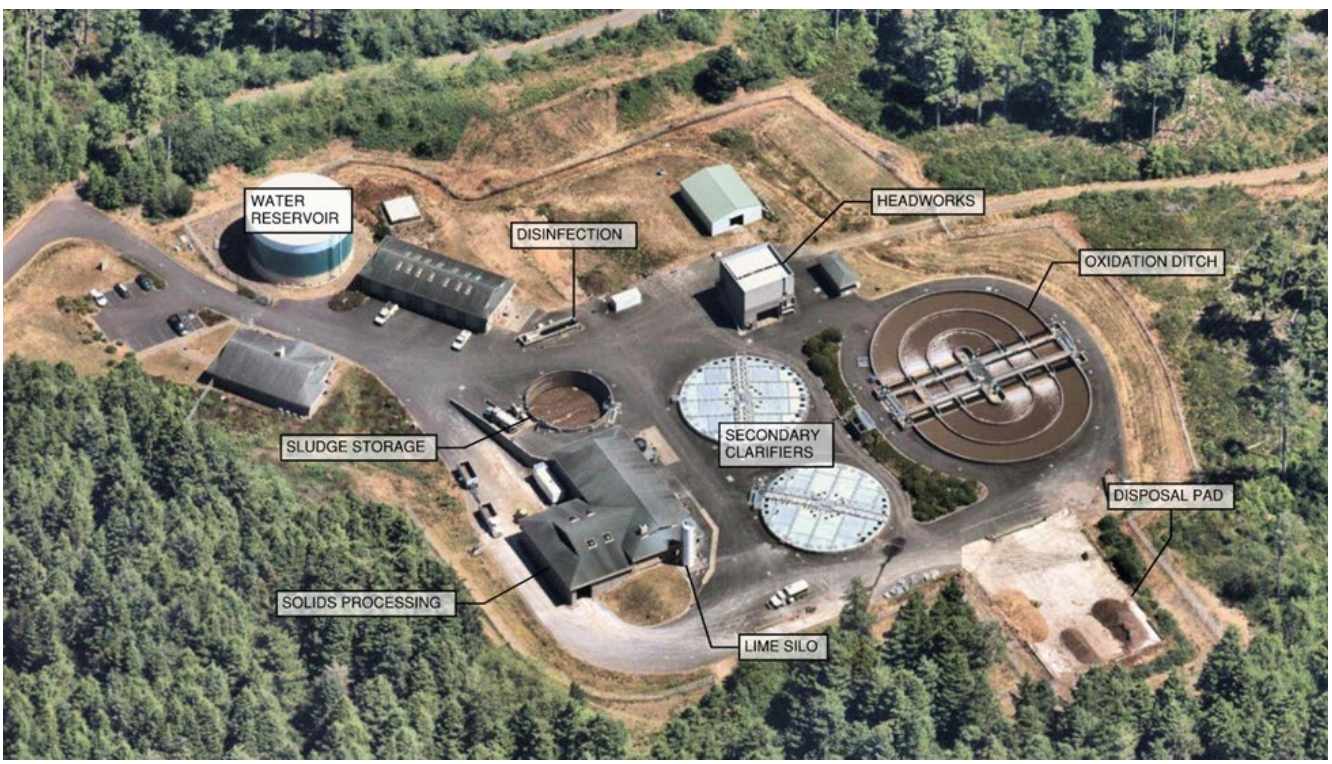
Brown AND Caldwell

DRAFT REPORT | Prepared for
City of Newport, Oregon

Wastewater Treatment Master Plan

Phase II: Alternatives Development and Evaluation

May 2025



Newport Wastewater Treatment Master Plan Phase II: Alternatives Development and Evaluation

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List of Abbreviations

°C	degree(s) Celsius
°F	degree(s) Fahrenheit
AACE	Association (for the) Advancement of Cost Engineering
APLR	Annual Pollutant Loading Rate
As	arsenic
BC	Brown and Caldwell
BOD	biological oxygen demand
BOD_5	5-day biochemical oxygen demand
CASP	covered aerated static pile
CCL	Ceiling Concentration Limits
Cd	cadmium
CF	cubic feet
CFM	cubic feet per minute
CFR	Code of Federal Regulations
CIP	Capital Improvement Plan
CPLR	Cumulative Pollutant Loading Rate
Cu	copper
CY	cubic yard
d	day(s)
DEQ	(Oregon) Department of Environmental Quality
DO	dissolved oxygen
ea	each
EQ	Exceptional Quality
ERU	equivalent residential units
EPA	U.S. Environmental Protection Agency
ft	feet
FTE	full-time employee
FY	fiscal year
gal	gallon(s)
gpd	gallon(s) per day
H_2S	hydrogen sulfide
Hg	mercury
HMSC	Hatfield Marine Science Center
hp	horsepower
IPS	influent pump station
kg	kilogram(s)
KJ	Kennedy Jenks
kW-hr	kilowatt hour
lb(s)	pound(s)
MCRT	mean cell residence time
MG	million gallons
mg/L	milligram(s) per liter
mgd	million gallon(s) per day
mL	milliliter(s)
mL/g	milliliter(s) per gram
MLSS	mixed liquor suspended solids
mm	millimeter(s)
MMBTU	million British Thermal Unit
Mo	molybdenum
MPN	Most Probable Number
NFPA	National Fire Protection Association
Ni	nickel
NMC	Newport Municipal Code
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NSPS	Northside Pump Station
OHA	Oregon Health Authority
O&M	operations and maintenance
OPCC	Opinion of Probable Construction Cost
Pb	lead
PCL	Pollutant Concentration Limits
PFAS	per- and polyfluoroalkyl substances
PFRP	Process Further Reduce Pathogens
ppm	parts per million
PS	pump station
PSRP	Process (to) Significantly Reduce Pathogens
PSU	Portland State University
RAS	return activated sludge
RDT	rotary drum thickener
SCADA	supervisory control and data acquisition
Se	selenium
SOUR	specific oxygen uptake rate
SRT	solids retention time
SVI	sludge volume index
TM	technical memorandum
TSS	total suspended solids
VAR	vector attraction reduction
VS	volatile solids
VSS	variable suspended solids
WAS	waste activated sludge
WWTMP	Wastewater Treatment Master Plan
WWTP	wastewater treatment plant
Zn	zinc

Executive Summary

Brown and Caldwell (BC) and Kennedy Jenks (KJ) prepared this Wastewater Treatment Master Plan (WWTMP) for the City of Newport (City), focusing on near-term improvements at the Vance Avery Wastewater Treatment Plant (WWTP). This report represents Phase II–Alternative Development and Evaluation and includes updates to Phase I flow projections, capacity assessments, and criticality evaluations. Improvements for WWTP headworks, liquid stream processes, solids processes, and Northside Pump Station (NSPS) are recommended along with descriptions of key alternatives and capital improvement planning.

Updates and Analyses

Flow Projection Updates (Section 2): New population projections prepared by Portland State University suggest population growth will be much slower than was anticipated in the Phase I efforts; flow projections have been adjusted accordingly. Previous analyses suggest tourism is the main driver for flow variability; however, recent flow data revealed storm events show a higher degree of correlation than population spikes during holiday weekends. Loadings from Rogue Brewery (Rogue) have decreased by more than 50 percent following new pretreatment regulations.

Capacity Assessment Updates (Section 3): Key processes continue to operate at higher than design capacity including:

- Influent screens: The influent screens continue to be a capacity limitation, with firm capacity already exceeded.
- Dewatering centrifuges: The dewatering centrifuges are operating with no redundancy, and capacity of the system is exceeded at average load conditions.
- Lime pasteurization: The lime pasteurization system continues to exceed its design throughput. While this does not affect the plant's capacity to process solids, it impairs reliability and increases risk of system failure, as the system has less downtime for maintenance and repairs. System failure would result in increased solids disposal costs, since landfill disposal or hauling to another system for treatment would be the only other options.
- Secondary treatment: The secondary treatment process consists of a single oxidation ditch and two secondary clarifiers, which provides no redundancy.
  - Due to capacity limitations, the oxidation ditch typically operates at maximum overflow levels, which is not ideal.
  - Mixed liquor suspended solids (MLSS) concentration in the oxidation ditch is maximized at 3,000 milligrams per Liter (mg/L). With current flows and loads and a solids retention time (SRT) of 8-10 days, the WWTP cannot operate at an MLSS concentration below 3,000 mg/L. Operating at a longer SRT, as is common practice with this type of ditch, would overload the secondary clarifiers.
  - Secondary clarifier capacity of the system is approximately 3.2 million gallons per day (mgd), at recommended operating conditions in the winter. The current maximum month flow is 3.3 mgd. By this measure, the plant is already operating at capacity.
  - The combination of limited capacity and inadequate redundancy will limit the future available timeframe between repairs, and increase operational risk.

Condition and Criticality Updates (Section 4): In 2021, Waterdude Solutions (Waterdude) prepared the "*Wastewater Treatment Facilities Condition Assessment Update*", which revealed further deterioration of process equipment since the "*Draft Wastewater Treatment Facilities Condition Assessment*" was prepared in 2018. Facilities most at-risk from deteriorating conditions are the NSPS, headworks, septage screening, and solids handling.

Recommendations

Alternatives evaluations were conducted for improvements at the WWTP Headworks Facility, the liquids process, the solids process, and the Northside Pump Station (NSPS). The alternatives evaluations for the liquids process and solids process were considered together and included non-cost criteria due to their complexity and connectivity to each other. The alternatives for WWTP Headworks and NSPS were evaluated independently based on asset condition and capacity limitations. Recommendations for each process are summarized below.

WWTP Headworks Recommendations (Section 5): Multi-rake bar screens are recommended to replace the two existing rotary screens, which are at the end of their design life. A third screen is recommended to be installed in one of the unoccupied screening channels to increase process capacity and redundancy. Hydrogen sulfide (H_2S) concentrations are also very high and pose a safety risk to personnel working in this facility. Accordingly, odor control and building ventilation upgrades are recommended.

Liquids Process Recommendations (Section 6): A second oxidation ditch is recommended to provide additional capacity and redundancy for the existing, aging oxidation ditch. A third secondary clarifier will be sufficient to address downstream capacity issues. Disinfection storage tank and pump replacements are needed.

Solids Process Recommendations (Section 7): Aerobic digestion should be incorporated to stabilize sludge prior to dewatering and disposal. Other recommended processes are a packaged hauled waste receiving station, continued use of waste activated sludge (WAS) storage tank, mechanical thickening, centrifuge dewatering, and a Class A compost facility.

Specific to the recommendation of a Class A compost facility, solids drying and solids composting were two alternatives compared during development of this WWTMP. The Class A compost facility is projected to have significantly lower capital and annual operation and maintenance (O&M) costs compared to the Class A dryer–more than $10 million lower in total net present worth. The differences in capital costs are largely due to the dryer equipment costs, costs for constructing the new dryer Building, and the need to install a new natural gas pipeline to the plant for firing the dryer furnace. The dryer also has higher annual O&M costs than composting, mainly due to the high energy use associated with drying biosolids. For these reasons, and because there is available land at the WWTP, the Class A compost facility is recommended.

Northside Pump Station (NSPS) Recommendations (Section 8): Immediate improvements are required at the existing pump station located inside a geodesic dome structure due to health and safety concerns and aging equipment. When additional funding is secured, a new buildout facility is recommended, located adjacent to the existing facility.

Capital Improvements Plan (Section 9): The recommended improvements summarized above were compiled into a capital improvements plan (CIP) for the wastewater treatment facilities. Table ES-1 and Figure ES-1 show the estimated total annual funding required for applicable projects occurring during each fiscal year. Estimated costs have been adjusted to 2025 costs using a 5.0 percent cost increase based on increases in the Consumer Price Index from 2023 to 2025. Projects are set to start in FY27 due to current funding limitations, with schedules driven by the associated capacity, condition assessments, and balanced funding demands within the 10-year implementation timeframe. The most at-risk facilities are slated for upgrades earlier in this timeframe. The City's WWTP operations staff will need to mitigate current risks and overcome capacity limitations in the meantime.

Table ES-1. Capital Improvement Projects

Project	Estimated Cost	Schedule	Reference
NSPS Interim Improvements	$7,230,000	2027-2029	Appendix H
NSPS Dechlorination	$3,930,000	2027-2029	Appendix I
WWTP Centrifuge Upgrades	$5,880,000	2027-2029	Appendix E
WWTP Disinfection Upgrades	$270,000	2027-2029	Appendix L
IPS Pipe Replacement[a]	$370,000	2029	See Note a.
WWTP Headworks Upgrades	$4,670,000	2029-2031	Appendix B
WWTP 3rd Secondary Clarifier[c]	$21,640,000	2029-2032	Appendix C
WWTP Solids Upgrades	$34,130,000	2032-2035	Appendix D
IPS Upgrades	$1,050,000	2034	See Note a.
WWTP 2nd Oxidation Ditch	$18,760,000	2035-2038	Appendix C
NSPS Buildout Facility	$49,180,000	2039-2041	Appendix H

a. *Detailed cost estimates for the Influent Pump Station (IPS) have not yet been developed. Costs shown are for reference only and based on improvements described by the City.*

b. *Additional engineering and administrative costs have been applied to projects for which this was not applied during capital cost development.*

c. *The 3rd secondary clarifier project cost was estimated assuming incorporation of pump stations and flow distribution improvements to prepare for the future 2nd oxidation ditch.*

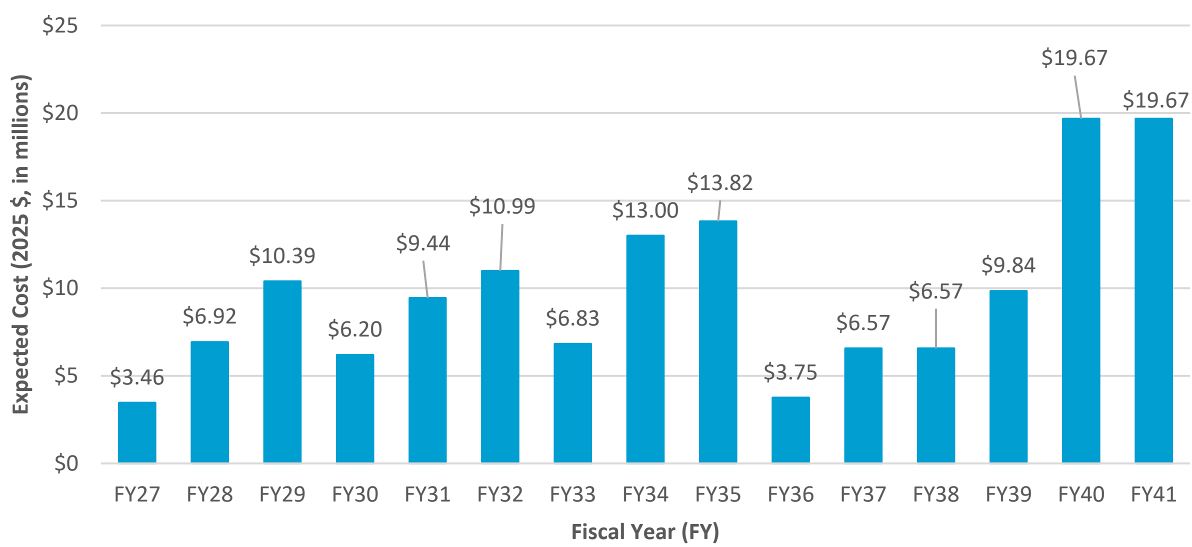

Figure ES-1. Capital cost distribution by year

Section 1

Introduction

The City of Newport (City) contracted with Brown and Caldwell (BC) to complete Phase II of their Wastewater Treatment Master Plan (WWTMP). The goal of the WWTMP is to evaluate existing infrastructure, operational procedures, equipment performance, projected population growth, future flows and loads, anticipated future regulations, and financial planning to develop a Capital Improvements Plan (CIP) to address both current needs and future needs for the next 20 years.

In 2018, Phase I of the WWTMP was completed, which included an assessment of existing operating conditions, an equipment condition assessment, flow and load forecasts, and a plant capacity assessment. A key finding of Phase I was that industrial users contribute a significant portion of headworks loads. Based in part on this finding, the City elected to pause Phase II of the WWTMP to voluntarily implement a pretreatment program. Once the program was established, Phase II of the WWTMP was initiated.

The focus of Phase II of the WWTMP is the Vance Avery Wastewater Treatment Plant (WWTP) but is informed by the previous planning conducted for the collection system. This WWTMP includes an alternatives evaluation for upgrades to the WWTP and presents a capital improvements plan (CIP) for the proposed improvements. The CIP will inform future efforts including a Facility Planning and Rate Structure analysis.

1.1 Background

Newport is in Lincoln County on the central Oregon coast about 55 miles west of Corvallis. The population of the city is just over 10,000 but can draw nearly 30,000 to 40,000 visitors during the tourist season. The City indicated a significant contribution of wastewater is attributable to residents from outside the city commuting into the city for work.

Newport is home to industries and businesses (e.g., breweries, fisheries, restaurants, and hotels, etc.) including the Oregon Brewing Company's Rogue Brewery. The National Oceanic and Atmospheric Administration (NOAA) bases four research vessels in Yaquina Bay and the Hatfield Marine Science Center (HMSC) is located on the south side of the bay.

Surface water is the city's primary water supply via the Big Creek Reservoirs but is supplemented in the summer with water pumped from the Siletz River. Drinking water is treated via membrane filtration at the 7 million gallons per day water treatment plant (WTP) located at the base of the lower dam. Residual waste produced by the WTP is discharged to the sewer system and eventually makes its way to the WWTP. The WTP generates an average of 5 million gallons of residual waste per month and pumps into the sewer system, when operating, at a rate of 600 gallons per minute.

Wastewater is conveyed to the Vance Avery WWTP for treatment before being discharged to the Pacific Ocean off Nye Beach. The City owns and operates the Vance Avery WWTP located on the south side of Yaquina Bay at 5525 SE 50th Place in Newport. The WWTP and influent pump station (IPS), commissioned in 2003, replaced the old WWTP located at the current NSPS at NW Nye Street and NW 3rd Street, approximately 3 miles north.

1.2 Objectives

The objectives of this Phase II WWTMP include the following:

1. Update key findings from the Phase I WWTMP, including flow and load projections, capacity assessments, and criticality evaluations.
2. Develop improvement alternatives for each major facility at the WWTP and Northside Pump Station, and summarize prioritization criteria and scoring.
3. Estimate high-level costs for each alternative.
4. Present alternatives in the form of updated site layouts at the WWTP.
5. Recommend a single alternative for implementation at the WWTP, guided by discussions with the City.
6. Discuss alternative development for NSPS and recommend path forward.
7. Present a CIP for 20-year improvements.

1.3 Wastewater System Policies

This chapter presents policies and standards that guide the operation and development of the City's wastewater treatment system. The policies and standards are derived from the City's Comprehensive Plan, City resolutions, and Newport Municipal Code (NMC).

1.3.1 Comprehensive Plan

The City revised its Comprehensive Plan in 2023 and it can be accessed in its entirety through the City's website. Table 1-1 presents the Comprehensive Plan goals and policies related to the WWTP:

Table 1-1. Comprehensive Plan Goals and Policies

Item	Policy, standard, or guideline statement
General Goals and Policies	
Goal	To assure adequate planning for public facilities to meet the changing needs of the City of Newport urbanizable area.
Policy 1	The city shall develop and maintain public facilities master plans (by reference incorporated herein). These facility plans should include generalized descriptions of existing facilities operation and maintenance needs, future facilities needed to serve the urbanizable area, and rough estimates of projected costs, timing, and probable funding mechanisms. Public facilities should be designed and developed consistent with the various master plans.
Policy 2	In order to assure the orderly and cost efficient extension of public facilities, the city shall use the public facilities master plans in the capital improvement planning.
Policy 3	The city shall work with other providers of public facilities to facilitate coordinated development.
Policy 4	Essential public services should be available to a site or can be provided to a site with sufficient capacity to serve the property before it can receive development approval from the city. For purposes of this policy, essential services shall mean water, sanitary sewer (i.e. wastewater), storm drainage and streets. Development may be permitted for parcels without the essential services if: a. The proposed development is consistent with the Comprehensive Plan; and b. The property owner enters into an agreement, that runs with the land and is therefore binding upon future owners, that the property will connect to the essential service when it is reasonably available; and c. The property owner signs an irrevocable consent to annex if outside the city limits and/or agrees to participate in a local improvement district for the essential service, except that annexation shall be required before property that is contiguous to the city limits can receive sanitary sewer service.
Policy 5	Upon the annexation of territory to the City of Newport, the city will be the provider of water and sewer service except as specified to the contrary in an urban service agreement or other intergovernmental agreement.

Table 1-1. Comprehensive Plan Goals and Policies

Item	Policy, standard, or guideline statement
Policy 6	Local Improvement Districts (LIDs) should be evaluated as a means of funding public facilities where the construction of such facilities is expected to enhance the value of properties that are adjacent or proximate to the planned improvements. For LIDs in developed residential areas, the aggregate assessment amount within a prospective LID should be no more than 10% of the assessed value of properties within the boundaries of the proposed district. The aggregate assessed value may be higher for other types of LIDs, such as developer initiated districts; however, in no case should it exceed 50% of the assessed value of the affected property. When considering a new LID, the City should proceed with preparing an engineer's report that sets out the likely cost of constructing the improvement. Consideration should be given to bundling LID projects with other capital projects that the City secures bond funds to construct. For an LID to proceed, it must have a reasonable chance of being self-financing, with adequate reserves to ensure that payments are made on bonds/loans regardless of the property-owners' repayment. If an LID project is considered by the City Engineer to be a partial improvement (less than ultimate planned design), the City should require that interim improvements conform to current City standards in a manner which will allow for completion of the total facility at such time that resources are available. New LIDs may be initiated by petition or resolution of the City Council. Formation of an LID by Petition The City Council shall evaluate new LIDs proposed by petition to determine if City resources should be expended to formulate an engineer's report. Only those projects with substantial public support should proceed. An LID petition that includes non-remonstrance agreements and/or petitions of support from property owners representing 75% of the benefited area shall be presumed to have substantial public support. If an LID petition seeks to leverage other funding to achieve 100% of the project costs then the City Council should consider the likelihood of whether or not those funds will be available within the timeframe that they would need to be committed for construction. When the City receives petitions for multiple LIDs, priority should be given to prospective LIDs with the highest level of documented support, as measured by recorded non-remonstrance agreements and/or petitions in the benefit area in question. The cost of completing the engineer's report should be included in the total LID assessment. The City should update its fee schedule to include a nonrefundable LID Application Fee to be paid by LID petitioner(s) for petition-initiated LIDs. City Council Initiated LIDs The City Council on its own motion or upon recommendation by the City Manager may initiate an LID without a petition. In doing so the City Council shall consider the following factors: • Project purpose and need, including whether or not the improvement addresses an immediate health and safety risk or if it has been identified as a priority improvement in an adopted public facility plan. • Whether the improvement will address existing deficient infrastructure that is chronically failing. • Capital cost of the improvement. • Project cost contingencies and related construction risk factors, such as the need to acquire new public right-of-way, unique construction challenges, or environmental issues. • Nature of the area benefited, including its existing condition. • The amount of potential non-LID funding that is expected to be leveraged by the LID, if any. This may include, but is not limited to, federal or state grants, sewer or other types of service charges, urban renewal funds, revenue or general obligation bonds, and reimbursement districts. • Percentage of properties within the benefit area that have prerecorded non-remonstrance agreements or have owners that favor formation of an LID. When considering multiple City-initiated LIDs, priority should be given to the LID that addresses the greatest number of factors identified above.
Policy 7	The City may use various means to finance, in whole or in part, improvements to public services in order to maintain public facility service levels and to carryout improvements identified in public facility plans, and adopted city goals and policies. This includes but is not limited to consideration of federal or state grants; water, sewer, storm drainage and other types of service charges; urban renewal funds, revenue or general obligation bonds, local improvement districts, and reimbursement districts.

Table 1-1. Comprehensive Plan Goals and Policies

Item	Policy, standard, or guideline statement
Wastewater Goals and Policies	
Goal	To provide a wastewater collection and treatment system with sufficient capacity to meet the present and future needs of the Newport urbanizable area in compliance with State and Federal regulations.
Policy 1	Improve and maintain the wastewater collection system as identified in the 1990 Public Facilities Plan for the City of Newport, by CH2MHILL, as amended by the following updates: • Wastewater Facilities Plan, by Fuller & Morris Engineering & CH2MHILL, dated May 1996 • 2006 South Beach Neighborhood Plan (Ord. No. 1899) • Sanitary Sewer Master Plan, by Brown and Caldwell, dated February 9, 2018
Policy 2	On-site sewer systems or holding tanks shall not be allowed unless the city's sanitary sewer system is greater than 250 feet away. In any case, a subsurface permit from the Lincoln County Sanitarian must be obtained prior to any development that will rely on an on-site sewer system or holding tank.
Policy 3	Existing structures within the city limits that contain sanitary facilities shall connect to the city's sanitary sewer system at such time as a gravity main or equivalent wastewater collection system is extended to within 250 feet of the property.
Policy 4	City wastewater services may be extended to any property within the urban growth boundary. Except for the very limited circumstances allowed by state law and regulations, the city will not generally provide wastewater services outside the urban growth boundary. The city may require a consent to annexation as a condition of providing wastewater service outside the city limits and shall require a property to annex before providing wastewater service if it is contiguous to the city limits. Nothing in this policy obligates the City to provide wastewater services outside of the city limits. For property outside the city limits but within the urban growth boundary, wastewater services may be provided at the City's discretion only for: • Residentially zoned lands as allowed by county zoning without urban services, and • Commercial and industrial zoned lands as allowed by county zoning at the scale of development in existence on September 4, 2007.
Policy 5	When designing the wastewater collection and treatment system to ensure there is sufficient capacity to meet current and future needs of the community, the City shall consider the demands of various users under normal and predictable daily and seasonal patterns of use.
Policy 6	When undertaking capital improvement planning, priority shall be given to projects that will repair, replace or upsize wastewater infrastructure with known condition or capacity limitations in order to minimize discharges that could compromise public health and safety, damage real property, or harm the environment.

1.3.2 City Resolutions

A resolution is a policy that has been adopted by the City Council. The following sections summarize resolutions that address wastewater policies. The entirety of the resolutions below can be accessed through the City's website.

1.3.2.1 Amending the List of Capital Improvement Projects Eligible to be Funded with System Development Charge Revenues: Resolution No. 3886

The City's *Resolution No. 3886* was adopted on May 18, 2020. This resolution amends the list of capital improvement projects eligible for funding with System Development Charge (SDC) revenues. The resolution lists various eligible projects across water, wastewater, storm drainage, transportation, and parks categories. Some of the key wastewater projects include upsizing the gravity sewer from the Bayfront force main to the Northside pump station, upgrading the capacity of the Northside pump station to 9.2 mgd, and upgrading the Nye Beach pump station to 2.74 mgd. These projects aim to enhance the city's wastewater infrastructure to meet future demands. Proposed upgrades to the Northside Pump Station are discussed later in this report.

1.3.2.2 Low-Income Utility Assistance Program and Funding: Resolution No. 3847

The City's *Resolution No. 3847* was adopted retroactively to February 1, 2019. This resolution establishes a Low-Income Utility Assistance Program funded by a one percent payment from the Water and Sewer Funds to the General Fund. The program aims to help low-income residents with utility payments and requires applicants to meet specific eligibility criteria, including having an income at or below 60 percent of the 2018 Lincoln County median income. Applications are processed through the Community Services Consortium (CSC) and must be completed annually.

1.3.2.3 Water, Wastewater and Stormwater Utility Rates: Resolution No. 3803

The City's *Resolution No. 3803: Setting Water, Wastewater and Stormwater Utility Rates* was adopted on October 15, 2018. The resolution went into effect December 1, 2018. This resolution sets charges, fees, deposits, and penalties for water, wastewater, and stormwater services within the city and its urban growth area. The wastewater related fees are broken down into the following categories:

- Metered rates: Defines established wastewater charges based on meter size and property type, within and outside of the city limits, and sets a rate for low income qualified residences within city limits. This resolution also includes an "extra strength charge" based on biochemical oxygen demand (BOD) for commercial properties, a monitoring sewage discharge rate, and a charge for fish plants
- Individually determined rate: Commercial customers shall have a sewer use charge established based on the impact of the property on the sewer system, as determined by the City Manager
- Septage: Defines a disposal rate for septage at the City's WWTP
- Class A sludge sales: Establishes the price per cubic yard of Class A sludge
- Utility Infrastructure Fee: Establishes a monthly charge imposed on properties with metered city water service to support utility infrastructure maintenance and improvements. This fee will be phased out over a three-year period.

Like wastewater, the utility rates for water services are based on the size of the water meter and the type of property, including single-family residences, multi-family residential buildings, and commercial properties. Water services also consider temporary service through a fire hydrant and water purchased and privately transported.

This resolution establishes rates for stormwater services to cover the costs of managing and treating stormwater runoff, including infrastructure maintenance and regulatory compliance. These rates are categorized by property types, with specific rates based on the size and impact of each property on the stormwater system.

The City's wastewater rates should be evaluated according to the financial obligation required to complete the projects established in this WWTMP.

1.3.2.4 System Development Charge Methodology: Resolution No. 3786

The City's *Resolution No. 3786* is an update to the 2007 System Development Charge (SDC) methodology and was adopted on August 7, 2017, effective September 6, 2017. This resolution outlines a comprehensive approach to updating and managing the SDCs in Newport, ensuring that the fees collected are fair, proportional, and aligned with the city's growth and development needs for growth-related projects likely needed within the next 20 years. This methodology includes a capital improvement plan, growth projections, evidence of system capacity needs, projected costs of improvements, and the portion of those costs attributed to future demand. SDCs are calculated by combining a reimbursement fee, which is based on the cost of available capacity per unit of growth, and an improvement fee, which is based on the cost of planned capacity-increasing capital projects. SDC rates are adjusted annually based on the Construction Cost Index.

This resolution includes a wastewater SDCs section which outlines the methodology for calculating SDCs for wastewater services in Newport. Growth is measured in Equivalent Dwelling Units (EDUs), with current customers, at the time of adoption, equating to 14,131 EDUs and projected to increase to 17,322 by 2037. The improvement fee cost basis is $12,064,320, adjusted to $11,750,461 after deducting the existing SDC fund balance, resulting in an SDC of $3,843 per EDU.

The City's list of eligible wastewater projects should be evaluated according to the financial obligation required to complete the projects established in this WWTMP eligible for SDC funding.

1.3.3 Newport Municipal Code

The NMC is a collection of the regulatory and penal ordinances and certain administrative ordinances of the City with the latest version having been codified in 2024. Chapter 5.15 of the NMC, "Sewer System and Charges," contains the ordinances most relevant to how the utility operates but several other sections contain pertinent wastewater related ordinances. The NMC in its entirety can be accessed on the City's website.

1.3.3.1 Existing Municipal Code

Table 1-2 below summarizes the information pertaining to the wastewater system in the NMC. The information is organized by the following categories:

- Service area
- Planning considerations
- Design standards
- Protection and improvement of the environment and public health
- Utility financing
- Wastewater quality
- Pretreatment
- Operations and maintenance

Table 1-2. Municipal Code Policies

NMC	Policy, standard, or guideline statement
Service Area	
5.15.020	<u>Connection Required</u> A. All structures containing sanitary facilities that are located within 250 feet of a collection sewer or intercepting sewer other than a force main must be connected to the sewer system. Connection to the public sewer system for new buildings or structures is required prior to the issuance of a certificate of occupancy. Any building served by a private sewage disposal system shall be connected to the city sewer system within 60 days of the date that a city sewer line is extended to within 250 feet of the property and is available for connection. At the request of the property owner of an existing structure, the City Council may allow deferral of the connection if connection would impose an undue hardship on the property owner. In determining what constitutes an undue hardship, the Council may consider the following factors: 1. Whether the property owner is contributing to the cost of extending the main. 2. The cost of connection. 3. The condition and capacity of the private sewage disposal system. Deferral shall be allowed only if the existing structure is served by a private sewage disposal system in good condition and adequate to serve the sanitary facilities on the property. Council may require proof that the disposal system is properly and regularly maintained and pumped, and routinely inspected by the county. The Council's decision shall be by written order with findings. Any deferral allowed by the Council may be revoked by the Council at any time. If sewer connection is deferred, the deferral is automatically revoked and sewer connection must occur within 30 days of: 1. Failure of the private sewage disposal system; 2. Failure of the private sewage disposal system to comply with all applicable state and county standards and requirements; 3. Sale of the property; or 4. Any determination by the state or county that the private sewage disposal system presents a health or environmental risk. B. All private sewage disposal systems allowed by subsection A shall comply with all applicable state and county standards and requirements. C. No person shall discharge any sewage into any storm drain or natural drainage outlet.
14.06.050	<u>Recreational Vehicles: General Provisions</u> D. It shall be unlawful for any person occupying or using any recreational vehicle within the City of Newport to discharge wastewater unless connected to a public sewer or an approved septic tank in accordance with the ordinances of the City of Newport relating thereof. All recreational vehicle parks within the City of Newport shall comply with the sanitary requirements of the City of Newport and the State of Oregon.
14.09.030	<u>Temporary Living Quarters.</u> A. Notwithstanding any other restrictions and prohibitions in this code, a recreational vehicle may be used as a temporary living quarters subject to the following conditions: 4. The recreational vehicle used as the temporary living quarters is self-contained for sanitary sewer;
Planning Considerations	
5.15.030	<u>Permit and Construction Requirements</u> A. No person, firm, or corporation shall construct or reconstruct any sanitary or storm drains within the city on private property or in public ways without a city permit. B. Applications for permits to construct or reconstruct sanitary sewers or storm drains shall be made in writing on a city form and include the location of the property, the name of the owner, the name of the person or firm engaged to construct or reconstruct the proposed sanitary sewer or storm drain and such other information and plans as may be required by the city. C. The applicant upon approval of permit shall pay all applicable fees established by Council resolution. If excavation work in the public right-of-way is required, the applicant shall deposit a cash bond in the amount determined by the city. D. All costs and expenses incidental to the installation of the building sewer connection shall be borne by the applicant. E. A separate building sewer connection shall be provided for every building, unless otherwise authorized in writing by the city. F. Existing building sewers may be used in connection with new buildings only when they are found, on examination and tests, to meet all requirements. G. All design, construction and materials and repairs shall conform to the city's design and construction standards. H. Emergency repairs may be made without first obtaining a permit providing that the owner or his representative shall obtain a permit at the earliest possible time, by the end of the next normal business day. I. Sewer system users are responsible for all costs of service laterals and building sewers.
12.15.090	<u>Prohibited Connection</u> No person may connect to the water or sewer system of the city or obtain a building permit unless the appropriate SDCs have been paid, or the installment payment method has been applied for and approved.

Table 1-2. Municipal Code Policies	
NMC	**Policy, standard, or guideline statement**
14.33.050	Criteria for Approval of an Adjustment The approval authority may grant an Adjustment using a Type I or Type III decision-making process when it finds that the application complies with the following criteria: C. The Adjustment will not interfere with the provision of or access to appropriate utilities, including sewer, water, storm drainage, streets, electricity, natural gas, telephone, or cable services, nor will it hinder fire access;
14.33.060	Criteria for Approval of a Variance The approval authority may grant a Variance using a Type III decision-making process when it finds that the application complies with the following criteria: E. The Variance will not interfere with the provision of or access to appropriate utilities, including sewer, water, storm drainage, streets, electricity, natural gas, telephone, or cable services, nor will it hinder fire access.
14.40.100	Procedure for Preliminary Development Plan (PDP) Application A PDP shall be provided for each development phase of the destination resort. Completion of construction of a phase shall not be a prerequisite to approval of subsequent PDP's. A. The PDP application shall include: 2. Text or graphics explaining and illustrating: d. Preliminary location of all sewer, water, storm drainage, and other utility facilities, and the materials, specifications and construction methods for the water and waste water systems
Design Standards	
11.05.130	Demolition A. The demolition of any building that contains asbestos or other hazardous materials shall be conducted in accordance with all applicable state laws and regulations, including regulations relating to removal, transportation and disposal of asbestos or other hazardous materials. B. The Building Official may require any or all of the following as conditions of issuing demolition permits: 4. Compliance with all applicable local, state and federal laws and regulations, including regulations relating to asbestos and hazardous materials and regulations relating to the protection of water and sewer systems.
14.04.180	Outfalls. By definition, an "outfall" is an outlet through which materials are discharged into the estuary. Outfalls include sanitary (sewer) discharges, storm drainage facilities, waste seawater discharges, and industrial waste discharges. A. As applicable, the standards for dredging, shoreline stabilization, and placement of structures as set forth in this ordinance must be complied within the installation of outfalls. B. Sanitary outfalls shall not be allowed in poorly flushed areas of the estuary.
14.04.190	Submerged Crossings. By definition, "submerged crossings" are power, telephone, water, sewer, gas, or other transmission lines that are constructed across the estuary, usually by embedding into the bottom of the estuary. A. Trenching or other bottom disturbance undertaken in conjunction with installation of a submerged crossing shall conform to the standards for dredging as set forth in this ordinance. B. Submerged crossings shall be designed and located so as to eliminate interference with present or future navigational activities. C. Submerged crossings shall be designed and located so as to ensure sufficient burial or water depth to avoid damage to the crossing.
14.32.070	Alteration, Expansion, or Replacement of Nonconforming Uses or Structures A. After verification of the status of a nonconforming use pursuant to Section 14.32.060, the approval authority may authorize alteration, expansion, or replacement of any nonconforming use or structure when it is found that such alteration, expansion, or replacement will not result in a greater adverse impact on the neighborhood. In making this finding, the approval authority shall consider the factors listed below. Adverse impacts to one of the factors may, but shall not automatically, constitute greater adverse impact on the neighborhood. 3. Adequacy of infrastructure to accommodate the use. For the purpose of this subsection, infrastructure includes sewer, water, and streets;

Table 1-2. Municipal Code Policies	
NMC	**Policy, standard, or guideline statement**
Protection and Improvement of the Environment and Public Health	
5.15.020	<u>Connection Required</u> C. No person shall discharge any sewage into any storm drain or natural drainage outlet.
5.15.060	<u>Discharge Regulations</u> F. No unauthorized person shall maliciously, willfully or negligently break, damage, destroy, uncover, deface or tamper with any part of the sewer system. G. The public works director may adopt specifications and additional regulations consistent with city ordinances to carry out the purpose of this chapter. A copy of such additional material shall be maintained in the public works department.
5.15.080	<u>Violation – Penalty</u> A. A violation of any provision of this chapter is a civil infraction subject to a civil penalty not to exceed $500.00. Each day on which a violation occurs or continues is a separate violation. B. Violations that constitute a health hazard are nuisances and may be abated as nuisance or by any other legal means of eliminating the hazard.
14.21.090	<u>Erosion Control Measures</u> A certified engineering geologist, geotechnical engineer, or qualified civil engineer shall address the following standards. K. Such non-erosion pollution associated with construction such as pesticides, fertilizers, petrochemicals, solid wastes, construction chemicals, or wastewaters shall be prevented from leaving the construction site through proper handling, disposal, site monitoring and clean-up activities.
Utility Financing	
5.15.070	<u>Sewer Service Charges</u> A. Users of sanitary sewer service shall be charged fees established by resolution of the City Council. The amounts may be based in whole or in part on the amount of water consumed at the property. The Council may establish fees for any service or impact on the system, including, but not limited to: 1. Application fees. 2. Connection fees. 3. Usage fees. 4. Inspection fees. 5. Fees for improper connection. 6. Fees for misuse of the system. 7. Disconnection fees. C. Sewer users are responsible for payment for sewer services as follows: 1. The city shall prepare and mail billings for sanitary sewer services monthly. Billing shall be in the same manner as billings for water services, and shall be combined with the water and stormwater bill, if applicable. Deadlines for payment shall be the same as for water bills.
12.05.005	<u>Initiation of Local Improvement Districts</u> A. The council by motion or on petition of the owners of 75 percent of the property benefited by the proposed public improvement may direct that a preliminary engineering report be prepared to assist the council in determining whether a local improvement district should be formed to pay all or part of proposed street, sewer, sidewalk, drainage and/or other public improvements.
12.10.020	<u>Application for a Reimbursement District</u> A. Any person who is required to or chooses to pay for some or all of the cost of a street, water, sewer or other improvement in excess of what is needed to provide services to the person's property may, by written application filed with the city engineer, request that the city establish a reimbursement district. The street, water and sewer improvements must include improvements in addition to those that are required in connection with an application for permit approval and must be available to provide service to property other than property owned by the applicant. Examples include but are not limited to full street improvements instead of half street improvements, off-site sidewalks, connection of street sections for continuity, and extension or over-sizing of water or sewer lines. The city may be an applicant. The application shall be accompanied by a fee or deposit in an amount set by Council resolution sufficient to cover the city's administrative costs. If the Council establishes a deposit system, the applicant shall be responsible for supplementing the deposit on demand by the city in an amount sufficient to cover all anticipated costs by the city, including the costs of engineer's reports.

Table 1-2. Municipal Code Policies	
NMC	Policy, standard, or guideline statement
12.10.070	City Council Action D. The City Council resolution and reimbursement agreement shall determine the boundaries of the reimbursement district and shall determine the methodology for imposing a fee which considers the cost of reimbursing the applicant for financing the construction of a street, water or sewer improvement within the reimbursement district.
12.10.110	Obligation to Pay Reimbursement Fee A. The applicant for a permit related to property within any reimbursement district shall pay the, in addition to any other applicable fees and charges, the reimbursement fee established by the Council, if within the time specified in the resolution establishing the district, the person applies for and receives approval from the city for any of the following activities: 5. Connection to or new use of a sewer improvement, if the reimbursement district is based on the sewer improvement;
12.15.020	System Development Charged Imposed; Method for Establishment B. Unless otherwise exempted, SDCs for water, wastewater, storm water, transportation and parks are imposed on all development within the city, on all development outside the city that connects to the water and/or sewer facilities of the city, and on all other development which increases the usage of the water and/or sewer system or that contributes to the need for additional or enlarged capital improvements. This shall include new construction and the alteration, expansion or replacement of a building or development if such alteration, expansion or replacement results in a change in any of the components of the formula for determining the amount of SDCs to be paid. For redevelopment, the amount of the SDC to be paid shall be the difference between the rate for the proposed redevelopment and the rate that would be applicable to the existing development.
12.15.050	Collection of Charge A. The SDC is payable on: 2. Issuance of a development permit or approval for development not requiring the issuance of a building permit. A permit or approval to connect to the water and/or sewer system; 4. Issuance of a permit to connect to the sewer system or actual connection to the sewer system if a permit is not obtained. B. SDCs are payable only for those types of improvements affected by the development, permit or connection. For example, a permit to connect an existing structure to the sewer system does not necessarily trigger an obligation to pay Parks, Transportation, Water or Stormwater SDCs. C. The amount of SDC payable shall be established by resolution relying on an approved methodology and SDC project plan. The SDC project plan, methodology and amount of charge may be adopted in a single resolution, and more than one type of SDC (water, sewer, storm, transportation and park) can be included in a single resolution.
12.15.065	Credits B. A credit of the improvement fee portion of the SDC only shall be given to the permittee against the cost of the SDC charged, for the cost of a qualified public improvement incurred by the permittee, upon acceptance by the city of the public improvement. The credit shall not exceed the amount of the improvement fee even if the cost of the capital improvement exceeds the improvement fee. 1. If a qualified public improvement is located in whole or in part on or contiguous to the property that is the subject of the development approval and is required to be built larger or with greater capacity than is necessary for the particular development project, a credit shall be given for the cost of the portion of the improvement that exceeds the city's minimum standard facility size or capacity needed to serve the particular development project or property. The applicant shall have the burden of demonstrating that a particular improvement qualifies for credit under this subsection. The request shall be filed in writing no later than 60 days after acceptance of the improvement by the city. The city may deny the credit provided for in this section if the city demonstrates that the application does not meet the requirements of this section or if the improvement for which credit is sought is not included in the SDC Project List. 2. When construction of a qualified public improvement located in whole or in part or contiguous to the property that is the subject of development approval gives rise to a credit amount greater than the improvement fee that would otherwise be levied against the project, the credit in excess of the improvement fee for the original development project may be applied against improvement fees that accrue in subsequent phases of the original development project or otherwise imposed on the same property. 2. Credits for qualified public improvements may be used for future phases of development, redevelopment, a change in use of the property, or transferred to another property as provided in NMC 12.15.065(D)(6).* 3. Credit for qualified public improvements shall not be transferable from one type of capital improvement to another. 4. Credits for qualified public improvements shall be used within 10 years from the date the credit was given. 5. Credits for qualified public improvements may be transferred from one property to another within the 10-year period the credits are valid if (a) the receiving property is being developed with a residential use and (b) the amount of credit transferred is less than or equal to 50% of the total SDC assessment that would otherwise be payable.*

Table 1-2. Municipal Code Policies	
NMC	Policy, standard, or guideline statement
	6. If the public improvement for which a credit is sought is not on the SDC Project List, the applicant may submit an application for both the credit and for the placement of the improvement on the SDC project list. If the city manager determines that the project is of a type and location that is appropriate for inclusion, the project shall be added to the SDC Project List and a credit may be given, but the additional of the project shall not change the SDC amount payable by others. 7. The City Council shall conduct a public hearing no later than August 21, 2023, to evaluate the impact of transferred SDC credits on the City's ability to fund qualified public improvements and determine if changes should be made to provisions of this section related to the transfer of SDC credits.*
12.15.020	Method of Assessment C. In establishing a fair and reasonable method for apportioning actual or estimated costs of local improvements among benefited properties, the Council may, but in no way is required to, rely upon the following guidelines (as summarized in Exhibit 12.05.050-1) and described below: 4. Improvement Costs of Water and Sewer Lines. a. The properties specially benefited by a sewer main or water pipe shall bear the cost of the system up to and including 8 inch-diameter pipes. These costs shall be apportioned to each parcel on the basis of a cost per square foot of service area, determined by dividing the total system cost by the total service area. b. In addition to main or pipe costs, each property benefited by a sewer main or water pipe shall be considered to have at least one service line connection point. If more than one service line connection point is provided for a benefited parcel, it shall be assessed for the actual number of service line connection points. All costs related to the service lines, including overhead costs, shall be divided by the total number of service line connection points, to determine the cost per service line connection point.
12.05.055	Alternative Methods of Financing B. The council may use other means to finance, in whole or in part, the improvements, including but not limited to: federal or state grants-in-aid, sewer or other types of utility charges, urban renewal funds, revenue or general obligation bonds.
Wastewater Quality	
5.15.060	Discharge Regulations A. No person shall discharge or cause to be discharged any stormwater, surface water, groundwater, roof runoff, cooling water or unpolluted industrial process waters to any sanitary sewer. In the event the sewer system user fails to comply with any order requiring disconnection or it is impractical to require the disconnection of any storm drain from the sewer system, the sewer system user shall be required to pay a surcharge for the use of the system as established by Council resolution. B. Storm water and all other unpolluted drainage shall be discharged to storm drains, ditches, or natural storm drainage facilities or into drywells as approved by the city. C. Except as provided in this section, no person shall discharge or cause to be discharged any of the following waters or wastes to any public sewer: 1. Any liquid or vapor having a temperature higher than 150° Fahrenheit; 2. Any water or waste which may contain more than one hundred parts per million, by weight, of fat, oil, or grease; 3. Any gasoline, benzene, naphtha, fuel oil, or other flammable or explosive liquid, solid or gas; 4. Any garbage except organic wastes from a commercial source that have been shredded by a disposal system with a maximum 1.5 horsepower; 5. Any ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, paunch manure, or any other solid or viscous substance capable of causing obstruction to the flow in sewers or other interference with the proper operation of the sewer system; 6. Any waters or wastes having pH lower than 5.5 or higher than 9.0 or having any other corrosive property capable of causing damage or hazard to structures, equipment and personnel of the sewage works; 7. Any waters or wastes containing a toxic or poisonous substance in sufficient quantity to injure or interfere with any sewage treatment process or constitute a hazard in the receiving waters of the sewage treatment plant; 8. Any waters or wastes containing suspended solids of such character and quantity that unusual attention or expense is required to handle such materials at the sewage treatment plant; 9. Any noxious or malodorous gas or substance capable of creating a public nuisance; 10. Any material from septic tanks or recreational vehicle holding tanks except at dump stations for that purpose operated or authorized by the city. D. Grease, oil, and sand interceptors shall be provided when necessary for the handling of those wastes; except that interceptors shall not be required for private living quarters. All interceptors shall be of a type and capacity approved by the city and shall be located so as to be easily cleaned and inspected. Where installed, all grease, oil and sand interceptors shall be maintained by the sewer system users, at their expense, in continuously efficient operation. The city may inspect facilities at any time for proper operation and maintenance.

Table 1-2. Municipal Code Policies

NMC	Policy, standard, or guideline statement
Pretreatment	
5.15.070	Sewer Service Charges B. When an industrial or commercial sewer system user will discharge sewage of unusual strength or character, the city reserves the right to reject the application for service, to require pretreatment of such waste, and/or require the sewer system user to pay additional charges as provided in this chapter.
5.15.060	Discharge Regulations E. The admission into the sewer system of waters or wastes having: 1. A 5-day Biochemical Oxygen Demand greater than 300 parts per million by weight, or 2. Containing more than 350 parts per million by weight of suspended solids, or 3. Containing any quantity of the substances described in Subsection C., or 4. Having an average daily flow greater than two percent of the average daily sewer flow of the city shall be subject to the review and approval of the city manager. The city may require pretreatment at the owner's expense and may establish a fee for acceptance of the wastes
5.15.065	Industrial Pretreatment All non-domestic users of the city sewer system shall comply with industrial pretreatment standards of 40 CFR Chapter 1 Part 403.
Operations and Maintenance	
5.15.040	Power and Authority of Inspectors A. Duly authorized city employees shall be permitted to enter upon all properties for the purposes of inspection, observation, measurement, samplings and testing. B. It shall be the permittee or permittee's representative responsibility to request inspection of the work and to allow reasonable time for the city to schedule the inspection. Inspections shall be requested for and made during the normal business hours of the city. Should inspections be required during non-business hours, the permittee shall reimburse the city for all overtime costs incurred.

Section 2

Flow Projection Updates

For the 2018 Phase I WWTMP, a capacity study provided a set of flow and load projections that were derived from a combination of Portland State University (PSU) population forecasts and water use data from 2004 through 2017. The evaluation presented in this section provides an update to those projections with more recent data. The updated flow and load projections were used to evaluate the capacity of the existing WWTP processes.

2.1 Population Projection Updates

Population projections for Newport and Lincoln County are periodically developed by PSU. PSU's 2017 projection estimated a 0.91 percent annual growth rate for the city between 2017 and 2067. From 2004 to 2017, water use within the city increased at an annual rate of approximately 0.1 percent. While some of this reflects water conservation, the water-use data suggested that PSU projections could overestimate development. As a compromise, the 2017 capacity study used a set of projections with a 0.45 percent annual growth rate.

PSU updated its population forecasts in 2021, and the new forecasts were much lower than those developed in 2017. The 2021 PSU projections forecast an overall reduction in population within the city from 2020 to 2070, and only a small incremental increase (0.2 percent annual growth) in Lincoln County as a whole. Actual population growth within the city averaged 0.96 percent between 2000 and 2020, with a 1.39 percent annual growth rate from 2010 to 2020.

A new set of population projections were developed for this study to rationalize the available data. The new projections start with the 2000-2020 annual growth rate of 0.96 percent and gradually reduce to 0.03 percent, which is the annual growth rate projected for Lincoln County after 2040 in the PSU 2021 forecast. Figure 2-1 presents the new projections alongside those from the 2017 capacity report, the two PSU projections, and the historical population for Newport.

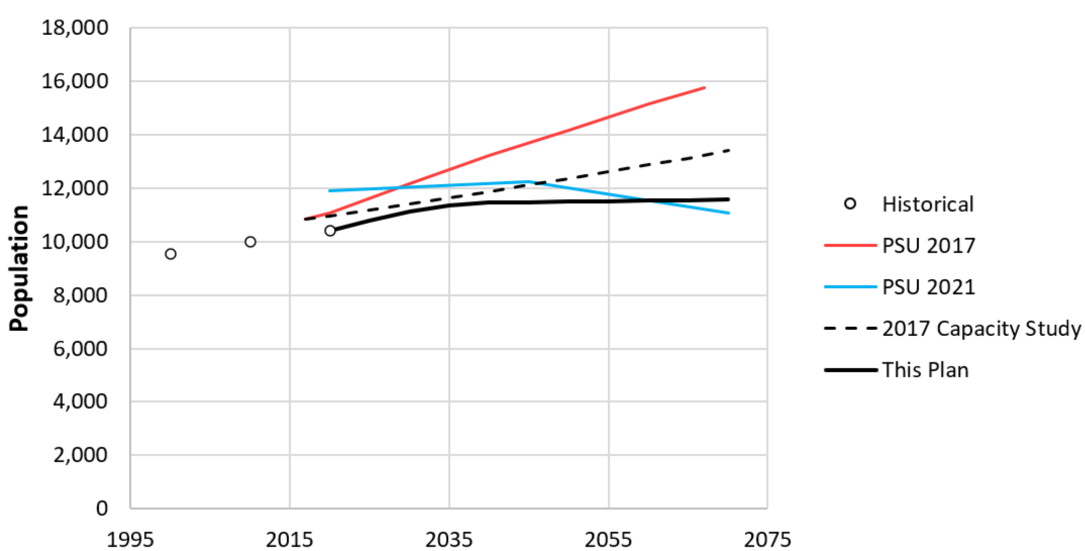

Figure 2-1. Population projections for Newport

The new projections are somewhat lower than those used in the 2017 capacity report. In total, the city population is projected to increase by 1,168 (11 percent) between 2020 and 2070.

2.2 Current Flows

Wastewater flow at the City's WWTP follows a seasonal trend due to wet weather impacts, with high flows in the rainy winter months and low flows during the summer. Figure 2-2 presents the daily flow record for the past 15 years.

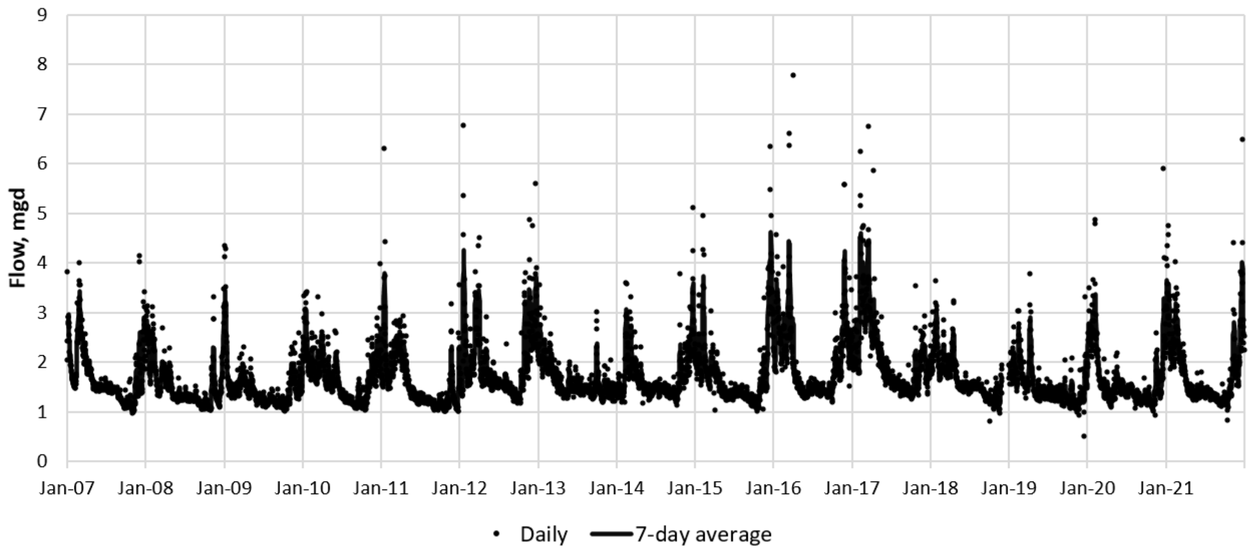

Figure 2-2. Daily flow at the Vance Avery WWTP

The base sanitary flow is defined as the 7-day minimum flow recorded each year, which approximates sanitary flow without impacts from inflow and infiltration. The base sanitary flow typically occurs near the end of the summer. Figure 2-3 presents the annual base sanitary flow from 2007-2021.

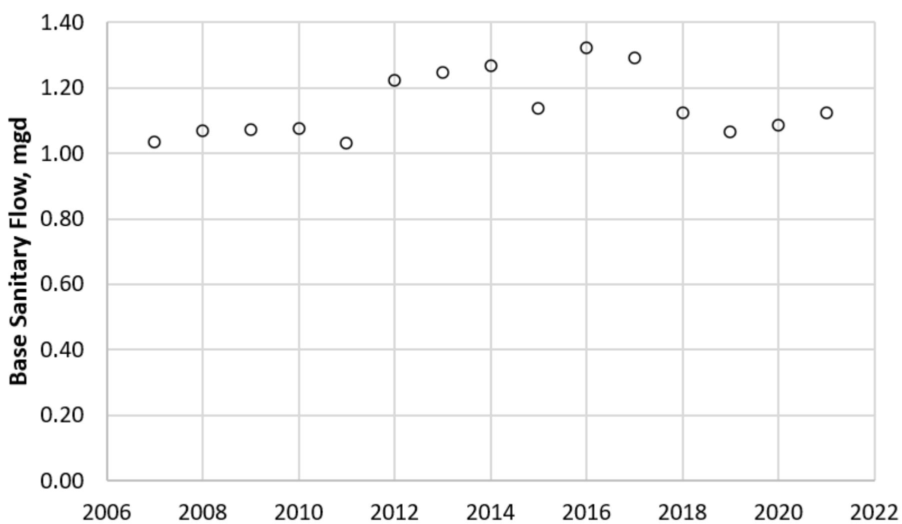

Figure 2-3. Annual base sanitary flow at the Vance Avery WWTP

Although some annual variation exists, the base flow has increased steadily between 2006 to 2021, and currently averages approximately 1.1 million gallons per day (mgd). Figure 2-4 presents average flows by the day of the year, from 2017 to 2021.

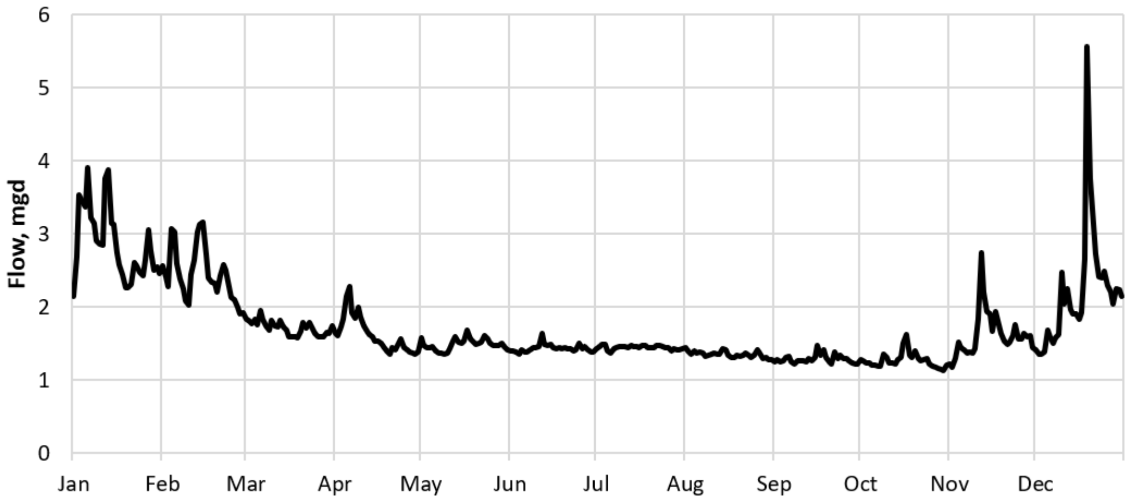

Figure 2-4. Average flow by day of the year, 2017-2021

The City is a tourist destination, particularly during the summer. However, the wastewater flow record exhibits only a marginal tourism component. Flow impacts during the summer months and from major holidays such as Independence Day, Labor Day, and Memorial Day are negligible according to the data. Instead, seasonal inflow and infiltration result in winter flows averaging 1 to 2 mgd higher than summer flows. The spikes on Figure 2-4 represent days on which major storm events occurred. The very large spike on December 20 reflects the coincidental arrival of major rainstorms on the same day in both 2020 and 2021.

A statistical analysis of the flow data from 2017 to 2021 is summarized in Table 2-1. The table presents current flows and peaking factors, which will be used as the basis for flow projections.

Table 2-1. Current Flows and Peaking Factors

Parameter	Flow (mgd)	Peaking (flow/base sanitary)
Base sanitary	1.10	1.00
Minimum month	1.15	1.05
Average	1.75	1.59
Maximum month	3.30	3.00
Maximum 14-days	3.75	3.41
Maximum day	6.50	5.91
Peak hour[a]	13.9	12.68
Summer average	1.40	1.27
Winter average	2.10	1.91

a. Peak hour flows are not tracked. The data in Table 2-1 were applied to the Oregon Department of Environmental Quality (DEQ) method of determining wet weather and peak flow projections to estimate an average peak hourly flow. Plant operators have reported that flows up to 15 mgd have been observed, although such flows are infrequent.

2.3 Current Loading and Industrial Contributions

Influent loadings are presented on Figure 2-5. The figure shows the daily and 30-day average loadings for biological oxygen demand (BOD) and total suspended solids (TSS).

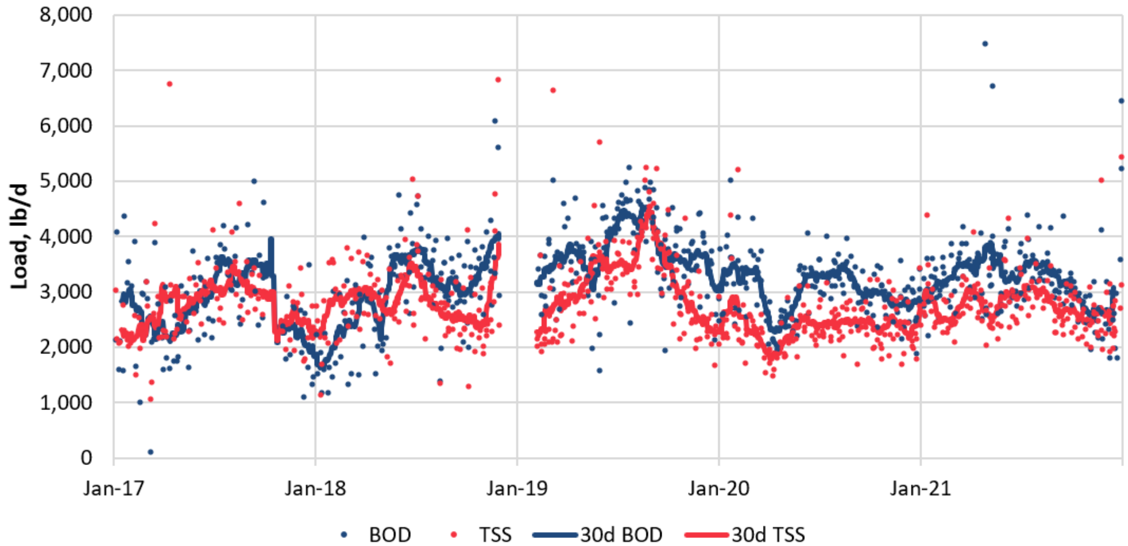

Figure 2-5. Daily and 30-day average influent BOD and TSS loadings

Although it is hard to visualize due to the scatter, the loadings demonstrate seasonal variation. Loadings are typically 10 to 15 percent higher in the summer, peaking in July. As was the case with flows, it is difficult to determine a tourism-related load impact. Figure 2-6 presents average BOD loadings by calendar date, using data from 2008 through 2021. While the summer increase is clear, specific holiday-related peaking is not conclusively observed.

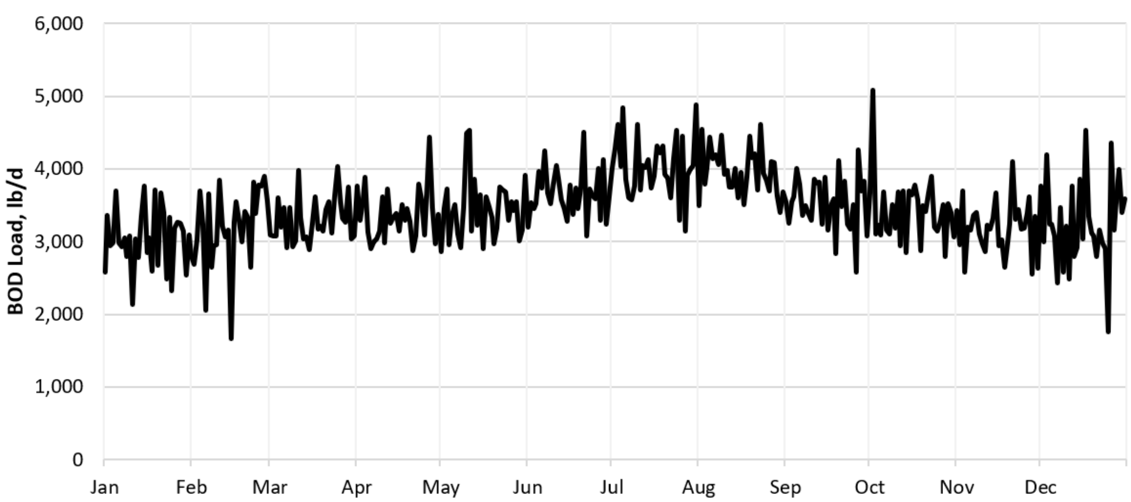

Figure 2-6. Average daily BOD loading by calendar date,(2008-2021)

A key component of the influent loading is the Rogue Brewery (Rogue). Rogue currently contributes approximately 26,100 gallons per day (gpd) of flow, with a high BOD content (2,160 pounds [lb]/day[d]). Table 2-2 summarizes Rogue flows and loads since 2020, when the latest pretreatment regulations went into effect.

Table 2-2. Rogue contribution to Newport, 2020-2021			
Parameter	Rogue	Total	Rogue % of total
Flow, mgd			
Average	0.026	1.75	1.5%
Maximum month	0.031	3.30	0.9%
Maximum day	0.060	6.50	0.9%
BOD, lb/d			
Average	475	3,200	14.8%
Maximum month	700	4,250	16.5%
Maximum day	1,900	6,500	29.2%
TSS, lb/d			
Average	50	2,775	1.8%
Maximum month	120	4,000	3.0%
Maximum day	550	6,800	8.1%

Table 2-3 summarizes the current overall loadings, with peaking factors. BOD loadings have been adjusted to exclude the average Rogue loading of 475 lb/d. TSS loadings are unadjusted, as Rogue contributions are insignificant (less than 2 percent of the total at average load conditions). Adjusting the BOD loadings for Rogue ensures that per capita load generation rates and peaking factors are independent of Rogue, and Rogue loadings can be projected separately.

Table 2-3. Influent Loads and Peaking Factors		
Parameter (excludes Rogue)	Loading	Peaking (compared to average load)
BOD, lb/d		
Minimum month	1,925	0.71
Average	2,725	1.00
Maximum month	3,775	1.39
Maximum 14-day	4,125	1.51
Maximum day	6,500	2.39
TSS, lb/d		
Minimum month	1,900	0.68
Average	2,775	1.00
Maximum month	4,000	1.44
Maximum 14-day	4,600	1.66
Maximum day	6,800	2.45

2.4 Equivalent Residential Units

Equivalent residential units (ERUs) may be defined based on flow or load and are used to compare trends in flow or load in units roughly equivalent to a single household. This approach can make it easier to correlate flow and load impacts and future projections to population trends.

To define based on flow, the current base flow of 1.1 mgd is divided by the 2021 residential population of 10,591 to estimate an average per capital wastewater generation rate of 103.9 gallons/capita/day. Multiplying this by the average household size of 2.29 gives a flow-based generation rate of 238 gpd/ERU. By this measure, there are 4,625 ERUs in the City system.

To define ERUs based on load, during the winter, the average BOD load is 2,625 lb/d, which excludes contributions from Rogue. Dividing this by the population of 11,882 gives a per capita loading of 0.25 lb/capita/d. Multiplying this by the average household size gives a load-based generation rate of 0.57 lb/d/ERU. The load basis may be used to project the number of additional ERUs observed during the summer and ERUs associated with Rogue:

- Current ERUs: 4,625
- ERUs added during the summer: 661
- ERUs associated with Rogue: 837

On average, the City has approximately 4,625 households in the wastewater system and adds approximately 661 households' worth of BOD load (a 14 percent increase) each summer. The BOD load from Rogue is equivalent to 837 households (an 18 percent increase) added to the collection system when the brewery is discharging.

2.5 Flow and Load Projections

Flow and load projections were derived by extrapolating current base flow and average loads into the future based on population forecasts (Figure 2-1). Peaking was derived from the peaking factors presented in Tables 2-1 and 2-3. Rogue flows and loads were assumed to remain constant, with the average BOD loading of 475 lb/d applied to all future projections. Table 2-4 summarizes the flow and load projections.

Table 2-4. Influent Flow and Load Projections

	2021	2030	2040	2050	2060	2070
Flow, mgd						
Base sanitary	1.10	1.19	1.25	1.26	1.26	1.27
Minimum month	1.15	1.24	1.30	1.32	1.32	1.33
Average	1.75	1.89	1.98	2.01	2.01	2.02
Maximum month	3.30	3.56	3.74	3.78	3.79	3.81
Maximum day	6.50	7.01	7.36	7.45	7.47	7.50
Maximum hour	13.9	15.0	15.8	16.0	16.0	16.1
Summer	1.40	1.51	1.59	1.60	1.61	1.61
Winter	2.10	2.26	2.38	2.41	2.41	2.42
BOD load, lb/d						
Minimum month	2,400	2,550	2,650	2,680	2,690	2,690
Average	3,200	3,410	3,560	3,600	3,610	3,620
Maximum month	4,250	4,550	4,750	4,800	4,820	4,830
Maximum 14-day	4,600	4,920	5,150	5,200	5,220	5,230
Maximum day	6,500	7,010	7,360	7,450	7,470	7,500
TSS load, lb/d						
Minimum month	1,900	2,050	2,150	2,180	2,180	2,190
Average	2,780	2,990	3,140	3,180	3,190	3,200
Maximum month	4,000	4,310	4,520	4,580	4,590	4,610
Maximum 14-day	4,600	4,970	5,220	5,280	5,300	5,310
Maximum day	6,800	7,330	7,700	7,790	7,820	7,840

a. Includes contributions from Rogue.

In summary, the flow and load projections are expected to mirror the population projection, with only a small increase (13 to 15 percent) over the next 50 years.

2.6 Permit Requirements

The WWTP is permitted to discharge under National Pollutant Discharge Elimination System (NPDES) Permit 102497, issued on May 3, 2002. The permitted discharge limits are summarized in Table 2-5. The current permit, which expired on April 30, 2007, remains in effect until a new permit is issued. These limits were used to evaluate the WWTP processes' ability to handle the projected increases in flows and loads without risk of permit violations.

Table 2-5. NPDES Permit Regulations

BOD and TSS Limits						
	Concentration-based Limits (mg/L)		Mass-based Limits (lb/d)			Removal Efficiency
	Monthly	Weekly	Monthly	Weekly	Daily Maximum[a]	
Summer (May 1–Oct 31)						
BOD	30	45	770	1,100	1,500	85%
TSS	30	45	770	1,100	1,500	85%
Winter (Nov 1–Apr 30)						
BOD	30	45	960	1,700	2,300	85%
TSS	30	45	960	1,700	2,300	85%
Other Limits						
Fecal coliform bacteria	126 per 100 mL (monthly geometric mean) with no sample exceeding 406 per 100 mL					
pH	6–9					
Total residual chlorine	0.47 mg/L					

Abbreviations: lb/d = pound(s) per day, mg/L = milligram(s) per liter, mL = milliliter(s)

a. Daily maximum limits suspended when flow exceeds 6.4 mgd.

2.7 Effluent Performance

Effluent concentrations from the WWTP for BOD and TSS have generally remained well below permit limits. Figures 2-7 and 2-8 present monthly average effluent concentrations and loadings, respectively, compared to permit limits. The WWTP currently is able to meet permit limits, and performance became notably more stable in 2020 and 2021.

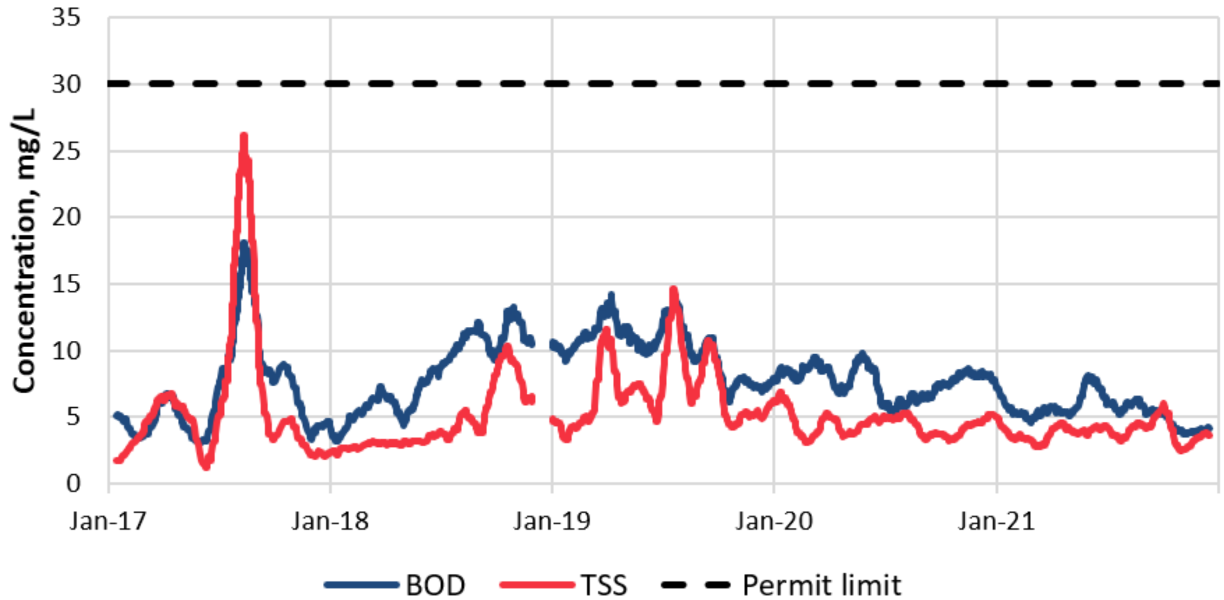

Figure 2-7. Effluent BOD and TSS concentration, 30-day average

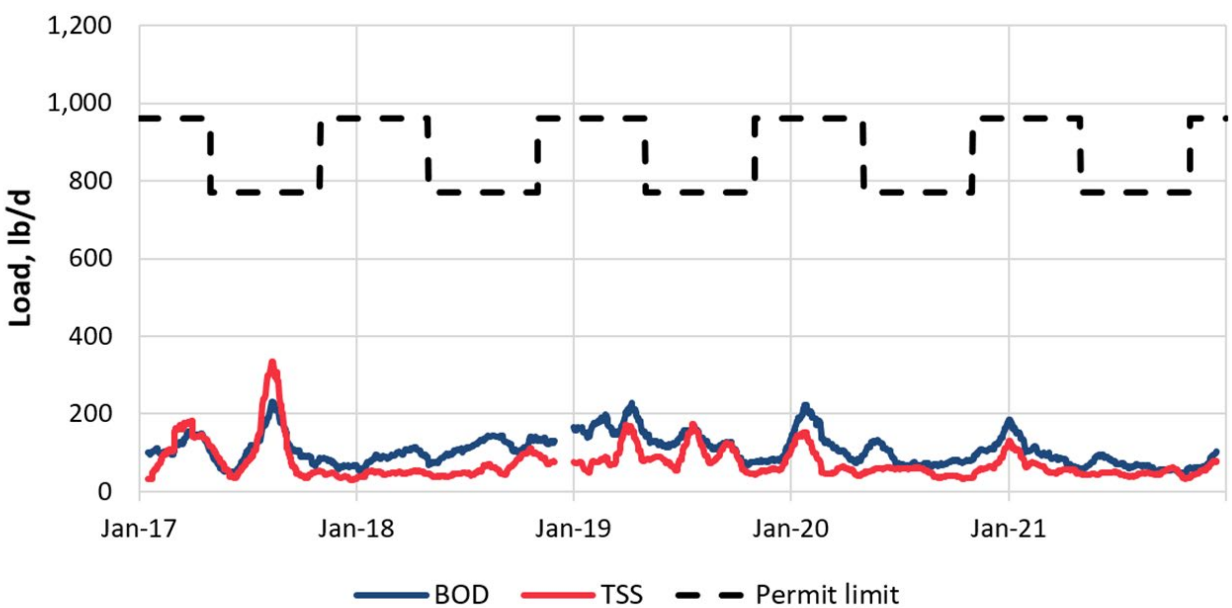

Figure 2-8. Effluent BOD and TSS loading, 30-day average

Section 3

Updated Condition and Criticality Evaluation

This section describes the processes and recommendations for near-term improvements for the Vance Avery Wastewater Treatment Plant (WWTP). This section reflects an update to BC's 2019 Existing Conditions Technical Memorandum (TM), stemming from the updated (2021) "*Wastewater Treatment Facilities Condition Assessment Update*" performed by Waterdude and included in Appendix A. Waterdude previously performed a condition assessment in 2018 which informed the 2019 BC TM. Unless otherwise noted, condition status per Waterdude have been paraphrased for brevity.

3.1 Condition Summary

The locations of major facilities at WWTP are shown on Figure 3-1.

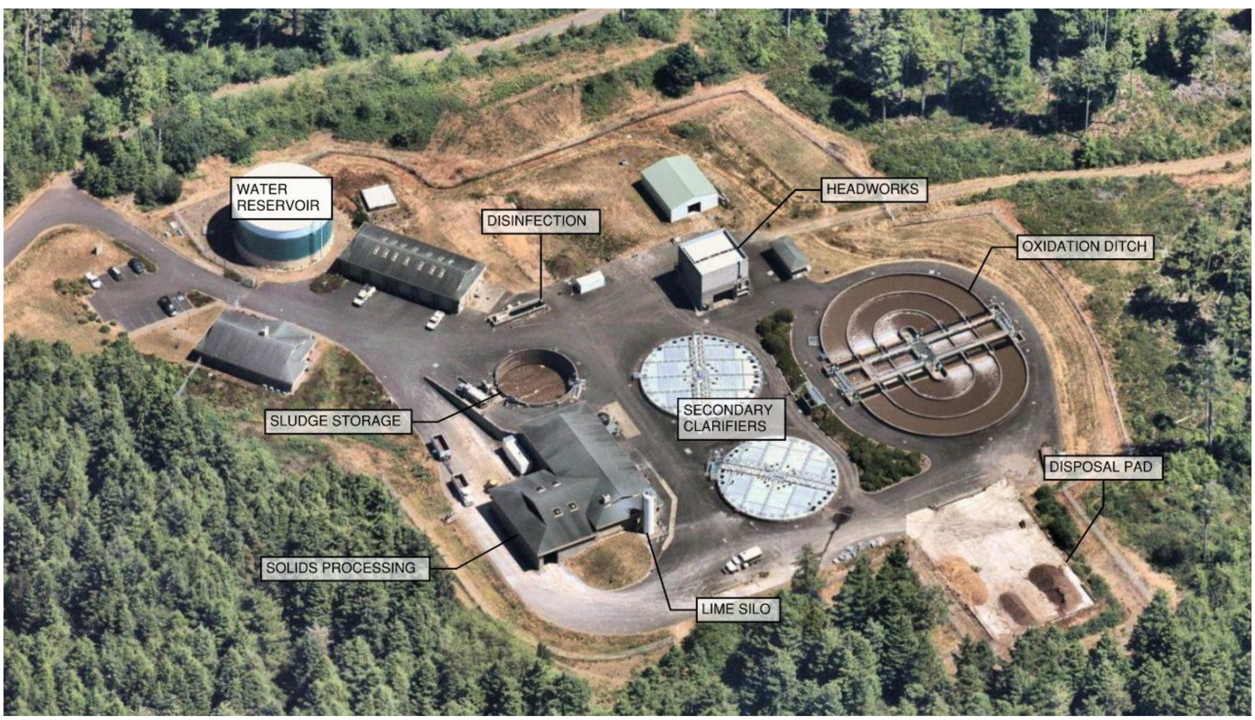

Figure 3-1. WWTP aerial layout

Table 3-1 summarizes applicable 2018 and 2021 criticality ratings. Ancillary processes that have been identified as critical are Northside Pump Station (NSPS) (discussed in Appendix H) and septage screening (discussed in Section 7). The status of each major unit process is summarized next.

Table 3-1. Major Unit Process Condition Rating Changes			
Description	2018 Rating	2021 Rating	Rating Change
Headworks Screenings	3.0	3.7	-0.7
Oxidation Ditch	2.9	2.7	+0.2
Secondary Clarification	2.0	2.3	-0.3
Disinfection System	2.5	3.3	-0.8
Lime Storage and Feed	2.8	3.4	-0.6
Biosolids System	2.6	3.4	-0.8

a. A rating of 1 reflects "very good" condition and 5 reflects "very poor" condition.

3.2 Headworks

The headworks contains the influent screening process, which removes rags, plastics, and medium to large debris from the influent flow stream, preventing their passage to downstream processes. Removing this debris protects downstream pumps and equipment and reduces maintenance requirements for downstream facilities.

Cylindrical screens and shaftless cleaning and conveying screws are housed in two of the four existing screening channels. The remaining two channels were constructed to facilitate future expansion and are currently blocked and unused. Screenings material is washed and compacted during its transport to a dumpster for offsite disposal. The City has noted "ragging" of the existing rotary screens results in buildup that impact screen performance and require regular clearing. Note that while grit removal was initially planned to be incorporated into the process, the City has indicated there are no current concerns with excess grit.

Corrosion is prevalent throughout the headworks building, and the odor control system is currently out of service. Corrosion could be a result of the proximity of the plant to the ocean and the fact that the upper level of the building is open to marine air. However, hydrogen sulfide (H_2S) concentrations are also very high and pose a safety risk to personnel working in this facility. H_2S also contributes to concrete erosion throughout the building in areas of high moisture. Corroding facilities such as the roof access ladder and stair gratings are safety concerns.

From 2018 to 2021, the condition of the existing screening system has worsened, partially due to increased corrosion over time. The screens have further degraded since 2021 and are due for replacement. As discussed in the 2018 condition assessment, there is insufficient screening redundancy or passive bypass; bypassing the screening process would only be possible by removing a screen entirely, for a certain period.

3.3 Oxidation Ditch

An Orbal oxidation ditch manufactured by Evoqua Water Technologies uses surface aerators to mix and aerate the wastewater. The basin is fitted with adjustable effluent gates that allow the water surface to be controlled to provide optimal mixing and aeration. The aeration process promotes growth of naturally occurring bacteria that consume biochemical waste material in the wastewater. This process removes 5-day biochemical oxygen demand (BOD_5), solids, and nutrients from the wastewater.

The aeration basin consists of three concentric, oval-shaped channels with four banks of surface aerators. Screened raw sewage and return activated sludge (RAS) typically enter the outer channel but can also be fed directly to the middle channel or both channels. The outer channel is operated at a near zero dissolved oxygen (DO) condition while the middle channel is operated at a DO of approximately 2 milligrams per liter (mg/L), and the inner channel is operated at a DO around 5 mg/L. Mixed liquor from the aeration basin is conveyed to the two secondary clarifiers via the mixed liquor splitter box.

The WWTP experienced increased TSS in the effluent from 2017-2019 and contracted with an operations specialist to evaluate and make operational recommendations to improve performance and optimize treatment processes. While the evaluation considered the whole WWTP, emphasis was placed on operational improvements to the aeration basins. The improvements aim to maintain set DO levels within each channel and set operational protocols for both the aeration basin and secondary clarifiers. Solids retention time (SRT) was recently reduced from 10 to 15 days, down to 9 days. Mixed liquor suspended solids (MLSS) has also been reduced recently from 3,200 mg/L to 2,400 mg/L, and process adjustments continue.

Due to capacity limitations, the ditch is typically operated at maximum overflow level. This is not ideal as it places the aerator shafts and bearings in contact with the activated sludge, leading to accelerated corrosion of these components. Furthermore, Phase I capacity analyses indicated the aeration system was not able to provide the target transfer efficiency to support the process.

Since 2018, the aerators underwent refurbishment and repairs, including new drives, bearings, and lubrication. In addition, the rotating speed was increased to provide more oxygen overall. These improvements are reflected in the 2021 criticality rating for the oxidation ditch. However, the capacity challenges will limit the timeframe between subsequent repairs moving forward if additional capacity is not incorporated to support the process.

3.4 Secondary Clarifiers

The secondary clarifiers take mixed liquor from the oxidation ditch and allow particles to settle out of the mixture forming sludge on the bottom of the clarifier. This sludge is drawn off the bottom of the clarifier and pumped to the aeration basin as RAS to improve process efficiency, or it is pumped as waste activated sludge (WAS) to the sludge storage tank. Pumps for the RAS and WAS processes are in the solids building. Scum floating on the clarifier surface is collected by skimmers, directed to the scum box, and pumped to the sludge storage tank.

Physically, the clarifiers are in decent condition with a few notable issues, as summarized below:

- The original scum removal sprayers have been removed due to plugging, and the current spray system is ineffective.
- In 2021, the drives and submerged portions of the blade-type mechanisms showed signs of corrosion. Deterioration of these components are reflected in the downgraded criticality rating between 2018 and 2021. However, the drive for Clarifier No. 2 was recently replaced, and the mechanism was recently recoated to mitigate corrosion.
- According to the City, the clarifier covers require regular cleaning and present an operational challenge due to the obstruction of the equipment below. The City has noted a preference to have the covers removed, if possible, but they were included in the original design due to proximity to the regional airport and a stated criterion of minimizing attractions for birds. Reconsideration of this requirement may be warranted, including coordination with the Federal Aviation Administration to confirm that covers are required by law.

3.5 Disinfection

The disinfection system inactivates pathogens and other microorganisms before the effluent is discharged to the Pacific Ocean. Sodium hypochlorite solution (12.5 percent) is stored in a 3,650-gallon storage tank and pumped to the chlorine contact basin, where it is mixed with secondary effluent. The sodium hypochlorite solution can also be used at various other locations on the site. Disinfected effluent from the contact basins is measured with a Parshall flume before flowing by gravity through a 30-inch-diameter gravity effluent line under Yaquina Bay to the effluent booster pump station, where it is pumped to the ocean outfall near Nye Beach.

No capacity limitations were noted with the existing sodium hypochlorite disinfection system. However, the eyewash station present at the chlorine injection point is reaching the end of its useful life. In the past, eyewash stations have not received the required monthly inspections to ensure safety systems are fully operational. Furthermore, in 2023, a failure involving the existing diaphragm pumps resulted in an unplanned discharge of unchlorinated effluent. Pump replacement strategy and costs are presented later in this report. Finally, the disinfection tank outlet was drilled into the tank side and attached after fabrication rather than cast into the tank structure, and there have been issues with tank leaks. A new disinfection tank (of the same size) is recommended.

In 2019, the chlorine delivery system was upgraded from manual control to automatic delivery. The chlorine set point is currently based on a control loop, which continuously analyzes effluent conditions and adjusts the dosage accordingly. This system has been reported to be effective.

3.6 Solids Treatment

The solids stream receives waste activated sludge (WAS) and septage via the Hauled Waste Receiving Station. The WAS is conveyed from the RAS piping to the aerated WAS Storage Tank by WAS pumps located in the Solids Handling Building gallery. Septage from the Hauled Waste Receiving Station is also conveyed to the WAS Storage Tank.

Centrifuge Feed Pumps located in the Solids Handling Building gallery pump stored WAS and septage at a concentration of approximately 0.55 percent to centrifuges located on the ground level in the Solids Handling Building. Centrifuges and a liquid emulsion polymer system dewater WAS to approximately 20-percent solids concentration. Centrate decanted from the centrifuge is then returned to the plant headworks.

Conveyors transport dewatered cake to the Lime Stabilization equipment, located in the lime processing room adjacent to the centrifuges on the ground level of the Solids Handling Building. Cake is conveyed to a thermoblender where it is mixed with quicklime and heated. From the thermoblender, the heated sludge/lime mixture drops into a pasteurization vessel where it is held and heated for 30 minutes to produce Class A biosolids. The lime-stabilized, Class A biosolids finished product is conveyed to the solids storage bay on the west side of the Solids Handling Building where it is truck loaded and hauled to a biosolids end user or stored at Crestmont Farms, near Wren, Oregon. At the time of this evaluation, the plant had approximately 3 weeks of biosolids storage available onsite. A schematic of the existing solids stream is shown on Figure 3-2. Photos of the existing WAS Storage Tank, Centrifuge Feed Pumps, Centrifuges and RDP system are shown on Figures 3-3 through 3-6.

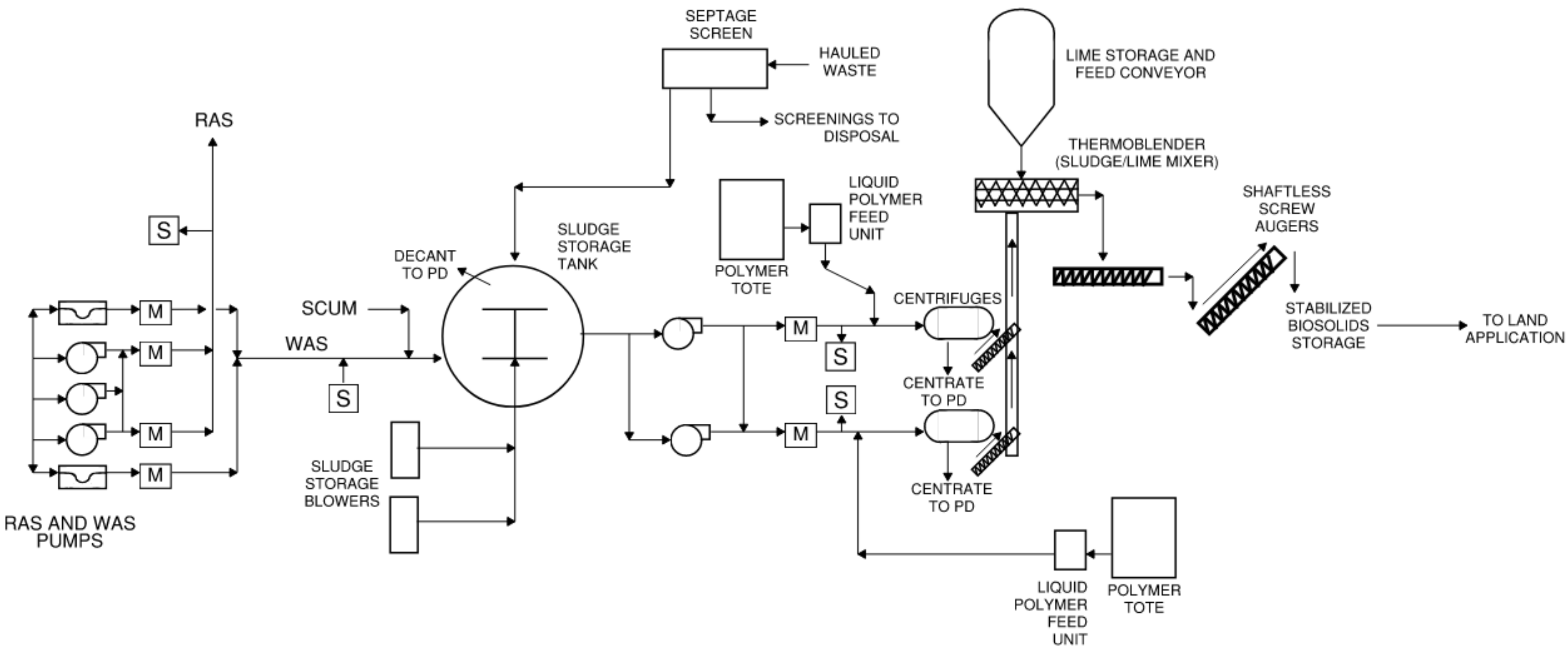

Figure 3-2. Solids stream schematic

Figure 3-3. WAS storage tank

Figure 3-4. Centrifuge feed pumps

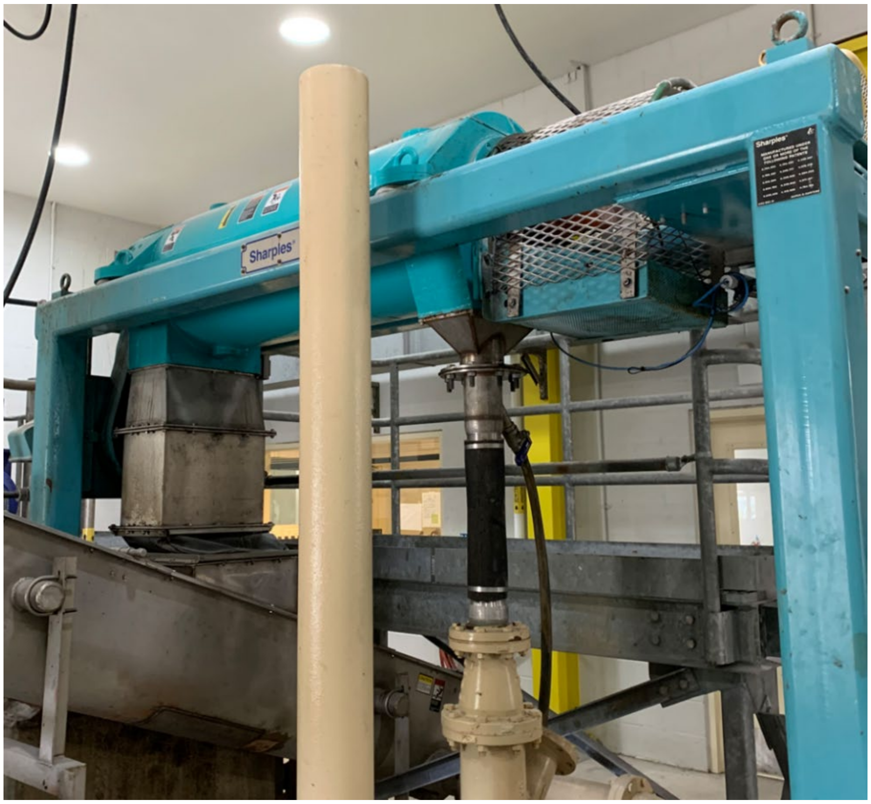

Figure 3-5. Centrifuges

Figure 3-6. RDP lime stabilization equipment

The solids process has experienced capacity issues for several years and a Biosolids Capacity Evaluation in 2012 made several recommendations to further evaluate and resolve the issues (BC, 2012). A rebuild of the centrifuges was completed in 2018 along with the installation of new control panels and a new polymer delivery system. The dewatering centrifuge capacity issues are also documented by BC in a 2018 capacity assessment, and by Kennedy Jenks in a Centrifuge Replacement TM (Appendix E).

The plant is currently looking to implement an emergency centrifuge replacement project, as the existing centrifuges are undersized and have reached the end of their useful life. Additional existing conditions information relating to dewatering is provided in the Centrifuge Replacement TM. Existing conditions of solids processes are also described in the Solids Basis of Design TM, included as Appendix J.

The existing RDP Lime Stabilization process is also reaching the end of its useful life, and product support and parts are becoming increasingly difficult to obtain for the existing system. The finished biosolids product is poor quality (e.g., consistency) and odiferous, making it more difficult to partner with agricultural land application sites and other end users.

Labor challenges with respect to biosolids hauling has resulted in backups at the plant. The plant pays to store biosolids at Crestmont Farms from November through April, as it is difficult to access the Class A Biosolids site during these months due to wet weather. DEQ has also notified the City that land application of biosolids is no longer permitted during the wet season (October through February), due to low nutrient update during winter months and difficulty with applying biosolids at the land application site. Large quantities of rainfall in the area do not allow the plants to absorb the nutrients in biosolids. The City has contracted storage of Class A biosolids with Crestmont Farms over the next 5 years. The farm will allow the City to haul and store a maximum of 4,500 wet tons of Class A biosolids annually, until they can be land-applied during the dry season. There are several sites available to the City for land application of Class A biosolids in the Siletz valley, mostly pasture lands; however, odors can be an issue on smaller sites. The DEQ is allowing the City to blend RDP Class A biosolids product with wood chips to improve quality and odor issues at certain sites. This is considered a “blended” product and allowed by the City’s existing Biosolids Management Plan. Wood chips are provided by Central Lincoln P.U.D. and are free to the City.

Section 4

Capacity Assessment Update

A capacity assessment was developed as part of the 2018 Phase I Wastewater Treatment Master Plan (WWTMP). The capacity assessment was based on a combination of equipment data, historical operation and observations, and biological process modeling. That assessment has been updated as part of this plan using the same biological process model, with updates as described below.

4.1 Plant Operation

Figure 4-1 presents a process flow schematic representation of the plant.

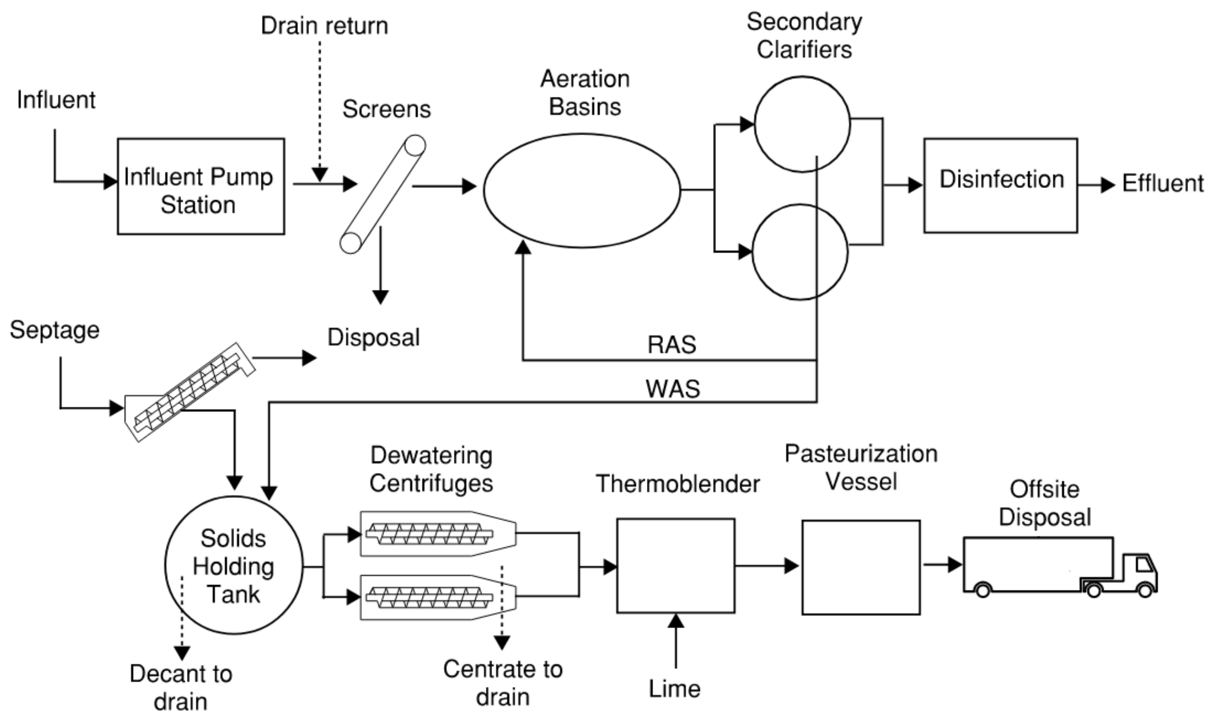

Figure 4-1. Plant process flow schematic

Influent is pumped up to the headworks, which houses a pair of in-channel rotary screens. Each screen has 0.25-inch openings and is rated for a capacity of 8 million gallons per day (mgd). Screened influent is conveyed to a 1.5-million-gallon Orbal oxidation ditch, which operates at a liquid depth of 11.5 feet. The Orbal system consists of three loops, each of which operates at a different DO concentration (Figure 4-2).

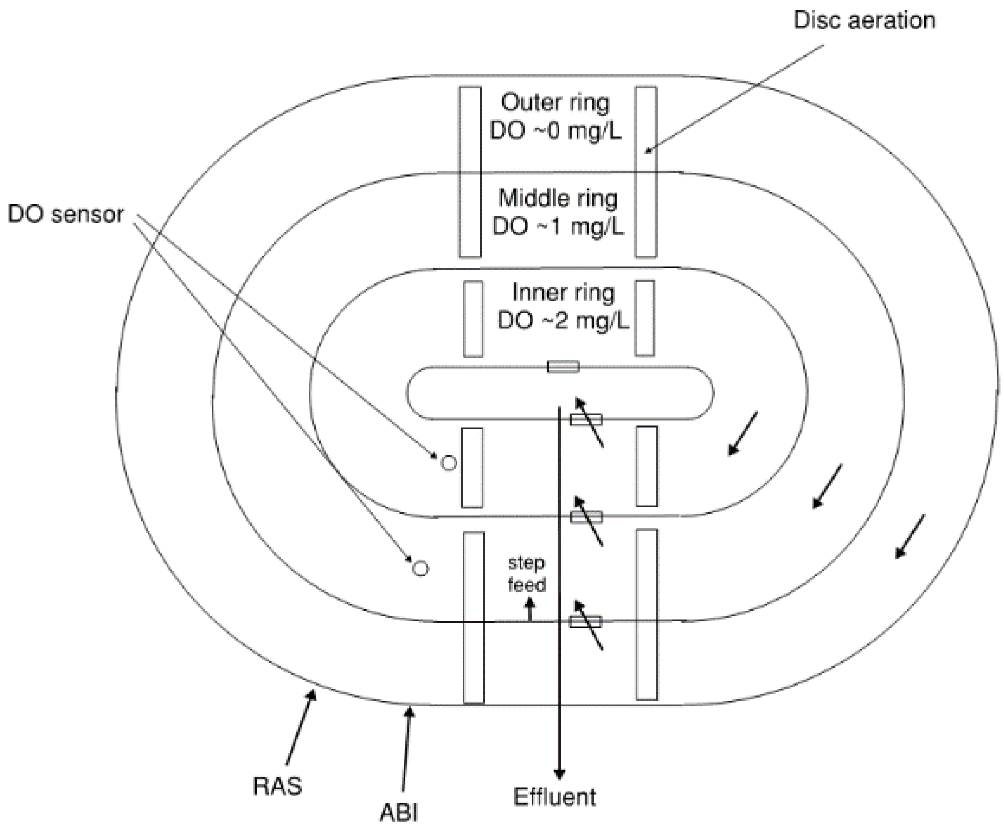

Figure 4-2. Schematic of Orbal oxidation ditch

The oxidation ditch is currently operated at an solids retention time (SRT) of 8 to 10 days. The mixed liquor suspended solids (MLSS) concentration is maintained at an average of 2,560 mg/L, with a typical monthly average range from 2,250 to 2,980 mg/L.

Mixed liquor from the ditch is sent to a pair of 90-foot-diameter secondary clarifiers for solids separation. Activated sludge bacteria are sent back to the ditch as RAS, and effluent is sent to a 13,600-gallon disinfection channel. The disinfection channel is primary used for mixing, with contact time achieved in the outfall pipeline, which has an estimated volume of 580,000 gallons.

WAS from the secondary clarifiers is sent to a holding tank where it is mixed with septage. The combined sludge is dewatered with a pair of centrifuges and stabilized via a lime pasteurization process.

4.2 2018 Capacity Assessment

The 2018 capacity assessment identified several capacity limitations:

1. The influent screens were operating with no redundancy, and firm capacity of the system was exceeded at peak flows.
2. The dewatering centrifuges were operating with no redundancy, and firm capacity of the system was exceeded at average load conditions.
3. The lime pasteurization system was operating above its design throughput of 24 hours/week.

4. The secondary process appeared to be operating near its capacity. The rated capacity, based on the ditch's design SRT of 5.5 days, was estimated to be 4.1 mgd (maximum month flow basis). However, it was recommended, due to a nutrient imbalance, to keep the SRT at a minimum of 8 days to improve mixed liquor settleability. Operation at the recommended minimum SRT of 8 to 10 days would reduce the rated capacity to 3.7 mgd, which was the flow rate projected to be observed shortly after 2030.
5. Oxidation ditch aeration capacity appeared to be limited, based on operator observation of DO depression during peak loadings. This was assumed to be caused by a combination of the oxidation ditch disc aerators performing below specification with respect to oxygen transfer, and to a transfer efficiency depression which may have been related to peak loadings from Rogue.
6. The influent pumps and plant design hydraulics, both rated to 15 mgd (maximum hour), were projected to become capacity-limited in the early 2040s.

4.3 Capacity Assessment Update

The capacity assessment performed as part of the 2018 Phase I WWTMP has been updated as part of this planning effort. Updates include:

1. Incorporating the new flow and load projections (see Section 2).
2. Reducing the Rogue BOD loadings from approximately 1,100 pounds per day (lb/d) to the current average of 475 lb/d. Since the 2017 assessment, pretreatment regulations have reduced Rogue loadings by more than 50 percent. This, combined with mechanical improvements to increase the motor power delivered by the oxidation ditch disc aerators, has eliminated the aeration limitations observed in the 2017 assessment.
3. Updating the secondary process capacity assessment based on more stable operation in recent years, specifically improved mixed liquor settleability. The modeled sludge volume index (SVI) was decreased from 361 milliliters per gram (mL/g) to 325 mL/g, to reflect this operational improvement.

Major findings from the capacity update include:

1. The influent screens continue to be a capacity limitation, with firm capacity already exceeded.
2. The dewatering centrifuges continue to be a capacity limitation.
3. The lime pasteurization system continues to exceed its design throughput. While this does not affect the plant's capacity to process solids, it impairs reliability and increases risk, as the system has less down-time for maintenance and repairs.
4. The influent pumps and plant design hydraulic limitations are expected to be exceeded a few years earlier (the late 2030s instead of the early 2040s), based on the updated flow projections.
5. Secondary process remains near capacity. The secondary process evaluation considered two factors:
   - **MLSS concentration in the oxidation ditch**: A common operating MLSS for oxidation ditches is 3,000 mg/L, and that is the maximum concentration currently being observed. With current flows and loads and an SRT of 8 to 10 days, the WWTP cannot operate at an MLSS concentration below 3,000 milligram per Liter (mg/L). Operating at a longer SRT, as is common practice with this type of ditch, would drive the MLSS concentration well above 3,000 mg/L and overload the secondary clarifiers.
   - **Secondary clarifier capacity**: At a 10-day SRT and the current SVI of 325 mL/g, which would be a recommended operating condition in the winter, capacity of the system is

approximately 3.2 mgd. The current maximum month flow is 3.3 mgd. By this measure, the plant is at capacity.

- The secondary process is also limited with respect to redundancy. The above analysis assumes both secondary clarifiers are in service. With one clarifier out of service, which could happen at any time for required repairs or maintenance, capacity would be cut in half, and the plant would be severely restricted. Based on Oregon State guidelines, the clarifiers should have capacity to treat the maximum day with flow both units in service, and the maximum month dry weather flow with one unit out of service. The winter maximum day requirement is typically more limiting.

Figure 4-3 compares the capacity findings to current and future flows in terms of equivalent residential units (ERUs). The capacities of each unit process and future projected flows were converted to ERUs as discussed in Section 2.4. Various operating conditions for each process are presented to demonstrate how the WWTP operations staff can consider capital improvements or operational approaches to maintain or improve capacity. Where the capacity columns in the chart fall below the ERUs line, that indicates a condition in which that process would be over capacity. For example, the current secondary clarifier total capacity (with SVIs at 325 mL/g, not 250 mL/g), is approximately 4,500 ERUs; since the wastewater system currently has 4,625 ERUs, the clarifiers are over capacity.

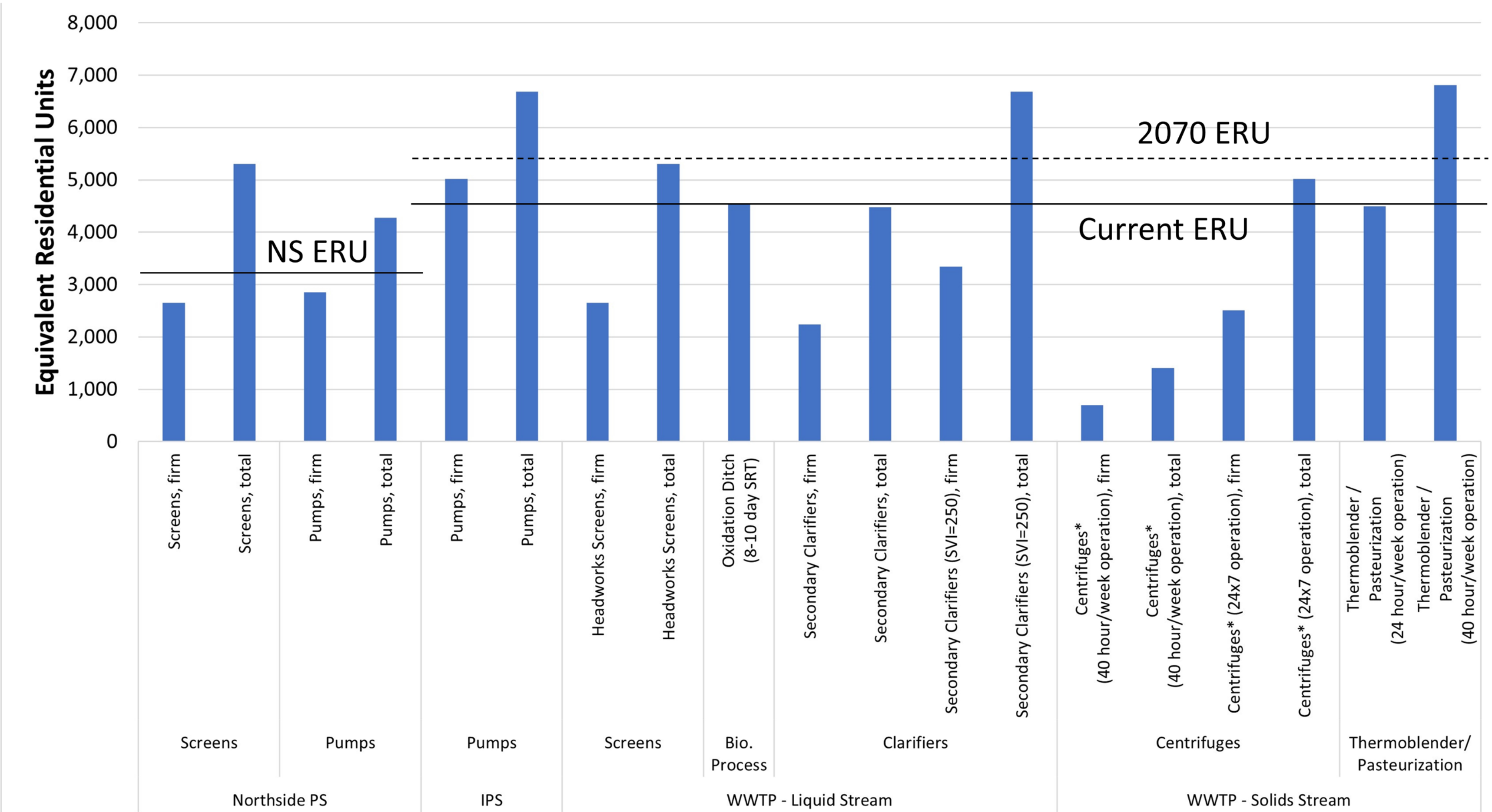

Figure 4-3. Capacity summary

NOTE: Capacity columns falling below the ERUs line indicates a condition in which that process would have insufficient capacity.

4.4 Capacity Implications

Most of the capacity limitations can be addressed by replacing equipment with larger units or adding infrastructure. The alternatives assessment evaluates upsizing or adding units specific for screens, dewatering, and biosolids management, and such alternatives are presented in Sections 5, 6, and 7.

Secondary process capacity limitations are somewhat more complicated. The plant was designed with a single Orbal ditch and two secondary clarifiers. Design criteria reflected an extremely aggressive approach to operation, with a 5.5-day SRT in the ditch, and no redundancy in either the ditch or the clarifiers. Site layouts included plans for a second oxidation ditch and two more secondary clarifiers. Options for expanding capacity of the secondary process include the following:

1. **Reduce loadings from Rogue.** This option has already been implemented by imposing pretreatment regulations on Rogue. The implementation of pretreatment regulations has resulted in greater than 50 percent reduction in Rogue loadings. While this has certainly reduced capacity risk, it has not eliminated capacity limitations.
2. **Reduce loadings by applying pretreatment at the plant.** The most common form of pretreatment is primary clarifiers, which could reduce solids loading by 60 to 70 percent and reduce BOD loadings by 25 to 40 percent. Additional primary clarifiers would extend capacity of the secondary process for all projected flows and loads. However, additional primary sludge would impact biosolids decisions. The best way to stabilize a combined sludge from primary and secondary treatment (i.e., WAS) would be to implement a form of solids digestion at the plant.
3. **Expand capacity by building a second oxidation ditch and more secondary clarifiers.** The recommendation to address capacity limitations at the WWTP would be to build the second ditch plus one additional secondary clarifier, which would resolve both capacity and redundancy limitations. A second ditch would provide capacity not only for projected loadings, but could also accommodate brewery or other industrial expansion, if desired.

Option 3 will be discussed in more detail in Section 6 of this plan.

Section 5

Headworks Alternatives Development

The status of the existing headworks building and associated equipment was discussed in Section 3.2 and 4.3. This section presents improvement alternatives and recommendations.

5.1 Alternative Descriptions and Evaluation

Two alternatives were developed for the existing headworks building as follows.

- **Alternative 1: Minimum Investment**–Replace equipment and proceed with improvements that have been identified as critical.
- **Alternative 2: Minimum Investments + Upgraded Functionality**–Proceed with critical improvements and additional improvements to decrease labor requirements and add operational flexibility.

5.1.1 Alternative 1 - Minimum Investments

Minimum improvements were identified based on critical needs per the updated capacity assessment and 2021 condition assessment discussed previously. Most notably, the existing rotary screens are due for replacement. Recommended screen replacements are discussed in Section 5.1.3. Additional minimum improvements recommended to combat odor issues, mitigate the impacts of corrosion, and improve personnel safety include the following:

- The existing screening channels should be enclosed and connected to an odor control unit to treat odorous air within the channels.
- The upper level should be enclosed to provide separation from the outside marine air, which in the past has contributed to corrosion issues throughout building.
- Access equipment that is currently corroded should be replaced, such as the roof access ladder and discharge channel maintenance hole covers.
- Fall protection measures are needed at the existing screening chute.
- Electrical work is required to repair inoperable lighting and switches.
- Roof replacement or rehabilitation is recommended due to significant rust on the interior face.

5.1.2 Alternative 2–Minimum Investments plus Upgraded Functionality

Additional improvements included as part of Alternative 2 could increase the functionality of existing headworks operations. Mainly, screening capacity and flexibility can be significantly increased with the addition of a third screen (see Section 5.1.3 for screen equipment options) in one of the two available screening channels north and south of the channels that are currently occupied. The south channel is highly preferred due to the proximity of the north channel to the building wall and associated space restrictions. The additional redundancy would be helpful in facilitating screen maintenance and repairs, when required. To facilitate third screen operation, slide gates would be required upstream and downstream of the screen location, similar to the existing screen channels.

The City has also noted a preference to minimize labor requirements and add automation to the existing process. Electric actuators could be added to the existing gates and new gates to increase the ease with which flows are directed between the three channels. The actuator controls could be connected to the existing supervisory control and data acquisition (SCADA) system to streamline operations with the rest of the plant.

5.1.3 Screen Replacement Options

Associated with Alternatives 1 and 2, the existing rotary screens are recommended to be replaced with multi-rake bar screens or flexible multi-rake bar screens. These two screen types were recommended for several reasons:

1. No flushing water is required for cleaning
2. Use of multiple rakes allows for higher loading rates
3. Relatively low headloss
4. Simple design requires relatively little maintenance
5. Reasonable cost
6. Steep installation angle reduces lay length within existing screening channels
7. City preference against screens with rotating augers due to consistent ragging issues

The recommended screen types are commonly used in the industry and BC has specified them in the past. Note that for the basis of this evaluation, the Huber RakeMax and Duperon FlexRake were considered, but other alternatives are available from competing manufacturers. The two screens are similar, but have a few notable differences:

- The flexible multi-rake bar screen is designed to stay in operation when larger debris causes an obstruction of the cleaning rakes. The lack of a bottom chain connection allows the rakes to move freely away from the screen when debris are obstructing the screen's face at the bottom of the channel. This arrangement is possible due to the chain used in the screen's design and eliminates the need to enter the channel to maintain connection points (although that is uncommon for screens with sprockets).
- The lack of a bottom connection point can also allow large debris to remain in the channel and obstruct the flow pathway without detection from operations personnel. There have also been reports of the rakes getting misaligned on flexible multi-rake screens, causing the rake teeth to not engage between the screen bars and properly clean the screen.
- Large debris are not commonly observed at the WWTP Headworks due to pre-screening at the upstream NSPS. However, having the ability to handle unscreened waste at the WWTP could add process flexibility if upstream screening is unavailable. Additionally, a smaller drive motor is included with flexible multi-rake screens, which is possible because the rakes are spaced closer together with more overall rakes.
- Key benefits of a conventional bar screen include technology maturity, simplicity, size, and cost. The Huber RakeMax, specifically, has been installed at several WWTPs in Oregon and is a much more proven technology when compared to flexible multi-rake screens, of which there are fewer installations in the immediate area. The relatively fewer rakes on the conventional bar screens mean that periodic maintenance is simpler. Also, the drive chains can be re-tensioned in place and remain in alignment due to the bottom connection point in the channel. Finally, conventional screens are slightly shorter and less expensive than the catenary type-screens, though the existing hatch opening and bridge crane in the headworks building can facilitate the installation of either screen.

5.2 Recommended Layout

Alternative 2 includes the installation of a third screen that would be placed in the unused south channel. The south channel is recommended to facilitate access around the screen; access around a screen at the north channel would be impeded by the building wall on the north side.

The proposed arrangement is shown on Figure 5-1. Note the additional screen is recommended to be staggered upstream of the two replaced screens in the center channels to create space for discharge piping to a new discharge chute. If preferred, the arrangement could be flipped so that the screens in the center channels are installed upstream of the screen in the outside channel.

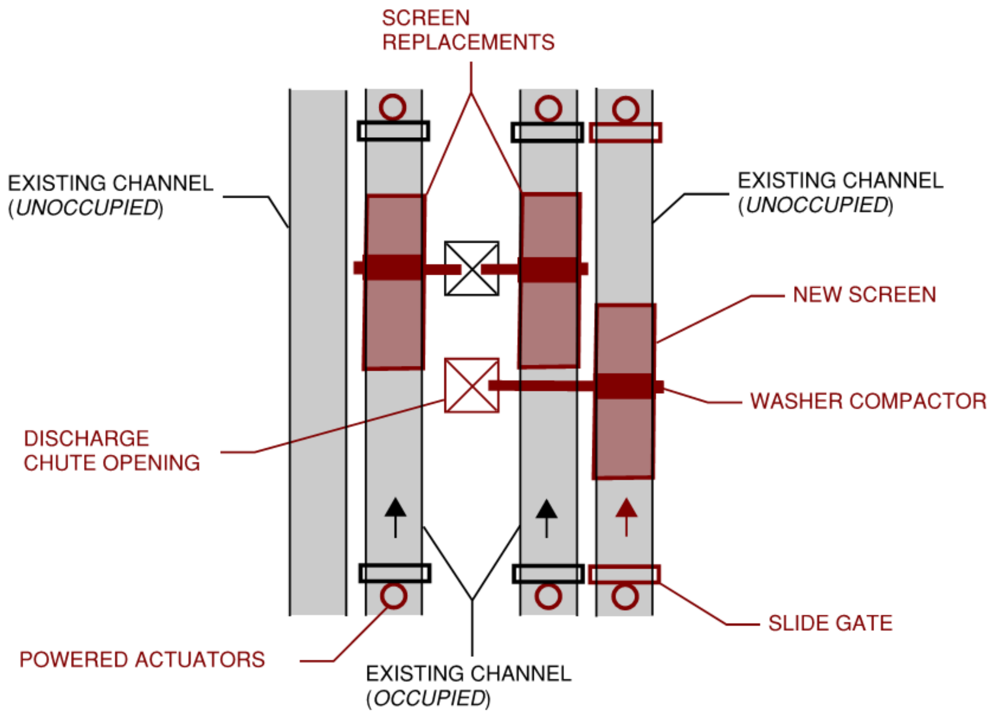

Figure 5-1. Headworks screening proposed plan

This staggered arrangement is possible because the proposed screens will be installed at a steeper installation angle than the existing rotary screens. The steeper angle decreases the lay length in the existing screening channels; however, note additional length upstream and downstream of the screens should be provided per manufacturer recommendations.

As shown on Figure 5-2, screened solids will be deposited into associated washer compactors and directed to the screening discharge chutes. To accommodate dual chute openings, a modification of the existing chute will be required, with one potential option shown on the figure. Separated discharge chutes may be desired to accommodate the additional screenings and facilitate distribution to the dumpster on the lower level.

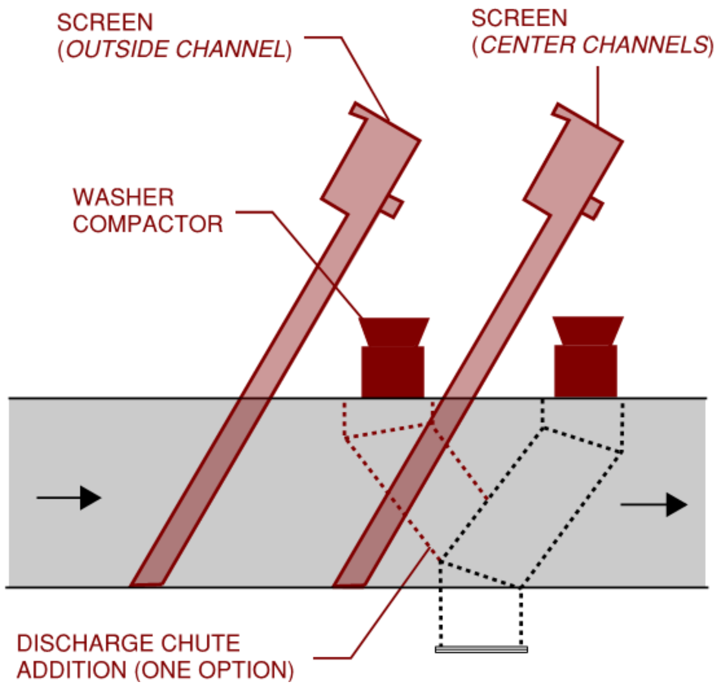

Figure 5-2. Headworks screening proposed profile

5.3 Costs

A construction cost summary for each alternative is listed in Table 5-1. Note that these costs are "construction only" and do not include additional fees necessary for engineering and administration. Duperon FlexRake screens were assumed for both Alternative 1 and Alternative 2 in Table 5-1. The costs in Table 5-1 have been adjusted to reflect 2025 costs using an average 5.0 percent cost increase. More detailed cost estimates are included in Appendix B and reflect the costs in 2023.

As shown, the expected cost increase to incorporate the non-critical upgrades is approximately $900K. These upgrades could be postponed to a time when additional funding is available; however, activities such as re-mobilization and additional planning would likely increase the total cost of the improvements listed for Alternative 2.

Table 5-1. Headworks Construction Costs

Project Element	Alternative 1–Minimum Investments	Alternative 2–Minimum Investments plus Upgraded Functionality
Replace Screens	$1,370,000	$1,370,000
Add Odor Control	$660,000	$660,000
Enclose Upper Level	$40,000	$40,000
Replace Corroded Elements	$50,000	$50,000
Electrical Allowance	$350,000	$530,000
Add New Screen	–	$670,000
Add Gates and Automation	–	$50,000
Total	$2,470,000	$3,370,000

Summarized life-cycle costs are presented in Table 5-2. Note that while an additional screen is proposed for Alternative 2, yearly labor costs will be similar between Alternative 1 and Alternative 2 since flow through each screen under Alternative 2 will be lower.

Table 5-2. Headworks Life-cycle Costs

Life Cycle Cost	Alternative 1	Alternative 2
Labor	$45,000	$45,000
Electricity	$3,439	$4,203
Yearly Totals:	**$48,439**	**$49,203**

a. Life-cycle cost analysis base assumptions:

- Electrical costs: $0.0464 per kWH (September-March), $0.0413 per kWH (April-August), $10.38 per KW peak demand,

- Labor costs: $45,000 per FTE; 0.05 FTE for maintenance, 0.25 FTE for operation of Headworks Facility

- Life-cycle costs cover a 20-year period with an escalation rate of 3.55% and a discount rate of 2.50%. Analysis was performed in 2023.

b. Conventional multi-rake bar screens were assumed for life-cycle analysis. Flexible multi-rake bar screens are expected to reduce yearly electrical costs by approximately $200 per year per screen.

c. Life-cycle cost comparisons were performed in 2023 and have not been updated to 2025 pricing.

5.4 Recommendations

Alternative 2 is recommended. The addition of a third screen increases process flexibility, redundancy, and capacity. Automated channel gates are recommended to decrease labor requirements and streamline operations moving forward. Combining these non-critical upgrades with the critical upgrades in Alternative 1 during construction is also recommended to reduce total project costs compared to implementing separately.

Further analysis is required to determine the ideal screen replacement type. A hydraulic evaluation is recommended to determine the anticipated water levels upstream and downstream of the proposed screens and rule out the need for any channel modifications. Comparative visits to nearby installations and discussions with manufacturers would also help inform key benefits and drawbacks of each type. As an additional option and if no strong preference is developed during design, these two screens have historically been bid head-to-head, with contract documents allowing both options for the contractor’s consideration.

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Section 6

Liquids Stream Alternatives Evaluation

Guided by findings from capacity and condition assessments as well as discussions with WWTP staff, recommended improvements to the existing liquid stream processes are described and evaluated in this section.

6.1 Alternative Descriptions and Evaluation

While the existing secondary treatment process was not deemed to be in critical condition, limitations to capacity and redundancy are anticipated to compound with population growth, as described in Section 4.3. Two alternatives are presented in this section for consideration, and both include a third secondary clarifier to address the current capacity limitation.

6.1.1 Primary Clarification + Third Secondary Clarifier

One alternative to reduce the biological oxygen demand (BOD) load to secondary treatment would be to add primary clarification upstream of the existing oxidation ditch. While clarifiers implement a different treatment mechanism than activated sludge treatment, they are sometimes capable of removing a similar percentage of BOD from the waste stream as biological treatment–reducing the capacity requirements for the downstream process. When compared to biological treatment, additional benefits include increased solids removal, lower energy costs, and smaller footprint within the site. The City also suggested primary clarifiers could act as a stabilization tank upstream of the existing oxidation ditch, helping to resolve issues with variable BOD loading described in Section 2.3.

The main drawback with incorporating primary clarifiers is that they limit the space on site for a future biological process expansion for secondary treatment redundancy. The existing oxidation ditch is currently limited in terms of capacity and has been in service for over 20 years. Also, as the equipment associated with the primary clarification ages, increasing amounts of maintenance will be required. Finally, tank covers and a dedicated odor control system may also be needed for the primary clarifiers.

6.1.2 Additional Oxidation Ditch + Third Secondary Clarifier

Biological treatment redundancy is recommended for all publicly owned wastewater treatment facilities, to allow for a tank to be taken out of service if maintenance is needed. Currently, with only one oxidation ditch, the City has no ability to empty the tank for maintenance or even inspection of the structure. If there were a catastrophic failure of the tank structure or any other major component of the oxidation ditch treatment system, the City would be in violation of their NPDES permit until the situation is remedied.

To provide this system redundancy, the other alternative is the installation of a second oxidation ditch. Drawbacks of this approach are that it would take more energy than primary clarification, and it has a larger site footprint than two primary clarifiers, resulting in higher life-cycle costs. In addition, there would be times when the influent loading to the WWTP would be more than one tank could handle but lower than two tanks might need for stable operation. To mitigate these potential issues with variable loading, the City could consider incorporating other equalization measures, such as a contact stabilization operating strategy, or selector zones upstream. Expanded oxidation would also produce less odors than primary clarification.

6.1.3 Downstream Impacts

Digestion will be incorporated downstream of the secondary process and is discussed in Section 7. While this process is separate from primary and secondary treatment, it is impacted by the type of technology incorporated upstream. Primary clarification would produce primary sludge, which is beneficial for anaerobic digestion and production of biogas. Conversely, WAS from secondary treatment has minimal biogas production potential in anaerobic digestion. If there are no primary clarifiers, anaerobic digestion is typically nonviable. Accordingly, the additional oxidation ditch alternative is associated with aerobic digestion rather than anaerobic digestion.

6.2 Site Planning

Preliminary locations for equipment and associated piping associated with the two alternatives are shown in Appendix F for consideration. The additional facilities associated with Alternative 1 and Alternative 2 could be installed north of the existing facilities within a defined setback area from the property line. The area to the east of the existing ditch was also explored for expansion potential, however the steep slopes present in this direction would require significant earthwork to accommodate the required elevations for the proposed equipment.

For costing and consideration of the Primary Clarification + Third Secondary Clarifier alternative, two rectangular clarifiers would be located east of the headworks building and north of the existing oxidation ditch–each tank 16 feet wide by 80 feet long. The primary clarifier footprint would be significantly less than a second oxidation ditch. For the Additional Oxidation Ditch + Third Secondary Clarifier alternative, the additional oxidation ditch was assumed to be located in the same location as the primary clarifiers and the same size as the existing oxidation ditch.

The third secondary clarifier is proposed to be located directly south of the two existing clarifiers–south of the fence line–to minimize lengths of site piping and streamline pumping between the existing and future clarifiers.

Figure 6-1 shows the Additional Oxidation Ditch plus Third Secondary Clarifier alternative for reference.

Figure 6-1. Updated proposed oxidation ditch and clarifier locations

6.3 Costs

The anticipated construction costs for liquid stream alternatives are included in Appendix C and summarized in Table 6-1.

Table 6-1. Liquids Alternatives Construction Costs		
Project Element	**Alternative 1: Primary Clarifiers + Third Secondary Clarifier**	**Alternative 2: Second Oxidation Ditch + Third Secondary Clarifier**
Primary Clarifiers/Oxidation Ditch	$8,100,000	$9,100,000
Secondary Clarifier	$6,300,000	$6,300,000
PS or RAS/WAS Pumping Station	$1,200,000	$1,200,000
PE Distribution Box or RAS Mixing Box	$200,000	$200,000
ML Splitter Box	$400,000	$400,000
Site Upgrades	$800,000	$800,000
Site Piping	$3,400,000	$3,700,000
Electrical	$5,300,000	$5,500,000
Total	$25,600,000	$ 27,200,000

Summarized life-cycle costs are presented in Table 6-2.

Table 6-2. Liquids Process Life-cycle Costs		
Life-cycle Cost	**Alternative 1: Primary Clarifiers + Third Secondary Clarifier**	**Alternative 2: Second Oxidation Ditch + Third Secondary Clarifier**
Labor	$1,080,000	$1,200,000
Electricity	$650,000	$2,300,000
Yearly Totals:	**$1,730,000**	**$3,500,000**

a. Life-cycle cost analysis base assumptions:

- Electrical costs: $0.0464 per kWH (September-March), $0.0413 per kWH (April-August), $10.38 per KW peak demand.

- Labor costs: $45,000 per FTE.

- Life-cycle costs cover a 20-year period with an escalation rate of 3.55% and a discount rate of 2.50%. Analysis was performed in 2023.

b. Life-cycle cost comparisons were performed in 2023 and have not been updated to 2025 pricing.

6.4 Recommended Improvements

The alternatives evaluations for the liquids process and solids process were considered together and included non-cost criteria due to their complexity and connectivity to each other. For additional details on this evaluation, see Section 9.2.

Alternative 2, reflecting expansion of biological treatment by incorporating a second oxidation ditch and the addition of a third secondary clarifier is recommended for implementation due to recommended reliability and redundancy guidelines for secondary treatment. Despite the higher cost, this alternative will provide improved operational flexibility and industry standard reliability.

Capacity analyses suggest one additional oxidation ditch and one additional secondary clarifier will be sufficient to serve projected increased flows. These expansions will require additional RAS/WAS pumping and site piping to facilitate process flows between the additional equipment. An expanded process flow diagram is shown on Figure 6-2; red linework shows proposed additions to the existing network shown in black.

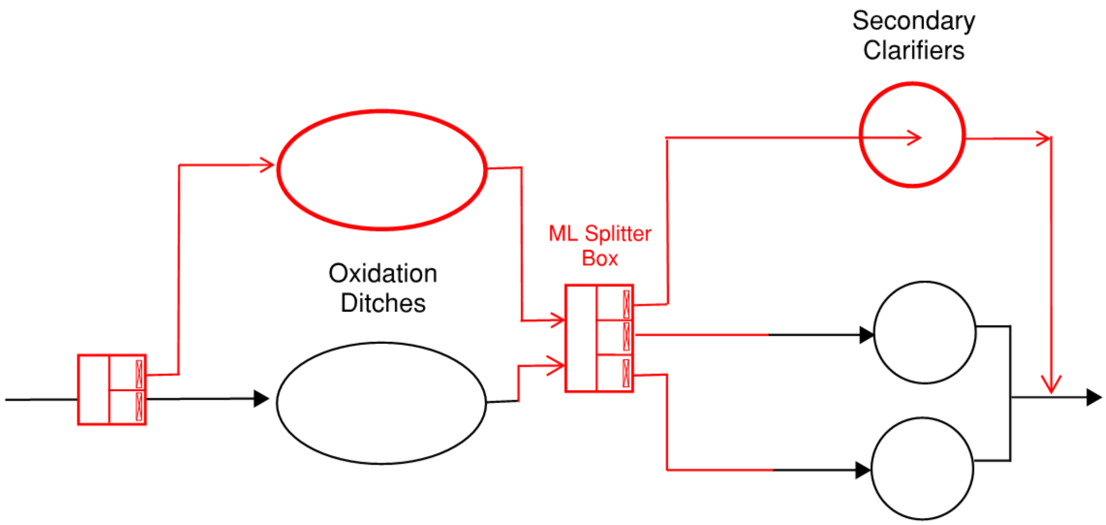

Figure 6-2. Proposed secondary treatment process flow diagram

Flows would be distributed between the two oxidation ditches and three clarifiers using a mixed liquor splitter box. For the purposes of this analysis, the existing mixed liquor splitter box was assumed to be abandoned or demolished after construction of an entirely new splitter box. While process capacity is expanded overall, the ability to distribute flows also provides additional redundancy in case process equipment is taken out of service for maintenance or other unexpected shutdowns. Downstream of the clarifiers, a RAS flow mixing box (not shown) is also recommended to distribute RAS back to the oxidation ditches and WAS to the downstream solids process.

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Section 7

Solids Stream Alternatives Evaluation

This section presents key alternatives for solids facility improvements and recommends additional processes to be incorporated into the Vance Avery wastewater treatment plant (WWTP).

7.1 Biosolids Regulations

Biosolids are the nutrient-rich organic material resulting from the treatment of sewage at domestic WWTPs. Through biosolids management, solid residue from the wastewater treatment process is treated to reduce or eliminate pathogens and minimize odors, forming a safe, beneficial product for land application or disposal.

Biosolids are regulated by both the U.S. Environmental Protection Agency (EPA) and Oregon Department of Environmental Quality (DEQ) to ensure quality standards are met. EPA's regulations can be found in 40 Code of Federal Regulations (CFR) Part 503 (Part 503) and DEQ's Chapter 340 Division 50 of the Oregon Administrative Rules (OARs) (Division 50). Regulations address pollutant concentrations, pathogen content, odor potential, and basic operational practices. Beneficial reuse of biosolids has long been preferred over historical disposal practices such as incineration or landfilling.

Land application practices and marketable biosolids products are encouraged, as an alternative to disposal, by state and federal regulatory authorities. Numerous publications from EPA and regional academic institutions such as Oregon State University, Washington State University, and University of Washington provide valuable information regarding biosolids management practices. DEQ's December 2005 biosolids guidance titled, "Implementing Oregon's Biosolids Program Internal Management Directive" (Biosolids IMD) provides very useful information for permit writers and the public regarding how Oregon administers state and federal biosolids regulations.

Currently, approximately 95 percent of biosolids in Oregon are beneficially used as Class B biosolids via agricultural land application or as Class A Exceptional Quality (EQ) biosolids as a marketable product (e.g., compost). Overall, there tends to be a slight reduction in biosolids beneficial use primarily because of the loss of farmland to development and decrease in public acceptance of Class B biosolids land application. There is an increasing trend, however, in the implementation of Class A EQ biosolids programs due to the decrease in available Class B biosolids land application sites. Overall, the regulatory outlook for biosolids management in Oregon remains supportive but there is a trend toward use of Class A EQ biosolids, and the additional flexibility presented to municipalities in markets for the end product.

7.1.1 Federal Regulations

Biosolids treatment for disposal and beneficial use is regulated at the federal level by the EPA to ensure quality standards are met. Promulgated in 1993, the Part 503 regulations set forth quality standards so that biosolids are protective of human health and the environment. Under these regulations, biosolids must meet risk-based pollutant limits and controls for pathogen reduction and vector attraction reduction (VAR). The rules also describe the requirements for land application, monitoring, testing, and reporting.

The federal regulations define two classes of biosolids based on pathogen reduction (i.e., Class B and Class A). Class B biosolids are treated but still contain detectable levels of pathogens. When utilizing Class B biosolids for land application, the site must be permitted. Agronomic application rates are specified and buffer requirements, public access restrictions, and crop harvesting restrictions must be met. This allows time for any pathogens that are present to be destroyed by environmental exposures to temperature changes, sunlight, drying, and competing soil microorganisms. Class A biosolids receive additional treatment and contain insignificant levels of pathogens. Class A biosolids that meet EQ standards have fewer restrictions on their use or sale to the public. Class A EQ biosolids meet the most stringent requirement for pathogens (Class A), vector control, pollutant concentrations, and are safe for unregulated use. In most cases, when a facility refers to producing a "Class A biosolids product" they meet the EQ designation as well. A review of Newport's biosolids quality testing data indicates the plant will likely meet the EQ standards in the future.

The following sections describe requirements for treating biosolids to reduce pathogens, VAR, pollutant concentrations (e.g., metals) as well as requirements for sampling and monitoring.

7.1.2 Class A Pathogen Reduction Requirements

Pathogen reduction can be achieved by treating solids prior to beneficial use or disposal and through environmental attenuation. Treatment processes are available that use a variety of approaches to reduce pathogens in solids making it a less effective medium for microbial growth (EPA, 2003). The 40 CFR Part 503 lists treatment technologies that are judged to produce biosolids with pathogens sufficiently reduced to protect public health and the environment. The regulation also allows the use of any other technologies that produce biosolids with adequately reduced pathogens as demonstrated through microbiological monitoring.

There are six alternative methods for demonstrating Class A pathogen reduction. The objective of these requirements is to reduce pathogen densities to below detectable limits. In addition to undergoing a treatment process, Class A biosolids must also be tested for bacteria. Class A biosolids must meet one of the following bacteria limits and one of the process treatment alternatives:

Biosolids must comply with one of the following bacteria limits:

- Fecal coliform is less than 1,000 Most Probable Number (MPN) per gram of total solids (dry weight).
- *Salmonella sp*. Bacteria density is less than 3 MPN per 4 grams total solids (dry weight).

Biosolids must meet one of the following treatment alternatives:

- Maintain the sludge at the time, temperature, and percent solids determined by using the formula in EPA Class A Alternative 1, per 503.32(a)(3).
- Maintain the temperature of the sludge above 52 degrees Celsius (ºC) (126 degrees Fahrenheit [ºF]) for 72 hours. The sludge must be above pH 12. Air dry the sludge to 50 percent solids or higher, EPA Class A Alternative 2, per 503.32(a)(4).
- Use a Process to Further Reduce Pathogens (PFRP) or equivalent treatment process approved by the permitting authority, EPA Class A Alternative 5 or 6, per 503.32(a)(7) and (8), and as listed in Table 7-1.

Table 7-1. Process to Further Reduce Pathogens	
Process	**Requirements**
Composting	Using either the within-vessel composting method or the static aerated pile composting method, the temperature of sewage sludge is maintained at 55 °C (131 °F) or higher for 3 consecutive days. Using the windrow composting method, the temperature of the sewage sludge is maintained at 55 °C (131 °F) or higher for 15 consecutive days or longer. During the period when the compost is maintained at 55 °C (131 °F) or higher, there shall be a minimum of five turnings of the windrow.
Heat Drying	Sewage sludge is dried by direct or indirect contact with hot gases to reduce the moisture content of the sewage sludge to 10 percent or lower. Either the temperature of the sewage sludge particles exceeds 80 °C (176 °F) or the wet bulb temperature of the gas in contact with the sewage sludge as the sewage sludge leaves the dryer exceeds 80 °C (176 °F).
Heat Treatment	Liquid sewage sludge is heated to a temperature of 180 °C (356 °F) or higher for 30 minutes.
Thermophilic Aerobic Digestion	Liquid sewage sludge is agitated with air or oxygen to maintain aerobic conditions and the mean cell residence time (MCRT) (i.e., the solids retention time) of the sewage sludge is 10 days at 55 °C (131 °F) to 60 °C (140 °F).
Beta Ray Irradiation	Sewage sludge is irradiated with beta rays from an electron accelerator at dosages of at least 1.0 megarad at room temperature (ca. 20 °C [68 °F]).
Gamma Ray Irradiation	Sewage sludge is irradiated with gamma rays from certain isotopes, such as Cobalt 60 and Cesium 137, at dosages of at least 1.0 megarad at room temperature (ca. 20 °C [68 °F]).
Pasteurization	The temperature of the sewage sludge is maintained at 70 °C (158 °F) or higher for 30 minutes or longer.

7.1.3 Class B Pathogen Reduction Requirements

The alternatives for Class B biosolids consist of either a treatment process, such as a Process to Significantly Reduce Pathogens (PSRP) or a fecal coliform bacteria limit. Biosolids must comply with the following bacteria limit:

- The geometric mean of the density of fecal coliform must be less than 2,000,000 MPN, per gram of total solids (dry weight).

Solids must undergo one of the PSRPs listed in Appendix B of 40 CFR Part 503 or an equivalent treatment method approved by the permitting authority (Table 7-2).

Table 7-2. Process to Significantly Reduce Pathogens	
Process	**Requirements**
Aerobic Digestion[a]	Sewage sludge is agitated with air or oxygen to maintain aerobic conditions for a specific MCRT (i.e., solids retention time) at a specific temperature. Values for the MCRT and temperature shall be between 40 days at 20 °C (68 °F) and 60 days at 15 °C (59 °F).
Air Drying	Sewage sludge is dried on sand beds or on paved or unpaved basins. The sewage sludge dries for a minimum of three months. During two of the three months, the ambient average daily temperature is above 0 °C (23 °F).
Anaerobic Digestion	Sewage sludge is treated in the absence of air for a specific MCRT (i.e., solids retention time) at a specific temperature. Values for the MCRT and temperature shall be between 15 days at 35 °C to 55 °C (131 °F) and 60 days at 20 °C (68 °F).
Composting	Using either the within-vessel, static aerated pile, or windrow composting methods, the temperature of the sewage sludge is raised to 40 °C (104 °F) or higher and remains at 40 °C (104 °F) or higher for 5 days. For 4 hours during the 5-day period, the temperature in the compost pile exceeds 55 °C (131 °F).
Lime Stabilization	Sufficient lime is added to the sewage sludge to raise the pH of the sewage sludge to 12 for ≥2 hours of contact.

a. The recommended aerobic digester will be sized for a MCRT of 25 days at a minimum operating temperature of 20 °C at design year conditions. This does not meet the requirements for a PSRP to achieve Class B biosolids but does provide some stabilization ahead of the Class A systems discussed in this section while maintaining good dewatering characteristics.

7.1.4 Vector Attraction Reduction Requirements

The pathogens in biosolids may pose a disease risk only if there are routes by which the pathogens are brought into contact with humans or animals (EPA, 2003). A primary route for transport of pathogens is vector transmission. Vectors are any living organism capable of transmitting a pathogen from one organism to another either mechanically or biologically by playing a specific role in the life cycle of the pathogen. Vectors for pathogens would most likely include insects, rodents, and birds. The VAR is accomplished by implementing one of the following:

- Biological processes which breakdown volatile solids, reducing the available nutrients for microbial activities and odor producing potential.
- Chemical or physical conditions which stop microbial activity.
- Physical barriers between vectors and volatile solids in the solids.

The term "stability" is often used to describe sewage sludge or biosolids. Although it is associated with VAR, stability is not regulated by 40 CFR Part 503. Stability is generally defined as the point at which food for microbial activity is no longer available (EPA, 2003). Solids which are stable will generally meet VAR but there are exceptions. Because stability is also related to odor generation and the continued degradation of solids, it is often considered an important parameter when producing Class A EQ biosolids for sale or distribution. Solids must undergo one of the VAR options set forth in 40 CFR Part 503, listed in Table 7-3.

Table 7-3. Vector Attraction Reduction Options

VAR Option	Requirements	Most Appropriate for the Following
#1-503.33(b)(1)	At least 38% reduction in volatile solids during sewage sludge treatment.	Sewage sludge processed by anaerobic or aerobic biological treatment.
#2-503.33(b)(2)	Less than 17% additional volatile solids loss during bench-scale anaerobic batch digestion of the sewage sludge for 40 additional days at 30 °C to 37 °C (86 °F to 99 °F).	Only for anaerobically digested sewage sludge that cannot meet the requirements of Option 1.
#3-503.33(b)(3)	Less than 15% additional volatile solids reduction during bench-scale aerobic batch digestion for 30 additional days at 20 °C (68 °F).	Only for aerobically digested liquid sewage sludge with 2% or less solids that cannot meet the requirements of Option 1 (e.g., sewage sludges treated in extended aeration plants). Sludges with 2% or greater solids must be diluted.
#4-503.33(b)(4)	Specific oxygen uptake rate (SOUR) at 20 °C (68 °F) is ≤ 1.5 mg oxygen/hr/g total sewage sludge solids.	Liquid sewage sludges (2% or less solids) from aerobic processes run at temperatures between 10 to 30 °C (50 to 86 °F) (should not be used for composted sewage sludges).
#5-503.33(b)(5)	Aerobic treatment of the sewage sludge for at least 14 days at over 40 °C (104 °F) with an average temperature of over 45 °C (113 °F).	Composted sewage sludge (For sewage sludges from other aerobic processes, it will likely be easier to meet Option 3 or 4.)
#6-503.33(b)(6)	Addition of sufficient alkali to raise the pH to at least 12 at 25 °C (77 °F) and maintain a pH ≥ 12 for 2 hours and a pH ≥ 11.5 for 22 more hours.	Alkali-treated sewage sludge (alkaline materials include lime, fly ash, kiln dust, and wood ash).
#7-503.33(b)(7)	% solids ≥ 75% prior to mixing with other materials.	Sewage sludges treated by an aerobic or anaerobic process (i.e., sewage sludges that do not contain unstabilized solids generated in primary wastewater treatment).
#8-503.33(b)(8)	% solids ≥ 90% prior to mixing with other materials.	Sewage sludges that contain unstabilized solids generated in primary wastewater treatment (e.g., heat-dried sewage sludges).

Table 7-3. Vector Attraction Reduction Options		
VAR Option	Requirements	Most Appropriate for the Following
#9-503.33(b)(9)	Sewage sludge is injected into soil so that no significant amount of sewage sludge is present on the land surface 1 hour after injection, except Class A biosolids which must be injected within 8 hours after the pathogen reduction process.	Sewage sludge applied to the land or placed on a surface disposal site. Domestic septage applied to agricultural land, a forest, or a reclamation site, or placed on a surface disposal site.
#10-503.33(b)(10)	Sewage sludge is incorporated into the soil within 6 hours after application to land or placement on a surface disposal site, except Class A biosolids which must be applied to or placed on the land surface within 8 hours after the pathogen reduction process.	Sewage sludge applied to the land or placed on a surface disposal site. Domestic septage applied to agricultural land, forest, or a reclamation site, or placed on a surface disposal site.

7.1.5 Pollutant Concentration Requirements

Biosolids for beneficial use must meet risk-based pollutant limits to protect public health and the environment. The 40 CFR Part 503 rules (Section 503.13) set regulatory limits for certain pollutants (metals) and requires biosolids be used in accordance with approved management practices including operational standards, monitoring, recordkeeping, and reporting.

The nine pollutants regulated are arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), and zinc (Zn). These limits determine how Oregon regulates land application under a permit. The regulatory limits are included in the sections to follow.

7.1.5.1 Ceiling Concentration Limits

This is the maximum concentration of each pollutant allowed in biosolids for beneficial use. According to 40 CFR Part 503, biosolids containing any pollutant that exceeds the Ceiling Concentration Limits (CCLs) cannot be beneficially used. This is also known as EPA Table 1, which is shown in the second column of Table 7-4 below.

7.1.5.2 Cumulative Pollutant Loading Rate

The Cumulative Pollutant Loading Rate (CPLR) is the maximum amount of a pollutant that can be applied to a site over its lifetime by all biosolids applications meeting ceiling concentration limits. Biosolids applications must be discontinued when any one of the pollutants reaches its maximum CPLR. This is also known as EPA Table 2, which is shown in the third column of Table 7-4 below.

7.1.5.3 Pollutant Concentration Limits

The Pollutant Concentration Limits (PCLs) are used along with the pathogen reduction and VAR requirements as quality standards for EQ biosolids. Biosolids with pollutant concentrations below the PCLs can be sold or given away without a permit from EPA or DEQ. However, these Class A EQ biosolids must still be land-applied at agronomic rates. Biosolids with pollutant concentrations above the PCL require a permit, applied at an agronomic rate, and the cumulative amounts of pollutants must be tracked. This is also known as EPA Table 3, which is shown in the fourth column of Table 7-4 below.

7.1.5.4 Annual Pollutant Loading Rate

The Annual Pollutant Loading Rate (APLR) sets the maximum amount of a pollutant that can be applied during a 365-day period. These rates apply to non-EQ biosolids. This is also known as EPA Table 4, which is shown in the fifth column Table 7-4 below.

Table 7-4. Pollutant Limits and Loading rates for Biosolids				
Pollutant[a]	Ceiling Concentration Limits, EPA Table 1 (mg/kg)[b]	Cumulative Pollutant Loading Rate Limits, EPA Table 2 (mg/kg)[b]	Pollutant Concentration Limits, EPA Table 3 (mg/kg)[b]	Annual Pollutant Loading Rate Limits, EPA Table 4 (mg/kg/365-d-period)[b]
Arsenic	75	41	41	2.0
Cadmium	85	39	39	1.9
Copper	4,300	1,500	1,500	75
Lead	840	300	300	15
Mercury	57	17	17	0.85
Molybdenum	75	—[c]	—[c]	—[c]
Nickel	420	420	420	21
Selenium	100	100	100	5.0
Zinc	7,500	2,800	2,800	140

a. Source: EPA 40 CFR Part 503; University of Georgia Extension (March 2017).

b. Dry-weight basis: mg/kg (milligrams per kilogram); kg/ha (kilograms per hectare).

c. February 25, 1994, 40 CFR Part 503 Rule Amendment deleted the molybdenum limits but retained the molybdenum CCL.

7.1.6 Oregon State Regulations

In addition to federal requirements, DEQ also implements regulations overseeing biosolids management in Oregon. OAR 340-050 incorporates all the legal requirements in 40 CFR Part 503 but goes further to require specific plans for land application, best management practices (e.g., setbacks), and additional public notice requirements.

In Oregon, biosolids are regulated under DEQ's water quality program through a water quality permit (NPDES or Water Pollution Control Facility permit), a biosolids management plan, and land application site authorization letters. The permit, management plan, and site authorization letters are specific to a facility and include conditions relevant to both state and federal regulations. The conditions in the management plan and site authorization letters are considered an integral part of the permit and thus are enforceable. Oregon's biosolids regulations are more restrictive than federal regulations.

Each permit is open for public comment when the facility's permit is renewed. The facility's biosolids management plan is also open for public comment when the facility's permit is renewed and anytime there are significant changes to the management plan. The public comment period is at least 30 or 35 days depending on the type of permit.

7.1.7 Future Biosolids Regulations

As part of this project, Kennedy Jenks (KJ) contacted DEQ's biosolids program staff to discuss their opinion regarding current and future trends in biosolids management. The staff at DEQ mentioned there is a general trend of moving from Class B to Class A EQ programs in Oregon. The trend allows more flexibility in biosolids product use, protects against any unforeseen regulatory changes, and addresses common public perception issues encountered with Class B land application. Also, there is continued public perception challenges on the Oregon Coast. Concerns are focused on odor, emerging contaminants, and lack of regulatory oversight.

When discussing potential future regulatory requirements, DEQ staff stated they did not foresee any immediate changes to OAR 340-050. However, they are intending on issuing a general permit for biosolids land application to allow facilities an additional option for permitting beneficial use.

The DEQ believes that much of the challenge associated with managing biosolids is the result of increased growth in rural areas. The urbanization of the Willamette Valley will continue to result in less local Class B land application sites and thus, more reliance on distant land application or Class A options for municipalities. On a federal level, new requirements will be implemented requiring utilities to test for per- and polyfluoroalkyl substances (PFAS).

The DEQ has designated PFAS as one of 60 priority chemicals or chemical classes for its Toxics Reduction Strategy. In addition, DEQ is working with the Oregon Health Authority (OHA) and other federal, state, and local agencies to address growing public health and environmental concerns. DEQ and OHA are evaluating appropriate policy responses to protect public health and the environment from PFAS contamination.

DEQ air, land, and water programs are taking the following steps to address PFAS:

- Identifying sites that may use PFAS in their operations.
- Overseeing site testing and assessment of impacts. This may include biosolids land application sites.
- Using newly developed analytical methods for testing for PFAS in water and working with the EPA and other agencies to develop testing methods for soil and biosolids.
- Using Cleaner Air Oregon's data on requested toxic pollutant emissions reports from industries that included PFAS.

7.2 Solids Alternative Descriptions

This section presents process descriptions for Hauled Waste Receiving, Thickening, Stabilization, Dewatering, and Class A Biosolids Treatment. Sizing and design criteria for the solids processes described this this section are included in the August 2022 Solids Stream Basis of Design and September 2022 Centrifuge Replacement Evaluation TMs prepared by KJ, included as Appendix J and Appendix E, respectively.

7.2.1 Hauled Waste

A new, packaged hauled waste system to receive septage trucked to the WWTP is included with each solids stream alternative evaluated in this report. The packaged system includes a truck unloading station, with an optional ticketing system for tracking loads. The proposed system is based on a Huber RoFas packaged receiving system which includes a 10-millimeter (mm) rotary drum screen, washer compactor, and grit and grease removal equipment. An optional rock trap can also be provided. An example installation of the Huber RoFas system is shown on Figure 7-1.

Figure 7-1. Huber RoFas packaged hauled waste system

(Source: Huber)

7.2.2 Stabilization

As discussed in Section 3.6, the current RDP Lime Stabilization system is reaching the end of its useful life, parts and support are increasingly difficult to obtain, and the system is not adequately sized for future biosolids production rates. The solids master planning effort has evaluated the following alternatives regarding stabilization:

1. **Lime Stabilization (base case scenario)**–Dewatered WAS would continue to be lime stabilized.
2. **No Stabilization**–Dewatered WAS would be discharged to an alternate Class A biosolids process, such as composting or indirect, belt dryer.
3. **Aerobic Digestion**–Thickened WAS would be discharged to an aerobic digester, capable of producing either Class A or B biosolids. The evaluation is based on conventional aerobic digestion. Alternatives such as Autothermal Thermophilic Aerobic Digestion are not evaluated due to high energy demands and odor potential associated with these processes.
4. **Anaerobic Digestion**–Thickened WAS would be discharged to an anerobic, mesophilic digester capable of producing Class A or B biosolids. Alternatives such as Thermophilic digestion and Thermal Hydrolysis pre-treatment were not evaluated.

Due to the issues with the existing RDP system discussed in Section 3.6, continued lime stabilization was eliminated from further consideration as its continued use is not feasible in the long term due to poor biosolids quality and difficulty obtaining support to maintain the equipment.

The production of Class A biosolids can be achieved without stabilization by either sufficiently drying the dewatered WAS or achieving volatile solids reduction through amending with a substrate and aerating. Belt dryers that heat solids indirectly and composting are evaluated in this report as Class A treatment alternatives. The lack of a stabilization step does not negatively impact the quality of the finished compost product; however, dried solids that have not been stabilized can be odiferous when re-wetted. The lack of a stabilization step also results in more solids that needs to be handled. For these reasons, solids alternatives that do not include stabilization were eliminated from further consideration.

7.2.2.1 Aerobic Digestion

In addition to improving odor characteristics and reducing the volume of handled materials, digestion provides additional treatment which improves the consistency of the finished product as well as the performance of downstream processes, such as dewatering and Class A drying.

Aerobic digestion is defined as the biological conversion of organic matter in the presence of air or oxygen. During aerobic digestion, bacteria convert organic matter to carbon dioxide, water, ammonia, new cellular biomass, and energy through oxidation. In the presence of adequate oxygen and declining food supply, the microorganisms convert their own protoplasm to energy that is used for cell maintenance purposes also known as endogenous metabolism. It is typically used at plants that have flow rates less than 5 mgd, but it has been installed at larger plants. The process requires higher energy to operate aeration equipment compared with anaerobic digestion. The space requirement is also slightly higher than anaerobic digestion, but the process is considered more stable under variable feed conditions and less labor intensive to operate.

Figure 7-2 shows an example of a rectangular aerobic digester.

Figure 7-2. Aerobic Digester

(Source: Ovivo)

Aerobic digestion can be used as a part of biosolids processing system to produce Class A and Class B biosolids, and is specifically discussed in EPA's biosolids regulations:

- **40 CFR 503.32(b)(3)**–Aerobic digestion is allowed as a PSRP to satisfy the pathogen reduction requirements for Class B biosolids. MCRT and temperature must be between 40 days at 20 °C (68 °F) and 60 days at 15 °C (59 °F).
- **40 CFR 503.33(b)(1)**–When aerobic digestion achieves a minimum volatile solids destruction of 38 percent, it may be used to satisfy the VAR requirements of this regulation.
- **40 CFR 503.33(b)(3)**–When aerobic digestion does not achieve a minimum volatile solids destruction of 38 percent, additional bench testing may be used to satisfy VAR requirements of this regulation.

Aerobic Digestion Process Considerations. Conventional aerobic digestion uses air to transfer oxygen to the sludge to facilitate the cell reproductive process. Oxygen requirements are typically based on volatile solids destruction requirements. Oxygen transfer is typically achieved through diffused air but can also be supplied by submersible jet aeration. Target (DO concentrations are between 0.4 and 1.0 parts per million (ppm) and 1.4 pounds of oxygen per pound of volatile suspended solids (VSS) destroyed. Ammonia is oxidized to nitrate in the aerobic process, causing reduced alkalinity and pH. Typically, the air is cycled off to promote denitrification and lower the nitrate concentrations in the return stream, which also stabilizes the alkalinity and raises the pH by producing carbon dioxide.

Mixing of the aerobic digester can lead to higher levels of air diffusion depending on the configuration of the digester and is typically required to keep solids from settling out of suspension. Mixing of the digester can be achieved by mechanical devices such as surface mounted or submersible mixers, jet (pump) mixing, or draft tubes. Jet mixing can be accomplished with submersible pumps or using pumps external to the tank and connected to an eductor mixing system.

Odors from new aerobic digesters will be less than the existing reactor because the digester will be designed to handle the plant’s solids quantities and typically would remain uncovered. However, covering the aerobic digesters can provide benefits:

- Temperatures can be maintained slightly higher in winter to achieve the desired volatile solids destruction in less time.
- Improved operations and maintenance (O&M) access to any location at the tank top over a standard open top tank configuration with perimeter walkways.

Biological activity in the digester leads to the breakdown of cellular material and soluble BOD remaining in the WAS and hauled waste. Byproducts of the reaction are nitrate (conversion from ammonia by nitrification), water and hydrogen ions. The reaction kinetics follow a first order decay rate, which varies based on temperature. The optimal temperature for aerobic digestion ranges between 20 °C (68 °F) and 35 °C (95 °F). At temperatures below 10 °C (50 °F) biological activity is severely reduced, and nitrification is inhibited.

Class B biosolids requirements to provide a 40-day MCRT during the maximum loading condition projected for year 2040 indicate a tank volume of 0.28 million gallons (MG) would be required based on the projected solids and hauled waste loads. A covered digester is assumed to better maintain a temperature of at least 20 °C (68 °F). The tank may also be partitioned and run with a 25-day MCRT ahead of a Class A process to maintain optimum dewaterability. By constructing sufficient volume to provide a 40-day MCRT, the plant would be able to produce Class B biosolids if the Class A treatment system was offline for an extended period.

Often municipalities may operate at shorter residence times of 20 to 30 days and still meet Class B based on SOUR or bench testing. The SOUR test is based on the biosolids consuming very little oxygen, which indicates their value as a food source to microorganisms is very low and therefore active microbes are unlikely to be attracted to them. This test is only applicable to liquid aerobic biosolids sampled from an aerobic process.

Research conducted on similar plants running aerobic digesters in Washington State with conventional secondary treatment found an average SRT of 30 days or less is required to achieve Class B VAR requirements based on SOUR testing results. The cities of Shelton (28-29 days SRT), and Gig Harbor, Washington (20-25 days SRT), operate aerobic digesters at an average SRT of less than 30 days. Given the City intends to meet Class A requirements, the need to make Class B biosolids will only be for times when the Class A treatment system is down for extended maintenance.

Extended residence time in the digester to achieve Class B can also create issues with dispersed floc, due in part to the release of soluble proteins and polysaccharides from the breakdown of cellular material, making subsequent dewatering of the biosolids more difficult. Studies have shown that addition of positively charged ions such as calcium or magnesium can improve floc formation and dewaterability in aerobic digesters (Murthy and Novak, 1999) and (Novak, et al, 1998). The addition of calcium or magnesium is not likely to be required given the ability to control cell residence time in the digester and operate on a shorter MCRT of 25 days. If calcium or magnesium were required to improve dewaterability, these chemicals would be added periodically using bulk bags and are not assumed to be liquid metering systems.

Advantages and Disadvantages of Aerobic Digestion. The advantages and disadvantages of aerobic digestion are summarized in Table 7-5.

Table 7-5. Aerobic Digestion–Advantages and Disadvantages

Advantages	Disadvantages
• Ability to meet Class B biosolids at ambient temperatures, likely without chemical addition • Relatively simple operational control, amenable to variations in sewage sludge feed composition • It is a common treatment technology for small to medium sized wastewater treatment facilities, and thus excellent operational knowledge exists in the industry • Volatile solids destruction exceeding 38% • or demonstrating required stabilization by alternative testing methods • Relatively low strength recycle stream as compared with anaerobic digestion • Improved safety without the generation of methane (as compared with anaerobic digestion) • Limited equipment to maintain	• High energy and capital cost requirements for aeration • Extended retention times to meet PSRP requirements • Dispersed floc can sometimes be difficult to dewater at higher SRT • Stabilization is reduced at colder water temperatures (i.e., winters in the Pacific Northwest) resulting in the need for longer detention times or addition of covers to help maintain temperature • Larger volume required compared to anaerobic digestion • No ability to harvest or reuse biogas

7.2.2.2 Anaerobic Digestion

Anaerobic digestion is a biological process in which anaerobic bacteria convert organic matter into methane and carbon dioxide (sometimes called biogas) in the absence of air. The process stabilizes the organic matter in wastewater solids, reduces pathogens and odors, and reduces the total solids quantity. Solids are reduced by converting the volatile solids fraction of the wastewater into biogas. Digesters run at mesophilic temperature ranging between 30 to 38 °C (85 to 100 °F) or thermophilic temperature ranging between 49 to 60 °C (120 to 140 °F) which result in solids destruction. Thermophilic digestion can produce Class A biosolids and has higher biogas outputs than conventional mesophilic digestion. Figure 7-3 shows an example of an anerobic digester.

Figure 7-3. Anaerobic digester

Anaerobic digestion generally requires less tank volume than aerobic digestion and produces biogas as a byproduct of the anaerobic decomposition process. However, the mesophilic anaerobic process evaluated requires a biogas or natural gas-fired sludge heating system to maintain sludge temperatures at 30 to 38 °C (86 to 100 °F) increasing the rate of digestion. When biogas is used to offset natural gas or electricity needs, the benefit can be significant and may offset some or all treatment facility energy costs.

Anaerobic digestion can be used as part of a biosolids processing system to produce Class A and Class B biosolids, and is specifically discussed in EPA's biosolids regulations:

- **40 CFR 503.32(b)(3)**–Anaerobic digestion is allowed as a PSRP to satisfy the pathogen reduction requirements for Class B biosolids. MCRT and temperature must be between 15 days at 35 to 55 °C (95 to 131 °F) and 60 days at 20 °C (68 °F).
- **40 CFR 503.33(b)(1)**–When anaerobic digestion achieves a minimum volatile solids destruction of 38 percent, it may be used to satisfy the VAR requirements of this regulation.
- **40 CFR 503.33(b)(2)**–When anaerobic digestion does not achieve a minimum volatile solids destruction of 38 percent, additional bench testing may be used to satisfy VAR requirements of this regulation.

Anaerobic Digestion Process Considerations. As stated, anaerobic digestion reduces the total solids quantity by converting part of the volatile solids fraction to biogas. Biogas, which is about 60-percent methane and 40-percent carbon dioxide, has historically been either used to power boilers, to heat digesters, used to run reciprocating engines to generate power, or flared. This process operates best under a constant homogeneous feed.

Advantages and Disadvantages of Anaerobic Digestion. The advantages and disadvantages of anaerobic digestion are summarized in Table 7-6.

Table 7-6. Anaerobic Digestion–Advantages and Disadvantages	
Advantages	Disadvantages
• Ability to meet Class B biosolids requirements at lower electrical cost and residence time. • Generates biogas, which can be used for heating or renewable energy. • Lower capital cost due to smaller tank volume required. • Suitable for cold environments. • Potential volatile solids destruction exceeding 55 percent. • Could potentially allow acceptance of outside feedstocks for co-digestion (e.g., FOG and Food Waste) that would provide additional tipping fees and increase gas production.	• High operation and maintenance costs for sewage sludge heating and mixing equipment. • Proper operation requires primary wasting, which is not currently available at the WWTP. • Greater operational complexity; potential for upset and slow startup/recovery period following upsets. • Safety risk due to handling of potentially explosive digester gas. • Typically, most cost effective with primary or raw sewage sludge, where more "food" is available as opposed to more stabilized septage and hauled sewage sludge. • Requires consistent and continuous solids feed for stability (not amenable to wide variability associated with hauled waste receiving). • Greater potential for odor generation.

7.2.3 Class A Treatment

Two key options are available for treatment of solids to a Class A product.

7.2.3.1 Compost

Composting is a treatment process that uses time and temperature to produce a final product that meets Class A pathogen reduction criteria and is highly marketable.

There are four general methods of composting including aerated static pile, covered aerated static pile (CASP), windrow, and in-vessel systems. Each method involves mixing dewatered biosolids with a "bulking material" to provide carbon and increase porosity. The resulting mixture is placed in a vessel or pile where microbial activity causes the temperature of the mixture to rise during the "active composting" period. The specific temperatures that must be achieved and maintained for successful composting vary based on the method and use of the biosolids end-product. After active composting, the material is screened, cured, and distributed for public use.

7.2.3.1.1 Compost Bulking Materials and Ratios

A carbon source is a necessary component of a composting system because it provides the energy and predominant cellular mass for compost, along with the "nitrogen" derived from the biosolids that is consumed during the active composting process. In addition to the carbon and nitrogen materials, a "bulking agent" is added which allows air to flow through the compost mixture. Typically, the carbon source and bulking agent together are referred to as the "bulking material."

Ground wood waste, hog fuel, green waste, or yard debris are regularly used as carbon sources in composting operations. Primary compost feed stocks typically consist of an easily degradable carbon source. As a carbon source, the primary purpose of the wood waste material is to break down during the composting process and, thus, a finer grade of material is desirable. The use of yard debris as a primary carbon source is desirable when material is relatively free of grass clippings, plastics, metals, and other contaminants. Yard debris is typically ground to a finer degree prior to being added to a composting process.

The use of wood chips for a bulking agent requires a coarser grade of material that will be screened-out after composting and reused. In this case, the size and other characteristics of the wood chips must be tailored to the aeration system and other operational parameters.

Covered Aerated Static Pile Technology Summary (CASP). For the purposes of this report, the CASP composting technology was considered. This technology was considered because it is a commonly used composting system proven to meet Class A regulatory requirements, and the final biosolids end-product is marketable for distribution to the public.

The CASP composting is a forced aeration composting system for treating blended piles of organic residuals. The CASP process utilizes the process of aerobic biological degradation to reduce pathogens and organic solids. Process airflow pushed through the piles provides adequate oxygen to support the microbial community while controlling the pile temperature. The CASP composting utilizes a cover (e.g., porous membrane or finished compost product) over the pile to control moisture levels, odor emissions, and reduce temperature variability. In addition, the capital costs for CASP are lower than aerated static piles (without covers) with fewer permanent structures required. The covered piles are aerated under positive and negative pressure using blowers with low energy requirements.

The CASP composting process takes place by means of controlled pressurized aeration in encapsulated windrow covers. A resultant insulating layer of air guarantees an even distribution of temperature in the body of the heap. The cover also works as a physical barrier against odors and other gaseous substances escaping from the composting material.

The aeration piping and leachate collection system are combined in an “in-floor” system with permanent aeration trenches. The aeration trenches have perforated metal lids and also serve as a leachate collection system. The biosolids composting process can take 6 to 8 weeks and occurs in three phases. The City of Albany’s CASP composting facility is shown on Figure 7-4.

Figure 7-4. Compost facility

Advantages and Disadvantages of Composting. The advantages and disadvantages of composting are summarized in Table 7-7.

Table 7-7. Composting–Advantages and Disadvantages

Advantages	Disadvantages
• Composting is a relatively simple, reliable technology. • Composting is the most used technology for achieving Class A biosolids standards according to the EPA. • Composting produces a highly marketable biosolids end-product that is typically well accepted by the public. • Composting can be gradually phased in with additional compost piles added over time. • There is sufficient space at the WWTP for a composting facility. • The City may be able to secure the bulking agent at little to no cost.	• Total volume of Class A biosolids will be greater than other alternatives because of the addition of bulking material (e.g., wood chips and yard debris) needed for the composting process. • The time required for the process to achieve Class A is the highest of the alternatives considered.

7.2.3.2 Dryer

Thermal drying technology removes water via evaporation from dewatered biosolids, reducing the volume and weight. The high temperatures utilized by a dryer ensure that the EPA time and temperature requirements for Class A biosolids are met. Thermal drying typically results in a material with a solids content greater than 90 percent dry weight.

A thermally dried Class A EQ biosolids product has universal applications. The dried biosolids can supplement fuel in the drying process, can be land-applied for reclamation and other soil improvement projects, or blended with other materials to create fertilizer.

Thermal drying can be accomplished by one of two main drying technologies: indirect convection or indirect conduction dryers. Direct dryers expose the biosolids to open flame and are not considered further in this evaluation. Figure 7-5 shows an image of an indirect belt dryer.

Figure 7-5. Indirect belt dryer

(Source: Centrisys)

Advantages and Disadvantages of Drying. The advantages and disadvantages of drying are summarized in Table 7-8.

Table 7-8. Drying–Advantages and Disadvantages	
Advantages	Disadvantages
• Thermal drying generates the least volume of biosolids because of the high solids concentration (>90 percent) and the absence of bulking agents such as lime or yard debris. This greatly reduces the amount of storage needed. • The cost of transport is reduced due to the volume reduction of the product compared to other treatment methods. To haul the same quantity of biosolids, three to four times as many truckloads are required to transport dewatered biosolids compared to a dried product. • Dryer facilities would be located at the WWTP site and do not require offsite land acquisition or lease agreements as is the case with composting. • Biosolids end-product is highly stable and less voluminous when compared to lime pasteurized products. • Biosolids end-product can be easily blended with landscape products (e.g., soil and compost mixes) to generate further markets of beneficial use. • Dryers are a popular technology for achieving Class A biosolids throughout the globe. • Several vendors that offer this technology.	• Adequate digestion is required to mitigate or eliminate the odor that can occur when a dried biosolids product is wetted in the environment. • Drying is an energy intensive process and is thus very sensitive to changes in fuel costs and increased moisture due to poor dewatering. Drying will require a new natural gas service be constructed into the WWTP site. The high end of the range of gas consumption was used in the alternatives analysis presented in Section 7.4. • The dryer can be operated intermittently, 16 hours per day, 4 days per week, which is preferred by the City based on current WWTP staffing. However, the dryer will operate with decreased energy efficiency due to daily heat up and cool down cycles, during which time the dryer will not be treating solids. • Due to their high organic content, both the heat-drying end-product and the dust generated during production of the end-product are flammable, and precautions must be taken to design the heat-drying process, equipment, and storage to minimize the potential for explosion or fire. The dryer will be outfitted with classified electrical equipment that meets the hazard classification based on the National Fire Protection Association (NFPA) Publication 820, latest edition.

7.2.4 Ancillary Processes

Sludge thickening and biosolids dewatering are recommended to be incorporated into the solids stream process, regardless of alternative selected.

7.2.4.1 Thickening

Sludge thickening is a physical process and is normally the first unit process in a plant's solids stream. The purpose of this unit process is to reduce the water content (increase solids concentration) of the WAS captured during the secondary clarification process. Thickening before sludge stabilization processes can aid in reducing the volume of tankage needed for downstream activities. For this report, thickening is included in the treatment alternatives with solids stabilization processes.

Solids thickening is achieved through physical separation of solid particles from liquid. The mechanism used for separation is often one of the following: centrifugal force, filtration, screening, sedimentation, or flotation. The effectiveness of the separation mechanism can depend upon hydraulic flow rate, solids loading rate, and the quantity of chemicals used for increasing particle size (e.g., polymer flocculation).

Rotary Drum Thickener. The use of rotary drum thickeners (RDTs) was assumed for this analysis. While there are other thickening technologies available, RDTs are more commonly used for new installations and are representative of the costs associated with thickening, as a whole. In addition, the relative cost difference in thickening operations between treatment train alternatives was expected to be the same regardless of thickening technology assumed. If thickening is needed for the selected treatment train alternative, other thickening processes will be considered during preliminary design and the advantages and disadvantages of each will be considered in more detail for the best fit for the WWTP.

RDTs are often used due to their mechanical simplicity, small footprint, low power requirements, and moderate capital cost. Sludge is conditioned with polymer before being introduced into a rotating drum screen. Free water drains through the screen openings and collects in a trough underdrain. Thickened sludge is conveyed through the rotating drum and out the discharge end via a continuous internal screw or angled flights. The drum is sometimes inclined to aid in dewatering.

A thickened solids content of 3 to 5 percent is typically obtained with RDTs, depending upon the solids concentration in the feed sludge. Polymer addition in the range of 8 to 12 lbs per dry ton is required for optimum thickening and represents most of the operational costs. Between 93 to 99 percent of solids are retained with this process. The unit is typically monitored whenever it operates to ensure proper function and accommodate fluctuating sludge characteristics by adjusting polymer dosage, feed rate, and drum speed. A typical RDT is shown on Figure 7-6.

Figure 7-6. Rotary drum thickener

(Source: FKC)

Thickener Considerations. Thickening facilities were assumed to include the following:

- Installation in the existing lime processing room
- Two equal capacity rotary drum thickeners sized for continuous, parallel operation.
- Odor control
- Polymer feed system
- New Thickening Feed Pumps installed in the Solids Handling Building gallery.
- Controls and electrical equipment
- Continued use of the existing WAS Storage Tank
- RDT operation allows for continuous, unattended operation, providing 24/7 wasting and Thickened WAS feed to the stabilization process.

7.2.4.2 Dewatering

Dewatering is the removal of water from biosolids to reduce the weight and volume of solids that require hauling and application. There are several dewatering technologies available such as a belt filter press, fan press, or screw press; however, as the City is soon moving forward with an emergency centrifuge replacement project, this evaluation will be based on centrifuge dewatering.

Centrifuge Dewatering. In a centrifuge, the applied centrifugal force causes suspended solids to migrate through the liquid away from the axis of rotation due to the difference in densities between the solids and liquids. The solids are then conveyed via auger, also called a scroll, to one end of the machine for discharge. The liquid filtrate overflows a weir and is discharged from the opposite end of the machine. The bowl and the scroll are controlled by separate drives, rotate at different speeds, and have relatively high electrical energy demands. High speed centrifuges can produce cake with solids concentrations higher than those produced using lower energy technologies. When using polymer, centrifuges can typically produce dewatered cake with 20 to 25 percent solids content and usually capture more than 95 percent of the solids. Conditioning with polymers is required to prevent floc shear and to improve centrate quality and solids capture.

Centrifuge dewatering is a closed process, which makes for easy containment of odors. The liquids and solids discharge from the bottom of the machine by gravity. The controlled discharge and containment of the dewatering mechanism allow for localized odor control at the liquids and solids discharge ports. Dewatered cake from a centrifuge is generally more odorous and odor control is required on the cake and centrate outlets. Because odor control is at point sources, smaller foul air volumes must be treated.

Centrifuges require operator attention, and therefore cannot be operated unattended. For this reason, the dewatering process as well as downstream processes are recommended to run 16 hours per day, 4 days per week to align with the WWTP's staffing availability.

As discussed in Section 3.6 and referenced in Appendix E, the existing centrifuges are undersized and have reached the end of their useful life and will be replaced. A photo of the existing centrifuges is shown on Figure 7-7. The existing odor control equipment serving the existing centrifuges will need to be evaluated in terms of size and condition for continued service following centrifuge replacement.

Figure 7-7. Existing dewatering centrifuges

7.3 Solids Alternative Site Plans

A preliminary overall site plan depicting proposed solids improvements is shown on Figure 7-8.

7.3.1 Hauled Waste Receiving

The proposed packaged Hauled Waste facility would be installed adjacent to the existing station to allow for the continued receipt of septage during construction. Consideration was made to relocate hauled waste receiving to the NSPS; however, that concept was abandoned early in the master planning process. Septage receiving and construction traffic/access would be coordinated during design. As there are no other nearby septage disposal locations, and waste from facilities at nearby tourist areas are hauled to the plant, continuation of septage receiving is desired. Septage receiving also brings in approximately $80,000 to $100,000 annually in revenues to the City.

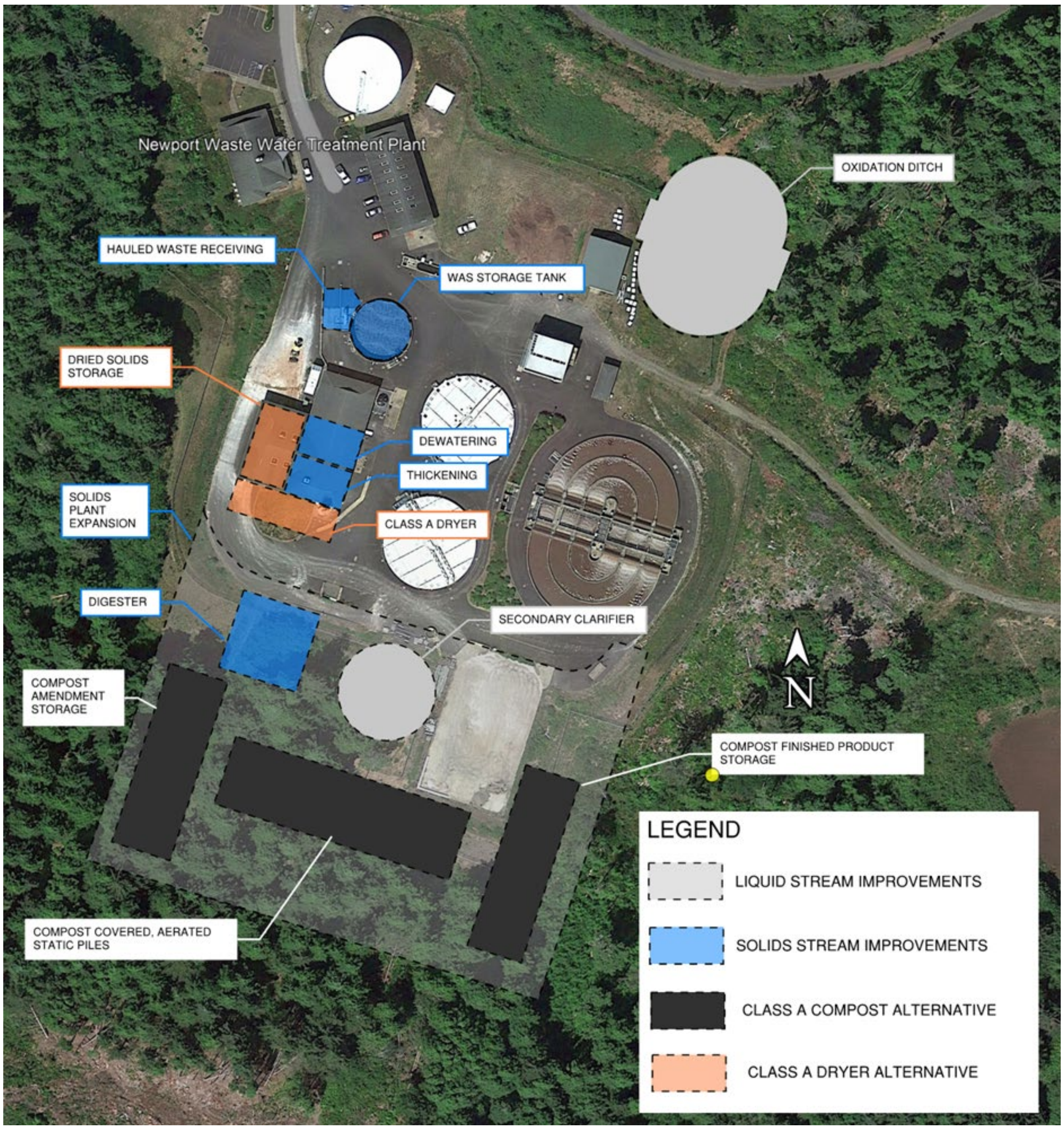

Figure 7-8. Solids stream site plan

7.3.2 Thickening

Mechanical thickening with RDTs is proposed to be installed in the existing lime processing room. The WAS would be wasted continuously, and the WAS Storage Tank would continue to be used to provide process flexibility. With the removal of the Lime Stabilization equipment, RDTs would be installed at ground level, with open-throat thickened WAS pumps installed on the intermediate level below and positioned beneath RDT discharges, as shown on Figure 7-9 and Figure 7-10.

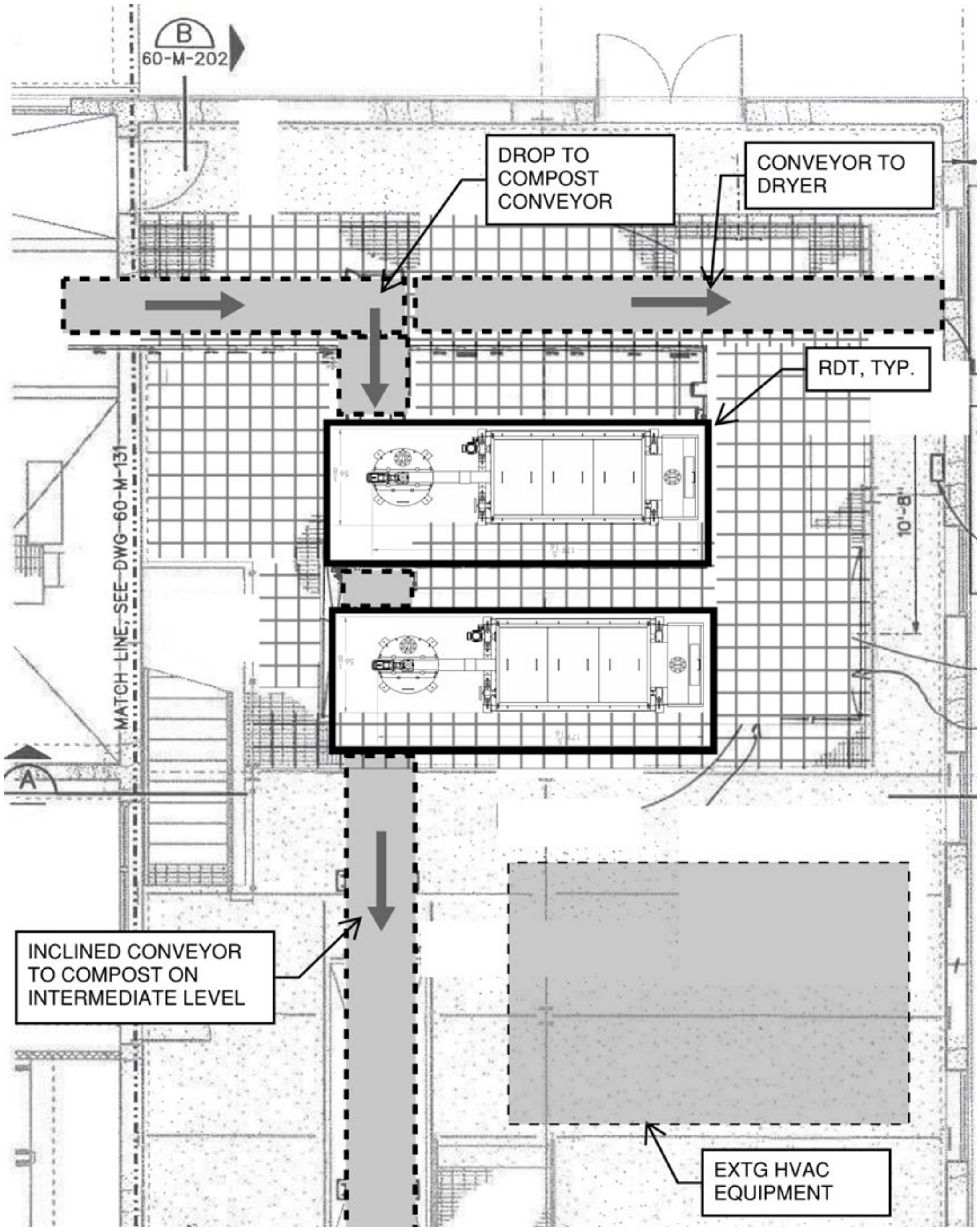

Figure 7-9. Thickening plan

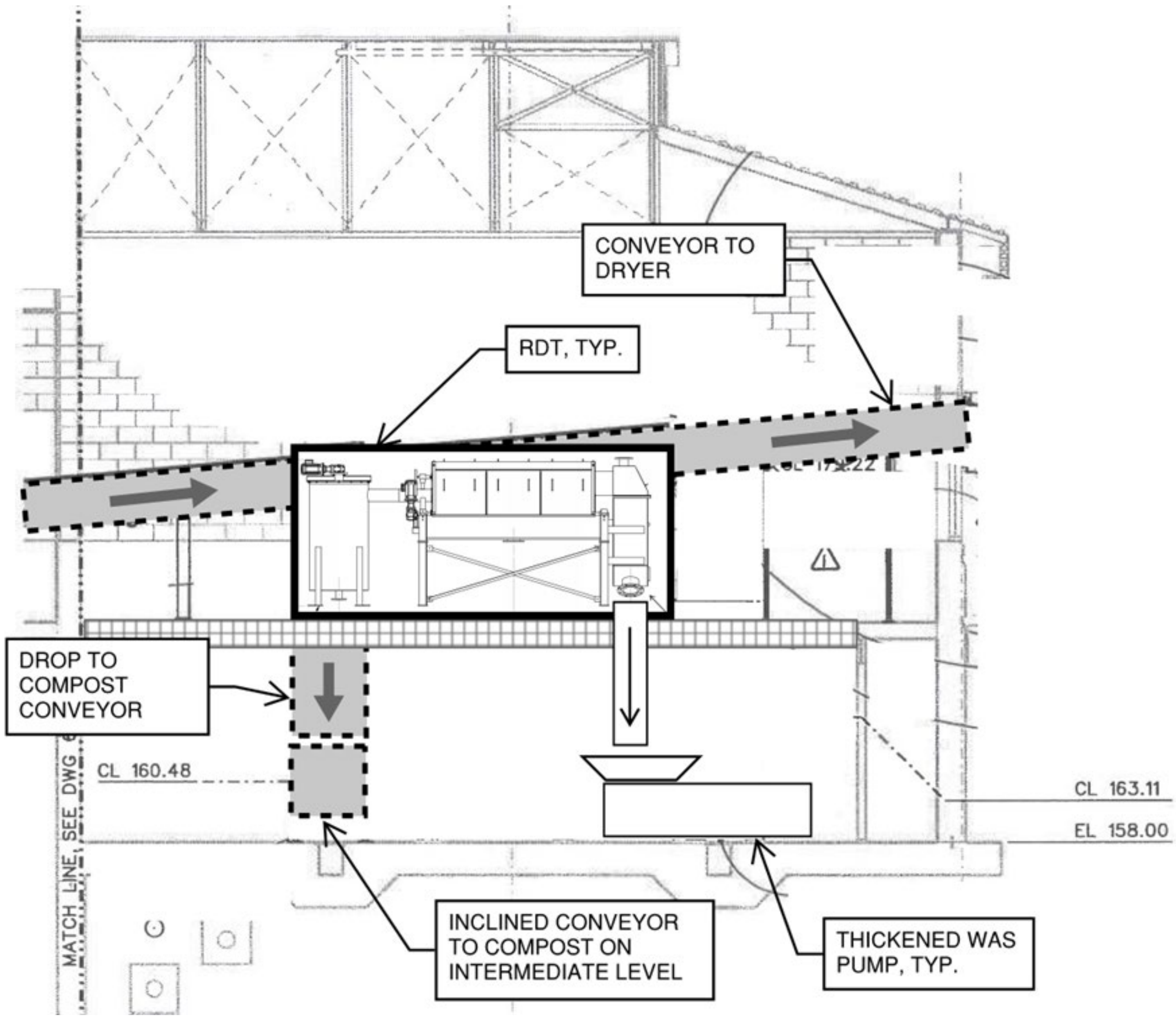

Figure 7-10. Thickening section

Alternatively, thickened WAS pumps may be installed on the same level as the RDTs. Concrete work to support equipment, along with grating and access platforms would be provided to facilitate access to RDTs while maintaining the existing stairway access to the intermediate level below. New thickening feed pumps would be installed in the Solids Handling Building gallery, replacing the existing centrifuge feed pumps.

7.3.3 Stabilization

The existing plant fence line is proposed to be extended south to accommodate the solids stabilization and composting facilities. Within the expanded area, the proposed stabilization process shown on Figure 7-8 is located across an existing roadway to minimize thickened WAS pumping distance. The stabilization area is roughly 75 feet by 75 feet and includes an adjoining support building.

Table 7-9 summarizes the sizing and facility descriptions for Aerobic and Anaerobic Digesters.

Table 7-9. Stabilization Sizing and Facilities

Parameter	Aerobic Digester	Anaerobic Digester
Footprint, feet	50 x 50[a]	40[b]
Volume, gal	280,000[c]	216,000[d]
Design Loading		
Average, ppd	3,380	3,380
Maximum Month, ppd	4,226	4,226
Sidewater Depth, feet	15[e]	23[f]
Support Building and Facilities	• Blowers • Electrical Room • Digested Sludge Pumps	• Boilers • Heat Exchangers • Digested Sludge Pumps • Electrical Room • Waste Gas Burner

a. *Covered, rectangular footprint is divided into four equally-sized cells equipped with mixers and diffusers.*

b. *Diameter of circular tank equipped with mixing system.*

c. *Design Condition–2040 Max Month: (1) Redundancy: None, (2) Thickened WAS solids concentration: 4%, (3) Digester content solids concentration: 2.67%, (4) Volatile Fraction: 0.83, (5) Solids Retention Time: 40 days.*

d. *Design Condition–2040 Max Month: (1) Redundancy: None, (2) Thickened WAS solids concentration: 4%. (3) Volatile Fraction: 0.83, (4) Volatile Solids (VS) Loading: 0.15 lbs VS/CF/day, (5) Solids Retention Time: 15 days minimum.*

e. *Minimum tank depth for efficient oxygen transfer.*

f. *Assumes 3 feet of freeboard and 6-feet dome height for a total height of 32 feet.*

7.3.4 Dewatering

Dewatering improvements described in the Centrifuge Replacement TM (as Appendix E) include the removal and replacement of existing centrifuges with larger centrifuges and conveyors sized to accommodate the 2040 max month loading condition. The sizing criteria in the Centrifuge Replacement TM indicates a WAS feed solids concentration to centrifuges of 0.55 percent, as no other solids improvements were considered as part of the centrifuge evaluation. The recommended replacement project includes a fully redundant centrifuge. For the master planning project, thickening and stabilization will precede dewatering. With this reduced loading, centrifuge operation will require fewer operating hours and offer increased redundancy. The proposed dewatering improvements are shown on Figure 7-11.

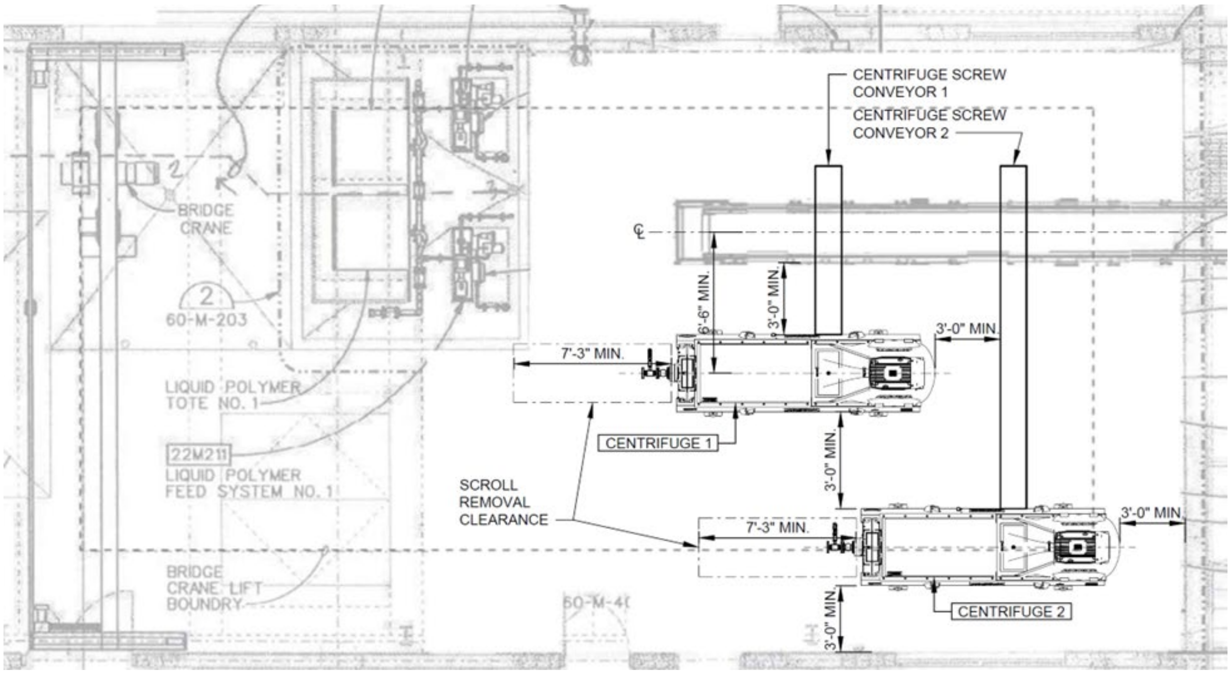

Figure 7-11. Dewatering plan

7.3.5 Class A Treatment

The proposed Class A Treatment alternatives would require expansion of the plant site and/or the existing Solids Handling Building. Design criteria relating to Class A treatment are discussed in the Solids Basis of Design TM, included as Appendix J.

7.3.5.1 Compost

The proposed Class A compost facility is located south of the existing plant fence line. This wooded area rises gradually in grade to the south and east. An extensive area would need to be cleared, grubbed, and graded to accommodate the large footprint of the compost area. A significant amount of earthwork, grading, and the installation of retaining walls would be needed to construct 20- to 30-feet wide paved roadways to facilitate the handling and transport of compost materials. Site footprint is also needed to locate amendment mixing and screening equipment for final processing of finished product.

A finished product storage area is included, which will negate the need to store solids at a third-party location (November through April) as the plant currently does. Compost facilities may be phased in over time, as the storage and processing bays are modular and can be readily expanded. Improvements would include a new system of conveyors to transport dewatered cake to the existing solids bay, as shown on Figure 7-9. A site plan of the proposed Class A compost facility is shown on Figure 7-12.

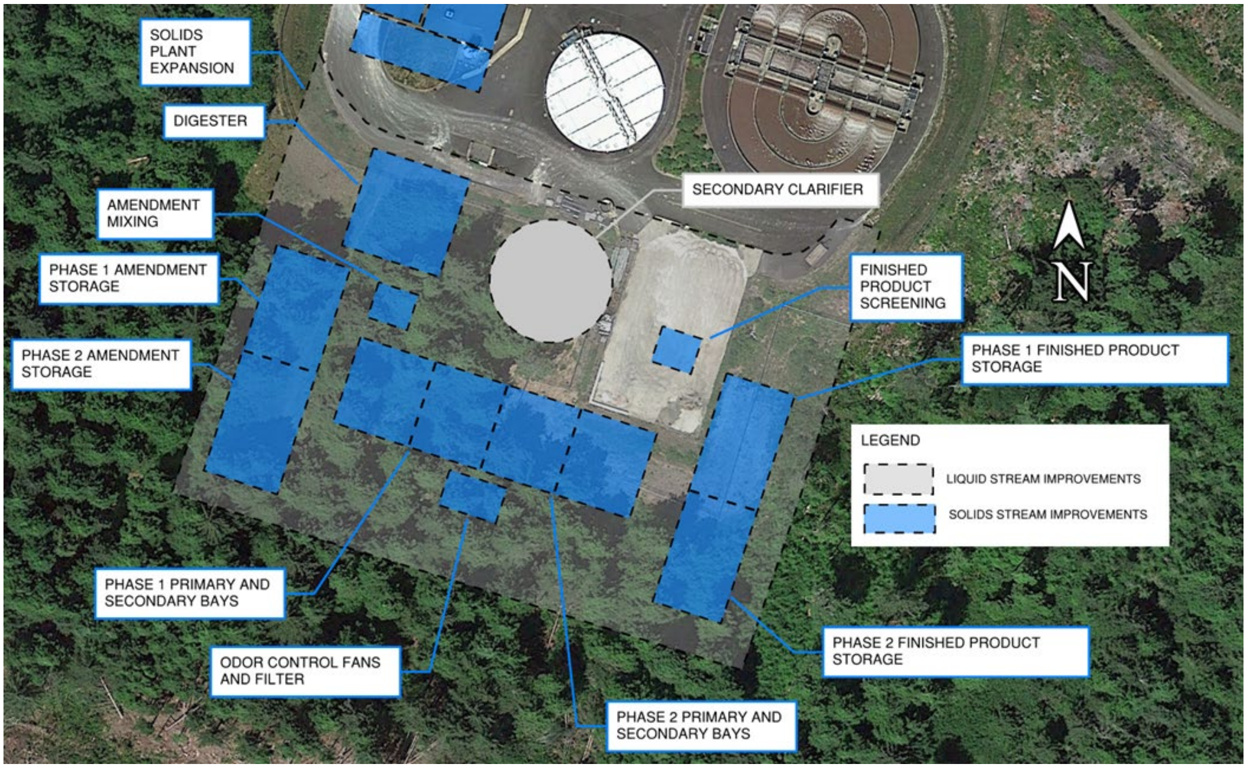

Figure 7-12. Class A compost facility plan

7.3.5.2 Dryer

The proposed Class A dryer is a large piece of equipment and may include numerous ancillary equipment depending on the manufacturer selected. The dryer itself may be 44 to 70 feet in length, 12 to 40 feet in width, and up to 26 feet in height, depending on the manufacturer.

The existing Solids Handling Building would be expanded to provide a dedicated room housing the Class A dryer, cake bin, and associated electrical and controls room. The existing Lime Silo and outdoor equipment would be demolished. Conveyors, shown on Figure 7-9, would transport dewatered cake from the dewatering area to the Dryer Room. Alternatively, a dedicated building may be constructed adjacent to the Solids Handling Building on its own foundation with minimal separation between the outside walls of new and existing structures. Dried solids would be bagged into supersacks and stored in the existing solids storage bay.

The new Dryer Room would be installed at an elevation that matches the existing intermediate level elevation in the Solids Handling Building. This would facilitate truck access to the supersack bagging system via a new roll-door on the south side of the room, transport of supersacks to the existing solids bay for storage and allow for a maximum building height close to the existing Solids Handling Building. The proposed dryer improvements are shown on Figures 7-13 and 7-14.

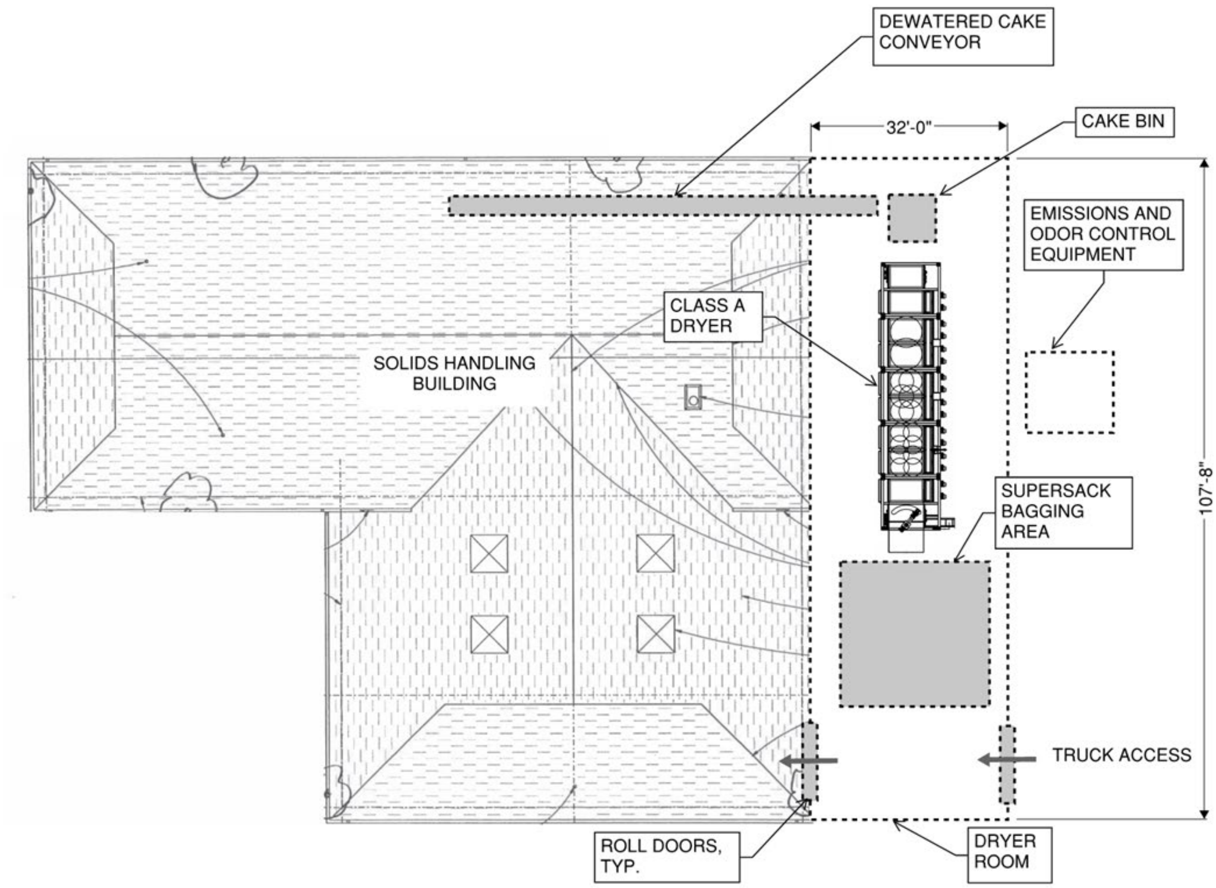

Figure 7-13. Class A dryer plan

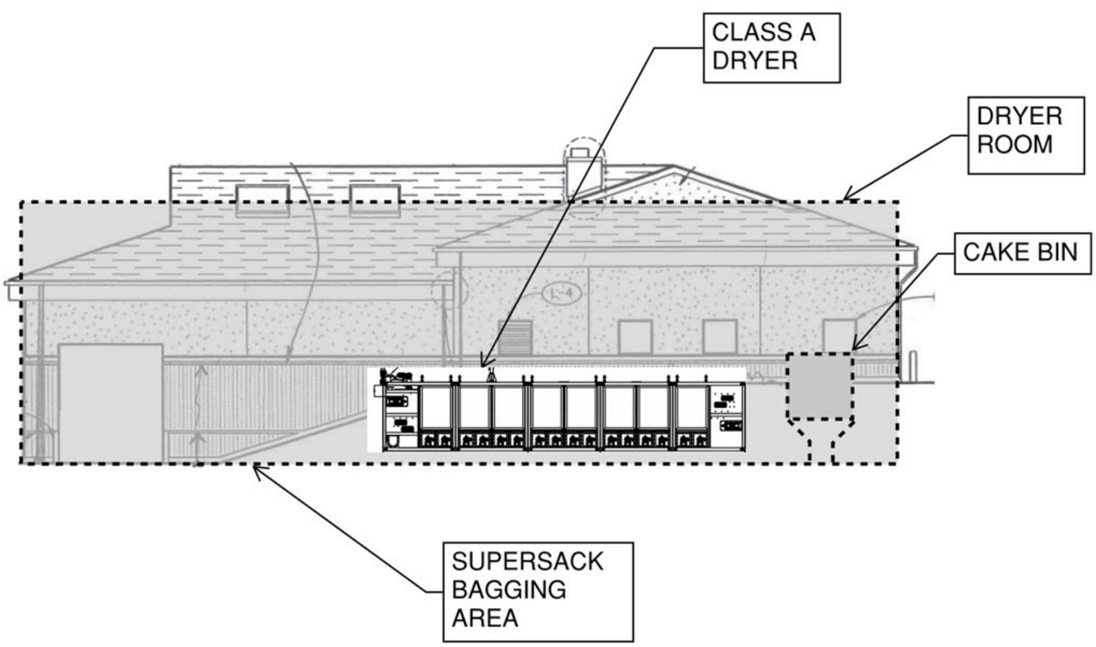

Figure 7-14. Class A dryer section

7.4 Solids Alternatives Evaluation

Solids processes such as Hauled Waste Receiving, Thickening, and Dewatering are common to each of the solids alternatives considered and are presented in Section 7.1, with additional detail and design criteria included in Appendix J. The following sections focus on the stabilization and Class A treatment alternatives under consideration.

Stabilization is recommended to reduce solids quantities and improve the performance of downstream processes. The inclusion of aerobic or anaerobic digestion also allows the production of Class B Biosolids if Class A Treatment systems are offline for an extended period. There are several key differentiators and considerations to account for in the evaluation of aerobic versus anaerobic digestion, including but not limited to labor resources, energy use, construction costs, and site conditions. A list of key considerations is provided in Table 7-10.

Table 7-10. Aerobic versus Anaerobic Digestion

Parameter	Aerobic Digester	Anaerobic Digester
Footprint	Slightly Larger Footprint	Slightly Smaller Footprint
Process Flexibility	Capable of Producing Class B Biosolids without downstream treatment	Capable of Producing Class B biosolids without downstream treatment
Odor Potential	Increased Potential for Odors	Less Odor Potential
Labor Requirements	Lower Labor Effort	Additional O&M Required
Capital Costs	Lower Capital Costs	Higher Capital Costs
Energy Costs	Increased Energy Costs for Aeration	Lower Energy Costs
General Sizing Criteria	Typical for Facilities < 5 mgd	Typical for Facilities > 5 mgd

While the capital cost for the aerobic system is significantly less than the anaerobic system, ongoing energy costs are higher due to aeration demands, Ongoing labor is relatively minor for an aerobic digester. In addition, odors produced by an aerobic digester are like those produced from the activated sludge process and no additional odor control system would be required.

Anaerobic digestion requires more labor effort to maintain the heating and mixing systems, along with gas handling equipment such as waste gas burners. There is potential with anaerobic digestion to meet digester heat demands by firing boilers on digester gas. Given the relatively small size of the facility, reduced labor and generally lower capital costs, aerobic digestion was selected as the preferred stabilization process by the City, BC, and KJ in a workshop held on April 25, 2023.

Class A treatment is recommended to improve the quality of biosolids, reduce odors, and maintain flexibility with respect to disposal at various land application sites. Table 7-11 summarizes the pros and cons associated with composting versus drying in the production of Class A Biosolids.

Table 7-11. Composting versus Drying		
Parameter	**Compost**	**Dryer**
Footprint	Land Intensive	Relatively Small Footprint Compared to Compost
Odor Potential	Potential for Odors	Indoor, Ventilated Process, Low Odor Potential when paired with adequate Odor Control equipment.
Labor Requirements	Labor Intensive, Labor Required to Handle Compost	Labor Intensive, Labor Required to Maintain Numerous Equipment
Capital Costs	Lower Capital Costs	Higher Capital Costs
Energy Costs	Less Energy Intensive	High Electricity and Natural Gas Use

Although the Class A dryer has higher capital and operation and maintenance (O&M) costs than a compost facility, it results in a dried product that is greater than 90 percent solids which significantly reduces the quantity of biosolids that need to be stored, handled, and transported. Compost however requires a bulking agent or amendment such as wood chips that significantly increases the volume of the finished product. The City indicates that the nearby Georgia Pacific mill is a reliable and long-term source for amendment material. A life-cycle cost analysis of the compost and dryer Class A alternatives is therefore recommended to understand the cost differences between the two alternatives.

7.5 Life-cycle Cost Evaluation

The estimated capital costs, annual O&M costs, and total O&M present-worth costs for the Class A compost and dryer alternatives are summarized in Table 7-12. Costs for solids improvements common to each alternative are also included to indicate the overall total costs. Detailed cost estimates are included in Appendix D.

The following assumptions were made in the preparation of the capital costs:

- Capital costs include Opinion of Probable Construction Cost (OPCC) as well as an allowance of 38 percent for soft costs, such as engineering, administrative, permits, and legal costs.
- Estimates are Association for the Advancement of Cost Engineering (AACE) Class IV estimates with a stated range of accuracy of +40 percent to -20 percent.
- Estimates do not include hazardous materials removal or disposal. Costs assume that structural conditions are suitable and that special foundations are not required.

Table 7-12. Class A Life-cycle Cost Evaluation		
Cost Element	Compost	Dryer
Capital Cost[a,b,c]		
Hauled Waste	$2,400,000	
Thickening	$2,400,000	
Aerobic Digester	$7,100,000	
Dewatering	$6,400,000	
Class A Biosolids Process	$11,200,000	$17,300,000
Sitework	$3,000,000	$4,300,000
Capital Cost Subtotal	$32,500,000	$39,900,000
Annual O&M Costs [d,e,f,g,h,i]		
Hauled Waste	($80,000)	
Thickening	$70,000	
Aerobic Digester	$80,000	
Dewatering	$110,000	
Class A Biosolids Process	$180,000	$380,000
Annual O&M Subtotal	$360,000	$560,000
Total O&M Present Worth Cost[j]	$7,500,000	$11,700,000
Total Present Worth Cost	$40,000,000	$51,600,000

a. Capital costs are rounded to the nearest $100,000.

b. Construction costs include a 17% adder for Electrical, Instrumentation and Controls.

c. Construction costs include the following markups: Contractor Indirects (12%), Overhead and Profit (15%), Contingency (25%) and Escalation (4% per year) assuming 5 years to the mid-point of construction.

d. O&M costs are rounded to the nearest $10,000, and include labor, maintenance, equipment replacement, utilities, chemical use, and biosolids hauling.

e. Electricity costs are based on a rate of $0.08 per kilowatt hour (kW-hr).

f. Natural Gas costs are based on a rate of $1.25 per therm.

g. Labor costs assume a burdened labor rate of $50 per hour.

h. Chemical costs are for liquid emulsion polymer, $4,20 per active lb. Assumes 8 to 10 active lbs of polymer per dry ton for thickening and 20 active lbs per dry ton for dewatering.

i. Maintenance costs are annualized at 2% of equipment costs.

j. Present worth costs are based on 20-year life-cycle costs in 2023 dollars, assuming a 3% inflation rate and 2.5 discount rate per OMB Circular A-94, Appendix C.

The Class A compost facility is projected to have lower capital and annual O&M costs compared to the Class A dryer. The differences in capital costs are largely due to the dryer equipment costs, costs for constructing the new Dryer Building, and the need to install a new natural gas pipeline to the plant for firing the dryer furnace. The dryer also has higher annual O&M costs than composting, mainly due to the high energy use associated with drying biosolids. The dryer is anticipated to require up to 10,333 million British Thermal Unit (MMBTU) (103,330 therms) of natural gas per year, and up to 640,000 kilowatt per hour (kW-hr) per year of electricity. For this reason, and given the available land at the WWTP, the Class A compost facility is recommended.

7.6 Recommended Solids Improvements

The alternatives evaluations for the liquids process and solids process were considered together and included non-cost criteria due to their complexity and connectivity to each other. For additional details on this evaluation, see Section 9.2.

The key recommended solids stream improvements include:

- Packaged Hauled Waste Receiving Station
- Continued use of WAS Storage Tank
- Mechanical Thickening
- Aerobic Digestion
- Centrifuge Dewatering
- Class A Compost Facility

Design data for the proposed solids improvements and projected solids loadings are summarized in Tables 7-13 and 7-14, respectively. Detailed design data for proposed equipment are also available in the vendor proposals included as Appendix K. Equipment and process sizing criteria are presented the Solids Basis of Design, included as Appendix J. A Site Plan and Process Flow Diagram for the recommended improvements are shown on Figures 7-15 and 7-16.

Solids improvements may be phased to prioritize critical areas and capacity bottlenecks. Dewatering improvements could be constructed in Phase 1. Phase 2 may include the Class A compost facility. Phase 3 may include Mechanical Thickening, Aerobic Digester, and Hauled Waste Receiving.

Table 7-13. Recommended Solids Improvements Design Data

Process Area/Parameter	Units	Value
Hauled Waste		
Type		Packaged, Rotary Drum Screen
No. of Systems		1
Operation		Intermittent
Days/Week		7
Hours/Day		2
Drum		
Perforation Size	mm	10
Motor	hp	3
Washer Compactor		
Motor	hp	7.5
Grit Screws		
No.		2
Screw Motors	hp, ea	0.75
Grease Pump		
Motor	hp	3

Table 7-13. Recommended Solids Improvements Design Data		
Process Area/Parameter	Units	Value
Thickening		
Thickening Feed Pumps		
No.		2
Type		Recessed Impeller
Motor	hp, ea	15
Thickeners		
No.		2
Type		Rotary Drum
Motor	hp, ea	1.5
Thickened WAS Pumps		
No.		2
Type		Progressing Cavity
Motor	hp, ea	2
Aerobic Digester		
No. of Cells		4
Cell Length	ft	25
Cell Width	ft	25
Sidewater Depth	ft	15
Volume	gal	280,000
Design SRT[a]	days	40
Blowers		
No.		4
Type		Hybrid Positive Displacement and Screw Compressor
Motor	hp, ea	150
Mixers		
No.		4
Type		Submersible
Motor	hp, ea	10
Digested Sludge Pumps		
No.		2
Type		Progressing Cavity
Motor	hp, ea	5
Dewatering		
Centrifuges		
No.		2
Motor	hp, ea	95 (75 hp Main Drive, 20 hp Back Drive)

Table 7-13. Recommended Solids Improvements Design Data		
Process Area/Parameter	Units	Value
Conveyors		
No.		3
Type		Shaftless Auger
Motor	hp, ea	(1) 3 hp and (2) 2 hp
Compost		
Type		CASP
No. of Stages		2, (1) Active, (1) Secondary
No. of Bays		4, (2) Active, (2) Secondary
Design Retention Time[b]		
Active Bays	days	20
Secondary Bays	days	20
Bay Length		
Active Bays	ft	40
Secondary Bays	ft	33
Bay Width		
Active Bays	ft	20
Secondary Bays	ft	20
Pile Height	ft	8
Aeration		
Capacity		
Active Bays	CFM/CY	6
Secondary Bays	CFM/CY	2.5
Fan Power		
Active Bays	hp	22.5
Secondary Bays	hp	5
Biofilter Area	ft^2	690

a. Assumes covered digester with minimum operating temperature of 68 °F.

b. At 2040 max month condition.

Table 7-14. Projected Solids Loadings					
Parameter	Units	Design Condition			
		Current-2023	Design-2040		
		Average	Average	Max Month	Max Week
WAS[a]					
Solids Loading	lb/d	3,198	3,558	4,448	5,338
Solids Flow	gpd	69,717	77,575	96,969	116,363
Solids Concentration	%	0.55	0.55	0.55	0.55
Thickened Sludge[b]					
Solids Concentration	%	4.00			
Solids Production	lb/d	3,038	3,380	4,226	5,071
Solids Flow	gpd	9,107	10,133	12,667	15,200
VSS/TSS Ratio[c]	%	83			
VSS Loading	lb/d	2,522	2,806	3,507	4,209
Thickener Supernatant					
Total Supernatant (daily flow)	gpd	76,450	83,282	100,143	117,003
Solids Concentration	mg/L	250	256	266	273
Aerobic Digester Feed[d]					
Solids Loading	lb/d	3,038	3,380	4,226	5,071
Solids Flow	gpd	9,107	10,133	12,667	15,200
Solids Concentration	%	4.00	4.00	4.00	4.00
Volatile Solids by Source					
Thick Sludge VSS Loading	lb/d	2,522	2,806	3,507	4,209
Thick Sludge VSS Reduction	%	40			
Thick Sludge VSS Reduction	lb/d	1,009	1,122	1,403	1,683
Total VSS Reduced	lb/d	1,009	1,122	1,403	1,683
Total Solids Remaining	lb/d	2,029	2,258	2,823	3,387
Dewatering Feed[e]					
Solids Loading (intermittent)[(f)]	lb/hr	222	247	309	370
Solids Loading (intermittent)	lb/d	3,551	3,952	4,940	5,928
Solids Loading (intermittent)	dry tons/day	2	2	2	3
Solids Flow (intermittent)	gpm	17	18	23	28
TSS Concentration	%	2.67	2.67	2.67	2.67
Dewatering Performance					
Cake Concentration	%	20.0			
Cake Production (intermittent)	lb/d	3,374	3,754	4,693	5,631
Cake Production (intermittent)	tons/d	1.7	1.9	2.3	2.8

Table 7-14. Projected Solids Loadings					
Parameter	Units	Design Condition			
		Current-2023	Design-2040		
		Average	Average	Max Month	Max Week
Centrate		1156	1286	1608	1929
Total Centrate (intermittent)	gpd	19,549	21,607	26,687	31,768
Centrate Solids Load	lb/d	169	188	235	282
Compost Feed					
Solids Loading (intermittent)	lb/d	3,374	3,754	4,693	5,631
Solids Loading (intermittent)	dry tons/day	1.7	1.9	2.3	2.8
Solids Concentration	%	20.00	20.00	20.00	20.00
Amendment[g]	wet tons/day	10	11	14	17
Amendment	wet tons/year	3,694	4,111	5,139	6,166
Compost Production					
Compost Production	CY/d	32.0	35.0	44.0	53.0
Compost Production	CY/year	11,545	12,846	16,059	19,269
Compost Production[h]	tons/d	14.0	15.3	19.2	23.1
Compost Production	tons/d	5,039	5,607	7,010	8,411

a. Assumes continuous wasting.

b. Two units, each sized for 100 gpm, 1 duty unit runs continuously with 1 standby unit. Assumes 95% capture.

c. RAS sampling-based on 1 week of data from December 2021. VSS/TSS ratio is provided by BC.

d. Continuous Digester Feed.

e. One duty, 1 standby unit. Assumes 95% capture.

f. Sixteen hrs/day, 4 days/week.

g. Based on 1.2 to 1.0 ratio of amendment to biosolids wet tons.

h. Based on nominal mix density of 873 lb/CY.

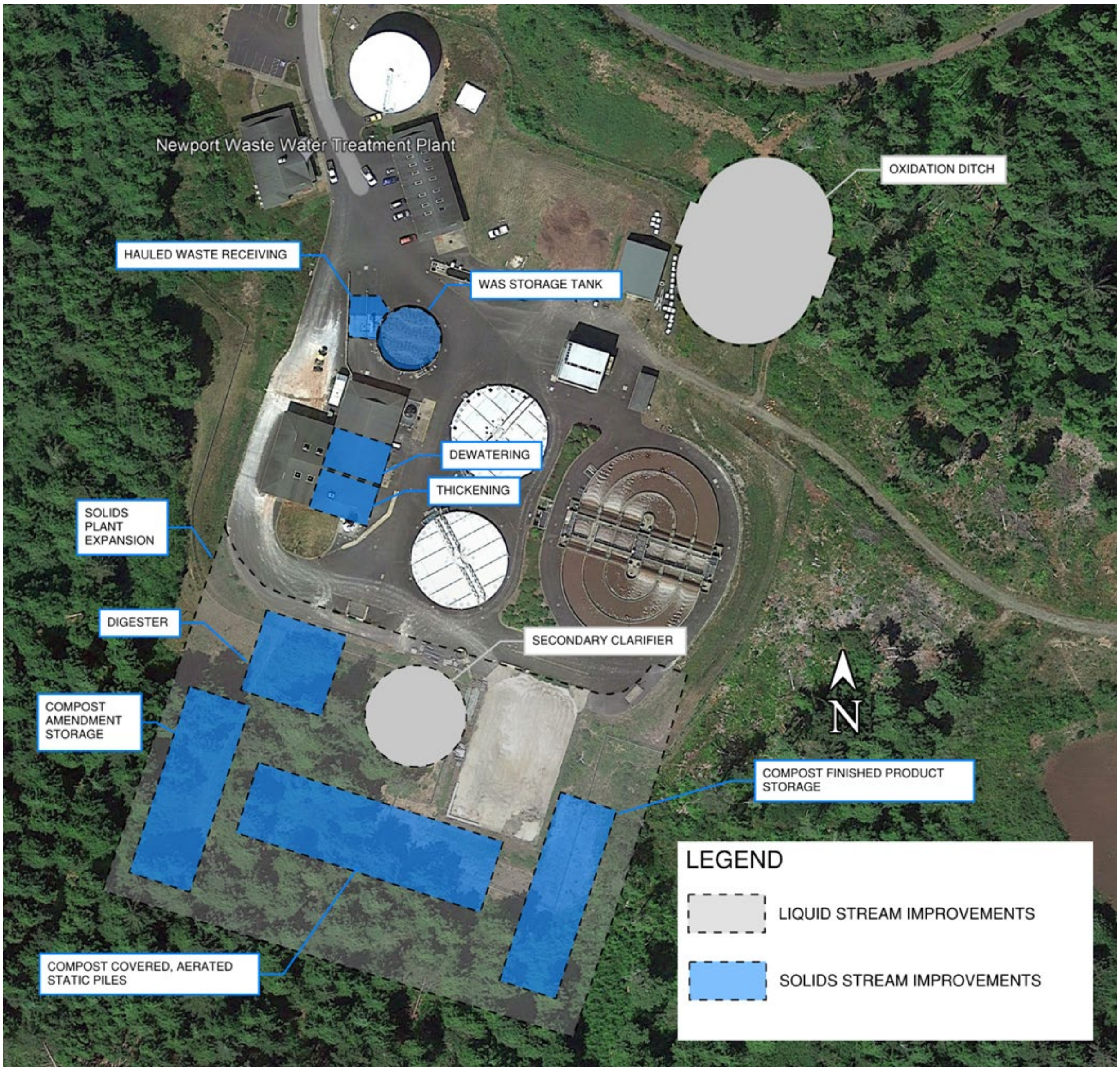

Figure 7-15. Recommended solids stream improvements site plan

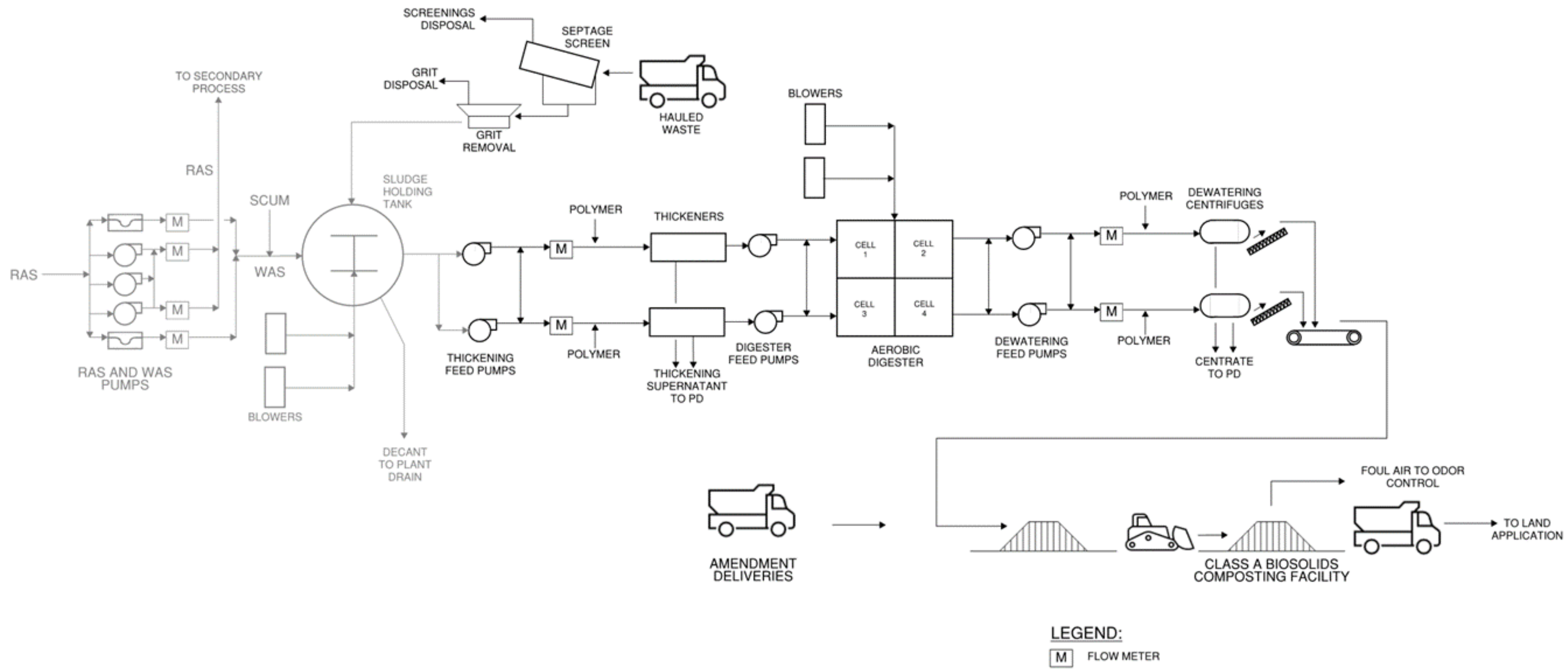

Figure 7-16. Recommended solids stream improvements process flow diagram

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Section 8

Northside Pump Station

Alternatives for Northside Pump Station were developed in a standalone TM under this project scope (see Appendix H). Imminent upgrades are required to replace failing equipment and address significant safety concerns. Ideally, a new facility would replace the existing facility entirely. Due to the limited funding available, the City has elected to proceed with interim improvements to address critical concerns while additional funding is secured to proceed with the incorporation of an entirely new buildout facility.

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Section 9

Recommendations and Conclusions

9.1 Near-Term Improvements

At the time of this WWTMP development, the following near-term upgrades are planned for key facilities:

1. NSPS Interim Improvements
2. NSPS Dechlorination Project
3. WWTP Centrifuge Replacements
4. WWTP Headworks Upgrades
5. WWTP Disinfection Improvements
6. Influent Pump Station Pipe Replacement

The NSPS interim improvements are summarized in Appendix H. Estimated design costs to incorporate dechlorination at this site have been developed separately and are driven by regulatory needs rather than condition or capacity reasons. Preliminary costs are included in Appendix I.

Imminent WWTP upgrades include headworks improvements, replacement of aging centrifuges, and disinfection pump replacements. Headworks upgrades are discussed in Section 3.2. Kennedy Jenks prepared a standalone TM presenting centrifuge alternatives and estimated costs, which is included as Appendix E

Detailed improvements to the disinfection system have been developed and are currently being incorporated into the existing system as time and funding allows. Key improvements are listed below. Preliminary costs are included as Appendix L.

- Two new peristaltic chemical delivery pumps to replace the existing diaphragm pumps.
- Associated pump skids to replace the existing chemical delivery system.
- Addition of a chorine analyzer assembly to ensure accurate chemical dosing.
- Submersible sewage pump to replace existing pump within the chlorine contact chamber.
- Addition of a submersible mixer within the chlorine contact chamber.
- Replacement of the existing disinfection storage tank due to recurring leaks.

The City is currently experiencing failure of pump suction and discharge piping at the influent pump station. While specific recommendations have not been developed as part of this WWTMP, replacement and rehabilitation is recommended as soon as funding can be secured. Complete pipe failures could cause flooding of raw sewage and unplanned pump shutdowns. Estimated yearly costs for all projects can be found in Section 9.2.2.

9.2 Liquids and Solids Process Alternative Criteria and Scoring

To facilitate selection of the liquids and solids process alternatives, the City of Newport (City) and Brown and Caldwell/Kennedy Jenks (BC/KJ) project team identified viable combinations of alternatives for the liquids process, solids stabilization, and solids processing alternatives. The team also developed a method of scoring non-cost considerations alongside life-cycle costs. Non-cost considerations were grouped into two categories, with subcategories:

1. **Operational Benefits**: Processes that optimize flexibility and simplicity in operations without compromising compliance or health and safety.
    a. *Process and Regulatory Flexibility*–Higher scores for alternatives that mitigate future risk. For biosolids, this can mean the ability to easily switch between Class A or B to provide for more beneficial use/disposal options. For liquids, this can mean the ability to adapt to potential future regulations (e.g., nutrients, metals, etc.).
    b. *Labor Requirements*–Higher scores for reduced need for additional full-time employees (FTEs) and level of skill required to run the proposed processes. Finding/retaining O&M staff has been a challenge for the City.
    c. *Simplicity, Reliability, and Health and Safety*–Higher scores for reduced level of effort required to operate and maintain in normal and failure modes, and how consistently the process is expected to meet design criteria. Intrinsic health and safety is also considered.
2. **Community Benefits**: Processes that optimize local resources and have minimal negative impacts on the community such as odor generation.
    a. *Fenceline Odor Potential*–Higher scores for reduced risk of odor migration offsite.
    b. *Expandability and Site Efficiency*–Higher scores for increased ease with which the process could be expanded for additional future loading. Higher scores also for processes that require less space at the treatment plant site and thus would not impact the constructability of potential future expansions.
    c. *Public Outreach and Resource Recovery*–Higher scores for processes that create an opportunity for the WWTP to be a community center and resource recovery facility.

The alternatives are identified and discussed in detail in Section 6 and Section 7. The viable combinations of alternatives and scoring is summarized in Figure 9-1.

	Alternative	**1**		**2**		**3**		**4**		**5**		**6**		**7**	
	Liquids Process	2nd Oxidation Ditch		2nd Oxidation Ditch		2nd Oxidation Ditch		2nd Oxidation Ditch		2nd Oxidation Ditch		Oxidation Ditch / Primary Clarifiers		Oxidation Ditch / Primary Clarifiers	
	Stabilization Process	No Stabilization		No Stabilization		No Stabilization		Aerobic Digester		Aerobic Digester		Anaerobic Digester		Anaerobic Digester	
	Solids Process	Existing RDP		Composting		Dryer		Composting		Dryer		Composting		Dryer	
Criteria	**Criteria Weight**	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
1 **Operational Benefits**	**50%**		**0.5**		**0.8**		**1**		**1.1**		**1.3**		**0.7**		**0.95**
Process and Regulatory Flexibility	20%	1	0.2	1	0.2	1	0.2	2.5	0.5	2	0.4	2	0.4	2.5	0.5
Labor Requirements	10%	1	0.1	2	0.2	3	0.3	2	0.2	3	0.3	1	0.1	2.5	0.25
Simplicity, Reliability, and Health and Safety	20%	1	0.2	2	0.4	2.5	0.5	2	0.4	3	0.6	1	0.2	1	0.2
2 **Community Benefits**	**30%**		**0.6**		**0.35**		**0.575**		**0.7**		**0.675**		**0.55**		**0.65**
Fenceline Odor Potential	15%	3	0.45	1	0.15	2.5	0.375	2	0.3	2.5	0.375	1	0.15	2	0.3
Expandability and Site Efficiency	5%	1	0.05	2	0.1	2	0.1	2	0.1	2	0.1	2	0.1	3	0.15
Public Outreach and Resource Recovery	10%	1	0.1	1	0.1	1	0.1	3	0.3	2	0.2	3	0.3	2	0.2
3 **Relative Cost (Net Present Value)**	**20%**	**3**	**0.6**	**2**	**0.4**	**2**	**0.4**	**2**	**0.4**	**2**	**0.4**	**2**	**0.4**	**2**	**0.4**
TOTAL	**100%**	2.3		1.9		**2.55**		**2.9**		**3.05**		2.2		**2.65**	

Each alternative assigned a score of 1 (negative / worse than average), 2 (average), or 3 (positive / better than average)

Figure 9-1. Alternatives evaluation criteria and scoring

Alternatives 4 and 5 were the highest scoring alternatives. Accordingly, the City and BC/KJ project team elected a second oxidation ditch with aerobic digestion as the liquids stream alternative and solids stabilization process, respectively. Subsequently, a more detailed cost analysis on the biosolids process confirmed selection of composting as the preferred alternative, with energy consumption and safety concerns associated with the biosolids dryer equipment being the primary deciding factors. Alternative 4 as presented in Figure 9-1 was selected for capital improvement planning efforts.

9.3 Capital Improvements Plan (CIP)

The following sections describe the basis and assumptions used to develop cost estimates for recommended projects, and the criteria used to prioritize individual projects within the CIP.

9.3.1 Cost Estimating Basics and Assumptions

An engineering opinion of probable construction costs (OPCC) has been developed for each of the improvement projects identified in previous sections. Project definitions and associated costs presented in this CIP are conceptual in nature due to the limited design information that is available at this stage of project planning. The scope of work for projects and studies were approximated based on equipment and/or facility size and comparison with similar replacement projects. As each project progresses into design and construction, the associated costs may vary as project-specific requirements are identified.

All estimates provided in this section were prepared in accordance with a Class 5 OPCC as defined by the AACE. A Class 5 estimate is appropriate for projects that have been developed to a conceptual level only. The purpose of a Class 5 estimate is to provide a cost that can be used in budgetary planning. The expected range in accuracy of a Class 5 estimate is from -20 percent to -50 percent low and +30 percent to +100 percent high and is typically developed through analogy to costs from similar construction, judgment, and parametric models. These cost estimates are based on unit costs developed using a combination of data from RS Means CostWorks® and recent bids, experience with similar projects, and foreseeable regulatory requirements. Project capital costs visualized by a figure or table in this report have been adjusted to reflect 2025 costs by applying a 5.0 percent cost increase to 2023 cost estimates for each project. Cost estimates performed in 2023 included in the attached appendices have not been updated to reflect 2025 costs.

The costs for each project in the CIP include an allowance for “soft costs” and for contingency, which were not included in the construction costs listed in previous sections. The “soft costs” are the portion a project’s total cost required to plan, design, and manage each project through construction and are estimated at the planning level using a percentage markup applied to the estimated construction cost. The contingency allowance accounts for aspects of the work that are currently unknown and that cannot be reasonably identified at the conceptual phase. The contingency allowance is also estimated at the planning level using a percentage markup, which can be reduced as the project is better understood through detailed design.

Adjustments to each project estimate were made using the following markups:

- 40 percent markup of the itemized construction sub-total was added to account for construction contingency and unforeseen work items.
- 38 percent markup of the total construction cost including contingency was added to account for project development services including project administration, planning, alternatives analysis, engineering design, surveying, permitting, construction administration, inspection, materials testing, etc.

Detailed cost estimates for each project, listed in Table 9-1, are included in the appendices. See Table 9-1 for specific reference information.

9.3.2 CIP Project Costs and Schedule

In addition to the wastewater treatment upgrades described in this report, key upgrades are required for aging collection system facilities, mainly NSPS and the IPS. Class 5 cost estimates are shown in Table 9-1 for the Alternative 4 system upgrades along with recommended implementation timeframes. Projects are set to start in FY27 due to current funding limitations, with schedules driven by the associated capacity, condition assessments, and balanced funding demands within the 10-year implementation timeframe. Most at-risk facilities are slated for upgrades earlier in this timeframe. The City's WWTP operations staff will need to mitigate current risks and overcome capacity limitations in the meantime.

Table 9-1. Capital Improvement Projects

Project	Estimated Cost	Schedule	Reference
Near-Term Improvements			
NSPS Interim Improvements	$7,230,000	2027-2029	Appendix H
NSPS Dechlorination	$3,930,000	2027-2029	Appendix I
WWTP Centrifuge Upgrades	$5,880,000	2027-2029	Appendix E
WWTP Disinfection Upgrades	$270,000	2027-2029	Appendix L
IPS Pipe Replacement[a]	$370,000	2029	See Note a.
WWTP Headworks Upgrades	$4,670,000	2029-2031	Appendix B
Liquids/Solids Process Selected Alternative and Longer-term Improvements			
WWTP 3rd Secondary Clarifier[c]	$21,640,000	2029-2032	Appendix C
WWTP Solids Upgrades	$34,130,000	2032-2035	Appendix D
IPS Upgrades[a]	$1,050,000	2034	See Note a.
WWTP 2nd Oxidation Ditch	$18,760,000	2035-2038	Appendix C
NSPS Buildout Facility	$49,180,000	2039-2041	Appendix H

a. *Detailed cost estimates for the Influent Pump Station (IPS) have not yet been developed. Costs shown are for reference only and based on improvements described by the City.*

b. *Additional engineering and administrative costs have been applied to projects for which this was not applied during capital cost development.*

c. *The 3rd secondary clarifier project cost was estimated assuming incorporation of pump stations and flow distribution improvements to prepare for the future 2nd oxidation ditch.*

Required funding for each project is expected to increase over the duration of the project. Projects expected to last 3 years will require 20 percent of the total funding for the first year, then 40 percent of total estimated cost during each of the next 2 years. Four-year projects will require approximately 10 percent of the total funding for the first year, then 20 percent, 35 percent, and 35 percent for the following years. This distribution was applied to each of the multi-year projects in Table 9-1 and used to develop Figure 9-2, which shows the estimated total yearly funding required for applicable projects occurring during each fiscal year. The costs in Figure 9-2 have been adjusted in the same way performed for Table 9-1 to reflect 2025 costs.

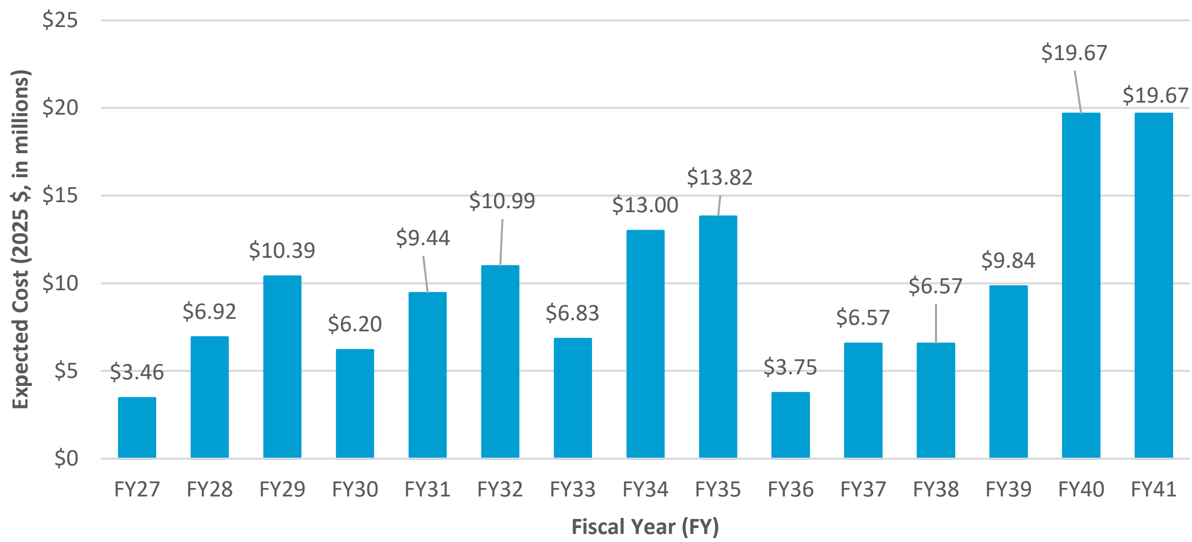

Figure 9-2. Capital cost distribution by year

9.3.3 System Development Charge (SDC) Estimates

Eligibility for System Development Charges (SDCs) can help offset the cost of the proposed improvements. To determine eligibility, the percentage of total project costs directly related to serving new customers is estimated and shown in Table 9-2. To clarify, improvements that represent a capacity expansion required by anticipated population growth are eligible for this funding. The costs shown in Table 9-2 have been updated to reflect 2025 costs by applying an average 5.0 percent cost increase from 2023 to 2025.

Table 9-2. System Development Charge (SDC) Summary

Project	Estimated Total Cost	Development Percentage	Estimated SDC Eligibility
NSPS Interim Improvements	$7,230,000	0%	$0
NSPS Dechlorination	$3,930,000	0%	$0
WWTP Centrifuge Upgrades	$5,880,000	50%	$2,940,000
WWTP Disinfection Upgrades	$270,000	0%	$0
IPS Pipe Replacement	$370,000	0%	$0
WWTP Headworks Upgrades	$4,670,000	25%	$1,167,500
WWTP 3rd Secondary Clarifier	$21,640,000	80%	$17,312,000
WWTP Solids Upgrades	$34,130,000	80%	$27,304,000
IPS Upgrades	$1,050,000	0%	$0
WWTP 2nd Oxidation Ditch	$18,760,000	80%	$15,008,000
NSPS Buildout Facility	$49,180,000	0%	$0

As most improvements are condition-driven rather than capacity-driven, most improvements are not eligible for SDC funding. These condition-related improvements are primarily associated with the Northside Pump Station and Influent Pump Station. The projects that are eligible are also partially condition-driven, as noted below.

1. The WWTP Centrifuge Upgrades are to address deteriorating conditions, operational and maintenance concerns, and already undersized equipment. The proposed increase in capacity to meet future conditions reflects the 50 percent SDC eligibility.
2. The WWTP Headworks Upgrades are largely driven by deteriorating conditions at the existing headworks facility, including screens which are past their service life and numerous corrosion issues. The addition of a third screen represents a capacity expansion, which is reflected in the 25 percent SDC eligibility.
3. The WWTP 3rd Secondary Clarifier and WWTP 2nd Oxidation Ditch represent capacity expansions, however, these projects are not fully SDC eligible because they introduce redundancy into the system, which is required due to the deteriorating condition of the existing clarifiers and oxidation ditch. The proposed SDC eligibility percentage for these two projects is 80 percent.
4. The WWTP Solids Upgrades, like the secondary clarifier and oxidation ditch, address aging infrastructure and condition concerns while increasing the capacity of the WWTP. Because of the associated increase in capacity, the proposed SDC eligibility percentage is 80 percent.

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Section 10

Limitations

This document was prepared solely for City of Newport in accordance with professional standards at the time the services were performed and in accordance with the contract between City of Newport and Brown and Caldwell dated March 9, 2017. This document is governed by the specific scope of work authorized by City of Newport; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by City of Newport and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Section 11

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