JOB NO. 2433-0010

2020 CAPITAL IMPROVEMENT PLAN

RECLAMATION DISTRICT 1000

SACRAMENTO, CALIFORNIA

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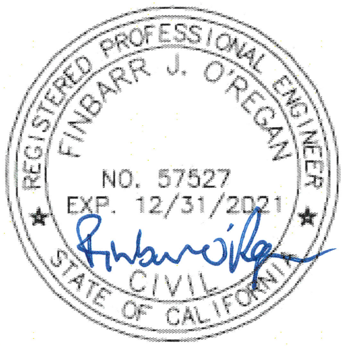
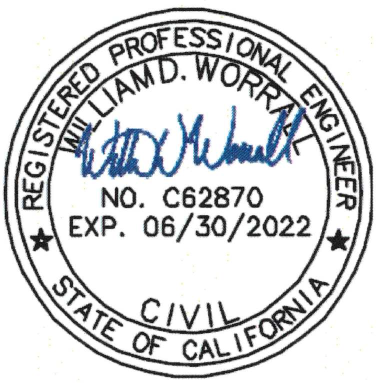


I hereby certify that this technical submission was prepared by me or under my direct supervision and that I am a duly registered engineer under the laws of the State of California.

Finbarr (Barry) O'Regan

My license renewal date is December 31, 2021



I hereby certify that this technical submission was prepared by me or under my direct supervision and that I am a duly registered engineer under the laws of the State of California.

William (Bill) D. Worrall

My license renewal date is June 30, 2022

Acknowledgements

KSN wishes to thank the following whose efforts were instrumental in creation of this Capital Improvement Plan:

Don Caldwell, RD 1000 Superintendent

Tony Del Castillo, RD 1000 Foreman

Kevin King, RD 1000 General Manager

Stephen Sullivan, RD 1000 District Engineer

Jeff Smith, RD 1000 Operations Committee

David Cristophel, RD 1000 Operations Committee

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Executive Summary

Reclamation District 1000 (RD 1000, or District) is located in Sacramento and Sutter Counties, north of the city of Sacramento and provides flood protection to the 55,000 acres in the Natomas Basin (Basin) by maintaining a ring levee system, interior drainage system, and pumping system to discharge stormwater to adjacent rivers and their tributaries. The District is also responsible for maintaining several culverts and drains throughout the Basin. This Capital Improvement Program Update (2020 CIP) identifies and prioritizes capital assets and projects that are necessary to meet the District's mission of continuously providing flood protection to the Natomas. It is anticipated that this 2020 CIP update will form the basis for regular updates and reassessment of CIP needs and priorities in future years.

This 2020 CIP focused on the District's pumping system and was developed to identify short- and long-term improvements necessary for the District to continue to carry out its mission. The CIP was developed by:

- Ranking how critical a pumping plant is by its capacity to remove precipitation from the basin, and the importance of the area it serves – a criticality rating or consequence of failure;
- Determining how likely a pumping plant is to fail to perform as designed, or likelihood of failure; and
- Determining relative risk for each pumping plant, which is a combination of the consequence of failure and likelihood of failure.

Potential projects to address potential deficiencies were identified by the following methods:

- Field condition assessment of each pumping plant;
- Establishing the desired Level of Service each pumping plant would optimally provide, and comparing existing performance against the desired Level of Service; and
- Defining the typical life cycle for the major pumping plant components, including major cost-effective maintenance items to extend the useful life.

The results of the Condition Assessment, Level of Service, and Life Cycle analyses showed that the District's system is overall in good working order, with several of its plants replaced within the last decade. The District's two most critical pumping plants were determined to be Plant 1B and Plant 8. Plant 1B was found to be in very good working order with some needed projects identified to maintain its condition. Plant 8 and its associated outfall piping has several life cycle replacements coming due concurrently which will require undertaking a major overhaul project for that facility.

CIP recommendations for the District's other pumping plants are mostly life cycle related actions, and upgrades to increase the reliability of the overall system, e.g. providing for backup power generation. Over a 30-year planning horizon, the program of recommended pumping plant upgrades to maintain reliability of the system is estimated to cost $67.4 million (un-escalated dollars):

- $32.4 million (M) in the first decade 2021-2030, with $29.6M planned in the first 6 years.
- $8.1M over years 2031-2040
- $26.9M over years 2041-2050, with several recently replaced critical components reaching the end of their useful lives.

In addition to major pumping plant upgrade costs, the following expenditures are recommended to be budgeted:

- Annual budget of $55,000 to perform cost-effective preventive maintenance for the duration of the CIP, or $1.65M over 30 years.
- Annual budget of $900,000 for life cycle replacement of culverts and drains, or $27M over 30 years.

The above costs, which total $96.05M over the 30-year planning horizon, were left unescalated so implementation can be modified and adjusted into the District's financial plan, which is currently being formulated.

Section 1

Introduction and Background

1.1 DISTRICT BACKGROUND

Reclamation District No. 1000 (District) was formed on April 8, 1911 by special act of the State Legislature to reclaim land in the Natomas Basin for agricultural purposes. The District is governed by the Reclamation District Act (California Water Code Sections 50000 et. seq.) The District is responsible for the flood protection, control, and drainage in a 55,000-acre area directly north of the City of Sacramento.

The District system consists of approximately 42.6 miles of project levee, 30 miles of main drainage canals, 150 miles of sub drainage canals, eight (8) exterior pumping plants, and two (2) interior pumping plants. This system in tandem, collects stormwater runoff and agricultural drainage and discharges it out of the basin, while keeping exterior floodwaters out. The District's interior drainage canals are also used during the summer non-flood season to convey irrigation flows to cultivated lands primarily in the northern area of the basin.

1.1.1 DISTRICT MISSION STATEMENT AND GOALS

The District's mission is flood protection for the Natomas Basin and providing for the public's health and safety by the operation and maintenance of the levees, canals, and pump stations in a safe, efficient, and responsible manner.

In addition to maintaining all components of its system, the District is prepared to respond to flood fight emergency events. The District maintains a stockpile of flood fight material and is prepared to acquire more resources or labor 24/7 as necessary.

1.2 PURPOSE OF CIP UPDATE

This Capital Improvement Program Update (2020 CIP) identifies and prioritizes capital assets and projects that are necessary to meet the District's mission statement and goals of continuously providing protection to the Natomas Basin in a strategic and efficient manner. It is anticipated that this 2020 CIP update will form the basis for regular updates and reassessment of CIP needs and priorities in future years.

This 2020 update focuses on the District's pumping plants as opposed to the District's levee system because: (i) the Natomas Levee Improvement Program (NLIP) continues to be implemented by the Sacramento Area Flood Control Agency (SAFCA) the U.S. Army Corps of Engineers (USACE), and California Department of Water Resources (DWR) and will result in improvement of the District's 42.6-mile exterior levee system to a 200-year level of flood protection by constructing levee improvements and replacing some existing pumping plants, and (ii) the City of Sacramento is currently undertaking an assessment of the District's interior levee system to determine if it meets Federal Emergency Agency (FEMA) standards. The findings of that assessment will be used to inform and update the CIP in future years.

While the largest component of the CIP is to replace and upgrade existing pumping plants based on a condition and needs assessment, a life cycle and annualized budget to replace culverts and drains for which the District is responsible is also included in the plan. Assessment or prioritization to replace specific culverts is not part of the scope. The major maintenance items associated with life cycle replacement of pumping plants are also identified in the CIP.

The 2020 CIP uses a risk-based approach to identifying and prioritizing projects. Project prioritization was based upon:

- Relative criticality of assets
- Likelihood of asset failure
- Desired Level of Service for assets; and
- Expected asset life cycle.

This 2020 CIP update was created through input and data provided by District staff, and the District Engineer. Meetings, site visits, and workshops were held with District staff and District Engineer to jointly establish the goals and criteria for this 2020 CIP in alignment with the District's mission, and to ensure the accuracy on which decisions are based.

1.3 PREVIOUS CIP REPORT

In 2014, a 30-Year Capital Improvement Program was completed by Domenichelli and Associates. It identified proposed improvements for the District's pumping plants, main canals, and levees. The previous program focused on the effect of the NLIP led by the USACE, identifying projects to be funded by the NLIP, as well as separate improvements on the District's end.

A portion of the SCADA, security, and corporation yard improvements that were identified have been put into place.

Section 2

Description of Facilities

This section describes the District's facilities with a focus on the Pumping Plants, as they are the focus of this 2020 CIP. The identification and description of these facilities are listed below.

2.1 DISTRICT FACILITIES

The District's 55,000-acre service territory and facilities are shown on Figure 2-1, adapted from Mead and Hunt's 2016 report. The exterior Pumping Plants are described by number, followed by the Interior Pumping Plants.

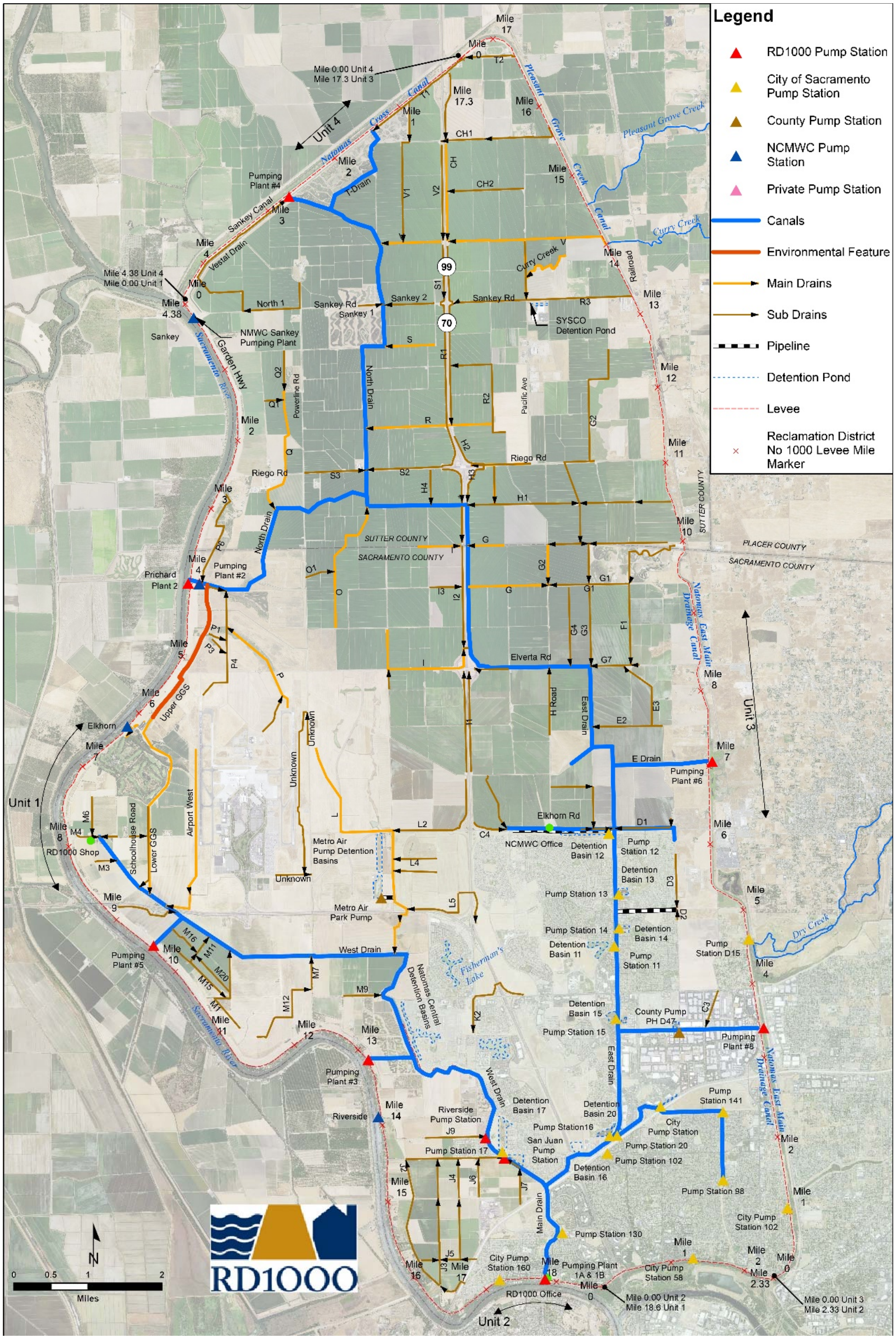

Figure 2-1 - Reclamation District 100 Service Territory and Major Features
Source: Mead and Hunt, 2016

2.1.1 Pumping Plant 1A

Pumping Plant 1A was the District's first plant, constructed in 1915, and has the second-greatest pumping capacity measured by cubic feet per second (cfs) in the District. It is co-located with Plant 1B across Garden Highway from District headquarters in the southern portion of the basin. Due to its age and difficulty starting and operating, Plant 1A has not been operated in over 20 years. The intake includes chained automatic bar screens for two (2) pumps and a manual bar screen for the other two (2) pumps. The four (4) pumps, housed inside a two-story concrete masonry unit building, discharge through four (4) manual cast iron slides gates into flows to two (2) concrete tunnels, that then transition into four (4) arch tunnels, each with a steel-framed wooden flap gate. The discharge goes through the levee with minimal elevation difference.

USACE is currently evaluating the four (4) tunnels for potential remediation or modification as part of the NLIP. The report with recommended action is expected within several months. The Plant capacity summary is found in Table 2-1 below.

Table 2-1 - Plant 1A Capacity Summary

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	600	2,400v	136	621
2	650	2,400v	181	
3	600	2,400v	152	
4	650	2,400v	152	

2.1.2 Pumping Plant 1B

Pumping Plant 1B has the third-largest pumping capacity and is regularly relied upon to remove significant flows from the District. The plant, originally constructed in 1959 and then reconstructed in 2003, includes six (6) vertically-oriented mixed-flow pumps, located in three (3) bays with two (2) pumps each. An automatic bar screen precedes the pump bays. The pumps lie on a concrete deck with an upper steel deck at motor level. The pumps discharge to steel pipes that cross under Garden Highway to the outfall structure.

The plant building houses the electrical and instrumentation. In 2012, a backup diesel generator was installed and the building expanded along with power system upgrades. With all the pumps running, the generator can support the plant for approximately 8 hours of runtime. The generator is capable of running all Plant 1B pumps plus two (2) Plant 1A pumps if necessary. The Plant 1B capacity summary is found in Table 2-2 below.

Table 2-2 - Plant 1B Capacity Summary

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	400	2,400v	100	600
2	400	2,400v	100	
3	400	2,400v	100	
4	400	2,400v	100	
5	400	2,400v	100	
6	400	2,400v	100	

2.1.3 Pumping Plant 2

Plant 2 is located on the western side of the District at the end of the North Drain Canal. The plant was rebuilt and relocated in 2012 under the NLIP.

There are two (2) vertical mixed-flow pumps and in Plant 2 located on a concrete platform with steel grating for access, with the electrical and instrumentation is housed in an adjacent cabinet with an overhang. Plant 2 has automatic bar screens for each pump, and cathodic protection was added to the discharge pipes during reconstruction. Plant 2 also has a connection for a portable generator. The Plant capacity summary is found in Table 2-3 below.

Table 2-3 - Plant 2 Capacity Summary

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	400	2,400v	80	120
2	250	2,400v	40	

2.1.4 Pumping Plant 3

Plant 3 is located northwest of Plant 1, connecting the West Drain. It was originally constructed in 1939, and then modified with increased capacity in 2001. There are four (4) drainage pumps, two (2) small irrigation pumps, and one (1) bay for future pump installation in Plant 3, all preceded by an automatic bar screen. The pumps are located outdoors on a concrete deck, with the electrical components housed in an adjacent building. The existing pumps discharge to a manifold structure connecting to a single pipe leading across the levee to the Sacramento River.

Current plant pumping capacity is 196 CFS, but pumping capacity is planned to be expanded by the USACE. Under USACE plans as part of the NLIP, the pumps will be replaced and the manifold will be replaced with separate discharge pipes. The current Plant capacity summary is found in Table 2-4 below.

Table 2-4 - Plant 3 Capacity Summary

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	200	2,400v	38	196
2	200	2,400v	38	
3	300	2,400v	70	
4	200	2,400v	50	

2.1.5 Pumping Plant 4

Plant 4 is the northernmost plant in the District, at the end of the North Drain. It is the lone plant in the District that is supplied power by Pacific Gas and Electric (PG&E), as all others receive power from Sacramento Municipal Utility District (SMUD). Originally constructed in 1964 then reconstructed in 1986, Plant 4 is to be replaced under the NLIP. Design has been completed; construction was expected to be complete in 2020, but construction has been delayed and completion is now expected no later than 2022. Currently there are three (3) vertical mixed-flow pumps in Plant 4 that discharge into the Natomas Cross Canal. The new plant will be similar to Plant 2 in layout, which includes replacing the current traveling automated screens with automated bar screens and the modifying voltage to 2.4kV. The current Plant capacity summary is found in Table 2-5 below.

Table 2-5 - Plant 4 Capacity Summary

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	300	480v	76	306
2	400	480v	115	
3	400	480v	115	

2.1.6 Pumping Plant 5

Plant 5 is located at the end of the West Drain near the Sacramento Airport. Currently there are three (3) vertical mixed-flow pumps at Plant 5 that discharge into the Sacramento River. Each pump intake includes a manual bar screen.

The plant is planned to be removed and replaced at a setback location because it is currently in the toe of the levee after the NLIP was constructed in its area. While it is included in the NLIP, a firm source of funding from USACE has not been committed. Like Plant 4, this plant will be replaced with similar layout and capacity to Plant 2 with automatic bar screens and voltage will be modified to 2.3 kV. There is also the intent to provide an empty space in the pump deck for an additional pump to handle more rapid runoff that could result from Sacramento Airport expansion activities.

The current Plant capacity summary is found in Table 2-6 below.

Table 2-6- Plant 5 Capacity Summary

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	100	480v	19	57
2	100	480v	19	
3	100	480v	19	

2.1.7 Pumping Plant 6

Plant 6 is located on the east side of the District approximately one (1) mile north of Elkhorn Boulevard, in the east central part of the District. It was constructed in 1974, and updated in 1997. This plant is the last utilized for drainage purposes due to complaints of area residents across the Natomas East Main Drainage Canal (NEMDC), to which it discharges. Residents complain that use of the plant causes flooding, despite evidence that this is actually a result of the NEMDC Stormwater Pump Station, also referred to as Pump Station D15, keeping its gates closed and backing water up the NEMDC. This plant has not been operated in at least 15 years.

The motors are housed in a steel building held elevated above the canal by steel sheetpiles and beams. There is a steel deck for manual screens just upstream of the four (4) vertical mixed-flow pumps. The electrical components are housed in a separate building adjacent building. The current Plant capacity summary is found in Table 2-7 below.

Table 2-7 - Plant 6 Capacity Summary

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	125	480v	28	180
2	200	480v	42	
3	300	480v	60	
4	250	480v	50	

2.1.8 Pumping Plant 8

Plant 8 is located on the east side of south portion of the District, just north of Interstate 80. The plant was originally constructed in 1983, and modified in 2001 for increased capacity, a new electrical and instrumentation building, and automatic trash racks. Plant 8 has the highest nominal capacity of any plant in the system.

The plant includes a total of nine (9) vertical mixed-flow pumps located outdoors on a concrete deck, with an electrical and instrumentation building located on the slope high above the pump platform. Automatic bar screens are located immediately in front of the pump deck. A steel deck above the platform allows access to the motors. Discharges route under Northgate Boulevard, a heavily travelled road serving both industrial and residential traffic before reach the levee and discharging into the NEMDC. The pipes under the levee and the outfall structure have recently been replaced as part of the

NLIP. Pumps 8 and 9 have significant cavitation problems and are operated only in reserve when water levels are high.

The current Plant capacity summary is found in Table 2-8 below.

Table 2-8 - Plant 8 Capacity Summary

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	700	480v	105	779
2	700	480v	105	
3	300	480v	48	
4	200	480v	33	
5	300	480v	48	
6	700	480v	105	
7	700	480v	105	
8*	500	480v	115*	
9*	500	480v	115*	

*In reserve usage; operated when water levels reach a high elevation only.

Although Pumps 8 and 9 do not operate under normal conditions, they are included in the Plant's reliable capacity because during adverse conditions when flows levels in the canals are elevated, the pumps can be operated effectively.

2.1.9 San Juan Pumping Plant

The San Juan Pumping Station is one (1) of two (2) interior plants in the District, located on the right bank of the West Drain Canal, south of San Juan Road. The plant was constructed in 1998 by the City of Sacramento for a development and was turned over to the District for operation. There are two (2) variable-speed hydraulically-driven axial flow pumps housed inside the plant building, each with a capacity of 65 cfs, alongside the electrical and instrumentation, that pump water from the sub drain to the West Drain. The pumps alternate operation because each has sufficient capacity to remove required flows. In addition to pumping operations, a siphon can be used as a backup system to drive flows into the West Drain should the main pump fail. The controls for the plant were replaced in 2015 and the coolers for the hydraulic fluid replaced in 2017.

2.1.10 Riverside Pumping Plant

The Riverside Pumping Station is the District's other interior plant, located approximately 1,800 feet north of the San Juan Pumping Station on the West Drain Canal. This plant was constructed concurrent with and is identical in layout and operation to San Juan Pumping Station, except that each pump has a lower capacity of 30 cfs due to its significantly smaller service area. The controls for the plant were replaced in 2015 and the coolers for the hydraulic fluid replaced in 2017.

Section 3

Program Approach and Development

3.1 APPROACH TO IDENTIFYING PROJECTS

The 2020 CIP consists of projects relating to the District's assets, contributing to the continuing function of the District. The focus of this 2020 CIP is the pumping plants under the District's jurisdiction, due to their criticality in the District's functions. This 2020 CIP uses a risk-based approach to identifying and prioritizing projects. Risk is a combination of the consequence of failure and the likelihood of failure. After identifying potential areas where the performance of assets might be less than optimal, the 2020 CIP identifies a plan to maximize risk reduction given the District's resources. The end objective is to cost-effectively allocate the District's resources to extend the life of and replace critical assets to maximize the reliability of the system. The focus is on reducing risk because the District has limited resources to carry out its mission. The primary steps taken to identify and prioritize projects were to define the:

- **Relative criticality of assets**. Critical assets have a high consequence of failure. For example, a high-capacity pump station in a highly populated area has a much greater consequence if it fails to provide the design service than a low-capacity pump station in a rural part of the District.
- **Likelihood of failure**. Likelihood of failure is primarily a function of the condition of the major asset components and whether sufficient backup systems are in place. Plants and/or components with high probability of failure are strong candidates for improvements.
- Desired **Level of Service** that each pump station would ideally meet, and compare each pump station against the criteria. The Desired Level of Service defines what a plant should have to safely and reliably perform as designed; when plants lack these characteristics or their ability to reliably provide the service is questionable, improvements may be necessary.
- **Asset life cycle** for critical pump station components. Closely related to likelihood of failure, because as assets age they become more likely to fail, the District needs to plan for replacement of assets to maintain reliability and worker safety.

After the above steps identified potential projects, the projects will be prioritized in subsequent sections. Prioritization will be based upon the reduction in risk with the ability to implement in an efficient manner. An example of efficient implementation would be waiting until after a plant is reconstructed under the NLIP to add a component so that it can be connected to the plant once. Whenever possible, assets are bundled into larger projects for more efficient implementation. Bundling primarily occurs when multiple components at a single pump station are near the end their useful life at similar timeframes.

Section 4

Criteria for Developing Program

In the previous section, the process to develop the 2020 CIP was described, which included determining:

- Relative criticality of assets
- Likelihood of failure
- Desired Level of Service for all pumping plants
- Asset life cycle for critical pump station components.

The relative criticality of assets and likelihood of failure scoring and optimal Level of Service criteria were presented and agreed to at an Operations Committee Workshop. The asset life cycle was developed with District personnel.

In this section, the criteria for the above steps are developed and described.

4.1 RELATIVE CRITICALITY OF ASSETS

Because studies that can assign an accurate level of failure with respect to loss of life, injury, property damage, and economic damage, have not been performed and are beyond the scope of this plan, asset criticality is rated on a relative scale. The Asset Criticality Score assigns a relative rating to each District asset, consisting of a combination of an asset's capacity ranking and immediate service area rating. The rating quantifies the relative consequence if a specific asset fails to function during a flood event. The rankings are intended to reflect that the District's most critical pumping plants remove the greatest volume of runoff from the most heavily populated areas and/or critical commercial locations and therefore have high consequences of failure.

The criticality ranking begins by determining the type of service area and assigning an importance ranking. The Natomas Basin can generally be described as urban/densely populated in the southern third and rural (mostly agricultural) in the northern two-thirds, with the Sacramento International Airport located in the west-central part of the basin. In additional, Interstates 5 and 80 each route through the basin, serving as major thoroughfares. Interstate 80 routes east-west through the densely populated southern portion of the basin, while Interstate 5 routes north out of downtown Sacramento before turning west past the airport and out of the basin.

The Immediate Service Area Rating assigns a number to each pumping plant that corresponds to the type of area that the plant immediate serves. As an area is more populated, or is an important part of infrastructure, a higher rating is given for the protection of health and safety that the plant provides. The area types and their respective rating numbers are shown in Table 4-1 below.

Table 4-1 - Immediate Service Area Ratings

Immediate Service Area Type	Rating
Rural	1
Urban	2
Rural/Airport	2
Urban/Airport	3

The resulting Immediate Service Area criticality scores for plants are shown in Table 4-2 below:

Table 4-2 - Pumping Plant Immediate Service Area Ratings

Pumping Plant	Immediate Service Area Type	Rating
1A	Urban	2
1B	Urban	2
2	Rural	1
3	Urban/Airport	3
4	Rural	1
5	Urban	2
6	Rural	1
8	Urban	2
San Juan	Urban	2
Riverside	Urban	2

Although localized storm events do occur in the basin, because the Natomas Basin is relatively flat, the capacity of a plant to remove water from the basin is generally more important in determining an exterior pumping plant's criticality; if a high-capacity plant fails, the probability and degree of internal flooding rises significantly more than with low-capacity plants. As a result, the relative scale for capacity scores is greater than the Immediate Service Area. The capacity ranking scales the capacity of the exterior pumping plants, with the highest capacity given the highest rank number of 6, and the lowest capacity given a capacity ranking of 1. Because Plants 1A and 6 have not been operated in several years and their reliabilities are questionable, and the Interior Pump Stations are significantly smaller, their relative capacities are not included in the rankings.

Table 4-3 - Pumping Plant Capacity Ratings

Pumping Plant	Capacity (cfs)	Rating
1A	621	-
1B	600	5
2	120	2
3	196	3
4	306	4
5	57	1
6	180	-
8	779	6

The net criticality ranking is determined by adding the Immediate Service Area and Capacity Ratings together as shown in Tab1e 4-4 below.

Table 4-4 - Pumping Criticality Ratings – Exterior Plants

Pumping Plant	Immediate Service Area Score	Capacity Score	Net Criticality Score
1A	2	-	-
1B	2	5	7
2	1	2	3
3	3	3	6
4	1	4	5
5	2	1	3
6	1	-	-
8	2	6	8

The net criticality rankings indicate that among regularly operated plants, Plants 1B and 8 are the most critical, while Plants 2 and 5 are the least critical. Interior Plants are excluded from the ranking.

4.2 LIKELIHOOD OF FAILURE

The likelihood of failure is primarily a function of the condition of the asset components, which is a result of age of the asset, amount of use, conditions under which operated, and amount of maintenance that has been performed. To state the relative likelihood of failure, a Condition Hazard Rating score is used, which assigns a 1-10 rating for the asset based on its condition. The score of each asset is based on age, physical assessment, and District experience. The higher the score, the more deteriorated the asset and the higher the probability of failure; a score of 1indicates a new asset, whereas a score of 10 indicates the asset is in run-to-failure mode. The definitions use to score each asset are in Table 4-5 below:

Table 4-5 - Condition Hazard Rating Definitions

Rating	Description
1	New or like new asset, no reduced functionality or increase in maintenance
2	Asset performs like new with slight increase in maintenance
3	Asset performs well but critical components showing some wear and increased maintenance
4	Asset still performs but replaceable critical components nearing end of useful life; replacement of components will restore condition to level 1 or 2. Potential for short-term failure but still highly unlikely
5	Notable decrease in performance but still reliable asset; with heavy maintenance load, asset has useful life >= 10 years
6	<50% of useful life remaining; budget for replacement should be firmly committed even if several years out
7	<30% of useful life remaining; replacement considered during annual district budgeting. Hazard level is below level of service for critical assets
8	<20% of useful life remaining, asset performance is significantly deteriorated but functional under normal scenarios
9	<10% of useful life remaining, asset performance is marginal
10	Failure Imminent, operating in run-to-failure mode

The condition assessment report is included as Appendix A. The condition assessment does not identify operational problems unless the observed condition prompted questions to District personnel. The condition hazard rating for each external Plant is listed in Table 4-6 below. Condition hazard ratings were determined cooperatively at an Operations Committee Workshop led by KSN after the field condition assessment was performed. Where plants have been replaced or are expected to be replaced under the NLIP, a Rating of 1 was assigned.

Table 4-6 - External Pumping Plant Condition Hazard Ratings

Pumping Plant	1A	1B	2	3	4	5	6	8
Condition Hazard Rating	9	2	1	1	1	6	7	6

The internal pumping plants, Riverside and San Juan, were each given a rating of 4.

4.3 NET RISK SCORES AND RANKINGS

Risk is a combination of the probability of failure and consequence of failure. The Net Criticality Rating and Condition Hazard Rating for each Plant are added to generate the Level of Risk Score. The Net Criticality Rating is the proxy for relative consequence of failure rating and the Condition Hazard Rating is the proxy for relative likelihood of failure ratings.

Table 4-7 – Level of Risk Scores and Rankings

Risk Criteria						Risk Ranking
Pumping Plant	Capacity Ranking	Immediate Service Area Rating	Net Criticality Rating	Condition Hazard Rating	Level of Risk	
8	6	2	8	6	14	**1**
1A	-	2	2	9	11	**2**
1B	5	2	7	2	9	**3**
5	1	2	3	6	9	**3**
6	-	1	1	7	8	**5**
3	3	3	6	1	7	**6**
4	4	1	5	1	6	**7**
San Juan	-	2	2	4	6	**7**
Riverside	-	2	2	4	6	**7**
2	2	1	3	1	4	**10**

4.4 LEVEL OF SERVICE

The Level of Service is the minimum level of functionality that an asset should provide, otherwise an upgrade or replacement project is generally deemed necessary. There are five (5) categories that describe the aspects of functionality that an asset can have: reliability, redundancy, capacity, operational flexibility, and maintainability. For each category, an asset either meets the minimum level, fails to meet it, or the category is not applicable. Table 4-8 below lists each category and the question(s) that are asked to determine whether an asset meets the requirements of each category. When the answer is a "no" a remediation project is considered.

Table 4-8 - Level of Service Definitions

Category	Question
Reliability	Can the asset dependably function as designed without committing additional resources during the design event?
Redundancy	Does the asset have sufficient backup systems to ensure its operation commensurate with its criticality?
Capacity	Are the asset's facilities able to provide the required service?
Operational Flexibility	Can the asset operate over a range of conditions? Can the asset be operated remotely?
Maintainability	Can employees safely and efficiently maintain the asset, and does the District have a sufficient supply of spare parts or are they readily available from suppliers?

The analysis of the Level of Service focuses on the District pumping plants due to their importance in the District's daily operations. Each separate component of the plants is given a Level of Service in order to assess each part for necessary improvements. The ten pumping plant components that were evaluated included:

1. Intake screens
2. Power supply
3. Motors
4. Pumps
5. Instrumentation and controls
6. Outfall structure and pipes
7. Cathodic protection system
8. Pump and motor structural
9. Access and security
10. Building

The above criteria result in the following Table 4-9 being used to evaluate and summarize each pumping plant's Level of Service. Where a component does not meet optimal level service, the efficiency and validity of whether a remedial action is needed is also evaluated. In some cases, it may be determined that remediation does not significantly increase pumping plant performance, so no action is taken. A column for remedial action under each Level of Service Indicator for those that do not meet the optimal is not shown for space limitations.

Table 4-9 - Level of Service Assessment Example Table

Pumping Plant:	Level of Service Indicators				
	Reliability	Redundancy	Capacity	Operational Flexibility	Maintain-ability
Pumping Plant Component	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)
Intake Screens					
Power Supply					
Motors					
Pumps					
Instrumentation & Controls					
Outfall Pipes					
Cathodic Protection System					
Pump & Motor Structural					
Access & Security					
Building					

4.5 LIFE CYCLE REPLACEMENT

The major components of the pumping plants have typical life cycles that require replacement at regular intervals. This section describes the life cycle of these major components and the major maintenance expenses that should be budgeted to cost-effectively extend their useful life and reduce risk of failure. The typical life cycle for the same components in Level of Service were proposed and determined based on typical industry experience and the District's recent experience. This allows determination of where each major component at each plant is in its life cycle and plan for replacement.

The description of need for replacement with the life cycle for major components is below.

4.5.1 Intake Screens

The single greatest point of vulnerability at RD 1000 pumping plants is the intake screens. If screens are not able to remove aquatic vegetation and debris that is capable of clogging flow to pumps, pumping plants can be rendered inoperable. RD 1000 is already expending significant effort to control this aquatic vegetation so reduction of the load cannot be expected. The major considerations include:

- Underwater maintenance by divers is regularly required to perform repairs to keep the screens operating, and to remove heavy vegetation and debris loads; large pumping plants require a more frequent service every two (2) years and smaller plants every four (4) years.

- Chains begin to stretch, wear out, and require significant maintenance with a noticeable deterioration in performance after about 10 years, which is their assigned life cycle.

- The assigned life cycle is 40 years as mechanical equipment rarely has a useful life exceeding this duration.

4.5.2 Power Supply

Several components make up the power supply chain: the transformer drop from the electricity provider; the motor control center; automated transfer switch; and the wiring in conduits that conducts the current to the motors to operate the pumps. In addition, the desired level of service is to have a generator to provide backup power in the event of electrical power outages. While each component may age at different rates, manufacturers often phase out support and manufacture of replacement components within 10 years. Although replacement components may not be available, most equipment can typically be operated for 20-30 years depending upon quality. An evaluation of the power supply systems is scheduled at 10 years to determine the remaining useful life and begin planning replacement. Concurrent replacement of all major power supply components, except for backup generators, is recommended for efficiency. Given that plants must be reliable, a useful life of 20 years is chosen.

Important notes for power supply include:

- The District's desire to move to a standard service medium-voltage service of 2.4 kilovolts (kV) because the components tend to produce less heat and have a longer life cycle. The local power providers do not service medium-voltage transformers so the District will need to increase its reliance on outside service providers to maintain its transformers as plants are converted to 2.3 kV service. In addition, pump motors must be replaced because they cannot be converted to run on medium voltage, and the District will need to implement a larger arcflash injury prevention program.

- Because natural gas service is less likely to be interrupted during a flood event than electric service, natural gas is the preferred source for backup generators where available. In areas without natural gas service, the power source will be diesel or propane.

4.5.3 Instrumentation and Controls

Instrumentation and controls are subject to the same limitations as power supply components in that replacement components become unavailable relatively soon after installation. Instrumentation and control components have similar life cycles to electrical components, so the same life cycle is adopted, included a concurrent evaluation after 10 years and concurrent replacement at 20 years.

4.5.4 Motors

Motors, like all mechanical equipment, require a heavy maintenance schedule to perform and ensure a full useful life cycle. For the motors, a periodic "clean and bake" is the most cost-effective method. This entails removing the cover, replacement of worn bearings, evaluation of the windings and whether a rewind is necessary, and epoxy recoating of the cover. Clean and bake will minimize degradation of performance, particularly efficiency, until replacement is necessary. The following life cycle is adopted for motors:

- Highest 50%-use motors – clean and bake every 8 years
- Lowest 50%-use motors – clean and bake every 12 years
- Replacement of motor every 50 years.

Clean and bake has been discontinued for the last several years so an accelerated program to catch up on deferred maintenance for the next 5 years is recommended.

4.5.5 PUMPS

Pumps are typically serviced and replaced concurrently with the motor they are installed with. Pumps will be removed and serviced concurrently with motor clean and bake and replaced on the same schedule as their motors.

- Highest 50%-use pumps – remove and service/evaluate every 8 years
- Lowest 50%-use pumps – remove and service/evaluate every 12 years
- Replacement of pump every 50 years.

4.5.6 OUTFALLS

Outfall structures are located on the water side of levees with flowing water. Outfall pipes all cross under paved roads, with most of the roads atop the external levees, making replacement expensive and disruptive to the public. Both the outfall structures and pipelines are located where they are subject to deterioration, so a comprehensive evaluation will be performed regularly that includes CCTV of the pipelines and operation and service of all valves and gates. The following maintenance and life cycle schedule is adopted:

- Pipeline CCTV evaluation and service/operation of valves and gates: 5 years
- Replacement of valves and gates: 25 years
- Replacement of Pipelines and Outfall structures: 75 years.

4.5.7 CATHODIC PROTECTION SYSTEM

While viewed as a component of the pipeline, nearly all outfall pipes are steel and cathodic protection systems are the most cost-effective method of extending the useful life of steel pipelines. The anode beds must be periodically replaced while the impressed current system and wiring last significantly longer. Anode bed useful life varies significantly depending upon the soil moisture but is typically 3-12 years. The impressed system rectifier is evaluated concurrent with the electrical and instrumentation systems. Useful life of the of components are

- 10 years for anode beds
- 25 years for impressed system, exclusive of wiring
- 75 years for wiring, to be replaced incidental to pipe replacement.

4.5.8 Pump and Motor Structural

The majority of pumps are located on concrete structures suspended above the canals, with steel decks or grating for access to motors. The structures are expected to have a long useful life with minimal maintenance. The following life cycle for each is adopted:

- Steel decking and grating: 75 years
- Pump and motor platform: 75 years.

4.5.9 Access and Security

Prevention of vandalism to keep plants operating as designed is a priority of the District given that each pump station is located off easily accessible roadways but are unmanned the vast majority of the time. The primary means of securing plants is complete perimeter fencing with anti-climb features and cameras. Each has the following anticipated lifecycle:

- Security Cameras: 10 years
- Fencing: 50 years.

Electrical and instrumentation is usually housed in a locked building providing further security, but its primary purpose is protecting components from the elements with climate control, so it is considered a separate component.

4.5.10 Buildings

Buildings house the power supply electrical and instrumentation components that includes climate-control to prevent overheating. While the buildings are expected to have a long useful life, the ventilation and roof require regular replacement to maintain the necessary dry, cool conditions. The following life cycles are assigned:

- Ventilation: 15 years
- Roof Replacement with external painting: 25 years
- Building: 75 years.

4.5.11 Life Cycle Summary

The above discussion of major components and their assigned life cycles is summarized in Table 4-10 below.

Table 4-10 - Asset Life Cycle

Item	Life Cycle, years	Notes
Intake Screens		
Dive Inspection	2-4	2 for major plant, 4 for minor
Chains	10	
Unit	40	
Power Supply (meter to pump)		
Evaluation	10	Assess remaining life cycle, plan replacement date
Transformer	20	Transformer replacement based on performance
In-building/in-panel ATS, etc.	20	
Backup Generator	30	
Instrumentation & Controls		Typically on same cycle as power supply
Evaluation	10	
Unit	20	
Motors		
Clean & Bake	8-12	High-use motors more frequent, low-use less
Unit	50	
Pumps		
Remove & Inspect	10	Concurrent with Motor Clean & Bake
Unit	50	
Outfalls		
Comprehensive Inspection	5	CCTV for pipes, service valves, operate outfall gates
Valves and Gates	25	
Outfall Structure	75	
Pump and Motor Structural		
Structure and Platform	75	
Steel Access and Grating	75	
Cathodic Protection System		
Anode Beds	5-10	Highly dependent upon soil moisture
Unit	25	Rectifiers may be replaced with electrical
Access & Security		
Fences	50	
Cameras	10	
Building		
Ventilation	15	
Roof and Paint	25	
Unit	75	

The life cycles are used to plan capital replacement and major service in conjunction with the condition assessment and Level of Service.

Section 5

Identification of Projects

5.1 CAPITAL IMPROVEMENT PROJECTS

As described in the previous sections, each pumping plant was evaluated for its likelihood of failure, level of service, and which components are coming due for replacement based on life cycle. This section includes a catalog of prioritized potential projects based upon that analyses. For the major maintenance items, a maintenance budget for each is established.

For each plant, projects at each plant are identified from the

- Condition assessment
- Level of Service evaluation, and
- Major component life cycle.

5.1.1 PUMPING PLANT 1A

5.1.1.1 Pumping Plant 1A Condition Assessment

The condition assessment noted that the plant is in poor condition in several aspects:

- The plant must be manually started and monitored at all times to be operated; the electrical power systems appears old and outdated and may not be up to code;
- The interior of the plant does not have physically safe access and locations for operations and maintenance, furthermore, building dimensions probably restrict the ability to make these safe
- Based upon their age there is a high probability that the pumps are coated in lead-based paint;
- Based upon its age it is assumed that the building interior contains lead-based paint and asbestos-containing insulation;
- The exterior paint is peeling excessively and not providing the level of protection needed; while it was confirmed that the building has been painted twice in the last 25 years, meaning the peeling paint is unlikely to contain lead-based paint, the underlying layers may contain lead-based paint.

Based on the above operational issues, at the workshop KSN held with the District to present the findings of its assessment and provide its approach to developing the 2020 CIP, parties agreed a Condition Hazard Rating Score of 9 was appropriate, defining performance as marginal.

The following potential projects are identified based on the condition assessment:

Table 5-1 - Pumping Plant 1A Assessment Potential Projects

Pump Station Component	Sub-optimal Reason	Proposed Improvement Project
Safety	Potential lead and asbestos Unsafe operation and maintenance areas	Evaluation for remediation and abatement Evaluation by qualified safety professional and install of new facilities
Power Supply	Outdated and potentially unreliable	Upgrade system
Building	Peeling exterior paint	Repaint

5.1.1.2 Pumping Plant 1A Level of Service

Table 5-2 - Pumping Plant 1A Level of Service

Pumping Plant: 1A	Level of Service Indicators				
	Reliability	Redundancy	Capacity	Operational Flexibility	Maintain-ability
Pump Station Component	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)
Intake Screens	Y	N	Y	Y	Y
Power Supply	Y	N	Y	Y	N
Motors	N	N	Y	Y	Y
Pumps	N	N	Y	N	Y
Instrumentation & Controls	N	Y	Y	N	Y
Outfall Pipes	Y	Y	Y	Y	N
Cathodic Protection System	Y	Y	Y	Y	Y
Pump & Motor Structural	N	NA	Y	NA	Y
Access & Security	N	NA	N	Y	N
Building	Y	NA	Y	NA	Y

Table 5-3 - Pumping Plant 1A Level of Service Potential Projects

Pump Station Component	Sub-optimal Reason	Proposed Improvement Project
Intake Screens	Half of pumps have manual bar screens No backup	Install automatic bar screens None
Power Supply	Potential Arc flash hazard Minimal backup capacity	Replace including PLC system Convert existing generator to use natural gas
Motors	Manual control No backup	Install PLC system for automation None
Pumps	Priming system needs automation No backup	Install PLC system for automation None
Instrumentation & Controls	Need for standardization and automation	Replace instrumentation and controls and install SCADA system
Outfall pipes	Lack on inspection access	Install access manholes
Access & Security	Walkway is of old age	Replace access walkway

- It was determined that it was not feasible or efficient to provide backup screens, motors, pumps, or cathodic protection, so no improvement projects are proposed for those potential shortcomings; this is the case for all Pumping Plants.

- Part of the existing screens are manually cleaned, so it is recommended that automatic bar screens be installed to increase operational efficiency and to reduce labor cost.

- District staff expressed concerns about the potential for arc flash hazard in the Plant 1A building, so in the short term, it is recommended that an external PLC system be installed to remove the need for workers to enter the building to start the pumps. The pumps, motors, and instrumentation and controls will all benefit from automation of the system. The walkways inside the building are also old, and do not appear to provide safe access to components; therefore it is recommended that they be replaced.

- The Plant 1B backup generator can power 2 of 4 pumps in Plant 1A when Plant 1B operates at capacity. Conversion to natural gas which would extend the runtime indefinitely and is considered a major and cost-effective upgrade for Plant 1A.

- The outfall pipes do not have access manholes for inspection. In order to routinely maintain and inspect the pipes, manholes should be installed.

5.1.1.3 Pumping Plant 1A Life Cycle State

As the pump station is in poor condition, nearly all components have reached the end of their standard useful lives, except for the roof, which has been replaced within the last year. Currently upgrades to the plant are occurring on an ad-hoc basis to keep the plant potentially viable in case it is needed during a significant storm event. Additionally, the District is awaiting evaluation of the outfall tunnels and would prefer to wait for the result to consider which replacements make sense. The lone item at Plant 1A identified for potential life cycle replacement are the chains on the automatic bar screen, which are effectively new given the plant has not been operated since their installation. The chains are assumed to require replacement in 2041. No additional life cycle components are included in the 2020 CIP.

5.1.2 Pumping Plant 1B

5.1.2.1 Pumping Plant 1B Condition Assessment

Plant 1B shows minimal outward signs of potential failure. The lone item that was identified as a potential shortcoming was the limited capacity of the backup generator diesel tank.

Based on the lack of operational issues, at the workshop parties agreed a Condition Hazard Rating Score of 2 was appropriate, defining performance as nearly like new. The following potential projects are identified based on the condition assessment:

Table 5-4 - Pumping Plant 1B Assessment Potential Projects

Pump Station Component	Sub-optimal Reason	Proposed Improvement Project
Backup Generator	Limited runtime with existing tank	Convert existing generator to use natural gas

5.1.2.2 Pumping Plant 1B Level of Service

Based on the condition assessment and workshop with the District, Table 5-5 summarizes where Plant 1B does or does not meet the optimal level of service indicated by the District.

Table 5-5 - Pumping Plant 1B Level of Service

Pumping Plant: 1B	Level of Service Indicators				
	Reliability	Redundancy	Capacity	Operational Flexibility	Maintain-ability
Pump Station Component	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)
Intake Screens	Y	N	Y	Y	Y
Power Supply	Y	N	Y	Y	Y
Motors	Y	N	Y	Y	Y
Pumps	N	N	Y	Y	Y
Instrumentation & Controls	Y	Y	Y	Y	Y
Outfall Pipes	Y	NA	Y	Y	Y
Cathodic Protection System	Y	N	Y	Y	Y
Pump & Motor Structural	Y	NA	Y	NA	Y
Access & Security	Y	NA	Y	Y	Y
Building	Y	NA	Y	NA	Y

Pump station components that do not meet the desired level of service and should be considered for near-term capital improvements are summarized in Table 5-6.

Table 5-6 - Pumping Plant 1B Level of Service Potential Projects

Pump Station Component	Sub-optimal Reason	Proposed Improvement Project
Intake Screens	No backup system	None
Power Supply	Current diesel generator is limited in size	Convert existing generator to use natural gas/diesel mixture
Motors	No backup system	None
Pumps	Cavitation issues at pump suction intakes	Construct baffles to separate each pump in a shared bay. Install anti-cavitation plates at bell of each pump.
Cathodic Protection	No backup system	None

- The current generator fuel tank is only large enough to provide backup for approximately 8 hours at capacity. The District would like at least 72 hours of capacity. Therefore it is recommended that the generator be converted to use a fuel mixture of diesel and natural gas, which can be brought in from the nearby PG&E natural gas line and greatly extend the operational time of the generator.

- The pumps currently suffer from some cavitation due to the proximity as they are paired in bays. The proposed solution would be to construct baffles between each pump suction to prevent the water siphoning from affecting the other pumps. Anti-cavitation plates affixed to the bottom of the intakes are also considered.

5.1.2.3 Pumping Plant 1B Life Cycle State

Pump station components that will require life cycle replacements to maintain level of service standards are listed in Table 5-7.

Table 5-7 - Pumping Plant 1B Life Cycle Replacement Initial Schedule

Item	Component or Service Item	Base Replacement Year	Life Cycle (Years)	Next Replacement or Service
Intake Screens	Dive Inspection	2003	2	2021
	Chain Replacement	2003	10	2021
	Unit Replacement	2003	40	2043
Power Supply	Evaluation	2012	10	2022
	Transformer	2012	20	2032
	In-building/in-panel ATS, etc.	2012	20	2032
	Backup Generator	2012	30	2042
Instrumentation & Controls	Evaluation	2003	10	2021
	Unit Replacement	2003	20	2023
Motors	Clean & Bake	2003	8	2021
	Replace Unit	2003	50	2053
Pumps	Remove & Inspect	2003	8	2021
	Replace Unit	2003	50	2053
Outfalls	Comprehensive Inspection	2003	5	2021
	Valves and Gates	2003	25	2028
	Outfall Structure	2003	75	2078
	Pipes	2003	75	2078
Cathodic Protection	Anode Beds	2003	5-10	2021
	Unit	2003	25	2028
Pump and Motor Structural	Structure and Platform	2003	75	2078
	Steel Access and Grating	2003	75	2078
Access and Security	Fences	2003	50	2053
	Cameras	2003	10	2021
Buildings	Ventilation	2003	15	2021
	Roof and Paint	2003	25	2028
	Building Replacement	2003	75	2078

5.1.3 Pumping Plant 2

5.1.3.1 Pumping Plant 2 Condition Assessment

Plant 2 was reconstructed in 2014, and is in excellent condition. The only recommended projects identified in the condition assessment is to either install a permanent backup generator or purchase a portable generator that can power Plant 2 and other similar size plants. Based on the recent reconstruction, at the workshop parties agreed a Condition Hazard Rating Score of 1 was appropriate, defining performance as like new.

The following potential projects are identified based on the condition assessment:

Table 5-8 - Pumping Plant 2 Assessment Potential Projects

Pump Station Component	Sub-optimal Reason	Proposed Improvement Project
Backup Generator	None; hookup for portable at plant	Add permanent backup generator or purchase portable generator that can operate several of the smaller plants

5.1.3.2 Pumping Plant 2 Level of Service

Table 5-9 - Pumping Plant 2 Level of Service

Pumping Plant: 2	Level of Service Indicators				
	Reliability	Redundancy	Capacity	Operational Flexibility	Maintain-ability
Pump Station Component	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)
Intake Screens	Y	N	Y	Y	Y
Power Supply	Y	N	Y	Y	Y
Motors	Y	N	Y	Y	Y
Pumps	Y	N	Y	Y	Y
Instrumentation & Controls	Y	Y	Y	Y	Y
Outfall Pipes	Y	NA	Y	Y	Y
Cathodic Protection System	Y	N	Y	Y	Y
Pump & Motor Structural	Y	NA	Y	NA	Y
Access & Security	N	NA	NA	Y	Y
Building	Y	NA	Y	NA	Y

Pump station components that will require life cycle replacements to maintain level of service standards are listed in Table 5-10.

Table 5-10 - Pumping Plant 2 Level of Service Potential Projects

Pump Station Component	Sub-optimal Reason	Proposed Improvement Project
Intake Screens	No backup system	None
Power Supply	No onsite back up	Install natural gas or diesel backup generator
Motors	No backup system	None
Pumps	No backup system	None
Cathodic Protection	No backup system	None
Access & Security	Fencing does not include anti-climb fabric	Install anti-climb fabric

- It was determined that it was not feasible or efficient to provide backup screens, motors, pumps, or cathodic protection, so no improvement projects are proposed for those potential shortcomings.
- The current plant has a generator hookup, but it is optimal to have an onsite generator to provide backup power without needing available staff or portable generator. It is proposed to install an onsite generator at the Plant 2 site. The type of generator will be determined based upon natural gas availability at the site.
- The plant's security system is up-to-date, but the fencing needs anti-climb fabric to prevent intrusion.

5.1.3.3 Pumping Plant 2 Life Cycle State

Pump station components that will require life cycle replacements to maintain level of service standards are listed in Table 5-11.

Table 5-11 - Pumping Plant 2 Life Cycle Replacement Initial Schedule

Item	Component or Service Item	Base Replacement Year	Life Cycle (Years)	Next Replacement or Service
Intake Screens	Dive Inspection	2014	4	2021
	Chain Replacement	2014	10	2024
	Unit Replacement	2014	40	2043
Power Supply	Evaluation	2014	10	2021
	Transformer	2014	20	2034
	In-building/in-panel ATS, etc.	2014	20	2034
	Backup Generator	-	30	TBD
Instrumentation & Controls	Evaluation	2014	10	2021
	Unit Replacement	2014	20	2023
Motors	Clean & Bake	2014	12	2021
	Replace Unit	2014	50	2053
Pumps	Remove & Inspect	2014	12	2021
	Replace Unit	2014	50	2053
Outfalls	Comprehensive Inspection	2014	5	2021
	Valves and Gates	2014	25	2039
	Outfall Structure	2014	75	2089
	Pipes	2014	75	2089
Cathodic Protection	Anode Beds	2014	5-10	2021
	Unit	2014	25	2028
Pump and Motor Structural	Structure and Platform	2014	75	2089
	Steel Access and Grating	2014	75	2089
Access and Security	Fences	2014	50	2053
	Cameras	2014	10	2024
Buildings	Ventilation	2014	15	2029
	Roof and Paint	2014	25	2039
	Building Replacement	2014	75	2089

5.1.4 PUMPING PLANT 3

5.1.4.1 Pumping Plant 3 Condition Assessment

Plant 3 is in a condition that it is expected to be able to provide the necessary service until it is replaced under the NLIP. Because a new plant will soon be in place, at the workshop parties agreed a Condition Hazard Rating Score of 1 was appropriate. No potential projects are identified that would not be identified under the Level of Service evaluation.

5.1.4.2 Pumping Plant 3 Level of Service

Table 5-12 - Pumping Plant 3 Level of Service

Pumping Plant: 2	Level of Service Indicators				
	Reliability	Redundancy	Capacity	Operational Flexibility	Maintain-ability
Pump Station Component	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)
Intake Screens	Y	N	Y	Y	Y
Power Supply	Y	N	Y	Y	Y
Motors	Y	N	Y	Y	Y
Pumps	Y	N	Y	Y	Y
Instrumentation & Controls	Y	Y	Y	Y	Y
Outfall Pipes	Y	NA	Y	Y	Y
Cathodic Protection System	Y	N	Y	Y	Y
Pump & Motor Structural	Y	NA	Y	NA	Y
Access & Security	N	NA	NA	Y	Y
Building	Y	NA	Y	NA	Y

- The new Plant 3 is expected to be very similar to Plant 2, therefore the same Level of Service assumptions have been used. Components not expected to meet the level of service standard and potentially need near term capital improvements are included in Table 5-13.

Table 5-13 - Pumping Plant 3 Level of Service Potential Projects

Pump Station Component	Sub-optimal Reason	Proposed Improvement Project
Intake Screens	No backup system	None
Power Supply	No onsite back up	Install natural gas or diesel backup generator
Motors	No backup system	None
Pumps	No backup system	None
Cathodic Protection	No backup system	None
Access & Security	Fencing does not include anti-climb fabric	Install anti-climb fabric

- It was determined that it was not feasible or efficient to provide backup screens, motors, pumps, or cathodic protection, so no improvement projects are proposed for those potential shortcomings.

- It is proposed to install an onsite generator at the Plant 3 site. Whether natural gas is available at this location must be determined.
- The fencing will need anti-climb fabric to prevent intrusion.

5.1.4.3 Pumping Plant 3 Life Cycle State

Pump station components that will require life cycle replacements to maintain level of service standards are listed in Table 5-14.

Table 5-14 - Pumping Plant 3 Life Cycle Replacement Initial Schedule

Item	Component or Service Item	Base Replacement Year	Life Cycle (Years)	Next Replacement or Service
Intake Screens	Dive Inspection	2022	4	2026
	Chain Replacement	2022	10	2032
	Unit Replacement	2022	40	2062
Power Supply	Evaluation	2022	10	2032
	Transformer	2022	20	2042
	In-building/in-panel ATS, etc.	2022	20	2042
	Backup Generator	-	30	TBD
Instrumentation & Controls	Evaluation	2022	10	2032
	Unit Replacement	2022	20	2042
Motors	Clean & Bake	2022	12	2034
	Replace Unit	2022	50	2072
Pumps	Remove & Inspect	2022	12	2034
	Replace Unit	2022	50	2072
Outfalls	Comprehensive Inspection	2022	5	2027
	Valves and Gates	2022	25	2047
	Outfall Structure	2022	75	2097
	Pipes	2022	75	2097
Cathodic Protection	Anode Beds	2022	5-10	2027
	Unit	2022	25	2047
Pump and Motor Structural	Structure and Platform	2022	75	2097
	Steel Access and Grating	2022	75	2097
Access and Security	Fences	2022	50	2072
	Cameras	2022	10	2032
Buildings	Ventilation	2022	15	2037
	Roof and Paint	2022	25	2047
	Building Replacement	2022	75	2097

5.1.5 Pumping Plant 4

5.1.5.1 Pumping Plant 4 Condition Assessment

Plant 4, while showing signs of age, is in a condition that it is expected to be able to provide the necessary service until it is replaced under the NLIP. The new plant replacement has been designed and is expected to be constructed by 2022. Therefore workshop parties agreed a Condition Hazard Rating Score of 1 was appropriate. No potential projects are identified that would not be identified under the Level of Service evaluation.

5.1.5.2 Pumping Plant 4 Level of Service

Table 5-15 - Pumping Plant 4 Level of Service

Pumping Plant: 2	Level of Service Indicators				
	Reliability	Redundancy	Capacity	Operational Flexibility	Maintain-ability
Pump Station Component	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)
Intake Screens	Y	N	Y	Y	Y
Power Supply	Y	N	Y	Y	Y
Motors	Y	N	Y	Y	Y
Pumps	Y	N	Y	Y	Y
Instrumentation & Controls	Y	Y	Y	Y	Y
Outfall Pipes	Y	NA	Y	Y	Y
Cathodic Protection System	Y	N	Y	Y	Y
Pump & Motor Structural	Y	NA	Y	NA	Y
Access & Security	N	NA	NA	Y	Y
Building	Y	NA	Y	NA	Y

- The new Plant 4 is expected to be very similar to Plant 2, therefore the same Level of Service assumptions have been used. Components not expected to meet the level of service standard and may need near term capital improvements are included in Table 5-16.

Table 5-16 - Pumping Plant 4 Level of Service Potential Projects

Pump Station Component	Sub-optimal Reason	Proposed Improvement Project
Intake Screens	No backup system	None
Power Supply	No onsite back up	Install natural gas or diesel backup generator
Motors	No backup system	None
Pumps	No backup system	None
Cathodic Protection	No backup system	None
Access & Security	Fencing does not include anti-climb fabric	Install anti-climb fabric

- It was determined that it was not feasible or efficient to provide backup screens, motors, pumps, or cathodic protection, so no improvement projects are proposed for those potential shortcomings.

- It is proposed to install an onsite generator at the Plant 4 site after construction. Natural gas is not available at Plant 4 so a diesel or propane tank sufficient for 48-72 hours is desired.

- The fencing will need anti-climb fabric to prevent intrusion.

5.1.5.3 Pumping Plant 4 Life Cycle State

Pump station components that will require life cycle replacements to maintain level of service standards are listed in Table 5-17. The same life cycle as Plant 3 is assumed.

Table 5-17 - Pumping Plant 4 Life Cycle Replacement Initial Schedule

Item	Component or Service Item	Base Replacement Year	Life Cycle (Years)	Next Replacement or Service
Intake Screens	Dive Inspection	2022	4	2026
	Chain Replacement	2022	10	2032
	Unit Replacement	2022	40	2062
Power Supply	Evaluation	2022	10	2032
	Transformer	2022	20	2042
	In-building/in-panel ATS, etc.	2022	20	2042
	Backup Generator	-	30	TBD
Instrumentation & Controls	Evaluation	2022	10	2032
	Unit Replacement	2022	20	2042
Motors	Clean & Bake	2022	12	2034
	Replace Unit	2022	50	2072
Pumps	Remove & Inspect	2022	12	2034
	Replace Unit	2022	50	2072
Outfalls	Comprehensive Inspection	2022	5	2027
	Valves and Gates	2022	25	2047
	Outfall Structure	2022	75	2097
	Pipes	2022	75	2097
Cathodic Protection	Anode Beds	2022	5-10	2027
	Unit	2022	25	2047
Pump and Motor Structural	Structure and Platform	2022	75	2097
	Steel Access and Grating	2022	75	2097
Access and Security	Fences	2022	50	2072
	Cameras	2022	10	2032
Buildings	Ventilation	2022	15	2037
	Roof and Paint	2022	25	2047
	Building Replacement	2022	75	2097

5.1.6 Pumping Plant 5

5.1.6.1 Pumping Plant 5 Condition Assessment

Plant 5 has been identified by the District for replacement. While showing signs of age, Plant 5's condition is such that it is expected to be able to provide the necessary service until it is replaced, whether under the NLIP or directly by the District. The plan is to begin design of the plant replacement in the upcoming year and begin to look for funds through the NLIP and/or grants. If external funding is not secured, it is assumed that the District will fund construction in 2026. Design is assumed to include all components necessary to meet all Levels of Service that will be installed at other plants, such as a backup generator. The Condition Hazard Rating of the Plant is 6; it should be monitored in upcoming years and further degradation could accelerate the urgency to replace it.

5.1.6.2 Pumping Plant 5 Level of Service

New Plant 5 will be designed to incorporate all Level of Service improvements, no analysis was performed.

5.1.6.3 Pumping Plant 5 Life Cycle State

Pump station components that will require life cycle replacements to maintain level of service standards are listed in Table 5-18. Construction is assumed in 2026 and it is assumed the plant will include any upgrades necessary to achieve optimal status in all areas, since all items can be incorporated into design.

Table 5-18 - Pumping Plant 5 Life Cycle Replacement Initial Schedule

Item	Component or Service Item	Base Replacement Year	Life Cycle (Years)	Next Replacement or Service
Intake Screens	Dive Inspection	2026	4	2030
	Chain Replacement	2026	10	2036
	Unit Replacement	2026	40	2066
Power Supply	Evaluation	2026	10	2036
	Transformer	2026	20	2046
	In-building/in-panel ATS, etc.	2026	20	2046
	Backup Generator	2026	30	2056
Instrumentation & Controls	Evaluation	2026	10	2036
	Unit Replacement	2026	20	2046
Motors	Clean & Bake	2026	12	2038
	Replace Unit	2026	50	2076
Pumps	Remove & Inspect	2026	12	2038
	Replace Unit	2026	50	2076
Outfalls	Comprehensive Inspection	2026	5	2031
	Valves and Gates	2026	25	2051
	Outfall Structure	2026	75	2101
	Pipes	2026	75	2101
Cathodic Protection	Anode Beds	2026	5-10	2036
	Unit	2026	25	2051
Pump and Motor Structural	Structure and Platform	2026	75	2101
	Steel Access and Grating	2026	75	2101
Access and Security	Fences	2026	50	2076
	Cameras	2026	10	2036
Buildings	Ventilation	2026	15	2041
	Roof and Paint	2026	25	2051
	Building Replacement	2026	75	2101

5.1.7 PUMPING PLANT 6

5.1.7.1 Pumping Plant 6 Condition Assessment

Under existing District operational practices, Pumping Plant 6 is the last plant to be operated during a storm event. It is only used in extreme conditions or when other assets have failed or flows are significant, and has not been operated in several years. The components that could be viewed during the assessment show visual signs of aging but not to the point that the plant could not function. While the District checks the power systems monthly during the flood season, the pumps have not been spun in several years. It is understood that operating the pumps off the local meter would initiate a service charge of $2,000 per month for 12 months. To more cost effectively test the pumps, a method to power the pumps using a portable generator is recommended to confirm the pumps will actually operate if and when needed.

Other potential projects noted during the assessment include:

- Replacement of the manual bar screens with an automatic bar screen
- The pump columns and outfall piping appeared corroded but could not be examined closely enough
- Fencing to prevent access to the bar screen deck.
- The plant has no backup generator or hookup for a portable generator.

Potential project based on the assessment are listed in Table 5-19 below.

Table 5-19 - Pumping Plant 6 Assessment Potential Projects

Pumping Plant 2: Near Term Capital Condition Assessment Improvements		
Pump Station Component	**Sub-optimal Reason**	**Proposed Improvement Project**
Intake Screen	Currently are manually cleaned	Install automatic bar screen
Pump Column and Outfall Piping	Potential corrosion; to be confirmed	Evaluation and potential replacement
Access & Security	Fencing does not prevent access to all facilities	Install new anti-climb fencing around entire plant perimeter
Backup Generator	None; hookup for portable at plant	Add permanent backup generator or install hookup if portable generator(s) to be purchased

5.1.7.2 Pumping Plant 6 Level of Service

Table 5-20 - Pumping Plant 6 Level of Service

Pumping Plant: 6	Level of Service Indicators				
	Reliability	Redundancy	Capacity	Operational Flexibility	Maintain-ability
Pump Station Component	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)
Intake Screens	N	N	Y	Y	N
Power Supply	Y	N	Y	Y	Y
Motors	Y	N	Y	Y	Y
Pumps	Y	N	Y	Y	Y
Instrumentation & Controls	Y	Y	Y	N	Y
Outfall Pipes	N	Y	Y	Y	Y
Cathodic Protection System	Y	Y	Y	Y	Y
Pump & Motor Structural	Y	NA	Y	NA	Y
Access & Security	N	NA	NA	N	Y
Building	N	NA	Y	NA	Y

Table 5-21 - Pumping Plant 6 Level of Service Potential Projects

Pumping Plant 6: Near Term Capital Improvements		
Pump Station Component	**Sub-optimal Reason**	**Proposed Improvement**
Intake Screens	Intake screens are manual bar screens No backup	Install automatic bar screens None
Power Supply	No backup	Install propane or diesel backup generator
Motors	No backup	None
Pumps	No backup	None
Instrumentation & Controls	Need for standardization and automation	Install SCADA system
Outfall pipes	Visible signs of corrosion	Evaluate and potentially rehabilitate or replace outfall pipes
Access & Security	New fencing is required Lack of security Building lock is rusted	Install anti climb fencing Install security cameras and alarm Replace building locks

- It was determined that it was not feasible or efficient to provide backup screens, motors, pumps, or cathodic protection, so no improvement projects are proposed for those specific deficiencies.
- The existing bar screens are manually cleaned, and it is recommended to install automatic bar screens to reduce the need for labor.
- There is no backup power supply, so to increase reliability, it is recommended that an onsite backup generator be installed.
- This plant's instrumentation and controls are recommended to be integrated into the SCADA system.
- The outfall pipes have visible signs of corrosion and need replacing.
- The security fencing and locks at the plant are old and are not effective at keeping the plant secure, so upgrades are needed.

5.1.7.3 Pumping Plant 6 Life Cycle State

Pump station components that will require life cycle replacements to maintain level of service standards are listed in Table 5-22.

Table 5-22 - Pumping Plant 6 Life Cycle Replacement Initial Schedule

Pumping Plant Life Cycle Replacements				
Item	**Component or Service Item**	**Base Replacement Year**	**Life Cycle (Years)**	**Next Replacement or Service**
Intake Screens	Dive Inspection	1997	4	2024
	Chain Replacement	1997	10	NA
	Unit Replacement	1997	40	2021
Power Supply	Evaluation	1997	10	2021
	Transformer	1997	20	2022
	In-building/in-panel ATS, etc.	1997	20	2022
	Backup Generator	1997	30	2022
Instrumentation & Controls	Evaluation	1997	10	2021
	Unit Replacement	1997	20	2022
Motors	Clean & Bake	1997	12	2024
	Replace Unit	1997	50	2047
Pumps	Remove & Inspect	1997	12	2024
	Replace Unit	1997	50	2047
Outfalls	Comprehensive Inspection	1997	5	2022
	Valves and Gates	1997	25	2022
	Outfall Structure	1997	75	2072
	Pipes	1997	75	2072
Cathodic Protection	Anode Beds	1997	5-10	2021
	Unit	1997	25	2022
Pump and Motor Structural	Structure and Platform	1997	75	2072
	Steel Access and Grating	1997	75	2072
Access and Security	Fences	1997	50	2047
	Cameras	1997	10	2022
Buildings	Ventilation	1997	15	2022
	Roof and Paint	1997	25	2022
	Building Replacement	1997	75	2072

5.1.9 PUMPING PLANT 8

5.1.9.1 Pumping Plant 8 Condition Assessment

This plant has the greatest nominal capacity to remove water from the basin but has significant issues that limit its practical capacity under most conditions. The coatings for the discharge pipes were noted to be in poor condition where exposed although obvious pitting could not be visually observed where bare steel was visible. District staff indicated that the pipes are out-of-round beyond manufacturer tolerance at the outfall. The plant has a hookup for a portable generator but no permanent backup generator. District operational staff note that electrical components have been consistently failing and needing replacement. Workshop parties agreed the Condition Hazard Rating Score is 6.

The following potential projects are identified based on the condition assessment:

Table 5-23 - Pumping Plant 8 Assessment Potential Projects

Pumping Plant 2: Near Term Capital Condition Assessment Improvements		
Pump Station Component	**Sub-optimal Reason**	**Proposed Improvement Project**
Outfall Piping	Poor condition of coating	Evaluate whether corrosion requiring remedial action has occurred
Backup Generator	None; hookup for portable at plant	Add permanent backup generator

5.1.9.2 Pumping Plant 8 Level of Service

Table 5-24 - Pumping Plant 8 Level of Service

Pumping Plant: 8	Level of Service Indicators				
	Reliability	**Redundancy**	**Capacity**	**Operational Flexibility**	**Maintain-ability**
Pump Station Component	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)
Intake Screens	Y	N	Y	Y	Y
Power Supply	N	N	Y	Y	Y
Motors	Y	Y	Y	Y	Y
Pumps	Y	Y	Y	Y	Y
Instrumentation & Controls	N	Y	Y	N	Y
Outfall Pipes	N	N	Y	Y	Y
Cathodic Protection System	Y	N	Y	Y	Y
Pump & Motor Structural	Y	NA	Y	NA	N
Access & Security	N	NA	NA	Y	N
Building	Y	NA	Y	NA	Y

Pump station components that will require life cycle replacements to maintain level of service standards are listed in Table 5-25.

Table 5-25 - Pumping Plant 8 Level of Service Improvements

Pump Station Component	Sub-optimal Reason	Proposed Improvement Project
Intake Screens	No backup	None
Power Supply	No backup	Install natural gas backup generator on property across Northgate Blvd.
	Unreliable low voltage power supply	Replace with to upgraded medium voltage power supply.
Motors	Incompatible with 2.3 kV standard	Replace motors
Pumps	Pair replacement with motor	Replace pumps
Instrumentation & Controls	Old age	Replace instrumentation and controls
Outfall Pipes	Outfall pipes are out of round	Replace pipeline not included in USACE work
Cathodic Protection	No backup	None
Access & Security	Camera system out of date	Replace cameras and hook up to SCADA
	Pump platform access issues	Install walkway for workers

In general, it is recommended that a major replacement project of most Plant 8 components be implemented, driven mostly by the poor condition of the electrical and instrumentation. While much of the electrical and instrumentation is approaching the end of its normal useful life, District experience is that the components have degraded faster than expected. For example, the District has replaced 4 of 9 soft starters which is beyond expectation over the timeframe. It is recommended that the replacement project be bundled to include the following components:

- Transformer and power supply: modified to 2.3 kV to match other plants
- Backup generator: powered by natural gas from PG&E line on Northgate Boulevard
- Motors: Must be replaced to run on 2.3 kV power
- Pumps: Pumps should be replaced when the motors they are paired with are replaced
- Pump platform steel deck: elevated deck should be expanded to the stairs so the pumps and motors can be accessed when water flood the platform due to low elevation of platform
- Cathodic protection system: should be replaced to operate on new voltage
- Ventilation: should be replaced to operate on new voltage and is approaching normal useful life
- Cameras: should be replaced

The outfall pipes have been found to be out of round, and need rehabilitation or replacement, up to where NLIP replacement work stops. While the hydraulics need to be coordinated with the replacement of the pumps in the major replacement, it is recommended as a separate project because separate contractors would be preferred. An evaluation to determine the rehabilitation method or replacement is recommended, with the construction project budgeted for replacement for conservative budgeting.

5.1.9.3 Pumping Plant 8 Life Cycle State

The pump station was originally constructed nearly 40 years ago and a major overhaul was performed nearly 20 years ago. The expected life cycle for Plant 8, not accounting for useful life of components expiring prematurely, is shown in Table 5-26. The electrical and instrumentation and controls have a combination of components that are nearing the end of their useful lives and some in the middle of their projected useful lives. The outfall structure is the sole component being replaced under the NLIP and is shown with an assumed completion year of 2021. For capital components already beyond their expected useful life, a replacement year of 2022 is listed to allow for planning and implementation.

Table 5-26 - Pumping Plant 8 Life Cycle Replacement Current Schedule

Item	Component or Service Item	Base Replacement Year	Life Cycle (Years)	Next Replacement or Service
Intake Screens	Dive Inspection	2019	2	2021
	Chain Replacement	2013	10	2023
	Unit Replacement	2001	40	2043
Power Supply	Evaluation	2001	10	2022
	Transformer	2001	20	2022
	In-building/in-panel ATS, etc.	2001	20	2022
	Backup Generator	(none currently)	30	
Instrumentation & Controls	Evaluation	2001	10	2022
	Unit Replacement	2001	20	2022
Motors	Clean & Bake	1983	8	2022
	Replace Unit	1983[1]	50	2033[1]
Pumps	Remove & Inspect	1983	8	2022
	Replace Unit	1983[1]	50	2033[1]
Outfalls	Comprehensive Inspection	1983	5	2027
	Valves and Gates	1983	25	2008
	Outfall Structure	2021	75	2097
	Pipes	1983	75	2058
Cathodic Protection	Anode Beds	2001	5-10	2022
	Unit	2001	25	2026
Pump and Motor Structural	Structure and Platform	2001	75	2076
	Steel Access and Grating	2001	75	2076
Access and Security	Fences	2003	50	2053
	Cameras	(none currently)	10	
Buildings	Ventilation	2001	15	2022
	Roof and Paint	2001	25	2026
	Building Replacement	2001	75	2076

[1]Pumps 8 and 9 were installed in 2001, all others 1983.

Several components are concurrently reaching the end of their normal useful lives; operations staff have confirmed a corresponding decrease in performance including the existing chains on intake screen and older electrical and instrumentation and controls components.

In addition to several components reaching the end of their useful lives, there is evidence multiple components have prematurely reached the end of their useful lives. For example, the outfall pipelines are known to be out-of-round beyond manufacturer tolerance with the lining delaminating near the outfall and several of the electrical and instrumentation components such as four (4) of nine (9) soft starters for the pumps have prematurely failed and required replacement.

With Plant 8 being critical and several major components nearing the end of its life cycle, a major replacement effort is recommended. While several of the components have some remaining useful life, a bundled project is recommended for maximum efficiency. The bundled components include:

- Replacing all electrical and instrumentation components to run on medium voltage 2.3 kV power. The District has moved towards a 2.3 kV standard and the remaining regularly used plants on low-voltage power are Plants 5 and 8.

- Replacing the motors, pumps, cathodic protection, and ventilation systems to run on the 2.4kV power. While the pumps and motors have over a decade of expected remaining useful life, the normal preventive maintenance has not been performed so each is likely to wear out prematurely. Because motors and other equipment cannot be modified to run on other voltages, concurrent replacement of the electrical, instrumentation, and mechanical components is recommended as a priority. If the projects were implemented piecemeal, the low-voltage equipment would have to remain in place for the plant to operate.

- Installation of a backup generator in the lot across Northgate Boulevard, adjacent to the cardlock fueling station, is a recommended Level of Service upgrade. This is an upgrade that can be made independently of the other recommended replacements. If not implemented with the other recommended replacements, installation of conduits across Northgate Boulevard is recommended to minimize future impacts.

- Implementing an outfall pipeline investigation and remedial action. A study to determine the best option is recommended. Replacement of the entire pipeline is assumed for budgeting purposes; the plan and expenditures will need to be updated after the study and evaluation is complete.

The number of components to be replaced is sufficient that bundling into a single large project is recommended for efficiency. If the electrical service is to be upgraded to 2.4kV, multiple components will have to be replaced concurrently regardless. If the recommended pumping plant replacements are implemented as recommended, the life cycle replacement schedule will be reset according to the schedule in Table 5-27. The assumed implementation year of 2022 becomes the baseline year for most life cycle replacement components going forward.

Table 5-27 - Pumping Plant 8 Life Cycle Replacement Schedule with Major Upgrades

Item	Component or Service Item	Base Replacement Year	Life Cycle (Years)	Next Replacement or Service
Intake Screens	Dive Inspection	2022	2	2024
	Chain Replacement	2022	10	2032
	Unit Replacement	2001	40	2041
Power Supply	Evaluation	2022	10	2032
	Transformer	2022	20	2052
	In-building/in-panel ATS, etc.	2022	20	2042
	Backup Generator	2022	30	2052
Instrumentation & Controls	Evaluation	2022	10	2032
	Unit Replacement	2022	20	2042
Motors	Clean & Bake	2022	8	2030
	Replace Unit	2022	50	2072
Pumps	Remove & Inspect	2022	8	2030
	Replace Unit	2022	50	2072
Outfalls	Comprehensive Inspection	2022	5	2027
	Valves and Gates	2022	25	2047
	Outfall Structure	2022	75	2097
	Pipes	2022	75	2097
Cathodic Protection	Anode Beds	2022	5-10	2027
	Unit	2022	25	2047
Pump and Motor Structural	Structure and Platform	2001	75	2076
	Steel Access and Grating	2001	75	2076
Access and Security	Fences	2001	50	2051
	Cameras	2022	10	2032
Buildings	Ventilation	2022	15	2037
	Roof and Paint	2022	25	2047
	Building Replacement	2001	75	2076

5.1.10 San Juan Pumping Plant

5.1.10.1 San Juan Pumping Plant Level of Service

Table 5-28 - San Juan Pumping Plant Level of Service

Pumping Plant: San Juan	Level of Service Indicators				
	Reliability	Redundancy	Capacity	Operational Flexibility	Maintain-ability
Pump Station Component	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)
Intake Screens	Y	N	Y	Y	N
Power Supply	Y	N	Y	Y	Y
Motors	Y	Y	Y	Y	Y
Pumps	Y	Y	Y	Y	Y
Instrumentation & Controls	Y	Y	Y	Y	Y
Outfall Pipes	Y	Y	Y	N	Y
Cathodic Protection System	Y	Y	Y	Y	Y
Pump & Motor Structural	Y	NA	Y	NA	Y
Access & Security	N	NA	NA	Y	Y
Building	Y	NA	Y	NA	Y

Table 5-29 - San Juan Pumping Plant Level of Service Improvements

Pump Station Component	Sub-optimal Reason	Proposed Improvement
Intake Screens	Intake screens are manual bar screens	Install automatic bar screens
	No backup	None
Power Supply	No backup	Install backup generator
Outfall pipes	Closing the gates is difficult	Install concrete vault with positive closure gates
Access & Security	Fences are climbable	Install anti climb fencing
	Lack of security	Install security cameras and alarm

The intake screens are currently manually cleaned, so installation of automatic bar screens is considered to reduce the need for labor. However, given that the ditches that convey water to the pumping plant are dry during portions of the year, the vegetation load is considerably less than the exterior pumping plants, so automatic screens are not considered cost-effective mitigation.

There is an existing building that used to house a diesel generator, but the generator was removed due to air quality concerns. It is recommended that a new permanent or portable be considered in its place, using the existing infrastructure.

The fencing needs anti-climb fencing installed, and security cameras and alarms also recommended to be installed.

5.1.11 Riverside Pumping Plant

The Riverside Pumping Station is located near the San Juan Pumping Station. This plant is identical in layout to San Juan Pumping Station, albeit smaller due to its smaller service area. The plant is in good condition, and there are no particular signs of excessive aging or damage.

5.1.11.1 Riverside Pumping Plant Level of Service

Table 5-30 - Riverside Pumping Plant Level of Service

Pumping Plant: Riverside	Level of Service Indicators				
	Reliability	Redundancy	Capacity	Operational Flexibility	Maintain-ability
Pump Station Component	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)	Optimal? (Y/N)
Intake Screens	Y	N	Y	Y	N
Power Supply	Y	N	Y	Y	Y
Motors	Y	Y	Y	Y	Y
Pumps	Y	Y	Y	Y	Y
Instrumentation & Controls	Y	Y	Y	Y	Y
Outfall Pipes	Y	Y	Y	N	Y
Cathodic Protection System	Y	Y	Y	Y	Y
Pump & Motor Structural	Y	NA	Y	NA	Y
Access & Security	N	NA	NA	Y	Y
Building	Y	NA	Y	NA	Y

Table 5-31 - Riverside Pumping Plant Level of Service Improvements

Pump Station Component	Sub-optimal Reason	Proposed Improvement
Intake Screens	Intake screens are manual bar screens.	Install automatic bar screens.
Power Supply	Lack of backup generator.	Install natural gas backup generator
Outfall pipes	Lack of outfall structure	Install concrete vault with positive closure gates
Access & Security	New fencing is required	Install anti climb fencing
	Lack of security	Install security cameras and alarm

Riverside Pumping Plant is identical in layout to San Juan, so the same improvements are recommended, except the generator, which would only need to be present at San Juan. The building currently at San Juan is also setup to serve Riverside.

5.1.12 Life Cycle Replacement of Culverts and Drains

The District owns and maintains a significant number of culverts and drains across its territory. Assuming 50-year and 60-year useful lives for culverts and drains, respectively, this plan does not estimate the cost of individual replacements, instead it aggregates the overall number of assets by size and length and determines the annual replacement cost to and number culvert and drains necessary to keep pace with assets reaching the end of their useful life.

5.1.13 Interior Drainage SCADA System

The operation of the District's pumping system is dependent on the water level inside the District's drainage canals. It is proposed to install a SCADA system that can read the elevations of the water at different points in the interior drainage system to enhance the District's ability to respond quickly and efficiently. The intent is that eventually the data will also be available to interested public on a site similar to State Department of Water Resources websites. The project begins by installing water level sensors at 12 locations around the District and aggregating the data for District personnel to be able to view.

5.1.14 Asset Management Program

For efficient long-term management and replacement of the District extensive assets, a formal asset management program is desired. The effort will become a long-term expense on the order of $50,000-100,000 per year once established, but a significant effort is required for program startup, which is the budget presented. The major components to start up an asset management program are: digital cataloging of the entire asset inventory, assigning criticality factors and health scores to each asset, and purchase of a Computer Maintenance Management System (CMMS). A CMMS will allow automated generation of work orders and tracking of asset age to support the life cycle replacement program.

5.2 FUTURE STUDIES

In addition to the projects identified above, there are potential projects that would need to be explored in order to determine their feasibility and benefit to the District.

5.2.1 North to South Conveyance Capacity Improvements Feasibility Study

The District's interior drainage canals are interconnected, allowing each pumping plant to pull from the entire Natomas Basin. The largest plants in particular at the southern end of the District, Plants 1 and 8, are able to act as the District's major points of discharge on a regular basis.

The layout of the major canal conveyance makes flows from the north end heading south route easterly before beginning a clockwise-like route that convey water closer to Plants 8 and 1 before reaching the physically closer Plants 3 and 5. There is a significant amount of existing ditch infrastructure that is nearly contiguous from the East Drain to Plants 3 and 5 that could potentially be made contiguous with a limited number of culvert additions to connect these ditches, facilitating more efficient routing of flows between the southwest and northern portions of the District. The culverts would generally cross roads including California Route 70/99 so the individual culverts would be expected to have high unit costs if practical to implement.

Section 6

2020 CIP

This section provides the net major costs associated with the Capital Projects identified during the Condition Assessment, Level of Service, and Life Cycle Replacement Program for Pumping Plant capital projects, Life Cycle Regular Maintenance Costs, and Capital Replacement of Culverts and Drains, and other significant near-term Noncapital Expenditures.

This section also provides a prioritization of the capital projects and recommended schedule for implementation.

6.1 PRIORITIZATION

The objective of this section is to identify and implement projects that cost-effectively reduce the risk of flooding within the Natomas Basin. Canal SCADA Monitoring and the Asset Management Program, as related projects that can provide cost-effective data and tools for managing risk, are included with the Pumping Plants. The methods for determining potential projects that should be considered for implementation was established in Sections 3 and 4 and potential projects based on the condition assessment, level of service, and asset life cycle were identified in Section 5. This section takes the potential projects identified in Section 5 and prioritizes them for implementation, with an implementation schedule that aims to balance District needs with financial resources.

As previously discussed, risk is a combination of the probability of failure and consequence of failure. To cost-effectively lower risk, assets or components with high risk would have an improvement or replacement implemented that reduces the risk. Given the District's location and geographical characteristics, the consequence of failure for the pumping plants cannot reasonably be lowered, so the focus is on projects that reduce the likelihood of failure. Table 6-1 below shows the net level of risk for each Pumping Plant that was shown in Table 4-7. From Section 4, the Net Criticality Rating and Condition Hazard Rating for each Plant are added to generate the Risk Score. The Net Criticality Rating is the proxy for relative consequence of failure rating and the Condition Hazard Rating is the proxy for relative likelihood of failure ratings.

Table 6-1 - Risk Ranking for Pumping Plants

Risk Criteria				Risk Ranking
Pumping Plant	**Net Criticality Rating**	**Condition Hazard Rating**	**Level of Risk**	
8	8	6	14	**1**
1A	2	9	11	**2**
1B	7	2	9	**3**
5	3	6	9	**3**
6	1	7	8	**5**
3	6	1	7	**6**
4	5	1	6	**7**
San Juan	2	4	6	**7**
Riverside	2	4	6	**7**
2	3	1	4	**10**

While a plant may rank high in the Risk Ranking Category, projects from plants with low criticality scores may not be as important as projects with high criticality scores. The following are generally considered when prioritizing projects:

- The most critical plants should have low Condition Hazard Ratings. The plants with the highest Net Criticality Ratings are 1B and 8, which have significantly more reliable capacity than other plants. Plant 1B has the low Condition Hazard Rating such a critical asset should have. Plant 1B is the type of asset where cost-effective measures that reduce risk should be implemented, maintenance should not be deferred, and key components should be replaced when they approach the end of their useful lives to keep the risk of failure low. However Plant 8 has a Condition Hazard Rating that is excessive for such a critical asset and should be prioritized for upgrades and replacements to restore it to good health.

- Plants with low Net Criticality Ratings may not be candidates for capital projects even with higher Condition Hazard Ratings than critical plants.

- Plants with uncertain futures are given lower priority. If development or future construction may require relocation of a plant, or the plant may no longer be needed because of facilities associated with development, the District is better served deferring projects until the need can be firmly established. This includes Plants 6, Riverside, and San Juan.

- Because the District has limited resources and may not be able to meet the optimal level of service at all plants, alternative projects that cost-effectively reduce risk may be preferred. The level of service would be increased but still less than optimal. Where an alternative project is recommended, it is described in this section.

- When identified projects at a single site can be bundled together for more efficient implementation, that is the preferred approach. When a component is nearing the end of its life cycle when other projects are scheduled, the aging component may be replaced slightly earlier or later to facilitate bundling with other projects. Bundling could also be done programmatically, where if a single component is needed at multiple pumping plants, it may be cost-effective to replace all components under a single contract.

This section also projects the associated life cycle costs for a 30-year planning horizon. While the implementation schedule 20-30 years out will change significantly, it provides an order of magnitude cost required to maintain the safe and reliable function of the District's Pumping Plants.

6.2 RELATIVE IMPORTANCE RATING

Before assigning an absolute ranking of potential capital projects, a relative importance for each of the projects on the list is given. This rating was done by KSN and the District General Manager. The following relative level of importance were initially assigned to each potential project:

With a comprehensive list of projects from the condition assessment, Level of Service evaluation, and Life Cycle, a relative level of priority was assigned to each project based on how critical the plant, condition of the existing component, and expected life cycle. Priority scores of 1-4 were assigned with the following definitions in a meeting between KSN and the District:

1 = Highest priority project

2 = Priority project

3 = Medium priority project

4 = Low priority project

S = priority 1 for assets to be replaced per the schedule determined by the asset life cycle

The relative importance rating for each is shown by plant in Table 6-2. The timeframe was extended out 30 years using the replacement lifecycle to provide the District with a basis for long-term budgeting, although the accuracy of the actual conditions will decrease the further out the projection is. The "S" rating was used because it provides the year the project is implemented based on the component life cycle.

Table 6-2 - RD 1000 CIP Relative Priority of Projects

Priority	Project	Plant	Criticality	Condition Hazard Rating	Net Cost	Construction/ Implementation	Notes	Plant Total
2	Asset Management Program				1,500,000	2022		
2	Canal SCADA Monitoring				150,000	2023		
2	Paint Exterior of Building	1A	2	11	72,000	2022		
3	Lead & Asbestos Abatement	1A	2	11	180,000	2029		
2	Replace instrumentation and controls; Install PLC and SCADA	1A	2	11	2,600,000	2031		
3	Install Automatic Bar Screens (2)	1A	2	11	650,000	2035		
2	Replace Chains on Existing Screens	1A	2	11	21,000	2041		
4	Install Access Manholes on Outfall Pipes	1A	2	11	45,000	2045		
4	Replace Access walkway	1A	2	11	125,000	2045	30 Year Plant 1A Total	3,700,000
4	Replace Cameras	1B	8	2	19,000	2021		
S	Replace Chains on Screens	1B	8	2	31,000	2021		
1	Install Anti-Cavitation Plates	1B	8	2	60,000	2021		
1	Replace Instrumentation and Controls	1B	8	2	1,300,000	2023		
1	Construct baffles to separate pumps (dewatering)	1B	8	2	760,000	2024		
2	Convert generator to natural gas	1B	8	2	450,000	2026		
2	Replace Roof & Paint Building	1B	8	2	625,000	2028		
S	Replace Valves & Gates	1B	8	2	412,500	2028		
S	Replace Anode Beds	1B	8	2	24,000	2028		
4	Replace Cameras	1B	8	2	19,000	2031		
S	Replace Chains on Screens	1B	8	2	31,000	2031		
1	Replace Power, Cathodic & Ventilation	1B	8	2	1,330,000	2032		
S	Replace Anode Beds	1B	8	2	24,000	2038		
4	Replace Cameras	1B	8	2	19,000	2041		
S	Major Plant Replacements	1B	8	2	2,182,500	2043		
S	Replaced Automated Screen	1B	8	2	1,950,000	2043		
S	Replace Instrumentation and Controls	1B	8	2	1,300,000	2043		
S	Replace Anode Beds	1B	8	2	24,000	2048	30 Year Plant 1B Total	10,600,000
S	Replace Chains on Screens	2	3	1	16,000	2024		
S	Replace Anode Beds	2	3	1	15,000	2024		
2	Install anti-climb fences	2	3	1	70,000	2024		
3	Mobile generator for plants 2,3 & 5	2	3	1	575,000	2022		
4	Replace Cameras	2	3	1	19,000	2034		
S	Replace Power, I&C, Cathodic, & Ventilation	2	3	1	2,180,000	2034		
S	Replace Chains on Screens	2	3	1	16,000	2034		
S	Replace Anode Beds	2	3	1	15,000	2034		
3	Replace Valves & Gates	2	3	1	220,000	2039		
3	Replace Cabinet Roof & Paint	2	3	1	50,000	2044		
4	Replace Cameras	2	3	1	19,000	2044		
S	Replace Chains on Screens	2	3	1	16,000	2044		
S	Replace Anode Beds	2	3	1	15,000	2044	30 Year Plant 2 Total	3,300,000
4	Replace Cameras	3	6	1	19,000	2032		
S	Replace Chains on Screens	3	6	1	21,000	2032		
S	Replace Anode Beds	3	6	1	24,000	2032		
3	Install anti-climb fences	3	6	1	83,000	2035		
4	Replace Cameras	3	6	1	19,000	2042		
S	Replace Power, I&C, Cathodic, & Ventilation	3	6	1	2,190,000	2042		
S	Replace Chains on Screens	3	6	1	21,000	2042		
S	Replace Anode Beds	3	6	1	24,000	2042		
3	Replace Cabinet Roof & Paint	3	6	1	50,000	2047		
S	Replace Valves & Gates	3	6	1	430,000	2047	30 Year Plant 3 Total	2,900,000
2	Install Anti-climb Fence	4	5	1	141,000	2027		
2	Install Diesel Generator (includes generator housing)	4	5	1	1,400,000	2028		
4	Replace Cameras	4	5	1	19,000	2032		
S	Replace Chains on Screens	4	5	1	16,000	2032		
S	Replace Anode Beds	4	5	1	12,000	2032		
4	Replace Cameras	4	5	1	19,000	2042		
S	Replace Power, I&C, Cathodic, & Ventilation	4	5	1	2,180,000	2042		
S	Replace Chains on Screens	4	5	1	16,000	2042		
S	Replace Anode Beds	4	5	1	12,000	2042		
3	Replace Cabinet Roof & Paint	4	5	1	50,000	2047		
S	Replace Valves & Gates	4	5	1	330,000	2047	30 Year Plant 4 Total	4,200,000
2	Relocation	5	3	1	8,900,000	2026		
4	Replace Cameras	5	3	1	19,000	2036		
S	Replace Chains on Screens	5	3	1	16,000	2036		
S	Replace Anode Beds	5	3	1	12,000	2036		
4	Replace Cameras	5	3	1	19,000	2046		
S	Replace Chains on Screens	5	3	1	16,000	2046		
S	Replace Anode Beds	5	3	1	12,000	2046		
S	Replace Power, I&C, Cathodic, & Ventilation	5	3	1	2,190,000	2046	30 Year Plant 5 Total	11,200,000
4	Replace Anode Beds	6	1	7	12,000	2032		
4	Replace Anode Beds	6	1	7	12,000	2042		
4	Replace Cameras	6	1	7	19,000	2042		
4	Major Plant Replacement - Power, I&C, Ventilation	6	1	7	3,300,000	2045		
4	Install SCADA system	6	1	7	187,500	2045		
4	Replace outfall pipes	6	1	7	1,053,000	2045		
4	Improve site security	6	1	7	112,000	2045		
4	Install Diesel Backup Generator	6	1	7	937,500	2045		
4	Install Automatic Bar Screens	6	1	7	1,300,000	2045	30 Year Plant 6 Total	7,000,000
1	Major Plant replacements	8	7	6	11,400,000	2022		
1	Pipeline Replacement	8	7	6	4,220,000	2022		
3	Replace Cameras	8	7	6	19,000	2032		
S	Replace Chains on Screens	8	7	6	47,000	2032		
S	Replace Anode Beds	8	7	6	24,000	2032		
S	Replace Automatic Screen	8	7	6	2,925,000	2041		
3	Replace Cameras	8	7	6	19,000	2042		
S	Replace Anode Beds	8	7	6	24,000	2042		
S	Replace Power, I&C, Cathodic, & Ventilation	8	7	6	2,200,000	2042		
2	Replace Roof & Paint Building	8	7	6	500,000	2047		
S	Replace Valves and Gates	8	7	6	970,000	2047	30 Year Plant 8 Total	22,400,000
3	Install concrete vault with positive closure gates	Riverside	2	4	94,000	2035		
4	Power, Instrumentation & Controls, Ventilation	Riverside	2	4	250,000	2036		
4	Install Security cameras	Riverside	2	4	19,000	2045	30 Year Riverside Plant Total	370,000
3	Install concrete vault with positive closure gates	San Juan	2	4	94,000	2035		
4	Power, Instrumentation & Controls, Ventilation	San Juan	2	4	250,000	2036		
4	Install Security Cameras	San Juan	2	4	19,000	2045	30 Year San Juan Plant Total	370,000
				30-year Total (unescalated)	$67,400,000			

Table 6-2 also list the unescalated cost to implement each project. Combining the costs for all projects over a 30-year timeframe, the capital costs totals $65.9M, for an average of $2.2M per year.

Table 6-3 shows the top 20 projects proposed for potential implementation. The projects were identified by either having an "S" rating for implementation by 2030 or having an importance rating of 2 or higher as shown in Table 6-2 without a life cycle year.

Table 6-3 - Project Prioritization

Absolute Ranking	Project	Plant	Criticality	Condition Hazard Rating	Net Cost
1	Major Plant Replacements	8	7	6	11,400,000
2	Pipeline Replacement	8	7	6	4,220,000
3	Anti-Cavitation Plates	1B	8	2	60,000
4	Construct Baffles to Separate Pumps	1B	8	2	760,000
5	Replace Instrumentation & Controls	1B	8	2	1,330,000
6	Replace Chains on Screens	1B	8	2	31,000
7	Replace Valves & Gates	1B	8	2	420,000
8	Replace Anode Beds	1B	8	2	19,000
9	Convert Generator to Natural Gas	1B	8	2	450,000
10	Replace Roof & Paint Building	1B	8	2	625,000
11	Relocation	5	3	1	8,900,000
12	Asset Management Program				1,500,000
13	Mobile Backup Generator for Plants 2, 3, & 5	2/3/5	3	1	575,000
14	Replace Chains on Screens	2	3	1	16,000
15	Replace Anode Beds	2	3	1	15,000
16	Canal SCADA Monitoring	4	5	1	1500,000
17	Install Diesel Generator	4	2	9	1,400,000
18	Paint Exterior of Building	1A	2	9	72,000
19	Lead & Asbestos Abatement	1A	2	9	180,000
20	Replace Power, I&C, Cathodic, and Ventilation	2	3	1	2,180,000

The projects with net costs estimated at $250,000 or greater or considered unusually cost-effective are discussed below in the order they appear on the list; some projects are grouped with their respective plants.

6.2.1 PUMPING PLANT 8 MAJOR PLANT REPLACEMENTS AND PIPELINE REPLACEMENT

Plant 8 is the highest priority to reduce risk, due to its location in a densely populated area, high capacity, and poor condition and thus its two (2) large projects are the highest-ranked for implementation. Were it to fail during a major storm event, the District would be challenged to prevent flooding within the basin. Major components necessitating priority projects include:

- Replacing the electrical and instrumentation system which is approaching the end of its useful life based on age as well as performance
- Replacing the discharge pipes which are out-of-round beyond manufacturer listed tolerance and losing lining at the outfall
- Eliminating Pumps 8 and 9 cavitation issues, which currently effectively preclude their use.

To implement the improvements recommended above, the following projects are recommended:

1. Major Plant Replacements
2. Pipeline Replacement

The Major Plant Replacements is a bundle of the projects identified under the condition assessment, level of service, and life cycle analysis, excluding the pipeline. The above are broken into two (2) projects because different contractors would likely be desired as the Major Plant Replacements are primarily electromechanical and the Pipeline Replacement is a civil project.

The Major Plant Replacements will include the following scope and assumptions:

- Electrical and instrumentation will be replaced. Electrical service will be changed to 2.3 kV service to match standardization at other plants
- Changing electrical to 2.3 kV will require replacement of motors, pumps, ventilation, and cathodic protection. The pumping capacity will match existing. The pumping arrangement will be evaluated and the cavitation issues will be eliminated during design. The pump deck will be evaluated for damage resulting from the cavitation but no rehabilitation is assumed
- As a critical facility, a backup generator will be installed. A pair of 2,500 kW generators will be installed in a new building on District property on the east side of Northgate Boulevard. To reduce the storage requirement, a generator that runs on a combination of diesel and natural gas is recommended. The cost is approximately half that of a natural gas generator while the diesel consumption is one-fourth that of a diesel-powered generator, making long runtimes possible while minimizing the effort to refill a large diesel tank. The existing line on Northgate Boulevard will be the source of natural gas.
- Decking to the motors needs to be extended to the stairway from the building so personnel can avoid walking through flooded areas when canal levels rise above the pump deck, which occurs regularly.

The Pipeline Replacement will include the pipe from the connection to the pumps to the pipe replaced at the outfall under the NLIP. It will begin with an evaluation of the pipelines and determine whether a rehabilitation method or replacement if preferred. Design should be performed concurrently with design for Major Plant Replacements to coordinate hydraulics.

6.2.2 PLANT 1B PROJECTS

The majority of the projects for Plant 1B are lifecycle replacement projects are high priorities to implement because 1B is a critical plant. The three (3) projects that are level of service upgrades are

1. Install Anti-Cavitation Plates on Pumps
2. Construct Baffles to Separate Pumps
3. Convert Generator to Natural Gas.

Each of these are discussed below.

Install Anti-Cavitation Plates: The reported cavitation issues are expected to decrease performance, increase maintenance requirements, and shorten the life of the pumps. Protection of the pumps is considered a priority for this critical asset. Anti-cavitation plates have the potentially to significantly reduce or the level of observed cavitation for minimal cost, therefore a priority is placed on implementing the item. It is assumed that the plates will be installed when the motors and pumps are removed for clean and bake and regular inspection, respectively; these assets should be a priority for clean and bake program. The cost to install the anti-cavitation plates separate from the regular inspection will be approximately double.

Construct Baffles: While the District avoids operating both pumps in a bay when possible, this method cannot be relied upon to protect the pumps at all time. In addition to the anti-cavitation plates, this project is recommended to further protect pumps. The project assumes concrete baffles will be installed between pumps in each of the 3 bays. If the anti-cavitation plates prove effective, the project priority can be lowered.

Generator Natural Gas Conversion: The current backup generator is diesel-powered and has a runtime of approximately 8 hours before the tank must be refilled. This is considered less than optimal reliability as 72 hours would be desired for such a critical facility. To increase the runtime, conversion to natural gas power via a connection to the existing line off Garden Highway is preferred. However, conversion of the existing generator to natural gas would reduce the power input such that it could only run 4 of the 6 pumps. The proposed alternative is to modify the generator such that it can operate on a mix of diesel and natural gas that does not reduce the rated power but reduces the diesel consumption rate by a factor of four. Increasing the backup runtime from eight (8) to 32 hours cost-effectively increases the runtime for significantly less expense than replacing the existing generator and is therefore recommended.

The life cycle replacement projects include

1. Replace Instrumentation and Controls
2. Replace Valves & Gates
3. Replace Roof & Paint Building

The criticality of Plant 1B makes these projects important to implement when needed to maintain reliability and protect this high-value asset. The I&C is near the end of its useful life but does not have reported operational problems like Plant 8. Part of the life cycle major maintenance is an evaluation of the Power and I&C systems every 10 years to assess its performance and actual remaining life; it is recommended that this be performed and the I&C replacement, as well as the power systems (expected in the early 2030s) scheduled based on the evaluation. Replacement of the valves and gates is evaluated as part of the outfall pipeline; the same type of evaluation is recommended to schedule replacement of these components. Replacement of the roof and painting (sealing) the building is recommended for replacement according to the life cycle replacement.

6.2.3 Plant 5 Relocation

Plant 5's location within the levee toe and its relatively poor condition due to its age makes relocation further away from the levee preferred. The project, while included in the NLIP, currently is not funded by the USACE or another external source. The intent is to begin design of the new plant immediately, modelling it after Plants 2 and 4, which makes obtaining external funds more probable, but deferring construction as long as performance warrants unless or until external funding is secured.

6.2.4 Asset Management Program

For efficient long-term management and replacement of the District extensive assets, a formal asset management program is desired. The effort will become a long-term expense once established, however the scope and budget presented is for program startup. The major components to start up an asset management program are: digital cataloging of the entire asset inventory, assigning criticality factors and health scores to each asset, and purchase of a Computer Maintenance Management System (CMMS). A CMMS will allow automated generation of work orders and tracking of asset age to support the life cycle replacement program.

6.2.5 Backup Generator for Plants 2, 3, and 5 and Plant 4

While a backup generator would optimally be installed each plant, generators are expensive and are low-use items. The alternative approach below is proposed:

Plant 4 is the lone plant served by PG&E. It is also the most remote plant in the District and has the third-largest capacity of the regularly-operated plants. Natural gas service is unavailable in this remote location. Therefore a dedicated diesel- or propane-powered generator is considered a priority for this location.

Plants 2, 3, and 5 are all relatively small and located on the western side of the District. Plants 2 and 3 have been designed and/or constructed with a hookup for a mobile generator; this option can also be implemented at Plant 5. A 1,000-kW generator is sufficient to power any of these plants and as concurrent power failure at all three (3) plants is highly unlikely, a trailer-mounted mobile generator with a 48-hour supply of diesel is recommended to serve as the backup for these plants.

Because the 1,000 kW capacity is sufficient to operate two (2) of the three (3) pumps at Plant 4, which will be constructed with a mobile generator hookup, the mobile generator is prioritized above the Plant 4 generator.

6.2.6 PLANT 1A PROJECTS

Plant 1A has the second-highest capacity of all plants in the District but is not a reliable plant. The pumps must be manually started and monitored full-time when in operation, and the inside of the plant does not facilitate safe access for maintenance activities. The age of the plant will make improvements more expensive than equivalent upgrades at other plants. While projects to restore the reliability would greatly increase the flexibility of the District, the District has other higher-priority plants with projects that are recommended for implementation beforehand. Once the major projects that provide reliability to Plants 8, 1B, replacement of 5, and the generators to provide backup power to Plants 2, 3, 4, and 5 are implemented, it is recommended that the District begin increasing the reliability of 1A. Because of the high costs to implement improvements at 1A, it may prove more cost-effective to mitigate performance problems that arise unexpectedly at other plants; the District should monitor the performance of other plants. The first projects recommended for implementation at 1A are repainting the exterior of the building and abatement of potential lead and asbestos, which aim to prolong the life of the building and make upgrades safe to implement.

6.3 CULVERT AND DRAIN REPLACEMENTS

While no specific culverts or drains are specifically identified for cost estimating and replacement, the District needs to budget and plan for replacement of these assets. Evaluation of the condition of culverts and urgency for replacement is not part of the scope of this plan, so a life cycle cost and resulting average per year is the extent of the analysis for culverts and drains. This was done by compiling the total number of culverts, net linear footage, and types from available GIS data. After the raw data was compiled, the number of culverts and drains were totaled at 477 and 491, respectively. The respective linear feet for each pipe size and were totaled for culverts and drains. An average length for culverts and drains was calculated and used as the standard length for each requiring replacement. A cost per linear foot associated with the diameter was applied to estimate the average cost for a culvert or drain of a certain size, assuming no greater than 5 feet of cover. The net costs for culvert and drain replacement is the sum of the cost for each size and type times the number of each size and type.

The estimated total replacement cost for culverts is $38M and drains is $9.8M. Generally culverts sizes tend to be much larger, as the maximum size is 120 inches in diameter, while the maximum drain size is 36 inches.

The more remote location of drains means they are exposed to less wear and tear and are expected to have a useful life of 60 years, whereas culverts being located under travelled roads will have a slightly shorter useful life of 50 years. Table 6-4 below summarizes the replacement needs.

Table 6-4 - Culvert and Drain Replacement Summary

Item	Units	# Replaced per year	Net Life Cycle Cost	Useful Life, Years	Annual Replacement Cost	30-year Replacement Cost
Culverts	477	11	$36,000,000	50	$760,000	$21,600,000
Drains	491	8	$10,400,000	60	$160,000	$5,400,000

The replacement rate over the 30-year timeframe is assumed to be uniform. The net 30-year cost for culvert and drain replacement is estimated at $27M.

6.4 LIFE CYCLE REGULAR MAINTENANCE COSTS

In creating the life cycle for the major pumping plant components, important, cost-effective maintenance activities were identified that should be performed implemented during the summer season. These activities are described in Section 4.4. These activities include:

- Dive inspection of the screens
- Power supply and instrumentation evaluation
- Motor clean and bake plus pump inspection
- Outfall Pipe Inspection.

These activities have either been implemented ad-hoc or irregularly. These activities require outside expertise or would require procuring expensive equipment to self-perform. Other regular maintenance that is currently being performed are not included in this section. Costs for these items included 10% of the vendor cost to oversee and/or administer the contracts. Costs are budgeted on the long-term average; where specific conditions exist that might move an action forward or back several years, it is not accounted for in the budget. The annualized cost for each, rounded to the next $500, along with special considerations, are described below.

6.4.1 DIVE INSPECTION OF SCREENS

As maintenance personnel have noted, the screens are the single most vulnerable component amongst those that could cause a pump station to fail. The District has implemented a vegetation management program and regular replacement of the chains and screen unit is included in this 2020 CIP under the life cycle replacement. The dive inspection facilitates removal of excessive vegetation and debris such as rocks that occasionally accumulate. The dive inspection also allows inspection of the underwater components such as the screen frame, screen moving components, pump, and pump deck.

The critical Pumping Plants 1B and 8 will each have a dive inspection performed every other year. Each also has screens coming due for replacement, so the dive inspection is recommended to be scheduled concurrent with replacement. The inspection frequency for the less critical plants is four (4) years. As the District has 6 plants in this category, the District will do a dive inspection of 1.5 less critical plants per year along with one (1) critical plant.

Recent dive inspections for one (1) critical and one (1) less critical plant performed in a single mobilization totaled just under $10,000, including replacement of worn parts. To budget conservatively, an estimate of $5,000 per plant regardless of capacity is budgeted, meaning the cost will alternate between $10,000 and $15,000, averaging $12,500.

6.4.2 Evaluation of Power and Instrumentation and Controls

The power and I&C systems are critical infrastructure with a life that can vary significantly, and the systems are often relied upon well past when replacement parts are readily available. Plants 1B and 8 are examples, as 1B is at the end of its useful life by years but has no reported problems, while 8 is similar vintage and has several reported problems. To plan for replacement and ensure the systems do not wear out prematurely without replacement being planned, a major evaluation is scheduled every 10 years. While a life cycle of 20 years is anticipated, if systems are found to be performing well, a second inspection should be performed as the age approaches 20 years to determine if the life can be safely extended. A major inspection is scheduled for each plant every 10 years. With 8 plants, at an average cost of $5,500 each, the District can expect to spend $44,000 over a 10-year period. An average annual cost of $4,500 is budgeted.

As Plant 1B is approaching its useful life, it is recommended that its electrical systems be evaluated immediately so replacement can be more accurately planned.

6.4.3 Maintenance of Motors and Pumps

Because motors are typically paired with a pump for their entire life, major maintenance is performed concurrently. District personnel change the oil each year and the motors have a heating element to significantly reduce the effects of condensation, but a more proactive program is recommended to extend the useful lives of motors. High-use or high-risk motors and pumps are scheduled for evaluation at 8-year intervals, with low-use pumps every 12 years, for an average of 10 years between evaluations. With 35 pumps in the District, 3.5 motors and pumps will be serviced per year. The cost for clean and bake is and pump inspection just under $3,000 per unit, bringing the annual budget to $10,500.

Because many of the plants have been recently replaced and Plant 8 has major replacements upcoming that include replacement of pumps and motors, the actual timing needs to be determined based on actual operating conditions. The first pumps to be serviced under this program should be the 1B pumps, and they have cavitation problems reported; the recommendation is to remove a single pump from each bay the first year and the other from each bay the following year, in case problems that might prevent any from being put back in service are discovered.

6.4.4 Inspection of Outfall Systems

The outfall inspection will focus on the state of the pipes and the associated outfall. The cost for this inspection is estimated at $11,000 per plant. With 8 plants and a frequency of 5 years, $18,000 per year is budgeted for this activity.

Because its pipes are known to be out-of-round beyond manufacturer tolerances, it is recommended that Plant 8 have an inspection performed immediately to determine if the pipes can be rehabilitated or should be replaced. Also, the Plant 1A outfall is being evaluated by the USACOE as part of the NLIP, so its inspection will be several years off.

6.4.5 NET LIFE CYCLE MAJOR MAINTENANCE BUDGET

Combining the annual cost of the dive inspection, evaluation of the power and I&C systems, maintenance of motors and pumps, and inspection of outfall systems, the net cost is estimated at $46,500. Adding 20% to account for unexpected contingencies, an annual budget of $55,000 is recommended. Over a 30-year timeframe, the net present value of the maintenance budget is $1,650,000.

6.5 NET PROGRAM COST

The net 30-year cost to implement the efforts in this section without escalation are shown in Table 6-5:

Table 6-5 - Program Cost Summary

Program Item	Net Cost
Pumping Plant Capital Projects	$67,400,000
Culvert and Drain Replacements	$27,000,000
Life Cycle Major Maintenance	$1,650,000
Total Expected 30-year Expenditure	$96,050,000

The unescalated net capital spend over the next 30 years is $96.05M, which equates to an average annual expenditure of $3.2M. The Pumping Plant Capital Projects and Culvert and Drain Replacement account for over 98% of the projected costs.

6.6 PUMPING PLANT IMPLEMENTATION SCHEDULE

This section presents a potential Pumping Plant CIP to be implemented over the 30-year planning horizon, with an emphasis on the first 10 years. As related efforts, the Canal SCADA Monitoring and Asset Management Program are included in this section. The schedule of projects and cumulative spend by year are shown in Table 6-5. Project costs are not escalated so the District can adjust the schedule and appropriately escalate based on available sources of revenue.

The schedule roughly follows the project prioritization shown in Table 6-3 and the major projects are described in Section 6.2. Where lower-priority projects precede higher-priority projects, the higher priority project is not implemented until it comes due based on the component life cycle.

The spend is front-loaded because of the urgency to reduce the likelihood of failure at Pumping Plant 8, accounting for over 20% of the 30-year projected pumping plant spend in the first couple years. The expected need to replace the I&C at Plant 1B and relocation of Plant 5 also contribute to a spend of approximately $29.6M through 2026.

The projects recommended for implementation in the first 10 years (through end of 2030) total $32.4M in estimated cost; meaning the recommended projects for the four (4) years after 2026 total just over $2.8M; the recommended rate of spend decreases after the most critical projects as the urgency to implement the next wave of projects decreases. The major projects recommended for this timeframe are replacement of the 1B roof, conversion of the 1B generator to natural gas, replacement of the 1B valves, and installation of a backup generator at Plant 4.

The recommended projects for years 11-20 (2031-2040) have a net estimated implementation cost of $8.1 M. The major recommended efforts during this timeframe are initial upgrades to make Plant 1A more reliable and safer to operate, life cycle replacement of Plant 1B power systems, and life cycle replacement of the Plant 2 power systems, I&C, cathodic protection, and ventilation.

The recommended Pumping Plant projects for years 21-30 (2041-2050) have a net estimated implementation cost of $26.9M, which is over three (3) times the recommended rate for years 11-20. This increased rate in spend is due to the recent replacement of several plants under the NLIP, Plant 8, and Plant 5 requiring major life cycle replacement work. Accordingly, there is no reason to accelerate most work in the schedule, but the District should be aware of and budget for the increase in replacement costs. Some of the major costs included are major replacements of Pumping Plant 6, which is rarely used and depending upon the development pattern in its vicinity, may be abandoned or require major replacement. The Plant 6 projects are deferred until years 21-30 under this 2020 CIP due to it uncertain future.

Table 6-6 - RD 1000 CIP Project Implementation Schedule

Project	Plant	Criticality	Condition Hazard Rating	Net Cost	Construction/ Implementation	Cumulative Total by year
Replace Cameras	1B	8	2	19,000	2021	
Replace Chains on Screens	1B	8	2	31,000	2021	
Install Anti-Cavitation Plates	1B	8	2	60,000	2021	110,000
Asset Management Program				1,500,000	2022	
Major Plant replacements	8	7	6	11,400,000	2022	
Pipeline Replacement	8	7	6	4,220,000	2022	
Paint Exterior of Building	1A	2	11	72,000	2022	
Mobile generator for plants 2,3 & 5	2	3	1	575,000	2022	17,880,000
Replace Instrumentation and Controls	1B	8	2	1,300,000	2023	
Canal SCADA Monitoring				150,000	2023	19,400,000
Replace Chains on Screens	2	3	1	16,000	2024	
Replace Annode Beds	2	3	1	15,000	2024	
Install anti-climb fences	2	3	1	70,000	2024	
Construct baffles to separate pumps (dewatering)	1B	8	2	760,000	2024	20,200,000
Relocation	5	3	1	8,900,000	2026	
Convert generator to natural gas	1B	8	2	450,000	2026	29,600,000
Install Anti-climb Fence	4	5	1	141,000	2027	29,700,000
Install Diesel Generator (includes generator housing)	4	5	1	1,400,000	2028	
Replace Roof & Paint Building	1B	8	2	625,000	2028	
Replace Valves & Gates	1B	8	2	412,500	2028	
Replace Anode Beds	1B	8	2	24,000	2028	32,200,000
Lead & Asbestos Abatement	1A	2	11	180,000	2029	32,400,000
Replace instrumentation and controls; Install PLC and SCADA	1A	2	11	2,600,000	2031	
Replace Cameras	1B	8	2	19,000	2031	
Replace Chains on Screens	1B	8	2	31,000	2031	35,000,000
Replace Power, Cathodic & Ventilation	1B	8	2	1,330,000	2032	36,310,000
Replace Cameras	3	6	1	19,000	2032	
Replace Chains on Screens	3	6	1	21,000	2032	
Replace Annode Beds	3	6	1	24,000	2032	
Replace Cameras	4	5	1	19,000	2032	
Replace Chains on Screens	4	5	1	16,000	2032	
Replace Annode Beds	4	5	1	12,000	2032	
Replace Annode Beds	6	1	7	12,000	2032	
Replace Cameras	8	7	6	19,000	2032	
Replace Chains on Screens	8	7	6	47,000	2032	
Replace Annode Beds	8	7	6	24,000	2032	36,600,000
Replace Cameras	2	3	1	19,000	2034	
Replace Power, I&C, Cathodic, & Ventilation	2	3	1	2,180,000	2034	
Replace Chains on Screens	2	3	1	16,000	2034	
Replace Annode Beds	2	3	1	15,000	2034	38,750,000
Install anti-climb fences	3	6	1	83,000	2035	
Install Automatic Bar Screens (2)	1A	2	11	650,000	2035	
Install concrete vault with positive closure gates	Riverside	2	4	94,000	2035	
Install concrete vault with positive closure gates	San Juan	2	4	94,000	2035	39,670,000
Replace Cameras	5	3	1	19,000	2036	
Replace Chains on Screens	5	3	1	16,000	2036	
Replace Annode Beds	5	3	1	12,000	2036	
Power, Instrumentation & Controls, Ventilation	Riverside	2	4	250,000	2036	
Power, Instrumentation & Controls, Ventilation	San Juan	2	4	250,000	2036	40,300,000
Replace Annode Beds	1B	8	2	24,000	2038	40,240,000
Replace Valves & Gates	2	3	1	220,000	2039	40,500,000
Replace Automatic Screen	8	7	6	2,925,000	2041	
Replace Chains on Existing Screens	1A	2	11	21,000	2041	
Replace Cameras	1B	8	2	19,000	2041	43,500,000
Replace Cameras	3	6	1	19,000	2042	
Replace Power, I&C, Cathodic, & Ventilation	3	6	1	2,190,000	2042	
Replace Chains on Screens	3	6	1	21,000	2042	
Replace Annode Beds	3	6	1	24,000	2042	
Replace Cameras	4	5	1	19,000	2042	
Replace Power, I&C, Cathodic, & Ventilation	4	5	1	2,180,000	2042	
Replace Chains on Screens	4	5	1	16,000	2042	
Replace Annode Beds	4	5	1	12,000	2042	
Replace Annode Beds	6	1	7	12,000	2042	
Replace Cameras	6	1	7	19,000	2042	
Replace Cameras	8	7	6	19,000	2042	
Replace Annode Beds	8	7	6	24,000	2042	
Replace Power, I&C, Cathodic, & Ventilation	8	7	6	2,200,000	2042	50,200,000
Major Plant Replacements	1B	8	2	2,182,500	2043	
Replaced Automated Screen	1B	8	2	1,950,000	2043	
Replace Instrumentation and Controls	1B	8	2	1,300,000	2043	55,700,000
Replace Cabinet Roof & Paint	2	3	1	50,000	2044	
Replace Cameras	2	3	1	19,000	2044	
Replace Chains on Screens	2	3	1	16,000	2044	
Replace Annode Beds	2	3	1	15,000	2044	55,710,000
Major Plant Replacement - Power, I&C, Ventilation	6	1	7	3,300,000	2045	
Install SCADA system	6	1	7	187,500	2045	
Replace outfall pipes	6	1	7	1,053,000	2045	
Improve site security	6	1	7	112,000	2045	
Install Diesel Backup Generator	6	1	7	937,500	2045	
Install Automatic Bar Screens	6	1	7	1,300,000	2045	
Install Access Manholes on Outfall Pipes	1A	2	11	45,000	2045	
Replace Access walkway	1A	2	11	125,000	2045	
Install Security cameras	Riverside	2	4	19,000	2045	
Install Security Cameras	San Juan	2	4	19,000	2045	62,810,000
Replace Cameras	5	3	1	19,000	2046	
Replace Chains on Screens	5	3	1	16,000	2046	
Replace Annode Beds	5	3	1	12,000	2046	
Replace Power, I&C, Cathodic, & Ventilation	5	3	1	2,190,000	2046	65,100,000
Replace Cabinet Roof & Paint	3	6	1	50,000	2047	
Replace Valves & Gates	3	6	1	430,000	2047	
Replace Cabinet Roof & Paint	4	5	1	50,000	2047	
Replace Valves & Gates	4	5	1	330,000	2047	
Replace Roof & Paint Building	8	7	6	500,000	2047	
Replace Valves and Gates	8	7	6	970,000	2047	67,400,000
Replace Annode Beds	1B	8	2	24,000	2048	67,400,000
			30-year Total (unescalated)	$67,400,000		

6.7 2020-2022 CIP PROJECTS AND BUDGET

This section recommends projects to begin planning for implementation immediately. In most cases a significant expenditure is necessary to prepare for construction and the construction cost is excluded from the listed budget. While the CIP budget lists the entire spend for the year of implementation, recommendations in this section are only for major engineering efforts or high-impact small projects. While the majority of the spend is anticipated to occur in the first year (2020-2021), it is likely that large efforts will have significant expenditure in the second year (2021-2022) as well. For major capital projects, one-half of the engineering and administrative costs is assumed to be required to complete design and permitting.

6.7.1 PUMPING PLANT 8 MAJOR PLANT REPLACEMENTS AND PIPELINE REPLACEMENT

Replacement of the poorly-performing components at Plant 8 is considered the District's top priority in this CIP. Design should begin to allow replacement as soon as possible during the next possible dry season. The projects should be designed concurrently so the hydraulic considerations the pump and pipeline replacement have on each other can be coordinated. The anticipated budget to complete design and permitting for both efforts is $1,550,000.

6.7.2 PUMPING PLANT 5 RELOCATION – PRELIMINARY DESIGN

It is anticipated that Plant 5 will be reconstructed in a new location. Significant progress or completion of design will increase the likelihood the District can secure external funding from USACE under the NLIP or other sources. If external funding is not secured, the new plant can be constructed when this aging plant requires replacement. While the anticipated budget to complete design and permitting is $900,000, the recommendation is to perform preliminary design for approximately $400,000 over the first two years.

6.7.3 PUMPING PLANT 1B ANTI-CAVITATION PLATES

While a small project, implementation can significantly reduce the accelerated wear on the pumps, extending the life of these high-value assets. Early implementation will also allow determination of how urgent construction of baffles to reduce cavitation on these pumps is, potentially allowing delay or elimination of the more significant Construct Baffles to Separate Pumps project. To minimize cost, this project is recommended to be implemented concurrent with the Motor Clean and Bake and Pump Inspection under the life cycle maintenance program. It is recommended that the 1B pumps be the first evaluated under this program, with three (3) motors and pumps be removed in consecutive summers and the anti-cavitation plates be welded to the bottom of the pump bowls. The anticipated budget to implement is $60,000.

6.7.4 CULVERT AND DRAIN CONDITION ASSESSMENT AND REPLACEMENT PLAN

A yearly budget for life cycle replacement of culverts and drains is included based on anticipated unit costs. However, no evaluation of the current condition of these assets including which might need urgent replacement has been performed; uniform replacement was assumed. It is recommended that each of these nearly 1,000 total assets be assessed to determine a replacement schedule and budget based on actual conditions and need. The anticipated budget to complete this plan is $150,000.

6.7.5 Asset Management Program

Over the first two years, efforts to kick off the program are recommended. While the estimated budget to initially develop an asset management plan is $1.5M, over the first two years initial steps to start the program are budgeted. An initial budget of $500,000 to develop the asset inventory is recommended.

6.7.6 Pumping Plant 1A Environmental Survey

Plant 1A contains several substances that may contain lead, asbestos, or other contaminants that are hazards to personnel and the environment. If the plant remains inactive, the hazard to workers inside the building is minimal. Discussions with operations indicate the paint peeling off the intake pipes or building is unlikely to contain lead or other hazardous chemicals. However, if hazardous substances are contained in the peeling paint, the substances are potentially being released to the surrounding environment and waterways. The approximate cost to prepare an environmental survey, which includes sampling for lead, asbestos, and other substances, results, and an estimate of abatement costs, is estimated at $15,000; this amount is included in the $180,000 Lead and Asbestos Abatement project budget but this portion is recommended for early implementation. The survey is recommended as a risk-mitigation measure which will also provide a more accurate estimate of abatement costs to make Plant 1A upgrades safe to implement.

6.7.7 Mobile Generator for Plants 2, 3, and 5

Availability of backup power sources is a key factor to increase the reliability of plants. A mobile generator able to serve several of the smaller plants would significantly reduce the impacts of local power outages, providing the District the ability to operate an additional pump station. Multiple lightly used generators in the 1 MW range were on the market as of June 2020; evaluation of and potential purchase of the equipment slightly earlier than planned at a reduced cost is included in the initial budget.

6.7.8 Net 2020-2022 Recommended Cost

The total cost to implement the work recommended in for 2020-2022 is shown in Table 6-7 below:

Table 6-7 – CIP 2020-2022 Cost Summary

Program Item	Year 1 Cost
Pumping Plant 8 Major Plant Replacements and Pipeline Replacement Engineering[1]	$1,550,000
Pumping Plant 5 Relocation – Preliminary Engineering	$400,000
Pumping Plant 1B Anti-Cavitation Plates	$60,000
Culvert and Drain Condition Assessment and Replacement Plan	$150,000
Asset Management Plan	$500,000
Plant 1B Environmental Survey	$15,000
Mobile Generator for Plants 2, 3, and 5	$575,000
2020-2022 Expenditure	$3,250,000

Section 7

Funding Plan

In May 2020, the District retained NBS to develop a comprehensive financial plan for the District. The proposed comprehensive financial plan will detail all District revenue sources, expenditures, reserves, capital improvement costs, repair and replacement costs and net revenue requirements. NBS will develop a 20-year financial projection model that will serve as a financial "roadmap" for the District. NBS will incorporate the plans for new facilities, infrastructure improvements, and asset replacement plans identified in this 2020 CIP Update into the comprehensive financial plan. NBS will evaluate the timing, costs, and available reserves needed to fund the proposed CIP and will develop approaches to funding CIP needs, which may include an appropriate balance between debt-funded and cash-funded projects.

Appendix A

CONDITION ASSESSMENT REPORT

KJELDSEN SINNOCK NEUDECK inc.
CIVIL ENGINEERS & LAND SURVEYORS

Stephen K. Sinnock, P.E.
Christopher H. Neudeck, P.E.
Neal T. Colwell, P.E.
Barry O'Regan, P.E.

2433-0010

FILE MEMORANDUM

January 23, 2020

To: Kevin King, General Manager, Reclamation District 1000

Subject: Condition Assessment Report

Project: Reclamation District No. 1000 Capital Improvement Plan Update

From: Kristy Chang, PE
Bill Worrall, PE

Review: Barry O'Regan, PE

1.0 OVERVIEW AND PURPOSE

The purpose of this memorandum is to review the existing characteristics of key assets in the Reclamation District No. 1000 (District) inventory, and assess the general condition of each identified asset. Per District direction, electrical and SCADA assessments have been excluded. This report will form much of the basis of the Capital Improvement Plan (CIP) for the District, for which this assessment is performed.

2.0 ASSESSMENT APPROACH

The condition assessment process comprised of three phases:
1. Initial Preparation and Discussion of Key Assets
2. Field Assessment
3. District Staff Interviews

An initial kickoff meeting was held on December 2, 2019. District staff, KSN staff, and District engineering staff were present to discuss the objectives of the new CIP project, including the District's key assets and concerns with the operation and maintenance. It was identified that there are numerous ongoing projects with modifying and improving District assets as part of the Natomas Levee Improvement Program (NLIP).

A field assessment meeting was then held on December 11, 2019, where Bill Worrall and Kristy Change of KSN were accompanied by Tony Del Castillo of District Operations to visit the District pumping plants, corporation yard, and various key sites in the District.

2.1 GENERAL EVALUATION CRITERIA

The general criteria that were evaluated for each District asset include the following:
1. Physical condition
2. Operational and maintenance deficiencies

3. Relative risk

Physical condition evaluates whether parts of the asset are damaged, the extent of the damage, age, and maintenance needs of the asset.

The operational and maintenance deficiencies category evaluates the ability of operations staff to safely operate and maintain the asset in good working order.

Relative Risk is a judged level of likelihood the Plant will not performed to its design criteria in the next several years based on the initial findings of the assessment.

3.0 SUMMARY OF FINDINGS

The portions of the District system that were evaluated include all of the District's exterior and interior pumping plants, the District exterior and interior levees, and canals. Portions that are excluded from the scope of this report are the electrical and SCADA elements of District assets.

3.1 PUMPING PLANTS

There are eight pumping plants under the jurisdiction of the District that are used to relieve storm and floodwaters from within the District.

3.1.1 Plant 1A

Plant 1A is located near District headquarters, and is part of Pumping Plant 1. It was constructed in 1915 as the first pumping plant in the District. Currently, this plant is used only as a backup if all the other pumps in the District are not enough.

Physical Condition

There are four (4) horizontal pumps in Plant 1A housed inside a two-story building, alongside the necessary electrical components. The pumps are shown in ***Figure 1***.

Figure 1 - Pumping Plant 1A Pumps

The pumps are generally believed to be in good shape, showing no visible abnormal wear. Piping, where visible, appears to be in good condition. However, the station has not been operated in at least 10 years, so its ability to serve as a backup system is not assured.

The intake leading to the pumps is preceded by both manual bar screens and an automatic chain screen. The four pumps lead to two concrete tunnels, that then transition into four arch tunnels where four (4) wooden flap gates and four (4) manual cast iron slide gates are placed. The discharge goes through the levee with minimal elevation difference.

The paint coating the pumps and several pipes and other appurtenances appear to be original or of vintage that likely contained lead-based paint. Some lines may also have insulation that contains asbestos. Because the plant has not been operated in several years, the potential hazard is considered low, but if the plant is to be brought up to standard, testing for lead and asbestos content and subsequent mitigation would be a high priority. In addition, the exterior paint on the building is in poor condition, peeling freely and exposing the paint or primer underneath. Evaluation of the potential hazard posed is considered a high priority because it may release lead to the environment.

The pumps are manual start, and have some difficulties with starting due to low head caused by the lack in elevation difference of the pump and the discharge. The plant must be staffed for startup and then continuously during all operational hours. The instrumentation and control system must be considered substandard given that the plant requires a crew for startup and operation. Additionally, we understand that the existing electrical system can only power a total of 8 pumps at the same time between Plants 1A and 1B.

Capacity, Operations, and Maintenance
The capacities of the Plant 1A pumps are shown in ***Table 1*** below.

Table 1 - Plant 1A Pumping Capacity

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	600	2,400v	136	621
2	650	2,400v	181	
3	600	2,400v	152	
4	650	2,400v	152	

Security
Both plants 1A and 1B are surrounded by a single security fence. Access is adequately controlled to all portions of the plant including the intakes, electrical and instrumentation, and pumps.

Relative Risk
This pumping plant is considered a backup plant, and is not run on a regular basis. It is only run if all the other pumps in the District cannot keep up with draining the canals. While being a backup system reduces its criticality, its reliability is questionable, and the resources to operate the plant may not be available during emergency conditions if the plant is needed; upgrading of the electrical and instrumentation system should be considered.

3.1.2 Plant 1B
Plant 1B is the other part of Plant 1, and is the main plant that is run on a regular basis. Plant 1B is located just north of Plant 1A. It was first constructed in 1959, and then reconstructed in 2003.

Physical Condition
There are six (6) vertically-oriented mixed-flow pumps located outside its electrical building, as shown in ***Figure 2*** below.

Figure 2 - Pumping Plant 1B Pumps

These pumps and visible pipe are in good condition, and are regularly maintained by the District. The intakes to these pumps are screened with automatic bar screens shown in ***Figure 3***.

Figure 3 - Pumping Plant 1B Intake Screens

The pumps discharge over the levee adjacent to Plant 1 into separate welded steel pipes to the Sacramento River through a concrete outfall structure fitted with flap gates. Siphon breaker valves are installed near the top on the water side. We understand that the US Army Corps of Engineers (USACE) is evaluating the existing tunnels as part of the Natomas Levee Improvement Project (NLIP) and will issue a report on their condition in upcoming months. Any improvements to the tunnels are assumed to be funded under the NLIP.

In 2012, a diesel generator was installed inside the plant building. The tankis relatively limited in capacity. With all the pumps running, the generator can support the plant for approximately 8 hours of runtime.

Figure 4 - Pumping Plant 1B Generator

The electrical and instrumentation components appear to be in good condition with no visible damage and are housed in a building protected from the elements.

<u>Security</u>
Both plants 1A and 1B are surrounded by a single security fence. Access is adequately controlled to all portions of the plant including the intakes, electrical and instrumentation, and pumps.

<u>Capacity, Operations, and Maintenance</u> The capacities of the Plant 1B pumps are shown in ***Table 2*** below.

Table 2 - Plant 1B Pumping Capacity

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	400	2,400v	100	600
2	400	2,400v	100	
3	400	2,400v	100	
4	400	2,400v	100	
5	400	2,400v	100	
6	400	2,400v	100	

The intake screens are functioning well, but the chains that rotate the automatic cleaners are needing replacement approximately every 10 years due to wear and tear.

Relative Risk

Plant 1B is one of the most important plants in the District, due to its location at the end of the Main Drain. The plant appears to be in good operating condition. The risk of failure of this plant is considered low since all components are in good working order.

3.1.3 Plant #2

Plant 2 is located on the western side of the District at the end of the North Drain Canal. The plant was originally constructed in 1959, reconstructed in 1976, and then rebuilt and relocated in 2014.

Physical Condition

There are two (2) vertically-oriented mixed-flow pumps and one (1) backup pump in Plant 2 located outdoors, with the electrical and instrumentation components housed in an adjacent building. The pumps are shown in ***Figure 5*** below.

Figure 5 - Pumping Plant 2 Pumps

Like Plant 1, Plant 2 has the same automatic bar screens operating with chains. Plant 2 also has connections for a portable generator, should the need arise. With the latest reconstruction, cathodic protection was added for the pumps' discharge pipes. Due to the recent reconstruction, everything at Plant 2 is still in excellent condition.

The electrical and instrumentation is housed in a cabinet with an overhang and shows no visible signs of unusual wear.

Security
New fencing was installed with wire atop, limiting access to the site, but the fabric installed is not anti-climb.

Capacity, Operations, and Maintenance The capacities of the Plant 2 pumps are shown in ***Table 3*** below.

Table 3 - Plant 2 Pumping Capacity

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	400	2,400v	80	120
2	250	2,400v	40	

Relative Risk
Plant 2 is in fairly new condition and has minimal risk of failing.

3.1.4 Plant #3

Plant 3 is located northwest of Plant 1, connecting the West Drain. It was originally constructed in 1939, and then modified with increased capacity in 2001.

Physical Condition
There are four (4) vertically-oriented mixed-flow drainage pumps, two (2) small irrigation pumps, and one (1) bay for future pump installation in Plant 3 located outdoors, with the electrical components housed in a building adjacent. The pumps are shown in ***Figure 6*** below.

Figure 6 - Pumping Plant 3 Pumps

The pumps discharge to a manifold structure to a single pipe leading across the levee to the Sacramento River.

This plant has no connection for a portable generator at present.

The plant is in fairly good condition, but is currently under plans to be relocated by the USACE as part of the NLIP, replacing the pumps and the manifold with separate discharge pipes. The replacement plant will be similar to Plant 2.

The electrical and instrumentation is housed in a separate building protected from the elements and appears capable of supporting the required service until the pump station is replaced.

Security
The building site is fenced but access to the pump platform is not limited.

Capacity, Operations, and Maintenance The capacities of the Plant 3 pumps are shown in ***Table 4*** below.

Table 4 - Plant 3 Pumping Capacity

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	200	2,400v	38	196
2	200	2,400v	38	
3	300	2,400v	70	
4	200	2,400v	50	

The pump capacity is currently planned to be expanded by the USACE.

Relative Risk
This plant is one of the main drainage points for the Sacramento International Airport. It also serves a sizeable urban area nearby. Therefore, the criticality of this plant is relatively high. Without a generator hookup, the risk of failure exists, but the new upgrades will add a new connection for a portable generator. The Plant appear capable of performing until the replacement plant is in place, at which time the risk will be considered low.

3.1.5 Plant #4
Plant 4 is the northernmost plant in the District, at the end of the North Drain. This plant was originally constructed in 1964, and reconstructed in 1986.

Physical Condition
There are three (3) vertically-oriented mixed-flow pumps in Plant 4 that discharge into the Natomas Cross Canal. This plant is relatively outdated, but due to impacts of the NLIP, it is planned to be entirely replaced. The plant will be removed in 2020 and setback from the new levee.

Of particular note is that the grating inside the pump station may have limited weight bearing capacity between sections of grating. It is recommended that no more than one person enter the pump station at a time for safety reasons unless the grating is upgraded.

The electrical and instrumentation is housed within the pump station building protected from the elements and appears capable of supporting the required service until the pump station is replaced.

Security
Access to the current plant which contains the pumps is currently within a locked building, so existing security is strong.

Capacity, Operations, and Maintenance The current capacities of the Plant 4 pumps are shown in ***Table 5*** below.

Table 5 - Plant 4 Pumping Capacity

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	300	480v	76	306
2	400	480v	115	
3	400	480v	115	

The plant is to be removed and replaced with an entirely new plant with the same layout and capacity as Plant 2. Power will be changed to 2,400 volts consistent with the other new plants and standard the District is moving towards. Ultimately, the capacity may be slightly reduced, but the pumps will have enough power to pump over the new levee 200-year elevation.

Relative Risk
Plant 4 will be replaced in the near future, which puts this plant at a low risk of failure after construction. The plant appears fully capable of providing the necessary service until replaced.

3.1.6 Plant #5
Plant 5 is located at the end of the West Drain near the Sacramento Airport. This plant was originally constructed in 1965 to handle additional runoff from the airport, along with Plant 3.

Physical Condition
There are three (3) vertically-oriented mixed-flow pumps in Plant 5 that discharge into the Sacramento River. The intake screens are manual bars. This plant is older, and shows sign of corrosion on the pipelines, but is slated to be removed and replaced at a setback location as part of the NLIP.

The electrical and instrumentation is housed in a separate building protected from the elements and appears capable of supporting the required service until the pump station is replaced.

Security
The plant is clearly visible from Garden Highway with access to the pump platform, while the are electrical and instrumentation is housed inside the existing building.

Operational and Maintenance
The current capacities of the Plant 5 pumps are shown in ***Table 6*** below.

Table 6 - Plant 5 Pumping Capacity

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	100	480v	19	57
2	100	480v	19	
3	100	480v	19	

Like Plant 4, this plant will be replaced with plans modelled after Plant 2, due to the plant being located too close to the newly upgraded levee. The plan is to provide an empty space in the pump deck for an additional pump to allow additional capacity resulting from more rapid runoff from Sacramento Airport expansion activities. The airport has tentatively agreed to provide funding for the additional capacity if needed. The airport has reportedly greatly increased its stormwater storage capacity which may defer the need for additional capacity at Plant 5 for several years.

<u>Relative Risk</u>
Plant 5 is one of the main pumping plants serving the Sacramento Metro Airport. Plant 5 is a relatively critical facility due to serving major infrastructure. Currently, it appears capable of serving for 5-10 more years until replaced. Once replaced in the near future, the risk of failure will be considered minimal. Due to its age, if the plant is not replaced under the NLIP, the associated risk may rise and will need to be re-evaluated; the primary concerns would be the electrical and instrumentation systems.

3.1.7 Plant #6

Plant 6 is located on the east side of the District approximately one mile north of Elkhorn Boulevard. It was constructed in 1974, and updated in 1997., Due to complaints of residents of the area across the Natomas East Main Drainage Canal (NEMDC) that use of this plant causes flooding, this plant is the last one called upon for drainage purposes, even though the restrictions at downstream Sacramento County Pump Station D15 are the actual cause of flooding. This plant has not been operated in at least 10 years.

<u>Physical Condition</u>
On the site visit, the lock on the pump building was rusted shut, and staff could not safely inspect the condition of the pumps except from a distance. The pumps appeared to show some wear. The electrical components, housed in a separate building, are checked monthly by District staff.

There are manual bar screens at the intake of the plant that appear to be in good condition.

<u>Security</u>
Fencing protects access to the plant electrical and instrumentation, but access restrictions do not prevent public from accessing the pump deck; at the time of the site visit, a person was fishing from the pump deck.

<u>Capacity, Operations, and Maintenance</u> There are four (4) vertically-oriented mixed-flow pumps at Plant 6 that discharge to the NEMDC, and their capacities are shown in ***Table 7*** below.

Table 7 - Plant 6 Pumping Capacity

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	125	480v	28	180
2	200	480v	42	
3	300	480v	60	
4	250	480v	50	

These pumps are unused and untested, so there is a possibility that the pumps would not run if needed.

Relative Risk

This plant is not used, as Plants 2, 4, and 8 are draining the canals in the area in place of Plant 6. Due to the lack of maintenance on the pumps and motors and lack of confirmation that the plant is operational beyond the electrical connections for several years, the reliability of the plant is questionable.

3.1.8 Plant # 8

Plant 8 is located on the east side of the District, west of Northgate Boulevard. The plant was originally constructed in 1983, and modified in 2001 for increased capacity, a new electrical and instrumentation building, and automatic trash racks.

Physical Condition

There are nine (9) vertically-oriented mixed-flow pumps, with two of them being redundant large pumps, located outdoors. These pumps are shown in ***Figure 7*** below.

Figure 7 - Pumping Plant 8 Pumps

The motors, pumps, pipes, and valves outwardly appear in fairly good condition. The fair to poor condition of the pipe coatings was noted, however the pipes, which are most likely to have associated poor performance, did not visually show signs of excessive corrosion. If additional records on the condition are available, it is recommended they be examined later in developing the capital program. Tony Del Castillo noted there is an anode system and the valve boxes marking each location were found the top of the hill just inside the fence. He also noted that cathodic protection is monitored and tested at each location by a consultant.

Trash racks are installed in front of a small forebay before the pumps and appear to be in good condition.

The electrical and instrumentation components are protected inside an alarmed building and appear to be in good condition. The plant has capability for connecting a portable generator.

Security

Access from Northgate Boulevard is limited by fencing. The plant is normally accessed by driving past a locked gate several hundred yards to the west on an access road. The electrical and instrumentation is housed in a locked building with alarm. However, positive physical barriers to the pumps and outlet piping from the west does not exist.

Capacity, Operations, and Maintenance

The capacities of the Plant 8 pumps are shown in ***Table 8*** below.

Table 8 - Plant 8 Pumping Capacity

Pump Unit No.	Horsepower	Service Voltage	Capacity (cfs)	Plant Capacity (cfs)
1	700	480v	105	779
2	700	480v	105	
3	300	480v	48	
4	200	480v	33	
5	300	480v	48	
6	700	480v	105	
7	700	480v	105	
8	500	480v	115	
9	500	480v	115	

This plant has the highest discharge of any plant in the system. In general, pump units 3, 4, and 5 are run the most often, and the larger pumps are only used in high water events, due to the high frequency of on and off cycling when the larger pumps run. There is a hookup for a portable generator in case of power outages; and the District is considering converting two of the large pumps to diesel or natural gas.

Relative Risk

Plant 8 is one of the most important facilities in the District due to its size and location in the urban area of Natomas. The North Natomas development was the trigger for the expansion of Plant 8, and serves one of the most densely populated areas in the District, so it must often handle rapid runoff.

No definitive signs of increased risk were identified during the assessment, but the condition of the coating for the outfall pipe, valves, and motors, combined with the duration since construction, warrant further evaluation of the risk as the CIP is developed. Criticality of this plant also makes reliability/backup power upgrades desirable.

3.2 INTERIOR PUMPING STATIONS AND CANALS

The District operates and maintains two pumping stations in the interior of the District. These pumping plants pump water from urban and irrigation canals into the District's Main canals.

3.2.1 San Juan Pumping Station

The San Juan Pumping Station is located on the right bank of the West Drain Canal south of San Juan Road.

Physical Condition

There are two hydraulic (2) pumps housed inside the plant building alongside the electrical and instrumentation that pump water from the sub drain to the West Drain. The pumps, power supply, and electrical appear to be in good condition.

Security

The pumps, electrical, and instrumentation are housed inside a building, providing adequate protection. Locked gates prevent motorized travel along the top of the canal, but joggers can easily gain access to the site and it is clearly visible from San Juan Road. Despite its relatively accessible location, the security measures protect most critical components.

Capacity, Operations, and Maintenance The two hydraulic pumps cycle between each other, and during the summer months, there is a gate that allows water from the main canal back into the sub drain for irrigation purposes.

There are no operational or maintenance deficiencies identified by the District or inspection of this pump station.

Relative Risk

San Juan Pumping Station serves a relatively large area in the southwestern portion of the District, but has no particular deficiencies that cause a risk of failure. Failure would likely result in localized flooding at the intersection of San Juan and El Centro during rain events. The risk of failure appears low for this pumping station.

3.2.2 Riverside Pumping Station

The Riverside Pumping Station is located just north of the San Juan Pumping Station, and has identical setup.

Physical Condition

This plant is identical to San Juan Pumping Station, albeit smaller due to serving a smaller area. The condition of the plant is similarly good, and there are not particular signs of aging or damage.

The electrical and instrumentation is housed inside the pump station building protected from the elements and appears to be in good condition.

Security

The pumps, electrical, and instrumentation are housed inside a building, providing adequate protection. Locked gates prevent motorized travel along the top of the canal but joggers can easily gain access to the site. Despite its relatively accessible location, the security measures protect most critical components.

Operation and Maintenance

There are no operational or maintenance deficiencies identified by the District for this pump station.

Relative Risk

Riverside Pumping Station serves only a small development nearby, so the relative consequence of failure is low. The pump station appears to be in good condition with low probability of failure.

3.2.3 Interior Drainage Canals

The major interior canals in the District include the Main Drain, North Drain, West Drain, and East Drain.

Physical Condition

The drainage canals have steep vertical walls, which over time have eroded, particularly in the Main Drainage Canal. Access is also limited due to effectively complete development in the most critical areas of the basin.

Operation, Maintenance, and Capacity

One of the main concerns with the canals is vegetation growth, which results in clogging the pump intakes at the trash racks and insufficient flow to pumps. As a result, vegetation maintenance is considered a high priority.

Structurally, due to the erosion issues, the District must continuously mitigate using rock slope protection. The West Drainage Canal through Fisherman's Lake has conveyance issues due to heavy sedimentation and vegetation growth. A continual problem is that the canals are used for irrigation during summer months, and typically the water levels are higher during the irrigation season than the wet season, providing an inadequate window to drain the canals and perform complete repairs.

Relative Risk

The Main Drainage Canal is critical infrastructure, and limits what is conveyed to the pumps if there are issues. Similarly, the West Drainage Canal is the main drainage point for the Sacramento International Airport. Consequence of losing conveyance capacity in the canals and limiting pumping capacity makes canal maintenance a high priority.

3.3 EXTERIOR LEVEES

The Natomas basin is surrounded by project levees that have undergone recent improvements, or are planned to be improved by the NLIP, or the USACE.

Physical Condition

Most of the levee reaches along the Sacramento River have been improved as part of the NLIP. The other portions of the levee are to be improved by the USACE to be at least a 200-year standard. When the NLIP is complete, the levees are assumed to be in excellent condition and therefore no condition assessment is made except as noted below.

In addition to the surrounding levees, there are five (5) culverts that run under the Pleasant Grove Creek Canal (PGCC), which routes north into the Natomas Cross Canal. These culverts are known to have been constructed in a manner that does not meet current standards, in poor condition, and have difficult maintenance access. The culvert may not be replaced as part of the USACE's levee improvement program.

Operations and Maintenance In the northeast portion of the Natomas Basin, there is a significant gap in the levee, named the Sankey Gap, shown in ***Figure 8***. The gap is vulnerable to high waters in the PGCC, and should be considered for closure, either in emergency situations with material staging areas, or a permanent construction solution. Our understanding is that to be closed, capacity in the upper reaches of either the NEMDC or Natomas Cross Canal would have to be significantly augmented to prevent upstream flooding in the PGCC when the water would otherwise flow through the gap. The Sacramento Bypass and Fremont Weir widening may significantly decrease the likelihood of stormwater entering the basin through the Sankey Gap and thus the value of any protection measures.

Figure 8 - Sankey Gap

Relative Risk
The exterior levees are an important part of the District, protecting the Natomas Basin from floodwaters outside of the District. The Natomas area continues to develop, and the importance of flood protection in the District increases as a result. The current plans to improve the levees will reduce the relative risk

of failure for these assets. Maintenance activities that allow effective monitoring should be considered a priority in District budgeting. Until the completion of the NLIP, however, capital improvements to the exterior levees funded by the District are not considered in this report.

3.4 CORPORATION YARD

The District's Corporation Yard is located on the east side of the Basin on Elkhorn Boulevard, holding the District's equipment and shop area. This yard is the intended home for the District's SCADA system.

Physical Condition
The Yard is in good condition, and the District has been making improvements by paving the area and expanding the Yard for the purpose of holding more equipment.

Security
Most of the facilities are located inside of existing structures with locks, and the entire area is secured with a fence and locking gates.

Operational and Maintenance
The Yard is to be expanded another three acres to provide storage space.

Relative Risk
The Corporation Yard is one of the District's centers of operation, but the yard is in good shape and is being improved upon at the moment. The main concern is that the yard or alternative locations be adequately stocked with levee maintenance and flood mitigation/fighting materials, or that the District's supply of these at other locations be adequate. The District's efforts should focus on maintaining an adequate supply of equipment and materials for operations at the site to minimize risks elsewhere in the District.

Appendix B

METHODOLOGY AND OPINION OF PROBABLE COSTS

Appendix B

Cost Estimating Methodology

Opinions of probable cost, generically referred to as cost estimates, were made for three major categories:

- Pumping Plant Capital Upgrades and Replacements
- Major Pumping Plant Component Maintenance
- Culvert and Drain Replacement.

The capital upgrades and replacement is the focus of this CIP and the greatest effort in determining appropriate budgets for capital upgrades and replacement was spent in this category. Major maintenance was a combination of recent District experience, discussion with specialty vendors, and industry experience. Culvert and drains were evaluated as a desktop exercise. The methods are discussed in more detail below.

1.1 PUMPING PLANTS

The opinions of probable cost for pumping plants were derived from multiple sources and compiled with the same methodology for each plant. Opinions were produced to address both one-time and recurring capital improvement costs over a roughly 30-year period. Costs for each component are shown individually and unescalated to allow implementation on varying schedule that still integrates with the financial plan that is being developed. Having estimates for each component also allows efforts that are recommended to be bundled for efficiency to be broken up and implemented on different schedules if District needs change.

1.1.1. COST ESTIMATE UNIT PRICE ITEMS

Two sources of information were heavily utilized in producing cost estimate unit price items to account for near term and recurring capital improvement costs at RD 1000 plants over a roughly 30- year period:

1. Nine (9) Tabulated construction bids from June of 2012 for work done at Pumping Plant 2
2. 2019 bid sheet from the Army Corps of Engineers for upcoming construction at Pumping Plant 4.

The integration of each is discussed below.

For the Plant 2 data, an average unit price from the collection of bids was used to produce each for each major component. Where certain individual bids were unreasonably higher or lower than the average unit price, that specific bid was not included in the cost estimate item. A CCI factor of 1.26 was applied to each bid item to project the unit price from June of 2012 to July of 2020 for the component. All component opinion of probable costs presented assume a CCI value of July 2020.

In general, the unit price items in the Plant 4 bids were larger than other reference sources. In order to address this, pumping plant 2 unit bid price averages were escalated to the June 2019 index using a CCI factor of 1.21, and 12 like bid items were compared to pumping plant 4 unit bid price items. On average, the Pumping Plant 4 unit bid price items were 65% higher than the escalated Pumping Plant 2 unit bid price items. Pumping Plant 4 unit bid price items that were used in producing cost estimate items were escalated to July 2020 CCI, then scaled down by a factor of 1.65 to normalize with the Plant 2 data.

Because Plants 2 and 4 only have hookups for generators, the only District data available is from the Plant 1B generator installation in 2012. The purchase for the generator was escalated to 2020 and confirmed with the supplier, Caterpillar. This unit cost was then applied for Plant 8, where two (2) equivalent-capacity generators are recommended because generators above 3.5 MW are significantly more expensive than multiple generators up to 2.5MW capacity. For the smaller generators at Plants 2, 3, 4, and 5, direct estimates were received from suppliers. For all plants, an installation factor including a protective structure was applied.

Other sources of information for cost estimate items include recent bids from other projects, information gathered from online suppliers, or estimates requested specifically for the purpose of this CIP report.

1.1.1.1. Cost Estimate Presentation

Opinion provided to address near term and recurring capital improvement costs at pumping plants are presented in a simplified manner, with many different components grouped into certain cost estimate items and presented as a single unit cost. Although the same methodology is followed for all pumping plants, specific pumping plants may contain more or less items, depending on the recommendations presented to achieve optimal level of service. Table 1 explains the different components grouped together for each cost estimate item. Cost estimate items not gathered from construction bids are applied an installation cost factor.

An administrative cost factor was also applied. For capital project requiring design, the administrative factor is 25%. For capital projects the District can contract directly with no or minimal design, the administrative factor is 15%. For major maintenance items, the administrative factor is 10%.

In general, all total costs presented are rounded up to reflect no more than three significant digits.

Table 1 - Cost Estimate Item Breakdowns

Cost Estimate Item	Component or Service Item
New outfall structure / New intake structure	Outfall / intake structure
	Cast in place foundation
	Class 2 AB
	3/4" drain rock
	Geotextile
	Railing
	Soil fill
New walkway for workers	Pump catwalk/steel decking
	Access stairway and handrails.
	Structural steel members
Replace instrumentation	Pedestals, panels and controllers
	Replacement of conduits and wires
	Installation of SCADA and PLC
	Replacement of electrical equipment and pads
New electrical building	New building costs
	Cast in place building slab
	Building plumbing
Discharge pipe	Discharge pipe
	Access manholes
	Gates and valves
	Pipe supports
	Pipe adapters
	Meters and vaults
	Soil fill
	Pipe bedding material

Recurring capital improvement costs are based off of initial construction/implementation dates for capital improvement items, and appropriate replacement schedules based on the life cycle of the item. The life cycle of specific items and the construction/implementation date for when life cycles begin was determined through condition assessment site visits conducted by KSN staff and conversations with RD 1000 district representatives. All life cycle costs are presented throughout an estimated 30-year time period looking forward from 2021, the initial year small items can realistically be implemented under this CIP. In each case, the installation year for the component is the year that determined the first life cycle replacement; when a second or third replacement falls under the planning cycle of this document, it is included in the tabulation. There is no readily visible presentation of second or greater life cycle replacements in the spreadsheets All life cycle costs are presented in terms of un-escalated July 2020 prices, with no CCI value applied to future costs.

~~1.2~~2.2 MAJOR MAINTENANCE

Major maintenance item opinions of probable cost were determined using the following methods:

- Recent costs when services were performed for District
- Quotes from vendors to perform the services

- Typical industry unit costs.

The dive inspections are an example where the District recently contracted to have intake screens inspected and debris, mostly vegetation, removed in advance of the upcoming season. For this item, the cost for the Plant was normalized to the average screen size to determine an average cost and frequency.

For items like the motor clean and bake and pump inspection, data on clean and bake costs was taken and compared against current vendor costs that include removal of the pump and motor and transport of the pump to a site for evaluation. Assumptions include that at least three motors and pumps will be concurrently evaluated to spread the cost of mobilization and a crane over the multiple units.

The resulting average frequencies and average service costs were then integrated to develop an average annual budget. It is important to note that the budget will vary from year to year depending on which major items need to be addressed. Some years may have minimal requirements whereas others may have costs approaching double the annual budget.

1.3 CULVERT AND DRAIN REPLACEMENT

The culverts and drains were estimated as a desktop exercise, as the scope did not include collecting data on condition and install years was not available. The effort was done to project a 30-year cost for budgeting with the assumption that replacement costs will be relatively uniform over the 30-year planning horizon, which needs to be determined during future efforts.

- The number of each respective size culvert and drain was tabulated from GIS data. The average length of culverts and drains was then determined. The total cost to replace culverts and drains was then calculated using the following:

- Multiplying the length by unit cost based on diameter. The same unit cost was used for both drains and culverts based on typical industry experience. Where box culverts exist, an equivalent pipe size unit cost was assumed.

- Adding a mobilization cost using expected equipment and crew to both culvert and drain replacement.

- Assuming that all culverts cross roads and highways, a traffic control setup and delay time using expected equipment and crew was added.

The resulting net costs for culverts and drains were then divided by expected useful lives of 50 and 60 years, respectively, resulting in an annualized average replacement cost for each. These annualized costs were then combined into an average annual cost and then to a 30-year program cost.

Pumping Plant 1A Capital Improvement and Replacement Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Construction Subtotal	Administrative Factor	Total	Construction/ Implementation	Life Cycle (Years)
Intake Screens									
Chain Replacement	1500	FT	$ 12	1	$ 18,255	1.15	$ 21,000	2041	10
Unit Replacement	2	EA	$ 260,000	1	$ 520,000	1.25	$ 650,000	2060	40
Install New Automatic Bar Screems	2	EA	$ 260,000	1	$ 520,000	1.25	$ 650,000	2035	40
Replace instrumentation and controls; Install PLC and SCADA	1	LS	$ 1,380,000	1.5	$ 2,070,000	1.25	$ 2,600,000	2031	20
Cathodic Protection Rectifier Unit	2	EA	$ 3,000	1.5	$ 9,000	1.25	$ 11,250	2031	20
Ventilation	1	EA	$ 2,500	1.5	$ 3,750	1.25	$ 5,000	2031	20
Backup Generator Replacement (See Plant 1B)									
Cathoid Protection Pipe Jumper Cables	1600	LF	$ 100	1	$ 160,000	1.25	$ 200,000	2097	75
Pumps and Pump Motors				1	$ -	1	$ -		
Replace Unit	4	EA	$ 650,790	1	$ 2,603,159	1.25	$ 3,260,000	2082	60
Outfalls									
Outfall Structure	1	LS	$ 293,186	1	$ 293,186	1.25	$ 370,000	2097	75
Pipes (48" WSP)	1600	LF	$ 1,400	1	$ 2,240,000	1.25	$ 2,800,000	2097	75
Install Access Maholes	4	EA	$ 9,000	1	$ 36,000	1.25	$ 45,000	2045	75
Access & Security									
Equip Fences with Anti-Climb	1000	LF	$ 46	1	$ 46,132	1.1	$ 51,000	2082	60
Building									
Paint exterior of building	1	LS	$ 60,000	1	$ 60,000	1.2	$ 72,000	2022	30
Lead and Asbestos abatement	1	LS	$ 150,000	1	$ 150,000	1.2	$ 180,000	2029	75
Pump Platform & Access	1	LS	$ 100,000	1	$ 100,000	1.25	$ 125,000	2045	75
Intake Structure	1	LS	$ 2,000,000	1	$ 2,000,000	1.25	$ 2,500,000	2097	75
Control Building Structure	1	LS	$ 216,000	1	$ 216,000	1.25	$ 270,000	2097	75
2025 TOTAL*							$ 80,000		
2030 TOTAL*							$ 260,000		
2040 TOTAL*							$ 3,520,000		
2050 TOTAL*							$ 3,710,000		

*TOTAL Indicates a running total through specified year, with total costs recurring for individual items according to life cycle years specified and construction/implementation date

Pumping Plant 1B Capital Improvement and Replacement Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Construction Subtotal	Administrative Factor	Total	Construction/ Implementation	Life Cycle (Years)
Intake Screens									
Chain Replacement	2200	FT	$ 12	1	$ 26,774	1.15	$ 31,000	2021	10
Unit Replacement	6	EA	$ 260,000	1	$ 1,560,000	1.25	$ 1,950,000	2043	40
Replace Power, Cathodic & Ventilation					$ 1,047,750		$ 1,330,000	2032	30
Replacement of Power	1	LS	$ 690,000	1.5	$ 1,035,000	1.25	$ 1,300,000	2032	30
Ventilation	1	EA	$ 2,500	1.5	$ 3,750	1.25	$ 10,000	2032	30
Cathodic Protection Rectifier Unit	2	EA	$ 3,000	1.5	$ 9,000	1.25	$ 20,000	2032	30
Replace Instrumentation and Controls	1	LS	$ 690,000	1.5	$ 1,035,000	1.25	$ 1,300,000	2023	20
Cathodic Protection Annode Beds	16	EA	$ 800	1.5	$ 19,200	1.25	$ 24,000.00	2028	10
Cathoid Protection Pipe Jumper Cables	700	LF	$ 100	1.5	$ 105,000	1.25	$ 131,250.00	2078	75
Convert Generator to Natural Gas	1	EA	$ 300,000	1.2	$ 360,000	1.25	$ 450,000.00	2026	30
Major Plant Replacements					$ 1,746,000		$ 2,182,500	2043	
Replace Pumps and Pump motors	6	EA	$ 91,000	1	$ 546,000	1.25	$ 682,500	2043	40
Replace Generator	1	EA	$ 1,000,000	1.2	$ 1,200,000	1.25	$ 1,500,000	2043	20
Outfalls									
Replace Valves and Gates	1	LS	$ 330,000	1	$ 330,000	1.25	$ 412,500	2028	25
Outfall Structure	1	LS	$ 518,000	1	$ 518,000	1.25	$ 647,500	2078	75
Pipes (48")	700	LF	$ 1,700	1	$ 1,190,000	1.25	$ 1,487,500	2078	75
Access & Security									
Equip Fence with Anti-Climb	1000	LF	$ 46	1.5	$ 70,000	1.25	$ 87,500	2053	50
Cameras	1	LS	$ 10,000	1.5	$ 15,000	1.25	$ 19,000	2021	10
Building									
Replace Roof and Paint Control Building	1	LS	$ 500,000	1	$ 500,000	1.25	$ 625,000	2028	25
Pump Platform & Access	1	LS	$ 200,000	1.5	$ 300,000	1.25	$ 375,000	2078	75
Intake Structure	1	LS	$ 3,000,000	1	$ 3,000,000	1.25	$ 3,750,000	2078	75
Construct Cast In Place Baffles (Plant Dewatering Included in Total)	3	EA	$ 52,000	1.5	$ 234,000	1.25	$ 760,000	2024	75
Install Anti-Cavitation Plates	6	EA	$ 5,000	1.5	$ 45,000	1.25	$ 60,000	2021	75
Control Building Structure	1	LS	$ 216,000	1	$ 216,000	1.25	$ 270,000	2078	75
2025 TOTAL*							$ 2,170,000		
2030 TOTAL*							$ 3,700,000		
2040 TOTAL*							$ 5,100,000		
2050 TOTAL*							$ 10,600,000		

*TOTAL Indicates a running total through specified year, with total costs recurring for individual items according to life cycle years specified and construction/implementation date

Pumping Plant 2 Capital Improvement and Replacement Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Construction Subtotal	Administrative Factor	Total	Construction/ Implementation	Life Cycle (Years)
Intake Screens									
Chain Replacement	1100	FT	$ 12	1	$ 13,387	1.15	$ 16,000	2024	10
Unit Replacement	3	EA	$ 260,000	1	$ 780,000	1.25	$ 975,000	2054	40
Power, Instrumentation & Controls, Cathodic & Ventilation					$ 1,739,250		$ 2,180,000	2034	20
Replacement of Power, I&C	1	LS	$ 1,440,000	1.2	$ 1,728,000	1.25	$ 2,160,000	2034	20
Cathodic Protection Rectifier Unit	1	EA	$ 5,000	1.5	$ 7,500	1.25	$ 10,000	2034	20
Ventilation	1	EA	$ 2,500	1.5	$ 3,750	1.25	$ 10,000	2034	20
Mobile Generator for Plants 2,3 & 5	1	EA	$ 500,000	1	$ 500,000	1.15	$ 575,000	2022	30
Cathoid Protection Annode Beds	8	EA	$ 1,000	1.5	$ 12,000	1.25	$ 15,000	2034	10
Cathoid Protection Pipe Jumper Cables	600	LF	$ 100	1	$ 60,000	1.25	$ 75,000	2089	75
Pumps and Pump Motors				1	$ -	1	$ -		
Replace Unit	3	EA	$ 228,807	1	$ 686,422	1.25	$ 859,000	2074	60
Outfalls									
Replace Valves and Gates	1	LS	$ 172,000	1	$ 172,000	1.25	$ 220,000	2039	25
Outfall Structure	1	LS	$ 518,000	1	$ 518,000	1.25	$ 647,500	2089	75
Pipes (48" HDPE)	696	LF	$ 1,000	1	$ 696,000	1.25	$ 870,000	2089	75
Pipes (34" HDPE)	440	LF	$ 800	1	$ 352,000	1.25	$ 440,000	2089	75
Pipes (42" WSP)	308	LF	$ 1,600	1	$ 492,800	1.25	$ 616,000	2089	75
Pipes (30" WSP)	296	LF	$ 1,400	1	$ 414,400	1.25	$ 518,000	2089	75
Access & Security									
Equip Fence with Anti-Climb	1000	LF	$ 46	1.2	$ 55,359	1.25	$ 70,000	2024	50
Cameras	1	LS	$ 10,000	1.5	$ 15,000	1.25	$ 19,000	2034	10
Building									
Replace and paint cabinet roof	1	LS	$ 50,000	1	$ 50,000	1	$ 50,000	2044	25
Pump Platform & Access	1	LS	$ 100,000	1	$ 100,000	1.25	$ 125,000	2089	75
Intake Structure	1	LS	$ 1,500,000	1.2	$ 1,800,000	1.25	$ 2,250,000	2089	75
Control Building Structure	1	LS	$ 216,000	1	$ 216,000	1.25	$ 270,000	2089	75
2025 TOTAL*							$ 670,000		
2030 TOTAL*							$ 670,000		
2040 TOTAL*							$ 3,120,000		
2050 TOTAL*							$ 3,300,000		

*TOTAL Indicates a running total through specified year, with total costs recurring for individual items according to life cycle years specified and construction/implementation date

Pumping Plant 3 Capital Improvement and Replacement Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Construction Subtotal	Administrative Factor	Total	Construction/ Implementation	Life Cycle (Years)
Intake Screens									
Chain Replacement	1450	FT	$ 12	1	$ 17,647	1.15	$ 21,000	2032	10
Unit Replacement	4	EA	$ 260,000	1	$ 1,040,000	1.25	$ 1,300,000	2062	40
Power, Instrumentation & Controls, Cathodic & Ventilation					$ 1,746,750		$ 2,190,000	2042	20
Replacement of Power, I&C	1	LS	$ 1,440,000	1.2	$ 1,728,000	1.25	$ 2,160,000	2042	20
Cathodic Protection Rectifier Unit	2	EA	$ 5,000	1.5	$ 15,000	1.25	$ 20,000	2042	20
Ventilation	1	EA	$ 2,500	1.5	$ 3,750	1.25	$ 10,000	2042	20
Mobile Generator (Included in Plant 2 estimate)	1	EA	$ -	1.5	$ -	1.25	$ -	2024	30
Cathoid Protection Annode Beds	16	EA	$ 800	1.5	$ 19,200	1.25	$ 24,000	2032	10
Cathoid Protection Pipe Jumper Cables	2350	LF	$ 100	1	$ 235,000	1.25	$ 293,750	2097	75
Pumps and Pump Motors				1	$ -	1	$ -		
Replace Unit	4	EA	$ 232,953	1	$ 931,812	1.25	$ 1,165,000	2082	60
Outfalls									
Replace Valves and Gates	1	LS	$ 343,195	1	$ 343,195	1.25	$ 430,000	2047	25
Outfall Structure	1	LS	$ 518,000	1	$ 518,000	1.25	$ 647,500	2098	75
Pipes (42" WSP)	450	LF	$ 1,400	1	$ 630,000	1.25	$ 787,500	2098	75
Pipes (48" WSP)	450	LF	$ 1,550	1	$ 697,500	1.25	$ 871,875	2098	75
Pipes (24" WSP)	450	LF	$ 1,050	1	$ 472,500	1.25	$ 590,625	2098	75
Access & Security									
Install Anti-Climb Fences	1000	LF	$ 75	1	$ 75,000	1.1	$ 83,000	2035	50
Cameras	1	LS	$ 10,000	1.5	$ 15,000	1.25	$ 19,000	2032	10
Building									
Replace and Paint Cabinet Roof	1	LS	$ 50,000	1	$ 50,000	1	$ 50,000	2047	30
Pump Platform & Access	1	LS	$ 200,000	1.5	$ 300,000	1.25	$ 375,000	2098	75
Intake Structure	1	LS	$ 3,000,000	1	$ 3,000,000	1.25	$ 3,750,000	2098	75
Control Building Structure	1	LS	$ 1,500,000	1	$ 1,500,000	1.25	$ 1,875,000	2098	75
2025 TOTAL*							$ -		
2030 TOTAL*							$ -		
2040 TOTAL*							$ 150,000		
2050 TOTAL*							$ 2,900,000		

*TOTAL Indicates a running total through specified year, with total costs recurring for individual items according to life cycle years specified and construction/implementation date

Pumping Plant 4 Capital Improvement and Replacement Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Construction Subtotal	Administrative Factor	Total	Construction/ Implementation	Life Cycle (Years)
Intake Screens									
Chain Replacement	1100	FT	$ 12	1	$ 13,387	1.15	$ 16,000	2032	10
Unit Replacement	3	EA	$ 260,000	1	$ 780,000	1.25	$ 975,000	2082	40
Power, Instrumentation & Controls, Cathodic & Ventilation					$ 1,739,250		$ 2,180,000	2042	20
Replacement of Power, I&C	1	LS	$ 1,440,000	1.2	$ 1,728,000	1.25	$ 2,160,000	2042	20
Cathodic Protection Rectifier Unit	1	EA	$ 5,000	1.5	$ 7,500	1.25	$ 10,000	2042	20
Ventilation	1	EA	$ 2,500	1.5	$ 3,750	1.25	$ 10,000	2042	20
Install Diesel Generator	1	EA	$ 600,000	1.5	$ 900,000	1.25	$ 1,125,000	2028	30
Cathoid Protection Pipe Jumper Cables	1200	LF	$ 100	1	$ 120,000	1.25	$ 150,000	2097	75
Cathoid Protection Annode Beds	8	EA	$ 800	1.5	$ 9,600	1.25	$ 12,000	2032	10
Pumps and Pump Motors				1	$ -	1	$ -		
Replace Unit	3	EA	$ 428,262	1	$ 1,284,785	1.25	$ 1,606,000	2082	60
Outfalls									
Replace Valves and Gates	1	LS	$ 172,000	1.5	$ 258,000	1.25	$ 330,000	2047	25
Outfall Structure	1	LS	$ 630,000	1	$ 630,000	1.25	$ 787,500	2097	75
Pipes (48" WSP)	1200	LF	$ 1,600	1	$ 1,920,000	1.25	$ 2,400,000	2097	75
Access & Security									
Install Anti-Climb Fences	1000	LF	$ 75	1.5	$ 112,500	1.25	$ 141,000	2027	50
Cameras	1	LS	$ 10,000	1.5	$ 15,000	1.25	$ 19,000	2032	10
Building									
Replace and Paint Cabinet Roof	1	LS	$ 50,000	1	$ 50,000	1	$ 50,000	2047	25
Pump Platform & Access	1	LS	$ 100,000	1	$ 100,000	1.25	$ 125,000	2097	75
Intake Structure	1	LS	$ 1,500,000	1	$ 1,500,000	1.25	$ 1,875,000	2097	75
Generator Housing Structure	1	LS	$ 216,000	1	$ 216,000	1.25	$ 270,000	2028	75
2025 TOTAL*							$ -		
2030 TOTAL*							$ 1,540,000		
2040 TOTAL*							$ 1,590,000		
2050 TOTAL*							$ 4,200,000		

*TOTAL Indicates a running total through specified year, with total costs recurring for individual items according to life cycle years specified and construction/implementation date

Pumping Plant 6 Capital Improvement and Replacement Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Construction Subtotal	Administrative Factor	Total	Construction/ Implementation	Life Cycle (Years)
Intake Screens									
Chain Replacement	1500	FT	$ 12	1	$ 19,000	1.15	$ 22,000	2055	10
Install New Automatic Bar Screens	4	EA	$ 260,000	1	$ 1,040,000	1.25	$ 1,300,000	2045	40
Power, Instrumentation & Controls, Cathodic, Ventilation, Valves & Gates, Pumps & Motors					$ 2,618,750		$ 3,300,000	2045	
Replacement of Power, I&C	1	LS	$ 1,280,000	1.2	$ 1,536,000	1.25	$ 1,920,000	2045	30
Cathodic Protection Rectifier Unit	2	EA	$ 3,000	1.5	$ 9,000	1.25	$ 20,000	2045	25
Cathoid Protection Pipe Jumper Cables	760	LF	$ 100	1	$ 76,000	1.25	$ 100,000	2045	75
Ventilation	1	EA	$ 2,500	1.5	$ 3,750	1.25	$ 10,000	2045	20
Valves and Gates	1	LS	$ 230,000	1	$ 230,000	1.25	$ 290,000	2045	25
Pumps and Pump Motors	4	EA	$ 191,000	1	$ 764,000	1.25	$ 960,000	2045	60
Install SCADA	1	LS	$ 100,000	1.5	$ 150,000	1.25	$ 187,500	2045	20
Cathoid Protection Annode Beds	8	EA	$ 800	1.5	$ 9,600	1.25	$ 12,000	2032	10
Install Diesel Generator	1	EA	$ 500,000	1.5	$ 750,000	1.25	$ 937,500	2045	30
Outfalls									
Outfall Structure	1	LS	$ 1,000,000	1	$ 1,000,000	1.25	$ 1,250,000	2095	75
Pipes (42" WSP)	190	LF	$ 1,750	1	$ 332,500	1.25	$ 319,000	2045	75
Pipes (30" WSP)	190	LF	$ 1,500	1	$ 285,000	1.25	$ 260,000	2045	75
Pipes (36" WSP)	380	LF	$ 1,200	1	$ 456,000	1.25	$ 474,000	2045	75
Access & Security									
Install Anti-Climb Fences	1000	LF	$ 74	1.5	$ 111,273	1	$ 112,000	2045	50
Cameras	1	LS	$ 10,000	1.5	$ 15,000	1.25	$ 19,000	2042	10
Building									
Pump Platform & Access	1	LS	$ 100,000	1.5	$ 150,000	1.25	$ 187,500	2095	75
Intake Structure	1	LS	$ 2,000,000	1	$ 2,000,000	1.25	$ 2,500,000	2095	75
Control Building Structure	1	LS	$ 216,000	1	$ 216,000	1.25	$ 270,000	2095	75
2025 TOTAL*							$ -		
2030 TOTAL*							$ -		
2040 TOTAL*							$ 20,000		
2050 TOTAL*							$ 7,000,000		

*TOTAL Indicates a running total through specified year, with total costs recurring for individual items according to life cycle years specified and construction/implementation date

Pumping Plant 5 Capital Improvement and Replacement Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Construction Subtotal	Administrative Factor	Total	Construction/ Implementation	Life Cycle (Years)
Plant Relocation									
All Plant Relocation Costs	1	LS	$ 8,900,000	1	$ 8,900,000	1	$ 8,900,000	2026	75
Intake Screens									
Chain Replacement	1100	FT	$ 12	1	$ 13,387	1.15	$ 16,000	2036	10
Unit Replacement	3	EA	$ 260,000	1	$ 780,000	1.25	$ 975,000	2064	40
Power, Instrumentation & Controls, Cathodic & Ventilation					$ 1,746,750		$ 2,190,000	2046	20
Replacement of Power, I&C	1	LS	$ 1,440,000	1.2	$ 1,728,000	1.25	$ 2,160,000	2046	20
Cathodic Protection Rectifier Unit	2	EA	$ 5,000	1.5	$ 15,000	1.25	$ 20,000	2046	20
Ventilation	1	EA	$ 2,500	1.5	$ 3,750	1.25	$ 10,000	2046	20
Mobile Generator for Plants 2,3 & 5 (Included in Plant 2 estimate)	1	EA	$ -	1.5	$ -	1.25	$ -	2022	30
Cathoid Protection Annode Beds	8	EA	$ 800	1.5	$ 9,600	1.25	$ 12,000	2036	10
Outfalls									
Replace Valves and Gates	1	LS	$ 235,000	1	$ 235,000	1.25	$ 300,000	2051	25
Access & Security									
Fences	1000	LF	$ 73	1.5	$ 109,000	1	$ 109,000	2084	60
Cameras	1	LS	$ 10,000	1.5	$ 15,000	1.25	$ 19,000	2036	10
2025 TOTAL*							$ -		
2030 TOTAL*							$ 8,900,000		
2040 TOTAL*							$ 9,000,000		
2050 TOTAL*							$ 11,200,000		

*TOTAL Indicates a running total through specified year, with total costs recurring for individual items according to life cycle years specified and construction/implementation date

Pumping Plant 5 Relocation Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Administrative Factor	Total Cost
Mobilization and Demobilization @ 5%						$ 420,000
Traffic Control	1	LS	$ 32,000	1	1.25	$ 40,000
Storm Water Pollution Control	1	LS	$ 82,000	1	1.25	$ 102,500
Exclusionary Silt Fencing	2000	LF	$ 9	1	1.25	$ 22,500
Temporary Protective Fencing	500	LF	$ 10	1	1.25	$ 6,250
Site Clearing and Grubbing	1	AC	$ 30,000	1	1.25	$ 37,500
Demolition	1	LS	$ 170,000	1	1.25	$ 210,000
Dewatering	1	LS	$ 450,000	1	1.25	$ 562,500
Structure Excavation	3000	CY	$ 13	1	1.25	$ 50,000
New Intake Structure	1	LS	$ 1,840,000	1	1.25	$ 2,300,000
New Outfall Structure	1	LS	$ 224,000	1	1.25	$ 280,000
New walkway for Workers	1	LS	$ 70,000	1.5	1.25	$ 130,000
Pumps and Pump Motors	3	EA	$ 100,000	1	1.25	$ 340,000
Automatic Bar Screens	3	EA	$ 260,000	1	1.25	$ 975,000
Power, Instrumentation and Control	1	LS	$ 1,440,000	1	1.25	$ 1,800,000
New Electrical Control Building	1	LS	$ 216,000	1	1.25	$ 270,000
24" discharge pipe	1200	LF	$ 10,000	1	1.25	$ 1,100,000
Cathodic Protection	1200	LF	$ 121	1	1.25	$ 181,000
Mobile Generator for Plants 2,3 & 5	1	LS	$ 125,000	1.5	1.25	$ 240,000
Install Alarms and Cameras	1	LS	$ 10,000	1.5	1.25	$ 18,750
Install Anti-Climb Fences	800	LF	$ 73	1.5	1.25	$ 109,000
TOTAL						$ 8,900,000.00

Pumping Plant 8 Capital Improvement and Replacement Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Construction Subtotal	Administrative Factor	Total	Construction/ Implementation	Life Cycle (Years)
Major Plant Replacements									
All Major Plant Replacement Costs	1	LS	$ 11,400,000	1	$ 11,400,000	1	$ 11,400,000	2022	75
Intake Screens									
Chain Replacement	3300	FT	$ 12	1	$ 40,161	1.15	$ 47,000	2032	10
Unit Replacement	9	EA	$ 260,000	1	$ 2,340,000	1.25	$ 2,925,000	2041	40
Power, Instrumentation & Controls, Cathodic & Ventilation					$ 1,754,250		$ 2,200,000	2042	20
Replacement of Power, I&C	1	LS	$ 1,440,000	1.2	$ 1,728,000	1.25	$ 2,160,000	2042	20
Cathodic Protection Rectifier Unit	3	EA	$ 5,000	1.5	$ 22,500	1.25	$ 30,000	2042	20
Ventilation	1	EA	$ 2,500	1.5	$ 3,750	1.25	$ 10,000	2042	20
Cathoid Protection Pipe Jumper Cables	2250	LF	$ 100	1.5	$ 337,500	1.25	$ 421,875	2097	75
Cathoid Protection Annode Beds	16	EA	$ 800	1.5	$ 19,200	1.25	$ 24,000	2032	10
Pumps and Pump Motors				1	$ -	1	$ -		
Replace Unit	9	EA	$ 370,000	1	$ 3,330,000	1.25	$ 4,170,000	2072	50
Outfalls									
Replace Valves and Gates	1	LS	$ 516,000	1.5	$ 774,000	1.25	$ 970,000	2047	25
Outfall Structure	1	LS	$ 1,000,000	1	$ 1,000,000	1.25	$ 1,250,000	2062	75
Pipes (54" WSP)	1250	LF	$ 1,500	1	$ 1,875,000	1.25	$ 2,343,750	2022	75
Pipes (60" WSP)	250	LF	$ 2,100	1	$ 525,000	1.25	$ 656,250	2022	75
Pipes (36" WSP)	750	LF	$ 1,300	1	$ 975,000	1.25	$ 1,218,750	2022	75
Access & Security									
Retrofit Fences for Anti-Climb	1000	LF	$ 46	1	$ 46,132	1.1	$ 51,000	2022	50
Cameras	1	LS	$ 10,000	1.5	$ 15,000	1.25	$ 19,000	2032	10
Building									
Replace Roof and Paint Control Building	1	LS	$ 500,000	1	$ 500,000	1	$ 500,000	2047	25
Pump Platform & Access	1	LS	$ 300,000	1.5	$ 450,000	1.25	$ 562,500	2097	75
Intake Structure	1	LS	$ 5,000,000	1	$ 5,000,000	1.25	$ 6,250,000	2097	75
Control Building Structure	1	LS	$ 350,000	1	$ 350,000	1.25	$ 437,500	2097	75
2025 TOTAL*							$ 15,700,000		
2030 TOTAL*							$ 15,700,000		
2040 TOTAL*							$ 15,800,000		
2050 TOTAL*							$ 22,400,000		

*TOTAL Indicates a running total through specified year, with total costs recurring for individual items according to life cycle years specified and construction/implementation date

Pumping Plant 8 Major Plant Replacement and Pipeline Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Administrative Factor	Total Cost
Mobilization and Demobilization @ 5%						$ 700,000
Traffic control	1	LS	$ 32,000	1	1.25	$ 40,000
Storm Water Pollution Control	1	LS	$ 82,000	1	1.25	$ 102,500
Exclusionary Silt Fencing	4000	LF	$ 9	1	1.25	$ 45,000
Temporary Protective Fencing	1000	LF	$ 10	1	1.25	$ 12,500
Demolition	1	LS	$ 50,000	1	1.25	$ 320,000
Site Clearing and Grubbing	1	AC	$ 30,000	1	1.25	$ 37,500
Structure Excavation (pipeline)	3889	CY	$ 13	1	1.25	$ 60,800
New Walkway for Workers	1	LS	$ 137,000	1.5	1.25	$ 238,000
New Pumps and Pump Motors	9	EA	$ 370,000	1	1.25	$ 4,157,000
Replace Instrumentation	1	EA	$ 1,440,000	1	1.25	$ 1,800,000
54" Discharge Pipe	1250	LF	$ 1,400	1	1.25	$ 2,100,000
60" Discharge Pipe	250	LF	$ 2,000	1	1.25	$ 600,000
36" Discharge Pipe	750	LF	$ 1,200	1	1.25	$ 1,100,000
Cathodic protection	2250	LF	$ 120	1	1.25	$ 334,000
Backup generator	2	LS	$ 1,000,000	1.5	1.25	$ 3,750,000
New Generator Housing	1	LS	$ 350,000	1	1.25	$ 437,500
Replace cameras and hookup to SCADA	1	LS	$ 10,000	1.5	1.25	$ 18,750
TOTAL						$ 15,600,000

Riverside Pumping Plant Capital Improvement and Replacement Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Construction Subtotal	Administrative Factor	Total	Construction/ Implementation	Life Cycle (Years)
Power, Instrumentation & Controls, Ventilation	1	LS	$ 130,000	1.5	$ 195,000	1.25	$ 250,000	2036	40
Outfalls									
Concrete Vault with Positive Closure	1	LS	$ 50,000	1.5	$ 75,000	1.25	$ 94,000	2035	60
Access & Security									
Cameras	1	LS	$ 10,000	1.5	$ 15,000	1.25	$ 19,000	2045	10
2025 TOTAL*							$ -		
2030 TOTAL*							$ -		
2040 TOTAL*							$ 350,000		
2050 TOTAL*							$ 370,000		

*TOTAL Indicates a running total through specified year, with total costs recurring for individual items according to life cycle years specified and construction/implementation date

San Juan Pumping Plant Capital Improvement and Replacement Cost Estimate

Item	Quantity	Unit	Cost/unit	Install factor	Construction Subtotal	Administrative Factor	Total	Construction/ Implementation	Life Cycle (Years)
Power, Instrumentation & Controls, Ventilation	1	LS	$ 130,000	1.5	$ 195,000	1.25	$ 250,000	2036	40
Outfalls									
Concrete Vault with Positive Closure	1	LS	$ 50,000	1.5	$ 75,000	1.25	$ 94,000	2035	60
Access & Security									
Cameras	1	LS	$ 10,000	1.5	$ 15,000	1.25	$ 19,000	2045	10
2025 TOTAL*							$ -		
2030 TOTAL*							$ -		
2040 TOTAL*							$ 350,000		
2050 TOTAL*							$ 370,000		

*TOTAL Indicates a running total through specified year, with total costs recurring for individual items according to life cycle years specified and construction/implementation date

Drain Inventory Replacement Opinion of Probable Cost
Reclamation District 1000 2020 CIP

Raw Data		
Total Linear Feet of Drains	17276	
Total Number of Drains	491	
Average Length of Drains	35	
Net Length Drains up to 18"	11837	LF
# of Drains up to 18"	336	
Net Length Drains 20-24"	4629	LF
# of Drains 20-24"	132	
Net Length Drains 30-36"	810	LF
# of Drains 30-36"	23	
Assumptions		
Traffic Control	No	
Lost Productivity for Travel and Mobilization	2	hours per Drain
Base Cost of Pipe, $/in	$ 20	

Culvert Size	LF Price	Drain Length	Pipe Subtotal	Mobilization	Unit Cost	# of Drains	Extended Cost
Up to 18"	$ 360	35	$ 12,600	$1,646	$ 14,246	336	$ 4,786,543
20-24"	$ 480	35	$ 16,800	$1,646	$ 18,446	132	$ 2,434,828
30-36"	$ 720	35	$ 25,200	$1,646	$ 26,846	23	$ 617,450
						Drain Replacement Total	$ 7,838,822

Mobilization & Lost Productivity Equipment Cost	Rate	Hrs	Extended	
Cat 320 Track Excavator	$96.87	2	$194	Hourly rate per Caltrans Equipment Rates
Cat 446 backhoe loader	$60.13	2	$120	Hourly rate per Caltrans Equipment Rates
3-axle end dump	$71.55	2	$143	Hourly rate per Caltrans Equipment Rates
		Subtotal	$457	
		15% Surcharge per Caltrans Equipment Rates	$69	
		Equipment Total	$526	
Mobilization & Lost Productivity Labor Cost	Rate	Hrs	Extended	
4-man crew & truck driver for 2 hours	$100.00	10	$1,000	
		12% Surcharge	$120	
		Labor Total	$1,120	
		Net Mobilization and Lost Productivity Cost per Drain	$1,646	

Culvert Inventory Opinion of Probable Cost
Reclamation District 2020 CIP

Culvert Inventory Replacement Estimate
Raw Data

Total Linear Feet of Culverts	20589		Base Cost of Pipe, $/in of diam	
Total Number of Culverts	477		Up to 24"	$ 20
Average Length of Culverts	44		Up to 36"	$ 30
Net Length Culverts up to 18"	1968	LF	48"	$ 35
# of Culverts up to 18"	45		60"	$ 50
Net Length Culverts 20-24"	6053		72"	$ 60
# of Culvertss 20-24"	138		96"	$ 75
Net Length Culverts 30-36"	6571		120"	$ 100
# of Culverts 30-36"	149			
Net Length Culverts 42-48"	3848			
# of Culverts 42-48"	87			
Net Length Culverts 54-60"	1103			
# of Culverts 54-60"	25			
Net Length Culverts 66-72"	360			
# of Culverts 66-72"	8			
Net Length Culverts 96"	299			
# of Culverts 96"	7			
Net Length Culverts 120"	150			
# of Culverts 120"	3			
Length of Culverts 2x4'x5'	115			
# Culverts 2x4'x5'	3	Equivalent to 96"		

Pipe Size	LF Price	Culvert Length	Pipe Subtotal	Mobilization	Unit Cost	# of Culverts	Extended Cost
Up to 18"	$ 360	44	$ 15,840	$3,140	$ 18,980	46	$ 873,103
20 & 24"	$ 480	44	$ 21,120	$3,140	$ 24,260	140	$ 3,396,470
30 & 36"	$ 1,080	44	$ 47,520	$3,140	$ 50,660	152	$ 7,700,396
42 & 48"	$ 1,680	44	$ 73,920	$3,140	$ 77,060	89	$ 6,858,384
54 & 60"	$ 3,000	44	$ 132,000	$4,958	$136,958	26	$ 3,560,915
66 & 72"	$ 4,320	44	$ 190,080	$4,958	$195,038	8	$ 1,560,306
96"	$ 7,200	44	$ 316,800	$9,456	$326,256	10	$ 3,262,565
120"	$ 12,000	44	$ 528,000	$9,456	$537,456	3	$ 1,612,369
						Culvert Replacement Total	$ 28,824,507
						Total with 25% Administrative Cost	$ 36,030,634

	Rate	Hrs	Extended	
Mob, Traffic Control Equip Cost - up to 48"	Rate	Hrs	Extended	
Cat 320 Track Excavator	$96.87	3	$291	Hourly rate per Caltrans Equipment Rates
Cat 446 backhoe loader	$60.13	3	$180	Hourly rate per Caltrans Equipment Rates
3-axle end dump	$71.55	3	$215	Hourly rate per Caltrans Equipment Rates
		Subtotal	$686	
		15% Surcharge	$103	
		Equipment Total	$788	
Mobilization Labor Cost per Culvert	Rate	Hrs	Extended	
6-man crew + truck driver for 3 hours	$100.00	21	$2,100	
		12% Surcharge	$252	
		Labor Total	$2,352	
		Net Mobilization and Traffic Control Cost per Culvert	$3,140	
Mobilization Equipment Cost - up to 72"	Rate	Hrs	Extended	
Cat 235 Track Excavator	$131.74	4	$527	Hourly rate per Caltrans Equipment Rates
Cat 950B loader	$95.46	4	$382	Hourly rate per Caltrans Equipment Rates
3-axle end dump	$71.55	4	$286	Hourly rate per Caltrans Equipment Rates
		Subtotal	$1,195	
		15% Surcharge	$179	
		Equipment Total	$1,374	
Mobilization Labor Cost per culvert	Rate	Hrs	Extended	
7-man crew & truck driver for 4 hours	$100.00	32	$3,200	
		12% Surcharge	$384	
		Labor Total	$3,584	
		Net Mobilization and Traffic Control Cost per Culvert	$4,958	
Mobilization Equipment Cost - up to 120"	Rate	Hrs	Extended	
Grove RT990 Crane	$195.23	6	$1,171	Hourly rate per Caltrans Equipment Rates
Cat 235 Track Excavator	$131.74	6	$790	Hourly rate per Caltrans Equipment Rates

Cat 950B loader	$95.46	6	$573	Hourly rate per Caltrans Equipment Rates
3-axle end dump	$71.55	6	$429	Hourly rate per Caltrans Equipment Rates
		Subtotal	$2,964	
		15% Surcharge	$445	
		Equipment Total	$3,408	
Mobilization Labor Cost per culvert	Rate	Hrs	Extended	
8-man crew & truck driver for 6 hours	$100.00	54	$5,400	
		12% Surcharge	$648	
		Labor Total	$6,048	
Net Mobilization and Traffic Control Cost per Culvert			$9,456	

Count of Drains
Compiled from GIS Data

Row Labels	Count of Pipe_Size
0	1
6	1
8	1
10	1
12	37
15	137
16	5
18	220
20	2
24	75
30	1
36	10
Grand Total	**491**

Count of Culverts
Compiled from GIS Data

Row Labels	Count of Pipe_Size
0	21
6	1
12	6
15	1
18	29
20	5
23	2
24	133
28	1
30	50
36	76
42	25
48	40
54	5
60	7
66	1
72	5
84	2
90	2
96	1
120	1
2-10'x10'	2
2-4'x5'	2
2-5'x10'	2
2-6'x10'	2
2-6'x8'	2
2-7'x7'	3
2-8'x10'	3
3-10'x10'	2
3-5'x8'	2
3'x4'	3
3'x5'	2
4-10'x10'	2
4'x5'	2
6'x10'	2
6'x6'	17
6'x8'	15
Grand Total	**477**

Drains Inventory
Compiled from GIS Data

Sum of Pipe_Lengt	**Column Labels**							
Row Labels		**CMP**	**HCP**	**HDPE**	**Other**	**RCP**	**WSP**	**Grand Total**
0	0							0
6					20			20
8		20						20
10			20					20
12		450	366		256	110	20	1202
15		144	3123			138		3405
16		45		78		45		168
18		1319	5244	86		337	16	7002
20			80	32				112
24		1987	2068			462		4517
30						50		50
36		380				380		760
Grand Total	**0**	**4345**	**10901**	**196**	**276**	**1522**	**36**	**17276**

RD 1000 Culvert Inventory
Compiled from GIS Data

Sum of Pipe_Lengt	**Column Labels**							
Pipe Size		**CMP**	**HCP**	**HDPE**	**Other**	**RCP**	**WSP**	**Grand Total**
0	103				385	0		488
6							50	50
12		67			76	57		200
15			40					40
18		474	340	0	160	126	90	1190
20					285	180		465
23							62	62
24		2192	1697	322	210	1045	60	5526
28					35			35
30		734	449	0	20	1649	60	2912
36	116	1750	855		350	488	65	3624
42		65	424			696		1185
48		868	144	90		1375		2477
54		110				0		110
60	18	125	60			0		203
66		40						40
72		320						320
84		0						0
90						0		0
96	0							0
120		50						50
2-10'x10'	0				0			0
2-4'x5'					115			115
2-5'x10'	0							0
2-6'x10'	100							100
2-6'x8'	0							0
2-7'x7'	0							0
2-8'x10'	0							0
3-10'x10'	0							0
3-5'x8'	0							0
3'x4'	56				30			86
3'x5'						186		186
4-10'x10'	0				0			0
4'x5'					790			790
6'x10'	0							0
6'x6'	0				36			36
6'x8'	259					40		299
Grand Total	**652**	**6795**	**4009**	**412**	**2492**	**5842**	**387**	**20589**

RD 1000 Culvert Inventory
Compiled from GIS Data

1968	
6053	
6571	
3662	
313	
360	
50	
115	Equivalent to twin 60"
100	Equivalent to 120"
272	Equivalent to 48"
790	Equivalent to 60"
335	Equivalent to 96"