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KITSAP COUNTY

KINGSTON GENERAL SEWER PLAN UPDATE

January 2025

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ECOLOGY DRAFT

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Acronyms & Abbreviations

A	
AAF	Average annual flow
AACE	American Association of Cost Engineers
ADA	Americans with Disabilities Act
AFD	Adjustable Frequency Drive
AKART	all known and reasonable methods of prevention, control, and treatment
ANSI	American National Standards Institute
ASIL	Acceptable Source Impact Levels
ATS	Automatic Transfer Switch
B	
BOD	Biochemical oxygen demand
C	
CARA	Critical Aquifer Recharge Areas
CBOD	Carbonaceous biochemical oxygen demand
CCTV	Closed circuit television
CFR	Code of Federal Regulations
CIP	Capital improvement plan/program
CMMS	Computerized maintenance management system
CMOM	Capacity Management Operations and Maintenance
CMU	Concrete masonry unit
COD	Chemical Oxygen Demand
CoF	Consequence of failure
County	Kitsap County
CPU	Central processing unit
CT	Current Transformer
CWA	Clean Water Act
D	
DCD	Department of Community Development
DHI	Danish Hydraulic Institute
DMR	Discharge Monitoring Report
DO	Dissolved oxygen
DOH	Washington State Department of Health
E	
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERU	Equivalent Residential Unit
ESA	Endangered Species Act
F	
FOG	Fats, Oils, and Grease

fps	feet per second
FTE	Full-Time Equivalent
FWPCA	Federal Water Pollution Control Act
G	
GBT	Gravity belt thickener
GIS	Geographic Information Systems
GMA	Growth Management Act
gpcd	Gallons per Capita Per Day
gpd	gallons per day
gpd/sf	Gallons per day per square foot
gpm	gallons per minute
H	
H/H	Hydraulic and hydrologic
HP	Horsepower
HPA	Hydraulic Project Approval
HVAC	Heating, ventilation, and air conditioning
I	
I&I	Infiltration and inflow
I/O	Input/output
IBC	International Building Code
IFC	International Fire Code
IMC	International Machine Code
IPS	Individual Pump Stations
ISI	Industrial Systems Inc.
K	
KCCP	Kitsap County Comprehensive Plan
KPUD	Kitsap Public Utility District
kV	Kilovolt
kVA	Kilovolt amperes
L	
LAMIRD	Limited Area of More Intense Rural Development
LEL	Lower Explosive Limit
LUV	Land Use Vision
M	
MCC	Motor control center
MG	million gallons
mg/L	Milligrams per liter
MGD	million gallons per day
mL	Milliliter
MLLW	Mean lower low water
MLSS	Mixed liquor suspended solids
MMDF	Maximum Month Design Flow

MMDWF	Maximum month dry weather flow
MMWWF	Maximum month wet weather flow
N	
NASSCO	National Association of Sewer Service Companies
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NOC	Notice of Construction
NPDES	National Pollutant Discharge Elimination System
NSR	New Source Review
O	
O&M	operation and maintenance
OCI	Overall Condition Index
OFM	Washington State Office of Financial Management
OIT	Operator interface terminal
OPPC	Opinions of probable project cost
Orange Book	Washington State Department of Ecology's Criteria for Sewage Works Design
ORP	Oxidation Reduction Potential
Ortho-P	Orthophosphate
OSHA	Occupational Safety and Health Administration
P	
PDF	Peak day flow
PFAS	Per- and polyfluoroalkyl substances
PHF	Peak hour flow
Plan	General Sewer Plan Update
PLC	Programmable Logic Controllers
POTW	Publicly Owned Treatment Works
ppcd	pounds per capita per day
ppd	pounds per day
PSCAA	Puget Sound Clean Air Agency
PSD	Prevention of Significant Deterioration
PSE	Puget Sound Energy
psi	pounds per square inch
PSNGP	Puget Sound Nutrient General Permit
PSRC	Puget Sound Regional Council
R	
RAS	Return activated sludge
RCW	Revised Code of Washington
S	
SCADA	Supervisory Control and Data Acquisition
SCFM	standard cubic feet per minute

SCS	Soil Conservation Service
SEPA	State Environmetal Policy Act
SERP	Washington State Environmental Review Process
SF	Square feet
SHPO	State Historic Preservation Officer
SRT	Solids retention time
SSO	Sanitary Sewer Overflow
T	
TAC	Toxic air contaminants
TAZ	Traffic Analysis Zone
TIN	Total Inorganic Nitrogen
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TSS	Total suspended solids
TWAS	Thickened waste activated sludge
U	
UBC	Uniform Building Code
UFC	Uniform Fire Code
UGA	Urban Growth Area
UOS	Unstable old landslides
UPC	Uniform Plumbing Code
URS	Unstable recent slides
USACE	United States Army Corps of Engineers
UV	Ultraviolet
V	
VAC	Volts of alternating current
VFD	variable frequency drive
VSS	Volatile suspended solids
W	
WAC	Washington Administrative Code
WAS	Waste activated sludge
WHGC	White Horse Golf Course
WRIA	Water Resource Inventory Area
WWTP	Wastewater treatment plant

Executive Summary

ES.1 Introduction

Since the 1950s, Kitsap County (County) has worked to protect aquifers, surface water, and the Puget Sound by providing wastewater collection, treatment, and discharge. This Kingston General Sewer Plan Update (Plan) provides a road map for the Kingston service area's long-term wastewater infrastructure needs for the next 20 years. Planning the wastewater infrastructure needs of a dynamic and fast-growing region is challenging. Expanding populations in the County will require sewer service and the County will be responsible for appropriately collecting, conveying, and treating increasing wastewater flows. Infrastructure design and implementation will be strategically planned to maximize limited fiscal resources. Federal, State, and Locate regulations all contribute to a need to be on the cutting edge of emerging technologies and require the utility to continually think ahead. Planning at this level involves weighing a complicated array of interconnected—and often conflicting—factors and variables. This Plan provides a framework for the County to continue to manage growth within the context of a countywide wastewater service network and achieve the overall goal of providing sewerage service to protect public health and the quality of Kitsap and the Puget Sound's water resources.

The State of Washington adopted the Growth Management Act (GMA) with the intent of creating a consistent and unified growth planning process. The GMA requires that the County create and enact a Comprehensive Plan to provide a 20-year blueprint for local policy, planning and capital facility investment. A Comprehensive Plan is used as a guide for local governments through the establishment of vision statements, goals, objectives, policies, and implementing actions. This Plan constitutes the sewer capital facilities element of the Kitsap County Comprehensive Plan (KCCP). At the time of adoption, this Sewer Plan is consistent with the other elements of the KCCP.

This Plan is based on planning horizons of a six-year period (2023 to 2028), and a 20-year period (2029 to 2042). An updated KCCP is currently in progress and will cover a 20-year planning period from 2024 to 2044. Therefore, the recommendations and conclusions presented in this Sewer Plan have been reviewed to confirm alignment with the 2044 planning horizon of the Comprehensive Plan.

This Plan is also aligned with the County's *Water as a Resource* policy, adopted in 2009 and reaffirmed in 2016. One of the aims of *Water as a Resource* policy is to reduce water pollution. Implementation of the projects presented in this Plan are a direct expression of the County's guiding principle to view water as a valuable resource worthy of protection and careful stewardship.

Organization of the Plan

The Plan is organized into twelve sections that cover the Kingston wastewater system:

- **Section 1: Introduction** provides an overview of the Kingston service area, ownership of the system, and contents of the Plan.
- **Section 2: Service Area Characterization** reviews the physical and administrative characteristics of the Kingston wastewater collection basin.

- **Section 3: Population, Load, and Flow Projections** estimates the current sewer system population, analyzes the impact of projected population growth, and estimates future wastewater flows and loads within the Kingston service area.
- **Section 4: Regulatory Requirements** identifies relevant federal, state, and local regulatory requirements that affect planning and operations of the wastewater system.
- **Section 5: Collection and Conveyance Existing Conditions** evaluates existing conditions of the system's gravity sewers, pump stations, and force mains based on site visits, video inspections of pipes, and discussion with County staff.
- **Section 6: Wastewater Treatment Plant Existing Conditions** evaluates existing conditions of the Kingston Wastewater Treatment Plant (WWTP) facilities, processes, and equipment based on site visits, discussion with plant operators, historical plant performance, and modeling of the plant processes.
- **Section 7: Collection and Conveyance System Analysis** analyzes sewer system capacity and alternatives for improvements to the system using a hydraulic model and evaluating system performance during a 25-year, 24-hour storm event.
- **Section 8: Wastewater Treatment System Analysis** analyzes improvements needed to maintain and upgrade the Kingston WWTP based on condition deficiencies, capacity inadequacies, and regulatory requirements.
- **Section 9: Recycled Water** evaluates opportunities for recycled water reuse so that water treated at the Kingston WWTP can be used for beneficial purposes instead of discharged to the Puget Sound.
- **Section 10: Operations and Maintenance** documents the County's management structure, details the wastewater system operation and maintenance (O&M) practices, and makes suggestions to improve utility operation practices.
- **Section 11: Capital Improvement Plan** provides a 20-year plan for implementing capital improvement plan (CIP) projects that improve the operation of the collection and conveyance system and Kingston WWTP.
- **Section 12: Financial Strategy** identifies financial approaches to fund the CIP.

General Sewer Plan Requirements

This Plan meets the Washington State Department of Ecology (Ecology) regulations for general sewer plans contained in the Washington Administrative Code (WAC) 173-240-050.

Table ES-1 summarizes the requirements and the sections in the 2024 Plan where the requirements are addressed.

Table ES-1 | WAC 173-240-050 Requirements

Section	Section Description	Location in Plan
3.a	The purpose and need for the proposed plan.	Section 1.2
3.b	A discussion of who will own, operate, and maintain the systems.	Section 1.5
3.c	The existing and proposed service boundaries.	Figure 2-1

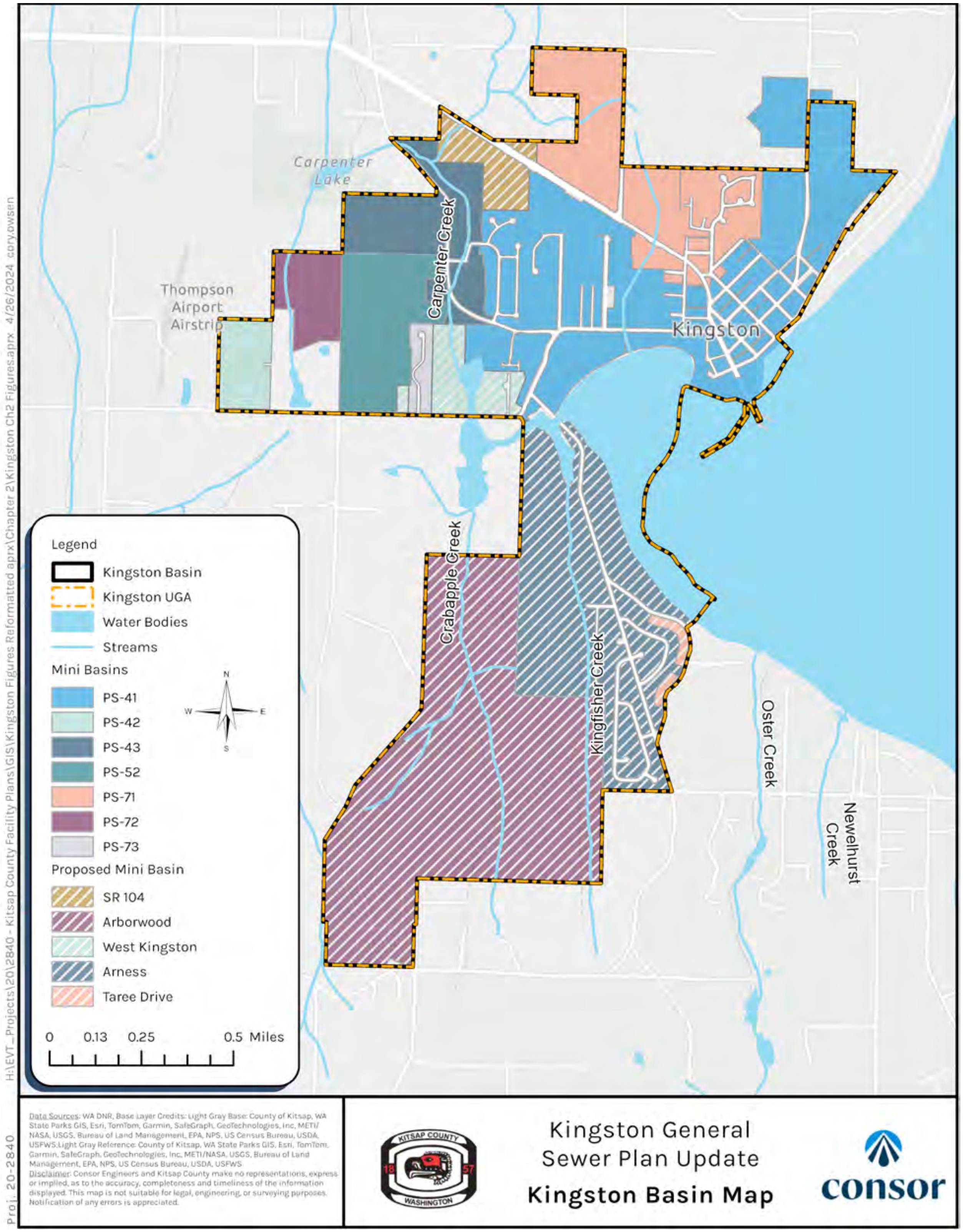
Section	Section Description	Location in Plan
3.d.i	Boundaries. The boundary lines of the municipality or special district to be sewered, including a vicinity map;	Figure 2-1
3.d.ii	Existing sewers. The location, size, slope, capacity, direction of flow of all existing trunk sewers, and the boundaries of the areas served by each;	Section 5 and Section 6
3.d.iii	Proposed sewers. The location, size, slope, capacity, direction of flow of all proposed trunk sewers, and the boundaries of the areas to be served by each;	Section 11
3.d.iv	Existing and proposed pump stations and force mains. The location of all existing and proposed pumping stations and force mains, designated to distinguish between those existing and proposed;	Section 5, Section 11
3.d.v	Topography and elevations. Topography showing pertinent ground elevations and surface drainage must be included, as well as proposed and existing streets;	Figure 2-2
3.d.vi	Streams, lakes, and other bodies of water. The location and direction of flow of major streams, the high and low elevations of water surfaces at sewer outlets, and controlled overflows, if any. All existing and potential discharge locations should be noted;	Figure 2-4
3.d.vii	Water systems. The location of wells or other sources of water supply, water storage reservoirs and treatment plants, and water transmission facilities.	Figure 2-5
3.e	The population trend as indicated by available records, and the estimated future population for the stated design period. Briefly describe the method used to determine future population trends and the concurrence of any applicable local or regional planning agencies.	Section 3
3.f	Any existing domestic or industrial wastewater facilities within twenty miles of the general plan area and within the same topographical drainage basin containing the general plan area.	Figure 1-1
3.g	A discussion of any infiltration and inflow problems and a discussion of actions that will alleviate these problems in the future.	Section 3.4.3
3.h	A statement regarding provisions for treatment and discussion of the adequacy of the treatment.	Section 6
3.i	List of all establishments producing industrial wastewater, the quantity of wastewater and periods of production, and the character of the industrial wastewater insofar as it may affect the sewer system or treatment plant. Consideration must be given to future industrial expansion.	Section 4
3.j	Discussion of the location of all existing private and public wells, or other sources of water supply, and distribution structures as they are related to both existing and proposed domestic wastewater treatment facilities.	Figure 2-5
3.k	Discussion of the various alternatives evaluated, and a determination of the alternative chosen, if applicable.	Section 7 and Section 8
3.l	A discussion, including a table, that shows the cost per service in terms of both debt service and O&M costs, of all facilities (existing and proposed) during the planning period.	Section 10, Section 11, and Section 12
3.m	A statement regarding compliance with any adopted water quality management plan under the Federal Water Pollution Control Act (FWPCA) as amended.	Section 4
3.n	A statement regarding compliance with the State Environmental Policy Act (SEPA) and the National Environmental Policy Act, if applicable.	Section 4

ES.2 Service Area Characterization

The County provides sewer service within the Kingston basin. The Kingston basin map is shown in **Figure ES-1**. The Kingston basin spans approximately 1,235 acres and is bounded by rural residential properties on three sides and Puget Sounds to the east. The basin contains small, unnamed lakes and streams in addition to several parks and neighborhood developments.

The County has established urban growth area (UGA) boundaries, land use designations, and zoning in accordance with the GMA. Urban level services, including sewer service, is not allowed outside of the UGA with limited exceptions. The County owns and maintains the sewer collection system that provides service primarily to the northern portion of the Kingston UGA, except the Kingston WWTP which is located to the west of the UGA. The system includes approximately 57,400 feet of gravity pipe, 26,000 feet of force main pipe, and 7 pump stations. All sewer flows within the basin are conveyed and treated at the Kingston WWTP.

Figure ES-1 | Kingston Basin Map



E.3 Population, Load, and Flow Projections

Current population and population growth are critical factors when considering required capacity and potential upgrades to the sewer system since sewer flows and population are closely linked.

The current sewered population in the Kingston basin was estimated based on an average of 2.5 people per equivalent residential unit (ERU). An ERU is a system specific unit of measure used to estimate wastewater volumes in the system based on the flow produced by an average single-family household.

Growth is presumed to occur within the UGA according to the land use designations and zoning in the 2016 KCCP. This plan, at the time of writing, is in alignment with the KCCP effort and is able to support the growth strategies described therein. The sewered population growth rate is estimated to be 4.04 percent based on the Puget Sound Regional Council (PSRC) and Washington State Office of Financial Management (OFM) information. The total current and projected populations for the sewered areas in Kingston basin are summarized in **Table ES-2**. Additionally, the Kitsap County Department of Community Development (DCD) prepared population projections as part of their update to the Comprehensive Plan. The population projects presented in this General Sewer Plan Update are consistent with the Comprehensive Plan update.

Table ES-2 | Kingston Basin Current and Projected Sewered Population

Year	Sewered Population
2020	2,553
2028	3,929
2042	6,337
2044	6,681*

Note:
*Extrapolated from 2042 population

Wastewater flows and loadings heavily influence WWTP facility design. Consequently, data related to wastewater characteristics and projected flows and loadings affect the selection of key criteria used to select project alternatives for further consideration. The existing flows and loads at Kingston WWTP were evaluated from January 2018 through June 2020 and correlated to current population to develop per capita values. The existing and projected flows and loads for the Kingston WWTP over the 20-year planning horizon are presented as **Table ES-3** and **Table ES-4**. Consistent with Ecology guidelines, flows are developed for average annual flow (AAF), maximum month wet weather flow (MMWWF), maximum month dry weather flow (MMDWF), peak day flow (PDF), and peak hour flow (PHF). Loads are developed for biochemical oxygen demand (BOD), total suspended solids (TSS), and total Kjeldahl nitrogen (TKN).

Table ES-3 | Kingston WWTP Current and Projected Flows

Flow Event	2020	2028	2042
AAF (MGD)	0.11	0.17	0.27
MMWWF (MGD)	0.15	0.23	0.36
MMDWF (MGD)	0.12	0.18	0.29
PDF (MGD)	0.21	0.32	0.51
PHF (MGD)	0.57	0.87	1.41

Note:
MGD = million gallons per day

Table ES-4 | Kingston WWTP Current and Projected Loads

Parameter	2020			2028			2042		
	AA	MMWW	MMDW	AA	MMWW	MMDW	AA	MMWW	MMDW
BOD (ppd)	280	533	525	431	821	766	696	1,324	1,236
TSS (ppd)	285	429	378	438	660	550	707	1,064	887
TKN (ppd)	54	65	72	84	101	111	135	162	179

Note:
ppd = pounds per day

ES.4 Regulatory Requirements

Collection, conveyance, and treatment facilities operation, design, and construction are regulated through federal, state, County, and local regulations. The regulations are detailed in **Section 4**.

The National Pollutant Discharge Elimination System (NPDES) program, administered by Ecology, is the primary permit for Kingston WWTP, which has been issued NPDES Permit No. WA0032077. The permit went into effect in 2015, was set to expire in 2020, was administratively continued, and remains in effect as of the date of this Plan. The permit includes limits on plant capacity and treated effluent discharge, solids disposal requirements, monitoring requirements, recordkeeping and reporting criteria, and O&M requirements.

In addition, Ecology recently issued the first Puget Sound Nutrient General Permit (PSNGP), effective as of Jan. 1, 2022. The Kingston WWTP is classified as a small Total Inorganic Nitrogen (TIN) load plant and is required to implement nutrient monitoring and reporting, develop a nutrient optimization plan, prepare and submit an approvable all known, available, and reasonable methods of prevention, control, and treatment (AKART) analysis. Evaluating compliance with the new PSNGP and developing options for anticipated future nutrient permit requirements is a key focus of the Kingston WWTP condition assessment and alternative analysis.

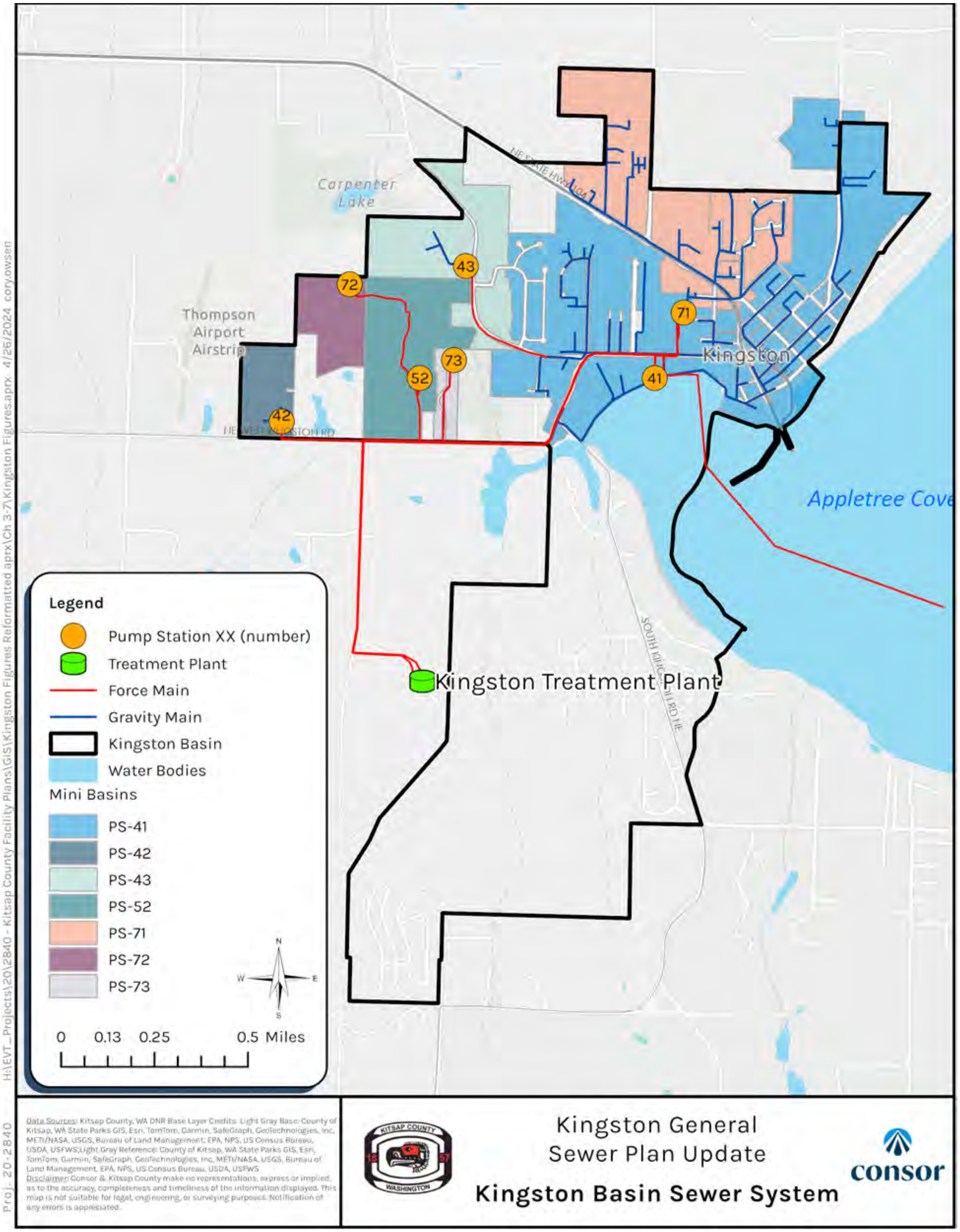
ES.5 Collection and Conveyance Existing Conditions

The Kingston basin collection and conveyance system is comprised of sewer assets owned and operated by the County within the northern portion of the Kingston UGA, except the Kingston WWTP which is located to the west of the UGA. The Kingston collection and conveyance system is shown in **Figure ES-2**. A detailed review of the existing collection and conveyance system is provided in **Section 5**.

Flows from the northern portion of the basin are routed through pump stations to the Kingston WWTP. Effluent from the WWTP is conveyed via an 18-inch diameter force main to Appletree Cove where it discharges. The Kingston basin currently contains seven mini basins: 41, 42, 43, 52, 71, 72, and 73. It is anticipated that sewer service will be eventually extended to cover the Kingston UGA.

There is approximately 57,400 feet of gravity main in the Kingston collection system. The County owns most of the pipes, which range in size from 6 inches to 12 inches in diameter. Approximately 1,000 feet of pipe are privately owned. There are approximately 26,000 feet of sewer force mains that convey pumped wastewater.

Figure ES-2 | Kingston Sewer System



There are seven pump stations within the Kingston sewer system: PS-41, PS-42, PS-43, PS-52, PS-71, PS-72, and PS-73. The firm capacity ranges from 20 gallons per minute (gpm) at PS-52 to 450 gpm at PS-71. The County classifies their pump stations as Critical, Regional, Relay, or Satellite pump stations based on how many mini-basins (or upstream pump stations) discharge into the pump station. **Table ES-5** shows the classification and number of pump stations in the Kingston basin. Pump station capacity typically increases from about 100 gpm for satellite stations to about 350 gpm for the critical pump stations.

Table ES-5 | Pump Station Type Consequence of Failure Definitions

Pump Station Type (from County)	Tributary Pump Stations	Number of Pump Stations in Kingston Basin
Satellite	0	5
Relay	1	0
Regional	2-3	0
Critical	4+	2

An evaluation of the pump stations was conducted consisting of site visits and discussions with County staff. To better inform the County's prioritization of future asset upgrades and replacements, an overall pump station "Asset Health" score was developed that synthesizes each pump station's existing likelihood of failure (condition) and consequence of failure (CoF). Each criterion is rated on a 1 to 5 scale where higher numbers indicate worse condition and high criticality, then the scores are multiplied together to get the overall Asset Health score (potential range from 1 to 25). The resulting scores ranged from 3.2 to 16, with one pump station rating higher than 10, five pump stations rated between five and 10, and one pump station rated below five.

The County has historically conducted pipeline condition assessments through video observation with the ability to examine the entire conveyance system in a 5-year cycle. This process entails inspecting pipes via closed circuit television (CCTV), storing the video in a database, reviewing the video, and assigning an Overall Condition Index (OCI) score based on the observations. The OCI score ranges from 0 to 100 with higher numbers indicating better condition.

The criteria that are scored for the OCI score are:

- Obstruction or Intrusion
- Worn Surface
- Belly or Sag in Pipe
- Crack or Fracture
- Break or Failure
- Lining or Repair Failure
- Joint Separation or Offset

The lengths of pipe in each OCI range are summarized in **Table ES-6**. Overall, the system is in good condition and none of the pipes in the Kingston basin are rated as moderate or severe condition.

Table ES-6 | Summary of Pipes OCI Scores

OCI Range	Length (ft)	Percentage of Total
0-20	-	0%
20-40	-	0%
40-60	-	0%
60-80	-	0%
80-99	3,600	6%
100	53,800	94%

ES.6 Wastewater Treatment Facilities Existing Conditions

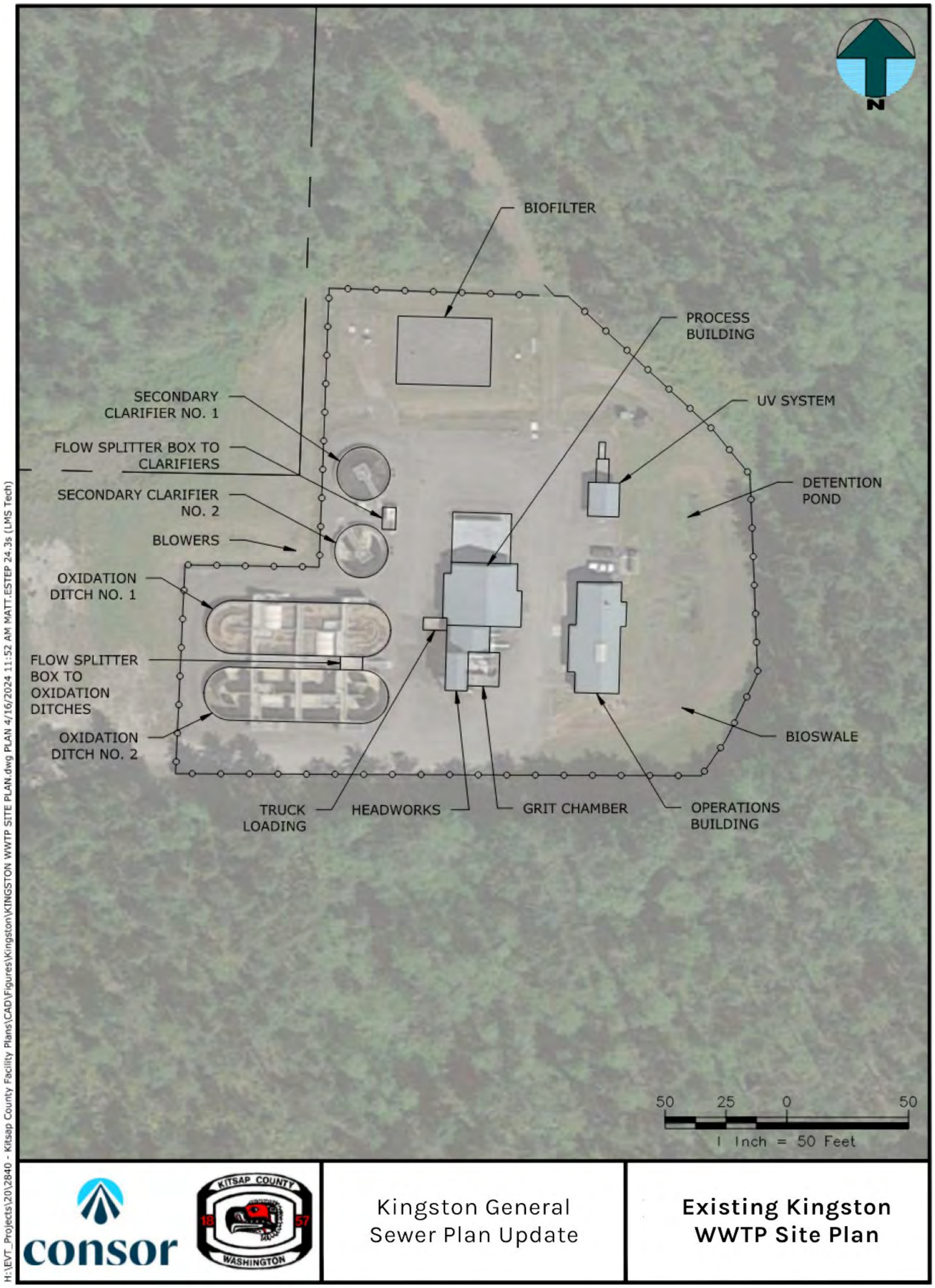
The Kingston WWTP was constructed in 2005, replacing a WWTP originally constructed in 1974. In 2006, the outfall to Appletree Cove was replaced and realigned. The Kingston WWTP is permitted to treat a maximum month design flow of 0.292 MGD. The plant is an oxidation ditch (extended aeration) type activated sludge facility. The Kingston WWTP site plan is shown in **Figure ES-3** with major structures and processes identified. The plant is located at the south end of Norman Road NE with undeveloped forested property on the east, south, and west sides, and rural residential properties to the north.

Plant processes are preliminary screening and grit removal, biological treatment in two oxidation ditches, two secondary clarifiers, and ultraviolet (UV) disinfection. Sludge removed from the secondary clarifiers is thickened with a gravity belt thickener (GBT) and sent to the County's Central Kitsap WWTP for further treatment and disposal. Treated effluent is discharged to the Appletree Cove of the Puget Sound in accordance with the NPDES Permit.

An evaluation of Kingston WWTP was conducted that consisted of a site review of equipment, facilities, processes, discussions with WWTP staff to understand operational issues, and analysis and modeling to determine capacity. Overall unit process Asset Health scores were developed, using the same method as the pump stations, to synthesize the condition and CoF. Each criterion is rated on a 1 to 5 scale where higher numbers indicate worse condition and high criticality, then the scores are multiplied together to get the overall Asset Health score (potential range from 1 to 25). All of the processes scored between 5 and 10, indicating fair to good overall condition.

A Visual Hydraulics© model was created to determine the hydraulic capacity and a Biowin© biological process model was used to evaluate the biological capacity of the existing Kingston WWTP unit processes. Model results indicated that all unit processes have sufficient hydraulic and biological capacity to handle existing and future flow and loads to meet current permit requirements.

Figure ES-3 | Existing Kingston WWTP Site Plan



ES.7 Collection and Conveyance System Analysis

The Kingston collection system was modeled using the Danish Hydraulic Institute's (DHI's) MIKE+ hydraulic and hydrologic (H/H) modeling platform to determine capacity deficiencies in the system. The projected population and increased rainfall due to climate change are the basis for establishing future system requirements. The model was developed using geographic information system (GIS) shapefiles, provided by the County, for the collection system, land use, contours, and soils in the Kingston basin. The model was calibrated to data from flow monitors installed in the collection system. The meters collected flow data from October 2020 through April of 2021. Results were compiled for the existing, 2042, and 2080 planning horizons using a 25-year 12-hour design storm.

Manholes, pipes, and pump stations were analyzed for deficiencies using the H/H model. Manholes are considered to have sanitary sewer overflows (SSOs) when the simulated water surface elevation in a manhole exceeds the rim elevation. Pipes are considered surcharged when the simulated water surface elevation in the upstream or downstream manhole connection exceeds the pipe crown. Pump stations are under capacity when the simulated flow to a pump station meets or exceeds the pump station firm capacity which is the station capacity with the largest pump out of service.

The total SSO count, surcharged gravity pipes, and velocity exceeded pipes are included in **Table ES-7**. Detailed maps can be found in **Section 7**. The results indicate that the PHF exceeds the firm capacity of PS-41 and PS-71 in all three planning horizons. These are the two largest pump stations in the Kingston basin, and PS-41 collects flow from the other stations and pumps to PS-71.

Table ES-7 | Pipe and Manhole Capacity Criteria

Scenario	Surface Sewer Overflows (SSO)	Number of Pipes Surcharged (Either end)
2022	0	10
2042	0	10
2080	0	11

ES.8 Wastewater Treatment System Analysis

The results from the WWTP Existing Conditions analysis were used to identify processes that require improvement and define feasible alternatives for WWTP improvements for the 6-year and 20-year planning horizons. Minor maintenance, repairs, and direct replacements were not subject to a full alternatives analysis due to the relatively simple nature of replacements or expansions. The recommended improvements follow.

Preliminary Treatment

All components (mechanical equipment, piping, and structures) of the preliminary treatment system are in fair or good condition and have adequate capacity through the 2042 planning period, therefore no improvements are required.

Secondary Treatment

The secondary treatment system was originally constructed in 2005 and upgrades to equipment and instrumentation in oxidation ditches were completed in 2020. The secondary clarifiers are generally in good condition. The only recommended improvement is to install ammonia and nitrate probes in the oxidation ditch to provide direct monitoring of nitrogen removal.

Disinfection

The UV equipment was installed in 2015 and is an older, basic model. Additional control and monitoring capabilities beyond what the current basic controller can offer is desired by the plant staff and will improve energy efficiency. Replacing the UV system with a Trojan UV3000Plus unit and controller is recommended but is not urgent, as the current unit works consistently and has adequate capacity.

Solids Treatment

The GBT was installed in 2005. It was observed that the GBT room had a very strong odor and operation staff confirmed this is common, indicating that the heating, ventilating, and air conditioning (HVAC) system may be underperforming. This may contribute to a more corrosive environment in the room. Maintenance and investigation of the HVAC system in the GBT room is recommended to address this issue before it creates bigger problems. Other solids treatment equipment works well and has adequate capacity, so additional upgrades are not needed.

Non-Potable Water System and Process Water Systems

Some equipment related to these systems will require in-kind replacement due to age and/or condition.

Odor Control

The odor control system was not functioning during the condition assessment visit but has since been repaired. Strong odor and corrosion were noted in the GBT room during the condition assessment. The odor should be reduced now that the odor control system is running again, but the corrosion may indicate that the HVAC system is not providing enough ventilation. Further investigation of the HVAC system is recommended to determine if upgrades are needed.

Electrical and Power Distribution System

Replacement of obsolete adjustable frequency drives (AFDs), programmable logic controllers (PLCs) and operator interface terminals (OITs) programs verification, and replacement of select electrical panels are needed.

Additionally, the County has recently completed a series of *Supervisory Control and Data Acquisition (SCADA) Master Plan technical memoranda* (HDR, 2022, Appendix F) that include an overview of the existing SCADA system, review of use and needs, selection of preferred technologies, and a project identification, estimate, and CIP.

ES. 9 Recycled Water

Recycling treated wastewater can provide numerous benefits, including conservation of limited groundwater resources, reduction of effluent discharge to the Puget Sound, and replenishment of streams and fish habitat. Use of recycled water to replace the use of potable water for non-potable purposes, such as irrigation, toilet flushing, reduces the stress on area groundwater and supports sustainable management of that limited resource. Prior County planning has resulted in the definition of a potential recycled water project. As described in the *Kingston Recycled Water Facility Plan* (Brown and Caldwell, 2020, Appendix I), the two applications deemed most feasible for recycled water use if it were produced at the Kingston WWTP are:

- Summer-time irrigation at the White Horse Golf Course (WHGC).
- Winter-time indirect groundwater recharge in an area north of WHGC, at North Kitsap Heritage Park.

The envisioned recycled water project would replace 29 million gallons (MG) per year of groundwater supply provided by the Kitsap Public Utility District (KPUD) for irrigation purposes at WHGC and infiltrate approximately 107 MG per year into the shallow aquifer that provides baseflow to Grovers Creek and its tributaries. Through this bolstering of groundwater levels, the baseflow in Grovers Creek could increase by up to 0.5 cubic feet per second, potentially providing 328 acre-feet per year to serve as an offset to consumptive impacts of new permit-exempt domestic groundwater withdrawals.

In addition to the projects described in the *Kingston Recycled Water Facility Plan,* a cursory review of other potential uses of recycled water was conducted. The County coordinated with water providers and potential stakeholders to determine if there are opportunities for irrigation use in the vicinity of the Kingston WWTP. Entities contacted were:

- Kitsap Public Utility District. KPUD has actively researched recycled water opportunities, having implemented a system in Port Gamble and considering integration into future housing developments. Additional coordination with that development group would be required to determine the level of feasibility of implementing such uses.
- Kitsap County Parks Department. A discussion was held but it was determined that there are no sites where recycled water use would be cost-effective at this time.

To produce Class A reclaimed water for the proposed irrigation and infiltration uses, upgrades to Kingston WWTP are required. *Kingston Recycled Water Facility Plan* presents a conceptual layout and sizing of facilities to produce 0.7 MGD of recycled water. The required upgrades include upgrades to the oxidation ditches, a new secondary effluent equalization tank, a tertiary filtration system, a UV and chlorine disinfection system, a recycled water pump station, and a recycled water distribution pipeline.

The capital investment to implement recycled water can be significant and is greater than what can be realistically recouped through recycled water rates. The County should seek low-interest loans or grant money from the state or federal government to support reuse implementation. Additionally, the County should continue stakeholder and public outreach and engagement and development of recycled water policies and procedures to support the program.

ES. 10 Operations and Maintenance

Section 10 includes a summary of the O&M programs for the collection and conveyance system, and the Kingston WWTP. A review of state and federal requirements that impact the County's O&M program are also included in Section 10.

The Sewer Utility Division consists of four main work groups: Utilities O&M (WWTPs and pump stations), Field Operations (collection system piping), Engineering and Administration, and Construction Management. A total of 72 staff work in the Sewer Utility Division and oversee O&M across each of the County's four wastewater systems. O&M activities include regular inspection of pump stations, cleaning and inspection of pipes, preventative maintenance of WWTP equipment, ongoing records management for all components of the system, and review and updates to the WWTPs O&M manual.

A staffing analysis was conducted for the collection and conveyance system and Kingston WWTP and determined that staffing levels and certifications are appropriate and adequate for current operations. No additional staff is expected to be required though the 20-year planning period.

Conclusions and recommendations based on a review of the County O&M practices are:

- Train and certify CCTV operators in National Association of Sewer Service Companies assessment to improve the consistency of sewer inspecting rating.
- Review spare parts inventories and assess the need for additional spare parts due to supply chain challenges.
- Institute an annual valve exercising and maintenance program.
- Develop training program to accelerate employees into Operator Certification Group III and prepare for anticipated Puget Sound Nutrient Reduction Goals and facility upgrades.
- Institute an Arc Flash Analysis and Protection program and incorporate as capital projects are designed and constructed.

ES.11 Capital Improvement Plan

The CIP projects were developed to remedy existing system deficiencies, address regulatory requirements, and provide adequate capacity for projected flows and loads. CIP projects to address immediate needs are presented in a 6-year planning horizon (from 2023 to 2028) and future CIP projects are included in the 20-year planning horizon (from 2029 to 2042). A planning level cost opinion of CIP project implementation is provided. It is assumed that minor projects will be completed with O&M budget, therefore they are not included in the CIP. CIP projects for the 6-year and 20-year planning horizons are presented in **Table ES-8**, **Table ES-9**, and **Table ES-10**. A preliminary implementation timeline of the CIP is provided in **Section 11**. There are no treatment projects proposed for the 6-year planning horizon. If funding becomes available, two proposed CIP projects, one collection and conveyance and one treatment, should be considered in the 6-year CIP.

Table ES-8 | 6-Year Kingston Collection and Conveyance Capital Improvement Projects

CIP No.	Item	Total Project Cost
CIP-K-CC-CAP-1	Replace PS-41 and Forcemain	$3,700,000
	Total	**$3,700,000**

Table ES-9 | 20-Year Kingston Collection and Conveyance Capital Improvement Projects

CIP No.	Item	Total Project Cost
CIP-K-CC-CAP-2[1]	Upgrade PS-71 and Replace Forcemain	$7,400,000
CIP-K-CC-DEV-4	Arness Pump Station and Conveyance	Expected to be paid for by developers
CIP-K-CC-DEV-5	Highway 104 Pump Station and Conveyance	Expected to be paid for by developers
CIP-K-CC-DEV-6	Taree Pump Station and Conveyance	Expected to be paid for by developers

CIP No.	Item	Total Project Cost
CIP-K-CC-DEV-7	Extend Gravity Sewer Flowing to PS-41	Expected to be paid for by developers
CIP-K-CC-DEV-8	Extend Gravity Sewer Flowing to PS-43	Expected to be paid for by developers
CIP-K-CC-DEV-9	Extend Gravity Sewers Flowing to Arborwood	Expected to be paid for by developers
CIP-K-CC-OM-10[1]	Annual Pipe Replacement	$14,000,000
	Total	**$21,400,000**

Note:

1. If funding becomes available, this project should be considered in the 6-year CIP.

Table ES-10 | 20-Year Kingston WWTP Capital Improvement Projects

CIP No.	Item	Total Project Cost
CIP-K-WWTP-OB-1[1]	Replace UV System	$880,000
CIP-K-WWTP-REG-2[2]	Nitrogen Optimization Improvements	$99,000
CIP-K-WWTP-REG-3	Reclaimed Water Improvements	$13,660,000
CIP-K-WWTP-OB-4	Replace Clarifier Drives	$480,000
	Total	**$15,120,000**

Notes:

1. If funding becomes available, this project should be considered in the 6-year CIP.
2. Future nutrient requirements and timing are unknown. Based on the current permit cycle for the PSNGP, it is assumed that effluent TIN restrictions to values below 10 milligrams per liter (mg/L) will not be implemented until 2031 at the earliest.

ES.12 Financial Strategy

Section 12 consists of the financial analysis performed by FCS group to develop a funding plan ("revenue requirement") for the County's sewer utility for the 2024 to 2042 planning horizon. The revenue requirement was identified based on operating and maintenance expenditures, fiscal policies, and the capital funding needs identified in **Section 12**.

The County sewer system has four basins, each with a treatment plant and corresponding collection system: Central Kitsap, Manchester, Suquamish, and Kingston. While a General Sewer Plan has been developed separately for each basin (this focus of this document is the Kingston basin), the County does not separate its sewer utility financial information by basin. As such, the information included in **Section 12** refers to the County sewer utility as a whole, unless explicitly stated otherwise. The result of the analysis indicates that a Countywide rate adjustment of 6.31 percent for 2025 and 6 percent per year through the remaining forecast period would be sufficient to support the capital program.

SECTION 1

Introduction

1.1 Introduction

The unincorporated area of Kingston is in Kitsap County (County), Washington. Kingston is in northwest Washington on the west side of the Puget Sound. This General Sewer Plan Update (Plan) provides the County with a 20-year plan (2022 to 2042) for the Kingston basin sewer collection, conveyance, and wastewater treatment plant (WWTP) infrastructure. The Central Kitsap, Suquamish, and Manchester basins sewer systems are covered under separate General Sewer Plan Updates.

A Kingston basin vicinity map is shown in **Figure 1-1**. The service area spans approximately 1,235 acres. Kingston is primarily residential, and the surrounding area is rural with some forested areas, including the North Kitsap Heritage Park.

The County owns, operates, and maintains the sewer facilities in the Kingston area. The system consists of approximately 57,400 feet of gravity pipe, 26,000 feet of force main pipe, seven pump stations (PS) and the Kingston WWTP.

The current sewered population in the basin was estimated by an analysis of sewer permits, indicating there are 1,021 equivalent residential units (ERU) yielding a population of 2,553 people. The sewered population is expected to grow to 3,929 in 2028 and 6,337 in 2042.

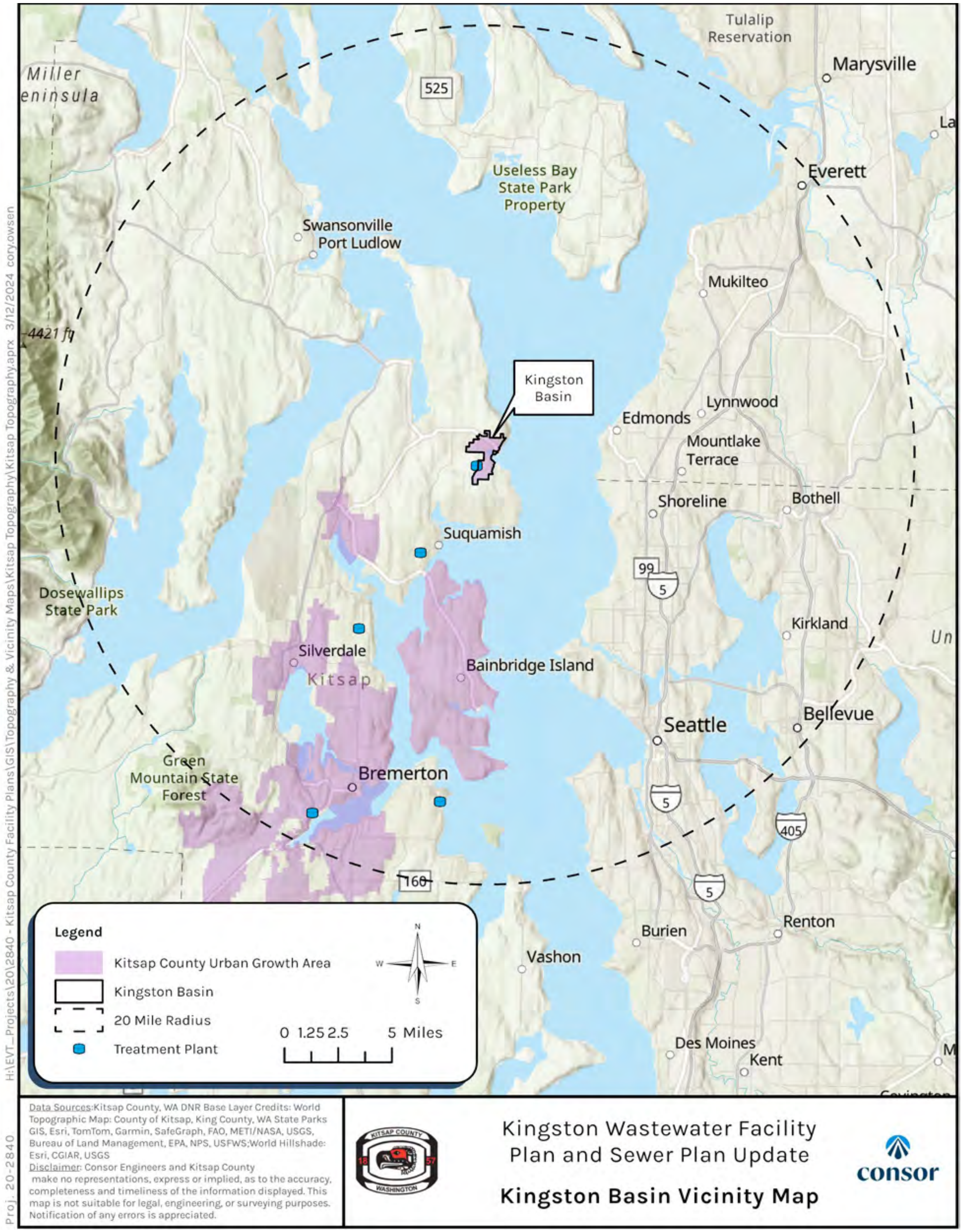
1.2 Purpose and Scope

This Plan evaluates the expected changes in the Kingston sewer service area, reports the existing condition of the collection system and Kingston WWTP, analyzes potential improvements to the system, and includes recommended and phased capital improvements that will provide service to the growing community over the planning horizon. The Plan was prepared to provide the County, the public, and regulatory agencies with information on the County's plans for maintaining, upgrading, and expanding the system. The Plan provides the roadmap for the County to continue to provide high quality service to its customers while protecting environmental quality. The Plan complies with the Washington State Department of Ecology (Ecology) regulations for general sewer plan (Washington Administrative Code [WAC] 173-240-050).

The Plan is based on planning horizons of a six-year period, 2023 to 2028, and a 20-year period, 2029 to 2042. The Plan lays out a strategy to provide wastewater services that accommodate population growth, comply with environmental regulations and permits, assess existing conditions, and maintain collection/conveyance system and treatment plant reliability and longevity. The population projections are in line with those developed by the Kitsap County Department of Community Development (DCD) over the 2044 planning horizon, which corresponds to the County Comprehensive Plan update. The recommendations presented here were made with consideration of the benefits of long-term investments that will continue to serve the community beyond the 20-year planning horizon.

Consor was contracted by the County in April 2020 to prepare the Plan and worked with the County to develop the Scope of Work, which provides guidance for decisions regarding the management and improvement of the County's wastewater treatment infrastructure.

Figure 1-1 | Kingston Basin Vicinity Map



1.3 Background

The County owns and operates the Kingston wastewater system that consists of a collection and conveyance system, seven pump stations, and the Kingston WWTP with an outfall to Appletree Cove in the Puget Sound. The oldest parts of the Kingston collection system were installed in the mid-1970s. Relatively little growth in the system occurred until the early 2000s with significant growth occurring in the first half of the decade. The oldest pump station is PS-41 which was built in 1974, the remaining pump stations, PS-42, PS-43, PS-52, PS-71, PS-72, and PS-73 were installed or updated in the 1990s and 2000s. The sewer system is separate from the stormwater system and consists of gravity sewers, pump stations, and individual pump stations (IPS). Some properties within the service area have on-site septic systems that are not connected to the collection system.

The Kingston WWTP was constructed in 2005 and replaced the original WWTP that was constructed in 1974. The original plant was approximately three miles from the current plant site. The liquids treatment processes in the Kingston WWTP includes headworks with screening and grit removal, two oxidation ditches, two secondary clarifiers, UV disinfection, and an effluent Parshall Flume, and the outfall. Sludge removed from the secondary clarifiers is thickened with a gravity belt thickener (GBT) and transported to the County's Central Kitsap WWTP for further treatment and disposal. The County operates the Kingston WWTP under National Pollutant Discharge Elimination System (NPDES) Permit WA0032077 that was renewed, effective December 1, 2015, and expired on November 30, 2020. The County has submitted the permit renewal application. The current permit was administratively continued and remains in effect as of this writing.

The County has prepared several sewerage planning documents since the 1960s. The last wastewater/sewer general sewer plan for the Kingston area was prepared in 2013. Since then, the Kingston area, and the County as a whole, has grown substantially. With this growth, the need for a renewed evaluation of sewer service to the entire County became increasingly apparent. This Plan presents the findings and recommendations for the Kingston basin sewer facilities.

1.4 General Sewer Plan Requirements

The Federal Water Pollution Control Act established the requirement for a Water Quality Management Plan. Resultantly, RCW 90.71 established the need for a Puget Sound Water Quality Management Plan. The stated objective of this plan is to protect and restore Puget Sound through effective coordination among governments and private interests, and through use of an adaptive management approach.

This Plan was prepared for the County to fulfill the requirements of Chapter 173-240-050 of the WAC, Chapter 90.48 of the Revised Code of Washington (RCW), and RCW 36.70A (Growth Management Act). The Plan provides the County with a comprehensive guide for managing and operating the sewer system and coordinating expansions and upgrades to the infrastructure through buildout. The Plan serves as a guide for policy development and decision-making processes for the County. The WAC requirements are outlined in **Table 1-1**.

Table 1-1 | General Sewer Plan Requirements per WAC 173-240-050

WAC Reference Paragraph	Description of Requirement	Location in Document
3a	Purpose and need for proposed plan	Section 1.2
3b	Who owns, operates, and maintains system	Section 1.5

WAC Reference Paragraph	Description of Requirement	Location in Document
3c	Existing and proposed service boundaries	Figure 2-1
3d	Layout map showing boundaries; existing sewers; proposed sewers; existing and proposed pump stations and force main; topography and elevations; streams, lakes, and other water bodies; water systems	Figure 2-1, Figure 2-2, Figure 2-4, Figure 2-5, Section 5, Section 6, Section 7, and Section 11
3e	Population trends	Section 3
3f	Existing domestic and/or industrial wastewater facilities within 20 miles	Figure 1-1
3g	Infiltration and inflow problems	Section 3.4.1
3h	Treatment systems and adequacy of such treatment	Section 6
3i	Identify industrial water sources	Section 4
3j	Discussion of public and private wells	Figure 2-5
3k	Discussion of alternatives	Section 7 and Section 8
3l	Define construction cost and O&M costs	Section 10, Section 11, and Section 12
3m	Compliance with water quality management plan	Section 4
3n	SEPA compliance	Section 4

1.5 Ownership and Management

The County owns, operates, and maintains the sewer facilities in Kingston.

The County's Sewer Utility Division (Utility) under the Department of Public Works is solely funded through fees from sewer ratepayers. The Utility does not receive funds from County tax revenue and cannot provide any financial assistance to other public works divisions or County departments. These revenues must provide for future capital improvements and cover the maintenance, operation, and replacement of sewer systems.

The operation and maintenance (O&M) of both the sewer collection system and the County’s four WWTPs is provided by the Utility. The Utility consists of four main work groups:

- Utilities Operations & Maintenance (Plant and Pump Station).
- Field Operations (Collections System).
- Engineering and Administration.
- Construction Management.

The Utilities Operation Group is responsible for running the WWTPs and laboratory. The Utilities Maintenance Group is responsible for maintaining the equipment associated with WWTPs and pump stations. The Field Operations group is responsible to maintain, repair, replace, clean, and inspect the sewer utilities collection systems. The Engineering Group manages the design of capital work. The Administration Group manages the geographic information system (GIS) database and provides review efforts for Developer proposed projects. The Construction Management Group manages the delivery of capital work.

SECTION 2

Service Area Characterization

2.1 Introduction

The Kingston wastewater system service area characteristics including geography, topography, water resources, general soil conditions, critical areas, endangered species habitats, the water supply system, and zoning designations are described in **Section 2**.

2.2 Growth Management Act

The State of Washington adopted the Growth Management Act (GMA) with the intent of concentrating most new development and population gains within the urban areas of the more populous and rapidly growing counties. State and local governments are required to define an urban growth area (UGA) boundary within which urban services like sewers are provided, and any new parcels created outside that boundary must be at a very low density with sufficient acreage to support on-site sewage disposal systems conforming to Washington State Department of Health (DOH) regulations.

The following exceptions to the prohibitions of sewers outside the UGA are recognized under state law (per RCW 36.70A.110(4), RCW 36.70A.070(5)(d), and WAC 365-196-320(1)(c)):

- Public schools outside the UGA can be served by sewers but are not required to be served.
- Areas of existing development outside the UGA where sufficient on-site sewage disposal systems have failed as to create a "severe public health hazard" can be served by sewers.
- Areas can be defined as a Limited Area of More Intensive Rural Development (LAMIRD), within which the development of necessary public facilities and public services, such as sewer, is allowed.

Sewers provided in either of these cases can be satellite systems limited to serving just the qualified and defined parcels, or a sewer extension can be 'tight-lined' to convey wastewater from the qualified and defined parcels into the UGA for connection to an existing sewer system.

2.3 Service Area

The Kingston service area and UGA boundaries are shown in **Figure 2-1**. The service area spans approximately 1,235 acres and is bounded to the north by the Carpenter Lake Natural Reserve, State Highway 104, and NE 272nd Street. It is bounded to the east by Appletree Cove, Taree Drive NE, and Washington Boulevard. NE. It is bounded to the south by NE Waterfront Way and NE West Kingston Road. It is bounded to the west by the Thompson Airport Airstrip and the Carpenter Lake Natural reserve. The service area contains small, unnamed lakes and streams in addition to several parks and neighborhood developments.

2.3.1 Topography

The topography of the service area is characterized as moderately hilly and sloping generally east towards Appletree Cove.

Figure 2-1 | Kingston Basin Map

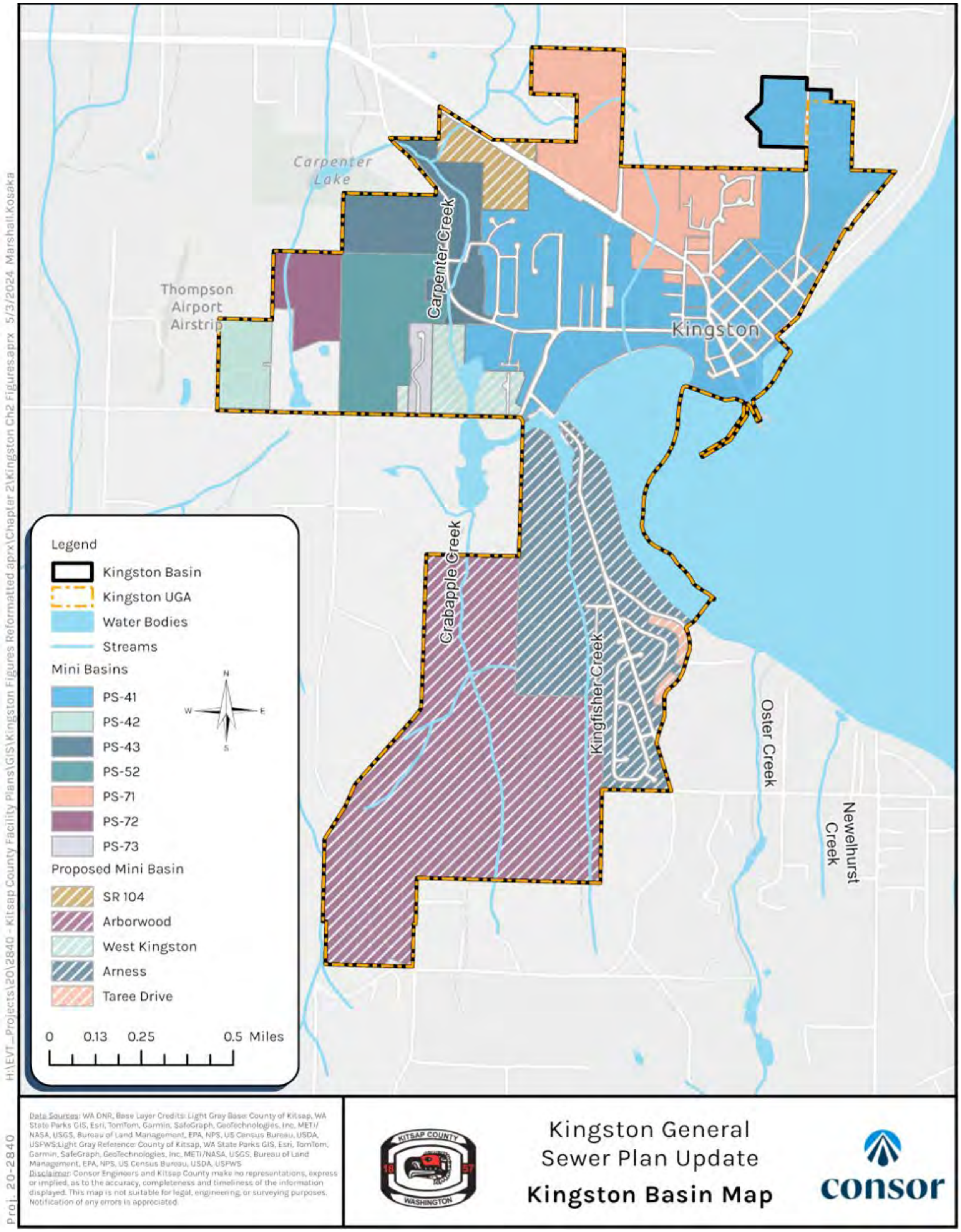
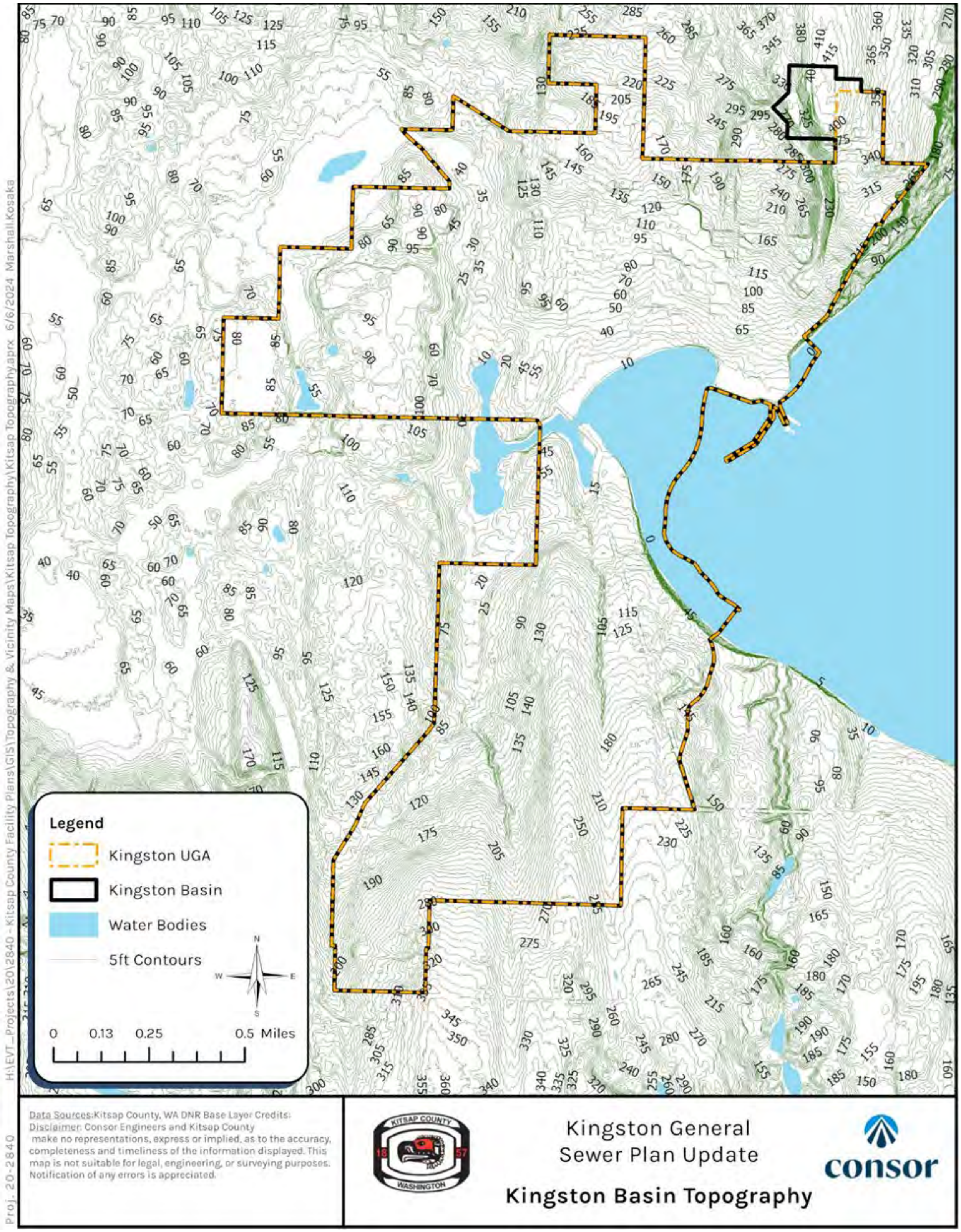


Figure 2-2 | Kingston Basin Topography



2.3.2 Water Resources

The primary water resources in the service area are Crabapple Creek, Carpenter Creek, Kingfisher Creek, and groundwater. There are several unnamed streams and surface water bodies in the service area which are shown on the map in **Figure 2-1**. Water resources in the basin are identified from the United States Geological Survey National Hydrography Dataset for Washington.

Carpenter Creek appears on Ecology's Water Quality Assessment list [303(d)] for impaired water bodies for dissolved oxygen (DO) and temperature.

2.3.3 Puget Sound Water Quality Management Plan

The Federal Water Pollution Control Act (FWPCA) established the requirement for a Water Quality Management Plan. Resultantly, RCW 90.71 established the need of a Puget Sound Water Quality Management Plan. The stated objective of this plan is to protect and restore Puget Sound through effective coordination among governments and private interests, and through used of an adaptive management approach. This Plan is consistent with the intended goals of the Water Quality Management Plan.

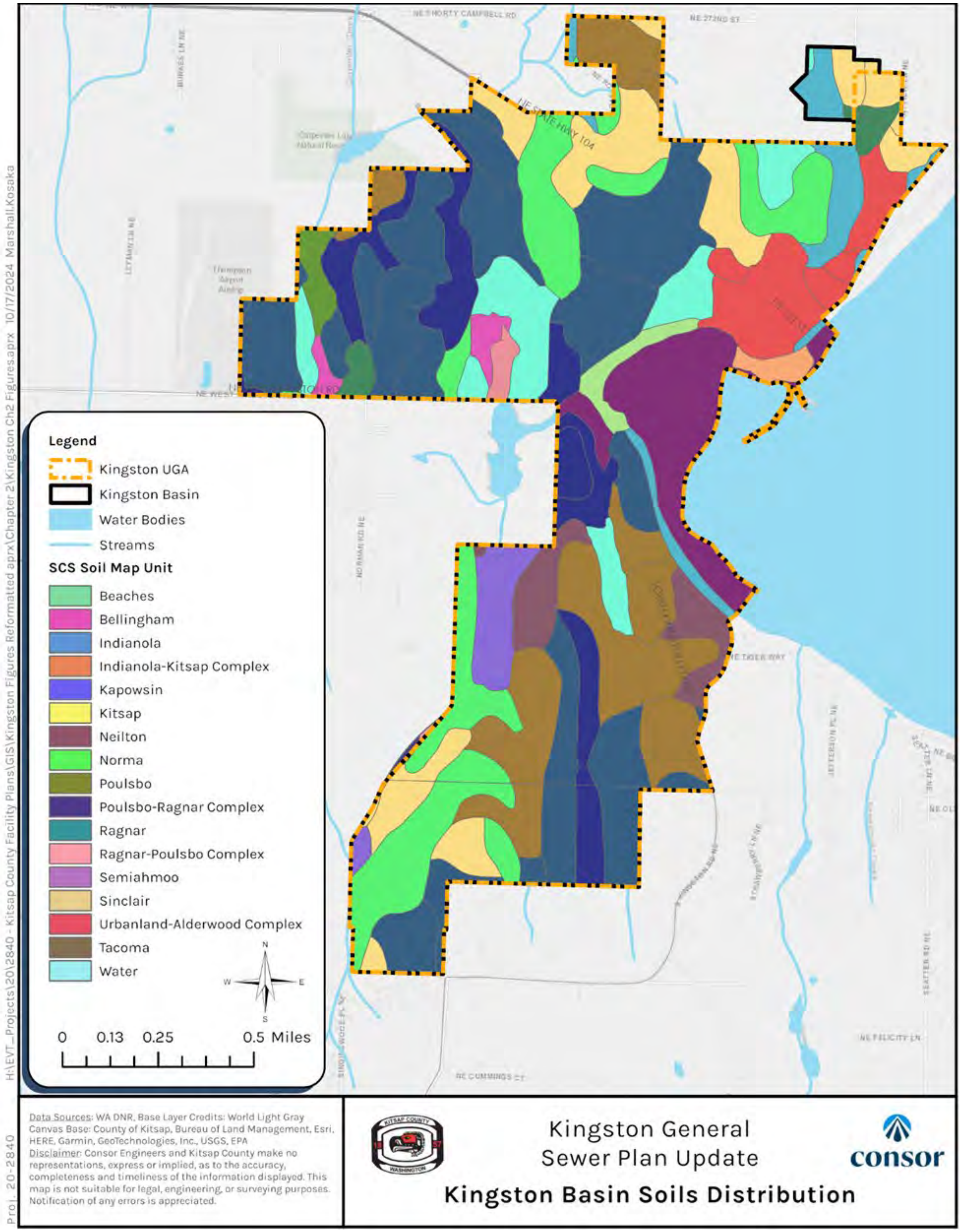
2.3.4 Geology

Soils and their aerial distribution in the basin are shown in **Figure 2-3**. The soil descriptions are referenced from the Soil Survey of Kitsap County by the United States Department of Agriculture and the Soil Conservation Service (SCS) in cooperation with the Washington State Department of Natural Resources and the Washington State University Agricultural Research Center. The aerial distribution is based on GIS data derived from the Private Forest Land Grading System and the Soil Survey of Kitsap County. Detailed descriptions in terms of SCS soil map units for the most prevalent soils are discussed below.

The Poulsbo series is the most prevalent soil type in the basin. The soil is moderately well drained and has a depth to hardpan ranging from 20 to 40 inches. Permeability is moderately rapid in the upper stratum and very slow through the hardpan. This soil is found in broad uplands and formed in glacial till.

The Kapowsin Series is the second most prevalent soil type in the basin. The soil is well drained has a depth to hardpan ranging from 20 to 40 inches. Permeability is moderate in the upper stratum and very slow through the hardpan. This soil is found in upland and terraces and formed in glacial till.

Figure 2-3 | Kingston Basin Geology



2.3.5 Critical Areas

There are critical areas throughout the Kingston Basin which will limit development, as shown on **Figure 2-4**. These areas consist of wetlands which were identified from the Department of Natural Resources 2000 Hydrology data set, the National Wetlands Inventory data set, and survey delineated wetlands from the County's parcel maps. The Critical Aquifer Recharge Areas (CARA) shown on the map are separated into Category 1 and Category 2 areas. Category 1 is defined as areas where the potential for certain land use activities to adversely affect groundwater is high. Category 2 is defined as areas that proved recharge effects to aquifers that are current or potentially will become potable water supplies and are vulnerable to contamination based on the type of land use activity. Geologic hazard areas are shown on the map and are categorized as areas of high concern and high hazard areas. High hazard areas are defined as areas with slopes greater than 30 percent and mapped by the Coastal Zone Atlas or Quaternary Geology and Stratigraphy of the County as unstable (U), unstable old landslides (UOS), or unstable recent slides (URS). Areas of concern are classified similar to the high hazard areas but with slopes between 15 percent and 30 percent and also includes areas that are classified as highly erodible or potentially highly erodible, and seismic areas subject to liquefaction.

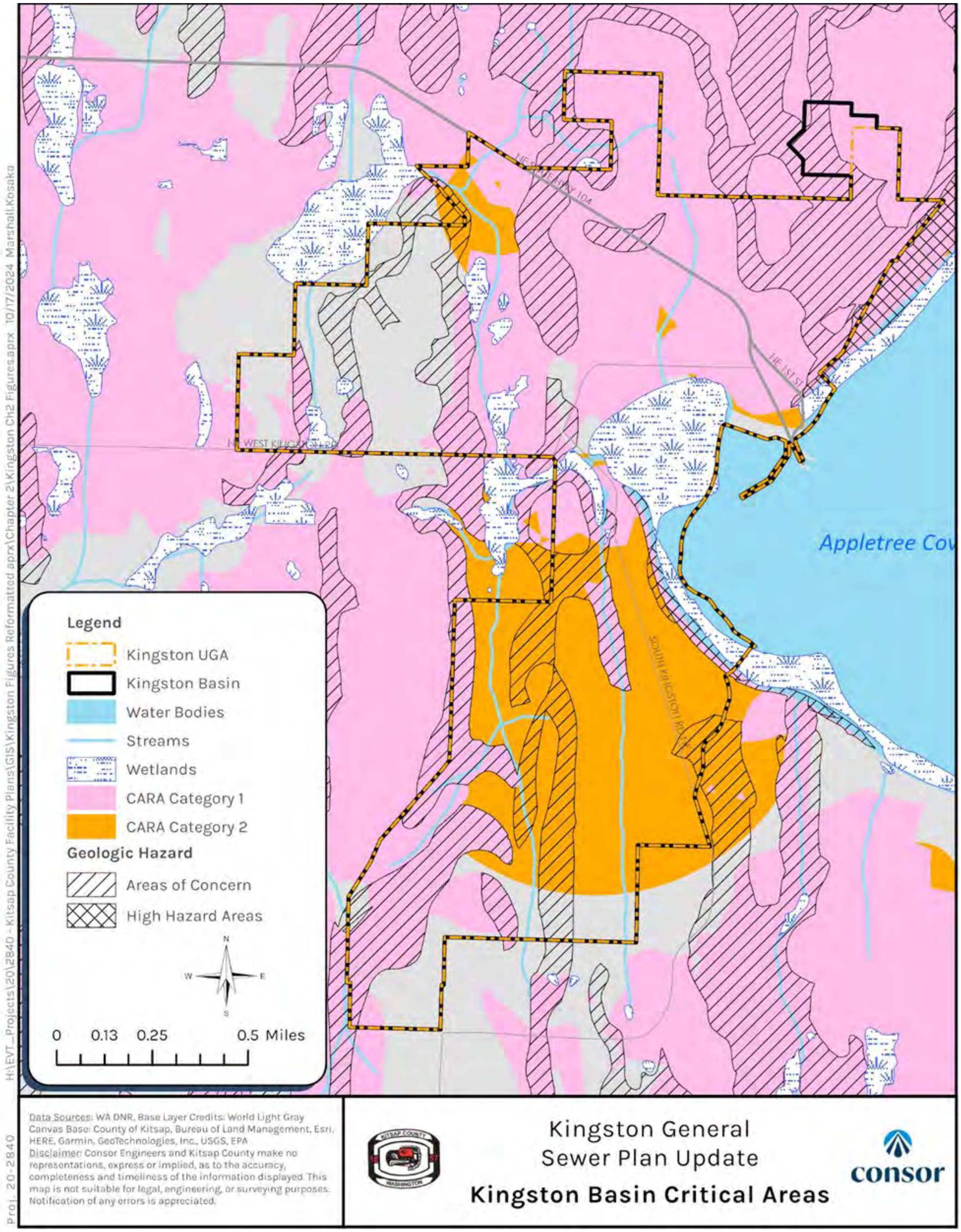
2.3.6 Endangered Species Habitat

The Washington Department of Fish and Wildlife produces a map denoting priority habitats and species throughout the state. Known species and their endangered species status for these creeks are listed in **Table 2-1**. Additionally, the basin contains numerous freshwater and marine wetlands which provide habitat for many species such as the Mountain Quail. Many of the creeks in the basin discharge to Appletree Cove which support habitat for numerous species of shellfish, waterfowl, and other fish species not listed in **Table 2-1**.

Table 2-1 | Species Present

Species	Carpenter Creek	Crabapple Creek	Kingfisher Creek	State Status	Federal Status
Coho	Yes	Yes		None	Species of Concern
Cutthroat	Yes	Yes	Yes	None	Species of Concern

Figure 2-4 | Kingston Basin Critical Areas



2.4 Water Supply System

Information regarding the basin's water system was taken from the Kitsap Public Utility District (KPUD) Water System Plan Part B, dated September 2011. The water supply system is mapped in **Figure 2-5**.

Water service for the basin is provided by KPUD's North Peninsula Water System. There are 15 operational wells in the system; eight are active production wells and 7 are reserved for emergency standby use. The system contains 17 reservoirs totaling 2.4 million gallons (MG) of usable volume. The current system is the result of consolidation of several systems over the preceding decades with further consolidation anticipated. Ultimately, it is anticipated that the North Peninsula will be connected to KPUD's Vinland System to the west and to KPUD's Miller Bay and Indianola Systems to the south. There are private wells in the basin as well as shown on **Figure 2-5**.

2.5 Land Use and Zoning

Land use and zoning within the Kingston UGA is currently established in the 2016 Kitsap County Comprehensive Plan (KCCP). Zoning in the Kingston basin is shown on **Figure 2-6**. Future growth within the Kingston basin is presumed to occur within the UGA according to the land use designations and zoning in the Comprehensive Plan.

Figure 2-5 | Kingston Water System

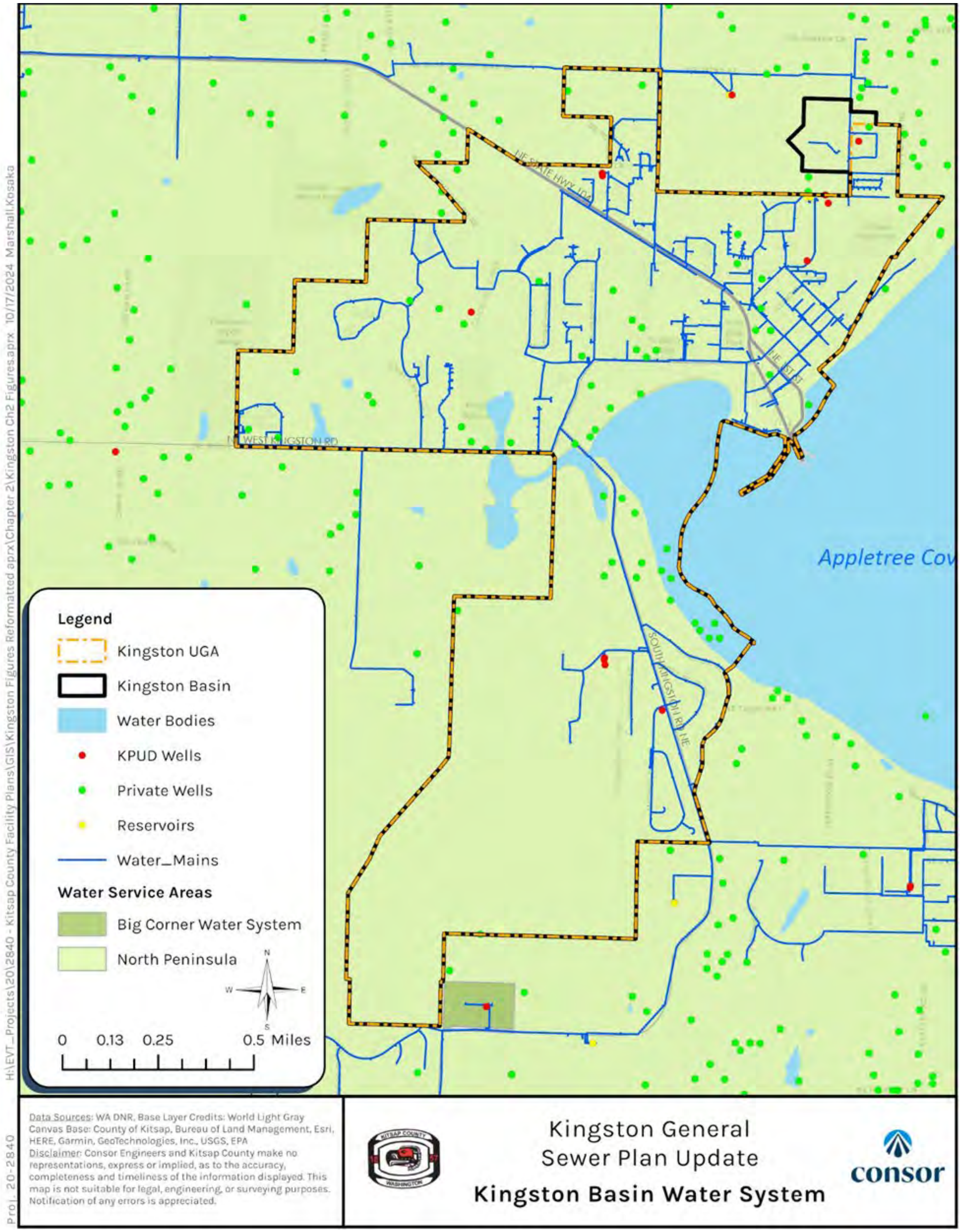
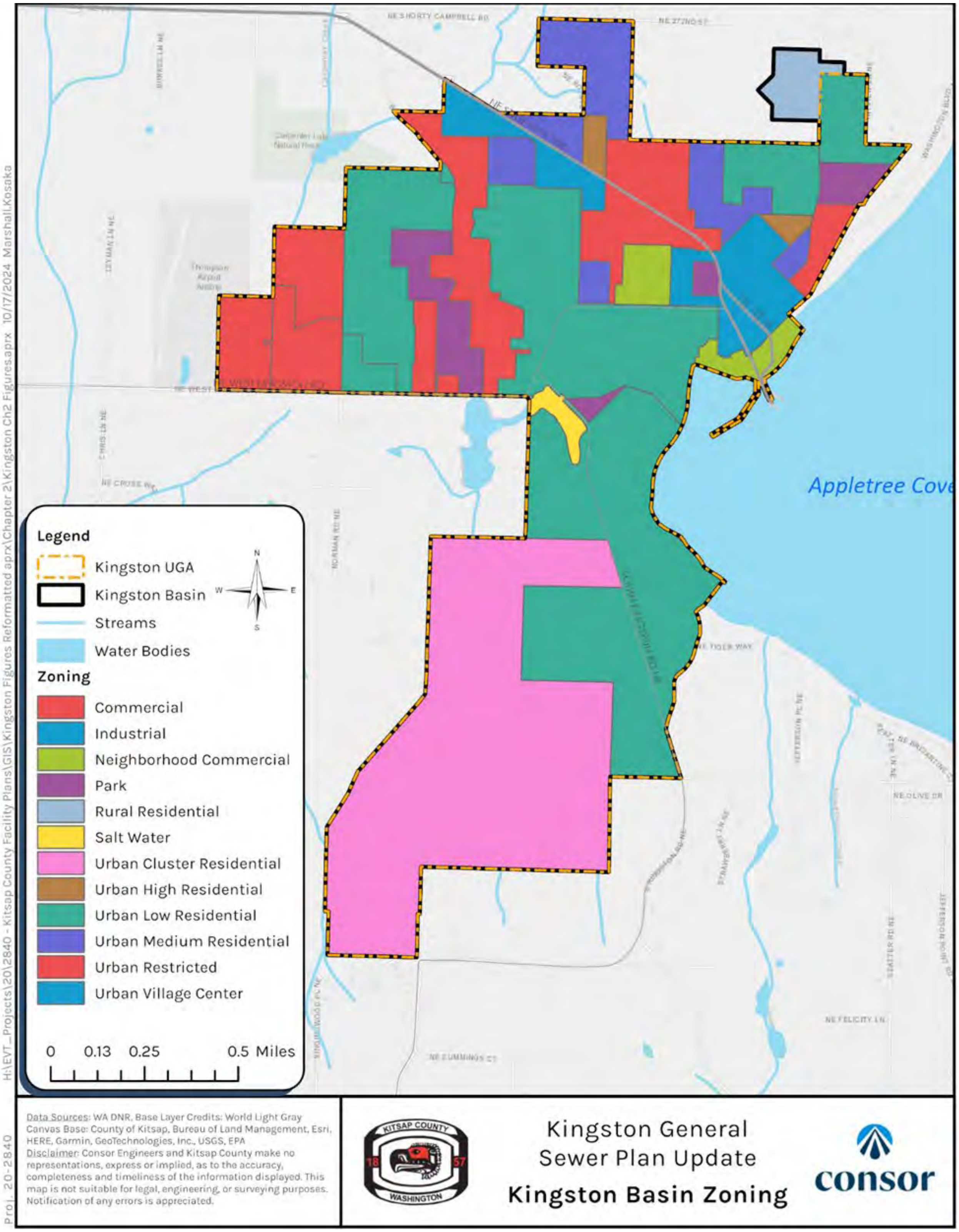


Figure 2-6 | Kingston Basin Zoning



SECTION 3

Population, Flow, and Load Projections

3.1 Introduction

The existing and projected populations and the methodology of determining the most appropriate sewered population and its growth rate to project future flows and loads for the Kingston WWTP and the collection and conveyance system are described in Section 3.

The projections consider existing and future customers within the Kingston basin in year 2028 (the 6-year projection) and year 2042 (the 20-year projection). With these population projections, future flows will be estimated and input into the hydraulic model to determine sewer system deficiencies and capital improvement projects the plan will estimate for the 6-year and 20-year planning horizons to improve and expand the Kingston WWTP and associated collection and conveyance system.

3.2 Definitions

Evaluation Period: The flows and loads analyzed are based on discharge monitoring reports (DMRs) from January 2018 through June 2020.

Wet Weather Season: The wet weather season is from November 1 through April 30 of the following year.

Dry Weather Season: The dry weather season is from May 1 through October 31.

Average Annual Flow (AAF): The average daily flow for the calendar year.

Maximum Month Wet Weather Flow (MMWWF): The largest volume of flow during a continuous 30-day period in wet weather season, expressed as a daily average.

Maximum Month Dry Weather Flow (MMDWF): The largest volume of flow during a continuous 30-day period in dry weather season, expressed as a daily average.

Peak Day Flow (PDF): The largest volume of flow during a one-day period, expressed as a daily average.

Peak Hour Flow (PHF): The largest flow rate during a one-hour period, over the metered time-period.

3.3 Population Projections

3.3.1 General

The population forecasts for the sewer service areas were provided by the Puget Sound Regional Council (PSRC). The PSRC is a leading source of data and forecasting for regional and local planning in the Puget Sound area, and PSRC develops policies and coordinates decisions related to regional growth and transportation and economic planning within Kitsap, King, Pierce, and Snohomish counties. The PSRC is also a leading source of data and forecasting for regional and local planning in the Puget Sound area.

The PSRC's population projections are based on their Land Use Vision (LUV) forecast. The LUV dataset reflects the VISION 2040 Regional growth strategy, local policies, and each county's adopted growth targets. The LUV dataset projects population growth for the Central Puget Sound region in five-year increments from 2020 through 2040. The PSRC's Regional Macroeconomic Forecast is apportioned to cities and unincorporated areas using the VISION 2040 Regional Growth Strategy and local growth targets to create annual control totals. The PSRC's land use model, UrbanSim, then uses the annual control totals to determine projected growth on developable land. These results can then be reported for varying geographies like UGA, LAMIRD, Census Tracts, or Traffic Analysis Zones (TAZ).

The projections used for this basis of planning are based on projected growth for the portions of TAZs within the Kingston sewer service areas. The PSRC projections for residential population are defined by household population. Household population includes both single-family and multi-family units. The population was then extrapolated to 2042 based on the 2040 projection and the average yearly growth between 2035 and 2040.

As a reference, the 2019 population developed by the Washington State Office of Financial Management (OFM) was also obtained. The OFM 2019 number falls between the PSRC projection in year 2014 and 2020, and therefore is considered a valid data point in this analysis. The detailed projection for the Kingston basin is discussed in the following sections.

Additionally, population targets from the 2016 KCCP were compared with population projections received from the PSRC in five-year increments from 2020 to 2040. The targets included in the KCCP are broken down by City or UGA and areas outside of those categories are included in the broad categories of "Unincorporated UGA" and "Rural Non-UGA". The PRSC data was available at a higher resolution which was needed for the Facility and Sewer Plans because the sewer service areas do not line up with the UGA boundaries, and because the Kingston needed more granularity to geographically distribute flows throughout their respective basins for modeling of the collection and conveyance system. The overall projections are similar to the KCCP, which gives confidence that the sewer and facility planning efforts will dovetail with the overall County planning efforts described in the KCCP. The PSRC data is somewhat more conservative, which is preferrable for wastewater facility planning.

3.3.2 Residential

The OFM estimate of the residential population in the Kingston basin was 2,400 for the year 2019. The 2042 projection for population for the Kingston basin is 5,957 yielding a 148 percent increase from 2019 to 2042. The PSRC population projections for the period 2014 through 2040 in five-year increments and the 2019 OFM estimate of population and the extrapolated population in 2042 are shown in **Table 3-1**.

Table 3-1 | Kingston Service Area Population Projections

Year	Residential Population[5]
2014[1]	2,168
2019[2]	2,400
2020[1]	2,984
2025[1]	4,027
2028[3]	4,598
2030[1]	4,978
2035[1]	5,645

Year	Residential Population[5]
2040[1]	5,868
2042[4]	5,957

Notes:
1. PSRC projections
2. OFM estimates, group quarters population not reported separately
3. Interpolated from 2025 and 2030 PSRC projections
4. Extrapolated based on yearly growth between PSRC projections for 2035 and 2040
5. The total sewered population was computed using a different methodology which is described in the subsequent section

3.3.3 Current Sewered Population

The current sewer system in the Kingston basin serves the northern portion of the basin while the population estimates and projections, presented above, represent the entire Kingston basin area. The current sewered population in the basin was estimated by an analysis of sewer permits using the ERUs and assuming 2.5 people per unit. The County's sewer permit data, provided in 2020, indicated there are 1,021 ERUs in the basin yielding a current sewered population of 2,553. This sewered population estimate is larger than the 2019 OFM population for the entire UGA, but less than the 2020 PSRC projected population of 2,984. The difference is likely in the assumed 2.5 people per unit, but without a basis for modifying that ratio, the population of 2,553 will be used. It is assumed that in the future the sewered area will cover the entire UGA as population in the basin increases. The Kingston basin sewered area is shown in **Figure 3-1.** It includes some parcels that are sewered but are outside of the UGA. Although not typically allowed by the GMA, there are allowable exceptions described in **Section 2.2**, such as changes in the UGA boundary, public schools, failed septic systems that create a severe public health hazard, and LAMIRDs.

3.3.4 Sewered Population Growth Rate and Projections

Two data sources are reviewed to determine the most appropriate sewered population growth rate as the basis for the WWTP flow and load projection:

- Estimated total population projection as presented in **Table 3-1**, based on the PSRC and OFM information. This projection shows a 148 percent growth between 2019 and 2042 within the entire UGA, which averages out to be an annual growth rate of 4.04 percent.

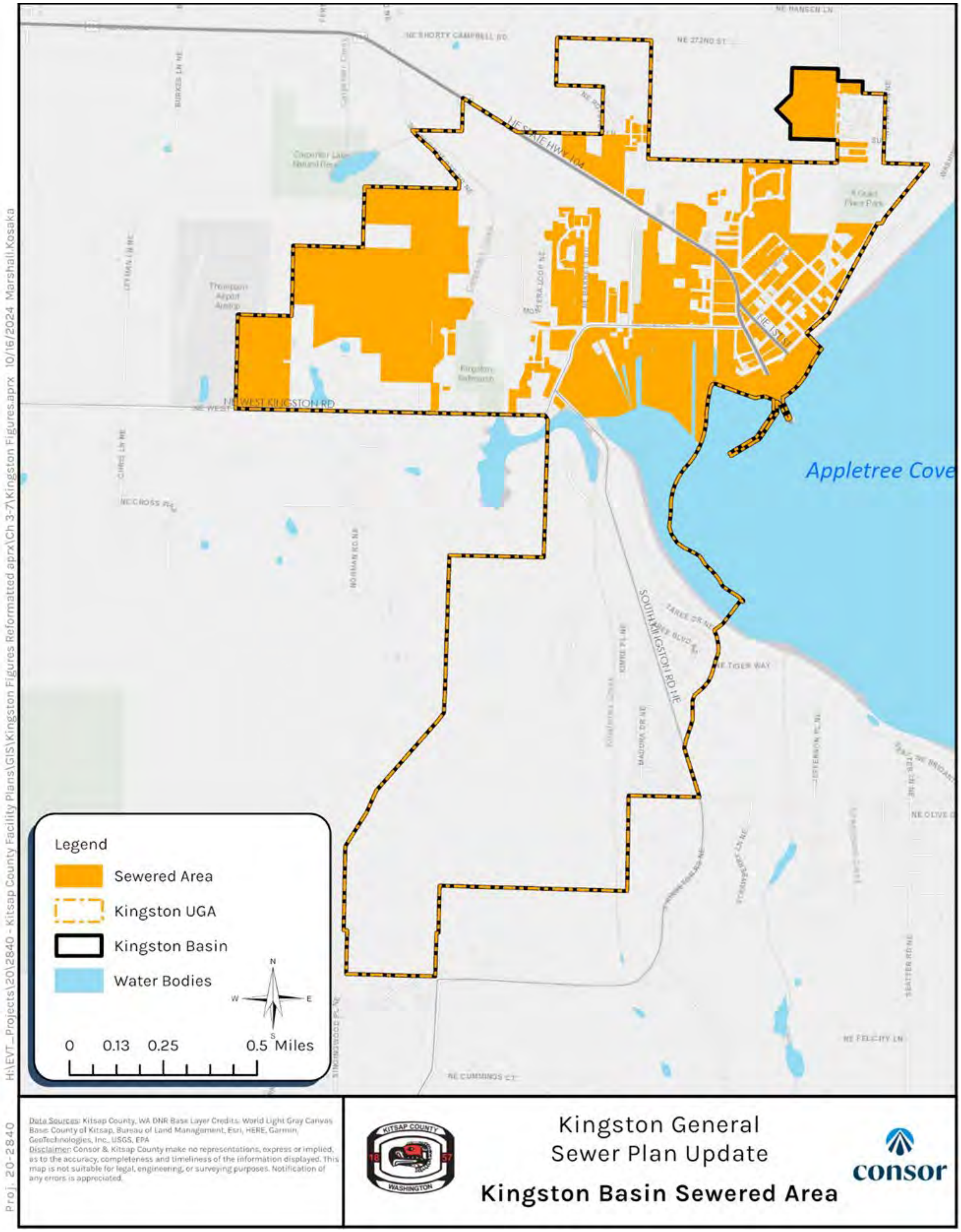
- Estimated sewered population projection as presented in **Table 3-2**, based on extrapolated growth from the 2013 Kingston Facilities Plan Update Addendum. This extrapolated growth projection shows a 191 percent growth between 2019 and 2042 within the sewered population projections, average annual growth rate of 4.75 percent.

Table 3-2 | 2013 Kingston Facilities Plan Update Addendum Projected Sewered Population

Year	Projected Sewered Population
2010	823
2019[1]	3,251
2025	4,870
2042[2]	9,457

Notes:
1. 2019 data is interpolated from the 2010 and 2025 population.
2. 2042 population is extrapolated from the 2010 and 2025 population.

Figure 3-1 | Kingston Basin Sewered Area



The growth rate from the PSRC was selected as the basis for the Kingston WWTP flow and load projections since the data is based on more recent analysis of growth in the area.

Based on the estimated sewered population in **Section 3.3.3** and using the population growth rate from PSRC, the projected sewered population in 2028 and 2042 for the Kingston basin is shown on **Table 3-3**. The 2044 population projection is also presented here and aligns with those developed by the Kitsap County DCD over the 2044 planning horizon, which corresponds to the County Comprehensive Plan update.

Table 3-3 | Kingston Projected Sewered Population

Year	Projected Sewered Population
2020	2,553
2028	3,929
2042	6,337
2044	6,681*

Note:
*Extrapolated from 2042 population

3.4 Wastewater Flows

Influent flow to the Kingston WWTP is made up of primarily domestic wastewater and a small amount of light commercial and minor industrial wastewater. Flow for this plant comes in through the influent PS-71 located offsite to the northeast of the Kingston WWTP.

3.4.1 Current Wastewater Treatment Plant Flow

Daily influent flow data were evaluated using DMR reports from January 2018 through June 2020 (the evaluation period) and are shown in **Figure 3-2**. Flows increase during the rainy season due to infiltration and inflow (I&I). Inflow is stormwater runoff entering the sewer directly, typically from storm sewer connections, basement sump pumps, roof drains and submerged manholes. Infiltration occurs as groundwater leaks into the sewer system through cracked or broken pipes and manholes, or through loose joints and connections. The flow is conveyed to the WWTP through two force mains from multiple offsite pump stations.

Figure 3-2 | Daily Flowrates

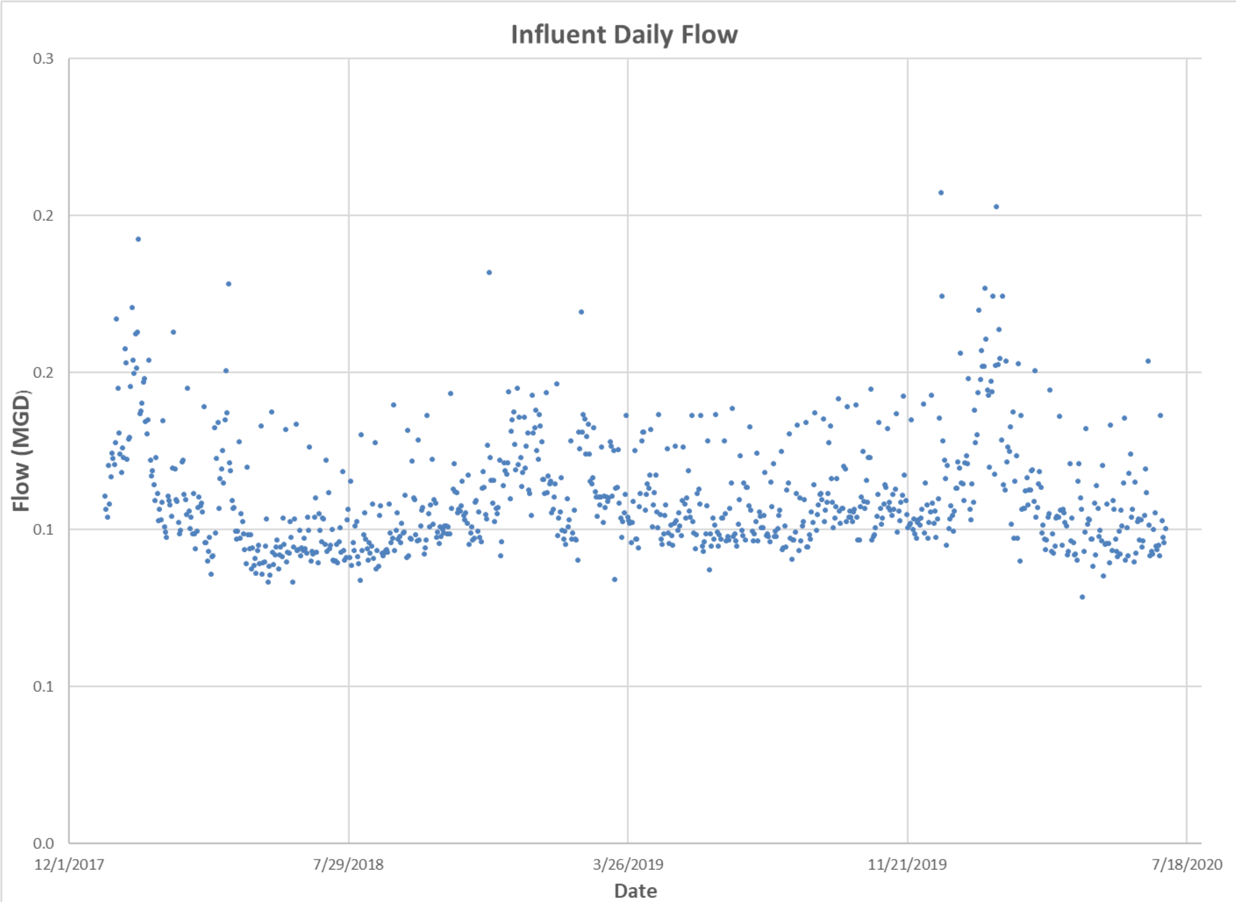


Table 3-4 summarizes the current (2020) AAF, MMWWF, MMDWF, PDF, and PHF from the plant DMR data and corresponding peaking factors and per capita values based on the estimated current sewered population of 2,553. The per capita flow values are in the normal range of most plants. Hourly flow data are not available at Kingston WWTP, so PHF was estimated based on the PS-71 discharge flow since the entire Kingston WWTP influent is pumped from PS-71. **Figure 3-3** shows the 60-minute moving average flowrate measured by the magmeter at the pump station forcemain on December 22, 2020, when the station received and pumped the highest flow during the rain event. The ratio of PHF to the average day flow on that day is 2.74. This ratio is then applied to the currently observed PDF to estimate the current PHF. The peaking factor PHF/AAF shown on **Table 3-4** is calculated by dividing the estimated PHF flow by the 2020 AAF flow.

Figure 3-3 | Pump Station 71 Discharge Flowrates on December 22, 2020

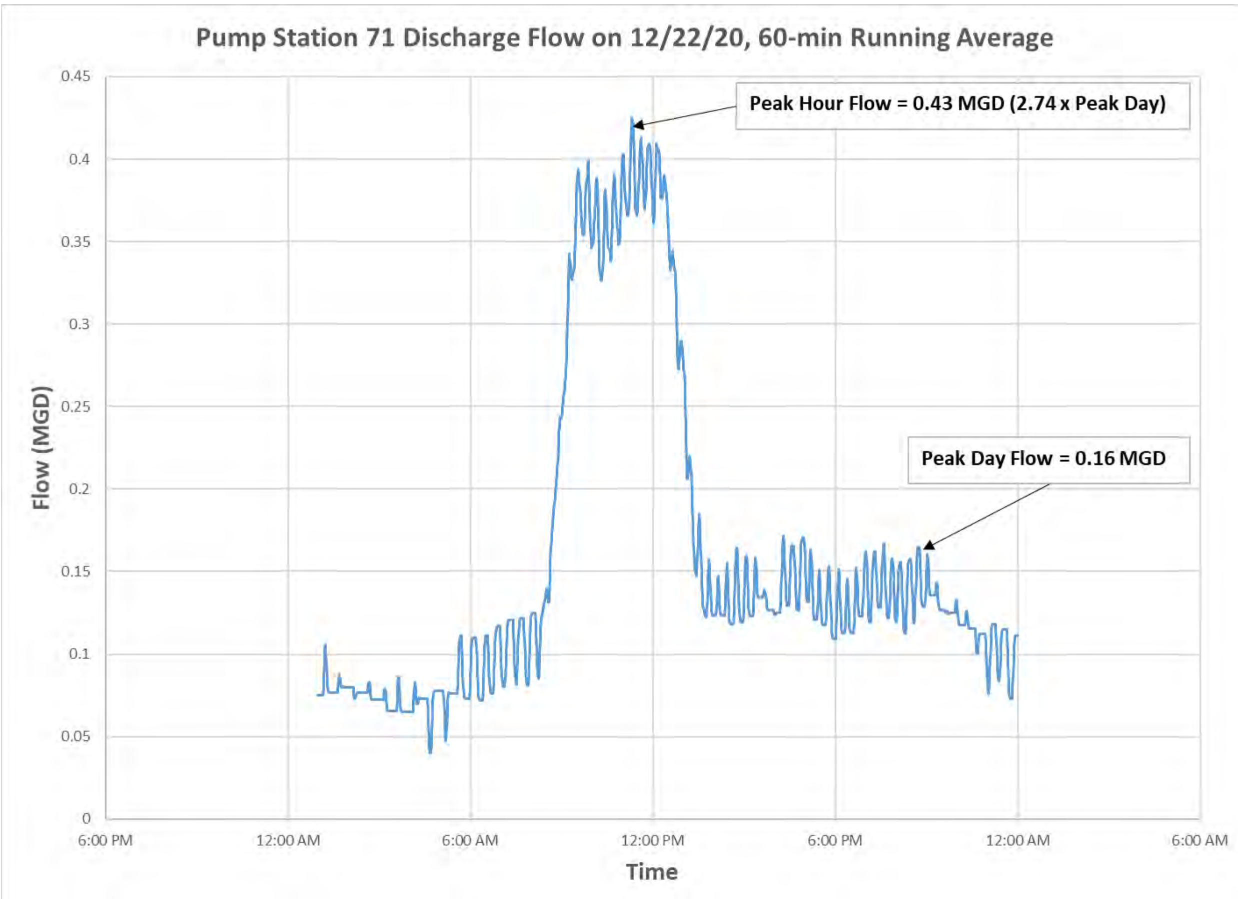


Table 3-4 | 2020 Influent Flows at Kingston WWTP

Flow Event	Current Flow (MGD)	Peaking Factor	Per Capita Flow (gpcd)
AAF	0.11	1.00	43
MMWWF	0.15	1.33	57
MMDWF	0.12	1.05	45
PDF	0.21	1.88	81
PHF	0.57	5.16	222

Notes:
MGD = million gallons per day
gpcd = gallons per capita per day

3.4.2 Wastewater Treatment Plant Flow Projection

Table 3-5 summarizes the projected flows in year 2028 (6-year projection) and year 2042 (20-year projection), based on the 2020 flows and anticipated growth rate.

Table 3-5 | Projected Influent Flows at Kingston WWTP Flows

Flow Event	2028	2042
Projected Sewered Population	3,929	6,337
AAF (MGD)	0.17	0.27
MMWWF (MGD)	0.23	0.36
MMDWF (MGD)	0.18	0.29
PDF (MGD)	0.32	0.51
PHF (MGD)	0.87	1.41

3.4.3 Infiltration and Inflow

The I&I is the wastewater component consisting of stormwater surface runoff entering the sewer system and infiltration from storm-saturated ground conditions. Inflow is runoff entering the sewer directly, typically from storm sewer connections, basement sump pumps, roof drains and submerged manholes. Infiltration occurs as groundwater leaks into the sewer system through cracked or broken pipes and manholes, or through loose joints and connections.

The I&I is important in determining the PDF and PHF through the system. They can vary significantly due to changes in groundwater tables, intensity of rainfall, duration of rainfall, and when the peak of the rain event occurs during the day.

The United States Environmental Protection Agency (EPA) publication 'Infiltration/Inflow – I/I Analysis and Project Certification' dated May 1985 was reissued as Ecology Publication No. 97-03. This publication established the following thresholds for possibly excessive I&I:

- If average dry weather flow is less than 120 gpcd, infiltration is non-excessive.
- If average wet weather flow is less than 275 gpcd, inflow is non-excessive.

The average dry weather and wet weather flows are summarized in **Table 3-6**. The average dry weather flows indicate that infiltration is non-excessive. The average wet weather flows indicate that inflow is non-excessive.

Table 3-6 | EPA/Ecology Excessive I&I Criteria

Parameter	Value
Population	2,553
Average Dry Weather Flow (MGD)	0.14
Average Dry Weather Flow (gpcd)	54
Average Dry Weather Dates[1]	1/18/2021-1/20/2021
Average Wet Weather Flow[2] (MGD)	0.22
Average Wet Weather Flow (gpcd)	86

Notes:
1. Dry weather flows are the average flow on days where no rainfall has occurred during a season of high groundwater.
2. Wet weather flows are the average of the three highest flow events from August 2020 through April 2021.

3.5 Wastewater Loads

3.5.1 Current Wastewater Loads

Wastewater loads to a treatment plant are used to evaluate different treatment alternatives and to determine the required treatment capacities. Current biochemical oxygen demand (BOD), total suspended solids (TSS), and total Kjeldahl nitrogen (TKN) daily mass loads were derived from the 2018-2020 DMR Evaluation period data as well as monthly influent nitrogen data collected by plant staff. These daily mass loads were divided by the projected 2020 sewered population of 2,553 to calculate per capita plant loads. These 2020 total and per capita loads for BOD, TSS and TKN during annual average, wet weather and dry weather flows are shown in **Table 3-7**. The load per capita values are typical of WWTPs.

Table 3-7 | 2020 Kington WWTP Influent BOD, TSS, and TKN Loads

Population	Parameter	Annual Average		Max Month Wet Weather		Max Month Dry Weather	
		Load (ppd[1])	Load Per Capita (ppcd[2])	Load (ppd[1])	Load Per Capita (ppcd[2])	Load (ppd[1])	Load Per Capita (ppcd[2])
2,553	BOD	280	0.110	533	0.209	525	0.195
2,553	TSS	285	0.112	429	0.168	378	0.140
2,553	TKN	54	0.021	65	0.026	72	0.028

Note:
ppd = pounds per day
ppcd = pounds per capita per day

3.5.2 Influent Wastewater Loads Projection

Per capita loading factors were multiplied by projected populations in 2028 and 2042 to project future plant BOD, TSS and TKN loading during average, wet weather, and dry weather conditions. Loading projections for 2028 and 2042 are shown in **Table 3-8** and **Table 3-9**.

Table 3-8 | 2028 (6-Year) Kingston WWTP BOD, TSS, and TKN Loading Projections

Population	Parameter	Annual Average		Max Month Wet Weather		Max Month Dry Weather	
		Load (ppd)	Load Per Capita (ppcd)	Load (ppd)	Load Per Capita (ppcd)	Load (ppd)	Load Per Capita (ppcd)
3,929	BOD	431	0.110	821	0.209	766	0.195
3,929	TSS	438	0.112	660	0.168	550	0.140
3,929	TKN	84	0.021	101	0.026	111	0.028

Note:
ppd = pounds per day
ppcd = pounds per capita per day

Table 3-9 | 2042 (20-Year) Kingston WWTP BOD, TSS, and TKN Loading Projections

Population	Parameter	Annual Average		Max Month Wet Weather		Max Month Dry Weather	
		Load (ppd)	Load Per Capita (ppcd)	Load (ppd)	Load Per Capita (ppcd)	Load (ppd)	Load Per Capita (ppcd)
6,337	BOD	696	0.110	1,324	0.209	1,236	0.195
6,337	TSS	707	0.112	1,064	0.168	887	0.140
6,337	TKN	135	0.02	162	0.026	179	0.028

Note:
ppd = pounds per day
ppcd = pounds per capita per day

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SECTION 4

Regulatory Requirements

The operation and construction of wastewater collection and conveyance systems and wastewater facilities are regulated through federal, state, and local regulations. Federal, state, County, and local government regulatory requirements applicable to the Kingston collection and conveyance systems, WWTP, and other wastewater facilities are described in this section.

4.1 Federal Rules and Regulations

4.1.1 Federal Water Pollution Control Act (Clean Water Act)

The FWPCA, also known as the Clean Water Act (CWA), is a comprehensive framework for the regulating the discharge of pollutants into waters of the United States. The EPA has delegated the administration of the NPDES permit program in Washington State to Ecology. NPDES permitting is discussed in further detail below, as are Pretreatment regulations and Biosolids Management.

4.1.2 U.S. Army Corps of Engineers

The United States Army Corps of Engineers (USACE) has jurisdiction over waterways and wetlands of the United States. Modifications to the treatment plant outfall or development or construction in wetland areas may require a permit from the USACE. Permitting is reviewed by Federal, State, and local agencies as well as Tribal entities. Permits are contingent on certification from Ecology that the project is consistent with the State of Washington Coastal Zone Management Plan.

4.1.3 Endangered Species Act

The National Marine Fisheries Service is directed under Section 4(d) of the Endangered Species Act (ESA) to issue regulations conserving species listed as threatened. The Section 4(d) rules apply to ocean and inland areas as well as any entity subject to U.S. jurisdiction. Species in the basin listed as threatened under Section 4(d) are listed in **Section 2.3.6**.

Section 9 of the ESA prevents “taking” or harm of threatened species and identifies some activities with a high risk of take. These activities include urban development in riparian areas and areas susceptible to erosion destruction or alteration of habitats, and violations of discharge permits.

4.1.4 Capacity Management Operations and Maintenance Programs

Capacity Management Operations and Maintenance (CMOM) is an anticipated regulation from the EPA related to control of sanitary sewer overflows (SSO) from sewer collection and conveyance systems or treatment facilities, which are prohibited under the Federal CWA. The EPA has prepared a draft rule titled “Sanitary Sewer Overflow Control Rule” which is intended to eliminate preventable SSOs through requiring owners and operators of sewer systems to develop and implement CMOM programs.

4.1.5 Puget Sound Water Quality Management Plan

The FWPCA established the requirement for a Water Quality Management Plan. Resultantly, the RCW, section 90.71 established the need of a Puget Sound Water Quality Management Plan. The stated objective of this plan is to protect and restore Puget Sound through effective coordination among governments and private interests, and through used of an adaptive management approach.

4.1.6 EPA Plant Reliability Criteria

The Kingston WWTP is required to meet the Reliability Class I standards, as defined in EPA's Technical Bulletin "Design Criteria for Mechanical, Electrical, and Fluid System Component Reliability," EPA 430-99-74-001. A summary of plant reliability criteria and requirements and current deficiencies at Kingston WWTP are discussed in **Section 6** of this Plan.

4.1.7 National Historic Preservation Act

The National Historic Preservation Act (NHPA) established processes to assess, designate, and protect historic and cultural resources. It also established the National Register of Historic Places and the State Historic Preservation Officer (SHPO) to administer state historic preservation program and coordinate with federal agencies on their proposed actions, also known as undertakings. Section 106 of the NHPA requires coordination between federal, state, local, and tribal entities to review the impacts of any undertakings on historical properties listed or eligible for listing on the National Register.

4.2 State Rules and Regulations

4.2.1 Department of Ecology

The approval of this Plan is per Ecology. Requirements for sewer plans are listed in RCW 90.48.110 and WAC 173-240. Ecology administers numerous regulations published in the WAC which are briefly described below.

4.2.1.1 Water Quality Regulations

Ecology's water quality standards for surface waters of the State are published in WAC 173-201A which also contains the anti-degradation policy. The anti-degradation policy has goals which include restoring and maintaining the highest possible quality of the surface waters of Washington and to ensure that all human activities that are like to contribute to a lowering of water quality, at a minimum, apply all known, available, and reasonable methods of prevention, control, and treatment (AKART).

Ecology established water quality criteria for marine environments under WAC 173-201A. Under this section, standards are set for "public health and public enjoyment of the waters and the propagation and protection of fish, shellfish, and wildlife." Within this section, water quality criteria are established for aquatic life uses, Shellfish Harvesting, recreation use, and miscellaneous uses. Under aquatic life uses, target levels for temperature, DO, and bacteria, turbidity, and pH were established with different quality thresholds based on the importance of the environment and the species present. Mixing zone regulations for WWTP outfalls are also specified in this regulation.

4.2.1.2 NPDES Regulations

Ecology has been delegated authority from the EPA to enforce the CWA to regulate the discharge of treated effluent from WWTPs through the NPDES program. Washington's NPDES Permit requirements are included in WAC 173-220, whose purpose is to "establish a state individual permit program, applicable to the discharge of pollutants and other wastes and materials to the surface waters of the state, operating under state law as a part of the NPDES created by Section 402 of the FWPCA." NPDES Permit limits must comply with Washington water quality standards and biosolids management regulations included in WAC 173-201A and WAC 173- 308, respectively.

The County's Kingston WWTP NPDES Permit #WA0032077 was renewed on December 1, 2015, allowing the discharge of treated effluent to Appletree Cove, Puget Sound. A copy of the WWTP's NPDES Permit is included in **Appendix A**. The NPDES Permit expired on November 30, 2020. The County submitted the permit renewal application six months before the expiration date per the Permit requirement. The current permit was administratively continued and remains in effect.

4.2.1.3 Pretreatment Regulations & Industrial Users

Kingston WWTP is required in Special Condition S6 of the NPDES permit to enforce the discharge prohibitions, identify and report existing, new, and proposed industrial users, and conduct industrial user survey.

According to 40 Code of Federal Regulations (CFR) Part 403 (General Pretreatment Regulations for Existing and New Sources of Pollution) all "significant industrial users", which are industrial users that discharged an average of 25,000 gallons per day (gpd) or more to the Publicly Owned Treatment Works (POTW) or makes up 5 percent or more of the average dry weather hydraulic or organic (BOD or TSS) capacity of the POTW, are required to be part of the National Pretreatment Program.

The National Pretreatment Program is charged with controlling toxic, conventional, and non-conventional pollutants from non-domestic sources that discharge into sewer systems, as described in CWA Section 307(a). Ecology has been given authority by the EPA to regulate the Pretreatment Program in Washington and is required to comply with the federal provisions of the National Pretreatment Program. The Pretreatment Program requires all large POTW that have a designed treatment capacity of more than 5 million gallons per day (MGD) to establish a Local Pretreatment Program.

Kingston WWTP, with design flows less than 5 MGD, is only required to develop a formal Pretreatment Program if the nature or volume of the industrial influent are contributing to treatment process upsets, violations of NPDES Permit Limits or other circumstances that warrant the development of a program to eliminate those occurrences per 40CFR 403.8 (a).

Since majority of wastewater in the Kington basin is from domestic sewer, and no industrial or commercial discharges have been found to impact the plant performance, a Pretreatment Program is not required for Kingston WWTP.

The County conducted an Industrial User Survey in 2020. The survey is included in **Appendix B**. There is no SIU identified within the Kingston service area.

4.2.1.4 Biosolids Management

Kingston WWTP is required in Special Condition S7 of the NPDES permit to store and handle all residual solids in accordance with the requirements of applicable state water quality standards. The final use and disposal of sewage sludge from this facility is regulated by EPA under 40 CFR 503, and by Ecology under RCW chapter 70.95, WAC 173-308, Biosolids Management, and WAC 173-350, Solid Waste Handling Standards. Washington state law requires that biosolids be put to beneficial reuse unless specifically permitted otherwise. The regulations also address the monitoring, record keeping, and reporting requirements.

The current Special Condition S7 of the Kingston WWTP NPDES permit only requires the County to handle and dispose of all solid waste material in such a manner as to prevent its entry into state ground or surface water. Biosolids from Kingston WWTP are sent to the Central Kitsap WWTP for disposal; therefore, no biosolids management plan is required.

4.2.1.5 Puget Sound Nutrient General Permit

In response to areas of the Puget Sound not meeting the water quality criteria for DO, Ecology initiated the Puget Sound Nutrient Source Reduction Project to investigate the causes and extent of DO deficits. As part of the analysis, Ecology, along with several academic partners, developed a Salish Sea Model and determined the source of these exceedances of the water quality standard was the discharge of excess nutrients, especially nitrogen.

Ecology has implemented the Puget Sound Nutrient General Permit (PSNGP) for WWTPs to address the largest source of excess nutrients going into Puget Sound. They issued the first PSNGP effective as of January 1, 2022 and expiring on December 31, 2026. This PSNGP applies to the 58 publicly owned domestic WWTPs discharging into Washington waters of the Salish Sea. The WWTPs are categorized as 'Dominant (D) Total Inorganic Nitrogen (TIN) loads', 'Moderate (M) TIN loads', or 'Small (S) loads' based on their percentage of TIN load currently discharged. The dominant or moderate TIN load plants have a facility specific action level and are required to implement nutrient monitoring and reporting, develop a nutrient optimization plan, conduct a nutrient reduction evaluation, and comply with action level exceedance corrective actions if nutrient discharge limits are exceeded. Small TIN load plants do not have a facility specific action level but are also required to implement nutrient monitoring and reporting, develop a nutrient optimization plan, and conduct AKART analysis. Kingston WWTP is classified as a small TIN load plant.

Ecology is working collaboratively with Puget Sound stakeholders through the Puget Sound Nutrient Source Reduction Project and Puget Sound Nutrient Forum to find solutions for reducing other human sources of excess nutrients.

4.2.1.5.1 Monitoring and Reporting Requirements

The PSGNP requires nutrient monitoring, recording, and reporting so nutrient loading can be calculated and tracked. The requirements under this permit will supplement the information collected under Kingston WWTP's NPDES permit and is limited to analyses necessary to track nutrients in the influent and effluent. The monitoring schedule is based on of the classification of the WWTP. The dominant TIN load treatment plants are required to monitor the influent and effluent two times per week, one time per quarter, or one time per month, depending on the parameter. The moderate TIN load treatment plants are required to monitor the influent and effluent nutrient concentrations one time per week, one time per quarter or one time per month, depending on the parameter. The small TIN load treatment plants are required to monitor the influent and effluent nutrients one time per quarter, or once or twice a month depending on the parameter.

The influent and effluent sampling requirements for small TIN load plants including Kingston WWTP are shown in **Table 4-1** and **Table 4-2**.

Table 4-1 | Influent Nutrient Sampling Requirement for Kingston WWTP

Parameter	Units	Minimum Sampling Frequency
CBOD	mg/L	2/month
Total Ammonia	mg/L as N	2/month
Nitrate plus Nitrite Nitrogen	mg/L as N	1/month
TKN	mg/L as N	1/month

Table 4-2 | Effluent Nutrient Sampling Requirement for Kingston WWTP

Parameter	Units	Minimum Sampling Frequency
Flow	MGD	2/month
CBOD	mg/L	2/month
Total Organic Carbon	mg/L	1/quarter
Total Ammonia	mg/L as N	2/month
Nitrate plus Nitrite Nitrogen	mg/L as N	2/month
TKN	mg/L as N	1/month
TIN	mg/L as N	2/month
TIN	ppd	2/month
Average Monthly TIN	Lbs	1/month
Annual TIN, year to date	Lbs	1/month

Note:
mg/L = milligrams per liter
mg/L = milligrams per liter as nitrogen
ppd = pounds per day
lbs = pounds

4.2.1.5.2 Nitrogen Optimization Plan

An annual Nitrogen Optimization Plan is a required submittal for all permittees and would be submitted electronically as a permit submittal. The purpose of the Nitrogen Optimization Plan is to provide a framework for developing, implementing, and documenting nitrogen optimization strategies. The permit provided detailed requirements of the Nitrogen Optimization Plan components, which vary slightly depending on the TIN load categories.

4.2.1.5.3 AKART Analysis

Small TIN Load WWTPs are required to prepare and submit an AKART analysis by December 31, 2025. Permittees that maintain an annual TIN average less than 10 mg/L and do not document an increase in load through their DMRs do not have to submit this analysis. The AKART analysis requirements are detailed in the final permit and supporting documents. The AKART analysis must include wastewater characterization, treatment technology analysis, economic evaluation, environmental justice review, alternative selection, and implementation timelines.

4.2.1.6 Clean Water Act Section 303(d) list

Ecology conducts the water quality assessment based on Federal laws, state water quality standards, and Water Quality Assessment Policy 1-11 to track water qualities in the rivers, lakes, and marine waters in the state. The water quality assessment compares water data to requirements detailed in Policy 1-11. The assessed waters are placed into categories that describe the status of water quality, before being submitted to the EPA for approval of the category 5 listings, also called the 303(d) list. The water quality assessment divides water bodies into the following impairment categories:

- Category 1: Meets tested standards for clean waters
- Category 2: Waters of concern
- Category 3: Insufficient data
- Category 4: Impaired waters that do not require a total maximum daily load
- Category 5: Polluted waters that require a water improvement project

4.2.1.7 Infiltration and Inflow

Ecology can require reductions in I&I in situations where diluted influent affect the 85 percent BOD removal and the suspended solids minimum removal limit. State and Federal regulations also require that recipients of loan or grant money demonstrate that their sewer collections systems are not subject to excessive I&I.

4.2.1.8 Engineering Design Criteria

Ecology's "Criteria for Sewage Works Design," also known as the Orange Book, identifies engineering criteria for design, construction, and operation of public sanitary sewer systems and wastewater treatment facilities.

4.2.2 Recycled Water Use

Recycled water is regulated by Ecology and the DOH, according to WAC 173-219. Ecology and DOH are both required to review recycled water proposals to determine if proposed treatment methods and uses will protect public health and the environment while not affecting existing water rights. The regulation also provides criteria to determine the lead agency based on the type of facility recycling the water. Requirements from both the lead and non-lead agency must be met as a condition of permitting. Recycled water from the Kingston WWTP would be regulated with Ecology as the lead agency under WAC 173-219-050 as the source water is effluent from a facility permitted by Ecology.

4.2.3 State Environmental Policy Act

The Washington State Environmental Policy Act (SEPA) is intended to help state and local agencies identify environmental impacts likely to result from a range or projects or decisions. Construction of public facilities such as sewer lines or WWTPs or adopting regulations or policies such as comprehensive plans often trigger a SEPA review.

4.2.4 State Environmental Review Process

The Washington State Environmental Review Process (SERP) is regulated according to WAC 173-98-720 and states all recipients of funding for water pollution control facility projects must comply with the SERP. SERP includes all provisions of SEPA. Mitigation measures identified in documents developed through the SERP become conditions of funding.

4.2.5 Puget Sound Clean Air Agency

The Puget Sound Clean Air Agency (PSCAA) has jurisdiction in the County and is responsible for regulating and permitting air emissions in the Puget Sound Region. Construction projects are often subject to regulation under PSCAA's Notice of Construction (NOC) Program. Projects that fall under the NOC program must not be subject to provisions of the Prevention of Significant Deterioration (PSD) or the New Source

Review (NSR) programs, administered by Ecology. Determination of the regulatory pathway is dependent on the potential change in emissions resulting from the project and two categorizations: the source is either characterized as a major or non-major source and emissions from the project categorized as either significant or less than significant. Acceptable Source Impact Levels (ASIL) are defined in WAC 173-460 and regardless of regulatory pathway, toxic air contaminants (TAC) emission increases must be compared to ASILs. Point sources such as waste gas burners, open tanks, and scrubber vents must be evaluated.

4.2.6 Washington State Department of Fish and Wildlife

The Washington State Department of Fish and Wildlife administers the State Hydraulic Code (WAC 220-660) which establishes regulations for the construction of hydraulic projects or work that will impact any salt or fresh waters of the state. It also sets forth procedures for obtaining Hydraulic Project Approval (HPA). Modifications to the Kingston WWTP outfall would likely require HPA.

4.3 Kitsap County and Local Government Requirements

The Kingston sewer basin falls within unincorporated Kitsap County.

4.3.1 Kitsap County Codes

Kitsap County Code Chapter 13.12 contains regulations governing public sewer systems. This chapter describes licensing and permitting of sewers, the locations of sewers and connections, and prohibited discharges and disposal of prohibited wastes. Specifications for sewers as well as standards for excavation and trenching are also included in Chapter 13.12.

Kitsap County Code Chapter 18 contains the basic requirements that apply to the SEPA process and describes the sections of the SEPA that have been adopted by the County. Contents of Chapter 18 include, but are not limited to, designation of responsible officials and lead agency, exemptions and threshold determinations, an environmental checklist for applicants, rules for preparing environmental impact statements, rules for commenting on environmental documents under SEPA, rules governing public notices and hearings, and rules describing agency compliance with SEPA.

Kitsap County Code Chapter 19 contains the County's Critical Areas Ordinance which identifies and protects critical areas as required by the GMA. Critical areas include but are not limited to wetlands, fish and wildlife habitat conservation areas, and geologically hazardous areas. Chapter 19 also outlines purposes and objectives for each critical area category and describes development standards, review procedures, and designation statuses.

Kitsap County Code Chapter 22 contains the County's Shoreline Master Program which guides future development of the shorelines in the county consistent with the Shoreline Management Act. Chapter 22 describes shoreline jurisdiction and environment designations, goals and policies for the program, regulations, permit review and enforcement, and shoreline use and modification standards. This chapter also contains a section describing requirements for reports for critical areas including wetlands, habitats, geotechnical, and hydrogeological. This sections addresses when reports are required, the qualifications of those preparing the reports, and timelines and schedules for the reports.

4.3.2 Growth Management Act

The GMA is a State, County, and City planning requirement which influences City and County plans for future growth. The GMA established a series of 13 goals under RCW 36.70A.020 as well as a 14th goal (RCW

36.70A.480) which adds the goals and policies from the Shoreline Management Act to those of the GMA. The County is subject to the full requirements of the GMA which requires planning for utilities including sewer service. This includes providing a capital facilities element in Comprehensive Land Use Plans as well as forecasting future needs for these facilities, proposed locations, and capacities of new or expanded facilities, and plans to fund these facilities into the future. The 2016 KCCP was prepared to satisfy the GMA requirements and describes the planned growth within the sewer service areas as well as plans to maintain and expand services within the sewer service area.

Based on the requirements of the GMA, the County is required to review, and if necessary, revise its Comprehensive Plan by June 30, 2024, and every eight years thereafter. As part of this review and revision, the County plans to revise its population and employment growth projections, which currently are projected to 2036, out to the year 2044. This revision is planned to begin in 2022, thus revised growth projections were not available at the time of this sewer plan update.

4.3.3 Water as a Resource Policy

The County's Water as a Resource Policy directs the County to treat water as a resource and not a waste stream. The policy focuses on improving water in the County through seven main guiding principles. While the guiding principles largely focus on controlling stormwater, guiding principles concerning conserving groundwater resources impacts the sewer system through use of recycled water or non-potable water for appropriate uses. The policy also contains guiding principles aimed at continual refinement of management tools. In addition to guiding principles, the policy directs the County to consider water as a resource when developing, re-developing, retrofitting, refurbishing, maintaining, and operating public assets. The policy also directs the County to consider water as a resource when developing or revising codes and regulations.

SECTION 5

Collection and Conveyance Existing Conditions

5.1 Introduction

The Kingston basin collection and conveyance system consists of sewer assets owned by the County located primarily in the northern portion of the Kingston UGA except the Kingston WWTP which is located to the west of the UGA.

The oldest parts of the Kingston collection system were installed in the mid-1970s. Relatively little growth in the system occurred until the early 2000s with significant growth occurring in the first half of the decade. The most recent period of growth began in the early 2010s, and continues today, following a short lull in 2015 and 2016. Many pump stations in the basin were installed or updated in the 1990s and 2000s. The most recent installation occurred in 2017 with the installation of PS-73. Additional pump station proposals are under review and may be approved or under construction by the time this Plan is published. The system now serves approximately 1 square mile of residential and commercial customers within the UGA boundary. The sewer system is separate from the stormwater system and consists of gravity sewers, pump stations, and IPS. Some properties within the service area have on-site septic systems that are not connected to the collection system.

5.2 Service Areas and Sewer Basins

The Kingston collection and conveyance system is shown in **Figure 5-1**. The collection and conveyance system primarily serves the northern portion of the UGA; the southern portion of the UGA is unsewered. Wastewater within the Kingston basin is ultimately conveyed to the Kingston WWTP west of the UGA.

At the level of single pump stations, service areas are delineated as 'mini basins', defined as the area from which the collection system drains to a specified discharge point. Delineations of mini basins are based on existing sewer service and topography. Each portion of the system contributing to a pump station is delineated as a separate mini basin for this analysis.

5.2.1 Flow Routing

Flows from the northern portion of the basin are routed through PS-41, PS-42, PS-43, PS-52, PS-71, PS-72, and PS-73 to the WWTP. Effluent from the WWTP is conveyed via an 18-inch diameter force main to Appletree Cove where it discharges. **Figure 5-2** shows a flow schematic of the Kingston basin's flow routing and pump station criticalities.

The Kingston basin currently contains seven mini basins: 41, 42, 43, 52, 71, 72, and 73. It is anticipated sewer service will be extended to cover the Kingston UGA creating five additional sub-basins identified in the 2013 Kingston Wastewater Facilities Plan Update: Arborwood, Arness, SR 104, Taree Drive, and West Kingston. The existing mini basins are summarized in **Table 5-1**. The existing and anticipated mini basins are shown in **Figure 5-3**.

Figure 5-1 | Kingston Basin Sewer System

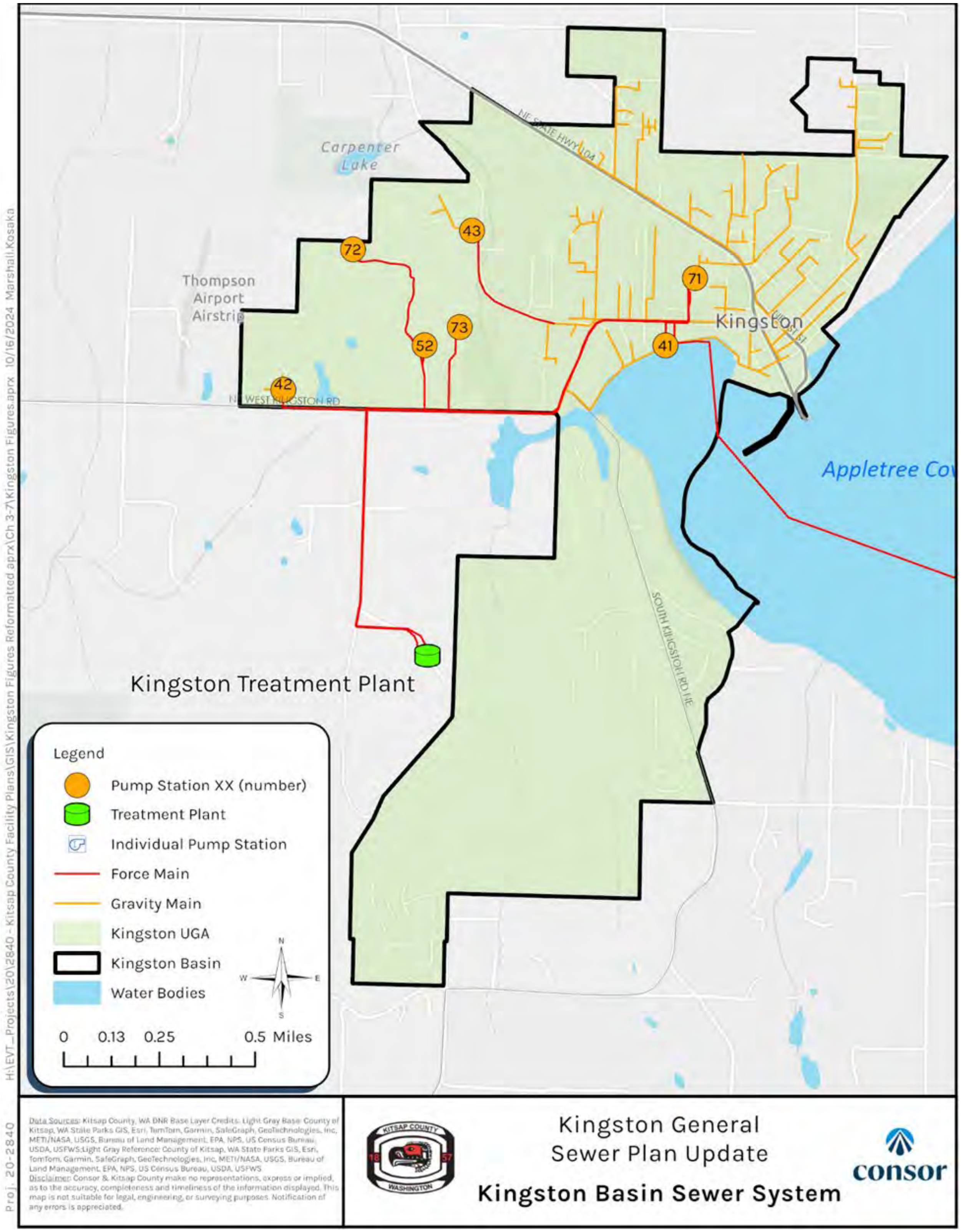


Figure 5-2 | Sewer System Schematic

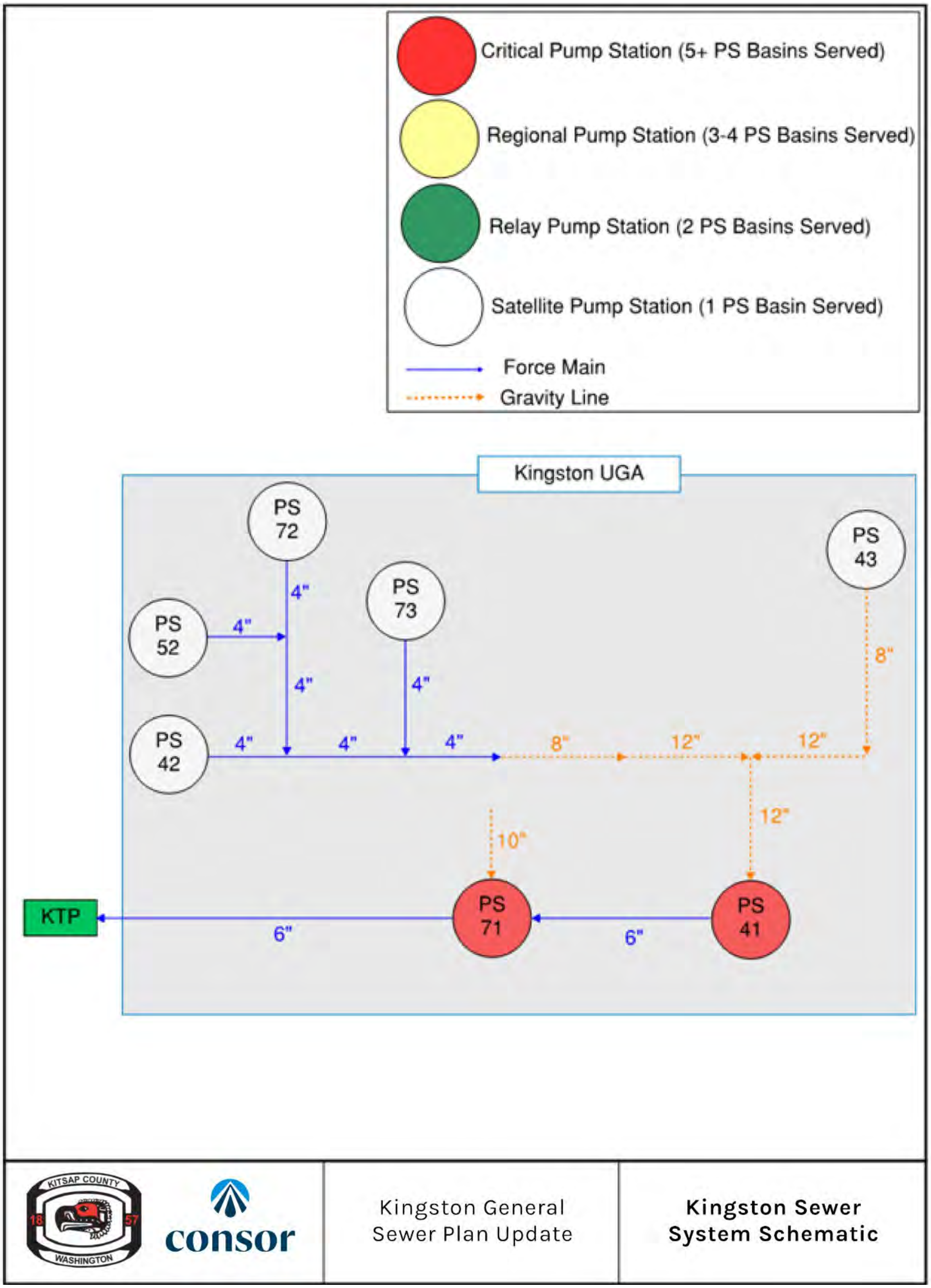


Figure 5-3 | Kingston Mini Basins

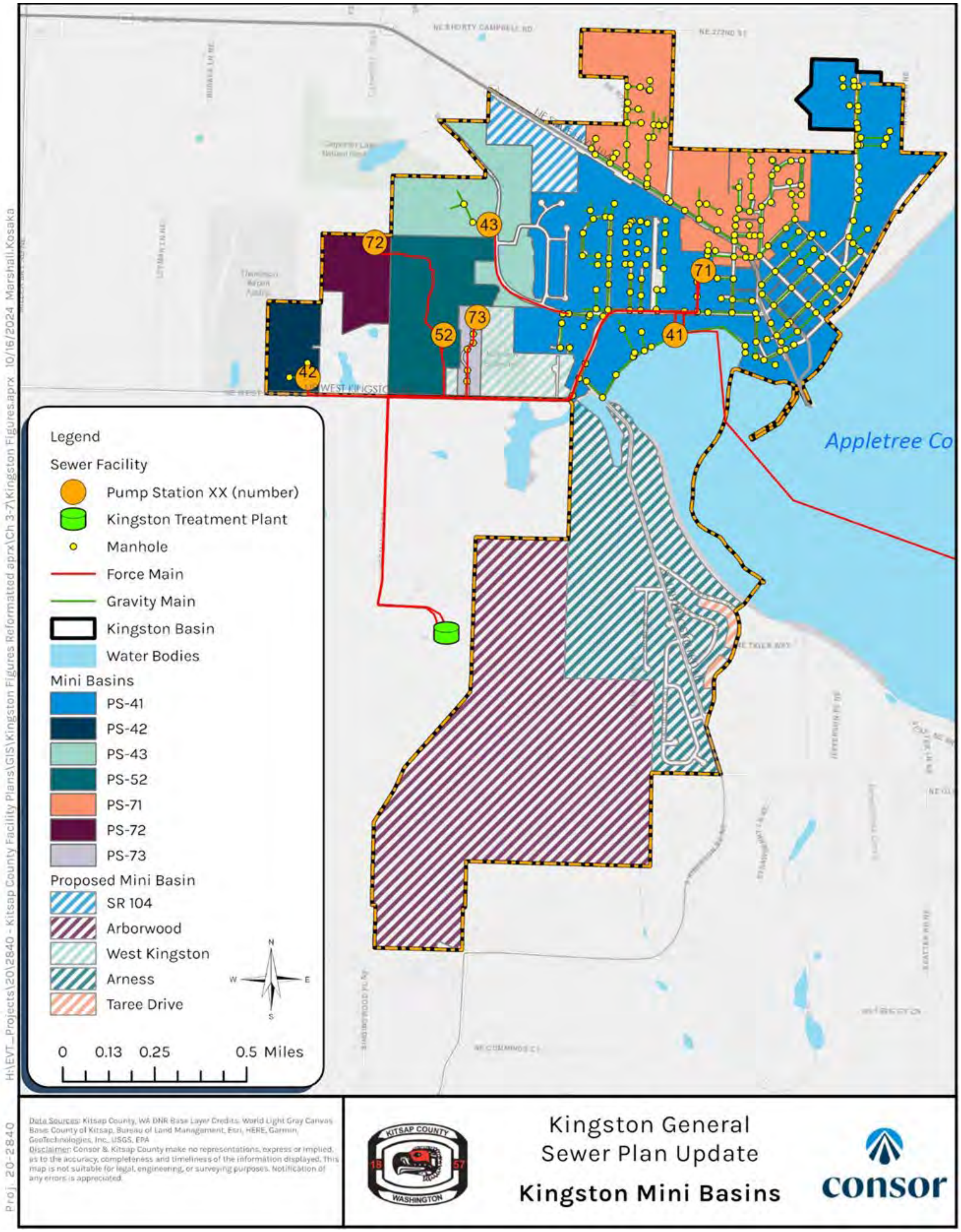


Table 5-1 | Existing Mini Basins Summary

Mini Basin	Area (ac)	Tributary Mini Basins	Downstream Mini Basins	Discharges to
PS-41	247	PS-42, PS-52, PS-72, PS-73	PS-71	6-inch dia. FM
PS-42	22	-	PS-41	4-inch dia. FM
PS-43	62	-	PS-41	4-inch dia. FM
PS-52	60	-	PS-41	4-inch dia. FM
PS-71	103	PS-41	-	6-inch dia. FM
PS-72	26	-	PS-41	4-inch dia. FM
PS-73	8	-	PS-41	4-inch dia. FM

5.2.2 Gravity Sewer

There are approximately 57,400 feet of gravity sewer pipes in the Kingston basin collection system ranging in size from 6 inches to 12 inches in diameter. The County owns most of the gravity pipe in the Kingston collection system, approximately 89 percent of which is 8 inches in diameter. The gravity sewer pipe is split roughly evenly between asbestos cement and polyvinyl chloride with approximately 50 percent and 47 percent, respectively. Ductile iron and concrete pipes comprise the remainder. An inventory of gravity sewer pipe is provided in **Table 5-2**. Pipe lengths are calculated based on GIS data provided by the County in October 2023. An updated total length was also provided by the County's sewer asset count in March 2024.

Table 5-2 | Gravity Sewer Pipe Inventory

Pipe Diameter (in)	Total Length (ft)
8	47,338
10	2,036
12	3,127
Total Gravity (2023 GIS)	**52,501**
Total Gravity Including Private (2024 Sewer Asset Count)	**57,392**

In addition to the County owned gravity sewer pipes, there is also approximately 1,000 feet of privately owned gravity pipes within the UGA boundary. Private gravity sewer pipes are summarized in **Table 5-3**.

Table 5-3 | Private Gravity Pipe Inventory

Pipe Diameter (in)	Total Length (ft)
6	158
8	975
Total Private Gravity (2023 GIS)	**1,133**

5.2.3 Force Mains

The County owns approximately 26,000 feet of sewer force mains in the Kingston basin. The force mains convey wastewater to downstream gravity conveyance or the WWTP. **Table 5-4** provides a summary of force mains in the Kingston sewer system; pipe lengths are approximated from GIS data provided by the County in May 2023. There are no privately owned force mains in the Kingston sewer system. The County provided an updated total length of forcemain in March 2024.

Table 5-4 | Force Main Summary

Force Main Diameter (in)	Total Length (ft)
4	10,612
6	11,558
Total Force Main (2023 GIS)	**22,171**
Total Force Main (2024 Sewer Asset Count)	**25,957**

5.2.4 Individual Pump Stations

Kingston basin does not have customers served by IPS.

5.2.5 Odor Control

Odor control facilities are present at several pump stations throughout the system and are summarized in **Table 5-5**.

Table 5-5 | Odor Control Inventory

Facility	Odor Control System	Operational Status
PS-41	Charcoal	Currently in use
PS-42	None	N/A
PS-43	None	N/A
PS-52	None	N/A
PS-71	Bioxide Addition	Currently in use
PS-72	None	N/A
PS-73	Passive Carbon Filter	Currently in use

5.2.6 Pump Stations

There are seven pump stations within the Kingston sewer system. The oldest pump stations were installed in the 1970s. Since then, pump stations have been added and upgraded with the most recent pump station installation occurring in 2017. The firm capacity of the pump stations in the Kingston sewer system ranges from 30 gallons per minute (gpm) at PS-52 to 450 gpm at PS-71.

The 2013 Kingston Wastewater Facilities Plan Update identified upgrades to existing pump stations in the 2013-2018 time-period. These include a full upgrade and increased capacity for PS-41 as well as higher capacity pumps, new electrical equipment, and new influent piping for PS-71. Additionally, the plan recommended installing flow meter vaults at PS-42, PS-43, PS-52, and PS-72. The 2013 Kingston Wastewater Facilities Plan Update also identified new installations of pump stations to serve the proposed mini basins identified in **Section 5.2.1** anticipated in the 2019-2025 timeline. This information was used to inform the development of CIP projects in this Plan.

On-site emergency generators have been installed at three of the seven pump stations: PS-71, PS-72, and PS-73. PS-41 receives power from PS-41.

Table 5-6 summarizes the existing pump stations based on data provided by the County including GIS data, O&M records, and draw down test records.

Table 5-6 | Pump Stations Summary[1]

Pump Station	Location	Year Built/ Upgraded	VFD	Firm Capacity (gpm)	Static Head (ft)	Total Dynamic Head (ft)	No. of Pumps	Pump HP	Individual Force Main		Mini Basins Served	Generator
									Diameter (in)	Length[2] (ft)		
PS-41	Kingston Waterfront	1974	N	240	70	85	2	15	6	1,371	PS-41, PS-42, PS-52, PS-72, PS-73	None; Power fed from PS 71; Pigtail Connection Available
PS-42	9000 NE West Kingston Road Kingston, WA 98346	1993	N	80	31	34	2	7.5	4	250	PS-42	None
PS-43	26331 Barber Cutoff Road NE Kingston, WA 98346	1990	N	400	31	34	2	5	4	2,041	PS-43	None; Pigtail Connection Available
PS-52	9918 NE West Kingston Road Kingston, WA 98346	1998	N	31	26	48	2	2	4	927	PS-52	None; Pigtail Connection Available
PS-71	Old Treatment Plant Site, Dulay Road NE	2002	N	450	-	205	2	75	6	679	PS-41, PS-71	Present; Cummins DFCC-5667357 (350 kW)
PS-72	26201 Siyaya Avenue NE Kingston, WA 98346	2006	N	95	-	180	2	10.7	4	2,325	PS-72	Present; Generator owned by Kingston High School (Type and kW Unknown)
PS-73	NE School House Place	2017	Y	-	39	127	2	17	4	1,240	PS-73	Cummins C40D6 (40 kW)

Notes:
VFD: Variable Frequency Drive
1. "-" indicates data not available at this time.
2. Length is from the pump station to the force main on NE West Kingston Road. PS-41 length is the length of force main to PS-71.

5.3 Pump Station Conditions Assessments

In September 2020 Murraysmith [now Consor] staff visited the pump stations in the Kingston basin and conducted site assessments of each facility. During these site visits, staff documented each pump station's current components and systems and their condition. Subconsultant Industrial Systems, Inc. (ISI) documented electrical equipment conditions and potential code violations. An assessment form was filled out for each pump station visited and is included as **Appendix C**.

5.3.1 Condition Summary Tables

To better organize the results of these assessments, the equipment and systems at the pump stations were arranged in several categories. While no two pump stations are identical, the stations are anatomically similar and can be characterized by a standardized set of component groupings. These component groupings are consistent with County Asset Functional Class Levels and are presented in **Table 5-7** along with definitions of the systems each comprises.

Table 5-7 | Component Group Definitions

Component Grouping	Constituent Systems and Components
Civil	Site, roadways, sidewalks, fencing
Structural	Buildings, tanks, vaults, wetwells, equipment pads, Parshall flumes
Pumping Systems	Pumps, suction, and discharge valves, check valves
Motors	Motors associated with pumps or rotating machinery.
Piping Systems	Suction piping, discharge headers, drain lines, backflushing lines, water lines, chemical dosing lines, segments of on-site force main
Valve Systems or Assemblies	Odor control system valves, washdown water valves
Support Systems	Compressed air systems, potable water, fire suppression, HVAC
Instrumentation	Level indicators, flow meters, pressure gauges, water quality analyzers, SCADA systems, network hardware, panel views
Electrical and Power Distribution	Electrical systems between MCC and main power disconnect, standby generators, transfer switches, lighting

5.3.2 Pump Station Asset Health Score

A pump station 'Asset Health Score' was developed that synthesizes each pump station's existing likelihood of failure (condition) and consequence of failure (CoF). The score was developed to better inform the County's prioritization of future asset upgrades and replacements.

For structural components like buildings and wetwells, individual condition ratings generally apply to the physical integrity of these assets in the face of material degradation due to environmental forces such as corrosion, weathering, settling, and flooding. Individual condition scores for mechanical, electrical, and instrumentation systems consider each system's physical integrity and their current ability to perform as designed. General observations and historical accounts from County O&M staff were also used to inform the condition ratings for all pump station components to incorporate phenomena not observed by Murraysmith [now Consor] staff during the site visits. Examples of this historical information from O&M staff include, but are not limited to, observed high frequencies of check valve failures, power outages, pump ragging, and pump seal failures. Individual condition ratings range from 1 to 5, with a score of 1 representing the best condition and a score of 5 representing the worst. It is important to note that condition scores are not simply reflections of age as dissimilar environmental and operational factors among the County's pump stations necessitate differing rates of condition degradation. Although age/obsolescence is not accounted for in the condition assessment, it will be a consideration for development of the 20-year CIP so that replacement of aging infrastructure is accounted for and can be budgeted. **Table 5-8** presents the definition of the component condition scores.

Table 5-8 | Component Condition Scores Definitions

Condition Rating	Definition
1	Very Good, well maintained, expected to remain reliable for more than 90% of the expected life.
2	Good, some degradation but performance and reliability are not significantly affected. Performance and reliability expected to remain satisfactory for 50-90% of the expected life.
3	Fair, performance and reliability are still acceptable, but some rehabilitation or replacement will be needed in the 50% +/- of the expected life.
4	Poor, performance and/or reliability has significantly decreased, maintenance rehabilitation or replacement needed to restore performance or reliability to acceptable levels. Failure (no longer functions) is likely in 10-50% of the expected life if not rehabilitated or replaced.
5	Very poor, performance and/or reliability has significantly decreased, and failure is probable within 10% of the expected life if rehabilitation or replacement is not performed.

Individual CoF ratings for pump station components are based on a consideration of the effects of failure of each component within the context of the local pump station. Individual CoF ratings range from 1 to 5, with a score of 1 representing the lowest consequence and 5 representing the highest. **Table 5-9** presents the definition of the CoF scores.

Table 5-9 | Component Consequence of Failure Definitions

Consequence of Failure Rating	Definition
1	Not Managed. Failure would not affect the pump station operation.
2	Not Critical. Could marginally reduce the pump station capacity or performance.
3	Important (critical but redundant). The pump station performance is significantly impacted without a currently installed redundant component.
4	Critical. The pump station performance is significantly impacted upon failure.
5	Highly Critical. Failure will cause an immediate loss of hydraulic throughput.

To fully develop an overall pump station score, the individual condition and criticality scores of each pump station's systems and components were considered within the larger context of the Kingston basin. To accomplish this, an overall pump station CoF score (from a system-wide perspective) is applied to an overall condition score for each station. This pump station criticality score is based on County conventions for pump station CoF rankings (Sheridan, Chris M. "FKC205-20 Pump Station Criticality Map 02272019", Message to Erika Schuyler. September 10, 2020. E-mail), in which a station's CoF is defined by the number of pump stations tributary to it. **Table 5-10** presents the overall CoF scores and ranking conventions.

Table 5-10 | Station Type Consequence of Failure Definitions

Station Type (from County)	Station CoF Score	Tributary Pump Stations	Total Station Flows Handled
Satellite	2	0	1
Relay	3	1	2
Regional	4	2-3	3-4
Critical	5	4+	5+

Overall condition scores for each station are weighted by component CoF and are defined as the quotient of the sum of the products of individual component condition and CoF scores and the sum of individual component criticality scores. This scoring is represented symbolically as follows:

$$Overall\ Condition\ Score\ \equiv \frac{\sum_{Components}(Condition\ Score\ \times Criticality\ Score)}{\sum Individual\ Criticality\ Scores}$$

This overall condition score is then scaled by the station CoF score to obtain the Asset Health Score:

$$Asset\ Health\ Score\ \equiv Overall\ Condition\ Score\ \times Station\ Criticality\ Score$$

The results of the analysis described in the preceding paragraphs are summarized in **Table 5-11** and detailed in **Table 5-12**. Note that condition and CoF scores (columns 4 and 5, rows 2 through 10) are for individual components; overall condition and station CoF scores are presented in row 1 of columns 4 and 5, respectively. The Asset Health Score will be used to rank the projects in the CIP.

Table 5-11 | Station Asset Health Summary

Pump Station	Consequence of Failure	Condition	Asset Health Score
41	5	3.2	16
42	2	2.9	5.8
43	2	3.3	6.6
52	2	2.9	5.8
71	5	1.7	8.5
72	2	3.7	7.4
73	2	1.6	3.2

Table 5-12 | Pump Station Condition Assessments

Pump Station	Asset Health Score	Station Component	Condition	CoF	Year Installed/ Upgraded	Notes	Recommendations
41	16.0	Overall	3.2	5.0	1974	➢ Odor complaints have been reported during low tide conditions. ➢ Few reported issues, but the station's age makes it worth monitoring closely. ➢ Power comes from LS-71. The station has lost power on several occasions when power connection has been damaged. ➢ Station is a Smith & Loveless style dry can configuration.	
		Civil	4.0	2.0	1974		
		Structural	3.0	5.0	1974		
		Pumping Systems	2.7	5.0	1974		
		Motors[1]	2.7	3.0	1974		
		Piping Systems	3.0	5.0	1974		
		Valve Systems or Assemblies	2.0	2.0	1974		
		Support Systems	3.5	1.0	1974		
		Instrumentation	3.0	5.0	1974		
		Electrical and Power Distribution	5.0	5.0	1974		
42	5.8	Overall	2.9	2.0	1993	➢ Corrosion observed on discharge piping. ➢ Has an overflow tank. ➢ National Electrical Manufacturers Association (NEMA) 4X junction box proximity to wet well is NFPA 820 4.2.2 and NFPA 70 (NEC) article 500 violation.	➢ Relocate junction boxes outside of the wet well's Class 1 Division 2 hazardous area classification boundary in compliance with current NFPA 70 (NEC) and NFPA 820 standards
		Civil	2.0	2.0	1993		
		Structural	3.0	5.0	1993		
		Pumping Systems	3.0	3.0	1993		
		Motors	3.0	3.0	1993		
		Piping Systems	4.0	5.0	1993		
		Valve Systems or Assemblies	3.0	2.0	1993		
		Support Systems	3.0	1.0	1993		
		Instrumentation	3.0	5.0	1993		
		Electrical and Power Distribution	2.0	5.0	1993		
43	6.6	Overall	3.3	2.0	1994	➢ NEMA 4 rated enclosure starting to rust out along bottom of Starter Panel Enclosure.	➢ Recommend enclosure replacement within 5 years.
		Civil	4.0	2.0	1994		
		Structural	3.0	5.0	1994		
		Pumping Systems	3.3	3.0	1994		
		Motors	3.3	3.0	1994		
		Piping Systems	4.0	5.0	1994		
		Valve Systems or Assemblies	3.0	2.0	1994		
		Support Systems	3.0	1.0	1994		
		Instrumentation	4.0	5.0	1994		
		Electrical and Power Distribution	2.0	5.0	1994		
52	5.8	Overall	2.9	2.0	1998	➢ Breakers have been observed to trip if pumps come back online after losing power while running. ➢ NEMA 4X junction box proximity to wet well is NFPA 820 4.2.2 and NFPA 70 (NEC) article 500 violation.	➢ Relocate junction boxes outside of the wet well's Class 1 Division 2 hazardous area classification boundary in compliance with current NFPA 70 (NEC) and NFPA 820 standards
		Civil	2.0	2.0	1998		
		Structural	3.5	5.0	1998		
		Pumping Systems	3.0	3.0	1998		
		Motors	3.0	3.0	1998		
		Piping Systems	3.0	5.0	1998		
		Valve Systems or Assemblies	3.0	2.0	1998		
		Support Systems	3.0	1.0	1998		
		Instrumentation	3.0	5.0	1998		
		Electrical and Power Distribution	2.0	5.0	1998		

[1] For motors <25 hp, condition scores are considered identical to Pumping Systems condition score.

Pump Station	Asset Health Score	Station Component	Condition	CoF	Year Installed/ Upgraded	Notes	Recommendations
71	8.5	Overall	1.7	5.0	2002	➢ Rags have been observed to collect on floats near influent inlet. ➢ Pumps are prone to frequent ragging. Grease mat has been observed to accumulate quicker since Covid-19 lockdowns have gone into effect. ➢ Force main capacity is limited; second pump running adds approx. 20-40 gpm. ➢ Feeds power to LS-41. ➢ A Bioxide® odor control system is on-site. ➢ A charcoal filter is located on-site and replaced every six months.	
		Civil	1.0	2.0	2002		
		Structural	1.7	5.0	2002		
		Pumping Systems	2.3	3.0	2002		
		Motors	2.0	3.0	2002		
		Piping Systems	1.5	5.0	2002		
		Valve Systems or Assemblies	2.0	2.0	2002		
		Support Systems	2.0	1.0	2002		
		Instrumentation	2.0	5.0	2002		
		Electrical and Power Distribution	1.0	5.0	2002		
72	7.4	Overall	3.7	2.0	2006	➢ Slight corrosion observed on discharge piping. ➢ Wetwell lid is observed to collide with electrical cables upon closing.	➢ Recommendation to install electrical cable J hooks along interior wall of wet well for these cables and reroute electrical cables.
		Civil	3.0	2.0	2006		
		Structural	3.5	5.0	2006		
		Pumping Systems	3.5	3.0	2006		
		Motors	3.5	3.0	2006		
		Piping Systems	4.0	5.0	2006		
		Valve Systems or Assemblies	3.0	2.0	2006		
		Support Systems	3.0	1.0	2006		
		Instrumentation	3.0	5.0	2006		
		Electrical and Power Distribution	5.0	5.0	2006		
73	3.2	Overall	1.6	2.0	2017	➢ No significant issues noted since installation in 2017. ➢ Passive carbon filter is noted to be largely ineffective. ➢ Station does not have a sign or phone number	
		Civil	2.0	2.0	2017		
		Structural	1.0	5.0	2017		
		Pumping Systems	1.0	3.0	2017		
		Motors	1.0	3.0	2017		
		Piping Systems	1.0	5.0	2017		
		Valve Systems or Assemblies	3.0	2.0	2017		
		Support Systems	3.5	1.0	2017		
		Instrumentation	3.0	5.0	2017		
		Electrical and Power Distribution	1.0	5.0	2017		

5.4 Pipeline Conditions Assessments

The County has historically conducted pipeline condition assessments through video observation. This process entails inspecting pipe pipes via closed circuit television (CCTV), storing the video in a database, reviewing the video, and assigning an Overall Condition Index (OCI) score based on the observations. The results of these assessments have been stored in their asset management database software, Cartegraph, since 2017. They are on a five year inspection cycle with about 20 percent of the pipes inspected each year. At the time of this writing, all of the pipes have been inspected and an evaluation has been stored in Cartegraph.

The County uses consistent scoring criterion when reviewing pipeline inspection videos with several criteria, which is summarized in **Table 5-13**. Each criterion has a defined score corresponding to the severity of the observed issue, if any. Lower scores indicate more severe issues based on this scoring methodology. Note that “Roots” and “I&I” have a weighting of zero which excludes these criteria from the OCI. The County captures information so that it can be filtered and viewed in Cartegraph but other categories describe the actual pipe conditions. For example, a pipe with roots present would also be scored under the obstruction or intrusion category. The OCI is calculated by this equation:

$$OCI = \frac{\sum_{pipe}(Category\ Value\ x\ Calculation\ Weight)}{\sum_{pipe} Calculation\ Weight}$$

Table 5-13 | OCI Criteria and Weighting

Category	Value	Description	Calculation Weight
Roots	0	Blockage	0
	30	Heavy	
	50	Medium	
	80	Light	
	100	None	
I & I	40	Gushing or Spurting	0
	60	Running or Trickling	
	80	Weeping or Dripping	
	90	Stain, Possible I&I	
	100	None	
Obstruction or Intrusion	0	Severe or Impassable	1
	60	Moderate	
	80	Minor	
	100	None	
Worn Surface	40	Severe	1
	60	Moderate	
	80	Minor	
	100	None	
Belly or Sag	40	Severe (>30%)	1
	60	Moderate (10 to 30%)	
	80	Minor (<10%)	
	100	None	

Category	Value	Description	Calculation Weight
Cracks or Fractures	40	Severe Cracking	3
	60	Moderate Cracking	
	80	Minor Cracking	
	100	None	
Break or Failure	0	Collapse	5
	15	Hole Void Visible	
	30	Hole Soil Visible	
	100	None	
Lining or Repair Failure	40	Severe	1
	60	Moderate	
	80	Minor	
	100	None	
Joint Separation or Offset	40	Severe (> 1.5 Pipe Thickness)	2
	60	Moderate (1 to 1.5 Pipe Thickness)	
	80	Minor (< Pipe Wall Thickness)	
	100	None	

The County provided OCI scores for 6,609 feet of pipe in the Kingston basin where issues were found within the 60 percent in Cartegraph. This data is included as **Appendix D**. Because only pipes with noted deficiencies were input into Cartegraph, it is assumed that inspected but unscored pipes have an OCI of 100. Discussions with County staff indicate that the pipes inspected and documented in Cartegraph are representative of the system as a whole. For planning purposes, the lengths of pipe in each OCI range have been extrapolated and are summarized in **Table 5-14**. The rankings of all County-owned pipelines in the Kingston basin are not below a threshold of an OCI score of 60, so there will be no prioritizations nor projected annual costs for pipeline replacement in the CIP for this basin.

Table 5-14 | Percentage of Pipes in OCI Condition Ranges

OCI Range	Length (ft)	Percentage of Total
0-20	-	0%
20-40	-	0%
40-60	-	0%
60-80	-	0%
80-99	3,600	6%
100	53,800	94%

SECTION 6

Wastewater Treatment Facilities Existing Conditions

6.1 Introduction

A description of the existing Kingston WWTP field evaluation and condition assessment, the capacity analysis of the plant facilities and processes, and an evaluation of each process to identify any deficiencies is presented in Section 6. Recommendations are provided to address challenges impacting facility operations along with maintenance upgrades necessary to continue meeting NPDES Permit requirements.

6.2 Existing Wastewater Treatment Plant Description

The Kingston WWTP was constructed in 2005, replacing a WWTP originally constructed in 1974 that was approximately 3 miles from the current plant site. In 2006, the outfall to Appletree Cove was replaced and realigned. The Kingston WWTP is permitted to treat 0.292 MGD Maximum Month Design Flow (MMDF). The plant is an oxidation ditch (extended aeration) type activated sludge facility. Plant processes are preliminary screening and grit removal, influent flow measurement with a Parshall Flume, biological treatment in two oxidation ditches, two secondary clarifiers, ultraviolet (UV) disinfection, and effluent measurement with a Parshall Flume. Sludge removed from the secondary clarifiers is thickened with a GBT and sent to the County's Central Kitsap WWTP for further treatment and disposal. Treated effluent is discharged to the Appletree Cove of the Puget Sound through an 18-inch diameter outfall extending 5,350 feet into Appletree Cove to a depth of 169 feet below mean lower low water (MLLW) in accordance with the NPDES Permit. The Kingston WWTP site plan is shown in Figure 6-1. Figure 6-2 shows the process schematic of the current Kingston WWTP.

The Kingston WWTP is a high performing treatment plant and has received Ecology's Outstanding Performance Award every year since it was commissioned except one.

Figure 6-1 | Existing Kingston WWTP Site Plan

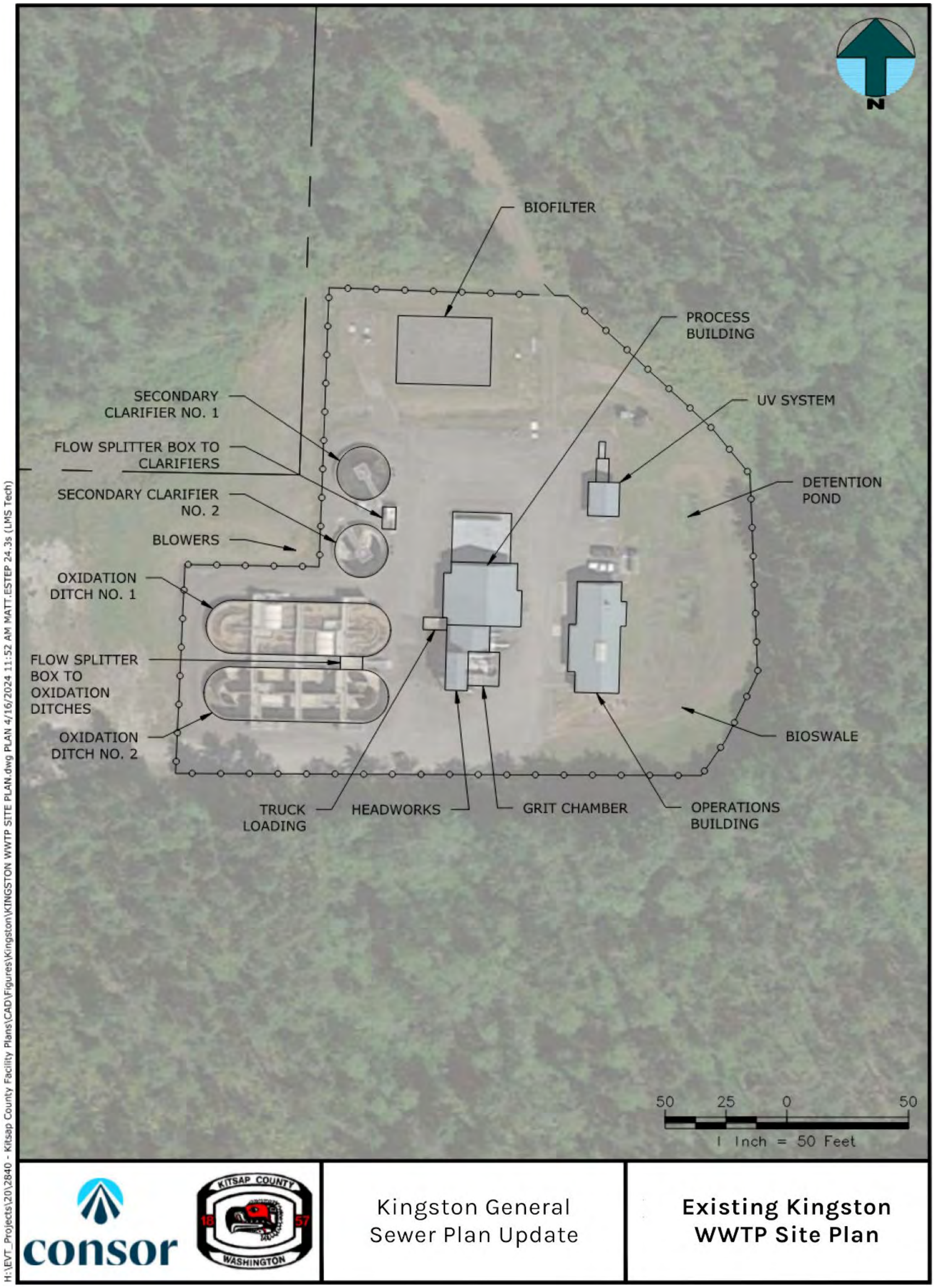
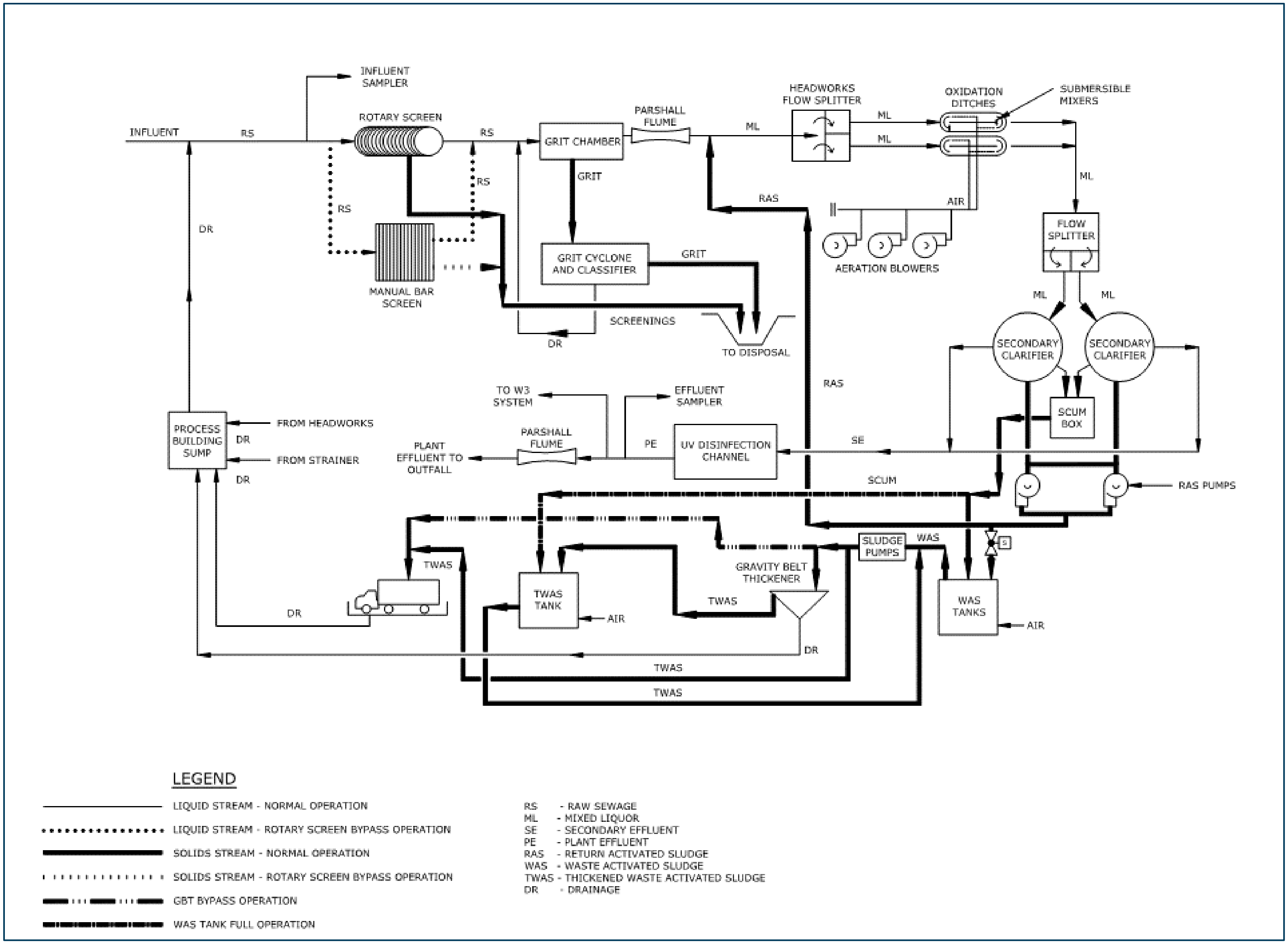


Figure 6-2 | Existing Kingston WWTP Schematic



6.3 Wastewater Treatment Plant Condition Assessment

The Murraysmith [now Consor] team visited the Kingston WWTP in September 2020 to observe and document existing plant conditions and to have discussions with plant staff regarding operational and plant performance challenges. The group investigated facilities and unit processes for the liquid streams and solids streams by walking through each process to ascertain equipment condition and manufacturing information. WWTP electrical equipment and structures were also observed. Plant staff provided information on the daily operations of the plant and past and current operational challenges. The information gathered from the assessment was used to develop a list of recommendations for maintaining plant operations and performance. The major equipment information, photos and field notes are summarized in **Appendix E**.

6.3.1 Condition Summary Tables

To better organize the results of the assessments at the Kingston WWTP, major processes were grouped as presented in **Table 6-1**.

Table 6-1 | WWTP Process Group Definitions

Process	Components
Civil	Site, site security, roadways, sidewalks, fencing
Preliminary Treatment	Screens and grit removal and associated equipment and piping
Secondary Treatment	Oxidation ditches, secondary clarifiers and associated equipment and piping
Disinfection and Effluent	UV system, effluent Parshall flume and associated piping
Solids Treatment	GBT, Waste Activated Sludge (WAS) storage tanks, Thickened Waste Activated Sludge (TWAS) storage tanks and associated equipment and piping
Support Systems	Odor control, sodium hypochlorite system, plant water system and process building sump and pumps
Power Distribution	Electrical services, transfer switches, standby generator, motor control centers and control panels

These processes were further broken down into several categories when appropriate. While no two processes are identical, the processes are anatomically similar and can be characterized by a standardized set of component groupings. These component groupings are consistent with County Asset Functional Class Levels and are presented in **Table 6-2** along with definitions. Note that the Asset Functional Class Level has nine groups: Civil, Structural, Piping Systems, Pump Systems, Valve System or Assemblies, Equipment, Support Systems, Instrumentation, Power Distribution. However, for the WWTP conditions assessments, the components are shortened to four groups, which are more directly applicable to the wastewater treatment processes. Civil, Power Distribution and Support Systems are treated as processes; Piping and Valves are grouped together; Pumps are grouped with Equipment.

Table 6-2 | Component Group Definitions

Component Grouping	Definitions
Equipment	Mechanical equipment such as screens, pumps, and blowers. Equipment and motors are treated as one piece of equipment.
Instrumentation	Electrical and measuring devices such as flowmeters, transmitters, and indicators.
Structural	Concrete structures such as buildings, basins, and tanks.
Piping	A system of pipes and valves used to convey fluids such as influent, effluent, air and sludge pipes and valves.

6.3.2 Treatment Plant Process Asset Health Score

To better inform the County's prioritization of future asset upgrades and replacements, an overall treatment plant process "Asset Health" score was developed that synthesizes each process's existing likelihood of failure (condition) and CoF.

Individual condition scores for equipment, instrumentation and piping systems consider each system's physical integrity and their current ability to perform as designed. For structural components, individual condition ratings generally apply to the physical integrity of these assets in the face of material degradation due to environmental forces such as corrosion, weathering, settling, and flooding. General observations and historical accounts from County O&M staff were also used to inform the condition ratings for all treatment plant process components to incorporate phenomena not observed by Murraysmith [now Consor] staff during the site visits. Examples of this historical information from O&M staff include, but are not limited to, challenges associated with equipment operation, lack of redundancy and lack of automation. Individual condition ratings range from 1 to 5, with a score of 1 representing the best condition and a score of 5 representing the worst. **Table 6-3** presents the definition of the condition scores. It is important to note that condition scores are not simply reflections of age as dissimilar environmental and operational factors among the Kingston WWTP necessitate differing rates of condition degradation. Although age/obsolescence is not accounted for in the condition assessment, it will be a consideration for development of the 20-year CIP so that replacement of aging infrastructure is accounted for and can be budgeted.

Table 6-3 | Component Condition Scores Definitions

Condition Rating	Definition
1	Very Good, well maintained, expected to remain reliable for more than 90% of the expected life.
2	Good, some degradation but performance and reliability are not significantly affected. Performance and reliability expected to remain satisfactory for 50-90% of the expected life.
3	Fair, performance and reliability are still acceptable, but some rehabilitation or replacement will be needed in the 50% +/- of the expected life.
4	Poor, performance and/or reliability has significantly decreased, maintenance rehabilitation or replacement needed to restore performance or reliability to acceptable levels. Failure (no longer functions) is likely in 10-50% of the expected life if not rehabilitated or replaced.
5	Very poor, performance and/or reliability has significantly decreased, and failure is probable within 10% of the expected life if rehabilitation or replacement is not performed.

Individual CoF ratings for process components are based on consideration of the effects of failure of each component within the context of the local process. Individual CoF ratings range from 1 to 5, with a score of 1 representing the lowest consequence and 5 representing the highest. **Table 6-4** presents the definition of the CoF scores.

Table 6-4 | Component Consequence of Failure Definitions

Consequence of Failure Rating	Definition
1	Not Managed. Failure would not affect the treatment plant operation.
2	Not Critical. Could marginally reduce the treatment performance
3	Important (Critical but redundant). The treatment plant performance is significantly impacted without a currently-installed redundant component.

Consequence of Failure Rating	Definition
4	Critical. The treatment plant performance is significantly impacted upon failure.
5	Highly Critical. Failure will cause an immediate loss of hydraulic throughput.

To fully develop an overall treatment plant process score, the individual condition and CoF scores of each process were considered within the larger context of the Kingston WWTP. To accomplish this, an overall treatment plant process CoF score (from a plant-wide perspective) is applied to an overall condition score for each process. The definition of the overall process CoF scores are the same as the definition of the component CoF scores.

Overall condition scores for each process are weighted by component CoF and are defined as the quotient of the sum of the products of individual component condition and CoF scores and the sum of individual component CoF scores. This scoring is represented symbolically as follows:

$$Overall\ Condition\ Score \equiv \frac{\sum_{Components}(Condition\ Score \times CoF\ Score)}{\sum Individual\ CoF\ Scores}$$

This overall condition score is then scaled by the process CoF score to obtain the overall treatment plant process score:

$$Asset\ Health\ Score \equiv Overall\ Condition\ Score \times Unit\ Process\ CoF\ Score$$

The results of the analysis described in the preceding paragraphs are summarized in **Table 6-5** and detailed in **Table 6-6**. The Asset Health Score will be used to rank the projects in the CIP.

Table 6-5 | Treatment Plant Process Asset Health Summary

Unit Process	Unit Process CoF Score	Overall Condition Score	Asset Health Score
Civil	1	2.0	2.0
Preliminary Treatment	3	1.8	5.4
Secondary Treatment	5	1.3	6.5
Disinfection and Effluent	3	2.4	7.2
Solids Treatment	3	2.0	6.0
Support Systems	3	2.2	6.6
Power Distribution	5	2.0	10.0

The current treatment plant components are described in more detail in the following sections. Following the description of each major process component is an outline of the observations made by the Murraysmith [now Consor] team and a list of recommended improvements. The major unit process condition, capacity, and recommendations are summarized in **Table 6-19**.

Table 6-6 | Treatment Plant Unit Process Condition Assessments

Unit Process [1]	Asset Health Score	Process Component	Condition	CoF	Year Installed/Upgraded	Notes	Recommendations
Civil	2.0	Overall	2.0	1.0		➢ The fence is in good condition. ➢ The site has minimal landscaping, providing clear visibility of the site from the road.	➢ Consider adding an automatically opening gate, intrusion alarms, and video surveillance.
Preliminary Treatment	5.4	Overall	1.8	3.0		➢ The grit cyclone and classifier have moderate corrosion.	➢ General maintenance practice on grit classifier to mitigate corrosion.
		Equipment	1.8	2.0	2019, 2005		
		Instrumentation	1.3	2.7	2019		
		Structural	2.0	3.0	2005		
		Piping	2.0	4.0	2005		
Secondary Treatment	6.5	Overall	1.3	5.0		➢ The scraper drives have significant body corrosion. The scum boxes are showing moderate surface corrosion. Both of the clarifier effluent box valve stems are showing significant corrosion.	➢ Replace secondary clarifier weir caulking during clarifier downtime; clean and coat the corroded areas on the clarifier drives, scum boxes and effluent box valve stem assemblies to prevent further degradation. ➢ General maintenance practice to mitigate corrosion.
		Equipment	1.4	3.0	2020, 2005		
		Instrumentation	1.0	3.7	2020		
		Structural	1.0	3.7	2005		
		Piping	1.7	3.7	2020, 2005		
Disinfection and Effluent	7.2	Overall	2.4	3.0		➢ Plant staff are cleaning the lamps manually. ➢ The basic controller of the UV system cannot turn on or off the bank based on the flow signal.	➢ Replace entire UV system for improved control in the next 5 to 10 years.
		Equipment	3.7	3.3	2005		
		Instrumentation	2.0	3.0	2005		
		Structural	2.0	2.0	2005		
		Piping	2.0	5.0	2005		
Solids Treatment	6.0	Overall	2.0	3.0		➢ The GBT appears to be in very good condition with some minor areas of paint missing on the frame, but no rust. ➢ The GBT room had a very strong odor, indicating that the HVAC system may be underperforming.	➢ Evaluate ventilation in GBT room to minimize corrosion. ➢ General maintenance practice to mitigate corrosion. ➢ Install or repair Lower Explosive Limit (LEL) combustible gas detection system at TWAS tank. ➢ Install fire alarm system in GBT room.
		Equipment	2.0	2.9	2005		
		Instrumentation	2.3	2.3	2005		
		Structural	2.0	3.5	2005		
		Piping	2.0	5.0	2005		
Support Systems	6.6	Overall	2.2	3.0		➢ During the site visit in September 2020 the biofilter was turned off due to the media collapse. It was later dug up and recovered by the plant staff. ➢ Plant staff noted that when in use, the hypochlorite tank could not be fully drained. ➢ Pump 902 (P-902) of the W3 system has some leakage which is causing corrosion to the pump and frame. This could be a failed casing gasket.	➢ Clean the exterior of air gap tank and monitor for future overflow. ➢ Repair or replace casing gasket on pump P-902.
		Equipment	2.1	1.9	2005		
		Instrumentation	N/A	1.0			
		Structural	3.7	1.8	2005		
		Piping	2.0	2.3	2005		
Power Distribution	10.0	Overall	2.0	5.0		➢ The Adjustable Frequency Drives (AFDs) installed in MCC-01 are in good condition, however they are obsolete and no longer supported by the manufacturer. ➢ The PLC system and OIT equipment are not readily available, as each brand of PLC and OIT requires special programming. ➢ The operator interface terminal (OIT) in CP-300 plant remote I/O panel is obsolete, and the model is no longer supported. ➢ Panels LP-GBT and LP-TLP interiors were not accessed and the installation of a controller (e.g. PLC) was not verified. It is likely one or both panels contain PLCs. ➢ The local control panel for the scum pump appears to have been partially filled with water or somehow compromised. Terminals indicate rust or corrosion, and the bottom interior of the enclosure is covered with residue.	➢ Complete arc flash study. ➢ Establish replacement plan for obsolete AFDs. ➢ Verify back-up copies of all PLC and OIT programs; create and store if not created. ➢ Spare parts for the PLC should be stored by the County in case of a failure. ➢ Develop and execute a migration/replacement plan if OIT in CP-300 is used as a main point of control. ➢ Verify whether there is a PLC in the LP-GBT or LP-TLP panel. ➢ Clean and inspect the local control panel for the scum pump.
		Equipment	2.1	3.4	2020, 2005, 2004		
		Instrumentation	N/A	N/A			
		Structural	N/A	N/A			
		Piping	N/A	N/A			

Notes:
See Table 6-1 for major equipment included in each unit process

6.3.3 Evaluation of Components

The current treatment plant components are described in more detail in the following sections. Following the description of each major process component is an outline of the observations made by the Murraysmith [now Consor] team and a list of recommended improvements. The major unit process condition, capacity, and recommendations are summarized in **Table 6-19**.

6.3.3.1 Civil

The Kingston WWTP is secured by a uniform chain link fence with barbed wire. Site access is through a manual gate. There is no video surveillance onsite.

Observation: The fence is in good condition, and the site has minimal landscaping, providing clear visibility of the site from the road.

Recommendation: The County may want to consider adding an automatically opening gate, intrusion alarms, and video surveillance.

6.3.3.2 Preliminary Treatment

Raw sewage is pumped into the Headworks Facility (Headworks) from PS-71 located approximately 1.2 miles northeast of the WWTP at 26198 Dulay Road NE. The pump station provides the wastewater with enough head to flow by gravity through all the treatment processes in the WWTP. Plant drainage from the Process Building sump combines with the raw sewage forcemain prior to entering Headworks.

Headworks is a two-story above grade concrete structure that was constructed in 2005. Headworks consists of a rotary screen, manual bar screen, Parshall flume, grit removal, and influent composite sampling. The rotary screen was recently replaced with a new unit as part of the 2019 Aeration System and Oxidation Ditch Improvements project. The new rotary screen has auxiliary pressate and booster pumps for enhanced screen washing.

Raw sewage enters Headworks into a channel where an automatic sampler takes composite influent samples. This influent channel splits to two channels; one with a rotary screen and one with a manual bar screen. Raw sewage normally flows through the channel with a ¼-inch opening rotary screen. A separate channel with a 1-inch opening manual bar screen bypasses the rotary screen. Both screen channels can be isolated with manual gates for inspection and maintenance. After screening, raw sewage enters a vortex-type grit chamber. The grit removal system can be isolated with manual gates, and the plant can continue operating with flow bypassing the grit removal and directly going to the oxidation ditches. Degritted wastewater passes through a 12-inch Parshall flume with an ultrasonic level meter to monitor influent flow rate.

Influent screenings removed within the rotary screen are washed, compacted, and then discharged into a dumpster for offsite disposal. Grit collected at the bottom of the grit chamber is pumped to a grit cyclone and 12-inch inclined screw grit classifier where the grit is washed and then discharged into the same dumpster as the influent screenings. The influent screenings and grit are disposed as solid waste.

Observations and recommendations for each major headworks process component are outlined below.

6.3.3.2.1 Influent Rotary Fine Screen

Observation: The ¼-inch opening rotary screen was installed in 2019. The rotary screen is in very good condition with no visible exterior corrosion, performance issues, or maintenance concerns reported by plant staff. The screening chute and dumpster are both in good condition with no visible corrosion or leaks. Plant staff reported no issues with the rotary screen. Ancillary pressate and booster pumps for enhanced screen cleaning were also installed in 2019 and appear to be in very good condition, with no issues reported by plant staff. The influent rotary fine screen is expected to meet the typical lifespan of 25 to 30 years and have more than 27 years of life remaining.

Recommendation: None.

6.3.3.2.2 Influent Manual Screen

Observation: The 1-inch opening manual bar screen was not observed in the channel. The plant staff reported no issues with the manual screen.

Recommendation: None.

6.3.3.2.3 Grit Removal

Observation: The grit chamber was installed in 2005. The exterior concrete structure and cover plates appear to be in very good condition with no visible exterior corrosion. The grit trap equipment is in good condition with minimal surface corrosion.

The grit cyclone and classifier were installed in 2005 and are located on the upper level of Headworks. This equipment is in fair condition with the body flanges showing moderate corrosion. The feed box has been replaced with a custom fabrication indicating that corrosion has been an ongoing issue for the classifier. This corrosion will not cause grit to leak from the equipment but allows some gas to escape the equipment and will eventually cause the equipment to leak and malfunction.

The grit pump was installed in 2005. The grit pump and piping appear to be in good condition with no visible exterior corrosion.

Plant staff reported that the grit removal system is operating well, with no outstanding performance or maintenance issues. The grit equipment is 16 years old with no noted performance issues or significant visible degradation; therefore, it is expected to exceed its typically expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years) but may require rehabilitation to maintain performance prior to replacement.

Recommendation: The corrosive area on the grit classifier should be repainted to mitigate further corrosion and odor.

6.3.3.3 Primary Treatment

There is no primary treatment at the Kingston WWTP. Effluent from Headworks flows directly to the oxidation ditches.

6.3.3.4 Secondary Treatment

Headworks effluent is split to two oxidation ditches. Return activated sludge (RAS) combines with the flow prior to the flow splitter into the oxidation ditches, which were originally constructed in 2005. Upgrades to equipment and instrumentation in both oxidation ditches were completed in 2020 and 2021. The brush aeration system originally installed in the oxidation ditch in 2005 was replaced with submersible mixers and an aeration system with blowers and fine bubble air diffusers. DO and oxidation reduction potential (ORP) probes are in the recycle turn zone downstream of the effluent weirs and upstream of the aerators.

Air is supplied to the oxidation ditches by three new variable-speed, 15-Horsepower (HP) positive displacement blowers (two duty, one standby) installed in 2020. The blowers were installed north of the oxidation ditches and west of Secondary Clarifier No. 2, in sound-attenuating enclosures. The blowers were commissioned to be controlled by ORP, however, after some difficulties with the plant operation, operators switched back to time-based aeration and plan to troubleshoot ORP-based operation when peak winter flows have receded.

From the oxidation ditches, flow is conveyed to a flow splitter located east of the secondary clarifiers. The flow splitter divides the flow to the two 35-foot diameter secondary clarifiers. The flow splitter and secondary clarifiers were constructed in 2005. Each of the secondary clarifiers has a side wall depth of 13 feet and a total surface area of 1,924 square feet. The clarifiers each have a central drive unit, center column and feed well, spiral rake arm, scum scraper, scum box, scum pit, effluent weirs, and inboard launder. Process water is sprayed onto the surface of the secondary clarifiers along the walkway to reduce foaming. Mixed liquor separates in the clarifier, and the active biomass settles to the bottom of the clarifier while treated secondary effluent flows over the v-notch effluent weir.

The biomass is concentrated and withdrawn from the bottom of the clarifiers as RAS or WAS. The sludge from the clarifiers is pumped by the two RAS pumps located in the Process Building. Both RAS pumps can pump from either clarifier. Flow from each RAS pump is metered and returned to the mixed liquor influent into the oxidation ditches. According to the plant Operations Manual, the variable speed RAS pumps normally operate automatically on a lead/lag basis and can be controlled in one of three modes: Ratio, RAS flow, or Manual. In Ratio mode, the speed of RAS pumps is automatically regulated to maintain a fixed RAS return ratio, i.e., the ratio between the recycle flow rate as measured by the RAS flow meters less the WAS flow meter value and effluent flow rate as measured by the effluent Parshall flume. In RAS flow mode, the speed of a given RAS pump is automatically regulated to maintain a constant flow rate as measured by the respective flow meter. In Manual mode, the speed of a given RAS pump is automatically regulated to maintain a constant speed.

WAS is periodically diverted from the discharge of the RAS pumps to the selected WAS tank via a motorized flow control valve downstream of the WAS flowmeter. Although the flow control valve could be manually opened or closed locally, it is normally automatically controlled by the SCADA in Time or Volume modes. In Time mode, the WAS valve opens when the operator opens it via the remote control and remains open for the duration of the time setpoint before automatically closes. In Volume mode, the WAS valve opens when the operator opens it via the remote control and remains open until the wasted sludge volume, as measured by the WAS flow meter, equals the volume setpoint. Based on the plant operation data in the last two years, the Volume mode has been used at the plant to waste approximately 3,000 to 7,000 gallons per day of sludge on each of five weekdays. The volume wasted is calculated based on mean cell residence time and TSS concentration.

The secondary clarifiers are equipped with a scum scraping mechanism that removes scum from the surface of the clarifiers. The scum is pushed into a scum trough that drains into a common scum pump station adjacent to the clarifiers. From the scum wetwell, a submersible scum pump normally pumps scum into the TWAS tank and can also pump scum into the WAS tanks if the TWAS tank is full or out of service. The scum pump must be turned on manually and will turn off based on a low-level switch in the scum wetwell.

Observations and recommendations for each major process component are outlined below.

6.3.3.4.1 Oxidation Ditches

Observation: The oxidation ditches concrete structures, walkways, and associated equipment and instrumentation all appear to be in very good condition. The oxidation ditches currently have sufficient capacity to be operated one at a time, and operation is alternated once per year. Two submersible mixers are moved between the oxidation ditches when they are rotated. Each oxidation ditch is equipped with two aeration diffuser grids with air supplied by the new blowers. During the site visit in September 2020, Oxidation Ditch No. 2 was operating with the new aeration blowers, diffusers and mixers, and Oxidation Ditch No. 1 still has old equipment and was drained. The upgrade to Oxidation Ditch No. 1 was substantially completed by the end of 2020. Staff reported no performance or maintenance issues with the new oxidation ditch equipment or other secondary process structures or equipment.

Recommendation: None.

6.3.3.4.2 DO/ORP probes

Observation: New DO and ORP probes were installed at Oxidation Ditch No. 2 during the Aeration System and Oxidation Ditch Improvements project. Similar to the submersible mixers, the DO and ORP probes will be shared between two oxidation ditches and installed in the operational ditch. The probes were not visible.

Recommendation: None.

6.3.3.4.3 Aeration Blowers

Observation: Three Aerzen blowers were installed in 2020 and appear to be in very good condition. The blowers have variable frequency drives. Three blowers share a common stainless-steel discharge air header which later splits into two piping to the two oxidation ditches. Air flow is measured by the thermal mass flow meter at each oxidation ditch. The blowers are currently operated on a time basis, typically 4 hours on and 2 hours off. DO is continuously monitored.

Staff reported that the blowers function well and the oxidation ditches are effective at nitrogen removal.

Recommendation: None.

6.3.3.4.4 Flow Splitter

Observation: The flow splitter box was constructed in 2005. It could not be drained for observation but appears to be in good condition. Plant staff reported that the flow splitter has no operational or maintenance issues and provides an even split between secondary clarifiers.

Recommendation: None.

6.3.3.4.5 Secondary Clarifiers

Observation: The secondary clarifiers were constructed in 2005. The concrete structures and walkways are in very good condition. Secondary Clarifier No. 1. was operating the day of the site visit, and Clarifier No. 2 was empty. The clarifier center column, scraper, and weir components appeared to be in good condition. The weir caulking is showing minor wear. The scraper drives are in fair condition, with significant body corrosion. The scum boxes are showing moderate surface corrosion. Both of the clarifier effluent box valve stems show significant corrosion.

The clarifier drive equipment is 16 years old and is expected to meet its typically expected lifespan of 25 to 30 years. It is expected that the equipment may have half of its expected serviceable life remaining (12 to 15 years) but will likely require rehabilitation to maintain performance prior to replacement.

Recommendations: Replace secondary clarifier weir caulking during clarifier downtime. Clean and coat the corroded areas on the clarifier drives, scum boxes and effluent box valve stem assemblies to prevent further degradation. Plan for increased maintenance requirements for the next 12 to 15 years, and then replace the equipment.

6.3.3.4.6 RAS/WAS Pumping

Observation: The RAS pumps located in the Process Building were installed in 2005 and appear to be in good condition. The exposed piping, valves and two RAS magnetic flow meters (magmeter) appear to be in very good condition. The WAS magmeter and flow control valve appear to be in very good condition.

Plant staff reported no performance or maintenance issues with operating the RAS/WAS pumping system. The RAS pumps are 16 years old with no noted performance issues or significant visible degradation; therefore, they are expected to meet or exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years).

Recommendation: None.

6.3.3.4.7 Scum Pump and Wetwell

Observation: The scum wetwell, pump, and piping were constructed in 2005. The wetwell concrete and hatch are in good condition. The submersible pump rail system, scum piping, and float were observed to be in good condition. Plant staff reported no performance or maintenance issues with the scum pumping system. The scum pump is 16 years old with no noted performance issues or significant visible degradation; therefore, it is expected to meet or exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years).

Recommendation: None.

6.3.3.5 Disinfection and Effluent

Secondary effluent is discharged to the UV disinfection channel located east of the secondary clarifiers. Flow enters the UV disinfection channel with two banks of UV lamps that alternate in lead/lag operation. The UV system is a Trojan UV3000B system configured in two banks equipped with 56 low pressure bulbs each. One of the two banks is usually energized to handle the normal flows. The second bank is brought online to deliver required UV dose during high flows. The system records the lamp life and can automatically alternate the banks for equal wear and time off to minimize bank cycling. The UV channel is built to provide extra width for additional lamp modules in the future if the capacity needs to be increased. The UV channel level is controlled by fixed level control finger weirs. There are high-level and low-level switches downstream of UV bank and upstream of the level control weirs. If the UV channel level drops below the set point, the UV system will generate a low level alarm to alter the operator to manually shut down the system to prevent the lamp overheating.

Following UV disinfection, effluent flow is measured with a 6-inch Parshall flume equipped with an open channel ultrasonic level sensor. Between the UV channel and the flume, there is a withdrawal point for plant water system. An automatic composite flow sampler collects samples upstream of the Parshall flume. Following metering, the effluent flows by gravity to the outfall.

Observations and recommendations for each major process component are outlined below.

6.3.3.5.1 UV Disinfection System

Observation: The concrete channel, grating, Parshall Flume and UV equipment were installed in 2005. The channels, grating and flume are in good condition. Plant staff clean the lamps manually. The Trojan UV-3000B system was installed in 2005 and has the basic controller which can only automatically alternate the lead and lag UV banks, monitor the bank run time, bank On/Off status, a common alarm and UV intensity. The basic controller can turn on but cannot turn off the tank based on the flow signal from the Parshall flume.

Recommendation: The Trojan UV-3000B system is an old model using the manufacturer's low-pressure high output open channel technology. Although there were no performance or maintenance issues observed, additional control and monitoring capabilities beyond what the current basic controller can offer, e.g., tracking the individual lamp status and the UV transmittance, are desired by the plant staff. The basic controller can be replaced with the touch smart controller and a new UV transmittance probe can be installed to meet most of the monitoring requirement, except the individual lamp failure status. If the individual lamp failure status needs to be monitored, the entire Trojan 3000B UV system needs to be upgraded. The Trojan UV-3000B system life is typically 20 to 25 years, therefore the UV system at Kingston WWTP is in poor condition and has about 2-10 years of remaining life. It is recommended to upgrade the entire UV system to provide those monitoring capabilities.

6.3.3.5.2 Parshall Flume and Effluent Sampling

Observation: The Parshall Flume was constructed in 2005 and is in good condition. The automatic sampler was installed in 2005 and is in fair condition. Plant staff reported no issues with effluent metering and sampling.

Recommendation: None.

6.3.3.5.3 Outfall

The plant effluent is discharged through an outfall in Appletree Cove in the Puget Sound by gravity through an 18-inch diameter pipe with seven 3-inch diameter diffuser ports 50 feet apart at the downstream end of the outfall pipe. The outfall was replaced and realigned in 2006 and inspected in 2019. The last diffuser port was not found during the inspection and the inspectors were able to confirm flow through only one of the diffuser ports.

Observations and recommendations for the outfall are outlined below.

Observation: The outfall components were not observed.

Recommendation: None.

6.3.3.6 Solids Treatment

Sludge is thickened and stored at the Kingston WWTP and then transported to the Central Kitsap WWTP for further treatment and ultimate disposal under the County's Class B biosolids program. The Process Building and solids handling processes were constructed in 2005. Sludge collected from the secondary clarifiers is pumped by two RAS pumps in the Process Building. RAS and WAS are metered and WAS flow is diverted from the RAS loop via a flow control valve and flow meter.

WAS is pumped to the Process Building, where it is stored in two below-grade 25,000-gallon aerated WAS tanks. The WAS tanks also accept scum from the secondary clarifiers. The WAS tanks are equipped with coarse bubble diffusers to mix and aerate the sludge and prevent septic conditions. Plant staff estimate the WAS quantity to be wasted on the daily basis to maintain a desired aeration basin sludge retention time and utilize the WAS control valve and flow meter to waste the target WAS volume. Sludge is currently wasted at the rate of approximately 3,000 to 7,000 gallons each weekday, so each WAS tank provides 3.3 to 8.0 days of storage. WAS tanks are filled and emptied simultaneously.

From the WAS tanks, sludge is pumped by one of the two sludge pumps to the GBT. WAS can bypass the GBT system and be pumped directly from the WAS tanks to tanker trucks if necessary. GBT is only run about one day a week when the plant does not collect composite samples. GBT drainage flows to the Process Building sump for discharge to Headworks. The GBT was installed in 2005. It has a 200 gpm capacity and is run to thicken sludge to 5.0 to 5.5 percent solids concentration. Operators have found that sludge thicker than 5.5 percent is difficult to get out of the tanker trucks. The GBT has one polymer mixing and dilution system to enhance sludge thickening in the GBT. The polymer dilution system dilutes neat polymer from delivered drums and injects the dilute polymer into the influent sludge stream entering the GBT.

TWAS is stored in a below-grade 16,000-gallon aerated TWAS tank in the Process Building, then pumped to the solids loading station on the south side of the Process Building. TWAS from the Kingston WWTP is transported by tanker trucks to the Central Kitsap WWTP for further processing. The tank is equipped with coarse bubble diffusers to mix and aerate the sludge and prevent septic conditions.

Two 15-HP variable speed, progressive cavity sludge pumps in the Process Building are used to feed WAS from the WAS tanks to the GBT, and TWAS from the TWAS tanks to the solids loading station. Piping is also configured so the pumps can pump TWAS back through the GBT or WAS directly to the tanker truck loading station. Three 15-HP positive displacement blowers provide continuous aeration to the WAS and TWAS tanks. The blowers were installed in 2005. Headspace air from the GBT room and the WAS and TWAS tanks is sent to the biofilter odor control system.

Observations and recommendations for each major process component are outlined below.

6.3.3.6.1 WAS Storage Tanks

Observation: The WAS storage tanks were constructed in 2005. The WAS tank interiors could not be observed, but a portion of the tank exterior surfaces is visible outside the Process Building. Both tanks appear to be in good condition. Tank Level Indicating Transmitters and gas monitors also appeared to be in good condition.

Plant staff did not report operational or performance issues with the WAS storage tanks. When staff observe reduced mixing in a WAS tank, the tank is emptied and sprayed down with a firehose, and the diffusers are replaced with a backup set of cleaned diffusers. A set of standby diffusers is kept onsite to accommodate this process as it happens several times per year.

Recommendation: None.

6.3.3.6.2 Gravity Belt Thickener

Observation: The GBT was installed in 2005 and appears to be in very good condition with some minor areas of paint missing on the frame, but no rust. The sludge feed piping and fittings are in good condition. It was observed that the GBT room had a very strong odor and operation staff confirmed this is common, indicating that the heating, ventilating, and air conditioning (HVAC) system may be underperforming. This may contribute to a more corrosive environment in the room.

The GBT is 16 years old with no noted performance issues or significant visible degradation; therefore, it is expected to exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years).

Recommendations: Clean and repaint areas of GBT where paint is chipped or missing to prevent corrosion. Test and rebalance HVAC system in the GBT room to achieve the required air changes.

6.3.3.6.3 GBT Polymer System

Observation: The polymer system is a Polyblend system that was installed in 2005 and appears to be in good condition. Plant staff reported no operational issues with the GBT thickening polymer system. The polymer system is 16 years old with no noted performance issues or significant visible degradation; therefore, it is expected to meet or exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years).

Recommendation: None.

6.3.3.6.4 TWAS Storage Tank

Observation: The TWAS storage tank was constructed in 2005. The TWAS tank interior could not be observed. Plant staff reported no maintenance or operational issues with the TWAS storage tank. When staff observe reduced mixing in the TWAS tank, the tank is emptied and sprayed down with a firehose, and the diffusers are replaced with a backup set of cleaned diffusers. A set of standby diffusers is kept onsite to accommodate this process as it happens several times per year.

Recommendation: None.

6.3.3.6.5 Sludge Tank Blowers

Observation: The sludge tank blowers were installed in 2005 and appear to be in good condition. Plant staff reported no maintenance or operational issues with the blowers. The blowers and low-pressure stainless-steel air piping appear to be in good condition.

The sludge tank blowers are 16 years old with no noted performance issues or significant visible degradation; therefore, they are expected to meet or exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years).

Recommendation: None.

6.3.3.6.6 Sludge Pumps

Observation: The sludge pumps, piping, and valves in the Operations Building were installed in 2005 and appear to be in good condition. The plant staff reported no performance or maintenance issues with the sludge pumps.

Recommendation: None.

6.3.3.6.7 Truck Loading

Observation: The truck loading station and installed in 2005 and appears to be in good condition. Plant staff reported no operational or maintenance issues with the truck loading station.

Recommendation: None.

6.3.3.7 Support Systems (Odor Control, Sodium Hypochlorite System, and Plant Water and Drainage Systems)

Kingston WWTP's odor control system was constructed in 2005 and consists of a biofilter with associated fan, humidifier, and heater. Foul air is pulled from Headworks, the WAS and TWAS tanks, and the GBT room into the humidifier and heater for conditioning. Then the air is sent to the biofilter, where it is treated then released to atmosphere. Equipment associated with the biofilter (fan, humidifier, and heater) is located adjacent to Headworks. The biofilter and associated sump is at the north end of the site.

Kingston WWTP's sodium hypochlorite system was constructed in 2005. It consists of a 2,000-gallon storage tank located between Headworks and the Process Building, and three metering pumps. The system, originally intended to feed sodium hypochlorite to Headworks, the secondary clarifiers and the W3 system, is unused.

The Kingston WWTP diverts various sources of plant drainage to the Process Building sump. The Process Building sump collects drainage from the GBT, truck sludge loading area, W3 system automatic strainer, and Headworks. There are two 5-HP Process Building sump pumps that operate automatically on level floats to return plant drainage to Headworks. The Process Building sump and pumps were constructed in 2005.

Kingston WWTP has a W2 nonpotable water system to supply water for polymer dilution, seal water for the sludge pumps, water for the odor control humidifier and biofilter, and interior hose bibs. The W2 system was constructed in 2005. It is supplied by the potable water system and consists of an air gap tank, two pumps and a hydropneumatic tank.

The W3 water system consists of two pumps operating in lead/lag, a third flush pump, and an automatic strainer. The lead/lag system normally operates automatically, drawing water from plant effluent between the UV system and the effluent Parshall flume and pumping it in a circulation loop to provide plant water on demand to various plant processes. The W3 system provides plant effluent to plant processes including the GBT, rotary screen, grit classifier, oxidation ditches, secondary clarifier spraydown, and exterior hose bibs. Some W3 water is separately and manually pumped by a third pump to feed a flush water connection for the influent raw sewage pipe at Headworks. This flush water does not go through the automatic W3 strainer.

6.3.3.7.1 Odor Control

Observation: During the site visit in September 2020 the biofilter was turned off due to the media collapse. It was later dug up and recovered by the plant staff. Kingston WWTP receives no odor complaints, but it was observed that the GBT room had a strong odor, indicating that the HVAC system may be underperforming. This may contribute to a more corrosive environment in the room. The fan, duct heater and humidifier are in good condition, therefore, they are expected to meet or exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years).

Recommendation: Investigate the HVAC system in the GBT room of effectiveness and capacity.

6.3.3.7.2 Sodium Hypochlorite System

Observation: The sodium hypochlorite system is not used. Plant staff noted that when in use, the hypochlorite tank could not be fully pumped out or drained, therefore it is not functional and its condition is rated as very poor.

Recommendation: None. Not needed.

6.3.3.7.3 Process Building Sump

Observation: The Process Building sump and pumps were constructed in 2005. The condition of the Process Building sump and pumps was not observed but plant staff reported no performance or maintenance issues.

Recommendation: None.

6.3.3.7.4 W2 System

Observation: All components of the W2 system were installed in 2005 and appear to be in good condition. The air gap tank appeared to have had overflow events. Plant staff did not report performance or maintenance issues with the W2 system. The W2 system is expected to meet or exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years).

Recommendation: Clean the exterior of the air gap tank and monitor for corrosion around the base of the tank.

6.3.3.7.5 W3 System

Observation: The W3 system has three pumps and an automatic strainer that were installed in 2005. The W3 system components appear to be in good condition. The W2 system is expected to meet or exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years). Pump 902 (P-902) has some leakage which is causing corrosion to the pump and frame. This could be a failed casing gasket.

Recommendations: Repair or replace casing gasket on P-902. Clean and recoat corroded areas of the P-902 to prevent further degradation.

6.3.3.8 Power Distribution

6.3.3.8.1 Utility Service Entrance

The utility service entrance is owned and provided by Puget Sound Energy (PSE). Electrical power service to the facility is provided from a 12,470-volt, 3-phase distribution line running underground to a 750 kilovolt amperes (kVA) three phase pad-mounted transformer located in the northeast area of the facility property just north of the generator fuel tank. The three-phase transformer steps the 12.47-kilovolt (kV) transmission primary voltage down to 480-volt secondary utilization voltage for the facility. The utility service entrance secondary conductors continue underground from the pad-mounted transformer to the utility current transformer (CT) enclosure and then onto the main circuit breaker located inside the Operations Building. The utility revenue metering equipment and CT enclosure is located outside of the

Operations Building on the east wall of the electrical room. The utility transformer, service conductors and power metering equipment are owned and maintained by PSE.

Observation: The utility service entrance equipment (transformer, service conductors, power metering equipment, etc.) was installed in 2005 and is in good condition. The equipment is expected to meet or exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years).

Recommendation: None.

6.3.3.8.2 Main Power Distribution

The facility is served by a 480-volt, 3-phase, 3-wire electrical power distribution system. The main service and distribution equipment were installed in early 2005 and are located in the main electrical room in the Operations Building. The facility power distribution system consists of the utility service entrance, standby generator, main circuit breaker, automatic transfer switch (ATS), metering, two motor control centers (MCCs), various 480-volt power panels, 480: 120/208 volts of alternating current (VAC) distribution transformers and 120/208 VAC lighting and power panels.

Observation: The main power distribution system including the service entrance rated 800 ampere main circuit breaker, distribution transformers, power panels, and MCCs is in good condition. The system is expected to meet or exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years).

No arc flash labeling was observed on any of the electrical equipment in this facility.

Recommendation: A complete arc flash study for the electrical infrastructure should be performed to comply with Occupational Safety and Health Administration (OSHA) standard 1910.269 which was made mandatory and put into effect on July 10, 2014.

6.3.3.8.3 Generator and Automatic Transfer Switch

Standby emergency power is supplied by a Cummins 350-kW diesel engine-generator. It is a non-enclosed generator located in the generator room in the Operations Building. The standby generator was installed in 2005 and has a 600-ampere circuit breaker and is fueled by an external diesel fuel storage tank on the northeast area of the facility. The standby generator engine was last serviced in 2019 according to labeling on the installed filters.

The 3-pole, 800-ampere, 480-volt, 3-phase, 3-wire ATS is located on the north wall in the main electrical room just south of the generator room in the Operations Building. It is fed from the 800-ampere service entrance main breaker (normal side) and standby generator (emergency side). The ATS load side connects to MCC-01 600-ampere main breaker and has a tap to the 480V, 225-ampere power panel DPP-01.

Observation: The generator and ATS were installed in 2005 and are in good condition.. The ATS and generator are sized to provide enough back-up power for all essential functions for the facility to continue operation in the event of a prolonged power outage.

Recommendation: None.

6.3.3.8.4 Motor Control Centers

There is a total of two MCCs in the plant, MCC-01 and MCC-01A. MCC-01 has a 600-ampere main breaker and is fed from the ATS. MCC-01A has a main lug connection and is fed from a circuit breaker in MCC-01. MCC-01 was installed in 2005 and MCC-01A was installed in 2020 as part of a plant upgrade. **Table 6-7** below shows the MCCs, their location, model, and rating.

Table 6-7 | MCC Locations, Models, and Rating

MCC	Location	Model	Rating [Amps]
01	Process Building Electrical Room	Cutler-Hammer Freedom Series 2100	600
01A	Process Building Electrical Room	Cutler-Hammer Freedom Series 2100	600

Observation: MCC-01A is new, in very good condition, and should have over 90 percent of its 25 to 30 year expected lifespan. MCC-01 was installed in 2004 and is in good condition. MCC-01 is expected to exceed the typical expected lifespan of 25 to 30 years. It is expected that the equipment may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years).

Most of the components in the MCC's individual buckets are consistent with industry standard and are readily available or could be replaced with similar manufacturer's devices.

The AFDs installed in MCC-01 are in good condition, however they are obsolete and no longer supported by the manufacturer.

Recommendation: A replacement plan for the obsolete AFDs should be established in the event of failure. A newer model is available, and a similar manufacture's AFD could be used, depending on physical space and options.

6.3.3.8.5 Control Panels

Control panels are located throughout the facility. The main plant controller is located in the office area of the Operations Building and the main remote input/output (I/O) rack is located in the Process Building electrical room. The control panels are comprised of Industry standard equipment including programmable logic controllers (PLCs), operator interface terminals (OITs), uninterruptable power supply (UPS), small digital readouts, and typical components including circuit breakers, relays, wiring, fuses, terminals, indicator lights, selector switches, etc. **Table 6-8** below shows the panels, their location, PLC and central processing unit (CPU) models and of an OIT is present. Local pushbutton, selector switch, and or indication stations are not listed.

Table 6-8 | Panel Locations and Models

Panel	Location	PLC Model	CPU Model	OIT
CP-200 Main CP	Operations Building Office Area	Allen-Bradley Compactlogix	1769-L33ER	N/A
CP-300 Rem. I/O for MCC-01	Process Building Electrical Room	Allen-Bradley Compactlogix	1769 Remote I/O	Y
FCP-201 Fine Screen	Headworks Area	Allen-Bradley Micrologix	1400 Series	Y
LP-200 Grit Collection	Headworks Area	N/A	N/A	N/A

Panel	Location	PLC Model	CPU Model	OIT
LP-710 Bio Filter Sump Pump	Bio-swale area	N/A	N/A	N/A
LP-920 Proc. Bldg Sump Pump	Process Building Lower Level	N/A	N/A	N/A
LP-TLP Truck Loading	Process Building near truck loadout	N/A	N/A	N/A
LP-TCP Thickening	Process Building Thickening Room	N/A	N/A	N/A
LP-GBT Gravity Belt	Process Building Thickening Room	See observation and recommendation	N/A	N/A
LP-Scum Pump	Clarifier Area	N/A	N/A	N/A

Observation: Most of the control panels installed appear to be operating adequately and are generally in good condition. The control panels are expected to meet or exceed the typical expected lifespan of 25 to 30 years. It is expected that the panels may have 50 to 90 percent of its expected serviceable life remaining (13 to 27 years). Components installed are consistent with industry standard and are readily available or could be replaced with similar manufacturer's devices. The exception to this is the PLC system and OIT equipment, as each brand of PLC and OIT requires special programming.

The main PLC system for the facility with equipment located in the CP-200 and CP-300 panels was upgraded by Quality Controls Corp. in 2020 as part of facility modifications.

Communication between the main and remote I/O panel is achieved via an ethernet link. The connection to the fine screen panel as well as connection to SCADA is also via an ethernet link.

CP-300 plant remote I/O panel has an OIT that is in good condition and functional, however it is obsolete, and the model is no longer supported.

Panels LP-GBT and LP-TLP interiors were not accessed and the installation of a controller (e.g. PLC) was not verified. It is likely one or both panels contain PLCs.

The local control panel for the scum pump appears to have been partially filled with water or somehow compromised and is in fair condition. Terminals indicate rust or corrosion, and the bottom interior of the enclosure is covered with residue. The scum pump panel is expected to have less than 50 percent of its expected serviceable life remaining (2 to 10 years).

Recommendations:

Verify back-up copies of all PLC and OIT programs have been created, and if not, have them created and stored in a safe place as soon as possible. Spare parts for the PLC system including a CPU, power supply, communication module, and a minimum of 1 spare I/O module per type should be stored by the County in case of a failure.

If the OIT in CP-300 is used as a main point of control and its function has not been replaced by the overall plant SCADA system, then a migration/replacement plan should be developed and executed as soon as possible.

Verify whether there is a PLC in the LP-GBT or LP-TLP panel. If a PLC exists, verify if it is still supported and if a back-up of its program has been saved. Given the apparent age of these panels, if a PLC exists it is likely outdated so we recommend a migration/replacement plan should be developed and executed as soon as possible.

The local control panel for the scum pump should be thoroughly cleaned and inspected. The source of the water infiltration should be identified and corrected.

6.3.3.9 SCADA System

SCADA system condition assessment and evaluation have been conducted as part of the County-wide SCADA master plan project. See *Kitsap County Sewer Utility SCADA Master Plan Technical Memoranda* (Murraysmith [now Consor] /HDR, 2021) in **Appendix F** for the details.

6.4 Code Review

Code requirements for the Kingston WWTP are summarized in **Section 6.4.1**. **Section 6.4.2** includes discussion of general code requirements that would be triggered should major upgrades be completed at the WWTP. Code requirements summarized in this report include:

- Washington State Building Code, including the following adopted codes. The 2021 versions of the code went into effect March 15, 2024 and are expected to be updated in approximately 2027.
  - International Building Code (IBC)
  - International Machine Code (IMC)
  - International Fire Code (IFC)
  - National Electrical Code (NEC) 70
  - National Fire Protection Association (NFPA) 820
  - NFPA 24
  - Uniform Plumbing Code (UPC)
- Americans with Disabilities Act (ADA)
- CFR

6.4.1 Summary of Existing Buildings and Use

The Kingston WWTP Site Plan is shown in **Figure 6-1**. There are two main buildings onsite, which are the Operations Building and the Process Building.

6.4.1.1 Operations Building

The Operations Building, located on the east side of the plant site, is a multipurpose building with the following functions:

- Administrative office space and control room
- Laboratory working space
- Garage/shop
- Bathroom, shower, and lockers
- Backup Generator room
- Electrical room

The Operations Building is a one-story above grade building. It has one roll up door for the garage/shop, and four man-doors. The Operations Building was constructed in 2005.

- Floor Area:
  - B (Office/Control Room, Electrical Room) Approximately 700 square feet (SF) (Allowable 8,000 SF).
  - S-3 (Garage/Shop, Generator Room) Approximately 900 SF (Allowable 8,000 SF).
- Height: 20 feet (Allowable 2 stories, 40 feet).
- Construction Type: 1997 Uniform Building Code (UBC) and Uniform Fire Code (UFC) Type V-N, constructed of non-combustible, non-fire rated materials. The building is constructed of a concrete slab, load-bearing concrete masonry unit (CMU) walls, and wood truss roof framing covered with sheet metal roofing.
- Occupancy Group:
  - Office/Control Room, Electrical Room - Group B per UBC 1997, where Section 304.1 defines Group B as occupancies consisting of business functions.
  - Garage/Shop, Generator Room – Group S-3 per UBC 1997, where Section 311.1 defines Group S-3 as occupancies consisting of repair garage functions.
- Calculated Occupancy Load:
  - B (Office/Control Room, Electrical Room) - 7 persons per IBC Table 1004.1.2 - occupant load factor of 100 gross for business areas.
  - S-3 (Garage/Shop, Generator Room) - 9 persons per IBC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.
- Fire Sprinklers: Not required per IBC Section 903.
- Safety features: Tepid eyewash/shower station required where the eyes or body of any person may be exposed to injurious corrosive materials per 29 CFR 1910.151 and the American National Standards Institute (ANSI) Z358.1.

6.4.1.2 Process Building

The Process Building, located east of the oxidation ditches and secondary clarifiers in the middle of the site, houses the following solids processing equipment:

- Dewatering room with GBT, associated polymer system and piping (upper level)
- Electrical room (upper level)
- Mechanical/Service room with W2 system (upper level)
- Solids handling including RAS pumps, aerated WAS and TWAS tanks, sludge tank blowers, sludge transfer pumps, W3 system, and Process Building sump (lower level)

The Process Building is two story building with one story below grade. It has two roll up doors for the GBT room and two man-doors. The Process Building was constructed in 2005.

- Floor Area:
  - S-2 Approximately 3,085 SF (Allowable 12,000 SF). GBT room is approximately 500 SF and Solids Handling area in basement is approximately 860 SF.
- Height: 23 feet (Allowable 2 stories, 40 feet).
- Construction Type: 1997 UBC and UFC Type V-N, constructed of non-combustible, non-fire rated materials. The building is constructed of a concrete slab, reinforced concrete walls below grade, load-bearing CMU walls, and wood truss roof framing covered with sheet metal roofing.
- Occupancy Group:
  - Group S-2 per UBC 1997, where Section 311.1 defines Group S-2 as occupancies consisting of low-hazard storage functions.
- Calculated Occupancy Load:
  - S-2 - 30 persons per IBC Table 1004.1.2 - occupant load factor of 100 gross for industrial areas.
- Fire Sprinklers: Not required per IBC Section 903. Fire detection and portable fire extinguishers required per NFPA 820, see **Section 6.4.2.3**.
- Safety Features: Tepid eyewash/shower station required where the eyes or body of any person may be exposed to injurious corrosive materials per 29 CFR 1910.151 and ANSI Z358.1.

6.4.2 General Code Requirements

6.4.2.1 Accessibility

Any new building anticipating personnel occupancy is required to comply with the accessibility requirements of Chapter 11 of the IBC. In general, this means that the building shall have an accessible parking stall and accessible path of travel from the accessible stall to the Operations Building entrance. Doors shall have lever hardware and accessible rooms shall meet the design and dimensional requirements of Chapter 11. Per the IBC, accessibility is not required for mechanical and process spaces as described in Section 1103.2.9 Equipment Spaces.

Existing buildings are governed by the Existing Building Code Section 305. Generally, any portions of the building that are altered, should comply as if it is a new building, including accessibility. But the entire building does not necessarily need to be upgraded. For example, if the alternation of the existing space does not include the toilet/locker area, then that area will not have to be upgraded to meet the accessibility requirement in the IBC.

Although the Operations Building at Kingston WWTP does not comply with the latest IBC code on the accessibility requirement, it is grandfathered in from the code when it was constructed. If the building is to be upgraded or modified, it will need to meet the current accessibility requirements. The Process Building at Kingston WWTP could be categorized as the equipment spaces in Chapter 11 Section 1103.2.9 therefore is exempt from the accessibility requirement.

6.4.2.2 Means of Egress

The Washington State Building Code mandates in Chapter 10 that in all buildings the means of exit discharge shall meet the following requirements:

- Illumination Required: Means of exit discharge shall be always illuminated by not less than 1-foot-candle (11 lux) at the walking surface per IBC 1008.2.

- Egress Sizing: The minimum width of each door opening shall be a minimum width of 32 inches and height of 80 inches, as well as sufficient for the occupant load thereof per IBC 1010.1.1.

6.4.2.3 NFPA 820

The NFPA 820 provides requirements for ventilation, electrical classification, materials of construction, and fire protection measures for the Collection Systems (Table 4.2.2), Liquid Stream Treatment Process (Table 5.2.2), and the Solid Stream Treatment Process (Table 6.2.2). Applicable locations have been summarized in the **Table 6-9** below.

6.4.2.4 NFPA 24

Fire suppression hydrants shall be installed in accordance with NFPA 24. Chapter 7 of NFPA 24 references the local jurisdiction for hydrant spacing requirements. The County fire code mandates hydrants to be located between 50 and 150 feet of the buildings to be protected. The closest fire hydrants are 55-feet from the northwest corner of the Process Building and 15-feet from the southeast corner of the Operations Building. Section C.4.1.3 of NFPA 24 generally recommends a minimum residual pressure of 20 pounds per square inch (psi) should be maintained at hydrants when delivering fire flow. Fire flow scenarios were not modeled as part of this planning effort.

6.4.3 Summary of Code Requirements

No code violation has been observed at the Kingston WWTP. Although the Operations Building does not comply with the latest IBC code on the accessibility requirement, such as the accessible parking stall, path from the accessible stall to the entrance, ADA bathroom, etc., it is grandfathered in from the code when it was constructed. If the building is to be upgraded or modified, it will need to meet the current accessibility requirements. It is recommended to install the fire alarm system in the GBT room and make sure functional fire extinguishers are available at all the locations listed in **Table 6-9**.

The following conditions require additional comprehensive analysis as they were beyond the scope of this review:

- HVAC compliance
- Seismic Anchoring

Table 6-9 | NFPA 820 Requirements Pertinent to the Kingston WWTP

Location	Fire and Explosion Hazard	Ventilation[1]	Extent of Classified Area	NEC Area Electrical Classification (All Class I, Group D)	Materials of Construction	Fire Protection Measures
Screen Channels	Possible ignition of flammable gases and floating flammable liquids	Continuously ventilated at 12 changes per hour	Enclosed – entire space	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable fire extinguisher and hydrant protection in accordance with NFPA 820 7.2.4.
Grit Removal Tank	Possible ignition of flammable gases and floating flammable liquids	Continuously ventilated at 12 changes per hour	Enclosed – entire space	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable fire extinguisher and hydrant protection in accordance with NFPA 820 7.2.4
Oxidation Ditches (not preceded by primary clarifier)	Possible ignition of flammable gases and floating flammable liquids	No ventilation, not enclosed	Interior of the tank from the water surface to the top of the tank wall. Envelope includes 18 inches above the top of the tank and extending 18 inches beyond the exterior wall; envelope 18 inches above grade extending 10 ft horizontal from the exterior tank walls	Division 2	Noncombustible, limited combustible, or low flame spread index material	Hydrant protection in accordance with NFPA 820 7.2.4
Secondary Clarifiers	N/A	No ventilation, not enclosed	N/A	Unclassified	Not required	Hydrant protection in accordance with NFPA 820 7.2.4
UV Disinfection	N/A	No ventilation	N/A	Unclassified	Not required	Hydrant protection in accordance with NFPA 820 7.2.4
Scum Pumping Area – secondary clarifiers scum pump station	Buildup of vapors from flammable or combustible liquids	No ventilation	Entire enclosed scum wetwell	Division 1	Noncombustible	Portable fire extinguisher and hydrant protection in accordance with NFPA 820 7.2.4
WAS and TWAS Storage Tanks	Possible generation of methane gas in explosive concentrations; carryover of floating flammable liquids	Continuously ventilated at 12 air changes per hour	Enclosed – entire space	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable fire extinguisher and hydrant protection in accordance with NFPA 820 7.2.4. Combustible gas detection system.
GBT Room	Accumulation of methane gas	Continuously ventilated at 6 air changes per hour	Entire room	Unclassified	Noncombustible, limited combustible, or low flame spread index material	Portable fire extinguisher, hydrant protection in accordance with NFPA 820 7.2.4, and fire alarm system.
Odor Control	Leakage and ignition of flammable gases and vapors	Not enclosed, open to the atmosphere	Areas within 0.9 m (3 feet) of leakage sources such as fans, dampers, flexible connections, flanges, pressurized unwelded ductwork, and odor-control vessels	Division 2	Noncombustible, limited combustible, or low flame spread index material	Portable fire extinguisher
			Area beyond 3 feet leakage sources	Unclassified		

Note:

1. Ventilation rates are the intended design values. Testing is needed to verify the actual ventilation during operation.

6.5 Existing Wastewater Treatment Plant Performance

The performance of the existing WWTP in terms of NPDES permit compliance, EPA's reliability requirement, and future nutrient removal requirement are summarized in this section.

6.5.1 Compliance to NPDES Permit

The County's Kingston WWTP NPDES Permit #WA0032077 was renewed December 1, 2015, allowing the discharge of treated effluent to Appletree Cove, Puget Sound. A copy of the WWTP's NPDES Permit is included as **Appendix A**. The NPDES Permit expired on November 30, 2020. The County has already submitted the permit renewal application six months before the expiration date per the Permit requirement.

Table 6-10 is a summary of waste discharge limitations for the Kingston WWTP Outfall 001 to Puget Sound as contained in Section S1 of the NPDES Permit.

Table 6-10 | Outfall 001 NPDES Waste Discharge Limits[1]

Effluent Limits: Outfall 001		
Parameter	**Average Monthly**	**Average Weekly**
CBOD	25 mg/L	40 mg/L
	61 ppd	98 ppd
	85% removal of influent BOD	
TSS	30 mg/L	45 mg/L
	73 ppd	110 ppd
	85% removal of influent TSS	
Parameter	**Daily Minimum**	**Daily Maximum**
pH	6.0	9.0
Parameter	**Monthly Geometric Mean**	**Weekly Geometric Mean**
Fecal Coliform Bacteria	200/100 mL	400/100 mL

Notes:
1. From current Kingston WWTP NPDES Permit # WA0032077
mg/L = Milligrams per liter
ppd = Pounds per day
mL=milliliter

The plant design criteria listed in Section S4 of the current permit set the upper limits for the influent flow, CBOD, and TSS loads, as following:

- Maximum month design flow is 0.292 MGD
- Influent CBOD loading for maximum month is 585 lb/day
- Influent TSS loading for maximum month is 585 lb/day

The County is required to submit a plan and a schedule for continuing to maintain capacity to Ecology when:

1. The actual flow or waste load reaches 85 percent of any one of the above design criteria for three consecutive months.

2. The projected plant flow or loading will reach design capacity within five years.

Figure 6-3 through **Figure 6-6** show the 7-day and the 30-day rolling average concentrations and loads for both effluent CBOD and TSS between January 2018 and June 2020. The corresponding NPDES permit limits are shown for comparison. These figures indicate Kingston WWTP has not exceeded the permit effluent CBOD and TSS limits during this period. In addition, the plant has not exceeded pH or Fecal Coliform limits during this same period based upon review of the monthly DMRs.

Figure 6-3 | 7-day Rolling Average Effluent CBOD and TSS Concentrations

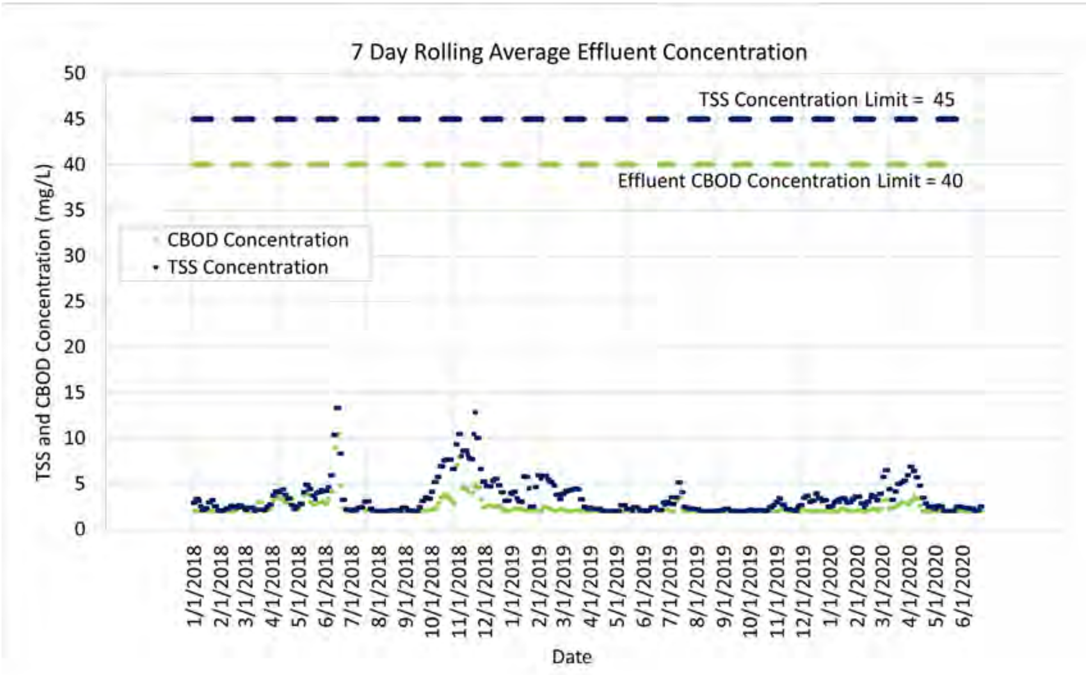


Figure 6-4 | 30-day Rolling Average Effluent CBOD and TSS Concentrations

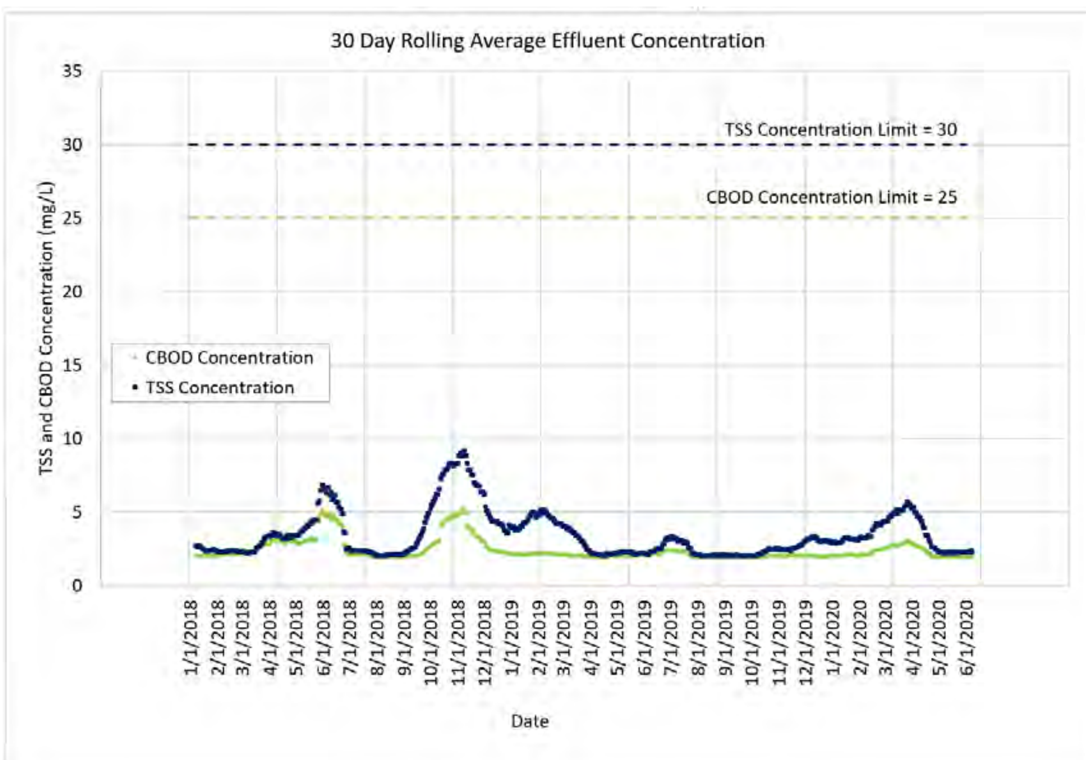


Figure 6-5 | 7-day Rolling Average Effluent CBOD and TSS Loads

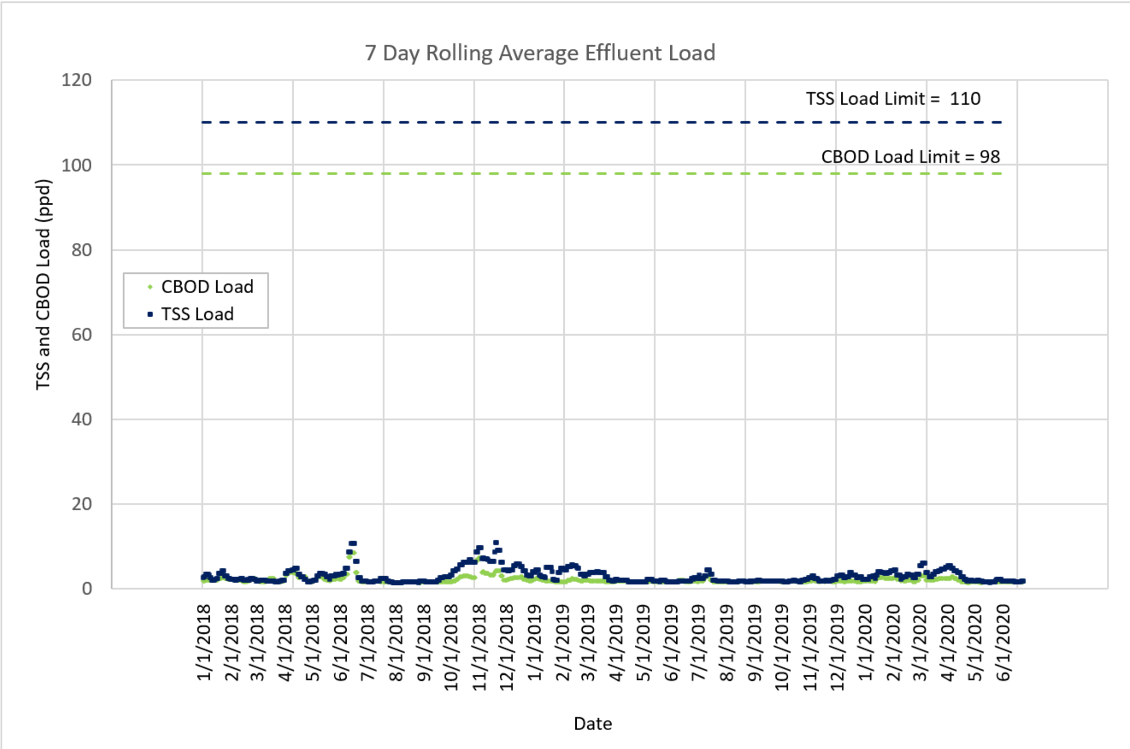


Figure 6-6 | 30-day Rolling Average Effluent CBOD and TSS Loads

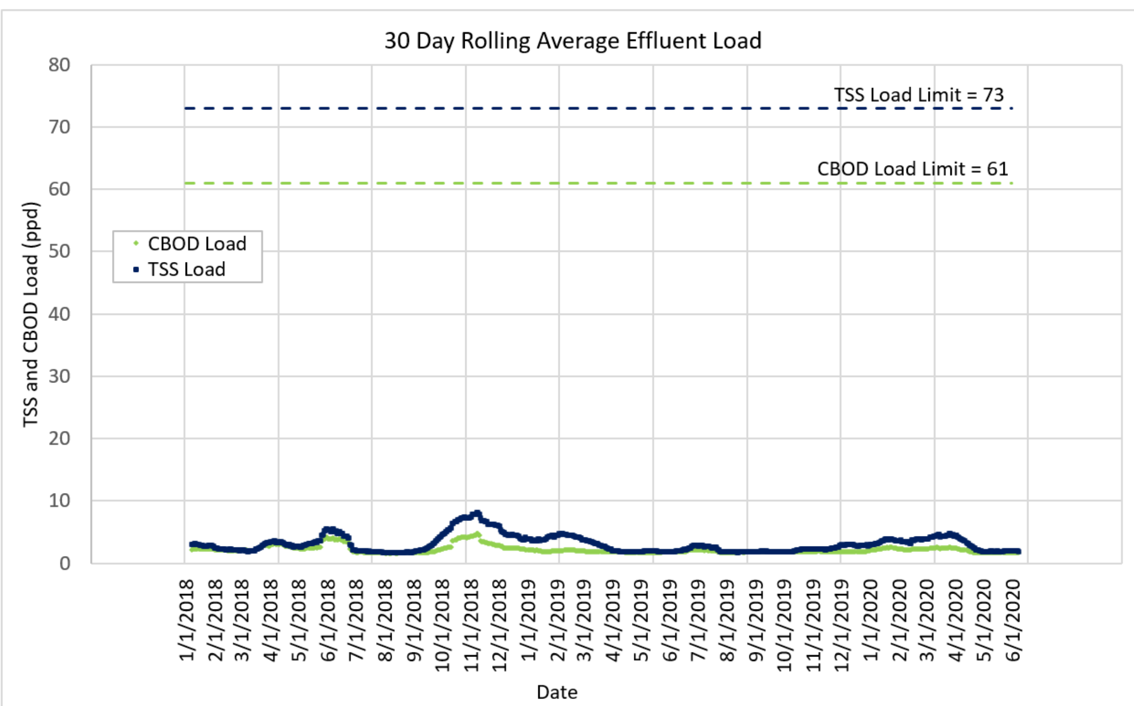


Figure 6-7 and **Figure 6-8** show the plant 30-day rolling average influent flow and BOD and TSS loads to compare with the design criteria in the permit. Both influent flow and loads are well below 85 percent of the designed values.

Figure 6-7 | 30-day Rolling Average Influent Flow

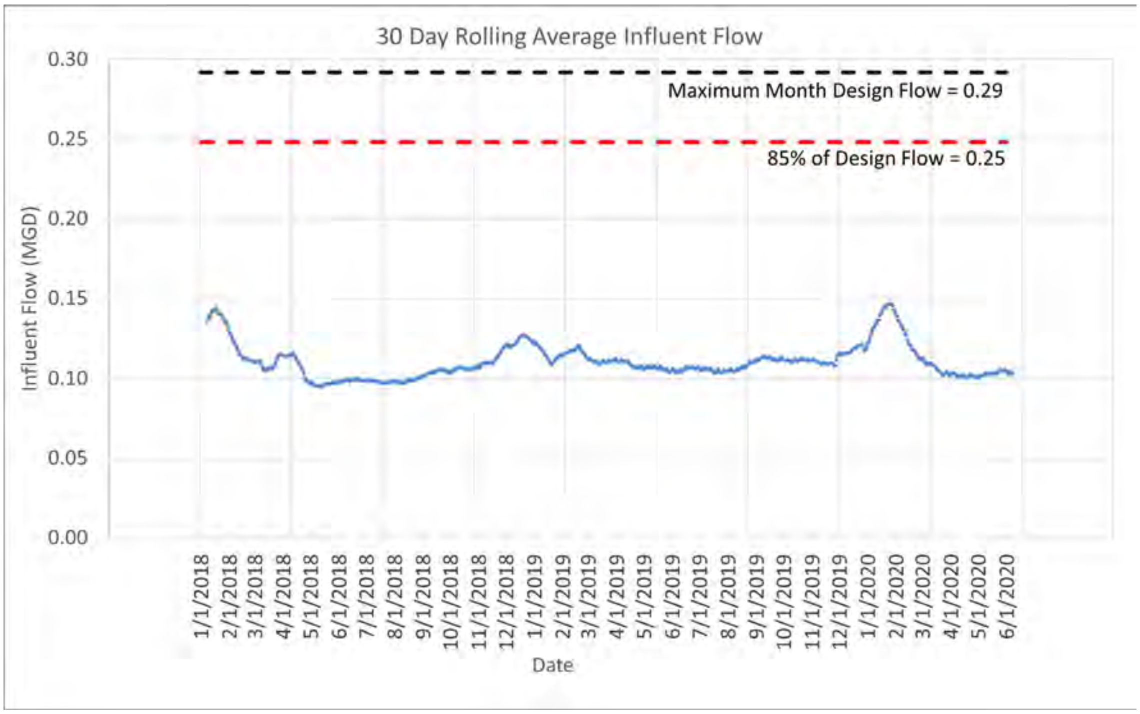
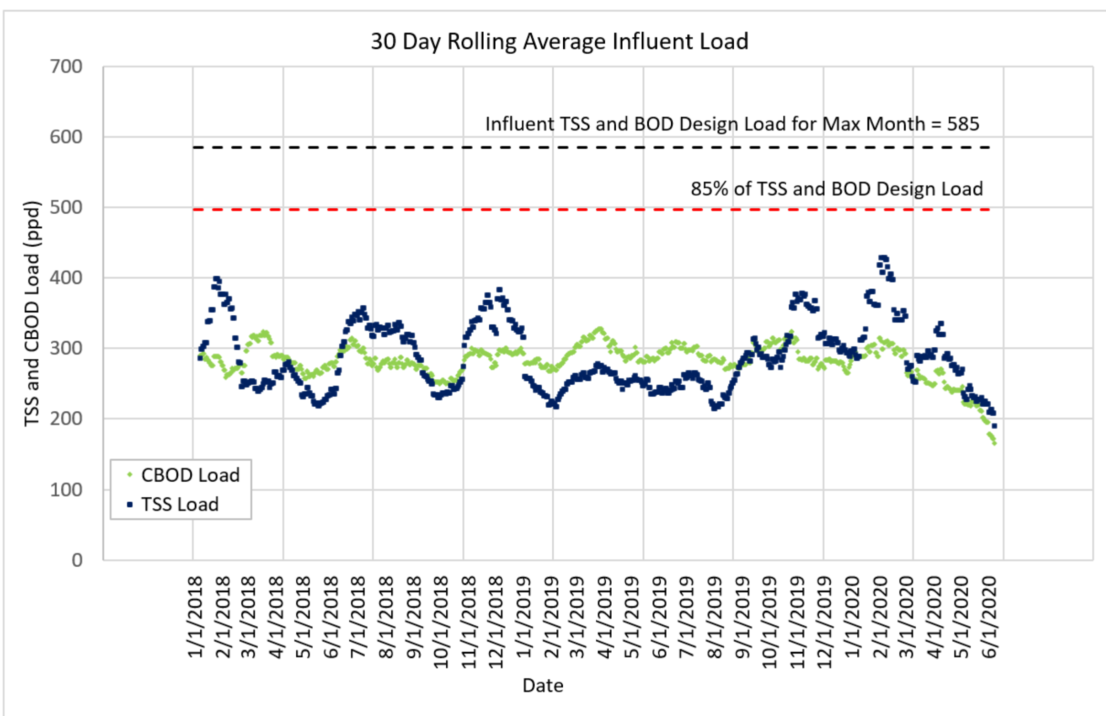


Figure 6-8 | 30-day Rolling Average Influent CBOD and TSS Loads



6.5.2 EPA Plant Reliability Criteria

The Kingston WWTP is required to meet the Reliability Class I standards, as defined in EPA's Technical Bulletin "Design Criteria for Mechanical, Electrical, and Fluid System Component Reliability," EPA 430-99-74-001. **Table 6-11** includes a summary of the reliability criteria and requirements to be considered as part of the Alternatives Evaluation and Recommended Plan.

Table 6-11 | EPA Class I Reliability Criteria

Treatment Unit Process	Reliability Class I Requirements	Current Deficiencies
Influent Screening	A backup bar screen designed for mechanical or manual cleaning shall be provided. Facilities with only two bar screens shall have at least one bar screen designed to permit manual cleaning.	None. A manual screen is provided to back up the mechanical screen.
Pumps (Liquids, Solids & Chemical Feed)	A backup pump shall be provided for each set of pumps performing the same function. The capacity of the pumps shall be such that, with any one pump out of service, the remaining pumps will have the capacity to handle the peak flow.	None. Backup is provided to RAS pumps and sludge transfer pumps.
Secondary Clarification	The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 75% of the total design flow.	None. One of two secondary clarifiers will be able to handle 75% of the total flow.
Aeration Basin	A backup basin will not be required; however, at least two equal-volume basins shall be provided.	None. Two oxidation ditches are provided.
Aeration Blowers and/or Mechanical Aerators	There shall be a sufficient number of blowers or mechanical aerators to enable the design oxygen transfer to be maintained with the largest-capacity-unit out of service. It is permissible for the backup unit to be an uninstalled unit, provided that the installed units can be easily removed and replaced. However, at least two units shall be installed.	None. Aeration blowers are designed to provide design airflow with one backup.
Air Diffuser Systems	The air diffusion system for each aeration basin shall be designed so that the largest section of diffusers can be isolated without measurably impairing the oxygen transfer capability of the system.	None. Two grids of diffusers are provided in each oxidation ditch. Isolation of any will not impair the oxygen transfer capability of the system
Disinfection	The units should be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units should have a design flow capacity of at least 50 percent of the total design flow.	None. The UV channel has two banks. One of two UV banks will be able to handle more than 50% of the total design flow.
Sludge Storage Tanks	Holding tanks are permissible as an alternative to component or system backup capabilities for components downstream of the tank provided the volume of the holding tank shall be based on the expected time necessary to perform maintenance and/or repair and the capacity of sludge treatment processes downstream can handle the combined flow from the storage tanks and the working sludge treatment system	None. WAS storage tanks and TWAS storage tank are provided to back up the GBT and sludge pump.

Treatment Unit Process	Reliability Class I Requirements	Current Deficiencies
Sludge Disposal	An alternative method of sludge disposal shall be provided for each sludge treatment unit process without installed backup.	None. If GBT is down, WAS storage tanks could store sludge for at least a week. Or un-thickened sludge could be trucked to Central Kitsap WWTP.
Electrical Power Supply	Two separate and independent power sources, either from two separate utility substations or from a single substation and an on-site generator. The backup power supply shall be sufficient to operate all vital components during peak wastewater flow conditions, including critical lighting and ventilation.	None. An on-site generator is provided.

6.5.3 Preliminary Nutrient Loading at Kingston WWTP

Although the small TIN load plants do not have a facility specific action level in the first PSNGP, the proposed action level TIN load limits that Ecology presented in the Preliminary Draft Nutrient General Permit for Kingston WWTP provide a useful basis for evaluating performance and may be relevant again in the future. The load limits are shown in **Table 6-12**.

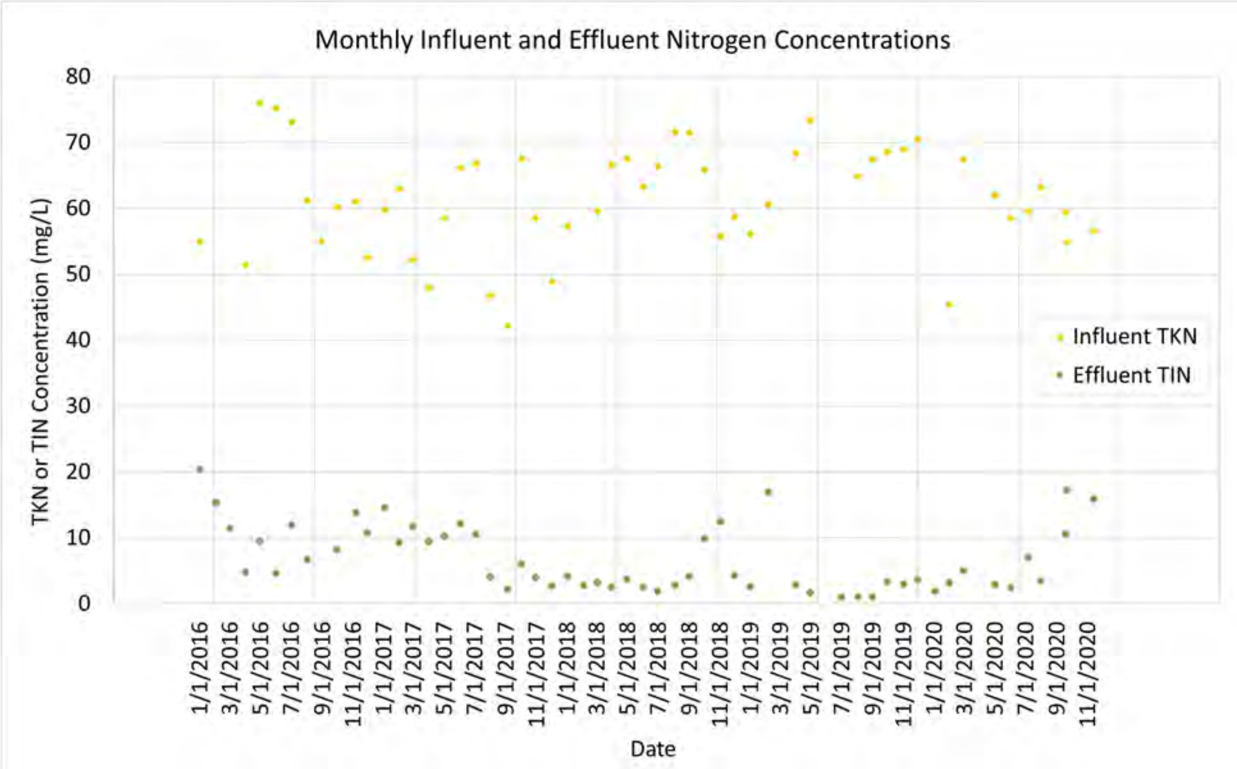
Table 6-12 | Kingston WWTP Preliminary Draft Nutrient General Permit Load Limits

Action Level	TIN Load Limit (lbs-N/year)	Maximum Average Annual Concentration[1] (mg/L)
Baseline (AL_0)	3,660	10.93
Secondary Threshold (AL_1)	7,555	22.56

lbs-N/year: pounds of nitrogen per year
Note:
1. Maximum Average Annual Concentration is the load limit divided by the current AAF

Since 2016, Kingston WWTP staff have been conducting monthly testing of the influent and effluent for nitrogen species, shown in **Figure 6-9**. Average influent TKN concentration was 61.4 mg/L, while effluent TIN concentrations ranged from 1.0 to 20.4 mg/L, with an average concentration of 6.8 mg/L.

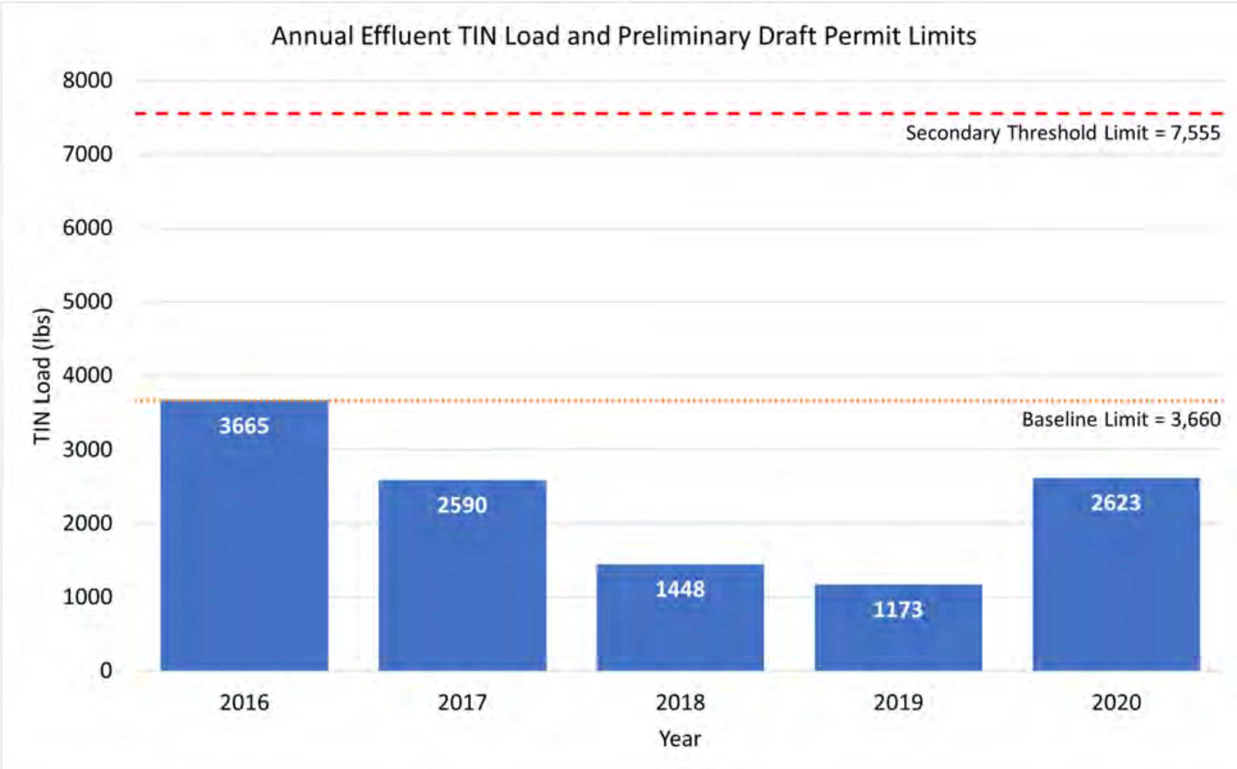
Figure 6-9 | Kingston WWTP Influent and Effluent Nitrogen Concentrations



The preliminary nutrient data was used in conjunction with effluent flow data to estimate annual TIN loading for comparison with the preliminary permit TIN load action levels in **Figure 6-10**. In a few instances, monthly data was not collected, and the effluent TIN concentration was interpolated to estimate the load for that month. In 2016, the estimated TIN load of 3,365 lbs just slightly exceeded the secondary threshold due to high Nitrate + Nitrite effluent concentration in the first few months of the year. In all other years, the TIN load was well below the load limits.

It may be feasible to further reduce TIN loading to the Puget Sound by implementing a recycled water program to divert effluent from the outfall. Kingston WWTP does not currently produce effluent that meets reuse requirements or have a recycled water permit. The potential for a water reuse program is discussed in **Section 9**.

Figure 6-10 | Kingston Annual Effluent TIN Loads



The data indicates that Kingston WWTP has the capacity to meet the originally proposed load limits and may be able to consistently achieve low TIN loading if load limits are implemented in the future.

6.6 Existing Wastewater Treatment Plant Capacity Evaluation

This section of the Plan documents the capacity of the existing WWTP. Capacity at the treatment plant consists of equipment capacity, hydraulic capacity, and process capacity. The Kingston WWTP is required to treat the design flow and waste loads according to the NPDES permit, as well as hydraulically pass the PHF rate without being flooded. Current and projected flows were developed in **Section 3** and are shown in **Table 6-13**, below.

Table 6-13 | Existing and Projected Kingston WWTP Flows (MGD)

Flow Description	Current Flows (Years 2018-2020)	2028 Projected flows	2042 Projected flows
Annual Average Flow (AAF)	0.11	0.17	0.27
Max Month Wet Weather Flow (MMWWF)	0.15	0.23	0.36
Max Month Dry Weather Flow (MMDWF)	0.12	0.18	0.29
Peak Daily Flow (PDF)	0.21	0.32	0.51
Peak Hour Flow (PHF)	0.57	0.87	1.41

Based on 2005 Kingston WWTP design documents, the plant was designed and constructed to handle the PHF of 2.26 MGD except for the UV equipment. The existing UV channel can pass 2.26 MGD hydraulically but requires additional UV bank to provide sufficient disinfection to 2.26 MGD or more.

6.6.1 Mechanical Equipment Capacity

The capacity of each existing major unit process is listed in **Table 6-14**.

Table 6-14 | Design Capacity of Unit Processes at Kingston WWTP

System	Data/Type
Mechanical Fine Screen	
Quantity	1
Capacity, each	2.6 MGD
Grit Chamber	
Type	Vortex
Quantity	1
Diameter	7 feet
Capacity flow	2.26 MGD
Oxidation Ditch	
Quantity	2
Volume (each)	274,000 gallons (36,600 square feet)
Average Sidewater Depth	10’-4”
Secondary Clarifier	
Quantity	2
Diameter	35 feet
Depth	13 feet
UV System	
Type	Low Pressure
Quantity	2 banks in 1 channel; 56 lamps per bank
Dosage	37 milliwatt sec/sq cm
Capacity	1.60 MGD with two banks in service
WAS Storage Tank	
Quantity	2
Volume, each	25,000 gallons
TWAS Storage Tank	
Quantity	1
Volume, each	16,000 gallons
Gravity Belt Thickener	
Quantity	1
Size	1-meter belt
Capacity	200 gpm

6.6.2 WWTP Liquid Stream Hydraulic Capacity

6.6.2.1 Hydraulic Capacity Analysis

To evaluate the hydraulic capacity of the existing WWTP, the treatment plant was modelled using Visual Hydraulics© based on the design and record drawings.

The hydraulic capacity was evaluated for flows up to the 2042 PHF of 1.41 MGD to identify how the existing plant hydraulics can be expected to perform during future flowrates. The model was run under two different flow scenarios, 2042 PHF and 2042 AAF. Under both scenarios two oxidation ditches are put into service since no redundant oxidation ditch is required per Ecology's reliability requirement. Under 2042 PHF scenario two sub-scenarios were modeled to simulate operation with one or two secondary clarifiers in service, since a redundant secondary clarifier is required per Ecology's reliability requirement. As part of the analysis, hydraulic limitations were identified when the water level reached within 12-inches of freeboard below the top of a containment structure. The hydraulic profile at the 2042 AAF and PHF is shown in **Figure 6-11** below. The RAS flowrate recycle fraction (RAS/Influent) was assumed to match the average design of 0.1 MGD/0.27 MGD for the AAF and was assumed to be 0.50 of the MMWWF for flows at or higher than the MMWWF. A detailed summary of the input parameters used in the Visual Hydraulics Model is included as **Appendix G**.

6.6.2.2 Headworks Facility Hydraulic Capacity

All components (mechanical equipment, piping, and structures) in Headworks have hydraulic capacity in excess of the 2042 PHF of 1.41 MGD per the model results and equipment design criteria.

6.6.2.3 Secondary Treatment Hydraulic Capacity

From Headworks, screened sewage is piped through a single 14-inch diameter pipe to a flow splitter control box between the two oxidation ditches which controls the sewage flow into the oxidation ditches. Effluent from the oxidation ditches is collected in parallel pipes that combine and redistribute flows in the secondary clarifier splitter box clarifiers. Parallel 14-inch diameter pipes send activated sludge from the splitter box to each of the secondary clarifiers. Effluent from the secondary clarifiers is collected in a common 14-inch diameter pipe that connects to the UV channels. All components of the secondary treatment system have hydraulic capacity in excess of the 2042 PHF of 1.41 MGD per the model results and equipment design criteria.

6.6.2.4 UV Channel and Effluent Basin Hydraulic Capacity

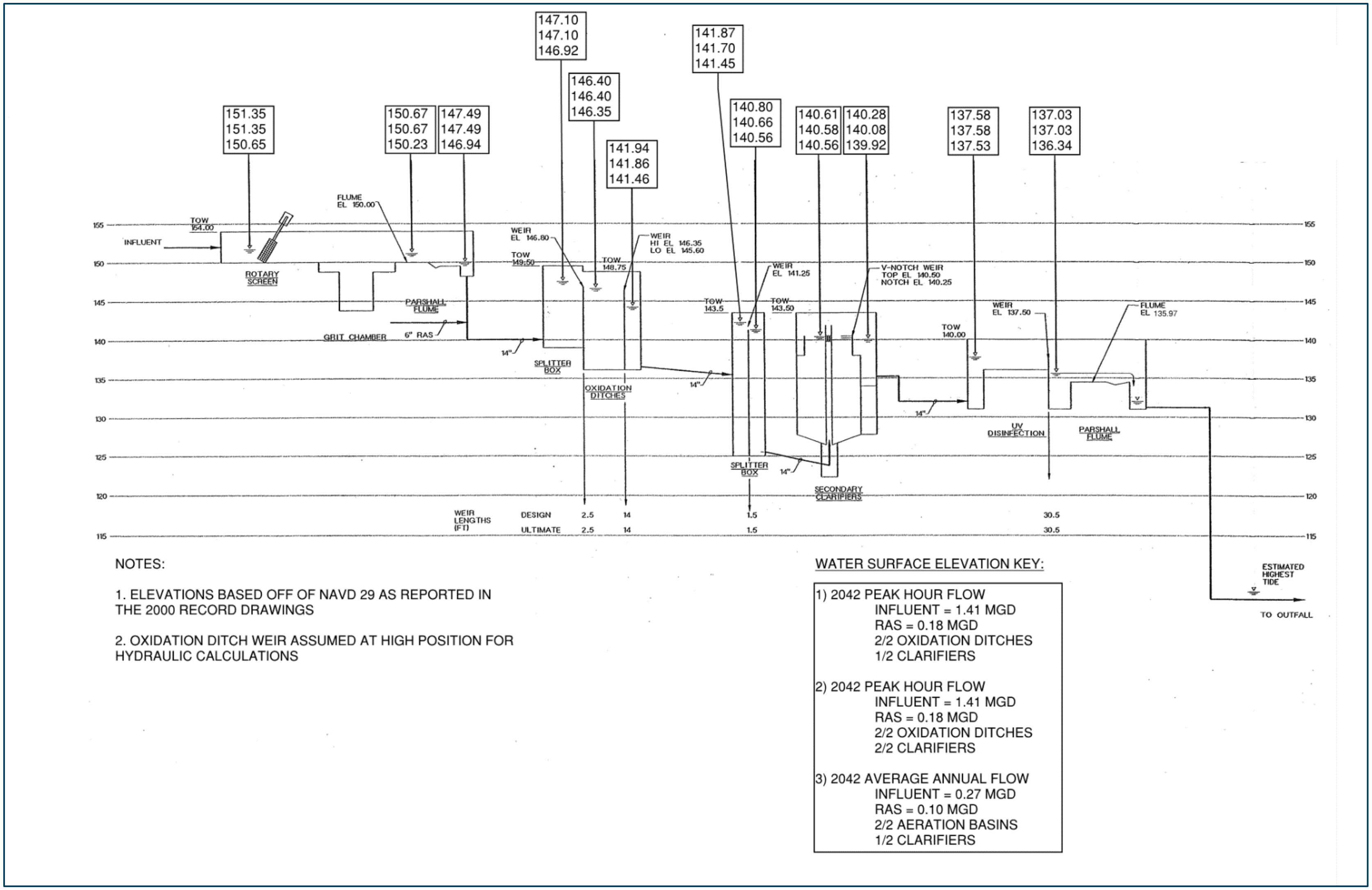
Following the secondary clarifiers, effluent flows through a UV disinfection channel and a Parshall flume before leaving the site in the 18-inch diameter effluent pipe. All components of the disinfection and effluent flow measurement structure have a hydraulic capacity that exceeds the 2042 PHF of 1.41 MGD per the model results. The outfall piping downstream of the Parshall flume and the outfall structure were not modeled.

The existing UV disinfection system has two UV banks with a total rated capacity of 1.60 MGD. The existing channel could be widened to accommodate additional UV lamps, which will increase the total capacity to greater than 2.54 MGD.

6.6.2.5 Summary

The hydraulic analysis indicates that all components of the Kingston WWTP have sufficient capacity to convey flows throughout the entire 20-year design period.

Figure 6-11 | Kingston WWTP Hydraulic Profile



6.6.3 Secondary Treatment System Process Capacity

6.6.3.1 BioWin™ Model Development

The existing oxidation ditches and secondary clarifiers were modeled using BioWin™ software to determine the existing secondary process treatment capacity. The oxidation ditches, secondary clarifiers, and WAS storage tanks were sized in the model based on record drawings as summarized in earlier sections. BioWin™ does not have a process element for an oxidation ditch, so a loop of reactors is used with high recycle to simulate one instead. The process model was evaluated under both current and future AAF, MMWWF, and MMDWF conditions.

6.6.3.2 Influent Wastewater Characterization

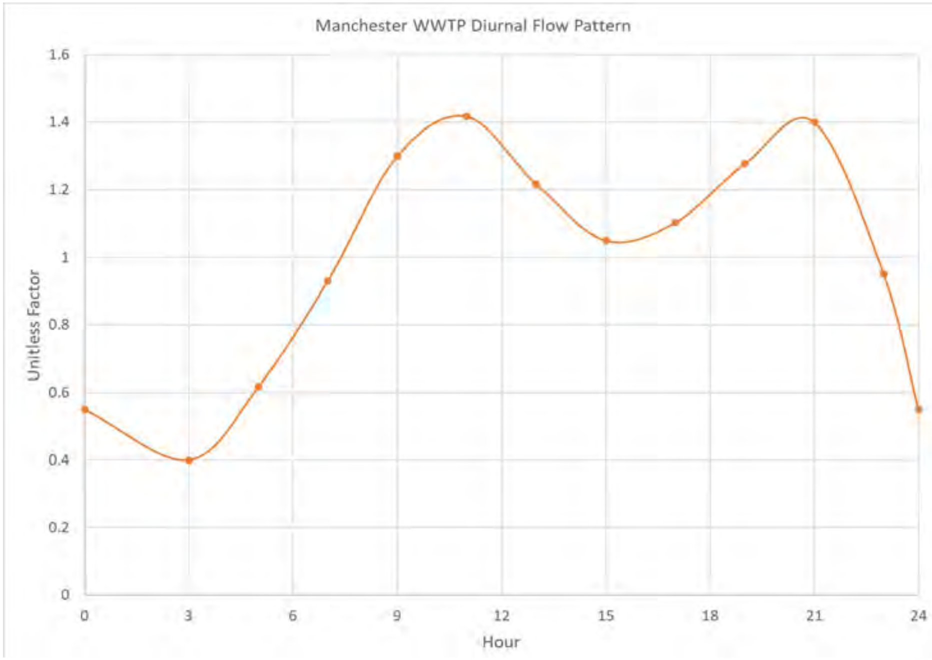
Following the sampling plan developed by Murraysmith [now Consor], County staff collected three wastewater characterization of influent and effluent composite samples in September 2020 including one on a weekend. The results of the wastewater characterization (**Table 6-15**) were included to develop the influent characteristics for the process model.

Table 6-15 | Average Influent Wastewater Characteristics

Parameter	Average Influent Value	Average Effluent Value
Total Chemical Oxygen Demand (COD) (mg/L)	614	Not Determined
Filtered COD (mg/L)	223	30
Flocculated and Filtered COD (mg/L)	112	Not Determined
Carbonaceous Biochemical Oxygen Demand (CBOD) (mg/L)	276	Not Determined
Filtered CBOD (mg/L)	72	Not Determined
TSS (mg/L)	298	2.9
Volatile Suspended Solids (VSS) (mg/L)	264	2.7
NH_3-N (mg/L)	37	0.4
NO_3-N & NO_2-N (mg/L)	2.67	14
TKN (mg/L)	57	1.9
Total Phosphorus (TP) (mg/L)	9.4	8.2
Orthophosphate (Ortho-P) (mg/L)	5.9	7.9
Alkalinity (mg/L)	326	169
Calcium (mg/L)	52	Not Determined
Magnesium (mg/L)	18	Not Determined
pH	7.46	7.39
DO (mg/L)	0.1	6.6

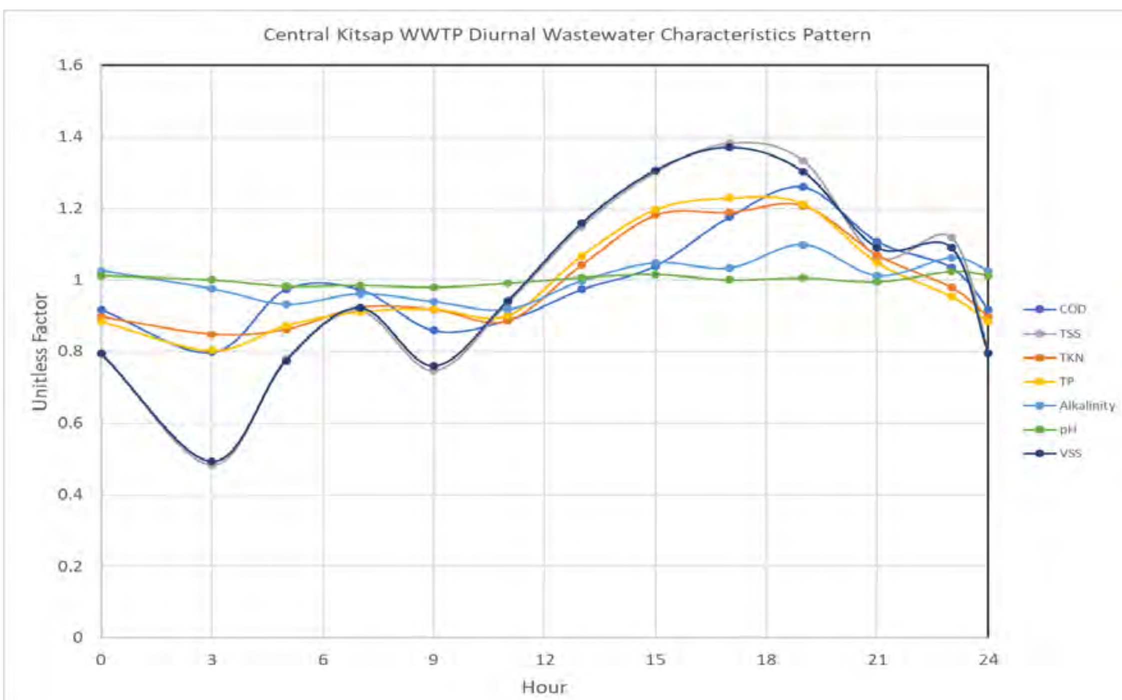
Since no hourly influent flow is recorded, the diurnal flow data from Appendix C of the 2014 Manchester Sewer Facilities Strategy Plan (BHC Consultants, October 2014) was used to simulate diurnal influent flow patterns. The County also operates the Manchester WWTP and it has a similar service area as the Kingston WWTP. The diurnal influent flow pattern is shown on **Figure 6-12.** In addition, diurnal influent wastewater sampling for COD, TSS, VSS, TKN, TP, Ortho-P, Alkalinity, and pH was performed at Central Kitsap WWTP on October 21, 2020 and were used as the basis of Kingston WWTP diurnal influent concentration pattern as shown on **Figure 6-13**. Both diurnal flow and concentration information was used in the process model dynamic simulations.

Figure 6-12 | WWTP Influent Flow Diurnal Flow Pattern



Source: 2014 Manchester Sewer Facilities Strategy Plan

Figure 6-13 | WWTP Influent Characteristics Diurnal Pattern



Source: Central Kitsap WWTP Wastewater Sampling Results, 2020

6.6.3.3 Treatment Requirements

Although Kingston WWTP is currently only required to meet the CBOD and TSS removal requirement and effluent CBOD and TSS concentration and load limits, and effluent pH and fecal coliform limits, the nutrient removal requirement will be applied soon. As part of the capacity evaluation for the plant, besides trying to meet the current permit requirements for CBOD of 25 mg/L and TSS of 30 mg/L on a monthly average basis, the plant was also evaluated for meeting a potential TIN concentration of 10 mg/L. It is anticipated the Nutrient General Permit will become more stringent with potential effluent TIN limit of 3 to 10 mg/L in the future. Potential alternatives to achieve as low as 3 mg/L will be discussed in the following section.

6.6.3.4 Oxidation Ditch Capacity

The results of various simulations at AAF, MMWWF, and MMDWF in 2020, 2028 and 2042 are shown in Table 6-16.

Under current 2020 flow and loads, one oxidation ditch with the current operation procedure can meet all the treatment goals on BOD, TSS, and annual TIN load. Although the mixed liquor suspended solids (MLSS) will get as high as 3,500 mg/L during the maximum month condition when 20-day of solids retention time (SRT) is maintained to promote nitrification and denitrification, the secondary clarifier settleability analysis (state point analysis in BioWin) indicates this high MLSS will not deteriorate the clarifier performance. This is supported by historical operational data that shows that the MLSS reached 3,000 mg/L and the effluent TSS was less than 15 mg/L.

As flow and loads increase over time, a second oxidation ditch will likely be required in the next six to eight years to maintain the same level of nitrification and denitrification to meet the same TIN cap. With two oxidation ditches in operation, the plant will have to drop the solids retention time down to 15 days by 2042 to account for the additional load and not overload the secondary clarifiers. In summary, the existing oxidation ditches have sufficient capacity to treat the projected 2042 TSS and BOD loads to meet the current NPDES permit limits and remove the projected nitrogen load to meet the potential TIN action level in the next 20 years. More detailed analysis on optimizing the oxidation ditches to meet more stringent nitrogen requirement will be discussed in the next section.

Table 6-16 | BioWin™ Process Model Simulation Results

Parameter	2020			2028			2042		
	AAF	MMWWF	MMDWF	AAF	MMWWF	MMDWF	AAF	MMWWF	MMDWF
Flow (MGD)	0.11	0.15	0.12	0.17	0.23	0.18	0.27	0.36	0.29
Temperature (°C)	15	11	22	15	11	22	15	11	22
Influent Alkalinity (mg/L)	330	330	330	330	330	330	330	330	330
No of AB Trains	1	1	1	2	2	2	2	2	2
DO Cycle (hrs)	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF
DO Target during ON Cycle (mg/L)	2	2	2	1.5	2	2	1.5	2	2
SRT (days)	38	20	20	30	20	13	15	15	18
MLSS (mg/L)	3,300	3,500	3,000	2,100	2,700	2,400	2,000	3,500	3,500
Effluent TSS (mg/L)	0.92	1.25	0.97	1.41	1.9	1.49	2.28	3.25	2.52
Effluent BOD (mg/L)	1.17	1.64	1.5	1.3	1.78	1.62	1.7	2.34	1.88
Effluent Ammonia (mg/L)	1	3.1	1.4	1	1.9	1.1	2	6.5	1.7
Effluent Nitrate and Nitrite (mg/L)	4.75	3.35	0.43	2.2	0.55	1.0	1.3	0.1	0.4
Effluent TIN (mg/L)	5.8	3.4	1.8	3.2	2.5	2.1	3.3	6.6	2.1
Annual Effluent TIN Load (ppd)	5			5			7		
Effluent pH	6.7	6.9	6.9	6.8	7.0	6.8	6.9	6.9	6.9
Effluent Alkalinity (mg/L)	119	219	167.5	139	217	158	178	220.5	168
WAS Solids (ppd)	172	362	309	276	548	483	500	969	802
WAS Tank Storage Capacity (days)	19	9	11	12	6	7	7	3	4
Thickened Biosolids (% solids)	5.1	5.4	5.1	5.4	5.4	5.4	5.4	5.4	5.4
Thickened Biosolids (ppd)	135	265	231	220	426	378	388	745	617
TWAS Storage Tank Storage Capacity (days)	50	27	29	33	17	19	19	10	12

6.6.3.5 Secondary Clarifier Capacity

Secondary clarifier capacity is mainly assessed based on the surface overflow rate. The typical secondary clarifier surface overflow rate under average flows is 400 to 700 gallons per day per square foot (gpd/sf). The typical secondary clarifier surface overflow rate under peak flows is 800 to 1,600 gpd/sf.

Ecology design criteria requires the secondary clarifiers to have sufficient capacity to pass 75 percent of the design flow when the largest unit is out of service. **Table 6-17** summarizes the surface overflow rate under various operating conditions. Modeling results indicate that one clarifier will be able to treat average flows through 2042. Both clarifiers will be required to handle the peak flows for reliable performance. The existing two clarifiers meet Ecology's redundancy requirement.

Table 6-17 | Secondary Clarifier Surface Overflow Rate

Parameter	AAF	MMWWF	PHF	75% of PHF	AAF	MMWWF	PHF	75% of PHF
Design Year	2028	2028	2028	2028	2042	2042	2042	2042
Flow (MGD)	0.17	0.23	0.87	0.65	0.27	0.36	1.41	1.06
No. of Secondary Clarifiers in service	1	1	2	1	1	1	2	1
Surface Overflow Rate (gpd/sf)	176	235	452	678	285	380	733	1,099

6.6.4 Solids Stream Capacity

The following sections discuss the capacity of each major component in the solids handling system.

6.6.4.1 WAS Tanks Storage Capacity

Sludge is currently wasted to the two 25,000 gallon WAS tanks at a rate of 3,000 to 7,000 gallons per day. At 5,000 gallons per day of wasting, WAS tanks currently have 10 days of storage capacity. At 2042 maximum month flows, the storage duration of the WAS tanks is reduced to three days based on BioWin™ model results presented in **Table 6-10**. The WAS tank storage duration could potentially be extended by slowing down the RAS pump speed and hence feeding a higher concentration of sludge to the WAS tanks. The TWAS storage could also be further utilized prior to building additional WAS storage by operating the GBT more frequently, i.e., every three days, to empty WAS tanks.

6.6.4.2 Gravity Belt Thickener Loading Rate

According to the 2005 design drawings for the Kingston WWTP, the GBT is designed for a hydraulic loading rate of 200 gpm. Once per week the GBT is run to empty the WAS tanks. **Table 6-18** summarizes the projected WAS production by the process model and the anticipated GBT operating hours each week when run at 200 gpm. The GBT has sufficient capacity to meet existing and future flow and loads.

Table 6-18 | Projected GBT Operation

Parameter	AAF	MMWWF	AAF	MMWWF	AAF	MMWWF
Design Year	2020	2020	2028	2028	2042	2042
WAS Solids (ppd)	172	362	276	548	500	969
Assumed WAS Concentration (mg/L)	8,000	8,000	8,000	8,000	8,000	8,000
WAS Flow (gpd)	2,600	5,400	4,100	8,200	7,500	14,500
GBT Operating Hours (hours per week)	1.5	3.2	2.4	4.8	4.4	8.5

6.6.4.3 TWAS Tank Storage Capacity

Sludge from the WAS tanks is thickened one day per week and sent to the 16,000-gallon TWAS tank. WAS concentration can range from 4,000 ppm to 9,000 ppm and is thickened from about 5 percent up to 6 percent solids. Current TWAS storage duration is approximately 50 days. In 2042, the BioWin™ model projects TWAS storage capacity of approximately 12 days. Therefore, TWAS storage capacity is not a limiting factor at the Kingston WWTP and is adequate for future flows.

6.7 Summary of Deficiencies and Recommendations

Table 6-19 provides a summary of the main findings for each unit process based on the condition assessment, code review, hydraulic analysis, and treatment capacity analysis described above.

Table 6-19 | Overall Unit Process Capacity and Deficiencies

Unit Process	Physical Condition[1]	Capacity	Recommendation
Preliminary Treatment			
Fine Screen	Very Good	2.6 MGD, peak	None
Grit Removal	Good	2.26 MGD, peak	None
Parshall Flume	Good	10.4 MGD, peak	None
Grit Pump and Classifier	Good	220 gpm	General maintenance practice on grit classifier to mitigate corrosion
Secondary Treatment			
Oxidation Ditches	Very Good	Over 0.36 MGD, maximum month	None
Oxidation Ditch Blowers	Very Good	528 scfm, firm	None
Oxidation Ditch Effluent Piping	Unknown	Over 1.62 MGD, peak	None
Flow Splitter to Clarifiers	Good	Over 1.62 MGD, peak	None
Secondary Clarifiers	Fair	Over 1.62 MGD, peak	General maintenance practice to mitigate corrosion
Secondary Clarifiers Effluent Piping	Unknown	Over 1.62 MGD, peak	None
RAS and WAS Pumps	Good	275 gpm, firm	None
Disinfection and Effluent			
UV System	Poor	1.6 MGD, peak	Replace entire system for improved control in the next 5 to 10 years
Effluent Parshall Flume	Good	2.5 MGD, peak	None
Solids Treatment			
Gravity Belt Thickener	Good	200 gpm	Evaluate ventilation in GBT room to minimize corrosion. General maintenance practice to mitigate corrosion Install fire alarm system in GBT room
WAS Storage Tanks	Good	50,000 gallons. WAS tanks' capacity could be a limiting factor in 2042.	System control to draw higher concentration WAS if needed.

Unit Process	Physical Condition[1]	Capacity	Recommendation
TWAS Storage Tank	Good	16,000 gallons	Install or repair LEL combustible gas sensors
Sludge Tank Blowers	Good	400 scfm, firm	None
Support Systems			
Odor Control	Good	N/A	None
W2 Water	Good	N/A	Clean the exterior of air gap tank and monitor for future overflow
W3 Water	Good	N/A	Repair or replace casing gasket on pump P-902
Power Distribution			
Electrical Service	Good	750 kVA service/800 amp main circuit breaker	None
Generator	Good	Generator has the capacity to fully power the plant during outages	None
MCCs	Good	N/A	Establish replacement plan for obsolete AFDs
Control Panels	Poor to Good	N/A	Complete arc flash study Verify back-up copies of all PLC and OIT programs; create and store if not created Spare parts for the PLC should be stored by the County in case of a failure Develop and execute a migration/replacement plan if OIT in CP-300 is used as a main point of control Verify whether there is a PLC in the LP-GBT or LP-TLP panel Clean and inspect the local control panel for the scum pump
Buildings			
Operations Building	Good	N/A	None
Process Building	Good	N/A	None

Notes:

SCFM: standard cubic feet per minute

1. Component condition rating based on **Table 6-3**

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SECTION 7

Collection and Conveyance System Analysis

7.1 Introduction

The Kingston collection system was modeled using the Danish Hydraulic Institute's (DHI's) MIKE+ hydraulic and hydrologic (H/H) modeling platform to determine capacity deficiencies in the system. Results were analyzed for the existing, 2042, and 2080 planning horizons using a 25-year 12-hour design storm. Selection of the design storm and other model information is included in the technical memorandum *Kingston and Suquamish Design Storm, Model Loadings, and Future Condition Parameters* (Murraysmith [now Consor], February 2022), included as **Appendix H**.

7.2 Capacity Criteria

The following criteria were used to determine if a collection and conveyance facility was capacity limited and in need of upsizing:

- Manholes are considered to have SSOs when the water surface elevation in a manhole exceeds the rim elevation. SSOs at manholes and pump stations are public health hazards and a source of contaminants that adversely impacts the water quality of streams, lakes, marine waters, and groundwater.

- Pipes are considered surcharged when the water surface elevation in the upstream or downstream manhole connection exceeds the pipe crown. This condition indicates that the sewer has reached flow capacity and hydraulic flow characteristics have worsened.

- Pipes with velocities exceeding 7 feet per second (fps) are considered capacity limited. High velocities cause increased scouring, wear of pipe materials, and shorten the useful life of pipe. High velocities also cause turbulent flow conditions and higher energy requirements for pumping equipment. This is primarily a factor for force mains.

- Pump stations are under capacity when the flow to a pump station meets or exceeds the pump station firm capacity. The firm capacity of a pump station is the pumping capacity of the station when the largest pump is out of service.

7.3 Analysis Results

The results of the modeling analysis are summarized in this section. Assets that were modeled as failing the criteria for the planning horizons are shown in **Figure 7-1**, **Figure 7-2**, and **Figure 7-3** and the total counts of SSOs and surcharged gravity pipes are included in **Table 7-1**. The pipe surcharge shown in **Table 7-1**, in **Figure 7-1**, and **Figure 7-2** flags any gravity pipe whose end node has a water surface elevation greater than the crown of the pipe at that node connection. Force mains are only considered under capacity if they fail the velocity criteria. Force mains and gravity pipes that fail the velocity criteria are shown in **Figure 7-3**.

Table 7-1 | Pipe and Manhole Capacity Criteria

Scenario	Surface Sewer Overflows (SSO)	Number of Pipes Surcharged (Either end)	Velocity Exceeding 7fps
2022	0	10	0
2042	0	10	3
2080	0	11	3

The model simulated PHF for each pump station in the Kingston basin is shown in **Table 7-2**. These results indicate that PS-41 and PS-71 exceed the firm capacity in all three planning horizons. Capital improvement projects will be recommended to increase the capacity at these stations. The pipe deficiencies shown in pipes in **Figure 7-1** and **Figure 7-2** immediately upstream of these two pump stations are due to the pump stations backing up, and not because the pipes cannot convey peak flows without the restriction at the pump station.

Table 7-2 | Pump Station Capacity and Peak Hour Inflows

Pump Station	Firm Capacity (gpm)	2022 Peak Flow (gpm)	2042 Peak Flow (gpm)	Build-Out Peak Flow (gpm)
PS-41	240	[441]	[562]	[596]
PS-42	80	35	43	47
PS-43	400	47	65	69
PS-52	31	19	27	29
PS-71	450	[609]	[792]	[840]
PS-72	95	35	43	46
PS-73	84	30	35	38

Note:
Flows exceeding the firm capacity are bracketed and in bold italics.

Deficiencies at pipes B28-3007-B28-3006 and B28-3006-B28-4090 are minor with approximately 6-inches of surcharge in the build-out scenario. B28-4064-B28-4TEE surcharges because the downstream invert of this 6-inch pipe is at the bottom of the downstream 12-inch pipe, so pipe flow greater than 50-percent in the 12-inch pipe can cause surcharging in the 6-inch pipe. Capital improvements to increase pipe conveyance capacity will not be recommended at this time based on these model results. Rather, it is recommended that the County continue to monitor these areas for evidence of surcharge.

7.4 Capital Improvement Plan Model Runs

Model runs were performed with improvements to both pump stations and pipe sizes to remove minor flow restrictions and to size improvements. These improvements are described in **Section 11**.

Figure 7-1 | Kingston Capacity Deficiencies

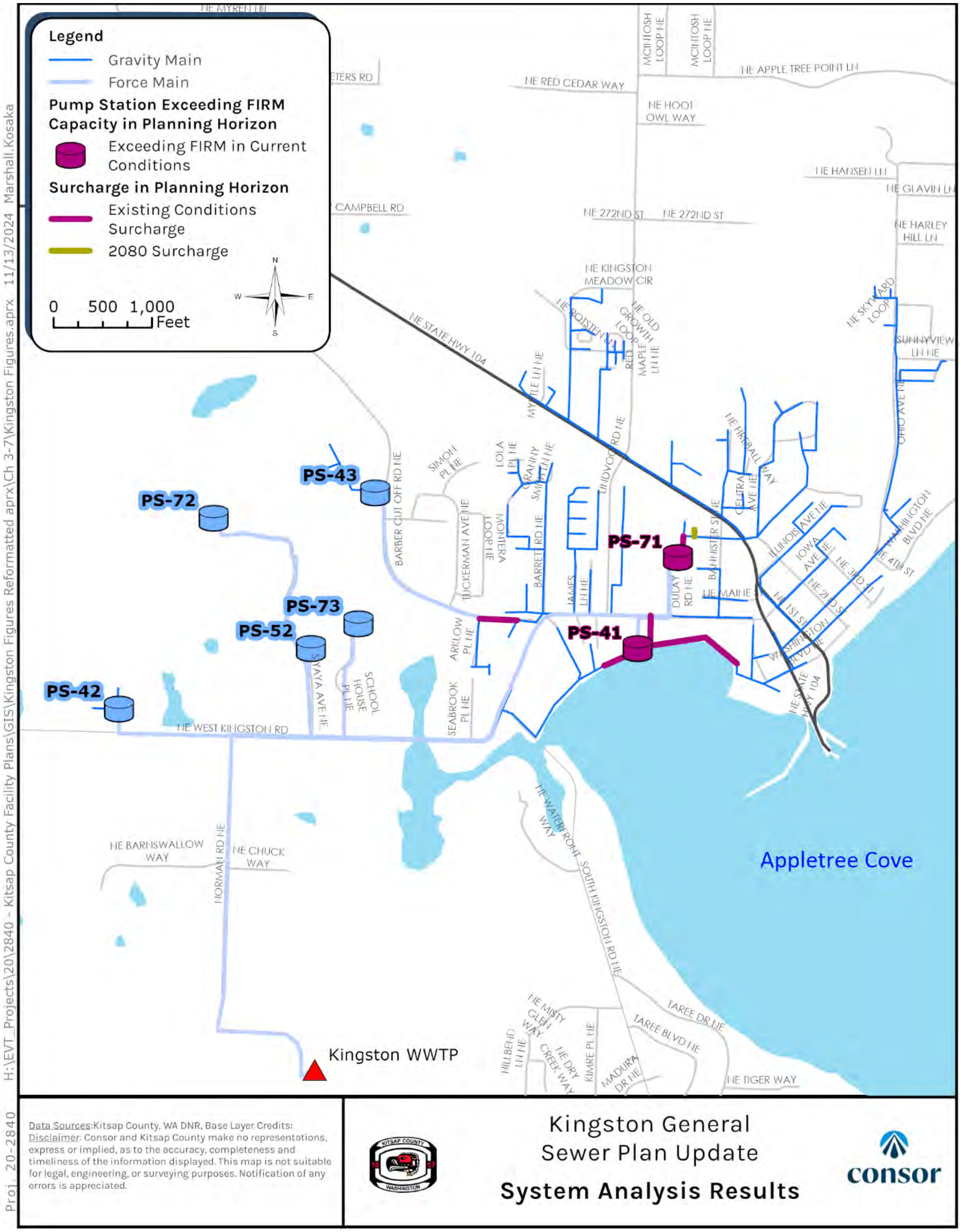

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Figure 7-2 | Kingston Capacity Deficiencies Detailed Map

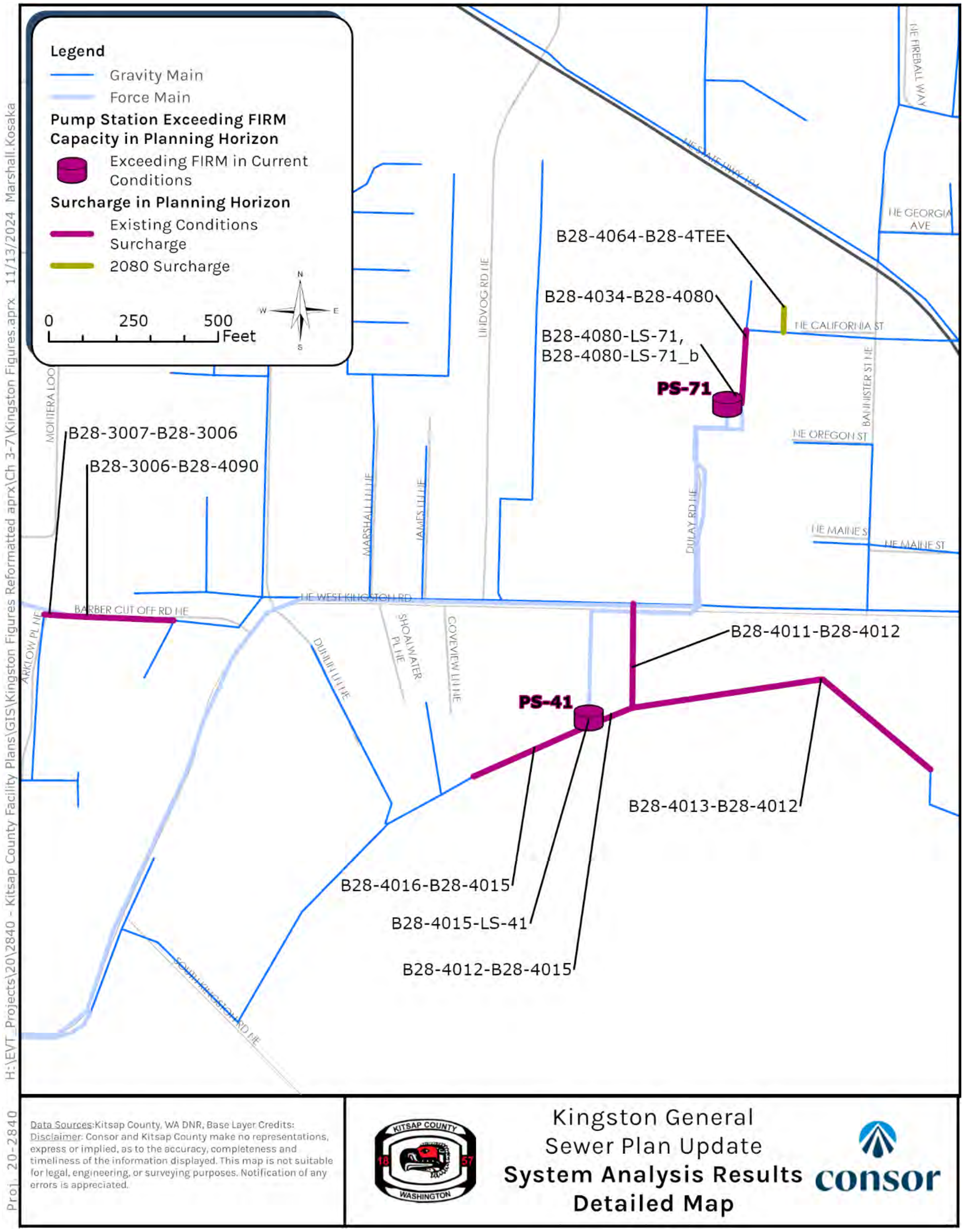
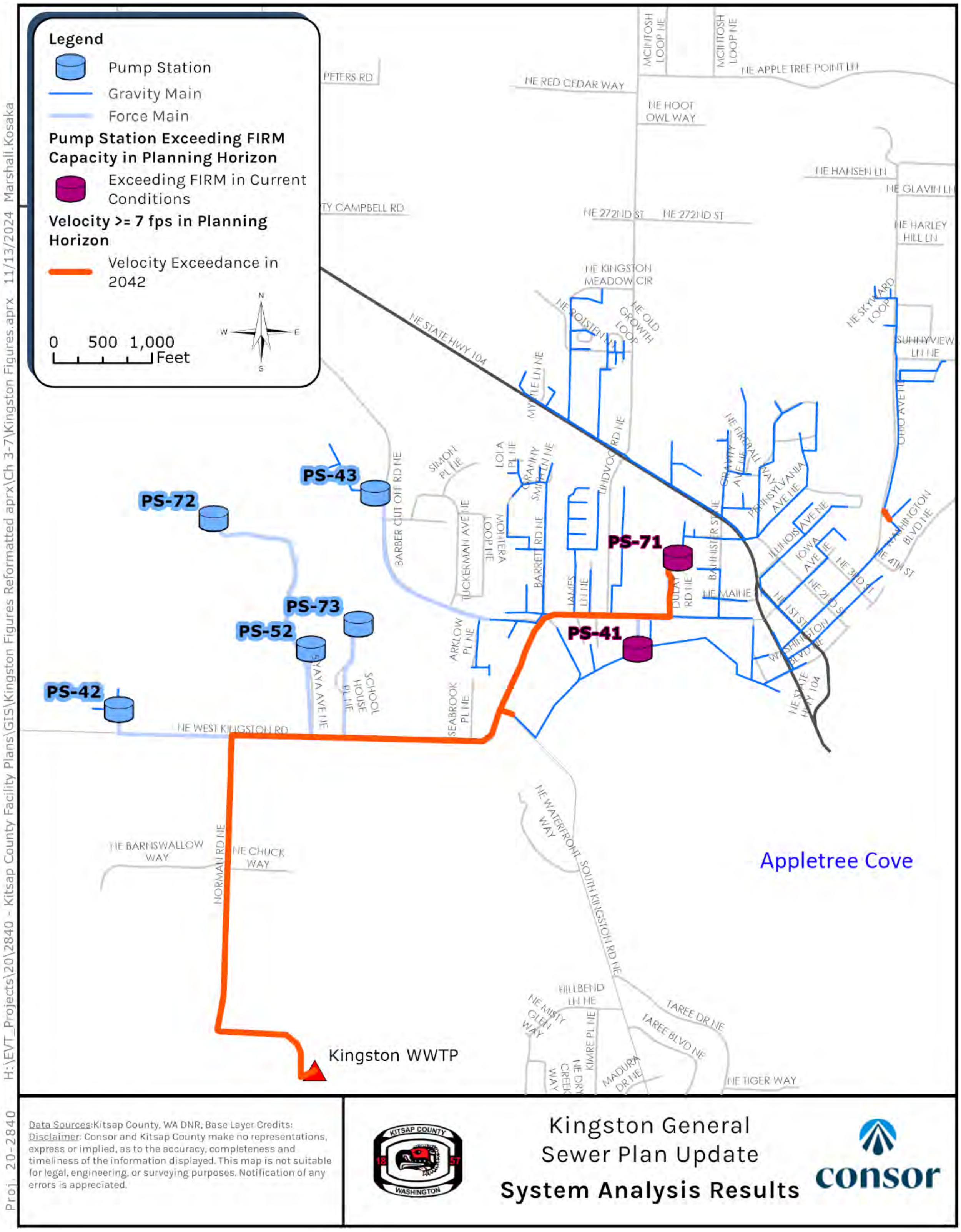


Figure 7-3 | Kingston Velocity Deficient Pipes



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SECTION 8

Wastewater Treatment System Analysis

The Kingston WWTP liquid stream improvement alternatives considered to improve the plant for the 6-year and 20-year planning horizons are described in this Section. Projected increases in flow and loading to the WWTP and aging equipment are the primary drivers for the improvements to allow the plant to consistently achieve the required effluent quality. The evaluation takes into consideration current deficiencies and the upgrades required, develops potential alternatives to achieve the expected treatment performance, and evaluates capital and life cycle costs.

The results of the condition assessment, capacity analysis, regulatory requirements, and projected flows and loadings, were used to identify processes that require improvement and define feasible alternatives for WWTP improvements. Minor maintenance, repairs, and direct replacements identified in the condition assessment **Table 6-19** are discussed briefly herein, but are not subject to a full alternatives analysis. These items as well as the preferred alternatives identified in this section will be included in the Capital Improvement Plan (CIP) in **Section 11**.

8.1 Overview of Improvements

Preliminary treatment components at Kingston WWTP include the Headworks Facility, a mechanical rotary screen, manual bar screen, and grit removal system. These components are generally in good or very good condition and have sufficient capacity, so no upgrades are required, and further analysis of alternative processes is not considered in this section. Kingston WWTP does not have any primary treatment processes.

Secondary treatment components at Kingston WWTP include two oxidation ditches, two secondary clarifiers, and associated support systems. The secondary clarifiers are in fair condition and require some general maintenance. Other components are in good or very good condition. All the secondary treatment components currently have sufficient capacity; however, implementation of the PSNGP has introduced new secondary treatment requirements and further changes the permit system are expected. Therefore, the capacity of the secondary treatment system will be examined more closely in this section.

The UV disinfection system condition is in poor condition and was identified in the condition assessment, **Section 6**, as the primary process requiring improvement. The process was reviewed, and two alternatives were identified and analyzed to select a preferred alternative to address the observed problems.

Each alternative is designated with a code identifying the location and alternative number as DIS (Disinfection)-#. Optimization and improvements will occur in the UV Facility.

- **Alternative DIS-1 Trojan UV3000B and Controller** replaces the existing Trojan UV3000B with a new version of the same system.
- **Alternative DIS-2 Trojan UV3000Plus and Controller** replaces the existing system with the upgraded Trojan 3000plus system which allows for greater operational control and monitoring.

No other UV manufacturers were considered in this analysis because the existing UV system is by Trojan. Replacing the existing UV system with Trojan system will require none to minimal modification to the existing UV channel.

Solids treatment at Kingston WWTP is provided by a GBT and includes WAS and TWAS storage tanks as well as blowers for the tanks. Some maintenance is needed in the GBT room to fix ventilation, address corrosion, and repair sensors, but otherwise all components are in good condition and have sufficient capacity, so further analysis of alternative processes is not considered in this section.

The odor control system was not functioning during the condition assessment visit but has since been repaired and may require further investigation. This will be discussed briefly in this section, but analysis of process alternatives is not necessary.

The non-potable water, process water, and power distribution systems are in good condition and have sufficient capacity, so no upgrades are required. Some equipment related to these systems will require in-kind replacement, but analysis of alternative processes is not considered in this section.

Figure 8-1 shows the site plan of WWTP with the unit process requiring improvement identified. **Table 8-1** provides a summary of the alternatives.

Table 8-1 | Treatment Improvement Alternatives Summary

Alternative Number	Alternative Name	Alternative Description	Deficiency Addressed
DIS-1	UV Disinfection – Trojan UV3000B and Controller	Replace the existing Trojan UV 3000B with a new unit; replace the basic controller with the touch smart controller; install a UV transmittance probe	Disinfection
DIS-2	UV Disinfection – Trojan UV3000Plus and Controller	Replace the existing Trojan UV 3000B with an upgrade version – Trojan UV 3000Plus with touch smart controller and UV transmittance probe	Disinfection

Figure 8-1 | Overview of Improvement Alternatives at the Kingston WWTP

8.2 Opinions of Probable Project Costs

Class 5 opinions of probable project costs (OPPC) for the 20-year planning period were developed for each alternative. The Class 5 OPPCs were prepared in accordance with the guidelines of the Association for the Advancement of Cost Engineering International (AACE) for planning-level evaluations with a range of -50 percent to +100 percent, based on the *AACE International Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries – TCM Framework: 7.3 – Cost Estimating and Budgeting.*

The OPPCs were developed using RSMeans Heavy Construction Cost Data, recent County project bid tabs, County input, industry experience, and local contractor and supplier costs. All costs were developed based on the preliminary concepts and layouts of the system components in 2022 dollars should be escalated with the future Consumer Cost Index for use in project budgeting. The OPPC includes both construction and project costs. The construction costs include construction work and materials plus markups for mobilization, general contractor markups, overhead, and profit, taxes, and a construction contingency of 30 percent. The project costs account for a markup of 25 percent for engineering, legal, and administration costs associated with project delivery.

The O&M costs and the 20-year net present values were also developed based on the following assumptions:

- Labor cost: $60/hour
- Electricity Cost: $0.10/kWh
- Discount rate: 3 percent
- Inflation rate from 2023 to 2024: 12 percent
- Inflation rate from 2025 to 2026: 8 percent
- Long term inflation: 5 percent

8.3 Secondary Treatment Improvements

8.3.1 Existing Condition Description

Two oxidation ditches provide secondary treatment at Kingston WWTP. Aeration is accomplished by a fine bubble diffuser system. Air is supplied by three positive displacement blowers (two duty, one standby) in the adjacent Blower Building. DO probes and ORP probes are used to assist in process monitoring.

According to the assessment in **Section 6**, the secondary treatment structures are in very good condition and will last for at least another 50 years. The oxidation ditches currently have sufficient capacity to be operated one at a time, and operation is alternated once per year. Two submersible mixers and the monitoring probes are moved between the oxidation ditches when they are rotated. The blowers are currently operated on a time basis and function properly. However, the process control could be improved by adding ammonia and nitrate probes to directly measure these constituents.

8.3.2 Nitrogen Removal Criteria

Ecology issued the PSNGP on December 1, 2021. The permit is effective on January 1, 2022, and expires on December 31, 2026. Kingston WWTP is categorized as a small TIN load plant. Though the permit does not specify an action level of TIN load for small TIN load plants, an AKART analysis is required for permittees who cannot maintain an annual average TIN of less than 10 mg/L. Thus, staying below the existing TIN load and achieving an annual average TIN of 10 mg/L through optimization is the goal for the secondary treatment process.

Future nutrient limits beyond the 2026 expiration of the permit have not been determined, but Ecology has indicated the target for future permits will likely be between 3 and 10 mg/L, and the permit requires a "Nutrient Reduction Evaluation" which includes consideration of technologies capable of achieving 3 mg/L seasonally for Dominant and Moderate load WWTPs.

As detailed in **Section 6** and shown in **Table 8-2** below, Kingston WWTP is capable of meeting an annual average TIN concentration below 10 mg/L both currently and under projected 2028 and 2042 flows and loads. With an expected 2042 average annual effluent TIN of 3.3 mg/L, the expected capacity of the plant is very close to the lower limit of target TIN concentrations identified by Ecology. Implementation of a reclaimed water program would also reduce effluent TIN loading and is discussed in **Section 9**.

Table 8-2 | Secondary Treatment Process Model Simulation Results

Parameter	2028			2042		
	AAF	MMWWF	MMDWF	AAF	MMWWF	MMDWF
Flow (MGD)	0.17	0.23	0.18	0.27	0.36	0.29
Temperature (oC)	15	11	22	15	11	22
Influent Alkalinity (mg/L)	330	330	330	330	330	330
No of AB Trains	2	2	2	2	2	2
DO Cycle (hrs)	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF	4 ON/2 OFF
DO Target during ON Cycle (mg/L)	1.5	2.0	2.0	1.5	2.0	2.0
SRT (days)	30	20	13	15	15	18
MLSS (mg/L)	2,100	2,700	2,400	2,000	3,500	3,500
Effluent TSS (mg/L)	1.41	1.90	1.49	2.28	3.25	2.52
Effluent BOD (mg/L)	1.30	1.78	1.62	1.70	2.34	1.88
Effluent Ammonia (mg/L)	1.0	1.9	1.1	2.0	6.5	1.7
Effluent Nitrate and Nitrite (mg/L)	2.2	0.55	1.0	1.3	0.1	0.4
Effluent TIN (mg/L)	3.2	2.5	2.1	3.3	6.6	2.1
Annual Effluent TIN Load (ppd)	5	-	-	7	-	-

Since Kingston WWTP already has the capacity to meet the 10 mg/L TIN AKART trigger throughout the planning period and the capacity to provide TIN treatment near the lowest future proposed limits, an analysis of secondary treatment alternatives is not necessary and is not included in this section.

8.4 UV Disinfection Alternatives

8.4.1 Existing Condition Description

According to the assessment in **Section 6**, the existing UV system is a two-bank Trojan UV3000B installed in 2005 and has about 2 to 10 years of remaining life. This model has a basic controller which can automatically alternate the lead and lag UV banks and monitor the bank run time, bank on/off status, a common alarm, and UV intensity. However, the basic controller cannot turn off the bank based on the flow signal. Plant staff cleans the UV lamps manually. It is recommended to replace the entire UV system with a new system that has additional monitoring and control capabilities, and cleaning capabilities.

8.4.2 DIS-1 UV Disinfection – Trojan UV3000B and Controller

For DIS-1, the existing Trojan UV3000B will be removed and replaced with a new UV3000B system (**Figure 8-2**), the basic controller will be replaced with a touch smart controller, and a new UV transmittance probe will be installed. This alternative will be able to monitor and control several operational parameters requested by operators including tracking bank lamp life, switching banks/bringing them on and off, tracking and alarming on UV intensity, and monitoring UV transmittance. However, the UV3000B unit can only be controlled based on flowrate, not UV dose, and the touch smart controller of UV3000B does not monitor the individual lamp On/Off status.

The manufacturer Trojan provided the recommended system design based on the 2042 peak flow condition and the state disinfection requirements of one bank shall handle 50 percent of the design PHF. A new UV3000B system will have two banks in a lead/lag operation with a total 64 lamps. The new UV banks can be placed in the existing UV channel without any modification to the UV channel.

Figure 8-2 | DIS-1 Trojan UV3000B System

8.4.3 DIS-2 UV Disinfection – Trojan UV3000+ and Controller

For DIS-2, the existing Trojan UV3000B system will be replaced with an upgraded model, the Trojan UV3000Plus (**Figure 8-3**). This alternative will provide all the monitoring control functionality of alternative DIS-1 and will provide flow rate adjustable intensity and additional monitoring capability including individual lamp failure status. It has a knob to adjust intensity and has an option of automatic cleaning system. With the touch smart controller, the system will be able to monitor the individual lamp status and dose pacing.

The manufacturer Trojan provided the recommended system design based on the 2042 peak flow condition and the state disinfection requirements of one bank shall handle 50 percent of the design PHF. Under the

2042 peak flow design condition, two banks will be installed in the existing channel with three UV modules per bank and six lamps per UV module, equating to 36 lamps. The new UV banks can be placed in the existing UV channel with minor modifications to the baffles to adjust the channel width.

Figure 8-3 | DIS-2 Trojan UV3000Plus System

The comparison of the existing basic controller, touch smart controller for UV 3000B and touch smart controller for UV 3000Plus are summarized in **Table 8-3**.

Table 8-3 | UV System Controller Capability Comparison

Capabilities	Current: Basic Controller for UV 3000B	DIS-1: Touch Smart Controller for UV 3000B	DIS-2: Touch Smart Controller for UV 3000Plus
Configuration			
Max. # of Channels	1	2	2
Max. Modules/bank	20	20	32
Max. Banks/channel	3	3	3
Control			
Flow Pacing	Yes	Yes	No
Dose Pacing	No	No	Yes
Individual Lamp Status	No	No	Yes
Lead Bank Rotation	Automatic	Automatic or Manual	Automatic or Manual
Redundant Bank Logic	No	Yes	Yes
Multiple Lamp Failure	No	No	Yes
Module Failure Alarm	No	No	Yes
Bank Communication Alarm	No	No	Yes
USB Data Logging	No	Yes	Yes
Remote Control Capabilities			

Capabilities	Current: Basic Controller for UV 3000B	DIS-1: Touch Smart Controller for UV 3000B	DIS-2: Touch Smart Controller for UV 3000Plus
Force System On/Off	No	Yes	No
Turn On Additional Bank (if available)	No	Yes	No
Remote Monitoring Capabilities			
SCADA	No	Yes	Yes
Bank Status	Yes	Yes	Yes
Common Alarm	Yes	Major, Minor	Critical, Major, Minor
Low UV Intensity Alarm	No	Yes	Yes
Bank UV Intensity Alarm	No	Yes	Yes
Average UV Intensity	No	Yes	No

8.4.4 UV Disinfection Cost Analysis

Class 5 OPPCs for the UV disinfection alternatives were developed as described in **Section 8.2** and are summarized in **Table 8-4**. The total project cost for the UV3000B system is lower than the UV3000Plus system because the equipment is less expensive, however, the annual operating costs are higher, so over the 20-year lifecycle the UV3000Plus system will cost approximately $25,000 less.

Table 8-4 | UV Disinfection Alternatives Cost Estimate

Alternative Number	Alternative Name	Project Cost	O&M 20-year Net Present Cost	Total 20-year Net Present Cost
DIS-1	UV Disinfection – Trojan UV3000B	$ 594,000	$ 445,000	$1,039,000
DIS-2	UV Disinfection – Trojan UV3000Plus	$ 809,000	$ 205,000	$1,014,000

8.5 Odor Control Improvements

8.5.1 Existing Condition Description

The odor control system consists of a biofilter with a fan, humidifier, and heater to provide appropriate filter conditions. The biofilter provides odor control for the entire WWTP, including the headworks, WAS tank, TWAS tank, and GBT room. The biofilter and associated equipment is in good condition but was turned off during the condition assessment because the media had collapsed. The County has since excavated and recovered the filter media and report that the filter is running well again.

8.6 Recommendations

This section provides a recommendation for each process based on the performance and cost analysis of alternatives which includes both capital costs and long-term O&M costs.

8.6.1 Secondary Treatment

Kingston WWTP already has the capacity to meet the 10 mg/L TIN AKART trigger throughout the planning period and to provide TIN treatment near the lowest future proposed limits, so major improvements to the secondary treatment process are not needed. The County should complete the Nitrogen Optimization Plan and implement low-cost improvements to assist in optimization as required by the PSNGP, including installing ammonia and nitrate probes in the oxidation ditch. These probes will provide direct monitoring of nitrogen removal processes and will assist operators in making well informed adjustments to process operation.

8.6.2 Disinfection

Alternative DIS-2 is recommended as the disinfection alternative because it provides greater functionality and efficiency. Although the capital cost is higher, the 20-year net present value is less than DIS-1, and the increased efficiency and reduced maintenance makes this alternative more favorable.

8.6.3 Odor Control

During the condition assessment strong odor and corrosion was noted in the GBT room. The odor should be reduced now that the odor control system is running again, but the corrosion may indicate that the HVAC system is not providing enough ventilation. Further investigation of the HVAC system is recommended to determine if upgrades are needed.

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SECTION 9

Recycled Water

Recycled water provides multiple potential benefits from wastewater management, water supply, and environmental enhancement perspectives. Because of these benefits, the County identified recycled water as a key strategy in its *Water as a Resource* policy, adopted in 2009 and reaffirmed in 2016, which aims to conserve groundwater resources, restore the natural hydrologic flow in local streams and creeks, and reduce water pollution. In short, implementation of recycled water efforts would be a direct expression of the County's guiding principle to preserve water as a resource rather than treating it as a waste stream. This section summarizes the County's assessment to date of the potential for developing and implementing a recycled water program involving the Kingston WWTP.

9.1 Recycled Water Regulatory Framework

Wastewater that is reused for beneficial purposes in a municipal context must meet certain regulatory and water quality requirements. In Washington, recycled water (also referred to as reclaimed water) is defined in WAC 173-219 as: "water derived in any part from a wastewater with a domestic wastewater component that has been adequately and reliably treated to meet the requirements of WAC 173-219, so that it can be used for beneficial purposes." As such, recycled water is no longer considered a wastewater once it is put to use.

WAC 173-219 defines the requirements and constraints pertaining to the use of recycled water for a wide range of purposes. Recycled water permits are issued by Ecology and DOH. Ecology is generally the lead permitting agency, with the primary exception being when the source water is generated by an on-site sewage system with a design flow of less than or equal to 100,000 gpd.

There are three classes of recycled water defined in WAC 173-219: Class B, Class A, and Class A+. These are defined by varying degrees of treatment and water quality, and are each applicable for various uses, as summarized below.

- Class B (meets oxidation and disinfection requirements) recycled water can be used for some construction and industrial purposes, and certain irrigation uses where access to the general public is restricted.
- Class A (meets Class B requirements, plus coagulation and filtration, or use of membrane filtration) recycled water can be used for a wide range of commercial uses (such as toilet/urinal flushing and street sweeping) and irrigation of areas that have open access to the public. This can also be used for groundwater recharge, assuming additional requirements are met, such as nitrogen limits.
- Class A+ (meets Class A requirements, plus additional needs to be health protective, as defined on a case-by-case basis) is required for direct potable reuse (i.e., drinking or direct ingestion).

The public access restriction requirements for Class B are typically difficult to meet for a municipal entity like the County, whereas Class A does not require access restriction, so Class A has a wider range of potential uses. Therefore, it is water of this quality that is considered in this Plan when evaluating potential reuse opportunities. While opportunities for use of lower quality water may exist, they are anticipated to be few in number with very limited benefit being received, based upon the experience of other Puget Sound utilities.

9.2 Prior Recycled Water Planning Efforts

In 2003, the County began assessing opportunities for using recycled water that could be produced at Kingston WWTP to meet an array of long-term water resource management objectives. Multiple studies have been conducted over the two decades since then, culminating in the development of a conceptual plan for how a recycled water program could be implemented in the Kingston area. The recent County recycled water planning efforts include:

- Kingston Reclaimed Water Environmental Feasibility Study (September 2010).
- Kingston Recycled Water Project Report (February 2016).
- *Kingston Recycled Water Facility Plan* (Brown and Caldwell, March 12, 2020), see **Appendix I**. This document, building upon the previous efforts, was prepared in part with federal funding through the United States Bureau of Reclamation WaterSMART Title XVI Water Reclamation and Reuse Program to satisfy the requirements for a Title XVI Feasibility Study. This is referred to hereafter as the 2020 Feasibility Study.

In addition, the concept of generating and using recycled water in Kingston was included in a watershed planning effort facilitated by Ecology for Water Resource Inventory Area (WRIA) 15, as directed by the Streamflow Restoration Act (RCW 90.94). This activity is documented in the *WRIA 15 Watershed Restoration and Enhancement Plan* (March 1, 2022). The evaluation presented in that document is based on the technical work conducted by the County and builds upon the broader water resource management benefits that a recycled water program could provide in this geographic area.

9.3 Benefits and Potential Uses

Recycled water can provide numerous benefits. Specific environmental benefits associated with the envisioned recycled water program at Kingston are summarized below.

- **Conserve limited groundwater resources**. Water use in the Kingston area is sourced from groundwater pumped primarily from the sea-level aquifer. This is a limited resource, with aquifer levels susceptible to decline as local water demand increases. In addition, saltwater intrusion can occur if groundwater levels are withdrawn below certain thresholds. Use of recycled water to replace the use of potable water for nonpotable purposes, especially during peak use times (i.e., summer irrigation season), reduces the stress on area groundwater and supports sustainable management of that limited resource.
- **Reduce marine water discharge**. Recycled water is being increasingly explored around Puget Sound as a means to reduce wastewater discharge (and therefore reduce nitrogen loading) to marine waters and comply with more restrictive wastewater discharge permit requirements, such as those established by the recently enacted PSNGP. Such actions serve to protect and improve marine water quality, which in turn improves fish and shellfish habitat by reducing the overpopulation of phytoplankton and zooplankton and avoiding development of algal blooms.

- **Restore and replenish streams and fish habitats**. Recycled water can be used to directly augment streams and wetlands and can be used to indirectly influence them through recharge of groundwater that supports such features.

Prior County planning has resulted in the definition of a potential recycled water project that would realize all the above benefits. As described in detail in the 2020 Feasibility Study, the two applications deemed most feasible for recycled water use if it were produced at the Kingston WWTP are:

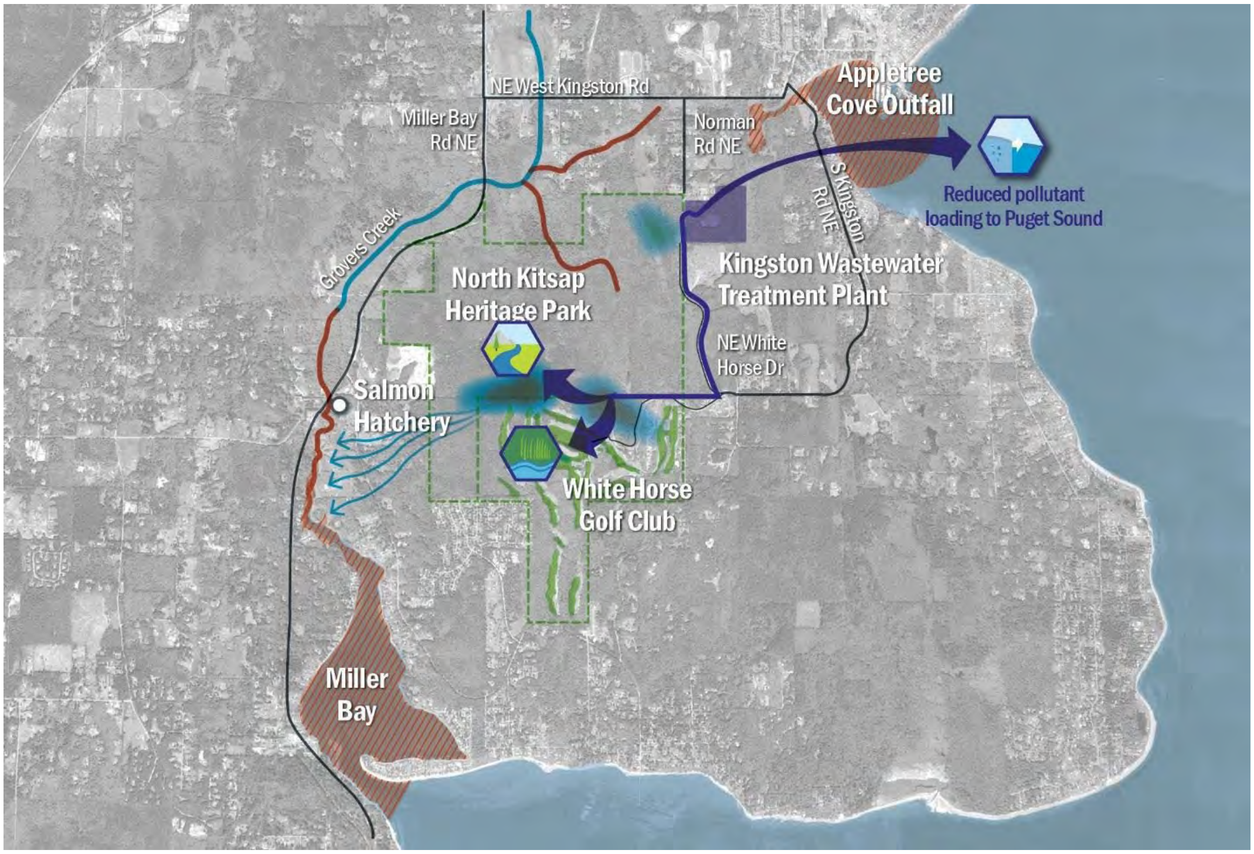
- Summer-time irrigation at the White Horse Golf Course (WHGC).

- Winter-time indirect groundwater recharge in an area north of WHGC, at North Kitsap Heritage Park.

The envisioned recycled water project would replace 29 MG per year of groundwater supply provided by KPUD for irrigation purposes at WHGC, which is owned and operated by the Suquamish Tribe. The golf course uses water mostly during May through September, with average water demands in the peak month of July being approximately 300,000 gallons per day.

In addition, the project would involve infiltration of approximately 107 MG per year into the shallow aquifer that provides baseflow to Grovers Creek and its tributaries. Through this bolstering of groundwater levels, the WRIA 15 Watershed Plan estimates that baseflow in Grovers Creek could increase by up to 0.5 cubic feet per second, potentially providing 328 acre-feet per year to serve as an offset to consumptive impacts of new permit-exempt domestic groundwater withdrawals. **Figure 9-1** provides a conceptual view of the proposed project.

Figure 9-1 | Conceptual-Level Map of Kingston Recycled Water Project



(Source: Figure 1-1 of 2020 Feasibility Study)

As part of development of this Plan, a cursory review of other potential uses of recycled water in the Kingston area was conducted. An investigation was made into the possibility of irrigation of other turf/landscaped areas. The County coordinated with water providers and other potential stakeholders to determine if there were any such opportunities for this type of recycled water use in the vicinity of the Kingston WWTP. Entities contacted were:

- Kitsap Public Utility District. The County discussed recycled water potential uses with KPUD staff in March 2023. KPUD has actively researched recycled water opportunities throughout portions of its service area and has implemented a system in Port Gamble. Key benefits of this resource to KPUD are the potential to relieve stresses on groundwater supplies during peak use periods and provide a tool for water rights mitigation efforts. In addition to the potential for irrigating the WHGC (as noted previously) and other sites examined in previous studies, KPUD staff noted that there are new housing developments occurring in this area, such as Arborwood, where there may be potential for integrating recycled water as a source of irrigation water into the planning of future phases. Additional coordination with that development group would be required to determine the level of feasibility of implementing such uses.

- Kitsap County Parks Department. A discussion was held with Kitsap County Parks Department staff in January 2022, regarding the possibility of irrigation of turf/landscaped areas managed by the County. It was determined that, based on locations of other irrigable areas and their relatively small amount of associated water consumption, there are no sites where recycled water use would be cost-effective.

Further investigation into other uses was not conducted, due to the comprehensive nature of the previous efforts already completed.

9.4 Capital Improvements

To produce Class A reclaimed water for the proposed irrigation and infiltration uses described in **Section 9.3**, upgrades to Kingston WWTP are required. Key components, the details of which are provided in the 2020 Feasibility Study, are:

- Modifications to the existing oxidation ditch, including upgrades to the aeration and mixing components of the oxidation ditch, are needed to provide for greater nitrogen removal to support groundwater infiltration. Some of these improvements were made to the WWTP in 2020, including installation of fine bubble diffusers and submersible mixers. Therefore, with additional improvements such as ammonia and nitrate probes, nitrogen removal should be achievable to levels required for groundwater infiltration.
- A secondary effluent equalization tank, to hold flows that exceed the design capacity of the recycled water disinfection and conveyance systems.
- A filter feed pump station, to direct flow from the biological process to tertiary filtration.
- Tertiary filtration, comprised of upflow sand filtration.
- UV light disinfection, followed by chlorination to provide for a chlorine residual.
- A recycled water pump station to introduce recycled water into the distribution system.
- A recycled water pipeline to convey the finished product to WHGC and the infiltration site.

The 2020 Feasibility Study presents a conceptual layout and sizing of facilities to produce 0.7 MGD of recycled water, based on predicted 2040 PDF rates considered in that analysis. Total capital costs associated with these improvements are estimated at approximately $13.7 million.

These projects are included in the CIP in **Section 11**, to continue to advance the project and support the County's efforts to obtain funding for the recycled water program.

9.5 Future Steps

As the County continues advancing the proposed recycled water project at Kingston WWTP, key implementation considerations that will be taken into account, beyond technical feasibility, costs, and water quantity/quality benefits, include those described briefly below. These items will be explored in greater depth as the County advances in its planning process.

- **Regulatory Requirements**. One of the more rapidly changing elements that will shape future recycled water programs are water quality requirements related to currently unregulated chemicals. In particular, the water industry's current focus on per- and polyfluoroalkyl substances (PFAS) will likely yield State or federal drinking water limits that are lower than the State Action Levels established for five PFAS compounds in 2021. This may lead to certain additional forms of treatment being required to produce recycled water suitable for purposes such as groundwater recharge or streamflow augmentation.

- **Funding**. The capital investment to implement reuse can be significant and is greater than what can be realistically recouped through recycled water rates. Most utilities seek low-interest loans or grant money from the State or federal government to support reuse implementation. At the State level, this includes funding through the Centennial Clean Water Fund, while at the federal level this can include funding through the WaterSMART Title XVI program.

- **Stakeholder and Public Outreach**. The County has had extensive coordination with the Suquamish Tribe during development of the proposed recycled water project. Continued collaboration with the Tribe, along with general public involvement, is critical to the success of this effort, largely in relation to the above two topics of water quality and funding. The public will want assurance that proposed reuse practices are protective of public and environmental health. In addition, the full range of benefits must be articulated so that the community can truly assess costs versus benefits, and understand how investment in reuse relates or compares to other priorities the County is facing.

- **Implementation Policies and Procedures**. Recycled water programs require much more than the upfront capital infrastructure. County policies will be needed to establish when, where, and how recycled water can be used and what the applicable rates are for customers who would use the resource. Depending on the extent of infrastructure that may be needed in the future, development standards may be required, including maintenance procedures specific to purple pipe distribution systems, water quality monitoring/reporting, and backflow prevention.

SECTION 10

Operations and Maintenance

10.1 Introduction

The County's Kingston sewer collection and conveyance system, WWTP O&M program, and review of State and Federal requirements that impact the County's O&M program are summarized in this section. Current department organization and staffing is presented, and future staffing needs are also discussed. Comments, observations, and recommendations to improve the efficiency and effectiveness of the County's O&M program are provided at the end of this section. Key O&M elements that have the potential to impact the CIP are carried forward and further discussed in the following sections.

10.2 Utility Management and Structure

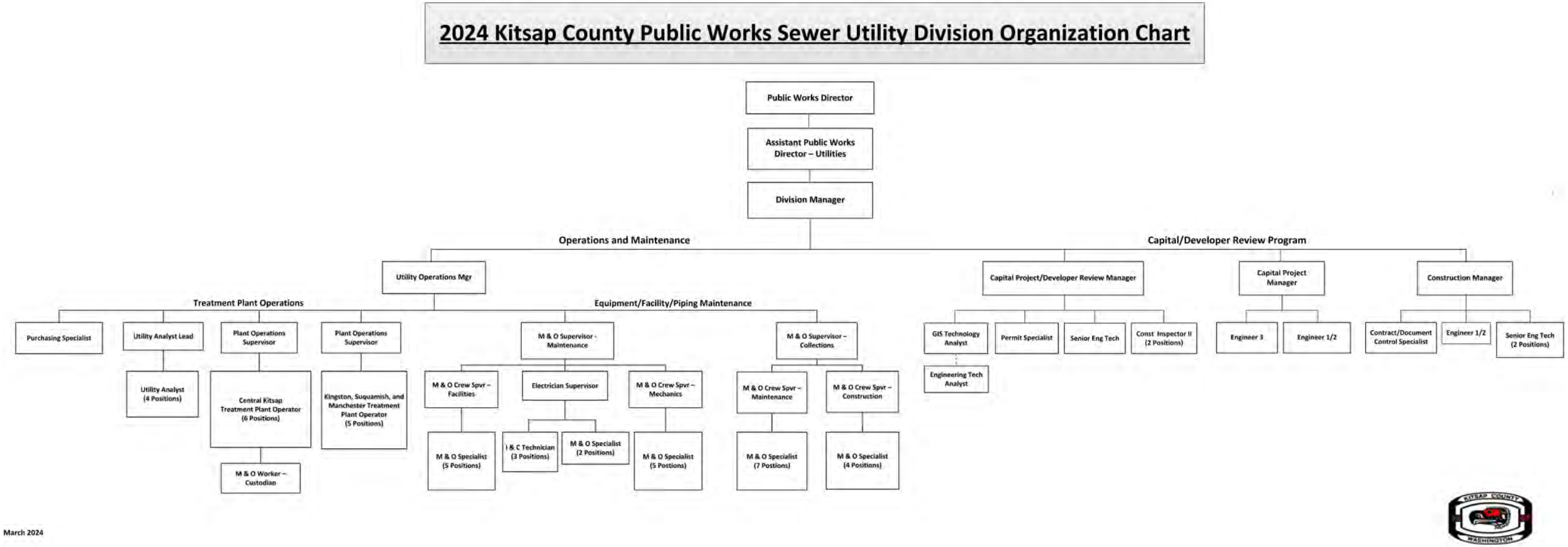
The County is managed by a three-person Board of County Commissioners, who are elected officials that represent one of three geographical districts. The Kitsap County Department of Public Works is responsible for management of County roads, recycling and solid waste, sewer, and stormwater, with separate Divisions for each. The Sewer Utility Division is responsible for O&M of both the sewer collection system and the County's four WWTPs. The organizational chart for the Sewer Utility Division is shown as Figure 10-1.

The Sewer Utility is led by the Sewer Utility Senior O&M Manager, who reports to the Public Works Assistant Director. A total of 72 staff currently work in the Sewer Utility Division. The Sewer Utility Division consists of four main work groups: Utilities (Plant and Pump Station) O&M, Field (Collection) Operations, Engineering and Administration, and Construction Management.

The Utilities (Plant and Pump Station) O&M is led by the Utilities Operations Manager. The pump station O&M of the plants and pump stations is run by the Sewer Utility O&M Supervisor who oversees two Maintenance Crew Supervisors, each with a five-person crew, and an Electrical Supervisor with a 5-person crew. The four WWTPs are managed by the two Plant Operations Supervisors: Outlying Plant Supervisor and Central Kitsap Treatment Plant Supervisor. The three smaller WWTPs, including Kingston, each have a lead operator and share two additional operators who work on all plants as needed. Central Kitsap WWTP is run with six plant operators, and one worker. The County cross-trains operations staff so that they can fill in for other staff during absences or emergencies.

The Field (Collection) Operations is responsible to maintain, repair, replace, clean, and inspect the sewer utilities collection systems. It is managed by the Sewer Collections O&M Supervisor who oversees two O&M Crew Supervisors. Engineering efforts are managed by both the Sewer Utility Engineering and Construction Management Groups. The Construction Management Group manages the delivery of capital work while the Engineering Group manages the design, both groups consult the Facilities and Conveyance operation groups for project specific challenges that will impact day to day or future operations. The Administration portion of the Engineering Group manages the GIS database utilized by the Operations groups and provides review efforts for Developer proposed projects.

Figure 10-1 | Kitsap County Public Works Sewer Utility Organizational Chart



10.3 Operation and Maintenance Requirements

10.3.1 Regulatory Compliance

Ecology has the authority to permit WWTPs through the NPDES program, which includes Kingston WWTP. Ecology has issued NPDES Permit WA0032077 to the County for Kingston WWTP, which includes operator certification and O&M requirements for both the WWTP and the collection system.

10.3.2 Operation and Maintenance Program

As required by the NPDES permit, the County has instituted an O&M program which consists of maintenance records for all major mechanical and electrical components for the WWTP, collection system, pump stations, and any other major facilities. The County uses a computerized maintenance management system (CMMS) to schedule and record all maintenance activities for plants and pump stations. The system identifies the frequency and type of maintenance recommended by the manufacturer and records the frequency and types of maintenance performed. The CMMS is available to all relevant County staff for review, update, and inspection. The County also uses a GIS system to inventory and record all maintenance and inspections of the conveyance pipe systems and is also used to populate downloadable asset layers accessible to the public.

10.3.3 Operation and Maintenance Manual

The Kingston WWTP O&M Manual provides basic information for the plant in accordance with the NPDES permit, WAC 173-240-080, and Ecology's Orange Book. It describes the treatment process in sufficient detail to familiarize personnel with both the normal operation of the plant as well as the alternate methods of operation that are available. In addition, it provides an overview of all miscellaneous components and management systems in use at the plant. The intent of the manual is to assist operators and other personnel with learning the overall operation of the plant, to serve as a basic reference for operating any of the system's components and provide emergency response and safety guidelines.

Pump station specific O&M information is located on the County's Electronic O&M website. This includes information on critical pieces of equipment such as pumps, electrical, instrumentation, controls equipment, valves, and odor control systems. Newer stations have more complete O&M data than older stations.

10.4 Supervisory Control and Data Acquisition

The County employs a Supervisory Control and Data Acquisition (SCADA) system to monitor and record the status of the pump stations and treatment plants. The SCADA system uses Aveva (previously known as Wonderware) software. The County recently completed a Sewer Utility SCADA Master Plan that evaluated the existing SCADA system, identified operational needs, determined preferred hardware and software, and presented recommended improvement projects. The Sewer Utility SCADA Master Plan is included as **Appendix F**. All the County pump stations are connected to the SCADA system, and new pump stations include force main pressure monitoring to provide greater remote insight into operating conditions.

The pump stations and treatment plants have a number of alarms that are linked to the County SCADA system that alert staff if a problem is occurring via either very high frequency licensed radio network or 4G cellular network. These alarms include high wet well level alarms, intrusion alarms, pump fail alarms, and others. The alarm functionality at pump stations designated as 'critical' is checked weekly to ensure they are operational.

10.5 Collection System Operation and Maintenance Activities

10.5.1 Collection System Overview

The Kingston collection and conveyance system primarily serves the northern portion of the Kingston UGA; the southern portion of the UGA is unsewered. Wastewater within the Kingston basin is ultimately conveyed to the WWTP west of the UGA. The Kingston collection and conveyance system is shown in **Figure 10-2**.

10.5.2 Pump Stations

County crews visit and inspect each pump station regularly to check on equipment, test alarms, and perform maintenance as needed. The inspection and testing frequency is determined by the criticality of the pump station and is completed as shown in **Table 10-1**. Criticality is determined by how many drainage basins (or upstream pump stations) discharge to the pump stations. A schematic of the conveyance system showing the pump station criticality is shown in **Figure 10-3**. Physical location of a pump station in relation to a water body or location that is difficult to access, may drive a higher criticality definition independent of number of contributing basins. Generator load exercise is completed with the pump station load at all critical stations and regional stations with loads greater than 200 kW. Stations with loads less than 200 kW are exercised with mobile load banks. Stations will be checked if alarms are indicated.

Table 10-1 | Pump Station Inspection & Testing Frequency

Pump Station Type[1]	Threshold for Designation	Inspection Frequency	Alarm Check Frequency	Generator Load Exercise[2]
Critical	5+ Basins Served, or if specifically identified	1x per week	Bi-weekly	Annually
Regional	3-4 Basins Served	1x per week	Bi-weekly	Annually
Relay	2 Basins Served	1x per week	Bi-weekly	Annually
Satellite	1 Basin Served	1x per week	Bi-weekly	Annually

Notes:
1. Certain pump stations may serve fewer basins, yet the selection of type is driven by location.
2. Generators are run monthly, however load tested annually.

10.5.3 Sanitary Sewers

Gravity sanitary sewer pipes and manholes are regularly cleaned to clear them of debris, settled solids, and grease buildup and inspected with video equipment to evaluate pipe condition. Sewer cleaning and inspection are vital to maintaining a well working sewer collection system. Over time, deterioration, solids build-up, and blockages can cause collapse and other pre-mature failures. Proactive maintenance through cleaning and inspection keeps the sewer collection system working efficiently and avoids many serious service disruptions from occurring.

Figure 10-2 | Kingston Basin Sewer System

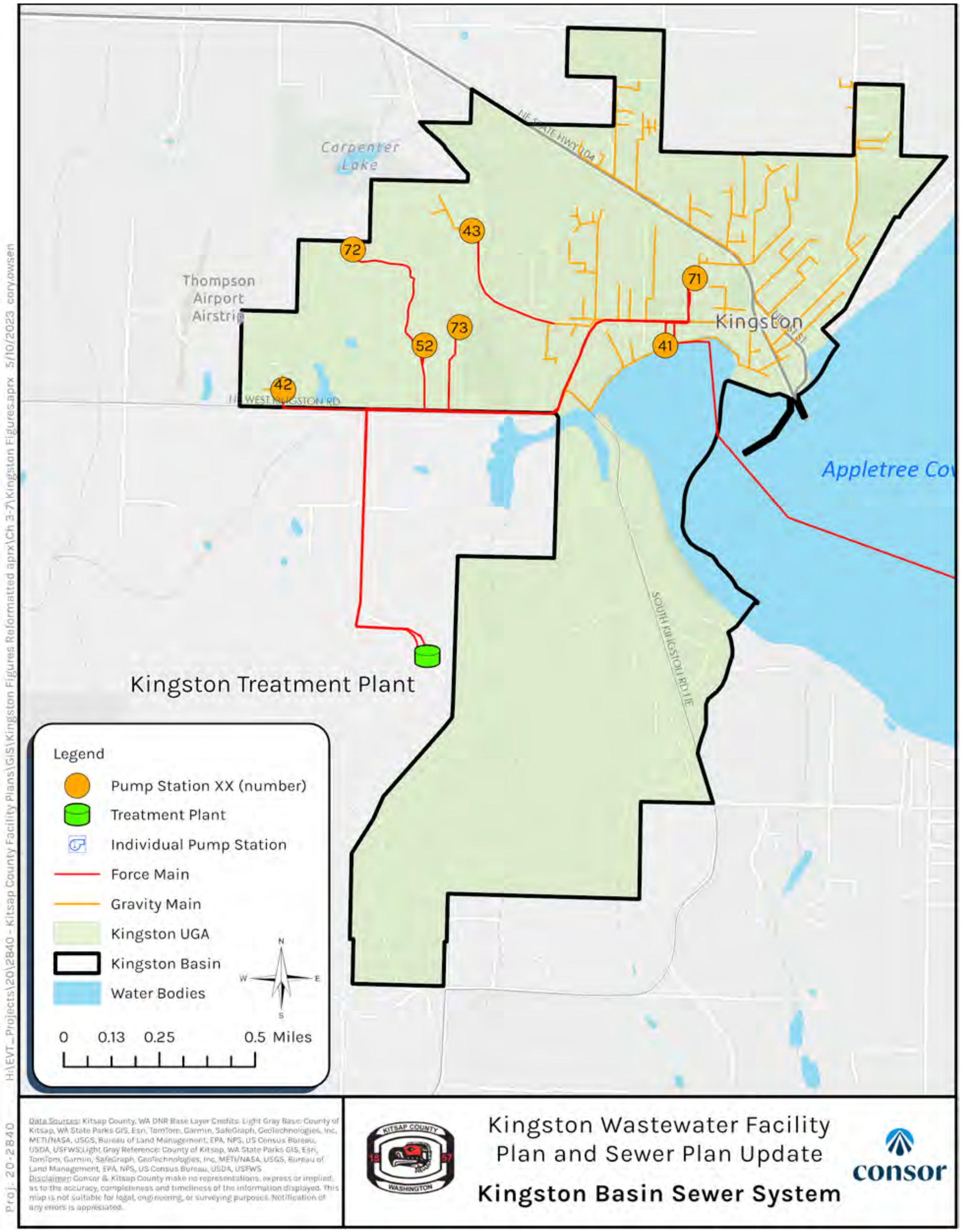
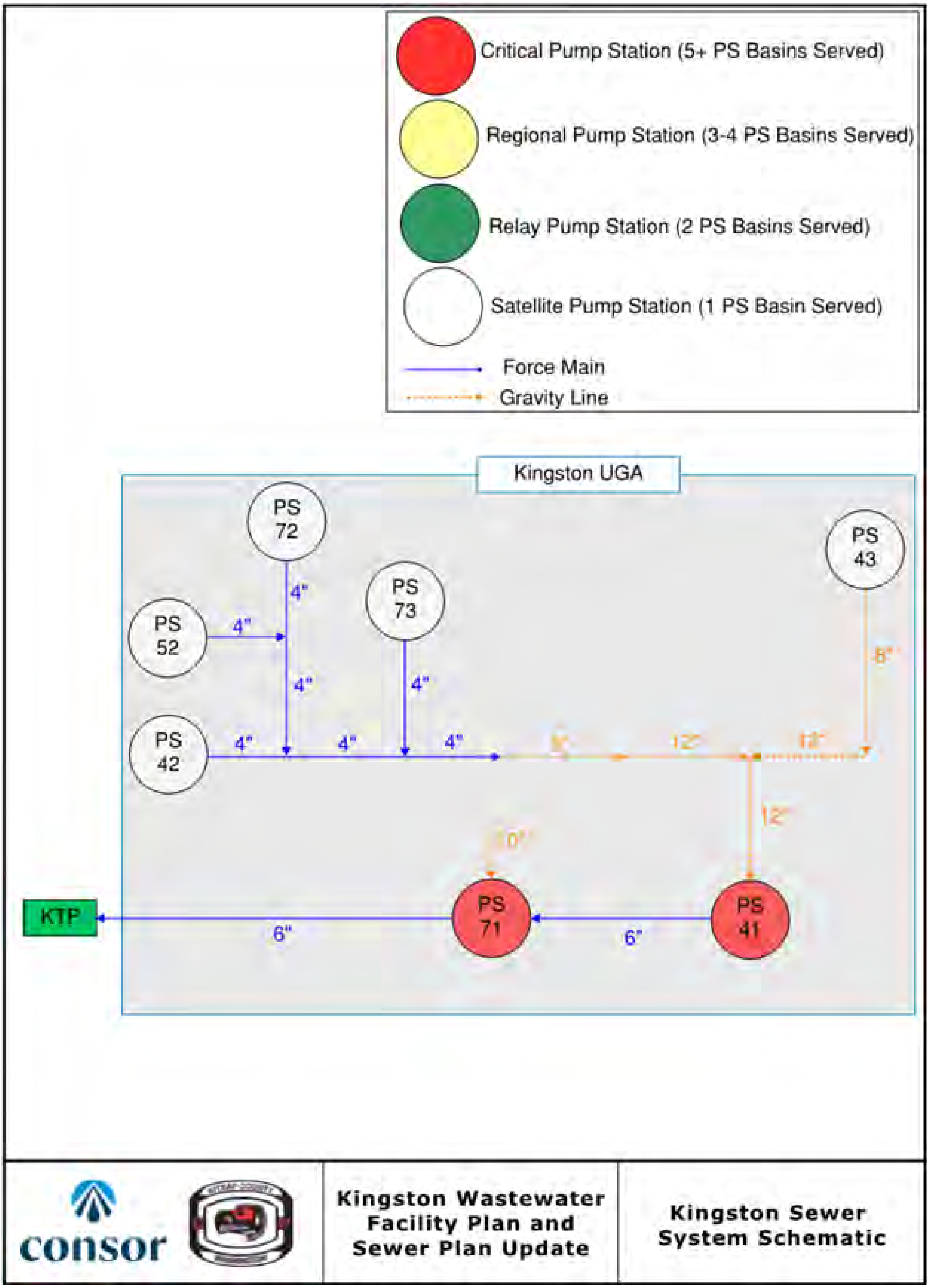


Figure 10-3 | Kingston Sewer System Schematic



The County performs pipe cleaning/jetting and CCTV inspection in-house. Reasons for inspection include routinely scheduled inspections, warranty inspections, new construction inspections and other special project inspections. The system is jetted prior to inspections to improve visibility by removing grease, roots by foaming, sand, grit, and debris, helping reduce blockages and odor issues.

The County process consists of inspecting pipes via CCTV, storing the video in a database, reviewing the video, and assigning an OCI score based on the observations. Pipe condition is evaluated based on operator experience and flagged for further investigation if needed. The County does not currently use a condition rating system such as the National Association of Sewer Service Companies (NASSCO) standards to evaluate and record observed conditions. It is recommended that the County consider having CCTV operators trained and certified in NASSCO assessment to improve the consistency of sewer inspecting rating.

The results of these assessments have been stored in their asset management database software Cartegraph since 2017. The County has a target metric to complete inspection of all pipes in the system on a five-year cycle (approximately 20 percent of the pipes inspected each year). According to Standard Operating Procedure, in addition to CCTV every five years, flushing is performed annually unless identified as a hot spot and frequency is then location dependent. At the time of this writing, all of the pipes have been inspected and an evaluation has been stored in Cartegraph.

The force mains and siphons are cleaned when needed. The County's force mains are designed to achieve scouring velocities that self-clean under normal system operation. If pipe conditions allow, pigging is performed annually. Destructive testing is only performed when lines are suspected of failure.

The Kingston WWTP outfall is inspected by divers following the procedures required by the NPDES permit.

10.5.4 Pretreatment Program

The County is required by the NPDES permit to enact a pretreatment program to ensure all commercial and industrial customers comply with the pretreatment regulations in 40 CFP Part 403 through 471. The program is required to take continuous and routine measures to identify all existing, new, and proposed significant industrial users. The County does not have any significant industrial users within the Kingston service area. Refer to **Section 4** for more information.

10.5.5 Odor and Corrosion Control Program

The County has several calcium nitrate (Bioxide™) solution dosing systems in the collection system to remove and prevent formation of hydrogen sulfide. The systems are located upstream of areas where odor complaints are common. These systems are set to dose automatically and are not connected to SCADA. Operators visit each system regularly to check on operation and refill on-site solution containers.

The County also utilizes hypochlorite dosing, charcoal filters, and organic biofilters at specific stations. Uses are prescribed based upon individual pump station characteristics.

10.5.6 Fats, Oils, and Grease Program

County Code 13.12.160 prohibits discharge of pollutants that will cause obstructions in the County sewer system. Businesses producing fats, oils, and grease (FOG) are required to have and maintain a grease removal system. Depending on the type and size of business, this may be a small grease trap maintained by employees or a large oil/water interceptor that is pumped out regularly by a permitted waste hauler.

The County accepts hauled FOG waste at the Central Kitsap WWTP and is currently designing a dedicated FOG receiving station to improve ease of disposal for FOG haulers.

The County is considering implementing code through the use of inspection, enforcement, or other financial penalties to ensure FOG compliance.

10.6 WWTP Operations and Maintenance Activities

10.6.1 Preventative Maintenance

The County maintains the Kingston WWTP to keep critical components in good operating condition. This includes inspecting machinery, cleaning tanks, and maintaining equipment. Maintenance is performed in accordance with the manufacturer's recommendations during the warranty period for equipment and maintenance intervals are adjusted based on operator experience after the warranty period expires. Spare parts for all equipment are tracked in the CMMS with critical spare parts identified. Key parts are kept on hand in instances where the part cannot be readily obtained from local suppliers.

It is recommended that the County develop a valve exercise program to minimize issues with infrequently used valves seizing as they age, and also review spare parts inventories and assess the need for additional spare parts due to supply chain challenges.

10.6.2 Laboratory Operation and Accreditation

The County maintains an accredited laboratory at the Central Kitsap WWTP (W660-21A) to provide analysis of a broad range of water quality parameters including those for reporting or permit monitoring data. The laboratory at the Kingston WWTP is not certified, so samples required for reporting purposes are analyzed at the Central Kitsap WWTP lab. The County must maintain accreditation in accordance with WAC 173-50. Ecology's *Procedural Manual for the Environmental Laboratory Accreditation Program* provides details on requirements, fees, recommended practices, proficiency testing, and audit procedures.

In addition to completing water quality testing, the laboratory is responsible for recalibrating and maintaining process probes and mobile testing instruments.

10.7 Sewer Collection System Staffing Needs

The County operates and maintains all four of their sewer basins as a single utility, and all sewer collection staff work in all the basins. A comparison of County sewer collection operations staff with similar utilities in the area is shown in **Table 10-2**. The County numbers reflect all County owned sewer collection and conveyance facilities from all County basins. The County has slightly less staff per mile of pipe, and fewer staff per pump station than the average of the other utilities.

Table 10-2 | Sewer System Staffing Comparison

Agency	Personnel (FTE)	Miles of Pipe	Personnel per Mile of Pipe	No. of Pump Stations	Personnel per Pump Station
Kitsap County	18	215[1]	0.09	64[2]	0.3
City of Bellevue	25	520	0.05	36	0.7
City of Enumclaw	4	142	0.03	7	0.6
City of Kent	13	211	0.06	7	1.8
City of Kirkland	24	123	0.19	6	4.0

Agency	Personnel (FTE)	Miles of Pipe	Personnel per Mile of Pipe	No. of Pump Stations	Personnel per Pump Station
City of Lacey	14	236	0.06	48	0.3
City of Port Orchard	6.5	75	0.09	21	0.3
Silver Lake Water and Sewer District	33	207	0.16	22	1.5
West Sound Utility District	15	45	0.33	12	1.3
Alderwood Water and Wastewater District	11	440	0.03	12	0.9
Average			**0.11**		**1.25**

Notes:

1. Total miles of gravity sewer pipe and force main pipe in Central Kitsap, Kingston, Manchester, Suquamish, and Navy Yard City, provided by the County's sewer asset count in 2024.
2. Number of pump stations in Central Kitsap, Kingston, Manchester, Suquamish, and Navy Yard City.

10.8 WWTP Staffing Needs

Kingston WWTP is classified by Ecology as a Class II facility, therefore, the operator in responsible charge must have a Group II operator certification. Additionally, a Group I operator must be in charge during all regularly scheduled shifts. Kingston WWTP shares the operators with the other three WWTPs. Operator certification of all four WWTPs is shown in **Table 10-3**. In addition to the plant operators, there are 5 laboratory staff who are required to obtain an operator certification within two years of being hired.

Table 10-3 | Operator Certifications

Operations Certification	Number of Staff
Operator in Training	0
Group I	4
Group II	5
Group III	3
Group IV	4
TOTAL	**16**

Current staffing at Kingston WWTP facility consists of one Lead Plant Operator specifically assigned to Kingston and one Plant Operations Supervisor and two Rover Plant Operators who oversee operations at Suquamish WWTP, Manchester WWTP and Kingston WWTP. Thus, the total full-time equivalent (FTE) for Kingston is approximately 2.0, with 1.0 FTE by the Lead Plant Operator and 1/3 FTE each by the Plant Operations Supervisor and Rover Plant Operators. During off hours, critical SCADA alarms from the plant are configured to ring through to an on-call operator. Maintenance at Kingston WWTP is conducted by the Sewer Utility O&M group which is shared across all of the County's WWTPs and collection and conveyance systems.

As flows and loads increase at the facility and as improvements are undertaken, staffing levels may change. **Table 10-4** identifies potential staffing needs at existing and future planning horizon based on *Estimating Staffing for Municipal Wastewater Treatment Facilities* (EPA, 1973) and *The Northeast Guide for Estimating Staffing at Publicly and Privately-Owned Wastewater Treatment Plants* (New England Interstate Water Pollution Control Commission, Nov 2008). These estimates include supervisory, administrative, clerical, laboratory, yard work, site maintenance, and unit process O&M. All methods assume 1,500 working hours per employee after holidays, time off, training, etc. These estimates are intended to be guidelines only;

specific staffing levels must be determined by the County and reviewed regularly to adequately operate and maintain the facility.

Table 10-4 | Kingston WWTP Staffing Comparison and Projection

Condition	Average Annual Flow (MGD)	Current Staffing	EPA Method Staffing[1]	Northeast Guide Method Staffing
Staff at 2020 *(additional staff needed)*	0.11	2.00	1.02 *(0)*	2.57 *(0.57)*
Staff at 2042[2] *(additional staff needed)*	0.27	-	0.85 *(0)*	2.41 *(0.41)*

Notes:

1. The minimum plant capacity covered in the EPA Method is 0.5 MGD, therefore a flow of 0.5 MGD was used as the basis for staffing determinations.
2. Staff required in 2042 is lower for both methods due to the replacement of aging equipment and improved automation and controls as recommended in the CIP.

Based on both the EPA and Northeast Guide methods, the County's current approach of having one dedicated staff person for Kingston with one additional FTE of shared support staff appears to be appropriate and adequate for current operations. There is a deficiency in staff using the Northeast Guide method. It is expected that if some additional effort is required it can be covered with assistance from other operating staff on an as-needed basis. There is little expected increase in flows and improvements at the plant are expected to improve staff efficiency, so no additional staff is expected to be required though the 20-year planning period. It is recommended that the County continue executing the Sewer Utility Plant Operator Qualification Program and additional external classroom training to accelerate employees into Operator Certification Group III and prepare for anticipated Puget Sound Nutrient Reduction Goals and facility upgrades.

10.9 Conclusions and Recommendations

Conclusions and recommendations based on a review of the County O&M practices are:

- Consider having CCTV operators trained and certified in NASSCO assessment to improve the consistency of sewer inspecting rating.
- Consider reviewing spare parts inventories and assessing the need for additional spare parts due to supply chain challenges.
- Institute and annual valve exercise and maintenance program.
- Consider developing additional classroom training to accelerate employees into Operator Certification Group III and prepare for anticipated Puget Sound Nutrient Reduction Goals and facility upgrades.
- Institute an Arc Flash Analysis and Protection program to identify deficiencies that can be mitigated through coordinated CIP projects.

SECTION 11

Capital Improvement Plan

11.1 Introduction

This section identifies CIP projects and O&M projects for the Kingston collection system and WWTP. These improvements are required to remedy deficiencies identified in Section 5, Section 6, Section 7, Section 8, and to implement a recycled water program as described in Section 9.

11.2 Capital Improvement Plan Criteria

CIPs are presented on a 6-year basis from 2023 to 2028 for immediate needs; and, for the 20-year planning horizon (from 2029 to 2042) for improvements that are anticipated but not pressing. A planning level cost opinion and a preliminary timeline of CIP project implementation is provided. It is assumed that minor projects will be completed with O&M budget and are listed separately. The methodologies for funding the CIP projects will be discussed in Section 12.

The Asset Health Scores discussed in Section 5 and Section 6 were used to identify the most critical projects across the County's system based on asset condition and the CoF. The CIP projects were prioritized based on the Asset Health Scores and factors including the extent and type of deficiency, customers impacted, environmental impacts, and capital and O&M costs.

In conjunction with the facility planning effort, the County has been working on a series of SCADA Master Plan technical memoranda which include project identification, estimates, and capital improvement planning in Technical Memorandum No. 5. SCADA system improvements are not incorporated into this CIP because they are generally implemented across the entire sewer division, and not specifically to process improvements at the Kingston WWTP. SCADA improvements were also included in a separate CIP.

Drivers of improvements are considered for five categories:

1. Capacity: An asset no longer has sufficient capacity when it cannot or is modeled in the future to not be able to meet the equipment, hydraulic, or process capacity requirements, as detailed in Section 6 for the WWTP and Section 7 for the collection and conveyance system. The proposed firm capacity for pump stations is determined through H/H model simulations considering increased population for the 2042 planning horizon and a 25-year storm event. Capacity driven improvements are assigned the maximum asset health score of 25 as these projects are considered the most critical. Capacities are defined as follows:

    a. A gravity sewer pipe no longer has sufficient capacity when the flow in the pipe is greater than or equal to 80 percent of pipe flowing full ($d/D \geq 0.8$).

    b. A force main no longer has sufficient capacity when the velocity in the pipe is greater than 7 feet per second.

    c. A pump station is over capacity if the largest pump is out of service and the remaining pump(s) is (are) unable keep up with the inflow.

   d. An equipment/treatment process no longer meets the equipment, hydraulic, or process capacity requirements, discussed in detail in **Section 6**.

2. O&M: County staff indicate the asset requires excessive maintenance, using valuable time and money. O&M issues are primarily driven by condition. The project goal will be to improve reliability and reduce maintenance call outs.

3. Obsolescence: The asset is reaching the end of its service life. Life expectancy of piping, structures, and mechanical/electrical equipment varies depending on the treatment processes and is discussed in **Section 6**. For the collection system, life expectancy of pipes are 100 years, structures are 50 years, and mechanical/electrical equipment is 25 years.

4. Developer: A new development in the County necessitates new or upgraded infrastructure that would not be needed by the existing customers and would be funded and constructed by a developer.

5. Regulatory: Regulatory projects will address facilities that are currently out of compliance or expected to become incompliant with existing, pending, or anticipated regulations set by the State and Federal agencies, such as Ecology or the EPA.

Projects for the County's sewer systems are identified with a code that identifies the basin, system, driver of improvements, and a project number using the following identifiers (note that basin identifiers are used as General Sewer Plan Updates for the three other service areas are being completed concurrent to this Plan):

- Project Category:
  - Capital Improvement Plan = CIP
  - Operation and Maintenance = O&M
- Basin Abbreviations:
  - Central = CK
  - Kingston = K
  - Suquamish = S
  - Manchester = M
- System:
  - Collection and Conveyance = CC
  - Wastewater Treatment Plant = WWTP
- Driver:
  - Capacity = CAP
  - Op and Maintenance = OM
  - Obsolescence = OB
  - Developer = DEV
  - Regulatory = REG

AACE International Class 5 OPPCs with an anticipated accuracy range of -50 percent to +100 percent were developed using RSMeans Heavy Construction Cost Data, recent County project bid tabs, County input, industry experience, and local contractor and supplier costs. The total project costs include construction costs for work and materials plus markups for mobilization, general contractor markups, overhead and profit, taxes, and a construction contingency of 50 percent plus an additional markup of 50 percent for engineering, legal, administration costs, and construction management associated with project delivery. The OPPCs were developed in 2023 dollars.

There is a five-year moratorium on pavement excavation and trenching following the completion of a new road or road overlay. This requirement restricts all road trenching except in the event of an emergency repair or if all trenching is outside of the paved area. Projects should be coordinated with road paving projects to avoid this moratorium and reduce paving costs.

11.3 Kingston Collection and Conveyance System Improvements

The collection and conveyance system includes pump stations, force mains, and gravity sewers. Proposed CIP projects address identified deficiencies for these assets. Projects are frequently combined for efficient project delivery. The projects components are broken down into pump stations, which include force mains, and pipeline projects, which include gravity sewers.

11.3.1 Recently Completed and Ongoing Kingston Collection and Conveyance CIP

There are no known current capital projects in the Kingston collection and conveyance system at the time of this writing.

11.3.2 6-Year Collection and Conveyance CIP (2023 to 2028)

Each of the projects identified for the Kingston collection and conveyance system 6-year CIP are summarized in **Table 11-1**. The location of the 6-year CIPs are shown in **Figure 11-1.** The conveyance sizes and PS firm capacities were determined considering increased population for the 2042 planning horizon and a 25-year storm event. A CIP is also included for annual gravity main replacement due to aging infrastructure or other unforeseen system needs. See OPPCs for individual projects in **Appendix J** for more detail.

11.3.2.1 CIP-K-CC-CAP-1 – Replace PS-41 and Forcemain

This project will replace the existing PS-41 and forcemain that connects this station to PS-71. It Is projected that wet weather flows to this station during a 25-year storm will exceed the exiting firm capacity within the near-term planning horizon. The existing station is near the shoreline at the south end of a private drive south of NE West Kingston Rd between Dulay Road NE and Lindvog Rd NE and is proposed to remain in this location. The station was originally constructed in 1974, making it the oldest station in the Kington area. This CIP is primarily driven by capacity, however, this station also had the highest (e.g. poorest rated) Asset Health Score based on condition assessment of the seven stations in the basin. The proposed firm capacity is determined through H/H model simulations for the 2042 planning horizon and a 25-year storm event. See **Table 11-1** for project details.

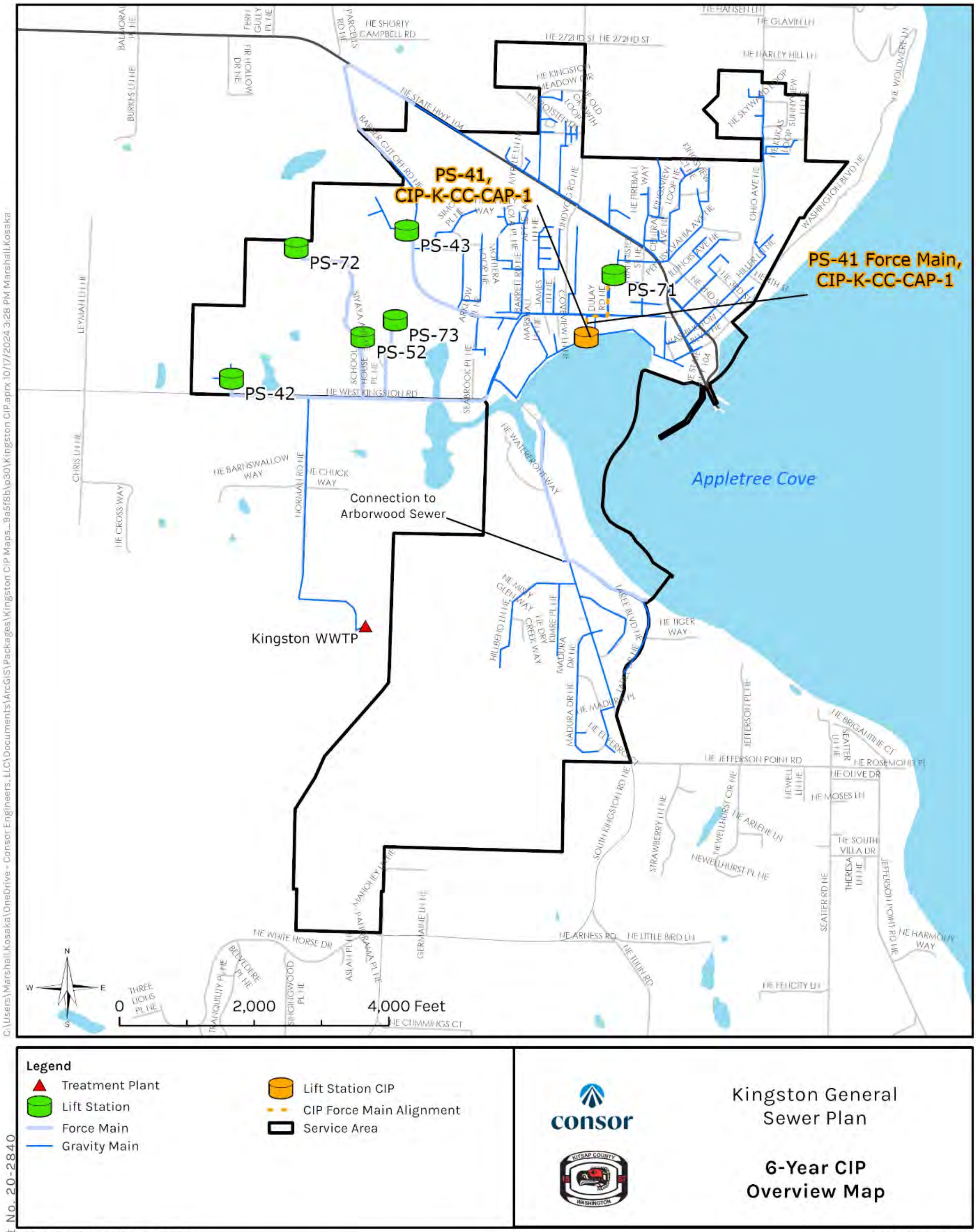
Table 11-1 | 6-Year Kingston Collection and Conveyance Capital Improvement Projects

CIP No	Asset Health Score	Project Name	Replacement[1]	Upgrade[2]	Capacity Increase[3]	Total Project Cost	Project Description
CIP-K-CC-CAP-1	25.0[4]	Replace PS-41 and Forcemain	X			$3,700,000	➢ Replace the pump station to increase firm capacity to 630 gpm ➢ Construct new wet well ➢ Construct new valve vault ➢ Construct new electrical, instrumentation, and controls equipment under a new canopy ➢ Construct new diesel generator set with Level 2 sound attenuating enclosure ➢ Replace 1,400 LF forcemain with 8-inch diameter pipe. Station upgrade will trigger forcemain replacement.
					TOTAL	**$3,700,000**	

Notes:

1. Replacement projects will construct a new facility.
2. Upgrade projects will replace components of the facility.
3. Capacity Increase projects will increase hydraulic capacity and can include system expansion.
4. An Asset Health Score of 25 has been assigned to this project overriding the condition assessment asset health score. PS-41 previously had an asset health score of 16.0.
5. An asset health score of 20 was selected to prioritize projects on an annual basis.

Figure 11-1 | 6-year Collection and Conveyance CIP (2023-2028)



Data Sources: Kitsap County, WA DNR.
Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Disclaimer: Consor and Kitsap County make no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes. Notification of any errors is appreciated.

11.3.3 20-Year Kingston Collection and Conveyance CIP (2029 to 2042)

Each of the projects identified for the Kingston collection and conveyance system 20-year CIP are summarized in **Table 11-2**. These projects are related to system expansion to new development or septic conversion. It is assumed that developer projects will be significantly funded by the developer and will be excluded from the financial analysis. The conveyance sizes and LS firm capacities were sized considering increased population for the 2042 planning horizon and a 25-year storm event. The location of the 20-year CIPs are shown in **Figure 11-2**. See OPPCs for individual projects in **Appendix J** for more detail.

11.3.3.1 CIP-K-CC-CAP-2 – Upgrade PS-71 and Replace Forcemain

This project will increase the pumping capacity of PS-71 and replace the existing forcemain that connects this station to the Kingston WWTP. It is projected that wet weather flows to the station during a 25-year storm will exceed the existing firm capacity in the near-term planning horizon. Forcemain replacement is required with increased pumping capacity in the near term. The existing station is located at the old treatment plant site on Dulay Road NE just north of the Village Green Community Center. The station was constructed in 2002 and is in relatively good condition based on the results of the condition assessment presented in **Section 5**. The proposed firm capacity is determined through H/H model simulations for the 2042 planning horizon and a 25-year storm event. See **Table 11-2** for project details.

*If funding becomes available, this project should be considered in the 6-year CIP.

11.3.3.2 CIP-K-CC-DEV-4 - Arness Pump Station and Conveyance

This project will include constructing new gravity sewer, a new PS, and associated forcemain in the Arness area in the south Kingston sewer service area. Development in this area or septic conversion will trigger the need for this project. The proposed Arness PS will discharge to the Arborwood development currently planned (portions are currently under construction). The proposed firm capacity and gravity main sizing is determined through H/H model simulations for the 2042 planning horizon and a 25-year storm event. It is assumed that this project would be funded by development. See **Table 11-2** for project details.

11.3.3.3 CIP-K-CC-DEV-5 – Highway 104 Pump Station and Conveyance

This project will include constructing new gravity sewer, a new PS, and associated forcemain near Highway 104 in the northeast Kingston sewer service area. Development in this area or septic conversion will trigger the need for this project. The proposed Highway 104 PS will discharge to the existing collection system tributary to PS-41. The proposed firm capacity and gravity main sizing is determined through H/H model simulations for the 2042 planning horizon and a 25-year storm event. It is assumed that this project would be funded by development. See **Table 11-2** for project details.

11.3.3.4 CIP-K-CC-DEV-6 - Taree Pump Station and Conveyance

This project will include constructing new gravity sewer, a new PS, and associated forcemain in the Taree area in the south Kingston sewer service area. Development in this area or septic conversion will trigger the need for this project. The proposed Taree PS will discharge to the Arborwood development currently planned (portions are currently under construction). The proposed firm capacity and gravity main sizing is determined through H/H model simulations for the 2042 planning horizon and a 25-year storm event. It is assumed that this project would be funded by development. See **Table 11-2** for project details.

11.3.3.5 CIP-K-CC-DEV-7 – Extend Gravity Sewers Flowing to PS-41

This project will include installing additional gravity sewers tributary to PS-41. Development in this area or septic conversion will trigger the need for this project. The proposed gravity main sizing is determined through H/H model simulations for the 2042 planning horizon and a 25-year storm event. It is assumed that this project would be funded by development. See **Table 11-2** for project details.

11.3.3.6 CIP-K-CC-DEV-8 - Extend Gravity Sewers Flowing to PS-43

This project will include installing additional gravity sewers tributary to PS-43. Development in this area or septic conversion will trigger the need for this project. The proposed gravity main sizing is determined through H/H model simulations for the 2042 planning horizon and a 25-year storm event. It is assumed that this project would be funded by development. See **Table 11-2** for project details.

11.3.3.7 CIP-K-CC-DEV-9 - Extend Gravity Sewers Flowing to Arborwood

This project will include installing additional gravity sewers tributary to the Arborwood sewer system. Development in this area or septic conversion will trigger the need for this project. The proposed gravity main sizing is determined through H/H model simulations for the 2042 planning horizon and a 25-year storm event. It is assumed that this project would be funded by development. See **Table 11-2** for project details.

11.3.3.8 CIP-K-CC-OM-10 – Annual Pipe Replacement.

This project will be an annual program that the County will develop to provide ongoing funding to replace aging and deficient pipes not identified in other capital improvement projects. These pipes may include deficiencies related to root intrusion, high rates of I&I, deflected joints, cracked pipes, insufficient slopes, and high rates of O&M call outs. It assumes that half of one percent of the pipe in the Kingston basin would be replaced each year. See **Table 11-2** for project details.

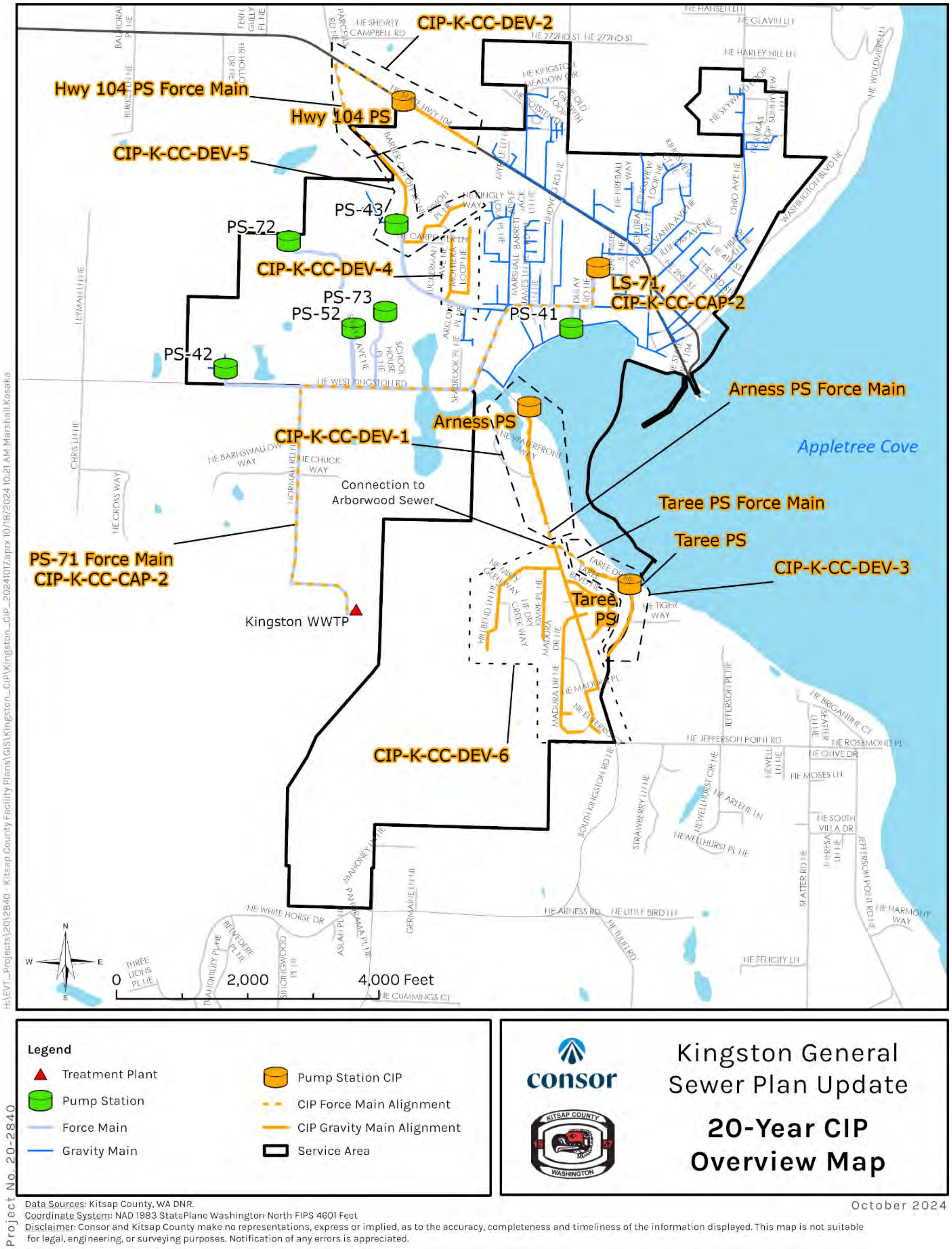
Table 11-2 | 20-Year Kingston Collection and Conveyance Capital Improvement Projects

CIP No	Asset Health Score	Item	Replacement[1]	Upgrade[2]	Capacity Increase[3]	Total Project Cost	Project Description
CIP-K-CC-CAP-2[6]	25.0[7]	Upgrade PS-71 and Replace Forcemain	X			$7,400,000	➢ Upgrade station to increase pump capacity of LS-71 to 790 gpm ➢ Replace pumps ➢ Replace electrical, instrumentation, and control equipment ➢ Replace 9,500 LF forcemain with 8-inch diameter pipe. Station upgrade will trigger forcemain replacement
CIP-K-CC-DEV-4	n/a[4]	Arness Pump Station and Conveyance			X	$0	➢ Construct 1,850 LF of new 8-inch diameter gravity sewer. ➢ Construct new 20 gpm PS and 2,200 LF associated 4-inch diameter forcemain. ➢ Project would discharge to the infrastructure being planned as part of the Arborwood development (portions currently under construction). ➢ Project expected to be paid for by developers. Estimated project cost is $5,700,000.
CIP-K-CC-DEV-5	n/a[4]	Highway 104 Pump Station and Conveyance			X	$0	➢ Construct 1,300 LF of new 8-inch diameter gravity sewer. ➢ Construct new 61 gpm PS and 2,800 LF associated 4-inch diameter forcemain. ➢ Project would expand the area served by PS-41 ➢ Project expected to be paid for by developers. Estimated project cost is $5,000,000.
CIP-K-CC-DEV-6	n/a[4]	Taree Pump Station and Conveyance			X	$0	➢ Construct 1,830 LF of new 8-inch diameter gravity sewer ➢ Construct new 26 gpm PS and 1,300 LF associated 4-inch diameter forcemain. ➢ Project would discharge to the infrastructure being planned as part of the Arborwood development (portions currently under construction). ➢ Project expected to be paid for by developers. Estimated project cost is $6,100,000.
CIP-K-CC-DEV-7	n/a[4]	Extend Gravity Sewer Flowing to PS-41			X	$0	➢ Construct 2,540 LF of new 8-inch diameter gravity sewers to expand the area served by PS-41 ➢ Project expected to be paid for by developers. Estimated project cost is $3,800,000.
CIP-K-CC-DEV-8	n/a[4]	Extend Gravity Sewer Flowing to PS-43			X	$0	➢ Construct 2,500 LF of new 8-inch diameter gravity sewers to expand the area served by PS-43 ➢ Project expected to be paid for by developers. Estimated project cost is $4,400,000.
CIP-K-CC-DEV-9	n/a[4]	Extend Gravity Sewers Flowing to Arborwood			X	$0	➢ Construct 10,140 LF of new 8-inch diameter gravity sewers. ➢ Project would discharge to the infrastructure being planned as part of the Arborwood development (portions currently under construction). ➢ Project expected to be paid for by developers. Estimated project cost is $15,900,000.
CIP-K-CC-OM-10	20[5]	Annual Pipe Replacement			X	$14,000,000	➢ Replace deteriorated and aging pipe. ➢ Project costs assume $1,000,000 per year totaled over 14 years (CIP years 7-20). ➢ Replacement assumes 0.5 percent of total system (225 LF) is replaced per year.
					TOTAL	$21,400,000	

Notes:

1. Replacement projects will construct a new facility.
2. Upgrade projects will replace components of the facility.
3. Capacity Increase projects will increase hydraulic capacity and can include system expansion.
4. Asset health score is not applicable for these projects that are development driven and do not exist.
5. An asset health score of 20 was selected to prioritize projects on an annual basis.
6. If funding becomes available, this project should be considered in the 6-year CIP.
7. An Asset Health Score of 25 has been assigned to this project overriding the condition assessment asset health score. PS-71 had an asset health score of 8.5.

Figure 11-2 | 20-year Collection and Conveyance CIP (2029-2042)



Data Sources: Kitsap County, WA DNR.
Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Disclaimer: Consor and Kitsap County make no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, or surveying purposes. Notification of any errors is appreciated.

11.4 Kingston WWTP Improvements

The Kingston WWTP has an oxidation ditch (extended aeration) type activated sludge that works well and can continue to provide treatment through the 20-year planning period. Much of the plant was installed or upgraded in 2005. Some additional repairs, replacements, and improvements will be required to ensure continuing operation. Additionally, implementation of the PSNGP has added additional TIN removal optimization requirements, which will require some upgrades to the secondary treatment process.

11.4.1 Kingston WWTP Alternatives Analysis

The alternatives analysis in **Section 8** evaluated different treatment technologies for key processes and recommended UV disinfection system upgrades. In addition, several minor maintenance, repairs, and direct replacements are identified in **Section 6** and will be required to keep the Kingston WWTP operating reliably over the next 20 years. The urgency of each of these projects has been assessed to develop a project list of short-term CIP projects that should be addressed in the next 6-years and a long-term project list for those CIP projects that are not urgent but will need to be executed later in the 20-year planning period. The remaining projects that can be completed by the plant staff are categorized as O&M projects. These project lists, project descriptions, and costs are presented in the sections that follow.

11.4.2 Recently Completed and Ongoing Kingston WWTP CIP

There are no known current capital projects at the Kingston WWTP at the time of this writing.

11.4.3 6-Year Kingston WWTP CIP (2023 to 2028)

There are no projects at Kingston WWTP for the 6-year CIP. If funding becomes available, projects identified for potential near term implementation in previous Plan sections should be considered in the 6-year CIP.

11.4.4 20-Year Kingston WWTP CIP (2029 to 2042)

Each of the projects for the 20-year CIP are described below and are summarized in **Table 11-3**. See OPPCs for individual projects in **Appendix J** for more detail.

11.4.4.1 CIP- K-WWTP-OB-1: Replace UV System

The existing UV system is approaching the end of its expected lifespan. Various alternatives for replacement were analyzed in **Section 8** and replacement with the Trojan UV3000Plus was selected as the preferred alternative. Replacing the UV system with this upgraded model will provide a system with advanced monitoring and control functionality which will reduce operating costs and O&M requirements.

*If funding becomes available, this project should be considered in the 6-year CIP.

11.4.4.2 CIP- K-WWTP-REG-2: Nitrogen Optimization Improvements:

Kingston currently has one set of DO and ORP probes that are manually moved between the two oxidation ditches depending on which one is in operation. Adding and additional DO probe will eliminate the need to move the probes between basins, and adding a ammonia-nitrate probes will provide direct measurement of nitrogen to assist in TIN optimization as required to meet permit requirements. As noted in **Section 8**, Kingston WWTP is expected to be capable of achieving TIN of less than 7 mg/L throughout the 20-year planning horizon if optimization upgrades are implemented.

11.4.4.3 CIP-K-WWTP-REG-3: Class A Reclaimed Water Improvements:

Section 9 introduces the benefits of recycled water and the following required upgrades to Kingston WWTP to produce Class A reclaimed water for the purpose of irrigation and infiltration uses. This project will reduce effluent TIN loading at the WWTP outfall by providing an alternative end use and can be implemented if TIN treatment requirements become more restrictive. This project will include the following elements:

- A secondary effluent equalization tank
- A filter feed pump station
- Tertiary filtration
- UV disinfection, followed by chlorination
- A recycled water pump station
- A recycled water pipeline

11.4.4.4 CIP-K-WWTP-OB-4: Replace Clarifier Drives:

The secondary clarifier drive equipment is expected to reach the end of their service life towards the end of 20-year planning horizon. This project will replace the drives, collection mechanisms, walkway and platform, and weirs with new equipment.

Table 11-3 | 20-Year Kingston WWTP Capital Improvement Projects

CIP No	Asset Health Score	Item	Replacement[1]	Upgrade[2]	Capacity[3]	Total Project Cost	Project Description
CIP-K-WWTP-OB-1[4]	7.2	Replace UV System		X		$880,000	➢ Replace obsolete UV system with new, more advanced model to reduce operating cost and O&M requirements
CIP-K-WWTP-REG-2[5]	6.5	Nitrogen Optimization Improvements		X		$99,000	➢ Project will improve TIN monitoring and control to ensure effluent TIN can be consistently reduced to below 10 mg/L ➢ Install additional DO probe ➢ Install ammonia and nitrate probes in each basin
CIP-K-WWTP-REG-3	6.6	Reclaimed Water Improvements		X		$13,660,000	➢ Use reclaimed water for irrigation at WHGC and indirect groundwater recharge at North Kitsap Heritage Park ➢ Construct secondary effluent equalization tank ➢ Construct filter feed station and tertiary filtration ➢ Add additional UV disinfection ➢ Construct recycled water pump station and pipeline ➢ Implement CIP-K-WWTP-CAP-3 if not already completed ➢ Project will reduce effluent TIN loading at the WWTP outfall by providing an alternative end use.
CIP-K-WWTP-OB-4	6.5	Replace Clarifier Drives		X		$480,000	➢ Replace secondary clarifier drives, collection mechanism, walkway, platform, and weirs
					Total	**$15,120,000**	

Notes:

1. Replacement projects will construct a new facility.
2. Upgrade projects will replace components of the facility.
3. Capacity Increase projects will increase hydraulic capacity.
4. If funding becomes available, this project should be considered in the 6-year CIP.
5. Future nutrient requirements and timing are unknown. Based on the current permit cycle for the PSNGP, it is assumed that effluent TIN restrictions to values below 10 mg/L will not be implemented until 2031 at the earliest.

11.4.5 O&M Projects

Each of the O&M projects are summarized in **Table 11-4**. Costs and drivers of improvements are not included for O&M projects since these are relatively minor projects implemented by County staff and not included in the CIP budget.

Table 11-4 | O&M Projects

O&M Project No	Asset Health Score	Item	Project Description
O&M-K-WWTP-1	5.4	Grit Classifier Recoating	➢ Repaint the corroded areas of grit cyclone and classifier to mitigate further corrosion and odor problems.
O&M-K-WWTP-2	6.5	Secondary Clarifier Cleaning, Coating, and Re-caulking	➢ Replace weir caulking, clean and coat the corroded areas to prevent further degradation.
O&M-K-WWTP-3	6.6	Replace GBT Fire Alarm and WAS/TWAS LEL Sensors	➢ Repair the Was/TWAS lower explosive limit sensors and replace the GBT room fire alarm system to improve safety.
O&M-K-WWTP-4	6.0	Rebalance GBT Room HVAC and Repaint GBT Room Mechanical Equipment	➢ Test and rebalance the GBT room HVAC system to provide better ventilation. ➢ Testing may determine that new equipment is required. ➢ Once the HVAC system is functioning better, equipment should be cleaned and repainted where paint is chipped or missing to prevent further corrosion.
O&M-K-WWTP-5	6.6	Monitor W2 Overflow	➢ Clean the exterior of the air gap tank and install an overflow logger to monitor the overflow and prevent corrosion around the base of the tank.
O&M-K-WWTP-6	6.6	Replace W3 Pump P-902 Casing Gasket	➢ Clean and recoat the corroded areas of P-902 and replace the casing gasket to prevent further degradation.
O&M-K-WWTP-7	10.0	Replace AFDs and Complete Control Panels Housekeeping	➢ Verify back-up copies of PLC and OIT programs for CP-300. A migration/replacement plan for OIT in CP-300 will be developed and executed if it is not functional. ➢ Verify the existence of the controller (PLC) in panels LP-GBT and LP-TLP and develop and implement a migration/replacement plan if the controller is outdated. ➢ Clean and inspect the scum pump local control panel and identify and correct the source of the water infiltration to prevent future corrosion. ➢ Replace the AFD's in MCC-01 with a newer model provided by a similar manufacturer to ensure it is functional if/when needed.
O&M-K-WWTP-8	10.0	Complete WWTP Arc Flash Study	➢ Complete arc flash study and install signage as needed ➢ May be combined with similar projects at other WWTPs
O&M-K-CC-1	6.4	Miscellaneous LS Improvements	➢ Minor improvements to LS-42: relocate junction box to comply with NFPA 820, install new canopy ➢ Minor improvements to LS-43: replace electrical enclosures, new canopy ➢ Minor improvements to LS-52: relocate junction box to comply with NFPA 820, new canopy ➢ Minor improvements to LS-72: install cable hooks inside wet well and reroute electrical cables, new canopy

11.5 Wastewater System 20-Year CIP

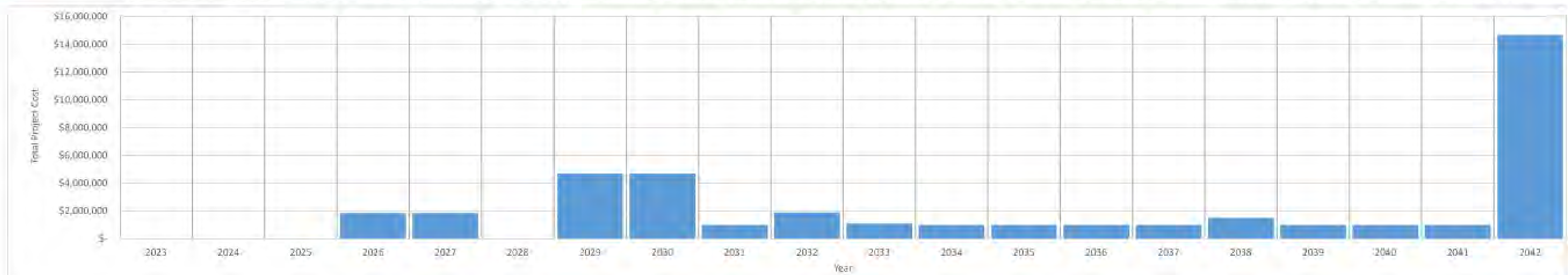
The 20-Year CIP is summarized in **Table 11-5** along with the consultant proposed spend plan over the 20-year planning horizon.

Table 11-5 | Recommended Capital Improvement Program Summary

Kingston Basin CIP Plan

consor

6 or 20 Year CIP	CIP No.	Asset Health Score	Project Name	Total Project Cost	6-Year CIP 2023	2024	2025	2026	2027	2028	20-Year CIP 2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
6	CIP-K-CC-CAP-1	20	Replace PS-41 and Forcemain	$ 3,700,000				$ 1,850,000	$ 1,850,000															
20	CIP-K-CC-OM-10	20	Annual Pipe Replacement	$ 14,000,000							$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000
20	CIP-K-CC-CAP-2	25	Upgrade PS-71 and Replace Forcemain*	$ 7,400,000							$ 3,700,000	$ 3,700,000												
20	CIP-K-WWTP-OB-1	7.2	Replace UV System*	$ 880,000										$ 880,000										
20	CIP-K-WWTP-REG-2	6.5	Nitrogen Optimization Improvements	$ 99,000											$ 99,000									
20	CIP-K-WWTP-OB-4	6.5	Replace Clarifier Drives	$ 480,000																$ 480,000				
20	CIP-K-WWTP-REG-3	6.6	Class A Reclaimed Water Improvements	$ 13,661,000																				$ 13,661,000
			Total Project Cost (2023)	$ 40,220,000	$ -	$ -	$ -	$ 1,850,000	$ 1,850,000	$ -	$ 4,700,000	$ 4,700,000	$ 1,000,000	$ 1,880,000	$ 1,099,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,480,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 14,661,000
			Assumed Inflation Rate			12%	8%	8%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
			Inflation Multiplier		1	1.12	1.21	1.31	1.37	1.44	1.51	1.59	1.67	1.75	1.84	1.93	2.03	2.13	2.23	2.35	2.46	2.59	2.72	2.85
			Future Value Cost		$ -	$ -	$ -	$ 2,416,781	$ 2,537,620	$ -	$ 7,107,736	$ 7,463,123	$ 1,667,293	$ 3,291,237	$ 2,020,172	$ 1,930,101	$ 2,026,606	$ 2,127,936	$ 2,234,333	$ 3,472,153	$ 2,463,352	$ 2,586,519	$ 2,715,845	$ 41,807,858



SECTION 12

Financial Strategy

12.1 Introduction

This chapter documents the Sewer Financial Plan, which shows how the investments in the CIP can be funded by the County sewer utility.

This Sewer Financial Plan was written by FCS, a Bowman company, under subcontract with Consor, the County's consulting engineers who have prepared the other required elements of this Plan.

12.1.1 Four Basins, One Financial Entity

The County sewer system has four basins, each with a treatment plant and a corresponding collection system: Central Kitsap, Manchester, Suquamish, and Kingston. The capital planning has been performed separately for each basin. However, the County does not separate its sewer utility financial information by basin, so all information shown in this Sewer Financial Plan document—unless explicitly stated otherwise—refers to the County sewer utility as a whole.

This sewer financial plan document has been written so it can be included with each of the Wastewater Facilities and Sewer Plan documents: Central Kitsap, Manchester, Suquamish, and Kingston. At the end of this chapter, a table showing the allocation of costs and revenues across the four basins is included, so that the Plan documents will each contain the required elements needed for submission to Ecology.

12.1.2 Sequence of Topics

After reviewing the historical performance of the sewer utility, we describe the methodology and key assumptions underlying the financial forecast. The key assumptions address the assumed fiscal policies, economic assumptions, and data sources. This section also summarizes the CIP, expressing total project costs in both constant 2023 dollars and future inflated dollars.

After the key assumptions and data sources, this chapter then shows the results of the revenue requirement forecast. This is a two-step process. First, the capital funding strategy describes how the capital costs can be financed over time, using both debt and non-debt sources. The debt issues lead to annual debt service costs. The second step is the annual forecast, which incorporates the debt service and other annual costs into a forecast that is balanced against projected revenues. The forecast is tested assuming existing rates. If either the projected cash balances are insufficient or the required bonded debt service coverage is not achieved, then rates are adjusted until the forecast is balanced. In this forecast, the forecast can be balanced with overall rate increases of 6.31% in 2025 (already adopted by the County) and 6% per year from 2026 through 2042.

This document then shows the implications of these rate increases on several metrics and policy targets: reserve fund balances, rate-funded capital investment, bonded debt service coverage, outstanding debt as a percentage of total assets, annual debt service as a percentage of total revenue ("debt service load"), and the average single-family bill as a percentage of median household income.

The next section of this document allocates the forecast results to the four basins. Finally, Appendix K contains a list of loan and grant programs administered by State agencies.

12.2 Financial History

This section is a summary of historical financial performance as reported on the County sewer utility income statements.

Table 12-1 shows comparative financial statements for the six-year period 2018 through 2023. These statements summarize the revenues, expenses, and ending reserves for each year.

Table 12-1 | Sewer Utility Income Statement Summary

Kitsap County Sanitary Sewer Statement of Revenue, Expenses, and Changes in Fund Net Position	2018	2019	2020	2021	2022	2023
Operating Revenues						
Charges For services	$ 29,148,750	$ 22,655,426	$ 22,463,052	$ 29,309,413	$ 29,874,573	$ 33,131,359
Miscellaneous	8,186	1	1,830	(952)	29,607	26,281
Total Operating Revenue	29,156,936	22,655,427	22,464,882	29,308,461	29,904,180	33,157,640
Operating Expenses						
Personnel services	6,300,329	6,279,287	5,685,451	4,687,211	7,096,959	7,204,619
Contractual services	2,457,856	1,139,373	2,005,189	3,274,795	1,526,763	1,677,788
Utilities	1,730,524	1,572,611	1,629,789	1,658,245	1,829,897	2,031,543
Repair and maintenance	363,500	206,538	124,609	276,907	67,014	383,963
Other supplies and expenses	822,068	2,411,869	2,904,338	24,091	3,522,734	3,624,846
Insurance claims and other benefits	23,206	41,016	48,593	36,905	55,869	71,221
Depreciation	8,067,911	8,229,732	7,938,653	7,936,876	7,798,372	7,564,530
Amortization	-	-	-	-	18,185	43,554
Total Operating Expense	19,765,394	19,880,426	20,336,622	17,895,030	21,915,793	22,602,064
Operating Income (loss)	9,391,542	2,775,001	2,128,260	11,413,431	7,988,387	10,555,576
Nonoperating Revenues (Expense)						
Interest and investment revenue	557,566	992,414	501,061	(108,225)	(514,379)	1,599,427
Grant Revenue	-	-	-	-	12,077,611	1,617,967
Miscellaneous revenue	7,995,466	974,624	-	-	-	11,521
Interest expense	(2,332,621)	(2,574,476)	(1,774,693)	(1,663,145)	(1,534,251)	(1,592,572)
Miscellaneous expense	(2,362)	-	-	-	-	-
Total Nonoperating Revenue (Expense)	6,218,049	(607,438)	(1,273,632)	(1,771,370)	10,028,981	1,636,343
Income (loss) Before Contributions & Transfers	15,609,591	2,167,563	854,628	9,642,061	18,017,368	12,191,919
Capital contributions	1,746,374	1,079,087	3,304,592	358,850	8,815	3,378,392
Transfers in	133,903	2,116,097	-	-	-	-
Transfer out	(167,214)	(364,731)	(139,181)	(47,868)	(47,940)	(78,250)
Transfer to Fiscal Agent	-	(2,066,310)	-	-	-	-
Change in Net Position	17,322,654	2,931,706	4,020,039	9,953,043	17,978,243	15,492,061
Net Position - Beginning	92,589,114	109,914,129	104,363,824	108,683,150	118,636,193	136,614,438
Prior period adjustment	-	(8,482,011)	299,286	-	-	-
Net Position - Ending	109,911,768	104,363,824	108,683,149	118,636,193	136,614,436	152,106,499

Following are some observations about the sewer utility's historical financial performance:

- "Charges for services" revenue varies from year to year, with the total ranging from $22.4 million to $33.1 million over the past six years. While population growth and retail rate increases account for a general upward trend over time, the "up and down" variability from year to year is largely driven by changes in capital cost sharing from contract customers.

The three primary contract customers are the City of Poulsbo, U.S. Navy Keyport, and Bangor. All three contract customers pay for ongoing service at the commercial rate. Poulsbo and U.S. Navy Keyport have separate cost-sharing agreements for capital costs. In the County's accounting system, capital cost-sharing is included in the "charges for services" revenue category.

- In 2018, the County received $7,995,466 in miscellaneous revenue, with a smaller amount ($974,625) received the following year. The County's annual report showed this revenue in the "operating grants and contributions" category. While we did not determine the source, it is clearly a non-recurring revenue.
- Total operating expenses have increased over time, with an average increase of 2.3% per year. There was a temporary decrease from 2020 to 2021 followed by a rebound in 2022. This pattern may have been influenced by the COVID-19 pandemic.
- The County received approximately $13.7 million in grants over the last two years with the majority ($12.1 million) being accounted for in 2022.
- The financial statements suggest that the County utility has been drawing down its balance of outstanding debt through the six-year period, since interest expense decreased from $2.3 million in 2018 to $1.6 million in 2023.
- In the annual report, the term "net position" refers to the utility's total assets minus total liabilities. (It is analogous to "owner's equity" in private sector financial statements.) The Kitsap County sewer utility's net position has increased by $59.5 million (64%) from the beginning of 2018 to the end of 2023. This equates to an average increase of 8.6% per year during the period.

12.3 Methodology and Assumptions

12.3.1 Revenue Requirement Forecast Methodology

The revenue requirement forecast identifies the total revenue needed to fully fund the utility on a stand-alone basis considering current and future financial obligations. For this analysis, the resulting rate increases are assumed to be applied "across-the-board" to all customer classes; no rate design changes are proposed in this financial plan.

Table 12-2 shows that the forecast is a two-step process. The first step is the capital funding strategy, shown in the left column. We begin with the total capital program provided by Consor as part of the General Sewer Plan Updates for each of the County's four wastewater basins. We then subtract all of the non-debt funding sources. The remainder is the amount of borrowing needed. The number at the bottom of the first column—the debt needed to fund the remainder of the capital program—determines the amount of new debt service, which is an annual cost.

The second step is the annual forecast, shown in the column to the right. The fiscal policy targets include the minimum reserve balances that must be maintained in the forecast. To that number we add each year's projected operating costs, existing and new debt service, and the amount of current rate funding used for capital expenditures. After deducting non-retail revenue, we now know how much money is needed each year from rates.

Table 12-2 | Revenue Requirement Overview

	Capital Funding Strategy
	Total Capital Projects
-	Grants
-	Wholesale Contributions
-	Newcomer Fees
-	Rate-Funded Capital
-	Cash Reserves
=	Debt Funding (Loans or Bonds)

	Annual Forecast
	Fiscal Policy Targets
+	Operating Costs
+	Existing & New Debt Service
+	Rate-Funded Capital
=	Revenue Requirement
-	Offset Revenues
=	Revenue Required from Retail Rates

The rate revenue requirement is next compared with the revenue projected to be generated by current rates. In addition, we test the current rates against required "debt service coverage," which is an important fiscal policy explained below. If the current rates are insufficient—either because they do not generate enough cash or because the debt service coverage target is not met—then the forecast rates are adjusted to the degree necessary to balance the cash flow requirements and ensure that the coverage target is achieved.

12.3.2 Fiscal Policies

The fiscal policies that affect a rate forecast include the target operating reserve, minimum capital reserve, minimum operating and capital cash, debt service coverage, rate-funded capital reinvestment. Each type of policy is discussed below.

12.3.2.1 Target Operating Reserve

"Reserves" are another word for fund balance. An operating reserve is a liquidity cushion; it protects the utility from the risk of short-term variation in the timing of revenues or expenses.

For operating reserves, we often characterize the target with both a minimum and a maximum. For any given year, if the forecast shows an ending fund balance below the minimum, then rates need to be raised higher to replenish the reserve. If the forecast shows the ending balance above the maximum, then the excess cash is re-characterized as a capital reserve.

The most common operating reserve target for sewer utilities is between 45 days and 60 days (12%-16%) of annual operating expenses. However, Kitsap County sewer rates include a volume charge for non-residential and contract customers, which introduces more revenue variability. We therefore suggest a larger cushion—an operating reserve target of 90 days (25%) of annual operating expenses.

Recommended Policy: Achieve a year-end operating fund balance of 90 days (25%) of total annual operating expenses. Results: For 2024, this amount is forecasted to be about $4.1 million; it increases throughout the forecast period as operating costs increase with inflation.

12.3.2.2 Minimum Capital Reserve

The capital fund balance fluctuates naturally because it serves two functions. First, capital reserves are a capital funding tool, the means by which a utility saves up in advance of major capital projects and avoids overreliance on debt. Utilities tend to go through waves of capital investment, so the reserve balance tends to grow over time and then drop suddenly after a large capital project.

There is also a second function of a capital reserve. It also serves as a risk reserve just like the operating reserve, giving the utility the flexibility to respond to unanticipated needs. Such needs could include a capital cost overrun, or an unexpected failure of a major asset. It could be an unexpected regulatory requirement or simply an opportunity-driven capital improvement. A cash cushion gives the utility flexibility to address unforeseen capital needs in a logical way.

That cash cushion is achieved by having a minimum capital fund balance in the projections. In other words, when we forecast capital spending and the fund balance naturally goes up and down, we only allow it to go down so far—only as far as the target minimum—not all the way to zero.

The target minimum capital fund balance could be defined as a certain percentage of the average CIP, or as the projected replacement cost of specified high-value assets. However, a simple and common way to set a target minimum capital reserve is to define it as 1% of the original cost of fixed assets in the system. This minimum naturally increases over time since future capital investment leads to a growing inventory of assets. That is the approach we recommend in this financial plan.

Recommended Policy: Achieve a year-end minimum capital balance target of 1% of the original cost of plant-in-service. Results: This equates to roughly $2.9 million for year-end 2024 and increases to $9.0 million in 2042 as capital is constructed.

12.3.2.3 Minimum Operating and Capital Cash

In recent years, bond rating agencies have focused on the combined operating and capital cash balance. A favorable indicator is when a utility maintains a combined year-end cash reserve of at least 180 days (50%) of annual operating expenses. That is the policy target we recommend here.

Recommended Policy: Maintain a minimum year-end operating and capital balance of 180 days (50%) of annual operating expenses. Results: This equates to roughly $8.2 million for year-end 2024 and increases thereafter. In this forecast, the 180-day target is achieved in all years.

12.3.2.4 Debt Management

The sewer utility currently has three revenue bonds, two Public Works Trust Fund (PWTF) loans, and four Department of Ecology (DOE) state loans. Additionally, the County is in the process of selling additional revenue bonds and securing another DOE loan. In 2024, debt service is about $5.2 million. With existing debt and the new debt arrangements already underway, debt service will rise above $7 million per year for 2027-2040, dropping off after 2040. In addition, to address the capital needs identified in this plan, additional revenue bonds are forecasted to be issued in future years. Each bond issue is assumed to have a 20-year term, issuance cost of 1%, and an interest rate of 5%.

12.3.2.4.1 Debt Service Coverage

Debt service coverage is a requirement typically associated with revenue bonds and some state loans. It is also a useful benchmark to measure the riskiness of a utility’s capital funding plans. Coverage is best understood as a factor applied to annual debt service. A typical requirement in selling revenue bonds is that bonded debt service coverage must be at least 1.25 throughout the life of the bonds. That means the County agrees to collect enough revenue each year to meet operating expenses and not only pay debt service but also an additional 25% above bonded debt service. This cushion makes bondholders more confident that debt service will be paid on time. The extra revenue can be used for capital expenditures, to build reserves, or for debt service on subordinate debt.

While the County's contractual minimum coverage is 1.25, achieving coverage greater than the minimum is a positive signal that bond rating agencies notice, and it can result in more favorable terms for future borrowing. For that reason, many utilities set a policy target higher than 1.25.

Recommended Policy: Set rates to achieve bonded debt service coverage of at least 1.50. Results: The utility is forecasted to achieve this policy in all years except 2032 and 2034, when coverage decreases to 1.38 and 1.49. That is still safely above the legal minimum of 1.25.

12.3.2.5 Rate-Funded Capital Investment

To avoid overreliance on debt, it is useful to have a target for the amount of capital investment that is funded by rates ("pay-as-you-go"). A common benchmark is to aim for rate-funded capital of at least 100% of original cost depreciation by the end of the forecast period. We recommend that approach.

Recommended Policy: Rate revenue should fund 100% of original cost depreciation expense by the end of the forecast period. Annual depreciation is $7.5 million in 2023, growing to $19.8 million by 2042. Results: In this forecast, rate-funded capital at 100% of depreciation is first achieved in 2039 and continues through the remainder of the forecast.

Table 12-3 provides a summary of the recommended fiscal policies for the sewer utility.

Table 12-3 | Summary of Fiscal Policies

Policy	Recommended Target
Operating Reserve	90 days (25%) of annual O&M expenses (initially, $4.1 million)
Minimum Capital Reserve	1% of original cost of plant-in-service (initially, $2.9 million)
Minimum Operating & Capital Cash	180 days (50%) of annual O&M expenses (initially, $8.2 million).
Debt Service Coverage	A policy target of at least 1.50 for bonded debt, which is higher than the contractual minimum of 1.25
Rate-Funded (Pay-as-You-Go) Capital Reinvestment	Rate-funded capital should equal 100% of original cost depreciation by the end of the study period ($19.8 million per year by 2042)

12.3.3 Key Assumptions and Data Sources

12.3.3.1 Economic & Inflation Factors

The operating expenditure forecast relies primarily on the County's 2024 adopted budget. The line items in the budget are then adjusted each year by one of the following factors:

- General Cost Inflation – After conversations with staff, we assumed 4% in 2024 followed by 3% per year thereafter.
- Construction Cost Inflation – Unless otherwise mentioned, all project costs were given in 2023 dollars, then escalated for construction inflation of 8% in 2024, 4% per year thereafter.
- Labor Cost Inflation – Assumed at 10% for 2025 to reflect the County's compensation study adjustments, followed by 3% per year based on the Employment Cost Indices for wages.

- ➢ Benefits Cost Inflation – Assumed at 5% per year, based on the Employment Cost Indices for benefits.
- ➢ Taxes – The State excise tax rate is 3.852%, the State Business and Occupation (B&O) tax rate is 1.75%. The State excise tax applies to rate revenue allocated to the collection system. The B&O tax applies to rate revenue allocated to treatment and transmission, as well as to system development charges and other miscellaneous fees.
- ➢ Fund Earnings – Assumed to be 4% in 2024 and decreasing one percentage point per year until 2027 and then remaining at 1% for the forecast period. Based on market conditions as well as historical Local Government Investment Pool (LGIP) returns.
- ➢ Customer Growth – Conservatively assumed to be 0.5% per year, based on discussion with staff. The assumed growth rate in sewered population varies for each of the County's four service areas, which are projected to be between 0.6%/yr and 4.8%/yr. Therefore, a 0.5%/year customer base growth rate represents a conservative estimate for the purposes of financial planning in the event assumed sewered population growth rates are not realized.
- ➢ Operating Budget Execution Factor – 95% in 2024 followed by 90% for all other years, based on discussions with staff and historical data on actual vs. budgeted spending.

12.3.3.2 Fund Balances

The County manages both an operating and capital fund related to the sewer utility. For the purpose of showing funds restricted for debt service repayment, the forecast contains a third category: debt reserves. These funds are assumed to come from the operating fund. **Table 12-4** shows the updated allocated cash balance for 2024 between operating, capital, and debt purposes for the financial modeling. It also shows the projected beginning fund balance for 2024, the beginning of the forecast period.

Table 12-4 | Cash Balances

Description	2024 Beginning Cash Balances
Operating Fund	$11,560,996
Capital Fund	$369,483
Debt Reserves	$6,827,376
Total Fund Balance	**$18,784,376**

While the capital fund reserves are below the initial target of $2.9 million for 2024 beginning balance, the operating fund balance more than covers the difference. In our forecast, any excess operating reserves are re-categorized as available for capital purposes.

12.3.3.3 Existing Debt

As stated previously, current outstanding debt for the sewer utility includes three revenue bonds, two Public Works Trust Fund (PWTF) loans, and four Ecology loans. Annual debt service payments are about $5.2 million in 2024. The County has opted to time the bonded debt service payments to smooth out year-to-year fluctuations in total debt service. The 2015 bond is retired in 2027 while the 2010C QECB loan is retired in 2028. Starting in 2028, the 2010B refunding bond starts to require principal payments. The two outstanding PWTF loans are fully repaid in 2031 and 2041. Two of the DOE loans are fully repaid in 2025 while the others are repaid gradually through 2038.

12.3.3.4 Near-Term Future Debt Obligations

Although not currently making payments on them, the County has begun the process of obtaining two additional debt issues. The first is a 20-year revenue bond which assumes repayment starting in 2025. The bond proceeds (including a bond premium) are assumed to be $32.5 million, requiring annual payments of $2.5 million once principal repayment begins in 2027.

The second loan in process is a $3.78 million DOE loan for the Capital Facility Plans update. Remaining draws on this loan are assumed to occur in 2024. Repayment starts in 2025, with annual payments of about $200,000 per year.

As of the time of writing, the County has also applied for other low-cost loans from State agencies. These additional loans will be described later in this document, under "Capital Funding Strategy."

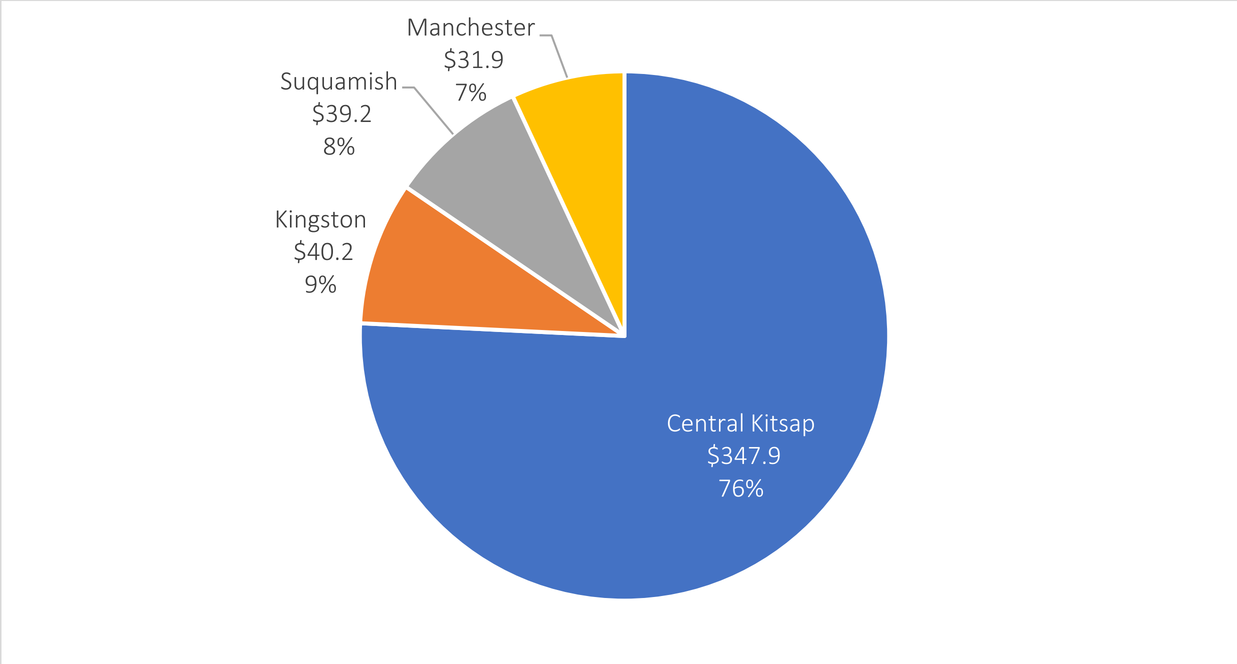
12.3.3.5 Capital Expenditure Forecast

12.3.3.5.1 Capital Projects Before Escalation

Capital project costs and timing were developed by Consor with County staff input. The resulting 2024-2042 capital improvement plan (CIP) shows estimated spending of about $459.2 million in 2023 dollars. Total capital costs in 2023 dollars by basin is shown in **Figure 12-1**. Central Kitsap is the largest treatment plant, and the Kitsap basin has 76% of the capital requirements.

The largest project in the early part of the CIP is the Solids and Liquid Hauled Waste Upgrades at the Central Kitsap treatment plant. Design for this project is currently underway, and its construction schedule is assumed to continue through 2028. (For convenience, it is sometimes referred to as the "digester project," even though it actually includes other elements besides new digesters.) Its total remaining cost (in escalated dollars) is assumed to be $140 million, and it dominates the early years of the forecast—much of the borrowing and resulting rate increases in the next few years are focused on financing the digester project. Because of the size of the project and the fact that its engineering is well advanced, its cost estimate is given in escalated dollars — no further inflation factor is applied to the $140 million cost. For the other projects, however, **Figure 12-1** shows cost estimates in 2023 dollars.

Figure 12-1 | Unescalated Capital Spending (Millions) 2024-2042



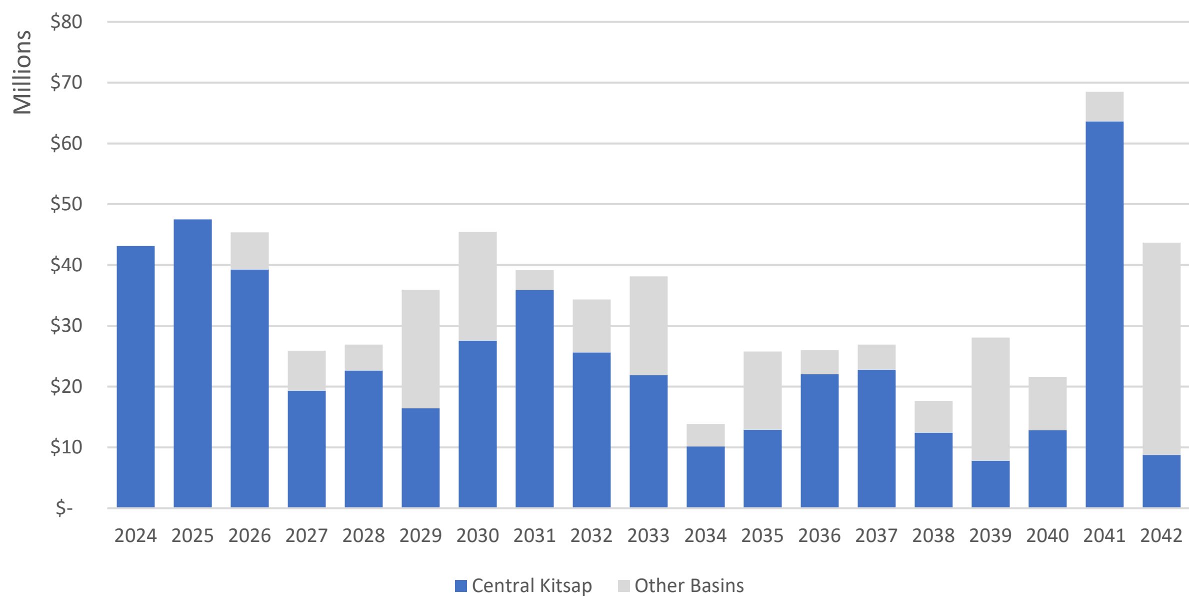
12.3.3.5.2 Projected Capital Expenditures after Cost Escalation

Figure 12-2 shows the year-by-year funding needs after applying the assumed inflation factors.

The digester project has expenditures extending from 2024 through 2028. After 2028, many of the identified capital projects are focused on the collection systems—the pipes and pumps that deliver wastewater to the four treatment plants. The 2029-2040 projects include needed improvements in the Kingston, Suquamish and Manchester basins in addition to the Central Kitsap basin.

In 2041, the CIP shows a major project ($50.3 million, in escalated dollars) to construct Aeration Basins 5 and 6 at the Central Kitsap plant, based on assumed requirements from the State. In 2042, a major upgrade (Class A Reclaimed Water Improvements, costing $29.9 million in escalated dollars) is shown for the Kingston plant. For these 2041 and 2042 projects, the nature of the regulatory requirements from the State are uncertain, but these estimates serve as a placeholder to flag the need for additional major investments in future years.

Figure 12-2 | Capital Expenditure Forecast 2024-2042 (escalated dollars) – Central Kitsap vs All Other Basins



The dark part of each column represents the Central Kitsap basin capital cost needs. The total escalated cost of capital improvements for the Central Kitsap basin is $472.6 million, about 72% of the total $654 million in escalated capital needs for the County.

12.4 County-Wide Revenue Requirement Results

The County currently has an adopted sewer rate increase for 6.31% in 2025. Following the adopted rate increase, the forecast shows that 6.0% annual rate increases would be necessary to continue to cover operations as well as fund the capital plan through a mix of cash funding and debt financing.

12.4.1 Capital Funding Strategy

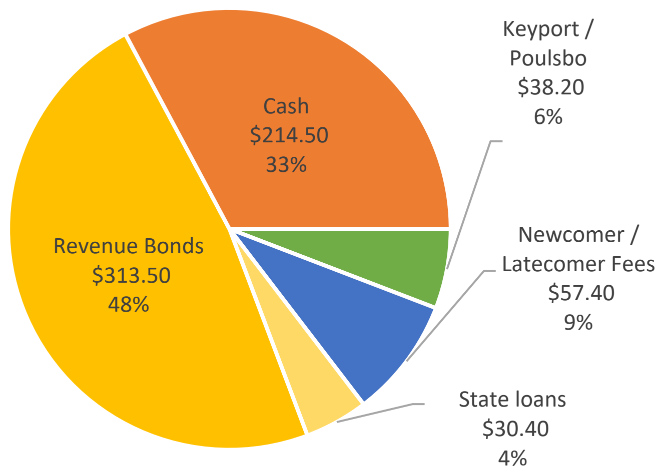
Over the full 19-year period from 2024 through 2042, the capital expenditure forecast (including inflation) contains $654 million of projects. In the capital funding strategy, our task is to identify where that $654 million will come from.

Figure 12-3 shows the forecasted sources of funding for this capital program.

- First is the capital cost sharing from U.S. Navy Keyport and Poulsbo. County staff provided estimates for 2024-2029, totaling $28.1 million for the 6-year period. We assumed that the cost share for 2029 ($778,000) continues in future years, so the total through 2042 is $38.2 million.
- Second, any available Newcomer or Latecomer revenue is applied to the capital program. The forecast assumes about $3,000,000 per year in revenue assuming no changes to the charge, or a total of $57.4 million.
- Next, we assume the low-interest loans that the County is currently pursuing from both Public Works and Department of Ecology. The assumed total is $30.4 million.

- The remaining capital funding need is balanced with a mix of cash vs. revenue bond debt. Each type of funding works to complement the other to fill the remaining funding gap. This includes:
  - Revenue bonds: issued in two-year cycles as needed, to cover capital costs for the year of issuance and the following year. Total debt proceeds are $313.5 million (48% of the total) through 2042. Except for the 2024/25 bond issue, we assumed 20-year bonds at 5% interest.
  - Cash funding: The covers the remaining $214.5 million (33% of the total). It is generated by the rate increases needed to repay revenue bonds and fund the remaining capital needs.

Figure 12-3 | Capital Funding Sources 2024 – 2042



12.4.1.1 Planned Low Interest Loans

The County has applied for low-interest State loans in the short term. The forecast assumes that the County receives the maximum $10 million in both 2025 and 2026 from the Public Works Trust Fund as well as an additional $9.85 million from the Department of Ecology. The total forecasted debt service on these loans is $1.8 million dollars.

12.4.1.2 Planned Revenue Bond Debt Issues

The first bond issue is currently in process as of 2024, but funding may not be available until 2025. After the first revenue bond debt issuance, additional issues are forecasted every two years as needed through 2041. **Table 12-5** shows the timing and magnitude of the bonded debt proceeds assumed in the financial plan, along with the annual debt service associated with each issue.

Table 12-5 | Planned Revenue Bond Issues in the Financial Plan

Year	Net Proceeds	Annual Debt Service
2024/2025	$32.5 million*	$2.5 million*
2026	$22 million	$1.9 million
2028	$42 million	$3.7 million
2030	$70 million	$5.9 million
2032	$58 million	$4.9 million
2034	$19 million	$1.6 million

Year	Net Proceeds	Annual Debt Service
2036	$25 million	$2.1 million
2039	$5 million	$0.4 million
2041	$40 million	$3.4 million
Total	**$313.5 million**	**$26.5 million**

Note:
*2024/2025 issue includes approximately $2.5m premium. Debt service is planned to have two years of interest-only payments in 2025 and 2026

12.4.1.3 Potential Grants and Other Low Cost State Loans

Due to the reliance on revenue bond funding for the capital program, the County should continue to pursue additional low-cost State loans. Grants and state loans provide two benefits. The first is the cost savings compared to the assumed alternative of issuing revenue bonds. In addition, by reducing its reliance on revenue bonds, the County improves its bonded debt service coverage calculation.

The following document is a helpful summary of the funding, eligibility, and contact details for water and sewer infrastructure assistance programs (both grants and low-cost loans) in Washington State: http://www.infrafunding.wa.gov/resources.html. This summary is updated each year by the Department of Commerce. The most recent version (September 17, 2024) is included as **Appendix K** to this report.

12.4.2 Annual Forecast

Figure 12-4 graphically represents the annual forecast through 2042. Total operating revenues are about $31.0 million in 2024 and $90.4 million in 2042. These figures exclude revenue restricted to capital purposes—debt proceeds, capital cost sharing from contract customers, or newcomer charges.

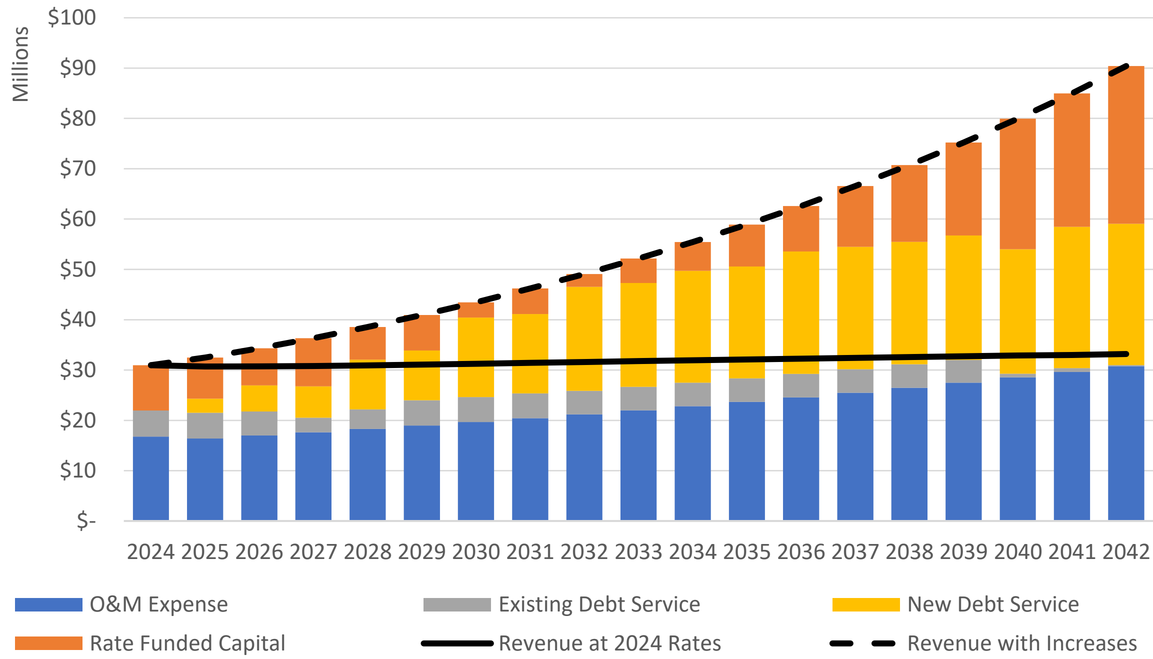
The stacked columns represent the costs of the utility, such as operating expenses, existing debt service, new debt service, and annual cash funding used for capital projects. The solid black line represents revenue at existing rates and the dashed line shows forecasted revenue with rate increases.

Below are further observations about these variables.

- Solid line: Revenue at existing rates.
  - Revenue is projected to increase with customer growth, even without future rate adjustments.
- Dashed line: Revenues with rate increases.
  - After the recommended rate increases, revenue is expected to grow to $90.4 million by 2042.
- Blue bar: Operating expenses.
  - Operating expenses increase with the annual cost escalation assumptions described earlier.
- Grey bar: Existing debt service.
  - Annual payments of about $5.2 million in 2024, declining to $214,000 by 2042.
- Yellow bar: New debt service.
  - New debt service begins in 2025. By 2042, it is about $28.1 million per year.

- Orange bar: Rate revenue available for capital projects.
  - This amount fluctuates year to year as the debt issues impact the difference between revenue collected and total other obligations.

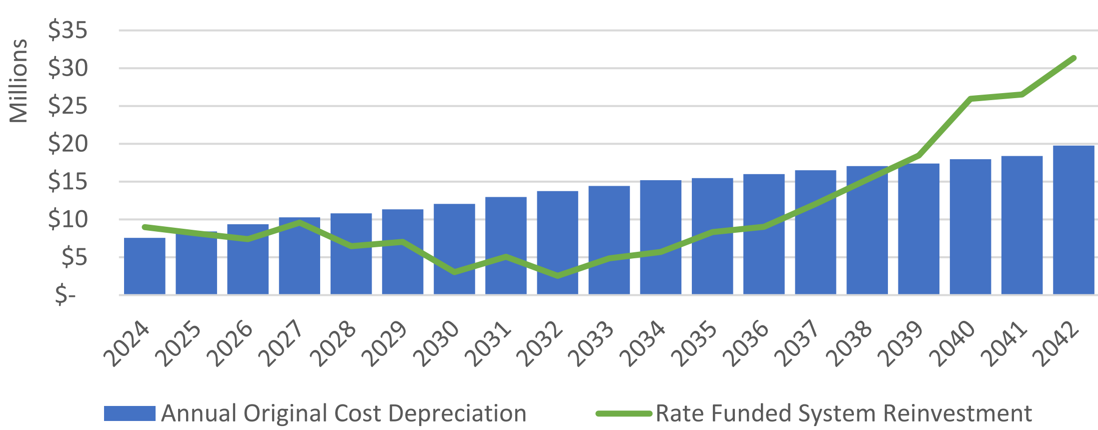
Figure 12-4 | Revenue Requirement Forecast



12.4.2.1 Rate-Funded Capital Investment

The green line in **Figure 12-5** shows the sewer utility's projected annual level of rate-funded capital investment in relation to annual depreciation.

Figure 12-5 | Annual Rate-Funded System Reinvestment



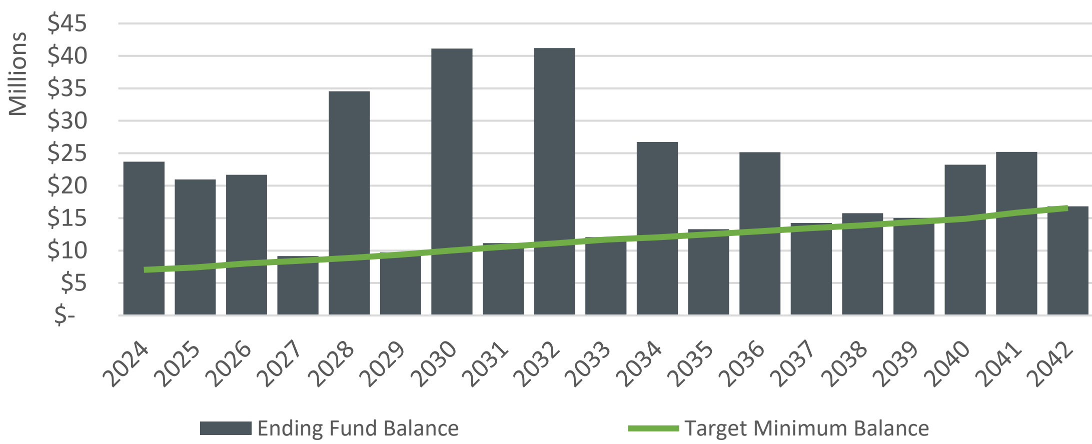
Over the forecast period, annual depreciation cost increases as the County completes capital projects. The blue line represents the same amount as the light green bar in **Figure 12-4**. Over this period, rate-funded system reinvestment reaches a low of 9% of annual depreciation in 2032. This coincides with the lowest bonded debt coverage (1.38) in the forecast. Beginning in 2039, rate-funded capital is projected to achieve the assumed policy target of at least 100% of annual depreciation cost.

12.4.2.2 Operating and Capital Reserve Level

The recommended minimum operating fund balance is 90 days of total annual operating expenses, and the recommended minimum capital fund balance is 1% of the original cost of assets. The sum of these two targets represents the combined minimum reserve balance—about $7.0 million in 2024. It grows to $16.6 million in 2042 as operating costs increase and the County adds assets to the system.

Figure 12-6 shows projected unrestricted fund balances through 2042 in relation to the reserve target (the green line). The utility is projected to achieve the reserve target each year.

Figure 12-6 | Operating and Capital Reserve Forecast

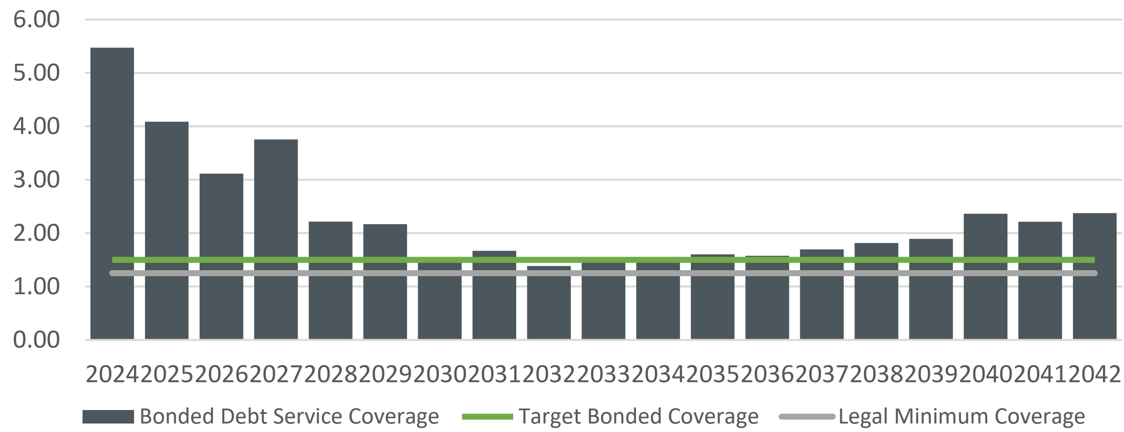


12.4.2.3 Bonded Debt Service Coverage

The legal minimum for revenue bond debt service coverage is 1.25 in each year in which bonds are outstanding. To enhance creditworthiness, many utilities set a policy target that is higher than the legal minimum. In this forecast, assumed a policy goal of at least 1.50 for bonded debt service coverage. However, we allowed exceptions to keep planned rate increases from going above 6% per year.

Figure 12-7 shows projected bonded debt service coverage through 2042 in relation to the assumed policy target of 1.50 and the legal minimum of 1.25. The utility is projected to achieve the policy target each year except for 2032 and 2034, when coverage drops to 1.38 and 1.49. The forecast stays above the legal minimum of 1.25 throughout the forecast period.

Figure 12-7 | Projected Bonded Debt Service Coverage in Relation to Target and Legal Minimum



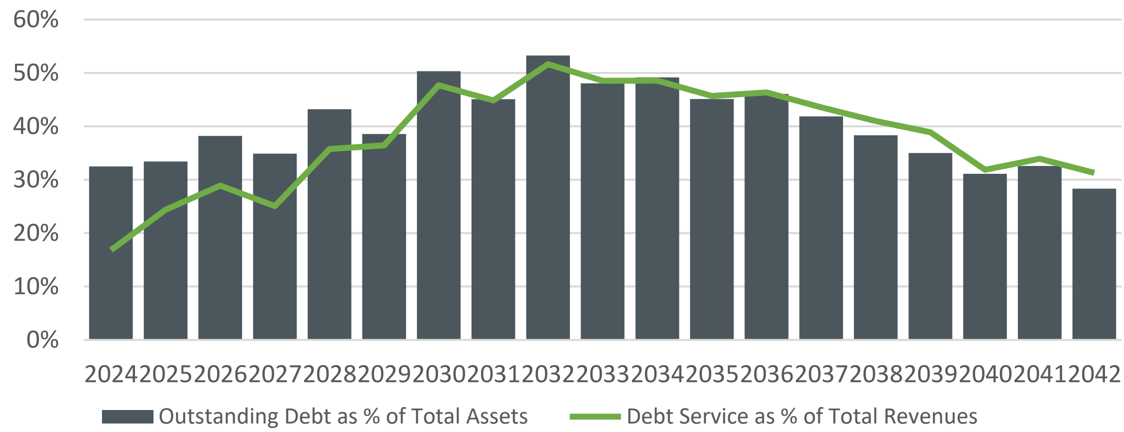
12.4.2.4 Analysis of Outstanding Debt and Debt Service Load

Because the County will need to borrow heavily to fund this CIP, two other debt-related metrics are relevant: the level of outstanding debt in relation to total assets ("debt-to-total assets ratio"), and the projected debt service as a percentage of total revenues ("debt service load"). Debt is a useful component in the capital funding toolbox, but it should not be overused. The cumulative effect of a series of borrowing decisions can be assessed by looking at these two metrics.

Figure 12-8 shows the projected debt-to-total assets ratio and the debt service load throughout the 2024-2042 forecast period. There is not a formal policy target to compare with, but we are aiming to keep both metrics below 50%. In this forecast, both metrics stay at or below 50% except in 2032, when outstanding debt is 53% of total assets and debt service is 52% of total revenue.

Based on these results, we observe that this forecast relies heavily on debt during the next 19 years, and we do not suggest greater borrowing. The significance of this finding comes from the fact that there is a tradeoff between rate increases and the level of borrowing. Higher rate increases allow more "pay-as-you-go" rate-funded capital funding (in lieu of debt), while higher levels of borrowing allow the rate impact to be pushed into future years. In this forecast, the recommended rate increases—6% per year after 2025—should not be ameliorated by more borrowing.

Figure 12-8 | Projected Debt-to-Total Assets Ratio and Debt Service as % of Total Revenue



12.4.2.5 Affordability

Since the inception of the Clean Water Act, the US Environmental Protection Agency (EPA) has provided some guidance on how to measure financial burdens. Called the residential indicator (RI), the EPA measure is the annual residential cost of utility service divided by the median household income (MHI) of the relevant service area. An RI of 2.0% or higher indicates a "high burden" according to the EPA standard for sewer utilities.

The median household income for Kitsap County is estimated to be $103,593 as of 2024. This is based on a survey from the Census Bureau 2023 American Community Survey plus one year of inflation.

Table 12-6 presents an average single-family sewer bill with projected annual rate increases for the forecast period, tested against the affordability threshold. We assumed that median household income increases at the same rate as general inflation, which after 2023 is 3.0% per year. Applying the 2.0% test, Kitsap County's sewer rates are forecasted to remain within the EPA affordability range through 2042. Note that the median income benchmark does not measure the impact on low-income households; the forecasted rates could be a significant burden on households at the lowest income levels.

Table 12-6 | Affordability Table

Year	Inflation	Median HH Income	Projected Monthly Bill	Projected Annual Bill	% of Median HH Income
2023		$99,609	$92.24	$1,107	1.11%
2024	4.00%	$103,593	$98.06	$1,177	1.14%
2025	3.00%	$106,701	$104.25	$1,251	1.17%
2026	3.00%	$109,902	$110.51	$1,326	1.21%
2027	3.00%	$113,199	$117.14	$1,406	1.24%
2028	3.00%	$116,595	$124.17	$1,490	1.28%
2029	3.00%	$120,093	$131.62	$1,579	1.32%
2030	3.00%	$123,696	$139.52	$1,674	1.35%
2031	3.00%	$127,407	$147.89	$1,775	1.39%
2032	3.00%	$131,229	$156.76	$1,881	1.43%
2033	3.00%	$135,166	$166.17	$1,994	1.48%

Year	Inflation	Median HH Income	Projected Monthly Bill	Projected Annual Bill	% of Median HH Income
2034	3.00%	$139,221	$176.14	$2,114	1.52%
2035	3.00%	$143,397	$186.71	$2,241	1.56%
2036	3.00%	$147,699	$197.91	$2,375	1.61%
2037	3.00%	$152,130	$209.78	$2,517	1.65%
2038	3.00%	$156,694	$222.37	$2,668	1.70%
2039	3.00%	$161,395	$235.71	$2,829	1.75%
2040	3.00%	$166,237	$249.85	$2,998	1.80%
2041	3.00%	$171,224	$264.84	$3,178	1.86%
2042	3.00%	$176,361	$280.73	$3,369	1.91%

12.5 Basin-Specific Revenue Requirement Forecasts

While the previous section discussed the overall financial obligations of the County's sewer utility, this section focuses on the obligations as allocated to individual basins. Because the County provides system-wide rates rather than area-specific rates, all customers share the same level of support for funding the Countywide sewer utility. The capital planning is performed for individual basins, but the funding of capital projects—including all debt obligations—and the subsequent rate changes are applied to the County sewer utility as a whole, not for individual basins.

However, this financial plan is one chapter within a set of larger General Sewer Plan Updates documents, and those documents are specific to each basin. In order to meet the Department of Ecology requirements for the planning documents, this section provides information about costs and revenues as they are allocated for each of the four basins: Central Kitsap, Manchester, Suquamish, and Kingston.

12.5.1 Allocating Costs Across Basins

As part of the financial forecast, the County provided an estimated number of Residential Billing Equivalents served by each basin. A Residential Billing Equivalent is used as a metric to estimate the proportion of revenue each basin generates and is based on how much a non-single family residential customer pays compared to a residential customer. For example, based on the County's current billing structure, a multi-family customer bill is approximately 80% of a single-family bill and would be treated as 0.8 Residential Billing Equivalent. Of the approximately 28,000 equivalents, the Central Kitsap area serves the vast majority of customers, representing 89.5% of the revenue. Accordingly, we allocated 89.5% of the overall costs to the Central Kitsap Basin. The same approach is taken to the other basins—the cost of O&M, capital, debt service, and required reserves are allocated in proportion to each basin's share of the system-wide total Residential Billing Equivalents. The Residential Billing Equivalents and resulting allocation percentages are shown in **Table 12-7**.

Table 12-7 | Allocation to Basins

Basin	Residential Billing Equivalents	Percentage
Central Kitsap	25,011	89.46%
Manchester	1,026	3.67%
Suquamish	970	3.47%
Kingston	950	3.40%
Total	**27,957**	**100%**

12.5.2 Results by Basin

The allocation of the revenue requirement to individual basins is shown in **Table 12-8**. For simplicity in presentation, we show the allocated revenue requirement only for the years 2025 and 2030, but the same percentage allocations can be applied to any of the forecast years.

Table 12-8 | Projected Revenue Requirement by Basin – 2025 and 2030

	Total	Central Kitsap	Manchester	Suquamish	Kingston
Allocation Percentage		89.46%	3.67%	3.47%	3.40%
2025					
Revenues					
Rate Revenue after Rate Increases	$30,005,499	$26,843,636	$1,101,178	$1,041,075	$1,019,610
Non-Rate Revenue	2,479,539	2,218,255	90,997	86,030	84,257
Total Revenue	**$32,485,038**	**$29,061,255**	**$1,192,175**	**$1,127,105**	**1,103,866**
Requirements					
Cash Operating Expenses	$16,403,199	$14,674,694	$601,985	$569,128	$557,393
Existing Debt Service	5,114,100	4,575,196	187,683	177,440	173,781
New Debt Service	2,802,218	2,506,931	102,839	97,226	95,221
Rate Revenue Available for Capital	8,165,521	7,305,070	299,668	283,312	277,471
Total Requirements	**$32,485,038**	**$29,061,891**	**$1,192,175**	**$1,127,105**	**$1,103,866**
2030					
Revenues					
Rate Revenue after Rate Increases	$41,168,068	$36,829,937	$1,510,836	$1,428,373	$1,398,922
Non-Rate Revenue	2,291,740	2,050,245	84,105	79,515	77,875
Total Revenue	**$43,459,808**	**$38,880,182**	**$1,594,941**	**$1,507,888**	**$1,476,797**
Requirements					
Cash Operating Expenses	$19,681,630	$17,607,656	$722,300	$682,877	$668,797
Existing Debt Service	4,946,317	4,425,094	181,526	171,618	168,080
New Debt Service	15,786,416	14,122,905	579,349	547,728	536,434
Rate Revenue Available for Capital	3,045,444	2,274,527	111,765	105,665	103,486
Total Requirements	**$43,459,808**	**$38,880,182**	**$1,594,941**	**$1,507,888**	**$1,476,797**

The sewer rate increases needed to support the above revenue requirements are the same for all four basins: 6.31% in 2025 and 6% per year through the remaining forecast period. Similarly, the projected debt service coverage is the same for all basins, as are the assumed policies for cash reserves. While the CIP is differentiated by basin, the debt obligations that are needed to fund the capital projects are all incurred at the countywide level, and all financial obligations apply to the County sewer utility as a whole, not to individual basins.