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2nd DRAFT
City of Sandy
Facility Plan Amendment
(2024 Plan Amendment)

12 November 2024

Prepared for

City of Sandy
39250 Pioneer Blvd
Sandy, OR 97055

KJ Project No. 2276020.00

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List of Acronyms and Abbreviations

AAF	Average Annual Flow
ADA	American Disability Act
ADWF	Average Dry Weather Flow
ASCE	American Society of Civil Engineers
ASSB	Aerated Sludge Storage Basin
AWWF	Average Wet Weather Flow
BOD	Biochemical Oxygen Demand
CAS	Conventional Activated Sludge
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
City	City of Sandy
CMOM	Capacity, Management, Operation and Maintenance
CWSRF	Clean Water State Revolving Fund
DDAE	Detailed Discharge Alternatives Evaluation Report
DEQ	Department of Environmental Quality
DMR	Discharge Monitoring Report
EDUs	number of new connections
EPA	US Environmental Protection Agency
gpd/sf	gallons per day per square foot
I&I	Inflow & Infiltration
IBC	International Building Code
IFC	International Fire Code
Leeway	Leeway Engineering Solutions
MBR	Membrane Bioreactor
MCLs	Maximum Contaminant Levels
MG	million gallons
mg/L	milligrams per liter
MGD	million gallons per day
MMDWF	Maximum Month Dry Weather Flow
MMWWF	Maximum Month Wet Weather Flow
NEC	National Electrical Code
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
Nursery	Iseli Nursery
O&M	Operation & Maintenance

OEESC	Oregon Energy Efficiency Specialty Code
OESC	Oregon Electrical Specialty Code
OFC	Oregon Fire Code
OPCC	Opinion of Construction Cost
OPSC	Oregon Plumbing Specialty Code
OSSC	Oregon Structural Specialty Code
OSU	Oregon State University
PDAF5	Peak Daily Average Flow: 5-year return period
PDR	Preliminary Design Report
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid (PFOA)
PFOS	Perfluorooctane Sulfonate
PGE	Portland General Electric
PHF	Peak Hour Flowrate
PIF	Peak Instantaneous Flowrate
ppcpd	pound per capita per day
ppd	pounds per day
PWF	Peak Week Flow
R&R	Rehabilitation and Replacement
RAS	Return Activated Sludge
scfm	Standard Cubic Feet Per Minute
SDC	System Development Charge
SDCs	System Development Charges
SRT	Solids Retention Times
TM	Technical Memorandum
TSS	Total Suspended Solids
UGB	Urban Growth Boundary
UPC	Uniform Plumbing Code
UV	Ultraviolet
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WES	Water Environment Services
WIFIA	Water Infrastructure Finance Innovation Act
WWF	Wet Weather Flow
WWTP	Wastewater Treatment Plant

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Reports:

2019 Plan	2019 City of Sandy Wastewater Systems Facility Plan
2020 PDR	2020 Preliminary Design Report
2024 Plan Amendment	2024 City of Sandy Wastewater Systems Facility Plan Amendment (This Report)
Recommended Plan	Recommended Plan within the 2019 Plan
2019 Condition Assessment	Sandy WWTP Condition Assessment Improvements Project

Executive Summary

ES.1 Introduction

The City of Sandy (City) currently discharges wastewater effluent from its wastewater treatment plant (WWTP) to Tickle Creek in the winter (wet weather). and provides filtered water to a local nursery for beneficial reuse in the summer (dry weather). These means of effluent discharge and reuse are constrained by the Three Basin Rule, which prohibits increases in mass load discharge to Tickle Creek, as well as limited demand for effluent during the spring and fall shoulder seasons.

To address these challenges, the recommended approach in the 2019 Plan was for the City to construct a satellite WWTP and convey treated effluent from this WWTP to the new Sandy River outfall. This recommendation was deemed unaffordable, and the City has elected to maintain treatment at the existing WWTP.

A subsequent Detailed Discharge Alternatives Evaluation (DDAE) Report evaluated options for locating a new outfall to the Sandy River and determined that the Ten Eyck Road and Revenue Bridge site had the most favorable hydrologic and geomorphologic conditions and limited fisheries impacts compared with other potential sites. Implementation of a discharge relocation solution is anticipated to be completed by 2030, and no later than 2033, requiring a near-term wastewater treatment solution to allow for discharges to Tickle Creek in the interim.

This Facility Plan Amendment (2024 Plan Amendment) has been prepared to evaluate alternatives for providing improvements required to maintain treatment at the existing WWTP and retain the Tickle Creek outfall while the City develops a new discharge option to the Sandy River. In addition, the 2024 Plan Amendment considers collection system storage and regional treatment plant alternatives. This 2024 Plan Amendment documents new flow projections reflecting the reduction in infiltration and inflow (I&I) achieved through recent collection system rehabilitation efforts and evaluates alternatives for providing treatment improvements required to maintain treatment at the existing WWTP. Ongoing activities and recent improvements in the collection system and at the WWTP are documented, treatment alternatives are evaluated, and a proposed Capital Improvement Plan (CIP) is identified to meet both near- and long-term needs.

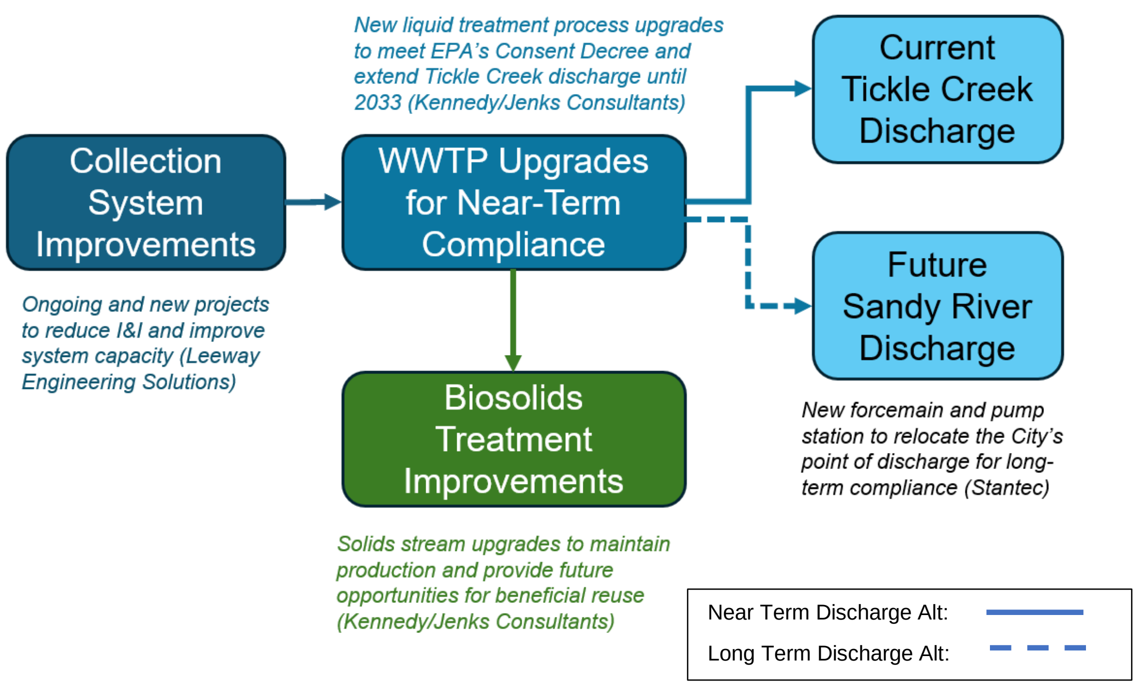
ES.1.1 Purpose

The overarching goal of the 2024 Plan Amendment is to provide the City with an affordable WWTP that meets current and future compliance requirements, updates aging infrastructure, and satisfies the reliability criteria required by the Consent Decree with the US Environmental Protection Agency (EPA). This 2024 Plan Amendment builds on the adopted Recommended Plan contained in the 2019 Plan and presents an evaluation of additional wastewater treatment alternatives to meet the City’s goal of remaining in compliance with the NPDES Permit and water quality rules, and a parallel goal accommodating growth.

Key objectives of this effort are to amend the 2019 Plan, to reflect recent and ongoing updates to the wastewater system, and to propose near- and long-term improvements to accommodate future growth and anticipated regulations. The 2024 Plan Amendment updates influent flowrate projections, reflecting the reduction in I&I achieved through recent collection system rehabilitation efforts, and evaluates alternatives to maintain wastewater facilities at the existing site. Specifically, the 2024 Plan Amendment evaluates five alternatives for liquid process improvements and vets five solid treatment solutions that will replace or expand facilities at the existing treatment plant site, to the southeast or northeast.

Figure ES-1 illustrates the major components of the 2024 Plan Amendment and anticipated improvements needed to meet growth goals and achieve near- and long-term compliance.

Figure ES-1: 2024 Plan Amendment Components



ES.1.2 Organization

The 2024 Plan Amendment is intended to supplement, not reproduce the 2019 Plan document. In doing so, this document mirrors the 2019 Plan outline and planning horizon, focusing on updates to the following sections to reflect new information relevant to the development of alternatives:

- Section 1 – Introduction
- Section 8 – Existing Wastewater Treatment Plant Evaluation
- Section 9 – Initial Wastewater Systems Alternatives Evaluation
- Section 10 – Long Term Wastewater Systems Evaluation
- Section 11 – Recommended Capital Improvement Program

All sections start with a brief summary of 2019 Plan content for that section with new information added, as appropriate, to provide context and memorialize activities over the last five years.

ES.2 Discharge Compliance Drives the Need for Facility Upgrades

The City's NPDES Permit was renewed on January 23, 2010, allowing discharge of treated effluent to Tickle Creek during the winter, wet weather) months, November to March, and to Iseli Nursery for irrigation in the summer, dry weather, April through October. Permit requirements restrict discharge to Tickle Creek during the winter months to only when a 10 to 1 dilution of the effluent can be achieved. This permit expired as of November 30, 2013. Although the City submitted a timely application for renewal, an updated permit has not been released to date. As a result, the Sandy WWTP has been operating under the existing permit, which has been administratively extended.

Tickle Creek is within the "Three Basin Rule" area, which prohibits increases in mass load discharge to Tickle Creek.. The purpose of the Three Basin Rule is to protect three river basins that serve as the primary source of drinking water for a large portion of Oregon's population.

Historically, during the Winter Season, discharges from the WWTP occasionally resulted in biochemical oxygen demand (BOD) and total suspended solids (TSS) mass load limitation violations. During the Summer Season, when stream flow decreases, no discharge is permitted into Tickle Creek, and is diverted to Iseli Nursery, which is constrained for storage during April and October. In effect, during the Summer Season no discharge from the City of Sandy will r be permitted into the Clackamas River Basin under the Three Basin Rule, and the number of mass load violations will increase with increased flows associated with growth without significant changes to the wastewater system.

Therefore, the mass load requirements in the new NPDES permit are expected to remain unchanged. To comply with the terms of the permit, the City must treat its wastewater to an increasingly higher standard and accommodate more influent volume as more residential connections are added to the system. 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.

The current NPDES permit currently constrains the City in the following ways:

- Requires higher levels of treatment as the City grows and more connections are added.
- Discharge to Tickle Creek is restricted when Tickle Creek flowrates are low and result in dilution rates less than 10 to 1.
- Prohibits discharge to Tickle Creek during periods when irrigation ponds are full and water is not needed for irrigation.

These challenges are significant, and detailed in this 2024 Plan Amendment. This analysis also proposes approaches to solving these challenges includes treatment alternatives, storage alternatives, and discharge alternatives.

The City signed a Consent Decree with EPA on September 11, 2023, to bring the WWTP into compliance until an additional discharge point can be located into the Sandy River. The Consent Decree requires the City to evaluate five new additional treatment alternatives, which is a focus of the 2024 Plan Amendment.

ES.3 Planning for Growth

The City is growing, and with growth comes increased wastewater volumes to the wastewater system and corresponding increased discharges. Discharge effluent loading requirements can be met in the short term through wastewater treatment plant upgrades, but in the long-term will require expanded storage capacity and an additional discharge location to the Sandy River. In addition, there are anticipated regulations and drivers that will influence the City's approach to managing biosolids from the wastewater treatment facility, creating an opportunity for beneficial reuse but also a recognized risk related to potential requirements related to emerging contaminants.

The current wastewater system has a design capacity to treat 9.3 million gallons per day (MGD). Projected peak hour wet weather flows are anticipated to increase to 12.2 MGD by 2040, indicating a treatment gap of nearly 3 MGD. The increased flows account for an annual population growth rate of 2.8% and future I&I into the collection system based on additional collection system modeling.

With increased population comes increased influent waste loads, which can stress the treatment facilities ability to handle additional loading, particularly due to BOD and TSS. BOD, which indexes the concentration of organics, is an essential metric in wastewater treatment processes to assess how effective the treatment process is. The amount of TSS, or non-dissolved particles, is important to wastewater treatment operations and environmental health. The City's average influent BOD is anticipated to increase 60% between 2024 and 2040, from 3,300 pounds per day (ppd) to 5,300 ppd. Influent TSS is similarly anticipated to increase by 63%, from 3,000 ppd to 4,800 ppd. Treatment upgrades are necessary to address these increasing loads to maintain compliance for current discharges to Tickle Creek as well as to meet future anticipated discharge requirements to an alternative location (e.g., the Sandy River).

ES.4 Using Value Engineering to Balance Costs and Risks

The 2019 Plan combined the WWTP and collections system into a unified plan to find the best balance investments for the wastewater system as a whole. This 2024 Plan Amendment considers the investments made to the wastewater system since the 2019 Plan, updated flow and load projections, and anticipated future regulations to evaluate a range of facility improvements to meet near- and long-term needs in an affordable way that reduces the City's risk of non-compliance.

The 2024 Plan Amendment makes conservative assumptions based on site constraints and implementation considerations to set reasonable targets and provide a buffer for uncertainties related to regulatory risks and cost influences. The City continues to implement projects that reduce loads on current facilities, repair and replace aging facilities and plan for future anticipated requirements, one step at a time. However, the necessary improvements for long-term compliance are costly, and optimization alone will not bring the City to long-term compliance. Thus, the City, their operations team, program management team and supporting consultants have worked together to address a complicated problem and identify a phased approach to move forward.

The City is pursuing a near-term approach and a long-term approach to collecting and treating wastewater for mass load limits, dilution ratio, and a seasonal discharge period. The following sections describe ongoing activities, and the screening of concepts and alternatives that lead to the recommendations to support an updated, phased CIP.

ES.5 Collection System

In most cases, every dollar spent on collection system improvements is capacity that is brought back at the treatment plant. In other words, projects that reduce I&I into the collection system results in lower peak flowrates entering the WWTP.

The 2019 Plan identified improvements to the collection system to provide capacity required to serve the projected growth under the recommended activities at that time. Since adoption of the 2019 Plan, the City has undertaken significant efforts to reduce I&I in the system and has initiated capacity improvements to address needs of the system.

The City has also implemented a Capacity, Management, Operation and Maintenance (CMOM) Program as a comprehensive strategy for managing the wastewater collection system. The City continues to implement collection system repair and rehabilitation projects as well as to identify new projects based on the recent collection system improvements.

ES.6 A Discharge Compliance Plan for the Near- and Long-Term

Compliance with current and anticipated future discharge requirements requires near-term improvements at the WWTP, continued reuse of effluent in the summer months and optimization of available storage.

The City is committed to implementing treatment plant upgrades that will achieve maximum effluent BOD and TSS concentrations that will maintain compliance with the NPDES Permit and enable the City to pursue a lower dilution ratio. The treatment alternatives being explored as part of the 2024 Plan Amendment are intended to address the requirements of EPA’s Consent Decree and allow for current and future discharge compliance.

The City will need a strategy to manage discharges of effluent to Tickle Creek and irrigation at Iseli Nursery from. The apparent trend of decreasing stream flow in Tickle Creek appears to be extending low stream flow during the discharge season, resulting in dilution issues. The shoulder seasons make irrigation challenging, as weather may eliminate the need to irrigate. Coordination with Iseli Nursery to empty ponds to the extent possible each April to provide maximum storage is a critical component of meeting seasonal discharge restrictions.

The City is committed to securing an alternative discharge as soon as reasonably possible. Two discharge alternatives considered in this Facility Plan Amendment are:

- Constructing a new outfall to a different receiving stream with assimilation capacity. The Sandy River has been selected as the preferred receiving stream. A conceptual design of a pump station and pipeline are the basis of cost estimates used for the planning level costs in this Plan.

- Conveying the City's wastewater to a regional treatment plant. The City has begun discussions with the City of Gresham to understand availability of treatment plant capacity, wholesale customer requirements, and system development charges (SDCs) for wholesale customers.

Either of these alternatives can be permitted, constructed, and in service by approximately 2033.

ES.7 Treatment Alternatives - EPA's Consent Decree

The 2024 Plan Amendment explores the WWTP improvements necessary to extend the Tickle Creek discharge until 2033 and meet the EPA's Consent Decree, which requires the City to evaluate new additional treatment alternatives, located on or near the existing WWTP site. A concept-level screening approach is applied to the following five possible wastewater treatment project concepts to identify economic, regulatory, implementation, resiliency challenges:

- **Alternative 1 - Conventional Activated Sludge (CAS):** Expansion of the current CAS process with tertiary treatment (additional aeration trains, secondary clarifier) and tertiary filtration.

- **Alternative 2 - Membrane Bioreactor (MBR):** Conversion of the existing plant to a MBR, a treatment technology that combines a biological treatment process with membrane filtration.

- **Alternative 3 - Hybrid MBR/CAS**: Conversion of the existing plant to a hybrid installation of an MBR train plant, and CAS by converting the existing aeration basin, secondary clarifier, and tertiary filtration train to wet weather operation only.

- **Alternative 4 - Regional Treatment Plant:** Pumping wastewater to an adjacent treatment facility by constructing a new pump station at the existing WWTP site and constructing a pipeline to a WWTP owned and operated by another municipality. This option would include shutting down most of the existing WWTP, but maintaining the option to treat and discharge to Tickle Creek.

- **Alternative 5 - Collection System Storage:** This concept includes detention of raw wastewater in a new equalization basin and pump station, or within the existing collection system, then metering the sewage to treatment after peak flowrates and loadings have passed. Select process units will require upgrade to remain in service.

Alternatives 1, 2, and 3 would be implemented at the existing plant site. Alternative 4 would be implemented at the existing plant site, but wastewater would be pumped to another facility for treatment. Alternative 5 would be implemented off site, and the existing plant liquid stream would be maintained (and updated as described) on site.

Alternative 4, the **Regional Treatment Plant concept** would involve the construction of a new pump station and 14-mile long forcemain. With the additional (SDCs), this alternative is not the lowest cost option. However, the capital cost may decrease if the City can negotiate lower SDCs as a wholesale customer at the City of Gresham.

Alternative 5, the **Collection System Storage concept**, would likely meet current regulatory requirements by building more storage to reduce peak flows during high flow events force the plant to operate above the available capacity. However, storing more wastewater would not resolve the treatment issue, would be unable to alleviate capacity concerns as growth occurs and waste loads increase, and would have challenging ongoing maintenance requirements to address odor issues and regular cleaning of facilities.

Thus, Alternatives 1, 2, 3 and 4 move forward for additional evaluation and a more comprehensive screening process to score, weight and rank four viable alternatives. The outcomes of the alternatives screening are presented in Table ES-1 and discussed below.

Table ES-0-1: Application of Screening Criteria for Liquid Process Alternatives

Criteria	Sub-Critiera	Alt 1: CAS	Alt 2: MBR	Alt 3: Hybrid MBR/CAS	Alt 4: Regional Treat Plant
ECONOMIC	Financial Implementability	1	4	2	3
	Annual Cost Effectiveness	4	3	2	3
PERMIT COMPLIANCE RISK	Near Term Regulatory Risk	3	4	4	4
	Future Regulatory Risk	2	2	2	4
OPERATIONAL CONSIDERATIONS	Operational Complexity	3	2	2	4
	Operational Impacts During Construction	2	4	2	4
	Operational Staffing	3	2	2	4
IMPLEMENTATION	Construction Schedule	2	4	3	4
RESILIENCY	Compliance	1	3	2	4
	Vulnerability	4	4	4	4
	Total Weighted Score:	**2.35**	**3.45**	**2.6**	**3.7**

Score	Legend:
4	Fully Meets Criteria
3	Mostly Meets Criteria
2	Somewhat Meets Criteria
1	Does Not Meets Criteria

Alternative 1: CAS scored lowest overall in the rating scoresheet. The CAS process has the highest construction cost ($117.3M) due to the large amount of concrete, new pumps, and need for a separate effluent filtration step. This cost includes construction of the Sandy River outfall and associated pump station. Staffing would remain roughly the same and current Operator certification level would not change. The implementation schedule is also longer due to time needed to construct the basins and challenges associated with operational impacts during construction, because the existing solids process would be interrupted to make the process upgrades. This alternative also requires changing the way the process works while keeping it online, requiring the pumping to the clarifiers rather than by gravity. There is also a greater regulatory risk as an upset in the clarifiers could result in losing solids, which would upset the downstream ultrafiltration process, requiring additional cleaning cycles that are more intense than

normal operations and at a worst case, without an additional barrier like a submerged membrane), after an upset condition the system could be unable to perform.

Alternative 2: MBR scored the second highest overall. An MBR plant has the benefit of a smaller footprint, lowest cost ($104.6M), and the ability to construct and startup without disrupting current operations. This cost includes construction of the Sandy River outfall and associated pump station. Staffing would remain roughly the same, however, the treatment process requires a higher level of Operator certification. The submerged membrane performs a physical barrier to the sludge, removing toxics and ammonia from the treated effluent. An MBR facility would require higher certification for operators, but due to built-in automation, the plant could be operated by the same number of staff. Overall, a single MBR solution would provide improved operation, compliance, and resiliency.

Alternative 3: Hybrid MBR/CAS scored third, blending the benefits and limitations of Alternatives 1 and 2. Staffing would remain roughly the same, however, the treatment process requires a higher level of Operator certification. Having two processes is more complex to operate, has a mid-range cost ($115.7M) and would require more staff along with higher certified staff for the MBR. This cost includes construction of the Sandy River outfall and associated pump station. During wet weather, half of the wastewater would go to the MBR and half to the CAS, and the upset challenges associated with Alternative 1 are not as significant and there will be better removal of ammonia in the portion treated by the MBR. The cost to construct two new treatment components is less than the CAS along but still greater than MBR alone.

Alternative 4: Regional Treatment Plant scored the highest overall and had the lowest construction cost ($67.3M), but the highest overall cost ($122.3M) due to the additional SDCs. Staffing would potentially be reduced because there would be less equipment to operate and maintain, and the Operator certification would likely revert to a collection system certification only. Pumping sewage 14 miles to treatment at the City of Gresham Wastewater Treatment Plant reduces the risk of permit violation and minimizes operational complexity. The added cost of SDCs could be negotiated lower if the City were to become a wholesale customer with Gresham.

Alternative 2 MBR. and **Alternative 4 Regional Treatment Plant** are evaluated further as on-site and off-site recommendations for treatment processes.

ES.7 Long-Term Biosolids Management and Anticipated Regulations

The 2024 Plan Amendment explores biosolids treatment upgrades needed to maintain production of Class B biosolids given increasing loading and to upgrade to Class A processing to increase beneficial reuse. The biosolids treatment process currently used by the City cannot reliability produce Class B biosolids and the biosolids produced cannot be beneficially reused (land applied) without additional treatment. The City currently stabilizes and dewaters biosolids, which are disposed at a landfill. The biosolids land application site certifications and agreement have expired, and the City is unable to land apply until new sites are certified and landowner agreements have been signed. The City needs a viable long-term solution for biosolids management, ideally one that provides opportunities for beneficial reuse of biosolids.

A concept-level screening approach is applied to the following four solids treatment concepts to identify economic, regulatory, implementation, resiliency and disposal challenges to assess the viability of solids treatment solutions:

1. Class A Aerobic Digestion, Dewatering, and Dryer
2. Class A Non-Digested with ASSB, Dewatering, and Dryer
3. Class B Aerobic Digestion and Dewatering
4. Non-Digested with ASSB and Dewatering

Concept 1 has the highest capital and operating costs, but offers unrestricted beneficial use of biosolids. Concept 4 has the lowest cost, but does not address future regulatory risks and the product solids cake cannot be used for land application.

Concept 4 most closely resembles the current approach of hauling partially digested and dewatered solids to the landfill during the planning horizon of the Facility Plan Amendment. This approach does not currently require any capacity-related improvements; however, it is recommended that the City consider implementing the recommendations included in Concept 4 (repair of the storage area canopy, replacement of the dewatered solids pump with an inclined screw conveyor) as reliability and maintenance improvements as funding is available.

The City continues to track potential future regulatory requirements related to per- and polyfluoroalkyl substances (commonly referred to as PFAS) limitations for biosolids. Neither Oregon nor the EPA have set any type of regulation on PFAS in biosolids, however, some states have already implemented their own rules and guidelines, offering a glimpse of what potential regulations could affect the City's biosolids.

EPA is conducting a perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) in biosolids risk assessment slated to be completed and released to the public in Winter 2024. The risk assessment will be the basis for determining if there will be regulations on PFOA and PFOS in biosolids.

ES.8 Capital Improvement Plan

This 2024 Plan Amendment brings together ongoing activities with near- and long-term solutions to balance costs and risks and determine a viable CIP for treatment and biosolids while continuing to implement collection system improvements and plan for a discharge relocation to the Sandy River. The foundation of this work is to be responsive to the EPA's Consent Decree while also developing a realistic CIP to be a road map for the City to meet its growth goals and maintain its assets.

The following sections summarize the CIP projects for the collection system, WWTP and biosolids treatment facilities.

ES.8.1 Collection System CIP

The *Draft TM – 2024 Wastewater Collection System Update* (Stantec, 2024a), included as Appendix A.2, identifies ongoing and upcoming activities and provides an updated CIP for collection system activities that are included in this 2024 Plan Amendment. The City has four completed projects, 12 ongoing projects and three monitoring projects related to pipeline capacity, I& I, storage and pump station improvements. The collection system CIP projects, costs and anticipated years of completion are listed in Table ES-2.

Table ES-2: Collection System Rehabilitation Program Projects

Project Name	CIP Cost Estimate (2024 dollars)	Anticipated Year(s) of Completion
Northside Pump Station Upgrades	$0.45M	2026
Pump Station Capacity Evaluation	$0.15M	2027
Flow Monitoring and Model Recalibration	$0.2M	2028
Citywide Manhole Grouting	$0.4M	2029
Basins 3, 9, 10 Rehabilitation	$10.0M	2030
Pump Station Condition and Capacity Upgrades	$2.0M	2031
Subtotal	**$13.2M**	

Source: *Draft TM – 2024 Wastewater Collection System Update* (Stantec, 2024a)

ES.8.2 Wastewater Treatment CIP

Near Term Improvements: The City is planning to make interim improvements prior to final design recommended WWTP upgrades to replace or upgrade critical processes that are aging and failing. Anticipated projects relevant to this 2024 Plan Amendment include:

- New medium-pressure ultraviolet (UV) disinfection planned for 2024/2025 that will improve disinfection and provide redundancy.
- Effluent pump station improvements to Iseli Nursery are currently in design and may be constructed in 2025.
- Improvements to the existing surge basin at the WWTP will provide additional storage. These improvements are being designed and may be constructed in 2025.

Biosolids Improvements: The 2019 Plan recommended the City move to a biosolids process that not only provides for greater volatile solids destruction (e.g. digestion) and a smaller footprint, but also produces a marketable Class A biosolids product. Class A biosolids can be reached without digestion, and the resultant Class A dried product is suitable for public use (i.e., fertilizer or soil amendment).

After evaluation of compliance considerations, the City's existing biosolids program, and budgetary constraints, the recommended Biosolids Approach is to provide reliability improvements to the existing process and continue to dispose dewatered biosolids at a landfill. The estimated capital cost of this program is $8.1M.

Liquid Stream Improvements: The recommended liquids treatment approach is to convert the existing WWTP to a Membrane Bioreactor (MBR) process, which will be constructed after the list of projects above are completed. Implementation of the recommended MBR process will enable the plant handle the higher influent flowrates and loads coming to the WWTP, while maintaining discharge at Tickle Creek. The estimated cost to complete the MBR improvements are $55.2M.

Complete Recommended Treatment Improvements:

The City is advancing two alternatives simultaneously and will select the one is cost effective and minimizes the City's risk of non-compliance. These alternatives are Alternative 2 – Membrane Bioreactor, and Alternative 4 – Regional Treatment Plant.

The estimated cost for Alternative 2 to construct the complete wastewater treatment improvements is $104.6M and is summarized in Table ES-3.

Table ES-3: Engineer's Estimate of Probable Cost Treatment Alternative 2 – Complete MBR Wastewater Treatment CIP

Process Area	Total Cost by Area
Site Work & Yard Piping	$3.0M
Electrical/I&C	$6.2M
Headworks	$2.8M
MBR Trains and Equipment	$25.4M
UV Disinfection	$3.0M
Recycled Water	$1.7M
Utility Upgrade Allowance	$5.0M
Biosolids Treatment	$8.1M
Total Treatment Costs	**$55.2M**
Sandy River Outfall	**$49.4M**
Total WWTP Improvements	**$104.6M**

The estimated cost for Alternative 4 to construct a pump station and pipeline to a Regional Treatment Plant is $122.3M and is summarized in Table ES-4.

ES-4: Engineer's Estimate of Probable Cost Treatment Alternative 4 – Regional Treatment

Process Area	Total Cost by Area
Site Work & Force Main	$58.9M
Pump Station	$1.2M
System Development Charges	$55.0M
Headworks	$2.2M
Utility Upgrade Allowance	$5.0M
Total	**$122.3M**

ES.8.3 New Sandy River Outfall CIP

The *Sandy River Effluent Pump Station – Draft Conceptual Design Report* (Stantec, 2024c), included in Appendix A.1, identifies a new pipeline alignment, pump station, and electrical building to convey treated effluent from the existing WWTP site to the proposed Ten Eyck Road discharge location. The project elements and costs for the new Sandy River Outfall Project are presented in Table ES-5. The outfall is estimated to be completed between 2029 and 2033.

Table ES-5: New Sandy River Outfall Project CIP

Project Element	Cost (2024 dollars)	Anticipated Year(s) of Completion
Sandy River Pump Station	$7.2M	2033
Electrical Building	$3.6M	2033
Effluent Force Main and Pipeline	$38.6M	2029
Total	**$49.4M**	

Source: Sandy River Effluent Pump Station – Draft Conceptual Design Report (Stantec, 2024c)

ES.8.4 Capital Improvement Plan Summary

The 2024 Plan Amendment provides a 20-year CIP, including costs associated with the Collection System Rehabilitation Program, Recommended Wastewater Treatment Improvements, and the Sandy River Outfall Project.:

- Collection System Rehabilitation Program = $13.2M
- Recommended Wastewater Treatment Improvements = $55.2M
- Sandy River Outfall Project = $49.4M

If the City selects Alternative 2, the total Capital Improvement costs are $117.8M. If the City selects Alternative 4, the total Capital Improvement Costs are $135.5M. The City has recently secured funding through several sources, primarily low-interest loans, in the amount of approximately $111M.

Section 1: Introduction

2019 PLAN | SECTION 1 SUMMARY

- Introduces the City of Sandy (City), its wastewater collection system and wastewater treatment plant (WWTP) infrastructure.
- Describes the purpose of the 2019 Plan to develop a strategy to provide wastewater services that accommodate population growth while staying in compliance with environmental regulations and permits.
- Provides an overview of the Sandy wastewater system.
- Outlines the scope and organization of the 2019 Plan to combine the WWTP and the collection system into a unified plan with investments balanced between collection and treatment.

1.1 Introduction

The Introduction section of the 2024 City of Sandy Wastewater Systems Facility Plan Amendment (2024 Plan Amendment) describes the purpose of the updated plan, the current state of facility planning, and new work completed since the 2019 City of Sandy Wastewater Systems Facility Plan (2019 Plan) (Murraysmith, 2019).

This document is intended to supplement the 2019 Plan and updates the following sections:

- Section 1 – Introduction
- Section 8 – Existing Wastewater Treatment Plant Evaluation
- Section 9 – Initial Wastewater Systems Alternatives Evaluation
- Section 10 – Long-Term Wastewater Systems Evaluation
- Section 11 – Recommended Capital Improvement Program

These updated sections reflect new information relevant to the development of additional alternatives. Minor updates to other sections are noted as appropriate. All sections start with a brief summary of 2019 Plan content for that section. Subheader numbering and content is in some cases unique to this document.

1.1.1 Wastewater Facility Planning Recent History

The City currently discharges treated effluent from its WWTP to Tickle Creek in the winter, November to March (wet weather), under a National Pollutant Discharge Elimination System (NPDES) Permit, and provides filtered water to a local nursery (Iseli Nursery) for beneficial reuse in the summer, April through October (dry weather). Current NPDES permit wet weather discharge limits are summarized in Table 1-1.

Table 1-1: Tickle Creek Wet Weather Discharge Limits

Parameter	Average Effluent Concentrations Monthly	Average Effluent Concentrations Weekly	Monthly Average (lb/day)	Weekly Average (lb/day)	Daily Maximum (lbs)[(1)]
BOD_5	10 mg/L	15 mg/L	125	187	250
TSS	10 mg/L	15 mg/L	125	187	250
E. coli Bacteria	Shall not exceed 126 organisms per 100 mL monthly geometric mean. No single sample shall exceed 406 organisms per 100 mL.				
pH	Shall be within the range of 6.0 – 9.0				
BOD_5 and TSS Removal Efficiency	Shall not be less than 85% monthly average for BOD5 and 85% monthly for TSS.				
Ammonia (NH_3-N)	Shall not exceed 10.9 mg/L daily maximum or 3.7 mg/L monthly average.				

(1) The daily mass load limit is suspended on any day in which the flow to the treatment facility exceeds 2.5 MGD (twice the design ADWF).

These means of effluent discharge and reuse are constrained by the “Three Basin Rule” (OAR 340-041-0350), prohibiting increases in mass load discharge to Tickle Creek. In addition to permit requirements and Three Basin Rule requirements, Oregon Water quality standards generally prohibit discharge to surface waters (including Tickle Creek) when stream flow is less than 10 times the effluent flowrate at the current permitted effluent concentrations. In addition, there is limited demand for effluent during the spring and fall shoulder season months, so conveying recycled water to Iseli Nursery during these months is not required. The NPDES permit was renewed on January 23, 2010, and expired as of November 30, 2013. Although the City submitted a timely application for renewal, an updated one has not been released to date. As a result, the Sandy WWTP has been operating under the existing permit, which has been administratively extended.

Historically, during the Winter Season, discharges from the WWTP resulted in biochemical oxygen demand (BOD) and total suspended solids (TSS) mass load limitation violations. During the Summer Season, when stream flow decreases, no discharge is permitted into Tickle Creek. In effect, during the Summer Season no increase in wasteload discharge from the City of Sandy will be permitted into the Clackamas River Basin under the Three Basin Rule, and the number of mass load violations will increase with increased flows associated with growth without significant changes to the wastewater system.

In addition, the WWTP’s permit does not allow for discharge to Tickle Creek when the calculated dilution value is less than 10. Based on growth projections, the City is expected to exceed the dilution criteria in the future, with most exceedances happening during wet weather peak events that correspond occur during low river flow conditions.

Mass load requirements in the new NPDES permit are expected to remain unchanged. Therefore, to comply with the terms of the permit, the City must treat its wastewater to an increasingly higher standard as more residential connections are added to the system.

Additionally, Iseli Nursery's ability to receive and use treated effluent is limited during the "shoulder" months of May/June and October, when discharge to Tickle Creek is not permitted, irrigation ponds are full, and soil conditions do not require irrigation of nursery stock. The nursery irrigation issue is simply an issue of storage of water until the irrigation season when it is needed.

To address these challenges, the recommended approach in the 2019 Plan was for the City to construct a satellite WWTP and convey treated effluent from the WWTP to a new Sandy River outfall. The recommendation for a satellite WWTP was deemed unaffordable and not practical for a small city. The City has elected to maintain treatment at the existing WWTP, and build a new Sandy River outfall to provide a reliable long-term discharge solution.

A subsequent *Detailed Discharge Alternatives Evaluation (DDAE) Report* (Murraysmith, 2021) evaluated options for locating a new outfall to the Sandy River. The DDAE Report determined that the Ten Eyck Road and Revenue Bridge site was the preferred location for a new Sandy River Outfall because it had the most favorable hydrologic and geomorphologic conditions and limited fisheries impacts compared with other potential sites. The City signed a Consent Decree with the US Environmental Protection Agency (EPA) on September 11, 2023 that provides a schedule for improving the collection and treatment systems. The Consent Decree also requires the City to evaluate five new additional treatment alternatives included in this Amendment.

Planning, permitting, and design of an additional outfall to the Sandy River is anticipated to be completed and in operation by 2033, requiring a near-term wastewater treatment solution to allow for discharges to Tickle Creek in the interim. This 2024 Plan Amendment builds on the adopted Recommended Discharge Approach contained in the 2019 Plan.

1.2 Project Goals and Purpose of the 2024 Plan Amendment

The goal of the 2024 Plan Amendment is to provide the City with a more affordable WWTP that meets compliance requirements, updates aging infrastructure, and satisfies the reliability criteria addressed in the Consent Decree with the EPA. This report presents an evaluation of wastewater treatment alternatives assessing the feasibility of a complete recommended plan that meets NPDES discharge permit limits for concentration and wasteload. This Amendment is also intended to determine the feasibility of meeting water quality standards with respect to dilution in Tickle Creek and effluent storage at Iseli Nursery.

The 2024 Plan Amendment updates influent flowrate projections, reflecting the reduction in inflow and infiltration (I&I) achieved through recent pipeline rehabilitation efforts, and evaluates alternatives for providing improvements required to maintain treatment at the existing WWTP site. Specifically, the 2024 Plan Amendment evaluates five alternatives for liquid process improvements and vets five solid treatment solutions that will replace or expand facilities at the existing treatment plant site, to the southeast or northeast.

In summary, key objectives of this effort are to update the 2019 Plan, to reflect recent and ongoing updates to the wastewater system, and to propose near- and long-term improvements to accommodate future growth and anticipated regulations.

1.3 Consent Decree Requirements

The City signed a Consent Decree with EPA on 11 September 2023 to bring the WWTP into compliance. The Consent Decree requires the City to evaluate five new additional treatment alternatives, including four located on the existing WWTP site. The specific liquid stream treatment alternatives to be evaluated are:

1) Expansion of current Conventional Activated Sludge (CAS) process with secondary treatment (additional aeration trains, secondary clarifier), tertiary filtration, and disinfection;

2) Conversion of the existing plant to a Membrane BioReactor System (MBR);

3) Conversion of the existing plant to a hybrid installation of an MBR train plant, and conversion of the existing aeration basin, secondary clarifier, and tertiary filtration train to wet weather operation only;

4) Pumping wastewater to adjacent treatment facility by constructing a new pump station at the existing WWTP site and constructing a pipeline to a WWTP owned and operated by another municipality. This task also includes select updates to headworks screening and grit equipment;

5) Detention of raw wastewater in a new equalization basin and pump station located in the collection system, or within the existing collection system by limited surcharging.

Alternatives 1, 2, and 3 would be implemented at the existing plant site. Alternative 4 would be implemented at the existing plant site, but wastewater would be pumped to another facility for treatment. Alternative 5 would be implemented off site, and the existing plant liquid stream would be maintained (and updated as described) on site with select process improvements to replace failing equipment.

As part of the alternative evaluation, the Kennedy/Jenks team also evaluated and refined solids stream treatment alternatives to provide Class B and Class A biosolid alternatives.

1.4 New Studies Completed Since the 2019 Plan

Since the completion of the 2019 Plan, the City has completed a number of studies and projects to implement the adopted recommendations. Table 1-2 lists recent studies, summarizing the relevance to the 2024 Plan Amendment. Section 8 summarizes recent process updates and anticipated or in-progress projects at the WWTP.

Table 1-2: Recently Completed Studies Relevant to the 2024 Plan Amendment

Title	Author Date	Relevance to 2024 Plan Amendment
Detailed Discharge Alternatives Evaluation (DDAE) Final Report	Murraysmith June 2021	• Builds on the adopted recommendations from the 2019 Plan. • Identifies and evaluates discharge options in lieu of or in combination with a direct year-round discharge to the Sandy River.
Preliminary Design Report (PDR) Sandy WWTP Immediate Needs Upgrade Project	Murraysmith July 2020	• Presented preliminary design for improvements required at the WWTP to implement recommendations from the 2019 Facilities Plan.
Sandy Wastewater Collection System Model Predicted flows for 2023 and 2040	Leeway Engineering Solutions (Leeway) Nov 2023	• Presented results from collection system modeling following the 2023 collection system repairs and one wet season of flow monitoring. • Provided updated influent wastewater flowrates under projected conditions from 2023 and 2040 that were used in process sizing for this 2024 Plan Amendment.
NPDES Permitting Support Subsurface Infiltration Feasibility Study	Parametrix Nov 2022	• Assessed the feasibility of infiltrating effluent from the WWTP to one or more areas for disposal based on technical, regulatory, and cost constraints.
Sandy WWTP Condition Assessment Improvements Project (2019 Condition Assessment)	West Yost Mar 2021	• Evaluated and modifies the recommendations from the 2019 Facility Plan Update. • Identified a "wish list" of improvements the City wants to complete at the WWTP. • Established cost-saving approaches to maximize investment in existing plant.
Preliminary Evaluation of Sandy Wastewater Treatment Capacity	West Yost Nov 2023	• Defined current flows and loads and identifies limitations in the current WWTP capacity. • Modeled anticipated future flows and loads and identifies how much can be reliably processed at the WWTP.
Wastewater Facility Plan Detailed Discharge Alternatives Evaluation Market Potential for Sandy's Recycled Water.	Barney & Worth, Inc. and Globalwise, Inc. May 2020	• Evaluated market options and identifies potential users for the City's recycled water in both the near and long term. • Discussed discharge alternatives for the City's recycled water.
Wastewater Treatment Facilities - Spare Parts and Repair, Replace, Refurbishment Prioritization Report	Waterdude Solutions August 2022	• Identified critical needs at the facility to increase reliability and maintain compliance with treatment standards. • Developed a prioritized list of spare parts and repair, replacements, and refurbishments that should be completed.

1.5 Current State of Facility Planning

The 2019 Plan serves as the basis of this 2024 Plan Amendment. Collection system improvements have reduced the infiltration and inflow (I&I) driven peak flowrates and allowed the City to increase the number of new connections (EDUs). The 2024 Plan Amendment is intended to provide a road map to carry the City through a 2040 planning window. The following are significant elements considered in this 2024 Plan Amendment.

- The existing NPDES Permit expired in 2013 and has been administratively extended. The City prepared an application to renew the existing permit and submitted it at least six months prior to expiration, complying with the requirements of the permit.
- The City has been in conversations with Oregon DEQ and EPA regarding permit limit exceedances and signed a Consent Decree in 2023 outlining the steps and schedule to achieve permit compliance.
- The WWTP improvement projects completed in 2022 have enabled the City to achieve a high quality effluent.
- The City conducted a series of stress tests at the WWTP in 2023. The purpose of the stress tests were to update the City's understanding of process unit capacity following recent plant updates in 2023. West Yost prepared a *Draft Sandy Wastewater Treatment Plant Capacity Evaluation Report* dated September 2023 summarizing the results of improvements, calibration of a process model, and summary of plant capacity. This report recommended next steps for the treatment plant to meet reliability requirements.
- The biosolids process currently used will not reliably produce Class B biosolids through the planning window, and biosolids cannot be beneficially reused (land application) without additional treatment.
- The City currently stabilizes and dewaters biosolids, which are disposed at a landfill. The biosolids land application site certifications and agreement have expired, and the City is unable to land apply until new sites are certified and land owner agreements have been signed.
- Several of the unit processes require upgrades to meet EPA redundancy and reliability requirements for a major discharger.

This 2024 Plan Amendment provides cost-effective solutions to address these issues.

Section 2: Study Area Characterization

2019 PLAN | SECTION 2 SUMMARY

- Outlines the wastewater system study area characteristics, including geography, topography, climate, general soil conditions, and zoning designations.
- Documents the City's socioeconomic conditions, including a discussion on the major sources of commerce within the City and the historical population trends.

There are no notable changes to the study area characterization from the 2019 Plan. For reference, Figure 2-1 illustrates the City's current wastewater service area, components of the wastewater collection and treatment system, and shows key geographic features referenced in this report.

Kennedy Jenks

Figure 2-1: Study Area and System Overview Map

[Insert PDF]

Section 3: Existing System Description

2019 PLAN | SECTION 3 SUMMARY

- Describes the City's 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 WWTP via a trunk sewer located along Tickle Creek, a tributary of Deep Creek and the Clackamas River.
- Treatment processes include preliminary treatment, activated sludge secondary treatment process, secondary clarification, disk cloth filtration, and disinfection.
- The WWTP is rated for a peak flow rate of 7 million gallons per day (MGD). Post-treatment effluent discharges to Tickle Creek during the winter and is applied to agricultural land during the summer.

The City has completed improvements to the WWTP since the 2019 Plan. Updates to the WWTP were completed in 2021 and 2022 to rehabilitate failing existing process equipment. A summary of recent updates and anticipated in-progress projects are summarized in Section 8 with additional detail provided in *Preliminary Design Report (PDR) Sandy WWTP Immediate Needs Upgrade Project* (Murraysmith, 2021)

Section 4: Regulatory Requirements

2019 PLAN | SECTION 4 SUMMARY

- Summarizes the current and future regulatory requirements for the City's WWTP and collection system.
- The following elements are discussed in detail:
  - 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 NPDES Discharge Permit Limits

As described in Section 1.1.1 the existing NPDES permit for the Sandy WWTP expired as of 30 November 2013. The City submitted a timely application for renewal, and a permit renewal is currently being prepared. In addition to BOD_5, TSS, pH, and E. coli, we anticipate DEQ will assess the need to include discharge limits for the following pollutants according to current water quality standards:

- Ammonia-Nitrogen
- Copper using the Biotic Ligand Model
- Metals – Zinc, Cadmium, and Nickel
- Trace Organics – Volatile and semi-volatile compounds

The Sandy WWTP has been operating under the existing permit, which has been administratively extended. This amendment generally references the existing permit limits.

4.1.1 Tickle Creek Outfall Discharge Limits Update

There are no predicted changes to current and future water quality requirements or predicted NPDES Permit limits from the 2019 Plan that are relevant to the 2024 Plan Amendment. The planning team primarily used existing permit limits as targets with consideration of anticipated water quality limits for ammonia and total nitrogen based on best available treatment capabilities of activated sludge with tertiary filtration. The NPDES permit and discharge evaluation update are further discussed in Section 9.

4.1.2 Sandy River Outfall Discharge Limits Update

The 2019 Plan recommended the City pursue an outfall to the Sandy River under its next NPDES Permit Renewal to allow the City to increase the volume of treated effluent discharged and also extend the discharge period to year-round. The *TM – Sandy River Pump Station Forcemain and Outfall* (May, 2024), included in Appendix A.1, provides additional details about the City's plan to construct a pump station and forcemain to convey treated effluent to the Sandy River.

Tickle Creek has more restrictions related to water quality, and therefore, has more stringent discharge limits. The Sandy River is larger and has fewer water quality limitations. Therefore, the Tickle Creek limits will be used as the basis of design for this 2024 Plan Amendment.

4.1.3 Summer Irrigation with Recycled Water

In the summer season, the City conveys treated effluent to Iseli Nursery where it is stored and used for irrigation. This generally coincides with the NPDES permit, which prohibits discharge of effluent to Tickle Creek from May through October. During unusually wet years, Iseli Nursery does not require irrigation, and their ponds may already be filled completely.

The Kennedy/Jenks team evaluated discharge alternatives, including increasing storage at Iseli Nursery. Increasing storage at the Nursery could allow storage of effluent during the shoulder seasons, the months immediately before and after the summer season, while the nursery does not require irrigation and continued use of effluent for irrigation throughout the dry season. The results of this evaluation are summarized in Section 9.1.2.

4.2 Reliability Requirements

As part of the *Preliminary Evaluation of Sandy Wastewater Treatment Capacity Evaluation Report* (West Yost, 2023), reliability requirements for the WWTP are discussed. Oregon does not have specific requirements for redundancy and reliability but does point to the EPA's reliability requirements. These were published in 1974 and do not address technological advancements, such as membrane bioreactor process equipment. Therefore, West Yost (2023) incorporated concepts from the following documents:

- Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability, Environmental Protection Agency, 1974.
- Recommended Standards for Wastewater Facilities ("Ten State Standards"), Wastewater Committee of the Great Lakes-Upper Mississippi River and Board of State and Provincial Public Health and Environmental Managers, 2014.
- Criteria for Sewage Works Design, ("Orange Book"), Washington State Department of Ecology, 2008.

West Yost assessed each process unit against EPA Reliability Class 1, which is generally considered as the following:

> *Works which discharge into navigable waters that could permanently or unacceptably be damaged by effluent which was degraded in quality for only a few hours. Examples of Reliability Class 1 works might be those discharging near*

drinking water reservoirs, into shellfish waters, or in close proximity to areas used for water contact sports.

Reliability Class 1 applies to this facility because it discharges within the Clackamas River Basin, which serves as a drinking water supply for a significant population in the Portland metropolitan area. West Yost's assessment included the assumption that the WWTP is a "small" plant, with an annual average influent flowrate that averages less than 2 MGD. While this may be true, Section 6 of this report summarizes projected flowrates prepared since the 2019 Plan and concludes that the annual average flowrate in 2040 will be 2.2 MGD. For these reasons, this 2024 Plan Amendment has been prepared for a "large" plant with an average annual flow (AAF) greater than 2.0 MGD.

For this 2024 Plan Amendment, it is assumed the City's WWTP discharging into a sensitive drinking water source requires firm capacity of all critical processes. Firm capacity means the WWTP will have hydraulic capacity to treat up to the Peak Instantaneous Flowrate (PIF) as appropriate. Table 4-1 summarizes the reliability requirements applied to Sandy's WWTP. The first three table columns are from West Yost (2023), while the last column presents the 2040 planning approach.

Table 4-1: Summary of Reliability Requirements

WWTP Process/ Component	Reliability Requirement	Status of Existing WWTP in 2023 Relative to Reliability Requirement [1]	How this Plan Addresses Reliability Requirements for 2040 [2]
Influent Screening	A backup bar screen, designed for mechanical or manual cleaning, shall be provided.	**Partially Meets:** The WWTP relies on both screens to treat the PIF. However, the entire PIF can hydraulically pass through the manual bar screen.	Replace existing failing mechanical screen with two mechanical screens to treat PIF and one manually cleaned bar screen to meet Firm Capacity requirements (12.2 MGD).
Grit Removal	For small facilities (less than 2 MGD average design flow), only one unit may be installed, with provisions for bypassing.	**Meets:** WWTP is considered a small facility.	No Action Required: Existing grit system has a capacity of 7 MGD, which is significantly more than the MMWWF. Grit removal is effective for long term protection of WWTP equipment but is not critical to operation under peak flow conditions, therefore, in our judgement, the existing system meets reliability requirements.
Utility Pump Station	A backup pump shall be provided for each set of pumps performing the same function. The pumps shall have capacity to handle peak flow with any one pump out of service.	**Potentially Meets:** The Utility Pump Station is equipped with two, equally sized utility pumps. These pumps are used to convey flow from the EQ basin to the treatment process. With one utility pump in operation, the EQ basin could be emptied in 2.5 days.	No Action Required: Utility Pumps are adequate for current conditions, however, utility pumps will be evaluated for size during pre-design based on secondary treatment process capacity.
Caustic Addition	All chemical feed equipment must have a backup system.	**Meets:** The WWTP has two equally sized caustic flow pumps, either of which is sufficient to provide the estimated peak caustic flow (see Table 7-12).	No Action Required: Chemical Systems are adequate to meet projected 2040 requirements. Biological process design will include alkalinity recovery prior to caustic feed.
Aeration Basins	A backup basin will not be required; however, at least two equal-volume basins shall be provided.	**Meets:** The WWTP has two equally sized aeration basins.	Additional aeration trains will be included to expand capacity. Process modeling indicates biological capacity can be provided at MMWWF with one train out of service for a short duration.
Aeration Basin Blowers	Multiple blowers must be provided.	**Meets:** The WWTP has three, equally sized blowers for the aeration basins, plus one slightly smaller blower.	No Action Required: Plant currently has 3 centrifugal blowers and one positive displacement blower.
	The number of blowers and their capacities must be such that the maximum air requirements can be met with the largest blower out of service.	**Meets:** Blower capacity with the largest unit out of service is 3,899 scfm, above the estimated design capacity maximum day aeration demand of 3,000 scfm.	Recent upgrades to the aerators has reduced aeration demand. Existing plant includes 3 centrifugal blowers and one rotary lobe blower that can meet the 2040 demand with no redundancy. To provide adequate redundancy, provide one additional blower with an approximate capacity of 2,000 scfm.
	Because blowers consume considerable energy, the design should provide for varying the volume of air delivered in proportion to the demand.	**Meets:** The blowers have VFDs.	New blower will be operated using a VFD.
	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.	**Partially Meets:** If the largest bank of diffusers is taken offline in one basin, 60 percent of diffuser capacity would remain. The remaining 750 diffusers in the affected basin could still convey the 3,700 scfm maximum air flow required without exceeding the per diffuser capacity of 6 scfm per diffuser. The system is also configured so that loads could be shifted to the unimpacted basin.	New aeration basins will be equipped with aerators constructed in sections to permit isolation as needed.
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 percent of the total design flow. DEQ staff have previously indicated that ADWF is considered the relevant total design flow for satisfying this criterion.	**Meets:** Two units are installed, and a single clarifier should be capable of treating a flow of 3.25 mgd (half of 6.5 mgd) operating at the worst-case MLSS concentrations of 2,200 mg/L.	New secondary clarifiers will be constructed for treatment alternatives where the conventional activated sludge biological treatment is expanded, so mixed liquor can be diverted to any clarifier from any aeration basin to permit effective hydraulic distribution. Clarifiers will be sized to operate within recommended loading ranges with the largest unit out of service.
Secondary Clarification: RAS Pumping	A backup pump shall be provided for each set of pumps performing the same function. The remaining pumps shall have capacity to handle peak flow with any one pump out of service.	**Partially Meets:** The WWTP has two RAS pumps, with one pump dedicated to each clarifier. They have a combined capacity of 2.6 mgd, which may be needed under peak flow conditions. However, one pump can be used to convey flow from both clarifiers. With one pump out of service, RAS pumping can convey about 1.7 mgd, which can accommodate a 50 percent return at an influent flow at 3.5 mgd. This influent flowrate is slightly higher than the anticipated future MMWWF of 3.4 mgd.	RAS will be combined in a single pump station where a set of pumps will convey return mixed liquor to each basin. The RAS pumps will be configured in N+1 so firm capacity is provided with the largest pump out of service.

Table 4-1: Summary of Reliability Requirements

WWTP Process/ Component	Reliability Requirement	Status of Existing WWTP in 2023 Relative to Reliability Requirement [1]	How this Plan Addresses Reliability Requirements for 2040 [2]
Secondary Clarification: WAS Pumping		**Meets:** The WWTP has two, 100-gpm WAS pumps with one pump dedicated to each clarifier. However, one pump can be used to convey flow from both clarifiers. One pump has sufficient capacity to convey WAS flows under the design capacity MMWWL conditions (see Table 7-21).	WAS will be combined in a single pump station where a set of pumps will convey wasted sludge to the Aerated Sludge Stabilization Basin (ASSB). The new diversion pump station will be designed with pumps in N+1 configuration so firm capacity is provided with larges pump out of service.
Diversion Pump Station	A backup pump shall be provided for each set of pumps performing the same function. The pumps shall have capacity to handle peak flow with any one pump out of service.	**Partially Meets:** The Diversion Pump Station is used to convey flows to the new tertiary filter. Flow must be equalized if one of the Diversion Pumps is not in operation during peak flow events.	Filters added to the WWTP will require a new diversion pump station to convey secondary effluent to new filters. The new diversion pump station will be designed with pumps in N+1 configuration so firm capacity is provided with largest pump out of service.
Tertiary Filtration	The filter system should be comprised of multiple units so that at least one unit can be backwashed or removed from service without overloading the remaining units.	**Partially Meets:** The WWTP has three, equally sized filters. All three units must be online during peak flow events. (Note that the filter units can complete a backwash cycle while in operation.) Flow must be equalized if one of the filters is not in operation during peak flow events.	New tertiary filters will be designed to meet PIF capacity with one unit out of service based on average and peak loading allowances.
	If pumped backwash is used, at least one standby backwash pump must be provided.	**Meets**: There are four backwash pumps for the three filter units.	New filters will have backwash pumps in N+1 configuration so firm capacity is provided.
UV Disinfection	Multiple reactor trains may be necessary to accommodate large flow variations.	**Meets:** The WWTP has two UV trains, one for flows up to 3.5 MGD and one train with two banks that can handle flows up to 7.0 MGD.	New UV units will be provided to ensure PIF can be treated with largest UV unit out of service.
	At least two banks in series shall be provided in each channel to ensure uninterrupted service during tube cleaning or other required maintenance.	**Partially Meets:** The open channel UV train has two banks in series, but the new, closed vessel UV has only one bank of lamps. Thus, the UV system can treat 7.0 MGD with any one bank out of service.	The existing aging in-channel UV unit will be replaced with an equivalent in-channel unit. Additional Capacity will be provided in closed units below.
	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 50 percent of the total design flow (PIF or Peak WWTP Hydraulic Capacity).	**Partially Meets:** The UV treatment capacity with the largest train out of service is 3.5 MGD, which is less than 40% of the design flow. However, if the largest train were out of service, flows to the treatment plant could equalized.	The existing aging in-channel UV unit will be replaced with a new open-channel unit. Two new closed-vessel units will be installed to provide total firm capacity of 14 MGD. These units will be fed by a new diversion pump station with duplex pumps.
Chlorine Contact Basin	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 50 percent of the total design flow.	**Partially Meets:** Chlorine contact requirements are met using the effluent pipeline, for which there is no redundancy. However, the City could rely on the UV system as a backup disinfection system, if needed.	No action required; transmission pipeline provides adequate disinfection and residual.
Chlorine Feed Pump	All chemical feed equipment must have a backup system.	**Meets:** The WWTP has two chlorine pumps dedicated to effluent disinfection.	No action required; Chemical Systems are adequate to meet projected 2040 requirements.
Effluent/ Irrigation Pump Station	A backup pump shall be provided for each set of pumps performing the same function. The pumps shall have capacity to handle peak flow with any one pump out of service.	**In Progress of Meeting:** There are three Effluent/Irrigation Pumps. Flows exceeding the pumping capacity must be diverted to the EQ basin (either using the EQ Pump Station or through gravity diversion at the headworks). Currently, there is not adequate EQ capacity to accommodate influent flows during a peak storm event given the capacity of the Effluent/Irrigation Pumps. As previously discussed, the City and its consultants are designing upgrades to the Effluent/Irrigation Pump station to increase capacity. In parallel with the design work, the City will calibrate the collection system model to determine the 1-in-10 year dry weather response and size the Effluent/Irrigation Pump Station improvements so that adequate capacity is provided to accommodate the design storm flows with the largest pump out of service. The treated effluent transmission line had 4 breaks in 2023/2024 and may be nearing the end of its useful life.	Existing effluent pump motors are suited for inside use; however, they are installed outside under cover. These pumps require replacement and will be replaced with pumps with TEFC motors. The capacity will be increased to convey additional effluent to Iseli Nursery's irrigation ponds. The recycled water pressure main to Iseli Nursery is near its capacity. Iseli has capacity for more water than is being received through the irrigation system during the dry season. If the City and Iseli coordinate pumping, storage, and irrigation to maximize Iseli's irrigation use, additional capacity in the pressure main could be useful. Replacing the transmission line with a new larger diameter pipeline would increase the line's capacity and restore reliability.

Table 4-1: Summary of Reliability Requirements

WWTP Process/ Component	Reliability Requirement	Status of Existing WWTP in 2023 Relative to Reliability Requirement [1]	How this Plan Addresses Reliability Requirements for 2040 [2]
EQ Pump Station		**Meets:** The EQ Pump Station is used to divert treated flows to the EQ basin and is typically used during the dry season only. Screened wastewater can also be diverted to the EQ Basin from the headworks (without pumping). Therefore, operation of the EQ Pump Station is not critical for operations.	No action required.
Aerobic Digestion	Multiple digestion units capable of independent operation are desirable and shall be provided in all plants where the design average flow exceeds 100,000 gallons per day (380 cubic meters per day). All plants not having multiple units shall provide alternate sludge handling and disposal methods.	**Partially Meets:** While the aerobic digester has two active cells, it is operated as a plug flow system and one cell cannot be bypassed. However, solids storage capacity is available in the aerobic digester if a system component were out of service and impacting performance.	If the City wishes to produce Class B biosolids, additional digestion volume would be required. Class A biosolids may be achieved without additional digesters if Class A characteristics have been met using heat treatment for drying.
Solids Dewatering	The number of mechanical dewatering facilities (e.g., Belt Filter Press) should be sufficient to dewater the biosolids produced with the largest unit out of service.	**Partially Meets:** The WWTP has only one belt filter press, with no redundancy. However, solids storage capacity is available in the aerobic digester if the press were out of service.	Solids dewatering will be revised significantly and will include two dewatering units, a single dryer (if selected), and dewatered/dried solids storage. If dewatered solids does not meet Class B characteristics, it may be disposed in a landfill.
Waste Pump Station	A backup pump shall be provided for each set of pumps performing the same function. The remaining pumps shall have capacity to handle peak flow with any one pump out of service.	**Meets:** The available firm pumping capacity of the Waste Pump Station will be sufficient to handle the anticipated peak flow.	No action required.

[1] From West Yost, 2023.
[2] Projected requirement for meeting Reliability Requirements for year 2040.

Section 5: Basis of Planning

2019 PLAN | SECTION 5 SUMMARY

- Describes the methodology for developing, evaluating, and selecting alternatives for the collection system and the treatment plant.
- The basis of planning includes the following considerations:
  - The alternatives and costs are based on future flow projections.
  - The collection system evaluation includes costs for I&I reduction alternatives along with conveyance deficiency.
  - The WWTP alternatives are developed for each unit process based on the range of flows associated with each I&I reduction alternative.
- The integrated alternatives combine the costs and other criteria associated WWTP modifications to determine the recommended alternative.

5.1 Introduction

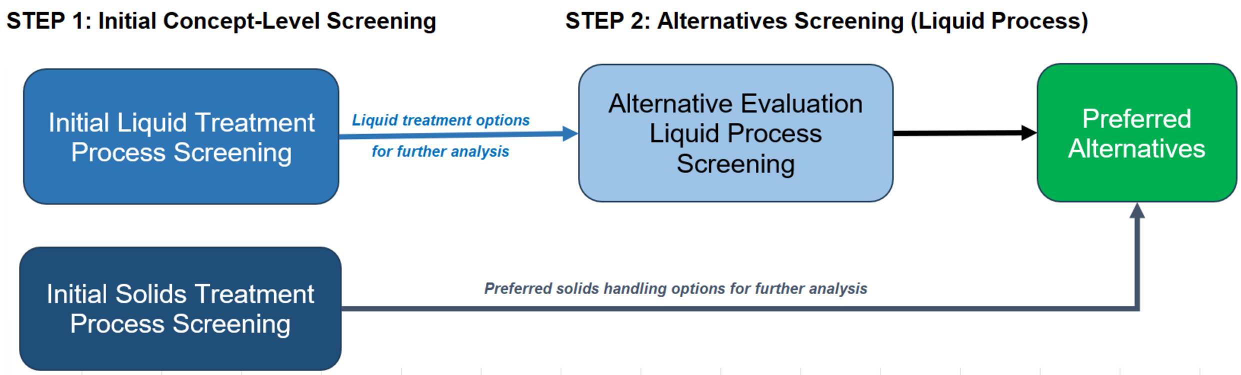
There are no notable changes to the basis of planning approach used in the 2019 Plan; however, there have been some improvements completed since the 2019 Plan in the collection system and at the WWTP, which are highlighted in Sections 7 and 8, respectively. Following collection system repairs, the 2023 and 2040 design influent flowrates were updated utilizing a calibrated collection system model (Leeway, 2023), which is further described in Section 6. The updated flowrates and waste loads were used to develop the treatment alternatives presented in Sections 9 and 10.

This section summarizes the approach that the Kennedy Jenks team took to evaluate five alternatives and select the most beneficial to proceed with a detailed analysis. The 2024 Plan Amendment introduces and applies a two-step screening methodology to evaluate and compare liquid and solid treatment processes. This section describes the screening approach and criteria that are applied to evaluate concepts and alternatives in Sections 9 and 10.

5.2 2024 Plan Amendment Screening Approach

A two-step screening approach was applied, as illustrated in Figure 5-1. STEP 1 screens a broad set of alternatives for liquid and solids upgrades to meet project goals. STEP 2 evaluates a short list of liquid upgrades alternatives based on costs, benefits, limitations, and other decision criteria.

Figure 5-1: Two-Step Screening Approach



5.3 STEP 1: Initial Concept Level Screening

STEP 1: Initial Concept-Level Screening approach identifies economic, regulatory, implementation, and resiliency challenges that would make a liquid process treatment solution concept non-viable or infeasible. A similar set of criteria are applied to assess the viability of solids treatment solutions, with disposal options (landfill or land application) and beneficial reuse included as an additional criterion.

Screening criteria for the initial liquid process concepts and initial solids treatment options are presented in Table 5-1 and Table 5-2, respectively. Concepts that are unable to meet one or more of the criteria are deemed not viable or infeasible and are eliminated from further consideration. Those concepts that are deemed viable or feasible are further evaluated and moved forward to the second screening step.

Table 5-1: Initial Liquid Process Screening Criteria

Initial Concept-Level Screening Criteria	Consideration for Assessing Viability/Feasibility
ECONOMIC	Is the concept affordable and within the City's current budgetary constraints?
CURRENT REGULATORY RISK	Will the concept be able to meet current NPDES permit requirements and biosolids regulations?
FUTURE REGULATORY RISK	Will the concept be flexible to address potential future permit requirements, anticipated biosolids regulations, PFAS regulations?
IMPLEMENTATION	Can the concept be constructed to comply with the consent decree timeline?
RESILIENCY	Does the concept offer the City flexibility to adapt for growth?

Table 5-2: Initial Solids Treatment Screening Criteria

Initial Concept-Level Screening Criteria	Consideration for Assessing Viability/Feasibility
ECONOMIC	Is the concept affordable compared to City's current solids handling/disposal costs?
CURRENT REGULATORY RISK	Will the concept be able to meet current NPDES permit requirements and biosolids regulations?
FUTURE REGULATORY RISK	Will the concept be flexible to address potential future permit requirements, anticipated biosolids regulations, PFAS regulations?
IMPLEMENTATION	Is this a proven technology/solution the City/industry has experience working with?
RESILIENCY	Does the concept offer the City flexibility to adapt for growth?
LANDFILL DISPOSAL	Are solids likely to be accepted for landfill disposal?
LAND APPLICATION	Can solids be treated to meet land application characteristics (Class B or A)?
BENEFICIAL REUSE	Will the concept be suitable or flexible to offer future market opportunities for beneficial reuse, partnerships, and public acceptance?

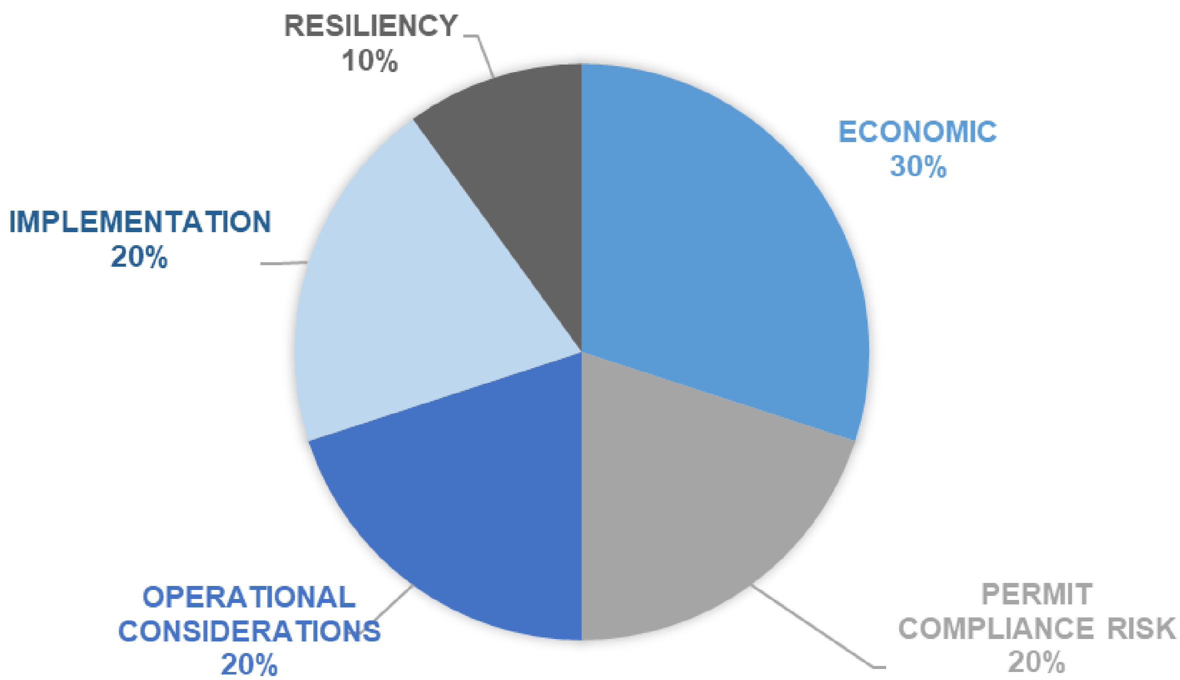
5.4 STEP 2: Alternatives Screening

Following the initial concept-level screening, a more in-depth alternatives evaluation and comparison is performed to rank the treatment concepts identified for further consideration. STEP 2: Alternatives Screening (Liquid Process) includes a “scorecard” approach used to compare the alternatives using qualitative and quantitative information applied to a set of decision criteria. The alternative evaluation includes a scoring, weighting, and ranking process as described in Table 5-3. The weighting of each criterion is shown in Figure 5-2.

Table 5-3: Criteria for Comparing Liquid Process Alternatives

Criteria	Sub-Criteria	Considerations	Fully Meets Criteria (Highest Scoring)	Numeric Scoring Generally Meets Criteria	Unable to Meet Criteria (Lowest Scoring)
			4	2 to 3	1
ECONOMIC	Financial Implementability	Relative capital investment	Lowest Construction Cost	Mid-Range Construction Cost	Highest Construction Cost
	Annual Cost Effectiveness	Relative operations & maintenance (O&M) costs	Lowest O&M Cost	Mid-Range O&M Cost	Highest O&M Cost
PERMIT COMPLIANCE RISK	Near-Term Regulatory Risk	Relative risk in ability to meet current NPDES permit requirements	Minimal Risk	Some Risk	High Risk
	Future Regulatory Risk	Relative risk to meet future regulatory requirements (2040) (e.g. ammonia, copper, toxics, PFAS)	Minimal Risk	Some Risk	High Risk
OPERATIONAL CONSIDERATIONS	Operational Complexity	Relative impact to current wastewater operations and responsibilities, suitable for gravity timeline	Minimal potential impacts	Range of potential impacts	Significant potential impacts.
	Operational Impacts During Construction	Relative impact to current operations during construction	Minimal potential impacts	Range of potential impacts	Significant potential impacts.
	Operational Staffing	Ability to maintain routine plant operation (number of staff and certification level needed)	Fewest daily staff required, highly automated, easy to understand	More daily staff than 4, highly automated, relatively low amount of process adjustments required.	Requires more staff, more process monitoring and adjustments.
IMPLEMENTATION	Construction Schedule	Ability to expedite construction and increase capacity	Accelerated construction schedule would provide an early capacity buffer	Construction Schedule would provide a limited capacity buffer.	Construction schedule would not provide a capacity buffer.
RESILIENCY	Compliance	Ability to maintain effluent limits under peak flow/loading conditions	Low risk of mixed liquor loss, filter plugging, disinfection failure	Requires significant effort to recover functionality after peak event.	Upset is likely under peak conditions, may result in poor treatment or process failure.
	Vulnerability to Supply Disruptions	Consumable chemicals and maintenance materials could limit ability to comply with permit requirements	Relatively low consumable chemicals, easy to acquire routine replacement parts, or replacement parts will be stocked at the plant	Consumable chemicals can be retained for long periods, manufactured locally, parts can be secured with some notice through multiple suppliers.	Chemicals have been historically difficult to source, long lead times, replacement parts are available from only one supplier.

Figure 5-2: Criteria Weighting for Liquid Process Alternatives



STEP 1 initial solids screening criteria are applied in Section 9.2.5 and the initial liquid process screening criteria are applied in Section 10.3. STEP 2 liquid process alternatives screening are applied in Section 10.5.

Section 6: Flow and Load Projections

2019 PLAN | SECTION 6 SUMMARY

- Documents the existing and projected flowrates and wastewater characterization in the wastewater collection system for the Sandy 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.
    - Flow characterization is based on 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 I&I, size capacity improvements in the collection system, and estimate influent volumes at the WWTP.
- Two methods are used to develop the current flow characteristics and future flow projections:
    - **Collection System Method:** based on analysis and modeling of the existing collection system, which allows for more robust flow projections because it considers population forecasts and designated land use as well as collection system characteristics including pipe degradation.
    - **DEQ Guidelines Method:** based on the guidelines from the *Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon* (Oregon Department of Environmental Quality, 1996). This method is used to confirm the validity of the collection system modeling estimation.
- The summary of loads focuses on the mass load of biochemical oxygen demand (BOD) and total suspended solids (TSS) into the WWTP.
    - Current mass loads are calculated using recent historical influent data for TSS and BOD.
    - The 2040 load projections are scaled from the current loads using a per capita basis analysis.

  The 20-year capital projects in the 2019 Plan were identified to improve and expand the City's wastewater collection and treatment facilities to meet future flow and load projections.

6.1 Introduction

The flow and load projections for the 2019 Plan have been updated to support the 2024 Plan Amendment. A detailed discussion of population, flow, and loading estimates is included in Section 6 of the 2019 Plan. This section summarizes the updated flow and load projections (Leeway, 2023), which were updated and applied to evaluate concepts and alternatives in Sections 9 and 10.

Additional supporting information for the flow and load evaluations is provided in Appendix B.1.

6.2 2024 Plan Amendment Updated Flow and Load Projections

This section summarizes the updated predictions of flowrates and waste loads for 2023 and 2040 based on recent repairs to the collection system, observed reductions in I&I, and additional collection system modeling. The updated projections are presented in Table 6-1 (Leeway, 2023) with additional detail included in Appendix B.1.

Table 6-1: Updated Predicted Flowrates for the WWTP

Design Condition	Projected Design Flowrate in 2023[(1)]	Projected Design Flowrate in 2040[(2)]
Peak Hour Wet Weather Flow (WWF)[(4)]	9.3 MGD	12.2 MGD
Maximum Month WWF (MMWWF)	2.0 MGD	3.6 MGD
Average Dry Weather Flow (ADWF)	0.9 MGD	2.2 MGD
Assumptions		
Population Annual Growth Rate		2.80%
Residential 2040 Population		22,600
Base Wastewater Peaking Factor for New Connections		1.6
Wastewater Demand for New Population (gallons per capita per day)		92.6
Peaking Factor for I&I assumed for new pipe to serve new population		1.5
I&I growth rate for old and new pipes (not rehabbed)[(3)]		5%

[1] Value estimated by Kennedy/Jenks.
[2] Value estimated by collection system modeling (Leeway, 2023).
[3] A 5% increase in infiltration and inflow assumption is incorporated for older pipes per decade in addition to anticipated connections to the sanitary sewer system as they age (Leeway, 2023).
[4] Assumed to be equivalent to PIF.

WWTP data from 2019 through 2022 were used to project the BOD and TSS waste loads into the plant by 2040. Influent TSS and BOD discharge monitoring report (DMR) data collected from 2019- 2022 were compared to the City population for the corresponding year to produce the BOD_5 and TSS loading factors in pound per capita per day (ppcpd). The maximum and average monthly loading factors for each year are presented in Table 6-2.

Table 6-2: Updated Influent Waste Load Contribution Data

	Per Capita Waste Load Contribution (ppcpd)					
	2019	2020	2021	2022	Max	Average
BOD						
Max Month	0.32	0.29	0.35	0.35	**0.35**	**--**
Average Day	0.22	0.23	0.27	0.20	**--**	**0.23**
TSS						
Max Month	0.33	0.25	0.33	0.30	**0.33**	**--**
Average Day	0.21	0.18	0.25	0.19	**--**	**0.21**

The 2030 population was estimated from the anticipated population and population growth rate in Table 6-1. The average and maximum TSS and BOD_5 loads to the plant in 2024, 2030, and 2040 were determined using the population estimates and above loading factors. The estimated influent loads, shown in pounds per day (ppd), are presented in Table 6-3.

Table 6-3: Projected Influent Waste Loads

	Influent Waste Loads (ppd)		
	2024	2030	2040
BOD			
Average	3,300	4,000	5,300
Maximum	5,000	6,000	7,900
TSS			
Average	3,000	3,600	4,800
Maximum	4,700	5,700	7,500

The updated flowrate and loading estimates are further discussed and applied in Section 8.5.

Section 7: Sanitary Sewer Collection System Evaluation

2019 PLAN | SECTION 7 SUMMARY

- Summarizes the pump station condition assessment, the wastewater collection system capacity analysis, and the hydraulic model assumptions.
  - System capacity is evaluated based on established design criteria for maximum allowable flow depth during dry and wet weather conditions, maximum velocity, and pump station capacity.
  - The hydraulic model is developed, calibrated, and used to simulate system responses for existing and future flows and to evaluate and recommend collection system capital improvement alternatives.
- Wet weather impacts to the system from the design storm event are evaluated, and capacity deficiencies and improvements are identified for the current system.
- The capacity improvement alternatives are developed at graduated levels of wet weather flow reduction, then combined and evaluated with corresponding treatment plant alternatives.
- A longer-term Rehabilitation and Replacement (R&R) program is recommended for on-going system maintenance.
- All improvements are evaluated at the master planning level for accuracy, which determines budget-level cost estimates for calculating system development charges (SDCs) and rates (user fees) to support the Capital Improvement Program (CIP).

Additional evaluation of sanitary sewer collection system improvements has been performed under separate contracts as part of the 2024 Plan Amendment. The *Draft Technical Memo (TM) - 2024 Wastewater Collection System Update (Stantec, 2024a)*, is included in Appendix A.2 and briefly summarized herein.

The 2019 Plan identified improvements to the collection system to provide capacity required to serve the projected growth under the recommended activities at that time. Since adoption of the 2019 Plan, the City has undertaken significant efforts to reduce I&I in the system and initiated capacity improvements to address needs of the system. The City has also implemented a Capacity, Management, Operation and Maintenance (CMOM) Program as a comprehensive strategy for managing the wastewater collection system, with efforts documented in the 2023 CMOM Implementation Report (Leeway, 2024a) and companion 2024 CMOM Strategic Plan (Leeway, 2024b). These documents define objectives and activities associated with the CMOM Program along with performance goals and schedules to meet those goals.

Stantec (2024a) documents improvements that have been completed since the 2019 Plan, identifies ongoing and upcoming activities, and provides an updated CIP for collection system activities, which are listed in Section 11.2.

Section 8: Existing Wastewater Treatment Plant Evaluation Update

2019 PLAN | SECTION 8 SUMMARY

- Provides an overview of the existing WWTP, review of applicable codes, and capacity evaluation of current WWTP and unit processes.
- Evaluates the existing WWTP based on a field evaluation and condition assessment of major unit processes.
- Identifies deficiencies and provides recommendations to address challenges impacting facility operations and maintenance upgrades necessary to keep the WWTP in good working order.
- 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.

8.1 Introduction

This section of the 2024 Plan Amendment focuses on updates to the existing WWTP since the 2019 Plan, providing information on new facilities, updating the condition of existing assets based on operator feedback, giving an updated capacity review and other rehabilitation, repair and replacement efforts.

Additional evaluation of WWTP improvements has been performed under separate contracts as part of the 2024 Plan Amendment. The *TM – Near-Term Plant Improvements at the WWTP (Stantec, 2024b)*, is included Appendix A.3 and briefly summarized herein.

8.2 Existing WWTP Evaluation Update

This section highlights some of the updates to the existing WWTP based on the evaluation and outcomes of the 2019 Plan.

8.2.1 WWTP Process Updates

Major updates to the existing WWTP in the last five years (since the 2019 Plan) are listed in Table 8-1.

Table 8-1: Process Updates Since the 2019 Plan

Project	Status	Relevance to 2024 Plan Amendment
Aeration Basin Plug Flow & Aeration Improvements	Installed in 2021-2022	Improved secondary treatment capacity, more efficient aeration
Surge Basin Improvements	Installed in 2022	Mitigates filamentous bacteria growth, improved sludge quality, maintains surge capacity.
Secondary Clarifier Mechanism Rehabilitation	Installed in 2022	Improved sludge collection and reduced TSS carryover
New Caustic Feed System	Installed in 2022	Mitigates low pH conditions during nitrification season
Waste Pump Station Rehabilitation	Installed in 2022	Replaced
New tertiary disk filters and diversion pump station	Installed in 2022	Increase hydraulic capacity, reduce effluent TSS, provide filtration redundancy
UV Closed Vessel Units	Installed in 2022	Provide additional treatment capacity and redundancy to existing UV system
Aerated Sludge Stabilization Basin Rehabilitation	Installed in 2022	Improve sludge quality before dewatering, reduce volatile solids.

8.2.1.1 Process Improvement Outcomes

In the time since the completion of the 2019 Facilities Plan was published, the process at the plant have been modified to improve treatment. Significant improvements include:

- Improved aeration control through blower valve modulation
- Replaced diffusers in aeration basins
- Added baffle walls in aeration basins
- Replaced and balanced clarifier mechanisms

As a result of these improvements:

- Dissolved oxygen levels in the aeration basins are consistently 2-3 ppm
- Mixed liquor suspended solids concentration has been improved in the secondary processing
- Secondary clarifiers are getting improved settling and compaction
- Tertiary filtration working better
- UV disinfection working better

Since these improvements plant has been able to consistently achieve TSS and BOD concentrations less than 10 mg/L.

8.2.1.2 Planned Improvements

The City is planning to make interim improvements prior to final design of the upgraded WWTP to replace or upgrade critical processes that are aging and failing. These process units are summarized in Table 8-2.

Table 8-2: Anticipated or In-Progress Projects Relevant to the 2024 Plan Amendment

Project	Status	Relevance to 2024 Plan Amendment
New medium-pressure ultraviolet (UV) disinfection	Planned 2024	Improve disinfection, provide redundancy
Effluent Pump Station Expansion	Planned 2024	Expand firm capacity to accommodate summer storm events
Replace ASSB Blower 2		Improve aerobic digestion in existing ASSB
Refurbish or replace Aeration Blower 4		Optimizes aeration when demand is low for process air
New Aeration Mixers		Improves biological process efficiency and consistency
New WAS Pump		Improve reliability with electric-driven pumps and add flow metering and SCADA programming
New Flow Meters and SCADA Programming		Improve process control of recycled flows to anoxic zone
Storage Pond Expansion		Add additional 750,000 gallon storage capacity to cut peak influent flows

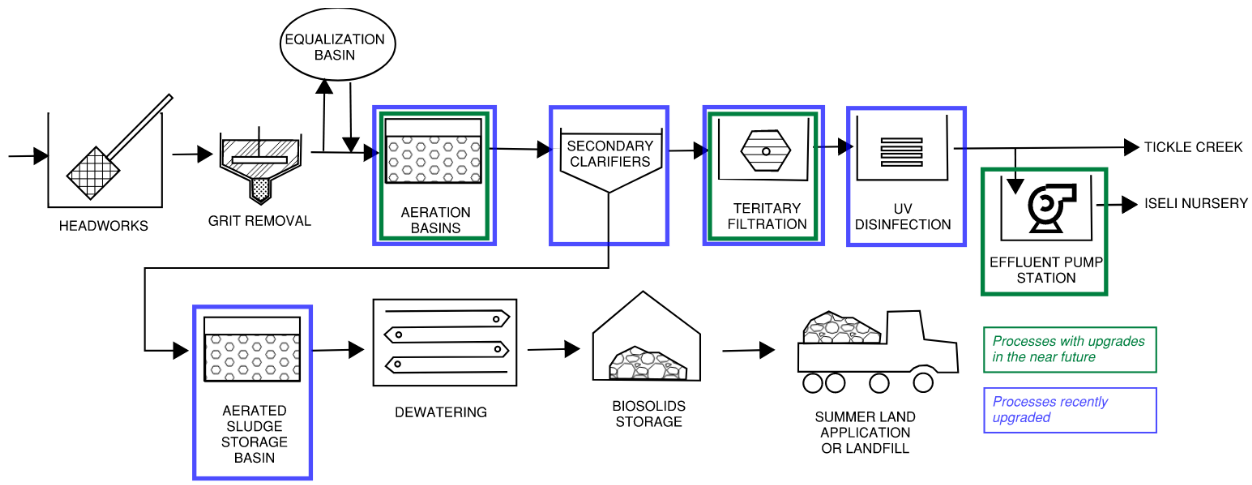
Additionally, areas in need of improvement for reliability are listed in Table 8-3.

Table 8-3: Reliability Improvement Projects Relevant to the 2024 Plan Amendment

Process Area	Relevance to 2024 Plan Amendment
Headworks Upgrade	Headworks screen is failing and in need of additional capacity and redundancy
Grit Classification Replacement	The grit classifier unit has been recently rebuilt to extend its useful life. It should be considered for replacement based on visual inspection and ongoing maintenance concerns.

Figure 8-1 illustrates recently updated process areas and process units designated for upgrades in the near future.

Figure 8-1: Existing WWTP Schematic Highlighting Recent and Future Process Updates



8.2.2 Condition Assessment Updates

The 2019 Plan included a comprehensive condition assessment and a list of recommended WWTP upgrades. In July 2020, Murraysmith developed the *Immediate Needs Improvements Project Preliminary Design Report* (2020 PDR). The 2020 PDR presented a preliminary design for the improvements required at the WWTP based on the recommendations in the 2019 Plan, the findings of the 2019 Condition Assessment (part of the 2019 Plan Update), and the improvements implemented in 2021 and 2022 (West Yost, 2021b).

West Yost prepared a Condition Assessment Improvements Project Report (2021 Condition Assessment), which identified additional immediate project needs beyond those identified in the 2019 Plan. The City then performed several operational and mechanical improvements to the WWTP after completion of the 2021 Condition Assessment. These improvements are summarized in Table 8-1.

The *Sandy Wastewater Treatment Facilities – Conditions Assessment Improvements Project* (West Yost, 2021) was prepared to evaluate the recommendations in the 2020 PDR and present a modified set of recommended improvements to more efficiently utilize the City's budget while also effectively addressing the current operational and maintenance deficiencies at the WWTP. These improvements were to be implemented under the City's WWTP Condition Assessment Improvements Project and completed in 2022. This report includes a "Wish List" that is intended to be a living document that can be changed over time to keep track of small and large improvements that the City wishes to complete.

8.2.3 Spare Parts, Repair, Replacement and Refurbishment Updates

The *City of Sandy Wastewater Treatment Facilities - Spare Parts and Repair, Replace, Refurbishment Prioritization Report* (Waterdude Solutions, 2022) evaluates the current WWTP facilities and develops a prioritized list of spare parts, as well as a list of identified repairs, replacements, and refurbishment needs. The primary objective of this effort was to identify current critical needs at the facility, increase reliability, maintain compliance, and prepare for an upcoming treatment system performance (stress) test.

- Spare parts are intended to facilitate rapid return to service upon a failure or detection of impending failure. The report includes a spare parts prioritization list and recommends a complete physical inventory of spare parts and a dedicated storage area to keep spare parts together.

- The report includes a prioritized list of identified repairs, replacements, and refurbishment needs, favoring current needs over the future considerations. Several repair and refurbishment projects led by the operators are underway at the WWTP.

Operation and Maintenance of the WWTP has been performed by contracted operators over the past several years. The current operations team, Veolia, began work in 2019. In 2021, a WWTP improvements project began and was completed in 2022. A treatment system performance test was conducted in 2023. As part of the next steps, the City, Veolia, Leeway, and WaterDdude are continuing to coordinate to track the repair budget, review expenditures of high-cost processes, and develop thresholds to support decision making.

8.2.4 Operator Feedback on Asset Conditions

As part of the 2024 Plan Amendment development, Kennedy Jenks received input from operators on asset conditions that impacted operations during and after the interim improvements completed in 2022. Table 8-4 provides additional information on the condition of key WWTP components base on operator feedback in 2023. Where feasible, we have incorporated these concepts into the alternatives considered in Section 9 and 10. Additional consideration will be given at the Pre-Design and Final Design phases of Engineering.

Table 8-4: Operator Feedback on Asset Conditions from 2023

WWTP Component	Recent Operator Input
W3 Pump Station	• Operators requested shelf spare pumps that will allow them to swap out when an in-service pump clogs.
Headworks	• Operators requested minimizing critical underwater equipment in screening, as well as installation that allows removal of the underwater components so they can be easily inspected and serviced. • Operators would like the grit system replaced with stacked plate settlers and no submerged equipment.
Aeration Basins	• Update anoxic zone mixers. • Install aeration basin instrumentation to monitor pH, ammonia, and alkalinity. • Install high-speed turbo blowers to improve efficiency, and reduce noise, vibration, footprint demands, and oil usage. • Add a spray system for the MLR basins and clarifier effluent channels to prevent scum accumulation and algae growth.
Secondary Clarifiers	• Update the scum removal system and pumps to avoid disruptions. • Install a sludge blanket level indicator.

WWTP Component	Recent Operator Input
	• Improve access to the inboard launders on the secondary clarifier for maintenance or prevent algae build-up via covers or a brush system.
RAS/WAS Pump Station	• Replace WAS air diaphragm pumps with electric motor pumps and reconfigure them for suction out of the RAS lines instead of aeration basin sumps. • Add RAS flow monitoring to each basin and WAS flow monitoring.
Equalization Basin	• Add instrumentation to monitor flowrate of wastewater pumping from the equalization basin. • Upsize the equalization basin to accommodate storm flows.
Tertiary Filters	• Reduce the maintenance requirements of the disc filters, which damage filter fabric pile where the backwash shoe touches the fabric.
UV Disinfection	• The UV system is failing, lamps are difficult to procure, and the UV unit is no longer supported by the manufacturer.
Dewatering and Solids Storage	• Add additional digesters. • Minimize the amount of dewatered solids going to landfills by improving the processing to produce Class B biosolids, and make efforts to move towards Class A processing. • Minimize the time demand of maintenance for the dewatered biosolids conveyor. • Improve the efficiency of and capability of the dewatering system.
Chemical Storage and Metering Facilities	• Replace chlorine supply tubing with rigid pipe to avoid the hazards of running the line above ground. • Evaluate and upgrade the chlorine storage tanks operation and seismic resilience. • Improve accessibility of pumps for maintenance. • Include instrumentation to monitor suspended solids, turbidity, and chlorine residual throughout the plant. • Chlorinate W3 water. • Replace jib cranes with swivel arm cranes.
Plant Air Compressor	• Wear on the current compressor concerns indicate replacement and/or removal of air-operated equipment.
Other	• Install solar panels to reduce energy costs. • Include a ceiling-mounted, mobile gantry in all applicable buildings. • Include hose reels for washdown in all process areas. • Remove unused buildings and equipment. • Additional exterior receptacles to minimize extension cord use. • Upgrade the interior lighting to LEDs to improve efficiency and reduce maintenance. • Prevent air from entering the water line from the potable well and inspect the line for leaks. • Evaluate the sufficiency of the generator power supply to support equipment during power failures. • Improve accessibility of yard hydrants. • Replace valves that are difficult to operate. • Remove encroaching dead trees. • Repair damaged fencing. • Improve break areas for crew members.

8.3 Existing WWTP Code Review

The existing WWTP code review from the 2019 Plan remains relevant to the 2024 Plan Amendment. The following Codes were referenced in the 2019 Plan and have since been updated. For further information, go to the applicable organization website for the latest code documents.

- Oregon Structural Specialty Code (OSSC), 2022
  - International Building Code (IBC)
- Oregon Fire Code (OFC), 2022
  - International Fire Code (IFC)
  - National Fire Protection Association (NFPA) Chapter 820
- Oregon Plumbing Specialty Code (OPSC), 2023
  - Uniform Plumbing Code (UPC)
- Oregon Electrical Specialty Code (OESC), 2023
  - National Electrical Code (NEC)
  - NFPA 70
- OR-OSHA (Oregon Occupational Safety and Health)
- Oregon Energy Efficiency Specialty Code (OEESC), 2024
- American Disability Act (ADA)
- Code of Federal Regulations (CFR)
- American Society of Civil Engineers (ASCE) 7 for Seismic Anchorage Design
- Local Land Use Requirements

At the time of the 2019 Plan, the following four items were recognized as needing additional analysis beyond the scope of the Facilities Plan review to further evaluate compliance at the Sandy WWTP. These items will receive a comprehensive review as part of Pre-Design:

- HVAC compliance
- Energy Efficiency Code
- Seismic Anchoring

- Electrical Code

In addition, the 2019 Plan identified that the following three conditions were not being met at the Sandy WWTP. These items have been addressed in the areas of the facility that have been updated since the 2019 Plan, however the rest of the WWTP is still in need of updates to address these deficiencies:

- Tepid eyewash/shower stations – current eyewash stations in the office/laboratory space do meet code requirements but are plumbed through the sink which is not ideal in emergency situations.
- Electrical clearances – a minimum of 42 inches of clearance should be provided in front of electrical panels and conspicuous signage shall be displayed in the working space.
- Hydrant requirements – portable fire extinguishers and hydrant protection must be provided as outlined in the 2019 Plan.

8.4 Electrical Capacity Considerations

The Sandy WWTP is served by a 480-volt, 3-phase, 4-wire electrical power distribution system. Standby emergency power is provided via a 750 KW diesel engine-generator with a 1200 ampere power output circuit breaker. The facility receives its power supply from a 12,470-volt, 3-phase overhead distribution line. A Portland General Electric (PGE)-owned 750 KVA transformer steps the transmission primary voltage down to the 480-volt secondary utilization voltage required for the WWTP.

A 2,000-ampere service entrance rated switchgear is the main distribution center for the electrical power system. In the time since the 2019 Plan, improvements to the WWTP have resulted in an existing load of approximately 1,810 amperes, leaving just under 200 amperes of spare capacity left for additional upgrades.

Any upgrades to the WWTP that will increase electrical load will require a larger electrical service. A discussion of electrical loads and existing capacities is presented for the complete recommended alternative in Section 10.6 to confirm the viability and size of electrical service, transformer, switch gear, and generator for the WWTP.

8.5 Existing WWTP Capacity Evaluation Update

For the 2024 Plan Amendment, three key flowrate criteria were updated following collection system repairs and one season of wet weather monitoring. The design flowrates and loadings were based on projections summarized in Table 6-1 and Table 6-3. Other influent parameters, such as ammonia-nitrogen, were developed from 2019 through 2022 influent DMR data.

8.5.1 Existing Plant Deficiencies

The existing plant processes are undersized for the projected peak flows and loading. As the city grows, additional connections will be made to the sanitary sewer thus increasing dry weather wastewater volumes. The City's CMOM program will mitigate some of the I&I; however, wet weather impacts to the collection system will increase as the system ages. Capacity upgrades are required to accommodate future dry weather and I&I wastewater volumes.

8.5.1.1 Headworks

8.5.1.1.1 Screening

A single inclined automatic rotary rake fine screen (1/4-inch aperture) captures and removes debris from the influent stream. A manually cleaned bar screen (3/4-inch aperture) provides backup screening to the automatic screen. The current screen has a firm capacity of 6.6 MGD, and if flowrate exceeds this value, the overflow passes through the manual bar screen.

The headworks does not currently have the capacity to accommodate current or projected peak flowrates, nor does it have space to install a second automatic fine screen. For this plant, at least two screens are recommended to provide redundancy of operation, and the two screens can be sized so firm capacity can treat the peak flowrate with the largest screen out of service and a manual screen to provide redundancy.

8.5.1.1.2 Grit Removal

No redundancy is required for grit removal systems, which can store 76 cubic feet of grit. The capacity of the existing 10-foot diameter grit chamber is 7.0 MGD. While grit removal is important for long-term protection of basins, piping, and equipment, short periods exceeding the process capacity, such as those encountered under peak conditions, are not anticipated to adversely affect plant performance.

The grit classifier has a challenging role handling the most abrasive wastewater stream in the plant. The existing grit classifier has recently been rebuilt to extend its useful life.

8.5.1.2 Aeration Basins

The existing basins and blowers are adequately sized to treat current waste loads at average and maximum month flowrates and waste loads with surplus capacity. New diffusers in the aeration basin have improved efficiency, and blower control has improved so the plant can operate using much lower power consumption and dissolved oxygen is controlled to maintain desirable concentrations. As a result, sludge quality has improved, and foaming is not a routine issue. The Operations team has developed procedures to produce high quality mixed liquor that settles well, with sludge volumes typically in the range of 130 to 175 mL. Reliability requirements dictate at least two aeration basins shall be provided, and this condition is met. As the influent loading increases, more aeration basin volume will be required, and the existing blowers will need to be adjusted accordingly.. In addition, the aeration basins will require additional volume to support biomass and associated solids retention time to provide reliable BOD_5 removal and nitrification.

Return activated sludge (RAS) pumps are currently slightly oversized and cannot be turned down enough to match the through flowrate of the aeration basins at low influent flowrates. An ideal configuration would use multiple smaller pumps to meet the RAS demand over its entire projected range.

8.5.1.3 Secondary Clarifiers

The secondary clarifiers are adequately sized to treat current average and maximum month flowrates. The clarifiers have recently rebuilt sludge and scum collecting mechanisms and perform well. Historically, projected peak day and peak hour flowrates would exceed recommend surface loading rates, resulting in sludge blanket loss and permit limits exceeded. However, recent process updates and Operator changes to process control have improved the mixed liquor concentration and sludge settling and compaction to avoid these occurrences.

8.5.1.4 Disinfection

The disinfection system is currently sized to treat 10.5 MGD, which is approximately equivalent to the current PIF with no standby capacity. Redundancy requirements call for a minimum of two units with a minimum dose of 30 mJ/cm^2 at peak flowrate with all units online. However, if one unit were to fail during a PIF event, it could cause a permit limit to be exceeded.

8.5.1.4.1 Tertiary Filtration

The existing plant has three disc filter units with a total capacity of 10.5 MGD. Redundancy requirements call for more than one filter to be installed so that at least one unit can remain in operation during backwash and service events. However, if one unit were to fail during a PIF event, it could cause a permit limit to be exceeded.

8.5.1.4.2 Chlorine Residual

Recycled water irrigation requires a chlorine residual before pumping to the Iseli Nursery. Concentrated (12.5%) Sodium hypochlorite is pumped to the effluent chlorination chamber before pumping. The existing system has redundant sodium hypochlorite pumps and meets redundancy requirements.

8.5.1.5 Tickle Creek Outfalls

Outfall 001 to Tickle Creek is located approximately 7,350 feet downstream of the WWTP and has a capacity of 4.0 MGD. During the discharge seasons, when Outfall 001's capacity is exceeded, emergency Outfall 003 can be activated to pass an additional 7.0 MGD. This will allow the current PIF to pass, however, it will not pass the 2040 PIF of 12.2 MGD. Under 2040 PIF conditions, the limited outfall capacity would result in raising water surfaces in the treatment basins, and diverting screened/de-gritted influent to the equalization basin. If the peak flowrate were to occur for an extended time, the aeration basins and secondary clarifier levels would rise and could overflow. Therefore, additional outfall capacity will be required.

8.5.1.6 Effluent Pumps

Existing effluent pumps are capable of pumping 2.5 MGD to Iseli Nursery with one pump out of service. The ADWF is currently 0.9 MGD and the Maximum Month Dry Weather Flowrate (MMDWF) was projected in the 2019 Plan to be 2.4 MGD by 2040. The effluent pumps are adequate under most conditions, however, there were two major wet weather events in 2021 that resulted in higher dry weather flowrates which exceeded the effluent pumping capacity. In addition, wet weather events during the non-discharge season can overwhelm Iseli Nursery's ponds. This evaluation considered pumping more recycled water to Iseli Nursery working under the understanding they can accept up to 5 MGD.

8.5.2 Existing Process Unit Summary

A summary of process unit limitations and needs is provided in Table 8-5.

Table 8-5: Hydraulic Capacity Limitations

Unit Process	Existing Capacity (MGD)	Additional Capacity Required (MGD)	Notes
Fine Screening	6.6	5.6	Manual bar screen provides standby capacity
Manual Screening	6.6	--	Estimated
Grit Removal	7.0		Standby not required for short times
Aeration Basin	7.0	5.2	Plan to treat MMWWF with 1 train out of service
Secondary Clarifiers	6.9	5.8	Assuming 1,600 gpd/sf peak surface loading rate
Tertiary Filtration	9.5	2.7	Recommend treat MMWWF with 1 train of service
UV-Disinfection	10.5	7.0	Recommend treat MMWWF with 1 train out of service
Gravity Outfall 001	4.0	--	
Gravity Outfall 003	7.0	1.2	Emergency Use
Effluent Pumps Outfall 002	2.5	2.5	Iseli Nursery

Section 9: Initial Wastewater Systems Alternatives Evaluation Update

2019 PLAN | SECTION 9 SUMMARY

- Evaluates wastewater system alternatives available to the City to most cost-effectively manage the wastewater collections, treatment, and discharge for the planning horizon from 2019 through 2040 and beyond.
- Initial alternatives evaluation assumes 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:
  - 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 I&I and WWTP peak flow reductions; and
  - WWTP upgrades for treating the full range of flows for the collection system alternatives.

This section of the 2024 Plan Amendment focuses on updates to the discharge requirements and initial wastewater systems alternatives evaluations since the 2019 Plan, providing new information on summer and winter discharge options.

9.1 NPDES Permit and Discharge Evaluation Update

From November through April, the NPDES Permit allows the City to discharge treated effluent to Tickle Creek. The permit stipulates that in the dry season months of May to October, alternate discharge locations for the treated WWTP effluent must be utilized, and no discharge to Tickle Creek is allowed.

To understand and compare the expected discharges to Tickle Creek from the WWTP to the existing NPDES permit limits, an analysis of future waste loads and potential treatment processes was completed. This analysis is detailed in Appendix B.3 and summarized in the following sections.

9.1.1 Winter Discharge

Tickle Creek is located in the Clackamas River Basin and subject to Oregon's Three Basin Rule (OAR 340-041-003) as described in Section 1. Tickle Creek flowrate is recorded twice per week during the wet weather season and is reported in the WWTP's DMRs. This flow data was used in conjunction with the WWTP effluent discharge data to determine the dilution ratio for the wet weather seasons from May 2019 through April 2021. The minimum allowed dilution ratio of stream flowrate to WWTP effluent discharge is 10 to 1.

When the ratio of Creek flowrate to effluent flowrate is less than 10 to 1, the discharge exceeds permitted limits and could result in a permit violation. To mitigate this exceedance, a portion of the effluent could be stored and recycled for beneficial use.

This section summarizes an analysis of discharge to Deep Creek and to an effluent storage pond at Iseli Nursery. Details of the analysis are provided in Appendix A.3.

9.1.1.1 Tickle Creek Discharge Limitations

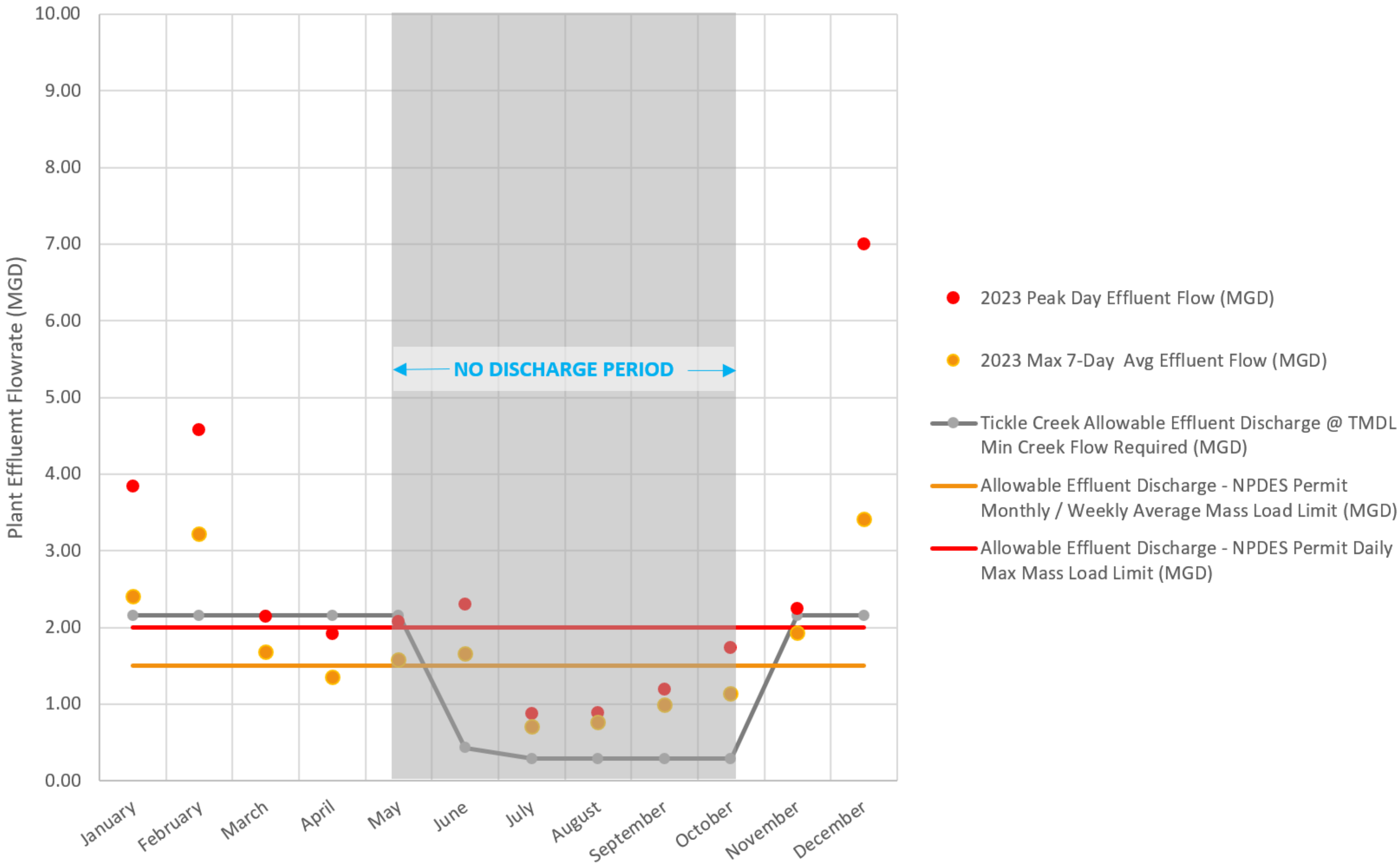
Tickle Creek flowrate was used to develop an understanding of its seasonal discharge. This data was used to calculate the dilution ratio for the wet weather seasons from May 2019 through April 2021. The evaluation revealed that (on days the stream gauge was read) 15% of the calculated dilution ratios were less than the permitted minimum value of 10.

WWTP effluent flowrates were extrapolated 20 years using an estimated wet weather flow increase of 55% and compared against recorded creek flows (based on peak day flow projections). The dilution ratio was recalculated for future wet weather seasons from May 2039 through April 2041. A summary of this information is shown in Figure 9-1.

The USGS streamflow database (Streamstats) for Tickle Creek and DMR reported effluent discharge flowrate indicate in spring near the end of the WWTP effluent discharge season the flowrate in Tickle Creek declines relatively quickly in the spring, while rainfall impacts on I&I have historically remained high well into early summer. Based on StreamStats and the reported discharge flowrates, during April 2023, as many as 28% of days have experienced discharges resulting in a dilution ratio less than 10 to 1. This finding also aligns with the 2019 Plan findings.

Figure 9-1 illustrates the allowable effluent discharge based on dilution (gray line), based on weekly average BOD/TSS limits (orange line), and based on Daily Maximum BOD/TSS limits (red line). The gray line indicates there may be some days in November (during the discharge season) when Tickle Creek flowrate is too low to provide 10 to 1 dilution to the WWTP's effluent.

Figure 9-1: Tickle Creek Capacity Evaluation for Current (2023) Conditions



To comply with the 10 to 1 dilution limit, the WWTP would need to discharge into a larger stream. Alternatively, if the City can negotiate a lower dilution ration, the facility may be allowed to continue to discharge if wasteloads do not increase.

Section 9.1.1.2 summarizes an evaluation of extending the outfall to Deep Creek to take advantage of greater stream flowrate.

9.1.1.2 Deep Creek Discharge Limitations

Similar to Tickle Creek, Deep Creek is within the Three Basin area, and also subject to no increase in mass load limitations. Tickle Creek is tributary to Deep Creek, which is larger and has a greater stream flowrate documented in the Deep Creek StreamStats. For this analysis, no change to effluent mass load limits was assumed, and the 10 to 1 dilution ratio would also apply to Deep Creek discharge. The analysis found that, like Tickle Creek, 9% of the calculated dilution ratios in April would fall below the allowed minimum value of 10.

This WWTP effluent data was then extrapolated 20 years using an estimated wet weather flow increase of 55% and compared against recorded creek flows. The dilution ratio was recalculated for the wet weather seasons from May 2039 through April 2041. It is estimated that by the end of the planning period, 21% of the dilution ratios would be below the permitted minimum value of 10. This indicates that discharging solely to Deep Creek during wet weather is not a viable option, and alternate options should be considered.

Figure 9-2 shows the results of this comparison and overlays dilution limits, mass load limits, historical creek flow data, and plant effluent data all in terms of plant effluent flow. Note that current maximum 7-day average flows and peak day flows consistently exceed the discharge limits in the NPDES Permit. This indicates that as plant effluent flows increase over time, discharge to Deep Creek would also result in exceedances of permit limits, and there would be little benefit to the City relocating Outfall 001 to Deep Creek under the 10 to 1 dilution minimum.

9.1.1.3 Tickle Creek and Deep Creek Conclusions

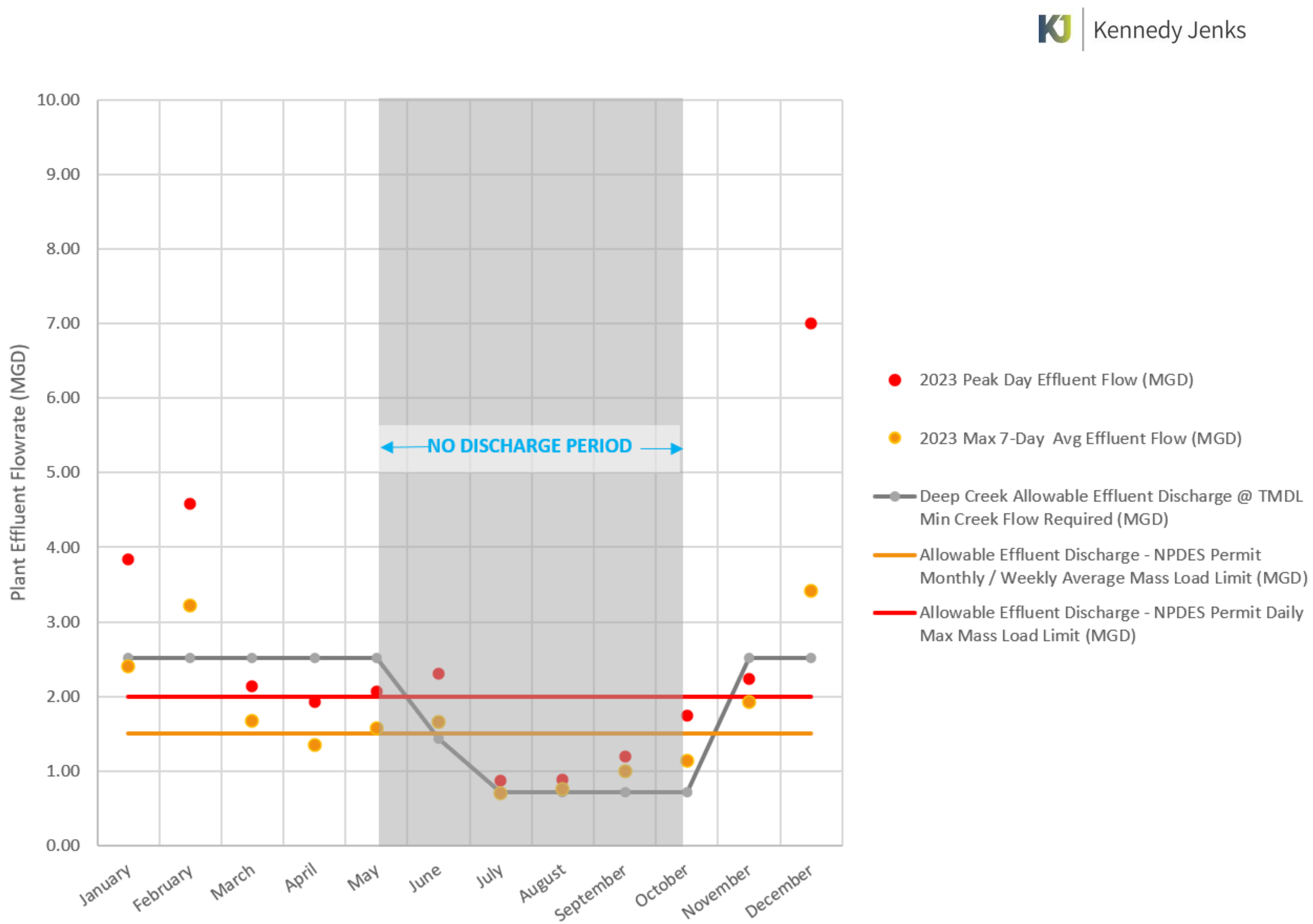
Discharges to Tickle Creek or Deep Creek were evaluated for dilution capacity based on available stream data. The data comparison between StreamStats and effluent DMR data at the plant is reasonable for the “planning-level” assessment of this amendment. The collection system responds quickly resulting in high effluent peak flowrates during the shoulder seasons (April and November). Based on storm events in 2021 through 2023, this could result in discharges that do not meet the 10 to 1 dilution ratio. The changing nature of weather in the Pacific Northwest indicates storm patterns could continue to drive wastewater peaks that results in issues with dilution in Tickle Creek and in Deep Creek.

Options for continued discharge to Tickle Creek include:

- Increased storage during the shoulder seasons to attenuate effluent volumes, and discharge of a portion of the effluent to another basin, such as the Sandy River

- Subsurface infiltration of effluent under a revised permit.

Figure 9-2: Deep Creek Capacity Evaluation


Kennedy Jenks
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Plant Effluent Flowrate (MGD)
NO DISCHARGE PERIOD
January
February
March
April
May
June
July
August
September
October
November
December
2023 Peak Day Effluent Flow (MGD)
2023 Max 7-Day Avg Effluent Flow (MGD)
Deep Creek Allowable Effluent Discharge @ TMDL Min Creek Flow Required (MGD)
Allowable Effluent Discharge - NPDES Permit Monthly / Weekly Average Mass Load Limit (MGD)
Allowable Effluent Discharge - NPDES Permit Daily Max Mass Load Limit (MGD)

- Pursuing a lower allowed dilution ratio may allow the City to discharge to Tickle Creek through Outfall 001. Such a reduced dilution ratio requires study to assess discharge of BOD_5, TSS, and Ammonia-N during lower streamflow periods for thier impacts on threatened or endangered species in Tickle Creek, Deep Creek, and the Clackamas River.

These options are discussed in subsequent sections.

9.1.2 Summer Discharge Options

9.1.2.1 Iseli Nursery

The City has an agreement in place to send Class B recycled water to the Iseli Nursery from May through October. Recycled water is pumped to Pond 4, where it is distributed to three other ponds and used for irrigation. With effluent flowrates anticipated to increase over time, the existing storage or Nursery usage will need to increase to store the recycled water during the summer months and provide storage for flows exceeding permit limitations during the winter months.

9.1.2.1.1 Iseli Expansion

The City and Nursery held discussions to assess interest and feasibility of expanding their existing storage ponds and increasing recycled water usage. This included an expansion of existing Pond 4 from 1.7 MG to 3.7 MG, construction of a new 33-MG Pond 5, and construction of a new pump station at Pond 5 to transfer recycled water to the other irrigation ponds. A summary of the total potential storage, including the existing storage at the WWTP and proposed recycled water ponds at the nursery, is summarized below in **Table 9-1**.

Table 9-1: Total Available Pond Storage

Name	Storage (MG)
Existing Pond 1	1.8
Existing Pond 2	3.1
Existing Pond 3	14.7
Existing Pond 4	1.7
Existing WWTP Storage Pond	2.4
Total Existing Storage	**23.7**
Pond 5 Phase 1	11.9
Pond 5 Phase 2 [1]	32.6
Total Planned Storage	**48.2**
Total Existing and Planned Storage	**68.2**

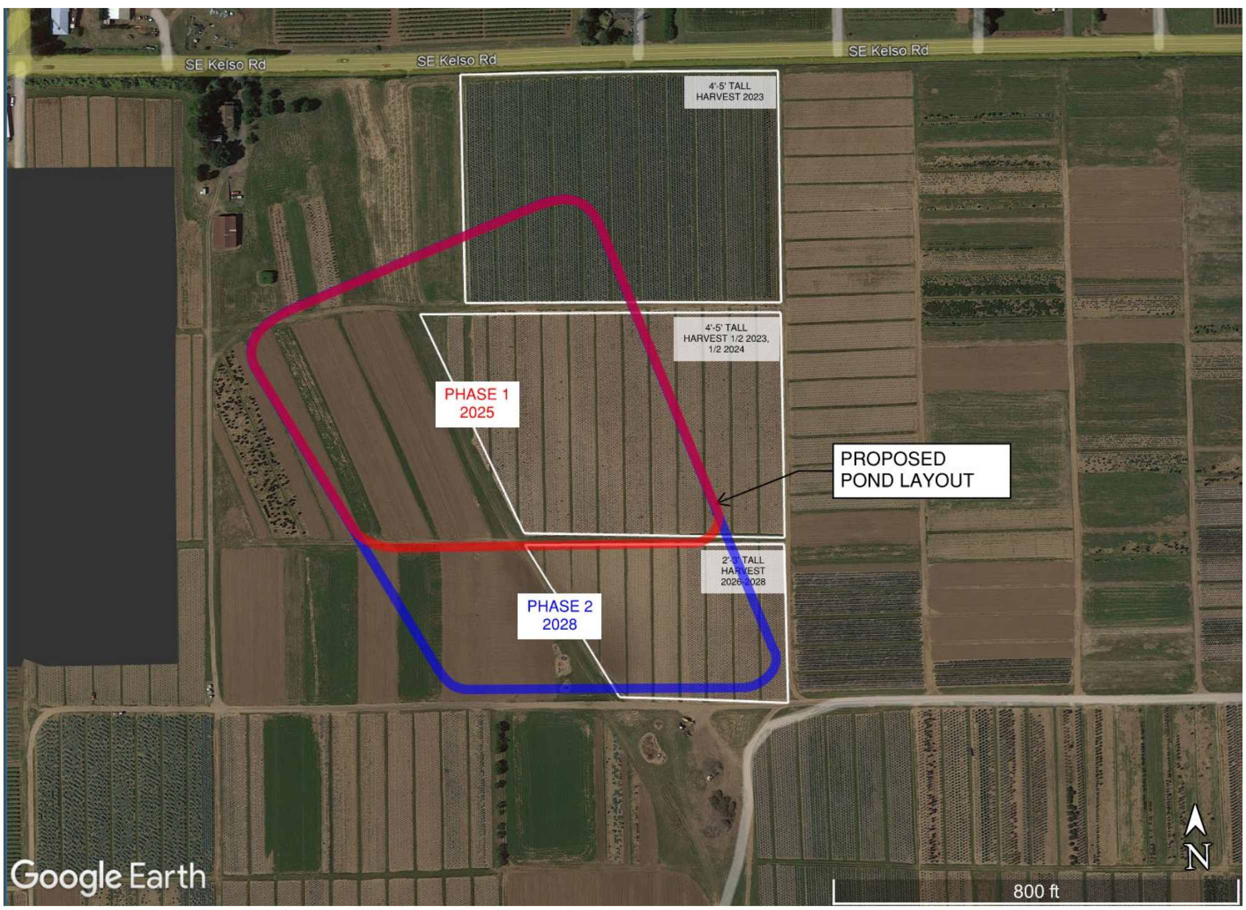
[1] This 2nd phase will be constructed in 10 years after newly planted saplings are grown.

Expansion of Pond 4, where the Nursery stores the City's treated effluent, would be accomplished by expanding the footprint slightly and raising the top of dike elevations. The feasibility of this work has not been assessed and depends significantly on the geotechnical conditions. Pond 4 sits near a slope, and the Nursery is not aware of a geotechnical assessment completed for this pond. There may be risks related to expanding this pond horizontally or vertically, and any consideration of this option would require field investigation and development of a preliminary design to use in evaluating stability of the pond. The amount of storage required is approximately 70 MG, so adding 3.7 MG in Pond 4 would improve the conditions, but may carry with it significant risk. For this reason, this report focuses on a new Pond 5.

Figure 9-3 shows the proposed Pond 5 at Iseli Nursery that would allow storage for an additional 48 MG and would attenuate discharge of effluent to Tickle Creek for approximately 5 years. The phasing of the pond is based on storage need and the harvest schedule for the plantings. By 2028, all plantings in the areas proposed for the pond would be harvested and available if the Nursery agreed to dedicate this land to the pond. It is estimated that there is approximately 39.3 MG of total potential storage for recycled water in the near future and 71.9 MG within the next 10 years.

The downstream (North) end of proposed Pond 5 would border a mapped wetland, which may require mitigation. This and other permitting considerations may impact the project schedule.

Figure 9-3: Proposed Effluent Storage Pond at Iseli Nursery



9.1.2.2 Iseli Expansion Cost

The total cost to construct the storage pond shown in Figure 9-3 is $35 million, and includes demolition, excavation, fill, gates, wetland mitigation, polyethylene liner, pumps and controls, piping, and electrical service.

The cost to construct the 33 MG Pond 5 is considerable and would not extend the Tickle Creek discharge beyond approximately 5 years before the pond capacity was exceeded due to wastewater growth from the growing City. Based on the cost and limited benefit, the City determined storage is not a good investment, considering the Sandy River outfall is an option.

9.1.3 Effluent Infiltration

The team considered infiltration as an option for treated effluent. Project Geotechnical Engineering partner Shannon & Wilson conducted test pits near the location of proposed Pond 5. The infiltration rate in the native soils of the nursery were low, and the presence of a drain tile system throughout the nursery resulted in shallow groundwater observed in multiple test pits. The Nursery’s practices resulting in shallow groundwater presents an ongoing obstacle to surface infiltration of effluent at the site. For this reason, infiltration is not feasible at this site.

9.1.4 Discharge Option Conclusions

Winter Discharge of effluent in 2040 can meet current permitted mass load limits if secondary treatment and tertiary filtration can meet a 1.5 milligrams/Liter (mg/L) BOD_5 and TSS concentration, respectively. The 10 to 1 dilution ratio may not be met in November. Summer discharge will not be allowed due to current permit requirements and dilution requirements (see Section 1.1).

The City’s existing NPDES permit has been administratively extended since its expiration in 2013. Sandy applied for renewal of the existing NPDES permit in 2023, and a draft permit is currently being developed by DEQ. Until an alternate discharge can be secured, the city is seeking the inclusion of interim limits and conditions in the discharge to Tickle Creek that reflect the current capabilities of the WWTP and the limited options for effluent management during the spring and fall shoulder season when there is little or no demand for recycled water. Interim measures include the following:

- Permitting higher BOD and TSS mass loads for near-term flows and current treatment capabilities.
- Authorizing discharge to Tickle Creek during the late spring (i.e., May/June) and early fall (i.e., October) period when there is little or no demand for recycled water and effluent storage is full.
- Modifying the dilution requirement to reflect the existing dilution requirement in the Oregon Administrative Rule, or to waive the dilution requirement as has been allowed in effluent-dominated streams in Oregon.

The Sandy River outfall is currently being planned as a discharge option for the City, which will allow for year-round discharge. The timing may be of concern, as the Sandy River outfall is expected to be constructed, permitted, and in service by approximately 2033. If the WWTP improvements can extend the Tickle Creek discharge until 2033, then the Sandy River outfall is anticipated to be in service. The City is pursuing a lower dilution criteria to continue to discharge to Tickle Creek without violating their permit in the interim.

9.2 Recommended Long-Term Biosolids Approach

The 2019 Plan recommended the City move to a biosolids process that not only provides for greater volatile destruction (e.g. digestion) and a smaller footprint, but also produces a marketable Class A biosolids product. The 2019 Plan further indicates that this product will significantly reduce the long-term solids storage space needed onsite and provide for opportunities to market the product locally for beneficial reuse.

The 2024 Plan Amendment revisits the options for long-term biosolids management by exploring four biosolids treatment concepts, as described next and applying the initial biosolids treatment process screening approach introduced in Section 5.

The City currently sends dewatered biosolids to landfill year-round. If the City continues to operate the existing process and continues to landfill biosolids, the facility remains in compliance with both NPDES permit limits and Biosolids "503" regulations. If the City wishes to land-apply biosolids, significant upgrades to the solids treatment process would be required to meet Class B or A biosolids characteristics to comply with biosolids regulations. If the City wishes generate Class A biosolids that can be used without restriction, the cost to upgrade the biosolids treatment process would be significantly higher, as described in Section 9.2.3.1.

9.2.1 Current Solids Treatment Concept

Currently, sludge is stored in the aerated sludge storage basin (ASSB) and is pumped to a belt filter press for dewatering using a submersible pump inside the storage basin. The existing ASSB is comprised of rehabilitated packaged-treatment plant basins. There is a center basin surrounded by two wells. The center basin and two surrounding cells have been retrofitted into an aerobic digester. The center cell of the aerated sludge storage basin has a storage volume of 90,000 gallons. All cells pump decant to the headworks. The projected 2040 flows and loading will require 603,000 gallons of digester volume to maintain minimum solids retention times (SRT) of 40 to 60 days. Based on this requirement, the existing stabilization and storage basins have insufficient volume for aerobic digestion of 2040 projected solids.

On the northeast side of the plant, a solids handling building houses a belt filter press, biosolids conveyance equipment, polymer mixdown equipment, and instrumentation and controls. Sludge from the ASSB is pumped to the belt filter press feed pump. The belt filter press feed pump sends sludge into the belt filter press. After passing through the belt filter press, the dewatered sludge exits into a hopper with a dewatered sludge pump. The dewatered sludge pump moves dewatered sludge through a series of piping before discharging into the solids storage area on the south side of the solids building. The building is comprised of a concrete slab, ecology blocks, a metal canopy, and an outdoor covered dewatered sludge storage slab.

The aerated sludge storage basin is in fair condition and was recently rehabilitated to provide improved aeration and sludge transfer capability. The belt filter press was recently rehabilitated and is performing well. There is a single BFP, which meets reliability requirements, however, the City may consider a secondary method of dewatering in the future to provide some redundancy during maintenance of the BFP. The primary issue with the dewatering system is the system conveying dewatered cake, which frequently fails. All of the biosolids alternatives presented in this report include a new conveyor system to replace the existing pump.

9.2.2 Biosolids Treatment Goals

The City has a stated goal of producing Class A biosolids. The EPA 503 Rule establishes requirements for final use or disposal of biosolids. Class A biosolids are biosolids that are safe for handling and use by the general public and could be made available for public use as a soil amendment or fertilizer. In addition, after a Class A biosolids distribution program is established, this could be a revenue source for the City. There is a need for fertilizer production in the region, so there is potential demand for a Class A product.

Subpart D of the EPA 503 rule sets pathogen and vector attraction reduction requirements to achieve each biosolids classification. Class A biosolids are treated so that that there are no detectable pathogens, while Class B biosolids have a reduced level of pathogens. To achieve Class A biosolids, the facility would need to implement advanced sludge stabilization. Typical methods to achieve Class A biosolids pathogen and vector reduction requirements include alkaline stabilization with a supplemental heat source, anaerobic or aerobic digestion with thermal drying, or alkaline stabilization with composting.

Anaerobic digestion is not practical in a WWTP that does not produce primary sludge, therefore aerobic digestion is the most practical approach to digestion for the city specifically. Class A biosolids can be achieved without digestion, though it is more common to reach Class A via digestion prior to drying. The resulting Class A dried product is suitable for public use and requires no physical setbacks for agricultural application. To accomplish Class A biosolids within the site constraint limits will likely require the installation of new dewatering equipment and a solids dryer.

9.2.3 Solids Treatment Concepts

The 2024 Plan Amendment includes a review of several concepts for expanding the sludge dewatering, stabilization/drying, and biosolids storage system and arrived on four possible solids treatment concepts listed below from highest to lowest level of treatment.

1. Class A Aerobic Digestion, Dewatering, and Dryer
2. Class A Non-Digested with ASSB, Dewatering, and Dryer
3. Class B Aerobic Digestion and Dewatering
4. Non-Digested with ASSB and Dewatering

The City discontinued the use of lime at the facility several years ago. Therefore, alkaline stabilization methods were immediately ruled out.

Preliminary conceptual level costs for these concepts were developed, and summarized herein with detailed cost tables and assumptions provided in Appendix C.

9.2.3.1 Concept 1: Class A Aerobic Digestion, Dewatering, and Dryer

Concept 1 produces the highest quality biosolids, with the following components:

- Aerobic digestion in a new set of aerobic digesters to reduce volatile solids content and stabilize biosolids.

- Dewatering in new solids processing equipment that will increase solids content from 12% to 18%.

- Thermal Drying in heat producing equipment to increase solids content between 80% to 90%.

Aerobic digestion provides stabilization and the added benefit of end-product odor control. Thermal drying provides additional pathogen and vector attraction reduction. Thermal drying would require improvements to the sludge dewatering system. This concept is a reliable way to meet Class A pathogen and vector attraction requirements.

9.2.3.1.1 Aerobic Digester

Preliminary design calculations indicate that the aerobic digester would require a volume of approximately 600,000 gallons to maintain an SRT of 40 to 60 days year-round through the 2040 plan year. An SRT of 40 to 60 days is typically the minimum SRT for aerobic digestion, depending on the season. The existing ASSB does not have the volume necessary to achieve the required SRT for aerobic digestion throughout the plan year.

The new digester will be a set of rectangular concrete tanks with a wall height of approximately 20 feet, and a length and width of 100 feet by 50 feet. There is no available space at the plant for a digester of this size within the developed areas of the plant, and available space around the liquid treatment areas will need to be used for expansion of the liquid stream processes. The area northeast of the existing biosolids handling building is relatively flat and has no existing structures. This area is large enough for the digester and the most suitable location.

9.2.3.1.2 Biosolids Dewatering

Screw presses and fan presses were considered for dewatering. Screw presses provide a consistent and reliable solids concentration of 15% to 18% solids which is acceptable solids concentration for most dryers. Screw presses are simple to operate and inexpensive to maintain but have a significant capital cost. Energy costs are typically low for screw presses.

Fan presses, also known as rotary presses, are an inexpensive option that may be more suitable for the City. Rotary presses are modular and can expand as flows and loads increase. They require more maintenance than screw presses but do provide a relatively consistent solids concentration of 16-18% solids. Rotary presses typically have higher energy costs than screw presses.

Dewatering requires use of a polymer product to improve dewatering characteristic of the biosolids. Bulk polymer will be stored in totes and prepared for use in a package polymer make-down unit before mixing with biosolids.

9.2.3.1.3 Biosolids Drying

Thermal drying is applied to the dewatered biosolids to produce a product that is 80% to 90% solids in content and resembles soil in texture. This evaluation considered belt dryers and paddle dryers. Paddle dryers operate at higher temperature than belt dryers and should be operated 24-hours per day until the sludge is completely processed. Generally, paddle dryers have lower operating and maintenance costs and have more manageable maintenance schedules than other methods. Paddle dryers also have smaller footprints than belt dryers, which is a significant limiting factor for this facility.

Belt dryers are a low-temperature option and can be operated intermittently and are commonly operated 8- to 12-hours per day. They generally require more operation and maintenance labor than paddle dryers and often have a capital cost higher than paddle dryers. Belt dryers have a larger footprint that increases significantly with the solids feed rate.

9.2.3.1.4 Dewatered/Dried Biosolids Storage

The facility stores dewatered biosolids on a concrete slab under a metal canopy, contained by concrete blocks. Biosolids are loaded from the storage area to trucks by a contracted service, and then hauled to a landfill for disposal. This method of storage is effective for the current practice; however, the City is subject to rising costs for loading/hauling and landfill disposal.

The City prefers to continue using the bulk storage area method, but the existing canopy is damaged, and the area does not have adequate space for long-term storage. A simple solution would be to build a similar storage bay directly northeast of the new dryer room, with a concrete pad, CMU blocks, and canopy to protect biosolids from weather. An inclined screw conveyor would transfer biosolids from the dryer to the storage area.

9.2.3.1.5 Biosolids Concept 1 Summary

Biosolids Concept 1 is summarized below:

- Digestion - Build aerobic digester and digester control building with blowers and pumps northeast of the existing solids building. Digestion will reduce VSS content and stabilize biosolids. Continue to use existing ASSB for additional storage and aeration volume.
- Dewatering - Remove belt filter press, hopper, polymer feed system, and conveyance system from dewatering building and replace with two screw presses.
- Dryer - Convert solids storage area into dryer room by finishing walls and new roof with electrical, plumbing, and ventilation. Install paddle a dryer to generate Class A biosolids. Install a dried solids conveyor system to transport solids from the dryer to new solids storage area.
- Biosolids Storage Building – Construct a new concrete slab/CMU building with ventilation northeast of new digester. Stockpile dried solids in the building for periodic load out and disposal.

The process outlined for Concept 1 produces the highest quality biosolids that can be used without restriction, can be used by the public without concern, and offers the City the most flexibility with disposal options.

The total estimated capital cost for this Solids Concept 1, with contracting, engineering, contingency, and escalation included, is approximately $43 million.

Operating Energy Costs for Biosolids Concept 1 are summarized in **Table 9-2**. Costs for polymer would be equivalent amongst all dewatering alternatives and were not included in operating estimates.

Table 9-2: Summary of Biosolids Concept 1 Energy Costs

Unit Process	Type	Operating Hours Per Week	Weekly Power Consumption (kWh)	Estimated Weekly Energy Cost
ASSB	Existing ASSB	168	8,960	$900
Aerobic Digester	New Digesters	168	50,740	$5,800
Dewatering Unit	Screw Press	120	270	$30
Dryer Unit	Paddle Dryer	120	5,420	$1,200[1]
WEEKLY ENERGY COST				**$7,930**

[1]Includes Electrical and Natural Gas Costs at year 2040

The annual cost to operate Concept 1 is approximately $250,000 before inflation. The net-present value over the course of the 20-year planning period for operations and maintenance is approximately $3,690,000, assuming a 3% annual inflation rate.

9.2.3.2 Concept 2: Class A Non-Digested with ASSB, Dewatering, and Dryer

Concept 2 produces high quality biosolids, with the following components:

- Retain existing ASSB for storage of approximately 15 days of sludge in 2040. Continue to aerate sludge.
- Dewatering in new solids processing equipment that will increase solids content to 12% to 18%.
- Thermal Drying in heat producing equipment to increase solids content to 80% to 90%.

9.2.3.2.1 Aerated Sludge Storage Basin

Existing Aerated Sludge Stabilization Basin will be retained for partial volatile suspended solids (VSS) destruction and storage of up to 270,000 gallons of sludge to feed biosolids processing equipment. This volume will store approximately 15 days of sludge from estimated 2040 flows and loading.

9.2.3.2.2 Biosolids Dewatering

Dewatering of stabilized sludge will take place in the same manner as described in Section 9.2.3.1.2.

9.2.3.2.3 Biosolids Drying

Drying of stabilized sludge will take place in the same manner as described in Section 9.2.3.1.3.

9.2.3.2.4 Dewatered/Dried Biosolids Storage

Storage of dried biosolids will take place in the same manner as described in in Section 9.2.3.2.4.

9.2.3.2.5 Biosolids Concept 2 Summary

Biosolids Concept 2 is summarized below:

- Retain the existing ASSB, but do not upgrade to aerobic digestion. The existing ASSB does not have enough volume to reliably produce Class B biosolids. However, it can provide some VSS destruction and minimizes odors from stored sludge.
- Dewatering - Remove belt filter press, hopper, polymer feed system, and conveyance system from dewatering building and replace with two screw presses or a fan/rotary press.
- Dryer - Convert solids storage area into dryer room by finishing walls and new roof with electrical, plumbing, and ventilation. Install paddle a dryer to generate Class A biosolids. Install a dried solids conveyor system con transport solids from the dryer to new solids storage area.
- Biosolids Storage Building – Construct a new concrete slab/CMU building with ventilation northeast of new digester. Stockpile dried solids in the building for periodic load out and disposal.

The process outlined for Concept 2 produces Class A biosolids that can be used without restriction and offers the City many options for disposal. The primary drawback from the use of the biosolids product from this Concept is that the lack of VSS destruction can result in odors when the product becomes wet after use.

The total estimated capital cost for this Solids Concept, with contracting, engineering, contingency, and escalation included, is approximately $30 million.

Operating Energy Costs for Biosolids Concept 2 are summarized in Table 9-3.

Table 9-3: Summary of Biosolids Concept 2 Energy Costs

Unit Process	Type	Operating Hours Per Week	Weekly Power Consumption (kWh)	Estimated Weekly Energy Cost
ASSB	Existing ASSB	168	8,960	$900
Dewatering Unit	Screw Press	120	270	$30
Dryer Unit	Paddle Dryer	120	5,420	$1,500[1]
WEEKLY ENERGY COST				**$2,430**

[1] Includes Electrical and Natural Gas Costs

The annual cost to operate Concept 2 is approximately $70,000 before inflation. The net-present value over the course of the 20-year planning period for operations and maintenance is approximately $1,000,000, assuming a 3% annual inflation rate.

9.2.3.3 Concept 3: Class B Aerobic Digestion and Dewatering

Concept 3 produces Class B biosolids with the following components:

- Digestion - Build aerobic digester and digester control building with blowers and pumps northeast of the existing solids building. Digestion will reduce VSS content and stabilize biosolids.

- Dewatering – Replace belt filter press with new solids processing equipment that will increase solids content to 12% to 18%.

Aerobic digestion provides stabilization, and the added benefit of end-product odor control. Dewatering produces solids with a solids content between 12% and 18%. This concept is a reliable way to meet Class B pathogen and vector attraction requirements.

9.2.3.3.1 Aerobic Digester

Aerobic digestion of sludge will take place in the same manner as described in in Section 9.2.3.1.1.

9.2.3.3.2 Biosolids Dewatering

Dewatering of stabilized sludge will take place in the same manner as described in in Section 9.2.3.1.2.

9.2.3.3.3 Biosolids Drying

This concept does not include biosolids drying or other stabilization methods that could produce Class A biosolids.

9.2.3.3.4 Dewatered Biosolids Storage

For this solids concept, the existing biosolids storage area can continue to be used although some improvements are required. The damaged canopy over the existing biosolids storage area should be replaced with a new canopy, and the dewatered solids pump should be replaced with an inclined conveyor for more reliable conveyance.

9.2.3.3.5 Biosolids Concept 3 Summary

Biosolids Concept 3 is summarized below:

- Sludge Storage – Retain the existing ASSB, but do not upgrade to aerobic digestion. The existing ASSB does not have enough volume to reliably produce Class B biosolids, however, it can offer some volatile suspended solids destruction and minimizes odors from stored sludge.
- Digestion - Build aerobic digester and digester control building with blowers and pumps northeast of the existing solids building.
- Dewatering - Remove belt filter press, hopper, polymer feed system, and conveyance system from dewatering building and replace with two screw presses.
- Biosolids Storage Building – Continue to use the existing biosolids storage area after replacing damaged canopy and replacing dewatered sludge pumps with inclined conveyors.

The process outlined for Concept 3 produces Class B biosolids that can be beneficially used as a soil amendment with some specific limitations. Class B biosolids are typically used on forest land, grass fields, and crops not grown for human consumption. Class B biosolids cannot be handled by the general public and can only be used for commercial or industrial purposes.

There are setback requirements for application fields that reduce the effective application area. However, Class B biosolids can also be disposed at a landfill, offering some flexibility for disposal.

The total estimated capital cost for this Solids Concept 3, with contracting, engineering, contingency, and escalation included, is approximately $20 million.

Operating Energy Costs for Biosolids Concept 3 are summarized in **Table 9-4**.

Table 9-4: Summary of Biosolids Concept 3 Energy Costs

Unit Process	Type	Operating Hours Per Week	Weekly Power Consumption (kWh)	Estimated Energy Cost (assume 10 cents/kWh)
Aerobic Digester	New Digesters	168	50,740	$5,800
Dewatering Unit	Screw Press	120	270	$30
WEEKLY ENERGY COST				**$5,830**

The annual cost to operate Concept 3 is approximately $200,000 before inflation. The net-present value over the course of the 20-year planning period for operations and maintenance is approximately $2,740,000, assuming a 3% annual inflation rate.

9.2.3.4 Concept 4: Non-Digested with ASSB and Dewatering

Concept 4 produces partially stabilized dewatered biosolids, with the following components:

- Retain existing ASSB for storage of approximately 15 days of sludge production in 2040.
- Dewatering in new solids processing equipment that will increase solids content to 12% to 18%.

This concept is the lowest cost alternative. It does not allow for production of Class A or Class B biosolids, is not suitable for any beneficial use, and assumes that the end-product will be hauled to a landfill. While is concept costs much less to implement than others, it has the disadvantage of limited disposal options. If for some reason landfill disposal is no longer a viable option for disposal, there are no other options for end-product disposal.

9.2.3.4.1 Aerated Sludge Storage Basin

The existing Aerated Sludge Stabilization Basin will be retained for partial VSS destruction and storage of up to 270,000 gallons of sludge to feed biosolids processing equipment. This volume will store approximately 15 days of sludge produced in 2040 loading conditions.

9.2.3.4.2 Biosolids Dewatering

Dewatering of stabilized sludge will take place in the same manner as described in Section 9.2.3.1.2.

9.2.3.4.3 Dewatered/Dried Biosolids Storage

For this solids concept, the existing biosolids storage area can continue to be used although some improvements are required. The damaged canopy over the existing biosolids storage area should be replaced with a new canopy, and the dewatered solids pump should be replaced with an inclined conveyor for more reliable conveyance.

9.2.3.4.4 Biosolids Concept 4 Summary

Biosolids Concept 4 is summarized below:

- Sludge Storage – Retain the existing ASSB, but do not upgrade to aerobic digestion. The existing ASSB does not have enough volume to reliably produce Class B biosolids, however, it can offer some volatile suspended solids destruction and minimizes odors from stored sludge.
- Dewatering - Remove belt filter press, hopper, polymer feed system, and conveyance system from dewatering building and replace with two screw presses.
- Biosolids Storage - Continue to use the existing biosolids storage area. Stockpile dewatered solids in the building for periodic load out and disposal.

Dewatering provides the benefit of reducing the volume of the biosolids to reduce storage space needed for the end-product. Like Concepts 2 and 3, this concept allows for continued use of biosolids storage in the existing biosolids storage area. The damaged canopy will be replaced, and the dewatered solids pumps and piping will be replaced with an inclined conveyor.

9.2.3.4.5 Biosolids Concept 4 Summary

Biosolids Concept 4 is summarized below:

- Retain the existing ASSB, but do not upgrade to aerobic digestion. The existing ASSB does not have enough volume to reliably produce Class B biosolids, however, it can offer some volatile suspended solids destruction and minimizes odors from stored sludge.
- Dewatering - Remove belt filter press, hopper, polymer feed system, and conveyance system from dewatering building and replace with two screw presses.
- Biosolids Storage – Continue to use the existing biosolids storage area. Stockpile dewatered solids in the building for periodic load out and disposal.

The process outlined for Concept 4 produces dewatered solids that are not suitable for beneficial use and can only be disposed at a landfill.

The total estimated capital cost for this Solids Concept 4, with contracting, engineering, contingency, and escalation included, is approximately $10 million.

Operating Energy Costs for Biosolids Concept 4 are summarized in Table 9-5.

Table 9-5: Summary of Biosolids Concept 4 Energy Costs

Unit Process	Type	Operating Hours Per Week	Weekly Power Consumption (kWh)	Estimated Energy Cost
ASSB	Existing ASSB	168	8,960	$900
Dewatering Unit	Screw Press	120	270	$30
WEEKLY ENERGY COSTS				**$930**

The annual cost to operate Concept 4 is approximately $40,000 before inflation. The net-present value over the course of the 20-year planning period for operations and maintenance is approximately $470,000, assuming a 3% annual inflation rate.

9.2.4 Biosolids Concept Cost Comparison

Capital costs and operations and maintenance costs were estimated for each alternative. Economic criteria accounts for the capital investment for each solids concept, and the energy costs for each concept over the 20-year planning period. The capital costs account for equipment, materials, and labor costs. Capital costs also account for the cost of additional items calculated based on a percentage of the subtotal. These include Division 1 specification costs (12% of subtotal), contractor overhead & profit (8%), contingency (30%), engineering/legal/administrative fees (25%), market contingency (10%), and escalation to the midpoint of construction (13%). Costs are compared in Table 9-6.

Table 9-6: Biosolids Concept Cost Comparison

	Concept 1	Concept 2	Concept 3	Concept 4
Capital Cost	$ 43 M	$ 31 M	$ 20 M	$ 8.1M
20-Year Operating Cost	$ 6.7 M	$ 1.0 M	$ 2.8 M	$ 0.5 M
Total Life Cycle Cost	**$ 49.7 M**	**$ 32.0 M**	**$22.8 M**	**$ 8.5 M**

9.2.4.1 Biosolids Hauling and Disposal Costs

Currently, the City pays a vendor to haul dewatered solids to the Wasco County Landfill located approximately 90 miles from the Sandy WWTP. The picking and hauling costs are $100/ton, and the landfill tipping fee is $22/ton. Overall, the total cost for pickup, hauling, and disposal is approximately $122/ton. Assuming the hauling cost is about half of the $100/ton fee, the disposal cost of a ton per mile is approximately $0.56/ton-mile. Current biosolids hauling and disposal costs are summarized below.

- Pickup Costs: $50/ton
- Hauling Costs: $50/ton ($0.56/ton-mile)
- Landfill Tipping Fee: $22/ton

- Total: $122/ton

If the City were to identify a disposal location within 20-miles of the treatment facility, or a landfill with a lower tipping fee, disposal costs could be similar to costs summarized below.

- Pickup Costs: $50/ton
- Hauling Costs: $0.56/ton-mile @ $20 miles =$11.20/ton
- Landfill Tipping Fee: $15/ton
- Total: $76.20/ton

A summary of estimated annual biosolids disposal costs for year 2040 is provided in Table 9-7.

Table 9-7: Comparison of Annual Biosolids Disposal Costs for Year 2040

	Annual Biosolids Disposal Cost[1]			
	Concept 1	**Concept 2**	**Concept 3**	**Concept 4**
Landfill Disposal[2]	$160,000	$160,000	$650,000	$650,000
Land Application[3]	$100,000	$100,000	$410,000	--[(4)]

(1) All costs rounded to nearest $1,000.

(2) Assumes $122/ton as described above.

(3) Assumes $76.20/ton as described above.

(4) Land application is not allowed for Concept 4 solids, as they do not meet Class B biosolids characteristics.

The City may benefit from identifying a disposal location closer to the treatment facility to save on disposal costs. If the City implements a Class B or Class A biosolids end-product that can be used for commercial or industrial purposes, the disposal location does not need to be a landfill. It is important to note that if the City elects to implement Concept 4, the disposal location can only be a landfill.

9.2.5 Initial Solids Concept Treatment Screening

As described in Section 5, an Initial Concept-Level Screening approach is applied to identify economic, regulatory, implementation, resiliency, and disposal challenges to assess the viability of solids treatment solutions. The outcomes of the initial screening of solids treatment concepts are presented in Table 9-8**.**

Table 9-8: Application of Screening Criteria for Initial Solids Treatment Concepts

Initial Solids Concept Criteria ↓	Concept 1: Class A Aerobic Digestion, Dewatering, and Dryer	Concept 2: Class A Non-Digested with ASSB, Dewatering, and Dryer	Concept 3: Class B Aerobic Digestion and Dewatering	Concept 4: Non-Digested with ASSB and Dewatering
ECONOMIC	✘	~	~	✓
CURRENT REGULATORY RISK	✓	✓	✓	✓
FUTURE REGULATORY RISK	✓	✓	~	~
IMPLEMENTATION	~	~	~	✓
RESILIENCY	✓	✓	✓	✓
LANDFILL DISPOSAL	✓	✓	✓	✓
LAND APPLICATION	✓	✓	✓	✘
BENEFICIAL REUSE	✓	~	~	✘

The colored boxes indicate whether the concept can meet (green), likely to meet (yellow), or unable to meet (red) the criteria as indicated in the following legend:

LEGEND: Viable or Feasible	
YES	✓
Likely	~
NO	✘

The biosolids treatment concepts 1 through 4 have decreasing treatment capabilities. Concept 1 provides the highest level of treatment, capable of producing Class A biosolids. However, it requires the most space and would incur the greatest amount of capital and operating expenditures. Concept 4 is the lowest cost alternative, reusing much of the existing solids processing equipment, and assumes the end-product will be hauled to a landfill. This concept retains the existing ASSB and replaces the existing dewatering equipment to increase solids content prior to storage in the existing biosolids storage area. The modifications to the existing solids process does not enable the production of Class A or B biosolids but can be implemented quickly for lowest cost, as a short-term solution. The new screw presses can be reused in more robust biosolids processing if the City decides to move to Class A biosolids production.

9.2.6 Recommended Biosolids Approach

Concept 4 can be an initial phase for any of the biosolids treatment alternatives. The low capital costs, operating costs, and space requirements of implementing the upgrades to dewater and stabilize solids for landfilling make this alternative the desired approach. While this concept does not have the advantage of biosolids production for beneficial reuse, each of its parts can be reused and upgraded as funding becomes available to treat to higher solids quality. If additional value engineering is necessary during the design phase of the project, the screw press dewatering system could be switched out for a rotary press system. This concept will be applied to all three liquid stream treatment alternatives for the complete alternatives analysis.

The following is a summary of the initial phase of the recommended biosolids approach:

- Retain existing ASSB and continue to use for additional sludge storage and aeration
- Remove existing belt filter press and replace with screw presses. If necessary to reduce capital costs, consider a fan/rotary press for dewatering.
- Replace the canopy over the biosolids storage area.

The total estimated cost for the complete recommended biosolids approach is **$8.1M** as summarized in Table 9-9.

Table 9-9: Estimated Probable Construction Costs – Biosolids Unit Processes

Process Area	Cost
Dewatering	$8.0M
Drying	$--
Solids Storage	$0.1M
TOTAL BIOSOLIDS COST	**$8.1M**

The recommended biosolids alternative is applied to all liquid stream alternatives in the following sections summarizing the recommend treatment plant expansion projects.

9.2.7 PFAS in Biosolids

Per- and polyfluoroalkyl substances (PFAS) are contaminants of concern in drinking water and are under consideration for regulation for land application of biosolids. PFAS compounds in biosolids are not currently regulated in Oregon or at the Federal level and impacts of PFAS compounds is currently unknown. Given the uncertainty, the City should continue to track potential PFAS implications, but the priority for funding at this time should be the treatment process improvements recommended in this Plan Amendment.

9.2.7.1 Federal Action on PFAS/PFOS

In April of 2024, EPA set Maximum Contaminant Levels (MCLs) for six different types of PFAS in drinking water, however the establishment of national standards regarding PFAS in biosolids is still ongoing. Of the many groups of chemicals classified as PFAS, perfluorooctanoic acid

(PFOA) and perfluorooctane sulfonate (PFOS) have been identified as the most prevalent forms in biosolids. EPA is conducting a PFOA and PFOS in biosolids risk assessment slated to be completed and released to the public in Winter 2024. The risk assessment will be the basis for determining if there will be regulations on PFOA and PFOS in biosolids (*Final PFAS National Primary Drinking Water Regulation*, EPA 2024a).

Ongoing research components of the risk assessment include understanding the fate and transport of PFAS in land-applied biosolids, management strategies for land-applied biosolids, and studying the effectiveness of potential destruction and disposal options. Updated interim destruction and disposal guidance published by the EPA in April 2024 focuses on thermal treatments, landfills, and underground injection; however, there are several information gaps yet to be addressed. (*Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl* Substances— Version 2, EPA, 8 April 2024b).

EPA published a draft questionnaire in March 2024 intended to send to 400 Publicly-Owned Treatment Works (POTWs) dischargers. No sample results are required for the questionnaire response, instead, it inquires about industrial users, methods of discharge, and biosolids management practices. A subset of up to 300 respondents will be selected to participate in a two-phase sampling program of liquid and biosolids stream to help EPA build a database to assess PFAS prevalence.

In addition, the EPA is in the final stages of validating a method to test for PFAS in several mediums including wastewater and biosolids. Rulemaking based on this methodology is likely to start in 2024 and is already being recommended in some NPDES permits (*Joint Principles for Preventing and Managing PFAS in Biosolids*, EPA 2024c).

9.2.7.2 State Action on PFAS

Oregon has been actively researching PFAS in water systems and is working towards developing a greater understanding of PFAS in biosolids- particularly on how they may impact both public health and the environment. The Biosolids Bill (HB 4049) is currently waiting to be passed by the Oregon legislature and would offer funding to research the occurrence, distribution, fate, and transport of PFAS in land-applied biosolids derived from wastewater. The Oregon State University (OSU) Extension and OSU College of Agricultural Sciences would conduct the study and, if the bill gets passed, will publish a report by December 15, 2025 (*Biosolids, PFAS and Oregon Agriculture*, Karen Lewotsky, 22 February 2024).

While neither Oregon nor the EPA are yet to set any type of regulation on PFAS in biosolids, some states have already implemented their own rules and guidelines. These regulations are summarized in Table 9-10 and are provided to contextualize what potential regulations could affect Sandy’s biosolids management in the future.

Table 9-10: Summary of Current State PFAS Regulations

State	Regulation
Colorado	Established monitoring requirements for biosolids preparers with a threshold for PFOS. If PFOS level is ≥ 50 µg/kg, biosolids preparers must develop and implement a Source Control Program. (Regulation 64 – Biosolids Program) Note that 50 µg/kg is not a risk-based threshold.
Maine	Complete ban on biosolids land application from sludge or septage generated from a municipal, commercial, or industrial wastewater treatment plant unless it can be demonstrated that the biosolids are PFAS free. (HP 1417 – LD 1911)
Massachusetts	Requires quarterly monitoring of PFAS in residuals with an Approval of Suitability (AOS) and are permitted to be used through land application.
Michigan	Implemented classifications for PFAS impacted biosolids: • Industrially impacted: PFOS or PFOA concentrations of 100 µg/kg or higher. Unable to be land applied and require further actions including notification and source reduction plans. • Elevated concentrations: PFOS or PFOA concentrations between 20 µg/kg and 100 µg/kg. Require reduced land application rates or alternative risk mitigation strategies. • Below 20 µg/kg: biosolids with PFOS or PFOA concentrations below 20 µg/kg may be land applied with no additional requirements. • Exceptional Quality (EQ): Must maintain combined PFOS and PFOA concentrations below 20 µg/kg. Michigan also requires quarterly monitoring of PFAS in residuals with an AOS for land application.
New Hampshire[(1)]	Depending on PFOS and PFOA concentrations, biosolids are classified as industrially impacted, elevated, or below specific thresholds. New Hampshire Department of Environmental Services works individually with each generator of biosolids permittee in the state. Each generator is required in their annual report to describe measures taken to reduce concentrations of PFAS present in their biosolids.

[1] Developing standards for the land application of biosolids.

The determination of PFAS limits for land application of biosolids in Oregon and Federally are pending. There is no defined time frame on when that will be made, and the liquid stream process improvements must proceed. The City conducted PFAS sampling of the influent, effluent and biosolids in May, 2024 as part of a study conducted by the Oregon Association of Clean Water Agency, and PFAS/PFOS compounds were observed. The results of this study will inform ACWA's position on regulations related to the compounds.

Recent literature indicates significant thermal destruction of PFAS compounds requires temperatures greater than 700 degrees Fahrenheit (*High-Temperature Pyrolysis for Elimination of Per-and Polyfluoroalkyl Substances (PFAS) from Biosolids*, Hanieh Bamdad, et al., 25 October 2022). Temperatures in this range can cause pyrolysis or combustion, which leads to PFAS destruction. The methods proposed for treatment in this Plan Amendment will not destroy PFAS compounds. If limits on PFAS are identified for biosolids, the City will have two immediate options:

- Investigate Treatment Options Available – Ongoing research will develop effective methods of PFAS destruction. At the time DEQ and EPA publish draft limitations on PFAS in biosolids land-application, the City should then further investigate available treatment options.

- Dispose of biosolids in a landfill – The City is currently disposing of biosolids in a landfill and could continue this practice.

One of the wastewater treatment alternatives considered in this report includes Alternative 5, conveyance and treatment at a regional treatment plant. This reduces the City's exposure to PFAS/PFOS regulations; however, the receiving treatment plant will take on the regulations and may share some of the source control requirements with the City through the agreement between the two parties.

9.3 Wastewater System Upgrades Cost Effectiveness Evaluation

The 2019 Plan focused on comparing collection system upgrades to treatment process upgrades. This analysis no longer applies for the 2024 Plan Amendment.

9.4 Conclusions from Comprehensive WW System Alternatives Evaluation

The 2019 Plan focused on the conclusions from comparing collection system upgrades to treatment process upgrades. This analysis no longer applies for the 2024 Plan Amendment.

9.5 Recommendations from Comprehensive WW System Alternatives Evaluation

The 2019 Plan focused on the recommendations from comparing collection system upgrades to treatment process upgrades. This analysis no longer applies for the 2024 Plan Amendment.

Section 10: Long-Term Wastewater Treatment Alternatives Evaluation Update

2019 PLAN | SECTION 10 SUMMARY

- The alternatives analysis in Section 9 concluded that:
  - The most cost-effective option for wastewater system upgrades is a balanced approach to address the City's challenges associated with wastewater collections, treatment, and discharge.
  - The recommended approach incorporated 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.
  - It also concluded that 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 primarily because the current intermittent discharge to Tickle Creek is not viable long-term as the City continues to grow.
- Thus, pursuing a year-round discharge to the Sandy River has been identified as the best long-term discharge option for the City.
- This section further developed and evaluated 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.

10.1 Introduction

The 2019 Plan recommendations led to project costs that were far beyond the City's available budget. The 2024 Plan Amendment revisits the prior alternatives and develops new alternatives with a focus on affordability and phasing to comply with current regulatory requirements while preparing for future growth.

10.2 Wastewater Treatment Concepts (Liquid Stream Update)

The 2019 Plan developed four alternatives to further evaluate wastewater treatment requirements and associated collection system capacity upgrades for the 2040 planning horizon. These were complex projects with high costs that were deemed to be unaffordable given the City's current budgetary constraints. Since the 2019 Plan was approved, the City invested in repairs to its collection system, which has reduced I&I. These efforts reduced peak wet weather flowrates, extending the utility of the City's existing WWTP.

The 2024 Plan Amendment revisits the options for improving wastewater treatment to address economic, regulatory, implementation, and resiliency challenges. Five possible wastewater treatment project concepts are identified and summarized in this section.

- Alternative 1 - Conventional Activated Sludge (CAS)
- Alternative 2 - Membrane Bioreactor (MBR)
- Alternative 3 - Hybrid MBR/CAS
- Alternative 4 - Regional Treatment Plant
- Alternative 5 - Collection System Storage Concept

Preliminary conceptual level costs for these concepts were developed and are summarized herein, with detailed cost tables and assumptions provided in Appendix C.

10.2.1 Conventional Activated Sludge Concept

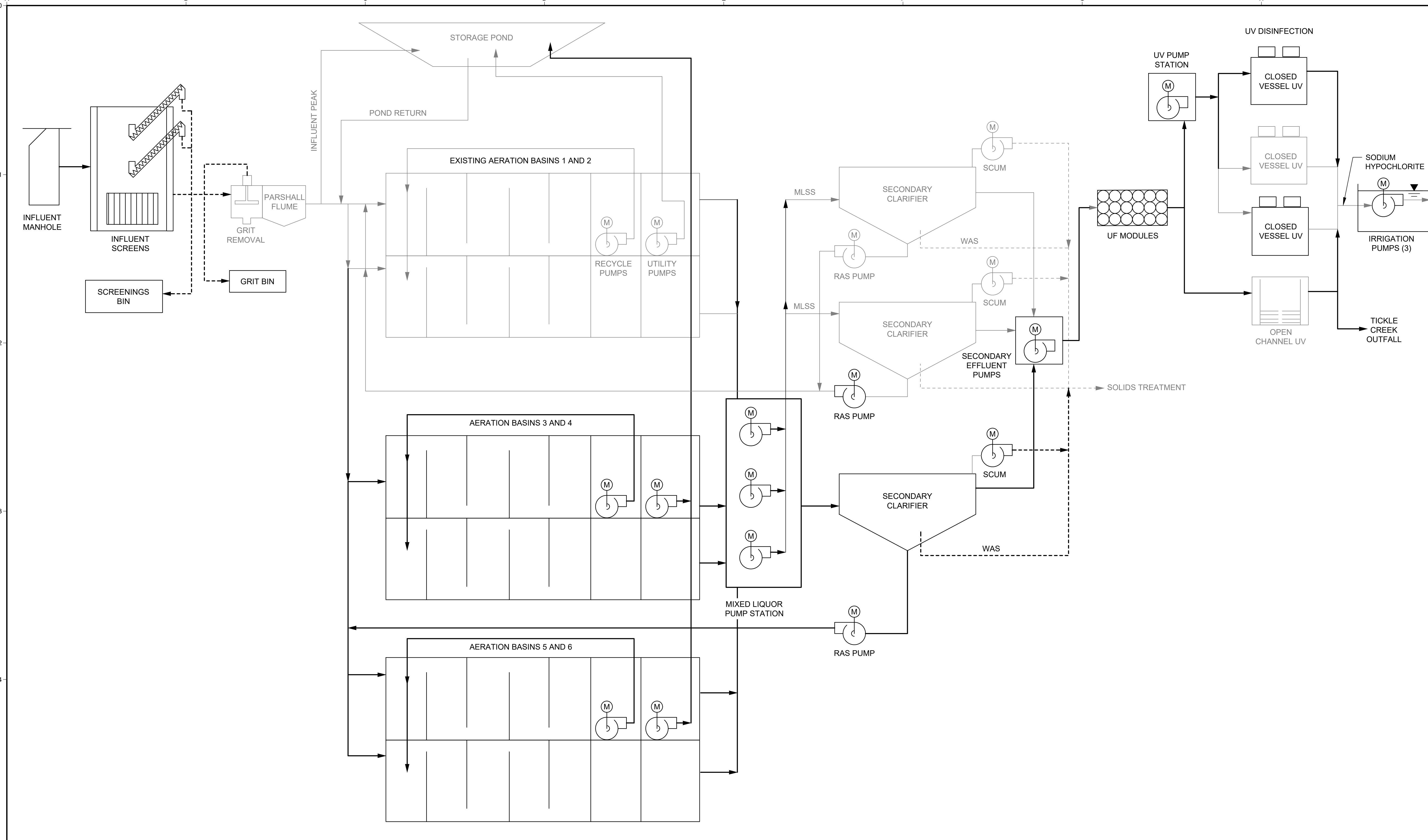
Alternative 1 will expand the existing activated sludge process to include additional aeration basins to improve BOD and ammonia removal. The proposed CAS system consists of the following components:

- Influent Screening – Two automatically cleaned basket fine screens to remove large and floatable materials from the influent stream, with a manual bar screen as standby.
- Grit removal – Existing grit removal system remains in service to remove sand, gravel, and other heavy items from the influent. All parts of existing system are in good working order.
- Aerobic Treatment – The existing conventional activated sludge process will be expanded with additional aeration trains to provide additional secondary biological treatment capacity.
- Secondary Clarification – A third secondary clarifier will be constructed to provide additional treatment capacity.
- Tertiary Filtration – Secondary clarifier effluent will be conveyed to ultrafiltration tertiary membrane filters to remove most of the remaining suspended solids. Filtered solids will be returned to the plant influent for additional treatment.
- UV Disinfection – Tertiary effluent will be disinfected using ultraviolet light to deactivate pathogens.
- Recycled Water Chlorination – Recycled water will be chlorinated before pumping to Iseli Nursery to comply with Class B recycled water requirements.
- Biosolids Upgrades – Sludge will continue to be aerated in the ASSB. The dewatering system will be replaced, a dryer will be added, and a new storage area will be constructed per Biosolids Concept 2 described in Section 9.
- Electrical Upgrades – Electrical upgrades to support upgrades described above.

A process flow diagram is provided in Figure 10-1.

Figure 10-1: Alternative 1- Conventional Activated Sludge Expansion

Figure 10-2: Site Plan Alternative 1 Conventional Activated Sludge Treatment



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NO	REVISION	DATE	BY

SCALES

0 1"

0 25mm

IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY NOT FOR CONSTRUCTION

DESIGNED AM

DRAWN RLH

CHECKED RSP

CITY OF SANDY, OREGON

WASTEWATER SYSTEM FACILITY PLAN

FACILITY PLAN AMENDMENT

WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

ALTERNATIVE - 1 CONVENTIONAL ACTIVATED SLUDGE EXPANSION

SCALE NTS

JOB NO 2276020.00

DATE MAY 2024

SHEET OF ---

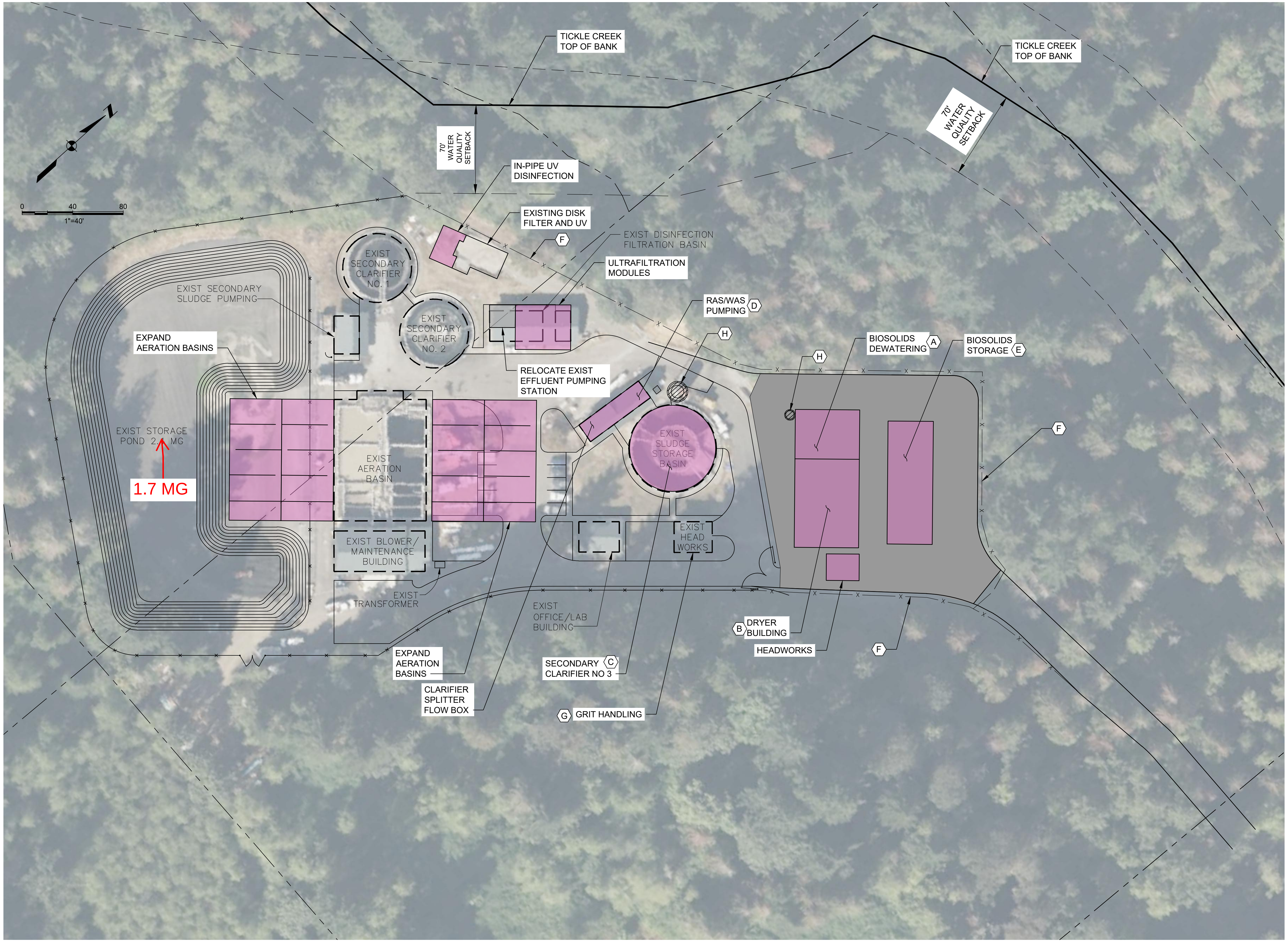
FIG-10-1

GENERAL SHEET NOTES

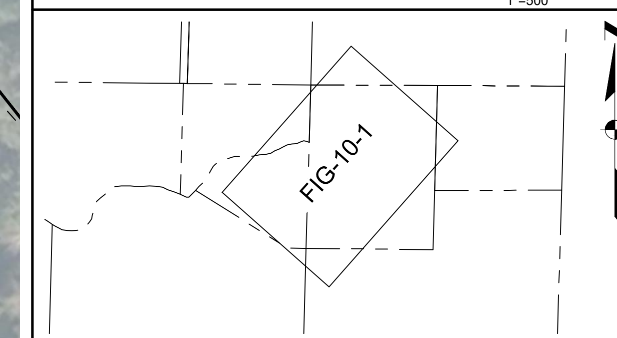
1. NEW PAVEMENT TO BE ADDED AROUND THE DEWATERING, DRYER, AND BIOSOLIDS STORAGE BUILDING.

SHEET KEYNOTES

A. DEMO BELT FILTER PRESS. INSTALL TWO SCREW PRESSES FOR DEWATERING.
B. REHAB BUILDING AND USE AS DRYER BUILDING. INSTALL PADDLE DRYER.
C. DEMO BASIN, REPLACE WITH THIRD SECONDARY CLARIFIER.
D. EXPAND SLUDGE PUMPING.
E. BUILD CONCRETE STORAGE PAD WITH CANOPY FOR CLASS A SLUDGE STORAGE AREA. COVER WITH ALUMINUM CANOPY.
F. EXTEND FENCE AROUND NEW BIOSOLIDS STORAGE BUILDING.
G. DEMO EXISTING HEADWORKS SCREEN.
H. DEMO SLUDGE TANK AND LIME SILO.



KEY PLAN



LEGEND

NEW/UPDATED PROCESS AREA
ASPHALT

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SCALES
0 1"
0 25mm
IF THIS BAR IS NOT 1" IN DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY NOT FOR CONSTRUCTION

DESIGNED AM
DRAWN RLH
CHECKED RSP

CITY OF SANDY, OREGON
WASTEWATER SYSTEM FACILITY PLAN
FACILITY PLAN AMENDMENT
WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

SITE PLAN
ALTERNATIVE 1: CONVENTIONAL ACTIVATED SLUDGE TREATMENT

SCALE 1" = 40'
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DATE MAY 2024
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FIG-10-2

Plot Date: 5/23/2024 12:01 PM

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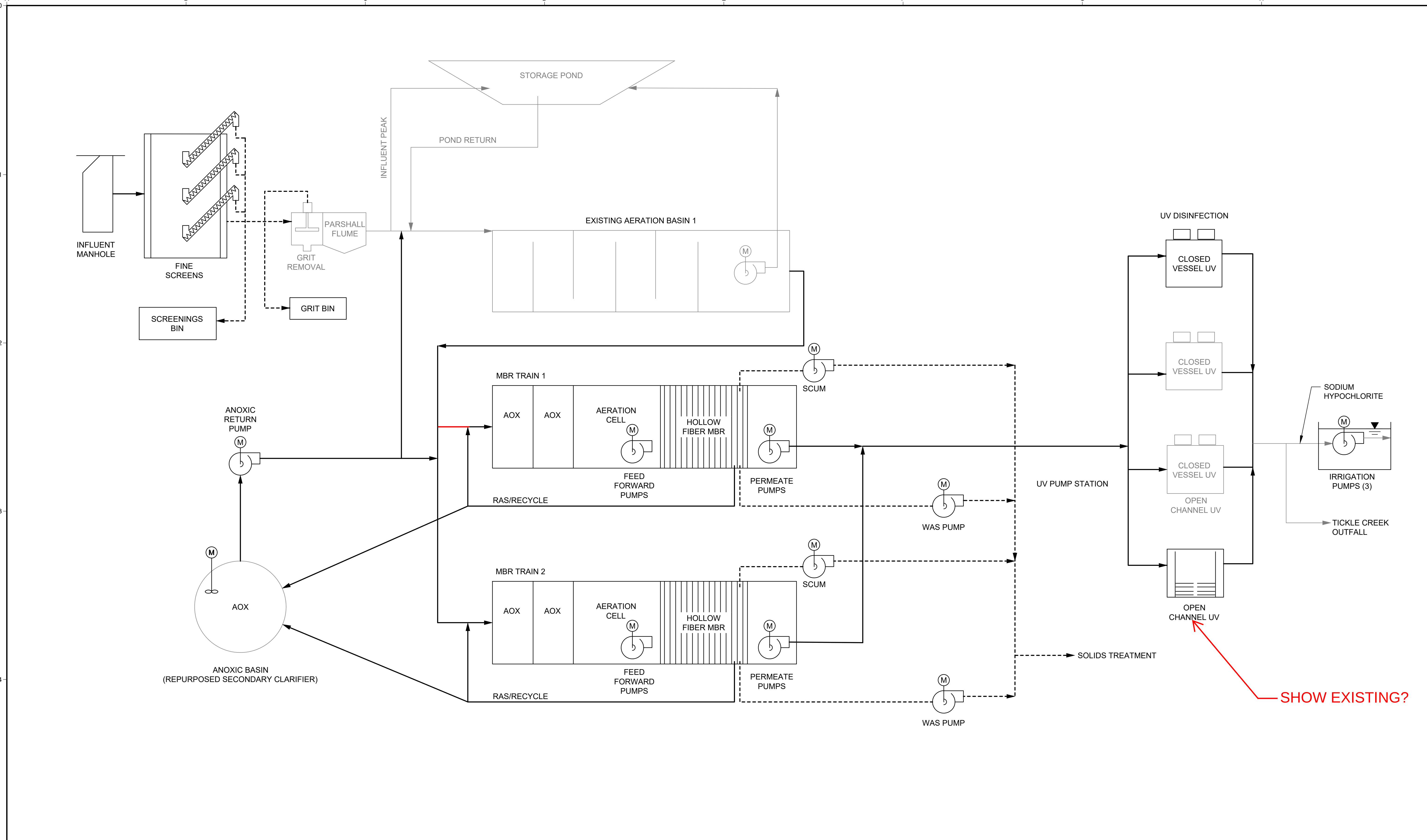
pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\Sandy, City of OR\Projects\Wastewater Facility Plan Amendment_2276020.00\10-Design\10.06-Drawings\Civil\Misc\2276020000-C-FIG-10-3



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CITY OF SANDY, OREGON

WASTEWATER SYSTEM FACILITY PLAN

FACILITY PLAN AMENDMENT

WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

ALTERNATIVE - 2 MEMBRANE BIOREACTOR PROCESS

SCALE NTS

JOB NO 2276020.00

DATE MAY 2024

SHEET OF ---

FIG-10-3

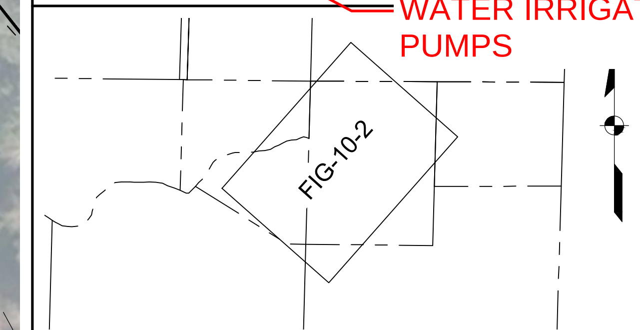
GENERAL SHEET NOTES

1. NEW PAVEMENT TO BE ADDED AROUND THE DEWATERING, DRYER, AND BIOSOLIDS STORAGE BUILDING.

SHEET KEYNOTES

A. DEMO BELT FILTER PRESS. INSTALL TWO SCREW PRESSES FOR DEWATERING.
B. REHAB BUILDING AND USE AS DRYER BUILDING. INSTALL PADDLE DRYER.
C. RETROFIT CLARIFIER FOR ANOXIC TREATMENT. TAKE ADDITIONAL CLARIFIER OFF-LINE.
D. DEMO EXISTING DISK FILTERS, ADD ADDITIONAL IN-PIPE UV TREATMENT.
E. DEMO AERATION BASIN. PLACE MBR TREATMENT TANKS AND EQUIPMENT ROOM.
F. DEMO HEADWORKS SCREEN.
G. CMU BUILDING FOR CLASS A SLUDGE STORAGE.
H. EXTEND FENCE AROUND NEW BIOSOLIDS STORAGE BUILDING.
I. DEMO SLUDGE TANK AND ~~LIME SILO.~~ LIME
J. ~~REPLACE RECYCLED WATER IRRIGATION PUMPS FOR GREATER CAPACITY.~~ NEW RECYCLED WATER IRRIGATIO PUMPS

KEY PLAN



LEGEND

NEW/UPDATED PROCESS AREA
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CITY OF SANDY, OREGON
WASTEWATER SYSTEM FACILITY PLAN
FACILITY PLAN AMENDMENT
WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

SITE PLAN
ALTERNATIVE 2: MEMBRANE BIOREACTOR TREATMENT

SCALE 1" = 40'
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FIG-10-4

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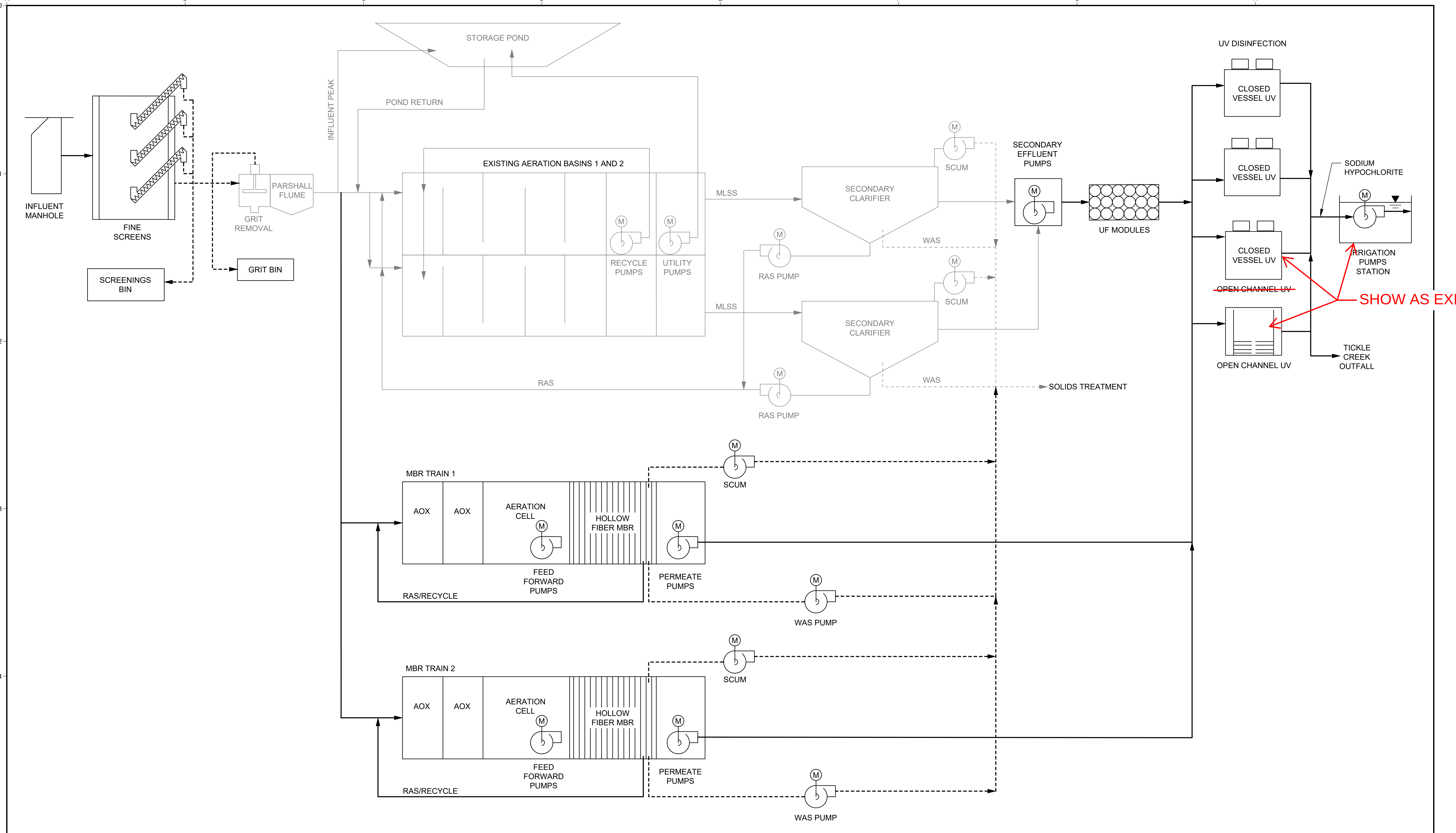
pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\Sandy, City of OR\Projects\Wastewater Facility Plan Amendment_2276020.00\10-Design\10.06-Drawings\Civil\Misc\2276020-C-FIG-10-4



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CITY OF SANDY, OREGON

WASTEWATER SYSTEM FACILITY PLAN

FACILITY PLAN AMENDMENT

WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

ALTERNATIVE - 3 HYBRID TREATMENT PROCESS

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DATE MAY 2024
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FIG-10-5

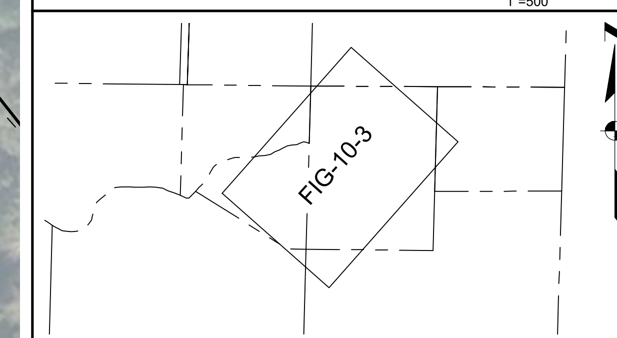
GENERAL SHEET NOTES

1. NEW PAVEMENT TO BE ADDED AROUND THE DEWATERING, DRYER, AND BIOSOLIDS STORAGE BUILDING.

SHEET KEYNOTES

A. DEMO BELT FILTER PRESS. INSTALL TWO SCREW PRESSES FOR DEWATERING.
B. REHAB BUILDING AND USE AS DRYER BUILDING. INSTALL PADDLE DRYER.
C. DEMO EXISTING DISK FILTERS, ADD ADDITIONAL IN-PIPE UV TREATMENT.
D. ADD MBR TREATMENT TANKS AND EQUIPMENT ROOM.
E. BUILD CONCRETE STORAGE PAD WITH CANOPY FOR CLASS A SLUDGE STORAGE AREA.
F. DEMO EXISTING HEADWORKS SCREEN.
G. DEMO SLUDGE TANK AND LIME SILO.
H. EXTEND FENCE AROUND NEW BIOSOLIDS STORAGE BUILDING.

KEY PLAN



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CITY OF SANDY, OREGON
WASTEWATER SYSTEM FACILITY PLAN
FACILITY PLAN AMENDMENT
WWTP IMPROVEMENTS ALTERNATIVES

Kennedy Jenks

SITE PLAN
ALTERNATIVE 3: CAS/MBR TREATMENT HYBRID

SCALE 1" = 40'
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DATE MAY 2024
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FIG-10-6

Plot Date: 5/13/2024 12:32 PM
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pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\Sandy, City of OR\Projects\Wastewater Facility Plan Amendment_2276020.00\10-Design\10.06-Drawings\Civil\Misc\2276020.00-C-FIG-10-6

10.2.2 Membrane Bioreactor Concept

Alternative 2 will replace the existing CAS process with a higher density activated sludge process that replaces secondary clarifiers with membrane filters that allow operators to maintain higher mixed liquor concentrations. The proposed MBR process consists of the following components:

- Influent Screening – Three automatically cleaned basket fine screens will remove floatable materials from the influent wastewater.
- Grit removal – Existing grit removal system will remain in service to remove sand, gravel, and other heavy items from the influent.
- Aerobic Treatment – The existing conventional activated sludge process will be converted to an MBR style aeration basin to provide biological secondary treatment capacity.
- Membrane Filtration – Secondary Clarifiers will be repurposed and replaced with membrane filters, which both separate secondary effluent from mixed liquor, and provide tertiary filtration in one step.
- UV Disinfection – Tertiary effluent will be disinfected using ultraviolet light to deactivate pathogens.
- Recycled Water Chlorination – Recycled water will be chlorinated before pumping to Iseli Nursery to comply with Class B recycled water requirements.
- Biosolids Upgrades – Sludge will continue to be aerated in the ASSB. The dewatering system will be replaced, a dryer will be added, and a new storage area will be constructed per Biosolids Concept 2 described in Section 9.
- Electrical Upgrades – Electrical upgrades to support upgrades described above.

A process flow diagram is provided in Figure 10-3.

Figure 10-3: Alternative 2 Membrane Bioreactor Process

[Insert pdf]

Figure 10-4: Site Plan Alternative 2 Membrane Bioreactor Treatment

[Insert pdf]

10.2.3 Hybrid CAS/MBR Concept

Alternative 3 will replace the existing CAS process with a higher density activated sludge process that replaces secondary clarifiers with membrane filters that allow operators to maintain the higher mixed liquor concentrations. The proposed MBR process will consist of the following components:

- Influent Screening – Automatically cleaned basket fine screens to remove floatable materials from the influent wastewater.
- Grit removal – Existing grit removal system will remain in service to remove sand, gravel, and other heavy items from the influent.
- Aerobic Treatment
    - CAS Expansion – The existing conventional activated sludge process will be expanded with additional aeration trains to provide additional secondary biological treatment capacity.
    - MBR Addition – MBR style aeration basins will be constructed in parallel with the CAS aeration basins.
- Secondary Clarifiers – Existing secondary clarifiers will remain in use.
- Filtration – One membrane train will be provided to treat dry weather volumes.
- UV Disinfection – Tertiary effluent will be disinfected using ultraviolet light to deactivate pathogens.
- Recycled Water Chlorination – Recycled water will be chlorinated before pumping to Iseli Nursery to comply with Class B recycled water requirements.
- Biosolids Upgrades – Sludge will continue to be aerated in the ASSB. The dewatering system will be replaced, a dryer will be added, and a new storage area will be constructed per Biosolids Concept 2 described in Section 9.
- Electrical Upgrades – Electrical upgrades to support upgrades described above.

A process flow diagram is provided in Figure 10-5.

Figure 10-5: Alternative 3 Hybrid Treatment Process

[Insert pdf]

Figure 10-6: Site Plan Alternative 3 CAS/MBR Treatment Hybrid

[Insert pdf]

10.2.4 Regional Treatment Plant Concept

Alternative 4 involves collecting the City's wastewater at the existing plant site and pumping to a regional wastewater treatment provider, such as Clackamas Water Environment Services (WES) Tri-City WWTP or the City of Gresham WWTP. The physical components of Alternative 4 include the following:

- Influent screening – The new headworks structure will have two automatically cleaned coarse basket screens to remove floatable materials from the influent wastewater. A third manually cleaned bar screen will provide emergency service and redundancy.
- Influent Pump Station – The new pump station will include a concrete wet well, two submersible low flow pumps (60 hp each) and three submersible high flow pumps (335 hp each) to convey wastewater along public highway and street rights-of-way to the designated treatment plant.
- Forcemain – The forcemain will include a 30-inch cement mortar-lined ductile iron pipe equipped with regularly spaced plug valves, air release valves, cleanouts, and surge tanks to transport raw wastewater to the regional plants.

10.2.4.1 Tri-City WWTP

The forcemain alignment to **Clackamas WES Tri-City WWTP** is approximately 17 miles long and discharges to an interceptor that connects to the Tri-City WWTP. Significant obstacles would include major intersections, railroad crossings, and creek crossings.

Major costs would include:

- Construction of the forcemain, pump station, and downstream gravity/pump station upgrades.
- The SDC for Clackamas WES treatment is $8,860 per EDU.

10.2.4.2 City of Gresham WWTP

The **City of Gresham** concept includes a forcemain alignment that is approximately 14-miles long. The pipe would run most of its length along Highway 26, avoiding as many large intersections as possible before ending at the Gresham WWTP.

Major costs would include:

- Construction of the forcemain, pump station, and downstream gravity/pump station upgrades.
- The SDCs for Gresham treatment is $7,451 per EDU.

10.2.4.3 Alternative 4 Discussion

Based on the length of forcemain and SDC charges, it is apparent that the capital and SDC cost to connect to the City of Gresham WWTP would be less than the Clackamas WES connection. For the purposes of this analysis, the treatment cost is assumed to be similar and would not be a significant factor in this selection.

The capacity of the pump station would be 12.2 MGD with the largest pump out of service.

Given the length and diameter of the forcemain, and the pressures at the pump station, it is anticipated that surge will be an issue, and one or more surge tanks may be required to mitigate pressure spikes that could occur during pump startup or shutdown and a power failure. Pipeline characteristics and estimated costs to construct and connect and are summarized in Table 10-1.

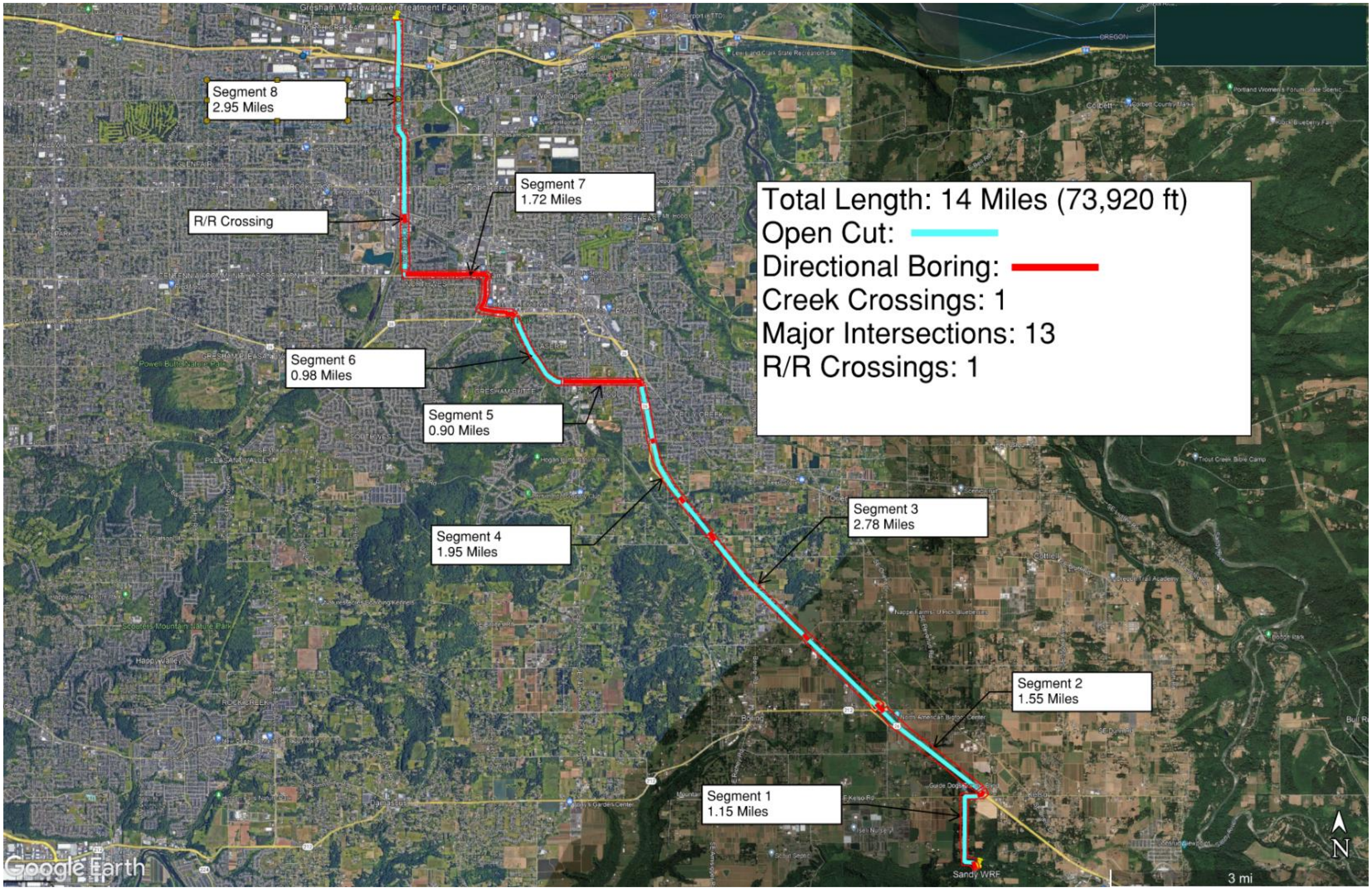
Table 10-1: Alternative 4 Summary of Forcemain and Pump Station Design Information and Total Cost

Treatment Plant	Pipeline Length	Number of Crossings	Major Inter--sections	Construction Cost	Pump Station Cost	SDC Cost	Total Cost
WES Tri-City	17 Miles (96,624 ft)	2 Creek, 1 River, 1 Railroad	14	$74M	$1.2M	$75M	$150M
Gresham	14 Miles (73,920 ft)	1 Railroad, 1 Creek	13	$59M	$1.2M	$55M	$115M

The SDCs for the two alternatives are applied to all existing and new connections and represent the largest component of the costs for each alternative. The collection system element of the SDC cost may not apply to the City. The actual cost for the SDCs could be negotiated if the City becomes a wholesale customer of the City of Gresham. Without the SDCs,the Gresham alternative falls into the cost range of Alternatives 1, 2, and 3, and will be carried to preliminary screening.

The proposed alignment for the forcemain to the Gresham is shown in Table 10-7.

Figure 10-7: Gresham Pipeline Alignment



10.2.4.4 Alternative 4 Discussion

Alternative 4 includes construction of a new headworks and pump station at the existing plant, and a 14-mile pipeline to Gresham's WWTP. Gresham has capacity for Sandy's wastewater; however, each connection (existing and new) will be required to pay the SDC for each EDU to pay for their portion of the treatment plant capacity, which increases Sandy's capital cost by $55M.

The WES option includes similar construction of a headworks, pump station, and a 17-mile pipeline. WES's SDC cost for existing and new connections would be $75M. Drawbacks to this alternative include significant maintenance on long pipelines, public disturbance at unavoidable intersections, and cost.

Capital and SDC costs for discharge to the City of Gresham are comparable to upgrading the Sandy WWTP and constructing a new outfall to the Sandy River. The Engineer's Estimate of Probable Cost to construct Alternative 4, including SDCs, is $122.3M. In addition to capital and SDC costs, the City and wastewater customers would be subject to monthly sewer charges from the City of Gresham. Gresham's residential sewer rate is currently $42.78 and will increase each year according to the Gresham's rate program.

Gresham currently has two wholesale wastewater customers (Fairview and Wood Village) and has established unique rates for these customers based on annual flow, BOD, and TSS load. Sandy may be able to negotiate a similar cost and payment structure if the City pursues becoming a wholesale customer of the City of Gresham,

10.2.5 Collection System Storage Concept

Alternative 5 is a collection system storage concept that considers diverting wastewater from the collection system to an offline equalization basin within the collection system to store wastewater during peak wet weather events. When the peak condition subsides, stored wastewater will be fed back to the collection system to be treated. This allows the plant to treat peak flow volumes without a major process expansion by spreading the peak flowrate over several days.

10.2.5.1 Storage Volume Estimates

This concept includes construction of a raw sewage storage basin in the collection system, a pump station, a pipeline connecting the collection system to the storage basin, and a forcemain conveying wastewater back to the gravity collection system. This scenario considered sizing a storage basin requirement to manage peaks for the existing plant capacity of 7 MGD. Effort included identifying possible locations for the equalization tank near the treatment facility.

Peak flowrate hydrographs were analyzed for two storms in January 2022, as provided by Leeway Engineering Solutions. The analysis is presented in Appendix B.2. Two methods were used to determine the required storage volume, and the results were similar. Both methods yielded an estimated storage volume of approximately 3.0 MG.

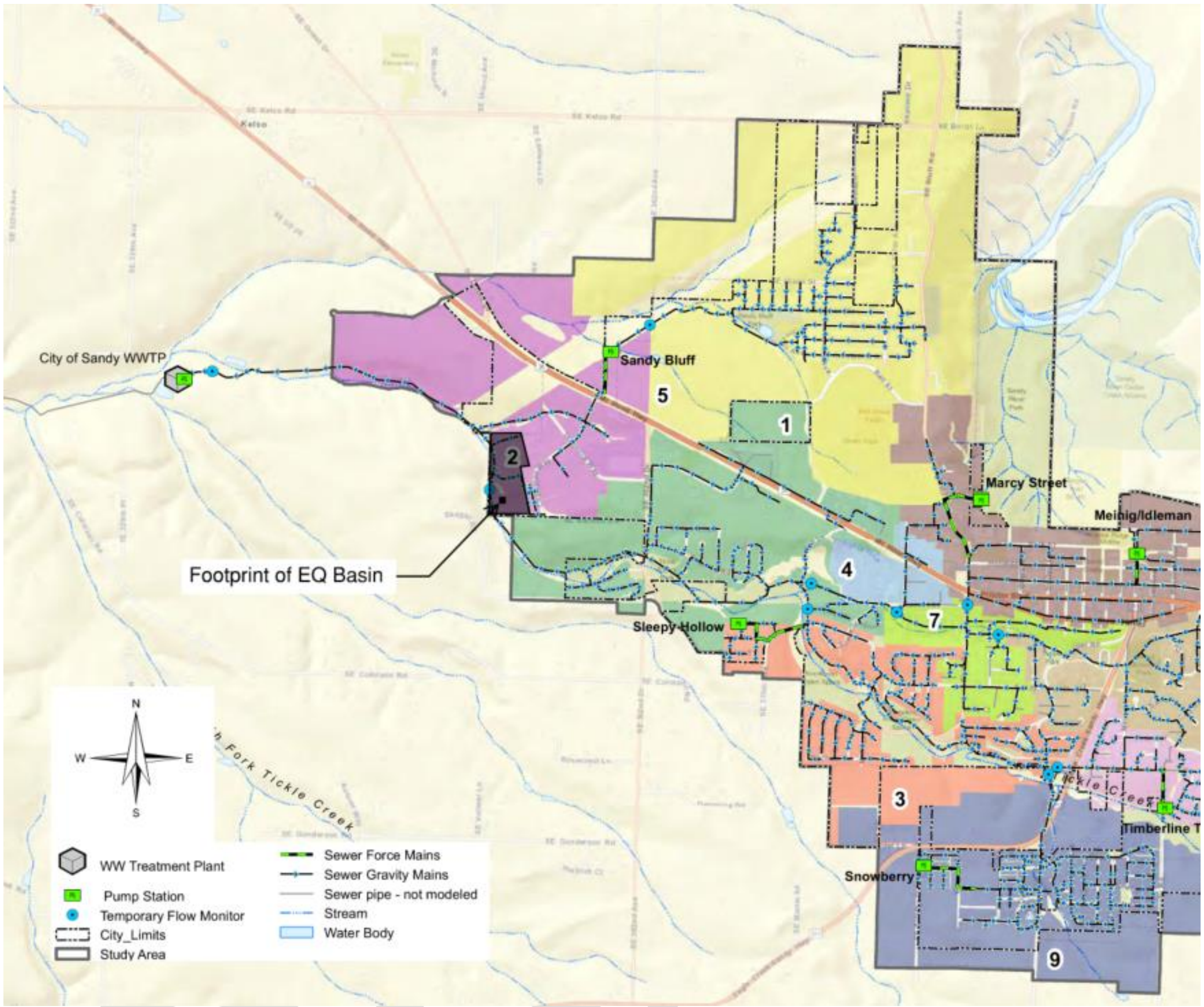
10.2.5.2 Storage Tank Site Location

The second portion of the storage system concept study included scouting for sites near the treatment facility. A square-based storage tank was sized to 100 feet x 100 feet x 45 feet deep, with 15 feet of the tank below, to accommodate about 3.0 MG of storage. Site selection was based on the following parameters, under the assumption that the City would need to buy the property for the equalization basin:

- Open space 2-5 acres minimum, and relatively level.
- The property should be close to the existing gravity sewer.
- Tank should be positioned to accommodate most sewer line branches.
- Site should be uphill from the treatment plant.
- Gravity conveyance from the storage tank would be beneficial, but not required.
- Property is zoned non-residential (exclusive farm use, commercial, or industrial).

Due to topographical limitations near the treatment facility and the sewer line branch layout, only one possible site was identified for the location of the storage vessel. This site is shown in Table 10-8.

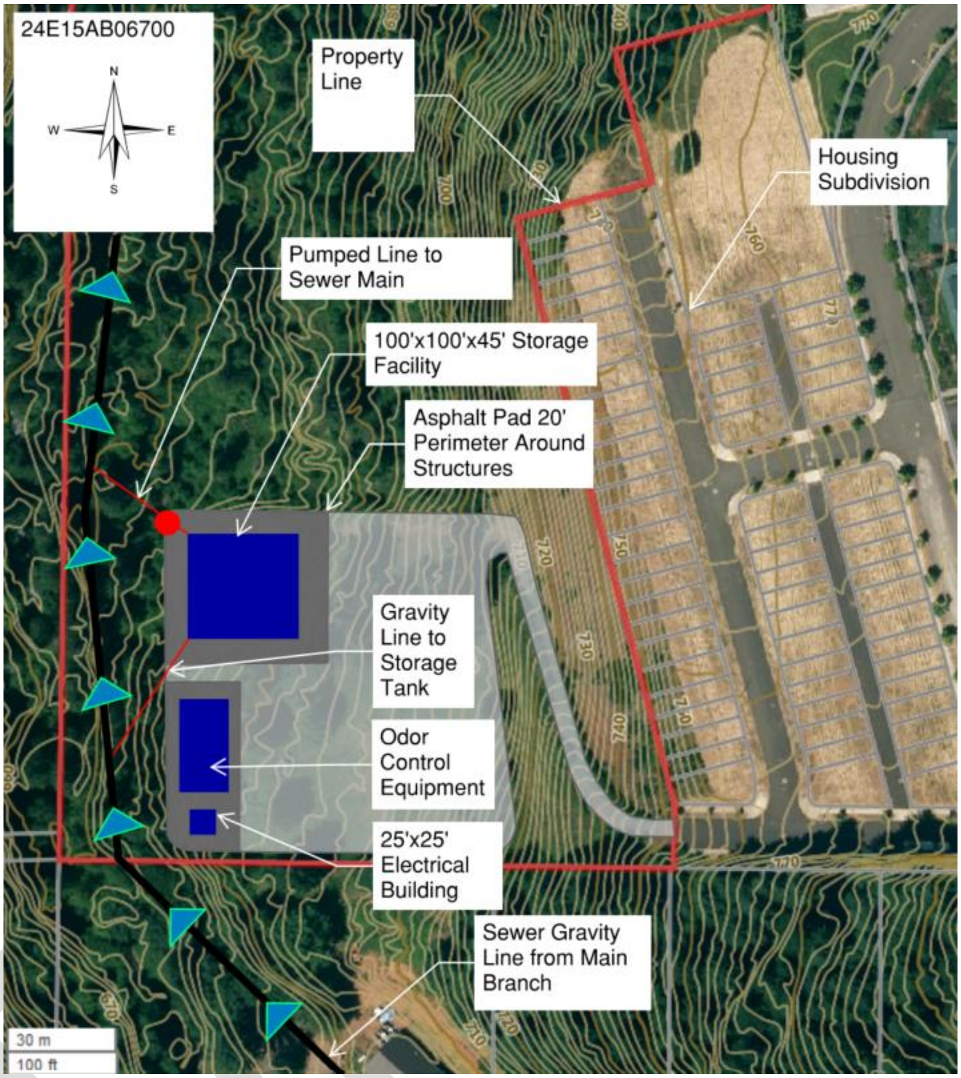
Figure 10-8: Collection System Storage Basin Site Location



This tax lot is 16.61 acres with a Market Total Value of approximately $1.4 million. Although this lot is large, due to topographical limitations and the necessity for the tank to be close to the main sewer line, there is only one location that the tank could be placed on the lot. Wastewater would be conveyed to the tank by gravity, but a pump station would be required for pumping wastewater back to the interceptor towards the treatment plant. The proposed location of the tank on the lot is shown in Table 10-9.

The site is located in General Industrial Zone (I-3). Wastewater utilities are not an outright permitted use for this zone, therefore, it would require a Conditional Use Permit for land use approval.

Figure 10-9: Collection System Storage Tank Location



10.2.5.3 Required Treatment Plant Upgrades

The existing treatment plant capacity would be sufficient to treat the dampened wastewater volumes; however, there are plant elements that require upgrading to replace failing equipment and provide required redundancy. Those elements are:

- Headworks Screens: Two automatic coarse screens and one manually cleaned bar screen like the headworks described for Alternative 1.
- Tertiary Filtration – Ultrafiltration using membranes to meet effluent waste load requirements similar to the effluent filtration described for Alternative 1.
- UV Disinfection – One additional diversion pump station and two new closed-vessel UV similar to the units described for Alternative 1.
- Solids Processing (discussed in Section 9.2.6).

- Electrical Service – The existing facility is currently operating near the electrical service capacity, which will require an upgrade.

In addition to treatment plant upgrades, the storage tank concept would require the following mechanical elements:

- New electrical service
- Pump Station – to return the stored wastewater to the interceptor
- Odor Control System – chemical odor control tower system

10.2.5.4 Alternative 5 Discussion

Although, in theory a storage system prior to the treatment plant would offer the facility a large buffer in treatment capacity, there are several significant limitations in this collection system concept.

Because the projected MMWWF would be within the plant's existing capacity, the option to shave peak volumes could manage the peaks and minimize the amount of treatment plant upgrades required. However, as noted in Section 10.2.5.3, the number and cost of treatment plant upgrades required is significant.

Due to the general hilly topography of the region, particularly close to the treatment plant, KJ was able to identify only one suitable location that was both appropriately zoned and flat enough to reasonably facilitate this alternative. As shown in Figure 10-3, this parcel still has significant elevation change and would require extensive grading.

The proposed parcel is also adjacent to a housing development, and odor control would be required. This would increase the operations and material cost substantially as weekly maintenance would be required for chemical-based odor control systems.

Environmental permitting would require assessment of natural resources and sensitive species, which may be present at this location on the edge of developed City. The tank and associated equipment are not an outright allowed use in the General Industrial Zone; therefore, a Conditional Use Permit (CUP) Process would be followed. Environmental and Land Use permitting for this site is estimated to require 2 to 5 years to complete. The CUP could require architectural and landscape screening improvements, as this location is adjacent to a neighborhood. It is possible, the location adjacent to the residential zone would not be allowed due to public opposition, therefore, there is permitting risk for this Alternative.

Treatment plant improvements are significant and pose a significant element of capital cost for this alternative.

The Engineer's Estimate of Probable Cost to construct Alternative 5 is $62M.

10.3 Initial Liquid Process Concept Screening of Five Alternatives

As described in Section 5, an Initial Concept-Level Screening approach is applied in order to identify economic, regulatory, implementation, and resiliency challenges to assess the viability of liquid process treatment solutions. The outcome of this screening is presented in Table 10-2. In this table, the colored boxes indicate whether the concept is able to meet (green), likely to meet (yellow), or unable to meet (red) the criteria, which are defined in Table 5-1.

Table 10-2: Application of Screening Criteria for Initial Liquids Treatment Concepts

Initial Liquid Process Concept → Criteria ↓	Alt. 1 CAS	Alt. 2 MBR	Alt. 3 Hybrid MBR/CAS	Alt. 4 Regional Treatment Plant	Alt. 5 Collection System Storage
ECONOMIC	~	✓	~	✓	~
CURRENT REGULATORY RISK	~	~	~	✓	~
FUTURE REGULATORY RISK	~	✓	~	✓	✗
IMPLEMENTATION	✓	✓	✓	~	✗
RESILIENCY	~	✓	~	~	~

Concepts that are unable to meet one or more of the criteria are deemed non-viable / unfeasible and are eliminated from further consideration. Based on the screening of initial concepts, the 2024 Plan Amendment includes three viable wastewater treatment (liquid process) alternatives, summarized in the following section:

- ✓ **Alternative 1: CAS**
- ✓ **Alternative 2: MBR**
- ✓ **Alternative 3: Hybrid MBR/CAS**
- ✓ **Alternative 4: Regional Treatment Plant**

These three liquid process treatment approaches are relatively comparable in terms of their ability to meet each of the criteria. However, none of the proposed liquid process alternatives address concerns about the dilution ratio at the outfall to Tickle Creek, or assure enough storage to accommodate flows into the plant when demand of recycled water for irrigation is low. A lower dilution ratio for high-quality effluent at the outfall to Tickle Creek will reduce the required storage during the permitted discharge months. Constructing an additional outfall to the Sandy River will eliminate the need for storage during the dry season.

Alternative 4, the **Regional Treatment Plant concept**, meets all non-financial criteria. Costs to construct the pump station and forcemain are less than the cost to construct full treatment plant upgrades. However, the SDC costs could increase the total capital cost to a level greater than lowest cost treatment alternative. The City has met with Gresham and understands there are potential wholesale rates and City-specific SDC charges. There may be an opportunity to reduce SDCs from the amount assumed in this report, and significantly reduce the capital costs for Alternative 4. This alternative could remove most of the compliance concerns and responsibility from Sandy in exchange for monthly user fees and system development charges.

Alternative 5, the **Collection System Storage concept**, would likely meet current regulatory requirements by providing additional storage to reduce the peak flows into the WWTP, resolving the issues that arise when high flow events force the plant to operate above the available capacity. However, storing more water doesn't resolve the treatment issue and would be unable to alleviate capacity concerns as growth occurs in the City and wastewater flows increase. As a result, the future regulatory risk of implementing this alternative is unacceptable. There are also significant challenges related to implementing a raw water storage facility, which would require a large amount of space for new infrastructure, including a raw water pump station and tank, in addition to challenging ongoing maintenance requirements to address odor issues and regular cleaning of facilities. For these reasons, this alternative was removed from further consideration.

10.3.1 Complete Liquids Alternatives Assumptions

The complete alternatives discussed in this section include several items not specifically stated in the alternative descriptions, but necessary for plant improvements. Each alternative includes all of the required scope items, however, the magnitude of the capital cost may vary, so they were estimated for each alternative. The following items are included in each alternative:

- Site Work & Yard Piping – This includes all process and utility piping within the plant site.
- Electrical/I&C – This includes electrical and instrumentation ductbanks, conduit, wiring, installation of equipment, control systems such as PLCs, programming, and SCADA.
- Recycled Water Pump Upgrades – This item applies to the three treatment alternatives, and not to the Regional Treatment Plant alternative.
- Utility Upgrade Allowance – The utility requirements for the plant upgrades vary somewhat, and estimating them is an effort beyond the scope of this report. We have assigned an allowance for the utility upgrades to include electrical, water, and natural gas.
- Equalization Basin - The current project to increase equalization basin capacity is being completed under a separate near-term project. The equalization basin will retain its aeration capacity and existing pumps will convey wastewater back to the aeration basins.

The utility upgrade allowance was applied uniformly to all treatment and regional treatment plant alternatives.

10.3.2 Alternative 1 – Conventional Activated Sludge

10.3.2.1 WWTP Upgrades for Alternative 1

10.3.2.1.1 *Influent Screening*

Automatically cleaned fine screens will screen large floatable materials, rags, and other objects from the influent wastewater at the plant headworks. Two rotary basket fine screens with ¼-inch spacing, rated at 6.8 MGD each, will remove floatables, rinse and dewater the screenings, and convey them to a covered waste bin to be hauled away for landfill disposal. A manually cleaned bar screen will be installed in a third channel in the headworks for redundancy if one of the automatic screens is out of service. The existing rotary drum screen will be decommissioned.

The basket style headworks screen has several benefits, including an integral rinsing and dewatering stage. The screens selected will use plant water to rinse screenings to minimize odors. In addition, the screen units will be installed with a fulcrum mount that will allow operators to remove the screen end from the wastewater stream for easy inspection and service without a significant disassembly effort. The spray system will be equipped with a cold weather package to prevent freezing. Design parameters for the headworks screens are summarized in Table 10-3.

Table 10-3: Influent Screen Design Parameters

Design Parameter	Automatic Screen No. 1	Automatic Screen No. 2	Manual Screen
Bar Spacing (in)	0.25	0.25	0.75
Peak Capacity (MGD)	6.8	6.8	6.8

The headworks screens will be installed in a cast in place concrete structure with three channels. The headworks will be covered but with open sides. The two automatic screens will serve as primary duty and standby screens. A third manually cleaned bar screen will screen floatable materials if one or both automatic screens are out of service and will also come into operation if the automatic screens cannot accommodate peak flowrates.

10.3.2.1.2 *Grit Removal*

The existing vortex grit removal unit will be maintained. The unit was rehabilitated within the last five years and is expected to continue to be operable, if maintained, through 2040. The unit has a capacity of 7 MGD and will serve the City well through MMWWF and PWF. Grit may pass through during the PDAF and PIF; however, these conditions occur for a duration of 24 hours or less.

The grit pump will be maintained; however, a new grit classifier will replace the existing unit, that has reached the end of its useful life. Grit will dump into a landfill-bound container for disposal.

10.3.2.1.3 *Aeration Basins*

The existing two-train aeration basin secondary treatment system was recently updated. Improvements included new internal walls to encourage plug flow and new fine bubble aerators to improve aeration efficiency. The updates have improved aeration efficiency and provided operators significantly better control over dissolved oxygen within the selector channels and aeration zones, which allows the plant to operate both aeration basins using only one of four blowers during normal loading.

To treat project 2040 waste loads, KJ determined that four new aeration trains will be required for a total of six aeration basins. If designed and operated similarly to the existing aeration trains, one new blower will be required to treat the projected peak wasteload with one of the existing blowers offline. The biomass contained in the six aeration basin plant will be sufficient to reduce ammonia concentrations below conventional detection limits, and reduce the total nitrogen concentration to between 0.5 and 2 mg/L.

A preliminary BioWin process model was prepared for Alternative 1 to verify aeration basin sizes. Detailed results of process modeling are provided in Appendix B.4. Since the BioWin model was prepared, the City has added a sodium hydroxide addition system to control pH. The Aeration Basin Design Parameters for the planning window to 2040 are summarized in Table 10-4.

Table 10-4: Aeration Basin Design Parameters

Design Parameter	Total Capacity	Capacity with One Unit out of Service
Number of Aeration Trains	6	5
Swing Zone 1 Volume	112,400 gallons	93,650 gallons
Swing Zone 2 Volume	112,400 gallons	93,650 gallons
Aerobic Zone Volume	2,099,000 gallons	1,742,900 gallons
Total Aeration Basin Volume	2,323,800 gallons	1,930,200 gallons
Air Required at MMWWF (firm capacity)	4,880 scfm	4,880 scfm
Blowers		
Centrifugal Blower 1	1,350 scfm	1,350 scfm
Centrifugal Blower 2	1,350 scfm	1,350 scfm
Centrifugal Blower 3	1,350 scfm	1,350 scfm
Rotary Lobe Blower 1	1,199 scfm	1,199 scfm
New Blower	2,000 scfm	------- scfm
Total Blower Capacity	7,249 scfm	5,249 scfm

scfm – Standard Cubic Feet Per Minute

10.3.2.1.4 *Secondary Clarifiers*

The two existing 54-foot diameter secondary clarifiers were recently rehabilitated, and we have assumed they will remain functional through the 2040 planning window with maintenance. The peak capacity of the two clarifiers will not accommodate the peak design flowrates; therefore, one additional 70-foot diameter secondary clarifier will enable the updated treatment process to meet the peak loading requirements. To accommodate the new clarifier, the existing Aerated Sludge Storage Basin will be demolished, and the new clarifier constructed in its place. Clarifier surface loading rates at design flowrates are summarized in Table 10-5.

Table 10-5: Secondary Clarifier Surface Loading Rates

Design Condition	Design Flowrate (MGD)	Surface Loading Rate (gpd/sf)			
		One 54-ft Clarifier	Two 54-ft Clarifiers	Two 54-ft Clarifiers + One 70-ft Clarifier	Design Limit
AAF	2.2	960	480	260	800
MMWWF	3.6	1,570	790	430	800
PIF	12.2	5,330	2,670	1,450	1,600[(1)]

gpd/sf = gallons per day per square foot

(1) Maximum surface loading rate for activated sludge with anoxic selectors.

10.3.2.1.5 *Tertiary Filtration*

Secondary effluent will be conveyed to tertiary treatment through a set of ultrafiltration modules for polishing. The tertiary filters are comprised of a set of membrane filters with an average pore size of 0.01 microns, which can remove activated sludge floc that has carried over from the clarifiers, plus most pathogenic bacteria, and some viruses. Filters are periodically backwashed automatically, and the backwash is returned to the plant influent for treatment.

An existing effluent submersible diversion pump station will be used to convey wastewater to one set of new tertiary filters. The existing pumps will be upgraded to increase capacity to half of the projected PIF. An additional submersible pump station will be constructed to divert wastewater to the second set of filters.

The existing smaller disc filters will be demolished, and the ultrafiltration units will be located under the cover of the existing filtration and disinfection shed.

The proposed configuration to treat projected 2040 flowrates is summarized in Table 10-6.

Table 10-6: Tertiary Filter Modules Required

	Flux Rate (gpd/sf)

Design Condition	Design Flowrate (MGD)	Filter Unit, Each	Filter Unit, Each with One Offline	Design Limit
AAF	2.2	5.0	4.3	12
MMWWF	3.6	8.1	7.0	26.3
PIF	12.2	27.6	23.7	34.5

gpd/sf = gallons per day per square foot

10.3.2.1.6 *Ultraviolet Disinfection*

Disinfection during the wet weather discharge season will be accomplished primarily using UV light/radiation, which renders pathogens inert. The existing Trojan open channel UV disinfection system is obsolete, no longer supported by the manufacturer, and replacement lamps are only available from third party manufacturers. Lamps are difficult to source, and costs continue to escalate. Work is underway to replace the existing open-channel UV unit with more modern equipment, capable of treating 7 MGD.

Two additional Evoqua closed-vessel UV units provide 3.5 MGD each of disinfection capacity, bringing the plant's total disinfection capacity to 14 MGD; however, the firm capacity is 7 MGD. Therefore, two more closed vessel UV units will be required to meet firm capacity requirements for disinfection. The City is investigating using UV for disinfection year-round. A summary of the UV units is provided in Table 10-7.

Table 10-7: UV Disinfection Equipment Summary

UV Unit	Manufacturer	Type	Capacity	Status
1	Trojan	Open Channel	7 MGD	Existing
2	Evoqua	Closed Vessel	3.5 MGD	Existing
3	Evoqua	Closed Vessel	3.5 MGD	Proposed
4	Evoqua	Closed Vessel	3.5 MGD	Proposed
5	Evoqua	Closed Vessel	3.5 MGD	Proposed

10.3.2.1.7 *Sodium Hypochlorite Residual*

In addition to UV disinfection, during the non-discharge season, effluent is recycled to Iseli Nursery and requires a free chlorine residual for use as recycled water. The existing sodium hypochlorite system is adequate to provide the required residual up to 7 MGD, which greater than the effluent pumping capacity of the current pump expansion project. The City is currently investigating UV disinfection to disinfect irrigation water, therefore, no improvements are currently proposed to this system.

10.3.2.2 Alternative 1 Discussion

Alternative 1 represents an expansion of the existing plant with minor changes, but not a significant change in the process. The Operator Certification Level will not change; therefore, the existing treatment plant staff will be qualified with no update. The footprint of four new aeration basins and one new clarifier will be the largest of the treatment alternatives considered. A site plan showing all components of Alternative 1 is provided in Figure 10-2. A summary of process area capacities is provided in Table 10-8.

Table 10-8: Alternative 1 Process Area Capacity Summary

Process Area	Total Capacity (MGD)	Firm Capacity[2] (MGD)
Fine Screens	20.4	13.7
Aeration Basins	12.2	12.2
Secondary Clarifiers	12.2	12.2[1]
Tertiary Filtration	12.2	12.2
UV Disinfection	21	14

[1] Meets stated loading rate guidelines for short term peak flowrate with anoxic selector.
[2] Largest unit out of service.

To enable the third clarifier to function with equivalent hydraulics, all aeration basins will convey mixed liquor to a distribution pump station, which will distribute mixed liquor to the three clarifiers proportionally. This pump-forward approach is unusual but required for this arrangement.

The third clarifier will be constructed in the existing sludge stabilization basin; therefore, a new storage/stabilization basin will be required if the solids process requires storage.

Adding two of the four new aeration trains will require a portion of the existing surge pond to be filled. This will reduce storage volume, which is undesirable to operations staff.

The Engineer's Estimate of Probable Cost to construct the liquids processing portion of Alternative 1, including new interconnecting yard piping and electrical and instrumentation allowance, is $59.8M as outlined in Table 10-9.

Table 10-9: Liquid Stream Alternative 1 Engineer's Estimate of Probable Cost

Process Area	Total Cost by Area
Site Work & Yard Piping	$3.5M
Electrical/I&C	$8.6M
Headworks	$2.2M
Aeration Basins	$14.4M
Secondary Clarifiers	$5.4M
Tertiary Filtration	$18.0M
UV Disinfection	$2.7M
Recycled Water Pumps	$1.7M
Utility Upgrade Allowance	$5.0M

Total Cost	$59.8M

The cost for Alternative 1 is the highest of the onsite treatment alternatives, thus, would likely be less preferred.

10.3.3 Alternative 2 - MBR

10.3.3.1 WWTP Upgrades for Alternative 2

10.3.3.1.1 *Influent Screening*

Three automatically cleaned basket fine screens will replace the single existing rotary drum screen. The proposed screens are the same as previously discussed in Alternative 1, each rated at 6.8 MGD capacity with 2-mm spacings in the screens. The screens will be configured for operation with two duty screens and one on standby to accommodate peak flows. The MBR membranes require greater git removal to prevent damage to the filters. Consequently, the manual bar screen will not be needed. The screens will reside in a prefabricated concrete structure with three channels where each screen will be fulcrum mounted to remove floatables, rags, and other debris. The design parameters are summarized in Table 10-10.

Table 10-10: Influent Screen Design Parameters

Design Parameter	Automatic Screen No. 1	Automatic Screen No. 2	Automatic Screen No. 3
Bar Spacing (mm)	2	2	2
Peak Capacity (MGD)	6.8	6.8	6.8

10.3.3.1.2 *Grit Removal*

Similar to Alternative 1, the existing vortex grit removal unit will be reused in these proposed upgrades, and the grit classifier will be replaced to capture and dispose of grit.

10.3.3.1.3 *Aeration Basins*

To treat project 2040 waste loads, four packaged MBR tanks split between two process basins will be needed. Half of the existing aeration basin will be converted and improved to hold anoxic, pre-aeration, and MBR tanks. The other half of the basin can serve as additional storage for anoxic treatment or be equipped to expand the MBR system for additional treatment capacity. If designed and operated similarly to the existing aeration trains, one new blower will be required to treat the projected peak wasteload with one of the existing blowers offline. An additional equipment room next to the basin will house the scour blowers for each of the MBR tanks, as well as the RAS, WAS, and permeate pumps to convey flows within the tank, to tertiary liquids treatment, and to solids processing.

Two process basins will be sufficient to reduce ammonia concentrations below conventional detection limits, and reduce the total nitrogen concentration to approximately 2 mg/L. The secondary clarifiers will no longer be needed following the MBR-equipped aeration basin. Both clarifiers could be decommissioned, or one could serve as additional anoxic volume. The pH control system installed in 2022 will enable operators to maintain sufficient alkalinity for pH control.

A preliminary BioWin process model was prepared for Alternative 2 to verify aeration basin sizes. Results of process modeling are provided in Appendix B.4. The Aeration Basin Design Parameters for the planning window to 2040 are summarized in Table 10-11.

Table 10-11: Aeration Basin Design Parameters

Design Parameter	Total Capacity	Capacity with One Unit out of Service
Number of Aeration Trains	2	1
Swing Zone Volume	12,000 gallons	6,000 gallons
Aerobic Zone Volume	366,600 gallons	183,300 gallons
Anoxic Volume	146,600 gallons	73,300 gallons
Total Aeration Basin Volume	525,200 gal	262,600 gal
Air Required at MMWWF	4,410 scfm	4,410 scfm
Blowers		
Centrifugal Blower 1	1,350 scfm	1,350 scfm
Centrifugal Blower 2	1,350 scfm	1,350 scfm
Centrifugal Blower 3	1,350 scfm	1,350 scfm
Rotary Lobe Blower 1	1,199 scfm	1,199 scfm
New Blower	2,180 scfm	------ scfm
Total Blower Capacity	7,429 scfm	5,249 scfm

10.3.3.1.4 *Membrane Filters*

Each set of MBR cassettes can treat an average flowrate of 2.7 MGD and a PIF of 3.1 MGD. The plant will require a total of 20 MBR cassettes, housed between four tanks across two process trains. The proposed configuration to treat projected 2040 flowrates is summarized in Table 10-12.

Table 10-12: MBR Design Flux Rate Summary

		Flux Rate (gpd/sf)		
Design Condition	Design Flowrate (MGD)	Per MBR Train	Per MBR Train with One Offline	Design Limit
AAF	2.2	4.0	5.3	12

MMWWF	3.6	6.5	8.7	19.6
PIF	12.2	14.7	22.1	22.2

gpd/sf = gallons per day per square foot

10.3.3.1.5 *UV Disinfection*

Similar to Alternative 1, two additional closed vessel UV units will be required to meet firm capacity requirements for disinfection. A summary of the UV units is provided in Table 10-7.

10.3.3.1.6 *Sodium Hypochlorite Residual*

Similar to Alternative 1, the existing sodium hypochlorite system is adequate to provide the required residual required up to 7 MGD. No improvements are proposed to this system.

10.3.3.1.7 *Effluent Pumping*

Effluent pumping will be the same as Alternative 1, whereby the existing vertical lineshaft effluent pumps will be increased in size to 2.5 MGD each, in a two duty and one standby configuration. This will require retrofitting the effluent basin and possibly the roof of the effluent building.

10.3.3.2 Alternative 2 Discussion

Alternative 2 represents an expansion of the existing plant with minor changes, but not a significant change in the process. The Operator Certification Level will increase to Level 4, which will require the plant's current Operators to update their training and certification. The footprint of the MBR plant is the smallest of the alternatives under consideration. A summary of the process areas is provided in Table 10-13. A site plan showing all components of Alternative 2 is provided in Figure 10-8.

Table 10-13: Alternative 2 Process Area Capacity Summary

Process Area	Total Capacity (MGD)	Firm Capacity[2] (MGD)
Fine Screens	20.4	13.7
Aeration Basins	12.2	12.2
Membrane Filters	12.2	12.2[1]
UV Disinfection	21	14

[1] Allowed for 2 consecutive hours.
[2] Largest unit out of service.

One of the existing clarifiers and the remaining half of the aeration basin tanks that are no longer needed with the installation of the MBRs can be reused for complete anoxic treatment. The other secondary clarifier can store sludge for additional solids handling capacity. The ASSB will remain online for aerated sludge storage.

The Engineer's Estimate of Probable Cost to construct the liquids processing portion of Alternative 2 is $55.2M as outlined in Table 10-14.

Table 10-14: Liquid Stream Alternative 2 Engineer's Estimate of Probable Cost

Process Area	Total Cost by Area
Site Work & Yard Piping	$3.0M
Electrical/I&C	$6.2M
Headworks	$2.8M
MBR Trains & Equipment	$25.4M
UV Disinfection	$3.0M
Recycled Water Pumps	$1.7M
Utility Upgrade Allowance	$5.0M
Total Cost	**$47.1M**

The cost for Alternative 2 is the lowest of the treatment alternatives that can be completely contained on the treatment plant site and preserve 100% of the existing surge basin.

10.3.4 Alternative 3 – CAS/MBR Hybrid

10.3.4.1 WWTP Upgrades for Alternative 3

10.3.4.1.1 *Influent Screening*

Automatically cleaned basket fine screens will screen large floatable materials, rags, and other objects from the influent wastewater at the plant headworks. Three rotary basket fine screens rated at 6.8 MGD each will remove floatables, rinse and dewater the screenings, and convey them to a covered waste bin and will be hauled away for landfill disposal.

Because the plan includes MBR trains, the minimum bar spacing will be 2 mm and must include full redundancy to protect membranes. The screens will be configured for operation with two duty screens and one on standby to accommodate peak flows, similar to Alternative 2. Design parameters for the headworks screens are summarized in Table 10-15.

Table 10-15: Influent Screen Design Parameters

Design Parameter	Automatic Screen No. 1	Automatic Screen No. 2	Automatic Screen No. 3
Bar Spacing	2 mm	2 mm	2 mm
Peak Capacity	6.8 MGD	6.8 MGD	6.8 MGD

The headworks screens will be installed in a cast in place concrete structure with three channels. The headworks will be covered but will have open sides.

10.3.4.1.2 *Grit Removal*

Grit removal will be the same as Alternative 1. The existing vortex grit removal unit will be reused in these proposed upgrades and the grit classifier will be replaced to capture and dispose of grit.

10.3.4.1.3 *Aeration Basins*

The existing, two-train, aeration basin secondary treatment system will be upgraded and neighbored by a two-train MBR system. The aeration basins and MBR process basins will share the influent flows into the plant to accommodate peak flows and seasonal operation.

The MBR process basins will be sized to convey peak flowrates if one aeration basin must be taken offline. The MBR tanks will have their own blowers to provide scour air for the MBR cassettes and will use the existing blowers for process aeration. If designed and operated similarly to the existing aeration trains, no new process aeration blowers will be required to treat the projected peak waste loadings. The process basins are sized to treat ammonia levels to below detection limits.

An additional equipment room will be constructed next to the MBR basins to house the scour blowers, RAS, WAS, and permeate pumps for the MBR. The existing RAS, WAS, and internal recycle pumps will be used to convey flows for the existing aeration basin and secondary clarifiers.

The Aeration Basin Design Parameters for the planning window to 2040 are summarized in Table 10-16.

Table 10-16: Alternative 3 Aeration Basin Design Parameters

Design Parameter	Total Capacity	Capacity with One Unit out of Service
Number of Aeration Trains	2	1
Swing Zone 1 Volume	37,500 gallons	18,750 gallons
Swing Zone 2 Volume	37,500 gallons	18,750 gallons
Aerobic Zone Volume	712,200 gallons	356,100 gallons
Total Aeration Basin Volume	787,200 gal	393,600 gal
Air Required at MMWWF	3,385 scfm	3,385 scfm
Blowers		
Centrifugal Blower 1	1,350 scfm	---- scfm
Centrifugal Blower 2	1,350 scfm	1,350 scfm
Centrifugal Blower 3	1,350 scfm	1,350 scfm
Rotary Lobe Blower 1	1,199 scfm	1,199 scfm
Total Blower Capacity	5,249 scfm	3,899 scfm

10.3.4.1.4 *Membrane Filters*

Each MBR cassette is capable of treating an average flowrate of 2.7 MGD and a PIF of 3.1 MGD and will be able to handle half of the influent flows during split-plant operation. The WWTP will require a total of 20 MBR cassettes, housed between 4 tanks in two process trains. The proposed MBR configuration that will accompany the above aeration basin to treat projected 2040 flowrates is summarized in Table 10-17.

Table 10-17: MBR Design Flux Rate Summary

Design Condition	Design Flowrate (MGD)	Flux Rate (gpd/sf) Per MBR Tank	Flux Rate (gpd/sf) Per MBR Tank with One Offline	Flux Rate (gpd/sf) Design Limit
AAF	1.1	2.0	2.7	12
MMWWF	1.8	3.3	4.4	19.6
PIF	6.1	11.1	14.8	22.2

gpd/sf = gallons per day per square foot

10.3.4.1.5 *Tertiary Filtration*

Secondary clarifier effluent will be conveyed to tertiary treatment through a set of ultrafiltration modules for polishing. Like Alternative 1, the tertiary filters are comprised of a set of membrane filters with an average pore size of 0.01 microns and can remove activated sludge floc that has carried over from the clarifiers, most pathogenic bacteria, and some viruses. Filters are periodically backwashed automatically, and the backwash is returned to the plant influent for treatment.

The existing smaller disc filters will be demolished, and the ultrafiltration units can be located under the cover of the existing filtration and disinfection shed if sufficient space is available.

The proposed configuration to treat projected 2040 flowrates is summarized in Table 10-19.

Table 10-18 Tertiary Filter Modules Required

Design Condition	Design Flowrate (MGD)	Flux Rate (gpd/sf) Filter Unit, Each	Flux Rate (gpd/sf) Filter Unit, Each with One Offline	Flux Rate (gpd/sf) Design Limit
AAF	1.1	3.6	4.8	12
MMWWF	1.8	5.9	7.9	26.3
PIF	6.1	20.1	26.8	34.5

gpd/sf = gallons per day per square foot

UV Disinfection

Two additional closed vessel UV units will also be included in Alternative 3 to meet firm capacity requirements for disinfection. A summary of the UV units is provided in Table 10-7.

10.3.4.1.6 *Sodium Hypochlorite Residual*

Similar to Alternative 1, the existing sodium hypochlorite system is adequate to provide the required residual required up to 7 MGD. No improvements are proposed to this system.

10.3.4.1.7 *Effluent Pumping*

Effluent pumping will be the same as Alternative 1. The existing vertical lineshaft effluent pumps will be upsized to accommodate 2.5 MGD each, with two duty and one standby pump. This will require retrofitting the effluent basin and possibly the roof of the effluent building.

10.3.4.2 Alternative 3 Discussion

Alternative 3 represents preserving the existing plant and the addition of new parallel MBR trains. The Operator Certification Level will increase to Level 4, which will require the plant's current Operators to update their training and certification. The footprint of the hybrid plant is between Alternatives 1 and 2. A site plan showing all components of Alternative 2 is provided in Figure 10-8. A summary of process area capacities is provided in Table 10-19.

Table 10-19 Alternative 3 Process Area Capacity Summary

Process Area	Total Capacity (MGD)	Firm Capacity[2] (MGD)
Fine Screens	20.4	13.7
Aeration Basins	12.2	12.2
Membrane Filters	12.2[1]	9.3[1,3]
Tertiary Filtration	7.0	5.3[3]
UV Disinfection	21	14

[1] Allowed for 2 consecutive hours.
[2] Largest unit out of service.
[3] Both CAS and MBR processes to be online for firm capacity to meet 12.2 MGD PIF.

The hybrid plant configuration will require both CAS and MBR trains to be online during wet weather to provide sufficient filtration capacity. With both processes online, the biological process is fully supported, and tertiary filtration capacity is provided with the largest unit out of service.

The existing secondary clarifiers will remain online to support the conventional activated sludge portion of the plant. With reduced flows to the clarifiers, the surface loading rates with be lowered to optimize solids settling and prevent overflow of sludge and scum to the subsequent processes. The ASSB will continue to be utilized for aerated sludge storage.

The Engineer's Estimate of Probable Cost to construct the liquid's processing portion of Alternative 3 is $56.5M as summarized in Table 10-20.

Table 10-20: Liquid Stream Alternative 3 Engineer's Estimate of Probable Cost

Process Area	Total Cost by Area
Site Work & Yard Piping	$3.3M
Electrical/I&C	$12.4M
Headworks	$2.8M
MBR/CAS Treatment	$19.7M
UV Disinfection	$3.0M
Tertiary Filtration	$10.3M
Recycled Water Pumping	$1.7M
Utility Upgrade Allowance	$5.0
Total Cost	**$58.2M**

The cost for Alternative 3 is the highest of the treatment alternatives that can be completely contained on the treatment plant site, without encroaching on the existing surge basin.

10.3.5 Alternative 4 – Regional Treatment Plant

Alternative 4 will include a 14-mile, 30-inch ductile iron forcemain and pump station to transport influent wastewater flows to the City of Gresham Wastewater Treatment Plant. The Gresham plant has sufficient treatment capacity and a reliable point of discharge to avoid any permit compliance issues. The City of Sandy can negotiate an agreement for appropriate SDCs to send flows to Gresham, but without adding any stress to Gresham's collection system.

10.3.6 Cost Estimates for Complete Treatment Alternatives

The alternatives costs were developed for capital construction costs for the liquid and solid treatment recommendations. Alternative 4 would require a headworks screen and pump station, but no other plant improvements.

A summary table of Alt 1-4 costs is provided in **Table 10-21**.

Table 10-21 - Cost Estimates Complete Wastewater Treatment Alternatives

Alternative	Liquid Process Construction	Solids Process Construction	Sandy River Outfall	Total Capital Cost
Alternative 1: CAS	$59.8M	$8.1M	$49.4M	$117.3M
Alternative 2: MBR	$47.1M	$8.1M	$49.4M	$104.6M
Alternative 3: Hybrid MBR/CAS	$58.2M	$8.1M	$49.4M	$115.7M

Alternative 4: Regional Treatment Plant	$122.3M	--	--	$122.3M

10.4 Beneficial Projects for Future Consideration

The City may consider additional projects that can be attached to selected wastewater projects that could further benefit the community and the City. These projects include:

- **Hydro Power Opportunities –** The proposed Sandy River Outfall will pump over the ridge between the Tickle Creek and Sandy River basins. A portion of the energy required to pump over this ridge can be recovered and returned to the grid through use of a turbine inside the outfall pipe. Feasibility of this opportunity should be studied as part of the Sandy River Outfall project preliminary design. Energy Trust of Oregon has incentive programs to fund studies and support construction of energy saving and generating projects.

- **Streamflow Augmentation –** The recommended alternative will produce extremely high-quality effluent that may achieve pollutant concentrations below detection limits during the summer season. The City may consider, as part of its NPDES permit renewal strategy, to have consultation with state and federal agencies regarding stream flow augmentation. Such a program could allow beneficial use of very high-quality effluent to augment declining stream flow in Tickle Creek and benefit aquatic populations.

10.5 Liquid Process Alternatives Screening

As described in Section 5, the Alternatives Screening (Liquid Process) approach is applied to the three alternatives evaluation in Section 10.3. The screening criteria and scoring guidance, previously defined in Table 5-3 are applied to compare and rank the three treatment alternatives. The outcomes of the alternatives screening are presented in Table 10-22 and discussed below.

Table 10-22: Application of Screening Criteria for Liquid Process Alternatives

Criteria	Sub-Critiera	Alt 1: CAS	Alt 2: MBR	Alt 3: Hybrid MBR/CAS	Alt 4: Regional Treat Plant
ECONOMIC	Financial Implementability	1	4	2	3
	Annual Cost Effectiveness	4	3	2	3
PERMIT COMPLIANCE RISK	Near Term Regulatory Risk	3	4	4	4
	Future Regulatory Risk	2	2	2	4
OPERATIONAL CONSIDERATIONS	Operational Complexity	3	2	2	4
	Operational Impacts During Construction	2	4	2	4
	Operational Staffing	3	2	2	4
IMPLEMENTATION	Construction Schedule	2	4	3	4
RESILIENCY	Compliance	1	3	2	4
	Vulnerability	4	4	4	4
	Total Weighted Score:	**2.35**	**3.45**	**2.6**	**3.7**

Score	Legend:
4	Fully Meets Criteria
3	Mostly Meets Criteria
2	Somewhat Meets Criteria
1	Does Not Meets Criteria

Alternative 1: CAS scored lowest overall. The CAS process has the highest construction cost due to the amount of concrete, new pumps, and need for a separate effluent filtration step. The implementation schedule is also longer achievable due to time needed to construct the basins and challenges associated with operational impacts during construction, since the current solids process would need to be interrupted to make the process upgrades. This alternative would also require changing the way the process works while keeping it online, requiring the pumping to the clarifiers rather than using gravity. There is also a greater regulatory risk as an upset in the clarifiers could result in losing solids, which would upset the downstream ultrafiltration process, requiring additional cleaning cycles that are more intense than normal operations. Additionally, in the worst case, a solids release without an additional barrier like a submerged membrane could create an upset condition resulting in a permit violation.

Alternative 2: MBR scored the second highest overall. A package plant has the benefit of a smaller footprint, lowest cost, and the ability to construct and startup without disrupting current operations. The submerged membrane performs better as a physical barrier to the sludge, removing toxics and ammonia from the treated effluent. An MBR facility would require higher certification for operators, but due to built-in automation, the existing number of staff may be able to operate the plant as are currently overseeing operations. Overall, a single MBR solution would provide improved operation, compliance, and resiliency.

Alternative 3: Hybrid MBR/CAS scored in third, blending the benefits and limitations of Alternatives 1 and 2. Having two systems is more complex to operate, and would require the most staff along with higher certified staff for the MBR. Since half the flow would go to the MBR and half to the CAS, the upset challenges associated with Alternative 1 are not as significant and there will be better removal of toxics and ammonia in the portion treated by the MBR. The cost to construct two new treatment components is less than the CAS alternative but still 30% more than the MBR alternative.

Alternative 4: Regional Treatment Plant scored the highest overall. Pumping sewage to Gresham, with sufficient treatment and discharge capacity, reduces the risk of permit violation and minimizes operational complexity. The added cost of SDCs could be negotiated if the City were to become a wholesale customer with Gresham.

10.6 Recommended Alternatives

10.6.1 Recommended Complete Treatment Alternative

Table 10-23 summarizes the screening outcomes for the four complete process alternatives, including solids treatment, and identifies Alternative 2 MBR as the top-ranking alternative for on-site treatment, and Alternative 4 for overall permit compliance.

Table 10-23: Ranking of Complete Alternatives

Option	Complete Alternative Capital Costs	Annual Operating Power Costs	RANKING
Alt 1: CAS	$117.3M	$1.6M/yr	4
Alt 2: MBR	$104.6M	$1.4M/yr	2
Alt 3: Hybrid MBR/CAS	$115.7M	$1.4M/yr	3
Alt 4: Regional Treatment Plant	$122.3M	$0.5M/yr	1

Alternative 2 is the preferred treatment alternative based on the screening approach detailed above.

10.6.2 Recommended Electrical Service Requirements

To implement the recommended liquid process upgrades in Alternative 2, the electrical service and standby power generator will require a significant increase in service size to serve the upgraded WWTP. Proposed improvements are expected to more than triple the electrical demand and exceed the existing service capacity of 2,000 Amperes. Table 10-24 provides an outline of these electrical load requirements.

Table 10-24: Alternative Two Electrical Load Summary

Utility	Estimated Demand (Amperes)
Current Demand Load	4,800
New Items Demand Load	1,900
Total Expected Loads	6,700
25% Spare Capacity	1,700
Total Loads	**8,400**

10.6.3 Recommended Discharge Alternative

The DDAE Report (Murraysmith, 2021) determined that the Ten Eyck Road and Revenue Bridge site has the most favorable hydrologic and geomorphologic conditions and limited fisheries impacts compared with other potential sites for the new Sandy River outfall.

This 2024 Plan Amendment documents new design flowrate projections reflecting the reduction in I&I achieved through recent pipeline rehabilitation efforts and evaluates alternatives for providing improvements required to maintain treatment at the existing WWTP.

The *Sandy River Effluent Pump Station – Draft Conceptual Design Report* (Stantec, 2024c), included in Appendix A.1, identifies a new pipeline alignment and documents the effluent pumping requirements to convey treated effluent from the existing WWTP site to the proposed Ten Eyck Road discharge location.

The driving criteria for the new effluent pipeline and outfall is the peak hour flowrate (PHF) projected to occur during a 1- in 5-year winter storm. The City's collection system model was recently calibrated to reflect the observed reduction in I&I, resulting in a year 2040 peak hour flow has been reduced to 12.2 MGD.

Also, this same report (Stantec, 2024c) identifies a new pressurized pipeline alignment from the WWTP to Bluff Road and a gravity main from Bluff Road to the outfall location near the Revenue Bridge. The Sandy River Effluent Pump Station is sized to convey effluent ranging the projected peak day flowrate of 12.2 MGD to the anticipated minimum flow at startup conditions of 1 MGD. The Opinion of Construction Cost (OPCC) for the pump station, electrical building and effluent force main and pipeline is $49.4 million, in 2024 dollars (Stantec, 2024c).

Section 11: Recommended Capital Improvement Plan Update

2019 PLAN | SECTION 11 SUMMARY

- 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.

11.1 Introduction

The recommended wastewater collection, treatment, and discharge alternatives are summarized in this section. Costs were prepared by all of the Consultants currently working on wastewater systems for the City and are summarized in this CIP section for the City's convenience. Generally, these areas include:

- Collection System Repairs
- Complete Wastewater Treatment Alternatives (Liquid Stream & Solids Stream)
- Long Term Discharge Alternative (Sandy River Outfall)

11.2 Recommended Plan Overview

11.2.1 Collection System Rehabilitation Program

The *Draft TM – 2024 Wastewater Collection System Update* (Stantec, 2024a), included in Appendix A.2, identifies ongoing and upcoming activities (Table 11-1), and provides an updated CIP for collection system activities that are included in this 2024 Plan Amendment (Table 11-2).

Table 11-1: Status of 2019 Facility Plan Recommended Collection System Improvements

Designation	Project Name	Project Description	Status	Ongoing Project
Capacity	Sandy Bluff	Additional pumping capacity, mechanical and electrical upgrades	Ongoing	Northside PS Upgrades; PS Capacity Evaluation
Capacity	Jacoby/ Timberline Trails	Additional pumping capacity	Ongoing	PS Capacity Evaluation
Capacity	Marcy Street	Additional pumping capacity, mechanical and electrical upgrades	Ongoing	PS Capacity Evaluation
Capacity	Meinig Avenue	Additional pumping capacity, mechanical and electrical upgrades	Ongoing	PS Capacity Evaluation
Capacity	Snowberry Pump Station	Additional pumping capacity	Ongoing	PS Capacity Evaluation
Capacity	Sandy Bluff	FM Upgrades	Ongoing	PS Capacity Evaluation
Capacity	Jacoby/ Timberline Trails	FM Upgrades	Ongoing	PS Capacity Evaluation
Capacity	Sandy Heights – Dubarko Road	Gravity upgrade	Monitor	Evaluate need based on Model Recalibration
Capacity	Dubarko Road at Tupper Rd	Gravity upgrade	Monitor	Evaluate need based on Model Recalibration
I&I	Sandy Bluff	Gravity upgrade	Monitor	Evaluate need based on Model Recalibration
I&I	Site-specific	Flow monitoring	Ongoing	Flow Monitoring and Model Recalibration
I&I	33% of System	Condition Assessment (CCTV)	Ongoing	CCTV and Grade 4/5 Defects
I&I	System-wide	Smoke testing	Completed	N/A
I&I	Basin 2	Rehabilitation (piping and laterals)	Completed	N/A
I&I	Basin 8	Rehabilitation (piping and laterals)	Completed	N/A
I&I	Basins 5, 6, 7, 10	Rehabilitation (piping and laterals)	Basins 6 & 7 Completed	Basin 5 MHs as part of Manhole Grouting Contract
I&I	System-wide	Stormwater Disconnects	Completed	N/A
I&I	System-wide	$200k/yr ongoing I&I	Ongoing	CCTV and Grade 4/5 Defects

Designation	Project Name	Project Description	Status	Ongoing Project
I&I	System-wide	Collection system repair and replacement program	Ongoing	CCTV and Grade 4/5 Defects
I&I (New)	Manhole Grouting	Focused grouting of manholes in Basins 5, 6, and 7 and throughout the City as identified by City staff	Ongoing	Manhole Grouting
I&I (New)	Basins 3, 9, 10	Rehabilitation (non-plastic pipe, laterals, manholes)	New	Basins 3, 9, 10 Rehabilitation

Source: Draft TM –2024 Wastewater Collection System Update (Stantec, 2024a)

Table 11-2: Collection System Recommended Projects

Project Name	Project Description	CIP Cost Estimate (2024 dollars)	Year(s) of Completion
Northside Pump Station Upgrades	Upgrade pump station to provide firm pumping capacity of 1,200 gpm	$450,000	2024
Pump Station Capacity Evaluation	Revisit the need for capacity upgrades at the Jacoby/Timberline Trails, Marcy Street, Meinig Avenue, and Snowberry pump stations	$150,000	2025
Flow Monitoring and Model Recalibration	Collect additional flow monitoring to collect data reflecting recent rehabilitation efforts, and recalibrate model reflecting current conditions	$200,000	2025
CCTV Inspection	Complete CCTV inspection of remaining collection system	$200,000 (per year)	2024-2025
Citywide Manhole Grouting	Focused grouting of manholes in Basins 5, 6, and 7 and throughout the City as identified by City staff	$400,000	2023-2025
Grade 4/5 Defect Repairs	Repair Grade 4 and Grade 5 defects identified through CCTV inspection	$300,000 (per year)	2024-2028
Basins 3, 9, 10 Rehabilitation	Provide design and construction of comprehensive sewer rehabilitation in Basins 3, 9, and 10 based on results of CCTV inspection	$10,000,000	2026-2030
Pump Station Condition and Capacity Upgrades	Provide design and construction of pump station capacity and condition upgrades following completion of pump station capacity assessment	$2,000,000	2026-2030
	Total	**$14.8M**	

Source: Draft TM –2024 Wastewater Collection System Update (Stantec, 2024a)

11.2.2 Sandy River Outfall

The *Sandy River Effluent Pump Station – Draft Conceptual Design Report* (Stantec, 2024c), included in Appendix A.1, identifies a new pipeline alignment, and documents the effluent pumping requirements to convey treated effluent from the existing WWTP site to the proposed Ten Eyck Road discharge location. The project elements and costs for the new Sandy River Outfall Project are presented in Table 11-3.

Table 11-3: New Sandy River Outfall Project

Project Name	Project Element	Cost (2024 dollars)	Year(s) of Completion
Sandy River Outfall Project	Sandy River Pump Station – sized to convey peak day flow and min flow from both the conventional treatment process and the new (future) membrane treatment process, should be interconnected to the existing Effluent (Irrigation) Pump Station.	$7.2M	2030
	Electrical Building - a new fully enclosed structure located east of the existing electrical building and sized to accommodate the Year 2060 power demand	$3.6M	2030
	Effluent Force Main and Pipeline – includes a new pressurized pipeline alignment from the WWTP to Bluff Road and a gravity main from Bluff Road to the outfall location near the Revenue Bridge.	$38.6M	2033
	Total	**$49.4M**	

Source: Sandy River Effluent Pump Station – Draft Conceptual Design Report (Stantec, 2024c)

11.2.3 Near-Term Improvements

The City is currently completing several near-term projects to increase reliability and bridge the treatment plant's capability to the major treatment plant improvements. The City is pursuing several treatment plant upgrade projects that are on the 10 year horizon and beginning to construct those improvements:

- Upgrading UV Disinfection – New in-channel UV treatment, planning to pursue use of UV disinfection year round, including to irrigation
- Expanding Existing Equalization Basin – Adding approximately 0.8 MG to the surge basin will help the City manage additional wet weather peaks within the plant so the process can be protected somewhat.
- Process improvements will include replacement of Blower 4 and additional process control improvements to provide Operators better aeration control.
- Irrigation Pipeline Replacement – Replace the existing pipeline, which is nearing the end of its useful life.

There are additional projects being considered for the 10-year horizon, however, these are considered maintenance projects and do not fall under capital projects.

11.2.4 Complete Wastewater Treatment Alternatives

The City will pursue two recommended alternatives for wastewater treatment.

Alternative 2 – Upgrading the process to a **Membrane Bioreactor** process will treat projected influent wasteloads to achieve very low effluent loading. We anticipate treatment will achieve 5 mg/L effluent BOD_5 and TSS concentrations. This alternative will not consistently achieve 1.5 mg/L indicated to mitigate increase in effluent wasteload discharged to Tickle Creek. In addition, this alternative will not reduce the volume of treated effluent discharged to Tickle Creek when available dilution is less than 10 to 1. However, when the Sandy River Outfall is constructed, the discharge could be diverted from Tickle Creek to the Sandy River. The Estimate of Probable Cost to construct the Sandy River Outfall is discussed in 11.2.2. The City estimates the Sandy River Outfall will be online approximately 2033.

The expected cost to complete the WWTP facility upgrades outlined in Alternative 4 is summarized in Table 11-4.

Table 11-4: Engineer's Estimate of Probable Cost for Treatment Alternative 2 – Membrane Bioreactor

Process Area	Total Cost by Area
Site Work & Yard Piping	$3.0M
Electrical/I&C	$6.2M
Headworks	$2.8M
MBR Trains and Equipment	$25.4M
UV Disinfection	$3.0M
Recycled Water	$1.7M
Utility Upgrade Allowance	$5.0M
Biosolids Treatment	$8.1M
Sandy River Outfall	$49.4M
Total	**$104.6M**

Alternative 4 – The Regional Wastewater Treatment Plant Alternative provides a path for the City to mitigate most concerns about compliance NPDES Permit discharge limits. Under normal circumstances, the City's wastewater would be pumped to the City of Gresham Wastewater Treatment Plant for treatment. This removes the City's discharge to Tickle Creek and eliminates the need to treat and dispose of biosolids. The expected cost to complete the WWTP facility upgrades outlined in the recommended alternative is summarized in Table 11-5.

Table 11-5: Engineer's Estimate of Probable Cost Treatment Alternative 4 – Regional Treatment Plant

Process Area	Total Cost by Area
Site Work & Force Main	$58.9M
Pump Station	$1.2M
System Development Charges	$55.0M
Headworks	$2.2M
Utility Upgrade Allowance	$5.0M
Total	**$122.3M**

If the cost for this alternative can be reduced by negotiating SDCs with the regional treatment plant owner.

11.2.5 20-year CIP

A complete 20-year CIP is summarized in Table 11-6. This CIP includes the costs associated with the Collection System Rehabilitation Program, Recommended Wastewater Treatment Alternative, and the Sandy River Outfall.

Table 11-6: 20-Year Wastewater Capital Improvement Plan Summary

Project Element	CIP Cost Estimate (2024 dollars)	Year(s) of Completion
Collection System Rehabilitation Program		
Northside Pump Station Upgrades	$0.45M	2026
Pump Station Capacity Evaluation	$0.15M	2027
Flow Monitoring and Model Recalibration	$0.2M	2028
Citywide Manhole Grouting	$0.4M	2029
Basins 3, 9, 10 Rehabilitation	$10M	2030
Pump Station Condition and Capacity Upgrades	$2.0M	2031
Subtotal	**$13.2M**	
Recommended Wastewater Treatment Improvements	**$55.2M**	
Sandy River Outfall Project	**$49.4M**	
Total 20-Year CIP	**$117.8M**	

If the City selects Alternative 4 – Regional Treatment Plant, the total capital improvements would total $135.5M, including recommended Collection System Rehabilitation projects in Table 11-6 ($13.2M), pump station and pipeline construction plus SDCs ($122.3M).

Ongoing annual inspection tasks that were not included in the 20-Year CIP are summarized in Table 11-7.

Table 11-7: Ongoing Annual Inspection Tasks

Task	Anticipated Duration	Annual Cost Estimate (2024 dollars)	Cumulative Cost (2024 dollars)
CCTV Inspection	2024-2025	$0.2M	$0.4M
Grade 4/5 Defect Repairs	2024-2028	$0.3M	$1.2M
	Total	**$0.5M**	**$1.6M**

11.2.6 Preliminary Funding Plan

The City has secured funding through several sources, primarily in the form of low-interest loans. Sources of funding plan are summarized in Table 11-8.

Table 11-8: Summary of Funding Sources

Funding Source	Type of Funding	Total Available Funds
Clean Water State Revolving Loan Fund (CWSRF)	Loan	$46M
Water Infrastructure Finance Innovation Act (WIFIA)	Loan	$56M
American Rescue Plan Act (ARPA)	Grant	$7M(1)
US Environmental Protection Agency (EPA) Grant	Grant	$1M (funding allocated)
	TOTAL	**$110M**

(1) Grant total is $14.7M, and is partially expended.

The City has two other CWSRF loans that are nearly exhausted and have not been considered in this total. Based on the 20-year CIP proposed in Table 11-6, the City may require additional funding to support the full 20 years of projects.

11.2.7 Next Steps

Following adoption of this Amendment by City Council, the Amendment will be reviewed and approved by DEQ and EPA for conformance with the Consent Decree requirements.

11.3 Wastewater Discharge Plan

The wastewater discharge approach has been on hold until the completion of this 2024 Facility Plan Amendment. While the City has prepared a plan for a Sandy River Outfall, the new discharge will take up to 10 years to permit, design, and construct. The current NPDES permit renewal is focused on the existing permitted points of discharge, with a goal of including interim limits discussed in Section 9.1.4 until the final wastewater system improvements are implemented. In addition to interim limits, the City is in discussions with DEQ to allow discharge to Tickle Creek at dilution rates less than 10 to 1. If lower dilution rates are approved and permitted, this could extend the length of time until the Sandy River Outfall is needed and could be deferred from the current capital improvement plan.

In parallel with advancement of the Sandy River Outfall, the City is in discussions with the City of Gresham to advance planning of the Regional Treatment Plant alternative. If negotiations with the City of Gresham are not successful, the City will proceed with efforts toward the Sandy River outfall. While the outfall is being designed, the NPDES permit will be modified to add the new Sandy River outfall as a permitted point of discharge. Following commissioning of the Sandy River Outfall, the City will commence discharging to the Sandy River and will continue to pump treated effluent to Iseli Nursery when irrigation demand is present.

Section 12: References

12.1 New References Since 2019 Plan

Barney & Worth, In and Globalwise, Inc. (B&W/Globalwise), 2020. City of Sandy WSFP Detailed Discharge Alternatives Evaluation Market Potential for Sandy's Recycled Water. Prepared for the City of Sandy. May 2020.

Leeway Engineering Solutions (Leeway), 2024a. 2023 Sandy Collection System Capacity, Management, Operations and Maintenance Implementation Report. Prepared for the City of Sandy.

Leeway, 2024b. 2024 Sandy CMOM Strategic Plan. Prepared for the City of Sandy.

Leeway, 2023. Sandy Wastewater Collection System Model Predicted Flows for 2023 and 2040. Table and assumptions prepared for Kennedy Jenks. November 17, 2023.

West Yost, 2023. Sandy Wastewater Preliminary Evaluation of Sandy Wastewater Treatment Capacity. Prepared for the City of Sandy. September 2023.

West Yost, 2021a. Sandy Wastewater Treatment Plant Condition Assessment Improvements Project. Prepared for the City of Sandy and Leeway Engineering Solutions. March 2021.

West Yost, 2021b. Preliminary Design Evaluation Report Sandy WWTP Condition Assessment Improvements Project.

Murraysmith, 2021. Detailed Discharge Alternatives Evaluation (DDAE) Final Report. June.

Murraysmith, 2020. Preliminary Design Report Sandy WWTP Immediate Needs Upgrade Project.

Murraysmith, 2019. City of Sandy Wastewater System Facilities Plan. Herein referred to as the 2019 Plan

Oregon DEQ, 1996. Making Wet-weather and Peak Flow Projections for Sewage Treatment in Western Oregon.

Parametrix, 2022. Draft Summary Letter Report - City of Sandy NPDES Permitting Support Subsurface Infiltration Feasibility Study. Prepared for the City of Sandy and Leeway Engineering Solutions. November 2022.

Stantec, 2024a. Draft TM – 2024 Wastewater Collection System Update. Prepared for the City of Sandy. May 3, 2024.

Stantec, 2024b. Near-Term Plant Improvements at the WWTP.

Stantec, 2024c. Sandy River Effluent Pump Station Forcemain and Outfall Draft, May 2024

Waterdude Solutions, 2022. Wastewater Treatment Facilities - Spare Parts and Repair, Replace, Refurbishment Prioritization Report. August.

EPA, 2024a. Final PFAS National Primary Drinking Water Regulation.

EPA 2024b. Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances— Version 2, EPA. 8 April 2024.

EPA 2024c. Joint Principles for Preventing and Managing PFAS in Biosolids.

Letowsky, Karen. “Biosolids, PFAS and Oregon Agriculture.” *Oregon Environmental Council*, 22 February 2024.

Bamdad, H.; Papari, S.; Moreside, E.; Berruti, F. High-Temperature Pyrolysis for Elimination of Per- and Polyfluoroalkyl Substances (PFAS) from Biosolids. *Processes* 2022, *10*, 2187. https://doi.org/10.3390/pr10112187

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. 2018. Biosolids Management Plan.

U.S. Census Bureau QuickFacts: Sandy city, Oregon. 2019. https://www.census.gov/quickfacts/fact/table/sandycityoregon/HSD310217#HSD31021