increased.

The City is currently finalizing improvements which will enable co-thickening such that primary sludge will also be thickened using the GBTs prior to injection into the digesters. Under this future operating scenario, from a solids loading standpoint (design criteria of 1,000 lb of dry solids per hour per meter) the existing operational approach provides firm capacity (one unit operated 24 hours per day and one unit operated 10 hours per day) of 68,000 lb/day of capacity, while the estimated 2036 loading is only 34,123 lb/day. From a hydraulic loading standpoint (100 gpm per meter), the firm capacity is only 408,000 gpd while the estimated 2036 loading is 566,073 gpd. The second unit would have to be operated 24 hours per day to provide sufficient firm hydraulic loading capacity in 2036 under the co-thickening operating scenario. If the hydraulic loading criterion is increased to 200 gpm per meter, then firm capacity is still provided utilizing the current operating approach of one unit 24 hours per day and the second unit 10 hours per day.

4.3.7.2 Anaerobic Digestion

Initially, the primary driver for this evaluation was to defer construction of a third digester tank. But the capacity assessment presented in Chapter 2 concluded that with primary sludge and WAS co-thickening coupled with parallel digester operation, the 2036 projections and the current external high-strength waste loadings could be accommodated. However, no redundancy is provided under this scenario. Desirable attributes for the selected anaerobic digestion approach were defined as solutions that would provide:

- Solids stabilization reliability and redundancy
- Ease of operation (limit level of complexity)
- An exceptional quality/Class A biosolids product
- Energy efficiency or generation (i.e., biogas) providing sufficient heat for digestion and continuing net positive energy production
- A reduced quantity of generated biosolids (primarily a volume/truck trip issue)

4.3.8 Preliminary Screening of Selected Solids Technologies

Processes selected as preliminary candidates for the Gresham WWTP are listed below. Advantages and disadvantages are identified and described in addition to ability to meet the objectives of the City.

4.3.8.1 Conventional Mesophilic Digestion

Anaerobic digestion is a biological process that stabilizes organic matter in the absence of oxygen. During this process, biodegradable organic matter is converted to methane and carbon dioxide. Solids remaining after digestion are considered stable due to reduced biological activity and recalcitrant forms of organic materials that are not readily biodegradable. Biosolids are less odorous, attract fewer vectors (such as rodents, flies, mosquitoes, or other organisms capable of transporting infectious agents), and contain fewer pathogens. Anaerobic digestion reduces the mass of solids produced by wastewater treatment, which reduces solids hauling requirements. Biosolids are also a valuable fertilizer due to a preferable carbon, nitrogen, and phosphorus content. Digester gas produced during anaerobic digestion can be used as a source of renewable energy, reducing dependence on fossil fuels and offsetting emissions of fossil-fuel-based greenhouse gases. Advantages and disadvantages of continuing with mesophilic anaerobic digestion are presented in Table 4-12.

Table 4-12. Advantages and Disadvantages of Mesophilic Digestion

Advantages	Disadvantages
Continue with proven, known process	No redundancy and higher energy requirements
Ability to attain Class A biosolids	Does not attain Class A biosolids
	Lower than average biosolids dewatering performance

4.3.8.2 Anaerobic Thermophilic Digestion

While design criteria and system performance for thermophilic digestion are somewhat different from those for mesophilic digestion, thermophilic digestion is similar in configuration and operation to the current mesophilic process. Thermophilic digestion occurs at higher temperatures—50 to 58°C (122 to 136°F)—rather than near 35°C (95°F) for mesophilic. Single-stage thermophilic digesters have had only limited application and are typically coupled with mesophilic digestion in series post thermophilic.

Thermophilic digestion can achieve higher VSR per unit volume of digester than mesophilic digestion due to increased biological activity and reaction rates. The rule of thumb is that every 10°C (18°F) increase in temperature results in roughly a doubling in biological reaction rates. The microbial communities enriched at mesophilic temperatures are different from those present at thermophilic temperatures.

As the temperature is higher in thermophilic digestion, the heating energy requirements are higher compared to mesophilic digestion. Despite the greater heating requirements, thermophilic digestion has several advantages over mesophilic digestion. Advantages and disadvantages of thermophilic digestion are summarized in Table 4-13.

Table 4-13. Advantages and Disadvantages of Thermophilic Digestion

Advantages	Disadvantages
Improved pathogen destruction	Higher energy requirements
Ability to attain Class A biosolids	Poorer quality supernatant with significant quantities of dissolved solids
Higher VS loading capabilities	Decreased process stability
Faster VS reduction and biogas production	More odorous process and resulting biosolids
Stable operations at lower SRTs	
Potentially improved dewaterability	

Due to the higher operating temperatures, thermophilic digestion provides faster pathogen inactivation than mesophilic digestion. However, if continuous feed operation is implemented where constant feed and discharge occur, the potential for pathogen short-circuiting exists. Therefore, continuous-flow thermophilic anaerobic digestion is not considered a process that significantly reduces pathogen counts, and without batch adaptations, it is not automatically considered a Class A process per 40 CFR Part 503. To attain Class A biosolids with thermophilic digestion, four additional batch tanks operated at thermophilic temperatures in a fill, hold, hold, draw operating approach would be required to meet the time and temperature requirements instead of simply converting the existing mesophilic digesters to thermophilic digesters (Class B scenario). The initial costs would increase approximately $6,000,000 to go from a Class B thermophilic alternative to a Class A thermophilic alternative (Table 4-1, Brown and Caldwell, 2014a).

4.3.8.3 High-Solids Mesophilic Digestion (Omnivore)

The high-solids mesophilic anaerobic digestion is a proprietary offering from Anaergia called Omnivore that couples recuperative slow-rotation screw-type thickening with intermittently operating high-energy submersible digester mixing systems as shown conceptually in Figure 4-7. The recuperative thickener operates as needed to maintain the desired solids concentration in the digesters; the mixers operate approximately 30 minutes per hour at start-up and 15 minutes per hour during ongoing steady-state operation. Anaergia provides a process guarantee for the performance of the retrofitted digester system. For Gresham, which anticipates operating in co-thickening mode, Omnivore would provide roughly twice the hydraulic processing capacity, increasing from 6 and 3 percent solids to 12 and 6 for feed and digester concentrations, respectively. Anaergia claims that the curvature of the blades on the submersible mixers, which are designed to be removable from the digester tank without taking the digester offline, resist ragging. An operating system is installed at Victorville, California, and Clean Water Services has purchased two Omnivore mixers for installation in the digesters at the Rock Creek Advanced Wastewater Treatment Facility in Hillsboro, Oregon. Advantages and disadvantages of high-solids mesophilic anaerobic digestion are summarized in Table 4-14.

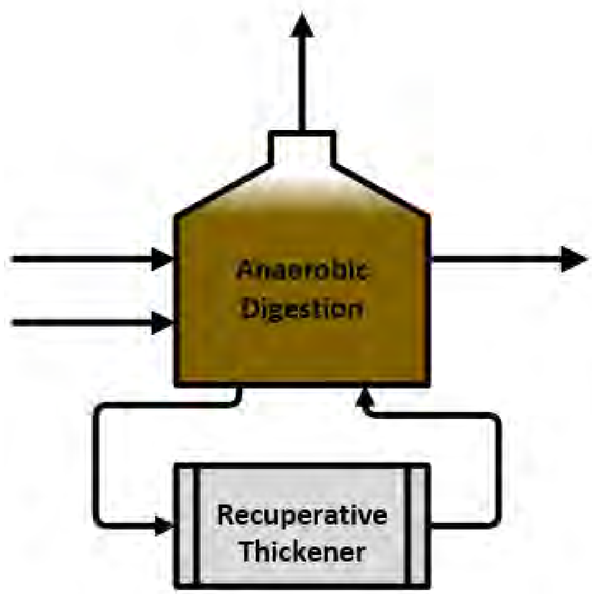


Figure 4-7. Conceptual Schematic of High Solids Mesophilic Digestion (Omnivore)

Table 4-14. Advantages and Disadvantages of High Solids Mesophilic Digestion (Omnivore)

Advantages	Disadvantages
Significant increase in capacity utilizing existing tankage	Additional recuperative thickening process required
Lower life-cycle cost	Increased operational complexity
Increased digested solids concentration	Few installations in North America, resulting in less comprehensive understanding of long-term operational impacts, although use of technology is increasing
Higher solids concentration acts as a buffer to slug loads	
Increased operational flexibility	
Potentially reduced polymer for dewatering	

4.3.8.4 Thermal Hydrolysis Process

Thermal hydrolysis (TH), conceptually shown in Figure 4-8, is a thermal conditioning pretreatment step prior to anaerobic digestion that significantly reduces the viscosity of the sludge such that a much thicker material can be fed to the digesters. It improves the digestibility of those feed solids and destroys pathogens to achieve Class A biosolids. The process is designed to lyse cells in sludge and to break down extracellular polymer substances. Thus, wastewater solids digest more efficiently in anaerobic digesters, resulting in higher VSR than traditional mesophilic anaerobic digestion. The process allows digesters to operate at higher VS loading rates than digesters without TH, which reduces the required volume of the anaerobic digestion process. TH also typically significantly improves the dewaterability of biosolids.

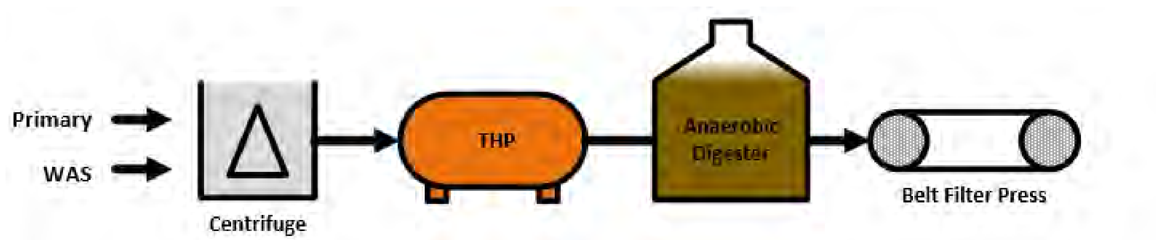


Figure 4-8. Conceptual Schematic of TH in the Solids Processing Flow Diagram

The TH reaction occurs in a batch reactor tank operating between 160 and 170°C (320 and 338°F) at a 20- to 60-minute retention time (typically 30 minutes). The reactor tanks are operated under pressure, typically 500 to 800 kilopascals (70 to 120 pounds per square inch). The processes of pre-heating, hydrolysis reaction, and depressurization can occur in one tank or with three tanks in series. The addition of heat and energy recovery units is common through the process. Heat for TH processes is typically from steam generated by boilers or by heat captured from combined heat and power systems at the WWTP. The TH process uses large amounts of heat and energy, but the use of digester gas as a fuel and heat recovery can offset the energy requirements of the TH reaction. Advantages and disadvantages of TH are summarized in Table 4-15.

Table 4-15. Advantages and Disadvantages of Thermal Hydrolysis

Advantages	Disadvantages
Decreased feed sludge viscosity	High capital cost
Increased anaerobic digestion capacity	Increased operational complexity

Table 4-15. Advantages and Disadvantages of Thermal Hydrolysis

Advantages	Disadvantages
Increased VS destruction	Requires specialized operators
Increased biogas production	Newer technology
Production of Class A biosolids	
Increased dewaterability	
Reduced foaming in digesters	
Reduced energy balance if biogas utilization is implemented	

4.3.8.5 Post-Aerobic Digestion

PAD, shown conceptually in Figure 4-9, is a recently developed advanced digestion process, where aerobic digestion is designed to follow anaerobic digestion. The most significant reason for implementing PAD is the reduction of nitrogen recycled back to the liquids stream without a need to add supplemental carbon or alkalinity. Other benefits include greater VSR, odor reduction, struvite stabilization, and possible dewatering improvements.

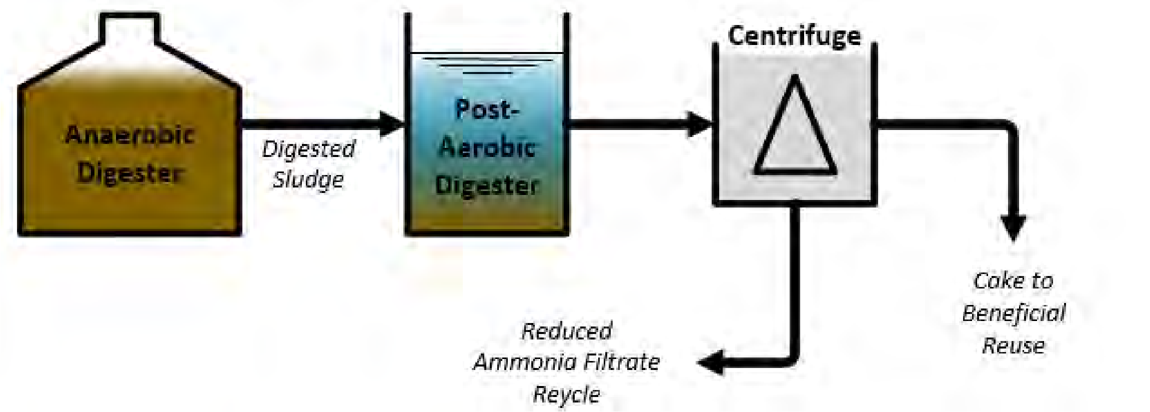


Figure 4-9. Conceptual Schematic of the Post-Aerobic Digester in the Solids Processing Flow Diagram

For sizing of a PAD system, the digested solids are sent to an aerobic digester prior to post-dewatering. A 7-day SRT is required in this aerobic digester. Nitrification and denitrification are accomplished in the biosolids matrix. By completing the nitrogen removal in the biosolids, denitrification can be accomplished using the slowly degradable residual carbon products in the digested sludge. Two other major considerations for the PAD system are the apparent ammonium concentration in the post-aerobic digester and process heat generation. Typical ammonium concentrations in the digested sludge stream would be high enough to inhibit nitrifying bacteria. However, as PAD is operated, the ammonium concentration in the post-aerobic digester is maintained below 200 mg/L. This maintains the system at an operable level to allow nitrifying communities to persist without being impacted by the high influent ammonium concentrations. Another consideration is heat generation. The PAD process is exothermic, and, unless cooling is done, can overheat. Therefore, cooling of the post-aerobic digester contents will also be required to maintain the temperature below 35°C (95°F). Advantages and disadvantages PAD are summarized in Table 4-16.

Table 4-16. Advantages and Disadvantages of Post-Aerobic Digestion

Advantages	Disadvantages
Simple nitrogen removal using anaerobically digested particulate organics for carbon source	Above 40°C (104°F) nitrification becomes unstable at an 8-day SRT
No chemical addition (carbon or alkalinity) when denitrifying	High process heat production
Increased VS destruction	Automation needed to achieve optimum balance between nitrification and denitrification
Possible mainstream nitrifier bioaugmentation	
Struvite stabilization for centrate	
Improved dewaterability/reduced polymer dose	
Reduced sludge odors	

4.3.9 Evaluation of Digestion Alternatives

The following four digester alternatives were selected for further quantitative evaluation because they provide a majority, but not necessarily all, of the attributes identified above:

- Alternative 1 – Mesophilic Anaerobic Digestion (MAD)
- Alternative 2 – Class B Anaerobic Thermophilic Digestion (ATD)
- Alternative 3 – High-Solids Mesophilic (HSM) Digestion (Omnivore by Anaergia)
- Alternative 4 – Thermal Hydrolysis (TH)

The components of each alternative are described below.

4.3.9.1 Alternative 1 – Mesophilic Anaerobic Digestion (MAD)

In Alternative 1 a third, conventional mesophilic anaerobic digestion tank would be installed to provide additional capacity and redundancy. The tank would be of similar shape and size as the two existing tanks (1 MG) and would be sited to the west of the existing digester area.

4.3.9.2 Alternative 2 – Class B Anaerobic Thermophilic Digestion (ATD)

There are several configurations of the WWTP that could utilize Class B ATD, including operating both tanks at thermophilic temperatures and temperature-phased anaerobic digestion or operating only the first tank at thermophilic temperatures while the second tank in series remains at mesophilic temperatures. The Chapter 2 analysis concluded that operation of the existing two digester tanks (at mesophilic temperatures) utilizing co-thickening and parallel operation could accommodate the 2036 loadings while maintaining current external FOG loadings. For this alternatives evaluation, it is assumed that Alternative 2 will convert both tanks to thermophilic operation, which is compatible with the parallel operational approach outlined in Chapter 2. Other assumed components for this alternative include:

- A screw press with conveyor, so that thermophilically digested solids, which are anticipated to be more odorous than conventional mesophilic digestion solids, can be dewatered in an enclosed mechanical dewatering device. A lower-cost option to address odors may be to upgrade/replace the existing odor control system for the existing BFPs in the Solids Building. This approach could be evaluated as part of a predesign if the City opts to proceed with Alternative 2.

- Walls to enclose the existing cake storage structure coupled with an in-ground biofilter or proprietary biotower odorous air treatment system, again so that the anticipated odors from the resulting cake biosolids can be mitigated.

4.3.9.3 Alternative 3 – High-Solids Mesophilic (HSM) Digestion

The HSM alternative involves using recuperative thickening to double the feed solids concentration to the digesters and changing out the existing digester mixing system to mix the higher percent solids in the tanks. The floating cover in Digester Tank 2 would be fixed as part of this project to accommodate the mixing system. Components include:

- Proprietary systems provided turnkey by Anaergia (see detailed product information, scope of supply, and associated budgetary quote in Attachment 4-A):
  - Conversion of digester mixing system from existing LMMs to submersible mixers (three per tank) with torque, rotation speed, and power controls and service box, and a mixer support and lifting system designed to enable mixer maintenance without interrupting digester operation.
  - Recuperative screw press thickener skid including 15-hp thickener unit utilizing structured wedgewire screen baskets, feed pumping system, flocculation tank, digestate return pumping system, filtrate recycle pump system, and emulsion polymer system. Unit would be piped to thicken from both digesters (e.g., thicken one digester for 8 hours then switch to the second tank). It is assumed that the skid will be in the mezzanine room between the two digesters (the room that used to house the compressors for the gas mix system).
- Strain press for digester feed to further mitigate ragging concerns of submersible mixers in digesters; Anaergia asserts that the curvature of the blades on the submersible mixers resist ragging.

Additional items that would have to be evaluated include the ability of the BFP feed pumps to pump 6 percent solids and whether the tube-to-tube heat exchangers would have to be upsized to account for the thicker digester contents.

4.3.9.4 Alternative 4 – Thermal Hydrolysis (TH)

The TH system for Gresham would be designed to accommodate all digester feed solids (both primary and WAS sludges as opposed to WAS only) and would therefore result in a Class A product. Components for Alternative 4 include:

- Pre-thickening complex, which would include two centrifuges and conveyors, and a polymer system, all enclosed in a new concrete masonry block building.
- Proprietary TH system including: steam hydrolysis package system, heating and cooling systems, holding tank, and a mixer support and lifting system designed to enable mixer maintenance without interrupting digester operation.

It is assumed that the biosolids products under all four alternatives would continue to be land-applied consistent with the existing biosolids management plan.

Table 4-17 provides a non-cost comparison summary of these four alternatives.

Table 4-17. Non-cost Comparison of Digestion Alternatives

Alternative	Capacity Increase/ Redundancy Provided	Operating Temperature	VSR/Gas Production	Pathogen Level Produced	Modifications or New Equipment Required
1 Conventional (MAD)	50%/ No	Mesophilic	Same as existing (63%)/ Similar conversion rates	Class B	High
2 Class B ATD	80%/ No	Thermophilic/ Mesophilic	65%/Increased	Class B	Medium

Table 4-17. Non-cost Comparison of Digestion Alternatives

Alternative	Capacity Increase/ Redundancy Provided	Operating Temperature	VSR/Gas Production	Pathogen Level Produced	Modifications or New Equipment Required
3 HSM Digestion (Omnivore)	200%/ Yes	Mesophilic	63%/Similar	Class B	Medium
4 Thermal Hydrolysis	200%/ Yes	~160°C	68%/Increased	Class A	High

4.3.9.5 Estimated Costs of Digestion Alternatives

Table 4-18 presents a cost comparison of the four alternatives. Equipment costs for Alternatives 1, 2, and 4 are based primarily on the 2014 *Solids Process Improvements Predesign Report* by Brown and Caldwell, and the installed system cost for Alternative 3 is based on a quote provided by Anaergia, the manufacturer of the proprietary Omnivore system (Attachment 4-A). Other components of the cost estimate such as concrete, building, process piping, etc. are based on company experience and industry averages for projects at treatment plants of similar size to the Gresham WWTP. Additional key assumptions used in developing the capital cost estimates are as follows:

- Contractor general conditions: 5 percent
- Bond/insurance: 1.5 percent
- Contractor overhead and profit: 15 percent
- Construction contingency: 30 percent
- Engineering, legal, and administrative costs: 25 percent

Table 4-18. Cost Comparison of Digestion Alternatives

Alternative	Project Cost	Annual O&M Costs (average for years 2026 to 2036)	Present Worth Cost (20-year project life; 3 percent discount rate)	Present Worth Cost per Unit of Capacity Added
1 Conventional (MAD)	$11.8 million	$448,000	$15.2 million	$447/lb VSS
2 Class B ATD	$5.6 million	$423,000	$10.1 million	$186/lb VSS
3 HSM Digestion (Omnivore)	$5.8 million	$196,000	$8.6 million	$126/lb VSS
4 Thermal Hydrolysis	$10.3 million	- $174,000	$9.2 million	$135/lb VSS

O&M = operation and maintenance

The capital cost estimates are considered an order-of-magnitude or Class 5 estimate as defined by AACE International. It is considered accurate to +100% to –50%, based upon less than 2 percent project definition. The cost estimates shown have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final cost of the project will depend upon the actual labor and material costs, market conditions, final project costs, implementation schedule, and other variable factors and will therefore vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed before making specific financial decisions to help ensure proper project evaluation and adequate funding. The estimate in this report is based on material, equipment, and labor pricing as of July 2017.

Key assumptions used in developing the operation and maintenance costs and for developing net present value costs are as follows:

- Capital improvements were assumed to commence operation in 2025; the associated annual operating cost or revenue corresponding to the alternative was likewise assumed to commence in 2025.
- Current annual cost of executing the Class B long-haul and land-application biosolids management plan is assumed to be $500,000; the average cost for the years 2013, 2014, and 2015 was $434,831.
- FOG tipping fee: $0.08 per gallon
- Escalation rate: 2 percent (except for FOG tipping fee)
- Discount rate: 3 percent

Additional assumptions and factors are documented in the detailed cost breakdown spreadsheet presented in Attachment 4-B.

A quantitative non-monetary weighted scoring was combined with a weighted life-cycle score to generate an overall score for each of the alternatives (Table 4-19). The drivers/evaluation criteria and associated criteria weighting were developed during the project workshops. Each criterion was scored for each alternative on a scale of 1 to 10 (10 being the best or most favorable score). The score was then multiplied by the criteria weighting.

Table 4-19. Comparison of Digestion Alternatives

Drivers/Evaluation Criteria	Weight	Maximum Possible Score	Conventional Mesophilic Anaerobic Digestion (MAD)	Thermophilic Digestion - Class B	High solids meso potentially with Recuperatirve thickening	Thermal Hydrolysis Process (THP)
Reliable	20	10	9	8	7	8
Ease of Operation and Maintenace (O&M) vs. Complexity	15	10	5	3	4	2
Regulatory Compliance Surety/Mitigates Risk (does option provide Class A/Exceptional Quality)	15	10	1	4	1	10
Produces Energy/Uses Energy Efficiently	5	10	5	4	7	7
Sustainable	5	10	7	6	8	7
Reduce biosolids quantity	5	10	5	6	6	10
Provide digester redundancy/increased capacity so that additional external waste could be accepted	5	10	10	1	10	10
Non-Monetary Weighted Total Score	**70**	**700**	**405**	**350**	**370**	**510**
Life Cycle Costs	**30**	**10**	**6**	**9**	**11**	**10**
Life Cycle Costs Weighted Subtotal		**300**	**182**	**273**	**321**	**300**
Total	**100**	**1000**	**587**	**623**	**691**	**810**

The life-cycle cost scores were determined by dividing each of the life-cycle estimates into the lowest life-cycle estimate (Alternative 3) and then using that resulting factor for each alternative and multiplying it by 10. Similar to each non-monetary criterion, the score was then multiplied by the assigned weighting (30 out of 100 in the case of the life-cycle costs) to develop the monetary score.

Based on these resulting scores, Alternative 4 – Thermal Hydrolysis ranked the highest, followed by Alternative 3 – High Solids Mesophilic, and then Alternative 2 – Class B Thermophilic. Alternative 1 – Mesophilic Digestion ranked fourth based on these results.

The analysis presented above is conceptual and further engineering analysis is needed to further refine project requirements and associated costs. There are many variables that impact the present worth comparison that will need to be reassessed during the next MP Update, including:

- Costs of proprietary technologies as they continue to mature (e.g., HSM and TH).

- Potential increase in land application costs and/or regulatory burden associated with executing the biosolids management plan.
- Community resistance/opposition to biosolids land application in Oregon.
- Changes in Class B hauling costs and development of a Class A program (e.g., local soil amendment).
- Ability to continue to attract external high-strength waste feedstocks for direct injection into the anaerobic digesters. One of the primary factors in the economic analysis is the tipping fees the City receives for high-strength wastes and FOG. Market conditions may change and the amount that the City will receive in tipping fees may drop or even be eliminated.
- Different biogas utilization approaches that would increase (or decrease) the revenue or cost offsets currently being received and/or for additional biogas that may be produced in future years.

4.3.10 Dewatering

The two 2-meter BFPs are currently used to dewater the digested solids. Typically, both units are operated 10 hours per day, 7 days per week. Dewatering needs for each of the four digester alternatives (discussed previously) were assessed using 2036 dry season maximum month loading and assuming co-thickening of the primary and WAS sludges being fed to the digesters. Consistent with the existing capacity assessment presented in Chapter 2, the following design criteria assumptions were utilized for this analysis:

- Solids loading criteria: 600 lb per hour per meter (Water Environment Federation Manual of Practice 8, Chapter 24-3.2 provides a range of 400 to 700 lb per hour per meter)
- Hydraulic loading criteria: 75 gpm per meter or 150 gpm per unit (based on maximum of 154 gpm per unit recorded from 2011 to 2016, at which the BFPs showed acceptable dewatering performance)

The results of this assessment indicate that the existing BFPs are solids loading limited and can accommodate future 2036 DSMM loads, as summarized in Table 4-20. With both units in service, no additional units and no increase in the current operating hours are required under the current operating approach; with one unit out of service (firm capacity), the remaining online unit would need to operate 14.75 hours per day to provide sufficient capacity.

Table 4-20. Future BFP Dewatering Needs Met Utilizing Existing Units

2036 DSMM Condition	Operating Upper Plant	Capacity (one unit in service/two units in service), lb TSS/day	2036 DSMM Loading
Solids Loading, dry solids lb/day	Current operation: 2 units 10 hours per day, 7 days per week 1 unit 14.75 hours per day, 7 days per week	12,000/24,000 17,700/not applicable	Alt. 1 MAD: 17,509 Alt. 2 Class B ATD: 17,477 Alt. 3 HSM: 17,296 Alt. 4 TP: 16,056
Hydraulic Loading, gpd	Current Operation: 2 units 10 hours per day, 7 days per week	90,000/180,000	Alt. 1 MAD: 71,180 Alt. 2 Class B ATD: 71,084 Alt. 3 HSM: 40,417 Alt. 4 TH: 65,272

4.3.11 Onsite Biosolids Cake Storage

The number of days of storage provided for the dewatered cake under the wet season average loading criteria was evaluated relative to the 60 days of storage requirement. The assumed dewatering performance for the four alternatives was as follows:

- Alternative 1 – Conventional (MAD): 14.5 percent
- Alternative 2 – Class B ATD: 14.5 percent
- Alternative 3 – HSM Digestion: 16 percent (improved performance primarily resulting from feeding the BFPs digested sludge in the range of 6 percent as opposed to 3 percent under MAD with co-thickening)
- Alternative 4 – Thermal Hydrolysis: 30 percent (based on operating experience at other facilities; actual performance at Gresham would need to be verified)

The numbers of additional cake storage bays for each of the four digester alternatives are presented in Table 4-21, Figure 4-10, and Figure 4-11.

Table 4-21. Onsite Cake Storage Needs

Alternative	Number of Biosolids Cake Storage Bays (additional/total)[a]	Year Additional Bays Must Be Online
1 Conventional (MAD)	3/12	2024
2 Class B ATD	3/12	2026
3 HSM Digestion (Omnivore)	2/11	2030
4 Thermal Hydrolysis	0/9 (only 6 required)	No additional bays required

[a] Assumes 14.5% cake solids generated by the BFPs.

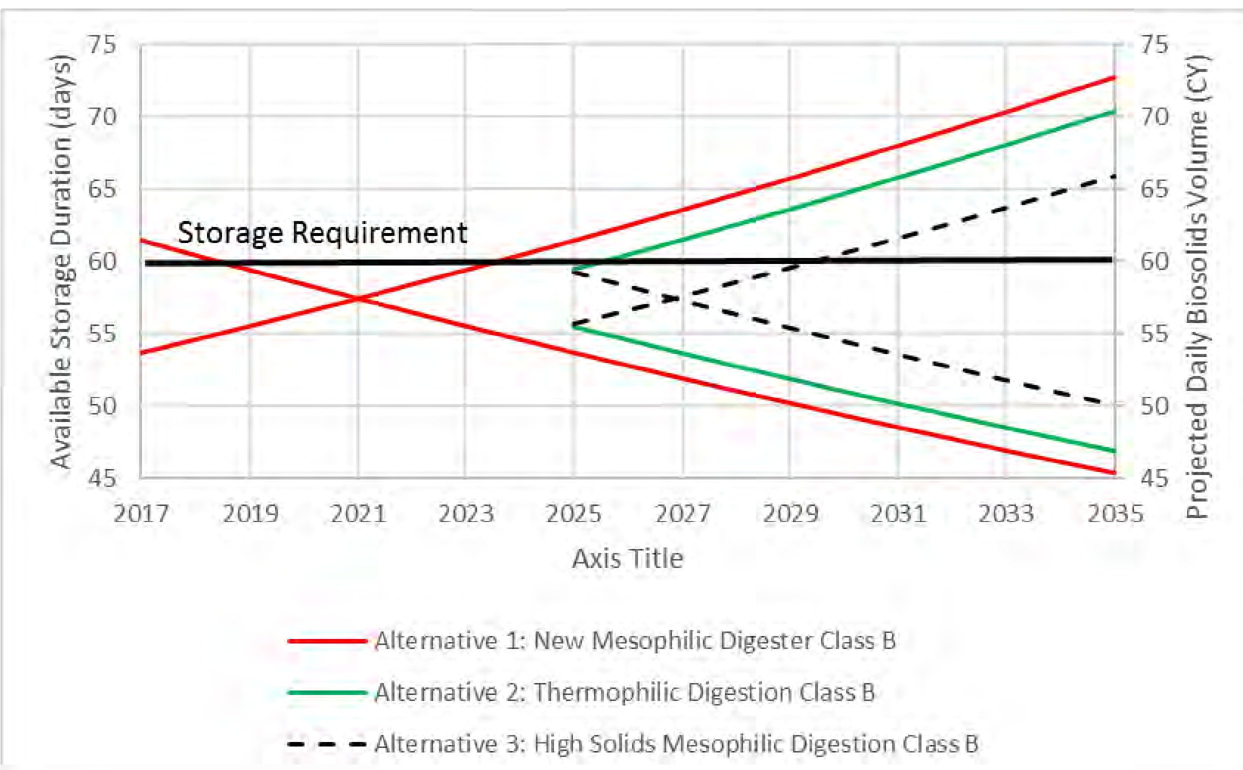


Figure 4-10. Biosolids Storage Digester Alternatives 1, 2, and 3

The City is in the process of pilot-testing Orege SLG technology to improve dewatering performance. The targeted performance is 17.5 percent; if this target is achieved, the City would be obligated to install the digested sludge pretreatment technology. Effective performance of this technology would assist in deferring the construction of additional cake storage bays.

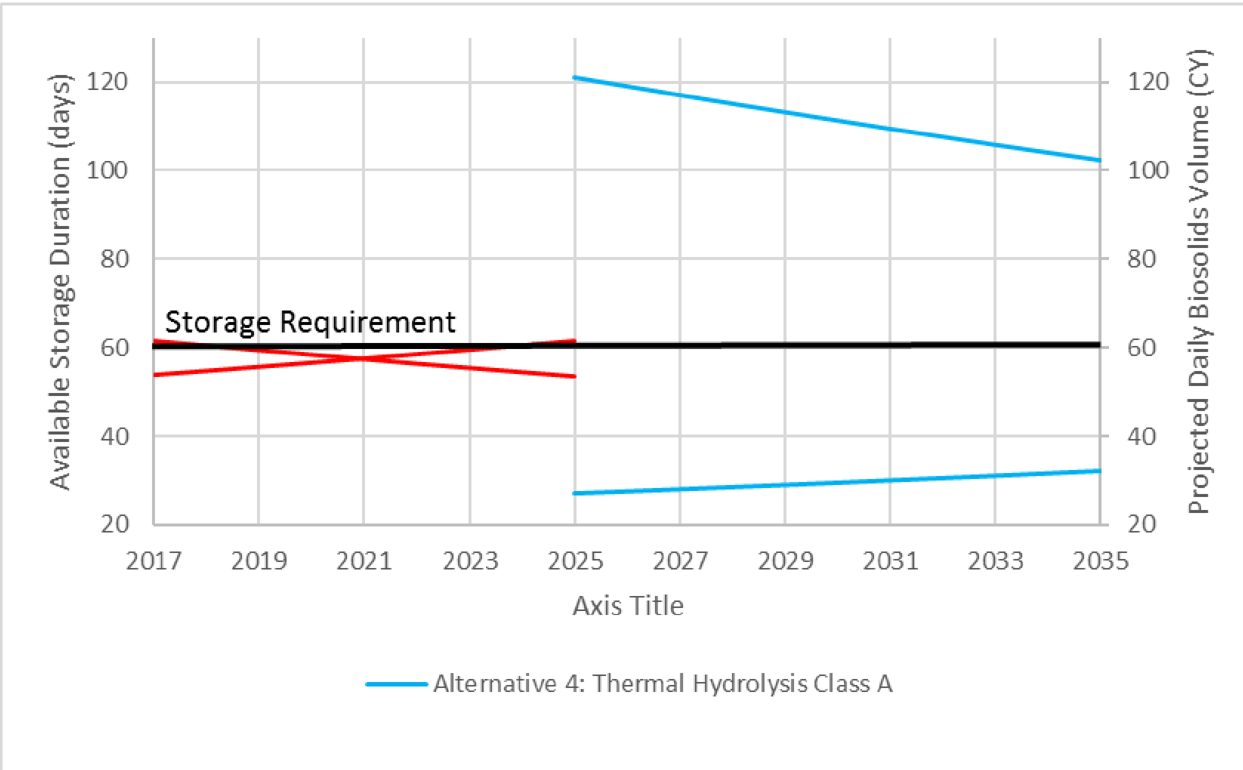


Figure 4-11. Biosolids Storage Digester Alternative 4

4.3.12 Biosolids Treatment – Class A

The City's biosolids management program complies with local, state, and federal requirements. While there are no immediate regulatory, economic, or community drivers that would require the City to change the current biosolids program, the City continually looks for ways to improve and enhance the program. However, there have been instances across the country where certain community stakeholders (in many cases based on misinformation) have requested changes to biosolids beneficial reuse practices. The City may opt to proceed in the short term (within the next 5 years) with more restrictive management practices to address community expectations (perceptions of risks associated with odors, pathogens). Production of a Class A product would assist the City in implementing these more restrictive management practices. The intent is for the City to revisit the digester options in the next WWTP MP update (typically conducted approximately every 5 years); however, if the City is compelled to convert the a Class A product before the next MP update project is undertaken, staff would like to have a short list of options that could serve as a starting point for a predesign alternatives analysis. After review of the Class A options evaluated in the 2011 MP Update, the 2014 Solids Process Improvements Predesign Report (Brown and Caldwell, 2014a), and this project, it is recommended that the following options be considered as the starting point for the analysis:

- Class A ATD (Digestion Alternative 2 presented above) with the addition of batch processing tanks, which was estimated in the 2014 Solids Process Improvements Predesign Report to have an initial cost and life-cycle cost of $9,300,00 and $12,200,000, respectively.

- Class A TH digestion (Digestion Alternative 4 presented above), which was estimated by this study to have an initial cost and life-cycle cost of $10,300,00 and $9,200,000, respectively (see Table 4-18)
- Composting on the land owned by the City to the north of the WWTP. This study and the 2014 study did not evaluate composting. The 2011 Master Plan Update estimated the initial costs to be $5,800,000 (in 2011 dollars); annual O&M costs were not presented.

If land application becomes undesirable, then composting is an option, but the program would need to be developed from the ground up with a market assessment to ensure that the material will be utilized by the community.

If the City wishes to discontinue or significantly curtail the current Class B long-haul land application program, then generating a Class A product that could be used for a local soil amendment would be the most likely path forward. Either TH or composting mesophilically digested solids would warrant further consideration. The City owns land to the north of the WWTP that could be used for a biosolids composting facility. Currently, the access to a portion of that land is restricted by a weight-limited bridge over the Columbia Slough. Construction of a bridge that would allow for the heavier biosolids hauling trucks to access this land would be beneficial.

4.4 Conclusions and Recommendations

Based on the analysis conducted in this MP Update, the following conclusions and recommendations were made.

4.4.1 Liquids

The primary liquids treatment recommendation is to nitrify the Upper Plant to reduce effluent ammonia and comply with potential future effluent ammonia permit limits. Recommended capital projects that support this operational approach are construction of a second secondary clarifier for the Upper Plant for increased redundancy/reliability and installation of a fourth blower in the Upper Plant blower building.

4.4.2 Solids

The solids treatment recommendation is to complete the modifications that will enable co-thickening and parallel operation of the existing two digesters, and to obtain operating data so that the performance assumptions contained in Chapters 2 and 4 can be validated. Selection and implementation of digestion upgrades (Alternatives 1 through 4) should be deferred until the next WWTP MP Update, if possible.

Resulting recommendations are either near-term (to occur within 5 years), intermediate-term (to occur within 5 to 10 years), or long-term (to occur greater than 10 years) projects.

Near-term operational changes or projects include the following:

- Nitrify Upper Plant during the dry season.
- Improve diffusers in Upper Plant aeration basins.
- Add a fourth blower or upgrade existing Upper Plant blowers.
- Operate digesters in parallel with co-thickening; the improvements to better enable operation of the WWTP in this manner are currently in progress.
- Conduct effluent mixing zone study and subsequent outfall improvements project in the event that such an effort is needed to retain or improve upon current dilution factors.

- Conduct Columbia River water quality monitoring study for pH, copper, alkalinity, and hardness as required by DEQ and associated with NPDES permit renewal.
- Implement digester solids and biogas improvements; these improvements are currently in progress and include repairing the cover seal on the primary digester, providing modifications to enable parallel feed to the digesters including associated pressure and level instrumentation, providing larger overflow and pressure relief hatches to help mitigate foaming/rapid rise events and other safety improvements, installing larger piping to accommodate additional biogas generation, installing a redundant flare that meets code, and refurbishing the BFPs.
- Implement dewatering performance improvements (for example, piloting of the SLG pretreatment of BFP feed sludge, which if demonstrated to be effective at sufficiently increasing cake solids and/or reducing polymer use will be made permanent).
- Conversion to Class A biosolids program if City deems it necessary to respond to community expectations or changes in regulations within the next 5 years (placeholder budget assumed use of TH has been established; technology to be further analyzed and determined during predesign if conversion to Class A is deemed necessary).

Intermediate-term projects include the following:

- Add new Upper Plant secondary clarifier for redundancy and more reliable nitrification operation.
- Automate the influent diversion structure so that flow split between the Upper and Lower Plants can be better managed.
- Automate the disinfection chemical feed systems so that effective disinfection and dechlorination can be achieved during periods of high flows/reduced contact times when increase sodium hypochlorite doses may be required.
- Construct three additional cake storage bays. This phasing assumes that the City opts to continue with conventional MAD and no improvements to dewatered cake concentration (currently average 14.5 percent) are attained. Actual number of bays and phasing will depend on the various factors, including which long-term digestion alternative is selected and if increases to cake solids concentration are achieved (e.g., if results of the Orege SLG digested sludge/dewatering feed pre-conditioning are favorable and that technology is installed permanently).

Long-term projects include the following:

- Further anaerobic digester stabilization improvements assuming conversion to Class A program is not pursued in the near term. Technology selection to be reevaluated during the next WWTP MP update. For this MP Update, the costs to upgrade to thermophilic digestion is used as the basis for the budget placeholder.
- Construct septage receiving station to provide a service to local/regional haulers and to generate additional revenues.
- Evaluate alternative biogas handling/utilization (clean biogas for injection into high-pressure natural gas line).
- Construct a bridge over Columbia Slough to provide better access for biosolids trucks to the property to the north if future use of that area is needed for activities such as biosolids composting.

More specific project phasing and associated project cost estimates for these projects are addressed in Chapter 6, Recommended Improvements.

Attachment 4-A
High-Solids Mesophilic (HSM) Omnivore - Budgetary Proposal

Anaergia
Breaking Barriers to Sustainability

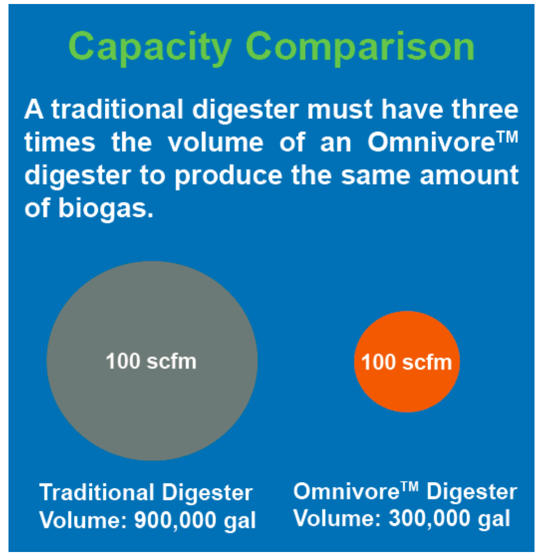
Omnivore Upgrade – Draft Budgetary Proposal

CH2M | City of Gresham
4/24/17



anaergia.com

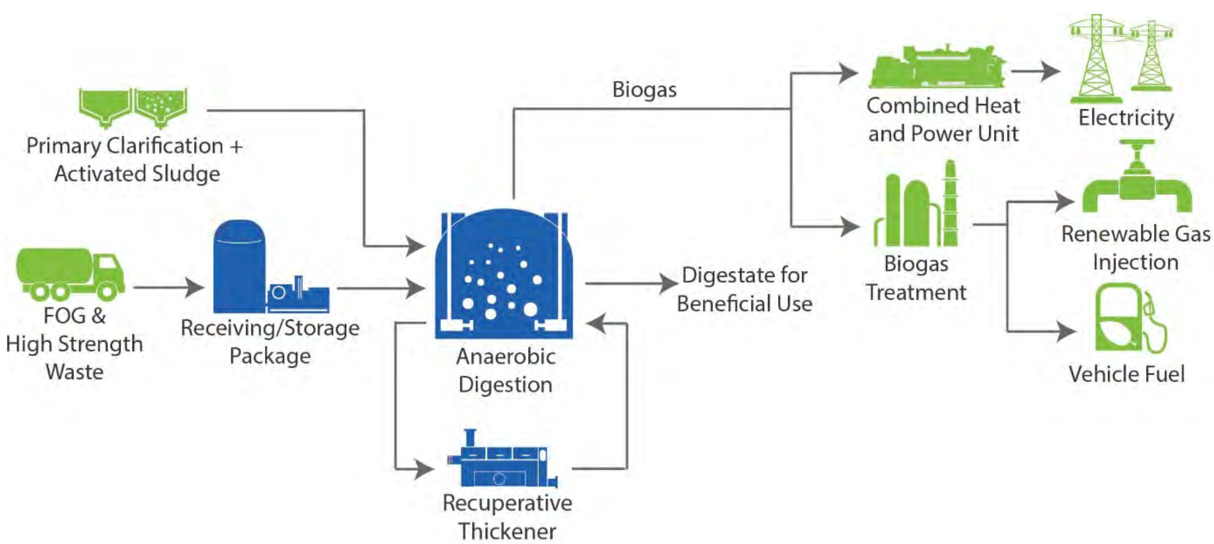
1. OMNIVORE OVERVIEW



Omnivore™ is an advanced high-solids anaerobic digestion solution which combines industry best practices and lessons learned in hundreds of high solids digestion applications around the world. Omnivore upgrades can triple the solids loading capacity and biogas production of existing traditional anaerobic digesters, or reduce requirements of new digester construction to 1/3 of the volume and footprint required by traditional digesters.

Omnivore™ combines the strengths of Anaergia's industry leading mixing and thickening systems into the world's most robust and cost-effective anaerobic digestion system. Omnivore™ technology offers dramatically reduced footprint (<33% of conventional digesters), operational control and flexibility, and easy maintenance including the ability to adjust and access mixers without taking the digesters out of service.

Unlike traditional anaerobic digesters which retain wastewater liquids along with digesting solids, the Omnivore™ system uses recuperative thickening to decouple the solids retention time (SRT) from the hydraulic retention time (HRT), increasing capacity of the digester by retaining digester solids while removing unnecessary liquid. Since the increased solids content raises digestate viscosity to levels unsuitable for conventional gas, jet, or draft tube mixing, proprietary slow speed submersible mixers stir the resulting thickened digestate. These mixers include proprietary service boxes installed on the digester cover which offer not only easy adjustment of mixer height and angle during operation, but also access for mixer maintenance while the digester remains in service. Separate control of SRT and



HRT introduces a greater level of operational flexibility, allowing operation at higher organic loading rates and enabling reception of additional organic waste streams.

2. OMNIVORE COMPONENTS

Omnivore upgrades in general consist of high solids mixers with integrated mounting and service boxes, and a thickener. Additional equipment may be added if required or if the functionality would improve overall system performance (further described in Section 3).

2.1 SUBMERSIBLE PSM MIXER

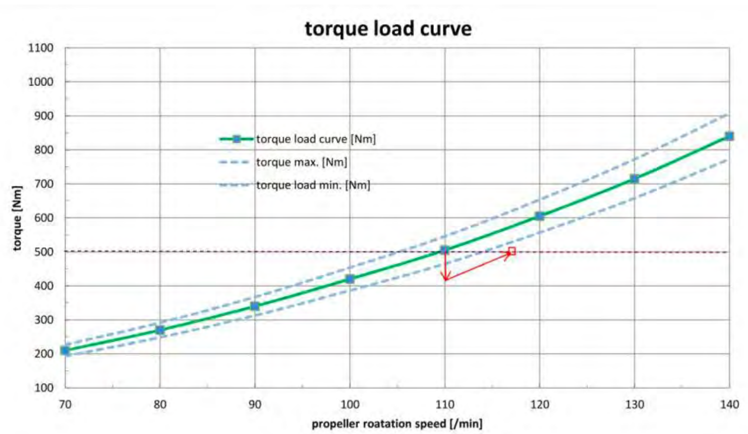
Intelligent mixing management based on interaction of newly developed system components:

- Submersible mixer with a permanent magnet synchronous motor (PSM) of variable speed and performance optimized three-blade propeller
- Dynamic Mixing Control (DMC)
- Automatic mixer positioning system (Optional)

The UTS S.M.A.Rt-System is the first automatically controlled intelligent mixing management system on the market, which detects and analyses changes in operating conditions and substrate characteristics and reacts dynamically. In this way the mixer always works at the highest efficiency to minimize energy consumption, wear, and operation costs.

The submersible mixer is equipped with a performance-optimized sickle-shaped three-blade propeller and a permanent magnet synchronous motor. The variable-speed PSM motor produces a high torque over a wide range of rotation velocities (approx. 80-140 rpm). Because the motor is driven directly, without gear or any other power transmitting elements, it works with a high efficiency at low energy consumption. This also results in additional power reserves allowing significant thrust increase on demand.

The mixer includes a 50 foot cable which is intended to extend to a NEMA 12 junction box outside of the classified



area on the perimeter of the digester (by others).

1. DYNAMIC MIXER CONTROL SYSTEM

The Dynamic Mixer Control System (DMC) controls the operation of the mixer as the core of the S.M.A.Rt-System. Several parameters (such as torque, rotation speed and power) are measured during operation and are adjusted to an optimal operation point according to the characteristic of the medium. The intelligent mixing management system not only reduces operation costs, it also has a positive influence on the digester biology.

2. SERVICE BOX AND MIXER SUPPORT SYSTEM

When servicing is required, the digester liquid level is raised above the bottom skirt of the service box, effectively sealing the service box headspace from the rest of the digester with a liquid seal. Digester gas is vented from the service box before the door is opened to access the mixer, which is raised to the top of the guide shaft. The digestion process is uninterrupted continues to produce biogas. When maintenance is complete, the mixer is remounted, the service box door is closed, the mixer descends back into position, and digester liquid level returns to normal.

A stainless-steel square post extends from the floor bearing to the service box, guiding and supporting the submersible mixer during normal operation and servicing. A lifting device is set on the support post, supporting mixer installation, height adjustment, and service retrieval. The lifting device includes cable winch, stainless steel cable, and deflection roll for lifting and lowering.

3. AUTOMATIC MIXER POSITIONING SYSTEM E&PS

The automatic mixer positioning system allows automated control of the mixer. The exact height of the submersible mixer can be altered automatically. The height of the mixing unit is adjusted by a gas-tight electric actuator.

2.2 RECUPERATIVE SLUDGE THICKENER

Anaergia's Sludge Screw Thickener (SST) increases the solids content of digestate, enabling high-solids digestion and increased biogas production in existing digesters. The SST does this by thickening digester solids and returning them to the digester while removing the liquid fraction. The SST's robust design allows for operational flexibility, minimal maintenance, and low power consumption. Some benefits of SST operations are:

Low Energy Consumption

Reduced energy consumption of up to 90% compared to an equivalent capacity decanter centrifuge.

Flexible Operation and Minimized Maintenance

Solids capture, hydraulic throughput, and cake dryness can be adjusted and optimized by operations personnel, and the thickener's integrated cleaning system offers easy maintenance without interrupting operation.

Simplified Installation

The SST comes assembled and skidded with most ancillary components (necessary valves, compressors, pumps, polymer system), offering simple site installation. The SST is contained in an enclosed housing with odor control connections.

3. ADDITIONAL EQUIPMENT CONSIDERATIONS (NOT INCLUDED)

Equipment in addition to the base equipment shown above in Section 2 may be incorporated depending on site conditions, existing infrastructure, and sludge characteristics. Some commonly added equipment is presented in this section.

3.1 MEMBRANE COVER FOR GAS STORAGE

Membrane covers are less expensive to install than steel or concrete alternatives, and increase the biogas storage capacity of the digester headspace. Membrane covers have an outer and an inner membrane, the outer membrane provides a weather resistant layer and is permanently inflated. A low pressure blower forces air into the space between the two membranes and a back pressure value on the air discharge serves to keep the outer layer "inflated" (giving this type of cover its characteristic "dome" appearance). The inner membrane rises and falls with gas production and demand based on the differential pressure between the inter-membrane space and the digester headspace providing effective biogas storage/ equalization in the digester gas system. Membrane covers require installation of a structural center column.

3.2 HEAT EXCHANGERS

The Omnivore upgrades may require upgrades to the digester heating systems due to the increased digester loading rates and digestate viscosity change due to increased solids content. Digesting more liquid and thicker sludge requires more heating capacity, so replacement of existing heat exchangers may be required if existing equipment is not suited for high solids sludge.

3.3 SLUDGE SCREEN

Depending on the plant's sludge characteristics, a sludge screen may help extend equipment life and reduce maintenance requirements. Sludge screens continuously remove contaminants such as hair, rags, and fibers, reducing maintenance associated with the clogging of pumps, valves, and instruments.

3.4 GRIT REMOVAL

Grit, sand, and precipitates (struvite, calcium phosphate, etc) are physical contaminants that not only add to OPEX costs and degradation in equipment, tanks, pipes, valves, they also build up in digesters, reducing capacity and accelerating maintenance cycles. Applications with high levels of grit and similar physical contaminants could benefit from removal of these contaminants via a hydrocyclone process. The compact and self-contained hydrocyclone removes and washes grit from high solids, high viscosity sludge streams (up to 10% solids).

3.5 DEWATERING SCREW PRESS

Anaergia's Sludge Screw Dewatering Press (SSD) is designed specifically to dewater anaerobic digester digestate to greater than 20% solids cake prior to disposal or land application. Built upon the same frame and operating principles as the SST, the SSD's robust design allows for operational flexibility, minimal maintenance, and low power consumption. Some benefits of SSD operations are:

Low Energy Consumption

Reduced energy consumption of up to 90% compared to an equivalent capacity decanter centrifuge.

Flexible Operation and Minimized Maintenance

Solids capture, hydraulic throughput, and cake dryness can be adjusted and optimized by operations personnel, and the dewatering press's integrated cleaning system offers easy maintenance without interrupting operation.

Simplified Installation

As an option, the SSD is available assembled and skidded with most ancillary components (necessary valves, compressors, pumps, polymer system), offering simple site installation. In all cases, the SSD is contained in an enclosed housing with odor control connections.

4. COMMERCIAL

Budgetary cost estimate for a fully installed system: $3,300,000 +/- 20% USD

The details contained herein are based on a preliminary understanding of information conveyed to Anaergia. Ultimate project scope and cost is subject to change upon further engineering. Applicable taxes and duties are not included.

APPENDIX A – SCOPE OF SUPPLY

Item	Quantity	Anaergia	Others
Mixer System			
Service Box - Concrete Roof or Steel	6	X	
Service Box - Working Platform	6	X	
Service Box - Concrete Roof Mounting Frame (Concrete Tank Only)	6	X	
Service Box - Concrete Roof Mounting Frame Cover (Concrete Tank Only)	6	X	
Service Box - Mounting Hardware	6	X	
Mixer - Submersible Electric PSM 940 w/Mounting Bracket	6	X	
Mixer - Submersible Electric Dynamic Mixing Control	6	X	
Mixer - Conductance Relay	6	X	
Mixer - Support Post incl. Floor Bearing Plate	6	X	
SST-400 Thickener Skid			
Thickener Feed Pump Inlet Isolation Valve	1	X	
Thickener Feed Pump Inlet Pressure Switch Isolation Valve	1	X	
Thickener Feed Pump Inlet Pressure Switch	1	X	
Thickener Feed Pump	1	X	
Thickener Feed Pump Discharge Pressure Switch Annular Diaphragm Seal	1	X	
Thickener Feed Pump Discharge Pressure Switch	1	X	
Thickener Feed Pump Discharge Pressure Gauge	1	X	
Thickener Feed Pump Discharge Drain Valve	1	X	
Thickener Feed Pump Discharge Isolation Valve	1	X	
Thickener Feed Pump Discharge Flow Transmitter	1	X	
Thickener Line Floc Stirrer	1	X	
Thickener Line Floc Tank	1	X	
Thickener Line Floc Tank Isolation Valve	1	X	
Thickener Line Floc Tank Discharge Drain Valve	1	X	
Thickener Line Floc Discharge Pressure Transmitter	1	X	
Thickener Process Water Inlet Valve	2	X	
Thickener	1	X	
Thickener By-Pass Line Flow Transmitter	1	X	
Thickener By-Pass Line Isolation Valve	1	X	
Thickened Digestate Return Pump Hopper	1	X	
Thickened Digestate Return Pump Hopper Level Transmitter	1	X	
Thickened Digestate Return Pump Hopper Level Switch	1	X	
Thickened Digestate Return Pump	1	X	
Thickened Digestate Return Pump Discharge Pressure Switch Annular Diaphragm Seal	1	X	
Thickened Digestate Return Pump Discharge Pressure Switch	1	X	
Thickened Digestate Return Pump Discharge Pressure Gauge	1	X	

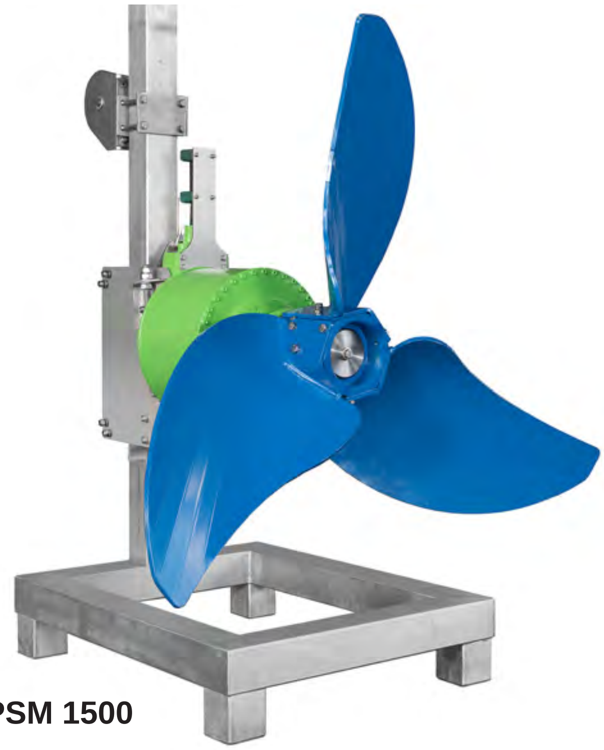
Item	Quantity	Anaergia	Others
Filtrate Recycle Pump Inlet Isolation Valve	1	X	
Filtrate Recycle Pump	1	X	
Filtrate Recycle Pump Discharge Pressure Switch Diaphragm Seal	1	X	
Filtrate Recycle Pump Discharge Pressure Switch	1	X	
Filtrate Recycle Pump Discharge Check Valve	1	X	
Filtrate Recycle Pump Discharge Isolation Valve	1	X	
Filtrate Discharge Pump Inlet Isolation Valve	1	X	
Filtrate Discharge Pump Inlet Drain Valve	1	X	
Filtrate Discharge Pump	1	X	
Filtrate Discharge Pump Discharge Check Valve	1	X	
Filtrate Discharge Pump Discharge Flow Transmitter	1	X	
Filtrate Discharge Pump Discharge Drain Valve	1	X	
Filtrate Discharge Pump Discharge Isolation Valve	1	X	
Thickener Pneumatic Cylinder #1 Compressed Air Inlet Isolation Valve	1	X	
Thickener Pneumatic Cylinder #1 Compressed Air Pressure Reducing Valve	1	X	
Thickener Pneumatic Cylinder #1 Compressed Air Line Bleed Valve	1	X	
Thickener Pneumatic Cylinder #2 Compressed Air Inlet Isolation Valve	1	X	
Thickener Pneumatic Cylinder #2 Compressed Air Pressure Reducing Valve	1	X	
Thickener Pneumatic Cylinder #2 Compressed Air Line Bleed Valve	1	X	
Skidding Fabrication	1	X	
Polymer Feed System - Emulsion (Packaged)	1	X	
PLC System for all Anaergia Supplied Equipment			
PLC System	1	X	
Other			
Warranty		X	
Transportation and Shipping of Equipment		X	
Bonding, if required			X
Any Additional (other than mandatory) Insurance, if required			X

APPENDIX B: EQUIPMENT CUT SHEETS AND DRAWINGS

TRG-E-PSM
Submersible Electric Mixers

Anaergia
Breaking Barriers to Sustainability

PSM 940



PSM 1500

The **PSM-940** and **PSM-1500** submersible electric mixers are compact units that handle high viscosity high solids mixing applications. These reliable and robust mixers deliver high thrust on demand while automatically reducing energy consumption.

Features

- Sickle-shaped, thrust-optimized propeller geometry
- The direct gearless drive with a variable-speed permanent magnet synchronous motor eliminates a gearbox within the process tank
- Standard 150x150mm square guide post mounting bracket
- Low maintenance front bearing with mechanical seal
- Standard 15m long electrical cable with cable clamps
- Leakage sensor and thermal winding protection

Advantages

- Higher thrust at reduced rotational speed
- Enormous power reserves for significantly higher thrusts on demand
- Resistant to clogging from long fibres and rags - suitable for municipal wastewater digesters
- Low operation and maintenance costs

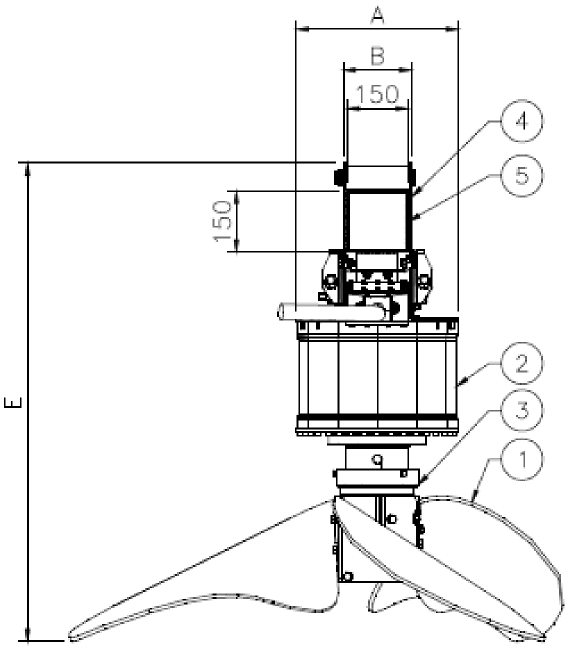
Applications

- Municipal wastewater resource recovery facilities
- Anaerobic digesters processing organic fraction from municipal solid waste
- Agri-Food including manure storage, anaerobic digestion and digestate holding tanks

Version: ON.PSM.V2

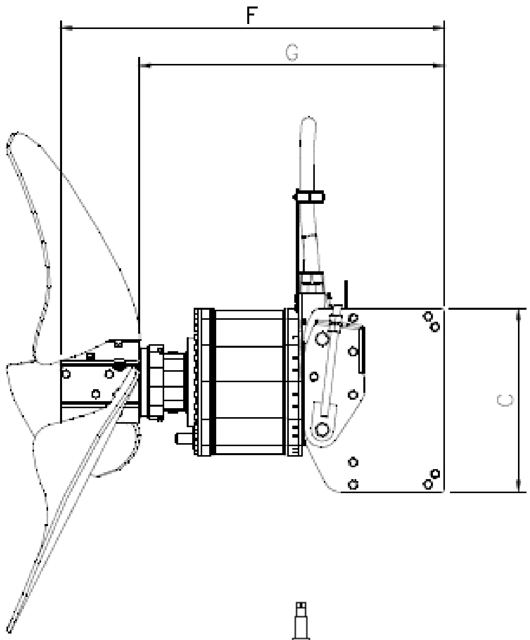
Anaergia

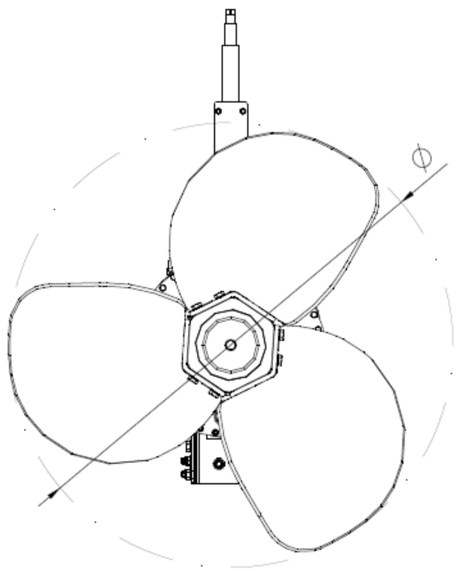
TRG-E-PSM



1	Blade
2	PSM motor
3	Bearing Assembly
4	Bracket / Console
5	Support Post

**Thrust, Torque and Shaft Power curves available





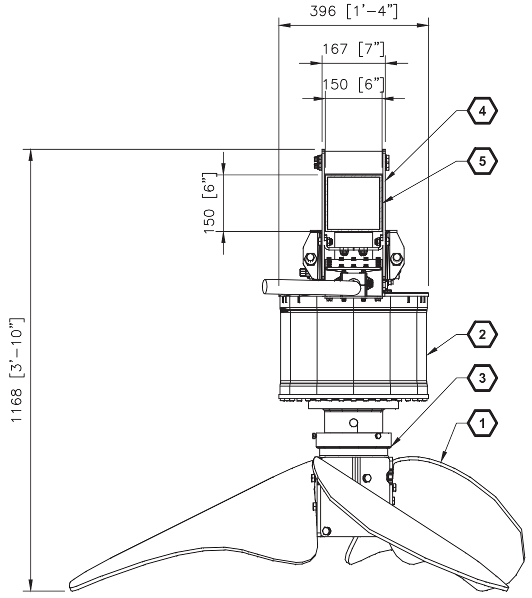
Motor Specifications	
Motor Type	High torque, permanent magnet synchronous motor (PSM)
Power Transmission	Direct gearless drive
Power* **(*Dependant on Medium)**	Operation: 7-12.5 kW
Torque* **(*Dependant on Medium)**	Normal Operation: 500-550 Nm Maximum: 800 Nm
Maximum Ambient Temperature	60°C
Thermal Protection	PTC Thermal control - PT100 (alternative KTY for Siemens FC)
Additional	• F class insulation (alternative H) • Winding Protection • ATEX Ex II 2G Explosion Protection • Mechanical seal • Leakage sensor

Propeller Specifications		
Model	**TRG-E-PSM 125-094-3-150**	**TRG-E-PSM 125-150-3-150**
Diameter	940 mm	1500 mm
Number of Blades	3	3
Geometry	3D; Sickle-shaped with optimized pitch	
Angle of Attack	Increasing from inside towards the outside	
Rotation **(Dependant on Medium)**	**Maximum**: 150 rpm **Range**: 120-150 rpm	**Maximum**: 120 rpm **Range**: 80-120 rpm
Thrust	**Normal Operation**: 3,550 N **Range**: 2,200-4,400 N	**Normal Operation**: 3,600 N **Range**: 1,900-6,500 N
Volumetric Flow	**Normal Operation**: 86 m³/min **Maximum**: 95 m³/min	**Normal Operation**: 111 m³/min **Maximum**: 153 m³/min

Model	**940**	**1500**
A	396 mm	396 mm
B	167 mm	167mm
C	489 mm	489 mm
Ø	940 mm	1500 mm
E	1150 mm	1170 mm
F	1024 mm	1024 mm
G	814 mm	814 mm
Weight	310 kg	330 kg

*Weight includes drive unit and propeller

Version: ON.PSM.V2



PLAN
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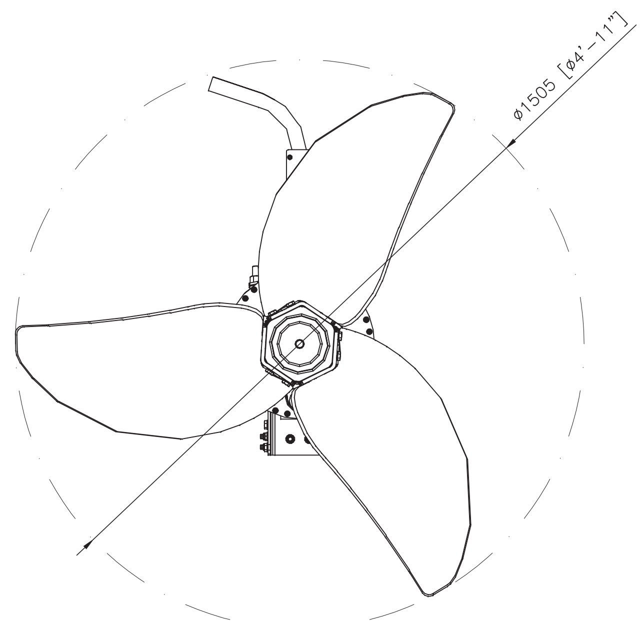
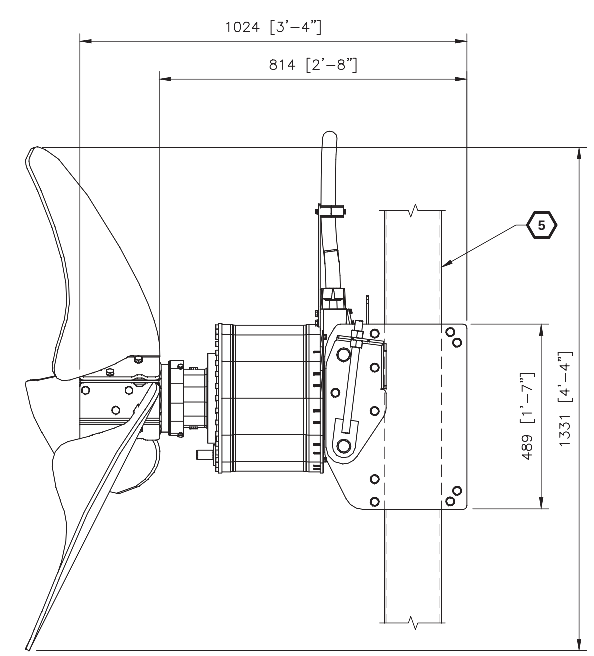
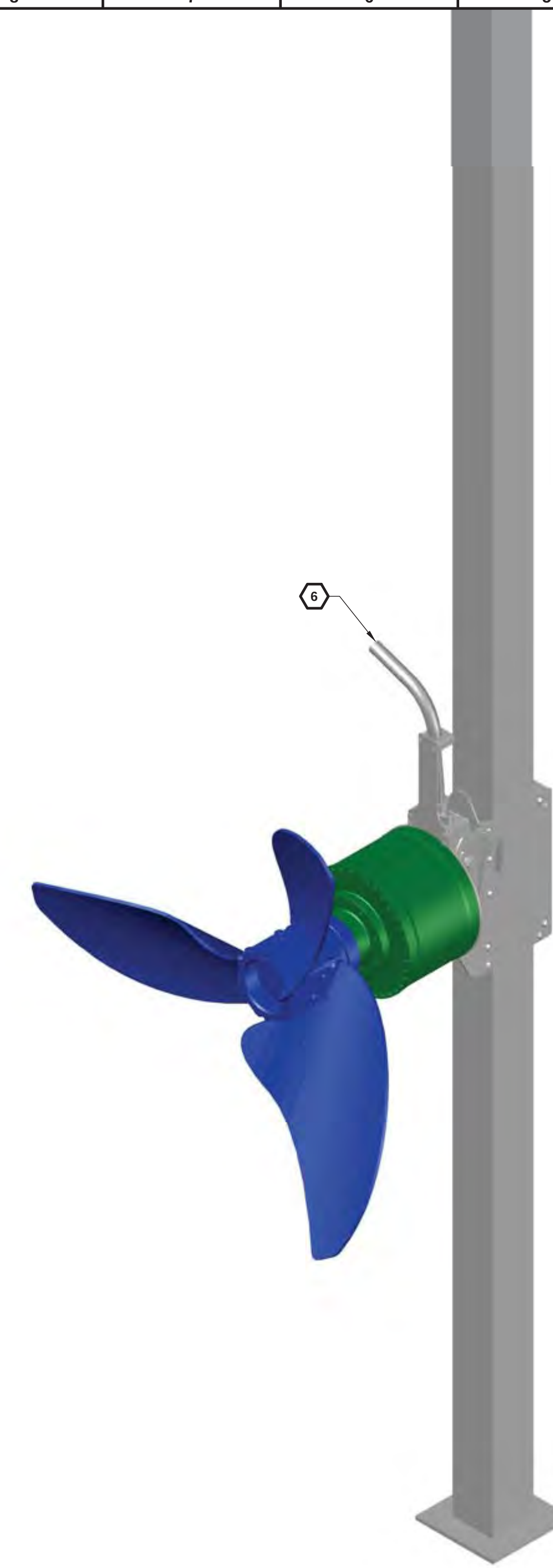


ELEVATION
1:10



ELEVATION
1:10



ISOMETRIC VIEW
1:10

EQUIPMENT LIST

1. BLADE
2. MOTOR
3. BEARING
4. SUPPORT BRACKET
5. POST
6. CABLE

EQUIPMENT NOTES

EQUIPMENT TYPE:

TYPE:	TRG-E-PSM 125-150-3-150
WEIGHT:	330kg (DRIVE UNIT AND PROPELLERS)

MOTOR:

TYPE:	HIGH TORQUE, PERMANENT MAGNETIC SYNCHRONOUS MOTOR (PSM)
TYPF: POWER TRANSMISSION:	DIRECT GEARLESS DRIVE
POWER:	DEPENDANT ON MEDIUM NORMAL OPERATION: 7-12.5kW MAXIMUM: 12.5kW
TORQUE:	DEPENDANT ON MEDIUM NORMAL OPERATION: 500-550Nm MAXIMUM: 800Nm
ADDITIONAL:	THERMAL PROTECTION – PTC THERMAL CONTROL – PT100 (ALT. KTY FOR SIEMENS FC) F CLASS INSULATION WINDING PROTECTION ATEX Ex11 2G EXPLOSION PROTECTION MECHANICAL SEAL LEAKAGE SENSOR

PROPELLER:

ROTATION:	DEPENDANT ON MEDIUM RANGE: 80-120 RPM MAX: 120 RPM
THRUST:	NORMAL OPERATION: 3,600N RANGE: 1,900-6,500N
VOLUMETRIC FLOW:	NORMAL OPERATION: 111m^3/MIN. MAXIMUM: 153m^3/MIN.

REV NUM	DESCRIPTION	DRWN BY	CHK'D BY	DATE
A	INTERNAL REVIEW	RN	AH	2016-05-02

ATTENTION:
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IF THIS BAR DOES NOT MEASURE 1" @ 22x34 or ½" @ 11x17, THEN DRAWING IS NOT TO SCALE - SCALE ACCORDINGLY

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DESIGNED:	UTS
DRAWN:	R. NADON
CHECKED:	S. SCATTERGOOD
APPROVED:	J. JOSSE
REFERENCE#:	
PROJECT NO.:	
SCALE:	1:10

ANAERGIA INC.
GENERAL ARRANGEMENT
EQUIPMENT LAYOUT

SUBMERSIBLE ELECTRIC MIXER PSM 1500
TRG-E-PSM-125-150-3-150

DRAWING NUMBER
GA-1
REV
A

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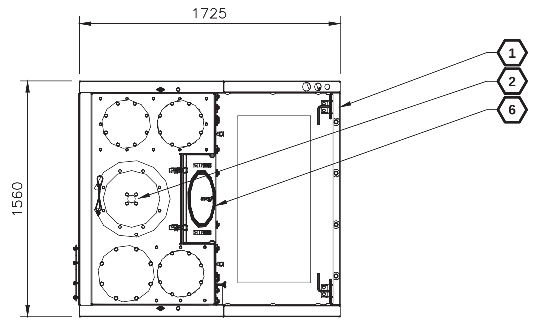
8/17/2016



PLAN
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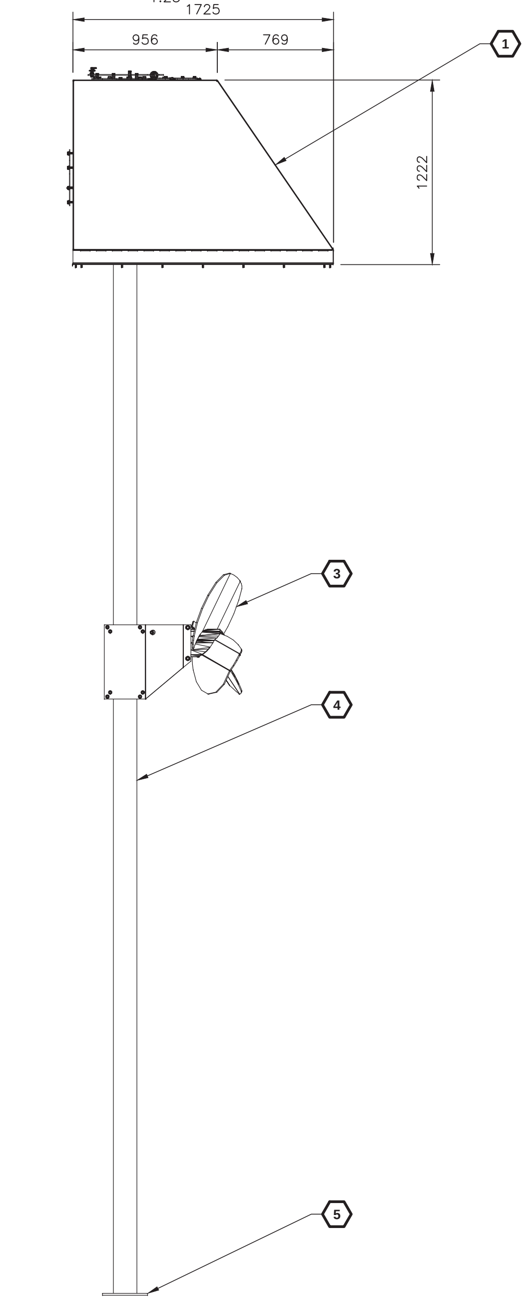
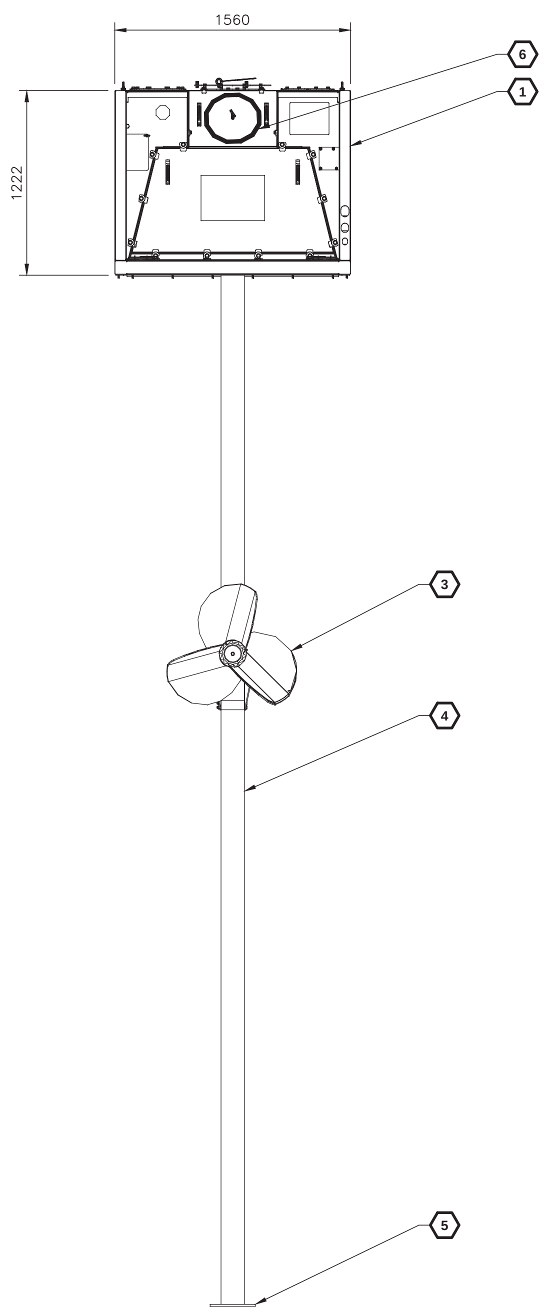


SIDE ELEVATION
1:25



FRONT ELEVATION
1:25

ISOMETRIC VIEW
1:20

EQUIPMENT LIST

1. SERVICE BOX
2. MIXER POSITIONER
3. HYDRAULIC OR ELECTRIC MIXER
4. MIXER SUPPORT POST
5. BOTTOM SUPPORT BEARING
6. SIGHT HATCH

DRAWING NOTES:

REV NUM	DESCRIPTION	DRWN BY	CHK'D BY	DATE
A	ISSUED FOR INTERNAL REVIEW	RN	SS	2016/03/28

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Anaergia
Breaking Barriers to Sustainability

DESIGNED:	S.S.
DRAWN:	R.N.
CHECKED:	S.S.
APPROVED:	J.J.
REFERENCE#:	
PROJECT NO.:	
SCALE:	AS SHOWN

EQUIPMENT
GENERAL ARRANGEMENT

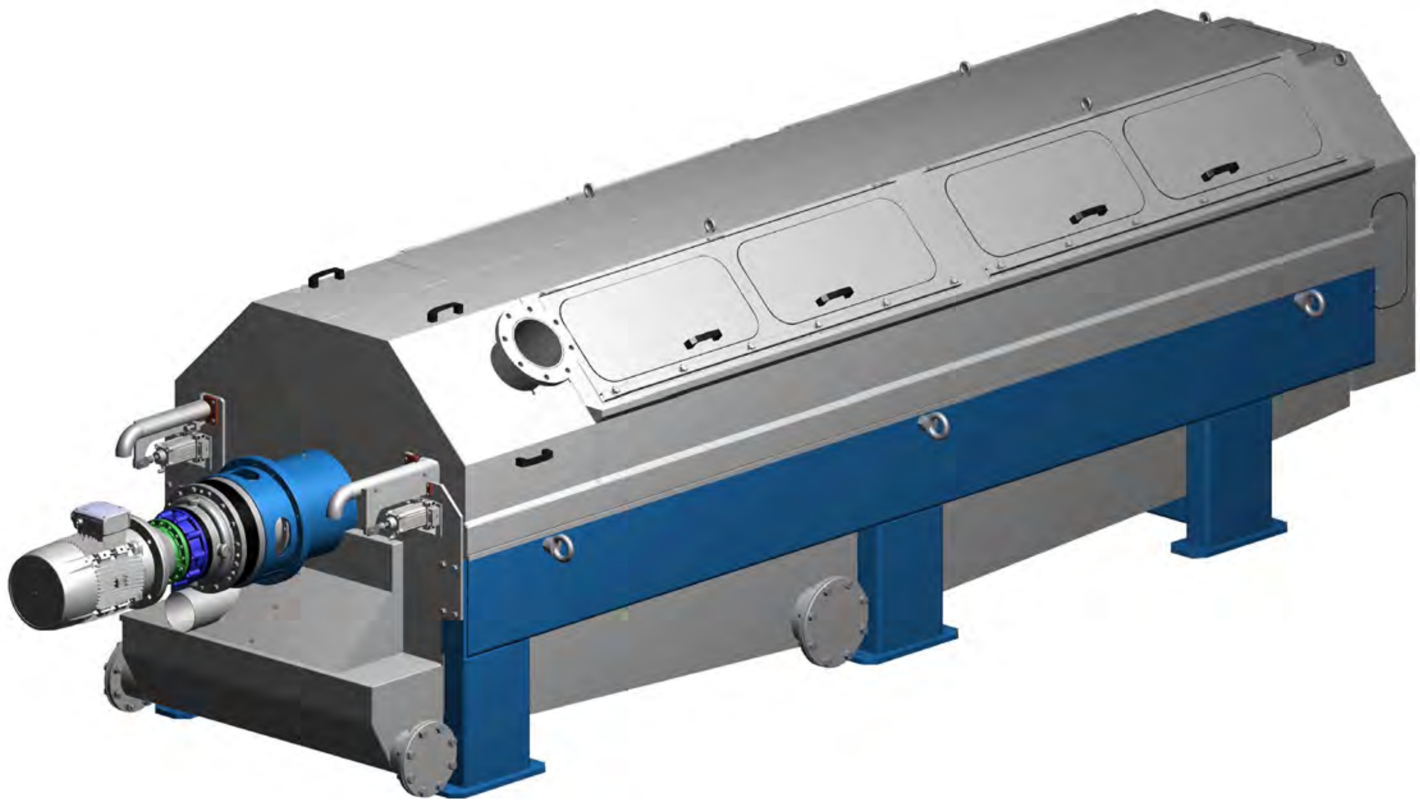
SERVICE BOX PRO CONCRETE COVER AND MIXER

DRAWING NUMBER
GA-1
REV
A

PRELIMINARY - NOT FOR CONSTRUCTION
O:\NAMENG\Equipment Data (Quotes & Cutsheets)\UTS Products\UTS Products - Mixers\Service Box Pro concrete cover and Mixer.dwg
3/28/2016

SST 400

Sludge Screw Thickener



SST 400 technology increases the solids content of liquid streams including digestate, municipal sludge and manure. Streams fed into the SST 400 are divided into a low solids liquid filtrate, and a nutrient rich high solids cake. The thickener's efficient separation process has an integrated spray cleaning system for easy maintenance without interrupting operation.

When used for recuperative thickening in anaerobic digestion, the SST 400 enables high-solids digestion for increased existing digester capacity and improves biogas production.

Its innovative design allows for continuous operation and minimizes both maintenance and power consumption.

Equipment can be delivered pre-assembled in a skidded package - significantly reducing engineering design and site installation costs.

Structured wedgewire screen baskets form the dewatering zone of the SST. These baskets can be factory installed or field replaced in a range of slot widths to optimize solids capture, hydraulic throughput and cake dryness.

Features

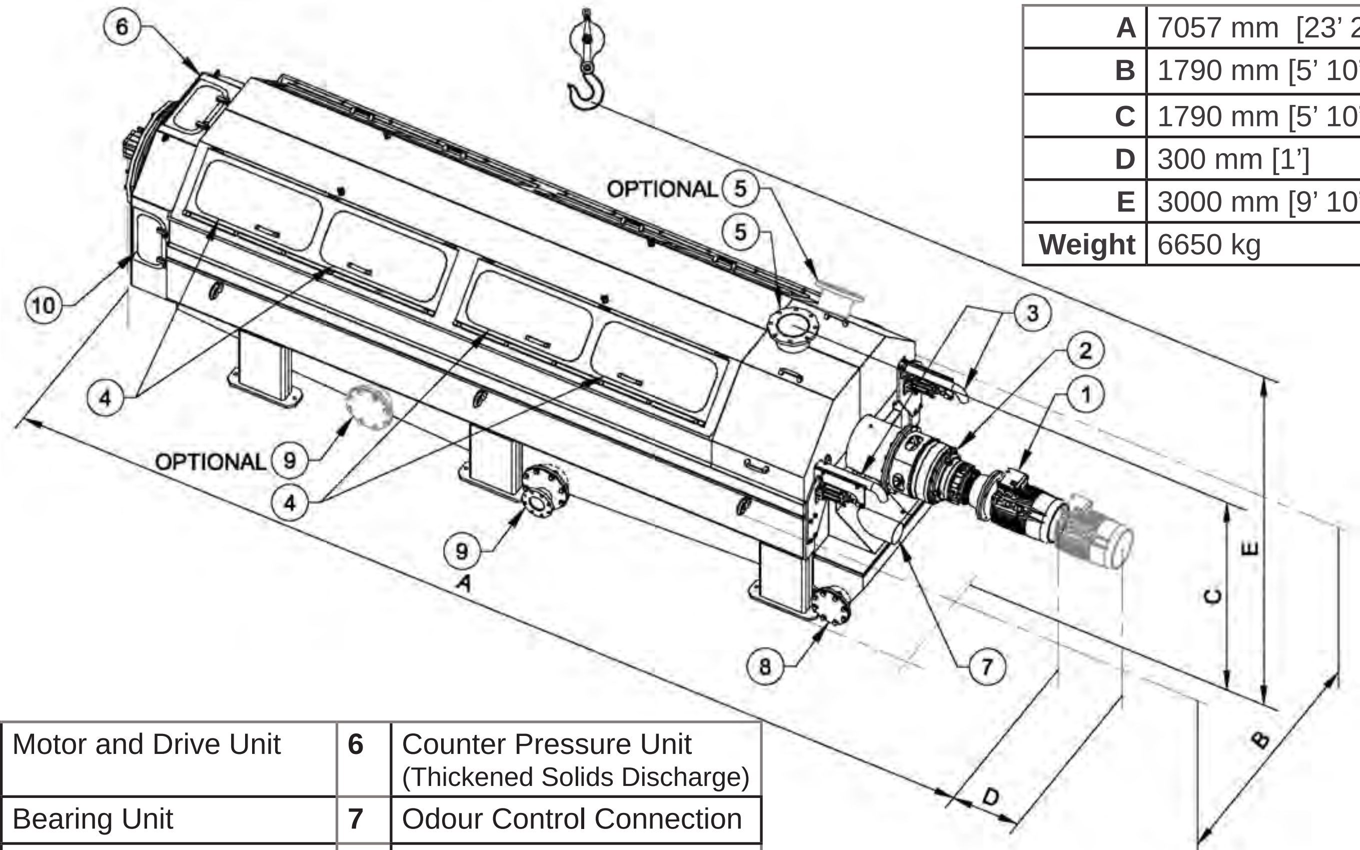
- Integrated spray cleaning system for easy maintenance
- Innovative wipers to reduce screen blockage
- Adjustable thickened solids moisture content
- Fully enclosed housing with odour control connection
- Removable wedgewire screen segments allow for quick maintenance and process optimization

Advantages

- Continuous operation and long duty cycles
- Low energy consumption
- Removing liquid increases existing digester capacity
- Slow rotational speed minimizes maintenance
- Pre-fabricated skid available for ease of installation
- Up to 90% lower energy costs compared to decanter centrifuges
- 2x drier cake compared to a rotary drum thickener (RDT) with the same polymer consumption

Version: ON.SST400.V2

SST 400



A	7057 mm [23' 2"]
B	1790 mm [5' 10"]
C	1790 mm [5' 10"]
D	300 mm [1']
E	3000 mm [9' 10"]
Weight	6650 kg

1	Motor and Drive Unit	6	Counter Pressure Unit (Thickened Solids Discharge)
2	Bearing Unit	7	Odour Control Connection
3	Wash Water Spray Bars	8	Overflow Connection
4	Inspection Covers	9	Gravity Filtrate Drainage **Optional Recycle
5	Inlet Housing **Optional Side Mount	10	Cake Inspection Covers

Feed	up to 6% TS
Capacity	Solids: 2200 kg/h dry Hydraulic: 60m^3/h
Output	12-13% TS

Specifications		
Power Supply	400VAC / 3ph / 50Hz 480VAC / 3ph / 60Hz 600VAC / 3ph / 60Hz	
Connected Power	11 kW, 15 hp (avg. consumption 8.1 kW)	
Auger	max. 7.8 rpm 1423 kg weight 4469 mm active length	
Control System	Local control at panel station, or remotely controlled via SCADA	
Wash Water	Supply: 200 LPM, 4 bar [53 GPM, 58 psi] Consumption: 102 LPH [27 GPH]	**Optional High Pressure Wash Water** Supply: 90 LPM, 20 bar [24 GPM, 290 psi] Consumption: 45 LPH [12 GPH]
Polymer Dose	2-4 kg polymer/MT TS	

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4210 South Service Rd.
Burlington, ON, L7L 4X5
T: 905.766.3333 F: 905.766.3330

Version: ON.SST400.V2

Attachment 4-B
Digester Cost Breakdown

COMPONENTS		(3)	(4)	(5a)
	Alternative 1 New Mesophilic	Alternative 2 Thermophilic*	Alternative 3 High Solids Mesophilic	Alternative 4 THP
Equipment	-	$1,426,254	$3,460,785	$3,516,904
Concrete	-	$71,313	$17,304	$351,690
Digester Structural Modifications	-	$293,701	-	-
Canopies/Buildings	-	$200,000	$0	$375,000
Process Piping	-	$213,938	$0	$175,845
Installation	-	$285,251	$0	$351,690
Electrical / I&C	-	$142,625	$69,216	$175,845
Site Work	-	$142,625	$0	$105,507
Construction Estimate Subtotal	$7,268,549	$2,775,706	$3,547,305	$5,052,482
General Conditions (10%)	-	$277,600	$0	$505,300
Overhead and Profit (15%)	-	$416,400	$0	$757,900
Construction Est.Subtotal (including GCs and OH/Profit)	$7,268,549	$3,469,706	$3,547,305	$6,315,682
Construction Contingency (30%)	$2,180,600	$1,041,000	$1,064,200	$1,894,800
Construction Cost Estimate	$9,449,149	$4,510,706	$4,611,505	$8,210,482
Escalation and/or Market Factor Adjustments	-	-	-	-
Engineering, Legal, and Adminstrative Costs (25%)	$2,362,300	$1,127,700	$1,152,900	$2,052,700
Total Capital Cost ($)	$11,800,000	$5,600,000	$5,800,000	$10,300,000
Previous Analysis	$16,120,000	$3,390,000	N/A	$10,210,000
*Assumed equipment will fit inside existing mezzanine				
20-Year Net Present Value (2017)	$15,200,000	$10,300,000	$9,100,000	$8,700,000
Previous Analysis	$21,200,000	$11,100,000	N/A	$7,100,000
				Class A

Attachment 4-A

Attachment 4-A
Project Number: 683244
Project Name: 2017 Gresham Master Plan Update
Capital Costs ***Alternative 1: New Mesophilic Digester Class B***

Scope
One new mesophilic digester

Assumptions
Excludes strain press

		Cost	Notes
Equipment			
New digester	$	7,268,549	Added 7.19% to adjust from 2015 dollars: $575,000
Subtotal	$	7,268,549	
Concrete			
Allowance	$	-	Included in equipment cost
Building			
Equipment building	$	-	Included in equipment cost
Process Piping			
Allowance	$	-	Included in equipment cost
Installation			
Allowance	$	-	Included in equipment cost
Electrical and I&C			
Allowance	$	-	Included in equipment cost
Site Work			
Allowance	$	-	Included in equipment cost

From Summary Sheet		Risk Adjustments (+/- percent)			
Year of Analysis	2017	Benefits			
Escalation Rate	2.00%	Capital Costs			Annual Biosolids Growth
Discount Rate	3.00%	Running Costs			1.70%

2017 Unescalated Dollars	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	NOTES
Biosolids Production, WT																					
Biosolids Production, DT/yr																					
Capital Costs																					
New Digester									11,800,000												Assume construction of new digester occurs in year 2025
Annual Costs																					
Annual Electrical Costs ($)	*6,336*	6,463	6,592	6,724	6,858	6,995	7,135	7,278	7,424	7,572	7,724	7,878	8,036	8,196	8,360	8,527	8,698	8,872	9,049	9,230	Used unescalated 2017 number from 2014 "Solids Process Improvements Predesign Report" and escalated at 2% for following years
Annual Natural Gas Cost ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Annual Polymer Costs ($)	60,104	61,128	62,174	63,220	64,287	65,397	66,507	67,638	68,791	69,943	71,138	72,355	73,572	74,831	76,111	77,392	78,715	80,060	81,405	83,033	Calculated per 63% volatile solids reduction and amount of digested sludge out (polymer cost $1.75/lb)
Labor for Operation ($)	*34,667*	35,360	36,068	36,789	37,525	38,275	39,041	39,821	40,618	41,430	42,259	43,104	43,966	44,845	45,742	46,657	47,590	48,542	49,513	50,503	Used unescalated 2017 number from 2014 "Solids Process Improvements Predesign Report" and escalated at 2% for following years
Labor for Maintenance ($)	*5,200*	5,304	5,410	5,518	5,629	5,741	5,856	5,973	6,093	6,214	6,339	6,466	6,595	6,727	6,861	6,999	7,138	7,281	7,427	7,575	Used unescalated 2017 number from 2014 "Solids Process Improvements Predesign Report" and escalated at 2% for following years
Class B Local Haul and Application ($)	*109,534*	*74,264*	*37,763*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Used unescalated 2017 number from 2014 "Solids Process Improvements Predesign Report"
Class B Long Haul and Application ($)	500,000	510,000	520,200	530,604	541,216	552,040	563,081	574,343	585,830	597,546	609,497	621,687	634,121	646,803	659,739	672,934	686,393	700,121	714,123	728,406	Used unescalated 2017 number from 2014 "Solids Process Improvements Predesign Report"
Total Annual Outlays ($)	**715,841**	**692,519**	**668,207**	**642,855**	**655,515**	**668,449**	**681,620**	**695,054**	**12,508,754**	**722,706**	**736,957**	**751,490**	**766,289**	**781,403**	**796,815**	**812,509**	**828,535**	**844,876**	**861,517**	**878,747**	
Annual Benefits																					
FOG gallons	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	Tipping fee $0.08/gallon, assume unescalated
FOG VS (lbs)	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	Tipping fee $0.08/gallon, assume unescalated
FOG Tipping Fees	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	Tipping fee $0.08/gallon, assume unescalated
Electricity Production ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gas Quality ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Annual Benefits Costs ($)	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	
Net escalated (benefit)/cost	**365,000**	**342,000**	**318,000**	**292,000**	**305,000**	**318,000**	**331,000**	**345,000**	**12,158,000**	**372,000**	**387,000**	**401,000**	**416,000**	**431,000**	**446,000**	**462,000**	**478,000**	**494,000**	**511,000**	**528,000**	
Cumulative escalated benefit/(cost)																					
Cumulative Total	365,000	707,000	1,025,000	1,317,000	1,622,000	1,940,000	2,271,000	2,616,000	14,774,000	15,146,000	15,533,000	15,934,000	16,350,000	16,781,000	17,227,000	17,689,000	18,167,000	18,661,000	19,172,000	19,700,000	
Life cycle cost analysis																					
PVs in 2017	**365,000**	**332,000**	**300,000**	**267,000**	**271,000**	**274,000**	**277,000**	**281,000**	**9,598,000**	**285,000**	**288,000**	**290,000**	**292,000**	**293,000**	**295,000**	**297,000**	**298,000**	**299,000**	**300,000**	**301,000**	
Cumulative PV	365,000	697,000	997,000	1,264,000	1,535,000	1,809,000	2,086,000	2,367,000	11,965,000	12,250,000	12,538,000	12,828,000	13,120,000	13,413,000	13,708,000	14,005,000	14,303,000	14,602,000	14,902,000	15,203,000	
NPV as of 2017	15,203,000																				

NOTES: Unescalated 2017 numbers used from 2014 "Solids Process Improvements Predesign Report" are *italicized* .

Attachment 4-A
Project Number: 683244
Project Name: 2017 Gresham Master Plan Update
Capital Costs ***Alternative 2: Thermophillic Digestion Class B***

Scope
Structural modifications and added heat exchangers to convert existing digesters to thermophilic digestion.

Assumptions
Excludes strain press

						Cost	Notes
Equipment							
Screw Press						514,512	Added 7.19% to adjust from 2015 dollars: $480,000
Conveyor						107,190	Added 7.19% to adjust from 2015 dollars: $100,000
Heat Exchanger						604,552	Added 7.19% to adjust from 2015 dollars: $564,000
Odor Control system for enclosed cake storage area						$200,000	In groundbiofilter or proprietary biotower system
Subtotal						$1,426,254	
Concrete							
Allowance						$71,313	2% of capital cost
Structural Modifications							
Digester Structural Modifications						293,701	Added 7.19% to adjust from 2015 dollars: $274,400
Building							
Equipment building	$	250	$/lnft	800	lnft	$ 200,000	Enclose cake storage area
Process Piping							
Allowance						$213,938	15% of capital cost
Installation							
Allowance						$285,251	20% of capital cost
Electrical and I&C							
Allowance						$142,625	10% of capital cost
Site Work							
Allowance						$142,625	10% of capital cost

From Summary Sheet		Risk Adjustments (+/- percent)	
Year of Analysis	2017	Benefits	
Escalation Rate	2.00%	Capital Costs	
Discount Rate	3.00%	Running Costs	

Annual Biosolids Growth
1.70%

	Year																				
2017 Unescalated Dollars	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	NOTES
Biosolids Production, WT																					
Biosolids Production, DT/yr																					
Capital Costs																					
Structural modifications, screw press, conveyor, heat exchanger									5,600,000												Assume conversion to thermophilic digestion occurs in year 2025
Annual Costs																					
Annual Electrical Costs ($)	*6,336*	6,463	6,592	6,724	6,858	6,995	7,135	7,278	7,424	7,572	7,724	7,878	8,036	8,196	8,360	8,527	8,698	8,872	9,049	9,230	Same as Alternative 1
Annual Natural Gas Cost ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Annual Polymer Costs ($)	60,104	61,128	62,174	63,220	64,287	65,397	66,507	67,638	66,505	67,619	68,775	69,951	71,127	72,344	73,582	74,820	76,100	77,400	78,700	80,274	Same as Alternative 1
Labor for Operation ($)	*34,667*	35,360	36,068	36,789	37,525	38,275	39,041	39,821	40,618	41,430	42,259	43,104	43,966	44,845	45,742	46,657	47,590	48,542	49,513	50,503	Same as Alternative 1
Labor for Maintenance ($)	*5,200*	5,304	5,410	5,518	5,629	5,741	5,856	5,973	6,093	6,214	6,339	6,466	6,595	6,727	6,861	6,999	7,138	7,281	7,427	7,575	Same as Alternative 1
Class B Local Haul and Application ($)	*109,534*	*74,264*	*37,763*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Same as Alternative 1
Class B Long Haul and Application ($)	500,000	510,000	520,200	530,604	541,216	552,040	563,081	574,343	585,830	597,546	609,497	621,687	634,121	646,803	659,739	672,934	686,393	700,121	714,123	728,406	Same as Alternative 1
Total Annual Outlays ($)	**715,841**	**692,519**	**668,207**	**642,855**	**655,515**	**668,449**	**681,620**	**695,054**	**6,306,469**	**720,382**	**734,593**	**749,085**	**763,844**	**778,916**	**794,286**	**809,938**	**825,919**	**842,216**	**858,812**	**875,988**	
Annual Benefits																					
FOG gallons	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	Same as Alternative 1
FOG VS (lbs)	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	Same as Alternative 1
FOG Tipping Fees	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	Same as Alternative 1
Electricity Production ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gas Quality ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Annual Benefits Costs ($)	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	
Net escalated (benefit)/cost	**365,000**	**342,000**	**318,000**	**292,000**	**305,000**	**318,000**	**331,000**	**345,000**	**5,956,000**	**370,000**	**384,000**	**399,000**	**413,000**	**429,000**	**444,000**	**460,000**	**476,000**	**492,000**	**508,000**	**526,000**	
Cumulative escalated benefit/(cost)																					
Cumulative Total	365,000	707,000	1,025,000	1,317,000	1,622,000	1,940,000	2,271,000	2,616,000	8,572,000	8,942,000	9,326,000	9,725,000	10,138,000	10,567,000	11,011,000	11,471,000	11,947,000	12,439,000	12,947,000	13,473,000	
Life cycle cost analysis																					
PVs in 2017	**365,000**	**332,000**	**300,000**	**267,000**	**271,000**	**274,000**	**277,000**	**281,000**	**4,702,000**	**284,000**	**286,000**	**288,000**	**290,000**	**292,000**	**294,000**	**295,000**	**297,000**	**298,000**	**298,000**	**300,000**	
Cumulative PV	365,000	697,000	997,000	1,264,000	1,535,000	1,809,000	2,086,000	2,367,000	7,069,000	7,353,000	7,639,000	7,927,000	8,217,000	8,509,000	8,803,000	9,098,000	9,395,000	9,693,000	9,991,000	10,291,000	
NPV as of 2017	10,291,000																				

NOTES: Unescalated 2017 numbers used from 2014 "Solids Process Improvements Predesign Report" are *italicized* .

Project Number: 683244

Project Name: 2017 Gresham Master Plan Update

Capital Costs ***Alternative 3: High Solids Mesophilic Digestion Class B***

Scope

New mixing and thickening equipment. See Appendix X for list of Omnivore equipment.

Assumptions

Excludes strain press

	Cost	Notes
Equipment		
Mixing and Thickening Equipment	$3,300,000	Quote from Anaergia 4/24/2017
Strain Press	160,785	Added 7.19% to adjust from 2015 dollars: $320,000 / To address rags with submersible mixers in digesters
Subtotal	$3,460,785	
Concrete		
Allowance	$17,304	0.5% of capital cost
		Inside mezzanine for the thickening unit; equipment pad
Building		
Equipment building	$ -	Assume thickener equipment located in existing mezzanine space
Process Piping		
Allowance	$0	
		Most of the process piping is included in the quote from Anaergia
Installation		
Allowance	$ -	
Electrical and I&C		
Allowance	$69,216	2% of capital cost
		Assume can resuse most of electrical from LMM and old gas compressors
Site Work		
Allowance	$0	
		assume none

From Summary Sheet		Risk Adjustments (+/- percent)			Annual Biosolids Growth
Year of Analysis	2017	Benefits			
Escalation Rate	2.00%	Capital Costs			
Discount Rate	3.00%	Running Costs			1.70%

Year

2017 Unescalated Dollars	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	NOTES
Biosolids Production, WT																					
Biosolids Production, DT/yr																					
Capital Costs																					
Mixing and Thickening Equipment (see Appendix X for equipment list)									5,800,000												Assume conversion to high solids mesophilic digestrion occurs in year 2025
Annual Costs																					
Annual Electrical Costs ($)	*6,336*	6,336	6,336	6,336	6,336	6,336	6,336	6,336	7,424	7,572	7,724	7,878	8,036	8,196	8,360	8,527	8,698	8,872	9,049	9,230	Used unescalated 2017 number from 2014 "Solids Process Improvements Predesign Report" and escalated at 2% for following years
Annual Natural Gas Cost ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Annual Polymer Costs ($)	60,104	61,128	62,174	63,220	64,287	65,397	66,507	67,638	83,491	84,643	85,838	87,055	88,272	89,531	90,811	92,092	93,415	94,760	96,105	98,027	Calculated per 63% volatile solids reduction and amount of digested sludge out (polymer cost $1.75/lb)
Labor for Operation ($)	*34,667*	35,360	36,068	36,789	37,525	38,275	39,041	39,821	40,618	41,430	42,259	43,104	43,966	44,845	45,742	46,657	47,590	48,542	49,513	50,503	Same as Alternative 1
Labor for Maintenance ($)	*5,200*	5,304	5,410	5,518	5,629	5,741	5,856	5,973	6,093	6,214	6,339	6,466	6,595	6,727	6,861	6,999	7,138	7,281	7,427	7,575	Same as Alternative 1
Class B Local Haul and Application ($)	*109,534*	*74,264*	*37,763*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Same as Alternative 1
Class B Long Haul and Application ($)	500,000	510,000	520,200	530,604	541,216	552,040	563,081	574,343	585,830	597,546	609,497	621,687	634,121	646,803	659,739	672,934	686,393	700,121	714,123	728,406	Same as Alternative 1
Total Annual Outlays ($)	**715,841**	**692,393**	**667,951**	**642,467**	**654,992**	**667,790**	**680,821**	**694,111**	**6,523,454**	**737,406**	**751,657**	**766,190**	**780,989**	**796,103**	**811,515**	**827,209**	**843,235**	**859,576**	**876,217**	**893,741**	
Annual Benefits																					
FOG (gal)	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	Max allowable FOG is 19,000 gallons based on 30% VS/Feed ratio
FOG VS (lbs)	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	9,983	9,983	9,983	9,983	9,983	9,983	9,983	9,983	9,983	9,983	9,983	FOG TS = 7%, VS/TS = 90%
FOG Tipping Fees ($)	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	554,800	554,800	554,800	554,800	554,800	554,800	554,800	554,800	554,800	554,800	554,800	Tipping fee $0.08/gallon, assume unescalated
Electricity Production ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gas Quality ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Annual Benefits Costs ($)	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	
Net escalated (benefit)/cost	**365,000**	**342,000**	**318,000**	**292,000**	**305,000**	**317,000**	**330,000**	**344,000**	**6,173,000**	**183,000**	**197,000**	**211,000**	**226,000**	**241,000**	**257,000**	**272,000**	**288,000**	**305,000**	**321,000**	**339,000**	
Cumulative escalated benefit/(cost)																					
Cumulative Total	365,000	707,000	1,025,000	1,317,000	1,622,000	1,939,000	2,269,000	2,613,000	8,786,000	8,969,000	9,166,000	9,377,000	9,603,000	9,844,000	10,101,000	10,373,000	10,661,000	10,966,000	11,287,000	11,626,000	
Life cycle cost analysis																					
PVs in 2017	**365,000**	**332,000**	**300,000**	**267,000**	**271,000**	**273,000**	**276,000**	**280,000**	**4,873,000**	**140,000**	**147,000**	**152,000**	**159,000**	**164,000**	**170,000**	**175,000**	**179,000**	**185,000**	**189,000**	**193,000**	
Cumulative PV	365,000	697,000	997,000	1,264,000	1,535,000	1,808,000	2,084,000	2,364,000	7,237,000	7,377,000	7,524,000	7,676,000	7,835,000	7,999,000	8,169,000	8,344,000	8,523,000	8,708,000	8,897,000	9,090,000	
NPV as of 2017	9,090,000																				

NOTES: Unescalated 2017 numbers used from 2014 "Solids Process Improvements Predesign Report" are *italicized* .

Attachment 4-A
Project Number: 683244
Project Name: 2017 Gresham Master Plan Update
Capital Costs ***Alternative 4: Thermal Hydrolysis Class A***

<u>Scope</u>
Pre-dewatering centrifuge system, CAMBI package (heating/cooling, and holding tank), rehabilitate and replace in the future the belt filter press.

<u>Assumptions</u>
Excludes strain press

						Cost	Notes
Equipment							
Pre-dewatering: Centrifuge							
Centrifuge	$ 343,008	$/ea	2	ea	$	686,016	Added 7.19% to adjust from 2015 dollars: $320,000
Conveyor	$ 53,595	$/ea	2	ea	$	53,595	Added 7.19% to adjust from 2015 dollars: $50,000
Polymer System	$ 43,948	$/ea	2	ea	$	43,948	Added 7.19% to adjust from 2015 dollars: $41,000
Cambi Package	$ 2,358,180	$/ea	1	ea	$	2,358,180	Added 7.19% to adjust from 2015 dollars: $2,200,000
Cambi heating and cooling	$ 214,380	$/ea	1	ea	$	214,380	Added 7.19% to adjust from 2015 dollars: $200,000
Cambi holding tank	$ 160,785	$/ea	1	ea	$	160,785	Added 7.19% to adjust from 2015 dollars: $150,000
Subtotal						$3,516,904	
Concrete							
Allowance						$351,690	10% of capital cost
Building							
Equipment building	$ 300	$/sqft	1,250	sqft	$	375,000	CMU block building
Process Piping							
Allowance						$175,845	5% of capital cost
Installation							
Allowance						$351,690	10% of capital cost
Electrical and I&C							
Allowance						$175,845	5% of capital cost
Site Work							
Allowance						$105,507	3% of capital cost

From Summary Sheet		Risk Adjustments (+/- percent)		Annual Biosolids Growth
Year of Analysis	2017	Benefits		
Escalation Rate	2.00%	Capital Costs		
Discount Rate	3.00%	Running Costs		1.70%

Year

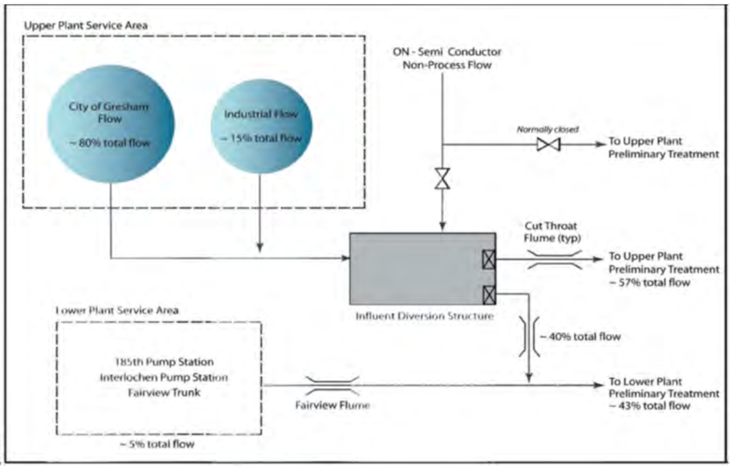
2017 Unescalated Dollars	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	NOTES
Biosolids Production, WT																					
Biosolids Production, DT/yr																					
Capital Costs																					
Pre-dewatering centrifuge system, CAMBI package, rehabilitate and replace belt filter press									10,300,000												Assume conversion to THP occurs in year 2025
Annual Costs																					
Annual Electrical Costs ($)	*6,336*	6,463	6,592	6,724	6,858	6,995	7,135	7,278	7,424	7,572	7,724	7,878	8,036	8,196	8,360	8,527	8,698	8,872	9,049	9,230	Used unescalated 2017 number from 2014 "Solids Process Improvements Predesign Report" and escalated at 2% for following years
Annual Natural Gas Cost ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Annual Polymer Costs ($)	60,104	61,128	62,174	63,220	64,287	65,397	66,507	67,638	119,620	121,624	123,702	125,818	127,934	130,123	132,350	134,577	136,878	139,216	141,555	144,386	Same as Alternative 3 except increase polymer consumption after conversion to THP for recuperative thickening
Labor for Operation ($)	*34,667*	35,360	36,068	36,789	37,525	38,275	39,041	39,821	75,000	76,500	78,030	79,591	81,182	82,806	84,462	86,151	87,874	89,632	91,425	93,253	Same as Alternative 1
Labor for Maintenance ($)	*5,200*	5,304	5,410	5,518	5,629	5,741	5,856	5,973	10,400	10,608	10,820	11,037	11,257	11,482	11,712	11,946	12,185	12,429	12,678	12,931	Same as Alternative 1 until conversion to THP in year 2025
Class B Local Haul and Application ($)	*109,534*	*74,264*	*37,763*																		Same as Alternative 1
Class B Long Haul and Application ($)	500,000	510,000	520,200	530,604	541,216	552,040	563,081	574,343													Same as Alternative 1 until conversion to THP in year 2025
Annual Cost of Class A Program ($)									71,752	73,187	74,651	76,144	77,667	79,220	80,804	82,420	84,069	85,750	87,465	89,215	Reduced cost for hauling Class A
Total Annual Outlays ($)	**715,841**	**692,519**	**668,207**	**642,855**	**655,515**	**668,449**	**681,620**	**695,054**	**10,584,195**	**289,491**	**294,927**	**300,467**	**306,075**	**311,828**	**317,689**	**323,623**	**329,705**	**335,899**	**342,171**	**349,015**	
Annual Benefits																					
FOG gallons	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	Same as Alternative 3
FOG VS (lbs)	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	6,305	9,983	9,983	9,983	9,983	9,983	9,983	9,983	9,983	9,983	9,983	9,983	Same as Alternative 3
FOG Tipping Fees	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	350,400	554,800	554,800	554,800	554,800	554,800	554,800	554,800	554,800	554,800	554,800	554,800	Same as Alternative 3
Electricity Production ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gas Quality ($)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Annual Benefits Costs ($)	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**350,400**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	**554,800**	
Net escalated (benefit)/cost	**365,000**	**342,000**	**318,000**	**292,000**	**305,000**	**318,000**	**331,000**	**345,000**	**10,234,000**	**(265,000)**	**(260,000)**	**(254,000)**	**(249,000)**	**(243,000)**	**(237,000)**	**(231,000)**	**(225,000)**	**(219,000)**	**(213,000)**	**(206,000)**	
Cumulative escalated benefit/(cost)																					
Cumulative Total	365,000	707,000	1,025,000	1,317,000	1,622,000	1,940,000	2,271,000	2,616,000	12,850,000	12,585,000	12,325,000	12,071,000	11,822,000	11,579,000	11,342,000	11,111,000	10,886,000	10,667,000	10,454,000	10,248,000	
Life cycle cost analysis																					
PVs in 2017	**365,000**	**332,000**	**300,000**	**267,000**	**271,000**	**274,000**	**277,000**	**281,000**	**8,079,000**	**(203,000)**	**(193,000)**	**(183,000)**	**(175,000)**	**(165,000)**	**(157,000)**	**(148,000)**	**(140,000)**	**(132,000)**	**(125,000)**	**(117,000)**	
Cumulative PV	365,000	697,000	997,000	1,264,000	1,535,000	1,809,000	2,086,000	2,367,000	10,446,000	10,243,000	10,050,000	9,867,000	9,692,000	9,527,000	9,370,000	9,222,000	9,082,000	8,950,000	8,825,000	8,708,000	
NPV as of 2017	8,708,000																				

NOTES: Unescalated 2017 numbers used from 2014 "Solids Process Improvements Predesign Report" are *italicized* .

Attachment 4-C
Asset Profile – Detailed Data Sheets

Influent Diversion Structure

Asset Profile



The WWTP receives domestic, commercial, and industrial wastewater from the incorporated areas of City of Gresham, Wood Village, and Fairview. Approximately 95 percent of this flow currently comes to the upper plant and is diverted for treatment. The lower plant receives overflow from the upper plant and has three dedicated influent lines - Fairview Trunk, 185th Pump Station, and Interlochen Pump Station. With the current configuration of the diversion structure, the flow to the lower plant cannot be routed to the upper plant.

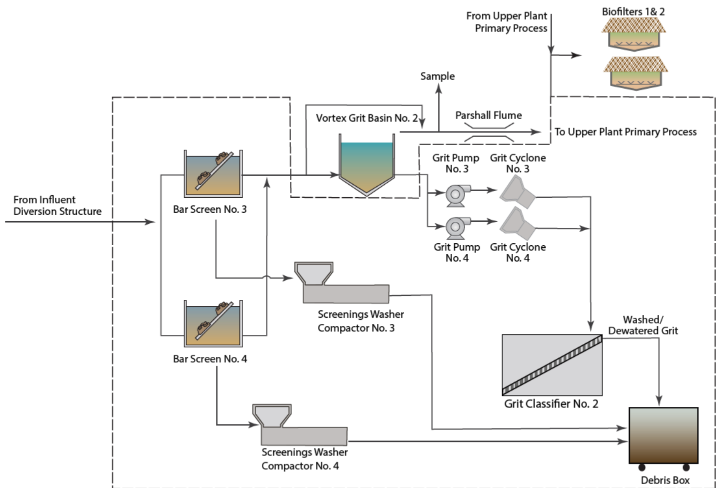
Demand Profile and Performance

Table: Peak, Average and Standby Design Capacities

System Sub Systems	Peak Design Capacity	Actual Performance
Lower Plant		
Flume Type	Cut-Throat	
Throat Width, feet	2	
Upper Plant		
Flume Type	Cut-Throat	
Throat Width, feet	2.87	

Upper Plant Preliminary Treatment

Asset Profile



Two mechanical climber type screens located in the upper headworks provide preliminary screening prior to diverting flow to the vortex grit chamber. Screenings from the plant are conveyed to the screenings washer/compaction systems. From the washer/compactors system, the debris is deposited in the grit hopper along with the grit from the vortex chambers for off-site disposal. Currently, there is no bypass around the bar screens. However, screened raw sewage can be diverted around the grit chamber. A biofilter system is used for control of odors from the headworks.

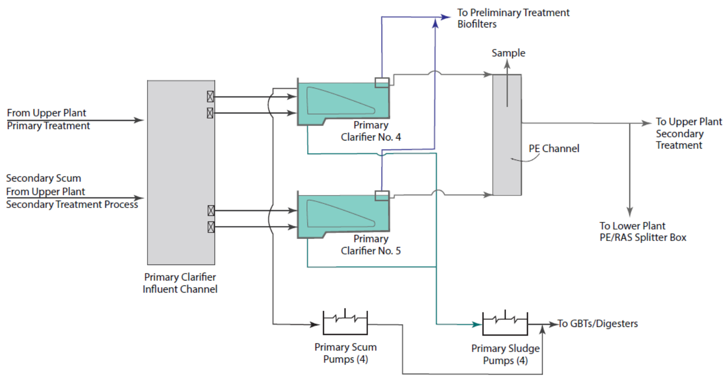
Demand Profile and Performance

Table: Peak, Average and Standby Design Capacities

System Sub Systems	Peak Design Capacity	Actual Performance
Upper Bar Screening and Removal System		
Screens	(2)-3/8 inch opening	
Washer/Compactors	(2)-2HP Washers & 5 HP Compactors	
Upper Grit Removal System		
Vortex Grit Cambers	(1)-20' D	
Grit Pumps	(2)-15 HP recessed impeller pumps	
Grit Cyclones and Classifiers	(2) grit cyclones; (1)-2HP grit classifier	
Upper Flow Measurement		
Parhsall Flume	(1)-48 inch	
Odor Control System		
Biofilter Blowers	(2)-30HP centrifugal FRP fan blowers	
Biofilters	biofilters	

Upper Plant Primary Treatment

Asset Profile



Primary treatment at the upper plant is provided with two 140-foot long 34-foot wide rectangular clarifiers. The effluent from the upper plant grit chamber and secondary scum enter the primary clarifier influent channel. This influent is split between Primary Clarifiers No. 4 and 5. Typically both primary clarifiers are in service during the wet season, while one clarifier is off-line during the dry weather season.

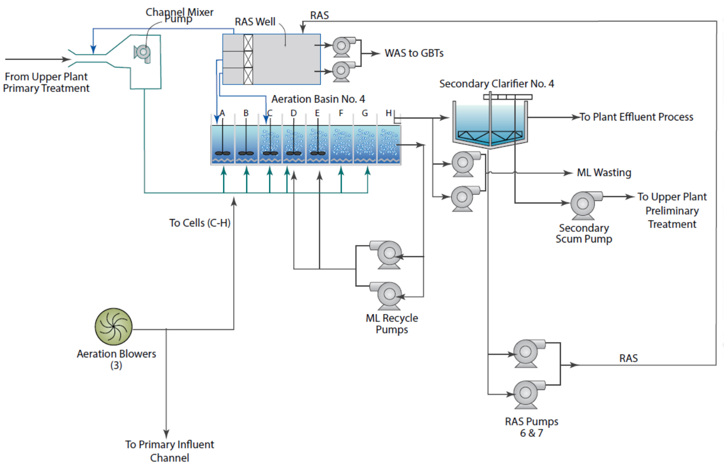
Demand Profile and Performance

Table: Peak, Average and Standby Design Capacities

System Sub Systems	Peak Design Capacity	Actual Performance
Primary Settling System		
Primary Clarifiers 4 and 5	(2)-140'L 34'W	
Primary Sludge & Scum Pumping Systems		
Sludge/ Pumps	(4)-150 gpm air operated diaphragm pumps	

Upper Plant Secondary Treatment

Asset Profile



The upper plant has one aeration basin (Aeration Basin No. 4) with 8 cells. The basin has multiple feed points for primary effluent (PE), return activated sludge (RAS), and mixed liquor recycle (MLR), which provide flexibility in operating modes. Currently, all PE and RAS are fed to Cell A, MLR is not currently used, and Cells A and B are unaerated. The effluent from AB No. 4 is sent to Secondary Clarifier No. 4. Aeration Basin No. 4 is operated at an aerobic solids retention time (SRT) of 2.5 – 4 days and a target mixed liquor suspended solids (MLSS) concentration of 1,200 - 1,800 milligrams per liter (mg/L). RAS is maintained at 45% - 55% of AB influent flow in the basins.

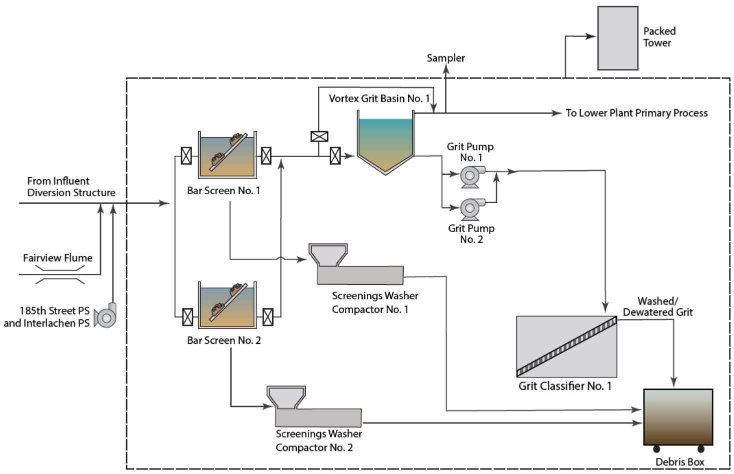
Demand Profile and Performance

Table: Peak, Average and Standby Design Capacities

System Sub Systems	Peak Design Capacity	Actual Performance
Upper Aeration System		
Aeration Basin 4	(1)@2 MG	
Capacity	13.5 mgd with a 3 day aerobic SRT and 2,000 mg/L MLSS	
Mixers	(8)-4.9HP submersible mixers	
Upper Blower and Air Distribution System		
Blowers	(6) single stage 300 HP blowers with 5,300 scfm each	
Diffusers	Sanitaire Discs	
Upper Secondary Clarification System		
SC 4	(1)-130'D 20'deep	
Upper RAS Pumping System		
RAS Pumps	(2) submersible 34 HP variable speed @3,472 gpm each	
Upper WAS Pumping System		
WAS Pumps	(2) non-clog 7.5 Hp variable speed @300 gpm each	
Upper Mixed Liquor Return Pumping System		
MLR Pumps	(2)7.5HP 3900 gpm axial flow pump?	
Upper Secondary Scum Pumping System		
Secondary Scum Pumps	(1) 5 HP 140 gpm submersible pump	

Lower Plant Preliminary Treatment

Asset Profile



Similar to the upper plant, two mechanical climber type screens and a vortex grit chamber provide preliminary treatment at the lower plant. Screenings are conveyed to the screenings washer/compactor systems. From the washer/compactors system, the debris is deposited in the grit hopper along with the grit from the vortex chambers for off-site disposal. The odor control system consists of two packed towers.

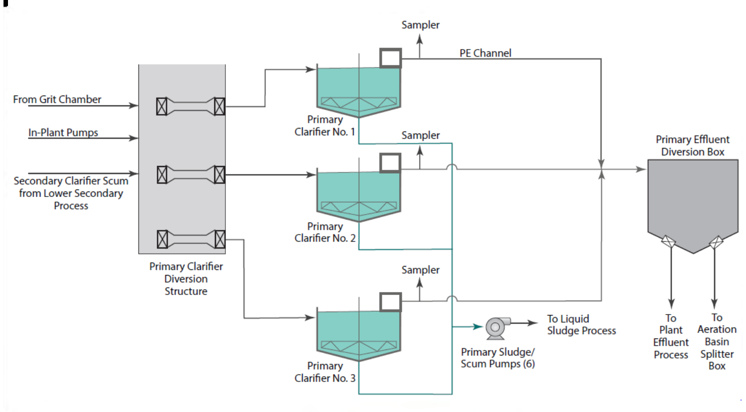
Demand Profile and Performance

Table: Peak, Average and Standby Design Capacities

System Sub Systems	Peak Design Capacity	Actual Performance
Lower Bar Screening and Removal System		
Bar Screens	(2)-1/4 inch	
Lower Flow Measurement		
Parshall Flumes	(1)-30 inch	
Lower Grit Removal System		
Vortex Grit Chambers	(1)-20' D	
Grit Pumps Cylones and Classifiers	(2)-15 HP recessed impeller pumps (1) grit cyclones; (1)-2HP grit classifier	
Lower Odor Control		
Odor Control System	7,875 scfm packed bed system	

Lower Plant Primary Treatment

Asset Profile



Primary treatment in the lower plant is provided with two 70-foot and one 110-foot diameter circular clarifiers. The primary influent flow is measured using three Parshall flumes and is split proportional to their surface areas.

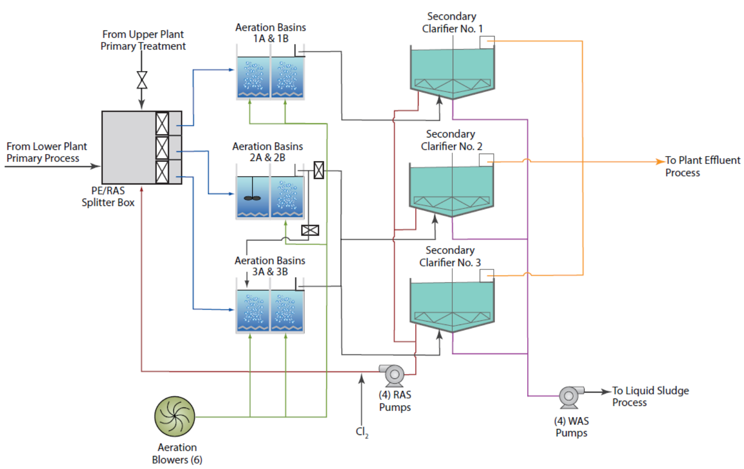
Demand Profile and Performance

Table: Peak, Average and Standby Design Capacities

System Sub Systems	Peak Design Capacity	Actual Performance
Lower Settling System		
Primary Clarifiers 1-3	(2)-70'D (1)-110'D	
Lower Primary Sludge and Scum Pumping System		
Primary Sludge/Scum Pumps	(6)-	
Flow Measurement		
Parhsall Flumes	(3)-27 mgd flumes	

Lower Plant Secondary Treatment

Asset Profile



The lower plant has three aeration basins split into two cells in per basin. Aeration Basin No. 1 can be operated only in parallel with Aeration Basins 2 and 3. Aeration Basin No.1 has not been used recently because the capacity has not been needed and it has the least efficient design of all of the aeration basins. Aeration Basins No. 2 and 3 are currently run in series with the first half of Aeration Basin No. 2 unaerated. RAS and PE are combined in the Aeration Splitter Structure, which can also receive PE flow diverted from the Upper Plant. Similar to AB No. 4 in the upper plant, the lower plant is operated at an aerobic SRT of 2.5 4 days and a target MLSS concentration of 1,200 - 1,800 mg/L.

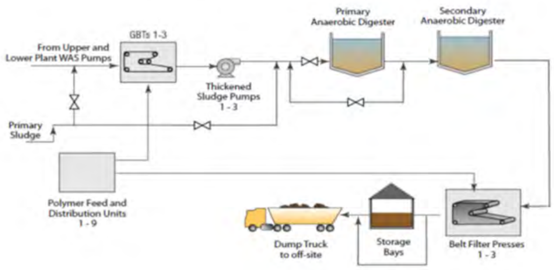
Demand Profile and Performance

Table: Peak, Average and Standby Design Capacities

System Sub Systems	Peak Design Capacity	Actual Performance
Lower Aeration System		
Aeration Basins 1-3	(3) basins	
Lower Blower and Air Distribution System		
Blowers	(6) multi stage 100 HP blowers with 1,600 scfm each	
Diffusers		
Lower Secondary Clarification System		
Secondary Clarifiers 1-3	(1)-110'D 13'deep; (1)-110'D, 16' deep	
Lower RAS Pumping System		
RAS Pumps	(4) non-clog 40 HP variable speed pumps.	
Capacity	3@3,470 gpm; 1@3,600 gpm	
Lower WAS Pumping System		
WAS Pumps	(4) WAS Pumps	

Solids Processes

Asset Profile



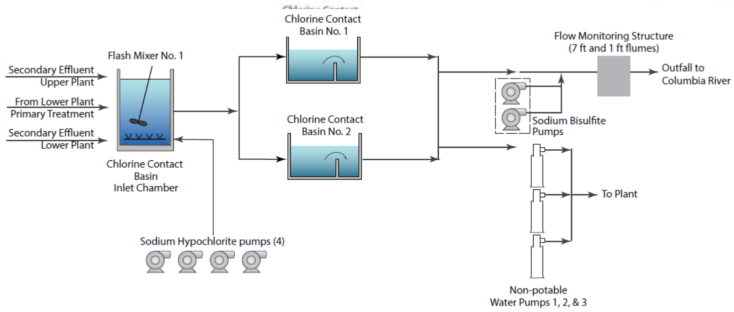
The waste activated sludge (WAS) from the upper and lower plant secondary clarifiers has been thickened with three, 2-meter gravity belt thickeners (GBTs) from approximately 0.5 percent to 4.5 percent dry solids. Currently, one unit is operated 24 hours per day and two units are operated 10 hours/day, 7 days/week. If needed, all three GBTs can be operated 24 hours per day. A project is being completed that will enable effective co-thickening of both primary sludge and WAS. Primary sludge is currently thickened in the primary clarifiers and fed directly to the digesters. Primary sludge and TWAS are digested in two anaerobic digesters. Historically, the digesters have been operated in series whereby the fixed cover digester is feed raw sludge and the outflow from the fixed cover tank flows into the floating cover tank. The City intends to operate in parrallel feed mode in the near future to reduce the solids loading. Digested solids are dewatered using the two 2-meter belt filter presses (BFPs). The BFPs are typically operated at a hydraulic loading rate of 80 gpm/press for 10 hours per day, 7 days per week. Dewatering throughput is currently limited due to deterioration in performance at higher loading rates. The dewatered cake is hauled for land application primarily to agricultural land in central Oregon. On-site solids storage provides a buffer for winter road conditions, and to provide for planned or unplanned down times for process equipment and/or truck hauling efforts.

Facilities Data Table

System Sub Systems	Number and Size
Polymer Feed System (utilized for thickening and dewatering)	
Preparation System	
Dry/Liquid	(2)@70 lb/hr each
Liquid	(2)@70 lb/hr each
Age Tanks	(4)@500 gal each
Feed and Dilution Pumps	(9)@140-1400 gph each
Thickening	
Gravity Belt Thickeners (GBTs)	
Size	(3) 2-meters wide
Solids loading	1,000 lbs/hr/meter
Hydraulic loading	100 gpm/meter
Thickened Sludge Pumping System	
Pumps (prior to 2017)	(3)-50gpm progressing cavity
Pumps (2017)	Retained (1)-50gpm progressing cavity; (2) -?? -gpm air-operated diaphram
Mesophilic Anaerobic Digester Tanks	
Primary Fixed Cover Digester	(1)@80'D, 27' sidewall depth, 1.015 MG
Secondary Floating Cover Digester	(1)@80'D, 27' sidewall depth, 1.015 MG (assuming volume is actively mixed and no volume allocated for gas or sludge storage)
Digester Mixing System	
Type	Linear motion mixer
Size	(1) per tank, 20 HP with VFDs
Solids concentration	3 % (maximum)
Digested Sludge (Belt Filter press) Pumping System	
Pumps	(2)-200gpm progressing cavity
Dewatering	
Belt Filter Presses (BFPs)	
Size	(2) 3-meters wide
Solids loading	600 lbs/hr/meter
Hydraulic loading	75 gpm/meter
On-Site Biosolids Storage	
Storage Bunkers	9 Bay @ 367 CY, Each; 3300 CY, Total

Plant Effluent Processes

Asset Profile



Disinfection of all secondary effluent is provided through two 0.3 million gallons (MG) chlorine contact basins. Liquid sodium hypochlorite is applied at either the chlorine mixing chamber or at the secondary clarifier effluent weirs. Chlorine is removed from the effluent through the addition of sodium bisulfite just upstream of the effluent Parshall flume.

Demand Profile and Performance

Table: Peak, Average and Standby Design Capacities

System Sub Systems	Peak Design Capacity	Actual Performance
Effluent Chlorination System		
Hypochlorite Pumps	(2)@23 gph; (2)@70 gph	
Storage Tanks	(2)@5,000 gallons	
Bisulfite Feed System		
Pumps	(2)@3.8gpm	
Storage Tanks	(2)@3,000 gallons	
Non-Potable Water System		
Pumps	(3)@400 gpm	
Effluent Contact Chamber and Outfall System		
Chlorine Contact Basins	(2)@0.296MG	
Upstream	48-inch line at 38 mgd	
Downstream	42-inch line at 40 mgd	

CHAPTER 5

Biogas Alternatives

5.1 Introduction

The City of Gresham WWTP is an energy net-zero facility. It produces its electrical needs onsite by operating two internal combustion engines using biogas generated by the anaerobic digesters and by purchasing electricity from a third party that is generated onsite by a solar photovoltaic array. Any surplus electricity that is generated onsite is fed back onto the Portland General Electric (PGE) electrical grid, allowing the City to bank surplus kilowatt-hours during a net meter year. The City is not reimbursed for any surplus "net metered" power left over at the end of a net meter year. The purpose of this chapter is to do the following:

- Review current biogas production and utilization.
- Estimate the electrical and thermal balances.
- Identify biogas alternatives for using excess biogas, electricity and/or heat for the following two scenarios:
  - Near-term, 5-year capital improvement plan
  - Long-term considerations
- Provide recommendations for future actions.

5.2 Background

The Gresham WWTP is a secondary treatment facility that produces both primary and secondary biosolids flow streams. Primary sludge has historically been thickened in the bottom of the primary clarifiers and then pumped directly to the anaerobic digesters. Secondary biosolids (waste-activated sludge) are pumped to the GBTs for thickening and then pumped to the digesters. The City is in the process of finalizing modifications that will enable co-thickening of the primary sludge on the GBT unit with the secondary biosolids. Polymer is added to the GBT feed to improve thickening performance. The WWTP has two 80-foot-diameter, 1-million-gallon digesters. The primary digester has a fixed cover and the secondary digester has a floating cover. Both tanks are mixed with a LMM.

In 2012, a FOG receiving station was constructed, and expanded in 2014. FOG discharges from restaurants, fast food outlets, and food processors can be categorized as yellow or brown FOG. Yellow FOG is waste material collected before entering the wastewater stream. Yellow FOG is collected and utilized by biodiesel producers. Brown FOG is material that has been discharged to sanitary sewers. Brown FOG contains water and other contaminants. Brown FOG collected from grease traps and trucked to the WWTP is fed into the City's FOG receiving station and then injected directly into the anaerobic digesters to produce additional biogas. The City has a total of 30,000 gallons of FOG receiving tankage.

Biogas extracted from the anaerobic digesters is used as fuel for two Caterpillar G3508 combined heat and power internal combustion cogen units. Cogen 1 is rated at 395 kilowatts (kW) and was installed in 2005. Cogen 2 is rated at 403 kW and was installed in 2015. The generated power is fed back into the plant's electrical grid and utilized. During times when surplus power is produced (for example when both engines are operating and the photovoltaic solar array is generating power), power is metered back to PGE. The heat generated by the cogen engines is used onsite to heat the administration building, anaerobic digesters, solids building, lower headworks, and thickener building. Any excess biogas is burned in the waste biogas flare. If one or both cogen engines are out of service, heat can be generated using the boiler, which can be operated using either biogas or natural gas.

In Chapter 4, four anaerobic digestion alternatives were selected for a qualitative analysis – MAD, Class B ATD, HSM digestion, and thermal hydrolysis (TH). The digesters currently use MAD, and MAD was used as a benchmark for the other alternatives. In terms of net heat and electricity, HSM digestion differs only slightly compared to MAD. Both TH and ATD would likely have no net impact; while each of them will create additional biogas, they both require additional heating/energy for heating the incoming digester feed to thermophilic temperature in the case of ATD and generating steam in the case of TH.

5.3 Biogas Production and Utilization

Biogas is produced at the two anaerobic digesters at the plant and combusted onsite in one of three ways: (1) as fuel for the cogen units to produce heat and power, (2) as fuel for the boiler to produce heat in the event that one or both engines are out-of-service, and (3) as excess biogas burned in the waste biogas flare. The primary use for the biogas is as fuel for the Caterpillar G3508 cogen engines. These engines generate heat and electricity that are used onsite. Any excess biogas is routinely burned in the waste biogas flare. If a cogen engine is out of service, additional heat can be generated using the boiler.

Historical 2015 and 2016 biogas generation quantities were analyzed for this evaluation. Biogas quantities are measured with flow meters on each of cogen engines, the flare, and the boiler. On average, the City produces approximately 300,000 standard cubic feet per day (scfd) of biogas from its anaerobic digesters, of which over 60,000 scfd is flared. See Table 5-1 for a summary of biogas usage over the previous 2 calendar years. There was a 9 percent increase in biogas production between 2015 and 2016, likely the result of receiving more FOG in 2016 than 2015.

Table 5-1. Biogas Production and Usage 2015-2016 (average scfd)

	2015	2016	Average
Cogen 1 Biogas Usage	127,393	126,859	127,126
Cogen 2 Biogas Usage	94,094	123,253	108,673
Flare	64,429	61,865	63,147
Boiler Biogas Usage	1,009	0[a]	505
Total Biogas Production	286,924	311,977	299,451

[a] Meter was not operating correctly in 2016.

Biogas production fluctuates between 250,000 and 350,000 scfd throughout the year. This is most likely related to the fluctuating amount of FOG received, not the time of year or ambient temperature. The boiler used biogas in 2015 and 2016; however, in 2016 the metering was not operating correctly, so boiler usage is not known during that timeframe. See Figure 5-1 for a graph of monthly biogas production and usage.

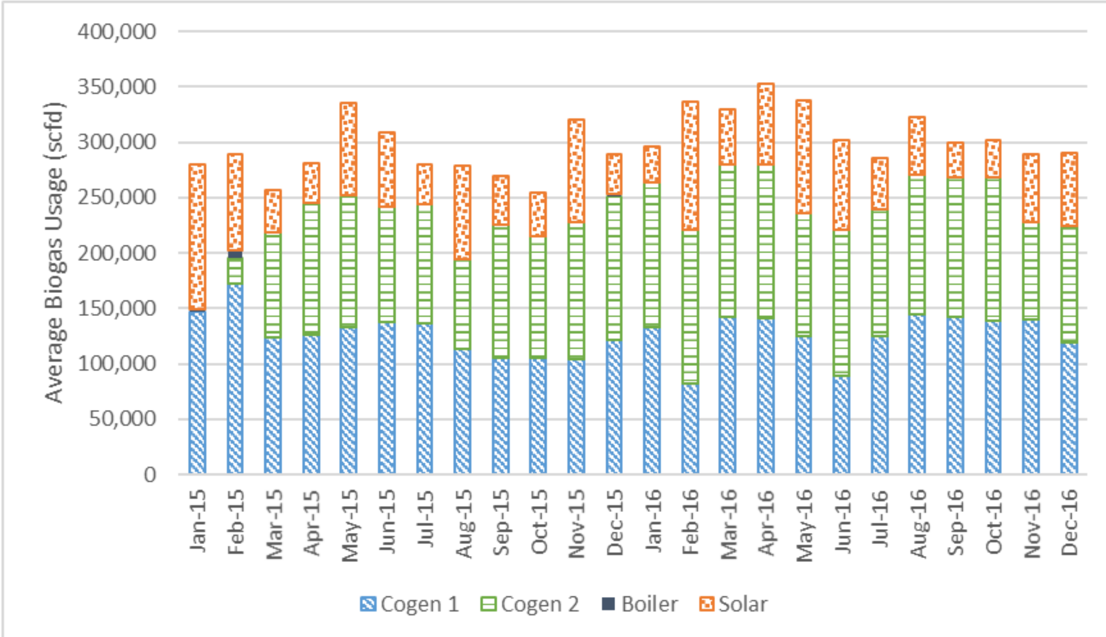


Figure 5-1. Biogas Monthly Production and Usage 2015-2016

Digester biogas typically comprises methane, carbon dioxide, oxygen, nitrogen, argon, and trace amounts of siloxanes and hydrogen sulfide. Table 5-2 outlines the makeup of fixed gases in the raw biogas. The December 2016 samples had slightly higher than expected concentrations of nitrogen and oxygen gases. This could potentially be a result of a small amount of air being introduced to the sample when taken. At the Gresham WWTP, raw biogas is conditioned to remove hydrogen sulfide by using an iron sponge medium, remove moisture by condensing the water vapor, and remove siloxanes by using granular activated carbon media. The biogas has an average heating value of 575 Btu per standard cubic foot (scf).

Table 5-2. Raw Biogas Composition of Fixed Gases

		July 2015		December 2016		
Parameter	**Units**	**Sample**	**Duplicate**	**Sample**	**Duplicate**	**Average**
Hydrogen	%, v/v	ND	ND	ND	ND	ND
Oxygen	%, v/v	0.588	0.489	0.893	0.943	0.728
Nitrogen	%, v/v	1.97	1.63	3.43	3.63	2.67
Carbon Monoxide	%, v/v	ND	ND	ND	ND	ND
Methane	%, v/v	62.7	63	62.4	62.1	62.6
Carbon Dioxide	%, v/v	34.8	34.9	33.3	33.3	34.1

ND = nondetectable; v/v = volume/volume

5.4 Electrical Balance and Production

The WWTP produces electricity onsite using a 395-kW cogen engine installed in 2005, a 403-kW cogen engine installed in 2015, and a 420-kW solar power generation system installed in 2010. Because the newest cogen engine was installed in 2015, only the past 2 years were examined for electrical production and usage for this analysis. The City records how much power was generated by each cogen engine and the solar panels.

The cogen engines typically run more than 90 percent of the time because of the consistent supply of biogas. Each cogen engine produces around 250,000 kilowatts-hours (kWh) per month. The solar panels, on the other hand, are impacted greatly by the weather. In 2015 and 2016, the solar panels generated between 10,000 and 70,000 kWh per month. July, August, and September saw the most electricity generated, while December and January saw the least. On average, the solar panels produced just under 37,000 kWh per month. Table 5-3 provides a summary of the average monthly electricity production at the WWTP.

Table 5-3. Average Monthly Power Production (kWh)

	2015	2016	Average
Cogen 1 Power Production	241,338	247,556	244,447
Cogen 2 Power Production	190,462	247,957	219,209
Solar Power Production	37,738	35,805	36,772
Total Power Production	469,538	531,318	500,428

Metering is used at the WWTP to monitor the amount of electricity consumed each month. Excess electricity is put back onto the PGE electrical grid when the Cogen 1, Cogen 2, and solar farm electrical production exceeds the WWTP's demand. Electricity is drawn from the grid when electrical production is not sufficient. Figure 5-2 shows how power demand has compared to production each month. The net metering year begins March 1 and goes through the following February 28. Since startup in February 2015 of Cogen 2, every month of operation except for November 2016 has been energy net zero and two full net zero years have been logged, with no purchase of electricity from the PGE.

Table 5-4 provides a summary of the monthly electricity balance at the WWTP. While Table 5-4 appears to show that the City purchased 14,400 kWh each month in 2015, those purchases took place during the startup of Cogen 2 and equal 14,400 kWh when averaged over an entire year. During the 2015 and 2016 calendar year, the City produced more power than it consumed (see Figure 5-3).

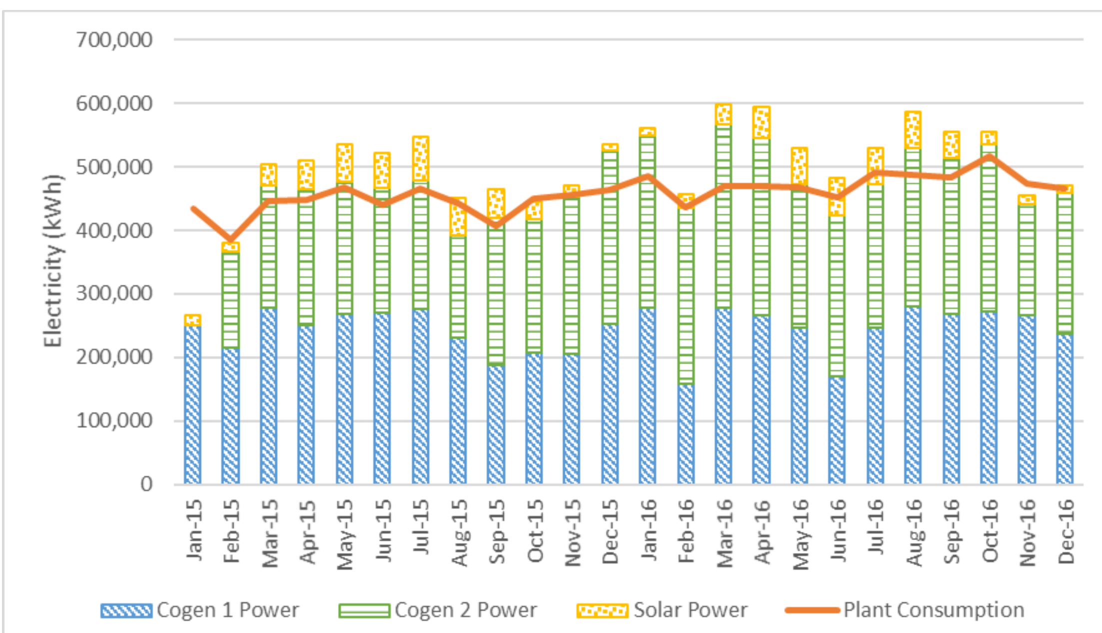


Figure 5-2. Monthly Power Demand versus Production

Table 5-4. Average Monthly Electrical Balance (kWh)

	2015	2016	Average
Total Power Production	469,538	531,318	500,428
Power Purchased	14,400	0	7,200
WWTP Power Demand	442,338	474,918	458,628
Excess Power	27,200	56,400	41,800

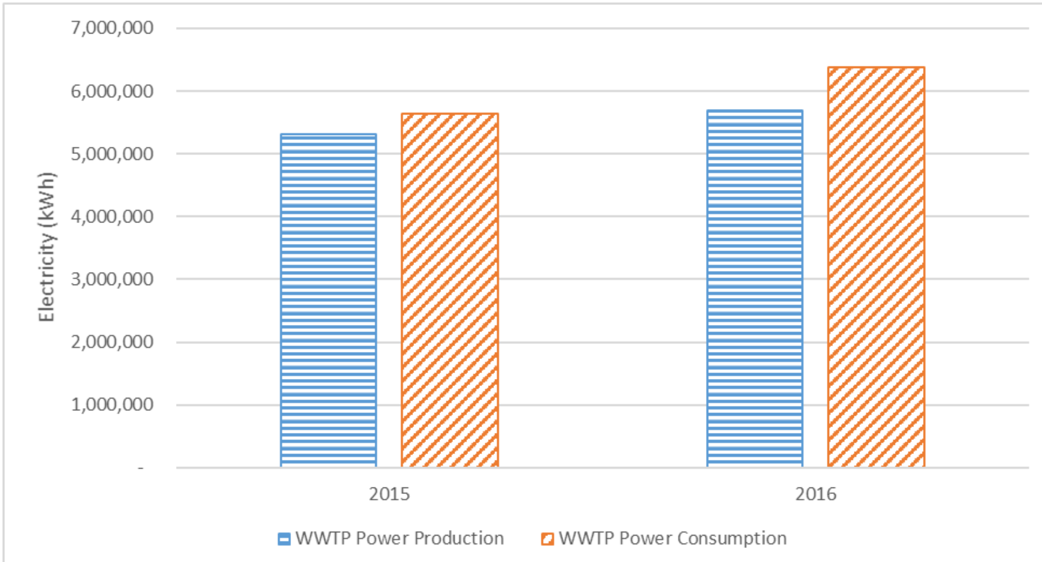


Figure 5-3. 2015 and 2016 Power Consumption versus Production

5.5 Thermal Balance and Production

The WWTP produces heat from the cogen units. Each unit is rated for approximately 1.9 million Btu per hour (MMBH). If a cogen unit is offline or extra heat is needed, the boiler can be used to produce additional heat. Currently, heat is recovered from the cogen units and used to heat the two anaerobic digesters and the administration building, solids building, and lower headworks building and for supplemental heat in the thickener building. The City is considering optimization efforts. The top priority would be to modify the boiler system so that it could be operated automatically when only one cogen is running and the other is down. Other options would be to automate Cogen 2 exhaust heat exchanger such that it provides heat as needed, and to install a new automated exhaust heat exchanger on Cogen 1. Future studies would identify possible heat sinks for waste heat; currently plant nonpotable water is utilized, which has high pumping costs. Starting in November 2015, the City began estimating the thermal usage. In 2016, the WWTP averaged approximately 1.40 MMBH of excess heat. See Table 5-5 for a summary.

Table 5-5. Average Monthly Thermal Balance (MMBH)

	2016
Cogen 1 Heat Production	0.93
Cogen 2 Heat Production	1.29
Boiler Heat Production	0.00
Total WWTP Heat Production	2.22
WWTP Heating Demand	0.82
Excess Heat	1.40

Heat consumption at the WWTP varies significantly over the year. During the winter months, more heat is required to heat the digesters and buildings. Most of the heat is used by the digesters to sustain an adequate temperature for digestion. However, during the entire year, there is excess heat at the WWTP, as shown in Figure 5-4. The amount of excess heat ranges from 0.76 to 1.95 MMBH (182 to 467 therms/day).

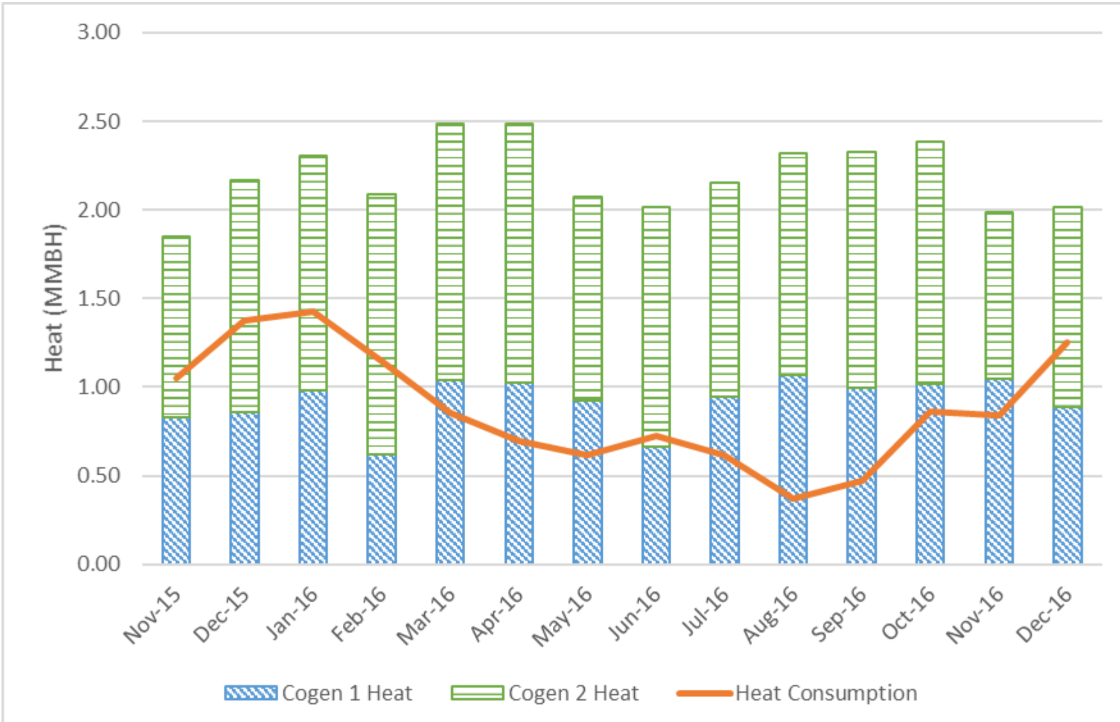


Figure 5-4. Heat Consumption

5.6 Biogas Alternatives

5.6.1 Identify Excess Biogas and Heat Consumer

Use of biogas by others was an alternative considered in the 2005 WWTP MP Update because there are two facilities adjacent to the WWTP that consume natural gas. Using biogas to offset heating or other uses at these facilities may be economically attractive because biogas is lower in cost than natural gas and is a renewable resource. The viability of this alternative depends on the cost of transporting the biogas to the end users, as well as the cost of upgrading existing equipment at these facilities needed to operate on biogas.

It is potentially feasible to sell all or a portion of the excess biogas to an adjacent commercial/ industrial facility. Potential offsite biogas buyers include two nearby commercial/industrial business on the south side of Sandy Boulevard. The first potential buyer is approximately 1,200 feet away, but uses relatively small quantities of natural gas and is referred to as the *smaller user*. The second potential buyer is approximately 1,800 feet from the Gresham WWTP, uses relatively more natural gas, and is referred to as the *larger user*. This alternative offers the advantage of providing a revenue stream to the City with excess biogas that would otherwise be flared.

An overriding consideration in the sale of biogas offsite is the cost associated with conditioning the biogas for offsite use, transporting it to adjacent facilities, and modifying the equipment at these facilities so they can accept the lower energy biogas. The primary drawbacks of conveying untreated biogas are impurities and moisture.

Water vapor causes the most problems during conveyance. As produced, biogas is warm and moist (almost saturated). Consequently, if transported untreated, the water vapor in the biogas can condense and potentially fill the pipe and block biogas flow. Therefore, it becomes highly desirable to dry the biogas to eliminate this risk.

Biogas has other impurities that can be problematic. At some facilities, these are removed and the biogas is cleaned to pipeline quality. The cost of scrubbing and pressurizing the biogas can be high both in terms of capital cost for the scrubber and operating costs. The cost of operating the system is highly influenced by the cost of electricity because the compressors, pumps, and blowers in the system consume large quantities of electricity and contribute significantly to the overall cost of converting the biogas to pipeline quality. For Gresham, however, the smaller user and larger user would use the biogas for heating purposes, which requires lower quality biogas. A gas cleaning system is not recommended. It is more cost-effective to make any modifications at the boiler or gas dryer, where the biogas will be used. For these reasons, it is assumed that the biogas will be dried, but not cleaned to pipeline quality, before being transported to any offsite entities.

Gresham currently has a biogas drying system that contains a booster allowing for increased gas pressure. Costs for drying biogas at the Gresham WWTP are relatively low. Additional gas compression equipment would be needed to pressurize the biogas so it could be transported the additional 1,200 to 1,800 feet to offsite users. The presence of a gas drying system at the Gresham WWTP and the proximity of offsite entities that use lower quality gas makes the sale of biogas an attractive alternative. Similar to the City of Portland's program to provide biogas to a roof shingle manufacturer adjacent to its Columbia Boulevard wastewater facility, minimal regulatory issues are anticipated. However, some risks associated with the sale of biogas to a third party would be if the consumer changed its process, moved, or went out of a business and no longer needed the supplemental biogas. Additionally, the pipeline would need to pass through the WWTP site and cross under Sandy Boulevard. There is a risk if rupture of that pipeline during future construction activities or seismic events.

In 2004, both industries were approached about their potential interest in purchasing biogas from the City of Gresham. Even though the larger user expressed interest in potentially purchasing biogas, there were several reasons that would make this project not viable. The first is their concern that the required equipment modifications on their end would be too expensive. The second is that the larger user requires that any improvement they fund related to this project be recovered through cost savings in 18 months, or less. The final reason that this project may not be attractive to the larger user is that they purchase large quantities of natural gas from Northwest Natural at wholesale rates and pay only a delivery charge, so savings from buying WWTP biogas could be minimal. Overall, the cost of building a pipeline for biogas and installing the necessary equipment to condition the biogas for use in the larger user's facilities is not economically attractive. Critical to this decision is the price of natural gas, which has historically been \$3 to \$4 per million Btu at the wholesale levels. Wholesale natural gas prices would have to be ≥ \$5 per million Btu for sustained periods to make this project attractive to the larger user. Given historic prices, however, this does not seem likely.

The smaller user has also shown interest in potentially using biogas from Gresham. The smaller user's natural gas use is considerably less than that of the larger user. Because of this, the smaller user is not able to purchase natural gas at wholesale rates and must pay retail rates. As a result, a project to pipe and purchase biogas from Gresham may be more economical. Because the smaller user would use the biogas for heating water and buildings (non-process use), this would only offset half of their natural gas purchases. Their natural gas requirements are not constant throughout the year, however. The smaller user's natural gas consumption is significantly higher in the winter. On average, the smaller user consumes 411 therms/day of energy in the winter compared to 172 therms/day in the summer. The City flares on average 393 therms/day (63,147 scfd of biogas with a heating value of 575 Btu/standard cubic foot), which would meet most of the smaller user's winter demand and all the summer demand.

Another option would be to sell excess heated water to the two industrial users. Unlike selling biogas, this option would not require modifications to the industrial users' boilers to accept lower-energy biogas. This option would require constructing an insulated heating loop, a heat pump, and potentially a heat exchanger. The lower capital costs might be more appealing to the users. For the larger user, this option may lower the capital costs such that a return on investment of less than 18 months may be achievable. As stated before, the smaller user consumes 411 therms/day of energy in the winter compared to 172 therms/day in the summer. The WWTP has only about 206 therms/day extra heat in the winter and 427 therms/day in the summer. This approach would allow the smaller user to reduce natural gas consumption in the winter and eliminate it in the summer. Figure 5-5 shows the seasonal small user heating demand and the WWTP's available heat.

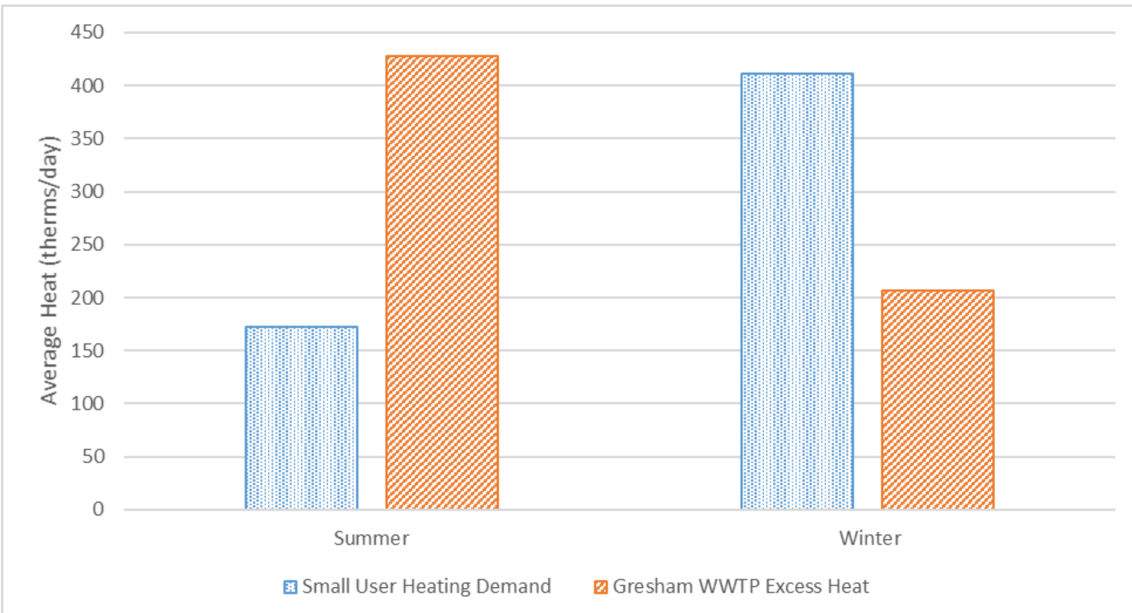


Figure 5-5. Seasonal Heat Demand and Supply

5.6.2 Use Excess Heat for Additional Building Spaces

Currently, heat is recovered from the cogen units and used to heat the two anaerobic digesters and the administration building, thickener building, solids building, and Lower Plant barscreen building. There are two additional spaces that have been identified for heating with biogas at the WWTP: the maintenance building and the Lower Plant blower building. The maintenance building option is being designed at the time of the writing of this MP Update.

If the heat loop were extended to the lower blower building, it could extend also to the future decant facility. Running the loop to the lower blower building is not being considered currently because the return on investment (payback) is too low. However, the decant facility is being designed with PEX tubing for hot water radiant floor heating if in the future it is decided to run the hot water loop to it. The decant facility is projected to receive 50 yd^3 of solids per month and require 75,000 Btu per hour (Btu/hr) (0.075 MMBH) heat. There is currently enough excess heat to supply that demand.

A solids improvement project already in design will revise the heat loop and route thermal heat to the maintenance building. This option is expected to require 188,000 Btu/hr (0.188 MMBH), and there is currently enough excess heat to supply that quantity.

5.6.3 Sell Excess Biogas as Renewable Natural Gas

There are two natural gas distributors that may be interested in buying the renewable natural gas: NW Natural and Williams. NW Natural is a natural gas distributor serving western Oregon and southwest Washington. Williams is an energy company that primarily processes and transports natural gas. Williams has interstate natural gas pipelines connecting much of the Pacific Northwest and the Rocky Mountains as well as the southeast United States. Both NW Natural and Williams have pipelines near the Gresham WWTP.

In order to sell its biogas as renewable natural gas, the City would need to expand current biogas cleaning operations. The City currently conditions the biogas to remove hydrogen sulfide, moisture, and siloxanes. Additional biogas cleaning equipment would be needed ensure a methane concentration in the biogas of at least 97 percent by removing carbon dioxide and potential nitrogen and oxygen gas. The biogas cleaning equipment alone would cost over $750,000. Additional costs would be required to potentially house and update the plant SCADA system. Annual operating costs for attaining 97 percent methane would be close to $100,000. This includes electricity costs, plant operations, and maintenance.

At this time, there are two potential pathways to selling renewable natural gas to NW Natural or Williams. The first would require the City to purchase the gas conditioning equipment to meet the renewable natural gas specification of NW Natural or Williams. The City would need to coordinate an injection point with either natural gas supplier, instrumentation to continuously monitor the renewable natural gas quality, and piping to connect the gas condition equipment to the injection point. Another pathway would be to work with a third party such as Clean Methane Systems who would obtain a system to clean biogas to pipeline quality and coordinate an injection point for either NW Natural or Williams with minimal upfront capital costs for the City. Because of the current high value of Renewable Identification Numbers (RINs), it is likely that over the next several years the City will be approached by third parties offering various public-private renewable natural gas partnerships that may have the potential to compete economically with the current plan of full-time cogen operation to avoid electrical utility costs.

On average, the City flares over 60,000 scfd of biogas (approximately 45 scfm). Because of the high costs associated with extensive gas conditioning systems and pipeline injection, 60,000 scfd is an insufficient quantity of biogas for pipeline injection. Equipment vendors have indicated that at least 300,000 scfd would be needed for this option to be economically feasible.

In addition to generating revenue from the sale of renewable natural gas, the City would be eligible to receive RINs, which are renewable energy credits established by the federal Renewable Fuel Standard (RFS) program. The RFS program was created under the Energy Policy Act of 2005, which amended the Clean Air Act and mandated minimum volumes of renewable fuels to reduce the quantity of petroleum-based transportation fuel. Refiners and importers of petroleum-based fuels must achieve compliance with the RFS by blending renewable fuels with petroleum-based fuels or by purchasing RINs.

Municipal wastewater treatment facility biogas is considered an approved source for renewable compressed natural gas, liquefied natural gas, and electricity. EPA categorizes digester biogas as a cellulosic biofuel (D-Code: 3): a biofuel produced from cellulose, hemicellulose, or lignin that must meet a 60 percent life-cycle greenhouse gas reduction. One RIN is awarded for each gallon of renewable fuel equivalence produced. One gallon of renewable fuel is equal to 77,000 Btu of compressed or liquefied natural gas or 22.6 kWh of electricity. Biogas-derived RIN values fluctuate between $0 and $2/RIN. This prices varies depending on the market and will likely stay within this range or increase slightly. On average, the City produces approximately 300,000 scfd of biogas from its anaerobic digesters, of which over 60,000 scfd is flared. The biogas has an average heating value of 575 Btu/scf. If the City converted the excess biogas (60,000 scfd) to renewable natural gas, this would result in up to $900 each day in

RINs (up to $328,500 annually). If the City converted all 300,000 scfd to renewable natural gas, that would result in up to $4,500 each day in RINs (up to $1,642,500 annually).

In 2007, the RFS program extended mandated renewable fuel volumes through 2022. For 2017, the program mandates a minimum of 24 billion gallons of renewable fuels and a minimum of 36 billion gallons by 2022. Beyond 2022, it is uncertain if the RIN program will continue.

5.6.4 Use Excess Electricity to Fuel Electric Vehicles

The WWTP now consistently generates more electricity than it consumes. Excess electricity could be used to fuel electric vehicles. Electric vehicles use an onboard rechargeable battery to store electricity to power electric motors. These vehicles produce no emissions at the tailpipe. Since 2012 City staff at the WWTP have used a Nissan Leaf primarily for short trips around town (not for everyday use). An electric charging station was installed in 2012 to serve two parking spaces in front of the Thickener Building, which was converted into office/conference room space. The station is utilized to charge the Leaf and other electric cars that are driven to the WWTP by occasional visitors. In the past 5 years, the Leaf has used approximately 2,600 kW-hours (equivalent to approximately 73 gallons of gasoline), which represents a small fraction of the power generated from the two cogens. This option could be expanded to provide renewable power on a larger scale for charging stations, which would require electrical site work and additional designated charging parking spots at the WWTP or offsite.

In 2016, the WWTP generated 676,800 kWh of excess electricity, equivalent to approximately 19,000 gallons of gasoline. If the electricity had been used for charging electric vehicles, the excess electricity would have been eligible for RINs. In 2016, that would have been nearly 30,000 RINs worth about $2 per RIN or $60,000. Recent changes have been made to the electric RIN rules, and there is no other WWTP known to be monetizing RINs from electricity used to power electric vehicles. As mentioned previously, beyond 2022, it is uncertain if the RIN program will continue.

5.6.5 Use Microturbines to Produce Additional Electricity

Microturbines are small combustion turbines generally divided into two classes: recuperated microturbines, which recover the heat from exhaust gas to boost the temperature of combustion and increase the efficiency, and unrecuperated (or simple-cycle) microturbines, which have lower efficiencies, but also lower capital costs. Commercial microturbines used for power generation range in size from about 30 to 1,000 kW. They produce both heat and electricity on a relatively small scale. The fuel-energy-to-electrical conversion efficiencies range between 25 and 35 percent. These efficiencies are attained when using a recuperator (a device that captures waste heat to improve the efficiency of the compressor stage). When used for cogeneration, microturbines are located at the source of power and have thermal electrical efficiencies up to 90 percent, depending on the heat process requirements. Unrecuperated microturbines have lower efficiencies at about 15 percent.

Based on the 60,000 scfd of excess biogas produced each day, the City would be able to power two 65-kW microturbine units. These units are over 6 feet tall, over 6 feet deep, and 2.5 feet wide, and would need to be housed inside a facility and have an exhaust outlet above the roofline. If these units ran 90 percent of the time, they would produce over 1,000,000 kWh each year (equal to approximately 28,000 gallons of gasoline or 40 to 50 vehicles driven on average 12,000 miles per year). Because this option provides more electricity to a WWTP that is already energy independent, the option should only be considered as part of the fueling electric cars option. If this option were paired with fueling electric vehicles, the 1,000,000 kWh of excess electricity would be equal to over 45,000 RINs.

5.7 Recommended Plan

5.7.1 Immediate Actions

The primary action recommended for completion within the next 5 years is to use the excess heat generated onsite for building spaces, such as the maintenance building heating project currently in design. The WWTP generates sufficient heating to provide heat for more buildings. The City will continue to consider heating additional building spaces onsite including the Lower Plant blower building, the disinfection buildings, and the floor of the new decant facility. However, recent analysis of these options has not yielded a reasonable payback.

5.7.2 2022 and Beyond

After 5 years, the City should study the life-cycle assessment costs to convert biogas to renewable natural gas. If a third party is able to obtain an injection point for trucked-in biogas, the City could evaluate the possibility of converting all biogas to renewable natural gas and buy natural gas for onsite needs. The City would be able to obtain RINs for all the renewable natural gas sold to NW Natural or Williams, and could buy natural gas as needed to heat the digesters using the boiler. The City could even consider if the economics at that time would warrant operating the cogens using the purchased natural gas, primarily to retain net positive electricity use at the WWTP. The City should continue to monitor the status of the RIN program. The benefit of selling renewable natural gas is lost if the RIN program is not renewed past 2022.

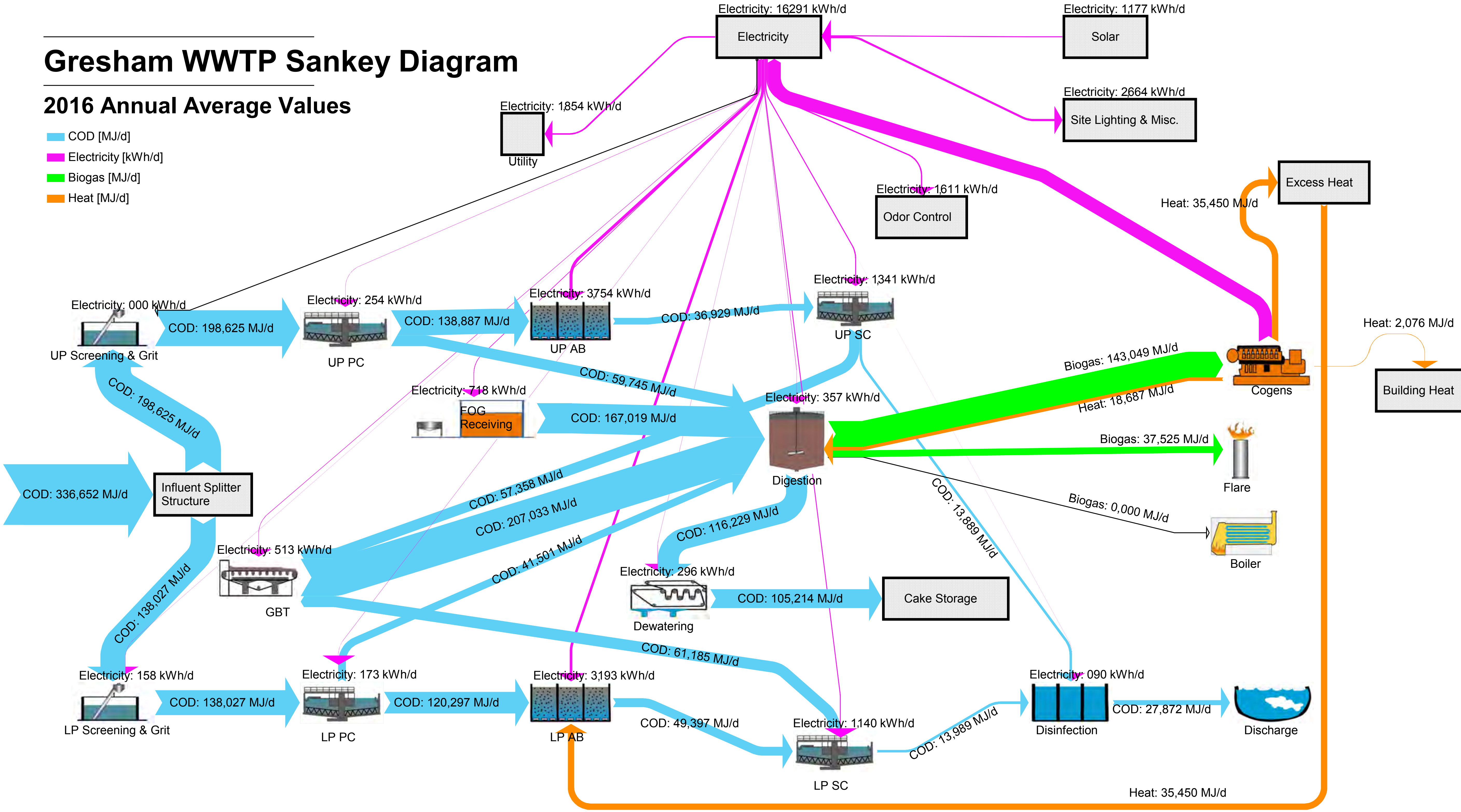
The City should also re-open discussions with local industries to explore the option of selling excess biogas and/or excess heat. Depending on the amount of excess heat or biogas in the future, this could be a low-cost option to sell excess biogas and heat that is currently wasted.

5.8 Sankey Diagram

A Sankey diagram was developed for the Gresham Wastewater Treatment Plant for COD, electricity, biogas, and heat (see Attachment 5-A). A Sankey diagram visually displays a flow stream line thickness proportional to its value. Electricity, biogas, and heat values were from 2016 annual average values provided by the City, and COD values were from dry season average values from 2011 through 2016 plant data. The dry season average and annual average peaking factors for BOD were both 1.0; therefore, no conversion to the dry season average values was computed. COD, fuel, and heat are shown in megajoules per day (MJ/d) and electricity is shown in kilowatt hours per day (kWh/d). Electricity values are not shown in relation to other flow streams since the values are significantly less and the lines would not be visible. COD values for each unit process are from the dry season average Pro2D model run in pounds per day. Electricity, biogas, and heat average monthly values are from City records (see previous subsections in this chapter).

The split of heat produced from the cogens was assumed to be 90 percent for the digesters and 10 percent used for heating building spaces. Electricity consumption of each unit process follows percentage breakdowns per *A Guide to Net-Zero Energy Solutions for Water Resource Recovery Facilities* (WERF, 2015) best practice loads except for odor control and FOG receiving, which were calculated based on horsepower usage. The best practice loads were adjusted to balance total electricity usage. There is a small amount of natural gas used to heat building spaces that is not incorporated in the Sankey diagram.

Attachment 5-A
Gresham WWTP Sankey Diagram


Gresham WWTP Sankey Diagram
2016 Annual Average Values
COD [MJ/d]
Electricity [kWh/d]
Biogas [MJ/d]
Heat [MJ/d]
Electricity: 16291 kWh/d
Electricity
Electricity: 1,177 kWh/d
Solar
Electricity: 2664 kWh/d
Site Lighting & Misc.
Electricity: 1,854 kWh/d
Utility
Electricity: 1,611 kWh/d
Odor Control
Excess Heat
Heat: 35,450 MJ/d
Electricity: 000 kWh/d
UP Screening & Grit
COD: 198,625 MJ/d
Electricity: 254 kWh/d
UP PC
COD: 138,887 MJ/d
Electricity: 3,754 kWh/d
UP AB
COD: 36,929 MJ/d
Electricity: 1,341 kWh/d
UP SC
Heat: 2,076 MJ/d
Building Heat
Biogas: 143,049 MJ/d
Heat: 18,687 MJ/d
Cogens
COD: 59,745 MJ/d
Electricity: 718 kWh/d
FOG Receiving
COD: 167,019 MJ/d
Electricity: 357 kWh/d
Digestion
Biogas: 37,525 MJ/d
Flare
COD: 198,625 MJ/d
COD: 336,652 MJ/d
Influent Splitter Structure
COD: 57,358 MJ/d
COD: 207,033 MJ/d
Biogas: 0,000 MJ/d
Boiler
COD: 13,889 MJ/d
COD: 116,229 MJ/d
COD: 41,501 MJ/d
COD: 138,027 MJ/d
Electricity: 513 kWh/d
GBT
Electricity: 296 kWh/d
Dewatering
COD: 105,214 MJ/d
Cake Storage
COD: 61,185 MJ/d
Electricity: 158 kWh/d
LP Screening & Grit
COD: 138,027 MJ/d
Electricity: 173 kWh/d
LP PC
COD: 120,297 MJ/d
Electricity: 3,193 kWh/d
LP AB
COD: 49,397 MJ/d
Electricity: 1,140 kWh/d
LP SC
COD: 13,989 MJ/d
Electricity: 090 kWh/d
Disinfection
COD: 27,872 MJ/d
Discharge
Heat: 35,450 MJ/d

CHAPTER 6

Recommended Improvements

Table 6-1 summarizes the recommended improvements associated with the Gresham WWTP, the driver behind the improvement, the estimated costs, and the phasing for the project. Projects are a result of ensuring that capacity and regulatory requirements are met, but also include general improvements identified through operator and staff comments. Project drivers are the criteria necessitating the improvement. Flow and load projections through 2036 and/or specific regulatory requirements have been used in determining when recommended improvements need to be online. See Chapter 3, Planning Criteria and Discharge Considerations*,* for a detailed description of how the flow and load projections used in this MP Update were established.

The project costs estimated for each project are order-of-magnitude estimates in 2017 dollars. The project costs are comprised of construction costs, a 30 percent construction contingency, and 25 percent for engineering and administration. Construction costs are typically parametric estimates, meaning they are based on previous estimates or bid tabulations from similar projects. Costs for individual project scope components include site work; mechanical, electrical, and instrumentation and controls; and contractor overhead, and are based on allowances (not detailed project-specific estimates). The 30 percent construction contingency is intended to cover unidentified and/or unknown items not anticipated at this master planning phase.

6.1 Project Phasing and Costs

The recommended phasing for capital/construction projects indicates the year that the project should be initiated as well as the year the improvements should be commissioned or brought online. The phasing for study projects indicates the duration of the study project. Figure 6-1 shows the site plan through 2036 and Figure 6-2 indicates the City's cash flow requirements for implementing the recommended plan. Summary sheets for each of the capital improvement projects identified in Table 6-1 are included in Attachment 6-A. The summary sheets include a description of the project, as well as project drivers, project triggers, funding resources, and a breakdown of expenses.

Table 6-1. Costs and Phasing of Recommended Improvements through 2036

Project	Description	Driver	Cost	Phasing
Near Term (0-5 years)				
Nitrification of the upper plant	Nitrify upper plant during the dry season. Improve diffusers in upper plant aeration basins.	Effluent discharge concentration regulatory limits	$252,000	2018 2018-2019
Mixing Zone Study	Effluent mixing zone study.	Effluent discharge concentration regulatory limits	$100,000	2018
Outfall Diffuser Improvements	Extend and improve outfall diffuser.	Effluent discharge concentration regulatory limits	$1,436,000	2019-20
Columbia River Study	Water quality monitoring study (pH, copper, alkalinity, and hardness) of Columbia River.	Effluent discharge concentration regulatory limits	$30,000	2017-18
Digester and Biogas Improvements	Operate digesters in parallel with co-thickening. Digester solids and biogas improvements.	Digester capacity	-	Improvements currently in progress
Intermediate Term (5-10 years)				
Fifth Secondary Clarifier Fourth Upper Plant Blower	Add 2nd upper plant secondary clarifier & secondary scum improvements. Add a 4th blower to upper plant blower building	Redundancy and more reliable nitrification operation	$7,192,000 $559,000	2020-2022
Influent Diversion Automation	Automate influent diversion structure.	Lack of automated control for flow split	$151,000	2022
Disinfection Automation	Automate disinfection chemical feed systems.	Lack of automated control when hydraulic residence time design criteria is exceeded	$151,000	2027
Alternative Biogas Utilization	Alternative biogas handling/utilization (clean biogas for injection into high pressure natural gas line).	Improved return on biogas	$1,000,000	2026-2027
Septage Receiving Facility	Construct septage receiving station at WWTP.	Generate additional revenue and support local businesses	$1,660,000	2028-2029
Additional Cake Storage	Construct 3 additional cake storage bays.	Maintain 60 days of storage in the wet season	$2,895,000	2023-2025
Long Term (10+ years)				
Digestion Capacity Improvements	Anaerobic digester stabilization improvements (assuming conversion to Class A program is not pursued in the near-term). Technology selection to be reevaluated at the next MP update.	Digestion capacity/redundancy	$10,300,000	2022-2025
North Access Bridge	Construction of a bridge over the Columbia Slough to the north of the existing plant for use of additional land for future projects.	Use of land north of WWTP	$582,000	2030-31

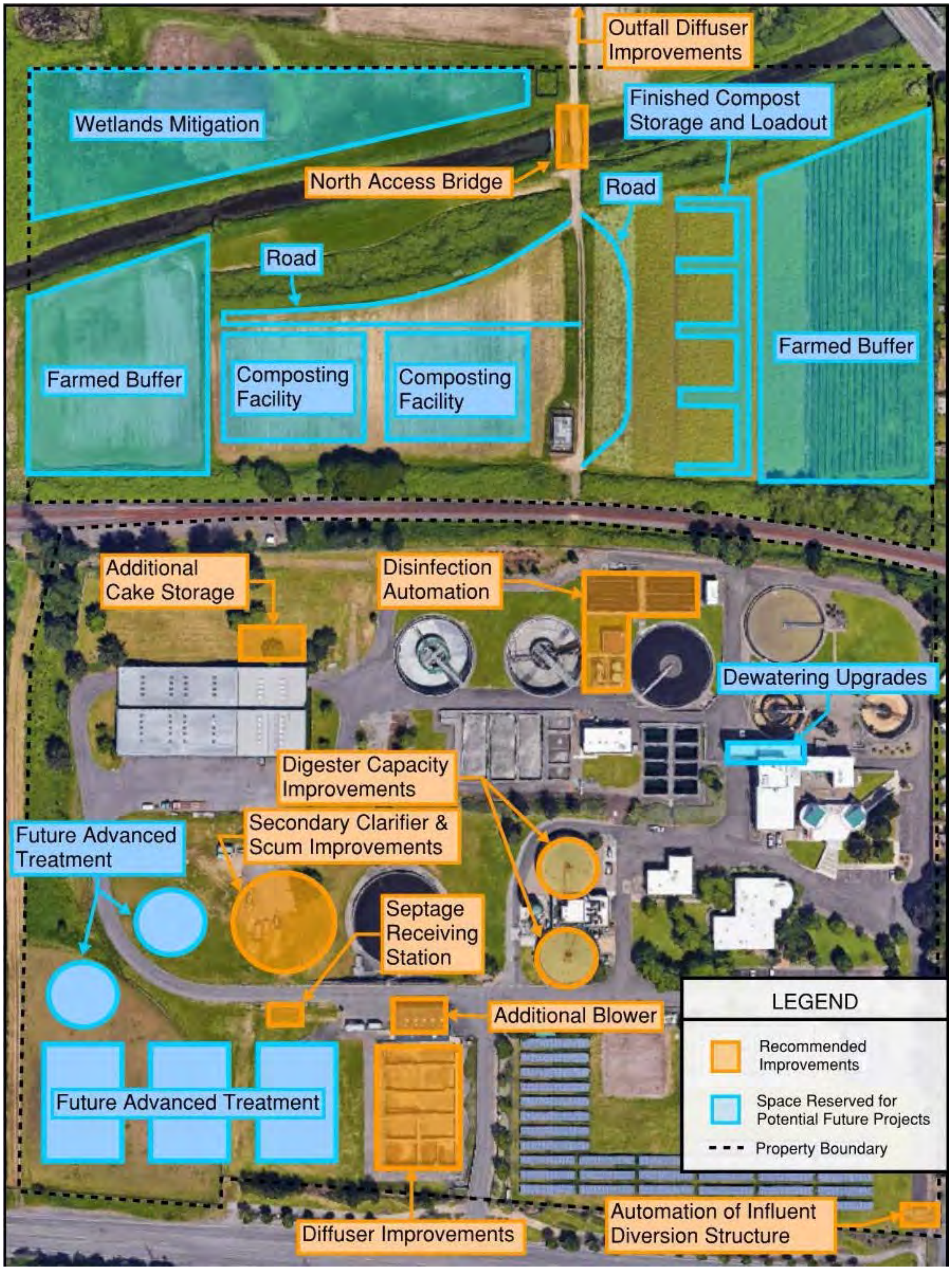


Figure 6-1. Recommended Improvements Plan

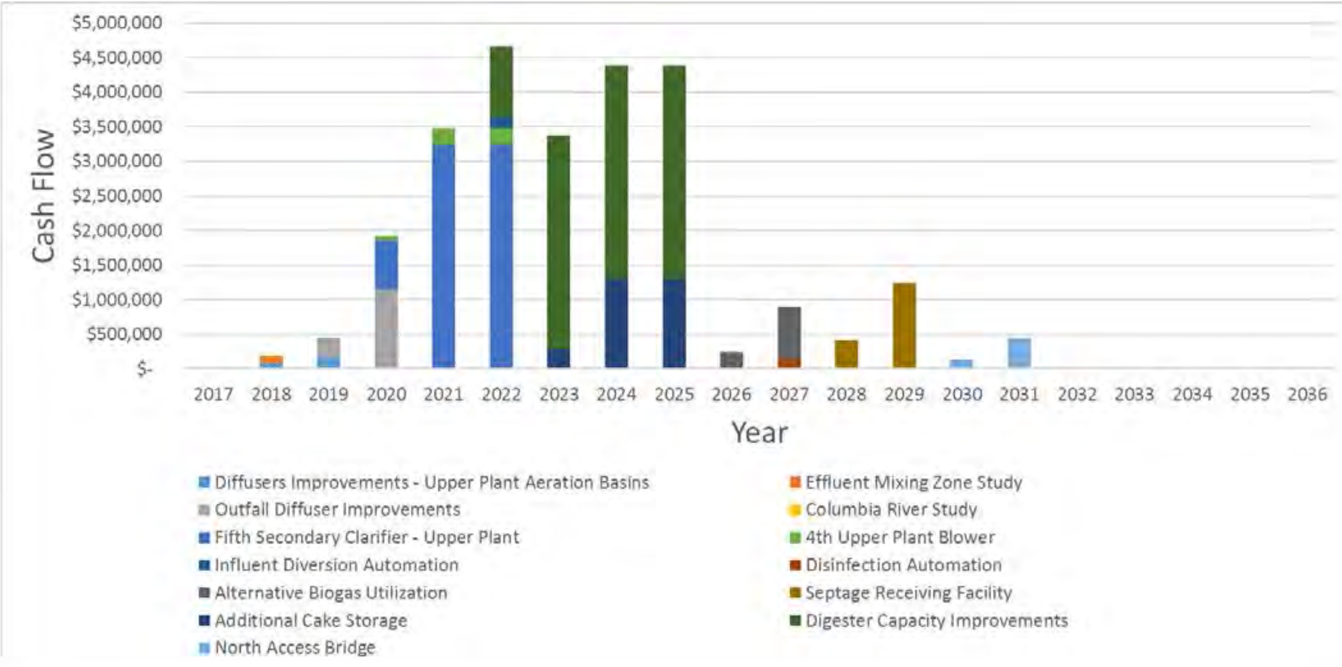


Figure 6-2. Cash Flow for Recommended Improvements

6.2 Project Descriptions

6.2.1 Efforts Already in Progress

- Operate digesters in parallel with co-thickening improvements to better enable operation of the WWTP.
- Implement digester solids and biogas improvements and repair cover seal on the primary digester, provide modifications to enable parallel feed to the digesters including associated pressure and level instrumentation, provide larger overflow and pressure relief hatches to help mitigate foaming/rapid rise events and other safety improvements, install larger piping to accommodate additional biogas generation, and refurbish the BFPs.
- Implement dewatering performance improvements (for example, piloting of the Orege SLG pretreatment of BFP feed sludge, which, if demonstrated to be effective at sufficiently increasing cake solids and/or reducing polymer use, will be made permanent).

6.2.2 Near-Term Improvements (0-5 years)

- Add nitrification of the Upper Plant in the dry season. Increasing the SRT in the aeration basin in the Upper Plant from 2 or 3 days to approximately 6 days will provide sufficient time to sustain a population of autotrophic ammonia-oxidizing bacteria, even at the lowest expected dry season water temperatures of 17°C (62.6°F) in the shoulder months of May and October. Projects or components of larger projects that enable or aid in the City’s ability to nitrify in the Upper Plant in the summer include adding more diffusers in Cells D and E, adding a fourth blower in the Upper Plant blower building, and constructing a second secondary clarifier for the Upper Plant.
- Improve diffusers in Upper Plant aeration basin. The number of fine bubble diffusers installed in the Upper Plant varies by cell, and was designed with a specific taper set at specific step-feed points. However, the drop-off in number of diffusers from Cell C to the similarly sized cells D and E is too great. Fine bubble diffusers generally should not be operated above 4 scfm per diffuser on a

continuous basis, or above 5 scfm per diffuser at peak conditions. It is recommended that the diffuser grids in Cells D and E be replaced with a higher-density grid (880 diffusers each similar to cell C; total of 1,760 diffusers), as both of these cells will have airflows well above 4 scfm per diffuser at 2036 max month conditions. The grids will have to be completely replaced in these two cells including new drop legs, manifolds, and holders. While the basin is out of service, the diffuser disk membranes in the other cells (3,626 diffusers) will be replaced in kind as those diffusers will be approximately 10 years old and near the end of their expected life.

- Conduct a mixing zone study. An updated mixing study would typically be required by DEQ prior to the next NPDES permit renewal application in December 2018. This study would result in a new calibrated dilution model for critical conditions that defines the allowable acute and chronic dilution factors used for water-quality-based effluent limits. Gresham should evaluate outfall diffuser operation and plan improvements to optimize the dilution performance.
- Make outfall diffuser Improvements. The mixing zone study may identify options for maintaining or improving outfall performance, such as reorienting existing discharge ports, replacing existing risers with different diameter pipes, different spacing of and/or adding discharge port check valves, and extending the 54-inch outfall pipe. As the pipe extension is anticipated to provide the most significant improvement, the placeholder cost is based on that approach.
- Conduct a Columbia River characteristics study. DEQ is requiring every discharger to provide sufficient quality and quantity of effluent and background river chemistry data (in accordance with the RPA-IMD) to allow NPDES permit renewals. Results of the RPA depend on effluent chemistry data, river chemistry data, and outfall dilution factors, and the RPA determines if water-quality-based effluent limitations are required in the NPDES permit.
- Add Upper Plant secondary clarifier. The City should construct a fifth secondary clarifier—a redundant upper plant unit—so that the Upper Plant secondary treatment can be operated with increased reliability, which will become increasingly important if the City needs to operate the Upper Plant in nitrification mode to meet permit limits or to help in avoiding or reducing the stringency of a future ammonia limit. one new 130-foot-diameter secondary clarifier with a 20-foot sidewater depth. It is recommended that the clarifier mechanism be stainless steel. Two new RAS pumps and three new WAS pumps will also need to be added. Similar to the existing Upper Plant RAS and WAS pumps, the new pumps will be submersible. The need for this process is dependent on risk associated with nitrification operation of the Upper Plant and the need to take the entire Upper Plant offline to perform maintenance on the secondary clarifier. As part of this project the City could add a fourth blower to the Upper Plant blower building to provide redundancy (firm capacity) and more reliable nitrification operation when nitrifying in the dry season. Also as part of this project, the Upper Plant scum collected in the existing secondary clarifier and new secondary clarifier should be rerouted directly to the digester. Currently the secondary scum is routed back to the headworks.
- Convert to Class A biosolids program. If the City wishes to respond to community expectations about biosolids management, it could upgrade to a Class A product within the next 5 years (the placeholder budget assumes use of thermal hydrolysis; the technology needs to be further analyzed).

6.2.3 Intermediate-Term Improvements (5-10 years)

- Automate influent diversion structure. Currently, flow is split to the Upper and Lower Plants with two manual gates that are not used very often. It is recommended that the gates at the influent diversion structure be automated to better control flow to the Upper and Lower Plants.

- Automate disinfection chemical feed systems. During peak flow events, if the applied sodium hypochlorite dose needs to be increased, operators must do it manually. This project would automate the chemical feed system for both sodium hypochlorite and sodium bisulfite.
- Implement alternative biogas handling/utilization. As part of the next WWTP Master Plan update in approximately 5 years, the City should study the life-cycle assessment costs to convert biogas to renewable compressed natural gas (RCNG). If Clean Methane Systems is able to obtain an injection point, the City should evaluate the possibility of converting all biogas to RCNG and buying natural gas to operate combined heat and power engines. The City would be able to obtain RINs for all the RCNG it sells to NW Natural or Williams, and could buy the natural gas needed to heat and power the WWTP. The City should continue to monitor the status of the RIN program. The benefit of selling RCNG is lost if the RIN program is not renewed past 2022. A placeholder estimate is included to clean and compress the gas for injection into a high-pressure natural gas line. The injection point into the high-pressure gas is unknown at this time; therefore, an estimate for the pipeline to transport the RCNG to this injection point is not included.
- Construct septage receiving station. A septage receiving station will provide a service to the region for receiving and processing septage from local/regional haulers.
- Expand onsite cake storage. Construct three additional cake storage bays for a total of 12 bays. Additional bays should be online by 2025 assuming that the City opts to continue with conventional mesophilic anaerobic digestion and no improvements to dewatered cake concentration (currently average 14.5 percent) are attained. Each new bay will be similar in size to the existing bays (367 yd^3 each). The actual number of bays and phasing will depend on the various factors, including which long-term digestion alternative is selected and whether increases to cake solids concentration are achieved (e.g., if results of the Orege SLG digested sludge/dewatering feed preconditioning are favorable and that technology is installed permanently). For Class B thermophilic, high-solids mesophilic, and thermal hydrolysis approaches, 3 bays (by 2027), 2 bays (by 2031), and no additional bays (only 6 of the existing 9) are required, respectively.

6.2.4 Long-Term Improvements (10+ years)

- Design and construct digestion capacity improvements. The 2017 WWTP MP Update analysis concluded that with co-thickening and parallel operation of the existing two digesters, no additional anaerobic digestion capacity is needed through 2036. However, no redundancy for digestion is provided under that scenario. No major regulatory changes are in place at this time that would drive the City to change current solids processing and biosolids beneficial reuse practices. However, future, more restrictive management practices may become necessary to meet regulatory requirements (constituents of emerging concern) and community expectations (perceptions of risks associated with odors, pathogens). The intent is for the City to revisit the digester options in the next WWTP MP Update project (typically conducted approximately every 5 years). Potential future options include:
  - Class A ATD (Digestion Alternative 2 presented in Section 4.3 above, with the addition of batch processing tanks)
  - Class A TH (Digestion Alternative 4 presented in Section 4.3 above)
  - Composting on the land owned by the City to the north of the WWTP

  For this MP Update, the costs to upgrade to TH is used as the basis for the budget placeholder because it ranked the highest of the evaluated alternatives.

- Construct an access bridge to the north property. Construction of a bridge over Columbia Slough would provide better access for biosolids trucks to the property to the north in the event that future projects such as biosolids composting or solar drying are determined to be needed.

Final buildout of the wastewater treatment plant to serve the buildout population of 183,501 people would include additional treatment capacity, a site layout for the buildout scenario is in Figure 6-3, which indicates that the City should be able to provide wastewater treatment service through buildout on the land currently owned at the site.

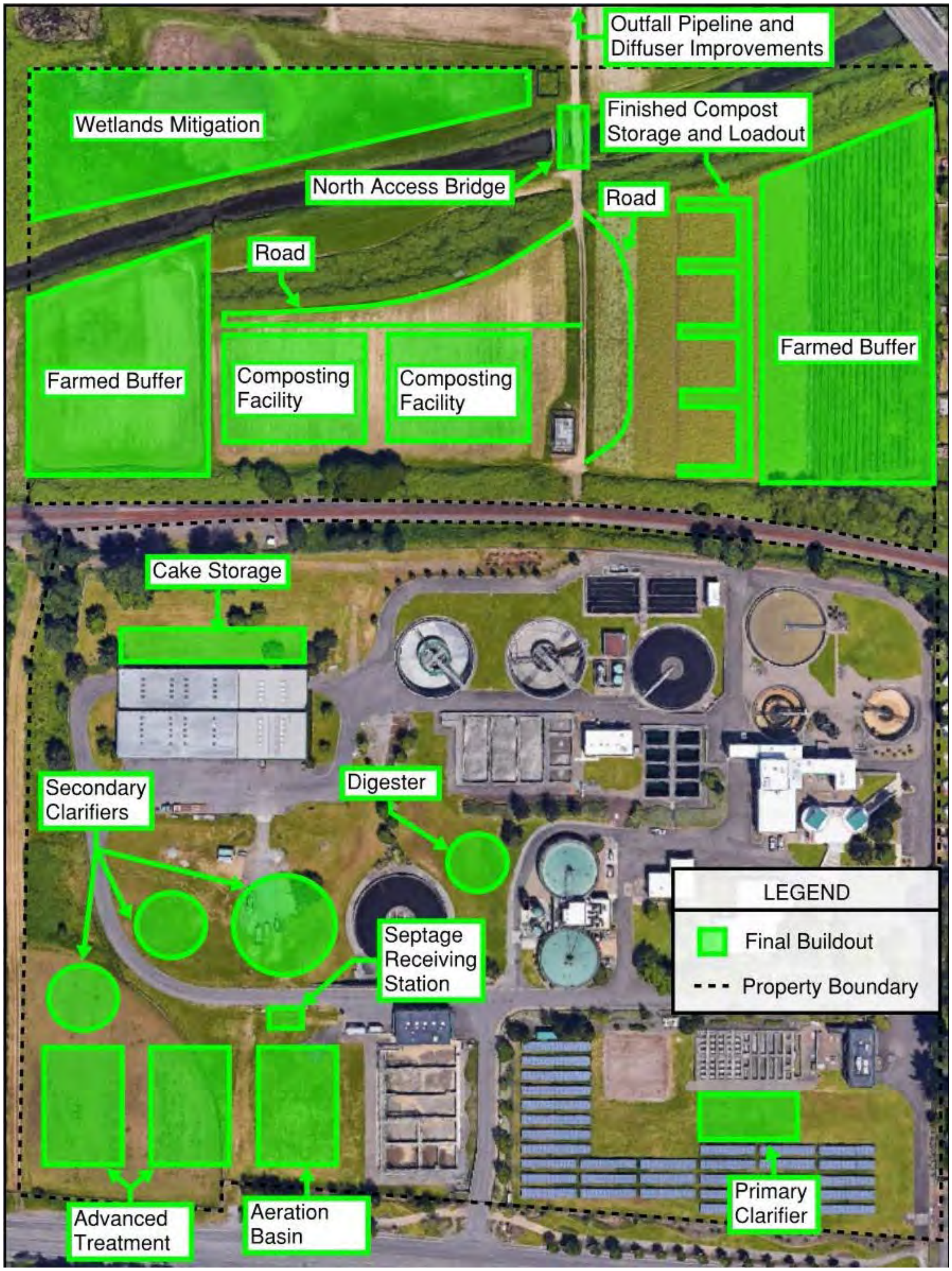


Figure 6-3. Buildout Site Plan

Attachment 6-A
Cost Backup

	Factors	Diffusers Improvements - Upper Plant Aeration Basins	Effluent Mixing zone study	Outfall Diffuser Improvements	Columbia River Study	Fifth Secondary Clarifier - Upper Plant	4th Upper Plant Blower	Influent Diversion Automation	Disinfection Automation	Digester and Biogas Improvements	Septage Receiving Facility	Additional Cake Storage	Digestion Capacity Improvements	North Access Bridge
Equipment		$124,260	-		-	$4,425,900	$275,000			-			-	
Concrete		-	-		-	-	-	-	-	-	-		-	-
Digester Structural Modifications		-	-		-	-	-	-	-	-	-		-	-
Canopies/Buildings		-	-		-	-	-	-	-	-	-		-	-
Process Piping		-	-		-	-	-	-	-	-	-		-	-
Installation		$31,065	-		-	-	$68,750	-	-	-	-		-	-
Electrical / I&C		-	-		-	-	-	-	-	-	-		-	-
Site Work		-	-		-	-	-	-	-	-	-		-	-
Construction Estimate Without Contingency		$155,325	-	$900,000	-	$4,425,900	$343,750	$93,000	$93,000	-	$1,019,100		$6,315,682	$358,000
Construction Contingency (30%)	30%	$46,598	-	$270,000	-	$1,327,770	$103,125	$27,900	$27,900		$305,730		$1,894,705	$107,400
Construction Estimate With Contingency		$201,923	-	$1,170,000	-	$5,753,670	$446,875	$120,900	$120,900	$0	$1,324,830		$8,210,387	$465,400
Engineering, Legal, and Administrative Costs (25%)	25%	$50,481	-	$292,500	-	$1,438,418	$111,719	$30,225	$30,225	$0	$331,208		$2,052,597	$116,350
Total Capital Cost ($)		$252,000	$100,000	$1,463,000	$30,000	***$7,192,000***	$559,000	$151,000	$151,000	$1,000,000	$1,660,000	$2,895,000	$10,300,000	$582,000

NOTE: Bold/italicized numbers are escalated by 7.19% from 2011 master plan to 2017 dollar

CHAPTER 7

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