Impact Fee Facilities Plan

Prepared for
North Davis Sewer District
Syracuse, Utah
September 2022

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Prepared for

North Davis Sewer District, Syracuse, Utah

September 2022

The following text is included as required by the Utah Code, Section 11-36a-306:

I (Brown and Caldwell) certify that the attached impact fee facilities plan:

1. includes only the costs of public facilities that are:
    a. allowed under the Impact Fees Act; and
    b. actually incurred; or
    c. projected to be incurred or encumbered within six years after the day on which each impact fee is paid;
2. does not include:
    a. costs of operation and maintenance of public facilities; or
    b. costs for qualifying public facilities that will raise the level of service for the facilities, through impact fees, above the level of service that is supported by existing residents; and
3. complies in each and every relevant respect with the Impact Fees Act.

Brown AND Caldwell

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List of Abbreviations

BC	Brown and Caldwell
BOD	biochemical oxygen demand
CFR	Code of Federal Regulations
CIPP	cured-in-place pipe
ERU	equivalent residential unit
ft^3	cubic feet
GIS	geographic information system
gpd	gallons per day
gpm	gallons per minute
GPS	global positioning system
GWI	groundwater infiltration
HAFB	Hill Air Force Base
HRT	hydraulic residence time
IFFP	Impact Fee Facilities Plan
lb or lbs	pounds
MG	million gallons
mgd	million gallons per day
NDSD	North Davis Sewer District
OLR	organic loading rate
PVC	polyvinyl chloride
RCP	reinforced concrete pipe
RDII	rainfall dependent inflow and infiltration
sf	square foot
SRT	solids retention time
SWD	side water depth
TBPEL	Technology-Based Phosphorus Effluent Limits
TS	total solids
TSS	total suspended solids
UPDES	Utah Pollutant Discharge Elimination System
UV	ultraviolet
VS	volatile solids
WAS	waste activated sludge
WWF	wet weather flow
WWTP	wastewater treatment plant

Executive Summary

The North Davis Sewer District (NDSD or District) is a political subdivision of the State of Utah. It was formed to provide wastewater collection and treatment facilities for the northern portion of Davis County and a portion of southern Weber County. The District owns and operates a wastewater treatment plant (WWTP) in west Syracuse City, next to the Great Salt Lake. The District also owns and operates a collection system that includes trunk lines that extend from the WWTP throughout the District where they connect with sewer collection systems operated by the various cities located within the District. The cities extend service to individual property owners through their own collection system lines.

This Impact Fee Facilities Plan (IFFP) presents a discussion of the District's needs for rehabilitation and expansion to continue to provide sewer service to both existing and future residents and customers of the District. The IFFP identifies the needs the District will have within a ten-year planning horizon.

This IFFP is used to determine the amount of impact fee that the District can charge new customers to cover improvement costs to treat and dispose of wastewater generated through new growth within the District. It presents a discussion of plant and collection system elements that will be constructed to provide capacity for the new growth.

Previous Studies

In 1998, the District determined that significant modifications to both the WWTP and collection system were required to meet projected demands. The District commissioned multiple studies, completed between 2000 and 2005, to examine the improvements that should be constructed to keep pace with growth and changing regulations. These studies culminated in the construction of new liquid treatment facilities at the WWTP and changes and enlargements to the collection system pipelines.

Subsequent studies and efforts were completed in the 2010s that identified various WWTP and collection system facilities that needed to be constructed to meet future needs. These included the Biosolids Master Plan in 2011 (BC 2011), a Collection System Master Plan conducted in 2010 (BC 2010), a Collection System Condition Assessment and Asset Management Program started in 2011, a Biosolids Predesign in 2011 (BC 2011), and a Capital Facilities Plan in 2012 (BC 2012). The previous IFFP was completed in 2013 (BC 2013). The Collection System Master Plan was updated in 2016 (BC 2016) and additional projects were identified in the 2019 Collection System Update Technical Memorandum (BC 2019). The Collection System Master Plan was being updated in 2022 at the same time this IFFP was prepared.

Information and recommendations from these studies are incorporated in this document. Full versions of these studies are available from the District office and only summaries of the recommendations of these studies are presented in this plan. The District has either completed or is at various stages of implementing (planning, designing, or constructing) the projects recommended in these and prior studies.

Population

This 2022 IFFP projects future District service populations for 2030 and 2060 of 246,982 and 305,354, respectively.

Wastewater Treatment Plant Modifications

The liquid treatment process at the plant was expanded and improved between 2001 and 2007 to serve the projected needs of the District through 2025. Since the 2013 IFFP, the Primary Sludge Thickening Facility and Cogeneration Facility have been completed. In addition, the two secondary anaerobic digesters were upgraded from unmixed and unheated tanks to mixed mesophilic digesters.

The main recommended WWTP projects that should be implemented in the next 10 years are:

1. **Addition of an effluent outfall line to Gilbert Bay of the Great Salt Lake to meet new Technology-Based Phosphorus Effluent Limits (TBPEL).** NDSD has investigated approaches to complying with the TBPEL. Those investigations indicate that constructing a new effluent outfall line to Gilbert Bay is in the District's best interest to comply with the new phosphorus standard. The new outfall is designed to convey 34 million gallons per day (mgd) which exceeds current influent flows and provides capacity for new growth.
2. **Replace Primary Clarifiers 1 and 2.** These units were constructed as part of the original plant and, as such, are more than 60 years old. The tanks and building are undersized for projected future flows and do not meet seismic requirements. The new units will provide capacity and redundancy required for future flows.

Collection System Modifications

Collection system improvements are planned to better serve the District and provide increased capacity. These changes include new and enlarged collection system lines delivering flows to the plant. Pipeline rehabilitation projects, including ultraviolet (UV) cured-in-place pipe (CIPP) lining and sliplining, are also planned to increase the life of old pipelines that would otherwise need replacement.

Cost of Improvements

This IFFP provides cost estimates for each of the proposed improvements planned by the District. For those elements already under design or construction, the project costs used are actual contract costs the District has incurred. For planned future projects, costs are estimated.

The total projected cost for all District projects needing to be constructed by 2032 is $188.0 million, of which $55.8 million is attributed to projected growth within the District. The projected cost of recommended WWTP improvements is approximately $64.3 million, of which $20.7 million is attributed to new growth. Collection system expansion and improvements total $123.8 million, of which $35.1 million is attributed to new growth.

Section 1

Introduction

1.1 Purpose of the Impact Fee Facilities Plan

The Utah Code requires that an IFFP be prepared and adopted before the District, a political subdivision of the State of Utah, can assess impact fees to cover the costs of wastewater treatment and collection infrastructure improvements to accommodate new development. This IFFP was prepared to identify improvements required to provide service for new development activity and to identify the costs of those improvements.

1.2 Background of District and Service Area

The District was formed in 1954 to provide wastewater collection and treatment facilities to areas located within the District boundaries. The District was formed under the provisions of Utah Code Title 17A, Chapter 2, Independent Special Districts. The District is governed by a Board of Trustees appointed by the communities and counties the District serves.

The District covers the northern portion of Davis County and portions of south Weber County and includes the cities of Clearfield, Clinton, Layton, Roy, Sunset, Syracuse, West Point, portions of Kaysville, and Hill Air Force Base (HAFB). The cities and HAFB provide collection systems that collect wastewater from individual properties within their boundaries and convey these flows to District-owned trunk lines. These trunk lines collect and convey wastewater to the District's WWTP in west Syracuse on the edge of the Great Salt Lake near the Antelope Island causeway.

The District's service area and the location of the WWTP are shown in Figure 1-1.

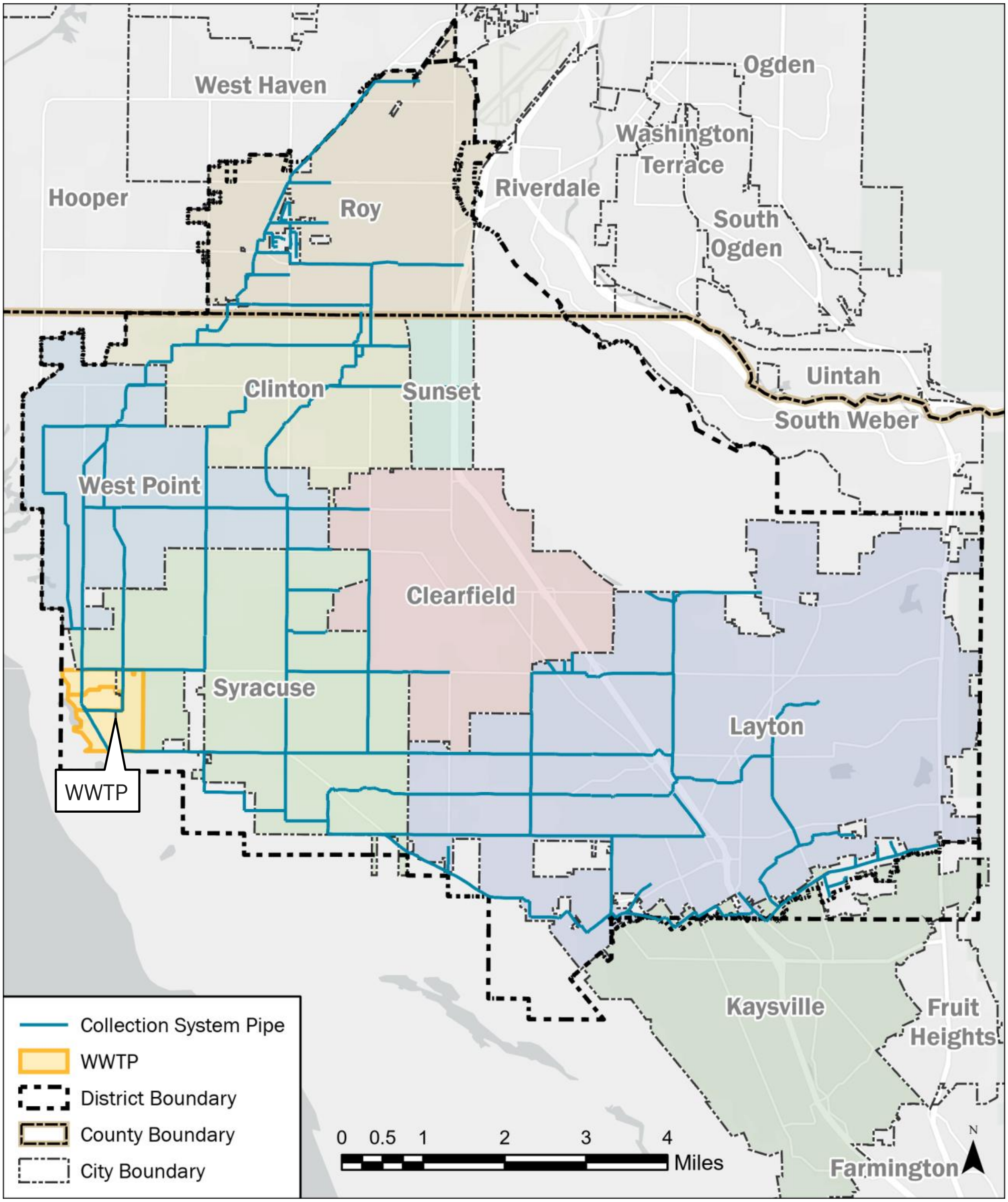

Figure 1-1. District Service Area and Facilities

1.3 Limitations and Certification

This document was prepared solely for the District in accordance with professional standards at the time the services were performed and in accordance with the contract between the District and Brown and Caldwell (BC) dated August 10, 2006. This document is governed by the specific scope of work authorized by the District; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. BC has relied on information or instructions provided by the District and other parties and, unless otherwise expressly indicated, has made no independent investigation as to the validity, completeness, or accuracy of such information.

This IFFP is based on best available information at the time it was prepared, and it assumes the District will follow the improvement plan and schedule as provided herein.

This 2022 IFFP recognizes improvements made since the 2013 IFFP and includes updates from other planning documents. The primary updates to this document include timing of adjustments of the WWTP and collection system projects based on the latest planning data. The addressed improvement projects are inside of a 10-year planning horizon spanning 2022 to 2032.

This 2022 IFFP is based on:

1. Review of past and current master planning documents including review of projects from those master plans already implemented or pending implementation.
2. Review of the 2013 IFFP including work completed or pending.
3. Discussions with plant staff regarding performance of the current system and recently implemented improvements (e.g., primary solids thickening and cogeneration from 2014-2016).
4. Updated average/max month influent flow projections.
5. Detailed review of solids loading to the digesters recognizing previous plans identified needs related to digestion.

Detailed review of condition of facilities, seismic evaluation, detailed consideration for newer technologies, biological train expansion, or detailed analysis of plant peaking factors and optimization was outside the scope of this report. A plant-wide master plan and Capital Facilities Plan update is recommended that incorporates both liquid stream and solid stream future needs including condition considerations such as compliance with current seismic codes. The recommended master plan and capital facilities plan should consider recent or ongoing improvements (e.g., solids handling from 2014-2016, 2018-2019 grit improvements, etc.), collection system improvements (which may impact peaking factors and wastewater character), and pending improvements related to TBPEL requirements.

Section 2

Population and Flows

2.1 Introduction

This section summarizes population and flow projections and shows updated current flows based on plant data.

2.2 Population and Flow Projections

The 2022 Collection System Master Plan Update was based on the latest available planning of buildout conditions within the District's service area. The 2022 plan updated the 2016 Collection System Master Plan with new growth projections, land use planning, flow monitoring, and other data. The 2022 master plan update had a time horizon to buildout, which was defined by the buildout of all vacant land within District boundaries based on land use planning.

The District's computer hydraulic model, developed by BC, was used for the master plan update. The model was calibrated using flow metering data collected in 2021. Calibration was important to update the model with the latest existing flows and to better project future flows.

Existing and future flows were calculated for the following components:

- Dry weather flows. Dry weather flows include the following two components:
  - Groundwater infiltration (GWI). GWI is groundwater that flows through joints and cracks in pipes and manholes. GWI varies by area depending on the condition of pipes and manholes and their location with respect to the local groundwater table. GWI typically stays constant throughout a day but can vary seasonally. GWI was calculated at each flow meter as a percentage of typical dry weather, low, nighttime flows over the period flow metering data was collected. Total existing GWI for each flow meter was then spread out evenly by acre over the drainage area upstream of each meter. Future GWI was calculated using the same GWI per acre as surrounding existing areas. An option that was considered was to reduce GWI per acre for new areas because new piping may have less GWI due to new piping construction. However, over time, pipes and manholes deteriorate, so existing GWI per acre values were used for new areas.
  - Domestic flow. Domestic flow, also called base wastewater flow, is wastewater generated from residential, commercial, industrial, public, and institutional sources that discharges into the wastewater collection system. Domestic flows were calculated as the difference between average dry weather flow at each flow meter minus GWI. Domestic flows were spread out over the drainage area upstream of each meter by using a percentage of average wintertime water billing data collected from each City. Existing domestic flow per acre was calculated for each land use type from existing domestic flows. Those existing flows per acre were then applied to future areas based on projected land use.
- Rainfall dependent inflow and infiltration (RDII). RDII consists of stormwater entering the collection system as the direct inflow of stormwater runoff and rainfall induced infiltration. RDII was calculated in the model by calibrating runoff parameters and the percent of rainfall entering the collection system upstream of each flow meter for several storm events. The RDII runoff parameters for each flow meter were then spread out evenly by acre over the drainage area

upstream of the meter. Like GWI, future RDII was calculated using the same RDII runoff parameters used in surrounding existing areas.

Buildout flows were calculated using land use planning data collected from each community served by the District. Intermediate flows for 2030, 2040, and 2050 interpolated from 2022 and 2060 flows using population projections. Table 2-1 lists historical and projected population for each entity served by the District.

Table 2-1. Historical and Projected Service Area Population

Area	Population Served by Year [1,2]						
	2000	2010	2020	2030	2040	2050	2060 (Buildout)
Clearfield	25,974	30,112	31,909	32,502	33,056	33,995	34,866
Clinton	12,585	20,426	23,386	26,008	27,126	29,100	30,871
Layton	58,474	67,311	81,773	84,894	84,953	90,327	94,942
Roy	32,885	36,884	39,306	41,890	43,876	44,739	44,618
Sunset	5,204	5,122	5,475	5,485	5,509	5,599	5,678
Syracuse	9,398	24,331	32,141	34,975	39,855	46,479	53,389
West Point	6,033	9,511	10,963	16,326	24,541	30,326	36,554
Hill AFB [3]	4,785	3,310	3,054	3,054	3,054	3,054	3,054
Kaysville [4]	Unknown	Unknown	784	820	855	891	926
Hooper [4]	Unknown	Unknown	78	80	83	85	87
West Haven [4]	Unknown	Unknown	21	24	26	29	32
Davis County [4, 5]	Unknown	Unknown	670	587	504	420	337
Weber County [4,6]	Unknown	Unknown	450	337	225	112	0
Total			230,010	246,982	263,663	285,156	305,354

1. Values in green are from the US Census records (US Census Bureau 2022).

2. Estimates for 2030, 2040, 2050, and 2060 are from the State of Utah "2012 Baseline Projections, Sub-County Population Projections" (Governor's Office of Management & Budget 2015). These values have not been updated since 2012.

3. On-base population values for Hill AFB for 2000 and 2010 are from US Census records for zip code 84056. Estimates for 2018 through 2060 are from November 2015 emails from Krista Ligman, a Hill AFB Community Planner. The population went down in 2014, will go down more in 2015, and is projected to stay at a constant population in the future.

4. These areas are only partially served by the District, so census values could not be directly used. The 2018 values are calculated based on the number of occupied parcels (as determined by aerial photography) served by the District and the US Census 2010 average household size for each community. Values for 2000 and 2010 are unknown because the number of occupied parcels for 2000 and 2010 is unknown. Values for 2060 were calculated assuming that all unoccupied parcels would be occupied (assuming buildout). Values for 2020 through 2050 were interpolated from the 2018 and 2060 values.

5. The Davis County population is projected to go down as County parcels are incorporated into neighboring cities.

6. The Weber County parcels are projected to eventually become part of Roy City.

Figure 2-1 shows the average monthly WWTP influent for 2013 through 2021. The trendline of flows shows a consistent plant influent despite increasing population. This trendline is likely due to the increased implementation of low-flow technologies, ongoing collection system rehabilitation efforts, and persistent lower than historic precipitation which had historically recharged the shallow groundwater leading to infiltration. Table 2-2 lists existing and future flows. For the purposes of this project, buildout flows are projected to occur in 2060. The flow projections are based on projected land use for vacant areas within the District's boundary.

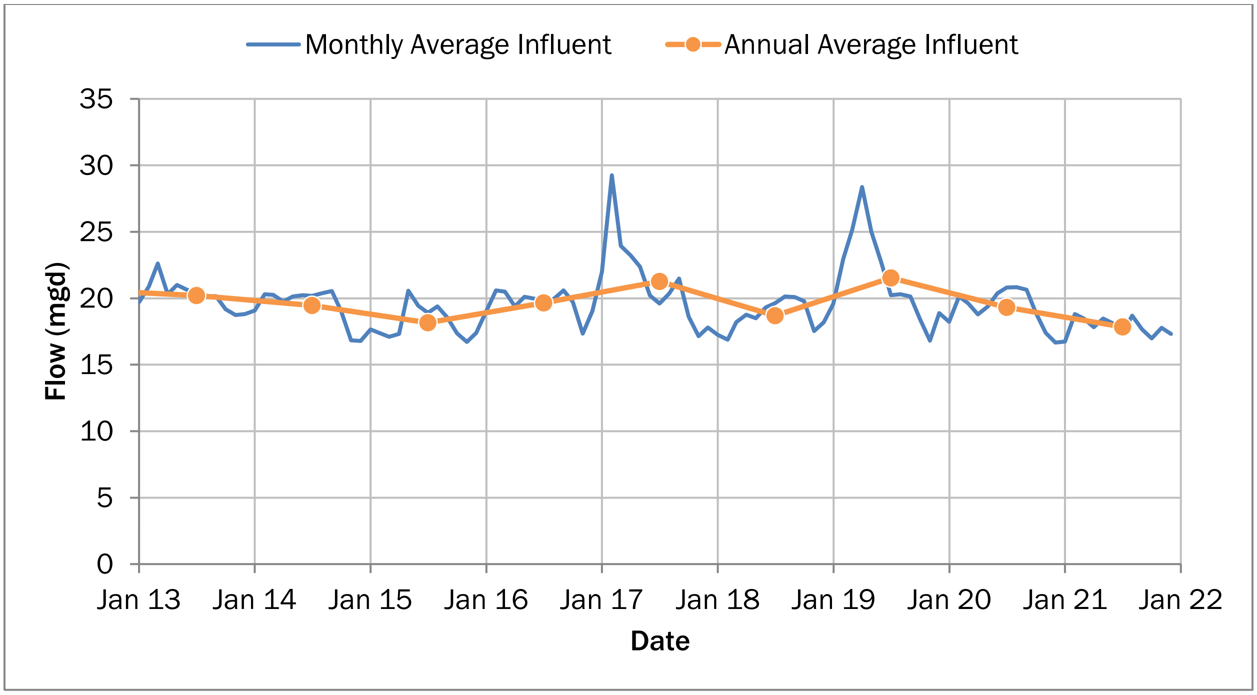

Figure 2-1. Average Monthly Plant Influent from 2013 to 2021

Table 2-2. Existing and Future Flows

Flow Condition	Flow (mgd) [1]											
	2013	2014	2015	2016	2017	2018	2019	2020	2030	2040	2050	2060
Residential, Commercial, Industrial Domestic Flow [2]									21.0	22.3	24.0	25.5
Dry Weather Groundwater Infiltration (GWI) [2]									6.8	7.3	7.9	8.4
Total Average Dry Weather [2]								19.3	27.8	29.6	31.9	33.9
Peak Dry Weather [2]									41.9	43.8	46.3	48.4
Rainfall Dependent Inflow and Infiltration (RDII) [2]									24.7	26.8	29.7	32.8
Peak 10-Year Storm [2]									52.5	56.4	61.6	66.7
WWTP Hydraulic Design Basis												
Average Daily Flow	20.2	19.5	18.2	19.7	21.3	18.7	21.5	19.3	27.8	29.6	31.9	33.9
Maximum Month [3]	22.6	20.5	20.6	20.6	29.3	20.1	28.4	20.8	31.7	33.7	36.4	38.6
Peak Day [3]	25.6	22.1	27.7	25.8	37.7	25.4	36.0	23.9	37.3	39.7	42.7	45.4
Peak Hour [3]				31.7	45.5	46.1	45.6	48.0	65.1	69.3	74.6	79.3

1. Values shaded in green are actual flows.

2. Flows were estimated for the 2022 collection system master plan update as described above.

3. Peaking factors for 2030 to 2060 projected flows include:

a. Maximum month to average daily = 1.14 (from monthly data from 2014-2018)

b. Peak day to average daily = 1.34 (from 2013 IFFP for 2007-2009)

c. Peak hour to average daily = 2.34 (from 2013 IFFP for 2007-2009)

Table 2-3 provides projected 2020 flows on a per equivalent residential unit (ERU) basis for each flow period. The District calculated that they served 83,510 ERUs in 2020.

Table 2-3. 2020 ERU Flows

Parameter	Flow (mgd)	ERUs	Equivalent Gallons per Day
Average Daily flow	19.3	83,510	231
Maximum Month	20.8	83,510	249
Peak Day	23.9	83,510	286
Peak Hour	48.0	83,510	575

Section 3

Wastewater Treatment Plant Improvements

The capital facilities presented in this IFFP were compiled from recommendations provided in the 2013 IFFP. The 2013 IFFP included information from the most recent treatment planning effort including the Biosolids Master Plan (BC 2011). Also included are capital improvements related to TBPEL requirements and from discussions with NDSD staff. Section 1 provides further details on data reviewed for this 2022 IFFP.

3.1 Process Overview

The District's WWTP treats municipal wastewater utilizing primary clarifiers followed by a trickling filter/solids contact process. The primary clarifiers remove a substantial amount of the influent biochemical oxygen demand (BOD) and total suspended solids (TSS) load as primary sludge while the trickling filter/solids contact process yields secondary sludge. Both primary and secondary sludge are subsequently stabilized by anaerobic digestion prior to thickening and dewatering.

3.2 Liquid Treatment Process

The following sections describe projects anticipated during the 10-year planning horizon described in this IFFP. The actual timing will be subject to further detailed review of plant performance and influent flow and loading characteristics.

3.2.1 Headworks

The District's headworks consists of four step screens and two mechanical grit removal units. At current flows, NDSD runs three of their four screens. Both screening and grit removal have sufficient capacity to meet projected peak hour flows in 2030.

3.2.2 Influent Pump Station

After screening and grit removal, influent is pumped to four primary clarifiers. The influent pump station has six pumps. Four pumps are rated for 22 mgd and two pumps are rated for 18 mgd. Currently, NDSD only utilizes three pumps, and based on projected 2030 peak hour flows, NDSD will be able to continue running only three pumps into 2030 with an excess capacity of 37 percent or 38 mgd.

3.2.3 Primary Clarifiers

Primary clarifiers 1 and 2 were built in the early 1950s and 1960s, respectively, and are beyond their useful design life of 50 years. These clarifiers are 135 feet in diameter with a 7-foot side water depth (SWD). Primary clarifiers 3 and 4 are newer at 150 feet in diameter and have a SWD of 12 feet. R317-3-6 recommends that primary clarifiers have no less than an 8-foot SWD. R317-3-6 further recommends surface overflow rates for primary clarifiers be between 600 and 1,000 gallons per day (gpd) per square foot (sf) on a maximum month design basis depending on the plant size with the guidance/criteria for NDSD (> 1 mgd) being 1,000 gpd/sf. This loading criterion is a guide for performance where actual performance depends on clarifier geometry and wastewater characteristics. NDSD reports the units currently perform in a satisfactory manner.

Assuming a conservative loading criteria of 800 gpd/sf, the capacity of the existing larger and smaller primary clarifiers with the largest unit out of service is 37.0 mgd. This capacity is expected to be exceeded during maximum month conditions between 2040 and 2050 and on a peak day basis between 2030 and 2040.

NDSD is showing replacement of primary clarifiers 1 and 2 on their Capital Funding Projections in the 2026-2028 period. Replacing the smaller units with two 150 feet diameter units (12-foot SWD) will increase the firm capacity from 37.0 to 42.4 mgd (using 800 gpd/sf criteria) which will provide capacity beyond 2050.

3.2.4 Biotowers, Trickling Filters, and Solids Contact Process

NDSD uses biotowers, trickling filters, and a solids contact process to remove BOD and nutrients from the influent after primary clarification. These processes are currently operating at 50 percent of the total design capacity. In 2030, the biotowers and trickling filters are expected to have 18.4 percent remaining capacity when treating the projected 2030 peak day flow while the solids contact process will have 9.6 percent remaining capacity when treating the projected 2030 max month flow. As a result, these processes do not need to be expanded or improved to meet projected 2030 flows.

3.2.5 Final Clarifiers

After the biotowers, trickling filters, and solids contact process, the treated influent then flows to four final clarifiers. When treating the projected 2030 peak day flow, the four clarifiers are expected to have an excess capacity of 23.5 percent.

3.2.6 Chlorine Contact Basins

The last step in the liquid treatment process is chlorine disinfection. NDSD has four chlorine contact basins which are expected to be able to treat the projected 2030 peak day flow with an excess capacity of 34.2 percent.

3.2.7 Technology Based Phosphorus Effluent Limit (TBPEL)

The Utah Water Quality Board adopted a new rule for control of phosphorus discharges into waters of the state that became effective January 1, 2015. The TBPEL Rule, R317-1-3.3 requires that discharges having reasonable potential to discharge phosphorus implement new water quality monitoring requirements by July 1, 2015 and requires that these dischargers meet specified effluent limits by January 1, 2020. The District submitted a request to the Utah Division of Water Quality seeking a variance to the TBPEL implementation in December 2017. In January 2019, the State of Utah gave a public notice of its intention to grant the variance.

To meet the new TBPEL, the WWTP effluent discharge is being relocated from Farmington Bay to Gilbert Bay of the Great Salt Lake (Jacobs 2019). This alternative eliminates the need for process upgrades at the WWTP and instead will construct a new outfall (Outfall 003) in Gilbert Bay and use the existing Outfall 001 as an emergency overflow location. A pump station and pipeline to Outfall 003 have been sized to initially convey 34 mgd. The pump station will have capacity to handle the projected average daily flow through 2050 of 31.9 mgd (see Table 2-2). High flows, such as during storm events or when daily peak dry weather flows exceed 34 mgd (projected to occur by 2030 per Table 2-2), will be directed to Outfall 001. In the future, as influent flows increase beyond the projected 2050 average daily flow, the pumps can be replaced with larger units to convey higher flows to Outfall 003.

In addition to the outfall relocation, the District will be conducting process optimization, permitting, and nutrient studies for the WWTP. It is anticipated these improvements related to the TBPEL will need to be operational by 2025 to meet the District's variance requirements.

3.3 Biosolids Treatment Process

The projected primary sludge load and secondary sludge load were used to evaluate existing solids handling capacity and to determine recommended improvements as part of the 2011 Biosolids Master Plan. To evaluate the capacity of specific unit operations, the following sludge loading criteria were developed for current operations to assess the systems:

1. **Average annual.** This represents the base operating condition of processes during a typical year. Maintenance often occurs during these base loading conditions, instead of during maximum loads, to avoid reducing available capacity during maximum loading conditions. For this analysis, it was assumed that the District would service its digesters and other equipment at average annual flows and loads.
2. **Maximum 14-day average.** The maximum 14-day average flow and load approximates the time frame of a primary process limitation of anaerobic digestion, which gives a limitation of a minimum hydraulic residence time (HRT) of 15 days.
3. **Maximum day.** The maximum day flow and load is used to evaluate the dewatering process, assuming significant maximum saving is not available through storage.

The 2021 solids loading data shows an average annual solids loading of 46,414 pounds of total solids per day (lbs-TS/day) with a maximum daily of 74,408 lbs-TS/day and a standard deviation of 6,959 lbs-TS/day. Outliers greater and less than three standard deviations were removed. Data from 2016 to 2021, as shown in Figure 3-1, show the average solids loading rate over the last five years has been consistent with a decrease in variability. However, it is expected that solids loading will increase in the future with increased population growth.

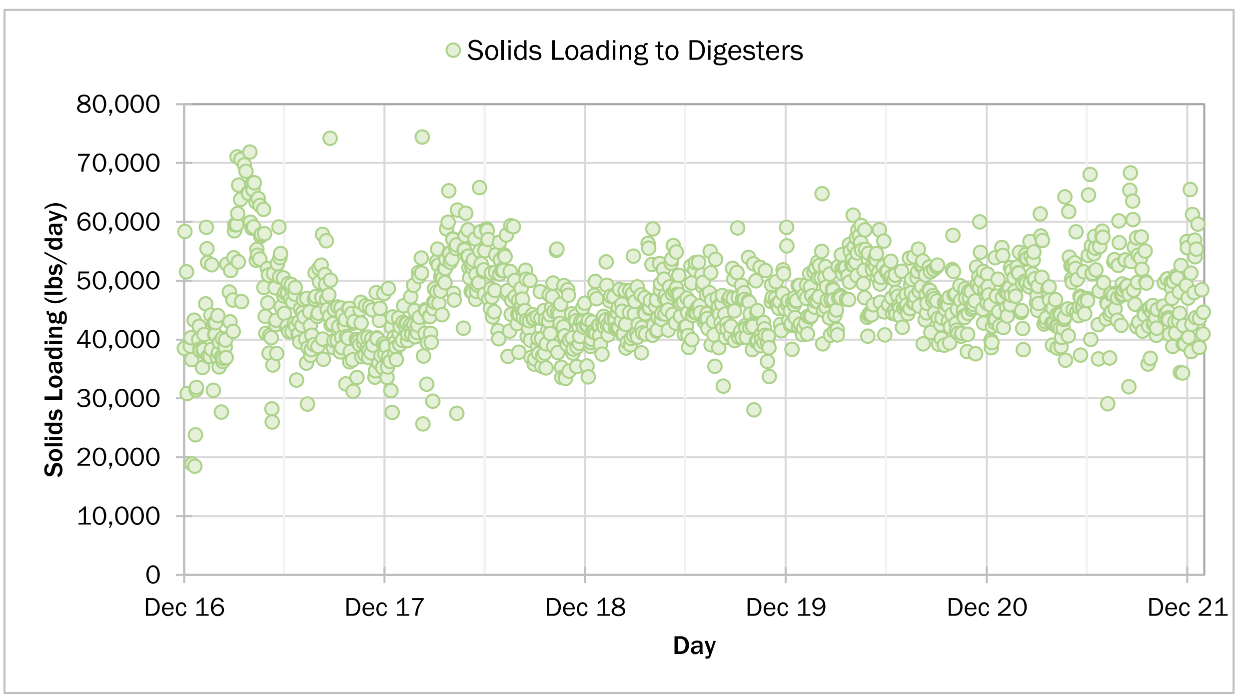

Figure 3-1. Solids Loading to Digesters from December 2016 to 2021

3.3.1 Solids Peaking Factors

To assess the capacity and sizing of existing and planned processes and equipment at the WWTP, a variety of maximum loading conditions were developed. Peaking factors for solids loading were developed by evaluating the WWTP data outlined above from December 1, 2016 to December 31, 2021. Using this large dataset mitigates the risk of underrepresenting maximum flows and loads the WWTP can receive. Table 3-1 summarizes the peaking factors used in this IFFP.

Table 3-1. North Davis Sewer District Solids Loading Peaking Factors

Parameter	Annual Average	Max Day	Max 7-day	Max 14-day	Max 30-day
Blended Sludge [1]	1.00	1.60	1.50	1.47	1.38

1. Blended sludge values were calculated directly from daily solids loading values.

3.3.2 Projected Solids Loading for Design Year 2030

To estimate the change in solids loading over time, it was assumed that solids production would increase proportionally to the expected increase in population in the service area as presented in Section 2.2. Based on Table 2-1, a 7.4 percent increase in population from 2020 to 2030 was used in this assessment. It should be noted that using this approach does not account for any industries entering the service area or changes in the plant process that may increase or reduce sludge production or solids loading to the digesters.

The current average and future solids loading, presented in Table 3-2, serve as the basis of all system evaluation in this IFFP.

Table 3-2. Summary of Projected Flow and Load Estimates for Blended Sludge (Digester Feed)

Parameter	2020 Load	2030 Projected Loads [1]				
	Average Annual	Average Annual	Max 30-day Average	Max 14-day Average	Max 7-day Average	Max Day
TS, lb-TS/day	48,133	49,800	69,000	73,000	74,900	79,900
Volatile solids (VS), lb-VS/day	39,737	40,400	45,300	59,200	60,700	64,700
Volatile fraction, lb-VS/lb-TS	81.0%	81.0%	81.0%	81.0%	81.0%	81.0%
TS concentration, lb-TS/lb-sludge	5.1%	5.1%	5.1%	5.1%	5.1%	5.1%
Flow (gpd)	108,570	116,600	130,700	170,800	175,100	186,900

1. Assumes sludge production growth is proportional to population growth; there will be no significant shift in the commercial, residential, and industrial composition of the service area for the planning period; and the main treatment processes current operation will continue in terms of efficiency and sludge yield.

3.3.3 Thickening Capacity Evaluation

The District currently co-thickens both primary sludge and waste activated sludge (WAS) using rotary drum thickeners. NDSD is planning to add one rotary drum thickener in 2024 (Table 3-5). With the addition of one rotary drum thickener, total thickening capacity (three rotary drum thickeners) will meet projected loads in 2030.

3.3.4 Digester Capacity Evaluation

Biosolids treatment facilities must provide sufficient firm capacity to treat the projected loads presented in Table 3-2 while complying with the State of Utah Division of Water Quality rules (Utah Administrative Code R317 design requirements) as well as federal requirements governing biosolids treatment and disposal (40 CFR 503). These requirements mandate a minimum of 15 days solids retention time (SRT) under mesophilic temperatures and a maximum mesophilic organic loading rate (OLR) of 0.12 pounds of volatile solids per cubic foot (lb VS/ft^3).

However, the District's Utah Pollutant Discharge Elimination System (UPDES) permit currently states that biosolids may be stabilized in the anaerobic digesters for at least 15 days at a temperature of at least 35°C (95°F). Digested solids are mechanically dewatered with belt filter presses and then stored in drying beds or transported to the District's remote biosolids drying/processing site. The solids may be windrowed and turned to achieve additional drying on the concrete storage pad. Straw or other acceptable amendments may be added to the solids to facilitate drying and processing. Solids on the storage pad continue to dry and are exposed to sun and environmental elements to complete the Class B Biosolids stabilization process (40 CFR 503.33(b)(1)).

This IFFP evaluated conventional anaerobic digestion at mesophilic conditions. Mesophilic design parameters are generally established to produce a Class B biosolids product by achieving a minimum temperature of 95°F and a minimum detention time of 15 days.

Given the process flows and loads projections described above, the required capacity of the digestion process was evaluated. The operating limits of the digestion system were based on the following flow and loading conditions:

1. **Annual Average.** This represents operation under annual average conditions.
2. **Max 14-day with all in service.** This loading condition is used to evaluate the peak loading condition to the digestion process.
3. **Max 30-day with one unit out of service.** This represents operation under a planned service outage for digester cleaning, equipment service, etc. Max 30-day is a more conservative approach and is an indicator of performance for 11 out of 12 months of the year.

This evaluation was completed under current operating conditions. An active volume of 1.0 mgd was used for the analysis assuming a ten percent derating or allowance reserved for any inefficiencies (i.e., mixing and grit accumulation). Volume expansion was not considered as it has not been a significant issue for NDSD. However, should any inefficiencies arise, each digester has a ten percent capacity allowance.

Note that using these loading criteria does not protect the digestion system against a catastrophic failure such as a toxic contaminant load leading to process upset. In such an event, the plant would need to haul excess solids to alternative disposal points until the process can be stabilized and/or recovered. It has been BC's experience that this level of process protection/redundancy is well accepted within the industry.

The resulting digester sizing requirements are provided in Table 3-3.

Table 3-3. Digester Process Volume Requirements					
Parameter	Criteria	Number of Mesophilic Digesters	Size/Volume (MG)	SRT (days)	Organic Loading Rate (lbs-VS/ft^3-day)
2020 Load Max 14-day Average	Max Loading	4	1	25.1	0.106
	Service Condition	3		18.9	0.141
	Annual Average	4		36.8	0.072
2020 Load Max 30-Day	Max Loading	4		32	0.083
	Service Condition	3		24	0.110
	Annual Average	4		36.8	0.072
2030 Load Max 14-day Average [1]	Max Loading	4		23.9	0.108
	Service Condition	3		17.9	0.145
	Annual Average	4		35.0	0.074
2030 Load Max 30-Day [1]	Max Loading	4		30.6	0.085
	Service Condition	3		22.9	0.113
	Annual Average	4		34.3	0.076

1. Assumes sludge production growth is to be proportional to population growth; there will be no significant shift in the commercial, residential, and industrial composition of the service area for the planning period; and the main treatment processes current operation will continue in terms of efficiency and sludge yield.

All current and projected loading scenarios show that the solids retention time will remain above the minimum detention time requirement of 15 days. Thus, the current digesters provide sufficient capacity to meet the required 15-day mesophilic SRT at 2030 design evaluation conditions. Additionally, under the evaluated maximum loading scenarios (max 14-day with all in service and max 30-day with one out of service), there is sufficient organic capacity to stay below the 0.12 lb VS/ft^3 design criteria for mesophilic anaerobic digestion outlined in the Utah Administrative Code. However, during max 14-day loading conditions, current and 2030, there is not sufficient organic capacity, based on the Utah Administrative Code, to take one digester out of service and comply with the loading criteria. BC's experience with mesophilic digestion is that the excursion in loading rate would not represent a significant risk as it relates to process stability nor present any risk to permit compliance. Further, if maintenance is performed on the digesters on a scheduled basis, a common practice among wastewater utilities, this condition can be avoided. Therefore, all planned maintenance should be completed during known lower flow periods.

3.3.5 Dewatering Capacity Evaluation

This IFFP also evaluated the current dewatering process at the District's WWTP. The current dewatering process includes two belt filter press units. Each unit has a 2-meter belt and receives approximately 200 gallons per minute (gpm) of digested sludge at a concentration in the range of 2 to 3.5 percent solids. The two units have a combined capacity of 96,000 lbs total solids per day (lbs-TS/day) when operated at 16 hours per day giving an individual loading capacity of 3,000 lbs-TS/hour and combined capacity of 6,000 lbs/hour. In addition, each unit is assumed to have a maximum hydraulic capacity of 200 gpm with a combined hydraulic capacity of 400 gpm.

To evaluate the dewatering process, annual average and max day flow and load conditions were used to define the operating limits of the system, including solids and hydraulic capacities. The solids capture rate was assumed to be 95 percent. An operational schedule of seven days and six hours per day was assumed based on the 2011 Biosolids Predesign report (BC 2011). The resulting dewatering sizing requirements are provided in Table 3-4.

Table 3-4. Dewatering Process Requirements

Parameter	2020 Load Annual Average [1]	2020 Load Max Day [1]	2030 Load Annual Average [1,2]	2030 Load Max Day [1,2]
Number of belt filter presses	2	2	2	2
Solids loading (lbs/hour)	1,486	2,382	1,633	2,618
Hydraulic loading (gpm)	113	181	121	195
Loading utilization (%)	25%	40%	27%	44%
Hydraulic utilization (%)	28%	45%	30%	49%

1. Based on operation at seven days per week and 16 hours per day.

2. Assumes sludge production growth is proportional to population growth; there will be no significant shift in the commercial, residential, and industrial composition of the service area for the planning period; and the main treatment processes current operation will continue in terms of efficiency and sludge yield.

Results of this evaluation indicate that the two current belt filter press units meet current and 2030 projected annual average and max day solids and hydraulic demand for flows and loads.

3.4 Wastewater Treatment Plant Improvements

Table 3-5 summarizes recommended WWTP projects with the anticipated year of construction and total estimated construction costs. The costs and timing were updated based on the District's 2020 15-Year Capital Project Funding Projections, which is updated yearly by the District. The costs are budgetary values that should be revised during planning and detailed design. The budgetary construction cost estimates can vary significantly from actual construction bid prices depending on competition, bid market, and labor and materials costs at the time of bidding.

Table 3-5. Wastewater Treatment Plant Projects

Project	Anticipated Year of Construction	Estimated Construction Cost [1]	Need
Performance/Permitting/Nutrient Studies	2022	$460,000	Final planning to meet TBPEL requirements; increases level of service and addresses growth
TBPEL - Discharge Relocation to Gilbert Bay	2026	$42,000,000	Comply with TBPEL including growth
Biosolids Master Plan Update	2025	$150,000	Incorporate performance of plant from 2014 improvements, consider biosolids alternatives to address growth
Replace Primary Clarifiers 1 and 2	2026-2028	$14,681,000	Replace two aging (50+ year old) primary clarifiers and increase capacity for new growth
Digesters 1 and 2 Cover Replacement	2024-2025	$6,000,000	Replace two aging primary digester covers for existing primary digesters
Rotary Drum Thickener Addition	2024	$1,000,000	Replace two existing gravity belt thickeners with one rotary drum thickener for waste activated sludge handling

1. Costs are from the 2020 NDSD 15-Year Capital Project Funding Projections and are based on previous planning documents. Costs are considered Class IV planning level estimates based on construction estimates from the 2020-2021 period. Actual future costs may be different and will need to be escalated for the time of construction.

Section 4

Collection System Improvements

This section summarizes past and future recommended improvements for the collection system. Improvements were based on recommendations from the District's collection system master plans. The history of collection system master planning is also discussed in this section.

4.1 Master Plan Updates

The District's original collection system Master Plan and updates have included:

1. February 1990. This first Master Plan evaluated the system's capacity at that point in time and provided a plan for serving future development. The plan was based on a planning period of 20 years and reflected projected growth and associated wastewater flows through 2010. The original master planning effort included a significant amount of facility inventory and fieldwork, such as locating and inspecting pipes and manholes.
2. January 1998. This update to the original Master Plan did not revisit the capacities of the existing collection facilities or system model. The future improvements detailed in the original plan were updated based on buildout conditions, and the future plan incorporated improvements to the collection system constructed after the original Master Plan was completed.
3. May 2005. This update incorporated improvements to the collection system built after 1998 and the latest facility inventory data. The update was based on the latest available planning of buildout conditions within the District's service area.
4. December 2010. This update was done to reflect new collection system projects and better collection system data. Between 2005 and 2010, the District surveyed the entire collection system using new global positioning system (GPS) equipment, and the information was entered into a geographic information system (GIS) database. Using this more accurate information, the hydraulic model was updated to provide a more accurate assessment of collection system capacity and shortfalls (BC 2010).
5. October 2016. After the 2010 update, the model was continuously updated. This update used the latest model and was done to analyze the continued growth that was occurring within the District's service area (BC 2016).
6. October 2018. This addendum to the 2016 Master Plan update was prepared to plan for worsening conditions in remaining unlined large-diameter concrete sewer lines and other maintenance requirements (BC 2018).
7. 2022. At the time of this IFFP, an update to the collection system master plan was being prepared. Recommended projects from the 2022 update are included in this IFFP.

In addition to the Master Plan updates, a condition assessment and asset management program was initiated in 2011 to evaluate and prioritize the rehabilitation needs of the collection system piping and manholes.

4.2 Recent Collection System Projects

Table 4-1 lists improvements to the collection system since 2010.

Table 4-1. Pipeline Improvement Projects Since 2010		
Project	Materials	Year Constructed
6000 South Lining	Ultraliner PVC	2010
South Outfall Replacement Sewer (Bluff Road to 1000 South)	HOBAS	2012
Ned Giles	RCP	2012
District re-route	RCP	2013
Lining Project 1	HOBAS, UV CIPP	2013
Lining Project 2	HOBAS, UV CIPP	2014
East Outfall Replacement Phase I	HOBAS	2015
2300 North Sewer Replacement	SDR 35 PVC	2015
Lining Project 3	UV CIPP	2015
Lining Project 4	HOBAS, UV CIPP	2016
Lining Project 5	HOBAS, UV CIPP	2017
West Point Realignment	HOBAS, UV CIPP	2017
East Outfall Replacement -Phase 2A	HOBAS	2018
Masterplan 2B Line Upgrade / Kays Creek Crossing	HOBAS	2018
Lining Project 6	HOBAS, UV CIPP	2018-2019
Master Plan 2A & 2B Project, I-15 Crossing, Main Street, and Kays Creek	HOBAS, UV CIPP	2018
Lining Project 7	Flowtite, UV CIPP	2019
Lining Project 8	UV CIPP	2020
East Outfall Phase 3 and 5600 South	C900 PVC	2020
East Outfall Phase 3 and 5600 South	HOBAS	2020
East Outfall Phase 3 and 5600 South	HOBAS	2021
1800 North Replacement	HOBAS	2021
Lining Project 9	UV CIPP	Under construction
Lining Project 10	UV CIPP	Under construction
Mutton Hollow Replacement	HOBAS	Under construction

4.3 Model Analysis

For the 2022 Collection System Master Plan update, flows in the model were updated and the model was analyzed to identify deficiencies in the collection system. The flows for the existing system were updated based on flow metering data collected in 2021. The model was calibrated to match the flow metering data for dry and wet weather conditions. The buildout scenario in the model was updated to match the buildout land use plans from each community served by the District and from the population projections listed in Table 2-1.

The existing and buildout scenarios were run for dry weather flows and 10-year design storm wet weather flows. The scenario results were analyzed, and locations with deficiencies were then identified. For the existing and buildout scenarios, the model did not predict any deficiencies under dry weather flow conditions. The model predicted deficiencies under wet weather conditions for a few areas throughout the collection system. Improvement projects were developed for those deficiencies as described below.

4.4 Recommended Improvements

Improvement projects were identified to address the deficiencies identified by the hydraulic model and condition assessment program. The proposed improvements were prioritized based on conditions such as the magnitude of the deficiencies, timing of other District projects, and the sequencing of projects (e.g., downstream to upstream where necessary). The construction start dates were selected based on the prioritization of the projects and their hydraulic importance.

Table 4-2 lists the projects along with their proposed project construction dates and the estimated costs for each project. Costs for projects were estimated for the 2022 Master Plan Update. The improvement projects are shown in Figure 4-1. The costs are budgetary values that should be revised during planning and detailed design. The budgetary construction cost estimates can vary significantly from actual construction bid prices depending on competition, bid market, and labor and materials costs at the time of bidding.

Table 4-1. Recommended Collection System Improvement Projects

Project	Anticipated Year of Construction	Estimated Construction Cost [1]
Master Plan Update	2027	$400,000
Master Plan Update	2032	$400,000
Collection System Engineering	2023-2032	$1,000,000
Lining Project 11	2023	$13,927,000
Lining Project 12	2024	$10,815,000
Lining Project 13	2025	$24,007,000
Lining Project 14	2026	$33,497,000
Lining Project 15	2027	$3,142,000
Hill Field Road	2023	$9,186,000
Fairfield Road	2024	$5,324,000
1800 North Phase 2	2024	$681,000
East Outfall Phase 4	2028	$7,695,000
East Outfall Phase 5	2029	$7,997,000
Reverse Grade Replacement	2030	$5,686,000

1. Costs are considered Class IV planning level estimates based on construction estimates in the 2020-2021 period. Actual future costs may be different and will need to be escalated for the time of construction.

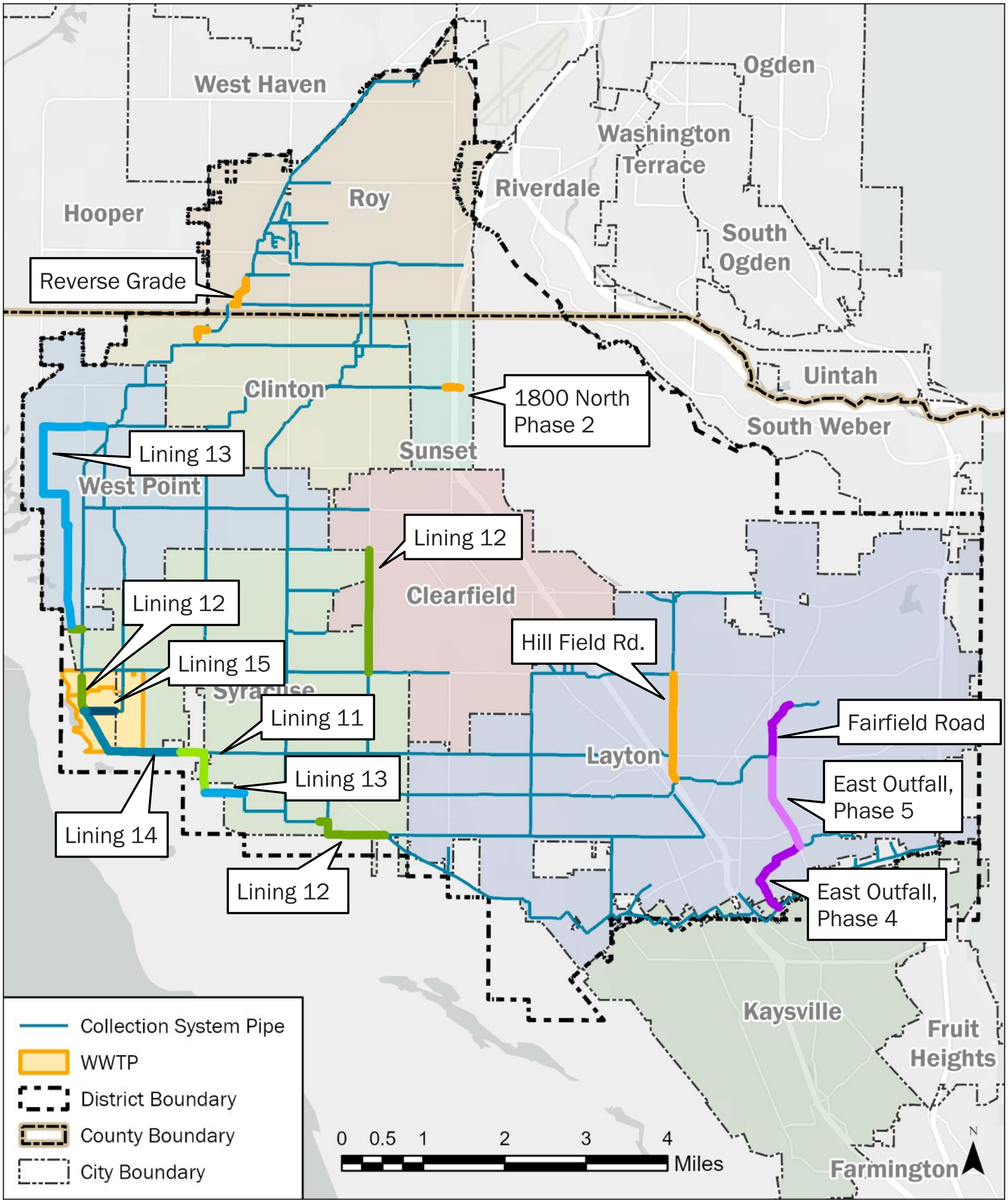

Figure 4-1. Recommended Collection System Improvements

Section 5

Cost Summary

This section presents a summary of costs for future capital improvements that are being made to the WWTP and collection system. The WWTP improvements are primarily for process improvements and to conform to existing and projected regulatory requirements.

The capital facilities costs for both plant and collection system projects are summarized below. The year the projects are scheduled to be constructed, along with the breakdown of cost among rehabilitation, replacement, and new growth, are also presented.

The estimated costs listed throughout this report are budgetary planning-level costs and can vary between +50 percent and -30 percent. The costs reflect average construction costs from the year each cost estimate was done as listed in the footnotes for each table in this report. When available, unit costs were developed from bid tabs on projects recently constructed for the District. Unit costs provided by the District were reviewed and updated based on current industry costs by BC's Construction Cost Estimating Group. Allowances for construction contingency and professional services are included in the cost estimates. At the time of this report, inflation was significantly higher than three percent and material and labor costs were also highly variable.

5.1 Cost Breakdown

The costs for each WWTP and collection system project were broken down into the following three categories to separate costs related to new growth (and new regulations) from costs related to maintaining existing treatment capacity:

1. **Rehabilitation.** Costs to extend the life and capacity of existing treatment or piping systems that can continue to be used into the future.
2. **Replacement.** Costs for replacing existing plant or pipe capacity and facilities that will serve into the future. Replacement needs at the WWTP are primarily due to the change in the type of treatment process employed at the plant and the removal and replacement of obsolete processes and equipment. Replacement needs for the collection system primarily include collection system piping that are not required for increased future flows due to growth.
3. **New growth.** Costs for new facilities to provide treatment or pipe capacity beyond the rated capacity of facilities as of 2019.

Costs attributable to new growth can be paid for by impact fees collected from new users of the treatment system, while those related to maintenance (rehabilitation and replacement) are paid for by ongoing user fees and taxes. Table 5-1 lists the costs for each recommended improvement along with a breakdown of the costs related to rehabilitation, replacement, or new growth. An explanation of how the cost breakdowns were calculated for the WWTP and collection system projects are explained below.

Table 5-1. Capital Facilities Cost Summary								
Project	Year	Total Cost [1]	Rehabilitation		Replacement		New Growth	
			%	Cost	%	Cost	%	Cost
WWTP Expansion and Improvement Projects								
Performance/Permitting/Nutrient Studies	2022	$460,000	-	-	88%	$404,800	12%	$55,200
TBPEL - Discharge Relocation to Gilbert Bay	2026	$42,000,000	-	-	57%	$23,940,000	43%	$18,060,000
Biosolids Master Plan Update	2025	$150,000	-	-	-	-	100%	$150,000
Replace Primary Clarifiers 1 and 2	2026-2028	$14,681,000	-	-	87%	$12,772,470	13%	$1,908,530
Digesters 1 and 2 Cover Replacement	2024-2025	$6,000,000	-	-	100%	$6,000,000	-	-
Rotary Drum Thickener Addition	2024	$1,000,000	-	-	50%	$500,000	50%	$500,000
TOTAL PLANT PROJECTS (excluding contingent projects)		$64,291,000		-		$43,617,270		$20,673,730
Collection System Projects								
Master Plan Update	2027	$400,000	-	-	-	-	100%	$400,000
Master Plan Update	2032	$400,000	-	-	-	-	100%	$400,000
Collection System Engineering	2023-2032	$1,000,000	10%	$100,000	15%	$150,000	75%	$750,000
Lining Project 11	2023	$13,927,000	86%	$11,977,000	-	-	14%	$1,950,000
Lining Project 12	2024	$10,815,000	75%	$8,112,000	-	-	25%	$2,704,000
Lining Project 13	2025	$24,007,000	56%	$13,444,000	-	-	44%	$10,563,000
Lining Project 14	2026	$33,497,000	84%	$28,138,000	-	-	16%	$5,360,000
Lining Project 15	2027	$3,142,000	76%	$2,388,000	-	-	24%	$754,000
Hill Field Road	2023	$9,186,000	70%	$6,430,000	-	-	30%	$2,756,000
Fairfield Road	2024	$5,324,000	90%	$4,791,000	-	-	10%	$533,000
1800 North Phase 2	2024	$681,000	82%	$558,000	-	-	18%	$123,000
East Outfall Phase 4	2028	$7,695,000	59%	$4,540,000	-	-	41%	$3,155,000
East Outfall Phase 5	2029	$7,997,000	41%	$3,279,000	-	-	59%	$4,719,000
Reverse Grade Replacement	2030	$5,686,000	84%	$4,776,000	-	-	16%	$910,000
TOTAL COLLECTION PROJECTS		$123,757,000		$88,533,000		$150,000		$35,077,000
COMBINED PROJECT COSTS		$188,048,000		$88,533,000		$43,767,270		$55,750,730

1. Costs are considered Class IV planning level estimates based on construction estimates from the 2020-2021 period (for WWTP projects) and 2022 (for collection system projects). Actual future costs may be different and will need to be escalated for the time of construction.

5.1.1 Wastewater Treatment Plant

This section provides further detail on how the costs were proportioned between maintaining existing levels of service and new growth.

Performance/Nutrient (TBPEL) Studies. Proportioned based on difference in annual average flow between 2020 (current needs) and 2030 (ten-year planning horizon which spans initial implementation of the TBPEL rules). Proportion to current flow/users: 88 percent, proportion to new growth (to 2030): 12 percent.

TBPEL Improvements (Gilbert Bay Outfall). These improvements represent a new and higher level of service required by DWQ to meet the TBPEL. The base level of service would be the outfall to meet the demands in the year 2020; any capacity provided beyond the 2020 flows could be considered growth related. The average day design capacity proposed for the Gilbert Bay outfall of 34 mgd exceeds the 2020 actual average day demand of 19.3 mgd. The proportional share for the cost of the 34 mgd Gilbert Bay Outfall 003 improvement is 57 percent to meet current needs and 43 percent attributed to growth (ratio of 19.3 mgd to 34 mgd).

Biosolids Master Plan Update. A Biosolids Master Plan Update is needed to review needs to accommodate growth. This project is 100 percent required for new growth.

Primary Clarifiers. Replacing the smaller units with two 150 feet diameter units (12-foot side water depth) will increase the firm capacity from 37.0 to 42.4 mgd (using 800 gpd/sf criteria) which will provide capacity beyond 2050. This proportional share of the new units considering the increased capacity is 87 percent for current demand and 13 percent for new growth.

Digesters 1 and 2 Cover Replacement. This project is 100 percent required to meet current needs.

Rotary Drum Thickener Addition. Replacing the gravity belt thickener with one rotary drum thickener increases thickening capacity from 33,600 lb/day to 66,100 lb/day. The proportional share of the new unit to new growth is 50 percent and 50 percent for current demand.

5.1.2 Collection System

The breakdown of collection system project costs into rehabilitation, replacement, and new growth costs was done by calculating the percent of future flow due to growth. The portion of costs attributable to new growth was estimated based on the percent increase in existing to buildout conditions for each project. See Appendix A for details on how these values were calculated.

Section 6

References

Brown and Caldwell, *Biosolids Master Plan*, 2011.

Brown and Caldwell, *Biosolids Predesign*, 2011.

Brown and Caldwell, *Capital Facilities Plan*, 2012.

Brown and Caldwell, *Capital Facilities Plan – Collection System 2019 Update Technical Memorandum*, 2019.

Brown and Caldwell, *Collection System Master Plan Update*, 2010.

Brown and Caldwell, *Collection System Master Plan Update*, 2016.

Brown and Caldwell, *Future Collection System Projects Technical Memorandum*, 2018.

Brown and Caldwell, *Impact Fee Facilities Plan*, 2013.

Jacobs, *North Davis Sewer District New Outfall Project*, 2019.

Appendix A: Collection System Cost Breakdown

Appendix A

Collection System Cost Breakdown

The breakdown of costs for collection system piping into rehabilitation, replacement, and new growth in Table 5-1 included the following for each project:

- **Master plan updates.** Master plan updates are done to plan for new growth, so they were applied 100% to new growth.
- **Collection system engineering.** The percentages were estimated based on the percent of work done each year for rehabilitation, replacement, and new growth.
- **Pipe lining.** These projects are primarily done for done for pipe rehabilitation but they also extend the life of piping and allow for capacity due to new growth. The breakdown in costs is described below.
- **Pipe replacement projects.** Pipe replacement projects are done for additional capacity due to new growth and for pipe rehabilitation. The breakdown in costs is described below.

Cost Breakdown

Table A-1 shows a summary of each pipe lining and replacement project and the percentage of that project that is attributed to rehabilitation and new growth. The table has the following columns:

1. **Project.** The name of the improvement project.
2. **Length.** Total length of piping for the project.
3. **Weighted Average Wet Weather Flow (WWF), Existing/Buildout.** The average existing and buildout WWF flow for each project. This was calculated as the weighted average flow for each pipe segment listed in Table A-2.
4. **WWF Increase.** Difference between existing and buildout summed weighted WWF.
5. **Percent Due to New Growth.** The percent of WWF increase due to new growth. This was calculated as the WWF Increase / Buildout WWF.
6. **Percent Due to Rehabilitation.** The percent of WWF increase needed for rehabilitation. This was calculated as 100% minus % due to growth.

Table A-1. Capacity Increase Due to Growth						
Project	Length (feet)	Weighted Average WWF (mgd)		WWF Increase (mgd)	% Due to Growth	% Due to Rehab
		Existing	Buildout			
Lining Project 11	4,153	19.71	22.95	3.24	14%	86%
Lining Project 12	15,579	5.46	7.25	1.80	25%	75%
Lining Project 13	21,362	5.86	10.42	4.56	44%	56%
Lining Project 14	7,924	25.93	30.75	4.82	16%	84%
Lining Project 15	2,075	11.51	15.05	3.54	24%	76%
Hill Field Road	6,827	3.82	5.45	1.63	30%	70%
Fairfield Road	4,052	4.00	4.45	0.45	10%	90%
1800 North Phase 2	930	2.99	3.66	0.67	18%	82%
East Outfall Phase 4	5,894	4.56	7.69	3.12	41%	59%
East Outfall Phase 5	6,251	2.58	6.21	3.63	59%	41%
Reverse Grade Replacement	3,348	4.06	4.82	0.76	16%	84%

Table A-2 lists existing and buildout diameters and flows for pipe segments included in each improvement project. The table has the following columns:

1. **Improvement Project.** Pipes were grouped by the name of the improvement project under which a pipe will be rehabilitated or replaced.
2. **Upstream/Downstream Manhole.** Upstream and downstream manhole ID
3. **Length.** Length of pipe segment between manholes.
4. **Diameter.** Existing/Buildout. Existing and buildout (upsized) pipe diameters.
5. **Peak WWF, Existing/Buildout.** Peak WWF for existing and buildout (with upsized diameter) pipes from the 2022 model. These flows were used to calculate the weighted average flows for each project listed in Table A-1. The weighted averages were calculated by averaging flows weighted by the length of each pipe segment.

Table A-2. Existing vs. Buildout Diameter and Flow						
Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)		Peak WWF (mgd)	
			Existing	Buildout	Existing	Buildout
Lining Project 11						
SY01021	SY01020	365	84	84	26.0	30.9
SY01022	SY01021	342	84	84	26.1	31.0
SY01023	SY01022	390	84	84	26.1	31.1
SY01024	SY01023	412	84	84	26.1	31.2
SY01025	SY01024	18	84	84	26.0	31.1
SY01026	SY01025	529	72	72	15.9	18.3
SY01027	SY01026	501	72	72	16.0	18.2
SY01028	SY01027	457	72	72	16.0	18.3
SY01029	SY01028	459	72	72	16.0	18.3
SY02001	SY01029	57	72	72	16.1	18.3
SY02002	SY02001	325	72	72	16.1	18.3
SY02003	SY02002	299	72	72	16.1	18.3
Lining Project 12						
SY13001	SY08012	466	30	30	2.4	2.7
SY13002	SY13001	479	24	24	2.4	2.7
SY13003	SY13002	503	24	24	2.4	2.7
SY13004	SY13003	463	24	24	2.4	2.7
SY13004A	SY13004	31	24	24	2.4	2.7
SY13005	SY13004A	448	24	24	2.4	2.7
SY13006	SY13005	479	24	24	2.4	2.7
SY13007	SY13006	415	24	24	2.4	2.7
SY13008	SY13007	503	24	24	2.4	2.7
SY13009	SY13008	504	24	24	2.4	2.7
SY13010	SY13009	495	24	24	2.4	2.7
SY13011	SY13010	492	24	24	2.4	2.7
SY13012	SY13011	434	24	24	2.4	2.7
SY13013	SY13012	327	24	24	2.4	2.7
SY13014	SY13013	486	24	24	2.4	2.6
SY13015	SY13014	494	24	24	2.4	2.6
SY13016	SY13015	502	24	24	2.4	2.6
SY13017	SY13016	403	21	21	2.4	2.7

Table A-2. Existing vs. Buildout Diameter and Flow						
Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)		Peak WWF (mgd)	
			Existing	Buildout	Existing	Buildout
Lining Project 12 (continued)						
TP01000	TP01001	385	48	48	4.3	10.0
TP01001	TP01002	97	48	48	4.3	10.0
TP01002	TP01003	274	48	48	4.3	10.0
TP01003	TP01004	7	48	48	4.4	10.0
TP01004	TP01005	17	48	48	4.4	10.0
WP01001	TP01000	433	48	48	4.3	10.0
WP01002	WP01001	409	48	48	4.3	10.0
WP01003	WP01002	444	48	48	4.3	10.0
WP11046	WP11047	356	48	48	4.4	10.1
WP11047	WP01011	348	48	48	4.4	10.1
SY02023	SY02022	563	60	60	17.6	19.5
SY02024	SY02023	419	48	48	10.1	12.3
SY02025	SY02024	415	48	48	10.2	12.3
SY02025A	SY02025	340	48	48	10.3	12.3
SY02026	SY02025A	70	48	48	10.2	12.3
SY02027	SY02026	408	48	48	10.2	12.3
SY02028	SY02027	416	48	48	10.2	12.3
SY02029	SY02028	408	48	48	10.2	12.3
SY02030	SY02029	416	48	48	10.3	12.3
SY02031	SY02030	464	48	48	10.3	12.4
SY02032	SY02031	465	48	48	10.1	12.1
SY02033	SY02032	505	48	48	10.1	12.2
Lining Project 13						
SY02004	SY02003	517	72	72	16.1	18.3
SY02005	SY02004	518	72	72	16.2	18.3
SY02006	SY02005	519	72	72	16.3	18.4
SY02007	SY02006	519	72	72	16.3	18.4
SY02007A	SY02007	51	72	72	16.4	18.5
SY02007B	SY02007A	209	72	72	16.4	18.5
SY02008	SY02007B	258	72	72	16.4	18.5
WP11002	WP11003	116	36	36	4.4	6.2

Table A-2. Existing vs. Buildout Diameter and Flow						
Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)		Peak WWF (mgd)	
			Existing	Buildout	Existing	Buildout
Lining Project 13 (continued)						
WP11003	WP11004	43	36	36	4.4	6.2
WP11004	WP11005	452	36	36	4.4	6.2
WP11005	WP11006	295	36	36	4.5	6.4
WP11006	WP11007	350	36	36	4.5	6.4
WP11007	WP11008	54	36	36	4.5	6.4
WP11008	WP11009	428	36	36	4.5	6.4
WP11009	WP11010	449	36	36	4.5	6.4
WP11010	WP11011	451	36	36	4.5	6.4
WP11011	WP11012	455	36	36	4.5	6.4
WP11012	WP11013	452	36	36	4.5	6.4
WP11013	WP11014	441	36	36	4.5	6.4
WP11014	WP11015	483	48	48	4.5	10.2
WP11015	WP11016	610	48	48	4.5	10.2
WP11016	WP11016A	411	48	48	4.5	10.2
WP11016A	WP11017	127	48	48	4.5	10.2
WP11017	WP11017A	187	48	48	4.5	10.2
WP11017A	WP11018	352	48	48	4.5	10.2
WP11018	WP11019	530	48	48	4.5	10.2
WP11019	WP11020	291	48	48	4.4	10.2
WP11020	WP11021	355	48	48	4.4	10.2
WP11021	WP11022	483	48	48	4.4	10.2
WP11022	WP11023	519	48	48	4.4	10.2
WP11023	WP11024	421	48	48	4.4	10.2
WP11024	WP11025	538	48	48	4.4	10.1
WP11025	WP11026	495	48	48	4.4	10.1
WP11026	WP11027	474	48	48	4.4	10.1
WP11027	WP11028	480	48	48	4.4	10.1
WP11028	WP11029	538	48	48	4.4	10.1
WP11029	WP11030	260	48	48	4.4	10.1
WP11030	WP11031	286	48	48	4.4	10.1
WP11031	WP11032	191	48	48	4.4	10.1

Table A-2. Existing vs. Buildout Diameter and Flow						
Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)		Peak WWF (mgd)	
			Existing	Buildout	Existing	Buildout
Lining Project 13 (continued)						
WP11032	WP11032A	307	48	48	4.4	10.1
WP11032A	WP11033	219	48	48	4.4	10.1
WP11033	WP11033A	194	48	48	4.4	10.1
WP11033A	WP11034	346	48	48	4.4	10.1
WP11034	WP11035	484	48	48	4.4	10.1
WP11035	WP11036	581	48	48	4.4	10.1
WP11036	WP11037	173	60	60	4.4	10.1
WP11037	WP11037A	568	48	48	4.4	10.1
WP11037A	WP11038	339	48	48	4.4	10.1
WP11038	WP11039	446	48	48	4.4	10.1
WP11039	WP11040	469	48	48	4.4	10.1
WP11040	WP11041	649	48	48	4.4	10.1
WP11041	WP11042	594	48	48	4.4	10.1
WP11042	WP11043	118	60	60	4.4	10.1
WP11043	WP11044	525	48	48	4.4	10.1
WP11044	WP11044A	168	48	48	4.4	10.1
WP11044A	WP11045	325	48	48	4.4	10.1
WP11045	WP11046	255	48	48	4.4	10.1
Lining Project 14						
SY01001	TP01014	135	72	72	25.9	30.8
SY01002	VAULT	27	84	84	25.9	30.8
SY01003	SY01002	439	84	84	25.9	30.7
SY01004	SY01003	501	84	84	25.9	30.7
SY01005	SY01004	501	84	84	25.9	30.7
SY01006	SY01005	494	84	84	25.9	30.8
SY01007	SY01006	503	84	84	25.9	30.8
SY01008	SY01007	503	84	84	25.9	30.8
SY01009	SY01008	422	84	84	25.9	30.8
SY01010	SY01009	356	84	84	25.9	30.8
SY01011	SY01010	85	84	84	25.9	30.8
SY01012	SY01011	458	84	84	25.9	30.8

Table A-2. Existing vs. Buildout Diameter and Flow						
Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)		Peak WWF (mgd)	
			Existing	Buildout	Existing	Buildout
Lining Project 14 (continued)						
SY01013	SY01012	438	84	84	26.0	30.8
SY01014	SY01013	421	84	84	26.0	30.8
SY01015	SY01014	446	84	84	26.0	30.8
SY01016	SY01015	439	84	84	26.0	30.8
SY01017	SY01016	406	84	84	26.0	30.7
SY01018	SY01017	382	84	84	26.0	30.7
SY01019	SY01018	407	84	84	26.0	30.7
SY01020	SY01019	399	84	84	26.0	30.8
TP01012	TP01011	6	60	60	25.9	30.8
TP01013	TP01012	20	116	116	25.9	30.8
TP01014	TP01013	15	116	116	25.9	30.8
VAULT	SY01001	122	84	84	25.9	30.8
Lining Project 15						
SY14001	TP01010	245	54	54	11.5	15.0
SY14002	SY14001	312	54	54	11.5	15.0
SY14003	SY14002	508	54	54	11.5	15.0
SY14004	SY14003	500	54	54	11.5	15.1
SY14005	SY14004	499	54	54	11.6	15.1
TP01010	TP01009	11	54	54	11.5	15.0
Hill Field Road						
LA08017	LA08016	54	15	24	4.1	5.9
LA08018	LA08017	370	18	24	4.1	5.9
LA08019	LA08018	38	15	24	4.1	5.9
LA08020	LA08019	176	15	24	4.1	5.8
LA08021	LA08020	380	15	24	4.1	5.8
LA08022	LA08021	57	15	24	4.1	5.8
LA08023	LA08022	369	15	24	4.1	5.8
LA08025	LA08023	125	15	24	4.1	5.8
LA08026	LA08025	30	15	20	4.1	5.8
LA08027	LA08026	8	15	20	4.1	5.8
LA08028	LA08027	242	15	20	3.8	5.5

Table A-2. Existing vs. Buildout Diameter and Flow						
Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)		Peak WWF (mgd)	
			Existing	Buildout	Existing	Buildout
Hill Field Road (continued)						
LA08029	LA08028	139	15	20	3.8	5.5
LA08030	LA08029	601	15	20	3.8	5.5
LA08031	LA08030	598	15	20	3.8	5.5
LA08032	LA08031	219	15	20	3.8	5.5
LA08033	LA08032	382	15	20	3.7	5.3
LA08034	LA08033	499	15	20	3.7	5.3
LA08035	LA08034	500	15	20	3.7	5.3
LA08036	LA08035	29	15	20	3.7	5.3
LA08037	LA08036	120	15	20	3.7	5.2
LA08038	LA08037	351	15	20	3.7	5.2
LA08039	LA08038	496	15	20	3.7	5.2
LA08040	LA08039	403	15	20	3.7	5.2
LA08041	LA08040	404	15	20	3.7	5.2
LA08042A	LA08041	238	18	20	3.7	5.2
Fairfield Road						
LA13020	LA13019A	368	15	20	3.9	4.5
LA13021	LA13020	411	15	20	3.9	4.5
LA13021A	LA13021	85	15	20	3.9	4.5
LA13022	LA13021A	313	15	20	3.9	4.4
LA13023	LA13022	395	15	20	3.9	4.4
LA13024	LA13023	224	15	20	3.9	4.4
LA13024A	LA13024	43	15	20	3.9	4.4
LA13025	LA13024A	19	15	20	4.0	4.4
LA13025A	LA13025	71	21	24	3.8	4.3
LA13025B	LA13025A	279	21	24	3.9	4.3
LA13026	LA13025B	170	21	24	3.9	4.3
LA13027	LA13026	290	21	24	3.9	4.3
LA13028	LA13027	221	21	24	4.0	4.4
LA13029	LA13028	382	21	24	4.1	4.5
LA13030	LA13029	12	21	24	4.2	4.6
LA13031	LA13030	201	21	24	4.2	4.6

Table A-2. Existing vs. Buildout Diameter and Flow						
Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)		Peak WWF (mgd)	
			Existing	Buildout	Existing	Buildout
Fairfield Road (continued)						
LA13032	LA13031	124	21	24	4.3	4.7
LA13033	LA13032	103	21	24	4.4	4.8
LA13034	LA13033	300	21	24	4.6	4.8
LA13035	LA13034	44	15	20	2.6	2.6
1800 North Phase 2						
ST01010	ST01009	110	12	18	3.0	3.6
ST01011	ST01010	338	12	18	3.0	3.6
ST01012	ST01011	18	12	18	3.0	3.7
ST01013	ST01012	312	12	18	3.0	3.7
ST01014	ST01013	25	12	18	3.1	3.7
ST01015	ST01014	127	12	18	3.2	3.7
East Outfall Phase 4						
LA12001	KY01007	254	21	24	4.8	7.9
LA12001A	LA12001	167	21	24	4.8	7.9
LA12002	LA12001A	199	21	24	4.8	7.9
LA12002A	LA12002	139	24	24	4.8	7.9
LA12003	LA12002A	145	24	24	4.8	7.9
LA12004	LA12003	159	24	24	4.8	7.9
LA12005	LA12004	241	24	24	4.6	7.7
LA12006	LA12005	89	21	24	4.6	7.7
LA12006A	LA12006	274	21	24	4.6	7.7
LA12007	LA12006A	141	21	24	4.6	7.7
LA12007A	LA12007	91	24	24	4.6	7.7
LA12008	LA12007A	291	24	24	4.6	7.7
LA12008A	LA12008	133	18	24	4.6	7.7
LA12009	LA12008A	297	18	24	4.6	7.7
LA12010	LA12009	363	18	24	4.6	7.7
LA12011	LA12010	35	18	24	4.6	7.7
LA12012	LA12011	408	15	20	4.5	7.7
LA12013	LA12012	413	15	20	4.5	7.6
LA12014	LA12013	247	15	20	4.5	7.6

Table A-2. Existing vs. Buildout Diameter and Flow						
Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)		Peak WWF (mgd)	
			Existing	Buildout	Existing	Buildout
East Outfall Phase 4 (continued)						
LA12015	LA12014	314	15	20	4.5	7.6
LA12016	LA12015	309	15	20	4.5	7.6
LA12016A	LA12016	221	15	20	4.4	7.6
LA12017	LA12016A	223	15	20	4.4	7.6
LA12018	LA12017	169	15	20	4.4	7.6
LA12019	LA12018	268	15	20	4.4	7.6
LA12019A	LA12019	50	15	20	4.2	7.4
LA12020	LA12019A	52	15	20	4.2	7.4
LA12021	LA12020	207	18	20	4.2	7.4
East Outfall Phase 5						
LA13001	LA12021	394	18	24	3.4	6.8
LA13002	LA13001	369	18	24	3.4	6.8
LA13003	LA13002	367	18	24	3.4	6.8
LA13004	LA13003	371	18	24	2.7	6.3
LA13005	LA13004	349	18	24	2.7	6.3
LA13006	LA13005	353	18	24	2.6	6.3
LA13007	LA13006	353	18	24	2.6	6.3
LA13007A	LA13007	246	15	20	2.6	6.3
LA13008	LA13007A	97	15	20	2.6	6.3
LA13009	LA13008	372	15	20	2.6	6.3
LA13010	LA13009	90	15	20	2.6	6.2
LA13011	LA13MBX1	157	15	20	2.6	6.2
LA13012	LA13011	370	12	20	2.3	6.0
LA13012A	LA13012	248	12	20	2.3	6.0
LA13012B	LA13012A	105	12	20	2.3	6.0
LA13013	LA13012B	23	12	20	2.3	6.0
LA13013A	LA13013	114	12	20	2.3	6.0
LA13014	LA13013A	252	12	20	2.3	6.0
LA13015	LA13014	274	12	20	2.3	6.0
LA13016	LA13015	98	12	20	2.1	5.8
LA13017	LA13016	369	12	20	2.1	5.8

Table A-2. Existing vs. Buildout Diameter and Flow						
Upstream Manhole	Downstream Manhole	Length (feet)	Diameter (inches)		Peak WWF (mgd)	
			Existing	Buildout	Existing	Buildout
East Outfall Phase 5 (continued)						
LA13018	LA13017	369	12	20	2.1	5.8
LA13018A	LA13018	35	12	20	2.1	5.8
LA13019	LA13MBX	109	12	20	2.1	5.8
LA13MBX	LA13018A	215	12	20	2.1	5.8
LA13MBX1	LA13010	124	15	20	2.6	6.2
LA13019A	LA13019	30	0	20	0.0	4.5
Reverse Grade Replacement						
CL01023	CL01022	485	42	42	5.4	6.5
CL01024	CL01023	19	42	42	5.4	6.5
CL01025	CL01024	309	42	42	5.4	6.5
CL01026	CL01025	307	42	42	5.4	6.5
RY01005	RY01004	300	42	42	3.8	4.5
RY01006	RY01005	400	42	42	3.3	3.9
RY01007	RY01006	115	42	42	3.3	3.9
RY01008	RY01007	35	42	42	3.3	3.9
RY01009	RY01008	344	42	42	3.3	3.9
RY01010	RY01009	190	42	42	3.3	3.9
RY01011	RY01010	147	42	42	3.3	3.9
RY01012	RY01011	83	42	42	3.3	3.9
RY01013	RY01012	16	42	42	3.3	3.9
RY01014	RY01013	361	42	42	3.3	3.9
RY01015	RY01014	238	42	42	3.3	3.9