murraysmith

CITY OF SANDY

Wastewater System Facilities Plan

Volume 1: Wastewater Facilities Plan

October 2019

SANDY
WHERE INNOVATION MEETS ELEVATION

Wastewater System Facilities Plan

City of Sandy

October 2019

REGISTERED PROFESSIONAL
ENGINEER
51615
OREGON
JANUARY 2, 1989
PRESTON VAN METER
RENEWS 6/30/20

Murraysmith

888 SW 5th Avenue
Suite 1170
Portland, OR 97204

Acknowledgements

Appreciation is expressed to all who contributed to the completion of this report.

City of Sandy

Kim Yamashita, City Manager

Mike Walker, Director of Public Works

Thomas Fisher, Engineering Technician

Table of Contents

Volume 1

Executive Summary

1. Introduction

2. Study Area Characterization

3. Existing System Description

5. Basis of Planning

6. Flow and Load Projection

7. Sanitary Sewer Collection System Evaluation

8. Existing Wastewater Treatment Plant Evaluation

9. Initial Wastewater Systems Alternatives Evaluation

10. Long-Term Wastewater Systems Alternatives Evaluation

11. Recommended Capital Improvement Program

Figures

Tables

Volume 2

Appendix

Executive Summary

Executive Summary

Introduction

Based on the Mutual Agreement and Order (MAO) signed between the City of Sandy (City) and the Oregon Department of Environmental Quality (DEQ), the City is required to update their Wastewater System Facility Plan (WSFP). In order to comply with this MAO, the City has prepared a facility plan according to the guidelines published by DEQ.

The facility plan covers the following elements

- Study Area Characterization
- Existing System Description
- Regulatory Requirements
- Basis of Planning
- Flow and Load Projections
- Sanitary Sewer Collection System Evaluation
- Existing Wastewater Treatment Plant Evaluation
- Initial Wastewater Systems Alternative Evaluation
- Long-term Wastewater Systems Alternative Evaluation
- Recommended Capital Improvement Program

Study Area Characterization

The City of Sandy is in Clackamas County, located between the Sandy River within the Columbia Basin and the Clackamas River within in the Willamette Basin, see **Figure ES-1**.

Figure ES-1
Vicinity Map

The City is largely residential with some commercial, industrial, and business districts. The total area is 3.6 square miles with a range of elevations from approximately 500 feet above mean sea level (MSL) to approximately 1,200 feet above MSL. The City is in the Warm-Summer Mediterranean Climate Zone per the Koppen Climate Classification System. The population according to Clackamas County in 2014 was estimated to be 10,908. **Table ES-1** shows the projected population growth for the City.

Table ES-1
Population Projections

Year	Population	Employees
2014	10,908	5,044
2024	14,377	6,648
2034	18,980	8,763
2040[1]	22,400	10,342

Existing System Description

The existing sanitary sewer collection system includes approximately 40 miles of gravity sewer, 1,100 manholes, 1.2 miles of force main, and six public pump stations (lift stations). For the

[1] Projected population based on an 2.8% annual growth rate as stated in the 2015 Sandy Urbanization Study.

purposes of this study, the area is divided by the basins contributing to ten temporary flow meters installed throughout the collection system. The meter basin areas are outlined in **Table ES-2.**

Table ES-2
Meter Basin Areas (Acres) Served by Wastewater Collection System

Meter ID	Basin Name	Industrial	Commercial	Residential	Vacant Developable	Total Area
1	Barnum	29	39	50	124	242
2	Treatment Plant	27	12	50	138	227
3	Sandy Heights			58	136	194
4	Ruben Lane	17	7	4	9	37
5	Sandy Bluff			242	306	548
6	Commercial Core		25	80	84	189
7	Sunset		2	35	35	72
8	Strawbridge		19	128	256	403
9	Tupper		1	59	159	219
10	Highway 211			62	166	228

Figure ES-2 illustrates the locations of meters, pump stations, and the City of Sandy WWTP.

Wastewater is collected by smaller service pipelines and is conveyed to the Sandy Wastewater Treatment Plant (WWTP) via a trunk sewer located along Tickle Creek. The WWTP was first constructed in 1998 and includes preliminary treatment, activated sludge secondary treatment process, disk cloth effluent filters, and disinfection as shown in **Figure ES-3**. Solids wasted from the secondary treatment process are first stored and thickened in the aerated sludge storage basin before dewatering with a dewatering belt press. The dewatered sludge is stored in the biosolids bay before disposing. Depending on the demand for biosolids, the facility can produce Class B Biosolids using lime stabilization.

Regulatory Requirements

City of Sandy NPDES Permit was renewed January 23, 2010, allowing the discharge of treated effluent to Tickle Creek (Outfall 001) from November 1st to April 30th, and to Iseli Nursery for irrigation (Outfall 002) from May 1st to October 31st. **Table ES-3** shows the effluent limits in the City's permit when discharging to Tickle Creek.

Table ES-3
Outfall 001 NPDES Waste Discharge Limits[a]

	Monthly Average Concentration (mg/L)	Weekly Average Concentration (mg/L)	Daily Maximum Concentration (mg/L)	Monthly Average Load[b] (lb/day)	Weekly Average Load[b] (lb/day)	Daily Maximum Load[b,c] (lb)
Winter Season (November 1 through April 30)						
BOD_5	10	15	NA	125	187	250
TSS	10	15	NA	125	187	250
Ammonia	3.7	NA	10.9	NA	NA	NA

Notes:

(a) From current Sandy WWTP NPDES Permit #102492 for File Number 78615.
(b) Mass load limits are based upon WWTP average dry weather design flow of 2.5 MGD.
(c) The daily mass load limit is suspended on any day in which the flow to the treatment facility exceeds 2.5 MGD.

Abbreviations:
mg/L = Milligrams per liter.
lb/day = Pounds per day.

Historically during the Winter Season, the City had biochemical oxygen demand (BOD) and total suspended solids (TSS) mass load limitation violations. During the Summer Season, no discharge is permitted into Tickle Creek. The WWTP's mass load cannot increase due to the Three Basin Rule (OAR 340-041-003) which prevents mass load limit increases for dischargers in the Clackamas River Basin. As a result, during the Summer Season no discharge from the City of Sandy will ever be permitted into the Clackamas River and the number of violations will increase with increased flows associate with growth without significant changes to the wastewater system.

In addition, the WWTP's permit also does not allow for discharge to Tickle Creek when the calculated dilution value is less than 10 based on the following equation:

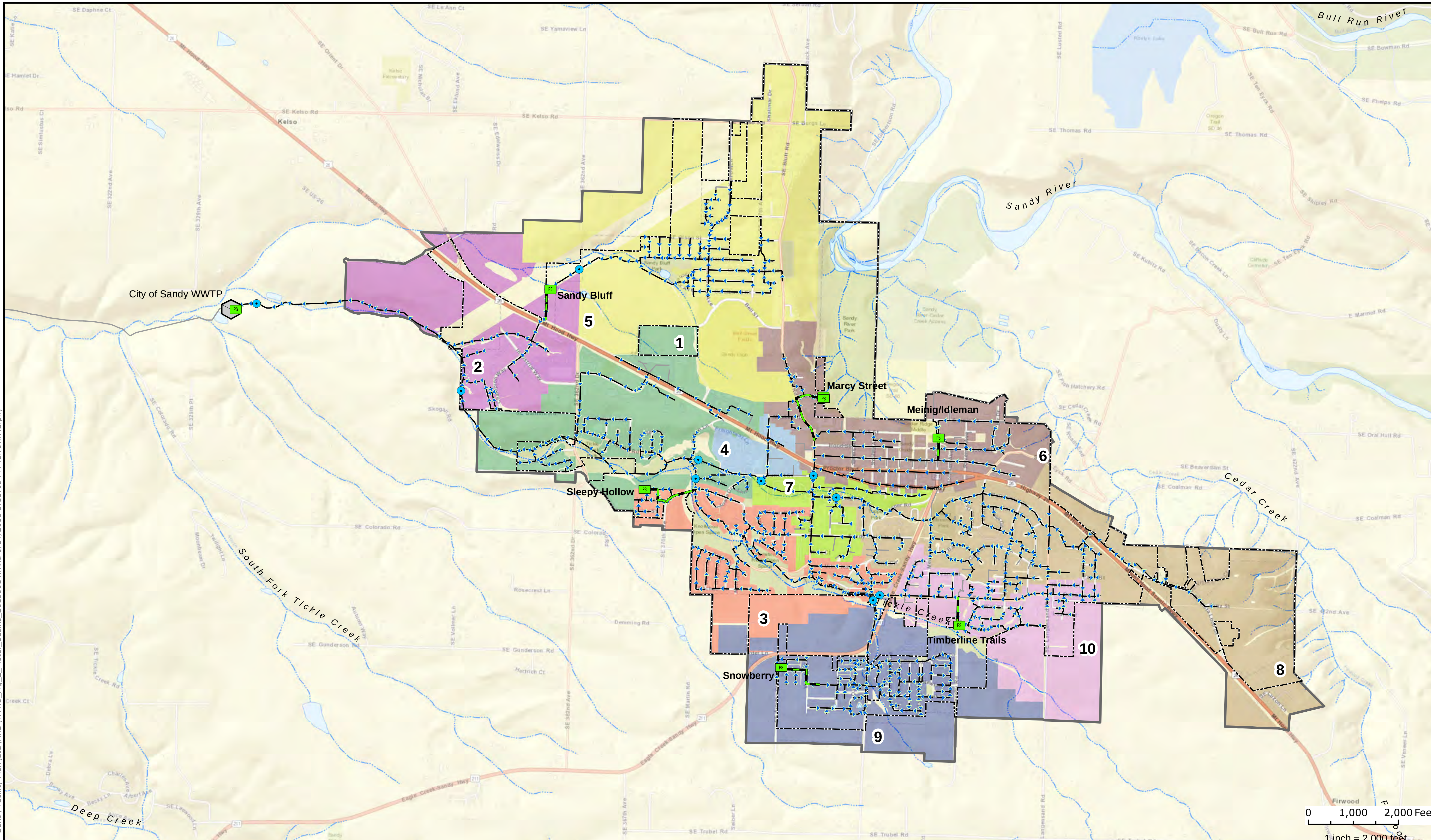
$$Dilution = \frac{(Q_e + Q_s)}{Q_e}$$

Where: Q_e = WWTP Discharge Flow in Million Gallons per Day (MGD)
Q_s = Tickle Creek Flow measured at a gauging station 1 mile upstream from Outfall 002

Based on the growth projections, the City is expected to exceed the dilution criteria in the future with most exceedances happening during lower flow events that correspond to low river flow conditions.

Basis of Planning

To evaluate alternatives as part of the WSFP, alternatives will be evaluated using a matrix-based approach incorporating cost and non-cost factors. The scores will be calculated by ranking each alternative to each other for specific cost and non-cost factors and assigning a relative importance



murraysmith

N
W E
S

City of Sandy, Oregon
Wastewater System Facility Plan

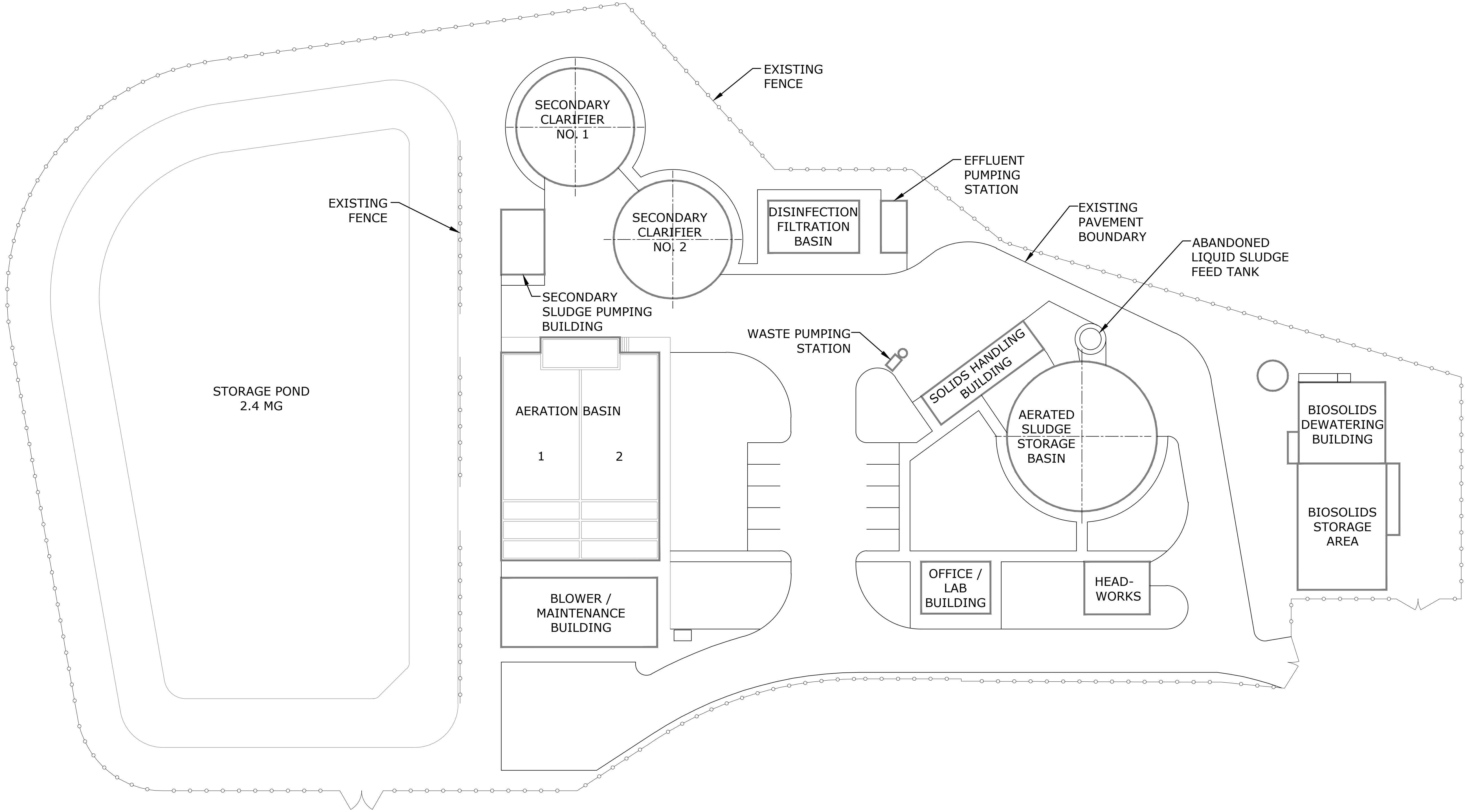
WW Treatment Plant
Pump Station
Temporary Flow Monitor
City_Limits
Study Area
Sewer Force Mains
Sewer Gravity Mains
Sewer pipe - not modeled
Stream
Water Body

Figure ES-2
Meter Basins

January 2019 17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM4_3_Fig_2_Meter_Basins_20180614.mxd 6/14/2018 3:31:05 PM Yarrow.Murphy

This page intentionally left blank



SITE PLAN

SCALE: 1"=50'

25 0 25 50

SCALE IN FEET

murraysmith

W N S E

City of Sandy, Oregon
Wastewater System Facility Plan

Figure ES-3
Existing Site Plan

January 2019 17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-FIG-7.dwg SITE PLAN 8/2/2018 12:03 PM DKH 23.0s (LMS Tech)

This page intentionally left blank

(weight) to each factor. The alternative with the highest score represents the preferred alternative for the City. The scoring is calculated as follows:

$$Dilution = \frac{(Q_e + Q_s)}{Q_e} Total = \sum_{Criteria} (Score * Weighting)$$

The factors and associated weights used in the alternative evaluation scoring include:

- Capital Cost (30%);
- 20-year Life-Cycle Cost (20%);
- Regulatory Compliance (20%);
- Environmental and Permitting (10%),
- Constructability (10%);
- Reliability/Resiliency (5%); and
- Phasing (5%).

Flow and Load Projections

Wastewater flows were projected for flow statistics outlined in the Guidelines from the Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon (Oregon Department of Environmental Quality 1996) using a collection system model which was constructed based on the existing infrastructure and calibrated using flow monitoring data collected in early 2018. Wet weather flow projections were estimated using model storm events in the collection system model. The collection system flow projections accounted for areas of potential growth within the Urban Growth Boundary (UGB) for the time period ending at the year 2040. **Table ES-4** shows the calculated 2040 flow projections from the collection system model.

Table ES-4
Summary of Projected Flows Derived through the Collection System Model

2040 Flow Event	Collection System Method
AAF	--
ADWF	2.0 MGD
AWWF	--
MMDWF	2.4 MGD
MMWWF	4.1 MGD
PWF	6.6 MGD
PDF	14.3 MGD
PIF	17.1 MGD

Notes:
AAF = Average annual flow
ADWF = Average dry weather flow
AWWF = Average wet weather flow
MMDWF = maximum month dry weather flow
MMWWF = Maximum month wet weather flow
PWF = Peak week flow
PDF = Peak daily flow
PIF = Peak instantaneous flow

For each meter basin, the collection system model was able to predict the dry and wet weather flows to identify basins in the collection system which contribute to peak flows shown in **Table ES-5**.

Table ES-5
Dry and Wet Weather Flow Summary by Meter Basin, in Million Gallons per Day

Meter ID	Basin Description	Existing ADWF	Existing Base sewer flow at Peak RDII[2]	Existing Peak RDII	Existing PIF
2	Sunset Street to the Treatment Plant	0.2	0.3	1.2	1.5
3[1]	Highway 211 to Sandy Heights	0.1	0.2	0.1	0.3
5	Sandy Bluff	0.2	0.2	2.1	2.3
6[1]	Commercial Core	0.1	0.1	1.7	1.8
7	Chalet Mobile Estates and Bluff Road	0.1	0.1	0.6	0.7
8	East end to Strawbridge	0.1	0.2	1.9	2.1
9[1]	Cascadia Village to Tupper	0.1	0.1	0.6	0.7
10[1]	Dubarko Drive east of Highway 211	0.1	<0.1	0.9	0.9
Total		**1.0**	**1.2**	**9.1**	**10.3**

Notes:
1 These basins have peak flows higher than the sum of the contributing flows due to pump station operation upstream of flow monitor.
2 The observed base sewer flow during peak RDII to estimate the PIF.

Using influent data from the City's Discharge Monitoring Reports from 2013-2018, the current BOD and TSS concentrations and mass loads were calculated for monthly average and maximum month conditions as shown in **Table ES-6.**

Future loading rates were developed through a population loading factor based on the current loading and future population projection. The projected 2040 monthly average and maximum month BOD and TSSS values are shown on **Table ES-7**.

Table ES-6
Current BOD_5 and TSS Loads

Parameter	2017 Population	Monthly Average			Maximum Monthly Average		
		Concentration (mg/l)	Load (ppd)	Load Factor (ppcd)	Concentration (mg/l)	Load (ppd)	Load Factor (ppcd)
Summer Season (May 1 through October 31)							
BOD_5	11,800	286	2,465	0.209	455	3,594	0.305
TSS	11,800	280	2,376	0.201	456	3,465	0.294
Winter Season (November 1 through April 30)							
BOD_5	11,800	192	2,397	0.203	297	3,467	0.294
TSS	11,800	190	2,383	0.202	342	3,927	0.333

Table ES-7
2040 BOD and TSS Loading Projections

Parameter	2040 Population	Monthly Average		Monthly Maximum	
		Load Factor (ppcd)	Load (ppd)	Load Factor (ppcd)	Load (ppd)
Summer Season (May 1 through October 31)					
BOD_5	22,400	0.209	4,679	0.305	6,822
TSS	22,400	0.201	4,511	0.294	6,577
Winter Season (November 1 through April 30)					
BOD_5	22,400	0.203	4,550	0.294	6,582
TSS	22,400	0.202	4,524	0.333	7,454

Sanitary Sewer Collection System Evaluation

The sanitary sewer collection system evaluation includes a wastewater collection system capacity analysis using a hydraulic model, analysis of rainfall derived infiltration and inflow (RDII) during the design storm event and a pump station condition assessment. RDII and capacity are evaluated for existing flow conditions and flows projected in 2040.

Collection System Capacity Deficiencies – Existing Flow Conditions

With the existing condition design storm peak flows, the major collection system capacity risks are found in pump stations and force mains. The Sandy Bluff Pump Station and Jacoby/Timberline Trails Pump Station are predicted to have flows exceeding total rated capacities and the Sandy Bluff force main velocity exceeds 10 fps. The Sandy Trunk is predicted to surcharge within two feet of the surface at four manholes near the WWTP, but flooding is not predicted.

Collection System Capacity Deficiencies – 2040 Flow Conditions

The 2040 collection system capacity deficiencies during the design storm can be grouped by location and type of facility. Gravity pipe capacity deficiencies are found in the 18- to 21-inch Sandy Trunk Sewer, which conveys flows from the tributary sewers to the WWTP. The 12-inch pipe conveying flows from the southeast neighborhoods to the Sandy Trunk and is also predicted to have flows exceeding the gravity sewer capacity in 2040 and causing extensive surface flooding. Five of the six pump stations in the collection system are predicted to have flows exceeding the pump station capacity in 2040, with Sleepy Hollow Pump Station being the one station with sufficient capacity. The two force mains serving Sandy Bluff and Jacoby Pump Stations are predicted to have peak design storm velocities exceeding 10 ft/s.

Rainfall Derived Infiltration and Inflow (RDII)

The City's wastewater collection and treatment systems experience capacity constraints related to RDII and direct stormwater connections, which are considered sources of inflow to the system. Peak RDII flows within contributing sewer basin areas can be summarized as flow-per-acre values, typically referred to as RDII rates. These RDII rates can vary significantly across the system, due to factors such as sewer basin development, land use differences, soil type, pipeline density and system condition (pipe and manhole). When applying the design storm to the City's calibrated existing system model, the calculated peak RDII rate is 12,000 gpad overall, which varies by sub-basin between roughly 1,300 gpad and 18,300 gpad as summarized in Table ES-8. For comparison, Oregon utilities typically use standard design rates for RDII in new systems in the range of 1,000 to 2,500 gpad. The rates found in the City indicate significant influence of RDII on the existing system, particularly in areas where there are older concrete pipes.

Table ES-8
Existing Peak RDII Rates by Meter Basin

Meter ID	Basin Description	Peak RDII for Design Storm (gpad)
2	Sunset Street to the Treatment Plant	6,900
3	Highway 211 to Sandy Heights	1,300
5	Sandy Bluff	11,700
6	Commercial Core	18,300
7	Chalet Mobile Estates and Bluff Road	15,800
8	East end to Strawbridge	16,600
9	Cascadia Village to Tupper	11,000
10	Dubarko Drive east of Highway 211	16,700

The RDII rates are expected to increase over time as the pipes degrade and the number and severity of defects grows. Using existing observed RDII rates, pipe materials and pipe ages, the RDII rates from existing pipes were projected to 2040. RDII is also expected to increase with population growth as pipes are built to extend service to new development. When applying the design storm to the City's wastewater system model with additional flows from future development and pipe degradation, the projected peak RDII rate for 2040 varies by sub-basin between roughly 11,700 gpad and 24,100 gpad.

An RDII Reduction Program is recommended which targets critical storm water system disconnections and structural pipe improvements for high priority infrastructure. A longer-term Repair and Replacement (R&R) Program is also recommended for on-going system maintenance to address long-term system degradation. Several recommended actions are summarized below, starting with identifying and repairing stormwater sources that may be contributing significant flows to the collection system. Following through on the RDII reduction recommendations will be key to successfully implementing the rest of the plan that balances flow reduction with investments in conveyance and treatment capacity.

Key RDII reduction actions for near term years 1 to 2:

- Additional flow monitoring to refine the characterization of the RDII rates, with confirmation of system response during larger storm events.

- RDII source detection and repair of identified stormwater connections to the sanitary collection system.

- Establish City code that provides for lateral repair on private property.

Key RDII reduction actions for years 2 to 5 years:

- Condition inspection of the entire gravity collection system for pipes 8-inch diameter and larger.

- Identify and develop priority RDII reduction projects.

- Begin designing and implementing the priority projects.

Key actions for medium term 5 to 13 years:

- Continue implementing projects and monitoring reduction results.
- Adjust priorities based on monitoring results.
- Coordinate monitoring and reduction success with treatment and effluent capacity.

Key ongoing and longer-term 14+ years actions:

- Monitor flows to evaluate success of RDII reduction and adjust need for further reduction efforts.

- Establish an R&R program to continue the condition inspection and implementation of rehabilitation, repair, or replacement projects as needed.

Pump Station Condition Assessment

Condition assessments for all pump stations in the collection system were conducted via field visits. Recommendations included making improvements to ensure public and worker safety, to protect the facilities from vandalism, to provide corrosion protection where missing and to selectively replace worn components. The key pump station condition improvements are summarized in Table ES-9. The detailed report is included in Appendix E.

Table ES-9
Key Pump Station Condition Improvements

Pump Station	Condition Assessment Summary
Marcy Street	Replace pumps Replace guide rails in the wet well Safety and site protection
Sandy Bluff	Replace pipes and valves in valve vault and wet well Ventilation in pump building needs active ventilation for cooling
Meinig Avenue	Rehabilitation or replacement of wet well Fire and explosion protection Replace pumps in 5 – 10 years
Jacoby/Timberline Trails	Replace the discharge piping due to corrosion Replace bolts in valve vault need with stainless steel bolts Replace pumps in 5 – 10 years
Sleepy Hollow	Install safety grate on valve vault
Snowberry	Install safety grate on valve vault Protect piping in the wet well and the valve vault against corrosion Safety protection

Existing Wastewater Treatment Plant Evaluation

The WWTP was first constructed in 1972. The liquid stream was upgraded in 1998, and the solids handling was last upgraded in 2003. While there have been some minor repairs and modifications, no major upgrades have been made since 2003. A conditions assessment was conducted at the WWTP in 2018. The field evaluation consisted of site visit where a review of the condition of the equipment was performed as well as discussions with WWTP staff to understand operational issues. Overall, several pieces of mechanical equipment are reaching the end of their useful life or are needing repair. A short list of recommended improvements includes:

Preliminary Treatment

- Immediately repair the fine screen to prevent solids from passing.
- Consider upgrading the rotary fine screen and install a redundant fine screen in place of current manual bar screen.
- Replace the aging vortex grit system and consider adding an additional grit chamber to provide redundancy and to handle future peak flows.
- Replace the Parshall flume size to accommodate future flow rates.

Secondary Treatment

- Repair or replace the broken blower to provide system redundancy.

- Evaluate the operational effectiveness of entire air delivery system to ensure optimal performance
- Install automatic spray down system or require manual hose down to periodically wash down the foam remaining on the concrete around the basin to prevent degradation of the concrete.
- Replace aging and corroding equipment (e.g. davit cranes).
- Replace the missing mixed liquor recycle pump. This could potentially be contributing to the flow split issue in the inlet channel.
- Replace missing internal mixed liquor recycle pumps and install flow meters.
- Repair process water spray-down in Secondary Clarifier 1.
- Sandblast and recoat all metal components at recommended frequency to mitigate corrosion.
- Improve slope of scum trough in Secondary Clarifier 2 to the scum pump station to solve scum drainage issues.
- Consider replacing the v-notch weirs on the effluent launder.
- Install new controls on the scum pumps to allow for automatic operation.
- Replace RAS and WAS pumps and install flow meters.
- Inspect Hypochlorite Storage Room to determine source of water to prevent failure of the secondary containment system.

Disinfection/Filtration Basin

- Repair High Pressure Wash Pump leak and contain exposed wiring.
- Examine and repair Filter No. 2 drive.
- Improve flow split between Filter No. 1 and 2 and inspect Filter No. 1 for operational issues.
- Repair or replace UV transmittance meter.
- Repair lamp quartz sleeve cleaning mechanism.
- Add an additional UV channel to handle peak flows and to add redundancy.
- Consider replacement of the UV 4000 system as it is medium pressure and is less energy efficient than other UV lamps

- Install another Sodium Hypochlorite metering pump for redundancy along with proper appurtenances.
- Replace V-notch weir in effluent metering chamber with a parshall flume or magnetic flow meter for a more accurate method of monitoring effluent flows.
- Investigate noisy outfall pumps.

Solids Treatment

- Increase sludge storage to improve sludge stabilization and dewaterability.
- Replace submersible belt filter press feed pump to handle the required current and future capacity.
- Consider replacing the entire sludge storage basin.
- Replace or remove the Liquid Sludge Feed Tank.
- Reevaluate overflow to EQ Pond and alternative sludge storage.
- The Belt Filter Press is nearing the end of its useful service life and has capacity issues, which may necessitate adding another unit or considering other dewatering options.
- Improve consistency of sludge feed rate to the belt filter press by replacing the belt filter press feed pump.
- Replace polymer injection system with flow meter.
- Rehabilitate control panel in the Dewatering Building.

A code review was performed for the WWTP to assess if the WWTP met code requirements for the following:

- Oregon Structural Specialty Code (OSSC), 2014
    - International Building Code (IBC)
- Oregon Fire Code, 2014
    - International Fire Code (IFC)
    - National Fire Protection Association (NFPA) 820
- Oregon Plumbing Specialty Code, 2017
    - Plumbing materials of construction
    - Uniform Plumbing Code (UPC)

- Oregon Mechanical Specialty Code, 2014
    - International Mechanical Code (IMC)
- Oregon Electrical Specialty Code, 2017
    - National Electrical Code (NEC)
    - NFPA 70
- OR-OSHA (Oregon Occupational Safety and Health)
- Oregon Energy Efficiency Specialty Code (OEESC), 2014
- American Disability Act (ADA)
- Code of Federal Regulations (CFR)
- American Society of Civil Engineers (ASCE) 7 for Seismic Anchorage Design
- Local Land Use Requirements

Based on the review, the following conditions have not been met at the Sandy WWTP:

- Tepid eyewash/shower stations – current eyewash inside the office/laboratory is plumbed to the sink and although it meets code requirements, it could be improved for better use in emergency situations.
- Electrical clearances – a minimum of 42 inches of clearance is required in front of electrical panels, as well as conspicuous signage for working space.
- Hydrant requirements – portable fire extinguishers and hydrant protection.

A Visual Hydraulics© model was constructed of the entire liquid stream to determine the hydraulic capacity of the existing WWTP. The hydraulic capacity was evaluated for the existing average annual flow (AAF) as well as the peak instantaneous flow (PIF) as shown in Figure ES-4. Based on the hydraulic capacity analysis, the plant is not designed to hydraulically pass the 2017 PIF of 10.3 MGD. The maximum hydraulic capacity, excluding mechanical equipment capacity, is approximately 9.0 MGD, 6.5 MGD, and 8.5 MGD for Headworks, Secondary Treatment, and Filtration Disinfection Basin respectively.

The capacity of the existing aeration basins was evaluated using a Biowin biological process model. The model was constructed based on the current dimensions and configuration of the aeration basins and secondary clarifiers. The influent characteristics for the biological model was determined based on a six-month sampling program at the facility.

The results of the model showed 3 MGD could effectively be treated in the existing foot print of the aeration basin under both MMWWF and MMDWF. Flows above 3 MGD, the model predicts that incomplete nitrification will occur, and the effluent ammonia will exceed the permit limit under both conditions. In addition, the model found that alkalinity was limiting in the influent to meet the demand from nitrification.

An evaluation of the solids handling capacity under current conditions identified that the aerated sludge storage basin has a 16-day storage capacity, and the biosolids bay has 72 days of storage.

As was noted earlier, the City of Sandy WWTP currently has the capacity to produce Class B Biosolids for land application. Storing biosolids is reportedly a challenge for the WWTP staff because of the narrow window of demand from local farmers and reportedly higher quantities of plastic products not effectively screened out of the biosolids historically deterred some farmers from accepting biosolids in the past. As a result, the City has been required to haul a significant amount of their biosolids to the landfill.

The 2018 Biosolids Management Plan indicates the City of Sandy is approved to apply biosolids over 175 usable acres across 25 sites. In 2017, the City of Sandy applied a total of 92 dry metric tons to agricultural fields over 56 of its approved acres. Using the typical biosolids Plant Available Nitrogen (PAN) quantities of 35 lb PAN/dry metric ton, approximately 507 dry metric tons in total would be permitted to be applied to agricultural sites using the City of Sandy biosolids, see Table 8-7. Both the current 2017 and future 2040 total dry metric tonnage of biosolids produced by the City of Sandy are 280 and 610 dry metric tons respectively, the current permitted application sites are sufficient, but more sites will need to be permitted in the future, especially considering the variability in product demand.

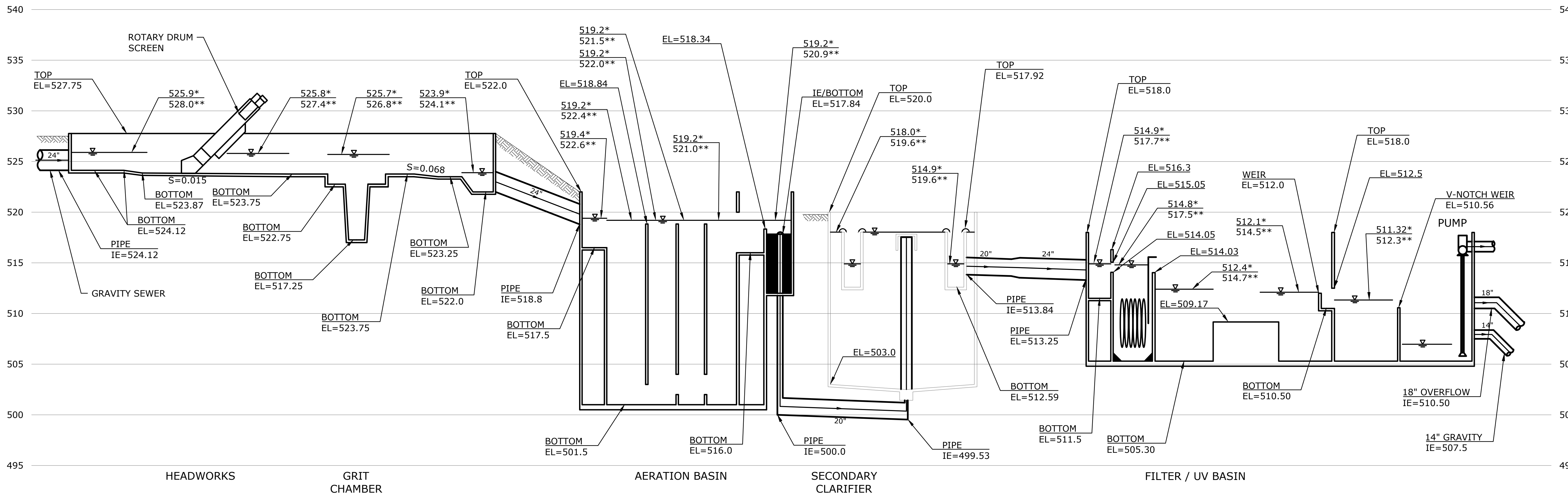
Initial Wastewater Systems Alternatives Evaluation

An evaluation was completed under the assumptions of continued discharge to Tickle Creek in the winter months, summer irrigation at Iseli Nursery and expansion of the current secondary-only treatment process. The primary goal of this initial alternatives evaluation is to identify the appropriate balance of investments in the City's wastewater system between collection system and treatment plant.

Based on the results from Sanitary Sewer Evaluation, RDII reduction scenarios were developed for a range of peak flow reductions to assess the cost effectiveness of RDII investments versus treatment plant expansion. Specifically, scenarios were developed based on performing 65% RDII reductions on different combinations of meter basins which resulted in 4 different peak flow (9.0, 10.5, 14, and 17.1 MGD). These RDII reduction scenarios were used to develop recommended upgrades to the collection system, the treatment plant, and the effluent discharge and recycled water storage. A brief summary of the scenarios is provided below:

- Peak Flow Scenario #1: 9.0 MGD
    - RDII Rehabilitation: full collection rehabilitation in all sewersheds

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-OR-SANDY HYD PROFILE.dwg FIG-X 10/24/2018 2:51 PM MATT.ESTEP 23.0s (LMS Tech)



HYDRAULIC PROFILE

SCALE: NTS HORIZ, 1"=5' VERT

LEGEND

Q=AAF
Q=PIF
WATER SURFACE ELEVATIONS

NOTES:

* AAF= 1.4 MGD
RAS=$1Q_{AFF}$
IMLR=$2Q_{AFF}$

** PIF= 10.3 MGD
MMWWF=2.6 MGD
RAS=$1Q_{MMWWF}$
IMLR=$2Q_{MMWWF}$

SANDY
WHERE INNOVATION MEETS ELEVATION

FIG ES-4

Sandy Facility Plan

HYDRAULIC PROFILE

Jan 2019

murraysmith

DRAFT

17-2137

This page intentionally left blank

  - Collection System Capacity Upgrades: Two pumps stations will be upgrades and 2,850 feet of gravity mains will be replaced.

  - Wastewater Treatment Plant Upgrades: Upgrade Facilities to meet 9 MGD flow including liquids and solids stream including addition of one new aeration basin and secondary clarifier.

  - Discharge/Storage Upgrades: Upgrade forcemain to Iseli Nursery, add 25 million gallons of storage at Iseli, and move the outfall 2 miles downstream.

- Peak Flow Scenario #2: 10.5 MGD

  - RDII Rehabilitation: Collection System rehabilitation in six sewersheds

  - Collection System Capacity Upgrades: Three pumps stations will be upgraded, 610 feet of force mains and 5,100 feet of gravity mains will be replaced.

  - Wastewater Treatment Plant Upgrades: Upgrade Facilities to meet 10.5 MGD flow including liquids and solids stream including addition of one new aeration basin and secondary clarifier.

  - Discharge/Storage Upgrades: Upgrade forcemain to Iseli Nursery, add 25 million gallons of storage at Iseli, and move the outfall 2 miles downstream.

- Peak Flow Scenario #3: 14.0 MGD

  - RDII Rehabilitation: Collection System rehabilitation in two sewersheds

  - Collection System Capacity Upgrades: Five pumps stations will be upgraded, 1,920 feet of force mains and 9,160 feet of gravity mains will be replaced.

  - Wastewater Treatment Plant Upgrades: Upgrade Facilities to meet 14.0 MGD flow including liquids and solids stream including addition of two new aeration basins and two secondary clarifiers.

  - Discharge/Storage Upgrades: Upgrade forcemain to Iseli Nursery, add 25 million gallons of storage at Iseli, and move the outfall 2 miles downstream.

- Peak Flow Scenario #4: 17.1 MGD

  - RDII Rehabilitation: No collection system rehabilitation.

  - Collection System Capacity Upgrades: Five pumps stations will be upgraded, 1,920 feet of force mains and 13,080 feet of gravity mains will be replaced.

  - Wastewater Treatment Plant Upgrades: Upgrade Facilities to meet 14.0 MGD flow including liquids and solids stream including addition of three new aeration basins and three secondary clarifiers.

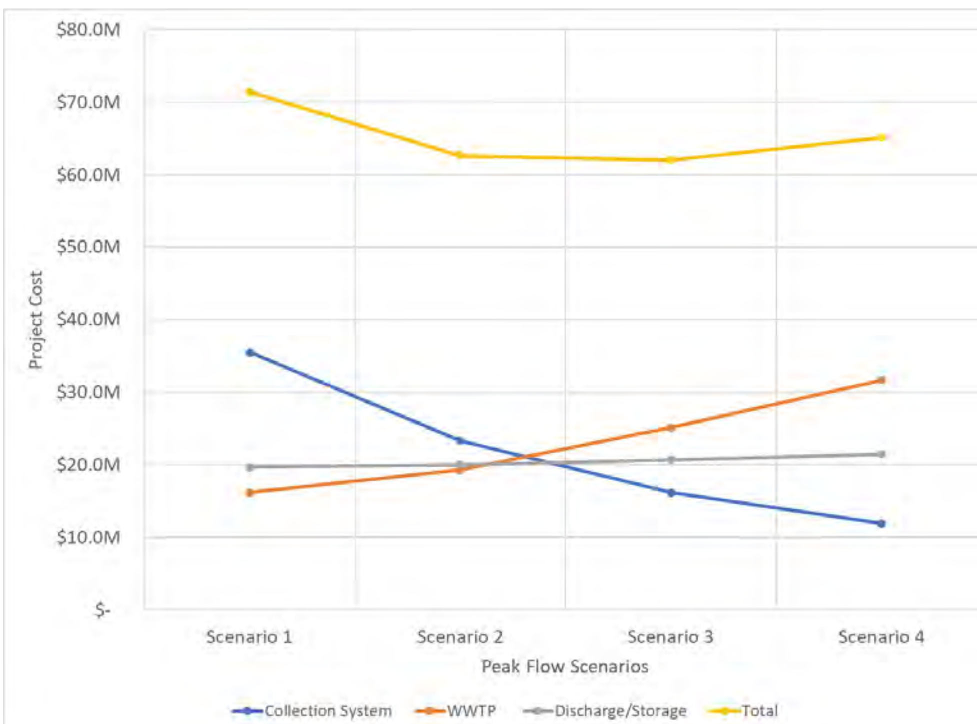
- o Discharge/Storage Upgrades: Upgrade forcemain to Iseli Nursery, add 25 million gallons of storage at Iseli, and move the outfall 2 miles downstream.

The cost for each of the peak flow scenarios is summarized in **Table ES-10** and **Figure ES-5**.

Table ES-10
Scenarios #1-4 Total Cost Summary

Item	Scenario 1 Cost	Scenario 2 Cost	Scenario 3 Cost	Scenario 4 Cost
Collection System Upgrades	$35.5M	$23.3M	$16.2M	$11.9M
WWTP Upgrades	$16.2M	$19.3M	$25.1M	$31.7M
Storage/Discharge Upgrades	$19.7M	$20M	$20.7M	$21.5M
Total	**$71.4M**	**$62.6M**	**$62M**	**$65.1M**

Figure ES-5
Peak Flow Scenarios Combined Costs



Peak Flow Scenario #3 was found to be the most cost-effective scenario; however, construction of additional storage at Iseli and relocating the outfall represent a significant investment by the city on private property which might need to be abandoned in the future due to closer of the nursery or discharge restrictions in Tickle Creek due to the dilution rule. In addition, continued half year discharge is not considered a viable for the City due to its expected growth. Therefore, it was recommended that other alternatives be evaluated for discharge to the Sandy River.

Long Term Wastewater Treatment Alternative Evaluation

Using the RDII flow reductions in Peak Scenario #4 and keeping the peak flow design of 14.0 MGD, four different alternatives that involved moving the outfall to the Sandy River for a year-round discharge were evaluated. The four wastewater treatment alternatives are summarized below:

Alternative A – Expansion of the existing WWTP treatment process including upgrades to the headworks, new aeration basins, new secondary clarifiers, expansion of the cloth-media tertiary filtration system, replacement and expansion of UV disinfection, dewatering system rehabilitation and the addition of a new solids dryer allowing the existing covered cake storage area to be utilized long-term.

Alternative B – Construction of a new membrane bioreactor (MBR) facility for secondary and tertiary treatment of approximately 7 MGD at the existing WWTP site, operating in parallel with the existing WWTP. Other upgrades include expansion of the headworks, dewatering upgrades and addition of a solids dryer.

Alternative C – Conversion of the existing WWTP to incorporate primary clarification and anaerobic digestion to better utilize the limited site footprint, reduce solids production through increased volatile solids destruction and reduce energy consumption by expanding the headworks, adding primary clarifiers, reduced aeration basin expansion, new secondary clarifiers, expansion of the cloth-media tertiary filtration system, replacement and expansion of UV disinfection, dewatering system rehabilitation and the addition of a new solids dryer.

Alternative D – Construction of a new Eastside Satellite Treatment Facility for an ultimate peak design flow of approximately 7 MGD with existing WWTP upgrades primarily focused on the needed improvements for treating and processing solids from both facilities including expansion of the headworks, addition of primary clarifiers, tertiary filtration system rehabilitation, UV system rehabilitation, solids dewatering system rehabilitation and the addition of a new solids dryer.

All these alternatives would keep the existing recycled water program intact at Iseli Nursery but moving the outfall to the Sandy River will allow for a year-round discharge which would relieve the need for additional storage at Iseli Nursery. For discharge, alternatives A-C would require the construction of a new effluent pump station that would pump the effluent from the existing WWTP to a new Sandy River Outfall. Alternative D would involve constructing a diversion pump station within the collection system to deliver some of the wastewater to the new Eastside Satellite Treatment Facility for treatment before discharging to the Sandy River. The existing treatment plant would keep its discharge into the Tickle Creek.

The capital cost for these four alternatives is summarized in **Table ES-11.**

Table ES-11
Alternatives Overall Cost Summary

Total[1]	ALT A	ALT B	ALT C	ALT D
Existing WWTP Rehabilitation	$ 2.5M	$ 2.5M	$ 2.5M	$ 2.5M
RDII Rehab	$ 6.2M	$ 6.2M	$ 6.2M	$ 6.2M
Ongoing RDII	$ 3.2M	$ 3.2M	$ 3.2M	$ 3.2M
Stormwater Disconnects/CCTV/Smoke Testing/Flow Monitoring	$ 2.5M	$ 2.5M	$ 2.5M	$ 2.5M
CS – Gravity	$ 2.8M	$ 2.8M	$ 2.8M	$ 1.7M
CS – PS&FM	$ 4.3M	$ 4.3M	$ 4.3M	$ 4.3M
WWTP – Liquid	$ 14.3M	$ 22.7M	$ 17.1M	$ 7.8M
WWTP – Solids	$ 12.3M	$ 12.3M	$ 13.4M	$ 13.4M
WWTP - EPS	$ 1.4M	$ 1.4M	$ 1.4M	$ 1.4M
WWTP - Satellite	$ -	$ -	$ -	$ 21.3M
Diversion - PS & FM	$ -	$ -	$ -	$ 8.2M
Effluent PS & FM	$ 25.3M	$ 25.3M	$ 25.3M	$ -
Outfall	$ 12.8M	$ 12.8M	$ 12.8M	$ 12.8M
Total	**$ 87.6M**	**$ 96.0M**	**$ 91.5M**	**$ 85.3M**

Notes:

1 All costs in 2018 dollars. Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

Because the largest operational and maintenance difference between the four alternatives is the energy required for effluent pumping and pumping from the diversion structure to the satellite treatment plant, the 20-year net present value (NPV) for energy usage difference for pumping for each alternative was determined, as shown in **Table ES-12**.

Table ES- 12
Alternatives 20-Year Net Present Value Energy Cost Difference

	ALT A	ALT B	ALT C	ALT D
20 Year NPV Energy Cost	$ 1.53M	$ 1.53M	$ 1.53M	$ 0.36M

Based on the analysis, Alternative D requires the least amount of energy as compared to the other alternatives.

For selection of the preferred alternative, a scoring system was prepared which considered capital cost, operational cost, and non-cost factors including regulatory compliance, environmental permitting, constructability, reliability/resiliency, and phasing. A summary pf the and scoring results for this Facility Plan for each alternative is shown on **Table ES-13.**

Table ES - 13
Alternative Scoring based on Cost and Non-Cost Factors

	Weight	Alt A	Alt B	Alt C	Alt D
Capital Cost	30%	3.0	2.0	2.5	3.5
20-year Life-Cycle Cost	20%	2.5	2.5	2.5	3.5
Regulatory Compliance	20%	2.0	2.5	2.5	3.0
Environmental Permitting	10%	2.0	2.5	2.5	3.0
Constructability	10%	2.0	2.0	2.0	3.5
Reliability/Resiliency	5%	2.0	2.5	2.5	3.0
Phasing	5%	2.0	2.0	2.0	4.0
Total	**100%**	**2.4**	**2.3**	**2.4**	**3.4**

Based on the scoring in this evaluation, Alternative D is recommended for implementation. While the selected alternative has higher initial treatment-related capital costs to construct a new greenfield satellite treatment facility, it avoids construction of the effluent pump station and force main to the Sandy River at least through the current 2040 planning horizon. In addition, construction and expansions of the satellite treatment facility can be phased and timed to community growth and success in the planned RDII Reduction Program. **Figure ES-7** and **Figure ES-8** show the proposed upgrades on the existing WWTP and at the Eastside Satellite Treatment Facility.

Recommended Capital Improvements Program

Implementation of the recommended plan will be broken into three phases to be completed over the 20-year planning period, largely because the success of collection system rehabilitation and the corresponding reduction in peak flows will not be well understood until the end of Phase 1 and into Phase 2. The three phases are summarized as follows:

- Phase 1 (2018-2024) involves completion of collection system rehabilitation in two basins, collection system capacity upgrades to provide for anticipated growth, completion of existing WWTP O&M upgrades, planning/permitting/design/construction of the new Eastside Satellite Treatment Facility, Sandy Trunk Diversion & Pump Station, and Sandy River Outfall.

- Phase 2 (2025-2032) involves ongoing collection system rehabilitation and capacity upgrades, repair and replacement of the collection system on an annual basis, and solids handling upgrades at the existing WWTP. Additional investment in on-going repair and replacement of the collection system on an annual basis is recommended to minimize system degradation and prevent future excess of RDII.

- Phase 3 (2033-2040) involves ongoing collection system rehabilitation and capacity upgrades, potential liquid stream expansion at the existing WWTP, and expansion of the Eastside Satellite Treatment Facility. Additional investment in on-going repair and replacement of the collection system on an annual basis is recommended to minimize system degradation and prevent future excess of RDII.

The proposed collection system improvements in the recommended plan are shown on **Figure ES-6.** In addition, wastewater treatment improvements include several improvements to the existing WWTP and the construction of a new Eastside Satellite Wastewater Treatment Plant as shown on **Figures ES-7 and ES-8,** respectively.

The recommended 20-year Capital Improvements Program including investments in collection system capacity expansions, collection system rehabilitation, existing WWTP, the Stage 1 and 2 Eastside Satellite Treatment Facility construction and new Sandy River outfall is summarized in **Table ES-14.**

Table ES-14
Recommended Plan Costs for each phase

Phase 3 Wastewater CIP [4]	Phase 1 (2018-2025)	Phase 2 (2025-2032)	Phase 3 (2033-2040)	Beyond 2040
Collection System Capacity Upgrades	$ 3.50 M	$ 1.60 M	$ 0.9 M	$ -
Collection System RDII Reduction Program	$ 8.68 M	$ 1.60 M	$ 1.60 M	$ 12.00 M[2]
Existing WWTP Improvements	$ 2.50 M[1]	$ 19.80 M	$ 1.40 M	$ -
Eastside Satellite Treatment Facility	$ 19.20 M	$ -	$ 2.10 M	$ -
Diversion Pump Station	$ 7.20 M	$ -	$ -	$ -
Force main to Sandy Outfall	$ 1.00 M	$ -	$ -	$ -
Sandy River Outfall	$ 12.8 M	$ -	$ -	$ -
Iseli Pump Station Upgrades	$ 1.40 M	$ -	$ -	$ -
Effluent Pump Station-Force Main to Sandy River	$ -	$ -	$ -	$ 25.30 M[3]
Totals	**$ 56.28 M**	**$ 23.00 M**	**$ 6.00 M**	**$ 37.30 M**

Notes:

1 Existing WWTP O&M Upgrades

2 RDII Reduction in 4 basins (5, 6, 7, 10); Reduction may delay requirements for Effluent Pump Station to Sandy River

3 Sandy River Effluent Pump Station from existing WWTP

4 All costs in 2018 dollars. Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

Preliminary Financial Plan

The Preliminary Financial Plan includes the funding requirements for each phase and year for the recommended plan, an overview of the current wastewater utility usage fees/rates, and preliminary funding options. The funding requirements are broken down by year and phase on Table **ES-15.** New rates were adopted on October 7th in conjunction with the adoption of the Facilities Plan and are shown below:

- Residential base fee: $20.61 per month
  - Usage rate $5.29 per 100 cubic feet of wastewater

G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\Figure11-2_Recommended_Conveyance_20181030.mxd 10/30/2018 4:25:43 PM Yarrow.Murphy

UGB

Existing Facilities

- Pump Station
- Manhole
- Gravity Sewer
- Forcemain

II Reduction Basin

Effluent Improvements (Phase 1)

- Diversion and Pump Station
- Satellite MBR
- New Force Main
- New Gravity
- New HDD Siphon

Capacity Improvements

- Ph 1 Gravity Mains
- Ph 3 Gravity Mains
- Ph 1 Force Main
- Ph 2 Force Main
- Ph 1 Pump Station
- Ph 3 Pump Station

murraysmith

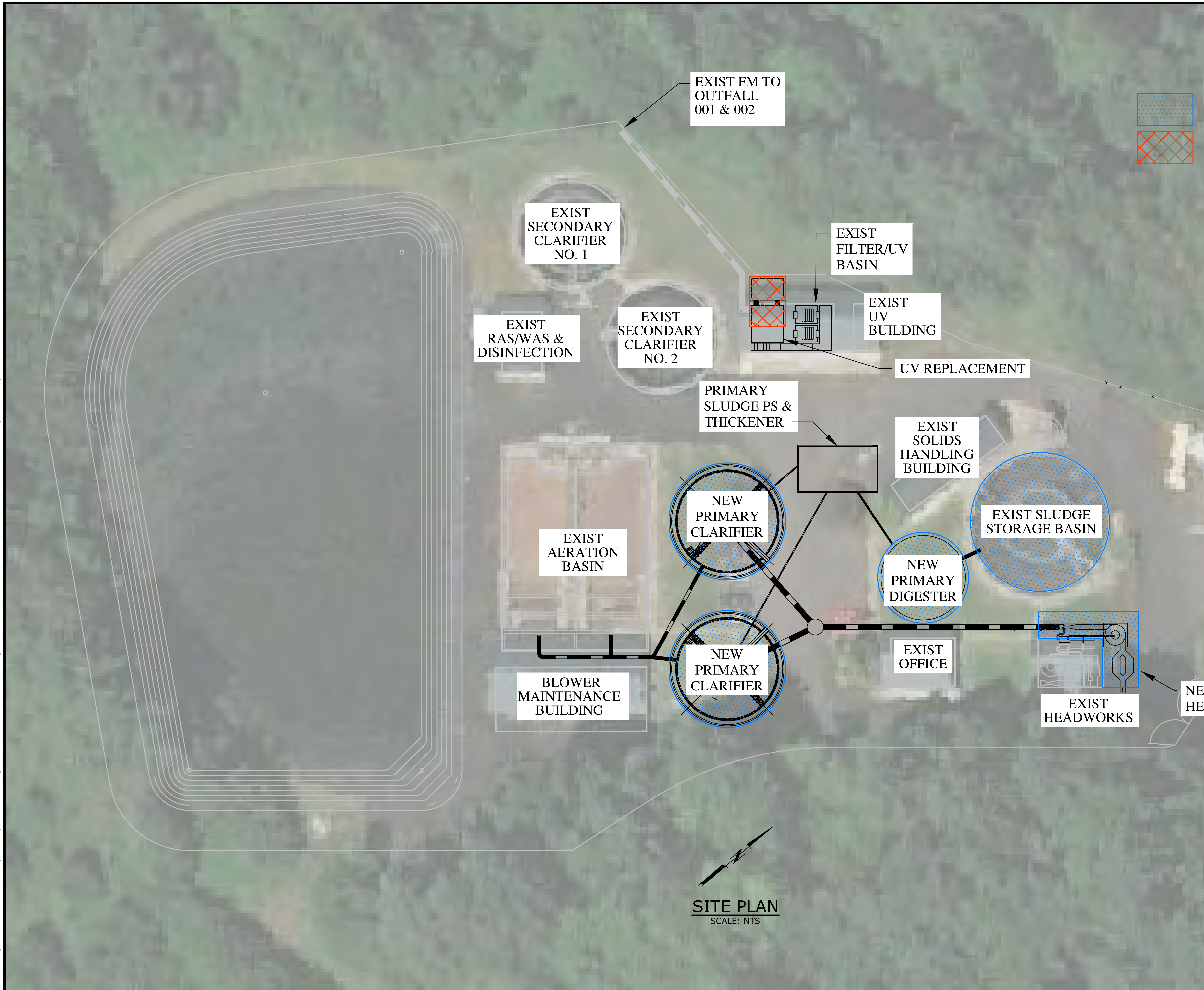
SANDY WHERE INNOVATION MEETS ELEVATION

City of Sandy, Oregon
Wastewater System Facility Plan

Figure ES-6
Recommended Improvements

January 2019 17-2137

This page intentionally left blank



SITE PLAN

SCALE: NTS

FIG ES-7

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

WWTP
UPGRADES SCHEMATIC - ALT D

Jan 2019

murraysmith

DRAFT

17-2137

This page intentionally left blank

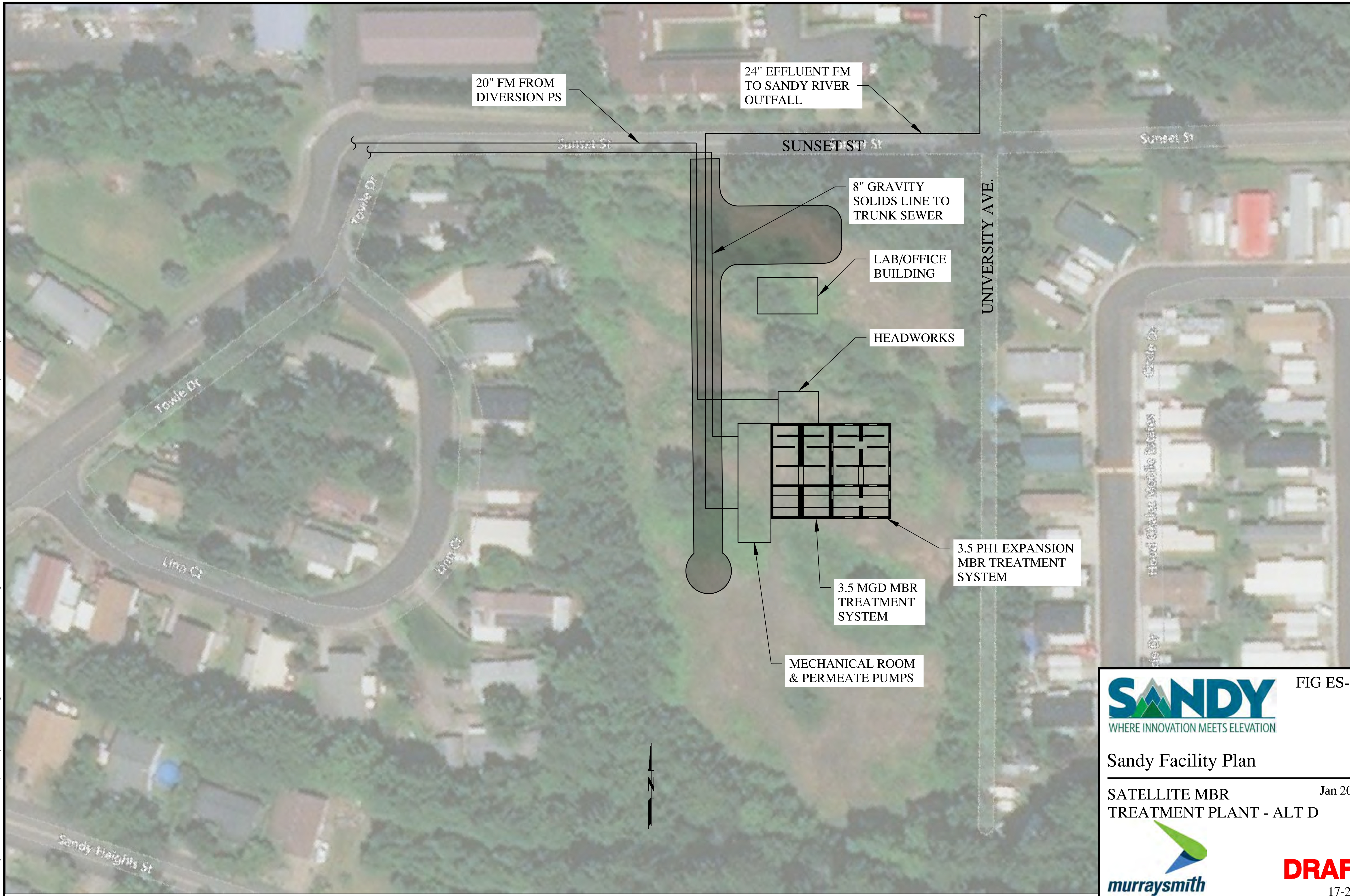


FIG ES-8

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

SATELLITE MBR TREATMENT PLANT - ALT D

Jan 2019

murraysmith

DRAFT

17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-FIG-10-11.dwg Satellite 10/30/2018 2:45 PM NICK.MCFADDIN 23.0s (LMS Tech)

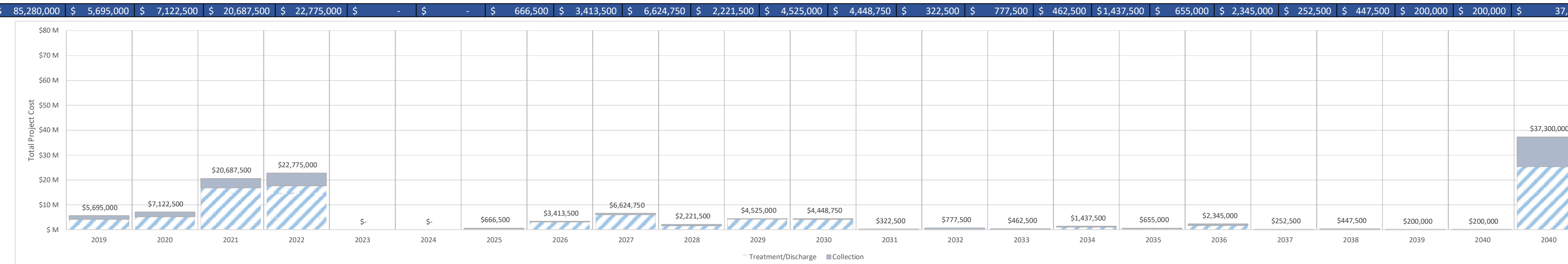
This page intentionally left blank

City of Sandy
Wastewater System Facility Plan

Capitol Improvement Progam Summary - Alternative D

Project Type			Phase I Subtotal (present value dollars)	Phase II Subtotal (present value dollars)	Phase III Subtotal (present value dollars)	Total CIP Cost Estimate (present value dollars)	Phase I						Phase II								Phase III								Beyond
							2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2040
	Collection		$ 12,180,000	$ 3,200,000	$ 2,500,000	$ 17,880,000	$ 1,430,000	$ 1,852,500	$ 3,860,000	$ 5,037,500	$ -	$ -	$ 267,500	$ 290,000	$ 571,250	$ 571,250	$ 200,000	$ 200,000	$ 322,500	$ 777,500	$ 217,500	$ 282,500	$ 287,500	$ 612,500	$ 252,500	$ 447,500	$ 200,000	$ 200,000	$ 12,000,000
Capacity	Sandy Bluff	Additional pumping capacity, mechanical and electrical upgrades	$ 2,600,000	$ -	$ -	$ 2,600,000			$ 455,000	$ 2,145,000																			
Capacity	Jacoby/Timberline Trails	Additional pumping capacity	$ 100,000	$ -	$ -	$ 100,000		$ 17,500	$ 82,500																				
Capacity	Marcy Street	Additional pumping capacity, mechanical and electrical upgrades	$ 400,000	$ -	$ -	$ 400,000		$ 70,000	$ 330,000																				
Capacity	Meinig Avenue	Additional pumping capacity, mechanical and electrical upgrades	$ -	$ 700,000	$ -	$ 700,000													$ 122,500	$ 577,500									
Capacity	Snowberry Pump Station	Additional pumping capacity	$ -	$ -	$ 100,000	$ 100,000															$ 17,500	$ 82,500							
Capacity	Sandy Bluff	FM upgrades	$ 200,000	$ -	$ -	$ 200,000	$ 15,000	$ 20,000	$ 82,500	$ 82,500																			
Capacity	Jacoby/Timberline Trails	FM upgrades	$ 200,000	$ -	$ -	$ 200,000	$ 15,000	$ 20,000	$ 82,500	$ 82,500																			
Capacity	Sandy Heights - Dubarko Road	Gravity upgrade	$ -	$ 900,000	$ -	$ 900,000							$ 67,500	$ 90,000	$ 371,250	$ 371,250													
Capacity	Dubarko Road at Tupper Rd	Gravity upgrade	$ -	$ -	$ 500,000	$ 500,000																	$ 87,500	$ 412,500					
Capacity	Sandy Bluff	Gravity upgrade	$ -	$ -	$ 300,000	$ 300,000																			$ 52,500	$ 247,500			
RDII	Site-specific	Flow Monitoring (minimum 5 locations, permanent and temporary)	$ 300,000	$ -	$ -	$ 300,000	$ 100,000	$ 100,000	$ 100,000																				
RDII	33% of System	Condition Inspection (CCTV)	$ 510,000	$ -	$ -	$ 510,000		$ 170,000	$ 170,000	$ 170,000																			
RDII	System-wide	Smoke Testing	$ 170,000	$ -	$ -	$ 170,000	$ 85,000	$ 85,000																					
RDII	Basin 2	Rehabilitation (piping and laterals)	$ 3,400,000	$ -	$ -	$ 3,400,000	$ 255,000	$ 340,000	$ 1,402,500	$ 1,402,500																			
RDII	Basin 8	Rehabilitation (piping and laterals)	$ 2,800,000	$ -	$ -	$ 2,800,000	$ 210,000	$ 280,000	$ 1,155,000	$ 1,155,000																			
RDII	Basins 5, 6, 7, 10	Rehabilitation (piping and laterals)	$ -	$ -	$ -	$ -																							
RDII	System-wide	Stormwater Disconnects	$ 1,500,000	$ -	$ -	$ 1,500,000	$ 750,000	$ 750,000																					
RDII	System-wide	$200k/yr ongoing RDII	$ -	$ 1,600,000	$ -	$ 1,600,000							$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000									$ 12,000,000
RDII	System-wide	Collection system repair and replacement program	$ -	$ -	$ 1,600,000	$ 1,600,000															$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	
	Treatment/Discharge		$ 44,100,000	$ 19,800,000	$ 3,500,000	$ 67,400,000	$ 4,265,000	$ 5,270,000	$ 16,827,500	$ 17,737,500	$ -	$ -	$ 399,000	$ 3,123,500	$ 6,053,500	$ 1,650,250	$ 4,325,000	$ 4,248,750	$ -	$ -	$ 245,000	$ 1,155,000	$ 367,500	$ 1,732,500	$ -	$ -	$ -	$ -	$ 25,300,000
CIP	Existing WWTP	Headworks Upgrade	$ -	$ 2,280,000	$ -	$ 2,280,000							$ 399,000	$ 1,881,000															
CIP	Exising WWTP	Primary Clarifiers	$ -	$ 4,150,000	$ -	$ 4,150,000										$ 726,250	$ 3,423,750												
CIP	Exising WWTP	Anaerobic Digester	$ -	$ 5,150,000	$ -	$ 5,150,000											$ 901,250	$ 4,248,750											
CIP	Exising WWTP	Dewatering Upgrades	$ -	$ 7,100,000	$ -	$ 7,100,000								$ 1,242,500	$ 5,857,500														
CIP	Exising WWTP	Dryer	$ -	$ 1,120,000	$ -	$ 1,120,000									$ 196,000	$ 924,000													
CIP	Exising WWTP	Filter/UV	$ -	$ -	$ 1,400,000	$ 1,400,000															$ 245,000	$ 1,155,000							
CIP	Existing WWTP	Condition Assessment Improvements	$ 2,500,000	$ -	$ -	$ 2,500,000	$ 1,250,000	$ 1,250,000																					
CIP	Existing WWTP	Iseli Pump Station Upgrades	$ 1,400,000	$ -	$ -	$ 1,400,000			$ 245,000	$ 1,155,000																			
CIP	Existing WWTP	Effluent Pump Station and Force main to Sandy Outfall (Beyond 2040)	$ -	$ -	$ -	$ -																							$ 25,300,000
CIP	Eastside Treatment Facility	Diversion Pump Station	$ 7,200,000	$ -	$ -	$ 7,200,000	$ 540,000	$ 720,000	$ 2,970,000	$ 2,970,000																			
CIP	Eastside Treatment Facility	Force main to Sandy Outfall	$ 1,000,000	$ -	$ -	$ 1,000,000	$ 75,000	$ 100,000	$ 412,500	$ 412,500																			
CIP	Eastside Treatment Facility	Sandy River Outfall	$ 12,800,000	$ -	$ -	$ 12,800,000	$ 960,000	$ 1,280,000	$ 5,280,000	$ 5,280,000																			
CIP	Eastside Treatment Facility	Headworks	$ 4,510,000	$ -	$ -	$ 4,510,000	$ 338,250	$ 451,000	$ 1,860,375	$ 1,860,375																			
CIP	Eastside Treatment Facility	Membrane Bioreactor	$ 13,260,000	$ -	$ 2,100,000	$ 15,360,000	$ 994,500	$ 1,326,000	$ 5,469,750	$ 5,469,750													$ 367,500	$ 1,732,500					
CIP	Eastside Treatment Facility	Disinfection	$ 1,080,000	$ -	$ -	$ 1,080,000	$ 81,000	$ 108,000	$ 445,500	$ 445,500																			
CIP	Eastside Treatment Facility	Satellite Solids Return	$ 350,000	$ -	$ -	$ 350,000	$ 26,250	$ 35,000	$ 144,375	$ 144,375																			
		Total Project Cost	$ 56,280,000	$ 23,000,000	$ 6,000,000	$ 85,280,000	$ 5,695,000	$ 7,122,500	$ 20,687,500	$ 22,775,000	$ -	$ -	$ 666,500	$ 3,413,500	$ 6,624,750	$ 2,221,500	$ 4,525,000	$ 4,448,750	$ 322,500	$ 777,500	$ 462,500	$1,437,500	$ 655,000	$ 2,345,000	$ 252,500	$ 447,500	$ 200,000	$ 200,000	$ 37,300,000

Notes:
- *All costs in 2018 dollars*
- *For planning purposes, future costs should be increased for cost escalation (inflation) based on Engineering News Record - Construction Cost Index (December 2018 ENR-CCI: 11,186) or other index preferred by the City.*
- *Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers (AACE), with a level of accuracy range between -30 to +50 percent.*



This page intentionally left blank.

- Non-residential base fee: $20.61 per month
  - Usage rate $7.18 per 100 cubic feet of wastewater
- System Development Charges
  - SDC = $4,489 / Equivalent Dwelling Unit

The City engaged FCS Group in April, 2019 to complete a rate study and SDC methodology review in order to evaluate the necessary rate changes to finance the recommended plan. Under these rates the typical monthly bill for a single-family dwelling will rise from $24.94/ month to $52.35/month (600 cubic feet per month).

Funding options for the Recommended Plan include:

- System Development Charges
- Revenue Bonds
- General Obligation Bonds
- State and Federal Programs
  a. Clean Water State Revolving Fund
  b. Water Infrastructure Finance and Innovation Act (WIFIA)
  c. Business Oregon – Infrastructure Finance, Water Wastewater Fund
- Energy Trust of Oregon Rebates and Incentives

Table ES-16 contains a summary of the City's eligibility for loan and grant programs based on the above listed funding programs.

Table ES-16
Funding Eligibility Overview

<table>
<tr><th>Program</th><th>Eligibility</th></tr>
<tr><td>Oregon Department of Environmental Quality
Clean Water State Revolving Fund (CWSRF)

The City of Sandy is designated as a small community with a median household income greater than the state average.</td><td><table>
<tr><th>Loan Type</th><th>Interest Rates
(Jan 1 – March 31, 2019)</th><th>Repayment Period</th></tr>
<tr><td>Planning:</td><td>1.06 %</td><td>5-years</td></tr>
<tr><td>Design/Construction:</td><td>1.06% to 2.84%</td><td>5-years to 30-years</td></tr>
</table>
Fees: 0.5% of the unpaid balance annually</td></tr>
<tr><td>Business Oregon
Infrastructure Finance:
Water Wastewater Fund</td><td>Maximum Loan Amount: $60,000 (technical assistance financing)
Maximum Loan Amount: $10,000,000 (combination of direct and/or bond funded loans</td></tr>
<tr><td>Special Public Works Fund (SPWF)</td><td>Maximum Loan Amount: $10,000,000
Maximum Loan Term: 25-years
Allowable Project Costs:
Project management expenses, engineering design, architectural work, surveying, and construction inspections, public facilities that are essential to support continuing and expanded economic development activity.
Interest Rate: set by Business Oregon based on market conditions for bonds with similar terms and credit characteristics.</td></tr>
<tr><td>Environmental Protection Agency
Water Infrastructure Finance Innovation Act (WIFIA)</td><td>Maximum final maturity date from substantial completion: 35 years
Maximum time that repayment may be deferred after substantial completion of the project: 5 years
Allowable Project Costs: Planning, engineering, and economic investigations related to an eligible construction project
Percentage of Total Project Costs:
WIFIA may finance up to 49% of the total project costs.
WIFIA and CWSRF combined may finance up to 80% of total project costs.
*NEPA, Davis-Bacon, American Iron and Steel, and all other federal cross-cutter provisions apply.</td></tr>
<tr><td>Energy Trust of Oregon
Wastewater Incentives</td><td>Energy Trust will pay up to $0.32/annual kWh saved or 50% of eligible project costs, whichever is less.
Maximum Rebate: $500,000 dollars per project with a limit of $1,000,000 annually per site.</td></tr>
</table>

Next Steps

The City will need to pursue adoption of the completed facility plan and associated rate increases. The adoption process and funding next steps are detailed below.

Adoption Process

Following the completion of the WSFP, the City conducted public outreach to the community and local watershed councils to communicate the recommended plan and request public comment. A mailer was sent out with the utility bill in August 2019 to inform the community about the recommended plan and proposed rate increases. Two City Council meetings were held, one in September and the other in October of 2019. The City held meetings with the Clackamas River Basin Council and the Sandy River Watershed Council and incorporated comments from public stakeholders into the final WSFP; A copy of all public comments received is included in Appendix N. The Plan and the recommended alternative was adopted by the City Council during a public meeting on October 7, 2019.

The adoption process included both significant increases in the sewer utility rates. System SDCs and adoption of the WSFP. The ratemaking process included a rate study, public notice period, a City Council work session and extensive public outreach to ratepayers. Public hearings on the proposed rate structure were held on September 16th and October 7th.

Notice of a hearing on the proposed SDC methodology and the availability of the methodology and proposed SDCs was provided per the requirements in ORS 223.304. The new wastewater SDCs were adopted on October 21st.

The adoption process also included a recommendation from the Sandy River Watershed Council to conduct a detailed evaluation of discharge alternatives. The decision to eliminate discharge from the Clackamas River Basin and to pursue a new discharge permit in the Sandy River Basin spurred the detailed evaluation. The Sandy WSFP Detailed Discharge Alternatives Evaluation includes the following major elements:

- Sandy River water quality testing and antidegradation evaluation for direct discharge
- River Outfall Siting Study
- Water recycling market assessment and stakeholder outreach
- Indirect discharge and Roslyn Lake alternatives evaluation
- Evaluation of connecting to the Clackamas County Water Environment Services or the City of Gresham systems for wastewater treatment and discharge

The WSFP Detailed Discharge Alternatives Evaluation is anticipated to be completed by the end of 2020 and will be incorporated into this Plan as an amendment when finalized.

A copy of a mailer sent out to all current sewer utility customers August 2019 is included in **Appendix O**. A copy of meeting minutes and presentation for the City Council held in 2019 on September 16th is included in **Appendix P**. A copy of meeting minutes and presentation for the City Council held in 2019 on October 7th is included in **Appendix Q**. DEQ comments are included in **Appendix R**.

Funding Next Steps

The impact of the Recommended Plan on wastewater rates will depend on a combination of State and Federal loan funding and SDC revenue. It is anticipated the project will be funded with loans. The CWSRF loan program has low interest rates and favorable terms and conditions. The City applied for financing from the Water Infrastructure and Finance Act program (WIFIA) in July, 2019 but was unsuccessful.

The following next steps are recommended to finalize the financial plan for the Wastewater System Facilities Plan Recommended Upgrades:

1. Request a "One-Stop" Financing Roundtable from the Business Oregon, Regional Development Officer for Clackamas County, Bryan Guiney at (503) 307-3662
2. Submit a revised application for WIFIA financing.
3. Submit an application for DEQ CWSRF loan funding.
4. Submit an application for USDA Rural Development financing.
5. Pursue potential grants with the above stated funding agencies

Section 1

Section 1

Introduction

1.1 Introduction

The City of Sandy (City) is located in Northwest Oregon, between the Portland metropolitan area and Mount Hood. This Wastewater System Facilities Plan (WSFP) provides the City of Sandy with a comprehensive plan for its wastewater collection system and wastewater treatment plant (WWTP) infrastructure. The plan includes recommended capital improvements phased through 2040 that will provide service to the growing community for decades to come.

1.2 Purpose

This WSFP is a valuable tool to guide the City's orderly and efficient management of its wastewater collection and treatment systems over the next 20 years. The plan lays out a strategy to provide wastewater services that accommodate population growth while staying in compliance with environmental regulations and permits. The recommendations presented here were made with consideration of the benefits of long-term investments that will continue to serve the community beyond the 20-year planning horizon. Combining planning of the entire wastewater system supported leveraging of the benefits of improvements in the collection system to reducing flows at the wastewater treatment plant, allowing optimization of cost effectiveness of overall system investments.

The document serves as a "Public Facilities Plan" for wastewater collection and treatment as required under Oregon Administrative Rule (OAR) 660, Division 11. This OAR stipulates that facility plans be developed as support documents for the City's Comprehensive Plan. This WSFP additionally complies with the City's Mutual Agreement and Order issued by Oregon Department of Environmental Quality on February 14, 2018.

1.3 Sandy Wastewater System Overview

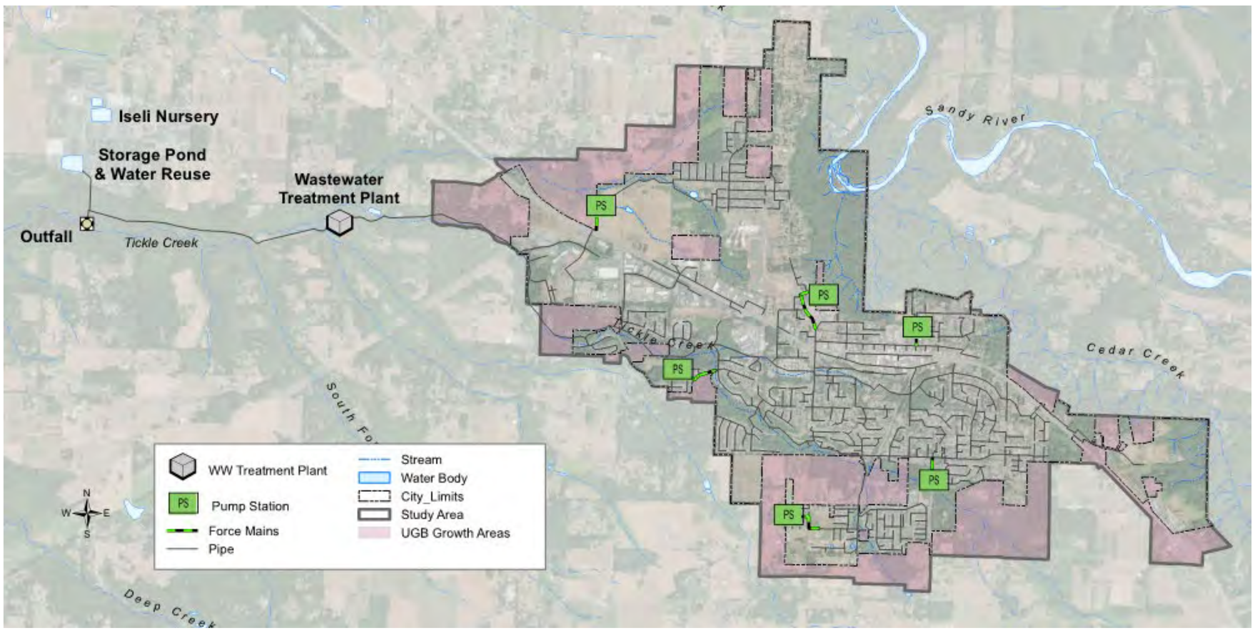
The City's wastewater system provides wastewater collection and treatment to a current population of approximately 11,000 residents and 5,000 employees within the City limits that has a total area of approximately 2,200 acres. The City is one of the fastest growing cities in Clackamas County and Oregon, with the population expected to double over the next 20 years.

The wastewater collection system is comprised of 40 miles of gravity sewer, 1,100 manholes, 1.2 miles of force main, and six public pump stations. Wastewater is collected by smaller service pipelines and conveyed to the Sandy Wastewater Treatment Plant (WWTP) via a trunk sewer located along Tickle Creek, a tributary of the Clackamas River.

All of the City's wastewater is treated at the existing WWTP in a tertiary treatment process that includes secondary treatment followed by filtration and ultraviolet (UV) disinfection. During the summer months from May through October, treated WWTP effluent is utilized for irrigation by Iseli Nursery. During the winter months from November through April, when no irrigation water is needed at the Nursery, water is discharged to Tickle Creek.

Figure 1-1 illustrates the City's current wastewater service area and the components of the wastewater collection and treatment system.

Figure 1-1
Study Area and System Overview Map

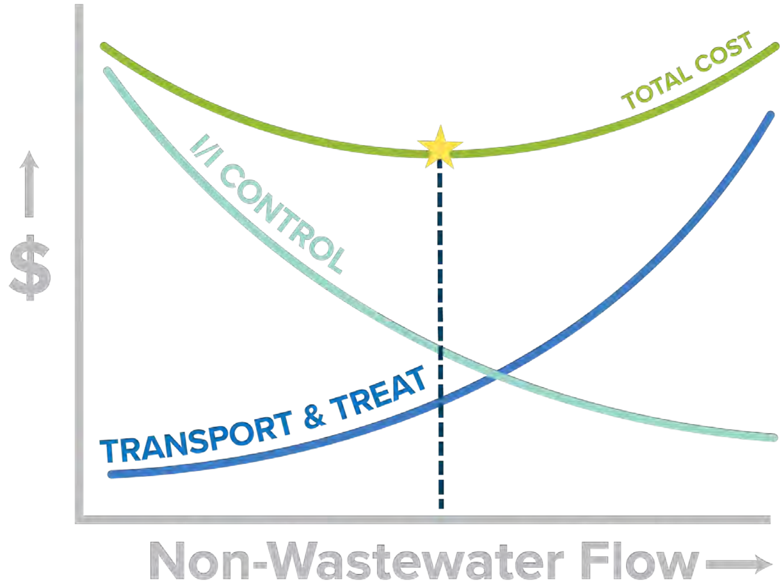


1.4 Scope

Murraysmith was contracted by the City in 2017 to prepare the WSFP and worked with the City to develop the Scope of Work, which provides guidance for decisions regarding the management and improvement of the City's wastewater collection and treatment infrastructure.

Overall, the Scope of Work combines the WWTP and the collection system into a unified plan, with investments balanced between the collection and treatment. This approach results in the best value for investments in the wastewater system, as shown in **Figure 1-2**. Critical tasks for this balanced approach to wastewater planning include characterizing non-wastewater flows, evaluating the opportunities to reduce those flows and determining the benefits of reduced flows to reduce needed capacity improvements in the conveyance and treatments systems.

Figure 1-2
Balancing Collection System and Treatment Plant Investments



The following summarizes the key elements of the agreed-upon Scope of Work:

- Development of a planning document providing for growth in the City for a 20-year planning horizon.

- Collection System evaluation and modeling, including an assessment of rainfall derived infiltration and inflow (RDII) and groundwater infiltration (GWI) evaluation from flow monitoring data in order to provide potential Inflow and Infiltration (I/I) and peak flow reduction targets at the WWTP.

- Sanitary sewer collection system hydraulic model development to be used as the tool for evaluating capacity deficiencies and improvements.

- Existing pump station condition assessment and capacity evaluation for the planning horizon.

- Development of a WWTP Facilities Plan conforming to DEQ requirements for the planning horizon, including review of regulatory requirements, development of flow and load projections, existing facility evaluation, alternatives evaluation and identification of the Recommended Plan for future upgrades to meet NPDES Permit requirements for the 20-year planning horizon.

- Preparation of an overall Capital Improvement Program for implementation by the City for the City's sanitary sewer collection system, pump stations and WWTP.

- Seismic evaluations, detailed structural analysis and geotechnical investigations are not included in this scope of work.

1.5 Organization of the Master Plan

The WSFP is organized in two volumes and includes an Executive Summary, 11 sections and 12 appendices. **Table 1-1** outlines the content of the sections in Volume 1 and **Table 1-2** outlines the content of Volume 2, the appendix.

Table 1-1
Document Organization – Volume 1

Section Identifier	Title	Description
ES	Executive Summary	Provides a succinct summary of findings and recommendations for quick reference. More detailed information found in the sections if required.
1	Introduction	Summarizes purpose, scope and organization of the WSFP.
2	Study Area Characterization	Describes the study area location and characteristics, including geography, topography, geology and soil conditions, land use.
3	Existing System Description	Provides overview of the existing wastewater collection and treatment systems including collection system basins, key pipelines, pump stations, treatment plant and outfalls.
4	Regulatory Requirements	Reviews the regulatory requirements related to collection, treatment and discharge of wastewater, including review of current NPDES permit and compliance evaluation.
5	Basis of Planning	Defines the methodology and criteria for alternative evaluation and cost estimating.
6	Flow and Load Projections	Documents existing and projected flows in the collection system and wastewater characterization at the WWTP. Defines terminology related to various design flows measures.
7	Sanitary Sewer Collection System Evaluation	Summarizes the evaluation of the collection system, including pump station condition assessment and collection system capacity analysis methods and results. This section discusses the impacts of infiltration and inflow on the wet weather flows and opportunities to reduce these impacts.
8	Existing Wastewater treatment Plan Evaluation	Summarizes the existing WWTP evaluation, code review and capacity evaluation.
9	Initial Wastewater Systems Alternatives Evaluation	Describes initial evaluation of opportunities to continue discharging to Tickle Creek during the winter and irrigating at Iseli Nursery during the summer. Includes evaluation of the current NPDES Permit and allowable discharge, a range of RDII and WWTP peak flow reduction scenarios, and WWTP upgrades for treating the range of flow scenarios.

Section Identifier	Title	Description
10	Long-Term Wastewater Systems Alternatives Evaluation	Presents alternatives and recommendation for improvements with RDII reduction resulting in a peak instantaneous flow of 14.1 MGD in 2040. Alternatives include capacity improvements in the collection system, expansion and improvement of the existing WWTP, continuing water reuse during the summer, continuing to use the outfalls to Tickle Creek, and constructing a new effluent pipe and outfall to the Sandy River.
11	Recommended Capital Improvement Program	Summarizes the key elements of the Capital Improvement Program. Includes recommended phased implementation plan and estimated costs for each project and year-by-year financial plan.

Table 1-2
Document Organization – Volume 2

Appendix Identifier	Title and Description
A	City of Sandy NPDES Permit
B	Oregon NOAA Atlas 2 Volume 10 Precipitation Frequency Isopluvial Maps
C	SFE Global Site and Data Reports
D	Model Calibration Plots
E	Pump Station Condition Assessment
F	Existing WWTP Condition Assessment Field Notes and Photos
G	Existing WWTP Operations Investigation
H	Preliminary List of Recommended Improvements
I	Visual Hydraulic Input Parameters
J	Biowin Model Report
K	Biosolids Input Parameters

Section 2

Section 2

Study Area Characteristics

2.1 Introduction

This section of the Wastewater System Facilities Plan (WSFP) outlines the wastewater system study area characteristics including geography, topography, climate, general soil conditions, and zoning designations. Zoning designations are of particular interest when planning wastewater infrastructure, as the contributing flow rates are dependent on land use category and density. The City of Sandy (City) socioeconomic conditions are also documented within this section, including a discussion on the major sources of commerce within the City and the historical population trends.

2.2 Geography

The City of Sandy is in Clackamas County, located between the Sandy River within the Columbia Basin and the Clackamas River within in the Willamette Basin (see **Figure 2-1**). The City has a total area of 3.6 square miles. The altitude of Sandy is 1,000 feet above mean sea level. Sandy is located approximately 25 miles southeast of the City of Portland along Oregon State Highway 26. Neighboring communities are Boring to the northwest, Firwood to the southeast, and Eagle Creek to the southwest.

Figure 2-1
Vicinity Map

2.3 Topography

The City is situated in the foothills of the Cascade Range's Mount Hood. The ground elevations within the City range from approximately 500 feet above mean sea level (MSL) to approximately 1200 feet above MSL. In general, the elevations are lowest in the northern portions of the City near the Sandy River, and highest in the southeast portions of the City, nearer to the mountain. Elevation change throughout the City is gradual, with typical slopes up to 8 percent. However, some steep slopes, which range up to 50 percent, are located near the Sandy River and Tickle Creek.

2.4 Climate

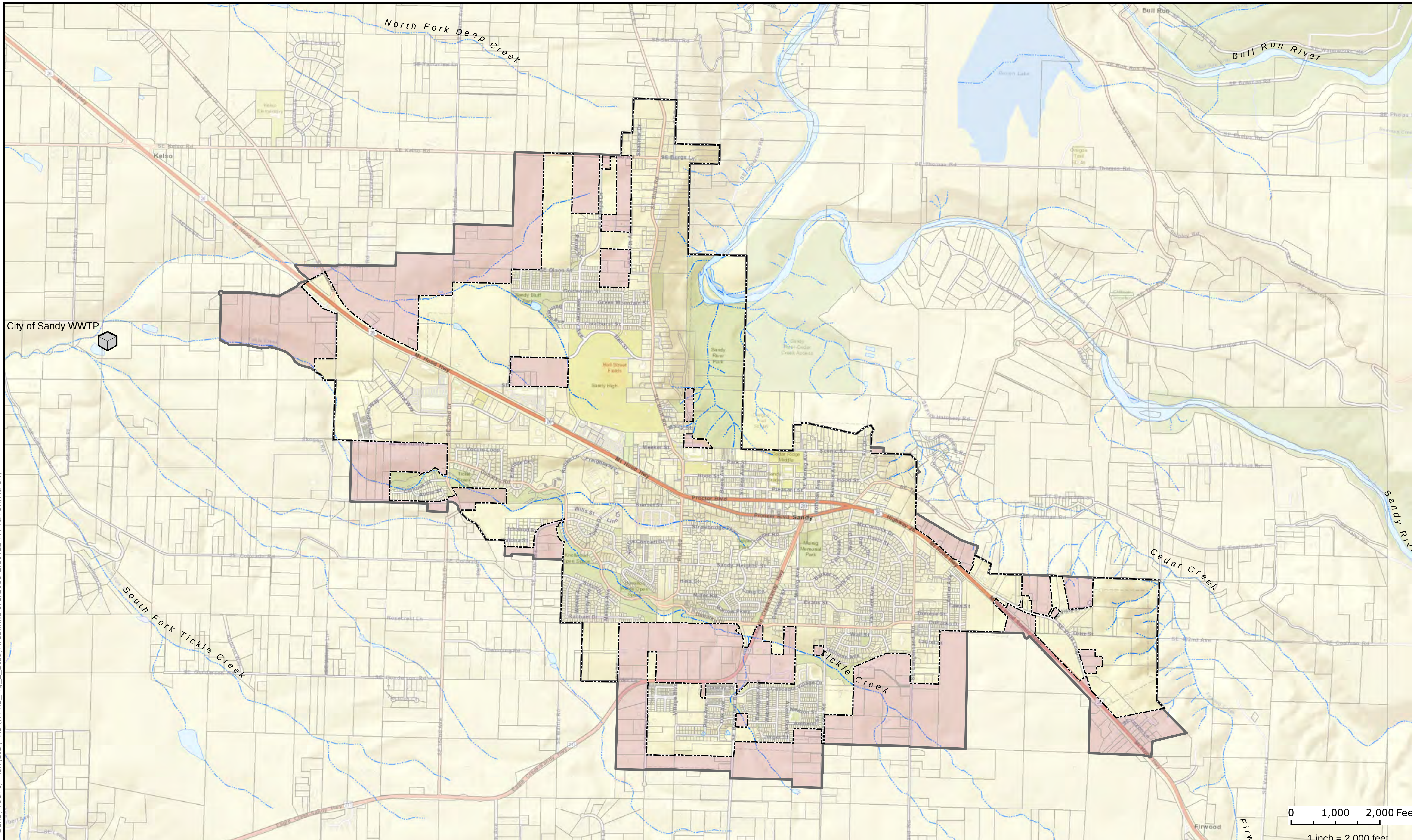
The City is in the Warm-Summer Mediterranean Climate Zone per the Koppen Climate Classification System. Temperatures are moderate year-round due to a marine influence from the Pacific Ocean that produces generally warm, dry summers and cool, wet winters. On average 47 inches of precipitation falls annually in the City. Precipitation primarily occurs during the winter, with November and December the wettest months, averaging 11 inches of precipitation. Annual snowfall averages 2.2 inches, which occurs between November and March. August is the warmest month, with an average high temperature of 78 degrees Fahrenheit (°F), and December is the coolest month, with an average low temperature of 35 °F (2018, National Centers for Environmental Information).

2.5 Study Area

The WSFP study area is illustrated in **Figure 2-2** and includes the current city limits and Urban Growth Boundary (UGB). The study considers potential impacts to the collection and treatment systems from growth within the UGB as identified in the Urban Growth Boundary Expansion Analysis Final Report published in 2017.

2.6 Land Use and Zoning

Understanding zoning and demographic characteristics within the study area is particularly important in sanitary sewer planning because of the impact they have on wastewater flows. To this end, all parcels within the UGB were assigned zoning designations in accordance with the City's Zoning Map and other relevant land use information supplied by the City. Some lands are categorized as "non-developable" lands, such as roadway or floodplain. A summarized inventory of developable and non-developable lands in the study area is shown in **Table 2-1**.



murraysmith

City of Sandy
Wastewater System Facilities Plan

Taxlots
City_Limits
Urban Expansion Areas
Study Area Boundary
Wastewater Treatment Plant

N W E S

Figure 2-2
Study Area

G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM4.1_Fig_2_StudyArea.mxd 5/1/2018 2:39:22 PM Yarrow.Murphy

January 2019 17-2137

This page intentionally left blank

2.7 Future Growth Areas

Future growth will occur on vacant and underdeveloped lands within the UGB. The City performed an Urbanization Study in 2015 to determine if the UGB was sufficient to accommodate projected population and employment growth through 2034. While this study identified potential redevelopment and growth within the UGB, it also determined that residential and employment lands available for development were insufficient to meet the demands of projected future growth. The UGB was studied and expanded in the February 2017 Urban Growth Boundary Expansion Analysis Final Report. The 2017 study resulted in the expansion of the UGB to 3100 acres, providing over 800 acres in gross land area outside of the city limits.

With the expanded UGB, vacant lands within the existing city limits in addition to the growth areas within the UGB will provide sufficient lands to accommodate residential and employment growth until 2034, as projected in the 2015 City of Sandy Urbanization Report. Commercial growth will primarily be focused around east and west commercial zoning areas adjacent to Highway 26. Residential growth areas have been designated to the north and south of the existing city limits.

2.8 Geology, Soils, and Groundwater

The NRCS classifies most soil types in the City vicinity as silty clay loam. These soils are well suited to nursery stock and berry crops. The soils are primarily in hydrologic soil group C, which has a moderately high runoff potential, with infiltration rates ranging between 0.14 and 1.4 inches per hour and depth to impermeable layers between 20 and 40 inches. Steep areas with rocky soils along the Sandy River on the Northern edge of the UGB are beyond the extent of the existing sanitary sewer system and outside of targeted future growth areas. Groundwater ranges between 20-200 feet below ground surface depending on the local topography.

Table 2-1
Zoning Categories for Study Area

Zoning Category	Existing City Limits	UGB Growth Areas	Total
	Developable Land (gross acres)		
Central Business District	54	0	54
General Commercial	209	81	290
Heavy Industrial	0	74	74
Industrial Park	40	0	40
Light Industrial	73	0	73
High Density Residential	154	1	155
Low Density Residential	165	171	236
Medium Density Residential	288	53	290
Single Family Residential	722	414	1136
Village Commercial	9	2	11
Subtotal – Developable Land	**1664**	**695**	**2359**

Zoning Category	Existing City Limits	UGB Growth Areas	Total
Non-developable Land (gross acres)[1]			
Parks and Open Space	161	8	169
Wetland	48	12	60
Roadway	335	41	376
Floodplain	29	9	38
BPA Easement	43	60	103
Subtotal – Non-developable Land	**616**	**130**	**746**
Developed versus Vacant Land Summary (gross acres)			
Subtotal – Developed land	**868**	**110**	**978**
Vacant	**796**	**585**	**1381**

2.9 Surface Waters

Tickle Creek is a perennial stream flowing through the City. Areas along Tickle Creek are located within the 100-year floodplain boundary, as defined by the Federal Emergency Management Agency (FEMA). Much of the floodplain area is located within Knollwood and Hamilton Ridge Open Spaces and other natural area parks. The 18-inch to 21-inch diameter sanitary sewer trunk pipeline passes through these floodplain areas between Highway 211 and SE 362nd Drive (2008, FEMA).

2.10 Air Quality

The City has three facilities with Oregon Department of Environmental Quality (DEQ) air contaminant discharge permits within 2 miles of the City center. Currently, there are no air quality meters in the City. The closest air monitoring station at the Gresham Learning Facility, was installed in 2016 and deactivated in March 2018 as part of a multi-year toxics monitoring project. The next closest air quality monitoring sites are in the Portland city center area.

2.11 Hazard Areas

DEQ has identified eleven sites within the city boundary as part of the environmental cleanup site database. Currently, four of the eleven sites are still active while the remaining sites have achieved a "no further action required" designation.

In the Greater Portland Area, there are two EPA Superfund sites (Reynolds Metals Company near Troutdale and Northwest Pipe and Casing Company in Clackamas) within 30 miles of Sandy. Based

[1] Non-developable Land refers to lands in the study area that have a City zoning designation of Parks and Open Space (POS), or have been otherwise categorized as wetlands, roadway, floodplain and/or BPA easement. These additional categories are defined as follows: Wetlands – As identified by City of Sandy's GIS data and the 1998 National Wetlands Inventory as mapped in the Metro RLIS GIS. Roadway - Land not part of a taxlot, considered to be dedicated to public rights-of-way. These include streets, highways, and railroads. Floodplain - Land in the 100-year floodplain, as delineated by FEMA. Current as of August 2008. BPA easement – Areas designated for power transmission lines as identified in the City of Sandy's GIS layer.

on data available for each of their EPA Superfund sites, Human Exposure pathways for both sites are under control, but there is insufficient data on groundwater mitigation.

2.12 Socioeconomic Environment

2.12.1 Population Trends

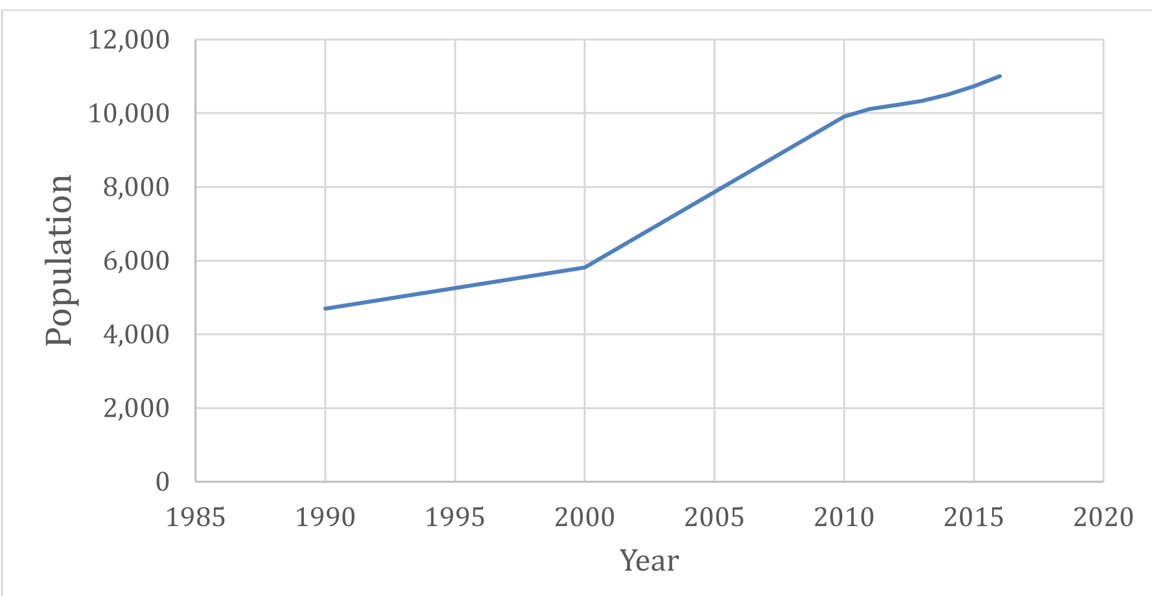
As of the 2010 census, there were 9,912 people living in the City. According to Clackamas County, the estimated population within the UGB in 2014 was 10,908 (2015, City of Sandy).

Table 2-2, Historical Population, and **Figure 2-3**, Population from 1990 to 2016, summarize the City's historical population growth.

Table 2-2
Historical Population

Year	Population
1990	4,697
2000	5,812
2010	9,912
2016	11,005

Figure 2-3
Sandy Population from 1990 to 2016



Based on the Clackamas County population forecast, the City's population is expected to increase at an overall average growth rate of 2.8% to 18,980 by 2034 (2015, City of Sandy). **Table 2-3** shows the projected population and employment within the expanded UGB during the planning period.

Table 2-3
Population Projections

Year	Population	Employees
2014	10,908	5,044
2024	14,377	6,648
2034	18,980	8,763
2040[2]	22,400	10,342

2.12.2 Economic Conditions and Trends

The City is located along a major transportation corridor between Mount Hood and the Portland metropolitan area. As a result, a large amount of economic activity is associated with tourism-related industries. The City's Market Analysis Update (2015) identified that the largest employment industries are services sector (36.9%), retail trade (26%), and manufacturing (9.7%). Employment is anticipated to grow at the same rate as the residential population, increasing from 5,044 employees in 2014 to 8,763 by 2034 (2015, City).

The City's education system includes three public schools within the Oregon Trail School District 46 (OTSD). These schools, all located north of Highway 26, include Sandy Grade School, Cedar Ridge Middle School and Sandy High School. The total student enrollment for the schools located in the City was 2142 as of June 2017 (2018, Oregon Trail Schools). Other schools within the OTSD serving Sandy residents are located to the west, east, and north of the UGB.

2.13 References

City of Sandy. 2015A. Sandy Market Analysis Update. Accessed 5/3/2018 via internet at https://evogov.s3.amazonaws.com/media/88/media/22983.pdf

City of Sandy. 2015B. Urbanization Study Final Report. Adopted per ordinance 2015-01.

City of Sandy. 2017. Urban Growth Boundary Expansion Analysis Final Report. Adopted per ordinances 2017-01 and 2017-02.

[2] Projected population based on an 2.8% annual growth rate as stated in the 2015 Sandy Urbanization Study.

Flood Insurance Management Agency (FEMA). 2008. Flood Insurance Study for Clackamas County and Incorporated Areas. Accessed 4/24/2018 via internet at https://www.orcity.org/sites/default/files/fileattachments/public_works/page/4511/fi_1_of_3.pdf).

National Centers for Environmental Information. 2018. US Normals Data (1981-2010) Map. Report for Headworks Portland Water Bureau station. Accessed 5/3/2018 at https://gis.ncdc.noaa.gov/maps/ncei/normals

Oregon Trail School District. 2018. 2017-2018 Current Enrollment Count. Accessed 5/1/2018 via internet at http://oregontrailschools.com/wp-content/uploads/2018/03/Enrollment-Count-2-28-18.pdf

Section **3**

Section 3

Existing System Description

3.1 Introduction

This section provides a brief description of the City of Sandy's (City) existing sanitary sewer collection and treatment systems. The existing sanitary sewer collection system includes approximately 40 miles of gravity sewer, 1,100 manholes, 1.2 miles of force main, and six public pump stations (lift stations). Wastewater is collected by smaller service pipelines and is conveyed to the Sandy Wastewater Treatment Plant (WWTP) via a trunk sewer located along Tickle Creek (see **Figure 3-1**). Tickle Creek is a tributary of Deep Creek and the Clackamas River. The treatment consists of preliminary treatment, activated sludge secondary treatment process, disk cloth filtration, and disinfection and is rated for a peak flow rate of 7 million gallons per day (MGD). After treatment, effluent discharges to Trickle Creek during the winter and is applied to agricultural land during the summer.

The following sections provide more details on the existing wastewater collection and treatment systems.

3.2 Utility Management Structure

Operating within the Public Works Department, the City's sanitary sewer system provides utility service to approximately 3500 service connections. The Public Works Director and nine staff are responsible for applicable system operations and maintenance of the public sewer facilities in the City. In addition to their responsibility for the sewer system facilities, these ten staff manage all other public facilities in the City, including stormwater, water, transportation, parks and buildings. The day-to-day maintenance and operations of the wastewater treatment plant are performed under a contract with Jacobs.

3.3 Collection System Summary

The City's collection system consists of gravity pipelines, manholes, lift stations and force mains. Generally, gravity pipelines convey wastewater from the residential, commercial, and industrial areas and route them to the WWTP. Due to the topography within the service area, six lift stations are required to provide service to some residential neighborhoods on the periphery of the city.

Within the City, most wastewater drains from the north to the main trunk pipeline (Sandy Trunk) that runs along Tickle Creek, near the southern city boundary. Two pump stations and a few residential neighborhoods are located to the south of Tickle Creek and the trunk line. Once collected in the trunk pipeline, the wastewater flows by gravity from east to west across the City to the WWTP. **Figure 3-1** shows the collection system, the location of the WWTP and the study area.

3.3.1 Wastewater Collection Basins and Tributary Areas

The sanitary sewer system serves approximately 945 acres of developed land within the study area. For the purposes of this study, the area is divided by the basins contributing to ten temporary flow meters installed throughout the collection system. The meter basin areas are outlined in **Table 3-1**.

Table 3-1
Meter Basin Areas (Acres) Served by Wastewater Collection System

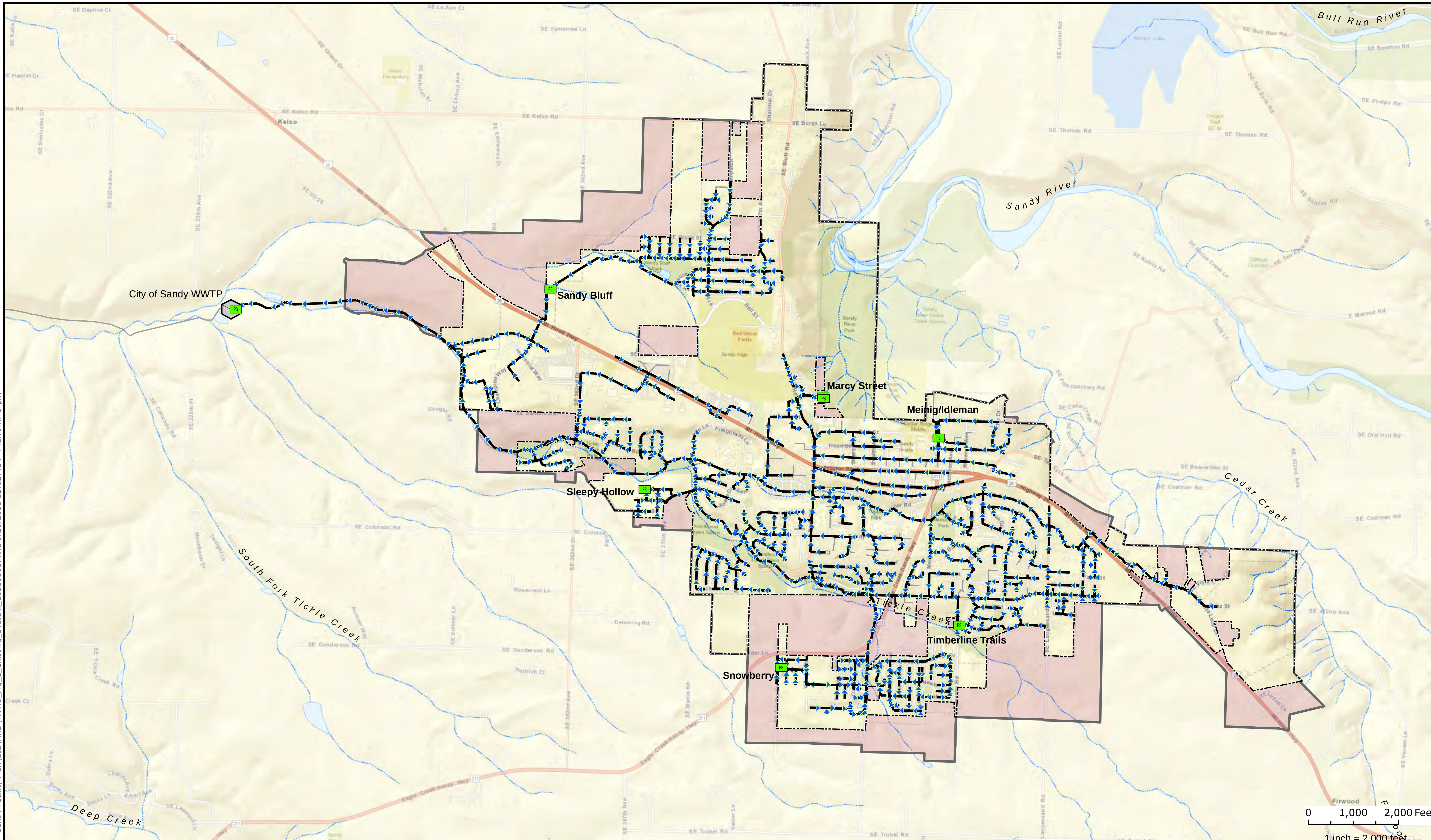
Meter ID	Basin Name	Industrial	Commercial	Residential	Vacant Developable	Total Area
1	Barnum	29	39	50	124	242
2	Treatment Plant	27	12	50	138	227
3	Sandy Heights			58	136	194
4	Ruben Lane	17	7	4	9	37
5	Sandy Bluff			242	306	548
6	Commercial Core		25	80	84	189
7	Sunset		2	35	35	72
8	Strawbridge		19	128	256	403
9	Tupper		1	59	159	219
10	Highway 211			62	166	228

Figure 3-2 illustrates the locations of meters 1,2,4 and 7 (Barnum, Treatment Plant, Ruben Lane and Sunset) on the trunk pipeline and downstream of other meters. Meters 3, 5, 6, 8, 9 and 10 (Sandy Heights, Sandy Bluff, Commercial Core, Strawbridge, Tupper and Highway 211) measured flows from tributary areas.

3.3.2 Gravity Pipelines

The sanitary sewer system is comprised of gravity pipes between 8 and 24 inches in diameter. **Figure 3-3** shows the diameters of sewer pipes throughout the collection system. The oldest assets in the City's wastewater collection system were constructed in the early 1950s. These older pipes serve the commercial core and the neighborhood north of Proctor Boulevard, including Sandy Grade School. Some of these pipes were rehabilitated with cured-in-place-pipe (CIPP) lining in 2008. As shown in **Figure 3-4**, the majority of the system piping was installed after 1990 when the City began to experience growth. **Figure 3-5** illustrates pipe materials. The pipe built after 1990 is primarily polyvinyl chloride (PVC), while the older gravity sewers were mostly constructed of concrete.

The smaller system pipelines (8-inch to 15-inch diameters) convey wastewater to the larger trunk sewer. The major trunk sewer is described in detail below. **Table 3-2** summarizes pipeline lengths by diameter and basin as listed in the City's GIS. **Table 3-3** and **Table 3-4** summarize pipeline lengths by material and age. Over 50 percent of the collection system pipes are PVC.



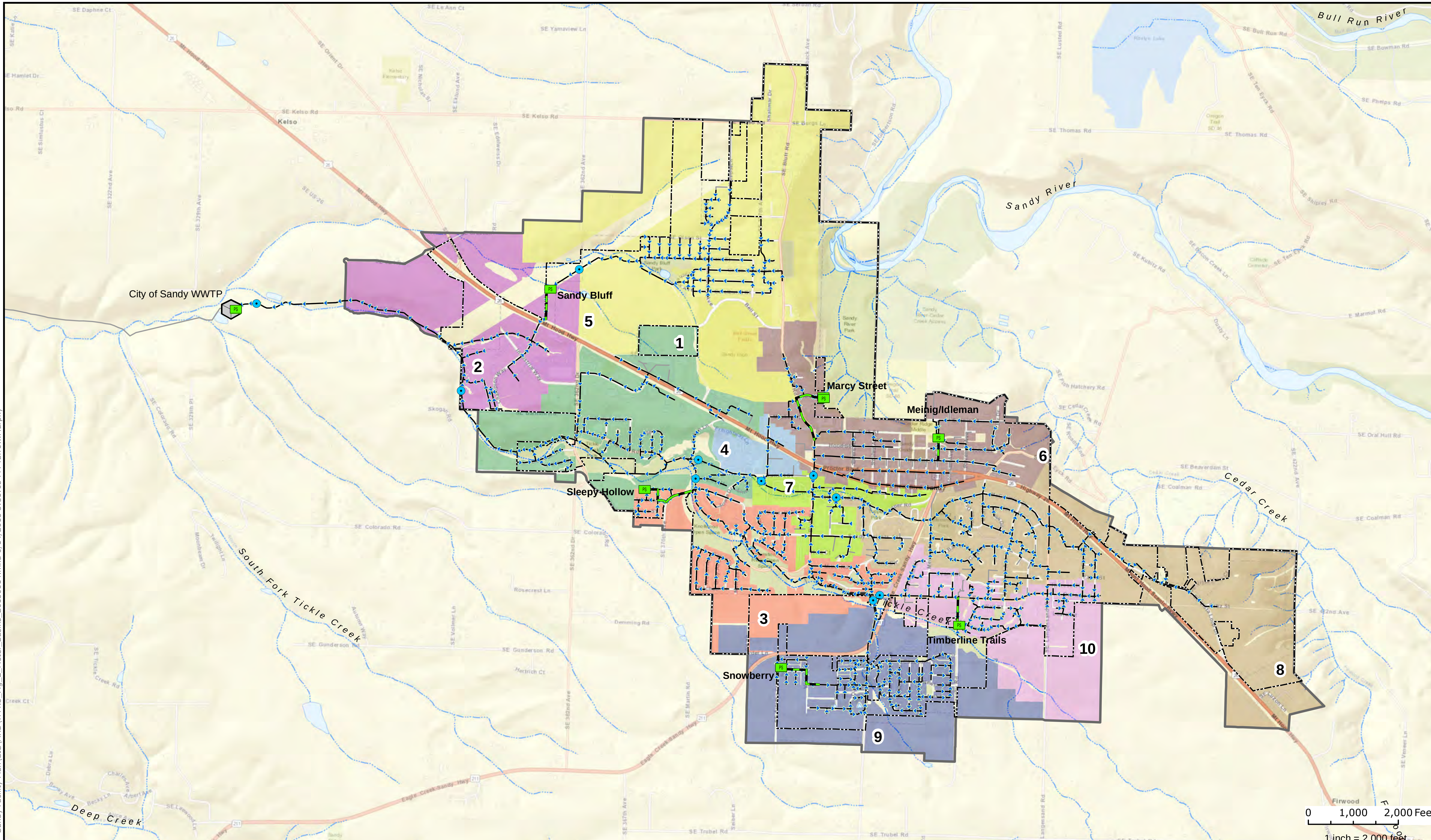
murraysmith

City of Sandy, Oregon
Wastewater System Facility Plan

WW Treatment Plant
Pump Station
Sewer Force Mains
Sewer Gravity Mains
Sewer pipe - not modeled
Stream
Water Body
City_Limits
Study Area
UGB Growth Areas

Figure 3-1
Existing System

This page intentionally left blank



murraysmith

City of Sandy, Oregon
Wastewater System Facility Plan

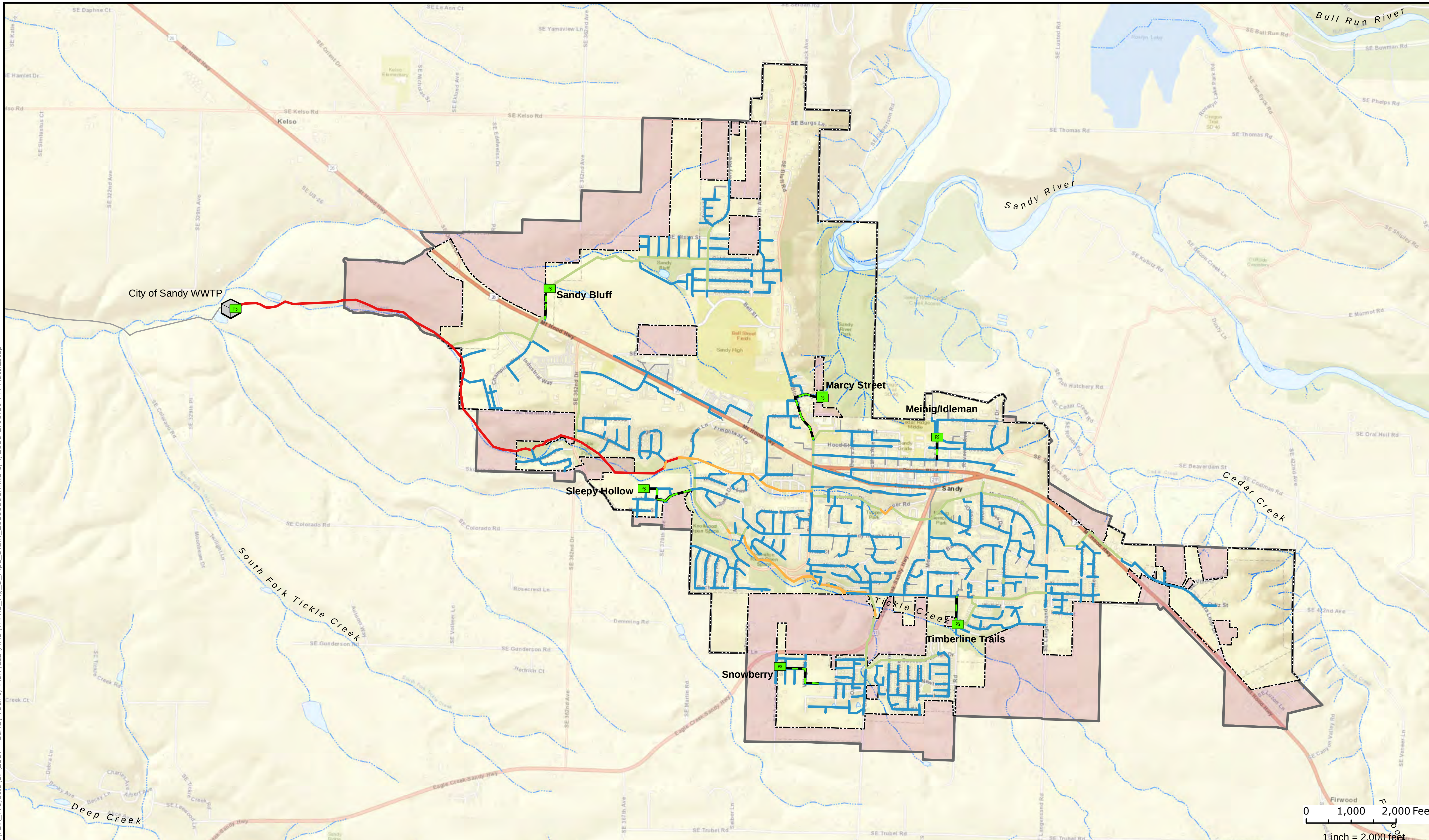
WW Treatment Plant
Pump Station
Temporary Flow Monitor
City_Limits
Study Area
Sewer Force Mains
Sewer Gravity Mains
Sewer pipe - not modeled
Stream
Water Body

Figure 3-2
Meter Basins

G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM4.3_Fig_2_Meter_Basins_20180614.mxd 6/14/2018 3:31:05 PM Yarrow.Murphy

January 2019 17-2137

This page intentionally left blank



murraysmith

City of Sandy, Oregon
Wastewater System Facility Plan

Treatment Plant
Pump Station
Sewer Force Mains
Sewer pipes - not modeled

Pipe Diameter
- <= 8-inch
- 10 to 12-inch
- 15 to 18-inch
- 21 to 24-inch

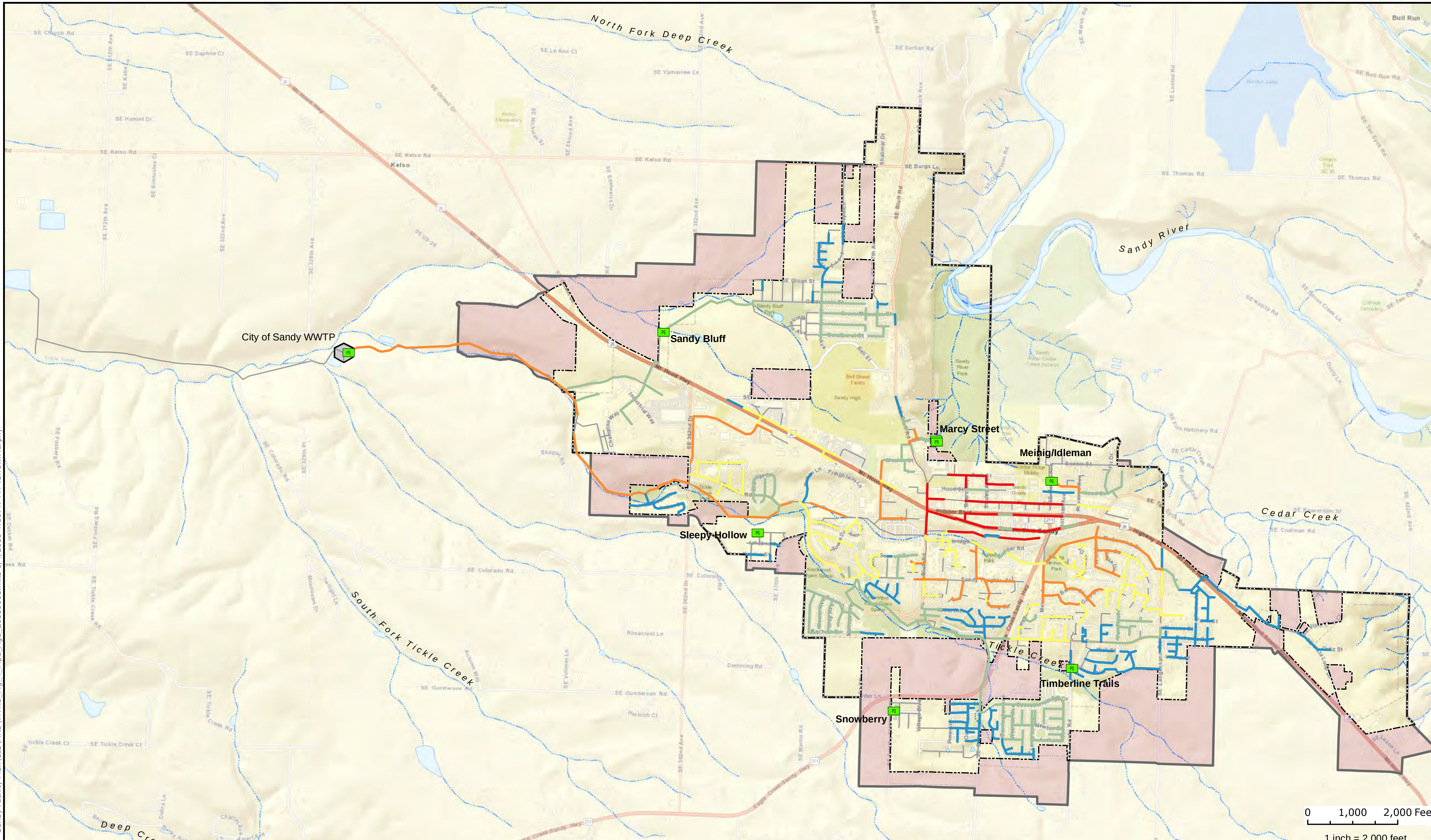
Stream
Water Body
City Boundary
Study Area
UGB Expansion

Figure 3-3
Existing System Pipe Diameter

January 2019 17-2137

\\ad.msa-ep.com\Portland\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM4.3_Fig_3_Pipe_Diam_20180501.mxd 6/4/2018 2:06:59 PM Matt.Estep

This page intentionally left blank



City of Sandy, Oregon
Wastewater System Facility Plan

City Boundary
Study Area
UGB Expansion
Water Body
Stream

Pipe Age (years)
Less than 15
16 - 25
26 - 40
41 - 55
more than 55

Sewer Pipes - Age Unknown
Treatment Plant
Pump Station

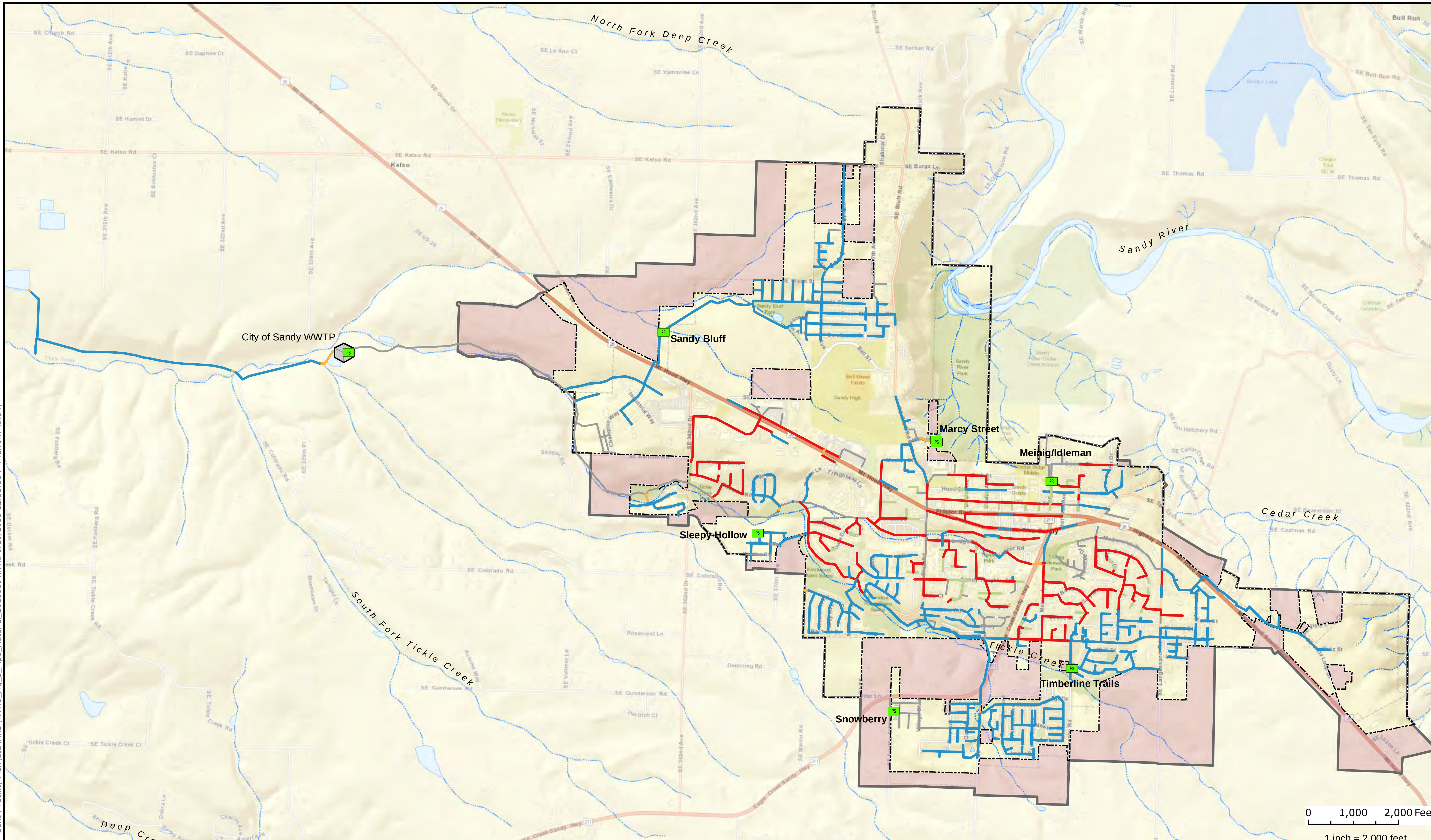
Figure 3-4
Existing System Pipe Age

murraysmith

January 2019 17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM4_3_Fig_4_Pipe_Age_20180601.mxd 6/4/2018 4:36:47 PM Yarrow.Murphy

This page intentionally left blank



City Boundary
Study Area
UGB Expansion
Water Body
Stream

Pipe Material
Cast Iron (CI)
Concrete (CSP)
Ductile Iron (DI)
Polyvinyl chloride (PVC)
Unknown

Treatment Plant
Pump Station

Note: Pipe material properties do not reflect lined rehabilitated pipes.

murraysmith

City of Sandy, Oregon
Wastewater System Facility Plan

Figure 3-5
Existing System Pipe Material

January 2019 17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM4_3_Fig_5_Pipe_Material_20180604.mxd 6/20/2018 12:35:38 PM Yarrow.Murphy

This page intentionally left blank

Table 3-2
Summary of Sewer Pipe Diameter

Diameter (inches)	Total Length Gravity Main (feet)	Total length Force Main (feet)
4		4,780
6	210	610
8	161,290	780
10	9,460	
12	18,030	
15	3,450	
18	4,090	
21	12,460	
24	25	
Total length	**209,020**	**6,170**

Table 3-3
Summary of Sewer Pipe Material

Material	Total Length Gravity Main (feet)	Total Length Force Main (feet)
Cast Iron (CI)	1,810	530
Concrete (CSP)	72,020	
Ductile Iron (DI)	970	410
Polyvinyl Chloride (PVC)	110,780	5,230
Unknown	23,440	
Total length	**209,020**	**6,170**

Table 3-4
Summary of Sewer Pipe Age

Age (years)	Total Length Gravity Main (feet)	Total Length Force Main (feet)
50 and greater	14,060	530
40 to 49	41,230	1,270
30 to 39	16,100	
20 to 29	32,810	1,180
20 or less	66,320	3,190
Unknown age	39,170	
Total length	**209,020**	**6,170**

3.3.3 Sandy Trunk

The Sandy Trunk is defined as the sanitary sewer trunk pipeline that originates at Bluff Road south of Sunset Street, then extends west along Tickle Creek and finally to the Sandy WWTP. The trunk pipeline was constructed between Sunset Street near University Avenue and the WWTP in 1971 and was later extended by 1400 feet to Bluff Road. The 15- to 21-inch diameter trunk pipeline is constructed of concrete pipe. The trunk pipeline is 15-inch diameter for the 2700 feet located above Dubarko Road and 21-inch diameter for the other 12,500 feet between Dubarko Road and the WWTP. Downstream of the lowest tributary pipe, the trunk pipeline has a minimum capacity flowing full of approximately 6.3 million gallons per day (mgd).

3.4 Pump Stations and Force Mains

The City's wastewater collection system depends on six pump stations (lift stations) to convey waste from neighborhoods to gravity pipes that connect to the trunk pipeline. Each pump station is equipped with duplex pumps and a wet well. The pump stations are summarized in **Table 3-5** and described in greater detail below. **Figure 3-6** shows the locations of the pump stations, the force mains and the areas served by each station.

Table 3-5
Pump Station Summary

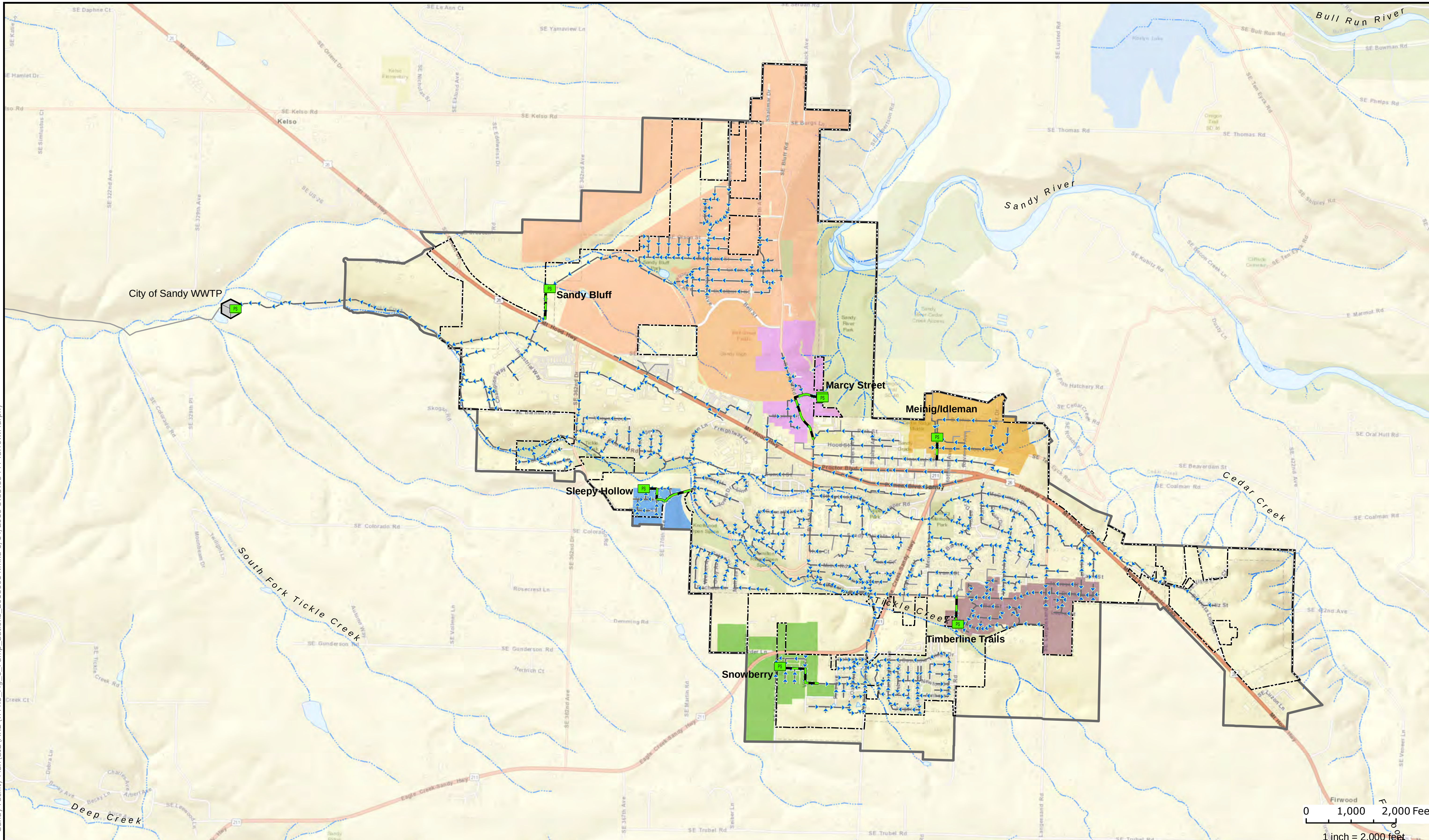
Name	Station Constructed, Year	Pump Installed, Replaced, year	Rated flow (gpm)	Total dynamic head (ft)
Marcy Street	1973	1998	128	124
Northside (Sandy Bluff)	1999	1999	550	84
Meinig Ave	1962	2003	300	60
Southeast (Jacoby/ Timberline Trails)	2005	2005	368	84
Southwest (Sleepy Hollow)	2007	2007	188	92.5
Southside (Snowberry)	2012	2012	180	100

3.4.1 Marcy Street Pump Station

The Marcy Street Pump Station, located at 38235 Marcy Street, provides sanitary sewer service to 90 residential tax lots along Bluff Road between Hood and Bell Street, and Meeker Street, Marcy Street and Marcella Court. The current pumps were placed in service in 1998 and are rated for 128 gpm at 124 ft total dynamic head (TDH). The force main is 1634 linear feet of 4-inch diameter C-900 PVC.

3.4.2 Northside Pump Station (Sandy Bluff)

The Northside Pump Station is located within the Bonneville Power Administration easement and is accessible via an access road. It was constructed in 1999 to provide sewer service to the Sandy Bluff development. In addition to the residences in this neighborhood, this pump station also serves Sandy High School. The duplex pumps are rated for 550 gpm at 84 feet TDH. These pumps have operated with variable frequency drives (VFD) since 2012. The force main is 790 linear feet of 8-inch diameter C-900 PVC.



murraysmith

City of Sandy, Oregon
Wastewater System Facility Plan

- WW Treatment Plant
- Pump Station
- City_Limits
- Study Area
- Sewer Force Mains
- Sewer Gravity Mains
- Pipes not modeled
- Stream
- Water Body
- Meinig Service Area
- Southeast Service Area
- Southwest Service Area
- Southside Service Area
- Northside Service Area
- Marcy Service Area

Figure 3-6
Pump Stations and Service Areas

January 2019 17-2137

This page intentionally left blank

3.4.3 Meinig Avenue Pump Station

The Meinig Avenue Pump Station is located on Meinig Avenue north of Idleman Street. This pump station was the first in the City, originally constructed in 1969, but it was rebuilt in 2003. Meinig Pump Station serves residences north of Hood Ave and east of Alt Street. The duplex pumps are rated for 300 gpm at 60 feet of TDH. The force main is 552 linear feet of 6-inch C-900 PVC.

3.4.4 Southeast Pump Station (Jacoby/Timberline Trails)

The Southeast Pump Station is located on Jacoby Road south of Trillium Avenue. This pump station was built in 2005 to serve the 248 residential tax lots in the vicinity of Dubarko Road west of Jacoby Road. These duplex pumps are rated for 368 gpm at 84 feet of TDH. The force main is 728 linear feet of 4-inch diameter C-900 PVC.

3.4.5 Southwest Pump Station (Sleepy Hollow)

The Southwest Pump Station is located on Constable Avenue, one block north of Ichabod Street. It was constructed in 2010 to provide sewer service to 40 residences in the Sleepy Hollow Development. Several large tax lots adjacent to the original development may be developed in the future and served by this pump station. The duplex pumps are rated for 188 gpm at 92.5 feet TDH. The force main is 1360 linear feet of 4-inch diameter C-900 PVC.

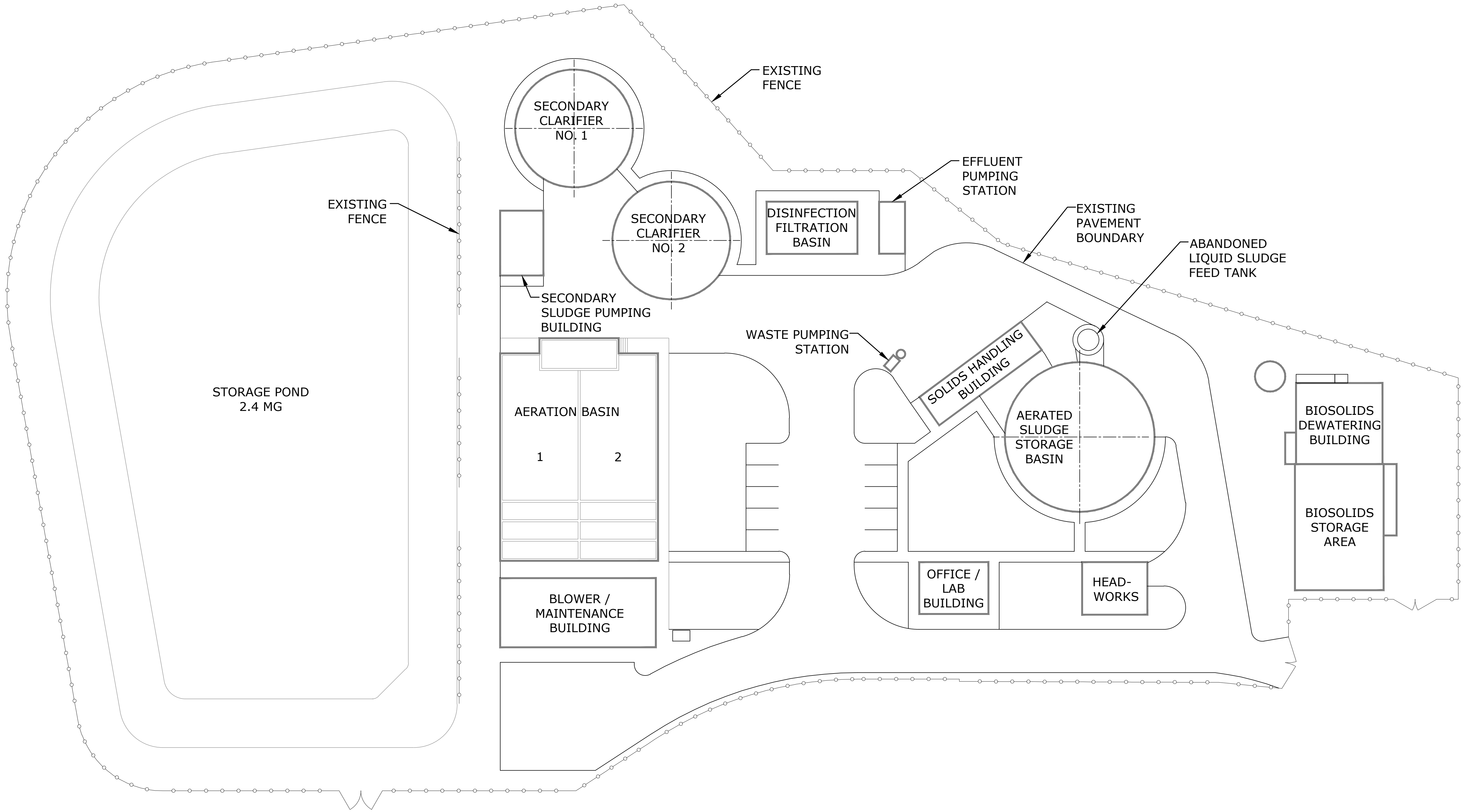
3.4.6 Southside Pump Station (Snowberry)

The Southside Pump Station is located at SE Arletha Court and Cascadia Village Drive. It is the newest pump station in the City, constructed in 2012 to provide sewer service to 99 residences in the Snowberry Development. Several large tax lots adjacent to the original development may be developed in the future and served by this pump station. The duplex pumps are rated for 180 gpm at 100 feet TDH. The force main is 1250 linear feet of 4-inch diameter C-900 PVC.

3.5 Wastewater Treatment System

The treatment system, shown in **Figure 3-7**, was first constructed in 1998 and included screenings, contact stabilization process, effluent polishing pond, and disinfection using a chlorine contact tank before discharging into Tickle Creek. The last major treatment plant update occurred in 1996 when the entire plant was updated to include grit removal, activated sludge secondary treatment process, disk cloth filtration, and UV disinfection. The following sections describes in more detail the current treatment plant components. **Subsection 8.3 Existing WWTP Capacity Evaluation** provides a table summarizing the existing unit process capacities.

This page intentionally left blank



SITE PLAN
SCALE: 1"=50'

25 0 25 50
SCALE IN FEET

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-FIG-7.dwg SITE PLAN 8/2/2018 12:03 PM DKH 23.0s (LMS Tech)

murraysmith

W N S E

City of Sandy, Oregon
Wastewater System Facility Plan

Figure 3-7
Existing Site Plan

January 2019 17-2137

This page intentionally left blank

3.5.1 Preliminary Treatment

The headworks consists of fine screening, grit removal, influent flow metering and influent composite sampling. The existing WWTP covered Headworks area is shown in **Figure 3-8**. Raw effluent from the collection system is passed either through a rotary fine screen, as shown in **Figure 3-9**, with a ¼-inch screen equipped with a screening conveyor with integral washing and compaction. Flows in excess of the influent screen capacity flow through a bypass channel with manual bar screen with ¾-inch aperature. For the rotary fine screen, the screenings are collected, washed, and conveyed to a dumpster. Following screenings, influent enters the 10-foot diameter vortex grit chamber. Grit removed from the bottom of the grit champer is washed in an adjacent grit classifier and conveyed to the to the screenings dumpster. Finally, preliminary effluent flows from the grit chamber passes through a 12-inch Parshall flume equipped with an ultrasonic level sensor. The influent composite sampler is located at the parshall flume.

Figure 3-8
Headworks

Figure 3-9
Fine Screen

3.5.2 Primary Treatment

There is no primary treatment at the Sandy WWTP. Preliminary effluent from the headworks flows directly to the aeration basin. A new secondary flow split structure is currently being installed to better split liquids and solids flows between the two aeration basins.

3.5.3 Secondary Treatment

Preliminary effluent feeds to two parallel 0.37 million gallon (MG) aeration basins. The basins consist of two 37,000 gallon anoxic selector zones, followed by 37,000 gallon Aerobic 1 zone and an ~260,000 gallon Aerobic 2 Zone as shown in **Figure 3-10**. Each aeration train is equipped with an internal mixed liquor (nitrate) recycle that returns flow from the Aerobic 2 zone to the Anoxic Selector zone. The mixed liquor recycle is not currently operating in Train 1 for a number of years.

Figure 3-10
Aeration Basin

a.) large aerobic zone

b.) small anoxic zone

c.) small aerobic zone

Mixed liquor from the aerations basins flows by gravity to one of two 54-foot diameter secondary clarifiers, shown in **Figure 3-11**. Each of the secondary clarifiers has a side water depth (SWD) of 15 feet. Mixed liquor separates in the clarifier, and the active biomass settles to the bottom of the clarifier while treated secondary effluent overflows the lauder weir. The biomass is concentrated and withdrawn from the bottom of the clarifiers as return activated sludge (RAS). The RAS is returned to the influent channel where it mixes with preliminary effluent upstream of the new influent flow split structure. A portion of the RAS as waste activated sludge (WAS) is removed from the system each day to maintain the target biomass and/or solids retention time in the aeration basin. WAS is pumped to the Aerated Sludge Storage Basin (ASSB) as summarized separately herein.

Figure 3-11
Secondary Clarifier

The secondary clarifiers are equipped with scum scrapping mechanisms that removes scum from the surface of the clarifiers. The scum is pushed into a scum trough that drains into the scum pumping station and then gets pumped into the WAS line, which flows to the ASSB.

3.5.4 Filtration, Disinfection, and Effluent Metering

Following secondary clarification, secondary effluent overflowing the clarifier launder weirs is filtered through one of two cloth media disk filters contained within two parallel basins in the Filtration/UV Area of the plant. One of the two filters is shown in **Figure 3-12**. Following filtration when discharging to Tickle Creek, the filter effluent is then disinfected with UV light using a Trojan UV4000 system equipped with 24 medium pressure bulbs. Following disinfection, the effluent is metered on a 6-foot wide 120-degree V-notch weir by measuring the head above the weir using an ultrasonic level transducer before flow discharges into the outfall wet well, as shown in **Figure 3-13**.

Figure 3-12
Cloth Disk Filter

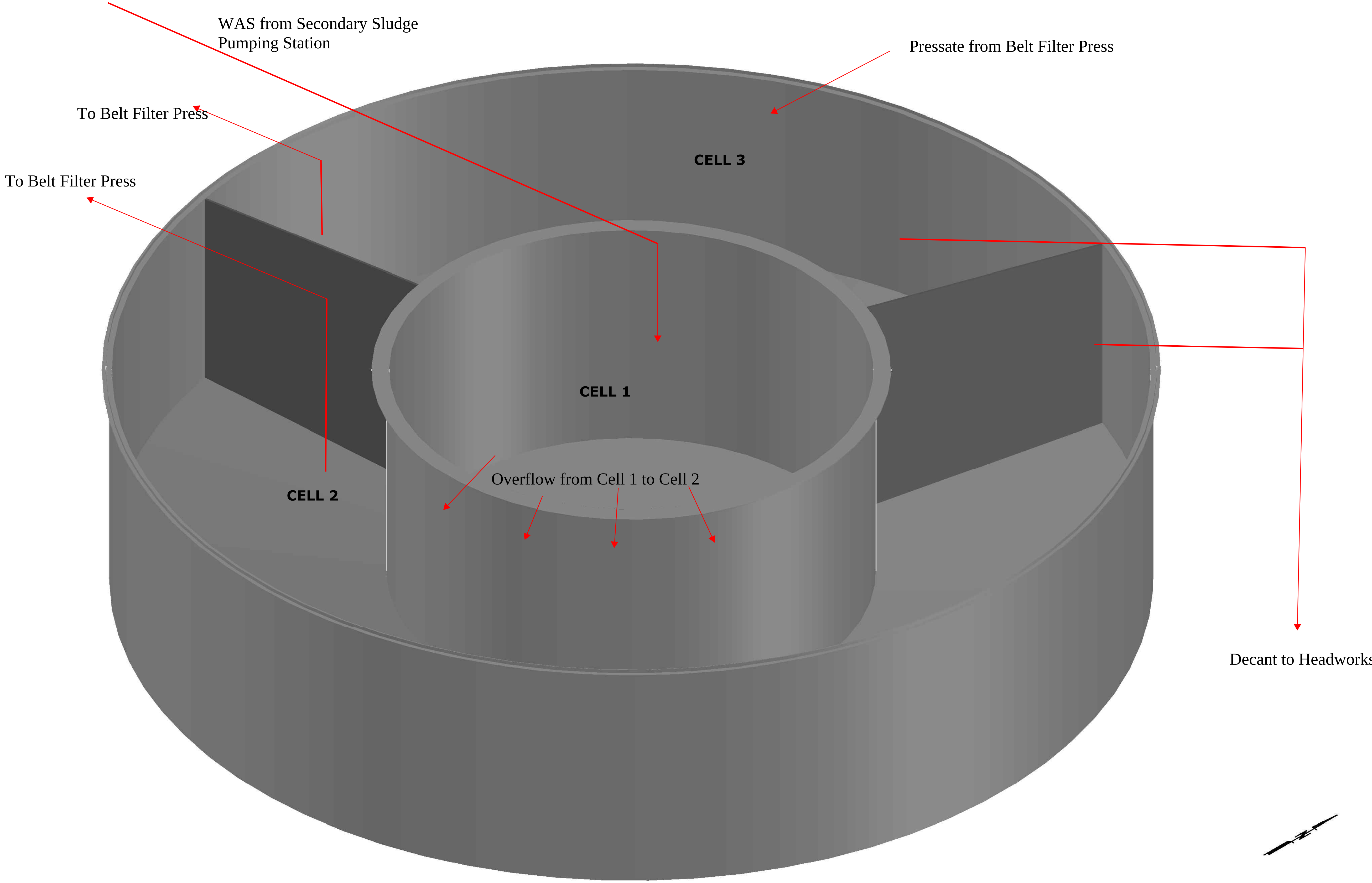
Figure 3-13
Effluent metering

3.5.5 Outfall

Four irrigation pumps on a cycling basis withdraw water from the wet well and discharge the treated effluent to either the Tickle Creek near Iseli Nursery or a storage pond at Iseli Nursery to be used for irrigation. The outfall locations are shown in **Figure 3-14** and **Figure 3-15**. The flow split is controlled via a valve located near the outfall at Tickle Creek. In addition, an 18-inch overflow pipe can be used during the winter to discharge to Tickle Creek when the flow exceeds 4 MGD.

Figure 3-14
Iseli Nursery Outfall

Figure 3-15
Tickle Creek Outfall



SE ISOMETRIC VIEW
SCALE: NTS

murraysmith

City of Sandy, Oregon
Wastewater System Facility Plan

Figure 3-16
Existing Sludge Storage Tank

January 2019 17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\3D Models\3D Sludge Storage Tank.dwg ISO-1 8/3/2018 2:28 PM HCM 21.0s (LMS Tech)

This page intentionally left blank

3.5.6 Solids Handling

WAS and scum collected from the secondary clarifier scum pumping station are temporarily stored in the Aerated Sludge Storage Basin (ASSB), which is shown in **Figure 3-16** and **Figure 3-17**. WAS and scum are discharged into the center well (Cell #1) for thickening. **Figure 3-16** shows a diagram with the flow path through the ASSB. Following settling and several loadings into the center well, the sludge overflows the edge of the center well into cell #2. The sludge is then pumped to the Solids Handling Building where the sludge is dewatered using the belt filter press, shown in **Figure 3-18**. The submersible pump inside the ASSB cannot meet the design flow and pressure requirements for the belt filter press and consequently, operators report difficulty in achieving adequate dewatering. When sites are available for land applying, the dewatered sludge is lime stabilized to produce Class B Biosolids, and stored in the biosolids bay prior to land application. The biosolids bay is shown in **Figure 3-19**. When not land applying, the dewatered sludge is not lime stabilized, but is stored in the biosolids bay before landfilling.

Figure 3-17
Aerated Sludge Storage Basin

Figure 3-18
Dewatering Belt Press

Filtrate from the belt filter press is collected and temporarily stored in the ASSB Cell #3 before being returned to the headworks facility.

Figure 3-19
Biosolids Bay

Figure 3-20
Equalization Pond

3.5.7 Flow Equalization

During high flow events, it is possible to convey treated effluent or sludge from the aerated sludge storage basin to the equalization pond. The equalization pond is lined with asphalt and has a 2.4-million-gallon storage capacity. A photo of the equalization pond is shown in **Figure 3-20**. During the summer of 2018, a new splitter box will be installed upstream of the aeration basins with an overflow to divert excessive influent flow to the equalization pond. Once the construction is complete, treated effluent and sludge will no longer be sent to the equalization basin.

Section 4

Section 4

Regulatory Requirements

This section summarizes the current and future regulatory requirements for the City of Sandy's wastewater treatment plant and collection system. Included are the following elements:

- Review of current NPDES Permit
- Permit Compliance Evaluation and Findings
- Future Estimated Discharges
- EPA Reliability Evaluation
- Review of Pre-Treatment Regulation
- Collection System Regulations
- Biosolids Management Regulations

4.1 Regulatory Requirements – Sandy Wastewater Treatment Plant

This section of the Wastewater System Facilities Plan includes a discussion of the City's NPDES Permit for the Sandy WWTP, Pre-treatment Regulations, Collection System Regulations, Biosolids Management, and future regulations that could impact WWTP operations.

4.1.1 Sandy WWTP Current NPDES Permit

The Oregon DEQ has delegated authority from the EPA to enforce the federal Clean Water Act (CWA) to regulate the discharge of treated effluent from wastewater treatment plants through the National Pollutant Discharge Elimination System (NPDES) program. Oregon NPDES Permit requirements are included in OAR Chapter 340, Division 45 (OAR 340-45), whose purpose is to "prescribe limitations on discharge of wastes and the requirements and procedures for obtaining NPDES and WPCF permits from the Department of Environmental Quality." NPDES Permit limits must comply with Oregon water quality standards and biosolids management regulations included in OAR Chapter 340, Division 41 (OAR 340-041) and OAR Chapter 340, Division 50 (OAR 340-050), respectively.

City of Sandy NPDES Permit #102492 was renewed January 23, 2010, allowing the discharge of treated effluent to Tickle Creek during the Winter NPDES Permit Season from November 1st to April 30th, and to Iseli Nursery for recycled water irrigation during the Summer NPDES Permit Season from May 1st to October 31st. A copy of the City's NPDES Permit is included in **Appendix A**. The NPDES Permit expired on November 30, 2013. However, the City has submitted a renewal application with a renewal timeframe that is currently unknown.

4.1.2 NPDES Outfall 001 - Tickle Creek Winter Season Discharge

Table 4-1 is a summary of waste discharge limitations for the Sandy WWTP Outfall 001 to Tickle Creek as contained in Schedule A of the City's NPDES Permit.

Table 4-1
Outfall 001 NPDES Waste Discharge Limits[a]

	Monthly Average Concentration (mg/L)	Weekly Average Concentration (mg/L)	Daily Maximum Concentration (mg/L)	Monthly Average Load[b] (lb/day)	Weekly Average Load[b] (lb/day)	Daily Maximum Load[b,c] (lb)
Winter Season (November 1 through April 30)						
BOD_5	10	15	NA	125	187	250
TSS	10	15	NA	125	187	250
Ammonia	3.7	NA	10.9	NA	NA	NA

Notes:
- (a) From current Sandy WWTP NPDES Permit #102492 for File Number 78615.
- (b) Mass load limits are based upon WWTP average dry weather design flow of 2.5 MGD.
- (c) The daily mass load limit is suspended on any day in which the flow to the treatment facility exceeds 2.5 MGD.

Abbreviations:
mg/L = Milligrams per liter.
lb/day = Pounds per day.

Based on Murraysmith's evaluation of monthly Discharge Monitoring Reports (DMR) for the WWTP and submitted to DEQ, there were a number of exceedances of the NPDES Permit Discharge Limits between January 2013 to December 2017, which are summarized in **Table 4-2**. In order to predict the potential for future exceedances, a population factor based on future population forecasts was applied to current BOD and TSS discharges from the WWTP. This percentage increase was then applied to develop projected flows and loads and potential future violations using the same BOD and TSS discharge concentrations. Current and future projected exceedances are summarized in **Table 4-2**.

Table 4-2
Current and Projected BOD and TSS Mass Load Discharge Violations

	Daily Maximum Load Violations	Weekly Average Load Violations	Monthly Average Load Violations
2013-2017			
BOD_5	4	25	10
TSS	8	20	9
2036-2040			
BOD_5	30	57	18
TSS	35	20	13

As shown in **Table 4-2**, the current NPDES Permit exceedances for BOD and TSS are anticipated to increase in the future as the City's population and flows increase in the planning horizon. Options to address the future exceedances could include reductions in BOD and TSS concentrations in WWTP effluent or identifying an opportunity for additional assimilative capacity by discharging to an alternate water body.

4.1.3 NPDES Outfall 002 – Iseli Nursery Summer Season Recycled Water

During the summer season (May 1st through October 31st), effluent flow from Sandy WWTP is pumped to Iseli Nursery for Class B Recycled Water storage and irrigation in accordance with Oregon Administrative Rules (OAR) 340-055. From 2013-2017, Sandy WWTP DMR data shows one week in May 2016 during which the median weekly total coliform organisms per 100 milliliters was greater than the 2.2 maximum established in Permit #102492. Therefore, the disinfection system is sized for future flows and no increase in permit exceedances at Outfall 002 is expected.

4.1.4 Out of Season Discharge to Tickle Creek

Based on the current permit, the City is only allowed to discharge to Tickle Creek from November 1st to April 30th and to Iseli Nursery from May 1st to October 31st. However, in part, because the WWTP does not have active equalization storage, out of season discharge to Tickle Creek does periodically occur. **Table 4-3** summarizes the total number of days over the past five years when water was discharged to Tickle Creek outside of the allowable Winter Season discharge and to Iseli Nursery outside of the Summer Season when recycled water irrigation capacity is available for land application.

Current efforts to utilize the existing WWTP equalization basin could reduce these out-of-season discharge occurrences. However, over the planning horizon, limitations on seasonal Tickle Creek discharge or recycled water irrigation may increase if the available equalization storage proves to be inadequate.

Table 4-3
Discharge to Outfall Outside of Appropriate Permit Season

	Effluent Discharged to Tickle Creek During Summer Permit Season (Days)	Effluent Pumped to Iseli Nursery During Winter Permit Season (Days)
2013	3	0
2014	0	49
2015	0	24
2016	6	12
2017	0	2

4.1.5 Tickle Creek NPDES Dilution Requirements Evaluation

During the allowed Winter NPDES Permit Season discharge to Tickle Creek from November 1st to April 30th, the current Permit does not allow for discharge to Tickle Creek when the available stream dilution is less than 10 based on the following equation:

$$Dilution = \frac{(Q_e + Q_s)}{Q_e}$$

Where: Q_e = WWTP Discharge Flow in MGD
Q_s = Tickle Creek Flow measured at a gauging station 1 mile upstream from Outfall 002

Table 4-4 summarizes the number of days during which the dilution value in Tickle Creek was less than 10 from 2013-2017 as well as the estimated number of days which are predicted to have dilution values less than 10 from 2036-2040 based on scaling the current flows using the estimated percent population growth.

Table 4-4
Current and Projected 10:1 Dilution Violations

	10:1 Stream Dilution Daily Violations
2013-2017	21
2036-2040	217

As shown, potential exceedances of the Tickle Creek dilution requirements will substantially increase over the planning horizon to an average of approximately 44 days per year. Therefore, improving flow equalization, storage and/or finding an alternative outfall is an important consideration in terms of long-term discharge from the Sandy WWTP.

4.1.6 Oregon Dilution Rule Compliance Evaluation

The Statewide Narrative Criteria (OAR 340-041-0007) restricts discharge to a receiving stream if the Effluent BOD concentration divided by the ratio of receiving stream flow to effluent flow is greater than one. **Table 4-5** summarizes Oregon Dilution Rule violations based on average monthly flows and BOD concentrations and by monthly maximum flows and BOD concentrations for months from 2013 to 2017 during which effluent was discharged to Outfall 001. **Table 4-5** also shows the estimated number of months in 2040 that are predicted to exceed permit limits based on scaling the current flows for 2040 based on population growth.

Table 4-5
Oregon Dilution Rule Calculations (2013-2017)

	Total Monthly Violations Based on Average Flow & BOD_5 Concentration	Total Monthly Violations Based on Maximum Flow & BOD_5 Concentration
2013-2017	0	13
2036-2040	17	24

Similar to the Tickle Creek NPDES Dilution Requirements Evaluation in the previous section, the City has documented exceedances of the Oregon Dilution Rule in the past 5 years, which are anticipated to increase as WWTP flows increase over the planning horizon through 2040. Therefore, improving flow equalization, storage and/or finding an alternative outfall is again an important consideration in terms of long-term discharge from the Sandy WWTP.

4.2 EPA Plant Reliability Criteria

The Sandy WWTP is required to meet the Reliability Class I standards, as defined in EPA's Technical Bulletin "Design Criteria for Mechanical, Electrical, and Fluid System Component Reliability," EPA 430-99-74-001. **Table 4-6** includes a summary of the reliability criteria and requirements to be considered as part of the Alternatives Evaluation and Recommended Plan. These requirements are required to be met for design flows and loads summarized in **Section 6**.

Table 4-6
EPA Class I Reliability Criteria

Treatment Unit Process	Reliability Class I Requirements	Current Deficiencies
Influent Screening	A backup bar screen designed for mechanical or manual cleaning shall be provided. Facilities with only two bar screens shall have at least one bar screen designed to permit manual cleaning.	The current configuration does have two screens, but the manual backup bar screen has too large of a clearance that allows large rocks and rags to enter the treatment system.
Pumps (Liquids, Solids & Chemical Feed)	A backup pump shall be provided for each set of pumps performing the same function. The capacity of the pumps shall be such that, with any one pump out of service, the remaining pumps will have the capacity to handle the peak flow.	Several pumps are lacking backup capacity including the internal Mixed Liquor Recycle Pumps, Process Water Pumps, Sodium Hypochlorite Feed Pump, and Belt Filter Press Feed Pump.
Secondary Clarification	The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 75% of the total design flow.	None. At the current estimated MMWWF of 2.66 MGD, the overflow rate is 871 gpd/sf which is acceptable but high

Treatment Unit Process	Reliability Class I Requirements	Current Deficiencies
Aeration Basin	A backup basin will not be required; however, at least two equal-volume basins shall be provided.	None
Aeration Blowers and/or Mechanical Aerators	There shall be a sufficient number of blowers or mechanical aerators to enable the design oxygen transfer to be maintained with the largest-capacity-unit out of service. It is permissible for the backup unit to be an uninstalled unit, provided that the installed units can be easily removed and replaced. However, at least two units shall be installed.	Current Operating Blower Capacity does not meet this requirement with one blower out of service.
Air Diffuser Systems	The air diffusion system for each aeration basin shall be designed so that the largest section of diffusers can be isolated without measurably impairing the oxygen transfer capability of the system.	Further analysis required including inspection of diffusers
Sludge Holding Tanks	Holding tanks are permissible as an alternative to component or system backup capabilities for components downstream of the tank provided the volume of the holding tank shall be based on the expected time necessary to perform maintenance and/or repair and the capacity of sludge treatment processes downstream can handle the combined flow from the storage tanks and the working sludge treatment system	Not sufficient capacity
Sludge Disposal	An alternative method of sludge disposal shall be provided for each sludge treatment unit process without installed backup.	None
Electrical Power Supply	Two separate and independent power sources, either from two separate utility substations or from a single substation and an on-site generator. The backup power supply shall be sufficient to operate all vital components during peak wastewater flow conditions, including critical lighting and ventilation.	None

4.3 Pre-Treatment Regulations

The City of Sandy does not currently have an industrial pretreatment program; however, the Sewer Use Ordinance does define Significant Industrial Users (SIUs) and includes strong prohibitions against discharging high strength industrial waste to the sewer system.

According to 40 CFR 403 (General Pretreatment Regulations for Existing and New Sources of Pollution) all “significant industrial users”, which are industrial users that discharged an average of 25,000 gpd or more to the POTW or makes up 5 percent or more of the average dry weather hydraulic or organic (BOD or TSS) capacity of the POTW treatment plant, are required to be part of the pre-treatment program.

The National Pretreatment Program is charged with controlling toxic, conventional, and non-conventional pollutants from non-domestic sources that discharge into sewer systems, as described in CWA Section 307(a). The Oregon DEQ has been given authority by the US EPA to regulate the Pretreatment Program in Oregon and is required to comply with the federal provisions of the pre-treatment program. The pre-treatment program requires all large, publicly owned treatment works (POTW) that have a designed treatment capacity of more than 5 million gallons per day (MGD) to establish local pretreatment programs. A Pretreatment Program for POTW above 5 MGD above would have to be established within 3 years after a reissuance or modification of its existing NPDES permit or within 1 year after written notification from DEQ after identification. The NPDES permit will be reissued or modified by DEQ to incorporate the approved Program as enforceable conditions of the Permit.

However, facilities such as the Sandy WWTP, with design flows less than 5 MGD are only required to develop a formal Industrial Pre-Treatment Program if the nature or volume of the industrial influent are contributing to treatment process upsets, violations of NPDES Permit Limits or other circumstances that warrant the development of a program to eliminate those occurrences per 40CFR 403.8 (a). Therefore, a pre-treatment program is not necessarily required for the City, but if the City decides to develop a program, the "significant industrial user" criteria can be used to evaluate which industrial dischargers should be included.

4.4 Sanitary Sewer Collection System Regulatory Requirements

There are several statewide regulatory requirements for sanitary sewer collection systems that develop minimum standards for the design capacity and design standards. The following sections describe the standards that will be used to evaluate the existing system and develop recommendations for future collection system expansions.

4.4.1 Oregon Statutes, Regulations and Permits

4.4.1.1 Oregon Administrative Rule, Division 340

Sanitary Sewer Overflows (SSOs) are prohibited based on *Oregon Administrative Rules Chapter 340-Division 041 (OAR 340-041-0009)*. However, DEQ may withhold enforcement action for those SSOs that occur from storm events larger than the winter one-in-five-year, 24-hour duration storm or the summer one-in-ten-year, 24-hour duration storm. These storm events are used in the planning and analysis of the City's sewer collection system and in the determination of the peak capacity of the City's WWTP.

4.4.1.2 *Oregon Administrative Rule, Division 660*

Oregon requires its cities and counties to adopt public facility plans for any urban growth boundary (UGB) areas with a population greater than 2,500. A public facility plan (PFP) helps assure that development within the UGB is guided and supported by the types and levels of urban facilities and services appropriate for the needs and requirements of the areas to be served, and that those facilities and services are provided in a timely, orderly and efficient arrangement, as required by Goal 11 and its implementing administrative rule at Oregon Administrative Rule (OAR) 660-011. This document has been developed in conformance with this rule and will act as a supporting document for the City's Comprehensive Plan.

4.4.1.3 Oregon Revised Statute, Division 224

This statute governs the City's wastewater system management. The operational aspects of the system are defined herein, including the authority of the City to charge for provision or service and obtain debt obligations for construction of sewer systems.

4.4.1.4 *Oregon Revised Statute, Division 223*

This statute allows the City to recover the costs of a new development's share of the system capacity by collecting system development charges (SDCs). Under this statute, new development must pay a proportional share of expenses to meet the increased demands that they place on the system. SDC fees can be imposed to offset the expense of any system accommodations made necessary by the new development.

4.5 Biosolids Management

Biosolids are the solids derived from primary, secondary, or advanced treatment of domestic wastewater which have been treated to significantly reduce pathogens and reduce volatile solids to the extent that they do not attract vectors. This term refers to domestic wastewater treatment facility solids that have undergone adequate treatment to permit their land application. In Oregon, the term "biosolids" has the same meaning as the term "sludge" in state statute and the term "sewage sludge" found elsewhere in state administrative rules as well as the code of federal regulations.

Most wastewater treatment plants in Oregon beneficially use their biosolids through agricultural land application on pasture, hay, wheat, and a variety of other crops. A small but increasing number of communities further treat their biosolids such as through composting or high-temperature lime stabilization so that the end product can be sold or given away to the public.

4.5.1 Biosolids Regulations

The DEQ implements regulatory oversight of biosolids beneficial use practices (e.g. land application) in Oregon. Although DEQ does not have formal delegation authority to implement the federal biosolids regulations, the EPA supports DEQ's regulatory oversight by providing funds, technical assistance and occasional compliance assistance to DEQ. Furthermore, the EPA does not currently conduct permitting activities for the beneficial use of biosolids in Oregon. This includes all beneficial use activities such as land application, composting, lime stabilization and air drying. The EPA maintains sole authority for biosolids management activities involving municipal sewage sludge incineration.

The DEQ implements their regulatory authority in accordance with OAR 340-050 (Land Application of Domestic Wastewater Treatment Facility Biosolids, Biosolids Derived Products, And Domestic Septage) which references and is consistent with EPA's biosolids regulations Title 40 CFR Part 503 (Standards for the Use and Disposal of sewage Sludge). DEQ implements regulatory requirements through a wastewater facilities' NPDES or WPCF permit depending on whether the facility has a surface water discharge. A Biosolids Management Plan is a component of the permit and contains a complete description of a facilities biosolids beneficial use process including: flows, treatment processes, quantity and quality, hauling procedures, spill response plans, land application site information, and site authorizations.

The state biosolids regulations define three measures for biosolids quality:

- Pathogen Reduction
- Vector Attraction Reduction
- Pollutants

4.5.2 Pathogen Reduction Requirements

Pathogens are disease causing organisms such as viruses, parasites and certain types of bacteria. These organisms are significantly reduced during the biosolids treatment process so that they can be beneficially used. Pathogen reduction requirements define two classifications of biosolids – Class A and Class B. These classifications indicate the density (number per unit mass) of pathogens in biosolids. Class A requirements necessitate almost the complete destruction of pathogens. Class B requirements call for significantly reducing the density of pathogens and land applying biosolids by implementing specific site management practices such as buffers from rivers and streams. A third classification of biosolids is Class A EQ (Exceptional Quality). This refers to biosolids that have met the Class A pathogen reduction requirements and have met the lower concentrations standards for pollutants or "metals".

To be classified as Class A, biosolids must be treated using one of EPA's six pathogen reduction alternatives which include several treatment methods known as Processes to Further Reduce Pathogens (PFRP), or an equivalent process. These processes include composting, heat drying, heat treatment, thermophilic aerobic digestion, beta ray irradiation, gamma ray irradiation and pasteurization. In addition to using one of the prescribed pathogen reduction alternatives, Class A biosolids must not exceed maximum allowable fecal coliform density or salmonella bacteria density.

Class B biosolids must be treated using one of EPA's three pathogen reduction alternatives which include several treatment methods known as Processes to Further Significantly Reduce Pathogens (PSRP), or an equivalent process. These processes include aerobic digestion, air drying, anaerobic digestion, and lime stabilization.

4.5.2.1 Vector Attraction Requirements

Vector attraction refers to the tendency of biosolids to attract rodents, insects and other organisms that can spread disease. Biosolids must meet one of the following requirements for reducing vector attraction if they are to be applied to land without restrictions:

- Volatile solids in the biosolids must be reduced by a minimum of 38 percent.
- The specific oxygen uptake rate for biosolids treated by aerobic digestion must be less than or equal to 1.5 mg oxygen per hour per gram of total solids at a temperature of 20° C.
- Aerobic processes shall treat the biosolids for a minimum of 14 days with an average temperature of at least 45° C and a minimum temperature of 40° C.
- Lime or other alkali addition must raise the pH of the biosolids to a minimum of 12 for two hours and maintain the pH at a minimum of 11.5 for an additional 22 hours without additional lime.

4.5.2.2 Site Management Practices

In addition to meeting pathogen reduction and vector attraction reduction requirements, Class B biosolids land application activities must implement certain site management practices. These practices include maintaining setback distances to drinking water wells and streams, controlling public access to the land application site, grazing or harvest restrictions based on the type of crop and biosolids application method, agronomic application rate calculations, and providing for public notification of the land application activity. There are also additional regulatory considerations that DEQ employs for what are called "Certain Lands". These considerations apply to land under the federal Conservation Reserve Program, land in proximity to airports, and land with easements. Specific information on these "Certain Lands" as well as detailed explanation of DEQ's biosolids regulations can be found in their guidance document titled, "Implementing Oregon's Biosolids Program -- Internal Management Directive, December 2005".

The use of Class A EQ biosolids do not have any of the site management practices and are essentially free of regulatory restrictions once the pathogen reduction and vector attraction reduction standards have been met at the wastewater treatment plant.

4.5.2.3 Pollutants

Wastewater facilities that generate and beneficially use (e.g. agricultural land application) biosolids must monitor for and meet concentration limits for nine pollutants. These pollutants commonly referred to as "metals" include: Arsenic, Cadmium, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, and Zinc. In addition to the nine pollutants, several other parameters must be monitored. The parameters include nitrogen, phosphorus, potassium, pH, total solids and volatile solids.

Four limits have been set for the nine pollutants, as follows:

1. Ceiling Concentrations – All biosolids applied to the land must meet the ceiling concentrations for pollutants listed in 40 CFR §503.13, Table 1. The ceiling concentrations are the maximum concentration limits for the nine regulated pollutants in biosolids. If a limit for any one of the pollutants is exceeded, the biosolids cannot be applied to the land until such time that the ceiling concentration limits are no longer exceeded.

2. Pollutant Concentrations – Biosolids that are to be sold or given away; or applied to the land and not be required to calculate cumulative pollutant loading (see below) must meet the concentrations listed in 40 CFR §503.13, Table 3. If the pollutant concentrations for the eight regulated metals in biosolids are exceeded, then the facility must track the cumulative loading of the metals until such time that the pollutant concentration limits fall below Table 3 levels.

3. Cumulative Pollutant Loading Rates – Biosolids that exceed the pollutant concentrations listed in 40 CFR §503.13, Table 3 but are below 40 CFR §503.13, Table 1, must be tracked and not exceed the cumulative pollutant loading rates per hectare in accordance with 40 CFR §503.13, Table 2.

4. Annual Pollutant Loading Rates – Biosolids that meet Class A requirements with respect to pathogen and vector attraction reduction requirements, are bagged, but do not meet the pollutant concentrations in Table 3 must not exceed the annual pollutant loading rates prescribed in 40 CFR §503.13, Table 4.

4.5.2.4 Biosolids Management Plan

Biosolids Management Plans serve as the planning and operation tool for the production, storage, transportation, and land application of biosolids for beneficial use in Oregon. All wastewater treatment facilities that apply biosolids to the land must have a Biosolids Management Plan approved by DEQ. Once approved by DEQ, the management plan becomes part of a facilities NPDES permit.

The City has a Biosolids Management Plan that was revised in March 2018. The plan currently includes Class B pathogen reduction and vector attraction reduction via lime stabilization. During 2017, Pathogen reduction requirements are met by increasing the pH with lime addition to the biosolids to achieve 12 SU for 2 hours. Vector attraction reduction is performed also by lime addition to maintain at pH of 12 SU for at least 24 hours.

In 2017, the City land applied 91 dry tons of Class B biosolids to approximately 56 acres across six sites. **Table 4-7** summarizes the biosolids application rate and amount of nitrogen applied.

Table 4-7
2017 Biosolids Land Application Summary

Owner	Site I.D.	Total Dry Tons Applied	Dry Tons/Acre	Lbs of Nitrogen/acre
Randy Carmony	CCR #1	7.25	0.78	17
Randy Carmony	CCR #2	48.9	3.44	75
Chuck Bobnick	Bobnick	1.5	0.53	12
Charles Brunn	Brunn	13.6	3.96	87
David Jackson	Jackson/D	5.7	0.48	10
Bob Bunnell Cousins	Bunnell/Cousins	14.8	1.02	22

The data for the soil nitrogen content at each land application site was not provided, so an evaluation of the applicate rate with respect for agronomic nitrogen loading could not be determined.

The City is required to monitor the nine regulated pollutants (Arsenic, Cadmium, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, and Zinc) and several other parameters (nitrogen, phosphorus, potassium, pH, total solids and volatile solids) based on the mass of biosolids applied to the land per year as prescribed in Table 1 of 40 CFR §503.16. The City land applied 83 dry metric tons in 2017 and thus was required to monitor for these pollutants once per year. The pollutant concentrations were below the limits found 40 CFR §503.13, Table 3 and are considered “high quality” with respect to pollutant concentrations. For example, assuming the City was to continue to land apply at the current application rate and biosolids quality it would take over a hundred years across the same acreage applied in 2017 to meet the cumulative pollutant loading rates for all pollutants.

Based on the pollutant loading concentrations and quality data of the other biosolids parameters the City should have ample capacity at their existing land application sites over the next planning horizon. However, as the formerly rural areas surrounding Sandy urbanize the City finds it challenging to retain approved application sites and find suitable new sites.

The City has had some issues with biosolids quality in the recent past that have led to challenges with certain land application customers. In recent months, in fact, the City has been landfilling biosolids without adding lime. If long-term landfilling of biosolids is a potential outcome, the City’s Biosolids Management Plan should be updated to be reflective of this ongoing practice that is discouraged by DEQ. As part of the alternatives evaluations, improvements in biosolids stabilization and quality should be investigated to ascertain the requirements associated with long-term biosolids land application and if continuation of the City’s Class B program is viable.

4.5.3 Other and Future Water Quality Standards and Regulations

Potential future regulatory issues and requirements that may impact the Sandy WWTP discharge to Tickle Creek in the future include:

- Toxic Substances Criteria, OAR 340-041-0033
- Clean Water Act Section 303(d) List
- Three Basin Rule, OAR 340-041-0350

4.5.3.1 Toxics Substances Criteria (OAR 340-041-0033)

Oregon DEQ has established allowable acute and chronic concentrations of Toxic Substances in fresh and marine waters for protection of aquatic life and human health which are summarized in Table 30 in OAR-340-041-8033. The criteria can be used to establish discharge limits for toxic substances based on both effluent and stream concentrations, but the criteria are mostly driven during low flow conditions during the summer months. Since the City of Sandy WWTP does not actively discharge to Tickle Creek during the summer, these criteria should not apply. However, if the discharge period should change, an analysis of the reasonable potential for of exceeding the acute or chronic concentrations would be required.

4.5.3.2 Clean Water Act Section 303(d) List

In 2014, Oregon DEQ submitted Oregon's 2012 Integrated Report and 303(d) list to the EPA. In December 2016, the EPA approved most of the submitted 303(d) list, but had a few required modifications. Based on the approved 303(d) list for Tickle Creek, ammonia, dissolved oxygen, E. Coli, chlorpyrifos, malathion, and parathion were listed but were not categorized as a Category 5 pollutant, which means that TMDL is not needed in the creek.

4.5.3.3 Three Basin Rule (OAR 340-041-003)

In 1996, Oregon DEQ established the Three Basin Rule which states that existing facilities with NPDES permits for discharge into the Clackamas River Subbasin may not be granted increases in their permitted mass load limitations. Under the assumption that the Sandy WWTP will receive increased flows with a forecasted increase in population, the Sandy WWTP will require greater treatment efficiency to maintain established mass load limitations.

The potential issue or concern for the City and WWTP associated with the Three Basin Rule is that a year-round discharge to the Clackamas River or tributary stream (e.g. Tickle Creek) may not be available to the City of Sandy if the current seasonal discharge approach is determined to be unsustainable over the planning horizon through 2040.

4.6 References

City of Sandy. 2018. Biosolids Management Plan.

murraysmith

Section **5**

Section 5

Basis of Planning

5.1 Alternative Development Methodology

This section summarizes the methodology for developing, evaluating, and selecting alternatives for both the collection system and the treatment plant to be included in the Recommended Plan. The alternatives and costs will be based on the existing and future flow projections. For the collection system, the costs for rainfall derived infiltration and inflow (RDII) reduction alternatives along with conveyance deficiency upgrades will be evaluated.

For the treatment plant, alternatives will be developed for each unit process based on the range of flows that will be present with each RDII reduction alternative. The integrated alternatives will combine the costs and other criteria for each RDII reduction alternative and associated wastewater treatment modifications to determine the recommended alternative. For planning purposes, the typical RDII reductions evaluated are as follows:

1. 0 percent - represents no collection system RDII improvements
2. 20 percent - targets primarily sewer trunklines
3. 30 percent - targets sewer trunklines and some service laterals
4. 65 percent - targets sewer trunklines and most service laterals

5.2 Alternative Evaluation Methodology

The recommended approach to alternatives evaluation uses cost effectiveness and non-economic factors including those factors which the City considers most important (e.g. public impacts or regulatory risk).

5.2.1 Scoring Procedure

Alternatives are evaluated using a matrix-based approach incorporating cost and non-cost evaluation criteria. Scores to select the preferred alternative for the City are calculated by scoring each alternative relative to others and assigning a relative importance, or weighting, to each criterion. The alternative with the highest score represents the preferred alternative for the City. The scoring equation is as follows:

$$Total = \sum_{Criteria}(Score * Weighting)$$

5.2.1.1 Score

Alternatives are scored from best to worst based on the number of alternatives being evaluated. Scores for each criterion from range from 4 (best) to 1 (worst). Comparable alternatives may receive the same score.

5.2.1.2 Weighting

The weighting factor is a percentage-based multiplier allowing the City to place greater emphasis on specific criterion of greater importance for the City. For example, life cycle and capital costs are important to the City and are given a higher weighting in the overall evaluation. All Evaluation Criteria and Weightings are developed with input from City staff and total to 100 percent.

5.3 Evaluation Criteria

Evaluation criteria used in the alternatives evaluation will include both cost and non-cost factors. Factors will include:

- Capital Cost;
- 20-year Life Cycle Cost;
- Regulatory Compliance;
- Environmental and Permitting,
- Constructability;
- Reliability/Resiliency; and
- Phasing.

Following is an introductory description of each criterion in the alternative's evaluation along with the weighting factor in parentheses.

5.3.1 Capital Cost (30%)

Capital costs are those costs associated with constructing facilities and appurtenances required for each alternative. Capital improvements may include treatment plant upgrades, pumping facilities, pipelines, and discharge or holding facilities. Recommended facilities are sized for projected 2040 flow and load projections.

Cost estimates are prepared to American Association of Cost Engineers (AACE) Class 5 estimate standards for planning-level evaluations with a range of accuracy of -30 percent to +45 percent.

5.3.2 Life Cycle Cost (20%)

Life cycle cost includes initial capital costs as well as annual O&M costs for required facilities. Annual O&M costs include WWTP personnel, energy (electricity and natural gas), chemicals, groundwater monitoring, maintenance, and other miscellaneous costs. The Net Present Value of annual O&M costs for determining the Life Cycle Cost will be calculated based on the following criteria:

- Labor Rate: $50/hour
- Energy Rate: $0.06/kilowatt-hour (kWh)
- Interest Rate: 3.5 percent
- Discount Rate: 3.0 percent
- Evaluation Period: 20 years
- Residual Value: $0

5.3.3 Regulatory Compliance (20%)

Regulatory compliance is based on the reliability of each alternative for meeting effluent discharge limits included in the NPDES Permit for the Sandy WWTP. Each selected design must reliably meet all NPDES requirements, but certain alternatives may have more variability or higher risk relative to long term compliance.

5.3.4 Environmental and Permitting Requirements (10%)

The environmental and permitting criterion is based on environmental permitting requirements, ability to meet current NPDES Permit requirements, and potential considerations related to future permitting requirements. This criterion also considers the ability to continue to meet environmental and permitting requirements while accommodating anticipated community growth projections.

5.3.5 Constructability (10%)

Constructability relates to the construction complexity and potential issues associated with constructing the proposed alternative and meeting critical deadlines. For example, construction of a new effluent storage lagoon at Iseli Nursery could impact their operations or require close coordination with a private property owner that could be more difficult to construct for various reasons.

5.3.6 Phasing (5%)

The proposed alternatives will be evaluated based on their potential to be implemented in phases that continually meet the conveyance and treatment needs of the City and whether the various pieces of the alternative can be timed with each other.

5.3.7 Reliability/Resiliency (5%)

Any option needs to consider the reliability/resiliency to meet performance criteria under a potential seismic event such as the Cascadia Subduction Zone or other event, or other unusual conditions that could impact overall system operation or functionality.

5.4 Basis of Cost Estimating

Construction costs for each alternative will be estimated based on recent construction costs for similar facilities, published standard construction cost data, and the Engineer's experience on similar projects. Standard mark-ups applied to conceptual construction cost estimates are summarized in **Table 5-1.**

Table 5-1
Applied Mark-ups for Conceptual Cost Estimates

Item	Mark-up as Percent of Construction Cost
Escalation per Year to Midpoint of Construction	3%
General Conditions (incl. Mobilization)	9%
Construction Contingency	30%
Engineering/Surveying/Legal/Administrative	25%

murraysmith

Section **6**

Section 6

Flow and Load Projections

6.1 Introduction

This section of the Wastewater System Facilities Plan (WSFP) documents the existing and projected flows in the wastewater collection system and wastewater characterization for the Sandy Wastewater Treatment Plant (WWTP). The flow projections consider existing and future customers within the project study area and highlight potential growth within the Urban Growth Boundary (UGB) for the time period ending at the year 2040. With these projections, the plan will estimate 20-year capital projects for improving and expanding the City's wastewater collection and treatment facilities.

The summary of flow projections in this section focuses on the flow characterization, per capita wastewater usage, unit flow factor development, and flow projections. The flow projections, together with the hydraulic analysis of the collection system are used to identify opportunities to reduce rainfall-derived infiltration and inflow (RDII), size capacity improvements in the collection system, and estimate influent volumes at the WWTP.

In this section, the current flow characteristics and future flow projections were developed using two separate methods. The first was through analysis and modeling of the existing collection system (Collection System Method) which allows for a more robust flow projections since it considers population forecasts and designated land use as well as collection system characteristics including pipe degradation. The results from this method will be compared against the Guidelines from the Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon [DEQ Guidelines] (Oregon Department of Environmental Quality 1996) to confirm the validity of the collection system modeling estimation.

The summary of loads in this section focuses on the mass load of biochemical oxygen demand (BOD) and total suspended solids (TSS) into the WWTP. Current mass loads will be calculated using recent historical influent data for TSS and BOD. The 2040 load projections will be scaled from the current loads using a per capita basis analysis.

6.2 Definitions

Evaluation Period: The updated flow projections for the WWTP are based on WWTP Discharge Monitoring Reports (DMRs) from January 2013 through December 2017.

Wet Weather Season: For the purpose of the flows and load characteristics, the wet weather season is from November to April the following year based on the dates established in the City of Sandy's WWTP NPDES permit.

Dry Weather Season: For the purpose of the flows and load characteristics, the dry weather season is from May to October based on the dates established in the City of Sandy's WWTP NPDES permit.

Average Annual Flow (AAF): The average daily WWTP flow for the calendar year, including the wet and dry seasons.

Average Dry Weather Flow (ADWF): The average daily WWTP flow from May 1 through October 31.

Average Wet Weather Flow (AWWF): The average daily WWTP flow from November 1 through April 30.

Maximum Month Dry Weather Flow (MMDWF): The WWTP flow associated with a 10-year return rainfall event during the dry weather period.

Maximum Month Wet Weather Flow (MMWWF): The WWTP flow associated with a 5-year return rainfall event for the wettest month during the wet weather season.

Peak Daily Average Flow (PDF): The WWTP flow associated with a 5-year return, 24-hour rainfall event during a period with high groundwater and saturated soils. The design annual 5-year return, 24-hour rainfall event in the City of Sandy is 3.8 inches, as published in Oregon NOAA Atlas 2 Volume 10 Precipitation Frequency Isopluvial Maps (**Appendix B**).

Peak Week Flow (PWF): The peak flow that occurs 1/52 of the time or 1.9 percent probability.

Peak Instantaneous Flow (PIF): The highest peak WWTP flow attained during a 5-year peak day flow event.

6.3 Collection System Method

For the Collection System Method, flow rates were developed and spatially distributed using population, land use and water use information. A computer model was developed to generate existing and future flows and evaluate system capacity. Specific discussion of model development, calibration based on flow monitoring data, and application of the flow methodology to evaluate the capacity of the collection system are provided in **Section 7, "Sanitary Sewer Collection System Evaluation"**.

The following information was used to develop dry and wet-weather flows:

- Population projections provided by the City
- Water use data by customer class

- *Urban Growth Boundary Expansion Analysis Final Report* and other planning documents
- Taxlot data including land and building values
- Traffic Analysis Zone (TAZ) data from Metro which is a Portland Regional Government Entity
- City and County land use and development data
- Sewer flow monitoring data at multiple locations in the system
- Historic WWTP influent flow records

Future flow projections are based on population forecasts and designated land use. Currently unsewered parcels were assumed to be sewered by 2040, except in the area along Bluff Road. For the purposes of future flow estimation, customers added by the year 2040 are distributed evenly across the vacant and partially developed lands.

6.3.1 Wastewater Flow Description

6.3.1.1 Flow Component Definitions

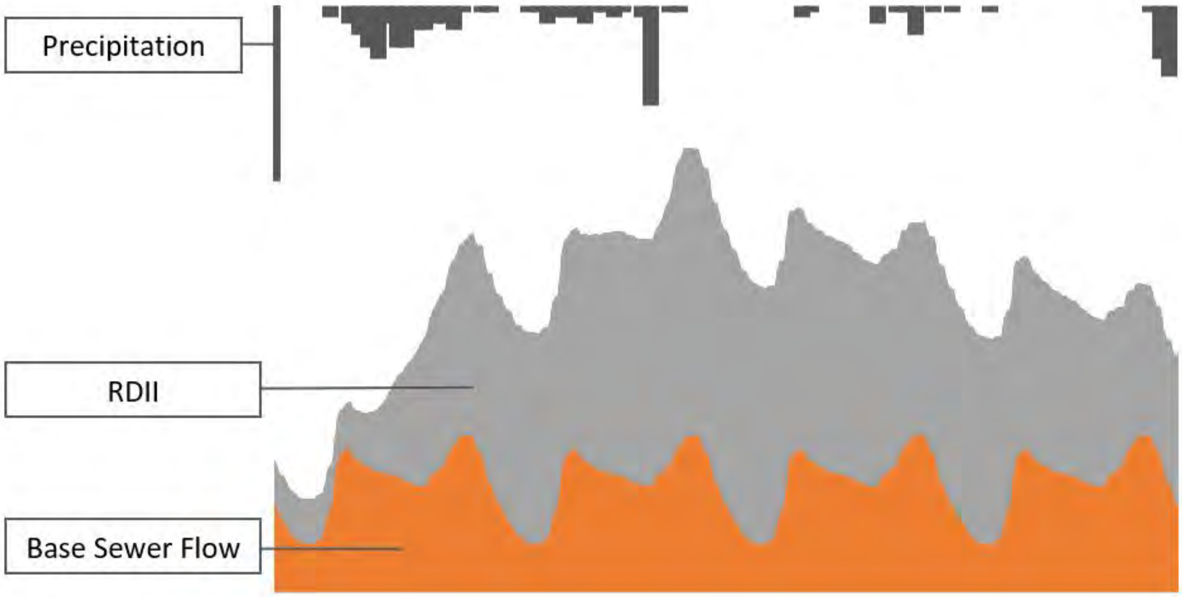
As part of the Collection System Method, the major components of the wastewater flow are defined below. **Figure 6-1** shows a generic schematic of the wastewater flow components.

1. ***Base sewer flow*** is wastewater from residential, commercial, institutional (e.g., schools, churches, hospitals) and industrial sources. The base sewer flow is a function of the population and land use and varies throughout the day in response to personal routines and business operations.

2. ***Groundwater Infiltration (GWI)*** is defined as groundwater entering the collection system unrelated to a specific rain event. GWI occurs when groundwater is at or above the sewer pipe invert, and infiltrates through defective pipes, pipe joints, and manhole walls. This component of the dry weather flow is typically seasonal.

3. ***Rainfall-Derived Infiltration and Inflow (RDII)*** is stormwater that enters the collection system during or immediately following a rain event. Stormwater inflow reaches the collection system by direct connections such as roof downspouts connected to sanitary sewers, yard and area drains, holes in manhole covers, or cross-connections with storm drains or catch basins. Rainfall derived infiltration includes flow that enters defective pipes, pipe joints, and manhole walls after percolating through the soil.

Figure 6-1
Example Schematic of Wastewater Flow Components



6.3.2 Flow Methodology

Existing system flows were developed from flow monitoring data. Future flow projections were based on unit flow factors derived from metered data and land use data. A general discussion of the flow methodology is provided below.

1. *Existing Base sewer flow* – The existing average base sewer flow, often referred to as dry weather loading, was generated from localized flow monitoring data and distributed to the collection system at the parcel level based on land use. The flow monitoring data was also used to develop a "diurnal pattern" to describe flow variability throughout the day at hourly increments for each flow meter basin. The base sewer flow was generated by multiplying the diurnal pattern by the average base sewer flow.

2. *Existing RDII* – The existing peak RDII relied on localized flow monitoring data to extract peak RDII rates and unit hydrograph parameters during an actual storm event. These parameters were extrapolated to a 5 to 7-year design storm event and applied to existing sewersheds (wet weather areas of impact represented by placing buffer areas around all existing pipelines).

3. ***Groundwater Infiltration (GWI) –*** GWI was calculated as an additional component to the existing base sewer flow and RDII based on flow monitoring data. This parameter represents the amount of groundwater entering the sewer based on elevated groundwater levels and not from rainfall events. It is assumed that GWI does not change throughout the planning period.

4. *Future Base sewer flow* – The future base sewer flows are projected by applying per capita (residential) and per acre (non-residential) unit flow factors by County land classification (zoning). The unit flow factors are based on the existing base sewer flows calibrated to monitored flows. The future forecasted base sewer flow is calculated by applying the unit flow factors to net developable acres of vacant parcels at a rate to accommodate the forecasted population. The diurnal peak future base sewer flow was generated by multiplying the representative existing diurnal pattern by the average future base sewer flow.

5. *Future RDII* – The future RDII projections are comprised of two components; RDII associated with pipes newly constructed to accommodate future development and increases in RDII resulting from pipes degrading over time. RDII for new pipes is assumed to start at a minimal value (1,500 gallons per acre per day, gpad). Projections of initial RDII for the new pipes utilized representative unit hydrograph parameters that resulted in the assumed initial RDII rate. The unit hydrograph parameters were extrapolated to a 5 to 7-year design storm event and applied to the future sewersheds (wet weather areas of impact represented by percentage of net acreage). RDII resulting from pipe degradation were based on curves developed with existing pipe age, material and RDII rates. The curves are used to project future increases in RDII given an existing rate and duration of aging (20 years). Existing unit hydrograph parameters are then applied to increases in sewershed area.

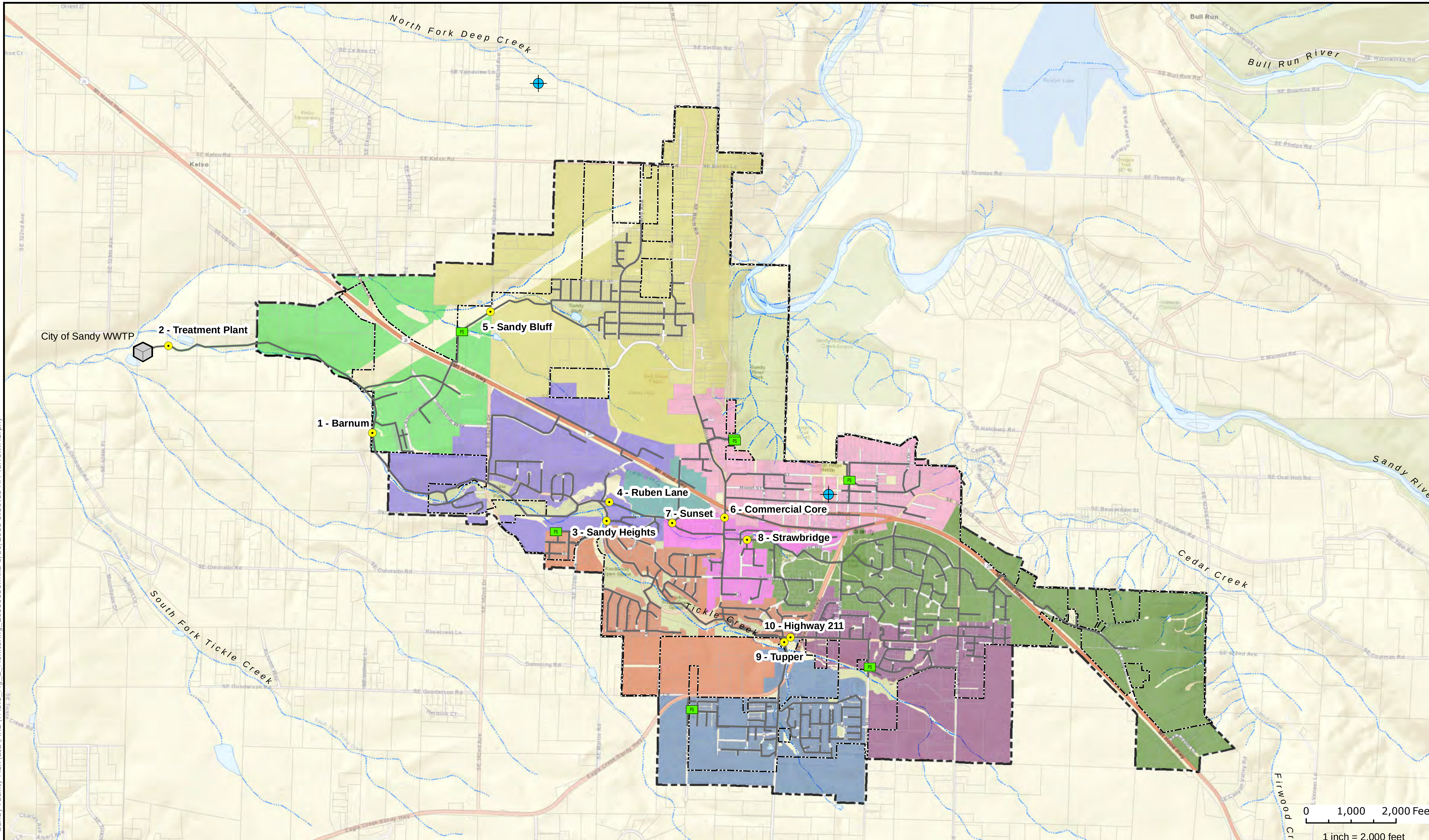
6.3.3 Existing Dry Weather Flow Characterization

The City's collection system primarily conveys the wastewater flows of domestic and commercial dischargers. Customers include residences, retail, commercial enterprises, and institutional facilities (e.g., schools). The City also serves a limited amount of light industrial customers which include non-retail commercial facilities or warehouses.

6.3.3.1 Historic Flow Trends

The City, in conjunction with SFE Global, performed temporary gravity flow monitoring at ten locations throughout the collection system. Each location, as shown in **Figure 6-2**, was equipped with an ISCO 2150 flow meter (pressure transducer probe and doppler area velocity sensor) from December 20, 2017 to February 28, 2018. Time series and flow versus depth plots were reviewed for each monitoring location to identify time periods of reasonable data quality as documented in the SFE Global site and data reports presented in **Appendix C**. Flows measured at site 1 (Barnum) were unreasonably high compared to the other sites including historic data at the WWTF, and therefore was not used. Data from the other nine metered sites, in conjunction with daily flow records from the WWTP discharge monitoring reports (DMR), chart records from the influent Parshall flume, and 15-minute influent flow data collected between December 12, 2017 and April 2, 2018 were used to develop system flow rates during dry and wet weather conditions. Rainfall during the monitoring period was typical of a one-year or less storm frequency.

This page Intentionally left blank



murraysmith

CITY OF SANDY OREGON 1911

City of Sandy, Oregon
Wastewater System Facility Plan

Figure 6-2
Metering Locations and Basin Boundaries

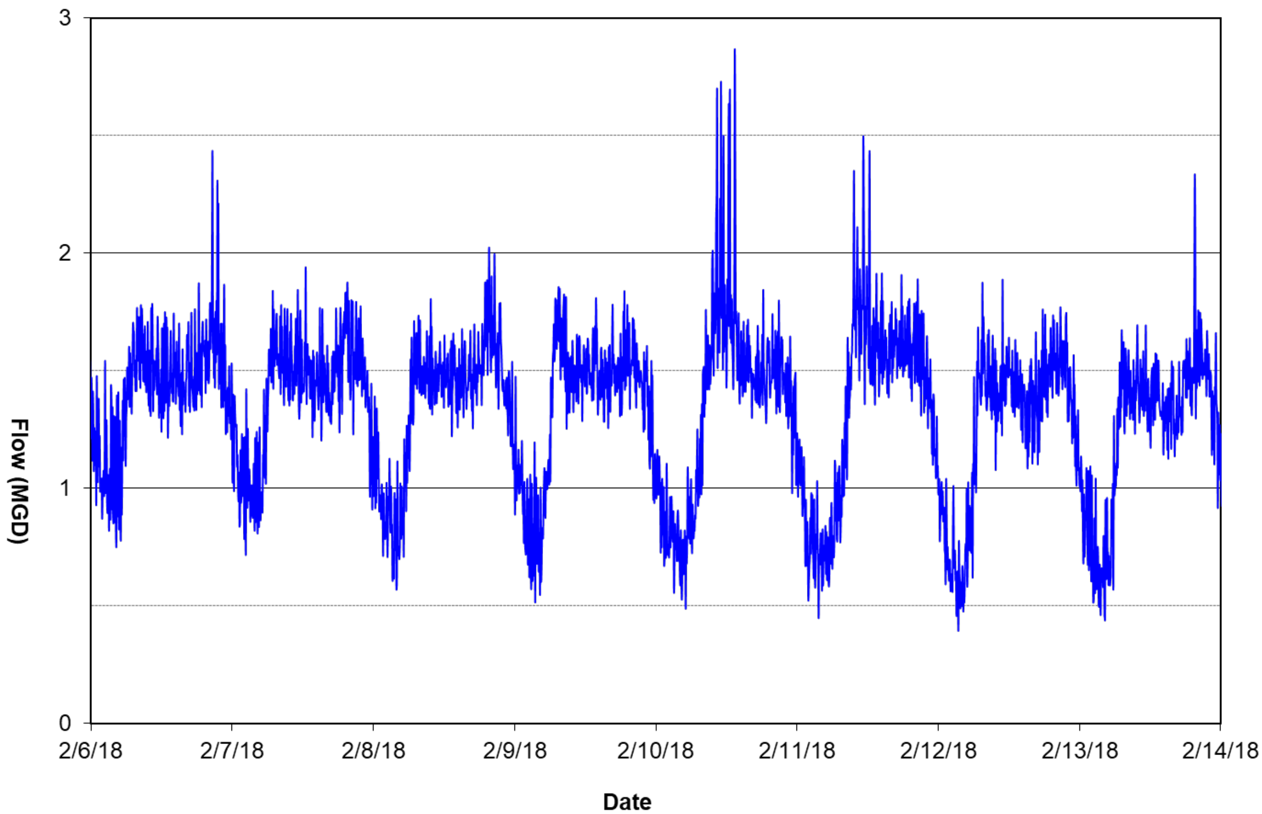
G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM5.1_Fig_2_Monitoring_20180830.mxd 8/30/2018 8:50:15 AM Yarrow.Murphy

January 2019 17-213

This page intentionally left blank

Historical base sewer flow information, recorded at site 2, near the Sandy WWTP, is provided in **Figure 6-3** and is representative of the overall system response during base sewer flow for the observed time frame. This data reflects flow measurements near the wastewater treatment plant during a period of no precipitation from February 6 - 14, 2018, and thus illustrates flows without rainfall influence.

Figure 6-3
Example Base Sewer Flow at Sandy WWTP from February 2018



6.3.3.2 Per Capita Wastewater Usage

Based on the winter-time water consumption data, the total average day water demands were calculated at 1.0 million-gallons-per-day (MGD). An average residential per capita water usage of 67 gallons-per-capita-per-day (gpcpd) was calculated from the 2016 population (11,005).

Calibrating to the measured flows in the collection system, the assumed wastewater demand was 67 gpcpd for residents, 55 gallons-per-employee-per-day (gpepd) for commercial and industrial users and 25 gallons-per-student-per-day for schools based on student population as reported by the Oregon Trails School District.

6.3.3.3 Existing Dry Weather Flow Summary

For the Collection System Method for dry weather flows, we calculated the flow characteristics based on the following methodology:

a. ***Average Dry Weather Flow (ADWF)*** is the average flow during dry weather. This does not include a GWI component.
b. ***Maximum Monthly Average Dry Weather Flow (MMDWF)*** is the average dry weather flow occurring during the month with maximum groundwater (GWI).

Within each meter basin, the daily average flows from the flow monitors were distributed to parcels based on land use type and development status. The base sewer flow and GWI values were developed for a dry weather period in February 2018. A constant GWI rate of 0.4 MGD was found within a limited area in the collection system, between the meter at Bluff Road (site 7) and the meter at Strawbridge (site 8) and the meter for the Commercial Core (site 6). The ADWF at the treatment plant, adjusted to remove GWI is 1.0 MGD, with a dry weather flow peaking factor of 1.54 and the peak dry weather flow at the treatment plant of 1.6 MGD. ADWF for the existing system are summarized in **Table 6-1** by basin.

Table 6-1
Existing Dry Weather Flow Summary by Basin

Meter ID	Basin Description	Existing ADWF (MGD)
2	Ruben Lane to the Treatment Plant	0.2
3	Highway 211 to Sandy Heights	0.1
4	Sunset Street to Ruben Lane	<0.1
5	Sandy Bluff	0.2
6	Commercial Core	0.1
7	Chalet Mobile Estates and Bluff Road	0.1
8	East end to Strawbridge	0.1
9	Cascadia Village to Tupper	0.1
10	Dubarko Drive east of Highway 211	0.1
Total		**1.0**

The MMDWF is the sum of the existing base sewer flow (1.0 mgd) and the estimated maximum GWI (0.5 mgd), or **1.5 MGD**. The maximum GWI was determined based on modeled calibration for the month of January.

6.3.4 Existing Wet Weather Flow Characterization

The wet weather wastewater flow is generated by base sewer flows and RDII and GWI where applicable. The timing and magnitude of RDII is characterized by calibrating the model to data collected with the temporary flow monitors during larger storm events. As part of the monitoring work, SFE Global installed a rain gage at Old Cedar Ridge Middle School, located at 38955 Pleasant

Street. The Old Cedar Ridge Middle School precipitation gage recorded rainfall from several storms used in calibration, including December 28th (1.0 inch 24-hour depth), January 8th – 9th (1.0 inch 24-hr depth), January 17th (1.3 inches 24-hour depth) and January 26th (0.8 inch 24-hour depth). Based on the *NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Oregon - Volume X* [NOAA, 1973], the 2-year-24-hour event for the Sandy vicinity is 3.7 inches, so the recorded 24-hour duration storm events correspond to storms with annual or sub-annual frequency. The RDII rate based on the recorded storms is extrapolated to a lower frequency, higher magnitude design storm.

To approximate the RDII generated in the collection system in response to the recorded rain events, estimates were made of the RDII components of the peak flow measured at each flow monitoring location. This was done by first estimating and subtracting out the portion of the total peak flow attributable to base sewer flow by using monitor data from the dry time periods. The RDII component was assumed to be the difference between the highest measured flow and the base sewer flow estimate at the time of the highest measured flow.

As part of the Collection System Method, we calculated the wet season flows based on the following methodology:

a. ***Maximum Monthly Wet Weather Flow (MMWWF)*** is based on the modelled flow from a 1 in 5-year frequency for January monthly rainfall depth. The MMWWF includes GWI.

b. ***Peak Daily Average Flow (PDAF)*** is the maximum average 24-hour flow having a 5-year frequency, based on the calibrated computer model results. This includes both the base sewer flow and RDII components, but not GWI.

c. ***Peak Instantaneous Flow (PIF)*** is the maximum flow for the 24-hour flow having a 5-year frequency design storm with both the base sewer flow and RDII components, excluding GWI.

d. ***Peak Weekly Average Flow (PWF)*** is the maximum average flow over a week having a 5-year frequency design storm. This includes both the base sewer flow and RDII components, but not GWI.

6.3.4.1 Rainfall Time Series

Rainfall in 5-minute intervals was recorded in support of this plan for a period of three months. Since this rainfall record is too short to identify a storm for use in design, several other sources of rainfall data from the vicinity were identified, compared and considered for use in this analysis. Rain gages at Cottrell School and Troutdale Airport both have 1-hour precipitation records starting in 1998. The United States Geological Survey has recorded precipitation depths in 15-minute intervals at Faraday Lake near Estacada starting in 2010. The daily depth at these three locations were compared to the daily and annual depths measured at the Sandy Wastewater Treatment Plant (WWTP) starting in 2010. The annual depths at the Troutdale Airport were within 3 percent of the depths recorded at the WWTP, and daily depths for larger storms correlated better than those recorded at the other two sites. Troutdale Airport data was selected as the longer-term rainfall time series used in this analysis because it was the best statistical match to the recorded depths at the WWTP and it had a 20-year period of record in 1-hour intervals.

6.3.4.2 Design Storm

All Sanitary Sewer Overflows (SSOs) are prohibited based on both the November 2010 "Internal Management Directive Sanitary Sewer Overflows" document from the Oregon Department of Environmental Quality (DEQ) and the Oregon Administrative Rules Chapter 340-Division 041 (OAR 340-041-0009). However, DEQ may withhold enforcement action for SSOs resulting from a storm larger than a winter storm that corresponds to a 1 in 5-year frequency, 24-hour duration event or a summer storm that corresponds to a 1 in 10-year frequency, 24-hour duration event.

Using the 1 in 5- to 7-year flow frequency storm for design reduces the risk of SSOs occurring due to high flows. Flow frequency is the average statistical frequency with which a given flow occurs, versus rainfall frequency, which is the frequency of a rainfall depth occurring over a given duration (such as 6- or 24-hours). Since risk of SSO is related to flow magnitude and regulatory actions are based on the probability of a given flow, the flow frequency is the basis of selecting the design storm. This plan uses the storm having peak instantaneous, 24-hour and 48-hour flows with a 1 in 5- to 7-year frequency. To identify the appropriate storm with the flows in the range of 5- to 7-year frequency, the storms with the peak 24-, 48- and 72-hour rainfall depths were identified for each year in the 20-year rainfall record. The computer model was used to simulate the flows during the storm events for each year. The resulting flows were ranked by peak instantaneous, peak 24-hour average and peak 48-hour average flows, and the flow frequencies calculated. The selected design storm occurred from January 1st to 4th, 2009 and has a maximum 24-hour rainfall depth of 5.0 inches. This rainfall depth is comparable to the 5-year, 24-hour storm depth of 4.7 inches for Sandy provided in the *NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Oregon – Volume X* [NOAA, 1973]. This storm also has a rainfall signature consistent with winter storms observed in western Oregon, with rain falling consistently and intensity building throughout the storm period. The January 2009 storm is used for the PIF, PDAF and PWF design criteria. Rainfall throughout the month of January 2009 was lower than the monthly depth with a 1 in 5-year frequency. A second storm, January 2008, was selected for determining the MMWWF which had a rainfall depth of 2.1 inches for the month. This 2008 storm has a 1 in 5-year frequency for monthly rainfall depth.

6.3.4.3 Existing Wet Weather Flow Summary

RDII can vary significantly across the system, due to factors such as sewer basin development, land use differences, soil type, and system condition (pipe and manhole). RDII were estimated for each flow monitoring location for the calibration flow and rainfall time series using the EPA software, Sanitary Sewer Overflow Analysis and Planning (SSOAP) Toolbox. The output of this analysis was a set of basin-specific unit hydrograph parameters, which were then applied to the design storm to simulate a rainfall-runoff response. Eight of the ten flow meters were used in developing existing RDII. Meters excluded from the wet weather flows analysis are described below.

- Meter 1 (Trunk line near Champion Way) – Flow measurements were higher than the magnitude of measured flows at Meter 2, located downstream. Therefore, the results do not appear accurate and are not considered. This sub-basin area is combined with meter basin 2 for development of unit hydrograph parameters and RDII rates.

- Meter 4 (Ruben Lane) – Flows at this meter during wet weather were significantly lower than those measured at site 7, located 1,500 feet upstream. Flow measurements were used to estimate base sewer flow, but not RDII. This sub-basin area is combined with meter basin 2 for development of unit hydrograph parameters and RDII rates.

The unit hydrograph parameters for each basin, developed based on the temporary monitoring period, were extrapolated to the design storm to determine the basin-specific peak flow rates summarized in **Table 6-2**. The calculated peak RDII rate is 12,000 gpad overall, which varies by basin between approximately 1,300 gpad and 19,400 gpad. For comparison, Oregon utilities typically use standard design rates for RDII in new systems in the range of 1,000 to 2,500 gpad. The rates found in the City indicate significant influence of infiltration and inflow on the existing system.

Table 6-2
Summary of Peak RDII for Meter Basins

Meter ID	Basin Description	Peak RDII for Design Storm (MGD)
2	Sunset Street to the Treatment Plant	1.2
3	Highway 211 to Sandy Heights	0.1
5	Sandy Bluff	2.1
6	Commercial Core	1.7
7	Chalet Mobile Estates and Bluff Road	0.6
8	East end to Strawbridge	1.9
9	Cascadia Village to Tupper	0.6
10	Dubarko Drive east of Highway 211	0.9
Total		**9.1**

6.3.5 Existing Wet Weather Flow Summary

Peak flow estimates for the existing system are summarized by basin and for the entire system in **Table 6-3** including base sewer flow and RDII estimates during the design storm.

Table 6-3
Dry and Wet Weather Flow Summary by Meter Basin, in MGD

Meter ID	Basin Description	Existing ADWF	Existing Base sewer flow at Peak RDII[2]	Existing Peak RDII	Existing PIF
2	Sunset Street to the Treatment Plant	0.2	0.3	1.2	1.5
3[1]	Highway 211 to Sandy Heights	0.1	0.2	0.1	0.3
5	Sandy Bluff	0.2	0.2	2.1	2.3
6[1]	Commercial Core	0.1	0.1	1.7	1.8
7	Chalet Mobile Estates and Bluff Road	0.1	0.1	0.6	0.7
8	East end to Strawbridge	0.1	0.2	1.9	2.1
9[1]	Cascadia Village to Tupper	0.1	0.1	0.6	0.7
10[1]	Dubarko Drive east of Highway 211	0.1	<0.1	0.9	0.9
Total		**1.0**	**1.2**	**9.1**	**10.3**

Notes:

1. These basins have peak flows higher than the sum of the contributing flows due to pump station operation upstream of flow monitor.
2. The observed base sewer flow during peak RDII to estimate the PIF.

Using the Collection System Method, the MMWWF, PWF and PDF into the WWTP were similarly characterized using criteria listed in Section 1.3.4. The resulting flows are **2.6 MGD**, **4.0 MGD** and **8.9 MGD** respectively.

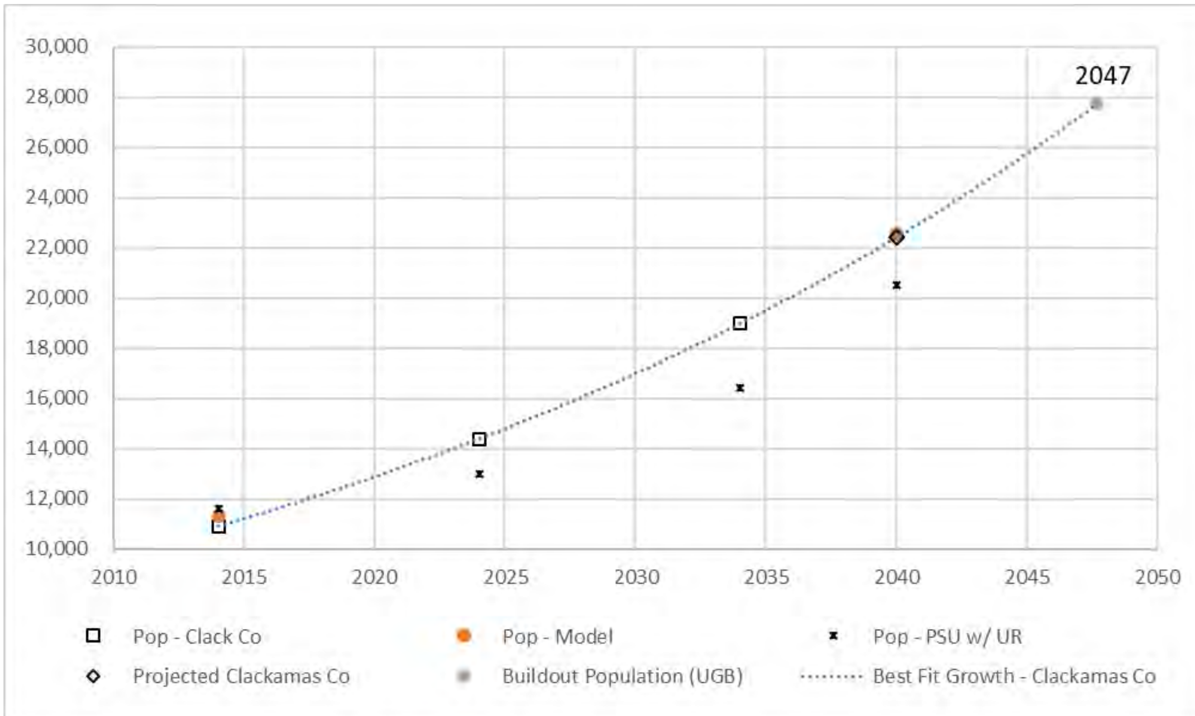
6.3.6 2040 Flow Projections

6.3.6.1 Dry Weather Flow Projections

Dry weather flow projections for the year 2040 assumed partial development with a population projection based on the City's assumed population growth rate of 2.8 percent per year. This growth rate would result in a residential population around 22,400 in 2040, which is 81 percent of the buildout population. The employee population is projected to be 10,300 in 2040, which is 75 percent of the buildout employment capacity.

Note that the population growth rate and projections are consistent with other recent planning documents of the study area. As illustrated in **Figure 6-4**, Portland State University's Population Research Center's population projections are slightly lower over the planning period (20,911 for 2040) and result in a reduction in the projected 2040 PIF of approximately 1%. The use of the Clackamas County population growth rate projections has no substantive impact on the findings or recommendations of this plan.

Figure 6-4
Population Forecast Comparison



Other assumptions related to the 2040 dry weather flow projections are provided below.

- A safe harbor of 10 percent for residential parcels and 20 percent commercial and industrial parcels was applied to the gross acreage of currently undeveloped parcels under 2040 conditions. The safe harbor accounts for undevelopable areas such as right-of-way, parks and open space, etc. Eight percent of the remaining 90 percent of residential parcel area is designated for school growth. These assumptions are consistent with the Sandy Urbanization Study.
- To develop 2040 average dry weather flows, unit loading factors by City land classification/zoning, presented in **Table 6-4** were applied to net acres of presently undeveloped or unserved parcels within the City limits.
- 65 percent of vacant, developable residential parcels and 40 percent of vacant and developable or redevelopable employment parcels is assumed to be developed by 2040 to accommodate the projected residential and employee population.
- Residential unit loading factors were based on projected densities by land use and a per household wastewater usage of 181 gallons per day (gpd) based on the existing estimate of 67 gallons per capita per day (gpcpd) and a City projected household size of 2.7 people per unit.

- Non-residential unit loading factors were based on projected employee densities by land use and a per employee wastewater usage at the same rates of the existing population; 55 gallons per employee per day (gpepd). School loading was based on 25 gallons per student per day. Additional school growth by 2040 is accounted for with the portion of newly developed residential area designated for schools.
- The North Bluff area is assumed to be on septic currently and in 2040, which limits density to one dwelling per two acres by 2040, per discussion in the Urbanization Study Final
- These North Bluff area parcels were not included in the loading to the sanitary sewer system but were counted in total population with a dwelling density at 0.5 per acre.

Table 6-4
Flow Factors Used to Project Flows to 2040

Zone	Description	Equivalent Density (Dwelling Units or Employees Per Acre)	Unit Load (gpad)
Employment Zones			
POS	Parks and Open Space	0	0
C2	General Commercial	27	1,485
C3	Village Commercial	27	1,485
C1	Central Business District	27	1,485
I2	Light Industrial	29	1,595
I1	Industrial Park	29	1,595
I3	Heavy Industrial	29	1,595
Residential Zones			
R1	Low Density Residential	8	1,447
R2	Medium Density Residential	12	2,171
R3	High Density Residential	14	2,533
SFR	Single Family Residential	5	905

The 2040 ADWF is summarized by sewer basin in **Table 6-5**. Based on the analysis, the ADWF for the build-out system is approximately 2.0 MGD.

Table 6-5
2040 Average Dry Weather Flow

Meter ID	Basin Description	2040 ADWF (MGD)
2	Ruben Lane to the Treatment Plant	0.4
3	Highway 211 to Sandy Heights	0.2
4	Sunset Street to Ruben Lane	0.0
5	Sandy Bluff	0.4
6	Commercial Core	0.2
7	Chalet Mobile Estates and Bluff Road	0.1

Meter ID	Basin Description	2040 ADWF (MGD)
8	East end to Strawbridge	0.3
9	Cascadia Village to Tupper	0.2
10	Dubarko Drive east of Highway 211	0.2
Total		**2.0**

6.3.6.2 2040 Wet Weather Flow Projections

Wet weather flow projections for 2040 conditions included existing RDII, RDII from expansion of the wastewater collection system, and additional RDII resulting from further degradation of the existing wastewater collection system. The sewer collection system would expand in proportion with the population and the extended system as a peak RDII rate of 1,600 gpad, which is consistent with design standards for new systems used by other municipalities in western Oregon. Based on these added sources of RDII and the extrapolation to the design storm, the peak RDII rate for 2040 for the entire system is 10,300 gpad (inclusive of existing and future wet weather flow contributions).

6.3.6.2.1 Pipe Degradation for 2040

Pipes degrade over time, resulting in increasing RDII rates. This increase in RDII was included in the wet weather flow projections for 2040 by developing a degradation curve based on observed existing RDII rates and pipe materials and ages. The curve is applied to the existing RDII rate within each basin. Some basins with high proportions of PVC pipe had higher than expected RDII rates (Sandy Bluff, meter basin 5 and Dubarko Drive east of Highway 211, meter basin 10). These higher than expected rates are likely driven by construction defects, such as improperly installed lateral connections or surface water connections. PVC installed in the future with few construction defects would have low initial increases in RDII, but those increases would accelerate when the gaskets in the joints begin to fail, starting at around 40 years, and then level off as the pipe approaches the end of its life cycle at approximately 100 years. As RDII rates approach a maximum, the RDII will increase very little over time. Non-pipe factors such as geology, soil conductivity and groundwater levels limit RDII once the pipe material has degraded. The results of the projected 2040 peak RDII are summarized by meter basin in **Table 6-6**.

Table 6-6
Summary of RDII Projections with Pipe Degradation

Meter ID	Basin Description	Existing[1] Peak RDII (MGD)	2040 New Pipe Peak RDII (MGD)	2040 Pipe Degradation Peak RDII (MGD)	Total 2040 Peak RDII (MGD)
2	Sunset Street to the Treatment Plant	1.2	0.2	1.6	3.0
3	Highway 211 to Sandy Heights	0.1	0.0	0.6	0.7
5	Sandy Bluff	2.1	0.1	0.0	2.2
6	Commercial Core	1.7	0.1	0.3	2.1
7	Chalet Mobile Estates and Bluff Road	0.7	0.0	0.0	0.7

Meter ID	Basin Description	Existing[1] Peak RDII (MGD)	2040 New Pipe Peak RDII (MGD)	2040 Pipe Degradation Peak RDII (MGD)	Total 2040 Peak RDII (MGD)
8	East end to Strawbridge	1.9	0.2	0.8	2.9
9	Cascadia Village to Tupper	0.5	0.1	0.8	1.4
10	Dubarko Drive east of Highway 211	0.9	0.7	0.1	1.7
Total		**9.1**	**1.4**	**4.2**	**14.7**

Note:
[1] Existing peak flows in basins 3, 6, 7, 9 and 10 are influenced by pump operations and may not reflect the actual peak flow into the collection system and pump stations.

6.3.6.3 2040 Wet Weather Flow Projection Summary

The total peak wastewater flow for 2040 is the summation of the base sewer flow and RDII flow components derived from the design storm event. The PIF was calculated by adding the projected base sewer flow at the time of peak RDII to the projected peak RDII and is summarized by service area in **Table 6-7**.

Table 6-7
2040 Dry and Wet Weather Flow Summary by Basin, in MGD

Meter ID	Basin Description	2040 ADWF	Base Sewer Flow at time of Peak RDII	2040 Peak RDII	2040 PIF[1]
2	Sunset Street to the Treatment Plant	0.4	0.5	3.0	3.5
3	Highway 211 to Sandy Heights	0.2	0.3	0.7	1
5	Sandy Bluff	0.4	0.5	2.3	2.8
6	Commercial Core	0.2	0.2	2.1	2.3
7	Chalet Mobile Estates and Bluff Road	0.1	0.1	0.6	0.7
8	East end to Strawbridge	0.3	0.4	2.8	3.2
9	Cascadia Village to Tupper	0.2	0.2	1.3	1.5
10	Dubarko Drive east of Highway 211	0.2	0.2	1.9	2.1
Total		**2.0**	**2.4**	**14.7**	**17.1**

Note:
[1] Assumes design storm

Using the Collection System Method, the MMWWF, PWF and PDF were similarly projected to 2040. The resulting flows are **4.1 MGD**, **6.6 MGD** and **14.3 MGD** respectively. The projected flows determined by the Collection System Method are summarized in **Table 6-8** below. As a note, the Collection System Method does not calculate the AAF or the AWWF since there is no defined criteria for the storm event.

Table 6-8
Summary of Projected Flows Derived through the Collection System Model

2040 Flow Event	Collection System Method
AAF	--
ADWF	2.0
AWWF	--
MMDWF	2.4
MMWWF	4.1
PWF	6.6
PDF	14.3
PIF	17.1

6.4 DEQ Guidelines Flow Estimation Method

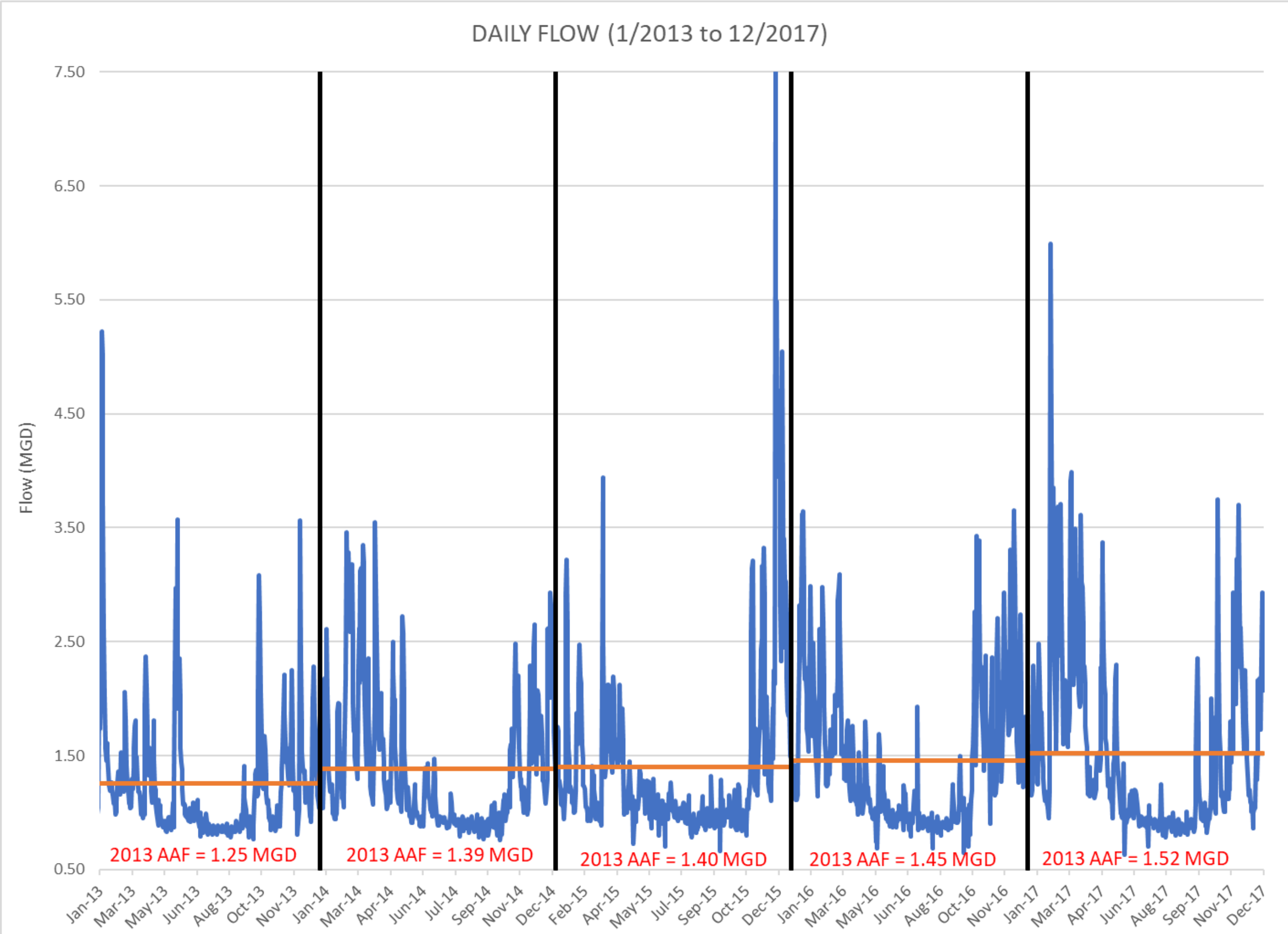
To determine the accuracy of the Collection System Method, flow characteristics were calculated using the DEQ Guidelines. The following sections summarize the methods and results from this analysis.

6.4.1 Existing Wastewater Flows

6.4.1.1 Daily Flow Analysis

Daily flow from January 2013 to December 2017 was plotted to review trends and is shown on **Figure 6-5**. Along with daily flow, the graph shows average yearly flows. As can be seen, the flows have slowly increased over the 5-year period.

Figure 6-5
Daily Flow (January 2013 to June 2017)



6.4.1.2 Existing WWTP Average Annual, Wet and Dry Weather Flows

Using historical WWTP influent flow rates provided by the City, we calculated the existing annual average flow (AAF), the average dry weather flow (ADWF) from May-October, and the average wet weather flow (AWWF) from November-April during the study period from 2013-2017. Based on the information in **Table 6-9**, the current AAF, ADWF, and AWWF for the Sandy WWTP using the plant influent flow data are **1.40 MGD**, **1.08 MGD**, and **1.78 MGD**, respectively.

Table 6-9
City of Sandy 2013-2017 Flow History

Season	Year	Average Inflow (MGD)
Annual	2013	1.25
	2014	1.39
	2015	1.40
	2016	1.45
	2017	1.52
	Average (2013-2017)	**1.40**
Dry Weather (May 1 - Oct 31)	2013	1.08
	2014	1.04
	2015	1.02
	2016	1.13
	2017	1.10
	Average (2013-2017)	**1.08**
Wet Weather (Nov 1 - Apr 30)	2013-14	1.66
	2014-15	1.52
	2015-16	1.98
	2016-17	1.97
	Average (2013-2016)	**1.78**

6.4.1.3 Existing WWTP Maximum Monthly Flows

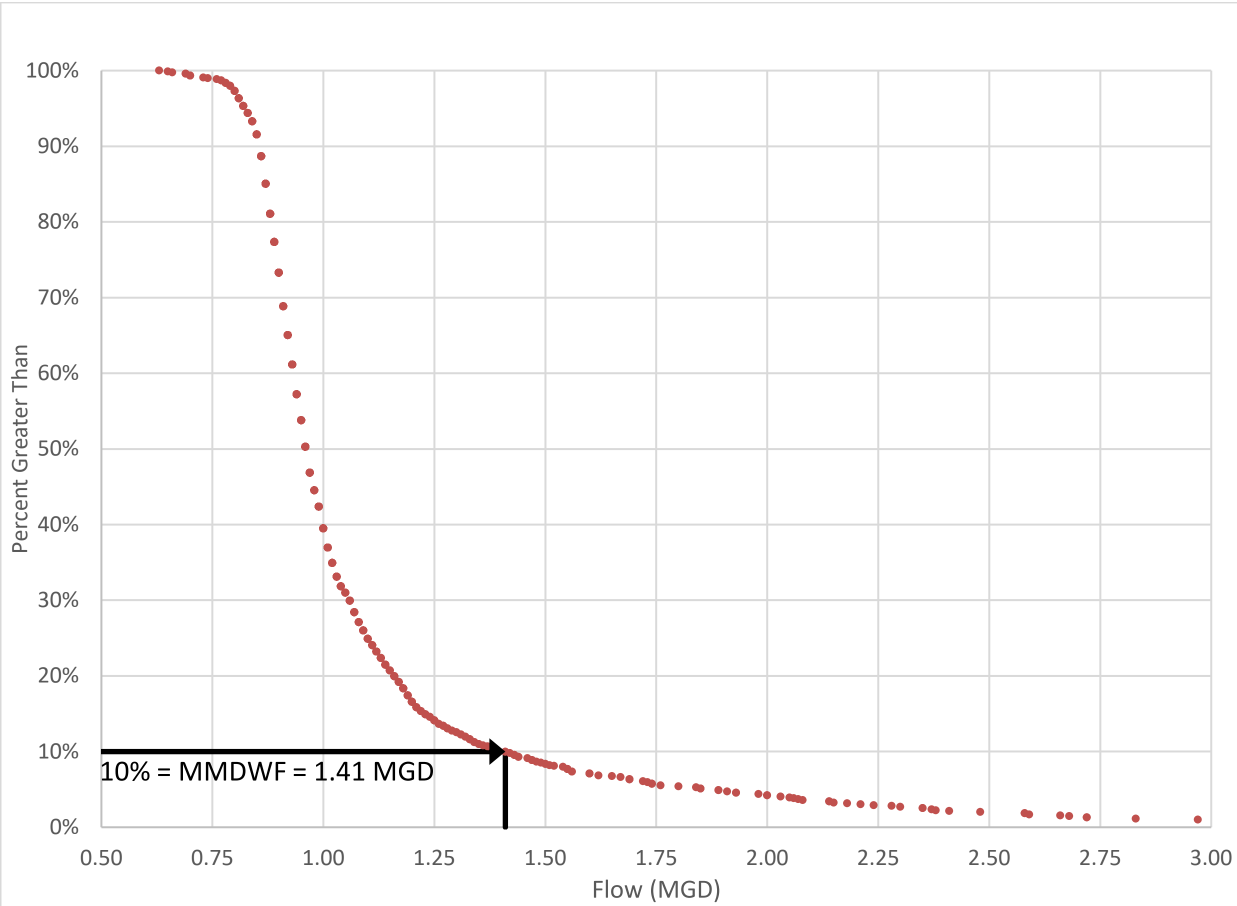
DEQ guidelines developed for Western Oregon suggest a method to calculate maximum month flows for wet and dry weather based on the probability of exceeding a particular design storm event. Current maximum monthly flows for the dry and wet weather season were then estimated as outlined in the DEQ Guidelines.

6.4.1.3.1 Maximum Monthly Dry Weather Flow

WWTP dry weather season flows during the evaluation period were tabulated and sorted from highest to lowest flow and the events were ranked according to the percentage of monthly dry weather flow events greater than the individual event. The percentile of each event was then plotted versus plant flow. Using DEQ definitions regarding plant reliability for the dry weather season, the flow event with a 10 percent exceedance probability based on the rankings was selected as the current MMDWF. **Figure 6-6** is a graph of the actual plant flow events sorted and plotted against percentile of flow events greater.

Based on this alternate methodology, the existing MMDWF for the City of Sandy WWTP is **1.41 MGD**.

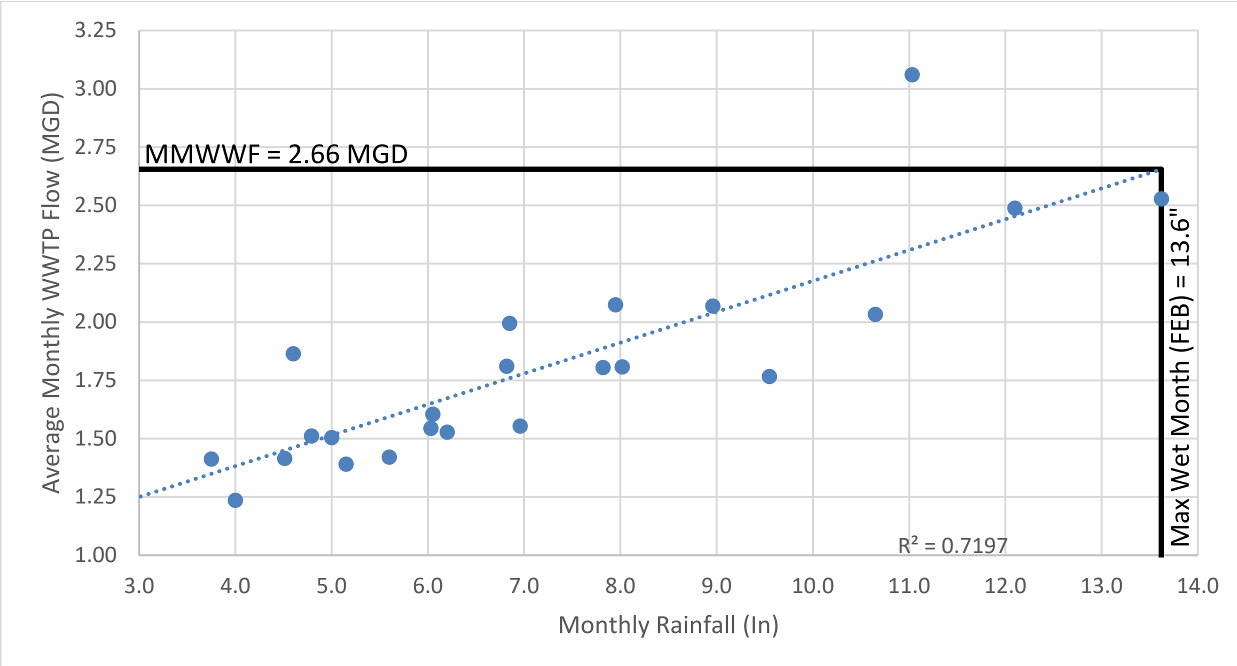
Figure 6-6
Sandy WWTP Dry Weather Flow vs. Ranked Flow Percentile



6.4.1.3.2 Maximum Month Wet Weather Flow

Current MMWWF was estimated following DEQ Guidelines by plotting monthly WWTP flows for the wet season between May through October from 2013 through 2017 versus total monthly rainfall. A statistical trendline was then developed based on the plot. The maximum monthly accumulation of rainfall, 13.6 inches, occurred in February of 2017. Based on the extrapolated trendline equation, the current MMWWF for the City of Sandy WWTP is 2.66 MGD, as shown on **Figure 6-7**.

Figure 6-7
Sandy WWTP Wet Weather Flow vs. Monthly Precipitation

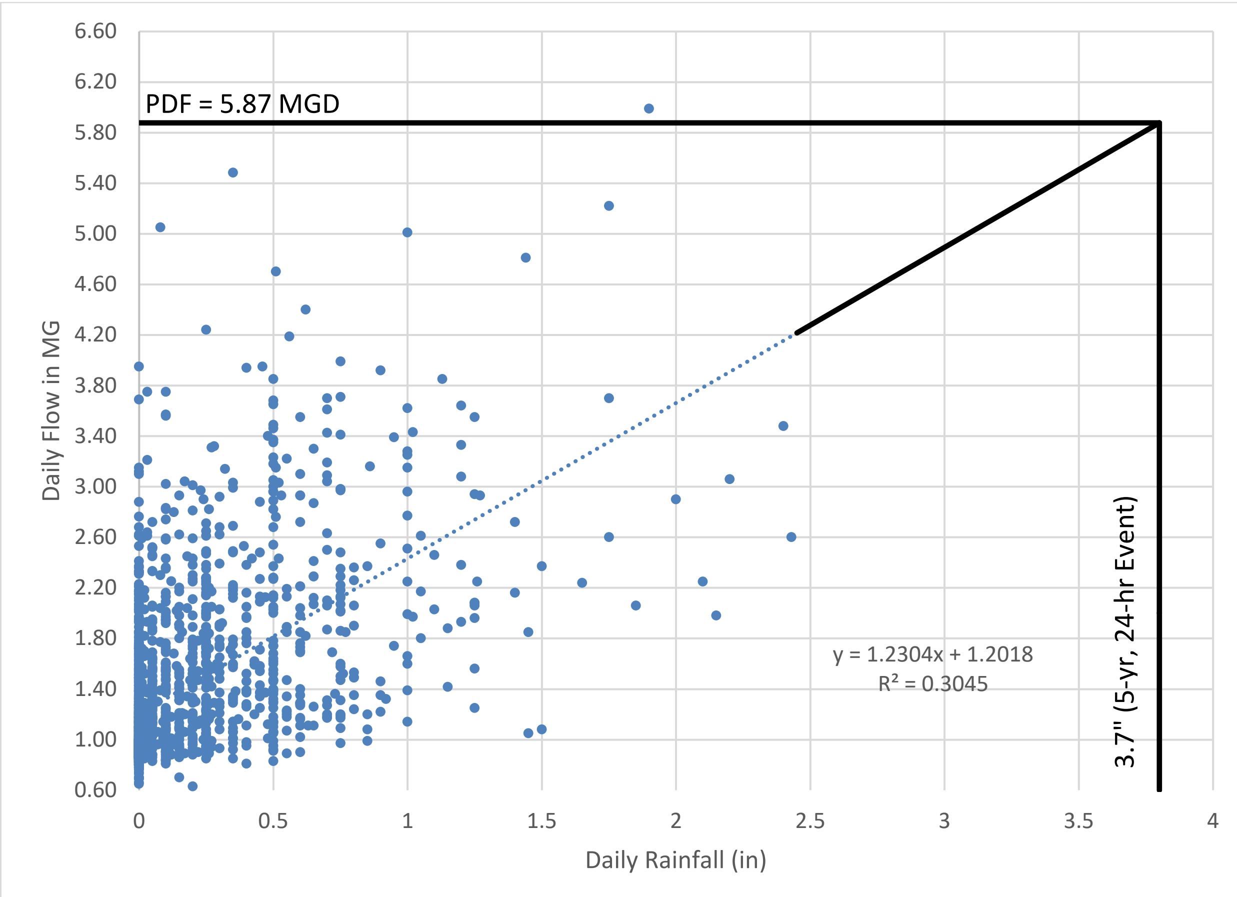


6.4.1.4 Existing WWTP Peak Daily Average Flow

The current Sandy WWTP PDAF was estimated by evaluating specific WWTP flows and rainfall events during the Evaluation Period. The peak rainfall event used to estimate the current WWTP PDAF was 3.7 inches which is the annual 5-year return, 24-hour rainfall event for the City of Sandy from Oregon NOAA Atlas 2 rainfall isopluvial maps.

Figure 6-8 is a graph of Sandy WWTP peak flow events 2013 through 2017. Based upon the evaluation, the estimated current Sandy WWTP PDAF is **5.87 MGD**.

Figure 6-8
Sandy WWTP Peak Flow Events vs. Daily Precipitation



6.4.1.5 Existing WWTP Peak Instantaneous Flow

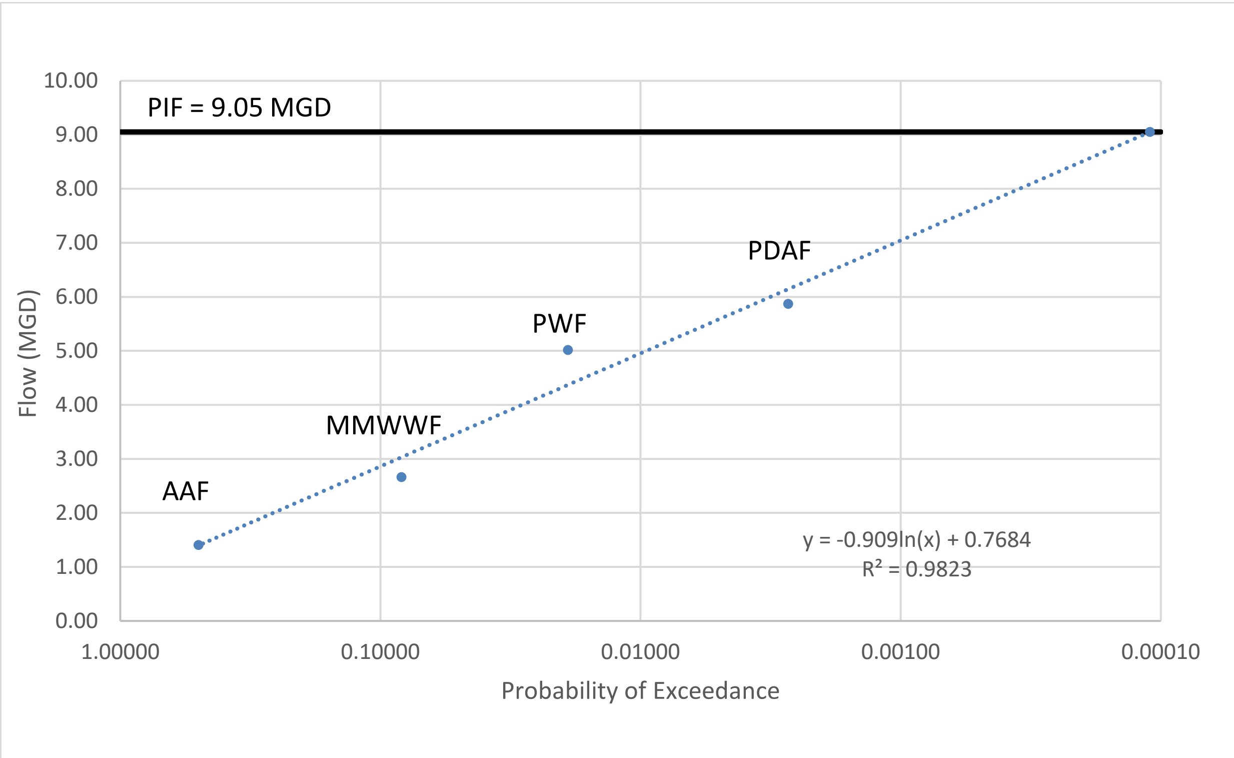
The existing PIF was estimated using the statistical probability procedure specified in the DEQ Guidelines. The procedure is an analytical evaluation assuming certain exceedance probabilities for design flow events:

- The exceedance probability for the AAF is 50 percent. The AAF used to determine the current PIF was 1.40 MGD.
- The exceedance probability for the MMWWF is 8.3 percent. The MMWWF used to determine the current PIF was 2.66 MGD.
- The exceedance probability for the PWF is 1.9 percent. The PWF used to determine the current PIF was 5.01 MGD
- The exceedance probability for the PDAF is 0.27 percent. The PDAF used to determine the current PIF was 5.87 MGD.

- The exceedance probability for the PIF is 0.011 percent.

Figure 6-9 is a probability chart used to estimate the current PIF. The AAF, MMWWF, PWF, and PDF were plotted, and the current PIF was estimated by extrapolation. Based on the evaluation, the current PIF for the City of Sandy WWTP is **9.05 MGD**.

Figure 6-9
Sandy WWTP Flow vs. Event Probability



6.4.2 Projected WWTP Flows

Per capita flow contributions and peaking factors for current design WWTP flow events and the estimated 2017 population of 10,872 are summarized in **Table 6-10**. Per capita flow factors were also developed. The PDF/AAF and PIF/AAF peaking factors are 4.19 and 6.46, respectively.

Table 6-10
Per Capita Flow Contributions for Design Flow Events

Flow Event	Current Flow (MGD)	Peaking Factor	Per Capita Flow (gpcpd)
AAF	1.40	1.00	129
ADWF	1.08	0.77	99
AWWF	1.78	1.27	164
MMDWF	1.41	1.01	130
MMWWF	2.66	1.90	245
PWF	5.01	3.58	461
PDF	5.87	4.19	540
PIF	9.05	6.46	833

For the DEQ Guideline Method, the existing per capita flow factors are used to project estimated future flows. Future population projections have been multiplied with the per capita flow factors to develop estimates of future flow events in 5-year increments as presented below in **Table 6-11**.

Table 6-11
Future Projected Flows (MGD)

Flow Event	2017	2020	2025	2030	2035	2040
AAF	1.40	1.45	1.53	1.74	1.95	2.39
ADWF	1.08	1.12	1.18	1.34	1.51	1.85
AWWF	1.78	1.85	1.95	2.21	2.49	3.05
MMDWF	1.41	1.46	1.54	1.75	1.97	2.41
MMWWF	2.66	2.76	2.91	3.30	3.71	4.54
PWF	5.01	5.19	5.48	6.22	6.99	8.56
PDF	5.87	6.08	6.42	7.28	8.19	10.03
PIF	9.05	9.38	9.90	11.23	12.63	15.46

6.5 Summary

Existing and projected 2040 flows determined from both the Collection System Method and the DEQ Guidelines method are presented in **Table 6-12**. Note that the Collection System Method does not calculate the AAF or the AWWF since there is no storm criteria available for assessing these. However, the remaining flow statistics between the two methods are similar.

Table 6-12
Comparison of Projected Flow Events Derived by Separate Methods

Flow	Existing		2040	
	Collection System Method	DEQ Guidelines Method	Collection System Method	DEQ Guidelines Method
AAF	--	1.40	--	2.39
ADWF	1.0	1.08	2.0	1.85
AWWF	--	1.78	--	3.05
MMDWF	1.5	1.41	2.4	2.41
MMWWF	2.6	2.66	4.1	4.54
PWF	4.0	5.01	6.6	8.56
PDF	8.9	5.87	14.3	10.03
PIF	10.3	9.05	17.1	15.46

Since the results of the Collection System Method and the DEQ Guidelines method are similar, the flows derived from the Collection System Method will be used going forward. The reason for this is because the modeled flows better represent expected buildout conditions. Projected flows determined by DEQ guidelines are based only on population growth assumptions, whereas the projected flows determined from the modeling of the collection system consider land use, new development, and pipe degradation in addition to population growth.

To account for the fact that the Collection System method does not calculate the AAF and AWWF, it is recommended that flows derived by the DEQ Guidelines Method be used for the AAF and AWWF. A summary of the final projected flow characteristics is presented in **Table 6-13**.

Table 6-13
Summary of Existing and Projected Flow Characteristics

Flow	Existing Flow, MGD	2040 Flow, MGD
AAF	1.4	2.39
ADWF	1.0	2.0
AWWF	1.78	3.05
MMDWF	1.5	2.4
MMWWF	2.6	4.1
PWF	4.0	6.6
PDF	8.9	14.3
PIF	10.3	17.1

6.6 Wastewater BOD and TSS Loads

Wastewater Loads to a treatment plant are used to evaluate different treatment alternatives and to determine the required treatment capacities. For this work, WWTP DMRs were analyzed for the Evaluation Period for monthly average and maximum month influent BOD_5 and TSS concentrations and mass loads. The calculated average and maximum monthly loads were divided by the 2017 population of 11,800 people to establish population loading factors for the Sandy WWTP.

As shown in **Table 6-14** average BOD_5 concentrations are approximately 286 milligrams per liter (mg/l) for the summer and 192 mg/l for the winter season, whereas current average monthly TSS concentrations are approximately 280 mg/l in the summer and 190 mg/l in the winter.

Table 6-14
Current BOD_5 and TSS Loads

Parameter	2017 Population	Monthly Average			Maximum Monthly Average		
		Concentration (mg/l)	Load (ppd)	Load Factor (ppcd)	Concentration (mg/l)	Load (ppd)	Load Factor (ppcd)
Summer Season (May 1 through October 31)							
BOD_5	11,800	286	2,465	0.209	455	3,594	0.305
TSS	11,800	280	2,376	0.201	456	3,465	0.294
Winter Season (November 1 through April 30)							
BOD_5	11,800	192	2,397	0.203	297	3,467	0.294
TSS	11,800	190	2,383	0.202	342	3,927	0.333

Population loading factors developed in **Table 6-14** were used in conjunction with estimated population projections for 2040 to estimate future BOD and TSS loads. **Table 6-15** presents the 2040 BOD and TSS loading projections for the summer (dry) and winter (wet) weather seasons.

Table 6-15
2040 BOD and TSS Loading Projections

Parameter	2040 Population	Monthly Average		Monthly Maximum	
		Load Factor (ppcd)	Load (ppd)	Load Factor (ppcd)	Load (ppd)
Summer Season (May 1 through October 31)					
BOD_5	22,400	0.209	4,679	0.305	6,822
TSS	22,400	0.201	4,511	0.294	6,577
Winter Season (November 1 through April 30)					
BOD_5	22,400	0.203	4,550	0.294	6,582
TSS	22,400	0.202	4,524	0.333	7,454

6.7 References

National Oceanic and Atmospheric Administration. 1973. *NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume X – Oregon*.

City of Sandy. 2015. Urbanization Study Final Report. Adopted per ordinance 2015-01.

City of Sandy. 2017. Urban Growth Boundary Expansion Analysis Final Report. Adopted per ordinances 2017-01 and 2017-02.

Oregon Trail School District. 2018. 2017-2018 Current Enrollment Count. Accessed 5/1/2018 via internet at http://oregontrailschools.com/wp-content/uploads/2018/03/Enrollment-Count-2-28-18.pdf

Section 7

Section 7

Sanitary Sewer Collection System Evaluation

7.1 Introduction

This section of the Wastewater System Facilities Plan (WSFP) summarizes the pump station condition assessment, the wastewater collection system capacity analysis and the hydraulic model assumptions. To evaluate system capacity, design criteria were established for maximum allowable flow depth during dry and wet weather conditions, maximum velocity, and pump station capacity. A hydraulic model was developed and calibrated to evaluate the response of the system against the design criteria for existing and future flows. The hydraulic model was used as a tool to evaluate and recommend system improvements. This section documents the model development, design criteria assumptions, application of future flows, existing and future system capacity evaluation, and capital improvement alternatives.

Additionally, this section of the WSFP summarizes wet weather impacts to the system from the design storm event. Capacity deficiencies and improvements are identified for the current system with flows including response to the design storm. The capacity improvement alternatives are developed at graduated levels of wet weather flow reduction, then combined and evaluated with corresponding treatment plant alternatives.

The wet weather analysis and recommendations to rehabilitate existing infrastructure are discussed in more detail at the end of the section. Wet weather is defined as the combination of rainfall derived infiltration and inflow (RDII) and ground water infiltration (GWI). The opportunities to prevent and reduce RDII could include a balance between pump station capacity improvements, storm water disconnects, and RDII reduction through pipeline repair or replacement. A recommended RDII reduction program would target critical storm water system disconnections and structural pipe improvements for high priority infrastructure. A longer-term Rehabilitation and Replacement (R&R) program is also recommended for on-going system maintenance.

All improvements are evaluated at the master planning level of accuracy, which determines budget level cost estimates for calculating system development charges (SDCs) and rates (user fees) to support the Capital Improvement Program (CIP) as presented in Section 11, "Recommended Plan and Improvement Schedule." Each improvement project will require standard design phases to identify construction details and refine infrastructure sizing prior to implementation.

7.2 Model Development

To evaluate the existing and future capacity of the system, a collection system hydraulic model was developed in INFOSWMM (a proprietary software program by Innovyze) which utilizes the industry-standard SWMM 5 hydraulic engine developed by the Environmental Protection Agency (EPA). Information required to perform the hydraulic calculations in a network model include pipeline diameter, length, slope (based on invert elevations), and manhole invert and rim elevations. GIS data from the City were used to create the model network populated with most of the information needed for the hydraulic model. Gravity pipelines 8-inches and larger were incorporated into the model network. Where necessary, pipes with diameters less than 8-inches were also included. Six pump stations were incorporated into the hydraulic model including the number of pumps, wet well dimensions, pump curves, and control set points provided by the City. The Sandy Bluff Pump Station was modeled as "ideal" (flow in equals flow out) to represent variable frequency drives. The downstream boundary condition in the model is a free outfall at the Sandy Wastewater Treatment Plant (WWTP) influent. Where the source GIS data were incomplete or appeared erroneous, assumptions were made to develop a functioning model with reasonable pipeline profiles. Examples of such revisions included matching adjacent pipe diameters and invert elevations, using topographic data to estimate manhole rim elevations and splitting pipelines at junctions with other pipes and interpolating invert elevations.

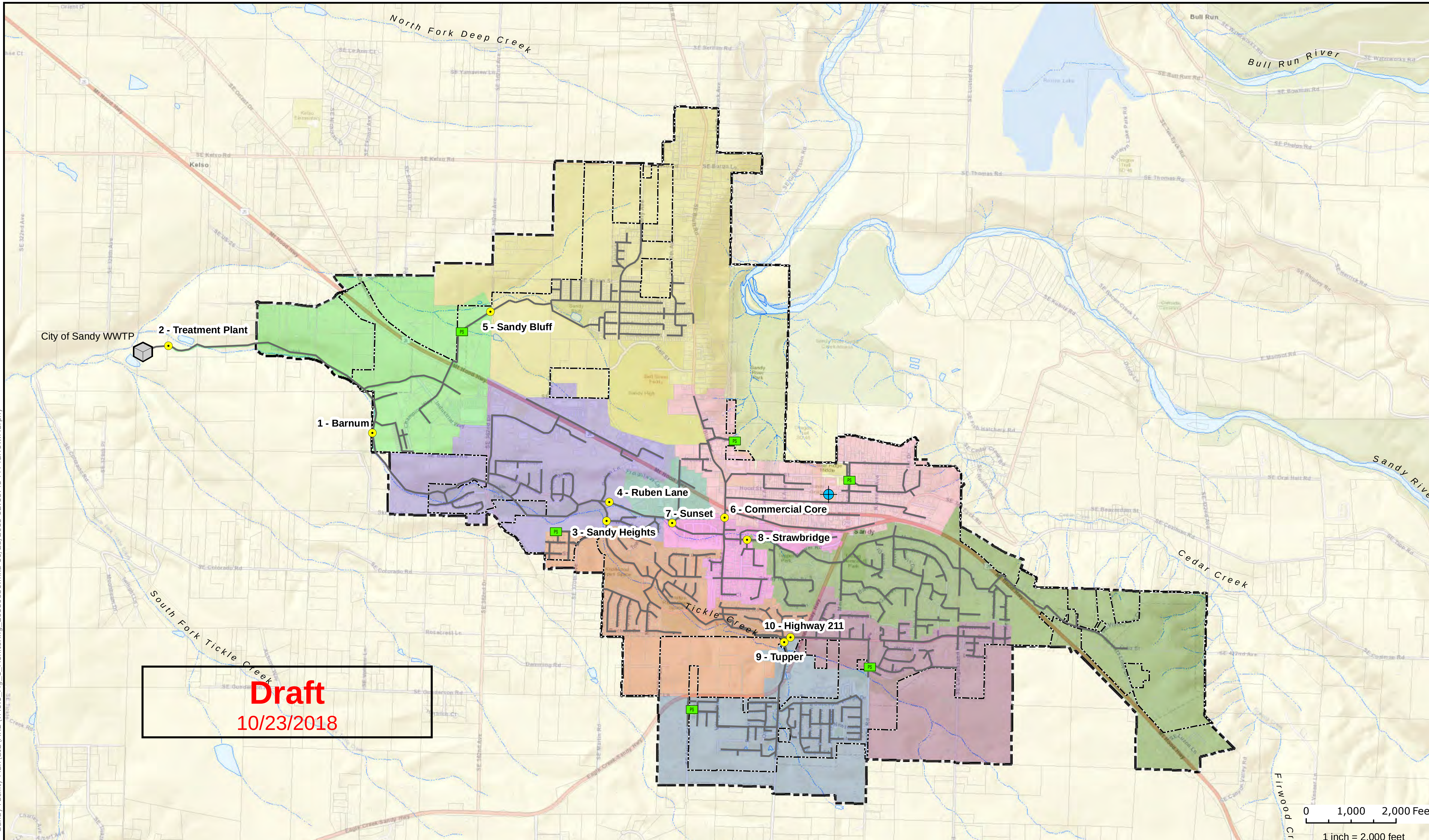
7.3 Model Calibration

Model calibration generally consists of establishing and adjusting model parameters until model and field data match to within a reasonable tolerance. After each calibration iteration, field data are compared with the modeled data to determine the model's level of accuracy. Once the desired level of accuracy has been achieved, the calibration is complete.

In collection system modeling, the calibration level of accuracy is both qualitative and quantitative. Flow rates measured at each flow monitoring site are visually compared to model flow rates for an extended period. A dry weather period and a wet weather period are selected for model calibration. The dry weather flow scenario is calibrated first with adjustments to the model loading (i.e., average dry weather flow and groundwater infiltration) and diurnal patterns. Next, the wet weather flow scenario is calibrated with adjustments to wet weather hydrographs, RDII parameters, and sewershed areas (wet weather impact areas) until field and model flows match during a significant rain event. Historical precipitation gage data is used in the model during the wet weather calibration. Levels of calibration accuracy include the following:

- Good – when field and model peak flows and volumes match within 10 percent,
- Moderate – when field and model peak flows and volumes match within 20 percent, and
- Poor – when field and model peak flows and volumes match within greater than 20 percent.

The City performed temporary gravity flow monitoring at a total of 10 locations in coordination with SFE Global between December 20, 2017 and February 28, 2018. The flow monitoring basins (meter basins) and meter sites are shown in **Figure 7-1**. The largest rain event of the flow



murraysmith

SANDY WHERE INNOVATION MEETS ELEVATION

City of Sandy, Oregon
Wastewater System Facility Plan

Figure 7-1
Metering Locations and Service Areas

January 2019 17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM6.1_Fig_1_Monitoring_20180830.mxd 10/23/2018 12:18:45 PM Yarrow.Murphy

This page intentionally left blank

monitoring period occurred between 5:00 PM on January 17, 2018 and 2:20 AM on January 20, 2018 with a total rainfall depth of 1.5 inches. The dry weather period selected for calibration occurred between February 6-13, 2018. The modeling parameters that impact the dry weather and wet weather calibration are described in detail below.

7.3.1 Existing System Dry Weather Flow Development

The existing system dry weather flow component of the model consists of a daily average flow and a normalized diurnal pattern that informs the model how to adjust the average flow throughout the day. Daily average flows and diurnal patterns for each meter basin were calculated for weekdays (Monday-Friday) and weekend days (Saturday-Sunday) separately.

Within each meter basin, service areas were comprised of parcels proximal to gravity sewer pipelines upstream of the meter. The calculated daily average flows from each the flow monitors were distributed to the associated service areas based on land use zoning classification. The flows were assigned to model nodes (manholes) at the upstream end of the pipe most proximal to each parcel (see **Figure 7-1**).

7.3.2 Existing System Wet Weather Flow Development

The wet weather flow component of the model consists of a storm event, sewershed acreage (wet weather area of impact), and RDII unit hydrograph (UH). The sewersheds are defined by placing a 25-foot buffer around all system pipes. During the model calibration, actual precipitation data is used to perform the wet weather simulations. Rainfall is converted to runoff as a function of the sewershed acreage and RDII parameters, thereby creating a volume of water. The sewershed areas are assigned to model nodes at the downstream end of the associated pipe (see **Figure 7-1**).

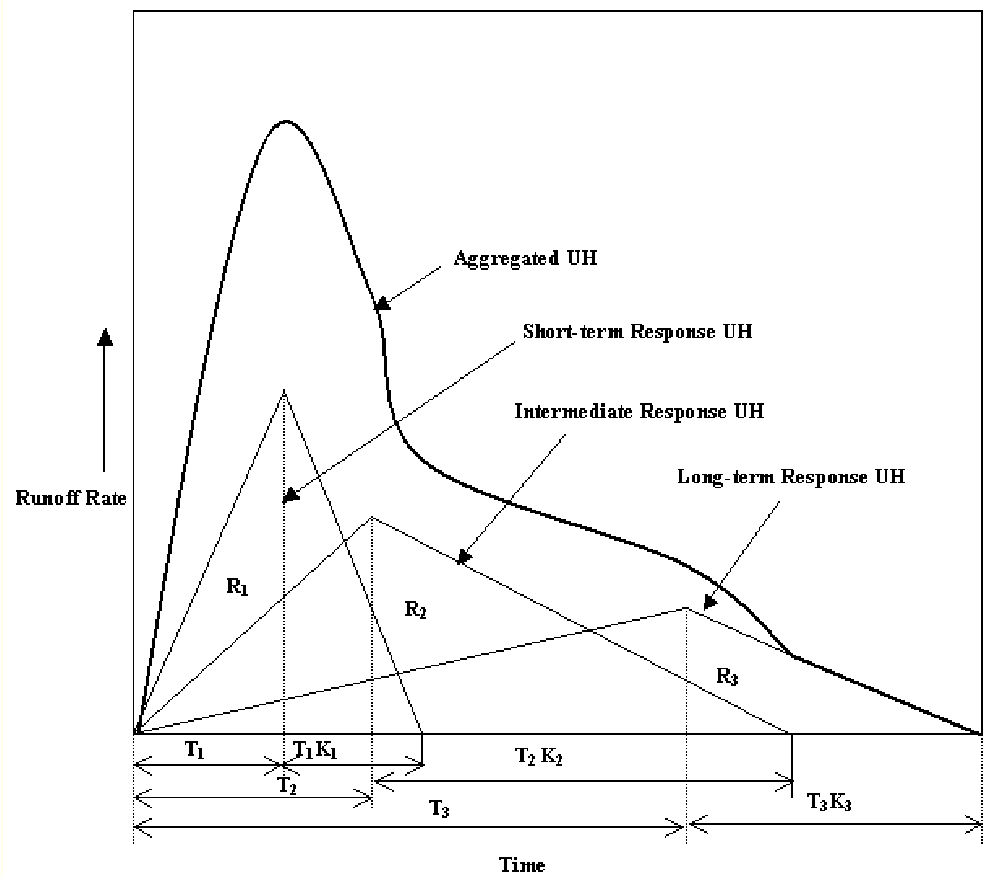
The RDII UH defines both the amount of runoff (percentage of the volume created from the sewershed and rain depth) that enters the system and the travel time. The RDII UH is a composite of three hydrographs representing the short-, intermediate-, and long-term system response. Each of the three hydrographs is defined by three parameters, which are adjusted during model calibration until field and model flows match within the desired level of accuracy (~10-percent). The RDII unit hydrograph parameters are described below and shown in **Figure 7-2**.

Unit Hydrograph Parameter 1 - R1, R2, R3 – Response ratios for the short-, intermediate-, and long-term UH responses, respectively.

Unit Hydrograph Parameter 2 - T1, T2, T3 – Time to peak for the short-, intermediate-, and long-term UH responses, respectively.

Unit Hydrograph Parameter 3 - K1, K2, K3 – Recession limb ratios for short-, intermediate-, and long-term UH responses, respectively.

Figure 7-2
EPA SWMM Unit Hydrograph



7.3.3 Dry Weather Calibration Results

The dry weather calibration results, including the diurnal pattern peaking factors and the quality of calibration at each meter, are presented in **Table 7-1**. Accurate dry weather metering data was available at nine locations. Plots comparing field and model flows are presented in **Appendix D.** for each flow meter location. The model was calibrated in each meter basin by adjusting diurnal patterns, average flow, and GWI with the overall goal of matching flow data at the Sandy Wastewater Treatment Plant (WWTP). Visual comparisons of the field and model dry weather flows show a reasonable model calibration with most meters providing "good" calibration results. It is important to note that several meters are impacted by pump station operation, and the model tends to dampen flow spikes caused by the pump station turning on and off. Efforts to address model conservancy were focused on the wet weather calibration since the peak flow rates caused by RDII are the primary source for system deficiencies.

Table 7-1
Dry Weather Calibration Results

Meter ID	Description	Diurnal Pattern Peaking Factor	Calibration Quality	Comments
1	Barnum	1.2	Moderate	Monitor consistently measuring more flow than seen at meter site 2, downstream
2	Treatment Plant	1.4	Good	
3[1]	Sandy Heights	1.5	Moderate	
4	Ruben Lane	1.2	Good	
5	Sandy Bluff	1.7	Good	Site located just upstream of a pump station.
6[1]	Commercial Core	1.6	Good	
7[1]	Sunset	1.4	Good	Peaks match well, but overall volume in model slightly high. This site is downstream of sites 6 and 8 which are well calibrated for dry weather. Therefore, this meter basin was not adjusted.
8	Strawbridge	1.6	Good	
9[1]	Tupper	1.8	Good	
10[1]	Highway 211	1.9	Moderate	Peak flows highly influenced by pump operation. Overall volume is good calibration quality.

Note:
1 Meters influenced by pump station operation upstream.

7.3.4 Calibration Storm Selection

The RDII unit hydrograph parameters are storm dependent. Typically, calibration priority is given to the storm that most closely resembles the theoretical design storm. This approach not only minimizes extrapolation of wet weather impacts but also reduces the level of conservancy in the analysis.

The rainfall data during the calibration period was collected from a temporary rain gauge located at the Old Cedar Ridge Middle School, located at 38955 Pleasant Street. During the 2-month monitoring period, the maximum 24-hour rainfall depth was 1.3 inches, while the 2-year 24-hour rainfall event for the Sandy vicinity is approximately 3.7 inches, based on the *NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Oregon - Volume X* [NOAA, 1973]. The storms during the monitoring period with the most significant flow response to rainfall were used in calibration and included December 28th (1.0 inch 24-hour depth), January 8th – 9th (1.0 inch 24-hr depth), January 17th (1.3 inches 24-hour depth) and January 26th (0.8 inch 24-hour depth). These storms had a frequency of approximately 1-year or less. The calibrated wet weather model was validated using the flow chart record at the influent of the WWTP on January 19 – 20, 2012 and rainfall from the Troutdale Airport.

7.3.5 Wet Weather Calibration Results

The modeled wet weather flow rates can be associated with contributing sewer basin areas to estimate flow per net area, gallons-per-acre-per-day (gpad) values, typically referred to as RDII rates. These RDII rates can vary significantly across the system due to factors such as sewer basin development, land use differences, soil type, and pipe condition, and storm water connections.

The wet weather calibration results, including the existing RDII rate during the January 2018 storm and quality of calibration at each meter, are presented in **Table 7-2**. Accurate metering data for the storm events was available at eight of the meter locations. 15-minute data recorded at the WWTP were also available for these events. Plots comparing field and model flows are presented in **Appendix D** for each flow meter location. Visual comparisons of the field and model wet weather flows show a reasonable model calibration with most meters providing "Good" calibration results during the storm events. Flows measured at Site 1 (at Barnum Road) were higher than flows measured downstream at the WWTP and Site 2 (near the WWTP). Flows during wet weather at Site 4 (at Ruben Lane) were significantly lower than those measured upstream at Site 7 (at Sunset Street). The wet weather flows at Sites 1 and 4 were assumed to be erroneous and, therefore, were not used for calibrating wet weather flows. The calibration effort focused on matching peak flow response rather than matching total storm volume.

Table 7-2
Wet Weather Calibration Results Summary

Meter ID	Description	Existing Peak RDII Rate for Calibration Storm (gallons per acre per day, gpad)	Calibration Quality	Comments
1	Barnum	NA	Not used	Monitor consistently measuring more flow than seen at meter site 2, downstream
2	Treatment Plant	95	Moderate	
3[1]	Sandy Heights	20	Moderate	
4	Ruben Lane	NA	Not used	Monitor consistently measuring significantly less flow than seen at meter site 7, just upstream. Also, very little response to rainfall.
5	Sandy Bluff	2,200	Good	
6[1]	Commercial Core	3,800	Good	
7[1]	Sunset	2,500	Good	
8	Strawbridge	3,300	Good	
9[1]	Tupper	4,200	Good	
10[1]	Highway 211	8,800	Moderate	Peak flows highly influenced by pump operation. Overall volume is good calibration quality.

Note:
[1] Meters influenced by pump station operation upstream.

7.4 Collection System Design Criteria

7.4.1 System Criteria for Deficiencies and Improvements

The criteria used for determining collection system deficiencies and planning improvements are shown in **Table 7-3**. These standards are consistent with the "Recommended Standards for Wastewater Facilities [The Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2004]." For pipelines, the criteria focus on a maximum water depth of 80-percent during dry weather conditions and elimination of surcharging within 2 feet of the ground surface during the design storm event. For pump stations, the criteria focus on pumping peak wet weather flows with the largest pump out of service. Maximum velocity and minimum scouring velocity are considered secondary criteria and are indicative of undersized or over-sized piping respectively. In the case of the minimum scouring velocity violations, the pipelines are flagged for additional maintenance and flushing to prevent solids deposition. Solids deposition can pose an issue when pipelines are constructed at less than the minimum design slopes or prior to build-out of the upstream service area.

Table 7-3
Design Criteria for Collection System Deficiencies

Category	Criterion	Explanation
Primary Standards		
Maximum water depth to diameter ratio during dry weather conditions	0.8	When the depth to diameter ratio exceeds 0.9, the pipe begins to lose gravity capacity due to greater frictional loss.
Minimum freeboard during 5-year design storm (clearance from water surface to manhole rim)	2.0 feet minimum, hydraulic grade line categories determine risk.	The standard is moderate in that it does not allow surcharging at less than 2 feet of freeboard during the design storm event. With this criterion, the maximum wet weather flow to design flow ratio can exceed 1.
Pump Station firm capacity[1]	Lift stations have capacity to pump at flows greater than or equal to peak hour flows with largest pump out of service.	The firm capacity criterion protects against loss of service during equipment failure and allows for pump cycling for longer equipment life.
Maximum force main velocity[1]	8.0 feet per second (fps)	The velocity criteria protects against excessive head loss and allows pumps to operate efficiently.
Secondary Standards		
Maximum gravity pipeline velocity	< 15.0 ft/sec or anchored appropriately for extreme slopes	The maximum velocity criteria protects pipelines from turbulent flow conditions and excessive air entrainment.
Minimum cleansing/scouring velocity, gravity pipeline[1]	2.0 fps	Pipe diameters and minimum slopes should be selected to prevent solids deposition.
Minimum cleansing/scouring velocity of force mains[1]	3.5 fps	Pipe diameters should be selected to prevent solids deposition.

Category	Criterion	Explanation
Minimum design slopes (feet per 100 feet)	8-inch (0.4); 10-inch (0.28); 12-inch (0.22); 15-inch (0.15); 18-inch (0.12); 21-inch (0.10); 24-inch (0.08); 27-inch (0.07); 30-inch (0.06); 36-inch (0.06)	Based on 2014 Public Works Standards. Minimum slope allows for 2 fps scour velocity when flowing full.

Note:

[1] Oregon DEQ standard.

7.4.2 Design Storm

Collection system deficiencies are typically the result of RDII associated with large storm events. The wet weather flow component of the model consists of a storm event, sewershed acreage (wet weather area of impact), and RDII unit hydrograph. The unit hydrograph defines both the amount of runoff (percentage of rainfall volume) that enters the system and the travel time. During the model calibration, the sewershed acreages and RDII unit hydrographs are established to reflect system response to rainfall based on available flow monitoring data and measured precipitation. During the deficiencies and improvements analysis, a design storm is substituted for the precipitation data, thereby allowing for an extrapolation of system response to the critical storm event. Selection of the design storm is discussed in **Section 6 "Flow and Loads Projection"**.

7.4.3 Rainfall Derived Infiltration and Inflow

When applying the design storm to the City's calibrated existing system model, the calculated peak RDII rates vary by sub-basin between roughly 1,300 gpad and 19,400 gpad as summarized in **Table 7-4**. For comparison, typical design standards for new collection systems in Oregon assume RDII rates on the order of 1,000 to 2,500 gpad. The peak rates for the City's existing system are significantly high in some areas, suggesting interconnections between the storm and sanitary systems or other sources of RDII.

Table 7-4
Existing RDII Peak Rates

Meter ID	Basin Description	Peak RDII Rate for Design Storm (net gpad)
2	Sunset Street to the Treatment Plant	6,900
3	Highway 211 to Sandy Heights	1,300
5	Sandy Bluff	11,700
6	Commercial Core	16,800
7	Chalet Mobile Estates and Bluff Road	19,400
8	East end to Strawbridge	16,600
9	Cascadia Village to Tupper	11,000
10	Dubarko Drive east of Highway 211	16,700

7.5 Existing Collection System Capacity Evaluation

The collection system model was used to identify system hydraulic response to existing dry and wet weather flows during the design storm based on the design criteria presented in **Table 7-3**.

Results of the analysis indicate hydraulic deficiencies in the existing trunk sewer near the wastewater treatment plant with existing design storm flows. Because of the limitations in pipeline capacity during the design storm, wastewater may back up in the pipeline upstream of the capacity limitation and cause surcharging in the manholes with minimum freeboard predicted to be less than two feet. The existing system deficiency results are presented in **Figure 7-4**.

Estimated peak flows into each pump station during the design storm were compared to pump station existing firm capacity. With the existing condition design storm peak flows, the major capacity risks are found in pump stations and force mains. The Sandy Bluff Pump Station is predicted to have flows of 1670 gpm while the firm capacity is only 600 gpm. The Jacoby Pump Station is predicted to have a peak flow of 760 gpm during the design storm, with only 300 gpm firm capacity. The Marcy Street Pump Station is deficient by 40 gpm. The Sandy Bluff force main velocity exceeds 10 ft/s given design storm flows of 1670 gpm. The other force mains do not exceed the 10 ft/s deficiency criteria. The results of the pump station capacity analysis are presented in **Table 7-5** and assume removal of all sanitary overflows and pipeline restrictions.

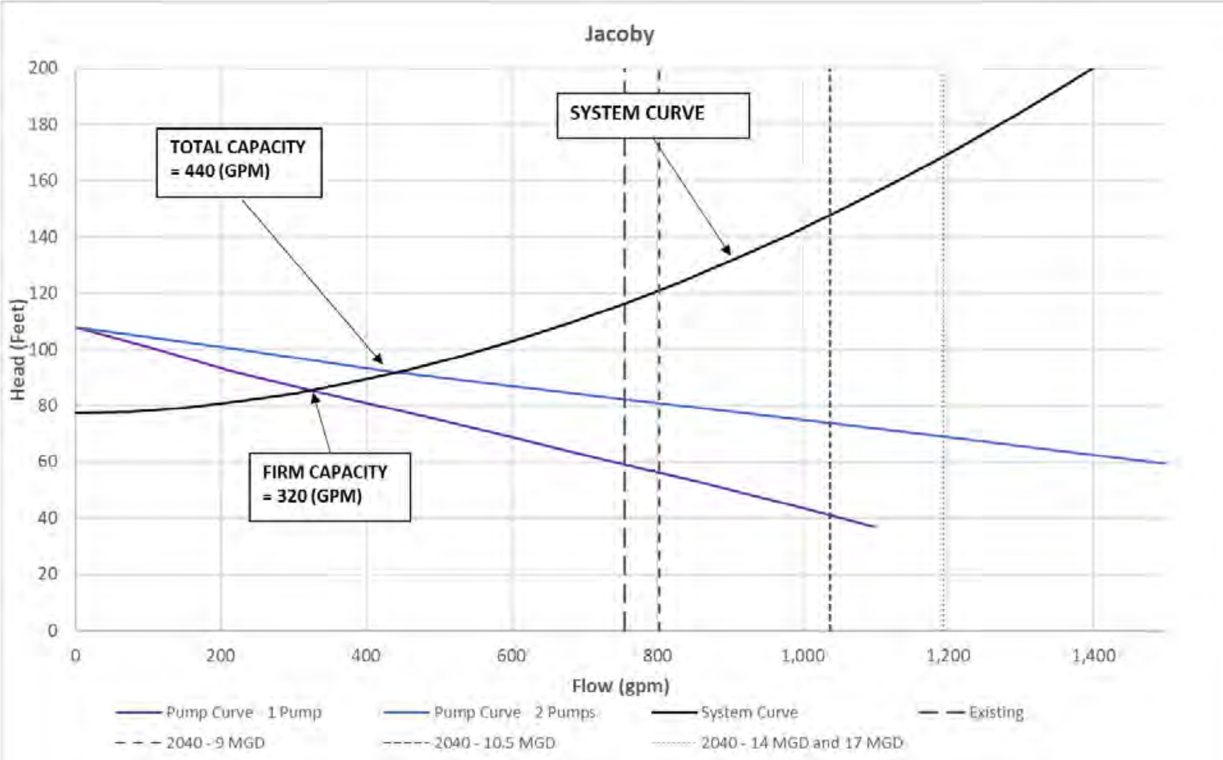
Table 7-5
Existing Pump Station Capacity

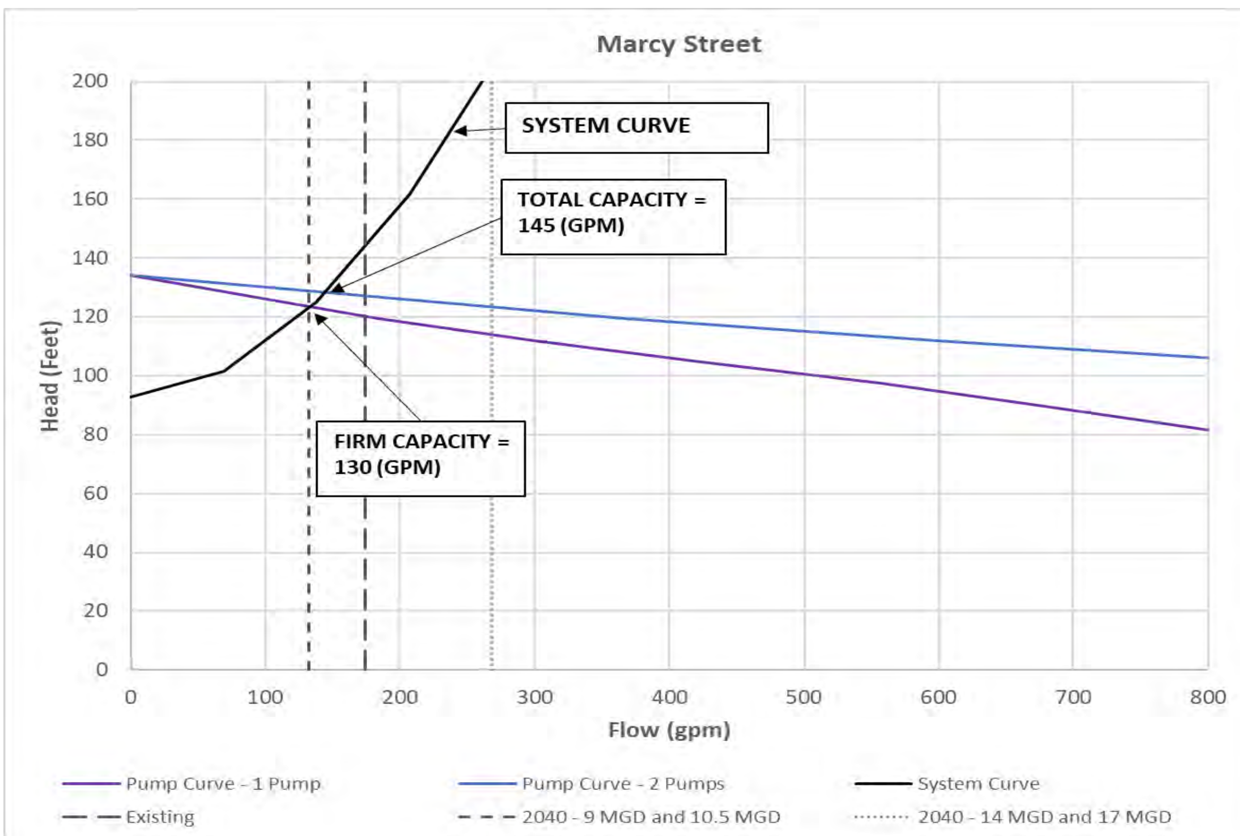
Pump Station	Firm Capacity (gpm)	Peak Flow to Pump Station (gpm)[1]	Peak Force Main Velocity (fps)
Marcy Street	130	170	4.4
Northside (Sandy Bluff)	600	1670	10.7
Meinig Ave[2]	355	330	3.8
Southeast (Jacoby/ Timberline Trails)	320	760	8.6
Southwest (Sleepy Hollow)[2]	115 (sheet says 188 at 92.4 ft)	10	0.10
Southside (Snowberry)	185	66	7.5

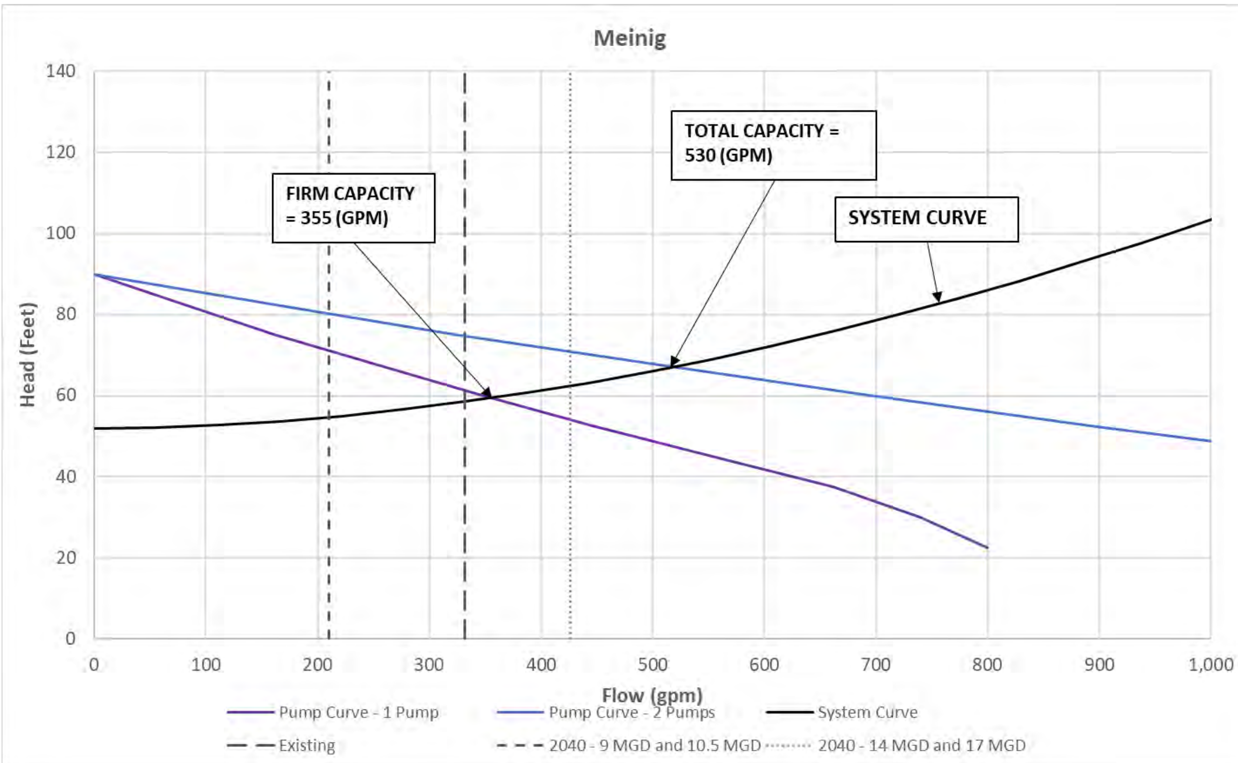
Notes:
1 Peak flow during design storm assuming removal of all sanitary overflows and pipeline restrictions.
2 Requires additional review and field verification

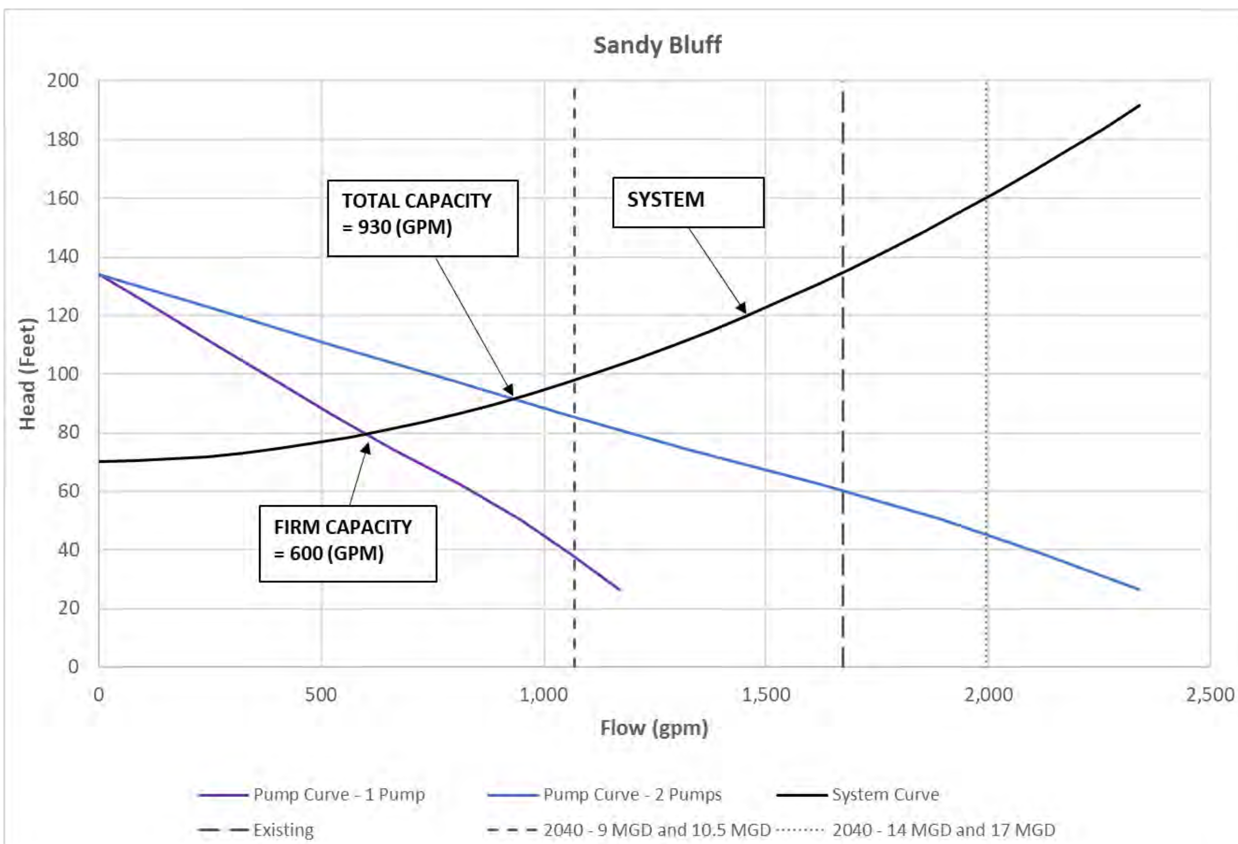
System curves and pump curves for the pump stations are provided in **Figure 7-3**. These figures identify the capacities of each pump station, including the firm and total capacities compared to peak flow contributions.

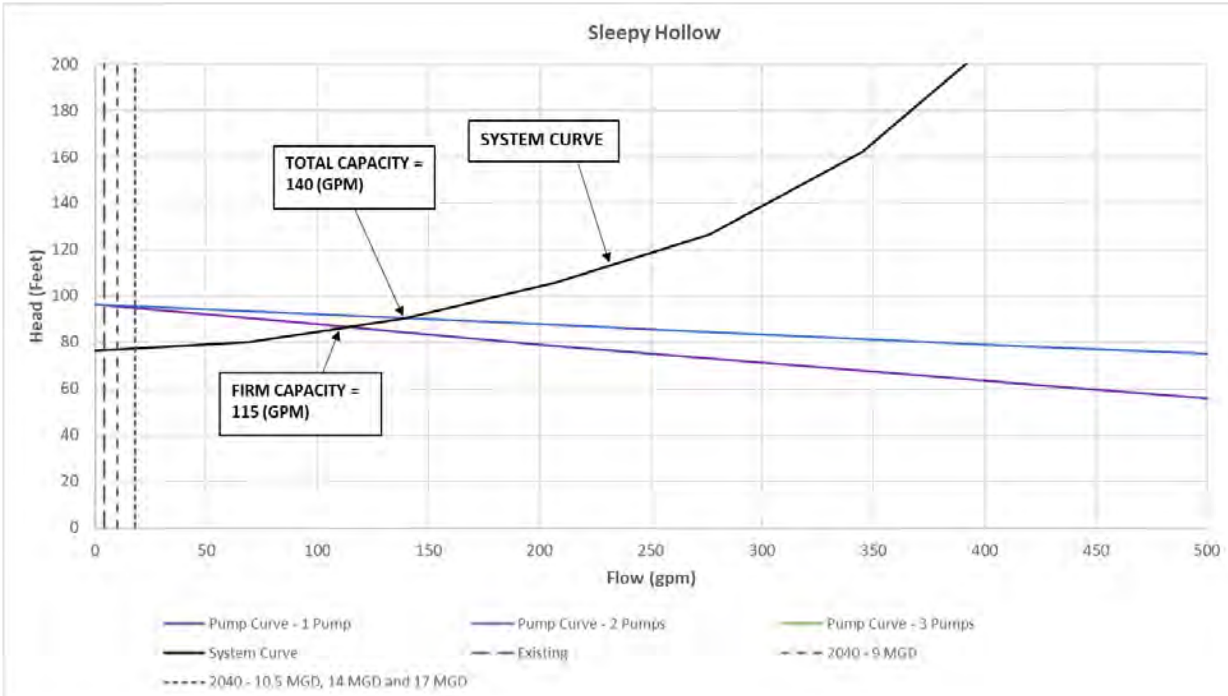
Figure 7-3
Pump Station Capacity Analysis

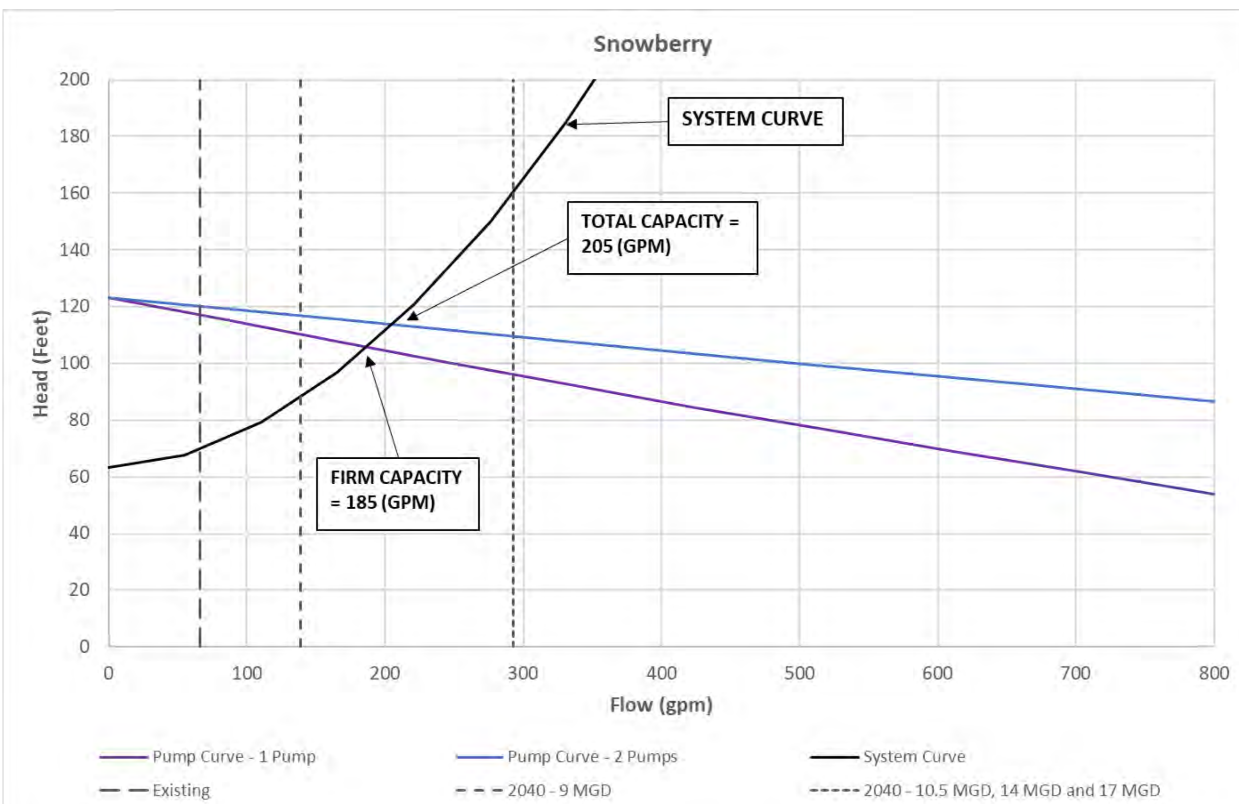





Meinig
140
120
100
80
60
40
20
0
Head (Feet)
0
100
200
300
400
500
600
700
800
900
1,000
Flow (gpm)
FIRM CAPACITY = 355 (GPM)
TOTAL CAPACITY = 530 (GPM)
SYSTEM CURVE
Pump Curve - 1 Pump
Pump Curve - 2 Pumps
System Curve
Existing
2040 - 9 MGD and 10.5 MGD
2040 - 14 MGD and 17 MGD


Sandy Bluff
200
180
160
140
120
100
80
60
40
20
0
Head (Feet)
0
500
1,000
1,500
2,000
2,500
Flow (gpm)
TOTAL CAPACITY = 930 (GPM)
SYSTEM
FIRM CAPACITY = 600 (GPM)
Pump Curve - 1 Pump
Pump Curve - 2 Pumps
System Curve
Existing
2040 - 9 MGD and 10.5 MGD
2040 - 14 MGD and 17 MGD

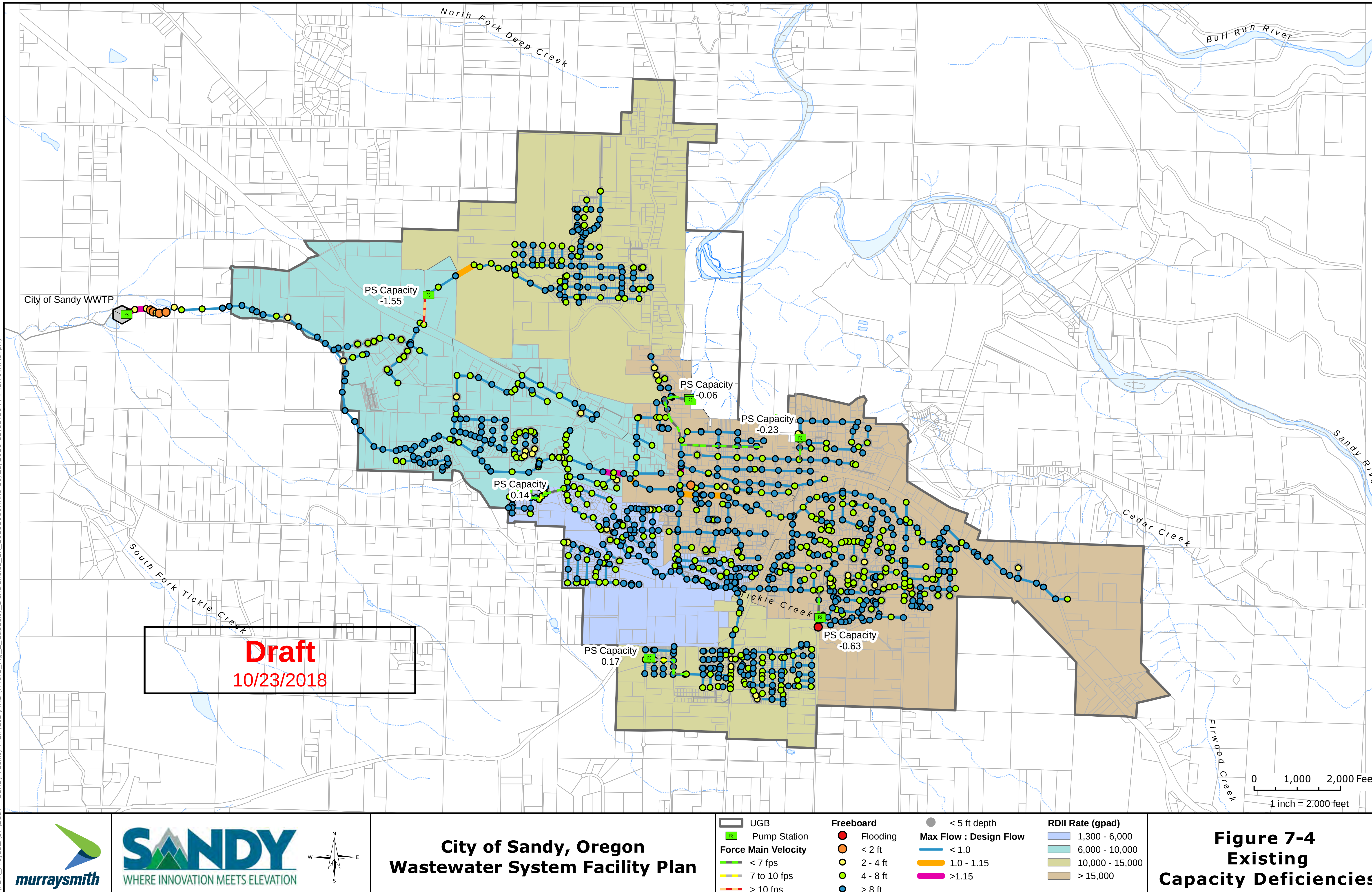




Notes for Figures.

Existing and build-out flows assume removal of all sanitary overflows and pipeline restrictions without reduction of stormwater impacts and RDII.

System curves are theoretical and are based on nominal force main diameter and a Hazen-Williams friction coefficient of 100-120. The system curves have not been verified with pump station field tests (draw down tests).



G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM6.1_Fig_2_Capacity_Deficiencies_EX_20181009.mxd 10/23/2018 11:53:30 AM Yarrow.Murphy

January 2019 17-2137

This page intentionally left blank

7.5.1 Existing System Capacity Evaluation Summary

With the existing condition design storm peak flows, the major capacity risks are found in pump stations and force mains. The Sandy Bluff Pump Station and Jacoby/Timberline Trails Pump Station are predicted to have flows exceeding total rated capacities and The Sandy Bluff force main velocity exceeds 10 fps. The Sandy Trunk is predicted to surcharge within two feet of the surface at four manholes near the WWTP, but flooding is not predicted.

7.6 Future (2040) Collection System Capacity Evaluation

The City's wastewater collection system model was used to identify system hydraulic response to 2040 base flows and RDII based on the design storm and criteria presented in **Table 7-3**. 2040 system base flows and deficiencies assume partial development of parcels within the UGB to accommodate the projected population. 2040 flow rates were generated by applying unit flow factors to unserved parcels by zoning classification as documented in **Section 6, "Flow and Load Projections."** Service and sewershed areas were assigned to manholes utilizing existing sub-basin delineation and available contour data. The results presented here include RDII based on projected pipe degradation over time and no RDII reduction.

For 2040, the collection system is predicted to be at significantly higher risk of capacity deficiencies compared to the existing system evaluation. The 2040 system deficiency results are presented in **Figure 7-5**, illustrating deficiencies without pipeline and pump station constraints.

Estimated peak 2040 flows into each pump station during the design storm were compared to pump station existing firm capacity, presented in **Table 7-6**. The 2040 pump station capacity analysis assumes removal of all sanitary overflows and pipeline restrictions. The 2040 peak flows are also highlighted in **Figure 7-5**.

Table 7-6
2040 Pump Station Capacity

Pump Station	Firm Capacity (gpm)	Peak Flow to Pump Station (gpm)[1]	Peak Force Main Velocity (fps)
Marcy Street	130	270	6.8
Northside (Sandy Bluff)	600	2000	12.7
Meinig Ave	355	430	4.8
Southeast (Jacoby/ Timberline Trails)	320	1190	13.6
Southwest (Sleepy Hollow)	115	20	0.5
Southside (Snowberry)	185	290	7.5

Notes:
[1] Peak flow during design storm assuming removal of all sanitary overflows and pipeline restrictions.

7.6.1 Summary of Deficiencies 2040

The 2040 collection system capacity deficiencies during the design storm can be grouped by location and type of facility. Gravity pipe capacity deficiencies are found in the 18- to 21-inch Sandy Trunk Sewer, which conveys flows from the tributary sewers to the WWTP. The 12-inch pipe conveying flows from the southeast neighborhoods to the Sandy Trunk is also predicted to have flows exceeding the gravity sewer capacity in 2040 and causing extensive surface flooding. Five of the six pump stations in the collection system are predicted to have flows exceeding the pump station capacity in 2040, with Sleepy Hollow Pump Station being the one station with sufficient capacity. The two force mains serving Sandy Bluff and Jacoby Pump Stations are predicted to have peak design storm velocities exceeding 10 ft/s.

7.7 Infiltration and Inflow Analysis

The City experiences capacity constraints related to RDII and direct storm water connections which are also considered sources of inflow to the system. An RDII Reduction Program is recommended which targets critical storm water system disconnections and structural pipe improvements for high priority infrastructure. A longer-term Repair and Replacement (R&R) Program is also recommended for on-going system maintenance to address long-term system degradation.

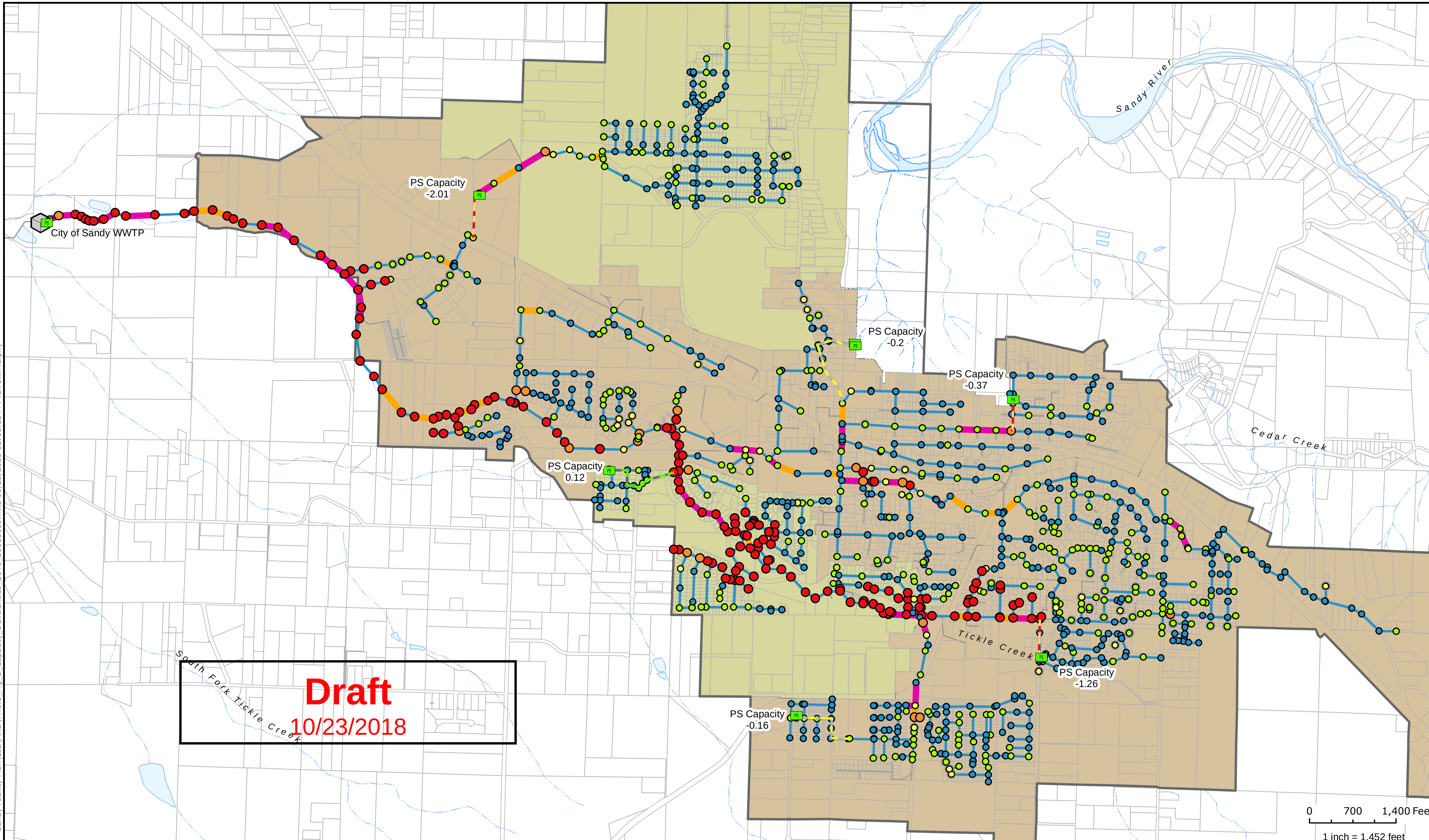
7.7.1 Rainfall Derived Infiltration and Inflow

Peak RDII flows within contributing sewer basin areas can be summarized as flow-per-acre values, typically referred to as RDII rates. These RDII rates can vary significantly across the system, due to factors such as sewer basin development, land use differences, soil type, and system condition (pipe and manhole). The RDII rates were estimated for each flow monitoring location for the calibration flow and rainfall time series using the EPA software, Sanitary Sewer Overflow Analysis and Planning (SSOAP) Toolbox. The output of this analysis was a set of basin-specific unit hydrograph parameters, which were then applied to the design storm to simulate a rainfall-runoff response. Eight of the ten meters were used in developing flow rates. Meters excluded from the wet weather flows analysis are described below.

- Meter 1 (Trunk line near Champion Way) – Flow measurements higher than the magnitude of measured flows at Meter 2, located downstream. The sub-basin area is combined with meter basin 2 for development of unit hydrograph parameters and RDII rates.

- Meter 4 (Ruben Lane) – Flows at this meter during wet weather were significantly lower than those measured at site 7, located 1,500 feet upstream. Flow measurements used to estimate DWF, but not RDII. The sub-basin area is combined with meter basin 2 for development of unit hydrograph parameters and RDII rates.

The unit hydrograph parameters for each basin, developed based on the temporary monitoring period, were extrapolated to the design storm to determine the basin-specific peak flow rates.



murraysmith

SANDY WHERE INNOVATION MEETS ELEVATION

City of Sandy, Oregon
Wastewater System Facility Plan

Figure 7-5
2040
Capacity Deficiencies

January 2019 17-2137

This page intentionally left blank

7.7.2 Existing System RDII Rates

When applying the design storm to the City's calibrated existing system model, the calculated peak RDII rate is 12,000 gpad overall, which varies by sub-basin between roughly 1,300 gpad and 18,300 gpad as summarized in **Table 7-7**. For comparison, Oregon utilities typically use standard design rates for RDII in new systems in the range of 1,000 to 2,500 gpad. The rates found in the City indicate significant influence of RDII on the existing system, particularly in areas where there are older concrete pipes, as illustrated in **Figure 7-6**.

Table 7-7
Existing Peak RDII Rates by Meter Basin

Meter ID	Basin Description	Peak RDII for Design Storm (gpad)
2	Sunset Street to the Treatment Plant	6,900
3	Highway 211 to Sandy Heights	1,300
5	Sandy Bluff	11,700
6	Commercial Core	18,300
7	Chalet Mobile Estates and Bluff Road	15,800
8	East end to Strawbridge	16,600
9	Cascadia Village to Tupper	11,000
10	Dubarko Drive east of Highway 211	16,700

7.7.3 Future (2040) RDII Estimation Methodology

Collection system extensions associated with future development will contribute some amount of RDII to the system. During the planning horizon, the sanitary collection system for 2040 was projected to grow at the same rate as the general population growth, with the RDII rates for new pipes set at the design rate of 2,500 gpad.

In addition to added RDII from new sanitary sewer pipes, existing pipes will continue to degrade and thus be sources of increasing RDII over time. This analysis assumed pipe condition degrades based on age and pipe material, with degradation continuing in the future at a rate similar to that observed in the existing system.

7.7.4 Future (2040) RDII Rates

When applying the design storm to the City's wastewater system model with additional flows from future development and pipe degradation, the calculated peak RDII rate varies by sub-basin between roughly 11,700 gpad and 24,100 gpad as summarized in **Table 7-8** and illustrated in **Figure 7-7**. These rates reflect the RDII from the existing pipes and existing area served, which is the appropriate measure to target RDII source reduction of existing facilities. The rates found in the City indicate growth in the influence of RDII on the collection system capacity.

Table 7-8
2040 RDII Rates by Meter Basin

Meter ID	Basin Description	Peak RDII for Design Storm (net gpad)[1]
2	Sunset Street to the Treatment Plant	15,900
3	Highway 211 to Sandy Heights	12,700
5	Sandy Bluff	11,700
6	Commercial Core	19,600
7	Chalet Mobile Estates and Bluff Road	19,400
8	East end to Strawbridge	22,100
9	Cascadia Village to Tupper	24,100
10	Dubarko Drive east of Highway 211	18,900

Note:

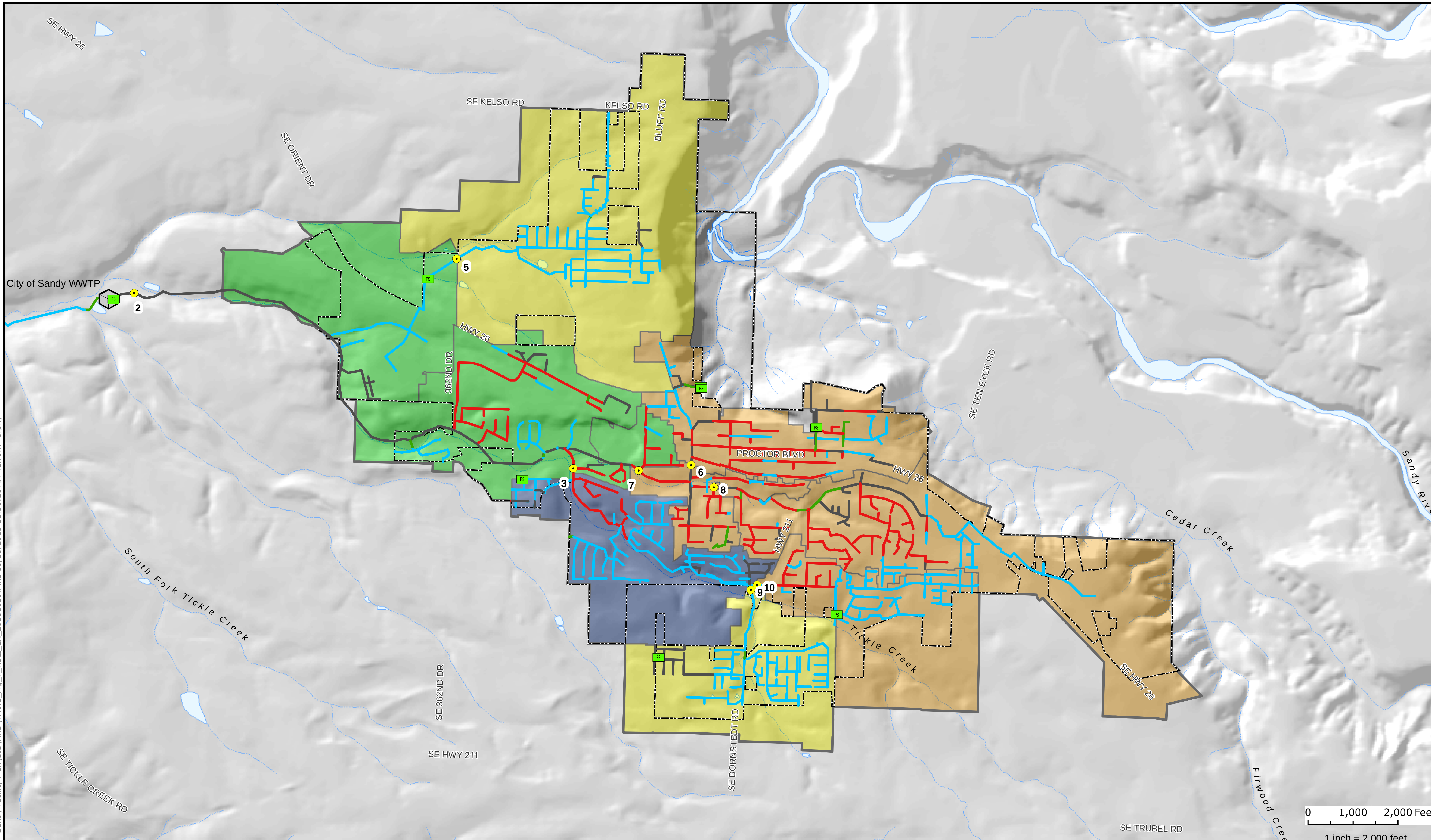
RDII rates for the existing pipe system and net service areas only. These rates do not include the future development areas and RDII resulting from pipes installed between 2018 and 2040.

7.7.5 Sanitary Sewer Condition

As the collection system ages, the structural and operational condition of the sewer system will decline as the number and type of defects in the piped system increase. If unattended, the severity and number of defects will increase along with an increased potential of sewer failure. Sewer failure is defined as an inability of the sewer to convey the design flow and is manifested by hydraulic and/or structural failure modes. Hydraulic failures can result from inadequate hydraulic capacity in the sewer, which can result from a reduction in pipe area due to accumulations of sediment, gravel, debris, roots, fats, oil, and grease, and structural failure. Further, a major loss of hydraulic capacity can be the result of excessive RDII or inappropriate planning for future growth that results in flows exceeding pipe capacity.

Structural defects left unattended can lead to catastrophic failures, such as pipe collapses and sanitary sewer overflows (SSOs). Structural failures may stem from common structural defects, such as cracks, fractures, holes, corrosion, and joint separations. Some cracked and broken sewers are the result of a condition called soil piping. Soil piping in this context is a loss of pipe bedding and backfill support due to small grain soil particles washing out of the supporting soils into the sewer as a result of infiltration at sewer cracks and separated joints. If these conditions are not addressed, sewers can fail, resulting in sinkholes, basement backups, and SSOs. Both hydraulic and structural failures can have a significant negative impact on the community and the environment.

An R&R program is required to extend the useful life of the collection system and minimize downstream capacity impacts by repairing or replacing failing infrastructure. Once the critical failures are eliminated, a R&R program proactively rehabilitates sewers prior to failure. Such a program extends the useful life of assets at minimum cost since the cost of rehabilitation is typically half the cost of pipe replacement and is even more economical when compared with the cost of repairing a failed sewer.



murraysmith

SANDY
WHERE INNOVATION MEETS ELEVATION

City of Sandy, Oregon
Wastewater System Facility Plan

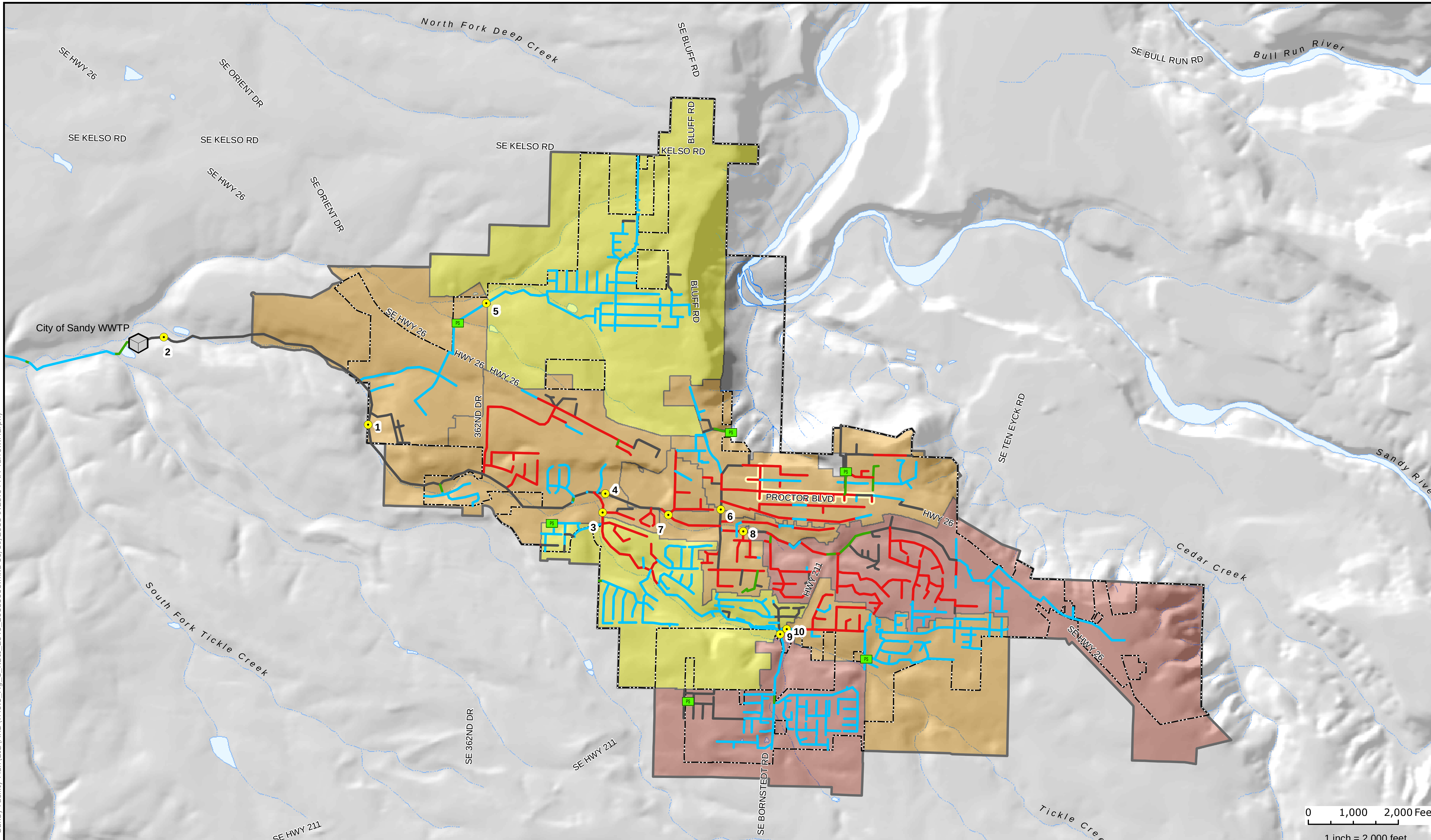
WWTP
Pump Station
Temp Monitor
Stream

Pipe Material
CI or DI
CSP
PVC
Unknown

RDII Rate (gpad)
< 1,500
1,500 - 5,000
5,000 - 10,000
10,000 - 15,000
15,000 - 20,000
> 20,000 gpad

Figure 7-6
Existing RDII Rates

This page intentionally left blank



murraysmith

SANDY
WHERE INNOVATION MEETS ELEVATION

City of Sandy, Oregon
Wastewater System Facility Plan

WWTP
Pump Station
Temp Monitor
Stream

Pipe Material
CI or DI
CSP
PVC
Unknown
CIPP Lined

RDII Rate* (gpad)
< 1,500
1,500 - 5,000
5,000 - 10,000
10,000 - 15,000
15,000 - 20,000
> 20,000

*Note: RDII Rate for existing pipes and areas including degradation.

Figure 7-7
2040 RDII Rates

This page intentionally left blank

An RDII Reduction Program focuses more on the excess water entering the collection system and less on the structural and hydraulic failures. There can be some significant overlap, as structural and hydraulic failures in a pipeline can contribute to higher RDII. However, an RDII Reduction Program will prioritize areas with the highest rates of leakage as well as non-sewer main sources of RDII, such as cross-connected storm drains, roof drain leaders, and private laterals.

Many of the non-sewer main potential RDII sources are prohibited by the City. Per the City's Municipal Code, "No spring, creek, surface water drainage, downspout shall be connected with the city sewer system without permission and the approval of the building official." (per 13.12.120). The City's code provides the authority to embark on an RDII Reduction Program and can even contemplate enforcement of their Code to private property owners to address those sources related to unauthorized connections.

The City's capital improvement program (CIP), as presented in **Section 11**, includes funds set aside for the development of an RDII Reduction Program. An R&R program is assumed to be established as a maintenance program outside of this CIP, with an investment rate between $0.5M to $1M per year. The foundation of these programs is a sewer inspection and condition assessment that identifies specific sewer and manhole condition. Sewer condition and other risk factors are used to establish improvement priorities. This risk-based approach considers the likelihood and consequences of sewer failure based on sewer structural integrity and hydraulic condition. Other factors include emergency sewer repair costs, sewer location, environmental impacts of failure, and health impacts of failure. A risk-based approach to implementing these programs helps ensure that capital dollars are spent where they will provide the greatest benefit.

7.7.6 Infiltration and Inflow Reduction

The City's sanitary sewer collection system and downstream infrastructure including treatment systems are significantly influenced by RDII. Reducing wet weather influence in the collection system may be the most cost-effective way of improving the hydraulic capacity and reducing the need to expand pump stations, piping, treatment, effluent storage and effluent piping to convey, treat and discharge existing and future flows. This plan considers the cost of RDII reduction, collection system capacity improvements and treatment improvements as a whole system, so the cost of RDII reduction is optimized with the CIP.

The following are suggested components of the City's RDII Reduction Program:

1. Additional flow monitoring to quantify the RDII in the collection system, especially during storm events similar in magnitude to the design storm event. Use additional flow monitoring to refine existing model calibration, pipe degradation rates and RDII predictions.

2. RDII source investigations and repair of stormwater inflow sources

3. Collection system condition assessment

4. Develop and prioritize RDII reduction projects

5. Design and construction projects.

6. Follow up RDII reduction projects with monitoring and modeling to inform further action and continue coordination with treatment and conveyance capacity.

An effective RDII Reduction Program requires comprehensive implementation efforts and critical coordination with local property owners to disconnect storm drains and replace failing laterals on private property. The RDII Reduction Program typically includes short-term goals to address the most deficient piping and service connections, and long-term goals of large-scale rehabilitation or replacement of aging infrastructure.

7.7.7 Infiltration and Inflow Source Investigation

It is recommended that the City take early action to identify likely sources contributing to high peak flows in the collection system and downstream infrastructure. Potential RDII sources within a basin include the following:

- Manhole covers and frames
- Basement sump pumps
- Foundation and area drains
- Pipe cleanouts
- Roof drain connections
- Cross-connections to storm water system
- Defective areas of pipes and manholes
- Defective pipe joints and manhole connections
- Defective service laterals and lateral connections to mainline

Techniques available to identify RDII include the following:

- Smoke testing - A nontoxic, odorless, non-staining smoke is injected into the collection system via a blower. The smoke will travel throughout the system and detect specific inflow points such as storm sewer cross-connections, roof connections, yard and area drains, foundation drains, and faulty service connections. In some cases, smoke testing will reveal locations of defective pipes and joints.

- Dye testing - Dyed water is injected into catch basins or storm drains to check for public storm drain cross-connections. Dyed water can be injected into downspouts, area drains, and floor drains to check for private sector connections to the sanitary sewer.

- Visual inspections - Visual inspections include the internal pipe CCTV inspections performed by City staff and can include external inspections conducted at the ground level. CCTV inspections are an excellent tool for identifying structural and operational defects in the collection system. In general, the identification of separated and broken joints, holes in pipes, and many other forms of structural decay indicate potential sources of RDII. However, CCTV inspections are not a good source for quantifying the volume of RDII in the system.

- Exfiltration testing - Exfiltration testing primarily identifies mainline defects, as service laterals cannot be isolated easily and tested with this method. This method is sensitive to the groundwater elevation at the time of the test and is most reliable in periods of dry weather or, at a minimum, after several days without significant rainfall. Exfiltration testing should be performed in similar groundwater conditions in both the pre- and post-rehabilitation stages.

- Refined flow monitoring - Flow monitoring is the primary tool available for quantifying the amount of RDII entering the collection system. Flow monitoring is required throughout dry and wet periods to establish both the base flow and wet weather contributions. Judicious use of flow monitors within a basin will help identify the RDII contributions for smaller, more localized areas.

The recommended CIP depends on identifying and addressing inflow sources throughout the collection system within the first 2 years of this plan. The program will focus on smoke testing, with the other techniques, such as dye testing, to be used when necessary to clarify connections. Smoke testing area priorities are outlined in **Table 7-9**. 169,000 LF of pipe is recommended for testing. At a rate of $1 per LF, the total estimated cost for the source detection is $169,000. The cost excludes the costs of repairs.

Table 7-9
RDII Source Detection Priorities

Priority	Location(s)	Pipe Length (LF)[1]	Note
1	Upstream of Meter 4 to meters 6 and 8	14,500	Observed GWI during the wet season and inflow during storm events.
1	Upstream of Meter 5	22,000	Observed inflow during storm events. Newer pipe in Basin 5 (Sandy Bluff area) not expected to have high RDII as recorded by monitor.
2	Basins 2 and 8	71,200	Priority RDII reduction basins
2	Basin 6	20,800	Cost effectiveness and RDII rate similar to Basin 8. Also has oldest pipes in the system. There may be some opportunities to address inflow sources there.
3	Basin 10	18,000	RDII rate exceeds 15,000 GPAD
3	Basin 9	22,800	RDII rate exceeds 10,000 GPAD

Note:
1 Pipe length exclusive of force mains.

7.7.8 Inspection and Condition Assessment

The USEPA's proposed Capacity, Management, Operation, and Maintenance (CMOM) requirements identify a sewer inspection program as being an essential element of a proactive maintenance program and its complementary R&R program.

Although there are currently a number of inspection and investigative technologies on the market, closed-circuit television (CCTV) inspection remains the most economic and versatile inspection technology available. Many of the other investigative technologies are best applied for specialized conditions not addressed by basic CCTV inspection.

Due to the time constraints in upgrading the wastewater treatment, reuse, and discharge components of the City's wastewater facilities, the collection system condition assessment should be expedited to be completed in a three-year cycle. The City has approximately 200,000 linear feet (LF) of sanitary gravity pipe eight inches and larger in diameter. To inspect the entire collection system on a three-year cycle, an average of 67,000 LF of sewer would need to be inspected annually. Assuming an average cost of $1.55 per LF for inspection and $1.05 per LF for engineering condition assessment, the cost for the inspection is approximately $520,000, or $173,000 per year for three years.

The City's inspection schedule should prioritize the oldest and leakiest portions of the system first, with an emphasis on structurally vulnerable pipe materials and the highest RDII. **Table 7-10** suggests a timeline for CCTV inspection.

Table 7-10
Suggested Inspection Schedule

Year	Basins	Total Pipe Length (ft)
2	2 and 8	74,200
3	5, 6 and 7	54,300
4	3, 9 and 10	71,000

The results of the inspection and condition assessment will inform investments in the long-term R&R program as well as identify shorter term, high priority actions that can be taken to address structural defects that are likely contributing high rates of RDII.

7.7.9 RDII Reduction Projects

The RDII projects that come from the investigative work include correcting inflow sources, sewer rehabilitation and replacement, service lateral replacement, and, potentially, the construction of new sanitary sewers.

If storm cross-connections, broken pipes near streams, roof drain connections, etc., are identified in the RDII source investigation, then these isolated sources should be corrected. These sources are often relatively inexpensive to correct but contribute a significant amount of RDII.

Sewer and manhole rehabilitation to reduce RDII may be implemented on a block-by-block or basin-wide basis. The approach depends on several factors though, in general, the condition of the sewers, the surface and sub-surface conditions (under road or gravel, in bedrock or soil), and available funding for the project will dictate if it is feasible to rehabilitate the entire basin or simply focus on the worst defects. However, the wastewater treatment strategy recommended in this plan is contingent on maintaining flows at specified levels by 2040, meaning that any failure to meet the RDII reduction target will result in financial consequences related to wastewater treatment capacity. These risks and tradeoffs are discussed in greater detail in Section 10, "Alternatives Analysis" and Section 11, "Recommended Capital Improvement Program".

7.7.9.1 RDII Reduction Costs and Scenarios

RDII reduction levels vary based on the extent of the program to include rehabilitation of sewer laterals. Recognizing that the City's jurisdiction is over the sewer mains and connections, three RDII reduction scenarios were considered for this plan with assumed RDII reduction rates as follows:

- Rehabilitate sewer mains only - 20%
- Rehabilitate sewer mains and connections - 30%
- Rehabilitate sewer mains, connections, and private laterals - 65%

The target removal percentages are based on several pilot studies and projects in Sweet Home, Oregon. The work consisted of rehabilitation of sewer mains and lateral connections only, laterals only (both lower and upper), and full rehabilitation of the mains and entire laterals to the building. The analysis showed that full rehabilitation was more cost-effective than partial rehabilitation. These types of reductions have been validated by RDII work performed in Portland, Oregon and throughout the country. The City has approximately 3,500 service laterals that may be addressed both for RDII reduction and to preserve structural integrity of the mains where they connect. In a program that addresses mains and laterals, laterals account for about 25 to 50-percent of the overall project cost depending on density of development. However, with the effectiveness of the RDII reduction more than doubling when adding the repair of the entire lateral, the most cost-effective approach tends to be to rehabilitate the mains, connections and the entire lateral.

For comparison purposes, planning level construction costs were calculated to holistically replace and rehabilitate the pipes in each basin for the three reduction scenarios (20-percent, 30-percent, and 65-percent). The percentage reductions are assumed to encompass a combination of stormwater removal from direct connections and from repair of structural defects. **Table 7-11** lists the key statistics of the meter basins, including the assumed number of laterals and pipe length by pipe diameter in each basin. **Table 7-12** list the approximate project costs by meter basin for trenchless (CIPP) construction techniques.

Table 7-11
Meter Basin Pipe Length and Laterals

Meter ID	Basin Description	Length of pipe (LF) by diameter (inches)				Number of laterals
		8-10	12-15	18-21	Total	
2	Sunset Street to the Treatment Plant	25,700	5,300	12,000	43,000	150
3	Highway 211 to Sandy Heights	23,300	2,000	3,800	29,100	520
5	Sandy Bluff	17,800	1,300	0	19,100	540
6	Commercial Core	22,600	800	0	23,400	230
7	Chalet Mobile Estates and Bluff Road	7,800	2,200	0	10,000	100
8	East end to Strawbridge	30,000	2,200	0	32,200	300
9	Cascadia Village to Tupper	23,000	600	400	24,000	550
10	Dubarko Drive east of Highway 211	16,000	2,600	0	18,800	330

Table 7-12
RDII Reduction Costs[2, 3] for CIPP Mainline Rehabilitation

Meter ID	Basin Description	20% RDII Reduction[1]	30% RDII Reduction	65% RDII Reduction
2	Sunset Street to the Treatment Plant	$2,593,000	$3,051,000	$3,395,000
3	Highway 211 to Sandy Heights	$3,044,000	$4,612,000	$5,788,000
5	Sandy Bluff	$2,693,000	$4,322,000	$5,544,000
6	Commercial Core	$1,499,000	$2,190,000	$2,708,000
7	Chalet Mobile Estates and Bluff Road	$775,000	$1,062,000	$1,277,000
8	East end to Strawbridge	$1,931,000	$2,832,000	$3,507,000
9	Cascadia Village to Tupper	$2,824,000	$4,469,000	$5,703,000
10	Dubarko Drive east of Highway 211	$2,054,000	$3,042,000	$3,783,000

Notes:

1 Pipes larger than 15-inch diameter excluded from the cost estimate due to unknown condition of the trunk sewer and higher costs associated with CIPP lining larger pipes, making the gains in RDII reduction less cost effective for these larger pipes. Any decision regarding replacement or rehabilitation of the trunk sewer due to condition will be based on further condition assessment.

2 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate.

3 Stormwater infrastructure for drainage disconnects is excluded form cost estimates.

Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. Costs estimates represent replacement and rehabilitation of small diameter (15-inches and smaller) sewer mains assuming one lateral per parcel in each meter basin. Costs estimates do not account for any additional needed stormwater conveyance, but do include costs for design, construction management and or other ancillary project costs, such as traffic control and bypass pumping.

Using the costs provided in **Table 7-12**, the peak flow rates and the assumed flow reduction with each approach, the costs are normalized to cost per peak flow removed. The peak flow reduction and costs per peak gallon per day removed are provided in **Table 7-13**.

Table 7-13
Rehabilitation Costs Summary

Meter ID	Basin Description	2040 Peak Flow Reduction (MGD)			Cost per Peak RDII Removed ($/gpd)		
		20% RDII Reduction	30% RDII Reduction	65% RDII Reduction	20% RDII Reduction	30% RDII Reduction	65% RDII Reduction
2	Sunset Street to the Treatment Plant	0.54	0.81	1.76	$4.80	$3.80	$1.90
3	Highway 211 to Sandy Heights	0.13	0.20	0.43	$23.00	$23.20	$13.40
5	Sandy Bluff	0.39	0.59	1.28	$6.90	$7.30	$4.30
6	Commercial Core	0.33	0.54	1.27	$4.50	$4.10	$2.10
7	Chalet Mobile Estates and Bluff Road	0.11	0.16	0.34	$7.40	$6.70	$3.70
8	East end to Strawbridge	0.51	0.76	1.65	$3.80	$3.70	$2.10
9	Cascadia Village to Tupper	0.25	0.37	0.80	$11.40	$12.10	$7.10
10	Dubarko Drive east of Highway 211	0.21	0.31	0.67	$9.90	$9.80	$5.60

Defining cost-effective RDII reduction projects requires consideration of the costs of conveying and treating the wastewater. The evaluation of the cost effectiveness of the complete set of wastewater collection and treatment system improvements needed is discussed in detail in **Section 10, "Alternative Evaluation"**.

7.7.10 Post Rehabilitation Project Monitoring

Post-rehabilitation monitoring and modeling are recommended to determine the impact and effectiveness of RDII reduction activities to meet the flow reduction targets established for the wastewater treatment and effluent capacity. This information may be used for ongoing refinement of RDII projects and downstream capacity improvements.

Although there are several ways to approach RDII reduction projects, the common denominator is a methodology to quantify RDII reduction achieved from the various efforts so that refinements to the program can be made and future investments can be better focused. For the City, this may be done most efficiently by conducting pre- and post-rehabilitation flow monitoring and recalibration of the hydrologic model and/or pre- and post-rehabilitation exfiltration testing. The key component in determining the impact of rehabilitation is having sufficient and accurate flow and rainfall data that is collected at similar locations so that a direct comparison can be made between pre- and post-rehabilitation results.

The temporary monitoring performed to calibrate the model and establish pre-treatment RDII rates included 10 monitors that were installed for just over two months. Monitoring equipment installed on a longer-term basis would enable the City to better monitor and understand flows in the collection system over time. The budget includes $100,000 per year to perform this monitoring at five sites throughout the collection system.

7.7.11 Summary of RDII Evaluation and Recommendations

The RDII rates for the existing condition indicate that the City's wastewater collection system and downstream infrastructure are significantly influenced by wet weather. Several actions are recommended for both the near-term and long-term to prevent the need to continually invest in infrastructure with greater capacity to accommodate growing flows.

Key actions for near term years 1 to 2 include:

- Additional monitoring to refine the characterization of the RDII rates, with confirmation of system response during larger storm events
- RDII source detection and repair of identified stormwater connections to the sanitary collection system.
- Establish City code that provides for lateral repair on private property.

Key actions for near term years 2 to 5 years:

- Condition inspection of the entire gravity collection system for pipes 8-inch diameter and larger.
- Identify and develop priority RDII reduction projects.
- Begin designing and implementing the priority projects.

Key actions for medium term 5 to 13 years:

- Continue implementing projects and monitoring reduction results.
- Adjust priorities based on monitoring results.
- Coordinate monitoring and reduction success with treatment and effluent capacity.

Key ongoing and longer-term (14+ years) actions:

- Monitor flows to evaluate success of RDII reduction and adjust need for further reduction efforts.
- Establish an R&R program to continue the condition inspection and implementation of rehabilitation, repair, or replacement projects as needed.

7.8 Pump Station Condition Assessment

Condition assessments for all pump stations in the collection system were conducted during field visits in January 2018. **Table 7-14** summarizes the findings of the condition assessments. The detailed report is included in **Appendix E**.

Table 7-14
Pump Station Condition Assessment Summary

Pump Station	Condition Assessment Summary
Marcy Street	Need to replace pumps and guide rails in the wet well. Hydrant in the valve vault needs backflow assembly. The valve vault needs fall protection. Site needs fenced enclosure for safety of the public and to protect from vandalism. Other equipment shows rust but is in fair condition.
Sandy Bluff	Pipes and valves in valve vault and wet well are in poor condition, need to be replaced in next 5 years. Safety grate needed on valve vault. Pump building needs active ventilation for cooling. Verify that variable frequency drive on pump 2 now functioning properly after installation of internal drop structure in wet well. Pumps in good condition.
Meinig Avenue	Wet well needs rehabilitation or replacement. Fan and heater in valve vault not rated explosion proof and the control panel and wiring are not protected. Pump condition not inspected but based on age, likely need to be replaced in 5 - 10 years.
Jacoby/Timberline Trails	The discharge piping needs replaced due to corrosion. Bolts in valve vault need to be replaced with stainless steel bolts. Pumps in fair condition – need to be replaced in 5-10 years.
Sleepy Hollow	No improvements recommended at this site. The valve vault is missing a safety grate. Condition of pumps not assessed.
Snowberry	No improvements recommended at this site. The valve vault is missing a safety grate. Discharge piping in the wet well and piping in the valve vault are missing adequate corrosion protection and showing signs of corrosion.

7.9 References

NOAA Atlas Volume 2.

Recommended Standards for Wastewater Facilities [The Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2004].”

City of Sandy. 2015B. Urbanization Study Final Report. Adopted per ordinance 2015-01.

City of Sandy. 2015A. Sandy Market Analysis Update. Accessed 5/3/2018 via internet at https://evogov.s3.amazonaws.com/media/88/media/22983.pdf

City of Sandy. 2017. Urban Growth Boundary Expansion Analysis Final Report. Adopted per ordinances 2017-01 and 2017-02.

Flood Insurance Management Agency (FEMA). 2008. Flood Insurance Study for Clackamas County and Incorporated Areas. Accessed 4/24/2018 via internet at https://www.orcity.org/sites/default/files/fileattachments/public_works/page/4511/fi_1_of_3.pdf).

National Centers for Environmental Information. 2018. US Normals Data (1981-2010) Map. Report for Headworks Portland Water Bureau station. Accessed 5/3/2018 at https://gis.ncdc.noaa.gov/maps/ncei/normals

Oregon Trail School District. 2018. 2017-2018 Current Enrollment Count. Accessed 5/1/2018 via internet at http://oregontrailschools.com/wp-content/uploads/2018/03/Enrollment-Count-2-28-18.pdf

Section **8**

Section 8

Existing Wastewater Treatment Plant Evaluation

8.1 Introduction

An evaluation of the existing wastewater treatment plant was performed to identify any deficiencies. The following sections will discuss the results of the Existing Wastewater Treatment Plant Evaluation, the Existing Wastewater Treatment Plant Code Review, and the Existing Wastewater Treatment Plant Capacity Evaluation.

8.2 Existing Wastewater Treatment Plant Evaluation

This technical memorandum summarizes Murraysmith's field evaluation and condition assessment of the City of Sandy's Wastewater Treatment Plant (WWTP). The WWTP handles domestic wastewater flows from the incorporated areas of the City and is evaluating the feasibility of potentially expanding service to incorporate sewage from a fruit processing facility.

Murraysmith completed an on-site evaluation of the major unit processes to identify specific areas for improvements, which are summarized in the sections that follow. Recommendations are provided to address challenges impacting facility operations along with maintenance upgrades necessary to keep the WWTP in good working condition as one of the City's most important long-lived assets.

This memorandum includes:

- Existing WWTP components
- WWTP Condition Assessment Recommendations
- Unit Process Capacity Evaluation
- Summary of Recommended Improvements

The evaluation culminates in a list of recommended WWTP upgrades at the existing facility to maintain facility performance, simplify operations and assure compliance with the City's current NPDES Permit requirements as summarized in the Regulatory section of this report. The list of recommended WWTP upgrades will be further developed to include costs as part of the WWTP unit process evaluations.

In terms of overall condition, the Sandy WWTP is an aging facility with capacity limitations for treating influent flows and loads. The facility is also lacking in controls and instrumentation to optimize the biological process for the widely variable range of flows experience between summer low flows of approximately 1.08 MGD and the peak winter flows upwards of 7.64 MGD. Key findings summarized in this condition assessment include:

1. **Headworks.** The existing headworks does not appear to be adequately screening out rags and debris, which clog downstream pumps and processes, and ultimately affect the desirability of the dewatered biosolids.

2. **Aeration Basin Flow Split.** Conveyance from the Headworks to the Aeration Basin is being upgraded to split flows between the two aeration basin trains and utilize the Equalization Pond. This important modification is anticipated to help buffer high flows upstream of the Aeration Basin and better optimize treatment performance and help maximize sludge storage in the plant.

3. **Mixed Liquor Recycle and Secondary Clarifier Flow Split.** Only one of the two aeration basins has a mixed liquor (ML) recycle. Furthermore, the hydraulics in the main channel cause the flow to unequally split to the two secondary clarifiers. While the new upstream flow split structure may help balance flows on the upstream end of the aeration basin, the unbalanced secondary clarifier flows will likely continue due to the ML recycle being in only one aeration basin.

4. **Aeration Basin Process Monitoring and Controls.** There are only two dissolved oxygen (DO) probes on the aeration basin and no pH monitoring. This absence of data plus the excessive foam present in the aeration basin suggest multiple deficiencies, which if corrected could enhance treatment and reduce foam.

5. **Secondary Clarifier Condition.** All components of the secondary clarifiers are aging and show signs of corrosion. The foam from the aeration basin persists into the clarifiers, where the scum is not effectively removed by the scum scrapers.

6. **Filtration and UV Disinfection Maintenance.** The filtration and disinfection have several major components which are in need of repair or replacement. Energy Trust of Oregon may be able to fund up to half the cost for upgrading the existing Trojan 4000 medium pressure UV system because of the excessive energy use in the system.

7. **Aerated Sludge Storage Basin, Solids Dewatering and Biosolids Storage Capacity.** The existing solids processing and handling facilities at the WWTP do not currently have capacity for current solids flows in the plant, which has led to the EQ Pond being used for sludge storage. The aerated sludge storage basin (ASSB) does not provide adequate detention time to reach Class B biosolids requirements and produces cake with significant odor issues that makes it an undesirable product for some land application sites. The dewatering feed pump and the polymer feed system is difficult to operate, which contribute to poor dewatering performance. Rags and floatables frequently end up in the biosolids, further exacerbating issues with Biosolids land application.

8.2.1 Existing Wastewater Collection System

As part of this project, the City and Murraysmith are performing an evaluation of the wastewater collection system that will include recommended improvements to the collection system infrastructure including limiting infiltration and inflow as well as pump station rehabilitation. The proposed improvements are anticipated to decrease peak flow rates associated with rainfall-derived inflow and infiltration (RDI/I). However, this WWTP condition assessment and capacity evaluation will not account for these recommended changes since they have not been determined to date.

8.2.2 Existing Wastewater Treatment Plant

The WWTP is located northwest of the city via Jarl Road. City records show that the plant was constructed around 1971 with a major upgrade in 1998. The facility was constructed with a capacity of 4 MGD during wet weather. An activated sludge process is currently in use in conjunction with effluent filtration and disinfection by ultraviolet (UV) light or chlorine. Between November 1st and April 30th, the effluent is discharged to Tickle Creek, a tributary of the Clackamas River. Between May 1st and October 31st, the effluent is used by Iseli Nursery to supplement their water demand for irrigation purposes. The effluent sent to Iseli Nursery is disinfected by chlorine between May 1st and October 31st and is disinfected with UV light during the rest of the year when the flow discharges to Tickle Creek.

The plant currently treats an average annual flow (AAF) of 1.4 MGD. Based on current planning phase flow projections, the WWTP will not have enough capacity to treat projected 2040 flows without replacing or adding a parallel system. The following sections detail each unit process and make recommendations for keeping the facility in good working order, optimizing performance and improving operations and maintenance.

A discussion of major WWTP components are summarized below and described in detail in the sections that follow.

- General Electrical: main power distribution, utility service entrance, generator and automatic transfer switch, main switch gear, motor control centers, SCADA system
- General Site: Yard piping and site security
- Preliminary Treatment: Fine screen, grit removal, influent flow meter, composite sampler, downstream conveyance to aeration basin
- Secondary Treatment: Blower/maintenance building, aeration basin, internal recycle pump station, downstream conveyance to secondary clarifiers, secondary clarifiers, scum pump station, secondary sludge pump station
- Filtration: Disk Filtration System

- Disinfection and Outfall: UV system, hypochlorite injection system, outfall, effluent sampling, and flow monitoring

- Flow Equalization: EQ pond

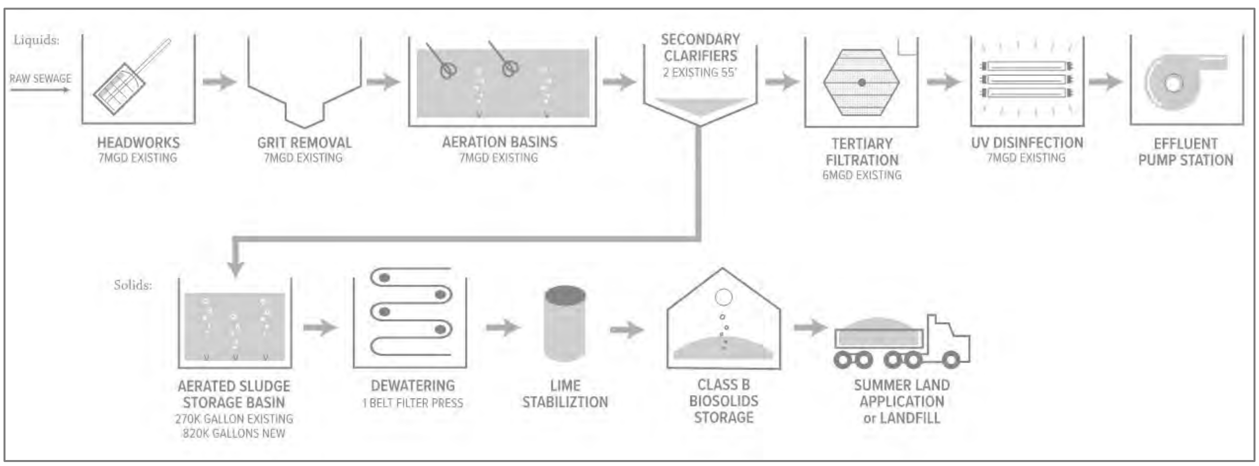
- Solids Treatment: Aerated sludge storage basin, belt filter press and biosolids storage area

- Miscellaneous Site Utility Systems: Utility vault and process water system

- Miscellaneous Site Buildings: Office/Lab, solids handling building

The Existing WWTP Site Plan is shown on **Figure 8-1**, and the Existing Process Schematic is shown on **Figure 8-2** below. A detailed list of mechanical equipment for the unit processes can be found in the Existing WWTP Capacity Evaluation of the Facility Plan.

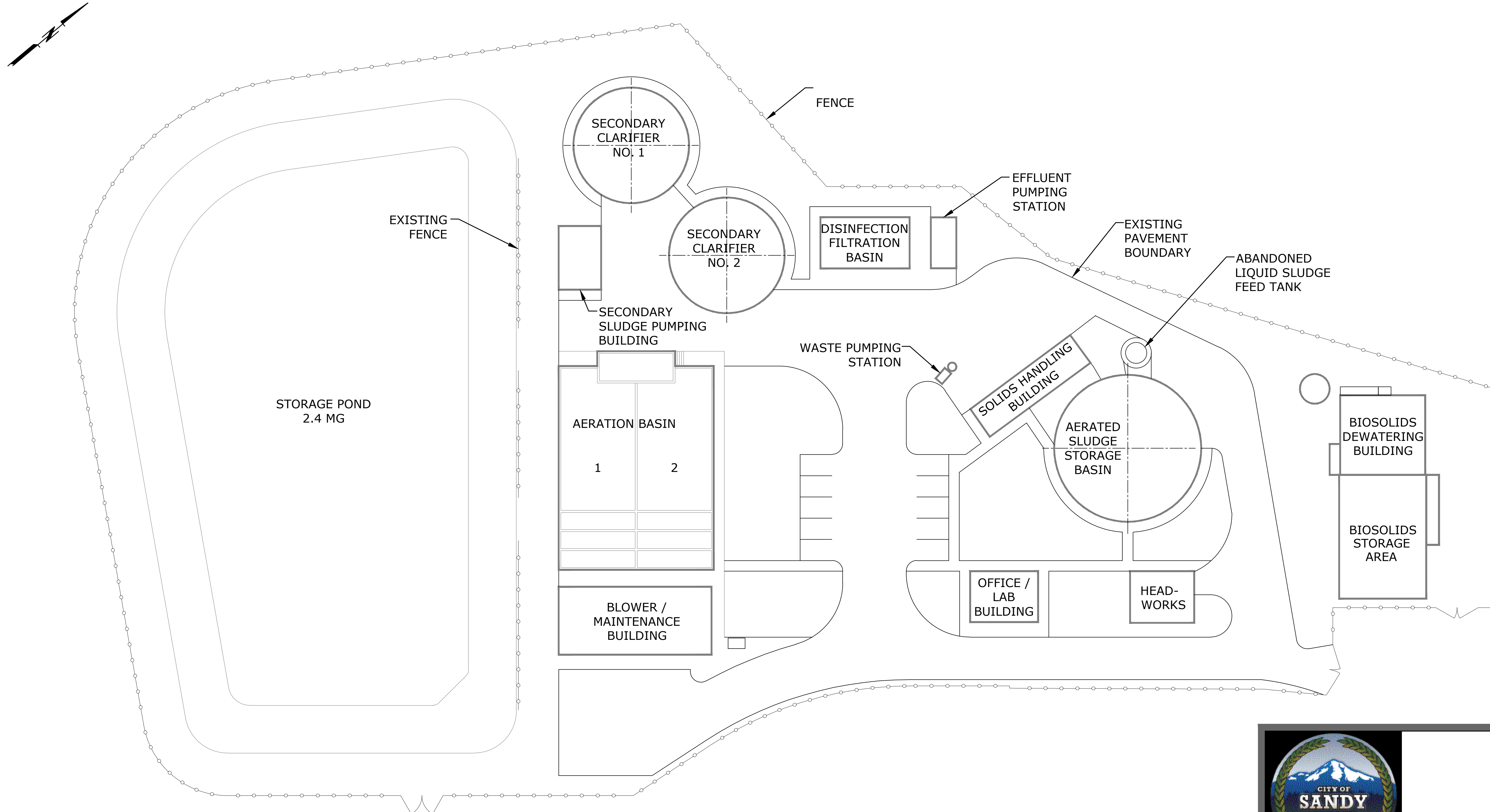
Figure 8-2
Existing Wastewater Treatment Plant Schematic



8.2.2.1 Existing WWTP Condition Evaluation

A team of Murraysmith engineers visited the WWTP to assess existing conditions on the 21st of March 2018. The group extensively investigated the liquids stream, solids handling, electrical equipment, and select structural components throughout the plant. The teams walked the plant to ascertain manufacturing information, design data, and condition of mechanical equipment. Due to ongoing operations and lack of redundancy, the structures could not be drained for inspection.

Condition assessment field notes and photos were collected electronically and are included as an **Appendix F** for reference. Information gathered from the assessment was used to develop a list of recommended improvements needed to keep the facility in good working order, optimize performance and improve operations and maintenance.



SITE PLAN
SCALE: 1/4" = 1'-0"

CITY OF SANDY WWTP

EXISTING SITE PLAN

January 2019

FIGURE 8-1

murraysmith

Project # - 17-2137

This page intentionally left blank

A wastewater treatment plant operations specialist identified operational issues for the City of Sandy WWTP. Detailed information can be found in the Operations Investigation which is included as **Appendix G** for reference. Major issues noted the Operations Investigation are listed below:

- Headworks Screen passing rags and some grit
- Foaming in Aeration Basin
- Appropriate dissolved oxygen (DO) levels in appropriate zones (e.g. anoxic, anaerobic, and aerobic zones) and complete mixing
- Recycle pump flows unequal and not metered
- Lack of Instrumentation on DO, flow, biochemical oxygen demand (BOD), ammonia, and pH in the aeration basin
- Manual cleaning of scum from secondary clarifiers by operators should be automated
- Better use of soda ash for pH adjustment (i.e. soda ash added to aeration basin to help with microbiology)
- Complexity of having two types of disinfection systems
- Belt filter press cumbersome to operate
- Need for good data and trending information
- Limited systems on SCADA

The following sections expand on these issues, including a summary of all WWTP unit processes, their condition and recommendations for improvements.

8.2.2.2 General Electrical

8.2.2.2.1 Main Power Distribution

The facility is served by a 480-volt, 3-phase, 4-wire electrical power distribution system. The main switchgear was upgraded in 1997 and is located in the blower/maintenance building on the west side at ground level. The facility power distribution system consists of the utility service entrance, standby generator, Automatic Transfer Switch (ATS), metering, main distribution switchgear, five Motor Control Centers (MCC), 480-volt power panels, lighting transformers and 120/208-volt lighting panels. Apart from the electrical equipment in the Dewatering Building which was upgraded in 2014, most of the power distribution equipment downstream of the main switchgear was upgraded in 1997. Further descriptions, assessments and recommendations for the facility electrical equipment follow below and in subsequent sections.

Condition Assessment and Recommendations – General Electrical

The main power distribution system including main switchgear, transformer and MCCs - *although installed in 1997* - are in good condition. No upgrade is recommended at this time.

8.2.2.2.2 Utility Service Entrance

The utility service entrance is owned and was provided by the local serving electrical utility company, PGE. Electrical power service to the facility is provided from a 12,470-volt, 3-phase overhead distribution line running on the east side of the facility. The utility power primary conductors run underground to a 750 KVA pad mounted transformer on facility property east of the blower/maintenance building. The utility owned 750 KVA transformer steps the 12.47 KV transmission primary voltage down to 480-volt secondary utilization voltage for the facility. The utility service entrance secondary conductors continue underground from the pad mounted transformer to the main circuit breaker in the switchgear. The utility revenue metering equipment is located in a switchgear metering bus section just ahead of the main circuit breaker. The utility transformer, service conductors and power metering equipment are owned and maintained by PGE. The service entrance rated main switchgear and its metering bus section is owned by the City.

Condition Assessment and Recommendations – Utility Service Entrance

The utility service entrance equipment (transformer, service conductors, power metering equipment, etc.) was installed in 1997 and is in good condition. It is within the second trimester of its 25-30 expected lifespan. No upgrade is recommended at this time due to the condition or serviceability of the equipment.

The 2000 ampere service entrance rated main switchgear has the capacity for future growth to handle an additional 750 KVA transformer.

It is recommended that the utility service entrance equipment be maintained by the utility in accordance with their preventive maintenance standards.

The City-owned service entrance rated main switchgear and its metering bus section are due for 5-year testing and maintenance in accordance with ANSI/NETA MTS-2015 *Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems* as it was last serviced in 1998. It is recommended that the 5-year maintenance be performed by a NETA certified testing contractor.

8.2.2.2.3 Generator and Automatic Transfer Switch

Standby emergency power is supplied by a 750 KW diesel engine-generator. It is in a sound attenuated genset located in the maintenance shop. The standby generator has a remote alarm annunciator mounted on a wall east of MCC-A in the same blower/maintenance building. It was installed in 1997 with the facility upgrades and has a 1200 ampere power output circuit breaker with a diesel fuel storage tank on the equipment skid. Its output is 480-volt, 3-phase, 4-wire connected to the ATS via overhead conductors connected to the emergency terminals on the ATS.

The 3-pole ATS is located right next to the service entrance rated main switchgear. The ATS is 2000 ampere rated and hardwired from its normal power connections to the switchgear 2000 ampere main Circuit breaker. The ATS load connections are hardwired to the switchgear 2000 ampere rated horizontal bus.

The CAT/Peterson standby generator last service was performed in 2016.

Condition Assessment and Recommendations – Generator and Automatic Transfer Switch

The generator and ATS were installed in 1997 and are in good condition. They are in their second trimester of their 25-30 year expected lifespan. No upgrades are recommended at this time due to condition or serviceability.

The 2000 ampere rated ATS has capacity for additional 500 KW of standby power in parallel with the existing 750 KW generator.

8.2.2.2.4 Main Switch Gear

The service entrance rated main switchgear MSB-1 is the primary power distribution center for the facility. Power is distributed to various processes and buildings on the campus via feeder circuits originating from MSB-1. The main switchgear consists of two major groups, the service entrance sections and the feeder sections. The service entrance group consists of the main circuit breaker section and metering section. The service entrance group is described in detail above. The feeder group consists of sections for circuit breakers feeding MCCs throughout the facility. There are currently installed four feeder circuit breakers that feed MCC-A, A1, B and C respectively. MCC-D is fed from MCC-C. The feeder section currently has spare space for at least four additional circuit breakers.

Condition Assessment and Recommendations – Main Switchgear

The service entrance rated main switchgear equipment was installed in 1997 and is in good condition. It is within the second trimester of its 25-30 year expected lifespan. No upgrade is recommended at this time due to the condition or serviceability of the equipment.

Based on the sizes of the existing utility service entrance and standby generator, the capacity of the main switchgear is underutilized and therefore there is plenty capacity for future growth to handle an additional 1000 amperes.

The main switchgear is due for 5-year testing and maintenance in accordance with ANSI/NETA MTS-*2015 Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems* as it was last serviced in 1998. It is recommended that the 5-year maintenance be performed by a NETA certified testing contractor.

8.2.2.2.5 Motor Control Centers

There are a total of five MCCs in the plant, MCC-A, A1, B and C fed from the main switchgear MSB-1 and MCC-D fed from MCC-C. Apart from MCC-C installed in 2014, there rest of the MCCs were installed in 1997. **Table 8-1** below shows the MCCs, their location, model and capacity.

Table 8-1
MCC Locations, Models and Capacity

MCC	Location	Model	Capacity [Amps]
A	Blower/Maintenance Building	GE Spectra Series	600
A1	Blower/Maintenance Building	GE 8000 Series	600
B	Effluent Pumping Station	GE Spectra Series	600
C	Solids Handling Building	GE Spectra Series	600
D	Dewatering Building	GE E9000 Series	600

Condition Assessment and Recommendations – Motor Control Centers

The four MCCs installed in 1997 and MCC-D installed in 2014 are in good condition. They are within the second and first trimester of their 25-30 year expected lifespan respectively. No upgrade is recommended at this time due to the condition or serviceability of the equipment. Although the electrical equipment and the electrical rooms are in good condition, important modifications need to be made to the rooms to fully comply with NEC standards, OSHA regulations, and good practices for electrical rooms. For each of the electrical rooms it is recommended to install fire/smoke detection inside the room, panic door assembly on exit doors, emergency sign and emergency lights to illuminate path of egress. Normal housekeeping and maintenance should be performed in MCC-A1, B and C to remove pieces of cardboard and storage totes from in front of the MCCs as is currently violating the minimum working space of 3-ft recommended by NEC. Similar in MCC-B, the PLC panel PN-1014 should be relocated from in front of the MCC as it is currently violating the minimum recommended working distance of 3.5 feet for electrical equipment between 151-600-volts. Furthermore, a complete arc flash study for the electrical infrastructure should be performed to comply with OSHA standard 1910.269 made mandatory and put into effect on July 10, 2014.

8.2.2.2.6 SCADA System

The facility SCADA system consists of a main control panel PN-900 and four local control panels PN-1004, 1011, 1014 and 1050 located in different areas of the plant. Consistent equipment was found inside the Local Control Panels including Programmable Logic Controllers (PLCs), UPS, small digital readouts, and typical components including circuit breakers, wiring, fuses, terminals, indicator lights, selector switches, etc. Apart from panel PN-1050 installed in 2014, the rest of the panels were installed in 1997. **Table 8-2** below shows the panels, their location, PLC and CPU models.

Table 8-2
Panel Locations and Models

Panel	Location	PLC Model	CPU Model
PN-900, PLC-100	Office/Laboratory Building	GE Fanuc 90-30	351
PN-1004, PLC-200	Blower/Maintenance Building	GE Fanuc 90-30	363
PN-1011, PLC-300	Secondary Sludge Pump Station	GE Fanuc 90-30	331
PN-1014, PLC-400	Effluent Pumping Station	GE Fanuc 90-30	331
PN-1050, PLC-500	Dewatering Building	GE Fanuc 90-30	363

8.2.2.2.7 Condition Assessment and Recommendations – SCADA

The above-mentioned General Electric PLCs appear to be operating adequately and in fair condition, however, they reached the end of their life cycle on October 1, 2017. This means there is limited manufacturer support, and while replacement parts may be available currently, the products are scheduled for discontinuation.

The communication between PN-900 and the four control panels is achieved through a GE proprietary communication bus called Genius Communication Bus (GCB) in the form of serial communications. The serial network consists of two main buses that include PN-1004 and 300 in one bus; and PN-1014 and 1050 in the second bus. None of the main buses exceeds the maximum bus length of 7500-ft recommended by the manufacturer. GE proprietary communication uses serial communication interface which is outdated and slow. Upgrading to Ethernet protocol for data transmission should be considered.

Though it is difficult to predict when the PLCs will stop working, the costs associated with operating and maintaining this equipment is expected to increase until support is no longer available. The state of the current SCADA system makes the WWTP's automation, reporting, and alarms vulnerable should a component fail. Replacement parts may not be available for timely repair.

It is strongly recommended to replace all obsolete GE PLCs with new Allen Bradley (AB) Control Logix PLCs. AB PLCs are provided by Rockwell Automation (RA) which is the leading automation supplier in the United States. Their equipment and software are currently used by many Municipal and Industrial customers. RA's support and service structure are extensive and cover the Sandy area well, and nearly all Systems Integrators and Automation Contractors are familiar with RA products. Also, the existing serial communication should be replaced with Ethernet communications over copper or fiber-optic for faster data transmission.

8.2.2.3 General Site

The following section describes the condition of appurtenances within the site that are not directly associated with the unit processes required for treatment. The condition of the plant's security system and yard piping are discussed, and recommendations for improvements are made where needed.

8.2.2.3.1 Site Security

Plant security is currently minimal. There is a uniform fence surrounding the plant. The natural foliage surrounding the plant is dense. The current gate is in good condition. The gate must be manually unlocked in the morning and locked in the evenings. There are currently no security cameras on site.

Condition Assessment and Recommendations – Site Security

Based on the above assessment Murraysmith recommends the following improvements:

- Install automatic entrance gate.
- Install security cameras and connect to SCADA.

8.2.2.3.2 Yard Piping

The influent gravity sewer enters the site near the entrance gate on the southeast side of the plant and leads to the headworks. This 21-inch gravity pipe routes wastewater from the City's collection system to the treatment plant.

Other yard piping spans the plant as it routes wastewater, utility water, and process water to their respective unit processes. Yard piping is adequate, but there are some capacity issues which will be discussed in later sections related to the unit processes. One inadequacy associated with the yard piping is the inability to buffer high flow into an equalization storage pond at the beginning of the treatment process, and subsequently, high flows are equalized post-treatment by re-contaminating treated effluent in the equalization pond.

Condition Assessment and Recommendations – Yard Piping

Based on the above assessment Murraysmith recommends the following improvements:

- Improve flow equalization storage and ability to divert flow to equalization pond before treatment.

8.2.2.4 Preliminary Treatment

WWTP preliminary treatment includes a fine screen, grit removal, and flow monitoring for the influent wastewater. Flow first passes through a rotary fine screen or a bypass channel equipped with a fixed bar screen. Collected screenings from the fine screen are then conveyed into a container and then transported to Wasco County Landfill for disposal.

Once the influent has been screened, a vortex grit chamber equipped with a Pista Grit System removes grit from the influent wastewater. The wastewater then passes through a Parshall flume with an ultrasonic level transmitter before being routed to the aeration basin.

8.2.2.4.1 Fine Screen

The influent screening process consists of one rotary drum fine screen with a ¼-inch effective clear space. Screenings are lifted by a spiral lifting screw up an auger. Within the auger, screenings are washed and dewatered prior to being dumped into an adjacent dumpster for disposal at a landfill. In addition, the facility has a bypass channel equipped with a manual bar screen with ¾-inch clear space that can be used if the rotary fine screen is out of service.

According to the City's Operation and Maintenance Manual the rotary drum fine screen has a maximum capacity of 6.6 MGD. The screen is more than capable of handling the AAF of 1.41 MGD, but could be overloaded during peak wet weather events in the future. For cleaning cycles, the screens require process water at a rate of approximately 17 gpm at 60 PSI for self-cleaning purposes.

Currently, solids and rags are not being effectively captured by the rotary drum fine screen as evidence of their presence downstream of preliminary treatment. In addition, the automatic fine screen cleaning system is on constantly during peak flow conditions.

Condition Assessment and Recommendations – Fine Screen

The lack of capacity of the current rotary fine screen to handle peak flows, the absence of a redundant screen, and the poor performance of the current rotary drum screen are major concerns for the overall performance of the WWTP and efficiency of the operators downstream.

Based on the above assessment, Murraysmith recommends the following improvements:

- Immediately repair the fine screen to prevent solids from passing.
- Consider upgrading the rotary fine screen to handle future and peak flow rates.
- Install by-pass screens with finer spacing.
- Install redundant fine screen in place of current manual bar screen to provide redundancy and to meet peak flow requirements.

8.2.2.4.2 Grit Removal

The PISTA grit removal system is comprised of a 10-foot diameter concrete grit chamber with a vortex-type grit removal system. Grit collected at the bottom of the grit chamber is pumped into a grit classifier where is it washed and transferred by screw conveyor into a dumpster for haul away to the landfill. This system has a firm capacity of 7 MGD and could be potentially overloaded with flows in the future.

Approximately 1 cubic yard of grit is removed per week. This value is within the typical design range for grit removal and does not indicate any issues with the grit removal system.

Condition Assessment and Recommendations – Grit Removal

The currently installed grit removal system is performing as designed, however, operators informed Murraysmith about issues encountered with the grit pump locking up previously and large rocks entering the grit chamber during a significant storm event in 2015 which damaged the mechanism. In addition, the motor for the grit pumps has been repaired.

Based on the above assessment, Murraysmith recommends the following improvement:

- Replace the aging vortex grit system and consider adding an additional grit chamber to provide redundancy and to handle future peak flows.

- Upgrade fine screen to protect grit system from debris.

- Provide heat tracing for new grit system to prevent freezing in the winter.

8.2.2.4.3 Influent Flow Meter and Composite Sampler

After grit removal, flow passes through a Parshall flume with an ultrasonic flow meter and is routed to the aeration basin. The 12-inch Parshall flume is functioning well and the on-screen display in the field is working well. During peak wet weather events, the Parshall flume is operating near its maximum design flow rate of 9.2 MGD as listed in the City's Operation and Maintenance Manual, and could have some issues in the future with expected increased flows.

The composite sampling system, located in a small unit adjacent to the Parshall flume, is in fair condition. Although it is approaching the end of its life cycle, the sampler is functioning adequately. It is recommended to revisit and reassess this equipment in the next 5 years.

Condition Assessment and Recommendations – Influent Flow Meter and Composite Sampler

Based on the above assessment, Murraysmith recommends the following improvements:

- Consider increasing the Parshall flume size to accommodate future flow rates.
- Consider replacing the ISCO sampler within the next 5 years.

8.2.2.4.4 Downstream Conveyance to Aeration Basins

The preliminary treatment effluent is carried through a 24-inch gravity drain pipe to the aeration basin influent channel. Construction of a new flow splitter box in front of the aeration basin with a 16-inch overflow to the adjacent storage pond will begin later in 2018.

Condition Assessment and Recommendations – Conveyance Aeration Basin

Based on the above assessment, Murraysmith recommends the following improvements:

- Evaluate performance of flow splitter box once installed.

- Evaluate hydraulic capacity of 24-inch pipe in conjunction with long term collection system planning.

8.2.2.5 Secondary Treatment

Secondary treatment at the WWTP consists of a two-train aeration basin and two secondary clarifiers. Once preliminary treatment effluent and RAS flow reach the aeration basin, it is distributed between the two aeration basin trains. The secondary clarifiers receive flow from the aeration trains.

8.2.2.5.1 Blower/Maintenance Building

The blower/maintenance building was constructed as part of the 1998 upgrades and is adjacent to the aeration basins. This building is one story with a control room, locker room, work room that stores a backup generator, and a blower room.

The blower room contains one rotary lobe blower and three multistage centrifugal blowers. The blowers deliver air into the aeration basin to support the biological treatment process. Currently, the rotary lobe blower is not operating, and the three multistage blowers are not able to consistently meet the target dissolved oxygen of 3-5 mg/L.

The work room contains the air compressor, generator, and two hydropneumatic tanks for the process and potable water systems. The hydropneumatic tanks appeared to be in good condition, but only the outside of the tank could be inspected. Similarly, the air compressor and generator also appeared to be in good operating condition, but some insulation on the exhaust piping for the generator is fraying and needs to be replaced.

The overall building structure appeared to be in good shape.

Condition Assessment and Recommendations – Blower/Maintenance Building

Based on the above assessment, Murraysmith recommends the following improvements:

- Repair or replace the broken blower to provide system redundancy.
- Evaluate the operational effectiveness of entire air delivery system to ensure optimal performance
- Repair insulation on the exhaust pipe from the generator.

8.2.2.5.2 Aeration Basin

The aeration basin structure is adjacent to the blower/maintenance building and was also constructed in 1998. The basin is comprised of two trains (Aeration Basin 1 and Aeration Basin 2), each containing two smaller anoxic cells followed by one small and one large aerobic cell. Aeration Basin 1 is located on the southwest side of the basin, and Aeration Basin 2 is located on the northeast side. Flow enters the basin through a 24-inch pipe into the aeration inlet channel that allows for flow to be directed to any of the cells through slide gates along the channel. Due to a pump failure, the mixed liquor internal recycle is only occurring in Aeration Basin 2. This operational variation causes a difference in head in the two aeration basins which appears to impact the flow split from the influent channel. Due to this flow split issue inside the basins, a metal sign has been temporarily placed inside the channel to limit flow to Aeration Basin 1 and balance MLSS concentrations in both basins.

The anoxic cells contain one wall mixer each. Each mixer appears to be sufficiently mixing the anoxic chambers, but the mixers were submerged so a complete examination of the mixers was not possible. The air process pipe from the blower/maintenance building travels under the sidewalk and through the side of the basin wall. The process air pipes are believed to leak somewhere outside of the blower building based on the sound of air escaping noted while at the site. The slide gates, davits, and valves at the aeration basin are rusting and should be repaired.

Both basins have a significant amount of foam that covers at least a portion of each cell in the basin, and the foam is coating the exposed concrete surfaces adjacent to the basin. To limit the foam, process water is sprayed into the first anoxic cell.

An undetermined amount of polymer (Clarifloc 9995) is fed to the inlet channel of the aeration basin using a peristaltic pump.

During the visit to the plant, it was noted that soda ash was being added to the filter discharge channel due to low pH issues in the effluent. This suggests that alkalinity is low in the wastewater influent. Considering that low pH negatively effects biological treatment processes and the nitrification process occurring in the aeration basins consumes alkalinity and drives the pH down, options for adding alkalinity to the wastewater ahead of the head of the aeration basins should be investigated.

Condition Assessment and Recommendations – Aeration Basins

Based on the above assessment, Murraysmith recommends the following improvements:

- Investigate and repair the source of the leak in the process air lines.
- Install automatic spray down system or require manual hose down to periodically wash down the foam remaining on the concrete around the basin to prevent degradation of the concrete.
- Consider replacing or repairing corroded mixer davit cranes and slide gates in the selector zones of Aeration Basins 1 and 2.
- Consider upgrades to provide improved plug flow conditions and reduce short circuiting in the aeration basins.

- Meter polymer dosing into the head of the aeration basin and re-evaluate polymer dosing to determine if it provides benefit or contributes to foam issue.

- Establish DO and pH monitoring on the aeration basin to improve process control. Evaluate options for improving biological processes in the aeration basins and optimizing RAS flow rate to minimize foaming and improve biological nutrient removal.

8.2.2.5.3 Internal Recycle Pump Station

An Internal Recycle Pump Station is located on the downstream end of the aeration basin. The pump station is designed to draw mixed liquor from the combined aeration basin effluent channel using a pair of submersible pumps, but one of the submersible pumps was removed several years ago and, as mentioned before, the mixed liquor is only recycled in Aeration Basin 2. In addition, the condition of the existing pump could not be determined because it was in operation during the site visit. There are no controls on the internal recycle in Aeration Basin 2 nor is the flow metered.

Condition Assessment and Recommendations – Aeration Basins

Based on the above assessment, Murraysmith recommends the following improvements:

- Replace the missing mixed liquor recycle pump. This could potentially be contributing to the flow split issue in the inlet channel.

- Examine the existing recycle pump to determine if the pump needs maintenance or replacement.

- Add flow meter to internal recycle pumps.

- Install VFD on internal recycle pumps to control flow rates and improve biological removal of nutrients from the wastewater.

- Connect pump flow rates and controls to SCADA for remote monitoring.

8.2.2.5.4 Downstream Conveyance to Secondary Clarifiers

The secondary clarifiers are filled with MLSS effluent from the aeration basin. The MLSS travels through the aeration basin effluent channel to a concrete splitter box that splits the flow to the two secondary clarifiers using slide gates. From the splitter box, two separate 20-inch ductile iron pipes convey the MLSS to the two secondary clarifiers (1 and 2). A plate has been temporarily installed inside the effluent channel gate from Aeration Basin 2 to Secondary Clarifier 2 to help balance flow, because higher rates and concentrations of MLSS typically flow to Secondary Clarifier 2, likely a result of the missing internal recycle pump on Aeration Basin 1.

Condition Assessment and Recommendations – Downstream Conveyance to Secondary Clarifiers

Based on the above assessment, Murraysmith recommends the following improvements:

- Replace the missing mixed liquor recycle pump and re-evaluate flow split. This could potentially be contributing to the flow split issue in the effluent channel.

8.2.2.5.5 Secondary Clarifiers

The secondary clarifiers are 54-foot diameter circular structures, each with 15-foot side-water depth. The clarifiers were constructed in 1998 The system consists of a central drive unit, scum scrapers, a scum box, submerged arm rakes, effluent weirs, and inboard launder.

The clarifier interior wall and launder surfaces appear to be in good shape, but there are several cracks on the outside wall of the clarifier that should be inspected. The launders appear to have some algae growth. The center well appears to be in good shape, but structures below the surface were not visible because both clarifiers were in service. There appears to be some minor corrosion on the clarifiers' mechanical equipment and metal structural components.

The clarifiers are equipped with a scum scraper and scum trough. The scum trough in each clarifier conveys the scum scraped from the top of the secondary clarifier via gravity to the scum pump station. The scum scraper and scum boxes are overloaded with foam carried over from the aeration basins. Also, the slope of the scum box in Secondary Clarifier 2 appears to be too shallow and therefore inadequate slope to convey the scum from the trough to the scum pump station. Because of this, the scum box needs to be hosed down regularly to wash the foam out of it.

Process water is sprayed onto the surface of the center well in Secondary Clarifier 2 which limits foam in that area, but the process water spray is not working on Secondary Clarifier 1. As a result, there is a large collection of foam present in the center well. Furthermore, the draw-off pipes in the center-well frequently plug with rags and must be manually rotated to clear out prevent sludge withdraw issues. The poor screening at the headworks cause these flow capacity and maintenance issues in the secondary clarifiers.

Condition Assessment and Recommendations – Secondary Clarifier

Based on the above assessment, Murraysmith recommends the following improvements:

- Repair process water spray-down in Secondary Clarifier 1.
- Sandblast and recoat all metal components at recommended frequency to mitigate corrosion.
- Improve slope of scum trough in Secondary Clarifier 2 to the scum pump station to solve scum drainage issues.
- Spot repair the outside wall cracks.
- Improve preliminary treatment to limit rags in the secondary clarifier.

- Clean out and evaluate launder structural condition.
- Consider replacing the v-notch weirs on the effluent launder.
- Perform routine maintenance and evaluate condition of Secondary Clarifier Drive.

8.2.2.5.6 Scum Pump Station

The scum pump station consists of a wet well and a dry well with a pneumatic pump located adjacent to the secondary clarifiers. Scum from the scum trough flows into the wet well. The scum pump delivers the scum to the aerated sludge storage basin (ASSB) for biosolids treatment and land application or landfill disposal. The pneumatic pump replaced a centrifugal pump that was not effective at pumping the foam. Automatic controls were established for the centrifugal pump, however, the pneumatic pump is not set up to operate automatically and so the operators are required to turn on the scum pumps manually multiple times daily to remove scum from the wet well.

Condition Assessment and Recommendations – Scum Pump Station

Based on the above assessment, Murraysmith recommends the following improvements:

- Install new controls on the scum pumps to allow for automatic operation.

8.2.2.5.7 Secondary Sludge Pump Station

The Secondary Sludge Pump Station is located immediately south of Secondary Clarifier 1 and was constructed as part of the 1998 WWTP upgrades. The pump station houses the Sodium Hypochlorite Storage and Feed System and the RAS and WAS pumps and control panels. The controls include both a VFD for the RAS pumps and display for the RAS Flow Rate.

The RAS pumps consist of two vertical mount, Wemco Hydrostal screw centrifugal pumps that are manually controlled. Each RAS pump is equipped with a flowmeter, and the pumps appear to be near the end of their useful life with a temporary plastic guard being installed on the outside face of each RAS pump as a safety precaution, and the motor for the RAS pump from Clarifier 1 has exposed wires. Lastly, the pumps use a significant amount of seal water during operation that is constantly being drained to a floor drain in the building.

The WAS pumps consist of two double diaphragm pumps. The pumps are heavily rusted in some areas. The lens for the pump air pressure gauge is obscured and no longer readable. The pump rocks during operation and is very noisy. Some of the gaskets around the flexible couples appear to be cracking. Lastly, there are no flow meters on the WAS Pump lines, so the only basis for calculating the flow rate for the WAS pumps is through counting stroke counts on the pumps which is difficult to track and not a very accurate way to measure flow.

For the hypochlorite feed system, the hypochlorite storage tanks and feed pump are stored in a separate room which acts as secondary containment. The tanks looked to be in good condition aside from the rusting of the seismic anchors. The peristaltic feed pump appears to be in good condition, but it is loosely mounted on a platform in the room. Also, the peristaltic pump is not equipped with typical appurtenances including a check valve, pulsation dampener, or calibration column which improves operational performance. The room is equipped with an emergency safety shower and eyewash which are inspected every month and noted in the plant's Maintenance Control database.

Some water was observed inside of the sodium hypochlorite containment area, which appears to be due to groundwater seeping into the building.

Condition Assessment and Recommendations – Secondary Sludge Pump Station

Based on the above assessment, Murraysmith recommends the following improvements:

- Replace RAS and WAS pumps.
- Install WAS flow meters.
- Install flow control valve for RAS and WAS pumps and connect to SCADA.
- Install check valve, pulsation dampener, and calibration column on hypochlorite feed pump.
- Inspect Hypochlorite Storage Room to determine source of water since it could suggest a failure of the secondary containment system.

8.2.2.6 Filtration

The secondary effluent overflows the clarifier weirs and leaves the lauder through a 20-inch ductile iron pipe. The two secondary clarifier pipes combine into a 24-inch combined clarifier effluent pipe to the inlet channel of the filtration basin.

8.2.2.6.1 Disk Filtration System

The Effluent Filtration and Disinfection Basin was constructed as part of the 1998 upgrades. The secondary effluent reaches the inlet channel and splits into two filter basins equipped with Aqua-Aerobics Aqua-Disk disk filters that draw water through a fabric filter to remove some of the remaining suspended particles. The filtrate from the disk filters is discharged in the Filter Discharge Channel and then is conveyed through the UV channel. In addition, some filtered effluent is pumped from the Filter Discharge Channel by two process water pumps to fill process water hydropneumatic tank. In addition, filter effluent can also be pumped to the equalization pond during high flow events.

To promote uniform usage of the disk filters, the disk filters are turned using a drive and chain system. Once the pressure drop across the filter increases to a set level, the disk filters are backwashed with the Filter High Pressure Wash Pump.

During the visit, the Filter High Pressure Wash pump was leaking around the volute and had a few exposed wires. Filter No. 2 drive and chain system was not spinning. Surprisingly, the water level in Filter No. 1 was significantly higher than Filter No. 2 even though Filter No. 1 was recently replaced.

During the visit, a dilute soda ash solution from a plastic container was being slowly pumped into the Filter Discharge Channel to increase the pH in the effluent to between 6-6.5 in the Filter Discharge Channel.

Condition Assessment and Recommendations – Disk Filtration System

Based on the above assessment, Murraysmith recommends the following improvements:

- Repair High Pressure Wash Pump leak and contain exposed wiring.
- Examine and repair Filter No. 2 drive.
- Improve flow split between Filter No. 1 and 2 and inspect Filter No. 1 for operational issues.

8.2.2.7 Disinfection and Outfall

The WWTP disinfection system utilizes UV disinfection between November 1st and April 30st when discharging into Tickle Creek. Alternatively, the WWTP uses Sodium Hypochlorite to disinfect between May 1st to October 31st when effluent is sent to Iseli Nursery for irrigation. A 14-inch pipe (PVC C-900) conveys disinfected effluent to either outfall location, which is controlled by a valve located between the two outfall locations.

8.2.2.7.1 UV Disinfection System

The UV System was installed during the 1998 upgrades and is equipped with a Trojan UV4000 Medium Pressure UV System with 24 lamps. Filtered effluent leaves the Disk Filtration System and then flows through the UV channel. The UV system has some evidence of corrosion, but overall the system looks to be in good repair. The structural concrete surrounding the system is in good condition. The system is designed for a maximum 7.0 MGD, so the system could be potentially hydraulically overloaded in the future.

According to Operators during the Site Assessment Visit, the UV transmittance meter is broken. Therefore, the operators cannot obtain an accurate determination of the UV dosage by the system under different flow conditions and water quality. In the absence of the meter, the operators have conservatively set the UV Transmittance to 45 percent manually on the system, which reportedly has been effectively disinfecting to permit targets, however, increases the already high energy demand from the medium pressure UV system. The Operations and Maintenance Manual recommends the UV system operate above 65 percent UVT. Also, medium pressure UV lamps typically use two to five times the amount of energy of low-pressure lamps. Lastly, the automatic cleaning mechanism for the lamps is broken so operators must clean them manually. Parts for replacing the cleaning mechanism are on site, and will be installed during the summer in 2018.

Condition Assessment and Recommendations – UV System

Based on the above assessment, Murraysmith recommends the following improvements:

- Repair or replace UV transmittance meter.
- Repair lamp quartz sleeve cleaning mechanism.
- Add an additional UV channel to handle peak flows and to add redundancy.
- Consider replacement of the UV 4000 system as it is medium pressure and is less energy efficient than other UV lamps

8.2.2.7.2 Sodium Hypochlorite Disinfection

The Sodium Hypochlorite Disinfection system is comprised of two 1,000 gallon Sodium Hypochlorite tanks and one metering pump in the Secondary Sludge Pumping Building as discussed above in Section 8.2.2.5.7.

There are two injection points of sodium hypochlorite: one in-line injection into to the RAS, which is not actively used, and one in-line injection into the 24-inch combined secondary effluent pipe. The feed line of sodium hypochlorite is conveyed from the Secondary Sludge Pump Station to a small water meter vault prior to injection into the secondary effluent pipe to allow for access to the feed lines. The sodium hypochlorite is delivered into the pipe using an injection quill. This feed line was constructed with brass fittings which should be replaced before being placed in service due to incompatibility with sodium hypochlorite.

Condition Assessment and Recommendations – Sodium Hypochlorite

Based on the above assessment, Murraysmith recommends the following improvements:

- Install another Sodium Hypochlorite metering pump for redundancy along with proper appurtenances.

- Replace brass fittings on the line and install secondary containment piping within the vault.

8.2.2.7.3 Outfall, Effluent Sampling, and Flow Monitoring

Final effluent passes through the UV channel and into a metering channel equipped with a 120-degree V-notch weir to measure flow to the outfall wet well. Flow rates are measured using an ultrasonic meter. This weir has the capacity to measure flow up to 8.3 MGD, although the inaccuracy of flow measurement with v-notch weirs can be as great as 5 to 15 percent. The wet well is equipped with three vertical turbine effluent pumps each rated at 700 GPM and an 18-inch winter overflow pipe. The 18-inch overflow is piped north and connects into the stormwater outfall. An ISCO sampler pulls composite samples from the metering channel. During high flow conditions, finished water gets pumped to the EQ pond; whereas it would be more efficient to equalize flow prior to treatment.

The vertical turbine pumps the treated effluent water out of the effluent wet well through a 14-inch pipe to one of the two aforementioned outfalls, depending on the season. During winter months, November 1st to April 30th, effluent is discharged by gravity to Tickle Creek. During Summer months, May 1st to October 31st, effluent is pumped to a reservoir located at the Iseli Nursey and then used for irrigation purposes.

The combined maximum capacity of the effluent pumps is 3.0 MGD which would likely not provide enough capacity in the future. Scum persisted beyond the secondary clarifiers and accumulated even into the final effluent wet well. In addition, some of the pumps are making substantial noises while operating and seal water was observed leaking during the site visit.

Condition Assessment and Recommendations – Outfall Piping, Sampling, and Discharge

Based on the above assessment, Murraysmith recommends the following improvements:

- Replace V-notch weir with a parshall flume or magnetic flow meter for a more accurate method of monitoring effluent flows.
- Investigate noisy outfall pumps.
- Improve treatment processes upstream to reduce foam.
- Evaluate hydraulic capacity to meet future flow demands.

8.2.2.8 Flow Equalization

The WWTP handles high flow conditions by diverting flow from both the liquid and solids streams to a 2.4 million-gallon, asphalt-lined pond on the southwest portion of the site.

8.2.2.8.1 EQ Pond

The EQ Pond was originally constructed to hold 2.7 million-gallons in 1971, and then the pond footprint was reduced, regraded and paved during the 1998 site improvements. Influent sources to the EQ Pond at the time of the Site Assessment included both disinfected effluent from the final effluent wet well and sludge from the aerated sludge storage basin. Supernatant from the pond may be decanted to the head of the aeration basin, and sludge can be pumped to either the aerated sludge storage basin or directly to the belt filter press. In the future, the pond will not be used for sludge storage. A new flow split constructed before the aeration basin will also have an overflow of untreated wastewater to the EQ Pond in high flow conditions.

Condition Assessment and Recommendations – EQ Pond

The asphalt visible above the liquid level had several cracks, primarily located either at the crown of the slope or perpendicular to the contours of the pond. All existing cracks have been sealed however have subsequently cracked again. The pumps and flexible tubing inside the EQ Pond are anchored to the fence.

Based on the above assessment, Murraysmith recommends the following:

- Repair existing asphalt.
- Consider alternative use of the land area used by the EQ Pond.
- Evaluate if upstream overflow of untreated sludge can buffer peak flows through the plant and eliminate the need for overflow from the treated effluent or ASSB.

8.2.2.9 Solids Treatment

The WWTP's solids handling consists of an ASSB with three cells, a belt filter press, and biosolids bay. In addition, excess WAS solids can currently be stored in the EQ Pond, but that will be halted once the new aeration basin flow split structure is installed. Waste activated sludge (WAS) from each secondary clarifier, combined with the secondary scum, is pumped into the center cell of the ASSB. Sludge is pumped from the ASSB to a belt filter press for dewatering. After the sludge has been adequately dewatered, it is collected in a biosolids bay and sent away for land application, when possible, or to the Wasco County landfill.

8.2.2.9.1 Aerated Sludge Storage Basin

The ASSB was originally constructed at the onset of the plant construction in 1971 as the only process treatment unit, but was later converted into a basin for sludge storage. The ASSB has the capacity to store 90,000 gallons of WAS and was designed to have 12 days of storage capacity for a WAS flow rate of 15,000 gallons per day if decanted. Cell nomenclature used by the operators does not match design drawing nomenclature. This document will follow operator naming conventions for the ASSB cells with Cell 1 being the center well, Cell 2 compromising a larger proportion of the donut structure on the west side of the ASSB that holds WAS, and Cell 3 compromising the smaller portion of the donut structure that receives pressate from the belt filter press.

WAS is pumped from the two secondary clarifiers through 4-inch lines and then combined into one 6-inch pipe before discharging into Cell 1. The 3-inch pipe from the secondary scum pump station also connects with the WAS line and then is discharged into Cell 1. Sludge is intended to thicken and then overflow from Cell 1 into Cell 2. A submersible pump within Cell 2 pumps sludge to the belt filter press or to the EQ Pond. Belt filter press filtrate flows back to Cell 3. Cell 3 decant pumps can be used to dilute the sludge in Cell 2 as needed because the centrifugal pump located in Cell 2 cannot convey sludge with solids concentrations much greater than approximately 2.5 percent. Alternatively, decant pumps in Cell 2 and Cell 3 convey supernatant to the headworks just downstream of the Parshall flume. During the winter months, Cell 3 is aerated to remove ammonia while Cell 2 is continuously aerated as a mechanism for mixing and to prevent anaerobic degradation of the stored sludge.

A liquid sludge feed tank was previously used to mix sludge with lime and provide head for conveyance to the belt filter press by a progressive cavity pump. The recirculation pump and liquid sludge feed tank are currently offline because the liquid sludge feed tank needs to be repaired or replaced. Sludge mixing is currently done through aeration and sludge is pumped from a submersible pump inside the ASSB Cell 2 directly to the belt filter press. The submersible pump inside the ASSB cannot meet the design flow and pressure requirements for the belt filter press and consequently, operators report difficulty in achieving adequate dewatering. When land applying, lime is added after the belt press to achieve Class B Biosolids for land application. However, the lime stabilization process is not performed when solids are sent to the landfill.

Condition Assessment and Recommendations – Aerated Sludge Storage Basin

The ASSB structure and components appear to be in poor condition. The coating on the piping is worn off and the piping appears to be rusting. The valves and pumps currently used for decanting to the headworks and conveying sludge to the belt filter press are all manually operated. When sludge storage exceeds the storage capacity of the ASSB, the EQ Pond is used for overflow. The submersible centrifugal pump used to convey sludge to the belt filter press and EQ Pond will likely not have the required capacity to keep up with future flow rates. Replacement pumps should be identified soon.

Since flows to the WWTP are projected to increase, options to increase sludge storage capacity is a pressing concern. Currently, sludge overflow is pumped to the EQ Pond during high flow conditions. Furthermore, the ASSB has design detention time of 12 days, which does not meet the requirements to Process to Significantly Reduce Pathogens of 40 to 60 days of aerobic digestion per Appendix B of 40 CFR Part 503. Instead, Class B biosolids are achieved by adding lime to reach a pH of 12 after 2 hours of contact.

Based on the above assessment, Murraysmith recommends the following:

- Increase sludge storage to improve sludge stabilization and dewaterability.
- Replace submersible belt filter press feed pump to handle the required current and future capacity.
- Consider replacing the entire sludge storage basin.
- Replace or remove the Liquid Sludge Feed Tank.
- Reevaluate overflow to EQ Pond and alternative sludge storage.

8.2.2.9.2 Belt Filter Press

Sludge is fed from the ASSB through an 8-inch line to the belt filter press feed pump inside the Dewatering Building, then injected and mixed with polymer, dewatered on the belt filter press and discharged through a hopper where it is mixed with lime. The lime is added from the lime silo via a dry lime conveyor and volumetric feeder at the belt filter press discharge hopper. Filter cake is then pumped to the Biosolids bay where it is held for a maximum of two weeks before it is used for fertilizer in land application or hauled to landfill. During seasons when there is not a demand for the biosolids, lime is not added and the biosolids are sent to the landfill.

Condition Assessment and Recommendations – Belt Filter Press

The feed rate for the belt filter press is slow since the decommissioning of the sludge stabilization tank and the sludge feed pump as mentioned in Section 8.2.2.9.1. The current belt filter press feed pump is submersible centrifugal pump that pumps at a significantly slower rate than the original progressive cavity pump. The Polymer injection system is manually operated and has been in operation since the 2003 Facility Improvements. It is difficult to operate, and the facility often has difficulty in achieving target solids concentrations.

Based on the above assessment Murraysmith recommends the following improvements:

- The Belt Filter Press is nearing the end of its useful service life and has capacity issues, which may necessitate adding another unit or considering other dewatering options.
- Improve consistency of sludge feed rate to the belt filter press by replacing the belt filter press feed pump.
- Replace polymer injection system with flow meter.
- Rehabilitate control panel in the Dewatering Building.

8.2.2.9.3 Biosolids Storage Area

The Biosolids Storage Area is approximately 2,185 square feet of covered roof area with three 6-inch drains, where dewatered sludge is stored after thickening on the belt filter press. The volume of the Biosolids Storage Area has the capacity to store 520 cubic yards, which translates to 100 days of storage capacity at the design sludge production rate of 5.5 cubic yards per day.

Condition Assessment & Recommendations – Biosolids Bay

The structural components of the building appear to be in good condition, with no visible signs of rust or deformation. The biggest operational concern is the timing and demand for biosolids by land application end users, and the limited time window of two weeks beyond which land application is no longer viable.

Based on the above assessment, Murraysmith recommends the following:

- Identify additional land application end users.
- Improve solids

8.2.2.10 Miscellaneous Site Utility Systems

WWTP utility systems include the utility and process water loops. These systems afford the operators flexibility in their day to day operations, and they allow for clean conditions at the plant.

8.2.2.10.1 Utility Vault

A utility vault is located at the northwest end of the aeration basin. The vault is used to drain various other unit process basins and convey flow back to the head of the aeration basin. Locations currently with the infrastructure plumbed to the utility vault include the Secondary Clarifiers, the groundwater collected by the basement sump in the WAS/RAS pump room, and the aeration basin. The Utility vault has the capability to pump to the EQ Pond as well. The utility vault appears to be in good condition.

8.2.2.10.2 Process Water

Process water is conveyed from the disk filter effluent channel using two submersible pumps rated at 50 gallons per minute at 100 psi to one of the two hydropneumatic tanks located in the Blower/Maintenance Building. The Process water is used throughout the facility including to spray down foam in the selector cells off the aeration basin and to keep foam down in the center well of the secondary clarifiers. During the summer months when the secondary effluent is disinfected with Sodium Hypochlorite, the process water is chlorinated.

Condition Assessment & Recommendations – Process Water

Based on the above assessment, Murraysmith recommends the following:

- Chlorinate process water year-round to reduce foaming in the aeration basins by delivering chlorine to the process water system directly.

8.2.2.11 Miscellaneous Site Buildings

There are several miscellaneous buildings on-site that indirectly support the day-to-day operation of the WWTP, most of which are discussed in previous sections. The following section discusses the combined Office and Laboratory Building.

8.2.2.11.1 Office/Laboratory Building

The administration building is the detached structure on the southeast side of the WWTP, near the headworks. It contains the administrator's office, a control room, unisex bathrooms, and the plant's laboratory. The laboratory has an eye wash installed on the sink, which meets the basic requirements for an eye wash station but is not an ideal setup in the case of an actual emergency. Furthermore, there is only one bathroom in the office, which is used by everyone and also used by the women as a locker room.

Condition Assessment & Recommendations – Process Water

Based on the above assessment, Murraysmith recommends the following:

- Install tepid eyewash station independent of sink.
- Consider upgrades to the bathroom/locker facilities

8.2.2.12 Consider building upgrades to improve bathroom/locker facilities. Summary of Existing WWTP Improvements

The Preliminary List of Recommended Improvements is included as **Appendix H** for reference and includes upgrades identified in the condition assessment to maintain facility performance and simplify operations. The total cost for these projects has not been determined at this time but will be addressed in later sections of the Facility Plan.

8.3 Existing Wastewater Treatment Plant Code Review

This technical memorandum summarizes current Code requirements for the Sandy WWTP along with a preliminary compliance evaluation should major upgrades be contemplated for the facility as part of the Recommended Plan. Code requirements summarized in this TM include:

- Oregon Structural Specialty Code (OSSC), 2014
    - International Building Code (IBC)
- Oregon Fire Code, 2014
    - International Fire Code (IFC)
    - National Fire Protection Association (NFPA) 820
- Oregon Plumbing Specialty Code, 2017
    - Plumbing materials of construction
    - Uniform Plumbing Code (UPC)
- Oregon Mechanical Specialty Code, 2014
    - International Mechanical Code (IMC)
- Oregon Electrical Specialty Code, 2017
    - National Electrical Code (NEC)
    - NFPA 70
- OR-OSHA (Oregon Occupational Safety and Health)

- Oregon Energy Efficiency Specialty Code (OEESC), 2014
- American Disability Act (ADA)
- Code of Federal Regulations (CFR)
- American Society of Civil Engineers (ASCE) 7 for Seismic Anchorage Design
- Local Land Use Requirements

Regulatory Requirements related to the Sandy WWTP effluent discharge to Tickle Creek, biosolids land application program, pre-treatment and other requirements are summarized in the Regulatory Requirements Section of the Facility Plan.

8.3.1 Summary of Existing Buildings and Use

The Existing WWTP Site Plan is shown by **Figure 8-1**. There are six main buildings on site plus three overhead structures. The main buildings include the Office/Lab Building, the Blower/Maintenance Building, Secondary Sludge Pumping Building, Effluent Pumping Station, Solids Handling Building and Biosolids Dewatering Building. The overhead structures are the Headworks, the Disinfection Filtration Basin, and the Biosolids Storage Bay.

8.3.1.1 Office/Laboratory

The Office/Lab is used both for administrative office purposes and as a laboratory working space. There is one bathroom, which is also used as a locker room for the female staff.

- **Floor Area:** Approximately 680 square feet (SF) (Allowable 9,000 SF per OSSC Table 503)
- **Height**: One story, 13.5 feet at the highest point from finish floor. (Allowable 2 stories, 40 feet per OSSC Table 503).
- **Construction Type**: OSSC Type V, wood-frame construction with beveled cedar siding, and wood truss roof framing covered with standing seam metal roofing.
- **Occupancy Group:** Group B per OSSC 2014, where Section 304.1 defined Group B as occupancies consisting of business functions.
- **Calculated Occupancy Load:** 7 persons per OSSC Table 1004.1.2 - occupant load factor of 100 gross for business areas.
- **Fire Sprinklers**: Not required per OSSC Section 903.
- **Safety features:** Tepid eyewash/shower station required where the eyes or body of any person may be exposed to injurious corrosive materials per 29 CFR 1910.151 and the American National Standards Institute (ANSI) Z358.1.

8.3.1.2 Blower Maintenance Building

The Blower/Maintenance Building is located southeast of the aeration basin. Inside the building are the blowers, control panels, emergency generator, emergency air compressor, potable water bladder pressure tank, and process water bladder pressure tank.

- **Floor Area:** Approximately 2,200 SF (Allowable 19,000 SF per OSSC Table 503).
- **Height**: Maximum building height 18.25 feet (Allowable 3 stories, 65 feet OSSC Table 503).
- **Construction Type**: OSSC Type III-A, constructed of non-combustible, non-fire rated materials. The building is constructed of a concrete slab, load-bearing CMU walls, and wood truss roof framing covered with standing seam metal roofing.
- **Occupancy Group**: Group F-1 per OSSC 2014, where Section 306.2 defines F-1 as occupancies consisting of moderate-hazard industrial functions.
- **Calculated Occupancy Load:** 22 persons per OSSC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.
- **Fire Sprinklers**: Not required for Group F-1 buildings less than 12,000 SF and less than three stories above grade plane per OSSC 903.24.
- **Safety Features:** OSHA guidelines specifically mention diesel fuel as a health hazard. Diesel fuel is classified per the Oregon Fire Code as Combustible Liquid (Class 2).
    - *Fire Extinguisher:* Per 29 CFR 1926.152(d)(2) at least one portable fire extinguisher having a rating of not less than 20-B units shall be located not less than 25 feet, nor more than 75 feet, from any flammable liquid storage area, such as the diesel fuel stored for the emergency generator.
    - *Quantity Limits:* Per 2014 OFC Section 603.3.2.1 the fuel storage tank must not exceed 660 gallons of class III combustible material unless the exceptions set forth in 2014 OFC Section 603.3.2.1 are met. Storage is subject to additional provisions in OFC Chapter 27 and 34, including overfill prevention and leak detention.
    - Emergency generator must exhaust outside to prevent carbon monoxide accumulation, per NFPA 37.

8.3.1.3 Secondary Sludge Pumping Building

The Secondary Sludge Pumping Building has two main rooms and is located west of the aeration basin. Inside it are the Waste Activated Sludge (WAS) pumps, Return Activated Sludge (RAS) pumps, and Sodium Hypochlorite storage tank. Adjacent to the Sodium Hypochlorite storage tank, there is also a metering pump and secondary containment for the Sodium Hypochlorite.

- **Floor Area:** Approximately 590 SF (Allowable 19,000 SF per OSSC Table 503).
- **Height:** Two stories, 13.5 feet at the highest point from finish floor. (Allowable 3 stories, 65 feet, per OSSC Table 503).
- **Construction Type:** OSSC Type III-A, constructed of non-combustible, non-fire rated materials. The building is constructed of a concrete slab, load-bearing CMU walls, and wood truss roof framing covered with standing seam metal roofing.
- **Occupancy Group:** Group H-3 per OSSC 2014, where Section 306.2 defines H-3 as occupancies consisting of moderate-hazard industrial functions.
- **Calculated Occupancy Load:** 6 persons per OSSC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.
- **Fire Sprinklers**: Automatic sprinklers are required for H occupancy buildings.
- **Safety Features**: Maximum storage of Sodium Hypochlorite is 500 gallons per Table 307.1(2). Hazard identification signs must be conspicuously affixed on stationary containers where hazardous materials are stored, handled, or used per IFC 2703.5 and NFPA 704.
- **Tepid eyewash/shower station**: Tepid eyewash/shower station required where the eyes or body of any person may be exposed to injurious corrosive materials per 29 CFR 1910.151 and the American National Standards Institute (ANSI) Z358.1.

8.3.1.4 Effluent Pumping Station

The Effluent Pumping Station is a small building northeast of the Disinfection Filtration Basin. This building houses the electrical equipment and control panels for the pumps, UV system and filters.

- **Floor Area:** Approximately 235 SF (Allowable 19,000 SF per OSSC Table 503).
- **Height:** One stories, 14.5 feet at the highest point from finish floor. (Allowable 3 stories, 65 feet, per OSSC Table 503).
- **Construction Type:** OSSC Type III-A, constructed of non-combustible, non-fire rated materials. The building is constructed of a concrete slab, load-bearing CMU walls, and wood truss roof framing covered with standing seam metal roofing.
- **Occupancy Group:** Group F-2. OSSC paragraph 306.3 defines F-2 as occupancies consisting of low-hazard industrial functions.
- **Calculated Occupancy Load:** 3 persons per OSSC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.

- **Fire Sprinklers:** Not required for Group F-1 buildings less than 12,000 SF and less than three stories above grade plane per OSSC 903.24.

8.3.1.5 Solids Handling Building

The Solids Handling Building is west of the Aerated Sludge Storage Basin. It has two roll-up doors and is used for general storage and to house the blower for the Aerated Sludge Storage Basin. This building used to house the Sludge Transfer Pump which is currently inoperable and has been decommissioned.

- **Floor Area:** Approximately 1,150 SF (Allowable 14,000 SF per OSSC Table 503).

- **Height:** Two stories, 13.5 feet at the highest point from finish floor. (Allowable 3 stories, 65 feet per OSSC Table 503).

- **Construction Type:** OSSC Type III-A, constructed of non-combustible, non-fire rated materials. The building is constructed of a concrete slab, load-bearing CMU walls, and wood truss roof framing covered with standing seam metal roofing.

- **Occupancy Group:** Group U. OSSC paragraph 312.1 Defines Group U as occupancies consisting of utility and miscellaneous functions.

- **Calculated Occupancy Load:** 12 persons per OSSC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.

- **Fire Sprinklers:** Not required for Group F-1 buildings less than 12,000 SF and less than three stories above grade plane per OSSC 903.24.

8.3.1.6 Biosolids Dewatering Building

The Biosolids Dewatering Building is northeast of the Aerated Sludge Storage Basin. It contains the dewatering belt press, associated pumps, mixers, and pipe. This includes a polymer injection system and two totes full of polymer. An electrical room beside the main room houses the control panel for the dewatering system.

- **Floor Area:** Approximately 1400 SF (Allowable 19,000 SF per OSSC Table 503).

- **Height:** 24 feet (Allowable 3 stories, 65 feet, per OSSC Table 503)

- **Construction Type:** OSSC Type III-A, constructed of non-combustible, non-fire rated materials. The building is constructed of a concrete slab, load-bearing CMU walls, and wood truss roof framing covered with standing seam metal roofing.

- **Occupancy Group:** Group F-2. OSSC paragraph 306.3 defines F-2 as occupancies consisting of low-hazard industrial functions.

- **Calculated Occupancy Load:** 14 persons per OSSC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.

- **Fire Sprinklers:** Not required for Group F-1 buildings less than 12,000 SF and less than three stories above grade plane per OSSC 903.24.

8.3.2 General Code Requirements

8.3.2.1 Accessibility

The Office/Lab Building is required to comply with the accessibility requirements of Chapter 11 of the OSSC. In general, this means that the building shall have an accessible parking stall and accessible path of travel from the accessible stall to the Office/Lab Building entrance. Doors shall have lever hardware and accessible rooms shall meet the design and dimensional requirements of Chapter 11. Per the OSSC, accessibility is not required for mechanical and process spaces.

8.3.2.2 Means of Egress

The OSSC mandates in Chapter 10 that in all buildings the means of exit discharge shall meet the following requirements:

- **Illumination Required**: Means of exit discharge shall be illuminated at all times by not less than 1 foot-candle (11 lux) at the walking surface per OSSC 1006.2 except for Occupancies in Group U.

- **Egress Sizing**: The minimum width of each door opening shall be a minimum width of 32 inches and height of 80 inches, as well as sufficient for the occupant load thereof per OSSC 1008.1.1.

8.3.2.3 Energy Code Requirements

Oregon Energy Efficiency Specialty Code (OEESC) 2014 lists prescriptive requirements in regard to building envelope and insulation, mechanical equipment and minimum energy requirements, water heater, electrical power and lighting systems. If a building's energy consumption can be demonstrated to not exceed that used by a similar building using similar forms of energy design in accordance with the prescriptive requirements of the OEESC 2014 code, then the Whole Building Approach (WBA) can be used.

8.3.2.4 Chemical Hazard Identification

The Code of Federal Regulations requires identification signs for safety purposes. Those applicable to the City of Sandy WWTP include:

- **Safety Data Sheet Requirements:** Section 19.1200(b)(1) of CFR 29 requires all employers to "provide information to their employees about the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, safety data sheets, and information and training. In addition, this section requires distributors to transmit the required information to employers."

- **Maintenance of Safety Data Sheets:** Section 1910.1200(b)(3)(ii) of CFR 29 requires, "Employers shall maintain any safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible during each work shift to laboratory employees when they are in their work areas"

- **Hazard identification signs:** Hazard identification signs must be conspicuously affixed on stationary containers where hazardous materials are stored, handled, or used per IFC 2703.5 and NFPA 704.

- **No smoking signs:** No smoking signs shall be provided in a conspicuous location where flammable or combustible materials are stored or handled per International Fire Code Section 310.

8.3.2.5 Electrical Requirements

The Oregon Electrical Specialty Code mandates electrical components meet all prescriptive requirements, including the following:

- **Minimum Clearance:** A minimum of 42-inch clearance is required in front of electrical panel per NFPA 70 (NEC) Article 110.26(A)(1).

- **Working Clearances:** Permanent and conspicuous signs provided when working space is required by NEC 110.26 around and about electrical equipment.

- **Ground-Fault Circuit-Interrupter Protection:** Ground-Fault Circuit-Interrupter Protection for Personnel is required as specified per OESC 210.8 outdoors, where receptacles are within 6 feet of sinks, indoor wet locations, garages, service bays, and similar areas.

8.3.2.6 HVAC Requirements

OSSC requires all buildings be ventilated naturally or by mechanical means per 1203.4 and Chapter 4 of the OMSC Chapter 4.

8.3.2.7 Seismic Anchoring

All equipment and structural components shall be anchored accordance with standards in Chapter 13 of ASCE 7-16.

8.3.2.8 National Fire Protection Association (NFPA) 820

The National Fire Protection Association (NFPA 820) provides requirements for ventilation, electrical classification, materials of construction and fire protection measures for the collection system (Table 4.2.2), the Liquid Stream Treatment Process (Table 5.2.2), and the Solid Stream Treatment Process (Table 6.2.2). Applicable locations have been summarized in the table below.

Table 8-3
NFPA 820 Liquid Stream (Table 5.2.2) and Solid Stream (Table 6.2.2) Treatment Process Pertinent to the City of Sandy

Location	Fire and Explosion Hazard	Ventilation	Extent of Classified Area	NEC Area Electrical Classification (All Class I, Group D)	Materials of Construction	Fire Protection Measures
Diversion Control Structures	Possible ignition of flammable gases and floating flammable liquids	Not enclosed, open to atmosphere	Within a 3m (10 ft) envelope around equipment and open channel	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher and hydrant protection in accordance with NFPA 820 7.2.4
Coarse and Fine Screen Facilities	Possible ignition of flammable gases and floating flammable liquids	Not enclosed, open to atmosphere	Within a 3 m (10 ft) envelope around equipment and open channel	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher and hydrant protection in accordance with NFPA 820 7.2.4
Grit Removal Tanks	Possible ignition of flammable gases and floating flammable liquids	Not enclosed, open to atmosphere	Within a 3 m (10 ft) envelope around equipment and open channel	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher and hydrant protection in accordance with NFPA 820 7.2.4
Aeration Basin	N/A	Not required		Classified	Not required	Hydrant protection in accordance with NFPA 820 7.2.4
Secondary Clarifiers	N/A	Not required	N/A	Classified	Not required	Hydrant protection in accordance with NFPA 820 7.2.4
Final Pumping Station	N/A	Not required	N/A	Unclassified	Nor required	Hydrant protection in accordance with NFPA 820 7.2.4
Ultraviolet Disinfection Unit	N/A	Not required	N/A	Unclassified	Not required	Hydrant protection in accordance with NFPA 820 7.2.4

Location	Fire and Explosion Hazard	Ventilation	Extent of Classified Area	NEC Area Electrical Classification (All Class I, Group D)	Materials of Construction	Fire Protection Measures
Scum pumping areas	Buildup of vapors from flammable or combustible liquids	Not enclosed	Within a 3 m (10 ft) envelope around equipment and open channel	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher and hydrant protection in accordance with NFPA 820 7.2.4
Sludge pumping stations dry side	Buildup of methane gas or flammable vapor	No ventilation or ventilated at less than six air changes per hour	Entire dry well when physically separated from a wet well or separate structure	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher and hydrant protection in accordance with NFPA 820 7.2.4
Sludge storage wet wells, pits, and holding tanks	Possible generation of methane gas in explosive concentrations; carryover of floating flammable liquids	Not enclosed, open to atmosphere	Envelope 0.46 m (18 in.) above water surface and 3 m (10 ft) horizontally from wetted walls	Division 2	Noncombustible, limited combustible, or low flame spread index material	Not required
Dewatering Buildings	Accumulation of methane gas	No ventilation or ventilated at less than six air changes per hour	Entire room	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable Fire Extinguisher, hydrant protection in accordance with NFPA 820 7.2.4,a
Pumping of Drainage from digested sludge-dewatering processes	N/A	Not required	N/A	Unclassified	Noncombustible, limited combustible, or low flame spread index material	Hydrant protection in accordance with NFPA 820 7.2.4,a

Fire suppression hydrants shall be installed in accordance with NFPA 24. Chapter 7 of NFPA 24, 2016 edition mandates hydrants to be located within 40 feet of the buildings to be protected. C.4.1.3 of NFPA 24 generally recommends a minimum residual pressure of 20 psi should be maintained at hydrants when delivering fire flow.

8.3.2.9 Local Sewer Ordinances, Agreements and Related Planning Policies

- **City of Sandy, Comprehensive Plan (October 1997), Ordinance No. 8-97:** The Sandy Comprehensive Land Use Plan is an official statement of the goals, policies, implementation measures and physical plans for the City's development. The plan was adopted by City Council Ordinance No. 8-97 in October 1997. It was last updated in January 2012 to include a number of amending ordinances.

- **City of Sandy, Municipal Code:** Public services and policies of the sewer system are defined in Title 13, Water and Sewer, of the Sandy Municipal Code. Chapter 13.12, "Sanitary Sewer System-Rules and Regulations", is the primary section of code addressing the use of the City's sanitary sewer system.

- **City of Sandy, Municipal Code**: This chapter describes provisions for use of and connection to the sewer system and names prohibited discharges to the public sewer system.

- **City of Sandy, Municipal Code:** Title 17 of the City's Municipal Code is the Development Code. It is enacted to promote the general public welfare by ensuring procedural due process in the administration and enforcing the City's Comprehensive Plan, zoning districts, design review, land division, and development standards.

- **City of Sandy Public Works Standard Details:** The Public Works Standard Details of the City have been developed to set forth uniform material and workmanship criteria applicable to infrastructure under the City's jurisdiction to meet minimum quality standards.

8.3.3 Summary of Code Requirements

8.3.3.1 City of Sandy WWTP Deficiencies

The following conditions have not been met at the Sandy WWTP:

- Tepid eyewash/shower stations – current eyewash inside the office/laboratory is plumbed to the sink and although it meets code requirements, it is not ideal for emergency situations.

- Electrical clearances – a minimum of 42 inches of clearance in front of electrical panels, as well as conspicuous signage for working space.

- Hydrant requirements – portable fire extinguishers and hydrant protection as listed in **Table 8-3** above.

8.3.3.2 City of Sandy WWTP prescriptive deficiencies

The following conditions were not examined during the site visit on March 21st, but would be easily determined to evaluate the Sandy WWTP compliance:

- ADA ramp slope
- Egress illumination
- Fire Extinguishers

8.3.3.3 City of Sandy WWTP deficiencies requiring more comprehensive analysis

The following conditions require additional comprehensive analysis, beyond the scope of this review, to evaluate the Sandy WWTP:

- HVAC compliance
- Energy Efficiency Code
- Seismic Anchoring
- Electrical Code

8.4 Existing Wastewater Treatment Plant Capacity Evaluation

This section of the Wastewater System Facilities Plan (WSFP) documents the capacity of the existing wastewater treatment plant (WWTP). Capacity at the treatment plant consists of equipment capacity, hydraulic capacity, and process capacity. The WWTP is required to meet the treatment process capacity based on the maximum month wet weather flow rate but must be able to hydraulically handle the peak instantaneous flow (PIF) rate with 12 inches of freeboard.

The last major liquid treatment upgrade to the entire WWTP was designed by Curran-McLeod in 1996 for a PIF of 6.5 million gallons per day (MGD). A solids handling upgrade was also designed by Curran-McLeod in 2003 in order to dewater and store more biosolids on site. This solids upgrade was also based on an average annual total suspended solids influent loading rate of 2,330 pounds per day (ppd).

As outlined in **Section 7 – WWTP Flow and Load Projections**, 2017 influent flow statistics are summarized in **Table 8-4** with the current PIF determined to be 10.3 MGD. The following sections will evaluate both the liquids and solids handling capacity and identify areas where there are deficiencies.

Table 8-4
Existing WWTP Influent Flow Characteristics

Design Criterion	2017 - Existing Flow (MGD)
Average Annual Flow (AAF)	1.4
Average Dry Weather Flow (ADWF)	1.0
Average Wet Weather Flow (AWWF)	1.8
Maximum Month Dry Weather Flow (MMDWF)	1.5

Design Criterion	2017 - Existing Flow (MGD)
Maximum Month Wet Weather Flow (MMWWF)	2.6
Peak Week Flow (PWF)	4.0
Peak Daily Average Flow: 5-year return period ($PDAF_5$)	8.9
Peak Instantaneous Flow: 5-year return period (PIF_5)	10.3

8.4.1 Mechanical Equipment Capacity

Based on the manufacturer's data, the process capacity of each of the unit processes is listed in **Table 8-5**. As noted below, most components are rated between 6.0 to 7.0 MGD which is not sufficient for meeting the existing PIF of 10.3 MGD.

Table 8-5
Design Capacity of Unit Processes at Sandy WWTP

System	Data/Type
Headworks Treatment	
Mechanical Fine Screen	
Type	Inclined Rotary Fine Screen
Make	Lakeside Equipment Corporation
Model	47FS-0.250-93
Quantity	1
Opening	6.35mm or ¼ " clear
Capacity (Each)	6.6 MGD
Wash Water Demand (Each)	17 GPM
Manual Bar Screen (Bypass)	
Type	Bar screen rack
Quantity	1
Bar Spacing	¾ " clear
Angle	60°
Influent Flow Measurement	
Type	Parshall Flume w/Ultrasonic Level Measurement
Quantity	1
Throat Width	12-inch
Maximum Capacity	9.2 MGD
Grit Chamber	
Type	Vortex
Quantity	1
Diameter	10 feet
Maximum Flow	7.0 MGD
Rotation	Counter Clockwise
Propeller Drive Motor	1 hp, 230V/460V, 3-phase, TEFC
Grit Storage Volume	76 cu ft

System	Data/Type
Make	Smith & Loveless
Model Number	70 CCW
Grit Pump	
Performance	250 GPM @ 30 FT TDH
Motor	10 hp, 230/460 VAC, 3-phase, TEFC
Construction	Cast Iron
Discharge	4” flanged
Grit Conveyor/Separator	
Type	Plate Separator
Inclination	22°
Motor	1 hp , 230/460 VAC, 3-phase, TEFC, 1160 rpm
Discharge	8” P.E. Pipe
Grit Concentrator	
Type	Constant Rate Vortex
Size	6”
Max Flow	250 GPM
Secondary Treatment	
Aeration Basin	
Number of Trains	2
Total Basin Volume	740,000 gallons
Selector Zone Cells (3 per train)	75,000 gallons each
Aerobic Cells (1 per train)	145,000 gallons each
Average Sidewater Depth	17.79 feet
Internal Recirculating Pumps	
Manufacturer	Flygt
Model Number	CP3102-441
Pump Capacity	750 GPM @ 12.0 FT TDH
Type	Submersible Non-clog, explosion proof
Impeller	No. 441
Motor	5 hp, 1735 rpm, 460 Vac, 3-phase, 6.6 Amp FLC
Selector Zone Mixers	
Manufacturer	ITT Flygt
Model	460-083706J
Construction	Stainless steel
Performance	4,200 GPM
Propeller Diameter	14 7/16 Inches
RPM	86
Motor	Submersible, 4hp, 860 rpm, 460 Volts, 6.7 Amp, S.F. 1.15, Insulation, Class F, Nema Design B
Disc Diffusers	
Type	Fine bubble, membrane disc
Diameter	7 inch
Quantity	Cells 3 and 7: 128 each cell

System	Data/Type
	Cells 4 and 8: 800 each cell
Orifice Size	13/64 inch
Process Blowers (No. 1-3) aeration basin	
Type	Centrifugal
Manufacturer	Gardner Denver Machinery, Inc
Model	810
Quantity	3
HP (Each)	100
Capacity (Each)	1,350 SCFM
Process Blower (No. 4) aeration basin	
Type	Rotary Lobe Blower
Manufacturer	Dresser
Model	412 ROOTS-FLO
Quantity	1
HP	60
Capacity	1,199 SCFM
Air Compressor – backup	
Type	Reciprocating Air Compressor
Manufacturer	Quincy Northwest
Model	QT-15-200 U Motor-AS93
Quantity	1
HP	15
Capacity (Each)	46.2 CFM
Secondary Clarifier	
Type	Center Feed – Inboard launder
Manufacturer	Gardner DenverEIMCO
Model	818-4-0-4-0-AD2545I-01A 5-97
Quantity	2
HP	100
Capacity (each)	3.5 MGD
Surface overflow rate at capacity	1,500 gal/d per ft^2
Quantity	2
Diameter	54 feet
Depth	15 feet
Volume (Each)	257,000 gal
Drive Model	C30LT, Momentary Peak Torque: 61,000 Ft Lb Mech Strength: 15,000 Ft Lb
Mechanism Model Number	Type CS3
Drive Motor	3/4 Hp, 230/460 Vac, 3 Phase, TEFC, 460 VAC, 1.15 sf, Class F Ins.
Algae Sweep Mechanism	Wetted Materials: 304 SS Brushes: Plastic/Polypropylene

System	Data/Type
Return Activated Sludge Pump Station	
Manufacturer	WEMCO Pump
Model	D4K-LT_DOS
Pump Type	Centrifugal, Hydrostal Screw
Quantity	2
HP (Each)	7.5
Design Point	600 GPM @ 23 FT TDH
Mechanical Seal	John Crane, Type 21
Discharge	6 in
Waste Activated Sludge Pump	
Manufacturer	Warren Rupp Co.
Pump Type	Double Diaphragm
Quantity	2
Capacity	0-260 GPM @ 0-230 FT TDH
Filtration	
Disk Filter	
Manufacturer	Aqua-Aerobic Systems, Inc.
Number of Units	2
Model Number	ADC-6
Type	Fabric Filter
Average Flow Rate	2 GPM/sq ft
Number of disks/filters	6
Total Process Capacity	6 MGD
Backwash Pump Manufacturer	WEMCO
Backwash Pump Quantity	2
Backwash Pump Model	A2QS2
Backwash Pump Type	Screw Centrifugal
Backwash Pump HP	2
High Pressure Wash Pump Model	Grundfos CR60-80U
High Pressure Wash Pump HP	40
High Pressure Drain Valves Type	6" Keystone Fig. AR2
High Pressure Drain Valves Lever Type	EPI-13 Electric Actuator
Drain Valves Type	6" Keystone Fig. AR2
Drain Valves Lever Type	Manual
High Pressure Wash Valves Type	2" Milwaukee Valve Co.
High Pressure Wash Valves Model	BA-300
High Pressure Wash Valves Lever Type	MCRB675 Electric Actuator
Disk Drive Mechanism Type	NORD UNIVASE
Disk Drive Mechanism HP	½
Disk Drive Mechanism Motor	SK33N-7IL4
EQ Pumps from Effluent Filtration to Pond	
Manufacturer	Wilo USA LLC

System	Data/Type
Model	FA 15.52E
Quantity	2
Type	Submersible
HP	10.1 HP
Performance	980 gpm @ 27 FT TDH
Disinfection (By UV Oct 15 – May 15)	
UV System	
Manufacturer	Trojan Technologies, Inc
Model	UV4000
Type	Medium Pressure
Dosage	30,010 microwatt sec/sq cm
Headloss	17.70 inches
Peak Flow Rate	7.00 MGD
Disinfection (By 12.5% Sodium Hypochlorite, May 15 – Oct 15)	
Sodium Hypochlorite Storage Tank	
Quantity	2
Capacity	1,000 gallons (Each)
Anchored	yes
Sodium Hypochlorite Pump	
Quantity	1
Type	Metering Pump
Manufacturer	gamma/L
Model	Gala 0220
Serial Number	2710009929
Capacity	5.0 gph
Sodium Bisulfite	
Bulk Storage Tank Volume	55 Gal drum
Effluent Pump Station	
Effluent Pump Station	
Manufacturer	Floway Pumps
Model	11JKM
Number of pumps	4
Type	Vertical Turbine
Performance	700 GPM @ 108 FT TDH
Stages	2
Impeller	Enclosed
Motor	
HP	25
Frame	284TPA

System	Data/Type
Solids Treatment	
Aerated Sludge Storage Basin	
Center Well	90,000 gallons
Cell No. 1:	90,000 gallons
Cell No. 2:	180,000 gallons
Process Blowers (ASSB)	
Type	Rotary Lobe Blower
Manufacturer	Dresser Industries
Model	406JH RCS WHISPAIR
Quantity	2
HP (Each)	25
Capacity (Each)	-unknown-
Decant Pumps	
Quantity	3
Type	"WE" Submersible Non-clog
Model	WE51
Motor HP	½
Design Point	50 GPM @ 22 FT TDH
Discharge	2-inch NPT
Sludge Transfer Pump (Dewatering Feed Pump)	
Manufacturer	Flygt
Quantity	2
Type	Submersible Centrifugal
Motor HP	10
Model Number	3102.090
Aeration Equipment Centerwell	
Model	Sanitaire Water Pollution Control
Type	Fine Bubble, Membrane Disc
Quantity	270
Diameter	7 inch
Orifice Size	13/64 inch
Aeration Equipment Cells No. 1 and No. 2	
Model	Variair
Type	Course Bubble
Quantity	Cell No. 1: 4 Cell No. 2: 12
Wet Sludge Loadout Flow Meter	
Size	4 inch
Type	Magnetic Flowmeter
Range	0-33 ft/s
Model Number	MAG3100
Lime Feed System Mixer	
Type	Gear driven

System	Data/Type
Motor HP	1.5 HP
Manufacturer	Neptune Mixer Company
Lime Slurry Pump	
Type	Peristaltic
Motor HP	1.5 HP
Performance	25 gpm @ 69 FT TDH
Dewatering Press	
Manufacturer	Ashbrook Corp. - Klampress
Type	Belt Press
Quantity	1
Capacity	640-1680 Dry LBS/HR
Flow Rate	160 GPM
Min Inlet Concentration	0.8%
Min Outlet Concentration	15%
Motor HP	5
Dewatered Sludge Pump	
Capacity	15 gpm
Quantity	1
Type	PC Positive Displacement
Motor HP	15
Dewatering Polymer System	
Quantity	1
Polymer Storage	1000 L Tote
Manufacturer	US Filter Polyblend
Model	M2400-D2.5AB
Emergency Generator	
Quantity	1
Manufacturer	Caterpillar
Model	3412 750 G/S eKW
Fuel Type	Diesel
Capacity	750 KW @ 60 Hz
Fuel Consumption	58.8 Gal/hr
Utility Water Pumps	
Manufacturer	Grundfos Pump Corp.
Model	60S50-9
Quantity	2
Type	Submersible
Performance	50 GPM @ 100 psig
Motor HP (Each)	5
Discharge	2” FNPT
Utility Water Booster Pump (for Belt Press)	
Manufacturer	Goulds Pumps
Model	SSH

System	Data/Type
Quantity	1
Type	Centrifugal
Motor HP	½
Pump Model	9SH2H52D0
Utility Water Flowmeter	
Manufacturer	Hersey Measurement Company
Size	2 inch
Type	Positive displacement meter
Model	MHR-S-03T
Flow range	8 - 450 gpm
Utility Water Pumps	
Manufacturer	ITT Flygt
Pump Type	Submersible, non-clog
Quantity	2
HP (Each)	5 HP
Design Point	750 GPM @ 12.0 FT TDH
Pump Model	CP3102-441

8.4.2 WWTP Liquid Stream Capacity

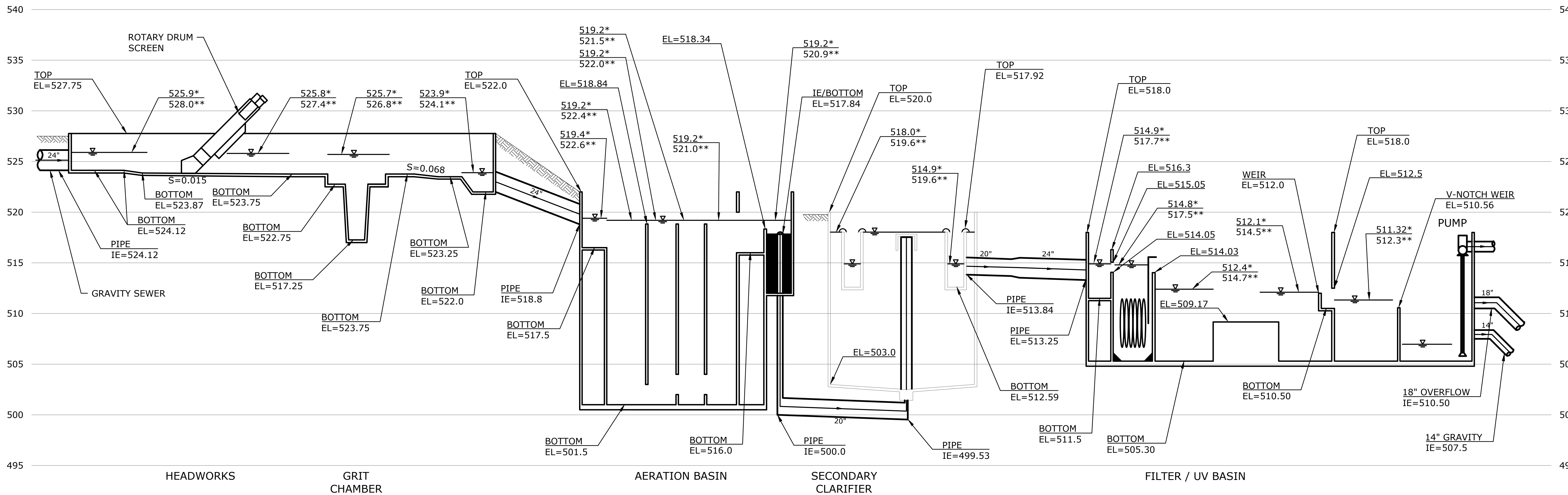
8.4.2.1 Introduction

The following section will evaluate both the process and hydraulic capacity of the liquid stream processes at the City of Sandy WWTP including the headworks facility, secondary treatment, filtration, and disinfection.

8.4.2.2 Hydraulic Capacity Analysis

To evaluate the process hydraulic capacity of the existing WWTP, the treatment plant was modelled using Visual Hydraulics© based on the design and record drawings from facilities improvements in 1992 and 2003 as well as discussions with equipment manufacturers.

The hydraulic capacity was evaluated for the existing average annual flow (AAF) as well as the peak instantaneous flow (PIF) based on flows listed in Table 1 to identify the existing plant hydraulics. As part of the analysis, hydraulic limitations were identified when the water level reached within 12-inches below the top of a structure. The hydraulic profile at existing AAF and PIF is shown in **Figure 8-3** below. A detailed summary of the input parameters used in the Visual Hydraulics Model is included as **Appendix I**.



HYDRAULIC PROFILE

SCALE: NTS HORIZ, 1"=5' VERT

LEGEND

Q=AAF
Q=PIF

WATER SURFACE ELEVATIONS

NOTES:

* AAF= 1.4 MGD
RAS=1Q_{AFF}
IMLR=2Q_{AFF}

**PIF= 10.3 MGD
MMWWF=2.6 MGD
RAS=1Q_{MMWWF}
IMLR=2Q_{MMWWF}

SANDY
WHERE INNOVATION MEETS ELEVATION

FIGURE 8-3

Sandy Facility Plan

HYDRAULIC PROFILE

January 2019

murraysmith

DRAFT

17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-OR-SANDY HYD PROFILE.dwg FIG-X 10/24/2018 2:51 PM MATT.ESTEP 23.0s (LMS Tech)

This page intentionally left blank

8.4.2.3 Hydraulic Capacity Results

8.4.2.3.1 Headworks Facility

The Headworks Facility consists of a rotary drum screen, grit chamber, and Parshall Flume. The visual hydraulics model determined that the peak hydraulic flow capacity through the existing headworks is 9.0 MGD if the headloss from the screen and grit chamber is eliminated; however, as shown in the table above the maximum flow capacity for the fine screen is 6.6 MGD and the grit chamber is 7.0 MGD. Including the headloss from the major headworks equipment, the maximum flow with 6 inches of freeboard is 7 MGD and only 4.8 MGD with 12 inches of freeboard. The Parshall flume can accurately measure up to 10 MGD before the flume becomes submerged and the flow measurement loses accuracy. The 24-inch diameter pipe from the Headworks facility can convey approximately 8.0 MGD to the aeration basin by gravity, given the 0.003 ft/ft slope.

8.4.2.3.2 Secondary Treatment

For the Secondary Treatment System, the model determined that a maximum total flow rate of 6.5 MGD can hydraulically pass through the aeration basin with 12 inches of freeboard. Using the minimum reasonable flow rates for return activated sludge (RAS) and internal mixed liquor recycle (IMLR) of approximately one times the maximum month wet weather influent flow ($1Q_{MMWWF}$) and 2^*Q_{MMWWF}, respectively. Approximately 7.0 MGD is passable through the aeration basin given lower IMLR/RAS rates, a smaller allowable freeboard, slight modifications to gate sizes, or a combination of these factors is considered.

The maximum flow through the secondary clarifiers is approximately 8.5 MGD with 12 inches of freeboard. However, the 55-foot diameter secondary clarifiers can pass a maximum of 7.1 MGD based on a maximum design overflow rate of 1,500 gallons per square foot per day for a secondary clarifier. The two 20-inch secondary effluent pipes tee together into one24-inch ductile iron pipe to the filter/UV basin. The maximum flow rate these pipes can convey is 10.3 MGD with both clarifiers online.

8.4.2.3.3 Disinfection Filtration Basin

The filter/UV basin houses disk filters, UV disinfection system, the effluent metering chamber, and the effluent pump station. The two disk-filter channels and UV channel passes 8.5 MGD with 12 inches of freeboard, including the headloss associated with the submerged UV system. The hydraulic model shows that the existing UV channel can hydraulically pass 14 MGD, however, the V-notch weir downstream of the UV system in the effluent metering chamber overflows at 10.3 MGD. The Operations and Maintenance Manual provided by Curran-McLeod only provides "head to flow rate" values up to 8.37 MGD.

The three existing effluent pumps in the effluent wet well each have a reported capacity of 1 MGD. As a result, the firm capacity of the effluent pump station is only 2 MGD. Since effluent flows exceed 2 MGD, the effluent pump station is equipped with an overflow pipe that discharges to

Tickle Creek near the WWTP. The 18 inch ductile iron overflow pipe to Outfall 003 has a capacity of 6.8 MGD at the reported 0.01 ft/ft slope.

8.4.2.3.4 Summary

Based on the hydraulic capacity analysis, the plant is not designed to hydraulically pass the 2017 PIF of 10.3 MGD. The maximum hydraulic capacity, excluding mechanical equipment capacity, is approximately 9.0 MGD, 6.5 MGD, and 8.5 MGD for Headworks, Secondary Treatment, and Filtration Disinfection Basin respectively, assuming a minimum of 12 inches of freeboard inside all structures.

8.4.3 Secondary Treatment System Process Capacity

8.4.3.1 Biowin Model Development

The existing aeration basins and secondary clarifiers were modeled using Biowin software to determine the existing secondary treatment process capacity for BOD and TSS degradation as well as ammonia oxidation. The aeration basins and secondary clarifiers were sized in the model based on record drawings of the basins. The model was evaluated under both wet weather and dry weather conditions at the maximum month flow rates for each. As part of the evaluation, the model was tested to determine under what flow rates could the secondary treatment process meet the permit requirements. As part of the model construction, the results of the wastewater characterization (**Table 8-6**) was included to develop the influent characteristics. Since all of the WW characterization sampling was performed during the summer/dry months, the influent characteristics for the model during wet weather flow conditions were decreased based on the observed ratio (approximately 65%) for BOD values between wet weather and dry weather months.

Table 8-6
Influent Wastewater Water Quality Characteristics

Parameter	Minimum Concentration (mg/l)	Maximum Concentration (mg/l)	Average Concentration (mg/l)
Raw Influent (9 Samples)			
Total COD	360	750	503
Filtered COD	110	200	140
Flocculated and Filtered COD	61	180	150
CBOD	226	435	317
Filtered CBOD	88	250	162
TSS	170	540	263
VSS	160	520	277
NH_3-N	34	43	38
NO_3-N	ND	ND	ND
TKN	41	74	53

Parameter	Minimum Concentration (mg/l)	Maximum Concentration (mg/l)	Average Concentration (mg/l)
Total-P	4.1	6.4	5.4
Ortho-P	1.4	6.1	2.8
Alkalinity	160	200	175
Ca	10	14	12
Mg	3.1	3.6	3.3
Temperature (ºC)	18.3	22.1	19.1
pH	6.4	7.3	6.9
Dissolved Oxygen	0.31	0.73	0.5

The model was first evaluated for performance under both MMWWF and MMDWF conditions to determine the process capacity of the secondary treatment system. The temperature was assumed to be 18 ºC for dry weather conditions and 12 ºC for wet weather conditions based on operational data provided by the City. As part of the analysis, the IMLR flow rate of 2Q and a RAS flow rate of 0.5 Q were assumed. Also, the solids retention time for summer and winter were set to 5 and 10 days. The input data used for the Biowin model and Biowin model report is included as an **Appendix J**.

8.4.3.2 Secondary Treatment Process Capacity Results

The results of the model showed 3 MGD could effectively be treated in the existing foot print of the aeration basin under both MMWWF and MMDWF. Flows above 3 MGD, the model predicts that incomplete nitrification will occur and the effluent ammonia will exceed the permit limit under both conditions. State point analysis of the clarifiers under both MMWWF and MMDWF conditions shows that the clarifiers are not overloaded, and the solids loading rate for both are 29 and 26 pounder per day per square foot (lbs/day/ft^2), respectively.

In addition, the treatment performance was evaluated at the current PIF of 7 MGD at 10 days SRT. The influent characteristics concentrations were further decreased by half from the MMWWF values due to dilution from the rain. Similar to the hydraulic model, the RAS and IMLR were set to 1X Q_{MMWWF} and 2X Q_{MMWWF}, respectively. Under these conditions, partial BOD, TSS, and ammonia removal was observed. Despite being noted before, the secondary clarifiers were near the design maximum surface overflow rate, and the analysis of the secondary clarifiers noted that the clarifiers were close to being critically loaded according to state point analysis. Also, the solids loading rate is 35 lbs/day/ft^2 which is near the upper limit of normal design.

8.4.3.2.1 WWTP Solids Stream Capacity

The City of Sandy's WWTP solids handling system consists of an aerated sludge storage basin, dewatering feed pumps, a belt filter press and polymer system, lime stabilization and storage of dewatered biosolids. The capacity of the system was based on the estimated waste activated sludge of 1,700 ppd produced from the Biowin Model under 2017 annual average flow rate conditions. The following sections discuss the capacity of each major component in the solids handling system.

8.4.3.3 Aerated Sludge Storage Basin Capacity

Based on an average wasting rate of 1,700 ppd determined by the Biowin model the WWTP has a 16-day storage capacity in the aerated sludge storage basin, based on a 1.2% incoming total solids concentration and including decanting back to the headworks.

8.4.3.4 Belt Filter Press Loading Rate

According to the design drawings for the 2013 Wastewater Treatment Facility Improvements, the belt filter press is designed for up to 600 lb/hour. Given the current 2017 wasting rate of 1,700 ppd, run through the existing belt filter press 8 hours a day, 4 days a week, the solids loading rate is approximately 370 lb/hour, therefore the existing belt filter press has sufficient capacity. However, operators on site reported poor performance of the dewatering equipment because of dewatering feed pump performance and an antiquated polymer feed system no longer supported by the manufacturer.

Future 2040 solids wasting rates are projected to be approximately 3,700 ppd. The existing belt filter press running 8 hours a day, 4 days a week, can process a maximum of 2,700 ppd give the solids loading rate of 600 lb/hr.

8.4.3.5 Dry Cake Storage Bay Capacity

According to the 2018 City of Sandy Biosolids Management Plan, the WWTP has 520 cubic yards of storage capacity for processed sludge. For 2017 wasting rates dewatered to 18% total solids, this is 72 days, approximately 10 weeks, of storage considering a sluffing factor of 1.3 applied.

8.4.3.6 Biosolids Recipient Limits and Uncertainty

The City of Sandy WWTP currently has the capacity to produce Class B Biosolids for land application. According to one operator, the demand for biosolids from local farmers is in September after Hay is baled. Storing biosolids is reportedly a challenge for the WWTP staff because of the narrow window of demand from local farmers and reportedly higher quantities of plastic products not effectively screened out of the biosolids historically deterred some farmers from accepting biosolids in the past. As a result, the City has been required to haul a significant amount of their biosolids to the landfill.

The 2018 Biosolids Management Plan indicates the City of Sandy is approved to apply biosolids over 175 usable acres across 25 sites. In 2017, the City of Sandy applied a total of 92 dry metric tons to agricultural fields over 56 of its approved acres. Using the typical biosolids Plant Available Nitrogen (PAN) quantities of 35 lb PAN/dry metric ton (“Fertilizing with Biosolids”, 2015), approximately 507 dry metric tons in total would be permitted to be applied to agricultural sites using the City of Sandy biosolids (See **Table 8-7**). Both the current 2017 and future 2040 total dry metric tonnage of biosolids produced by the City of Sandy are 280 and 610 dry metric tons respectively, the current permitted application sites are sufficient, but more sites will need to be permitted in the future, especially considering the variability in product demand.

Based on the pollutant monitoring data in the 2018 Biosolids Management Plan, the Land Application Pollutant allowable loading rates are much higher than the plant available nitrogen rates, therefore the limiting rates are determined based on the plant available nitrogen as discussed above. Based on the July 2017 data, the limiting pollutant is copper, which limits the biosolids application rate to 6,200 dry tons per acre **Table 8-8**). Based on the permitted sites in 2017, typical biosolids nutrient characteristics, and crop type designation provided by each land user, the permitted amount of biosolids for land application is approximately 500 dry tons ("Fertilizing with Biosolids", 2015). The input parameters used in the biosolids analysis are included as an **Appendix K**.

Table 8-7
Analysis of Allowable Biosolids Agronomic Loading for Approved Application Sites

Field ID	Acres	Usable Acres	Crop	Potential Application Rate, metric DT/site
Carmony/D	15.43	12.29	Hay	38
CCR # 1	9.3	9.3	Hay	29
CCR # 2	14.2	14.2	Hay	44
CCR # 3	6.6	6.6	Hay	17
CCR # 4	7.4	7.4	Hay	23
CCR # 5	8.8	8.8	Hay	23
CCR # 6	5.6	5.6	Hay	17
CCR # 7	4.78	4.78	Hay	15
V	2.23	2.23	Hay	7
W	2.75	2.75	Hay	7
Cedars	1.27	1.27	Hay	4
Bobnick	4.69	2.74	Hay	7
Brunn	19.75	3.43	Hay	9
Jackson/D	20.25	12.01	Hay	37
Jackson/S	38.6	10.43	Hay	32
Bunnell	19.55	6.01	Hay	19
Bunnell Cousins	40	14.47	Hay	45
Bunnell Sieberg	18.28	6	Hay	16
North		7.58	Pasture	20
SW		4.08	Pasture	11
South		1.61	Pasture	4
SE		1.6	Pasture	4
Buxton 1		13.83	Hay	36
Buxton 2		9.88	Pasture	26
Buxton 3		6.84	Pasture	18
Total	**239.48**	**175.73**		**507**

Table 8-8
Analysis of Allowable Biosolids Pollutant Loading (July 2017)

Parameter	Method	Dry Weight	Units	EPA Limits	CFR 40 Part 503 Cumulatvie Pollutant Loading Rate Limits (lb/acre)	Maximum Biosolids Application Rate dry ton/acre
Nitrate-Nitrite	EPA 9056	<0.000416	%			
Arsenic	EPA6020	1.52	mg/Kg	75	37	12171
Cadmium	EPA6020	0.438	mg/Kg	85	35	39954
Chromium					2700	
Lead	EPA6020	5.16	mg/Kg	840	270	26163
Molybdenum	EPA6020	2.39	mg/Kg			
Nickel	EPA6020	15.9	mg/Kg	420	380	11950
Selenium	EPA6020	2.66	mg/Kg	100	90	16917
Copper	EPA6020	105	mg/Kg	4300	1300	6190
Phosphorus	EPA6020	0.487	%			
Zinc	EPA6020	144	mg/Kg	7500	2500	8681
Potassium	EPA6010B	804	mg/Kg			
Mercury	EPA6020Hg	0.334	mg/Kg	57	15	22455

8.4.4 Potential Industrial User Considerations

Based on hydraulic and treatment capacity limitations, the City of Sandy should not accept high strength wastewater from significant industrial users (SIUs) until WWTP and collection system upgrades are complete. When the upgrades are made, it will still be important to consider the flow rate and concentration on a case by case basis for the approval of potential SIUs. If the City decides to accept SIUs discharges, the City should develop an industrial pretreatment program per 40CFR 403.8 (a).

8.4.5 Summary and Conclusions

The mechanical equipment on-site have capacities typically in the range between 6 MGD and 7 MGD. The disk filter has the limiting capacity of 6.0 MGD and the mechanical fine screen has a reported capacity of 6.6 MGD. Both the disk filter and fine screen have bypass channels to pass flow rates in exceedance of their specified ranges. Current 2017 peak flows exceed the capacity of the majority of the mechanical equipment.

The maximum hydraulic capacity, excluding mechanical equipment capacity, is approximately 9.0 MGD, 6.5 MGD, and 8.5 MGD for Headworks, Secondary Treatment, and Filtration Disinfection Basin respectively, assuming a minimum of 12 inches of freeboard inside all structures. Assuming less than 12 inches of freeboard inside all structures, the flow capacity of the Secondary Treatment can be maximized at 7.0 MGD.

The process capacity is limited to 1.5 MGD per train, therefore a total of 3.0 MGD in total under the current process conditions. Total flow beyond 3.0 MGD do not effectively reduce ammonia below effluent permit limits.

Currently, the dewatering system is rated for solids loading rates up to 2,700 pounds per day, which is sufficient for 2017 solids loading rates. However, according to the operators the actual performance of the dewatering equipment is reportedly inconsistent. The dry cake storage bay has capacity to store solids for approximately 10 weeks at the current dry solids concentration (approximately 18 percent total solids).

In summary, the aeration basin is a significant limiting capacity area in the plant, although the majority of mechanical equipment and the plant hydraulics are designed for approximately 7 MGD they are consistently undersized for the projected 2040 peak flows of 17.1 MGD. The equalization storage pond can currently mitigate the peak flows greater than 7 MGD that are already experienced at the existing WWTP, but as the influent flow rates continue to rise, the storage capacity in the storage pond will be exceeded and the treatment capacity of the plant will not be able to keep up with incoming flows. The storage capacity of solids on-site is also insufficient as was discussed above.

8.4.6 References

Health Research, Inc, Health Education Services Division. (2014) 10 States Standards: Recommended Standards for Wastewater Facilities. Retrieved October 18, 2018 from http://10statesstandards.com/wastewaterstandards.pdf

Oregon State University, Washington State University, University of Idaho. (2015). Fertilizing with Biosolids. Retrieved October 18, 2018 from https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw508_0.pdf

Section 9

Section 9

Initial Wastewater Systems Alternatives Evaluation

This section evaluates wastewater system available to the City to most cost-effectively manage the wastewater collections, treatment and discharge for the currently planning horizon through 2040 and beyond. This initial evaluation was completed under the assumptions of continued discharge to Tickle Creek in the winter months, summer irrigation at Iseli Nursery and expansion of the current secondary-only treatment process. The primary goal of this initial alternatives evaluation is to identify the appropriate balance of investments in the City's wastewater system.

The evaluation includes the following elements summarized in the sections that follow:

- NPDES Permit and discharge evaluation for continued Tickle Creek winter discharge with summer irrigation at Iseli Nursery;
- Collection system, discharge and storage requirements alternatives for a range of RDII and WWTP peak flow reductions; and
- WWTP upgrades for treating the full range of flows for the collection system alternatives.

9.1 NPDES Permit and Discharge Evaluation

As summarized in **Section 4 – Regulatory Requirements**, the City's NPDES Permit allows wet weather discharge to Tickle Creek from November through April. In the dry season, the City irrigates or stores Class B recycled water at nearby Iseli Nursery. Tickle Creek is located in the Clackamas River Basin, which is subject to limitations of Oregon's Three Basin Rule (OAR 340-041-003) preventing any increases in mass load limits for wastewater treatment plants. NPDES Permit requirements are summarized in **Table 9-1**.

Table 9-1
City of Sandy Tickle Creek Discharge NPDES Permit Requirements

	Monthly Average Concentration (mg/L)	Weekly Average Concentration (mg/L)	Daily Maximum Concentration (mg/L)	Monthly Average Load[b](lb/day)	Weekly Average Load[b] (lb/day)	Daily Maximum Load[b,c](lb)
Winter Season (November 1 through April 30)						
BOD_5	10	15	NA	125	187	250
TSS	10	15	NA	125	187	250
Ammonia	3.7	NA	10.9	NA	NA	NA

In order to evaluate the viability of the City's continued wet weather discharge to Tickle Creek with dry weather Class B recycled water irrigation at Iseli Nursery, the following analyses were completed:

- **Tickle Creek Wet Weather Mass Load Limits Analysis** for wastewater treatment and discharge requirements under the limitations for mass load increases under the Three Basin Rule.
- **Sandy WWTP NPDES Permit Stream Dilution Criteria Analysis** assessing the viability of the City's long-term discharge to Tickle Creek.
- **Iseli Nursery Dry Season Recycled Water Storage Analysis** assessing the needs for continued dry season Class B recycled water storage and irrigation at Iseli Nursery.

9.1.1 Tickle Creek Wet Weather Mass Load Limits Analysis

Under the limitations of the Three Basin Rule, no increases in BOD and TSS mass load limits are allowed for the City's current Tickle Creek discharge. In addition, obtaining BOD and TSS mass load limits for the dry weather months from May through October not allowed under the limitations of Oregon's Three Basin Rule.

Therefore, the only direct answer for maintaining the City's long-term discharge in Tickle Creek during the wet weather discharge period from November through April is improved treatment performance to lower effluent concentrations for BOD and TSS.

Based on the projected 2040 maximum month wet weather flow (MMWWF) of 4.2 MGD the WWTP effluent concentrations for BOD and TSS will need to be approximately 3.5 mg/L to comply with the mass load limits in the City's NPDES Permit. This is significantly lower than the monthly average concentration limits of 10 mg/L in the permit. Consistently meeting concentration limits of 3.5 mg/L will be difficult to meet reliably with the City's current secondary treatment process with cloth media tertiary filtration.

9.1.2 NPDES Wet Season Discharge Stream Dilution Criteria Analysis

An overview of the NPDES Permit Stream Dilution Criteria is included in Chapter 4, which limits discharge to Tickle Creek when the stream dilution is less than 10. **Figures 9-1** and **9-2** summarize the evaluation of Stream Dilution compliance for wet weather discharge from the WWTP to Tickle Creek. Future conditions were analyzed by projecting daily flows and using the same Tickle Creek flows.

Figure 9-1
Historical Tickle Creek NPDES Stream Dilution Analysis (2013-2017)

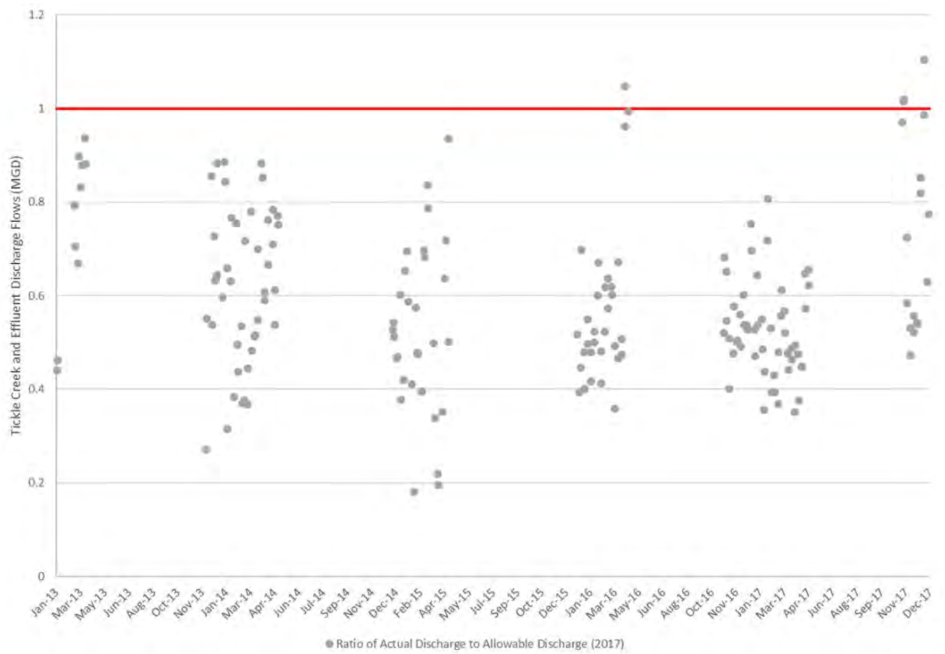
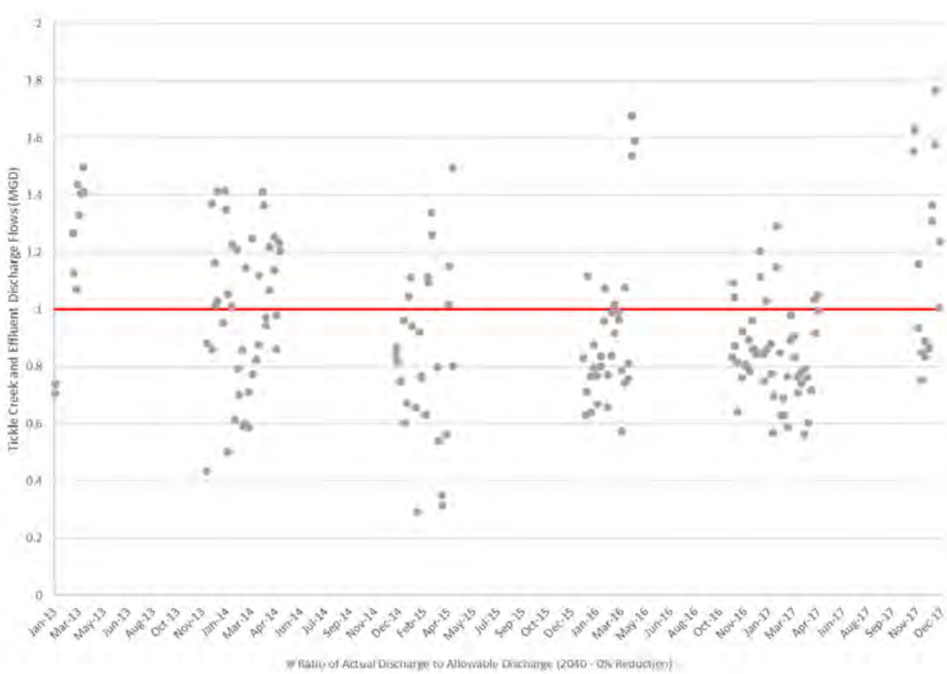


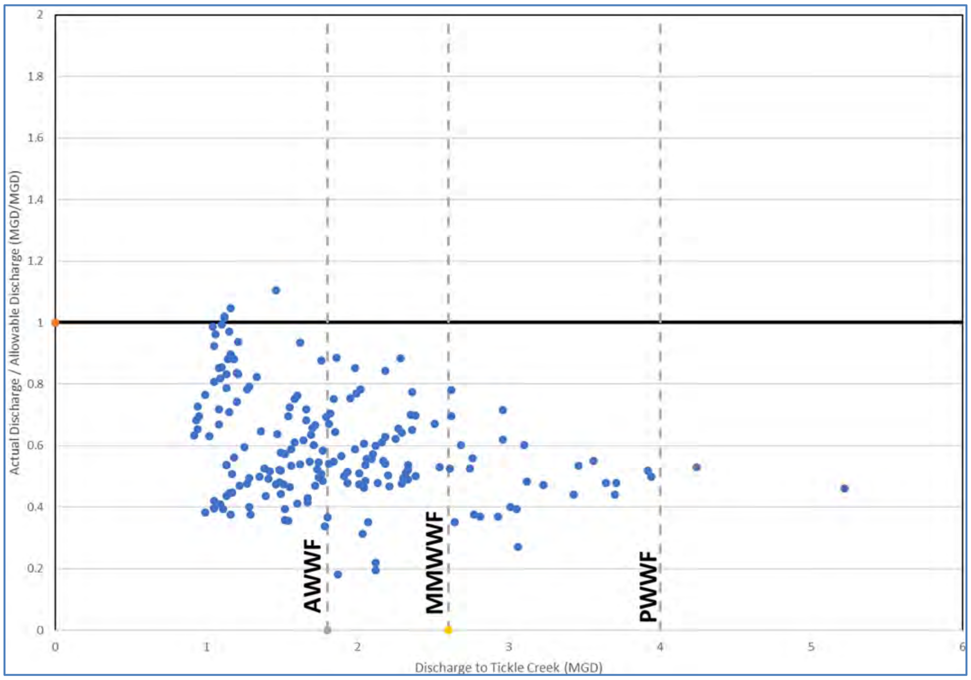
Figure 9-2
Projected Tickle Creek NPDES Stream Dilution Analysis (2037-2040)



As shown in the analyses, the City has current exceedances of the NPDES Permit Stream Dilution Criteria that will become very limiting toward the end of the current planning period through 2040.

In fact, continued discharge to Tickle Creek at the current location is not considered viable for the City and additional wet weather dilution flows are needed for long term wet weather discharge.

Figure 9-3
Timing Dilution Rule Exceedances (2013-2017)



While additional dilution flows are clearly required based on the analyses presented in **Figures 9-1** and **9-2**, the required timing of those flows is of interest because the current NPDES Permit allows discharge through Outfall 003, which is an overflow pipe from the effluent pump station, when WWTP flows are greater than 4 MGD. **Figure 9-3** shows that the additional dilution flows are required during lower system flows while during peak events there is generally always adequate dilution flows in Tickle Creek at the WWTP outfall. Therefore, it appears the existing WWTP outfall can continue to be utilized for discharge of peak flow events.

Outside of the peak flow events where the WWTP Outfall 003 is utilized, the NPDES Permit Stream Dilution Criteria analysis indicates additional stream flow of approximately double is required for continued wet weather discharge to Tickle Creek through 2040. This would require relocation of the existing Tickle Creek outfall approximately 2 miles downstream to the confluence of Tickle Creek and Deep Creek, where flows are estimated to be approximately 2.3 times greater than the flow at the current outfall location.

9.1.3 Iseli Nursery Dry Season Recycled Water Storage Analysis

The City currently has a long-term agreement to send Class B recycled water to nearby Iseli Nursery during the dry season(May – October) when discharge to Tickle Creek is not allowed. Currently, the Class B recycled water is pumped to Iseli Nursery Pond 4 where it is stored, transferred to the three other ponds and used to irrigate the nursery stock grown by Iseli at there facility.

Iseli Nursery primarily grows ornamental plants in pots, and they irrigate their field when they observe dry soil in the pots. Because the plants grow in pots and they only irrigate when the soil is dry, it is difficult to project water demands based on agronomic irrigation rates. Iseli has expressed a desire to have additional recycled water for the dry summer months in July and August. However, there have been issues with available storage in the Iseli ponds in the "shoulder" months of May and October when there is adequate rainfall yet no discharge to Tickle Creek is allowed.

With increased effluent flow over time, the increased potential for the Iseli storage ponds to exceed their capacity over time, and without the ability to discharge Tickle Creek during the summer, the only viable solution while staying in the Clackamas River Basin is to provide additional storage for Class B recycled water at Iseli Nursery.

Iseli Nursery has discussed with the City several optional storage pond expansions on their property including adding volume adjacent to Pond 4 where recycled water is initially pumped from the WWTP. Since performing a normal water balance to determine future water demand is difficult due to the nature of the irrigation requirements at the nursery, total storage requirements were estimated by assuming no irrigation demand during a two-week time period in October when rainfall typically exceeds agronomic irrigation demands. Based on this evaluation, the minimum additional storage volume required at Iseli Nursery is 25 million gallons.

9.1.4 Summary of NPDES Permit and Discharge Analysis

The following conclusions can be drawn from the analyses of the WWTP mass load limits, NPDES Permit Stream Dilution Criteria and Iseli Nursery storage requirements:

- Continued wet season discharge from November through April requires the WWTP to treat to BOD and TSS limits of approximately 3.5 mg/L, which pushes the technology limits of the City's existing treatment process;
- Additional dilution flows are required for continued wet season discharge to Tickle Creek, which will require relocation of the outfall approximately 2 miles downstream to the confluence of Tickle Creek and Deep Creek;
- Additional Class B Recycled Water storage of 25 million gallons is required at Iseli Nursery during the dry season from May through October to prevent unauthorized overflows to Tickle Creek; and
- Improved storage management is also needed at Iseli Nursery to provide adequate storage at the nursery in the "shoulder" months of May and October.

9.2 Wastewater Collection, Discharge and Storage Upgrades Overview

This section provides an overview of required upgrades to the city's wastewater collection system and discharge/storage/irrigation upgrades upstream and downstream of the WWTP, respectively. This information will then be combined into overall alternatives developed in the following section.

9.2.1 Existing Wastewater Collection System Overview

The City's wastewater collection and pump system consists of approximately 38 miles of pipelines and 6 pump stations as shown in **Figure 9-4** on the following page. The following sections will discuss the various alternatives that will be included as part of this Comprehensive Wastewater Systems Alternatives Evaluation.

Based on the results from Sanitary Sewer Evaluation Survey presented in Chapter 7, RDII reduction scenarios were developed for a range of peak flow reductions to assess the cost effectiveness of RDII investments versus treatment plant expansion. For the analysis, each of the meter basins were ranked from lowest to highest based on cost per gallon per day of RDII removed. Meter basins and associated rehabilitation costs were grouped based on targeted peak influent flows at the treatment facility utilizing the least cost and highest flow reduction meter basins first. The cost estimates are based on the rehabilitation of the mainlines and laterals with an overall goal of 65% RDII reduction per basin.

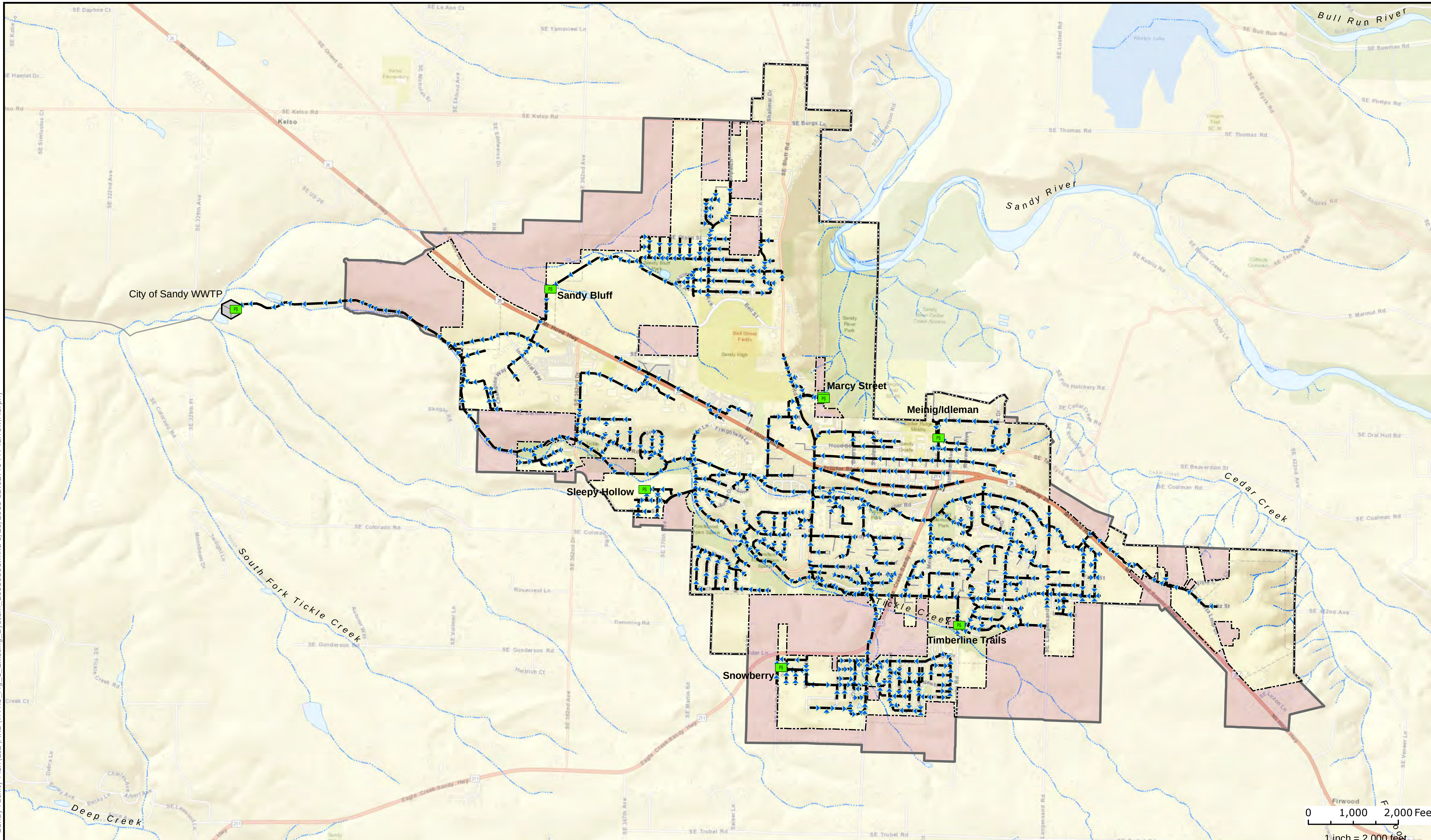
Using these data, four potential RDII reduction scenarios were developed based on the potential expansions of the existing WWTP and stepped by the 3.5 MGD capacity of each secondary treatment train (aeration basin and secondary clarifier) in the facility. The collection system upgrades for each scenario includes sizing and costs for preliminary upsizing of gravity pipelines, pump stations and force mains to satisfy City hydraulic design criteria utilizing flow rates established for 2040 with pipe degradation and respective RDII reduction. The meter basins selected for reduction in each scenario and preliminary conveyance system improvements are presented in the combined alternatives evaluation that follows after this section.

9.2.2 Existing WWTP Outfalls and Effluent Discharge Overview

Following treatment in the WWTP, Class B Recycled Water produced at the WWTP is discharged or recycled through one of three permitted NPDES outfalls, depending on the time of year:

NPDES Outfall 001: from November through April, effluent is discharged through a 14-inch outfall to Tickle Creek approximately one mile downstream of the WWTP.

NPDES Outfall 002: from May through October, Class B Recycled Water is pumped to Iseli Nursery Pond 4 for reuse at the nursery.



murraysmith

City of Sandy, Oregon
Wastewater System Facility Pla

WW Treatment Plant
Pump Station
Sewer Force Mains
Sewer Gravity Mains
Sewer pipe - not modeled
Stream
Water Body
City_Limits
Study Area
UGB Growth Areas

Figure 9-4
Existing WW System

This page intentionally left blank

NPDES Outfall 003: from November through April, effluent flows in excess of 4 MGD are allowed to be discharged through an overflow pipeline at the WWTP effluent pump station to Tickle Creek.

Following is an overview of each of the elements utilized for these three NPDES outfalls.

9.2.2.1 Effluent Pump Station and Force main to Iseli Storage Ponds

The existing WWTP effluent force main and pump station to the Iseli Storage facility will require upgrades for peak summer flow rates, especially during May and October "shoulder" months when Tickle Creek discharge permitted. Depending on the alternative being considered, the pump station costs will include pump replacement and expansion of the existing wet well, as well as the construction of a new parallel force main alongside the existing 14-inch force main.

9.2.2.2 Storage Pond Expansion at Iseli Nursery

The available Class B Recycled Water storage capacity at Iseli Nursery was evaluated by balancing a modeled influent hydrograph during a historic fall time period (October 2010, in which a 5 to 10-year frequency storm event also occurred) with crop demand and evaporation estimates as documented in the *City of Sandy Reclaimed Water Use Plan Update* (Curran-McLeod, 2017). The influent hydrograph was modeled assuming 2040 growth and system degradation with varied levels of RDII reduction. Costs for the storage facility improvements are estimated based on the additional storage required at the nursery for each alternative. While additional storage is required, better management of recycled water storage is also required to make sure adequate storage is available during May and October when agronomic irrigation is limited.

9.2.2.3 Outfall Relocation to Tickle Creek/Deep Creek Confluence

As discussed in Section 1.2, Tickle Creek dilution flows are inadequate in the current outfall location. For discharge through 2040, approximately double the dilution flows are required. To maintain the current NPDES discharge, the outfall will likely need to be relocated approximately 2 miles downstream to the confluence of Tickle Creek and Deep Creek. The outfall location was selected for compliance with the NPDES stream dilution criteria during winter time periods. Therefore, a new 9,100-foot outfall pipeline extension will be required for all alternative scenarios involving continued discharge to Tickle Creek.

9.3 Wastewater System Peak Flow Alternatives

Based on the collection system evaluation, comprehensive alternatives were developed twofold. First, the "do everything" and "do nothing" options related to collection system rehabilitation established the minimum WWTP design peak flow of 9.0 MGD and the maximum WWTP design peak flow of 17.1 MGD, respectively. Second, two intermediate peak flow alternatives of 10.5 MGD and 14.0 MGD were developed based on the 3.5 MGD secondary treatment train capacity of the existing WWTP and the additional capacity developed by adding new secondary treatment trains in increments of the 3.5 MGD per train capacity. Peak flow alternatives are described in the sections that follow.

Peak Flow Scenario #1: Maximum RDII reduction to 2040 peak flow of 9 MGD

This alternative represents the "do everything" option involving full replacement of the City's entire wastewater collection system. This alternative would reduce the projected 2040 peak flow from 17.1 MGD to 9.0 MGD, resulting in the least amount of collection and treatment capacity upgrades, but the greatest amount of collection system rehabilitation.

Peak Flow Scenario #2: RDII reduction to 2040 peak flow of 10.5 MGD

This alternative provides for a moderate WWTP capacity expansion to add one new secondary treatment train along with other upgrades, while coupled with extensive RDII investments that fall short of the full collection system replacement of Combined Alternative 1.

Peak Flow Scenario #3: RDII reduction to 2040 peak flow of 14 MGD

This alternative provides for more significant WWTP capacity expansion from 7 MGD to 14 MGD, coupled with lower investments in collection system RDII reduction. Compared to Combined Alternative 2, this alternative will require additional conveyance capacity and pump station upgrades in addition to WWTP upgrades associated with a peak flow of 14 MGD.

Peak Flow Scenario #4: Minimum RDII reduction for 2040 peak flow of 17.1 MGD

This alternative represents the "do nothing" scenario related to RDII peak flow reductions, representing the maximum collection system capacity and WWTP upgrades. This option is typically referred to as the "pump and treat" option, that is not typically recommended since the City's collection system will continue to deteriorate over time.

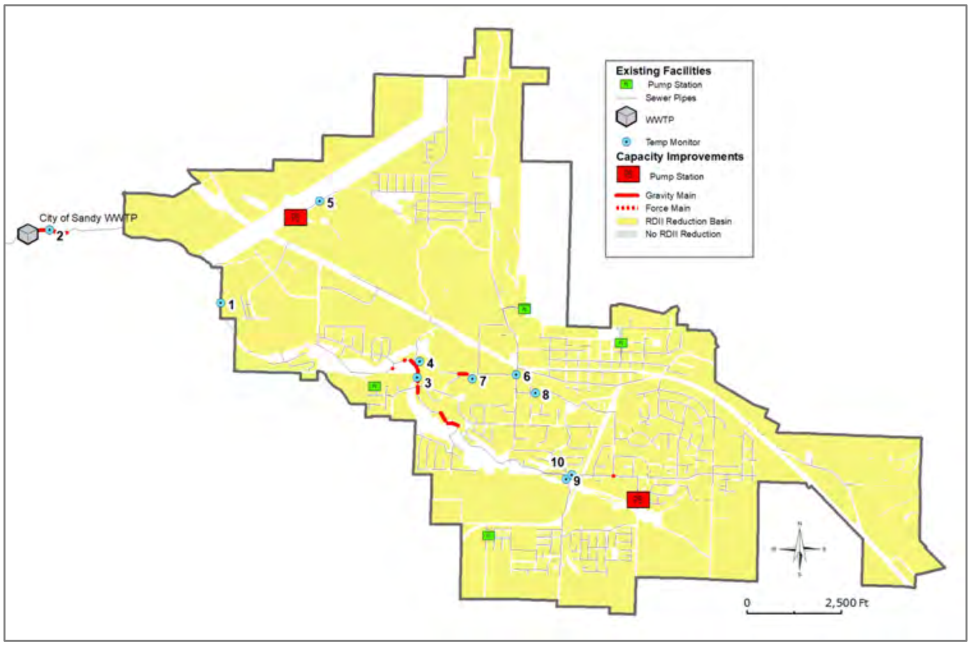
9.4 Peak Flow Scenario #1: WW System Upgrades for 9.0 MGD

Peak Flow Scenario #1 is the RDII "do everything" scenario involving full replacement of the City's wastewater collection system and laterals coupled with minimum WWTP upgrades. In addition, minimum amounts of conveyance capacity upgrades will be needed since peak flows will be reduced. Lastly, outfall pipe upgrades will be less since peak flows to Iseli Nursery will be reduced. The following sections summarizes the changes needed for each major component in detail.

9.4.1 Peak Flow Scenario #1 Collection System Upgrades

Under this Scenario, peak flows are reduced to the maximum extent possible through full collection system rehabilitation program in all sewersheds including pipe repair and replacements as well as removing cross connections from sewer mains, connections, and private lateral. This will reduce the peak flows from 17.1 MGD to 9.0 MGD. A map of the extent of collection system rehabilitation as well as required conveyance and pump station upgrades under this scenario is shown on **Figure 9-5**.

Figure 9-5
Peak Flow Scenario #1 (9 MGD) Collection System Capacity Improvements



For this scenario, two pump stations will need upgrading as well as 2850 ft of gravity mains will be replaced to meet capacity requirements. The cost for this scenario is listed on **Table 9-2.**

Table 9-2
Peak Flow Scenario #1 Collection System Cost Summary

Item	Cost
Collection System Rehabilitation	$31.7M
Conveyance and Pump Station Upgrades	$3.8M
Total	**$35.5M**

9.4.2 Peak Flow Scenario #1 WWTP Upgrades

To meet the additional capacity required to meet a peak flow demand of 9.0 MGD, several unit process upgrades are needed in the liquid stream as highlighted on **Figure 9-6** on the following page**.** The following sections will discuss the upgrade needed for Headworks Facility, Secondary Treatment, and Filtration Disinfection Basin.

9.4.2.1 Headworks

Upgrades to the Headworks Facility to meet the peak flows of 9 MGD include replacing the fine screen with a 9 MGD capacity rotary drum fine screen. The existing grit removal system and classifier will be reused. The existing 12-inch Parshall flume will be replaced with an 18-inch Parshall Flume to accurately measure flows of 9 MGD or greater.

9.4.2.2 Secondary Treatment Expansion

One new aeration basin of similar dimensions to the existing basins will be added to effectively treat an additional 3.5 MGD of peak flow. To account for the increased air demand for the new aeration basin, a new blower will be installed. In addition, upgrades to increase activated sludge pumping include a new return activated sludge pump for an additional 2 MGD and a waste activated sludge pump for an additional 0.5 MGD. Lastly, a third secondary clarifier with an additional scum pump station and associated piping will be included.

9.4.2.3 Disinfection Filtration Basin

To expand filtration capacity beyond 6 MGD, a new 6-disk filter basin will be added in a parallel to the existing disk filtration basins. In addition, disinfection capacity will be increased by replacing existing 7 MGD UV system in the existing reinforced concrete basin with a new 9 MGD UV system using two banks, each capable of disinfection 4.5 MGD.

To increase effluent pumping capacity to meet the peak flow requirement during the dry weather season when discharge to Tickle Creek is not allowed, the existing effluent pump station capacity will be increased to 8.1 MGD to the Iseli Nursery Site through a 20-inch diameter force main.

9.4.2.4 WWTP Solid Stream Upgrades

To meet the additional sludge storage handling requirements in 2040 for the increased loaded at the WWTP, several upgrades will be need. First, to achieve 15 days of storage in the aerated sludge storage basin (ASSB), the holding volume requires twice as much volume as the current ASSB. Therefore, a new ASSB will be built. In addition, the existing belt filter press will be replaced with a dewatering centrifuge and polymer to fit into the same footprint as the belt filter press but achieve greater throughput capacity. Lastly, the area for sludge storage of the dewatering cakes is currently 1,200 SF and the required space is approximately 9,000 SF based on 18% total solids concentrations of the dewatered sludge and storing for 5 months. Therefore 8,000 additional SF of storage would be necessary on-site. To achieve this footprint on the existing site requires use of the existing road, which is necessary to load the biosolids out of the existing WWTP.

9.4.2.5 Peak Flow Scenario #1 WWTP Cost Summary

Estimated costs for WWTP upgrades for Peak Flow Scenario #1 are summarized in **Table 9-3**.

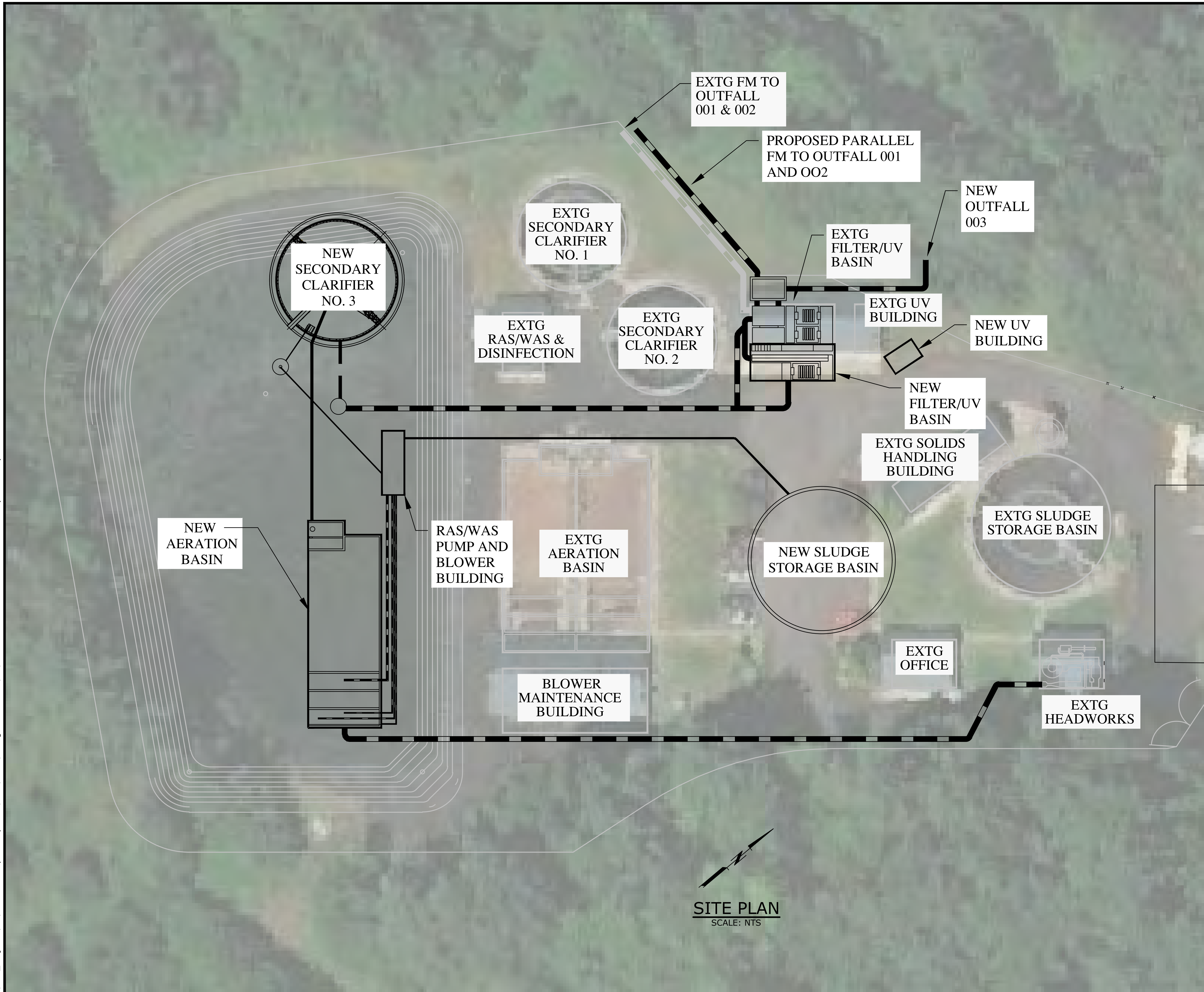


FIG 9-6

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

Scenario 1 WWTP
UPGRADES SCHEMATIC (9 MGD)

January 2019

murraysmith

DRAFT

17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\XREF\9.dwg Site Plan 10/26/2018 8:29 AM NICK.MCFADDIN 23.0s (LMS Tech)

This page intentionally left blank

Table 9-3
Peak Flow Scenario 1 WWTP Upgrades Cost Summary

Unit Process	Cost
Liquid Stream	
Headworks	$ 1,490,000
Secondary Treatment	$ 4,420,000
Disinfection Filtration Basin	$ 2,230,000
Effluent Pump Station	$ 1,100,000
Subtotal	**$ 9,240,000**
Solids Stream	
Aerated Sludge Storage Basin	$ 2,690,000
Dewatering Equipment	$ 1,170,000
Dewatered Solids Storage	$ 3,070,000
Subtotal	**$ 6,930,000**
Total	**$ 16,170,000**

9.4.3 Peak Flow Scenario #1 Discharge/Storage Upgrades

Under this Scenario, there are several upgrades required for the discharge/storage facilities required to handle the projected flow conditions (See **Figure 9-7**). First, the force main to Iseli will still need to be replaced with a new 18-inch force main to handle flows from May and October storm events as outlined in Section 1.2. In addition, a 25 million gallon (MG) storage pond expansion at Iseli Nursery will be required to handle the additional volume. Lastly, because of the stream dilution requirement outlined in Section 1.2, a new 18-inch gravity sewer outfall will need to be extended 2 miles downstream. The total cost for Discharge/Storage Upgrades for this scenario is summarized in **Table 9-4**.

Table 9-4
Peak Flow Scenario #1 Discharge/Storage Cost Summary

Item	Cost
Outfall Force Main Upgrades	$3M
Iseli Storage Pond Expansion	$9.6M
Gravity Outfall	$7.1
Total	**$19.7M**

9.4.4 Total Peak Flow Scenario #1 Cost Summary

The total cost for this scenario including collection system, WWTP, and storage/discharge upgrades is $71.4 M.

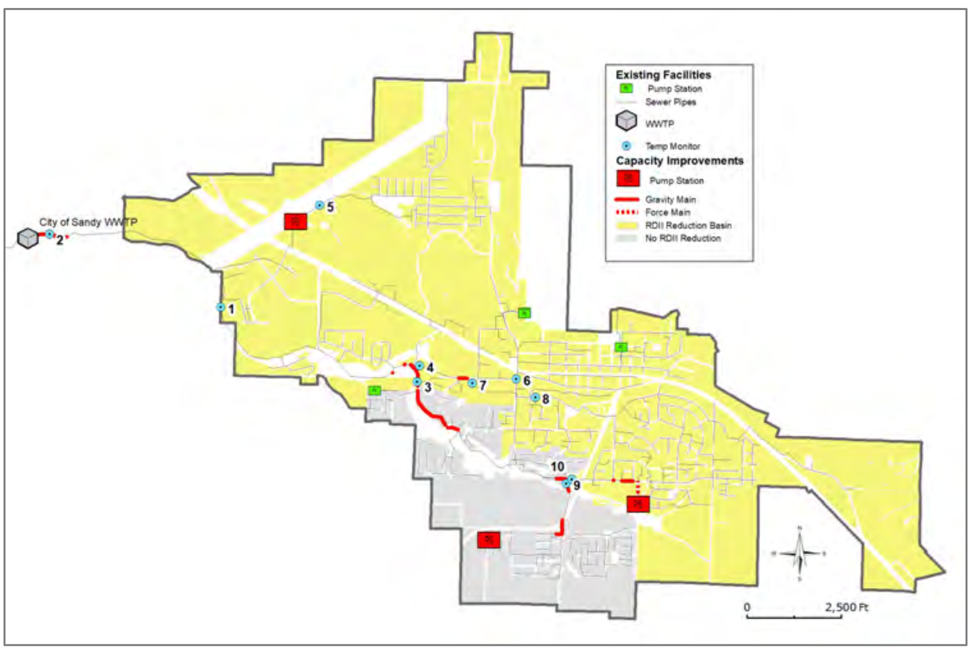
9.5 Peak Flow Scenario #2: WW System Upgrades for 10.5 MGD

This scenario involves moderate WWTP upgrades along with a large investment in rehabilitation of the existing in the collection system. As a result of less RDII reduction, more capacity upgrades will be needed to existing conveyance lines and pump stations as compared to Scenario 1 since peak flows will be higher. Lastly, outfall pipe upgrades will be increased as compared to Scenario 1 since peak flows to Iseli Nursery will be increased. The following sections summarizes the changes needed for each major component in detail.

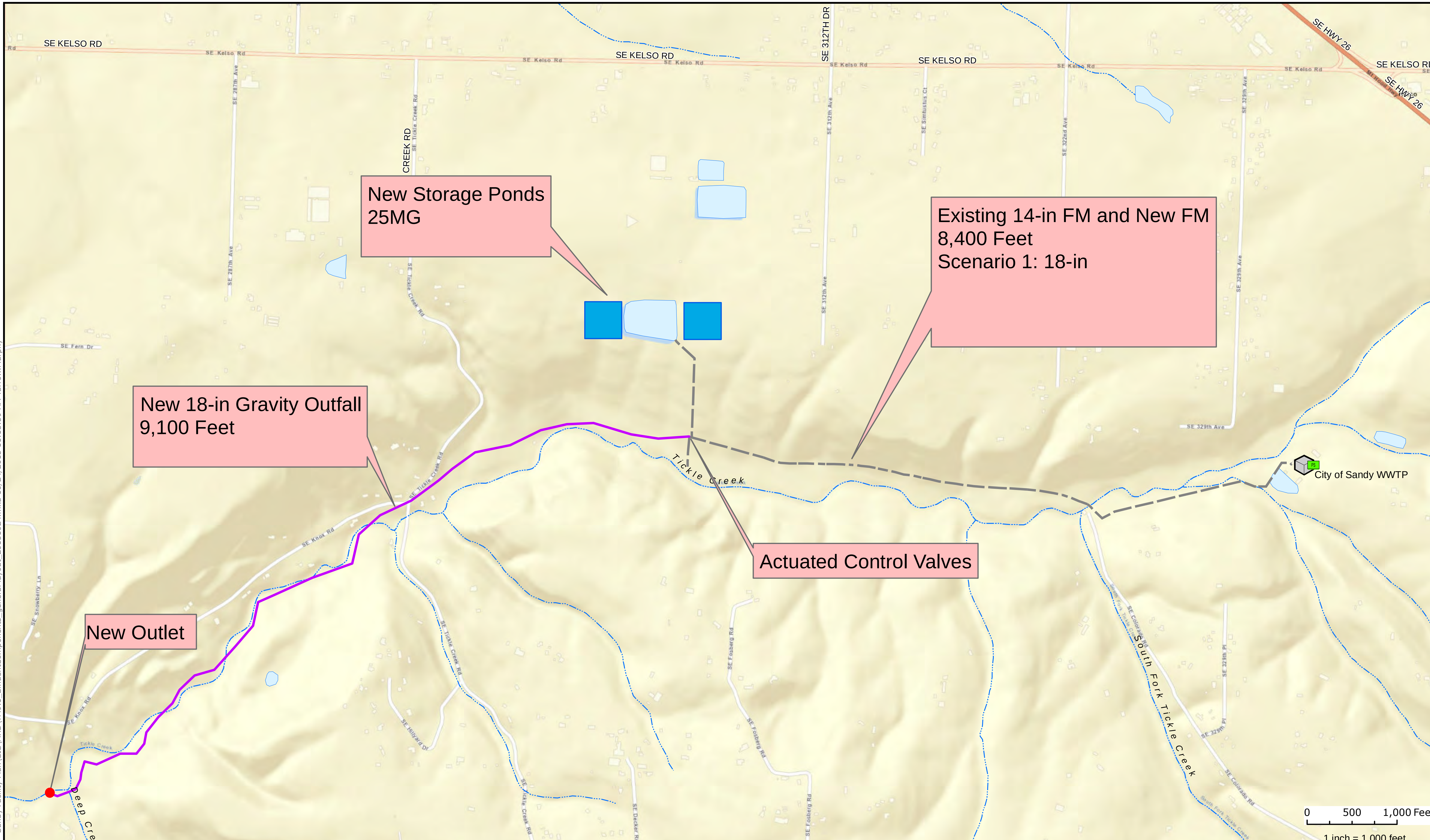
9.5.1 Peak Flow Scenario #2 Collection System Upgrades

Under this scenario, collection system rehabilitation program will be performed on in 6 sewersheds including pipe repair and replacements as well as removing cross connections from sewer mains, connections, and private lateral. This will reduce the 2040 peak flows from 17.1 MGD to 10.5 MGD. A map of the extent of collection system rehabilitation as well as required conveyance and pump station upgrades under this scenario is shown on **Figure 9-8.**

Figure 9-8
Peak Flow Scenario #2 (10.5 MGD) Collection System Capacity Upgrades



For this scenario, three pump stations will need upgrading as well as 610 feet of force mains and 5100 ft of gravity mains will be replaced to meet capacity requirements. The cost for this scenario is listed on **Table 9-5**.



G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM9.1_EffluentComponents_general layout_20181024.mxd 10/24/2018 11:13:59 AM Yarrow.Murphy

murraysmith

SANDY
WHERE INNOVATION MEETS ELEVATION

City of Sandy, Oregon
Wastewater System Facility Plan

- Proposed Outfall Conveyance
- Existing FM and Outfall
- Proposed Outfall
- Pump Station
- WWTP

Figure 9-7
Proposed Storage and Outfall Extension

January 2019 17-2137

This page intentionally left blank

Table 9-5
Peak Flow Scenario #2 Collection System Cost Summary

Item	Cost
Collection System Rehabilitation	$17.9M
Conveyance and Pump Station Upgrades	$5.4M
Total	**$23.4M**

9.5.2 Peak Flow Scenario #2 WWTP Upgrades

To meet the additional capacity required to meet a peak flow demand of 10.5 MGD, several unit process upgrades are needed in the liquid stream as highlighted on **Figure 9-9**. The following sections will discuss the upgrade needed for Headworks Facility, Secondary Treatment, and Filtration Disinfection Basin.

9.5.2.1 Headworks

Upgrades to the Headworks Facility to meet the peak flows of 10.5 MGD include the addition of a second fine screen and a grit removal system to increase the capacity by 3.5 MGD. This will include the construction of an overhand structure to house the expansion of the headworks. The existing grit removal system and classifier will be reused. The existing 12-inch Parshall flume will be replaced with an 18-inch Parshall Flume to accurately measure flows of 10.5 MGD or greater. Lastly, the existing 24-inch pipe from the headworks will be replaced with a 30-inch pipe.

9.5.2.2 Secondary Treatment

One new aeration basin of similar dimensions to the existing basins will be added to effectively treat an additional 3.5 MGD of peak flow. To account for the increased air demand for the new aeration basin, a new blower will be installed. In addition, upgrades to increase activated sludge pumping include a new return activated sludge pump for an additional 2 MGD and a waste activated sludge pump for an additional 0.5 MGD. Lastly, a third secondary clarifier with 65 feet in diameter with an additional scum pump station and associated piping will be included.

9.5.2.3 Disinfection Filtration Basin

To expand filtration capacity beyond 6 MGD, a new 8-disk filter basin will be added in a parallel to the existing disk filtration basins where the filter media will be replaced. In addition, disinfection capacity will be increased by adding a new parallel channel with three banks in series that are rated at 4 MGD each.

To increase effluent pumping capacity to meet the peak flow requirement during the dry weather season when discharge to Tickle Creek is not allowed, the existing effluent pump station capacity will be increased to 9.4 MGD to the Iseli Nursery Site through a new 24-inch diameter force main.

9.5.2.4 WWTP Solid Stream Upgrades

The solids stream upgrades for Scenario 2 are identical to Scenario 1 since the solids production is not impacted significantly by dropping peak flows. Therefore, the upgrades and cost will be identical to Scenario 2.

9.5.2.5 Scenario 2 WWTP Upgrades Cost Summary

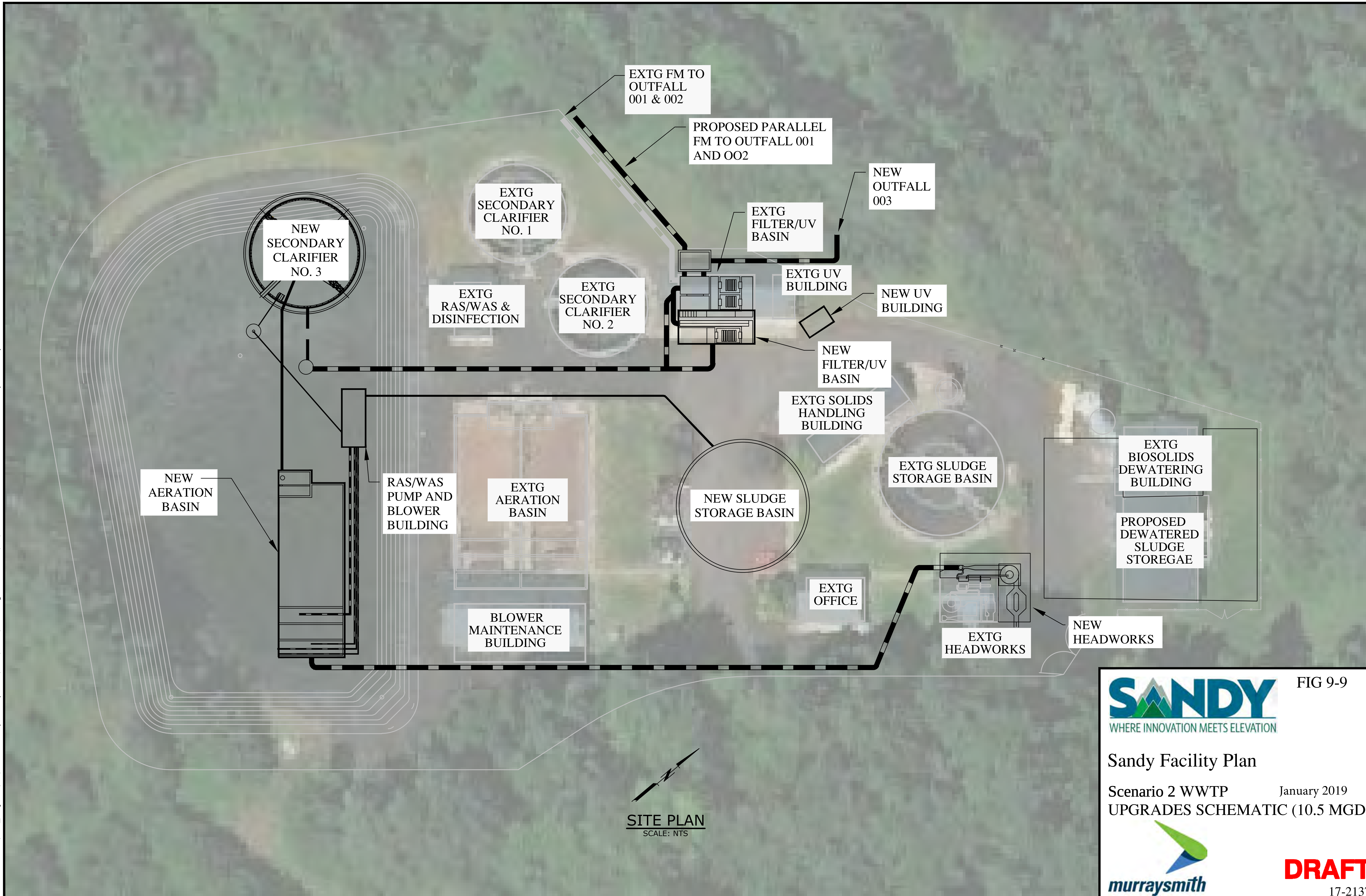
The total cost for WWTP upgrades for this scenario is $19,310,000 as outlined in **Table 9-6**.

Table 9-6
Peak Flow Scenario #2 WWTP Upgrades Cost Summary

Unit Process	Cost
Liquid Stream	
Headworks	$ 3,100,000
Secondary Treatment	$ 4,420,000
Disinfection Filtration Basin	$ 3,670,000
Effluent Pump Station	$ 1,190,000
Subtotal	**$ 12,380,000**
Solids Stream	
Aerated Sludge Storage Basin	$ 2,690,000
Dewatering Equipment	$ 1,170,000
Dewatered Solids Storage	$ 3,070,000
Subtotal	**$ 6,930,000**
Total	**$ 19,310,000**

9.5.3 Peak Flow Scenario #2 Discharge/Storage Improvements

Under this Scenario, there are several upgrades required for the discharge/storage facilities required to handle the projected flow conditions (See **Figure 9-7**). First, the force main to Iseli will still need to be replaced with a new 20-inch force main to handle flows from May and October storm events as outlined in Section 1.2. In addition, a 25 MG storage pond expansion at Iseli Nursery will be required to handle the additional volume. Lastly, because of the stream dilution requirement outlined in Section 1.2, a new 18-inch gravity sewer outfall will need to be extended 2 miles downstream. The total cost for Discharge/Storage Upgrades for this scenario is summarized in **Table 9-7**.



G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\XREF\10.5.dwg Site Plan 10/26/2018 8:27 AM NICK.MCFADDIN 23.0s (LMS Tech)

FIG 9-9

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

Scenario 2 WWTP UPGRADES SCHEMATIC (10.5 MGD)

January 2019

murraysmith

DRAFT

17-2137

This page intentionally left blank

Table 9-7
Peak Flow Scenario #2 Discharge/Storage Cost Summary

Item	Cost
Outfall Force Main Upgrades	$3.3M
Iseli Storage Pond Expansion	$9.6M
Gravity Outfall	$7.1M
Total	**$20.0M**

9.5.4 Total Peak Flow Scenario #2 Cost Summary

The total cost for this scenario including collection system, WWTP, and storage/discharge upgrades is $62.6 M.

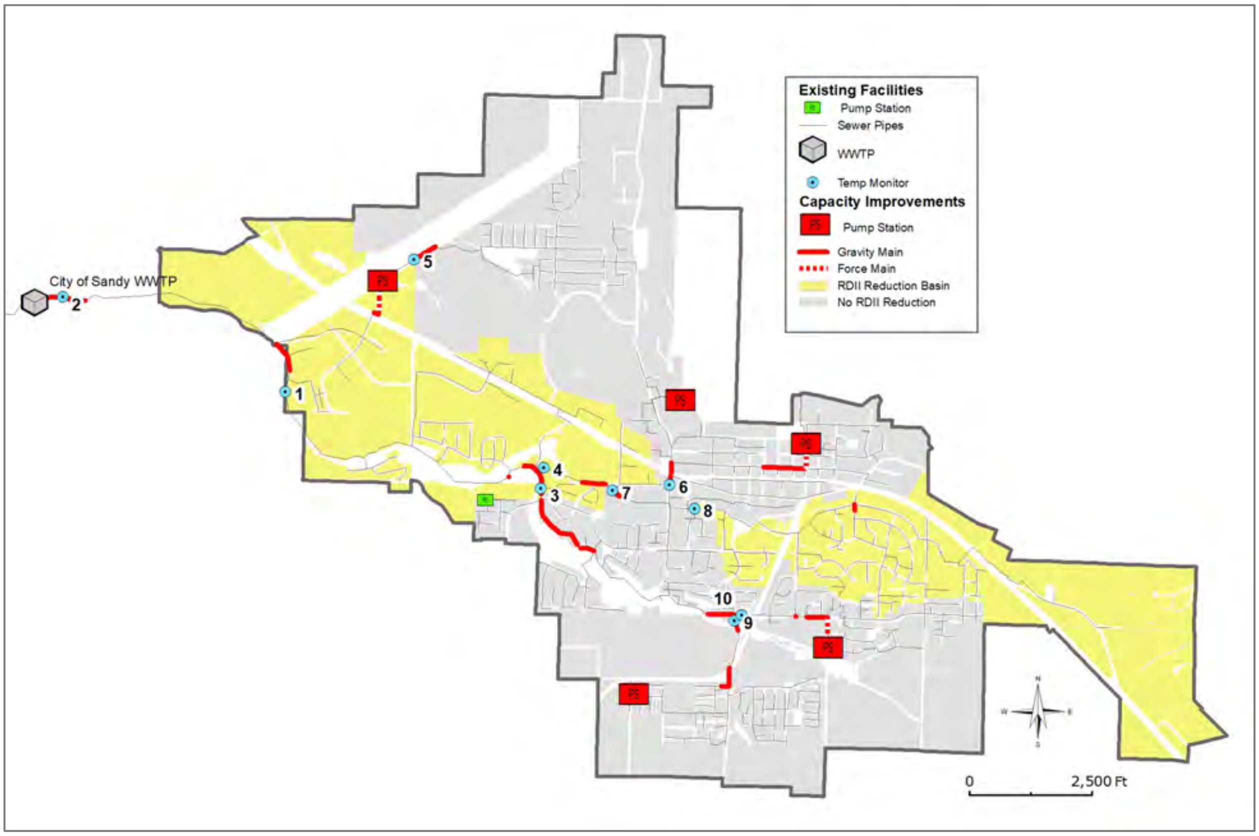
9.6 Peak Flow Scenario #3: WW System Upgrades for 14.0 MGD

For this scenario, the 2040 peak flow will be reduced from 17.1 to 14.0 MGD based on moderate collection system rehabilitation. Based on the small reduction in peak flow, this scenario will result in significant number of WWTP upgrades along with additional capacity upgrades in the existing conveyance lines and pump stations. Lastly, outfall pipe upgrades will also be increased as compared to Scenario 2 since peak flows to Iseli Nursery will be increased. The following sections summarizes the changes needed for each major component in detail.

9.6.1 Peak Flow Scenario #3 Collection System Upgrades

Under this scenario, collection system rehabilitation program will be performed on in 2 sewersheds including pipe repair and replacements as well as removing cross connections from sewer mains, connections, and private lateral. This will reduce the peak flows from 17.1 MGD to 14.0 MGD. A map of the extent of collection system rehabilitation as well as required conveyance and pump station upgrades under this scenario is shown on **Figure 9-10**.

Figure 9-10
Peak Flow Scenario #3 (14.0 MGD) Collection System Capacity Upgrades



For this scenario, five pump stations will need upgrading as well as 1920 feet of force mains and 9160 ft of gravity mains will be replaced to meet capacity requirements. The cost for this scenario is listed on **Table 9-8**.

Table 9-8
Scenario 3 Collection System Cost Summary

Item	Cost
Collection System Rehabilitation	$6.2M
Conveyance and Pump Station Upgrades	$10M
Total	**$16.2M**

9.6.2 Peak Flow Scenario #3 WWTP Upgrades

To meet the additional capacity required to meet a peak flow demand of 14.0 MGD, several unit process upgrades are needed in the liquid stream as highlighted on **Figure 9-11.** The following sections will discuss the upgrade needed for Headworks Facility, Secondary Treatment, and Filtration Disinfection Basin.

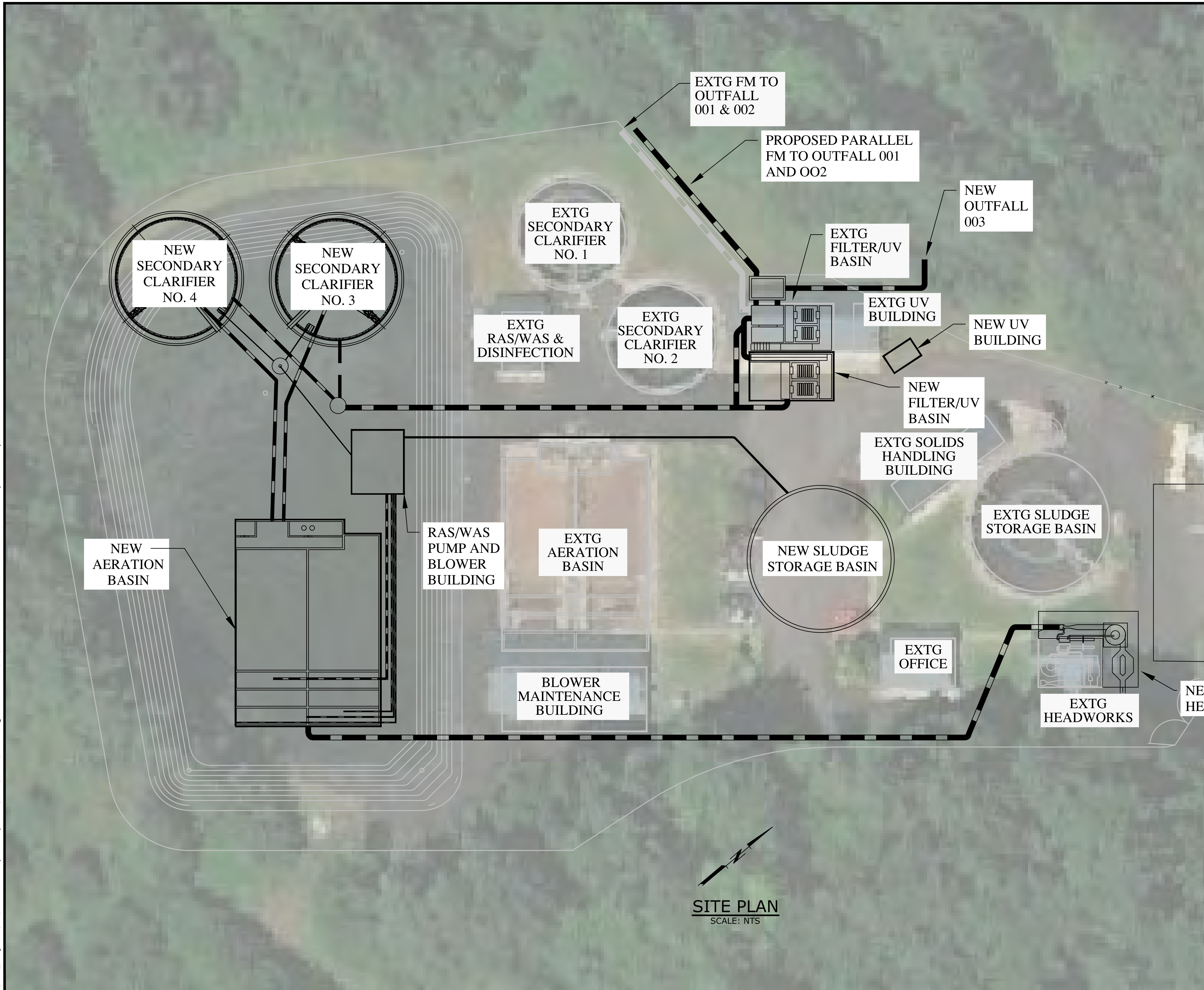


FIG 9-11

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

Scenario 3 WWTP UPGRADES SCHEMATIC (14 MGD)

January 2019

murraysmith

DRAFT

17-2137

This page intentionally left blank

9.6.2.1 Headworks

Upgrades to the Headworks Facility to meet the peak flows of 14.0 MGD include the addition of a second fine screen and a grit removal system to increase the capacity by 7 MGD. This will include the construction of an overhand structure to house the expansion of the headworks. The existing grit removal system and classifier will be reused. The existing 12-inch Parshall flume will be replaced with an 18-inch Parshall Flume to accurately measure flows up to 15 MGD. Lastly, a parallel pipe from the headworks to the aeration basins in addition to the existing 24-inch pipe will be installed to convey wastewater to a new flow split structure.

9.6.2.2 Secondary Treatment

Two new aeration basins of similar dimensions to the existing basins will be added to effectively treat an additional 7 MGD of peak flow. To account for the increased air demand for the new aeration basin, two new blowers will be installed. In addition, upgrades to increase activated sludge pumping include two new return activated sludge pump for an additional 2 MGD each and two waste activated sludge pump for an additional 0.5 MGD each. Lastly, two new secondary clarifiers with 65 feet in diameter with an additional scum pump station and associated piping will be included.

Each 6-disk tertiary filter has a capacity of approximately 3 MGD and so two parallel 8 disk filter basins were added. The cost of adding a parallel UV system with three banks each capable of treating 4 MGD and associated basin modifications increase the capacity to disinfect 14 MGD is added to the total cost of the 14 MGD Scenario

9.6.2.3 Disinfection Filtration Basin

To expand filtration capacity beyond 6 MGD, two new 8-disk filter basin will be added in a parallel to the existing disk filtration basins where the filter media will be replaced. In addition, disinfection capacity will be increased by adding a new parallel channel with three banks in series that are rated at 4 MGD each.

To increase effluent pumping capacity to meet the peak flow requirement during the dry weather season when discharge to Tickle Creek is not allowed, the existing effluent pump station capacity will be increased to 12.4 MGD to the Iseli Nursery Site through a new 30-inch diameter force main.

9.6.2.4 WWTP Solid Stream Upgrades

The solids stream upgrades for Scenario 3 are identical to Scenario 1 since the solids production is not impacted significantly by dropping peak flows; however, an additional dewatering centrifuge will be installed to provide redundancy for this scenario.

9.6.2.5 Scenario 3 WWTP Cost Summary

The total cost for WWTP upgrades for this scenario is $25,070,000 as outlined in **Table 9-9**.

Table 9-9
Peak Flow Scenario #3 WWTP Upgrades Cost Summary

Unit Process	Cost
Liquid Stream	
Headworks	$ 3,180,000
Secondary Treatment	$ 8,100,000
Disinfection Filtration Basin	$ 4,840,000
Effluent Pump Station	$ 1,330,000
Subtotal	**$ 17,450,000**
Solids Stream	
Aerated Sludge Storage Basin	$ 2,690,000
Dewatering Equipment	$ 1,860,000
Dewatered Solids Storage	$ 3,070,000
Subtotal	**$ 7,620,000**
Total	**$ 25,070,000**

9.6.3 Peak Flow Scenario #3 Discharge/Storage Upgrades

Under this Scenario, there are several upgrades required for the discharge/storage facilities required to handle the projected flow conditions (See **Figure 9-7**). First, the force main to Iseli will still need to be replaced with a new 24-inch force main to handle flows from May and October storm events as outlined in Section 1.2. In addition, a 25 MG storage pond expansion at Iseli Nursery will be required to handle the additional volume. Lastly, because of the stream dilution requirement outlined in Section 1.2, a new 18-inch gravity sewer outfall will need to be extended 2 miles downstream. The total cost for Discharge/Storage Upgrades for this scenario is summarized in **Table 9-10**.

Table 9-10
Peak Flow Scenario # 3 Discharge/Storage Cost Summary

Item	Cost
Outfall Force Main Upgrades	$4.0M
Iseli Storage Pond Expansion	$9.6M
Gravity Outfall	$7.1M
Total	**$20.7M**

9.6.4 Total Peak Flow Scenario #3 Cost Summary

The total cost for this scenario including collection system, WWTP, and storage/discharge upgrades is $62.0 M.

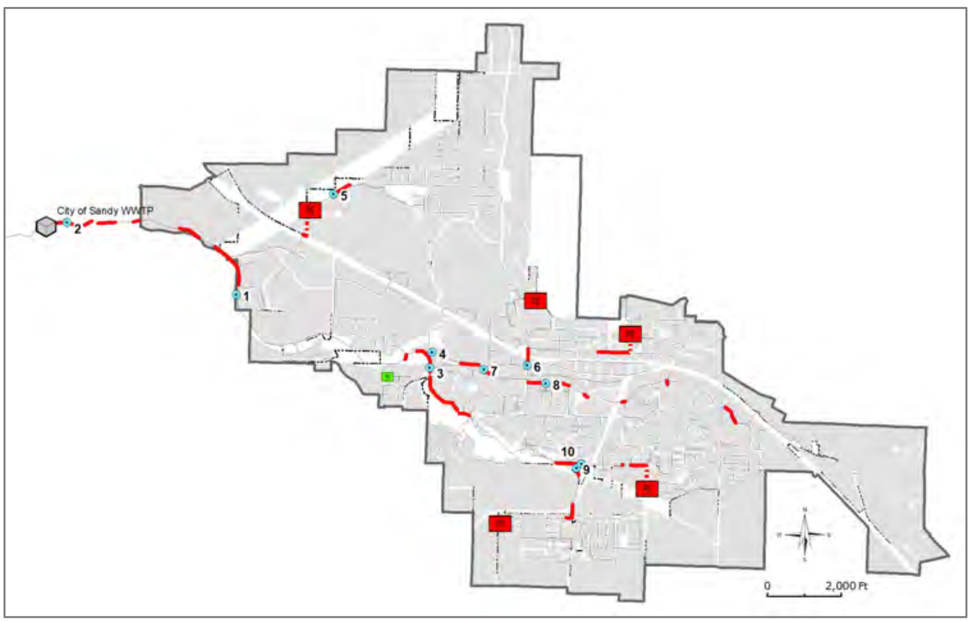
9.7 Peak Flow Scenario #4: WW System Upgrades for 17.1 MGD

Peak Flow Scenario #4 is the RDII "do nothing" scenario involving no rehabilitation of the existing collection system. Therefore, the peak flow under this scenario remains at 17.1 MGD. Therefore, this scenario involves maximum WWTP upgrades along with maximum investment of collection system and pump station capacity upgrades. Lastly, outfall pipe upgrades will also be increased as compared to Scenario 3 since peak flows to Iseli Nursery will be increased. The following sections summarizes the changes needed for each major component in detail.

9.7.1 Peak Flow Scenario #4 Collection System Upgrades

Under this scenario, collection system rehabilitation program will not be performed on any sewersheds, providing for an estimated 2040 peak flow to the WWTP of 17.1 MGD. A map of the extent of collection system rehabilitation as well as required conveyance and pump station upgrades under this scenario is shown on **Figure 9-12.**

Figure 9-12
Peak Flow Scenario #4 (17.0 MGD) Collection System Capacity Upgrades



For this scenario, five pump stations will need upgrading as well as 1920 feet of force mains and 13,080 ft of gravity mains will be replaced to meet capacity requirements. The cost for this scenario is listed on **Table 9-11**.

Table 9-11
Peak Flow Scenario #4 Collection System Upgrades Cost Summary

Item	Cost
Collection System Rehabilitation	$0M
Conveyance and Pump Station Upgrades	$11.9M
Total	**$11.9M**

9.7.2 Peak Flow Scenario #4 WWTP Upgrades

To meet the additional capacity required to meet a peak flow demand of 17.1 MGD, several unit process upgrades are needed in the liquid stream as highlighted on **Figure 9-13.** The following sections will discuss the upgrade needed for Headworks Facility, Secondary Treatment, and Filtration Disinfection Basin.

9.7.2.1 Headworks

Upgrades to the Headworks Facility to meet the peak flows of 17.1 MGD include the addition of two additional fine screens and a grit removal systems to increase the capacity by 10.5 MGD. This will include the construction of an overhand structure to house the expansion of the headworks. The existing grit removal system and classifier will be reused. The existing 12-inch Parshall flume will be replaced with an 24-inch Parshall Flume to accurately measure flows up to 21.3 MGD. Lastly, a parallel pipe from the headworks to the aeration basins in addition to the existing 24-inch pipe will be installed to convey wastewater to a new flow split structure.

9.7.2.2 Secondary Treatment

Three new aeration basin of similar dimensions to the existing basins will be added to effectively treat an additional 10.1 MGD of peak flow. To account for the increased air demand for the new aeration basin, three new blowers will be installed. In addition, upgrades to increase activated sludge pumping include three new return activated sludge pump for an additional 2 MGD each and three waste activated sludge pump for an additional 0.5 MGD each. Lastly, three new secondary clarifier with 65 feet in diameter with an additional scum pump station and associated piping will be included.

9.7.2.3 Disinfection Filtration Basin

To expand filtration capacity beyond 6 MGD, two new 12-disk filter basin will be added in a parallel to the existing disk filtration basins where the filter media will be replaced. In addition, disinfection capacity will be increased by adding a new parallel channel with three banks in series that are rated at 4 MGD each.

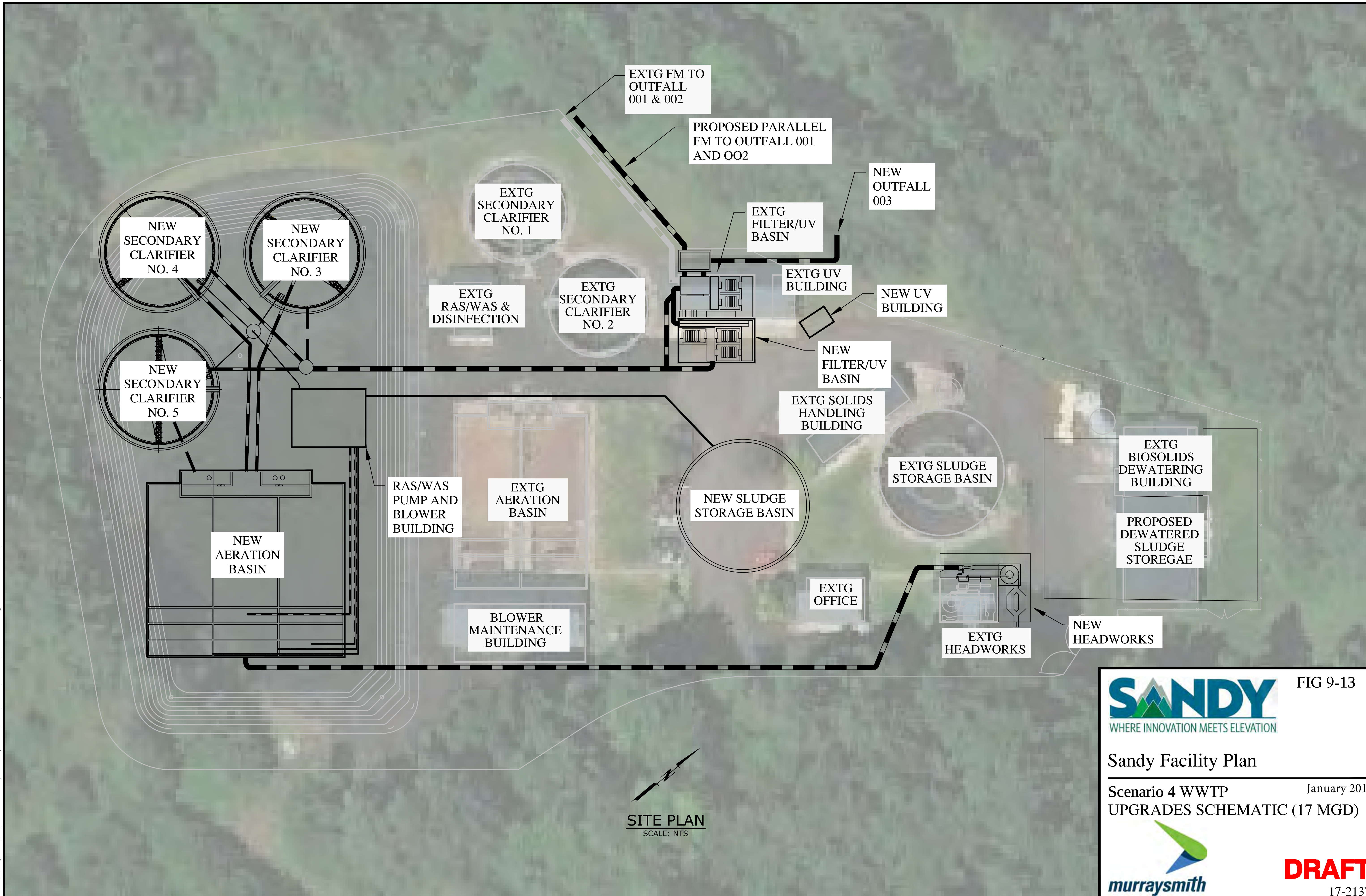


FIG 9-13

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

Scenario 4 WWTP
UPGRADES SCHEMATIC (17 MGD)

January 2019

murraysmith

DRAFT

17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\XREF\17MGD_wSolids.dwg Site Plan 10/26/2018 8:26 AM NICK.MCFADDIN 23.0s (LMS Tech)

This page intentionally left blank

To increase effluent pumping capacity to meet the peak flow requirement during the dry weather season when discharge to Tickle Creek is not allowed, the existing effluent pump station capacity will be increased to 15.0 MGD to the Iseli Nursery Site through a new 30-inch diameter force main.

9.7.2.4 WWTP Solid Stream Upgrades

The solids stream upgrades for Peak Flow Scenario #4 are identical to upgrades for Peak Flow Scenario #3.

9.7.2.5 Peak Flow Scenario #4 WWTP Upgrades Cost Summary

The total cost for WWTP upgrades for this scenario is $31,730,000 as outlined in **Table 9-12**.

Table 9-12
Peak Flow Scenario #4 WWTP Upgrades Cost Summary

Unit Process	Cost
Liquid Stream	
Headworks	$ 3,260,000
Secondary Treatment	$ 11,830,000
Disinfection Filtration Basin	$ 7,390,000
Effluent Pump Station	$ 1,630,000
Subtotal	**$ 24,110,000**
Solids Stream	
Aerated Sludge Storage Basin	$ 2,690,000
Dewatering Equipment	$ 1,860,000
Dewatered Solids Storage	$ 3,070,000
Subtotal	**$ 7,620,000**
Total	**$ 31,730,000**

9.7.3 Peak Flow Scenario #4 Discharge/Storage Upgrades

Under this Scenario, there are several upgrades required for the discharge/storage facilities required to handle the projected flow conditions (See **Figure 9-7**). First, the force main to Iseli will still need to be replaced with a new 30-inch force main to handle flows from May and October storm events as outlined in Section 1.2. In addition, a 25 MG storage pond expansion at Iseli Nursery will be required to handle the additional volume. Lastly, because of the stream dilution requirement outlined in Section 1.2, a new 18-inch gravity sewer outfall will need to be extended 2 miles downstream. The total cost for Discharge/Storage Upgrades for this scenario is summarized in **Table 9-13**.

Table 9-13
Peak Flow Scenario #4 Discharge/Storage Upgrades Cost Summary

Item	Cost
Outfall Force Main Upgrades	$4.8M
Iseli Storage Pond Expansion	$9.6M
Gravity Outfall	$7.1M
Total	**$21.5M**

9.7.4 Total Peak Flow Scenario #4 Cost Summary

The total cost for this scenario including collection system, WWTP, and storage/discharge upgrades is $65.1 M.

9.8 Recommended Long-Term Biosolids Approach

As was noted for each peak flow scenario, keeping the existing solids handling process involving aerated sludge storage, solids dewatering and Class B lime stabilization will require and an expansion of the existing WWTP footprint by approximately 8,000 square feet to accommodate existing liquids and dewatering cake storage. There is also a significant expense associated with the lime stabilization process and a limited duration during which the biosolids can be land applied. Currently, dewatered cake solids is being transported to landfill in the winter months.

Long-term, it is recommended the City move to a biosolids process that provides for greater volatile destruction (e.g. anaerobic digestion), smaller footprint and produces a marketable Class A biosolids product. Based on the site constraints, it is recommended the City consider the installation of a solids dryer for production of Class A Biosolids. The product would significantly reduce the long-term solids storage space needed onsite and would provide for opportunities t market the product locally for beneficial reuse.

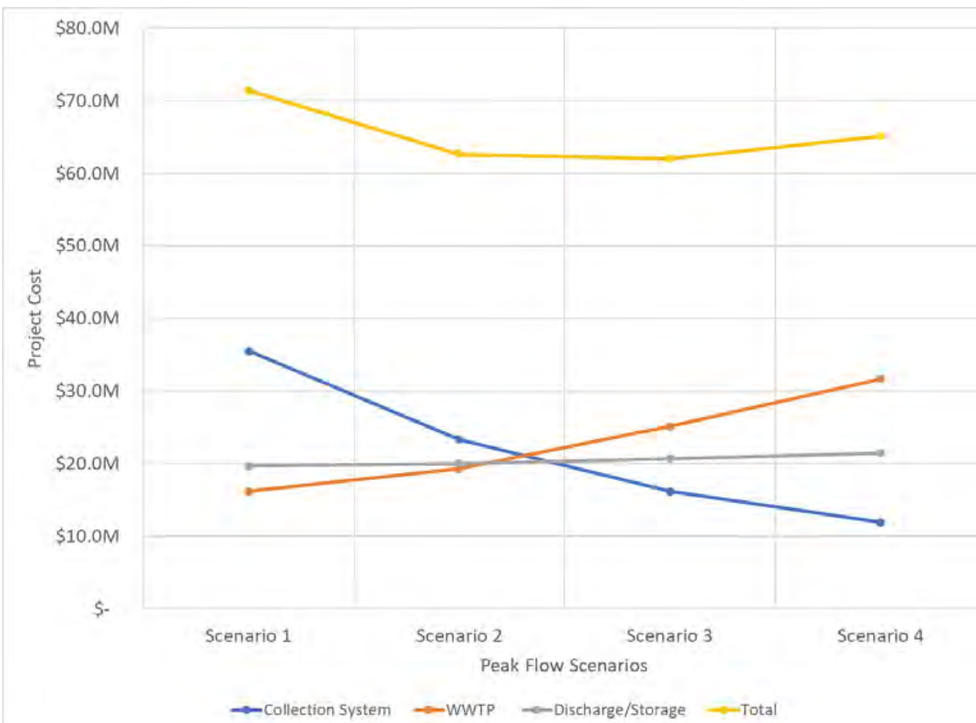
9.9 WW System Upgrades Cost Effectiveness Evaluation

This section summarizes the evaluations and provides a recommended approach for overall WW system upgrades that will balance collection system, treatment and discharge upgrades for the current planning horizon through 2040 and beyond. The overall costs for the four peak flow scenarios are summarized in **Table 9-14** below and graphically in **Figure 9-14**.

Table 9-14
Scenarios #1-4 Total Cost Summary

Item	Scenario 1 Cost	Scenario 2 Cost	Scenario 3 Cost	Scenario 4 Cost
Collection System Upgrades	$35.5M	$23.3M	$16.2M	$11.9M
WWTP Upgrades	$16.2M	$19.3M	$25.1M	$31.7M
Storage/Discharge Upgrades	$19.7M	$20M	$20.7M	$21.5M
Total	$71.4M	$62.6M	$62M	$65.1M

Figure 9-14
Peak Flow Scenarios Combined Costs



Based the evaluation, it is clear the most cost-effective upgrades represent a strategy of balanced investments in the City's wastewater collection, treatment and discharge system. Further evaluation of the cost-effectiveness of RDII reduction indicates the best option is to target a 2040 WWTP peak flow of 14.0 MGD. Therefore, the WWTP peak treatment capacity will need to be expanded to 14.0 MGD. The overall estimated cost for Peak Flow Scenario #2 is $62 Million.

9.10 Conclusions from Comprehensive WW System Alternatives Evaluation

The following conclusions are drawn related to the Comprehensive Wastewater System Alternatives Evaluation presented herein:

1. The most cost-effective option for comprehensive WW system upgrades represents balanced investments in the City's wastewater collection system to reduce peak flows by RDII reduction through rehabilitation of mainlines and laterals in two full sewersheds that will reduce the design 2040 peak WWTP flow from 17.1 to 14.0 MGD. The $62.0 Million overall estimated cost for Peak Flow Scenario #3 is broken down as follows:

    a. The estimated cost of RDII reduction in 2 sewersheds is approximately $16.2 Million.

    b. The estimated cost of WWTP upgrades to 14.0 MGD peak flow is approximately $25.1 Million.

    c. The estimated cost for outfall relocation and Iseli Nursery Storage Upgrades is approximately $20.7 Million.

2. Continuing to utilize the same secondary-only liquids stream treatment with aerated sludge storage and Class B lime stabilization should not be continued on the constrained WWTP site.

    a. WWTP options should consider the additional of primary clarification, conversion to anaerobic digestion and solids drying for Class B and Class A Biosolids production, respectively, to maximize use of available space on the existing WWTP site.

3. Continued long-term discharge to Tickle Creek is not recommended.

    a. Due to limitations of the Three Basin Rule that will prevent the City of obtaining a year-round river discharge and discharge restrictions associated with the Oregon Dilution Rule.

4. Additional storage of approximately 25 million gallons is required to be constructed at Iseli Nursery for continued operation of the dry season Class B Recycled Water Program.

    a. Beneficial reuse of the City's highly treated wastewater is recommended to be continued.

    b. The construction of additional storage at Iseli Nursery for dry weather "shoulder" storage does not appear viable long term.

5. Staying in the Clackamas River Basin, the City must relocate the existing Tickle Creek Outfall 001 downstream approximately 2 miles outfall to comply with the dilution rule.

    a. Constructing this outfall may ultimately put the City at risk of facing the same dilution rule challenges and outfall relocation requirements beyond 2040 and it is unclear if further relocation downstream is viable or cost-effective.

9.11 Recommendations from Comprehensive WW System Alternatives Evaluation

This Section has determined the optimal balance between RDII reduction efforts and WWTP investments is targeting peak flow reduction to 14.0 MGD over the planning horizon with a balance portfolio of investments in the City's wastewater collection and treatment systems. Long term, the water recycled program should be continued with Iseli Nursery, but continued reliance on recycling for the full summer season becomes very limiting in terms of supporting community growth. Continuing to rely on the current Tickle Creek winter discharge and Iseli Nursery summer irrigation program risks a $20 Million investment that will last no longer than the current 20-year planning horizon. The case has clearly been made that, if the City is going to invest approximately $60 Million in its wastewater system, the investments should be put toward a long-term solution.

In the 1992 Sewerage System Facilities Plan (CH2M Hill), several discharge options were considered in great detail, including zero discharge, Tickle Creek, Deep Creek, Sandy River and the Clackamas River. In addition, an export scenario was evaluated to pump raw wastewater to the City of Gresham. In this analysis, the two highest ranked options:

1. Tickle Creek/Iseli Nursery – this was the selected alternative that was constructed and is now in place involving winter discharge to Tickle Creek and summer irrigation at Iseli Nursery.
2. New Sandy River Outfall – the option to construct a new pump station and outfall in the Sandy River finished a close second to the recommended alternative. The new outfall would be constructed on City-owned property with Sandy River frontage, simplifying implementation from a land-ownership perspective.

Based on the previous analyses by CH2M Hill, it is recommended the City proceed with the second ranked alternative to construct a new Sandy River outfall. The proposes Sandy River outfall location is shown in **Figure 9-15** along with other City-owned properties that is important in terms of one of the long-term treatment alternatives to be considered in Section 10.

Recommendations associated with the comprehensive WW System Alternatives Evaluation presented herein are given below:

a) Proceed with initial RDII evaluations (smoke testing, inflow reduction, etc.) and begin implementation of rehabilitation upgrades for two sewer basins.

b) Proceed with permitting and construction of a new Sandy River outfall for year-round discharge that provides for long-term community growth without the ongoing limitations of the Tickle Creek Discharge and the Three Basin Rule.

c) Evaluate additional WWTP alternatives that maximize the use of the limited WWTP site and produce a high quality biosolids product that will not require landfilling.

d) Consider conversion to anaerobic digestion and installation of a solids dryer to produce Class A Biosolids as part of the existing WWTP upgrades to maximize space on the existing site and opportunities for beneficial reuse of biosolids.

e) Consider options that do not increase Tickle Creek discharge beyond 7 MGD as currently permitted and pursue a year-round discharge as the best long-term option for supporting the continued growth of the Sandy community.

murraysmith

SANDY
WHERE INNOVATION MEETS ELEVATION

City of Sandy, Oregon
Wastewater System Facility Plan

Taxlots
Other Taxlots (shaded white)
City of Sandy Property (no shading)

Figure 9-15
Sandy River
Outfall Site

January 2019 17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\Figure9-X_Outfall_Site_20190108.mxd 1/8/2019 3:12:45 PM Yarrow.Murphy

This page intentionally left blank

murraysmith

Section **10**

Section 10

Long Term Wastewater Treatment Alternatives Evaluation

10.1 Introduction

The alternatives analysis in **Section 9 - Comprehensive Wastewater System Alternatives Evaluation** concluded the most cost-effective option for wastewater system upgrades is Peak Flow Scenario 3, incorporating a balanced approach to address the City's challenges associated with wastewater collections, treatment and discharge. The recommended approach incorporates full rehabilitation of two sewersheds, including sewer main and lateral rehabilitation, to reduce 2040 projected peak wastewater system flow from 17.1 MGD to approximately 14.0 MGD coupled with expansion of wastewater treatment capacity.

The previous section also concluded expansion of the City's current wastewater treatment process incorporating secondary treatment, tertiary filtration, aerated sludge storage and lime stabilized Class B biosolids is not viable long-term for a number of factors. The primary concern being the current intermittent discharge to Tickle Creek that is not viable long-term as the City continues to grow. Pursuing a year-round discharge to the Sandy River has been identified as the best long-term discharge option for the City.

The purpose of this section is to further develop and evaluate additional wastewater treatment alternatives considering the limitations of the current WWTP site and discharge, planning for future discharge to the Sandy River and eventual production of a marketable Class A Biosolids product that will reduce the storage needed for lime stabilized Class B Biosolids and provide a more marketable biosolids product for distribution by the City. The alternatives also consider capacity improvements or deferments needed for the various options considered. Lastly, the evaluation also considers the impact of these scenarios on the required collection system and effluent infrastructure improvements.

10.2 Long-Term Wastewater Treatment Alternatives

Four alternatives were developed to further evaluate wastewater treatment requirements and associated collection system capacity upgrades for the 2040 planning horizon, including:

<u>Alternative A</u> – Expansion of the existing WWTP treatment process including upgrades to the headworks, new aeration basins, new secondary clarifiers, expansion of the cloth-media tertiary filtration system, replacement and expansion of UV disinfection, dewatering system rehabilitation

and the addition of a new solids dryer allowing the existing covered cake storage area to be utilized long-term.

<u>Alternative B</u> – Construction of a new membrane bioreactor (MBR) facility for secondary and tertiary treatment of approximately 7 MGD at the existing WWTP site, operating in parallel with the existing WWTP. Other upgrades include expansion of the headworks, dewatering upgrades and addition of a solids dryer.

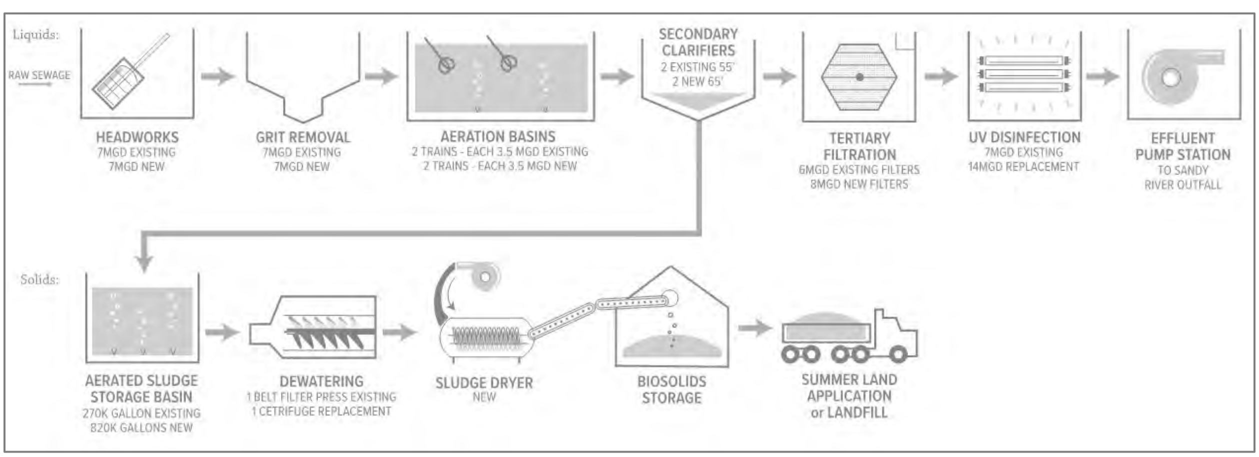
<u>Alternative C</u> – Conversion of the existing WWTP to incorporate primary clarification and anaerobic digestion to better utilize the limited site footprint, reduce solids production through increased volatile solids destruction and reduce energy consumption by expanding the headworks, adding primary clarifiers, reduced aeration basin expansion, new secondary clarifiers, expansion of the cloth-media tertiary filtration system, replacement and expansion of UV disinfection, dewatering system rehabilitation and the addition of a new solids dryer.

<u>Alternative D</u> – Construction of a new Eastside Satellite Treatment Facility for an ultimate peak design flow of approximately 7 MGD with existing WWTP upgrades primarily focused on the needed improvements for treating and processing solids from both facilities including expansion of the headworks, addition of primary clarifiers, tertiary filtration system rehabilitation, UV system rehabilitation, solids dewatering system rehabilitation and the addition of a new solids dryer.

10.2.1 Alternative A – Existing WWTP Secondary Treatment Expansion

Alternative A considers the costs associated with an immediate expansion of the existing WWTP unit processes on site. **Figure 10-1** shows a schematic of the proposed unit process upgrades.

Figure 10-1
Alternative A Treatment Process Schematic Diagram



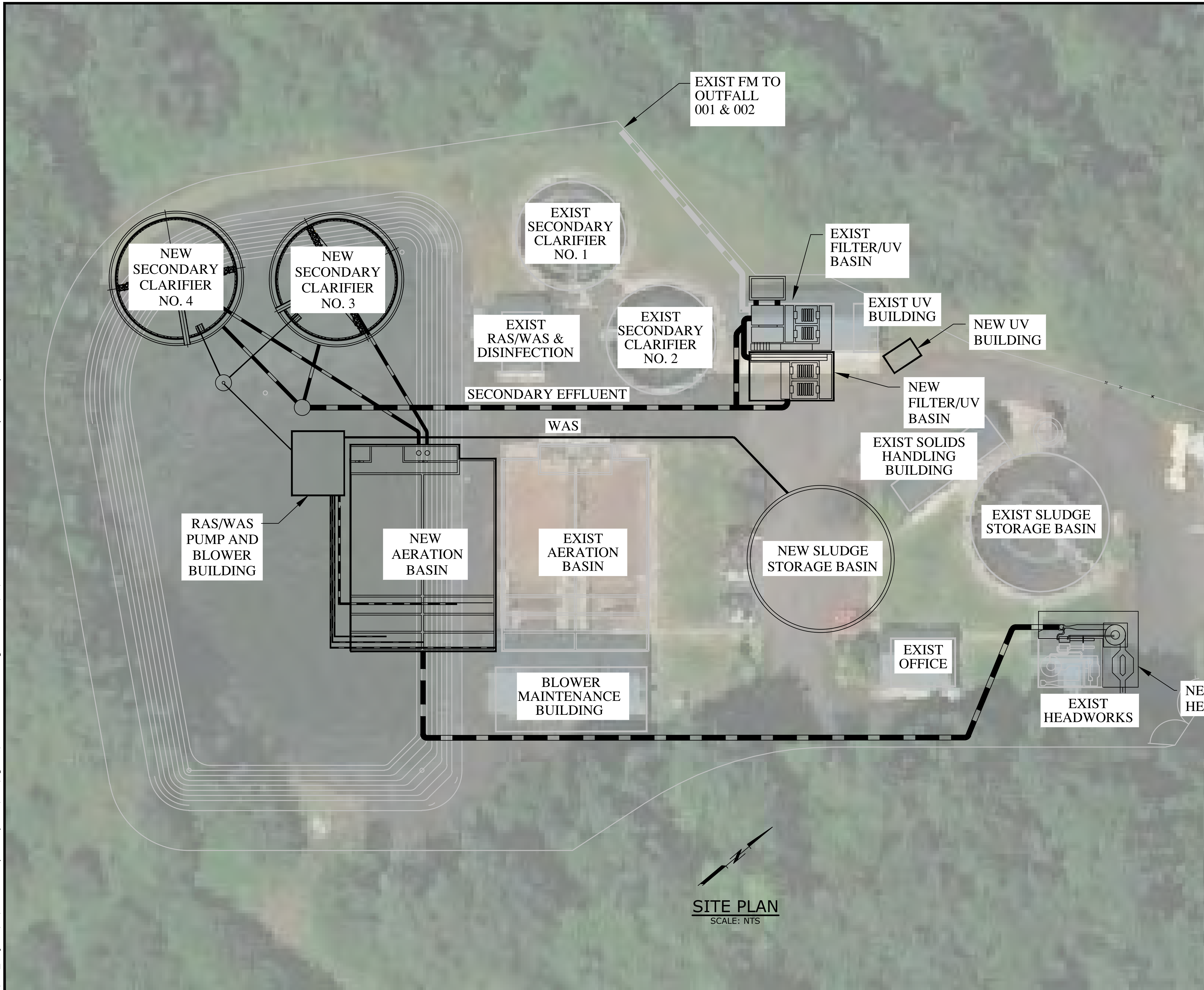


FIG 10-2

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

WWTP
UPGRADES SCHEMATIC - ALT A
14 MGD CAPACITY

January 2019

murraysmith

DRAFT

17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-FIG-10-2.dwg Site Plan 10/30/2018 2:41 PM NICK.MCFADDIN 23.0s (LMS Tech)

This page intentionally left blank

10.2.1.1 Alternative A – WWTP Upgrades

To meet the additional capacity required to meet a peak flow of 14.0 MGD, several unit process upgrades are needed in the liquid stream as highlighted on Figure 10-2. The following sections will discuss the upgrade needed for the headworks facility, secondary treatment, and filtration disinfection basin.

10.2.1.1.1 Headworks

Upgrades to the headworks facility to meet the peak flow of 14.0 MGD include the addition of a second fine screen and a grit removal system to increase the capacity by 7.0 MGD. This will include the construction of an overhang structure to house the expansion of the headworks. The existing grit removal system and classifier will be reused. The existing 12-inch Parshall flume will be replaced with an 18-inch Parshall flume to accurately measure flows of 14.0 MGD. Lastly, a parallel pipe from the headworks to the aeration basins in addition to the existing 24-inch pipe will be installed to convey wastewater to a new flow split structure.

10.2.1.1.2 Secondary Treatment

Two new aeration basins constructed in parallel to the existing basins will be added to effectively treat an additional 7 MGD of peak flow. To account for the increased air demand for the new aeration basins, a new blower will be installed. In addition, upgrades to increase activated sludge pumping include two new return activated sludge pumps and two waste activated sludge pumps. Furthermore, two new 65-foot diameter secondary clarifiers with an additional scum pump station and associated piping would be constructed.

10.2.1.1.3 Tertiary Filtration and Disinfection

Expansion of the two existing 6-disk cloth media filters is included to provide two new 8-disk filters in a new concrete structure to increase total capacity to 14.0 MGD.

UV disinfection capacity will be increased from 7.0 MGD to 14.0 MGD by adding a new parallel channel with three UV banks in series to provide disinfection for 2040 design flows. The new UV channel will utilize newer technology that will have three banks of UV lamps including a redundant bank.

10.2.1.1.4 Aerated Sludge Storage and Stabilization

To meet the additional sludge storage handling requirements in 2040 for the increased loading at the WWTP, several upgrades will be needed. First, to achieve 30 days of storage in the aerated sludge storage basin (ASSB) a second ASSB is to be constructed with associated appurtenances.

10.2.1.1.5 Solids Dewatering

The existing belt filter press will be replaced with a dewatering centrifuge to increase the solids capacity while utilizing the same building. A new polymer feed system is anticipated along with building upgrades for code compliance and other needed improvements identified in the plant condition assessment.

10.2.1.1.6 Solids Drying

In order to reduce the biosolids storage space required by approximately 80 percent and provide a marketable Class A biosolids product, a new solids dryer will be installed adjacent to the existing solids dewatering facility. Dewatered cake from the new centrifuge will feed the dryer and a conveyor system will be added to drop the dried product in the existing cake storage area.

10.2.1.1.7 Class A Biosolids Storage

The existing 1200 SF dewatered cake storage area will continue to be utilized for Class A Biosolids storage following solids dewatering and drying.

10.2.1.1.8 New Sandy River Effluent Pump Station and Forcemain

For Alternative A, a new effluent pump station and force main to the proposed Sandy River outfall will be constructed. These upgrades are summarized separately later in the discussion of Alternative A upgrades and included in the overall alternative cost tabulation.

10.2.1.1.9 Existing Facilities O&M Upgrades

As noted in **Section 8.1 WWTP Condition Assessment**, upgrades are needed at the existing WWTP to address O&M and other deficiencies to assure the existing plant processes remains operational and satisfy the requirements of the City's existing NPDES Permit. The costs include upgrades to liquid stream, solids stream, SCADA, and Admin/Building Upgrades.

10.2.1.2 Alternative A WWTP Upgrades Cost Summary

The cost of the Alternative A upgrades is approximately $ 30.5M. **Table 10-1** below summarizes the cost per each unit process.

Table 10-1
Alternative A – WWTP Upgrades Cost Summary

Unit Process	Cost
Liquid Stream	
Headworks	$ 2,760,000
Aeration Basin	$ 3,825,000
Secondary Clarifiers	$ 4,840,000

Unit Process	Cost
Tertiary Filter/UV Disinfection	$ 2,840,000
Effluent Pump Station to Iseli	$ 1,400,000
Solids Stream	
Aerated Sludge Storage Basin	$ 3,570,000
Dewatering Equipment	$ 7,650,000
Sludge Dryer	$ 1,120,000
Existing System O&M Upgrades	**$ 2,500,000**
Total	**$ 30,500,000**

10.2.1.3 Alternative A – Collection System Upgrades

Collection system upgrades for Alternative A include RDII reduction and capacity improvements to alleviate surface flooding to meet the peak flow rate of 14.0 MGD. Collection system improvements include upgrades to four existing pump stations, three force mains totaling approximately 1390 LF and gravity pipe totaling 6180 LF, including the Sandy Trunk Sewer. The conveyance capacity improvements are illustrated in **Figure 10-4** and described below.

10.2.1.3.1 Collection System Pump Station and Force Main Improvements

- **Sandy Bluff Pump Station** – Peak flow at the pump station exceeds total pump station capacity during the existing (2018) design storm. Pump station upgrades will include replacement of the pumps and associated mechanical and electrical improvements. The existing 780 LF force main with a velocity of over 10 fps at current peak flows should also be upsized.

- **Meinig Pump Station** – Peak flow exceeds total pump station capacity during the future (2040) design storm. Improvements include replacement of the pumps to increase capacity, and wet well rehabilitation to address condition assessment findings. During the initial phase of the analysis, the force main serving this pump station was assumed to be 4-inch diameter. However, it was later confirmed that this force main is 6-inch diameter.

- **Jacoby/Timberline Trails Pump Station** – Peak flow exceeds total pump station capacity during the existing (2018) design storm. Improvements include additional pumping capacity and upsizing the existing 610 LF force main to 10-inch diameter. This pump station was considered for decommissioning, as discussed below. Decommissioning in favor of a gravity pipeline may be cost effective if trenchless construction can be avoided.

- **Marcy Street Pump Station** – Peak flow exceeds total pump station capacity during the existing (2018) design storm. Improvements include additional pumping capacity and mechanical and electrical upgrades. Consideration of force main replacement relative to pump selection is also recommended during preliminary design of pump station improvements. Improvements also address the safety and condition concerns identified by the condition assessment, including a safety grate over the valve vault, a fenced enclosure, replacement of the guide rails in the wet well and a backflow prevention assembly on the hydrant.

- **Snowberry Pump Station** – Peak flow at the pump station is estimated to exceed the total pump station capacity by 2040. Future pump replacement to increase capacity will be needed but may be delayed beyond the current planning horizon. This pump station was considered for decommissioning, as discussed below. Decommissioning in favor of a gravity pipeline was not a cost effective alternative and not included.

10.2.1.3.2 Collection System Pipeline Capacity Upgrades

- **Sandy Trunk Upsizing** – Capacity constraints in 2040 LF of gravity trunk line, mostly near the WWTP, are the cause of extensive predicted surface flooding during 2040 flows with recommended RDII reduction. Minimum diameters required to eliminate the surface flooding range from 24 to 30 inches.

- **Dubarko Road near Sandy Heights Gravity Main Upsizing** – Capacity constraints in 2220 LF of gravity main are the cause of extensive surface flooding predicted during 2040 flows with RDII reduction. New pipes are recommended at 18-inch diameter.

- **Dubarko Road at Tupper Rd Gravity Main Upsizing** – Capacity constraints in 1130 LF of gravity main are the cause of surface flooding predicted during 2040 flows with recommended RDII reduction. New pipes are recommended primarily at 10-inch diameter with 100 LF recommended at 18-inch diameter.

- **Sandy Bluff Gravity Main Upsizing** – Capacity constraints in 790 LF of gravity main are the cause of surface flooding predicted during 2040 flows with recommended RDII reduction. New pipes are recommended at 15-inch diameter.

Planning level cost estimates are summarized in **Table 10-2**.

Table 10-2
Alternative A Collection System Upgrades Cost Summary

Description	Alternatives A Quantity	Alternatives A Cost
RDII Reduction – Flow Reduction	2 Basins	$6.2M
Pump Stations – Capacity & Condition	5 stations	$3.9M
Force Mains – Capacity	1390 LF	$0.4M
Gravity Mains – Capacity	6180 LF	$2.8M
Total Cost		**$13.3M**

10.2.1.3.3 Pump Station Decommissioning

Options for decommissioning pump stations and implementing gravity conveyance were considered for three pump stations; Snowberry, Timberline Trails/Jacoby and Sleepy Hollow.

Table 10-3 compares the capital and O&M costs for constructing gravity piping to serve these pump stations versus capital and O&M costs for pump station and force main improvements anticipated over the next 20 years. Cost estimates for the gravity improvements were based on preliminary alignments proposed by the City as shown in **Figure 10-3**.

The alignment for Snowberry Pump station requires pipelines at depths between 25 and 38 feet for approximately 800 feet resulting in a high construction costs for gravity infrastructure. Based on the cost review, decommissioning the Snowberry Pump Station is not recommended. Alternate gravity routes were considered, however, the differential costs between pumping and gravity alternatives still favored the pump station alternative.

Considering both capital and O&M costs, the Sleepy Hollow Pump Station may be cost effective to decommission. The 400-foot long proposed gravity pipe alignment follows a continuous downhill slope to the Sandy Trunk with no stream crossing.

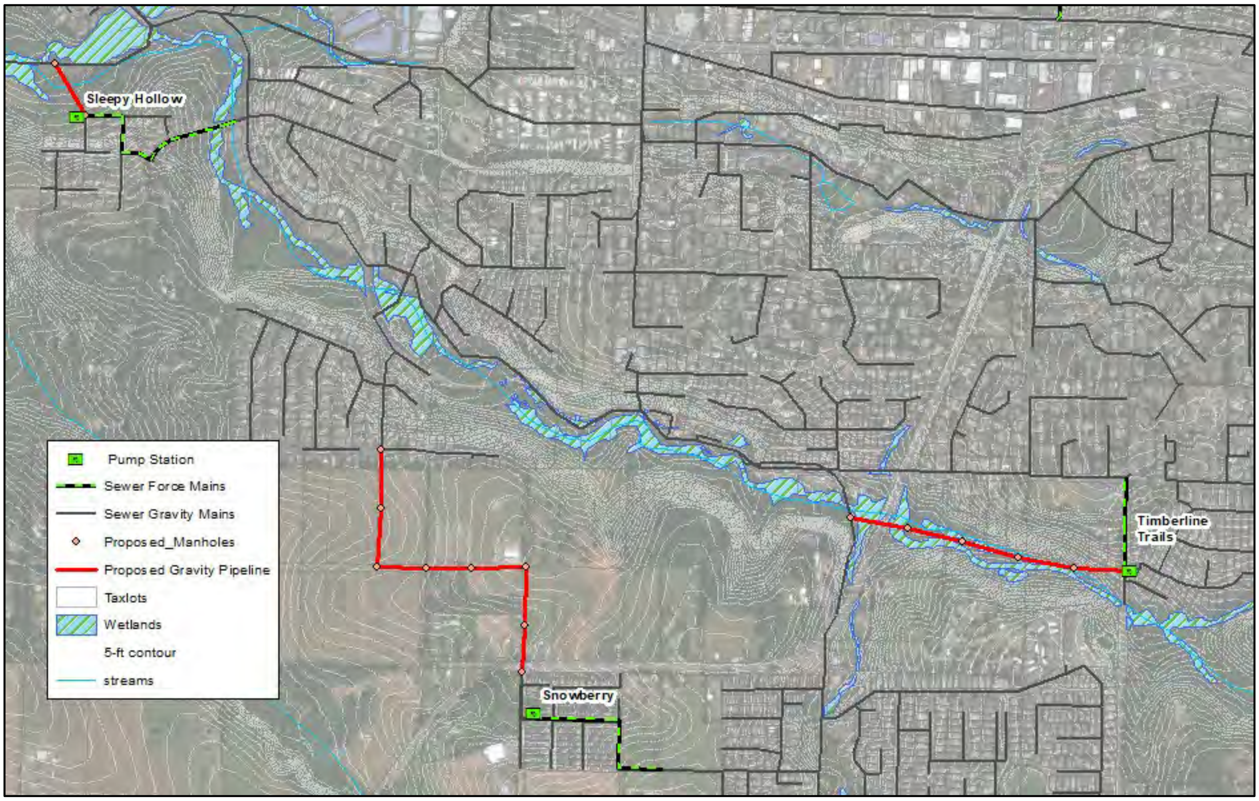
The decommissioning of the Timberline Trails/Jacoby Pump Station includes 1,900 linear feet of gravity pipeline, located adjacent to a stream channel and wetlands in a deep, narrow canyon and crossing a 2-lane highway. If no trenchless construction methods are required, the costs associated with decommissioning the Timberline Trails/Jacoby Pump Station are similar to the costs of improving and operating the pump station. In this case, the proposed gravity pipeline is estimated to cost approximately $50,000 more than the pump station and force main over the 20-year analysis period. However, if trenchless methods are required to extend the gravity pipeline across the stream channel and/or the highway, the costs for the gravity pipeline construction and O&M exceed the cost of the pump station and force main by $1.5 million. Any decision to construct gravity improvements required to decommission this pump station should consider the site constraints and constructability challenges, which would ultimately increase the capital investment required to provide gravity service in lieu of a pump station and force main.

Table 10-3
Costs for Gravity Improvements vs Pump Station and Force Main Costs

Pump Station	Gravity Improvement Cost			Pump Station & Force Main Cost		
	Capital	O&M[2,3]	Total Capital + O&M	Capital	O&M[2,3,4]	Total Capital + O&M
Southside (Snowberry)	$1.9M - $2.5M[1]	$0.2M	$2.1M - $2.7M	$0.1M	$0.6M	$0.7M
Southeast (Jacoby /Timberline Trails)	$0.7M - $2.2M[1]	$0.1M	$0.9M - $2.3M	$0.3M	$0.5M	$0.8M
Southwest (Sleepy Hollow)	$0.2M	$0.02M	$0.2M	$ -	$0.6M	$0.6M

Notes
High end costs assume bore required due to pipeline depth or stream crossing.
O&M costs calculated for 20-yr period.
Pipeline O&M, pressure or gravity, assumed $3/LF/yr.
Pump station O&M costs assumed $25,000 per year per station.

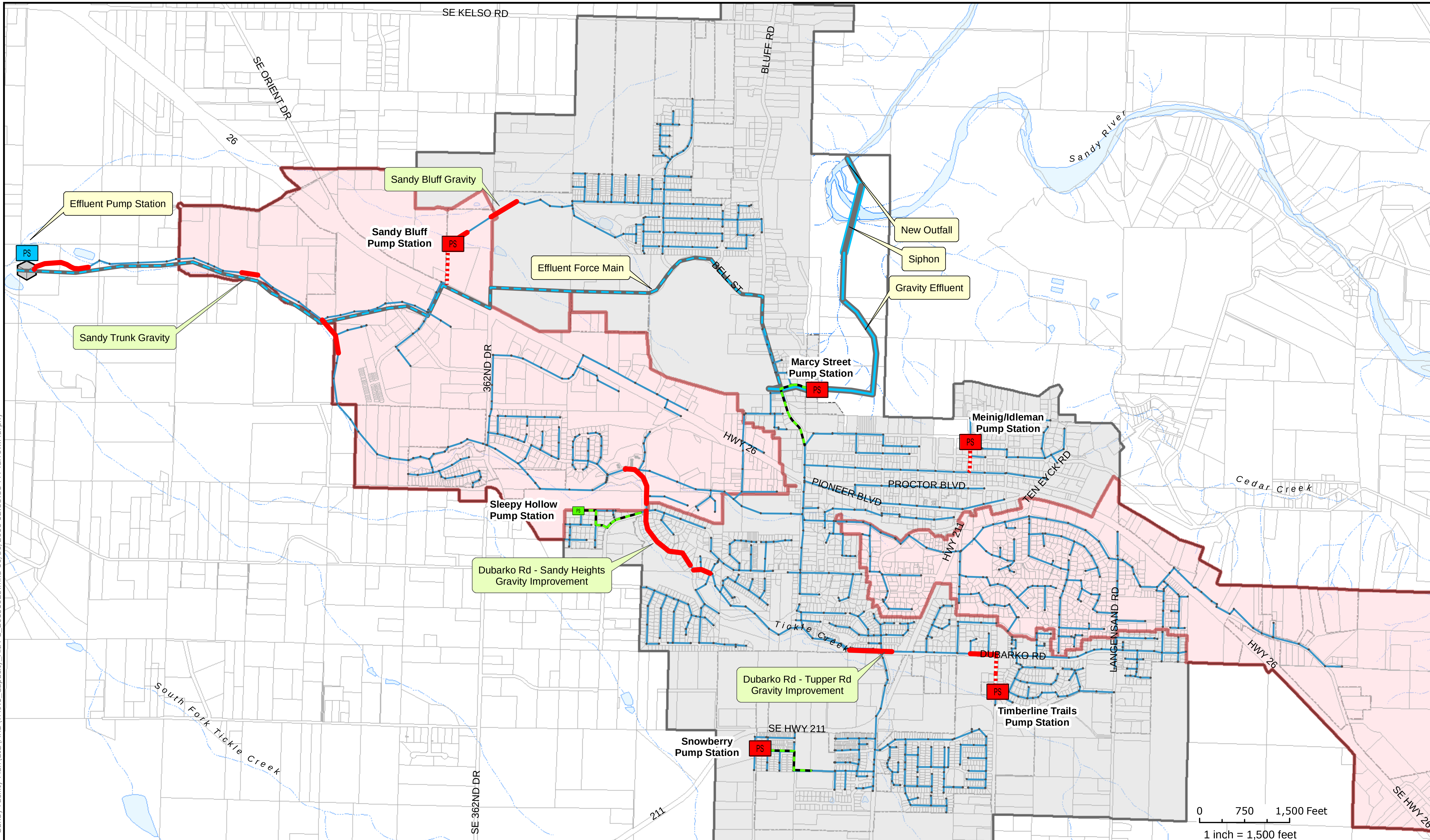
Figure 10-3
Proposed Gravity Infrastructure



10.2.1.4 WWTP Effluent Pump Station, Effluent Force Main and Sandy River Outfall

Under Alternative A, a new 14.0 MGD effluent pump station will be constructed at the Existing WWTP along with a force main through town and a new Sandy River outfall. Capacity of the new effluent pump station may be phased as peak WWTP flows increase over the planning horizon through 2040. A new effluent force main, approximately 3 miles in length, will be constructed as shown in **Figure 10-4**. The effluent force main will connect to the new Sandy River gravity outfall planned for construction on City-owned property adjacent to the river.

The preliminary gravity alignment from the discharge of the effluent force main to the Sandy River includes 5,950 LF of 24-inch to 30-inch diameter HDPE or PVC pipe over an elevation drop of approximately 500 feet. The proposed discharge point from the force main to the gravity alignment is located east of Bluff Road at Marcy Street. The gravity pipeline extends along the Sandy River Trail approximately 4,200 LF via traditional open cut pipeline installation through forested area and may require some tree removal. Due to steep slopes along the alignment, the design and construction of the pipeline will require multiple drop structures to dissipate energy and eliminate air entrainment, and the addition of pipe restraints and thrust blocking to control possible deformations or movement.



murraysmith

SANDY
WHERE INNOVATION MEETS ELEVATION

N
W E
S

City of Sandy, Oregon
Wastewater System Facility Plan

UGB
Existing Facilities
PS Pump Station
Manhole
Gravity Sewer
Forcemain

II Reduction Target
Capacity Improvements
Gravity
Ph 1 Force Main
PS Pump Station

Effluent Improvements
New Force Main
New Gravity
New HDD Siphon
PS Pump Station

Figure 10-4
Collection System Improvements
Alternatives A - C

January 2019 17-2137

This page intentionally left blank

To avoid the steepest slopes and bank erosion immediately adjacent to the Sandy River, the new outfall was placed beyond a critical river bend as shown in **Figure 10-5**. The placement of the outfall requires a 1,200 LF crossing of the river utilizing a double barrel siphon. Horizontal directional drilling (HDD) was assumed to be the preferred trenchless construction method for the siphon with special construction considerations for high drilling mud pressures during boring operation. Inverted siphons also require structures for air release. From the downstream end of the siphon, approximately 550 LF of trenchless 30-inch diameter piping installation is required to reach a desirable outfall location. The preliminary pipeline alignment requires further design level review to refine both the elevation profile and to coordinate right-of-way acquisition.

Continued use of the existing outfall to Tickle Creek up to regulated winter-time dilution is recommended to minimize use of the effluent pump station to the Sandy River. This will minimize power, operations, and maintenance costs associated with the effluent pump station.

Planning level cost estimates for the effluent infrastructure are summarized in **Table 10-4**.

Table 10-4
Alternative A - Effluent Pump Station, Force Main and Sandy River Outfall Cost Summary

Alt	Effluent Pump Station & Force main to Sandy River ($M)[1]	Sandy Gravity Outfall ($M)[1]	Total Effluent Infrastructure ($M)[1]
A	$25.3	$12.8	$38.1

10.2.1.5 Alternative A – Total Cost Summary

The total cost for this scenario including collection system, WWTP, and storage/discharge upgrades is $81.9 M as summarized in **Table 10-5**.

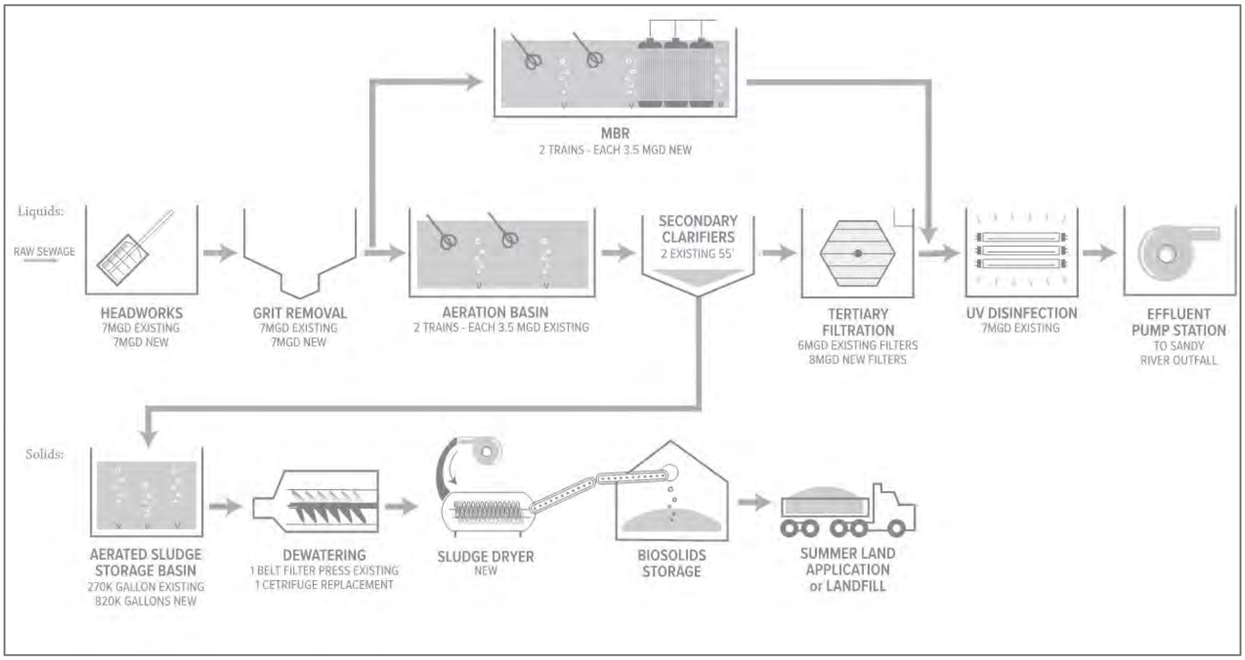
Table 10-5
Alternative A Total Upgrades Cost Summary

Item	Cost
WWTP Upgrades	$30.5M
Collection System Upgrades	$13.3M
Effluent Infrastructure	$38.1M
Total	**$81.9M**

10.2.2 Alternative B - Parallel MBR at Existing WWTP Site

Alternative B would add a new 7 MGD membrane bioreactor (MBR) in parallel with the existing secondary and tertiary treatment processes. **Figure 10-6** shows a schematic of the proposed unit process upgrades.

Figure 10-6
Alternative B Treatment Process Schematic Diagram



10.2.2.1 Alternative B – WWTP Upgrades

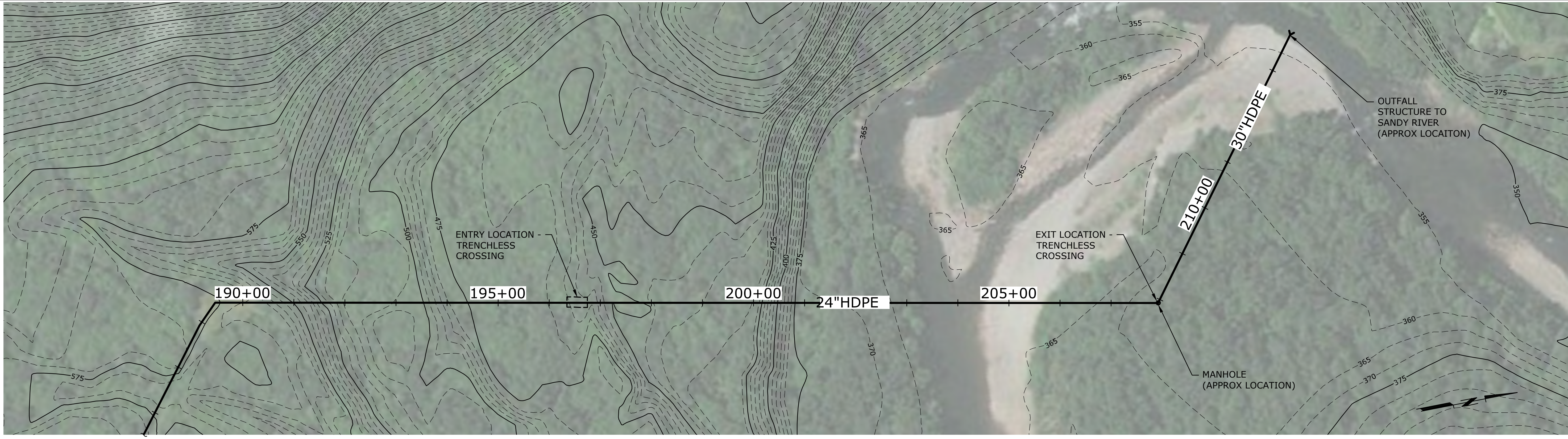
To meet the additional capacity required to meet a peak flow of 14.0 MGD, several unit process upgrades are needed in the liquid stream as highlighted on **Figure 10-7** and discussed in the following sub-sections.

10.2.2.1.1 Headworks

The same upgrades to the headworks of Alternative A will be constructed for Alternative B. This includes construction of additional fine screens, grit removal, flow measurement, and conveyance.

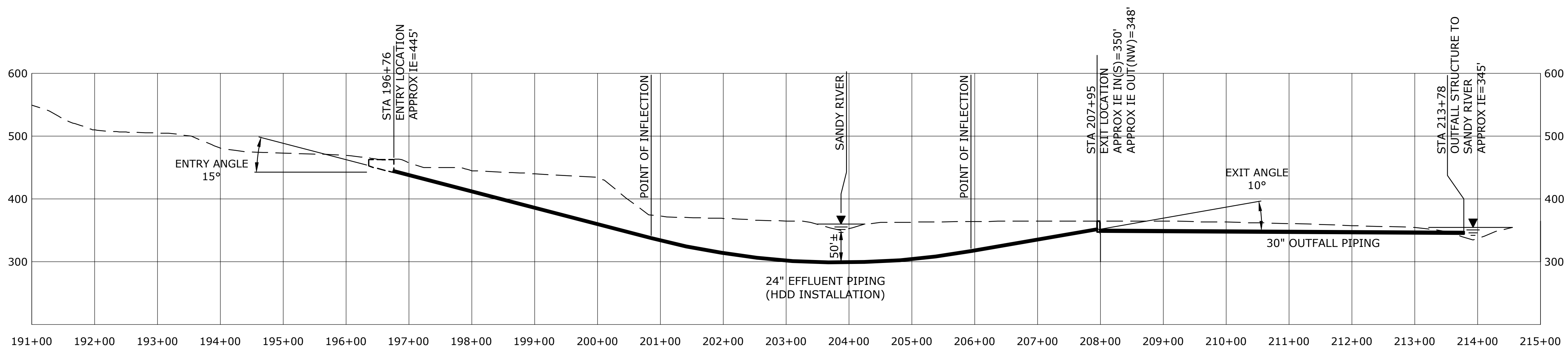
10.2.2.1.2 Membrane Bioreactor

Secondary treatment upgrades include the construction of a 7 MGD membrane bioreactor (MBR) with two parallel 3.5 MGD peak flow treatment trains operated in parallel with the existing secondary and tertiary treatment processes. A flow diversion structure will be constructed downstream of the headworks to split flows between the two separate treatment facilities. A mechanical building will also be constructed to house permeate pumps, waste pumps, aeration blowers and other appurtenant MBR equipment.



PLAN

SCALE: 1"=100'



PROFILE

SCALE: 1"=100' HORIZ, 1"=100' VERT

NOTES:

1. PIPELINE ALIGNMENT AND ASSOCIATED STRUCTURES ARE CONCEPTUAL IN NATURE, AND USED TO EVALUATE PRELIMINARY FEASIBILITY OF DESIGN. SUBJECT TO CHANGE.

2. ALLOWABLE RADIUS OF CURVATURE ASSUMED TO BE 1200FT FOR HORIZONTAL DIRECTIONAL DRILL (HDD) INSTALLED PIPELINE.

SANDY
WHERE INNOVATION MEETS ELEVATION

FIG 10-5

Sandy Facility Plan

SANDY RIVER OUTFALL PIPING
CONCEPTUAL OVERVIEW

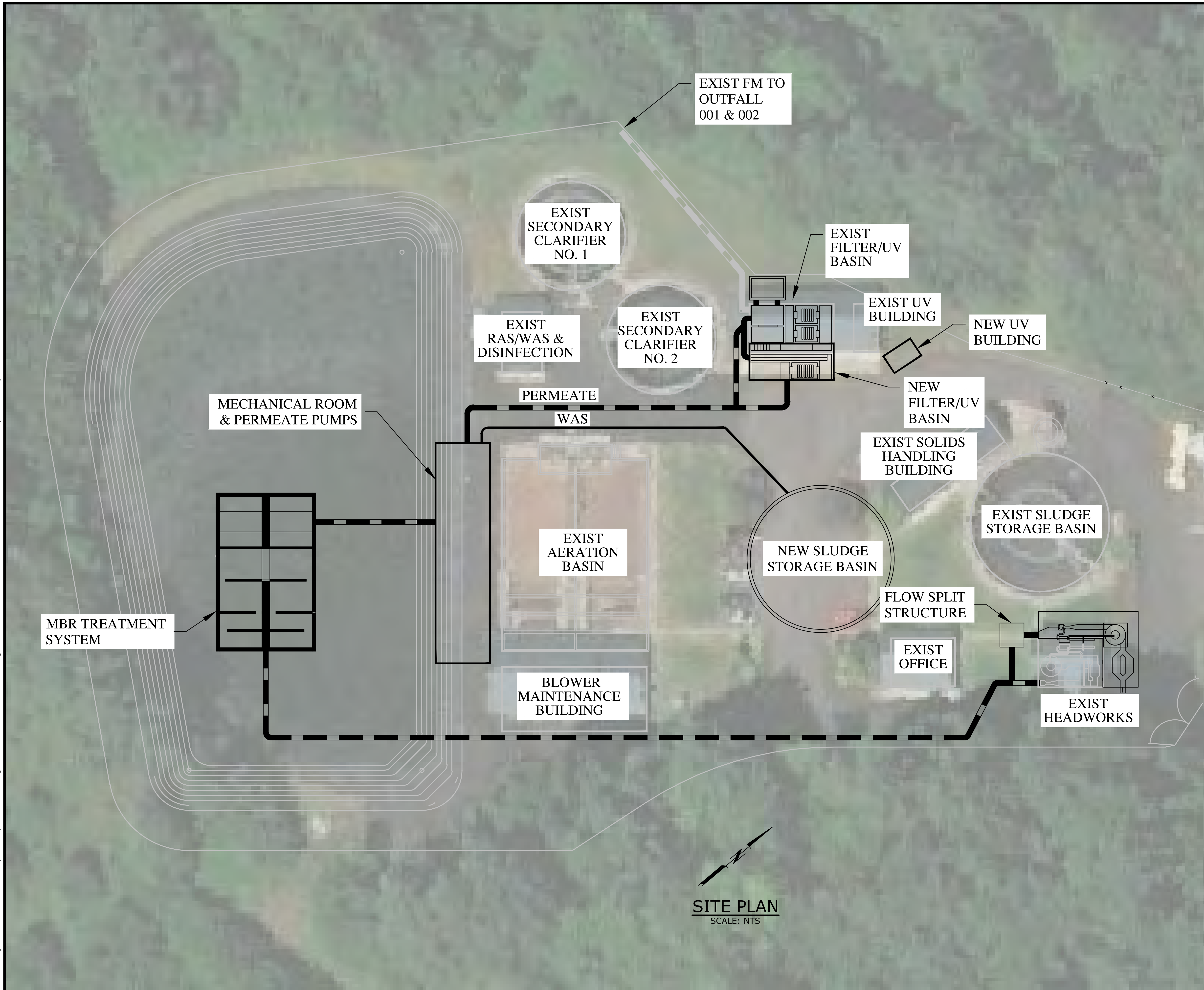
January 2019

murraysmith

DRAFT

17-2137

This page intentionally left blank



G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-FIG-10-6.dwg Site Plan 10/30/2018 2:41 PM NICK.MCFADDIN 23.0s (LMS Tech)

FIG 10-7

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

WWTP
UPGRADES SCHEMATIC - ALT B
14 MGD CAPACITY

Jan 2019

murraysmith

DRAFT

17-2137

This page intentionally left blank

10.2.2.1.3 Tertiary Filtration and Disinfection

Since the MBR permeate water quality is significantly better than traditional activated sludge effluent quality, there is no need for a tertiary filter on the MBR permeate. The existing two aqua-disk filters are sufficient for treating 7.0 MGD or less of flow of secondary effluent.

UV disinfection capacity will be increased from 7 MGD to 14.0 MGD by adding a new parallel channel with three UV banks in series to provide disinfection for 2040 design flows.

10.2.2.1.4 Solids

To meet the additional sludge storage handling requirements in 2040 for the increased loading at the WWTP, several upgrades will be needed. The solids upgrades proposed for Alternative B are the same as those proposed for Alternative A.

10.2.2.1.5 Existing Facilities O&M Upgrades

As noted in **Section 8.1 WWTP Condition Assessment**, upgrades are needed at the existing WWTP to address O&M and other deficiencies to assure the existing plant processes remains operational and able to comply with requirements of the City's existing NPDES Permit. The costs include upgrades to liquid stream, solids stream, SCADA, and Admin/Building Upgrades.

10.2.2.2 Alternative B WWTP Upgrades Cost Summary

The cost of Alternative B upgrades is approximately $38.9M. **Table 10-6** below summarized the cost per each unit process.

Table 10-6
Alternative B WWTP Upgrades Cost Summary

Unit Process	Cost
Liquid Stream	
Headworks	$ 2,760,000
Membrane Bioreactor	$ 18,360,000
Disinfection Filtration Basin	$ 1,610,000
Effluent Pump Station to Iseli	$ 1,400,000
Solids Stream	
Aerated Sludge Storage Basin	$ 3,570,000
Dewatering Equipment	$ 7,650,000
Sludge Dryer	$ 1,120,000
Existing System O&M Upgrades	$ 2,500,000
Total	**$ 38,970,000**

10.2.2.3 Alternative B – Collection System Upgrades

The collection system improvements are identical to Alternative A as shown on **Figure 10-4**. Therefore, the costs associated with collection system upgrades is $13.3M.

10.2.2.4 Alternative B – Effluent Infrastructure Upgrades

The effluent infrastructure improvements are identical to Alternative A as shown on **Figure 10-5**. Therefore, the costs associated with effluent infrastructure upgrades is $38.1M.

10.2.2.5 Alternative B - Total Cost Summary

The total cost for this scenario including collection system, WWTP, and storage/discharge upgrades is $90.4 M as summarized in **Table 10-7**.

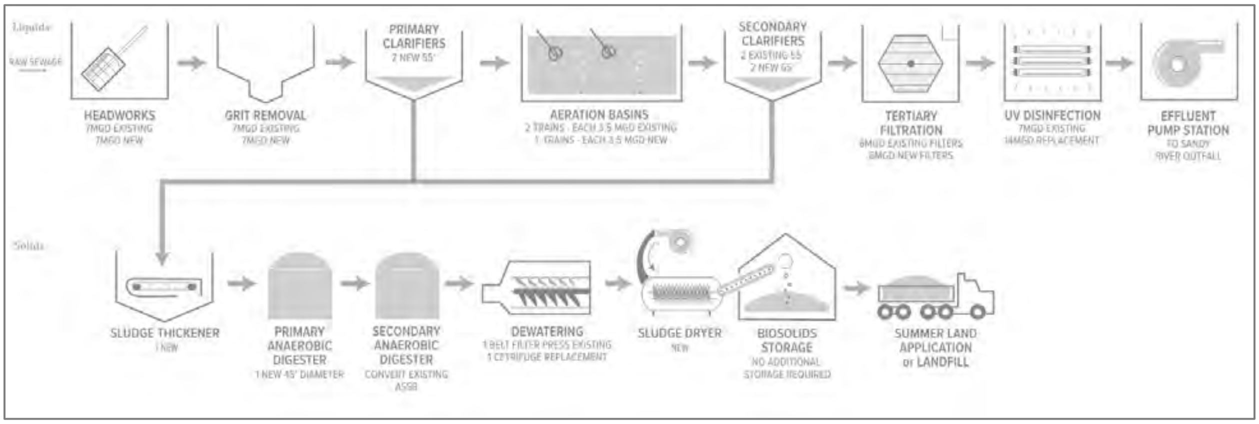
Table 10-7
Alternative B Total Upgrades Cost Summary

Item	Cost
WWTP Upgrades	$39.0M
Collection System Upgrades	$13.3M
Effluent Infrastructure	$38.1M
Total	**$90.4M**

10.2.3 Alternative C – Existing WWTP Conversion to Primary Clarification and Anaerobic Digestion

Alternative C involves the addition of primary clarification and expansion of the existing secondary process, as well as phased construction of an anaerobic digester at the current WWTP site. **Figure 10-8** shows a schematic of the proposed unit process upgrades.

Figure 10-8
Alternative C WWTP Treatment Process Schematic Diagram



10.2.3.1 Alternative C WWTP Upgrades

To meet the additional capacity required to meet a peak flow demand of 14.0 MGD, several unit process upgrades are needed in the liquid stream as highlighted on **Figure 10-9**. The following sections will discuss the upgrade needed for headworks facility, secondary treatment, and filtration disinfection basin.

10.2.3.1.1 Headworks

Upgrades to the headworks facility to meet the peak flow of 14.0 MGD include the reconstruction of the headworks and installation of a second fine screen and a grit removal system to increase the capacity by 7.0 MGD. Since this alternative includes the addition of primary clarification, the hydraulic profile of the headworks will need to be raised. An overhang structure to house the headworks equipment will be included. A new grit removal system and classifier will be installed capable of treating 14.0 MGD. The existing 12-inch Parshall flume will be replaced with an 18-inch Parshall Flume to accurately measure flows of 14.0 MGD. Lastly, a parallel pipe from the headworks will be constructed in addition to the existing 24-inch pipe to convey wastewater to the new primary clarifiers.

10.2.3.1.2 Primary Clarifiers

Two 55-foot diameter primary clarifiers will be constructed to reduce the BOD load on the existing aeration basins, prevent solids overloading of the existing secondary clarifiers and provide primary sludge needed for anaerobic digestion.

10.2.3.1.3 Secondary Treatment

One new aeration basin will be constructed in parallel to the existing basins to provide secondary treatment for 14.0 MGD alongside the added primary clarifiers. Secondary treatment upgrades will also include new aeration blowers along with RAS and WAS pumping upgrades. Downstream of the aeration basins, two new 65-foot diameter secondary clarifiers will be constructed along with associated appurtenant equipment.

10.2.3.1.4 Tertiary Filtration and Disinfection

Expansion of the two existing 6-disk cloth media filters is included to provide two new 8-disk filters in a new concrete structure to increase total capacity to 14.0 MGD.

UV disinfection capacity will be increased from 7 MGD to 14.0 MGD by adding a new parallel channel with three banks in series to provide disinfection for 2040 design flows.

10.2.3.1.5 Sludge Thickening and Anaerobic Digestion

A new 45-foot diameter primary anaerobic digester will be constructed and the existing aerated sludge storage basin will be converted to a secondary digester by adding a steel cover with internal draft tube mixer. To reduce the footprint of the anaerobic digester, a sludge thickener will be installed upstream of the digester for co-thickening primary sludge and secondary WAS. Consideration should be given to directly feed primary sludge to the primary digestion.

The secondary anaerobic digester will be used to regulate the dewatering feed while optimizing the capacity in the primary digester to maximize volatile solids destruction. Additional upgrades will include a new solids building with sludge heat exchanger, boiler and appurtenant equipment. Consideration could be given to adding cogeneration using microturbines during the initial upgrades or in the future.

10.2.3.1.6 Solids Dewatering, Solids Drying and Class A Biosolids Storage

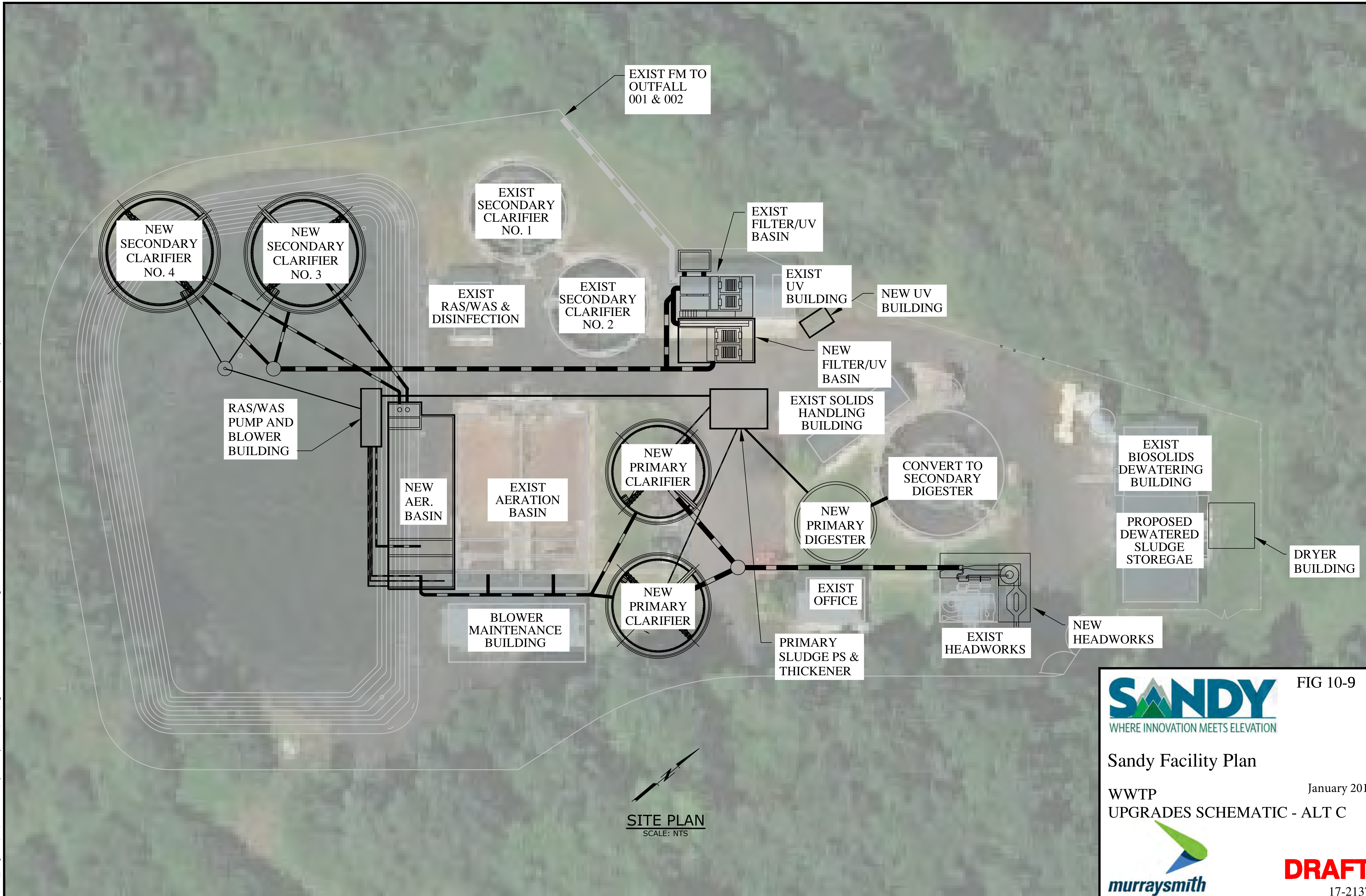
The solids dewatering, solids drying and Class A Biosolids Storage upgrades for Alternative C are the same as those described for Alternative A. However, the costs are reduced as the conversion to anerobic digestion reduces the solids required to be processed by these downstream facilities.

10.2.3.1.7 Existing Facilities O&M Upgrades

As noted in Section 8.1 WWTP Condition Assessment, upgrades are needed at the existing WWTP to address O&M and other deficiencies to assure the existing plant processes remains operational and able to comply with requirements of the City's existing NPDES Permit. The costs include upgrades to liquid stream, solids stream, SCADA, and Admin/Building Upgrades.

10.2.3.2 Alternative C WWTP Upgrades Cost Summary

The cost of Alternative C upgrades is approximately $34.3M. Table 10-8 summarizes the costs on a unit process basis.



G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-FIG-10-8.dwg Site Plan 10/30/2018 2:45 PM NICK.MCFADDIN 23.0s (LMS Tech)

This page intentionally left blank

Table 10-8
Alternative C WWTP Upgrades Cost Summary

Unit Process	Cost
Liquid Stream	
Headworks	$ 3,050,000
Primary Clarification	$ 4,140,000
Secondary Treatment	$ 7,040,000
Disinfection Filtration Basin	$ 2,840,000
Effluent Pump Station to Iseli	$ 1,400,000
Solids Stream	
Anaerobic Digester	$ 5,150,000
Dewatering Equipment	$ 7,100,000
Sludge Dryer	$ 1,120,000
Existing System O&M Upgrades	**$ 2,500,000**
Total	**$ 34,300,000**

10.2.3.3 Alternative C – Collection System Upgrades

The collection system improvements are identical to Alternative A and as shown on **Figure 10-4**. Therefore, the costs associated with collection system upgrades is $13.3M.

10.2.3.4 Alternative C – Effluent Infrastructure Upgrades

The effluent infrastructure improvements are identical to Alternative A as shown on **Figure 10-5**. Therefore, the costs associated with effluent infrastructure upgrades is $38.1M.

10.2.3.5 Alternative C - Total Upgrade Cost Summary

The total cost for this scenario including collection system, WWTP, and storage/discharge upgrades is $85.7 M as summarized in **Table 10-9**.

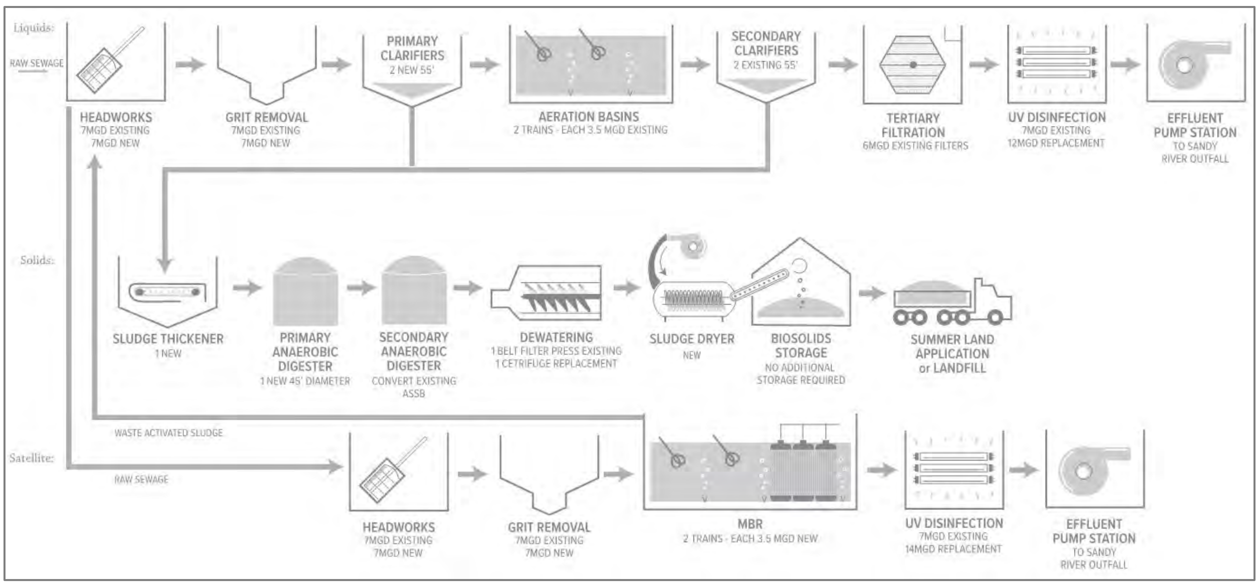
Table 10-9
Alternative C Total Cost Summary

C	Cost
WWTP Upgrades	$34.3M
Collection System Upgrades	$13.3M
Effluent Infrastructure	$38.1M
Total	**$85.7M**

10.2.4 Alternative D – New Satellite Treatment Facility

Alternative D involves the construction of a satellite treatment facility with reduced WWTP expansion at the existing WWTP site, limited to phased construction of an anaerobic digester at the current WWTP site. **Figure 10-10** shows a schematic of the proposed unit process upgrades. A detailed description of the upgrades proposed for *Alternative D* are in the following sections.

Figure 10-10
Alternative D Treatment Process Schematic Diagram



10.2.4.1 Alternative D – Existing WWTP Expansion

To meet the additional capacity required to meet a peak flow demand of 14.0 MGD, several unit process upgrades are needed as highlighted on **Figure 10-11** and discussed in the following sub-sections.

10.2.4.1.1 Headworks

A new headworks will be constructed to increase the hydraulic grade line to feed the new primary clarifiers. Two new screens will be constructed along with a new grit basin, grit classifier and appurtenant equipment. The headworks will be constructed in a new building to improve operations. A new parshall flume will be installed downstream of the new headworks.

10.2.4.1.2 Primary Clarifiers

Two 55-foot diameter primary clarifiers will be constructed to remove a high percentage of waste solids from the new satellite treatment facility for processing at the existing WWTP, reduce the BOD loading on the existing aeration basins, improve treatment performance for nutrient removal,

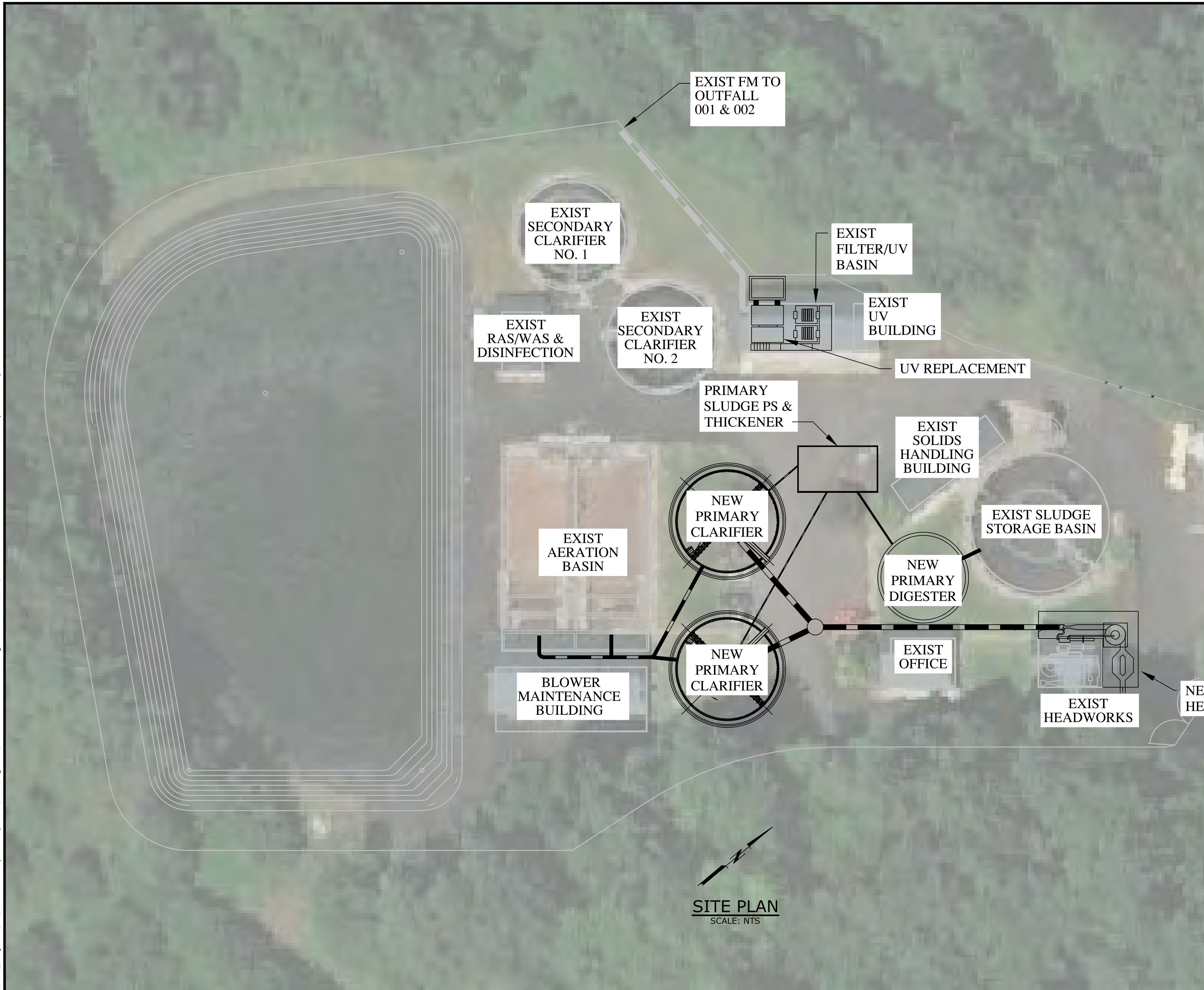


FIG 10-11

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

WWTP
UPGRADES SCHEMATIC - ALT D

January 2019

murraysmith

DRAFT

17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-FIG-10-10.dwg Site Plan 10/30/2018 2:42 PM NICK.MCFADDIN 23.0s (LMS Tech)

This page intentionally left blank

prevent solids overloading of the existing secondary clarifiers and provide primary sludge needed for anaerobic digestion.

10.2.4.1.3 Tertiary Filtration and Disinfection

Currently on site are two 6-disk tertiary filters, each with a capacity of approximately 3 MGD. These filters will be left in place, and the filter bypass channel will be utilized for flows exceeding 6.0 MGD. The existing UV system will be replaced by a more energy efficient system than the current Trojan 4000 medium pressure UV system.

10.2.4.1.4 Solids Dewatering, Solids Drying and Class A Biosolids Storage

The solids dewatering, solids drying and Class A Biosolids Storage upgrades for Alternative C are the same as those described for Alternative A. However, the costs are reduced as the conversion to anerobic digestion reduces the solids required to be processed by these downstream facilities.

10.2.4.1.5 Existing Facilities O&M Upgrades

As noted in Section 8.1 WWTP Condition Assessment, upgrades are needed at the existing WWTP to address O&M and other deficiencies to assure the existing plant processes remains operational and able to comply with requirements of the City's existing NPDES Permit. The costs include upgrades to liquid stream, solids stream, SCADA, and Admin/Building Upgrades.

10.2.4.2 Alternative D – New Eastside Satellite Treatment Facility

A preliminary layout of a potential new Satellite Treatment Facility is shown in Figure 10-12 and described below.

10.2.4.2.1 Administration Building

A new single-story Administration Building with water quality lab, conference room, operator work stations, locker rooms and other facilities will be constructed at the main plant entrance.

10.2.4.2.2 Headworks

A new 2-story headworks, with redundant rotary drum fine screens will be constructed upstream of the MBR. The fine screens will have an integral washer/compactor and will discharge to the lower level of the headworks building that will also house a storage area for O&M staff along with space for chemical storage and addition facilities (e.g. alkalinity addition).

10.2.4.2.3 Membrane Bioreactor

The building of the satellite treatment facility will include 4 trains, each with 1.75 MGD peak flow capacity. Each train will consist of an MBR process basin designed to meet the treatment requirements required for discharge to the Sandy River. A mechanical building to house MBR permeate piping, permeate pumps, closed-vessel UV disinfection equipment, plant utility water, electrical room and appurtenant equipment will be constructed next to the MBR treatment trains.

Waste solids from the satellite MBR will be pumped back to the collection system downstream of the satellite facility diversion pump station where it will flow to the existing WWTP for processing and handling in a centralized location for biosolids management.

10.2.4.3 Alternative D Existing WWTP and Satellite Facility Upgrades Cost Summary

The cost of Alternative D upgrades is approximately $47.3M. **Table 10-10** summarizes the costs on a unit process basis.

Table 10-10
Alternative D Existing WWTP and Satellite Facility Upgrades Cost Summary

Unit Process	Cost
Liquid Stream – Existing WWTP	
Headworks	$ 2,280,000
Primary Clarification	$ 4,150,000
Tertiary Filtration & Disinfection	$ 1,400,000
Effluent Pump Station to Iseli	$ 1,400,000
Liquid Stream – Satellite WWTP	
Headworks	$ 4,510,000
Membrane Bioreactor	$ 15,360,000
Disinfection	$ 1,080,000
Satellite Solids Return	$ 350,000
Solids Stream – Existing WWTP	
Anaerobic Digester	$ 5,150,000
Dewatering Equipment	$ 7,100,000
Sludge Dryer	$ 1,120,000
Existing System O&M Upgrades	**$ 2,500,000**
Total	**$ 46,400,000**

10.2.4.4 Alternative D – Collection System Upgrades

Alternative D includes RDII reduction to cap maximum 2040 influent flows to WWTP at 14.0 mgd and collection system improvements to alleviate surface flooding. Collection system gravity, force main, and pump station improvements are identical to other alternatives upstream of the Sandy Trunk Sewer. Because the remote satellite treatment facility diverts peak flow rates upstream of the trunk, improvements to the Sandy Trunk Sewer are eliminated from Alternative D resulting in a collection system cost savings of $1.1 million. Collection system improvements for Alternative D are shown in **Figure 10-13.** A comparison of total costs for all alternatives is summarized in **Table 10-11**.

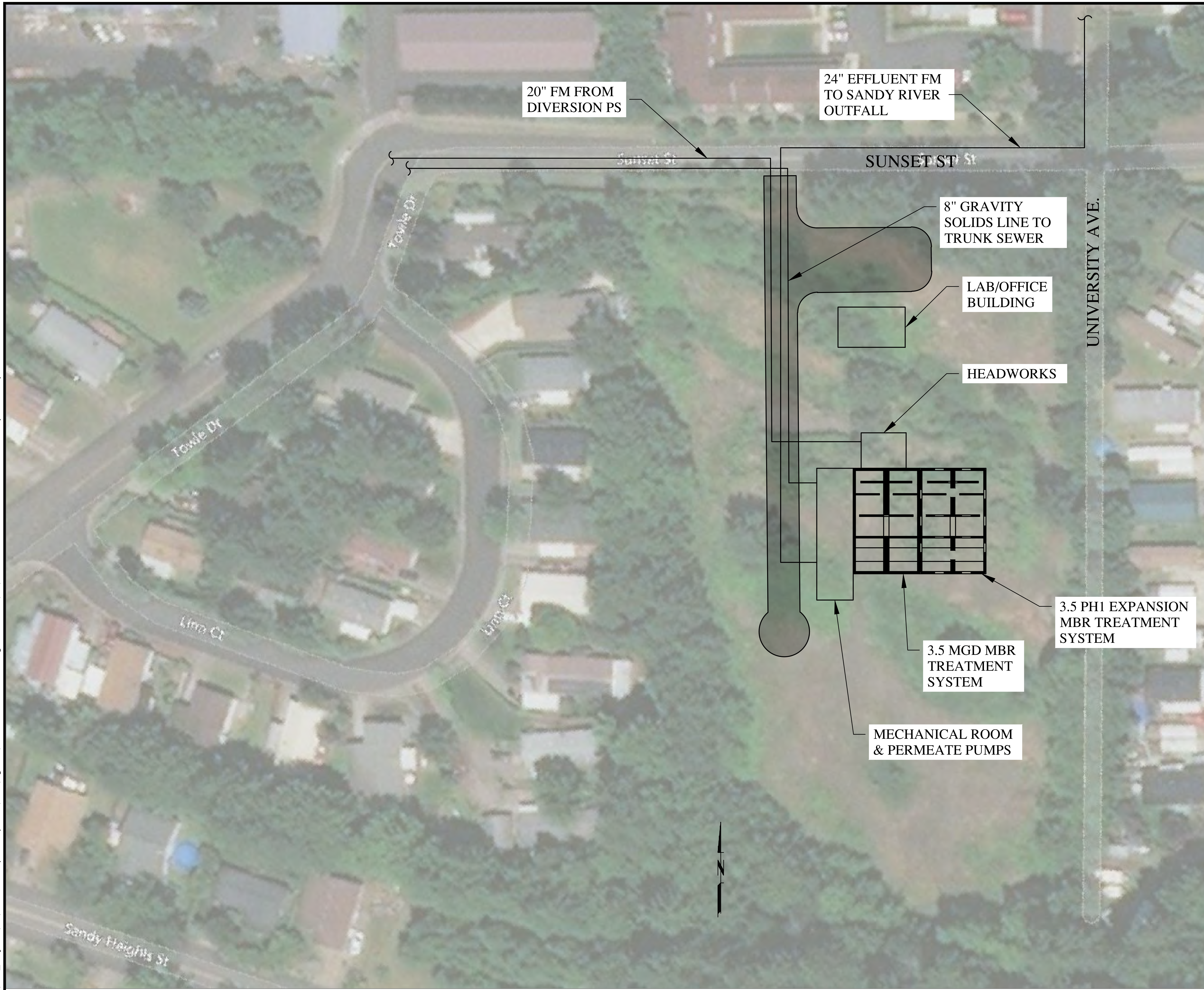


FIG 10-12

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

SATALLITE MBR TREATMENT PLANT - ALT D

January 2019

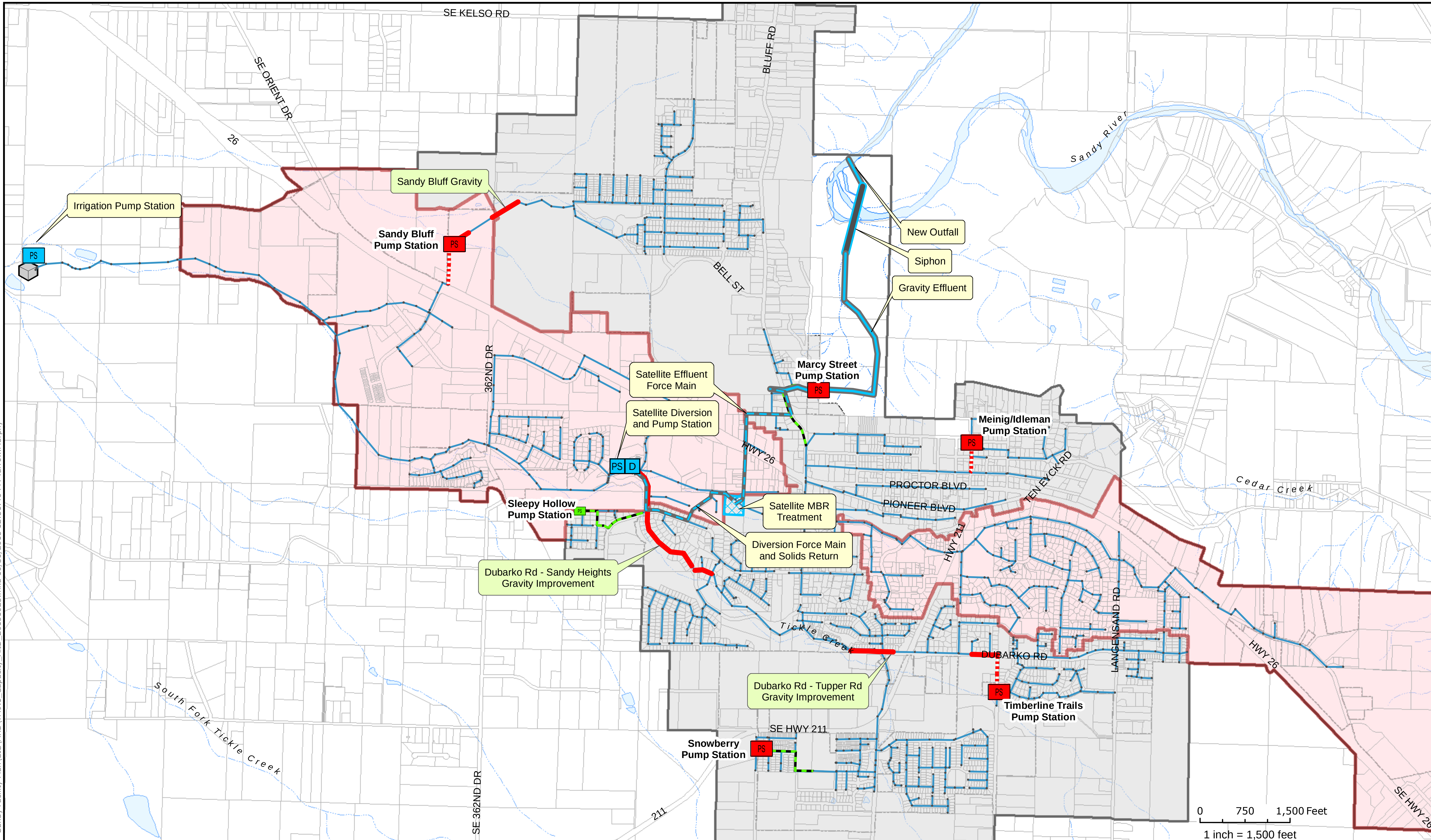
murraysmith

DRAFT

17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-FIG-10-11.dwg Satellite 10/30/2018 2:45 PM NICK.MCFADDIN 23.0s (LMS Tech)

This page intentionally left blank



City of Sandy, Oregon
Wastewater System Facility Plan

Figure 10-13
Collection System Improvements Alternative D

January 2019 17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\GIS\MXD\TM9.1_Capacity_AltD_20181025.mxd 10/30/2018 12:51:46 PM Yarrow.Murphy

This page intentionally left blank

Table 10-11
Alternative D – Collection System Improvements Cost Summary

Description	Alternative D Quantity	Alternative D Cost[1]
RDII Reduction – Flow Reduction	2 Basins	$6.2M
Pump Stations – Capacity & Condition	5 stations	$3.9M
Force Mains – Capacity	1390 LF	$0.4M
Gravity Mains - Capacity	4140 LF	$1.7M
Total		$12.2M

10.2.4.5 Alternative D – Effluent Infrastructure Upgrades

Alternative D splits the peak wastewater flow between the existing WWTP site and the Sandy River via construction of a Diversion Pump Station on the Sandy Trunk to divert flows to the new satellite treatment facility located higher up in the City's sewer collection system. Planned upgrades to the existing WWTP effluent pump station, diversion pump station and force main, waste solids return pipeline, Sandy River outfall force main from the new satellite treatment facility and the Sandy River gravity outfall pipeline are shown in **Figure 10-5** and described below.

Under Alternative D, continued operation of the existing WWTP utilizing wet weather discharge to Tickle Creek and Class B Recycled Water storage and irrigation and Iseli Nursery would continue to be utilized through the 2040 planning horizon. The existing WWTP effluent pump station will be upgraded to a peak capacity of approximately 5.5 MGD. Construction of a new effluent pump station will ultimately be required from the existing WWTP to the Sandy River outfall, but that is anticipated to be delayed beyond the current 2040 planning horizon.

Diversion of flows from the Sandy Trunk to the new satellite treatment facility will be through a diversion pump station constructed near Ruben Lane and Dubarko Road. The facility will have actuated gates to divert flows to the satellite facility and provide operational flexibility in terms of where how flows are split in the system. The diversion pump station is located approximately 1,800 LF from the proposed satellite facility site. A force main to send waste solids from the satellite facility downstream to the existing WWTP will be installed in parallel with the diversion pump station force main.

The gravity piping and outfall to the Sandy River is the same for Alternative D as described for Alternatives A, B, and C. For Alternative D, the 24-inch to 30-inch pipeline, double barrel siphon, and outfall are oversized to account for unknowns related to future effluent pump station requirements from the WWTP. The satellite treatment effluent force main discharges to the gravity outfall piping at Bluff Road at Marcy Street.

Planning level cost estimates for the effluent infrastructure are summarized in **Table 10-12**.

Table 10-12
Alternative D - Cost Summary for Effluent Infrastructure

Alt	Effluent Pump Station & Force main to Sandy River ($M)[1]	Diversion Pump Station to Satellite Treatment Facility ($M)[1, 2]	Force main from Satellite Facility to Sandy Gravity Outfall ($M)[1, 3]	Sandy Gravity Outfall ($M)[1]	Total Effluent Infrastructure ($M)[1]
D	--	$7.2	$1.0	$12.8	$21.0

10.2.4.6 Alternative D - Total Cost Summary

The total cost for this scenario including collection system, WWTP, and storage/discharge upgrades is estimated at $80.5 M as summarized in **Table 10-13**.

Table 10-13
Alternative D Total Upgrades Cost Summary

Item	Cost
WWTP Upgrades	$46.4M
Collection System Upgrades	$12.2M
Effluent Infrastructure	$21.0M
Total	**$79.6M**

10.3 Combined Alternatives Evaluation

The alternatives evaluation includes an evaluation of economic (capital and O&M Costs) and non-economic (non-cost) factors following the methodology presented in **Section 5 – Basis of Planning.**

10.3.1 Economic Considerations for Alternatives

This section summarized the primary economic considerations for the four alternatives, including capital cost and the primary O&M consideration related to economic impacts, which is energy cost associated with pumping wastewater from the existing WWTP to the new Sandy River outfall.

10.3.1.1 Alternative Capital Cost Summary

Capital costs for the four combined alternatives is provided in **Table 10-14** and **Figure 10-14**.

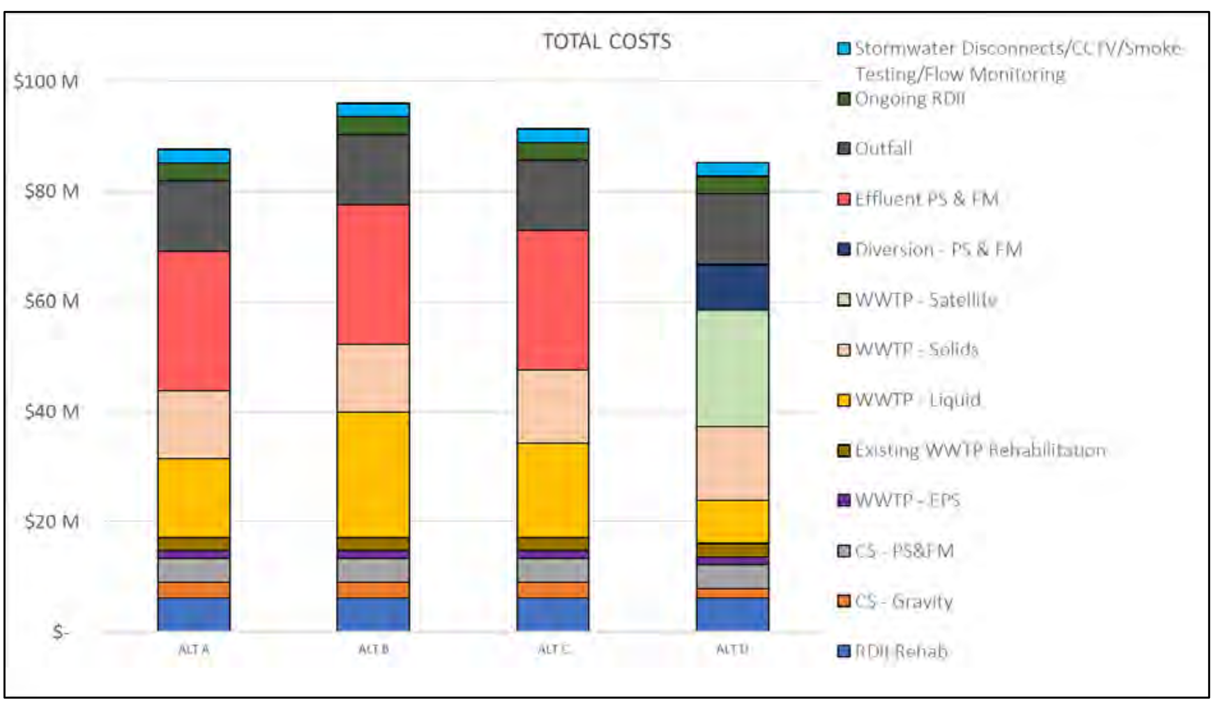
Table 10- 14
Combined Alternatives Capital Cost Summary

Total	ALT A	ALT B	ALT C	ALT D
Existing WWTP Rehabilitation	$ 2.5M	$ 2.5M	$ 2.5M	$ 2.5M
RDII Rehab	$ 6.2M	$ 6.2M	$ 6.2M	$ 6.2M
Ongoing RDII	$ 3.2M	$ 3.2M	$ 3.2M	$ 3.2M
Stormwater Disconnects/CCTV/Smoke Testing/Flow Monitoring	$ 2.5M	$ 2.5M	$ 2.5M	$ 2.5M
CS – Gravity	$ 2.8M	$ 2.8M	$ 2.8M	$ 1.7M
CS – PS&FM	$ 4.3M	$ 4.3M	$ 4.3M	$ 4.3M
WWTP – Liquid	$ 14.3M	$ 22.7M	$ 17.1M	$ 7.8M
WWTP – Solids	$ 12.3M	$ 12.3M	$ 13.4M	$ 13.4M
WWTP - EPS	$ 1.4M	$ 1.4M	$ 1.4M	$ 1.4M
WWTP - Satellite	$ -	$ -	$ -	$ 21.3M
Diversion - PS & FM	$ -	$ -	$ -	$ 8.2M
Effluent PS & FM	$ 25.3M	$ 25.3M	$ 25.3M	$ -
Outfall	$ 12.8M	$ 12.8M	$ 12.8M	$ 12.8M
Total	**$ 87.6M**	**$ 96.0M**	**$ 91.5M**	**$ 85.3M**

Notes:

1 All costs in 2018 dollars. Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

Figure 10-14
Combined Alternatives Capital Cost Summary Chart



As shown in the cost summary, Alternatives A, B and C offer lower treatment expansion costs at the existing WWTP site since much of the needed infrastructure is already in place. However, for these alternatives a new effluent pump station and force main is required to the proposed Sandy River outfall at considerable expense. These alternatives also continue to provide treatment on the space-constrained existing WWTP site.

Alternative A is a relatively low-cost option for upgrades within the existing WWTP but includes construction of a new pump station to the new Sandy River outfall, which dramatically increases the costs. This effluent pump station will be a high head pump station with significant energy consumption. However, it relies on continued expansion of the existing WWTP on a constrained site. This alternative also requires significant capacity upgrades on the Sandy Trunk to deliver peak flows to the existing WWTP site. The installation of solids drying will produce a marketable Class A biosolids product, but the infrastructure needed will be larger than other alternatives due to the limited volatile solids destruction offered through aerobic solids stabilization.

Alternative B utilizes a membrane bioreactor for secondary treatment at the Existing WWTP site, which produces a high-quality effluent in a smaller footprint than traditional activated sludges processes. While producing very high-quality effluent that would be ideal for continued use at Iseli Nursery, it would also add a second parallel treatment plant on the existing site that would be constructed in the area of the onsite equalization basins. This option would effectively require the same treatment infrastructure to be installed as Alternative D along with the collection system capacity upgrades and effluent pump station to the new Sandy River outfall.

Alternative C converts the existing WWTP to anaerobic digestion to reduce overall solids to be processed along with production of a marketable Class A biosolids product. The addition of primary clarifiers will reduce energy demand in the facility and optimize aeration basin capacity for nutrient reduction. Alternative C effectively provides for build-out of the WWTP on the existing site, which may be a consideration beyond the 2040 planning horizon. Previously noted collection system capacity upgrades would also be required for Alternative C.

Alternative D would divert wastewater flows upstream in the collection system on the Sandy Trunk to a new greenfield MBR facility that effectively offers “best available technology” to support permitting for the new Sandy River outfall. Energy costs will be significantly reduced using a diversion pump station instead of pumping all flows from the existing WWTP to the new Sandy River outfall. In addition, downstream collection system capacity upgrades are largely avoided. Construction of the satellite facility can be phased over time in response to the effectiveness of the RDII Reduction Program and to support community growth.

While Alternative D has higher initial treatment-related capital costs to construct a new greenfield satellite treatment facility, it avoids construction of the effluent pump station and force main to the Sandy River, at least through the current 2040 planning horizon. This may potentially allow the City to take advantage of “opportunity projects” for staged installation of the 3-mile force main that will ultimately be required for pumping effluent to the Sandy River outfall. In addition, construction and expansions of the satellite treatment facility can be phased and timed to community growth and success in the planned RDII Reduction Program.

10.3.1.2 Alternative Energy Cost Summary

The biggest difference between the four combined alternatives is the energy cost associated with expansion of the existing WWTP and adding a large pump station as provided in Alternatives A-C and the construction of a smaller diversion pump station and Eastside Satellite Treatment Facility as provided in Alternative D. While there are some additional O&M costs associated with operation of a second treatment facility, those impacts can partially be addressed through the treatment technology selected (membrane bioreactor) and level of automation.

Table 10-15 presents the 20-year NPV of energy use associated with pumping for each of the four combined alternatives. For the calculation, the discount rate and inflation rate outlined in **Section 5 – Basis of Planning** was used over the 20-year planning period. As shown, Alternative D offers a substantially lower pumping energy cost when compared with the three other alternatives. These pumping costs account for the "20-year Life-Cycle Cost" scoring criteria.

Table 10- 15
Alternatives 20-Year Net Present Value Energy Cost Difference

	ALT A	ALT B	ALT C	ALT D
20 Year NPV Energy Cost	$ 1.53M	$ 1.53M	$ 1.53M	$ 0.36M

Based on the analysis, Alternative D requires the least amount of energy as compared to the other alternatives. As a note, with the fall in elevation from the satellite wastewater treatment plant to the outfall, there is also an opportunity to explore options for pursuing energy recovery using microturbines placed in the outfall that could provide energy that could be used to be used to operate the satellite treatment facility.

10.3.2 Non-Economic Considerations

As outlined in the **Section 5 – Basis of Planning**, the four alternatives were also evaluated for several non-economic (non-cost) factors including regulatory compliance, environmental and permitting requirements, constructability, phasing, and reliability/resiliency. The following section discusses these non-cost factors for each proposed alternative.

10.3.2.1.1 Regulatory Compliance

All alternatives are expected to meet effluent requirements, but Alternative A relies only on secondary treatment and effluent filtration. In comparison, Alternative B and C, which include membrane filtration and primary clarifiers, respectively, are considered to be more reliable than Alternative A since they include an additional unit process to meet performance requirements.

Alternative D is considered to have a slightly higher score for regulatory compliance since it includes the addition of primary clarifiers at the existing wastewater treatment plant and the installation of membrane bioreactor at the satellite treatment plant.

All alternatives include complex environmental permitting for the new Sandy River outfall.

10.3.2.1.2 Environmental and Permitting Requirements

All alternatives include the complex environmental permitting requirements to obtain approval for the new Sandy River outfall. Alternative D provides for a phased approach where the City is able to use both the existing Tickle Creek discharge in the winter months while also discharging to the Sandy River for the flow diverted to the Eastside Satellite Treatment Facility. Alternatives B-D provide for improved effluent quality that will also be beneficial for permitting. Alternative D with the ability to phase upgrades to address any emerging permitting issues also provides valuable benefits in terms of longer-term permitting requirements.

10.3.2.1.3 Constructability

Alternatives A-C require invasive near-term retrofit of the existing WWTP and construction of a new effluent pump station. In addition, these alternatives require the construction of a force main from the existing plant to the Sandy River for discharge which will be a significant effort. Construction of Alternatives A-C carry a larger upfront cost and greater construction risk because they all require a significant amount of construction on the existing WWTP site, which is very constrained.

On the contrary, Alternative D offers the ability to construct the Eastside Satellite Treatment Facility and Diversion Pump Station on greenfield sites, where the primary constructability issue is connection of the Diversion Pump Station to the existing sewer collection system.

10.3.2.1.4 Reliability/Resiliency

Providing for a resilient design that could survive a significant earthquake such as the Cascadia subduction zone event that many local agencies have undertaken will be difficult for Alternatives A-C since it involves significant expansion of the existing WWTP that does not appear to have been construction with resiliency in mind. While some resiliency upgrades could be accommodated in Alternatives A-C, they would likely be relatively minor piping upgrades such as adding pipe bracing that are not likely to offer continued facility operations following a major earthquake event.

However, Alterative D would allow for the construction of a new facility designed with seismic resiliency and reliability in mind that could provide a reliable facility to serve the City in the aftermath of a major earthquake event. The overall system including the existing WWTP and Eastside Satellite Facility would be much more reliable than the existing WWTP alone.

10.3.2.1.5 Phasing

Alternatives A-C requires the majority of existing WWTP upgrades and new effluent pump station to the new Sandy River outfall to be constructed in a single phase. Alternative D provides for a phased implementation approach with future construction of the effluent pump station from the existing WWTP to the new Sandy River outfall. This phasing potential greatly reduces the initial Phase 1 costs to help make the overall program more affordable for local ratepayers.

10.3.3 Recommendation

Based on the discussion in the previous section, each alternative was scored for the non-cost factors. Combining the cost and non-cost factors scores, each alternative was scored using the method listed in **Section 5 – Basis of Planning**. The resulting scores for each alternative are summarized in **Table 10-16.** The scoring equation is as follows:

$$Total = \sum_{Criteria} (Score * Weighting)$$

Table 10-16
Alternative Scoring based on Cost and Non-Cost Factors

	Weight	Alt A	Alt B	Alt C	Alt D
Capital Cost	30%	3.0	2.0	2.5	3.5
20-year Life-Cycle Cost	20%	2.5	2.5	2.5	3.5
Regulatory Compliance	20%	2.0	2.5	2.5	3.0
Environmental Permitting	10%	2.0	2.5	2.5	3.0
Constructability	10%	2.0	2.0	2.0	3.5
Reliability/Resiliency	5%	2.0	2.5	2.5	3.0
Phasing	5%	2.0	2.0	2.0	4.0
Total	**100%**	**2.4**	**2.3**	**2.4**	**3.4**

Based on the above discussion and the results of scoring, Alternative D is recommended for implementation, offering the best long-term approach for the City's wastewater system with the security of a year-round river discharge that will provide for long-term community growth.

murraysmith

Section 11

Section 11

Recommended Capital Improvement Program

11.1 Introduction

This section includes an overview of the recommended Capital Improvement Program (CIP) for the City's wastewater system, providing a Recommended Plan overview, summary of required O&M upgrades at the City's existing WWTP, Phased Implementation Plan with estimated costs and Preliminary Financial Plan.

11.2 Recommended Plan Overview

Based upon previous evaluations, Alternative D is recommended as the best long-term option for the City. **Figure 11-1** shows the overall recommended plan, further summarized as follows:

11.2.1 Collection System Rehabilitation Program

Rehabilitation of the City's sanitary sewer collection system will focus on a combination of initial efforts to reduce infiltration and inflow throughout the collection system as well as full rehabilitation of sewer mains and laterals in two basins. The goal of the collection system rehabilitation program is to reduce 2040 peak wastewater flows from 17.1 MGD to 14.0 MGD. **Figure 11-2** summarizes the recommended collection system rehabilitation program.

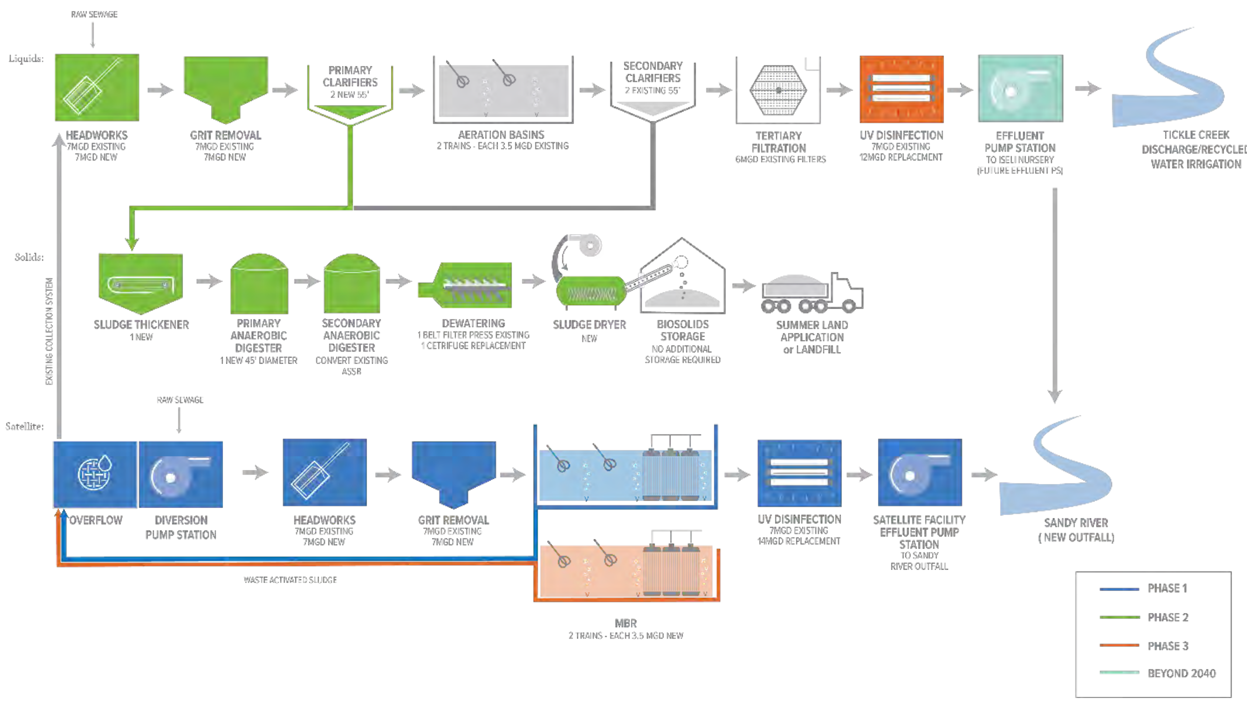
11.2.2 New Eastside Satellite Treatment Facility and Sandy River Outfall

A new satellite treatment facility will be constructed in two phases along with a new outfall to the Sandy River. Following completion of the permitting process for the new outfall, the satellite facility will operate year-round discharging highly treated effluent to the Sandy River while sending waste solids from the new facility back to the existing WWTP for solids process and disposal. **Figure 11-3** shows the preliminary layout for the Eastside Satellite Treatment Facility. **Figure 11-4** shows the preliminary plan and profile for the new Sandy River Outfall.

11.2.3 Existing Wastewater Treatment Plant Upgrades

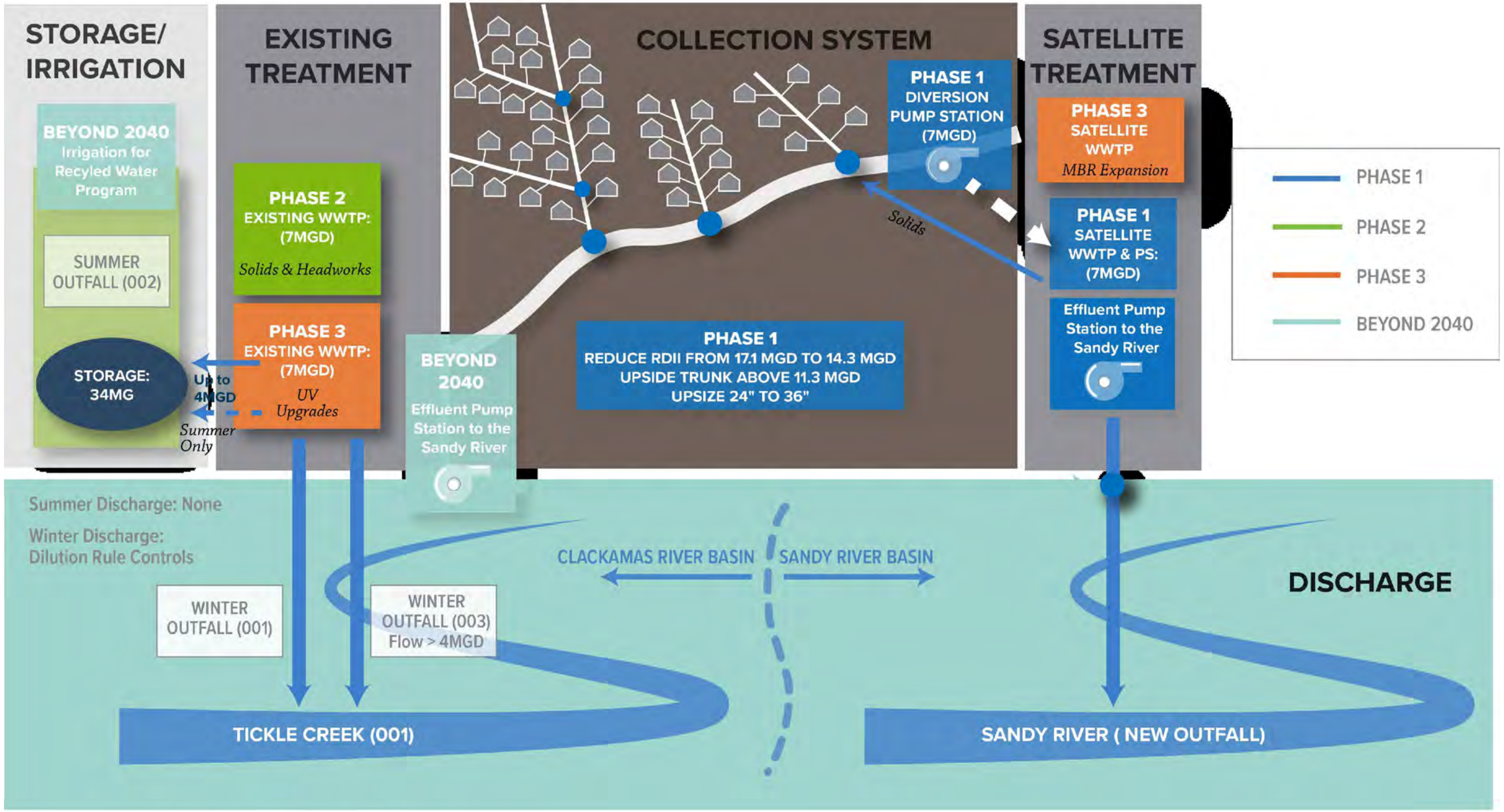
Upgrades to the existing WWTP to address O&M issues identified in the WWTP condition assessment are needed along with a capacity expansion of the existing WWTP. While no expansion of the existing WWTP liquids stream capacity is anticipated beyond the current 7 MGD capacity, future solids stream upgrades are needed to manage solids from the existing WWTP and East Side Satellite Treatment Facility. For the current planning horizon through 2040, the existing WWTP wet weather discharge and dry weather Class B Recycled Water irrigation program is anticipated. The schematic in **Figure 11-5** below summarizes phased upgrades of the existing WWTP and the satellite treatment facility. **Figure 11-6** summarizes phased upgrades to the existing WWTP.

Figure 11-5
Phased upgrades of the WWTP



11.2.4 Future Existing WWTP Effluent Pump Station

For the current planning horizon through 2040, it is anticipated the City will continue to operate the existing WWTP with Tickle Creek wet weather discharge and dry weather Class B Recycled Water irrigation at Iseli Nursery. Depending on the success of the RDII reduction program and community growth, it is anticipated the City will construct a new effluent pump station and force main to the new Sandy River outfall while retaining the beneficial reuse program with Iseli Nursery. Planning for the force main installation should be coordinated with projects along the potential pipeline alignment to reduce the overall cost to the City when full implementation is needed.



THE PLAN PROVIDES FOR:

- Avoids new trunkline to existing WWTP
- Delays major upgrades at existing WWTP and new effluent pump station and force main
- Greatest ability to phase improvements
- Long-term river discharge to support community growth

FIG 11-1

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

Recommended Plan Overview
Alternative D

Jan 2019

murraysmith

DRAFT

17-2137

This page intentionally left blank

UGB

Existing Facilities
- Pump Station
- Manhole
- Gravity Sewer
- Forcemain

II Reduction Basin

Effluent Improvements (Phase 1)
- Diversion and Pump Station
- Satellite MBR
- New Force Main
- New Gravity
- New HDD Siphon

Capacity Improvements
- Ph 1 Gravity Mains
- Ph 3 Gravity Mains
- Ph 1 Force Main
- Ph 2 Force Main
- Ph 1 Pump Station
- Ph 3 Pump Station

murraysmith

SANDY WHERE INNOVATION MEETS ELEVATION

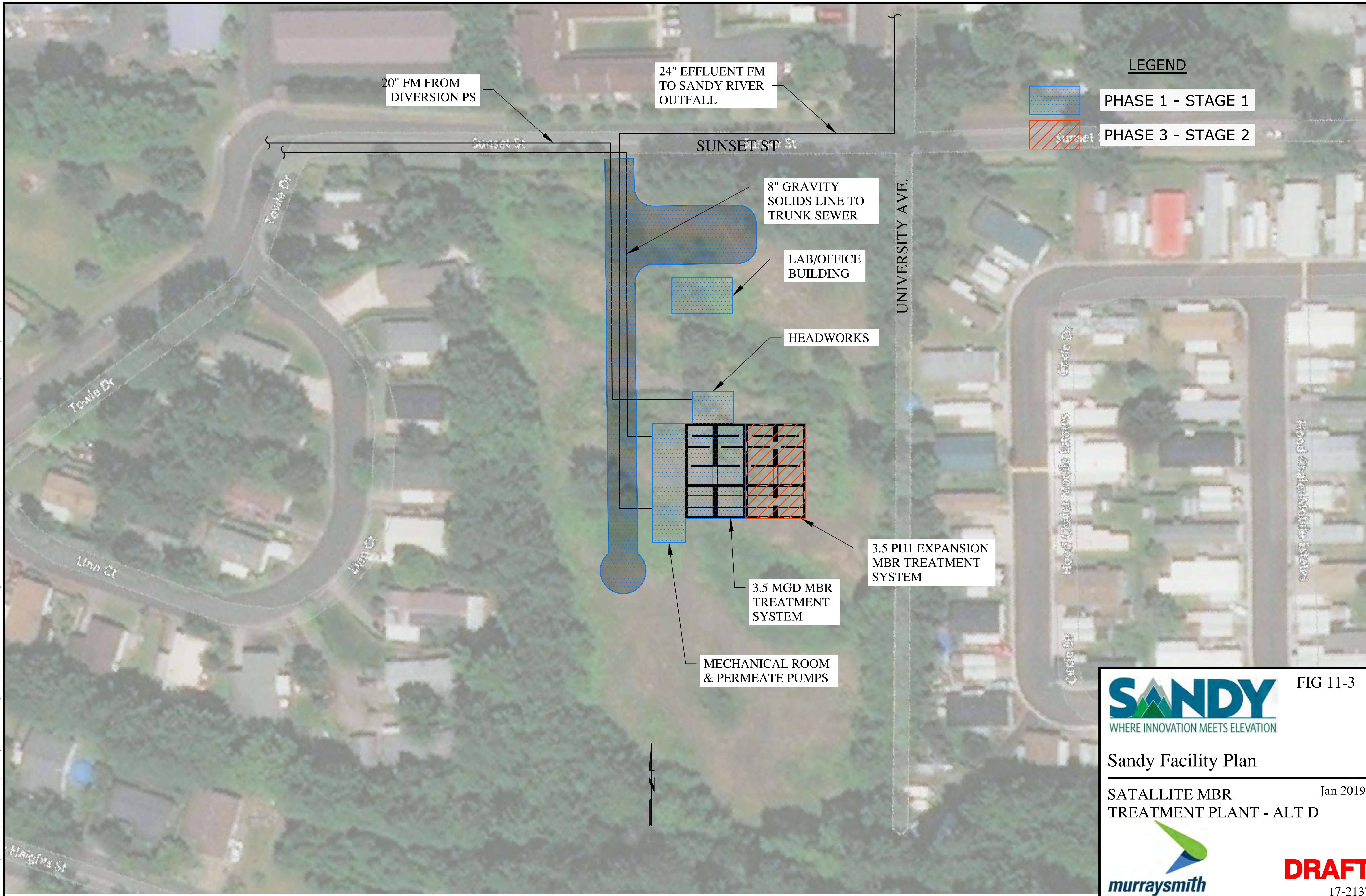
N E S W

City of Sandy, Oregon
Wastewater System Facility Plan

Figure 11-2 Recommended Improvements

January 2019 17-2137

This page intentionally left blank



SANDY
WHERE INNOVATION MEETS ELEVATION

FIG 11-3

Sandy Facility Plan

SATALLITE MBR TREATMENT PLANT - ALT D

Jan 2019

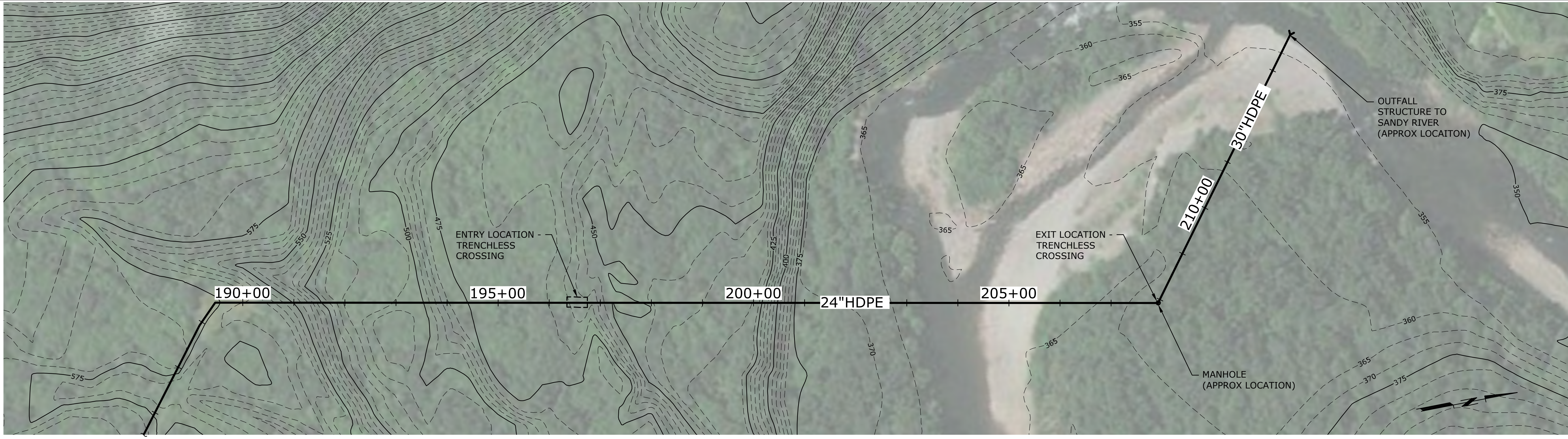
murraysmith

DRAFT

17-2137

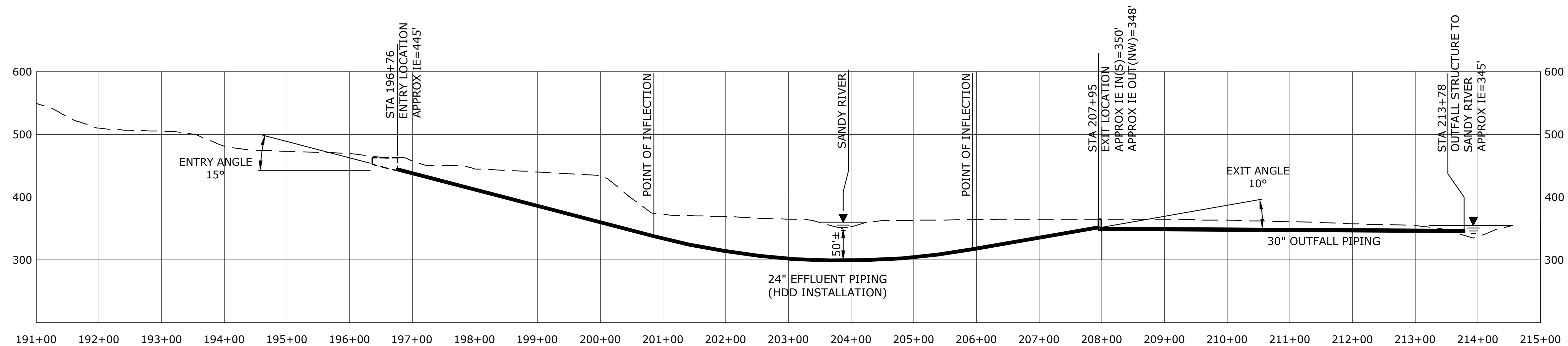
G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-FIG-11-XX.dwg Satellite 10/30/2018 2:45 PM NICK.MCFADDIN 23.0s (LMS Tech)

This page intentionally left blank



PLAN

SCALE: 1"=100'



PROFILE

SCALE: 1"=100' HORIZ, 1"=100' VERT

NOTES:

1. PIPELINE ALIGNMENT AND ASSOCIATED STRUCTURES ARE CONCEPTUAL IN NATURE, AND USED TO EVALUATE PRELIMINARY FEASIBILITY OF DESIGN. SUBJECT TO CHANGE.

2. ALLOWABLE RADIUS OF CURVATURE ASSUMED TO BE 1200FT FOR HORIZONTAL DIRECTIONAL DRILL (HDD) INSTALLED PIPELINE.

FIG 11-4

SANDY
WHERE INNOVATION MEETS ELEVATION

Sandy Facility Plan

SANDY RIVER OUTFALL PIPING CONCEPTUAL OVERVIEW

Jan 2019

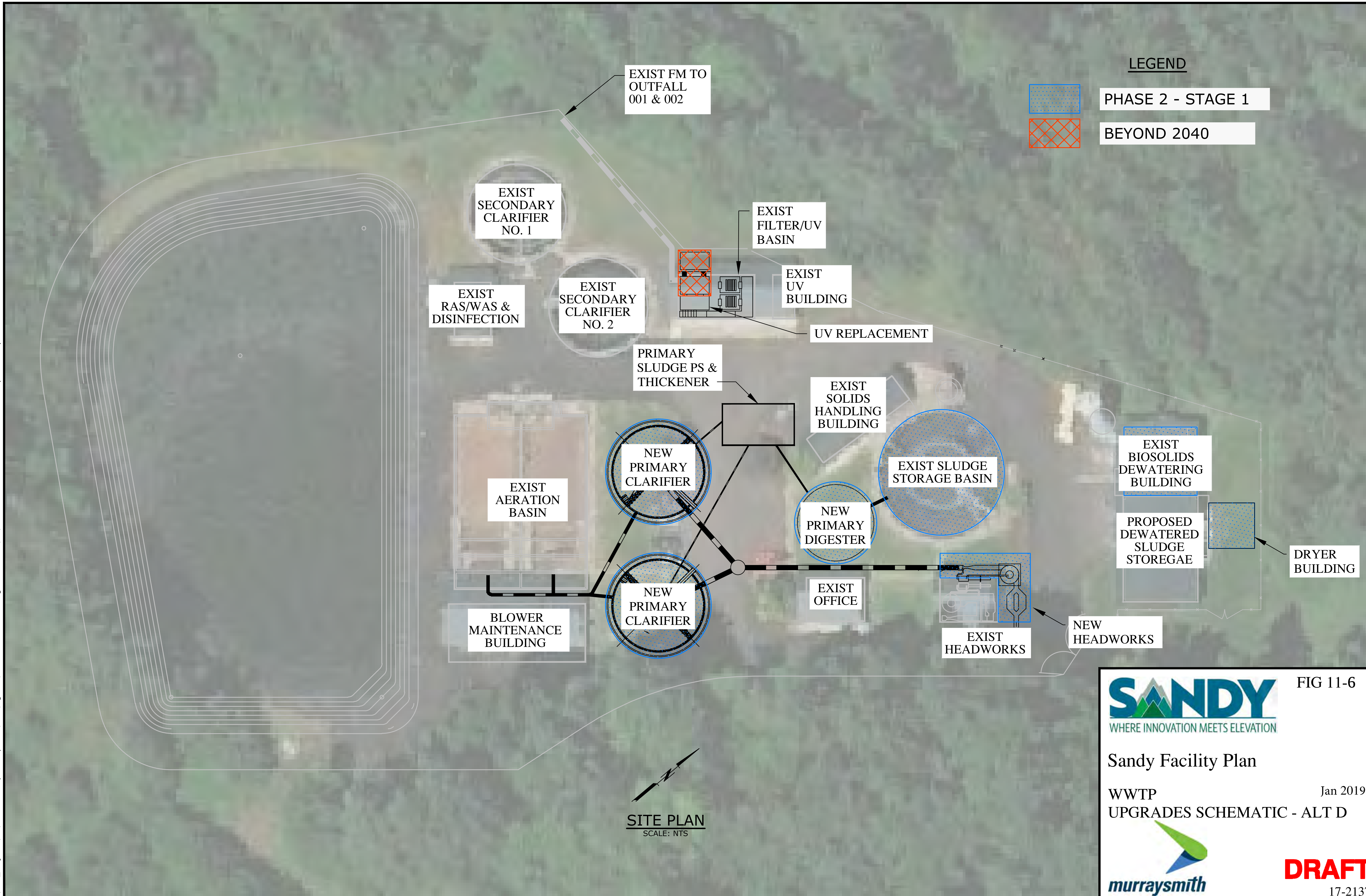
murraysmith

DRAFT

17-2137

G:\PDX_Projects\17\2137 - Sandy Facility Plan\CAD\Figures\17-2137-OR-SANDY PLAN_PROF-FIG.dwg FIGURE 0 10/25/2018 8:02 AM NICK.MCFADDIN 23.0s (LMS Tech)

This page intentionally left blank



SANDY
WHERE INNOVATION MEETS ELEVATION

FIG 11-6

Sandy Facility Plan

WWTP
UPGRADES SCHEMATIC - ALT D

Jan 2019

murraysmith

DRAFT

17-2137

This page intentionally left blank

Table 11-1
Phase 1 Recommended Force Main Improvements

Pump Station Served	Length	New Diameter (inches)	Estimated Cost[1]
Sandy Bluff	780	12	$0.2M
Jacoby/Timberline Trails	610	10	$0.2M
Total Phase 1	**1,390**		**$0.4M**

Notes:

1 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

11.2.4.1 Collection System Rehabilitation and RDII Reduction Program

Collection system rehabilitation targeting a reduction of approximately 3.2 MGD in peak flow at the existing WWTP will be focused on stormwater disconnects system-wide, and sanitary sewer rehabilitation in Basin 2 (Sunset Street to the Treatment Plant) and Basin 8 (East End to Strawberry) as shown in **Figure 11-2**. As part of the planning for the rehabilitation upgrades, additional flow monitoring will be implemented as well as a smoke testing program to identify inflow sources that can be cost-effectively corrected early in the Phase 1 upgrades. CCTV inspection of the gravity portions of the collection system will be used to identify poor condition pipes and prioritize rehabilitation. Flow monitoring is used to confirm system response associated with RDII and the effectiveness of RDII reduction. Permanent flow meters at the WWTP and Sandy Trunk are recommended to review system-wide flow reductions. Temporary flow meters are recommended upstream of priority gravity and pump station projects prior to project implementation. Collection system capacity related improvements may be delayed or accelerated based on the monitored wet weather response.

Estimated collection system rehabilitation program costs are summarized in **Table 11-2**.

Table 11-2
Collection System Rehabilitation Program Cost Summary, Phase 1

Location and Action	Cost[2]
Flow Monitoring (minimum 5 locations, permanent and temporary)	$0.30 M
Condition Inspection (CCTV)	$0.51 M
Smoke Testing (system-wide)	$0.17 M
Basin 2 – Rehabilitation (piping and laterals)	$ 3.40 M
Basin 8 – Rehabilitation (piping and laterals)	$ 2.80 M
Stormwater Disconnects[1]	$1.50 M
Total Cost	**$8.68 M**

Note:

1 Excludes cost of new stormwater infrastructure

2 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

11.2.4.2 Existing WWTP O&M Upgrades

As noted in the **Section 8 WWTP Condition Assessment**, upgrades are needed at the existing WWTP to address O&M and other deficiencies to assure the plant remains operational and able to comply with requirements of the City's existing NPDES Permit. These $2.5 Million in existing WWTP upgrades will be completed in compliance with the City's MAO completion deadlines. **Table 11-3** below summarizes the O&M costs.

Table 11-3
Existing WWTP O&M and Condition Assessment Upgrades

Plant Process Area	Cost[1]
General/Site Improvements	$ 0.10 M
Headworks/Grit Removal/Flow Metering	$ 0.50 M
Secondary Treatment	$ 0.90 M
Disinfection	$ 0.25 M
Solids Treatment	$ 0.35 M
SCADA Upgrades	$ 0.25 M
Admin/Lab Building Upgrades	$ 0.15 M
Total	**$ 2.50 M**

Notes:

1 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

11.2.4.3 Stage 1 Eastside Satellite Treatment Facility

Design and construction of a new diversion pump station and 3.5 MGD satellite wastewater treatment facility on the east side of the City will be completed by 2024. The treatment facility will be constructed on a 4.5-acre City-owned parcel and will provide liquids stream treatment only. Solids from the Eastside Satellite Treatment Facility will be pumped downstream of the new diversion pump station for treatment at the existing WWTP. The estimated cost of the new wastewater diversion pump station, influent force main, waste solids return pipeline, effluent force main and the Eastside Satellite Treatment Facility is $25.20 Million.

11.2.4.4 New Sandy River Outfall

Permitting, design and construction of a new Sandy River outfall from the Eastside Satellite Treatment Facility will be completed by 2024. The outfall will be constructed on property owned by the City with Sandy River frontage. A preliminary plan and profile of the Sandy River crossing are shown in **Figure 11-4**. The estimated cost of the new Sandy River Outfall is $12.80 Million.

11.2.4.5 Effluent Pump Station to Iseli Storage Ponds

The existing pump station to the Iseli Storage facility requires improvement to accommodate peak summer flow rates in excess of the diversion capacity of the Satellite Treatment Facility. These peak flows are controlled by storm events in May and October and are estimated at approximately 5.5 mgd. The improvement costs are limited to pump replacement, electrical, and mechanical upgrades. The existing wet well is assumed to be adequate for the increased capacity and backup power is assumed to be available at the WWTP. The existing 14-inch force main may not require improvement, however at 5.5 MGD, velocities are in excess of 8 feet per second with TDH exceeding 195 feet. Design considerations for the pump station should balance the following:

1. Reduction of pump station peak design flow by increasing the diversion and Satellite Treatment capacity at the Sandy Trunk

2. Pump selection and TDH vs upsizing of the force main

3. Pressure transient mitigation for normal operation and emergency power outage

The estimate cost of upgrades to the Existing WWTP effluent pump station upgrades is $1.40 Million.

11.2.4.6 Phase 1 Wastewater System Capital Improvements Program

Table 11-4 summarizes the recommended Phase 1 wastewater system capital improvements program costs for collection system rehabilitation and capacity upgrades, Existing WWTP O&M Upgrades, Stage 1 construction of the Eastside Satellite Treatment Facility and the new Sandy River outfall.

Table 11-4
Phase 1 Wastewater System CIP Summary

Phase 1 Sandy Wastewater CIP	Cost[1]
Collection System Capacity Upgrades	$ 3.50 M
Collection System RDII Reduction Program	$ 8.68 M
Existing WWTP O&M Upgrades	$ 2.50 M
Stage 1 Eastside Satellite Treatment Facility	$ 19.20 M
Diversion Pump Station	$ 7.20 M

Phase 1 Sandy Wastewater CIP	Cost[1]
Force Main to Sandy River Outfall	$ 1.00 M
New Sandy River Outfall	$ 12.80 M
Iseli Nursery Effluent Pump Station Upgrades	$ 1.40 M
Total Phase 1 CIP	**$ 56.28 M**

Notes:

1 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

11.2.5 Phase 2 Wastewater System Upgrades – 2025 through 2032

The second phase of the City's wastewater system upgrades involves ongoing collection system rehabilitation to stay in front of deterioration associated with the City's aging collection system, capacity upgrades at several pump stations and expansion of the existing WWTP to provide improved treatment and expansion of the solids stream for handling the existing WWTP and waste solids from the Eastside Satellite Treatment Facility.

Timing of Phase 2 upgrades will be highly dependent on the success of the RDII reduction program as well as anticipated growth. It is anticipated the timing of various Phase 2 upgrades will be evaluated in a subsequent planning study or Wastewater System Facilities Plan Update prior to implementation.

11.2.5.1 Collection System Capacity Upgrades

For the second phase of collection system capacity upgrade improvements, one pump station and one gravity pipe will need to be upgraded as discussed below:

4. Dubarko Road near Sandy Heights Gravity Pipe Upsizing – Capacity constraints in 2220 LF of gravity main are the cause of extensive surface flooding predicted during 2040 flows and RDII reduction. New pipes are recommended at 18-inch diameter.

5. Meinig Pump Station – Peak flow exceeds total pump station capacity during the 2040 design storm. Improvements include additional pumping capacity and mechanical and electrical upgrades. During the initial evaluation of this pump station, the force main serving this pump station was assumed to have a 4-inch diameter. Given the diameter was later confirmed at 6 inches, the adjusted pump station capacity analysis indicates that this pump station can be upgraded in Phase 2. However, rehabilitation of the wet well is still needed in Phase 1.

The costs for recommended Phase 2 gravity pipe and pump station improvements are as shown in **Table 11-5** and **Table 11-6**, respectively.

Table 11-5
Recommended Collection System Gravity Improvements

Project Group	Length (LF)	New Diameter (inches)	Estimated Cost[1]
Sandy Heights – Dubarko Road	2,220	18	$ 0.9 M
Total – Phase 2			**$0.9 M**

Notes:

1 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

Table 11-6
Phase 2 Recommended Pump Station Capacity Upgrades

Pump Station	Improvement	Estimated Cost[1]
Meinig Avenue	Additional pumping capacity, mechanical and electrical upgrades	$0.7 M
Total – Phase 2		**$0.7 M**

Notes:

1 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

11.2.5.2 Ongoing Collection System Rehabilitation Program

An ongoing collection system Repair and Replacement Program is recommended. While details of the program should be developed based on the results of the initial collection system rehabilitation program, an ongoing annual budget of approximately $200,000 per year is recommended for continuing repair and replacement efforts to minimize degradation of the system. This is for a continual inspection, monitoring, cleaning, and repairs of the collection system.

11.2.5.3 Existing WWTP Upgrades

As system base flows increase, the capacity of the existing WWTP aeration basins will be exceeded along with the solids capacity of the existing secondary process and Class B lime stabilization system. Therefore, upgrades will be completed at the existing WWTP to add primary clarification and convert to anaerobic digestion with solids dewatering and drying. The estimated cost for the Phase 2 Existing WWTP upgrades is $ 19.8 Million and is summarized in **Table 11-7**.

Table 11-7
Phase 2 Existing WWTP Upgrades Cost Summary

Phase 2 Existing WWT CIP	Cost[1]
Headworks Upgrade	$ 2.28 M
Primary Clarifiers	$ 4.15 M
Anaerobic Digester	$ 5.15 M
Dewatering Upgrades	$ 7.10 M
Dryer	$ 1.12 M
Total Phase 2 CIP	**$ 19.80 M**

Notes:
1 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

11.2.5.4 Phase 2 Wastewater System Capital Improvements Program

Table 11-8 summarizes recommended Phase 2 wastewater system capital improvements for collection system capacity and rehabilitation, and existing WWTP upgrades.

Table 11-8
Phase 2 Wastewater System CIP Summary

Phase 2 Wastewater CIP Summary	Cost[1]
Collection System Capacity Upgrades	$ 1.60 M
Collection System Repair and Replacement Program	$ 1.60 M
Existing WWTP Primary Treatment and Solids Stream Upgrades	$ 19.80 M
Total Phase 2 CIP	**$ 23.00 M**

Notes:
1 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

11.2.6 Phase 3 Wastewater System Upgrades – 2033 through 2040

The third phase of the City's wastewater system upgrades involves ongoing collection system rehabilitation to stay in front of deterioration of the City's aging collection system, collection system capacity upgrades and expansion of the Eastside Satellite Treatment Facility to 7.0 MGD to provide a total wastewater treatment capacity of 14.0 MGD.

Timing of Phase 3 upgrades will be highly dependent on the success of the RDII reduction program as well as anticipated growth. It is anticipated the timing of various Phase 3 upgrades will be evaluated in a subsequent planning study or Wastewater System Facilities Plan Update prior to implementation.

11.2.6.1 Collection System Capacity Upgrades

For the third phase of collection system capacity upgrade improvements, one pump station and three gravity pipe improvement will need to be upgraded as discussed below:

6. The Snowberry Pump Station Improvement – Peak flow at pump station exceeds total pump station capacity during 2040 condition design storm. Improvements include additional pumping capacity as flows increase over time with pipe degradation and new development.

7. Dubarko Road at Tupper Rd Gravity Main Improvement – Capacity constraints in 1130 LF of gravity main are the cause of surface flooding predicted with 2040 flows and recommended RDII reduction. New pipes would primarily be 10-inch diameter with 100 LF needing to be 18-inches.

8. Sandy Bluff Gravity Main Improvement – Capacity constraints in 790 LF of gravity main are the cause of surface flooding predicted with 2040 flows with recommended RDII reduction. New pipes would be 15-inch diameter.

The costs for the Phase 3 recommend pump station upgrades and force main upgrades are as show in **Table 11-9** and **Table 11-10**, respectively.

Table 11-9
Phase 3 Recommended Pump Station Improvements

Pump Station	Improvement	Estimated Cost[1]
Phase 3		
Snowberry	Additional pumping capacity	$ 0.10 M
Total – Phase 3		**$ 0.10 M**

Notes:

1 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

Table 11-10
Phase 3 Recommended Gravity Pipe Improvements

Project Group	Length (LF)	New Diameter (inches)	Estimated Cost[1]
Phase 3			
Dubarko Rd at Tupper Rd	1130	10	$ 0.50 M
Sandy Bluff Gravity Main	790	15	$ 0.30 M
Total – Phase 3	**1920**		**$ 0.80 M**

Notes:

1 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

11.2.6.2 Ongoing Collection System Rehabilitation Program

An ongoing collection system Repair and Replacement Program is recommended. While details of the program should be developed based on the results of the initial collection system rehabilitation program, an ongoing annual budget of approximately $200,000 per year is recommended for continuing repair and replacement efforts to minimize degradation of the system. This is for a continual inspection, monitoring, cleaning, and repairs of the collection system.

11.2.6.3 Existing WWTP Upgrades

While no additional capacity expansions of the City's existing WWTP are anticipated in Phase 3, the replacement of the existing UV disinfection system is recommended to switch to a more energy efficient unit.

11.2.6.4 Stage 2 Eastside Satellite Treatment Facility

To support growth, the expansion of the Eastside Satellite Treatment Facility from 3.5 MGD to 7.0 MGD peak flow to provide adequate capacity for the 2040 design peak flow of 14.0 MGD. The estimated cost of the Eastside Satellite Treatment Facility Expansion is estimated to be $3.5 Million.

11.2.6.5 Phase 3 Wastewater Capital Improvements Program

Table 11-11 summarizes the City's proposed Phase 3 wastewater system upgrades.

Table 11-11
Phase 3 Wastewater System CIP Summary

Phase 3 Wastewater CIP	Cost[1]
Collection System Capacity Upgrades	$ 0.90 M
Collection System Repair and Replacement Program	$ 1.60 M
Existing WWTP Upgrades	$ 1.40 M
Stage 2 Eastside Satellite Treatment Facility Upgrades	$ 2.10 M
Total Phase 3 CIP	**$ 6.00 M**

Notes:
1 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

11.3 Future Anticipated Wastewater System Upgrades – beyond 2040

Beyond the 2040 planning horizon, additional wastewater system upgrades and investments will be needed to continue addressing collection system deterioration and provide for anticipated community growth. A key element of the Beyond 2040 upgrades is the construction of a new effluent pump station at the existing WWTP and force main to the Sandy River outfall. Annual O&M requirements for the existing WWTP and Eastside Satellite Treatment Facility will also be needed.

11.3.1 Ongoing Collection System Rehabilitation Program

An ongoing collection system rehabilitation program is recommended beyond the 20-year planning horizon. The details of the program should be re-assessed periodically based on the monitoring and effectiveness of previous program phases. A larger scale system rehabilitation similar to the scale performed in Phase 1 may be required based on ongoing aging and degradation of the collection system. Costs for the additional rehabilitation program are assumed to occur beyond the 2040 timeframe.

11.3.2 Existing WWTP Effluent Pump Station and Force Main connection to the Sandy River Outfall

In addition to liquids stream capacity upgrades for the Existing WWTP, the City should plan for ultimately pumping treated effluent to the Sandy River outfall to assure discharge capacity in the dry weather "shoulder" months of May and October when discharge to Tickle Creek is not allowed. A routing study should be completed soon to determine the preferred force main alignment and allow the City to being installation of segments as "opportunity projects" arise associated with City street improvements or development projects.

11.3.3 Industrial Pretreatment Recommendation

Based on the data provided and discussed in this WSFP, connection of future significant industrial users (SIUs) should be evaluated on a case by case basis. At the present time, the existing WWTP does not have the treatment capacity to accept high strength waste streams from SIUs without pretreatment. It is recommended the City evaluate acceptance of higher strength industrial waste stream and the implementation of an industrial pretreatment program following completion of Phase 1 of construction of the recommended collection system and WWTP upgrades.

11.4 Wastewater System 20-year CIP

The recommended 20-year Capital Improvements Program is summarized in **Table 11-12** below showing investments in collection system capacity expansions, collection system rehabilitation, existing WWTP, the Stage 1 and 2 Eastside Satellite Treatment Facility construction and new Sandy River outfall.

Table 11-12
CIP and Condition Assessment Upgrade Costs

Wastewater CIP [4]	Phase 1 (2018-2025)	Phase 2 (2025-2032)	Phase 3 (2033-2040)	Beyond 2040
Collection System Capacity Upgrades	$ 3.50 M	$ 1.60 M	$ 0.9 M	$ -
Collection System RDII Reduction Program	$ 8.68 M	$ 1.60 M	$ 1.60 M	$ 12.00 M[2]
Existing WWTP Improvements	$ 2.50 M[1]	$19.80 M	$ 1.40 M	$ -
Eastside Satellite Treatment Facility	$19.20M	$ -	$ 2.10 M	$ -
Diversion Pump Station	$ 7.20 M	$ -	$ -	$ -
Force main to Sandy Outfall	$ 1.00 M	$ -	$ -	$ -
Sandy River Outfall	$ 12.8 M	$ -	$ -	$ -
Iseli Pump Station Upgrades	$ 1.40 M	$ -	$ -	$ -
Effluent Pump Station-Force Main to Sandy River	$ -	$ -	$ -	$ 25.30 M[3]
Totals	**$ 56.28 M**	**$ 23.00 M**	**$ 6.00 M**	**$ 37.30 M**

Notes:

1 Existing WWTP O&M Upgrades

2 RDII Reduction in 4 basins (5, 6, 7, 10); Reduction may delay requirements for Effluent Pump Station to Sandy River

3 Sandy River Effluent Pump Station from existing WWTP

4 Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -50 percent on the low end, and +50 to +100 percent on the high end, meaning the actual cost should fall in the range of 50 percent below the estimate to 100 percent above the estimate. $M = millions of dollars.

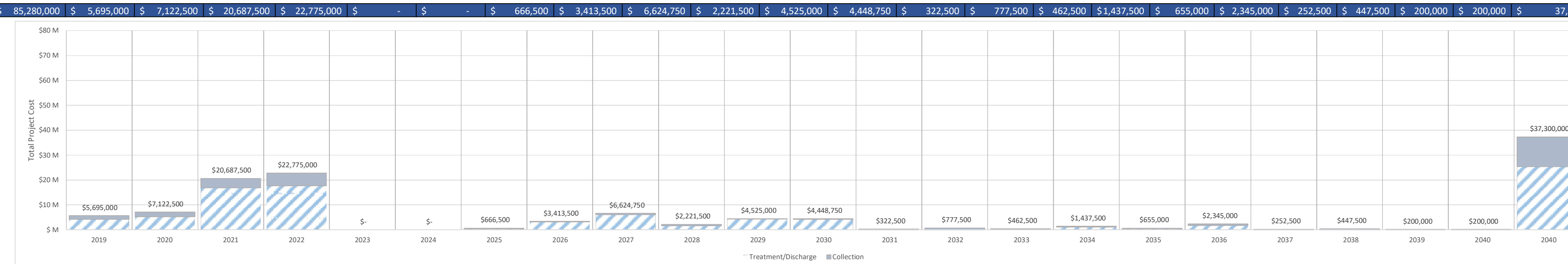
City of Sandy
Wastewater System Facility Plan

murraysmith

Capitol Improvement Progam Summary - Alternative D

		Project Type	Phase I Subtotal (present value dollars)	Phase II Subtotal (present value dollars)	Phase III Subtotal (present value dollars)	Total CIP Cost Estimate (present value dollars)	Phase I						Phase II								Phase III								Beyond
							2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2040
		Collection	$ 12,180,000	$ 3,200,000	$ 2,500,000	$ 17,880,000	$ 1,430,000	$ 1,852,500	$ 3,860,000	$ 5,037,500	$ -	$ -	$ 267,500	$ 290,000	$ 571,250	$ 571,250	$ 200,000	$ 200,000	$ 322,500	$ 777,500	$ 217,500	$ 282,500	$ 287,500	$ 612,500	$ 252,500	$ 447,500	$ 200,000	$ 200,000	$ 12,000,000
Capacity	*Sandy Bluff*	Additional pumping capacity, mechanical and electrical upgrades	$ 2,600,000	$ -	$ -	$ 2,600,000			$ 455,000	$ 2,145,000																			
Capacity	*Jacoby/Timberline Trails*	Additional pumping capacity	$ 100,000	$ -	$ -	$ 100,000		$ 17,500	$ 82,500																				
Capacity	*Marcy Street*	Additional pumping capacity, mechanical and electrical upgrades	$ 400,000	$ -	$ -	$ 400,000		$ 70,000	$ 330,000																				
Capacity	*Meinig Avenue*	Additional pumping capacity, mechanical and electrical upgrades	$ -	$ 700,000	$ -	$ 700,000													$ 122,500	$ 577,500									
Capacity	*Snowberry Pump Station*	Additional pumping capacity	$ -	$ -	$ 100,000	$ 100,000															$ 17,500	$ 82,500							
Capacity	*Sandy Bluff*	FM upgrades	$ 200,000	$ -	$ -	$ 200,000	$ 15,000	$ 20,000	$ 82,500	$ 82,500																			
Capacity	*Jacoby/Timberline Trails*	FM upgrades	$ 200,000	$ -	$ -	$ 200,000	$ 15,000	$ 20,000	$ 82,500	$ 82,500																			
Capacity	*Sandy Heights - Dubarko Road*	Gravity upgrade	$ -	$ 900,000	$ -	$ 900,000							$ 67,500	$ 90,000	$ 371,250	$ 371,250													
Capacity	*Dubarko Road at Tupper Rd*	Gravity upgrade	$ -	$ -	$ 500,000	$ 500,000																	$ 87,500	$ 412,500					
Capacity	*Sandy Bluff*	Gravity upgrade	$ -	$ -	$ 300,000	$ 300,000																			$ 52,500	$ 247,500			
RDII	*Site-specific*	Flow Monitoring (minimum 5 locations, permanent and temporary)	$ 300,000	$ -	$ -	$ 300,000	$ 100,000	$ 100,000	$ 100,000																				
RDII	*33% of System*	Condition Inspection (CCTV)	$ 510,000	$ -	$ -	$ 510,000		$ 170,000	$ 170,000	$ 170,000																			
RDII	*System-wide*	Smoke Testing	$ 170,000	$ -	$ -	$ 170,000	$ 85,000	$ 85,000																					
RDII	*Basin 2*	Rehabilitation (piping and laterals)	$ 3,400,000	$ -	$ -	$ 3,400,000	$ 255,000	$ 340,000	$ 1,402,500	$ 1,402,500																			
RDII	*Basin 8*	Rehabilitation (piping and laterals)	$ 2,800,000	$ -	$ -	$ 2,800,000	$ 210,000	$ 280,000	$ 1,155,000	$ 1,155,000																			
RDII	*Basins 5, 6, 7, 10*	Rehabilitation (piping and laterals)	$ -	$ -	$ -	$ -																							
RDII	*System-wide*	Stormwater Disconnects	$ 1,500,000	$ -	$ -	$ 1,500,000	$ 750,000	$ 750,000																					
RDII	*System-wide*	$200k/yr ongoing RDII	$ -	$ 1,600,000	$ -	$ 1,600,000							$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000									$ 12,000,000
RDII	*System-wide*	Collection system repair and replacement program	$ -	$ -	$ 1,600,000	$ 1,600,000															$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	
		Treatment/Discharge	$ 44,100,000	$ 19,800,000	$ 3,500,000	$ 67,400,000	$ 4,265,000	$ 5,270,000	$ 16,827,500	$ 17,737,500	$ -	$ -	$ 399,000	$ 3,123,500	$ 6,053,500	$ 1,650,250	$ 4,325,000	$ 4,248,750	$ -	$ -	$ 245,000	$ 1,155,000	$ 367,500	$ 1,732,500	$ -	$ -	$ -	$ -	$ 25,300,000
CIP	*Existing WWTP*	Headworks Upgrade	$ -	$ 2,280,000	$ -	$ 2,280,000							$ 399,000	$ 1,881,000															
CIP	*Exising WWTP*	Primary Clarifiers	$ -	$ 4,150,000	$ -	$ 4,150,000										$ 726,250	$ 3,423,750												
CIP	*Exising WWTP*	Anaerobic Digester	$ -	$ 5,150,000	$ -	$ 5,150,000											$ 901,250	$ 4,248,750											
CIP	*Exising WWTP*	Dewatering Upgrades	$ -	$ 7,100,000	$ -	$ 7,100,000								$ 1,242,500	$ 5,857,500														
CIP	*Exising WWTP*	Dryer	$ -	$ 1,120,000	$ -	$ 1,120,000									$ 196,000	$ 924,000													
CIP	*Exising WWTP*	Filter/UV	$ -	$ -	$ 1,400,000	$ 1,400,000															$ 245,000	$ 1,155,000							
CIP	*Existing WWTP*	Condition Assessment Improvements	$ 2,500,000	$ -	$ -	$ 2,500,000	$ 1,250,000	$ 1,250,000																					
CIP	*Existing WWTP*	Iseli Pump Station Upgrades	$ 1,400,000	$ -	$ -	$ 1,400,000			$ 245,000	$ 1,155,000																			
CIP	*Existing WWTP*	Effluent Pump Station and Force main to Sandy Outfall (Beyond 2040)	$ -	$ -	$ -	$ -																							$ 25,300,000
CIP	*Eastside Treatment Facility*	Diversion Pump Station	$ 7,200,000	$ -	$ -	$ 7,200,000	$ 540,000	$ 720,000	$ 2,970,000	$ 2,970,000																			
CIP	*Eastside Treatment Facility*	Force main to Sandy Outfall	$ 1,000,000	$ -	$ -	$ 1,000,000	$ 75,000	$ 100,000	$ 412,500	$ 412,500																			
CIP	*Eastside Treatment Facility*	Sandy River Outfall	$ 12,800,000	$ -	$ -	$ 12,800,000	$ 960,000	$ 1,280,000	$ 5,280,000	$ 5,280,000																			
CIP	*Eastside Treatment Facility*	Headworks	$ 4,510,000	$ -	$ -	$ 4,510,000	$ 338,250	$ 451,000	$ 1,860,375	$ 1,860,375																			
CIP	*Eastside Treatment Facility*	Membrane Bioreactor	$ 13,260,000	$ -	$ 2,100,000	$ 15,360,000	$ 994,500	$ 1,326,000	$ 5,469,750	$ 5,469,750													$ 367,500	$ 1,732,500					
CIP	*Eastside Treatment Facility*	Disinfection	$ 1,080,000	$ -	$ -	$ 1,080,000	$ 81,000	$ 108,000	$ 445,500	$ 445,500																			
CIP	*Eastside Treatment Facility*	Satellite Solids Return	$ 350,000	$ -	$ -	$ 350,000	$ 26,250	$ 35,000	$ 144,375	$ 144,375																			
		Total Project Cost	$ 56,280,000	$ 23,000,000	$ 6,000,000	$ 85,280,000	$ 5,695,000	$ 7,122,500	$ 20,687,500	$ 22,775,000	$ -	$ -	$ 666,500	$ 3,413,500	$ 6,624,750	$ 2,221,500	$ 4,525,000	$ 4,448,750	$ 322,500	$ 777,500	$ 462,500	$1,437,500	$ 655,000	$ 2,345,000	$ 252,500	$ 447,500	$ 200,000	$ 200,000	$ 37,300,000

Notes:
- *All costs in 2018 dollars*
- *For planning purposes, future costs should be increased for cost escalation (inflation) based on Engineering News Record - Construction Cost Index (December 2018 ENR-CCI: 11,186) or other index preferred by the City.*
- *Cost estimates represent a Class 5 budget estimate in 2018 dollars, as established by the American Association of Cost Engineers (AACE), with a level of accuracy range between -30 to +50 percent.*



This page intentionally left blank

11.5 Preliminary Financial Plan

The Preliminary Financial Plan includes the funding requirements for each phase and year for the recommended plan, an overview of the current wastewater utility usage fees/rates, and preliminary funding options. **Table 11-13** details the yearly costs by project and phase. A larger scale version of **Table 11-13** is included in **Appendix L**.

11.5.1 Recommended Plan Funding Requirements

Funding requirements for the Recommended Plan are as follows:

- Phase 1 investments of $56.28 million dollars between 2018 and 2025
- Phase 2 investments of $23.00 million dollars between 2025 and 2332
- Phase 3 investments of $6.00 million dollars between 2033 and 2040

11.5.2 Current WW Rates and System Development Charges

Wastewater usage rates are based on metered wastewater flows from November-May. The average volume during this period is used to determine sewer consumption from May-November. A typical bill for indoor usage of a single-family dwelling is $35.02 (roughly 1000 cubic feet per month). New rates were adopted on October 7th in conjunction with the adoption of the Facilities Plan and are shown below:

- Residential base fee: $20.61 per month
  - Usage rate $5.29 per 100 cubic feet of wastewater
- Non-residential base fee: $20.61 per month
  - Usage rate $7.18 per 100 cubic feet of wastewater
- System Development Charges
  - SDC = $4,489 / Equivalent Dwelling Unit

11.5.3 Preliminary Funding Options

Potential funding sources for completing the Recommended Plan may include some combination of the following:

- Local savings from near-term rate increases to help fund future construction
- Increasing SDCs
- Revenue Bonds

- General Obligation Bonds

- State and Federal Programs

  1. Clean Water State Revolving Fund
  2. Water Infrastructure Finance and Innovation Act (WIFIA)
  3. Business Oregon – Infrastructure Finance, Water Wastewater Fund

- Energy Trust of Oregon Rebates and Incentives

The City is required to repay loans by collecting revenues from system development charges (SDCs), increased usage rates, property taxes, or a combination of these funding options determined by the City. The City is required to comply with the terms and conditions of Grants in order to be eligible for Grant funding, however, the money provided by the Grants does not need to be repaid.

11.5.3.1 Local Savings from Near-Term Rate Increases

By increasing WW rates in the near-term, a significant amount of revenue can be saved to help fund future construction. These immediate changes are helpful for the City to generate funds without interest rates or to pay off previously acquired loans. In order raise enough funds for the recommended plan while also minimizing the economic burden on the community, a formal Rate Study should be conducted to determine the appropriate WW rate increases.

11.5.3.2 System Development Charges (SDCs)

SDCs are a one-time fee paid by new users of a Wastewater System at the time of connection. These fees offset the cost of expanding infrastructure to meet the demands of new development. SDCs in Oregon range from no charge to as high as $12,000 per residential connection. The median Wastewater SDC in Oregon is approximately double the City's current SDC charge.

A single residential connection with a standard ¾-inch water meter is the standing definition of an Equivalent Dwelling Unit (EDU) and used to define residential, commercial, and industrial connections. Based on statistics from 2013 to 2017, the City of Sandy has 2.7 persons per household (U.S. Census Bureau, 2019). Based on the 2016 population of the City of Sandy (11,005) there are approximately 4,076 EDUs, not including commercial and industrial connections. Population projections, discussed in Section 6, project a 2040 population of 22,400 or approximately 4,220 additional EDUs assuming the same average persons per household.

Based on the assumptions described above, the potential revenue from SDCs associated with the expected population growth after twenty years for the City of Sandy is described below in present value dollars:

- Potential Revenue for additional 4,220 EDUs at current rate: $7.74 million dollars
- Potential Revenue for additional 4,220 EDUs at doubled rates: $15.47 million dollars

11.5.3.3 Revenue Bonds

Revenue Bonds are supported by revenue specifically generated from Wastewater System usage. The implementation of a System Development charge or general increase of user rates is the mechanism relied upon to establish the credit of the issuing municipality. Since revenue bonds are dependent upon the income of the specific project, it is a higher risk than General Obligation bonds and therefore typically a higher rate of interest.

11.5.3.4 General Obligation Bonds

General obligation bonds are loans repaid through a variety of tax sources. Property taxes are a common form of credit for this type of bond.

11.5.3.5 State and Federal Grant/Loan Programs

Several State and Federal Grant and Loan programs exist to assist communities with infrastructure improvement projects. These include:

- Business Oregon – Infrastructure Finance: Water Wastewater Fund
- Water Infrastructure Finance Innovation Act
- Clean Water State Revolving Fund

11.5.3.5.1 Clean Water State Revolving Fund

Established in 1987, the CWSRF is a financial assistance program that uses federal and state funds to provide low-interest loans for planning, design, and construction of municipal wastewater facilities that have NPDES Permits for surface water discharges to Waters of the United States. Loans from the Clean Water State Revolving fund have repayment periods of up to 30 years. States may even provide up to a fixed percentage of funds as grants, principal forgiveness, or negative interest rate loans. Loans include an annual fee of 0.5 percent of the outstanding balance.

The CWSRF also has specific amount of program funds for financing green infrastructure, water efficiency improvements, energy efficiency improvements, or environmentally innovative activities.

More information on the DEQ CWSRF loan program is available at:

Oregon Department of Environmental Quality
700 NE Multnomah, Suite 600
Portland, OR 97232-4100

Primary Contact: Tiffany Yelton Bram
Phone: 503-229-5219
Website:
https://www.oregon.gov/deq/wq/cwsrf/Pages/ApplicationAssistance.aspx

11.5.3.5.2 Business Oregon – Infrastructure Finance, Water Wastewater Fund, Special Public Works Fund

Business Oregon provides financing opportunities for the design and construction of public infrastructure needed to comply with the Clean Water Act. The Fund is primarily a loan program, but some grant opportunities are available for specific financing needs. The maximum loan amount is $10.0 million dollars per project with terms up to 25 years. The maximum grant is up to $20,000 per project for municipalities with populations of less than 15,000 people for the purpose of planning, engineering, and economic investigations related to an eligible construction project.

11.5.3.5.3 Water Infrastructure Finance and Innovation Act (WIFIA)

The WIFIA program is a pool of financing set up through the EPA to provides loans for water, wastewater and general infrastructure project. For local government entities of communities with less than 25,000 people the project costs must exceed $5 million dollars. It is important to apply before June 1st to ensure the best chance for funding. WIFIA loans may have a length of up to 35 years. WIFIA loans can fund a maximum of 49% of the eligible project costs.

The Water Infrastructure Finance and Innovation Act (WIFIA) is a pool of financing set up through the EPA, which covers a range of water, wastewater, and general infrastructure projects. In 2018, the program set aside $5.5 Bn in credit assistance for water and wastewater infrastructure investment. 15% of the funds are set aside for municipalities smaller than 25,000 people; however, if these funds are not allocated by June 1, they will be used for other applicable projects. In 2018 small projects accounted for less than 1% of the awarded funds. Because smaller projects are underrepresented out of total applications, it is likely they will be more favorable. It is important to apply before June 1st to ensure the best chance for funding.

The borrower must have a form a dedicated source of revenue to repay the loan. This credit can be in the form of Revenue, General Obligation Bonds, or approved funding mechanism. **Appendix M** has more detailed information and an example application for a WIFIA loan. Since Sandy is an underrepresented applicant, the application process will have favorable award probabilities.

11.5.3.6 Energy Trust of Oregon (ETO)

The Energy Trust of Oregon provides incentive dollars or rebates for more energy efficient equipment installations. The capitol cost difference between the energy efficient case and the base case are considered eligible for the rebate if the associated energy savings have a payoff period of less than 15 years. Up to 50% of the cost difference between the base case and the energy efficient case is eligible for rebate up to $500,000 dollars per project with a limit of $1,000,000 annually per site.

11.5.3.7 Summary of Loan and Grant Programs

Table 11-14 contains a summary of the City's eligibility for loan and grant programs based on the above listed funding programs.

Table 11-14
Funding Eligibility Overview

<table>
<tr><th>Program</th><th>Eligibility</th></tr>
<tr><td>Oregon Department of Environmental Quality
Clean Water State Revolving Fund (CWSRF)

The City of Sandy is designated as a small community with a median household income greater than the state average.</td><td>

Loan Type	*Interest Rates* (Jan 1 – March 31, 2019)	*Repayment Period*
Planning:	*1.06 %*	*5-years*
Design/Construction:	*1.06% to 2.84%*	*5-years to 30-years*

Fees: 0.5% of the unpaid balance annually</td></tr>
<tr><td>Business Oregon
Infrastructure Finance:
Water Wastewater Fund</td><td><u>Maximum Loan Amount:</u> $60,000 (technical assistance financing)
<u>Maximum Loan Amount</u>: $10,000,000 (combination of direct and/or bond funded loans</td></tr>
<tr><td>Special Public Works Fund (SPWF)</td><td><u>Maximum Loan Amount:</u> $10,000,000
<u>Maximum Loan Term</u>: 25-years
<u>Allowable Project Costs:</u>
Project management expenses, engineering design, architectural work, surveying, and construction inspections, public facilities that are essential to support continuing and expanded economic development activity.
<u>Interest Rate:</u> set by Business Oregon based on market conditions for bonds with similar terms and credit characteristics.</td></tr>
<tr><td>Environmental Protection Agency
Water Infrastructure Finance Innovation Act (WIFIA)</td><td><u>Maximum final maturity date from substantial completion:</u> 35 years
<u>Maximum time that repayment may be deferred after substantial completion of the project:</u> 5 years
<u>Allowable Project Costs:</u> Planning, engineering, and economic investigations related to an eligible construction project
<u>Percentage of Total Project Costs:</u>
WIFIA may finance up to 49% of the total project costs.
WIFIA and CWSRF combined may finance up to 80% of total project costs.
*NEPA, Davis-Bacon, American Iron and Steel, and all other federal cross-cutter provisions apply.</td></tr>
<tr><td>Energy Trust of Oregon
Wastewater Incentives</td><td>Energy Trust will pay up to $0.32/annual kWh saved or 50% of eligible project costs, whichever is less.
<u>Maximum Rebate:</u> $500,000 dollars per project with a limit of $1,000,000 annually per site.</td></tr>
</table>

11.5.4 Next Steps

The City will need to pursue adoption of the completed facility plan and associated rate increases. The adoption process and funding next steps are detailed below.

11.5.4.1 City WSFP Recommended Plan Adoption

Following the completion of the WSFP, the City conducted public outreach to the community and local watershed councils to communicate the recommended plan and request public comment. A mailer was sent out with the utility bill in August 2019 to inform the community about the recommended plan and proposed rate increases. Two City Council meetings were held, one in September and the other in October of 2019. The City held meetings with the Clackamas River Basin Council and the Sandy River Watershed Council and incorporated comments from public stakeholders into the final WSFP; A copy of all public comments received is included in **Appendix N**. The Plan and the recommended alternative was adopted by the City Council during a public meeting on October 7, 2019.

The adoption process included both significant increases in the sewer utility rates. System SDCs and adoption of the WSFP. The ratemaking process included a rate study, public notice period, a City Council work session and extensive public outreach to ratepayers. Public hearings on the proposed rate structure were held on September 16th and October 7th.

Notice of a hearing on the proposed SDC methodology and the availability of the methodology and proposed SDCs was provided per the requirements in ORS 223.304. The new wastewater SDCs were adopted on October 21st.

The adoption process also included a recommendation from the Sandy River Watershed Council to conduct a detailed evaluation of discharge alternatives. The decision to eliminate discharge from the Clackamas River Basin and to pursue a new discharge permit in the Sandy River Basin spurred the detailed evaluation. The Sandy WSFP Detailed Discharge Alternatives Evaluation includes the following major elements:

- Sandy River water quality testing and antidegradation evaluation for direct discharge
- River Outfall Siting Study
- Water recycling market assessment and stakeholder outreach
- Indirect discharge and Roslyn Lake alternatives evaluation
- Evaluation of connecting to the Clackamas County Water Environment Services or the City of Gresham systems for wastewater treatment and discharge

The WSFP Detailed Discharge Alternatives Evaluation is anticipated to be completed by the end of 2020 and will be incorporated into this Plan as an amendment when finalized.

A copy of a mailer sent out to all current sewer utility customers August 2019 is included in **Appendix O**. A copy of meeting minutes and presentation for the City Council held in 2019 on September 16th is included in **Appendix P**. A copy of meeting minutes and presentation for the City Council held in 2019 on October 7th is included in **Appendix Q**. DEQ comments are included in **Appendix R**.

11.5.4.2 Funding Next Steps

The impact of the Recommended Plan on wastewater rates will depend on a combination of State and Federal loan funding and SDC revenue. It is anticipated the project will be funded with loans. The CWSRF loan program has low interest rates and favorable terms and conditions. The City applied for financing from the Water Infrastructure and Finance Act program (WIFIA) in July, 2019 but was unsuccessful.

The following next steps are recommended to finalize the financial plan for the Wastewater System Facilities Plan Recommended Upgrades:

1. Request a "One-Stop" Financing Roundtable from the Business Oregon, Regional Development Officer for Clackamas County, Bryan Guiney at (503) 307-3662

2. Submit a revised application for WIFIA financing.

3. Submit an application for DEQ CWSRF loan funding.

4. Submit an application for USDA Rural Development financing.

5. Pursue potential grants with the above stated funding agencies

11.6 References

U.S. Census Bureau QuickFacts: Sandy city, Oregon. 2019.
https://www.census.gov/quickfacts/fact/table/sandycityoregon/HSD310217#HSD310217

murraysmith

888 SW 5TH AVENUE, SUITE #1170

PORTLAND, OR 97204

www.murraysmith.us