



# FINAL Water Main Line Replacement and Rehabilitation Master Plan

McKinleyville Community Services District



# Executive Summary

## Introduction

The Water Main Line Rehabilitation Master Plan (Master Plan) has been prepared to provide a schedule for implementing replacements, rehabilitation, and upgrades to the McKinleyville Community Service District's (MCSD or District) water distribution system main lines and appurtenances (distribution system) for the next 50 years. This Master Plan effort includes an analysis of all of the pipelines, service laterals, blow-off assemblies, and valves (including isolation, air release, and pressure reducing valves) in the District's water distribution system. No analyses of booster stations or storage tanks are provided as a part of this study.

The original water distribution system was constructed in 1973. The average life expectancy of asbestos cement (AC) pipe which constitutes the majority of the original system is 50 to 70 years. Given the current age of the system is 47 years, the District can anticipate increased pipeline failures and leaks in the next five to ten years. As the system continues to age, replacement and rehabilitation of existing infrastructure will be necessary to maintain an effective, functional system. This report serves as the third and final phase of the master planning effort. The work on the various phases culminates in this Final Water Main Line Rehabilitation Master Plan (Final Master Plan). The Final Master Plan will serve as a final planning and budgeting outline to ensure the District is able to continue their high level of service to the community well into the future.

Phase 1 of the Master Plan includes a review and analysis of available information that was used to produce a planning-level long-term replacement plan. The development of a near-term rehabilitation plan was also considered. This near-term plan would include any areas identified as having performance or capacity constraints that need to be resolved in the next ten years; however, there are currently no such cases in the water distribution system. The District does currently have plans and has budgeted for the construction of a new water storage tank, but that planning effort is being done outside the scope of this document.

Phase 1 of the Master Plan provides the following:

- Overview of the existing distribution system
- Summary of previous related studies
- Information on anticipated population growth
- Preliminary needs assessment
- Long-term replacement analysis including cost and scheduling information
- Financial analysis based on the replacement cost estimates
- Conclusions, recommendations, and next steps

Phase 2 of the Master Plan effort builds on the system knowledge obtained in Phase 1 to create more detailed phasing information for the systematic replacement of the water mains.

Phase 2 of the Master Plan provides the following:



- Discussion of appropriate replacement methodologies (e.g. lining, bursting, or direct replacement) with associated construction cost estimates
- Determination of an appropriate yearly project cost based on the Phase 1 system requirements and financial analysis
- Outlining a schedule for the first 50 years of main line replacement for the MCSD water distribution system
- A financial analysis to forecast rates necessary to fund these replacements

Phase 3 of the master planning effort consists of direct physical assessment of portions of the system to determine the condition of the pipe and update the schedule established under Phase 2 based on physical testing of pipe samples and a risk-based prioritization.

Phase 3 provides the following:

- Determination of pipe condition through physical testing of pipe samples
- Evaluation of the prioritization based on risk considering all of the triple bottom line categories: social, environmental, and financial
- Discussion and comparison of performing construction work in-house or through contract with associated construction cost estimates
- Refinement of the appropriate yearly project cost based on the updated system requirements and updated opinion of probable costs
- Revision of the schedule for the first 50 years of main line replacement for the MCSD sewer collection system based on the risk assessment

### **Risk Assessment**

A Risk Framework was developed and applied to the linear assets in the MCSD sewer system. The Risk Framework considers the Probability of Failure and Consequence of Failure and assigns scores to each pipe. Probability of Failure considers the physical mortality failure and uses condition information from physical testing of sample pipes to assign scores. Consequence of Failure considers Triple Bottom Line categories (social, environmental and financial) and assigns values to each pipe using geospatial analysis and proximity to various data layers; for example, critical customers and sensitive habitats like rivers and waterbodies.

Rehabilitation Prioritization Probability of Failure and Consequence of Failure scores are then used to calculate the Core Risk and Business Risk Exposure scores. The risk scores are used to prioritize the rehabilitation of the system. Based on the results of the physical testing of sample pipes, it was determined that asbestos cement (AC) pipe with diameter 8-inch and smaller had less remaining wall thickness and therefore should be addressed prior to 10-inch and larger AC pipe. This drives the Probability of Failure score and therefore is a factor in the prioritization.



## Conclusions, Recommendations, and Next Steps

This Master Plan presents a Risk Framework for evaluating and assigning priority for the replacement of MCSD's sewer collection system. The District can replace the most critical portions of the MCSD water distribution system in the next 50 years with a reasonable adjustment to user rates by using the risk-based prioritization presented in this master plan.

Following the prioritization presented in this master plan, spending an average of \$1 million (2019 dollars) per year on the system will allow Priority 1 and over half of Priority 2 pipes to be replaced which equates to 18.6 miles of the District's 8-inch or smaller AC pipe in 50 years. This represents 50% of the District's 8-inch or smaller AC pipe, or 22% of the entire system. Replacement activities will help to ensure the continued high quality of service to their customers. Actual construction costs may differ and will depend on pipe conditions. Confirmation of the appropriate replacement method during the design phase of each project.

While there are currently no high-priority, near-term projects required for the distribution system, it is critical that the District begin planning and budgeting for upgrades and replacement of system components. The approved rates from Section 4 were made assuming that MCSD would begin putting aside \$860,000 to \$960,000 for each of the next four years starting in 2019 and then reserving the full \$1 million (2019 dollars) per year after that period. With rate adjustment approved, the project financing is securely in place and it is recommended that MCSD execute the replacement of its water system beginning with the pipe segments identified as Priority 1 followed by Priority 2 and then Priority 3. Within the Priority groups, it is recommended that Business Risk Exposure (BRE) scores be used to prioritize projects. The District should begin the planning and design process for the early proposed projects so construction can begin around 2024.

Asset condition for the risk assessment performed as part of this master plan is largely based on the 3 AC pipes samples collected and physically tested, one segment of ductile iron (DI) pipe CCTV-ed, and one location of DI pipe with ultrasonic thickness testing. Results of physical testing were then extrapolated to subsets of assets based on material and diameter; however, condition within a subset can vary. Additional physical testing could be performed to refine and update the condition of the assets, as well as additional physical testing. As pipes are replaced, condition scores should be updated to reflect the improvements.

This master plan focuses on the District's capital expenditures and using the risk assessment to prioritize capital projects. However, in addition to the capital project recommendations, the District can use the risk assessment results to identify appropriate maintenance activities and intervals for the water distribution system assets depending on the criticality of the pipe segment and appurtenances. Maintenance activities should include flushing of water lines and exercising of valves to ensure best performance and functionality.

Lastly, this master plan and the associated risk model is considered a living plan that should be updated as additional condition information is known or as replacement projects are completed. Condition scores and probability of failure can be updated at the asset level to obtain updated prioritization.



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# 1. Introduction and Background

The purpose of the McKinleyville Community Services District (MCSD, District) Water Main Line Rehabilitation Master Plan (Master Plan) is to provide a framework for planning, funding, and implementing replacements, rehabilitation, and upgrades to the District's water distribution system main lines and appurtenances (distribution system) for the next 50+ years. This type of master planning helps the District provide orderly, long-term maintenance and replacement of key elements of the distribution system, and to manage the timing of major capital projects to secure revenue needed to achieve District goals.

## 1.1 Overview of Existing System

MCSD is a special service district providing parks, recreation, water, wastewater, and streetlight services to residents of McKinleyville in Humboldt County, California (see Figure 1: Project Vicinity and Location Map). The MCSD boundary encompasses approximately 19 square miles, ranging from North Bank Road on the south to Patrick Creek on the north.

The original water distribution system was constructed in 1973. MCSD purchases wholesale treated water from the Humboldt Bay Municipal Water District (HBMWD), which diverts water from its one-million-gallon reservoir at the Turbidity Reduction Facility to MCSD's Grant A Ramey Pump Station (Ramey Pump Station) at the intersection of North Bank and Azalea Roads. Water is pumped into the rest of the District's system from the Ramey Pump Station. Water is distributed to the District's approximately 6,448 water services (as of November 2021) through approximately 91 miles of water mains (excluding private laterals). The MCSD water system also includes six storage tanks that provide a total of 5.25 million gallons (MG) of storage.

There are four pressure zones in the system. Pressure Zone 1 (approximately 13% of the system) includes all services west of Highway 101 and is fed from Pressure Zone 2 through four pressure reducing valve (PRV) stations. Pressure Zone 2 (approximately 84% of the system) includes two tanks at the Norton Road tank site (1 MG and 1.5 MG) and two tanks at the Cochran Road tank site (1 MG and 1.5 MG). There is a booster station near the Cochran Road tanks that pumps water up to the two McCluski Hill redwood tanks (0.1 MG and 0.15 MG) which serve the McCluski Hill area (Pressure Zone 3, approximately 3% of the system). Pressure Zone 4, along Blake Road, is a small specialty zone that services approximately 12 customers and is fed by a hydro-pneumatic tank from Pressure Zone 2.

An overview of the District's water system is shown in Figures 2 and 3. Figure 2 symbolizes the water mains with respect to size, and Figure 3 symbolizes the water mains with respect to material.

## 1.2 Summary of Previous Studies

Elements of the MCSD distribution system have been evaluated since the system was originally constructed. This section presents background information, findings, and recommendations from the following recent documents and studies regarding the MCSD distribution system:





- MCSD Water Distribution System – Preliminary Assessment – Revision 3, SHN – August 2011
- MCSD Water Model Technical Report, North Coast Mapping Solutions – July 2012
- McKinleyville Capital Improvement Plan, HSU Student Capstone Project – May 2015
- Water and Sewer Capacity Fee Study, Willdan Financial Services – September 2011
- Updated Water Rate and Financial Analysis, Willdan Financial Services – February 2014  
(Note that the Rate Study was updated during previous phases of the master planning effort in 2018 which is described in Chapter 5)

These previous studies are summarized in this report to provide additional context and highlight conclusions that can be drawn from work that has already been done. While more in-depth assessment of the distribution system is a part of this Master Plan effort, synthesizing information provided in previous studies is an appropriate way to begin this effort. Recent assessment of the water distribution system was started with a 2011 study that is summarized in the following section.

### **1.2.1 MCSD Water Distribution System – Preliminary Assessment – Revision 3, SHN – August 2011**

SHN Consulting Engineers & Geologists, Inc. (SHN) prepared a report titled *MCSD Water Distribution System – Preliminary Assessment* (Assessment) in August 2011. The Assessment provides an overview of the current and future MCSD water system and storage requirements to aid in the planning of future additional storage for the system, as well as aid in the development of the MCSD water distribution model, which is summarized in Section 1.2.2. Current water needs were established using data from 2010 and methods outlined in Title 22 California Code of Regulations (CCR) Section 64554(b)(3)(A-D). It was calculated that MCSD has an average daily demand (ADD) of 1.51 million gallons per day (MGD), a max daily demand (MDD) of 3.41 MGD, and a peak hourly demand (PHD) of 0.21 MG.

The California Department of Public Health (CDPH) and CCR 22 CA ADC 64554 require water storage equal to four hours of PHD plus the MDD at all times, which would require MCSD to have 4.25 MG of storage. MCSD desires to achieve a more stringent storage criterion of 5 days of ADD plus storage for fire flows, given the vulnerability of the main water supply transmission line and a lack of redundancy in water supply. Meeting this criterion would require 7.6 MG of storage under current system demands. Currently MCSD has 5.25 MG of available water storage, which is sufficient to meet CDPH standards, but insufficient for meeting MCSD standards.

In addition to the current system demands, the Humboldt County General Plan (General Plan) has proposed high-density housing that will increase the MCSD population by approximately 1,800 equivalent residential units (ERUs). With a demand of 254 gallons/ERU (calculated in the Assessment), this would require an additional 2.3 MG of storage to meet the MCSD storage goals, in addition to the current storage deficit of 2.3 MG. This would mean a total required storage of 9.8 MG, implying the MCSD needs to increase its current water storage by approximately 4.5 MG. The assessment presents conceptual cost estimates for the design and installation of one 4.5-MG tank at \$5,647,460 and for two 2.25-MG tanks at \$8,597,108.



Additionally, the Assessment outlines other requirements and specifications for the MCSD water system as follows:

- Minimum storage level is approximately 20 feet in each storage tank to account for fire flows and/or minimum pressure requirements.
- Maximum fire hydrant spacing is 500 feet in residential areas and 300 feet in commercial areas. A maximum of one hydrant is allowed on 6-inch mains between intersecting lines, and a maximum of two hydrants are allowed on 8-inch mains between intersecting lines.
- Minimum operating pressure of 40 pounds per square inch gauge (psig) available to residents with a lowered minimum of 20 psig available during fire flow demands.
- Minimum fire flows are 1,000 gpm and 2,000 gpm over a 2-hour period for residential and commercial areas, respectively. Note that a fire on September 16, 2002 lasted for 10 hours and consumed nearly 1.3 MG of water.

### **1.2.2 MCSD Water Model Technical Report, North Coast Mapping Solutions – July 2012**

The *MCSD Water Model Technical Report* was prepared by North Coast Mapping Solutions with review and stamped approval by SHN. The report summarizes the District's water system as well as MCSD and State of California water system regulatory criteria and standards as presented in the *MCSD Water Distribution System – Preliminary Assessment* (see Section 1.2.1). The report then outlines the development of a WaterCAD V8i water model for the District's water distribution system piping, tanks, and booster stations. The report includes a discussion on model limitations and components, rule-based operations used to define the model simulations, how demand was allocated throughout the system, and model calibration. Lastly, the report presents results for various scenarios to determine the system's adequacy for maintaining required flows, pressure, and storage per MCSD and State of California minimum requirements and regulations (see Section 1.2.1). The report presents model results for four scenarios:

1. Existing system
2. Addition of a 4.5-MG storage tank at the Cochran Road tank site
3. Addition of a 4.5-MG tank at the Cochran Road tank site and a 2.5-MG tank at the northeast end of Mather Road (Dows Prairie area)
4. Water system requirements to meet the growth projections for MCSD
  - a. This scenario was modeled with the additional 4.5-MG tank at the Cochran Road tank site and a 2.5-MG tank at the end of Mather Road
  - b. This scenario included demands based on population growth projections for years 2020 and 2030 (using a growth rate of 1.8% per year)

Each scenario analysis included the following:

- Steady state analysis testing pressures, flows, and fire flow availability



- Extended period simulation (EPS) testing storage capacity and pressures
- Extenuating circumstances testing each scenario under “earthquake” conditions
  - Under this scenario, the assumption is made that a natural disaster isolates MCSD’s system from HBMWD’s system and causes fires within the MCSD service area. With MCSD no longer connected to HBMWD’s system, water is provided solely by the storage in MCSD’s tanks.
- Results for a high-density build-out scenario with demands added into the model based on population growth projections in the General Plan

### 1.2.2.1 Steady State Analysis

The steady state analysis results showed that during peak hour demand plus a 2,000 gpm industrial fire event on Central Avenue, the existing system is able to provide adequate pressure (20 psi or greater) to all service connections except one junction at the end of Mather Road (Dows Prairie area), which is at a high elevation and is known as a low pressure region. With the addition of the 4.5-MG storage tank, all service connections are able to provide adequate pressure under maximum daily demand plus a 2,000 gpm fire event on Central Avenue.

With regard to fire flow, under maximum daily demand, the existing system failed to supply the required residential fire flow of 1,000 gpm to 9 junctions in the high elevation portions of the system, particularly in the Dows Prairie and McCluski Hill areas. The addition of the 4.5-MG storage tank improves fire flows, but there are still 7 junctions that do not receive adequate fire flow under this scenario. With the additional 2.5-MG storage tank, the system fails to provide 1,000 gpm to three junctions, but all are above 920 gpm. Under the year 2020 and year 2030 projected maximum daily demands, the addition of a 2.5-MG tank in the high elevation Dows Prairie area allowed for adequate fire flow above 1,000 gpm at all junctions.

Under all steady state scenarios, flow velocities throughout the system were below 5 ft/sec, and three junctions had pressures exceeding 100 psi. Those junctions are found at low elevations along Patrick Creek Drive and Little River Drive, and the modeled pressures are consistent with District field measurements.

### 1.2.2.2 Extended Period Simulation (EPS)

As it would be expected, the EPS showed that higher pressures are found in low elevation areas and low pressures are found in high elevation areas, particularly the Dows Prairie area. As the storage tank levels decreased, the number of junctions that failed to provide the minimum pressure of 20 psi of course increased. Under existing conditions, and employing the MCSD protocol minimum tank level of 20 feet, only two junctions failed to provide 20 psi (one in the McCluski Hill area and one at the end of Mather Road in the Dows Prairie area).

To determine the number of days of storage available, the main transmission line from HBMWD was set to closed, tank levels were set to full, and pumps were turned off. A 4-hour commercial fire (2,000 gpm) was set to occur along Central Avenue, and the assumption was made that water consumption was equal to average daily demand. There is less than two days of storage available



in the current system under this scenario. The addition of the 4.5-MG tank increases the available storage to four days, and the addition of the 2.5-MG tank increases the storage to five days.

### **1.2.2.3 Earthquake Scenario**

Similar to the EPS scenarios, the addition of both the 4.5-MG and 2.5-MG storage tanks is necessary to provide the five-day storage of ADD and fire flows under the “earthquake” scenario.

### **1.2.2.4 High-Density Build-out Scenario**

The addition of the 4.5-MG and 2.5-MG tanks only allows for 3.5 days of storage under the Humboldt County high-density build-out scenario. To meet the anticipated population growth projections, a minimum of 10.5 MG and 12 MG of additional storage is required for years 2020 and 2030, respectively. The population increase would also require additional or larger pumps to keep pace with the increase in demand.

## **1.2.3 McKinleyville Capital Improvement Plan, HSU Student Capstone Project – May 2015**

A group of Humboldt State University (HSU) engineering students prepared the McKinleyville *Capital Improvement Plan* as part of a school project. Among other information and analyses, the report provides recommendations for infrastructure upgrades of MCSD’s water distribution and sewer collection systems, preliminary designs for specific projects, and a schedule and estimated costs for systematically replacing the entire sanitary sewer collection and water distribution systems, accounting for expansion of each system to accommodate projected population growth. This report also analyzed how the “full buildout” scenario (developed based on potential rezoning and projected population growth per the General Plan) would affect the capacity and performance of each system.

The report developed design parameters for the installation of a new storage tank at the Cochran Road site to meet the MCSD requirement of having five days of storage at average daily demand (negating fire flow considerations). The recommended alternative was one 5-MG pre-stressed concrete tank. The report recommended the tank have 12 in thick walls, an inner diameter of 160 feet, and a height of 35 feet in order to leave 12 inches of freeboard for seismic activity. The tank would require 24, 48-inch structural beams with a 27-foot spacing to serve as both support and baffling. It was also recommended to partially bury the tank 4 feet into the ground to avoid extra pumping costs and excess pressure in the distribution system. The total cost for the storage tank was estimated as \$3,864,000.

The recommended replacement schedule for the entire distribution system was broken into two sections, replacing 8,500 ft/year until 2060 and then 5,500 ft/year until 2096. The total present worth cost for replacement of the water distribution system was given as \$31.5 million.

Under the “full buildout” scenario, model results showed that the system was able to maintain pressures above 20 psi, and that most of the system can generally accommodate buildout. However, the pressure in many mains dropped below 40 psi, and the report notes that any substantial development would require additional analysis to remedy low pressures.



### 1.2.4 Water and Sewer Capacity Fee Study, Willdan Financial Services – September 2011

Willdan Financial Services (Willdan) prepared a *Water and Sewer Capacity Fee Study* for MCSD in September 2011. Capacity fees are one-time charges that are collected as a condition of establishing a connection to the District’s systems. These fees are proportional and related to the capital facility demands of new development. Capacity fees are collected separately from connection fees, which are used to offset the costs associated with the physical connection to the utility. The previous water capacity fee established in 1991 was \$154 per equivalent residential unit (ERU), which is defined as any single-family residential structure. Willdan recommended switching from a water capacity fee based on ERUs to one based on the size of the installed water meter. Table 1 shows the total recommended water capacity fee by water meter size. The total water capacity fee includes storage, discharge, and joint costs per account.

**Table 1: Water Capacity Fees for MCSD by Water Meter Size**

Water Meter Size	Total Water Capacity Fee
5/8"	\$ 2,616
3/4"	\$ 3,818
1"	\$ 6,221
1 1/2"	\$ 12,231
2"	\$ 19, 442
3"	\$ 36,268
4"	\$ 60,305
6"	\$120,399
8"	\$ 192,511
10"	\$ 276,642

The study notes that recent building code regulations require single-family homes to be sized with a 1-inch meter for fire protection systems. The study recommends all new single-family residential units with meter sizes up to 1 inch be charged the 5/8-inch meter fee to reflect their typical demand on the system.

### 1.2.5 Updated Water Rate and Financial Analysis, Willdan Financial Services – February 2014

Willdan prepared an Updated Water Rate and Financial Analysis for MCSD in February 2014 which was reviewed as part of the Phase 1 of the Master Plan and is summarized in this section. Note that the rate study was updated in 2018 as part of the master planning effort and is described in Chapter 5. Another update to the rate study is scheduled for 2022. The initial rate study was completed in 2012 to update MCSD’s water rates such that the full operation and maintenance of the current system and future upgrades to the system were covered. At the time, the District was running at a net loss. The initial analysis mistakenly failed to include the base cost of water purchased from HBMWD for resale to MCSD customers, leading to a drastic decrease in MSCD’s reserves because customers were not paying for the water purchased for their use. To recover the lost revenue, the analysis calls for a pass through charge of \$1.22 per hundred cubic feet (HCF) of



water used by each customer. This pass through charge is then adjusted each year based on the wholesale water charges from HBMWD. Additionally, the analysis recommends a recovery surcharge of \$3.66 per ERU per month through the end of fiscal year 2017. The analysis also includes new recommendations for monthly base charges (Table 2) and variable commodity rates (Table 3) which account for water purchased from HBMWD.

**Table 2: Adjusted Monthly Base Charges in 2017 and 2018 for MCSD Customers by Meter Size**

Water Meter Size	ERU	2017 Rate	2018 Rate
5/8"	1	\$ 14.57	\$ 15.39
3/4"	1.5	\$ 19.06	\$ 20.13
1"	2.5	\$ 28.03	\$ 29.60
1 1/2"	5	\$ 50.46	\$ 53.29
2"	8	\$ 77.38	\$ 81.72
3"	15	\$ 140.18	\$ 148.05
4"	25	\$ 229.93	\$ 242.81
6"	50	\$ 454.21	\$ 479.70
8"	80	\$ 723.38	\$ 763.98

**Table 3: Adjusted Commodity Rates in 2017 and 2018 for MCSD Customers as a Volume Charged in Dollars per HCF Consumed**

Tier	HCF	2017 Rate	2018 Rate
1	0-8	\$ 1.39	\$ 1.47
2	8.01 +	\$ 3.46	\$ 3.66

### 1.3 Anticipated Growth

It is important to consider future demand when planning future rehabilitation and replacement of water main pipelines. Water demand increases as population grows, which requires more water to be conveyed through the mains in the system. Appropriate growth considerations can be used to determine if a pipe should be replaced in kind, or if the size should be increased to provide additional capacity.

The 2002 McKinleyville Community Plan (a subsection of the General Plan) notes that the most probable growth projection for McKinleyville was 1.8%, based on the growth trends at the time. The McKinleyville Community Plan has since not been updated.

McKinleyville had a population of 13,599 in 2000 (based on the 2000 census) and 15,177 in 2010 (based on the 2010 census). Based on data from the American Community Survey (ACS) 5-year estimate performed by the United States Census Bureau, McKinleyville had a population of 16,291 in 2015 and 16,262 in the 2020 census. Using these figures, population growth from 2000 to 2015 was approximately 1.21% per annum, growth from 2010 to 2015 was approximately 1.43% per



annum, and growth of 0% from 2015 to 2020. The District has indicated that they would consider using a rate of 1% per annum for growth projections when considering future development potential.

The only major subdivision development that has occurred since 2010 was the Central Estates Subdivision. Any population increase that resulted from this subdivision likely would have been captured in the 2015 ACS 5-year estimate, and the demands from this subdivision were also included in the water modeling that was performed by North Coast Mapping Solutions (NCMS) in 2012. Additionally, the General Plan has not been updated since the water modeling was performed in 2012.

NCMS ran model scenarios for the years 2020 and 2030 using a growth rate of 1.8%, which is conservative when considering the recent population growth trends described above. The water modeling also included demands from high-density housing proposed in the General Plan.

## 1.4 Overview of Master Planning Effort

This Master Plan effort includes an analysis of all of the pipelines, blow-off assemblies, and valves (including isolation, air vacuum/release, and pressure reducing valves) in the District's water distribution system. While booster stations and storage tanks are mentioned in this report, they are discussed in the context of the overall water system, and no analyses of booster stations or storage tanks are provided as a part of this study.

The overall Master Plan is developed through multiple major phases of effort and culminates in the development of this Final Water Main Line Rehabilitation Master Plan (Final Master Plan). The three phases of the master planning effort are:

- Phase 1: High-level overview of water distribution main lines
- Phase 2: More detailed cost analysis and phasing of the systematic replacement of water distribution main lines
- Phase 3: Physical assessment of some water distribution main lines, risk evaluation, and update of the phase 2 schedule based on risk.

The Phase 1 effort included the results of the high-level assessment of the District's distribution system for use in initial planning for replacement, rehabilitation, and upgrades. The Phase 1 effort helped to quantify the overall nature, scope, and magnitude of long-term main line maintenance and replacement.

The Phase 1 study focused on the following:

- General overview of MCSD and the existing distribution system
- Summary of previous related studies and findings that pertain to rate structure, capacity, maintenance and repair requirements, and other identified limitations of system components
- Description of the anticipated growth for the McKinleyville area
- Discussion on areas of the system that have pressure and fire flow issues
- Summary of MCSD's existing distribution system main lines, including information pertaining to size, age, material, and condition



- Discussion on considerations for replacement of the distribution system main lines
- Long-term replacement analysis with associated costs for systematically replacing the entire distribution system
- Financial analysis to assess the rate impacts to pay for the long-term systematic replacement of the entire system. It is important to note that we are not recommending the rate increases presented in the financial analysis section of the Phase 1 document, but merely assessing what it would cost to systematically replace the entire distribution system over a period of time.
- Conclusions, recommendations, and a summary of the next steps in the Master Plan process

Phase 2 of the Master Plan effort builds on the system knowledge presented in Phase 1 to develop more detailed phasing information for the systematic replacement of the water mains.

Based on planning with District staff, Phase 2 effort focuses on the following:

- Discussion of appropriate replacement methodologies (e.g. lining, bursting, or direct replacement) with associated construction cost estimates
- Determination of an appropriate yearly project cost based on the Phase 1 system requirements and financial analysis
- Development of a schedule for the first 50 years of main line replacement for the MCSD water distribution system
- Costs for these projects for the next 100 years, and a financial analysis to forecast rates necessary to fund these replacements.

Phase 3 of the effort consists of direct physical assessment of portions of the system to determine the condition of the pipe and revision of the schedule established under Phase 2 based on risk assessment. Phase 3 of the Master Plan provides the following:

- Determination of pipe condition through physical testing of pipe samples
- Evaluation of prioritization based on risk considering all of the triple bottom line categories: social, environmental, and financial
- Discussion and comparison of performing construction work in-house or through contract with associated construction cost estimates
- Refinement of the appropriate yearly project cost based on the updated system requirements and financial analysis
- Revision of the schedule for the first 50 years of main line replacement for the MCSD water distribution system based on the risk assessment

## **1.5 Key Points from the Phase 1 Report**

The system is generally in good condition with no identifiable near-term problems or areas of concern. There are some minor issues with low pressure and inadequate fire flow in higher elevation areas, and high pressure in lower elevation areas, that the District has plans to address





outside of the scope of this Master Plan. The principal issue is that a majority of the system piping is approaching design life expectancies, meaning pipe failures will likely become an issue in the next 10 to 30 years if the District does not begin the process of replacing system main lines.

The original water distribution system was constructed in 1973, making it 50 years old in 2023. The original piping comprises 55% of the current total distribution system piping and is 90% asbestos cement (AC) pipe and 10% ductile iron (DI) pipe. With an AC pipe design life of 50-70 years and a DI pipe design life of 75-100 years, the original system piping will require replacement in the relatively near future. The remaining 45% of the system consists of some AC pipe, but is mostly polyvinyl chloride piping (PVC), installed since 1980, which has a design life of 50-100 years.

The total construction cost estimate for replacing the entire water distribution system is \$142 million in today's dollars. The multi-year pro forma analysis on the MCSD water system found that MCSD could not afford replacement of the water distribution without an increase in rates. Using a phased-in approach of rate increases, it is projected that replacing the entire system over 50, 75, or 100 years would require annual rate increases of 6.25%, 5.00%, or 4.10%, respectively.

## **1.6 Key Points from the Phase 2 Report**

Phase 2 of this Water Main Line Rehabilitation Master Plan (Master Plan) was prepared to provide preliminary priorities and schedule for implementing replacements, rehabilitation, and upgrades to the McKinleyville Community Service District's (MCSD or District) water distribution system main lines and appurtenances (distribution system) for the next 50 years. This Master Plan effort includes an analysis of all of the pipelines, service laterals, blow-off assemblies, and valves (including isolation, air release, and pressure reducing valves) in the District's water distribution system. No analyses of booster stations or storage tanks are provided as a part of this study.

Given the current age of the system is over 45 years, the District can anticipate increased pipeline failures and leaks in the next five to ten years. As the system continues to age, replacement and rehabilitation of existing infrastructure will be necessary to maintain an effective, functional system. To ameliorate these coming failures, the District can replace all critical portions of the MCSD water distribution system in the next 50 years with a reasonable adjustment to user rates. Spending an average of \$1 million (2019 dollars) per year on the system will allow replacement of 97% of 10-inch or larger AC pipe, 85% of 8-inch AC pipe, and 100% of DI pipe in 50 years. Priority was based on replacing largest diameter pipes first, so no 6-inch or smaller AC pipe was included in the schedule for replacement during Phase 2.

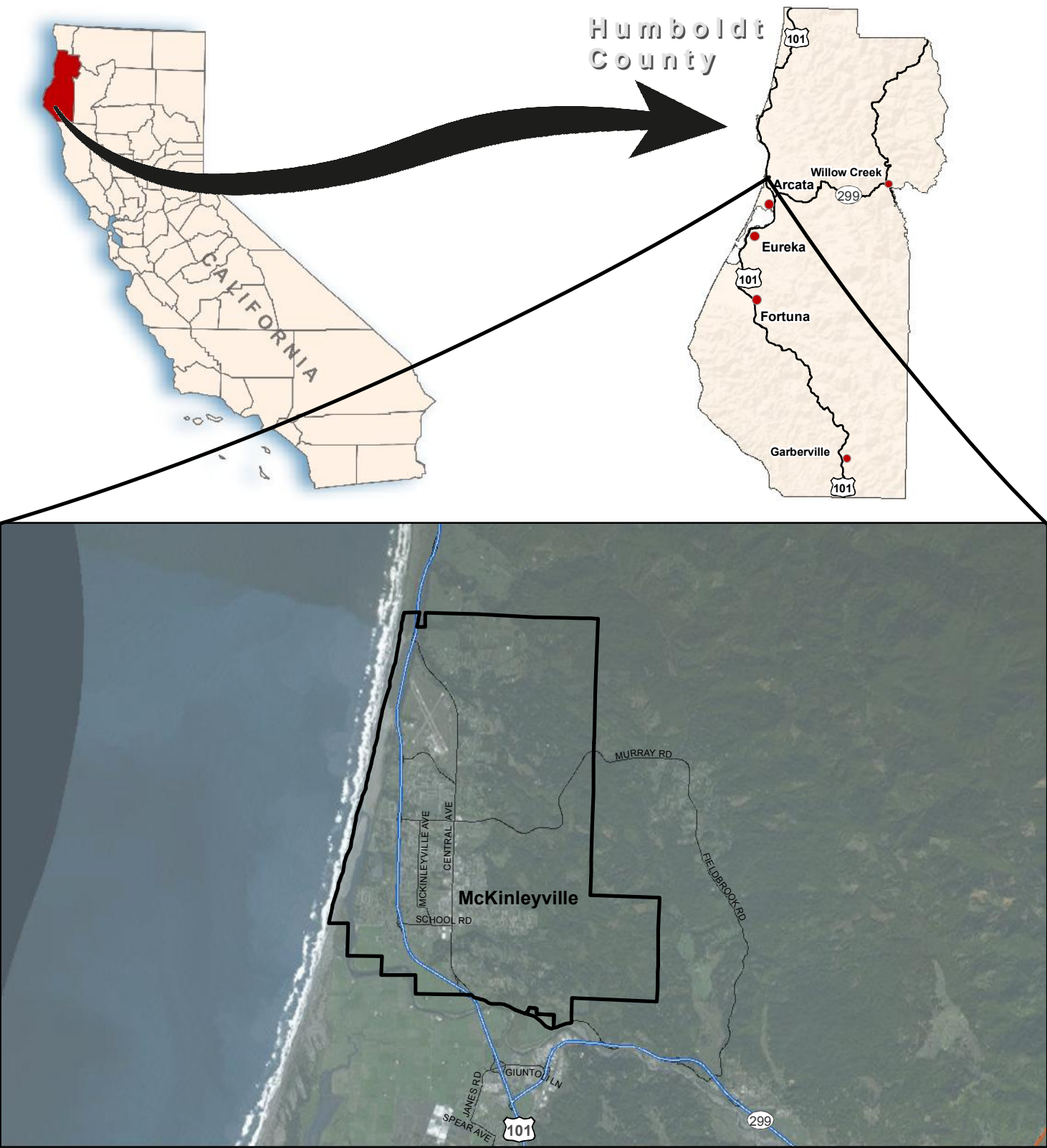
Phase 1 of the Master Plan included a review and analysis of available information that was used to produce a planning-level long-term replacement plan in Phase 2. The development of a near-term rehabilitation plan was also considered. This near-term plan would include any areas identified as having performance or capacity constraints that need to be resolved in the next ten years; however, there are currently no such cases in the water distribution system. The District does currently have plans and has budgeted for the construction of a new water storage tank, but that planning effort is being done outside the scope of this document.

While there are currently no high-priority, near-term projects required for the distribution system, it is critical that the District begin planning and budgeting for upgrades and replacement of system components. The approved rates from Section 5 (completed as part of Phase 2 in 2019) were made



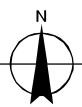
assuming that MCSD would begin putting aside \$860,000 to \$960,000 for each of the following four years and then reserving the full \$1 million (2019 dollars) per year after that period. With rate adjustment approved, the project financing is securely in place and MCSD can begin the planning and design process for the early proposed projects so construction can begin in 2023 four years after the completion of the Phase 2 report).

A major unknown following completion of Phase 2 is the condition of the DI pipe the runs from Humboldt Bay Municipal Water District, beneath the Mad River, to the intersection of Sutter Road and Central Avenue. This pipeline is the main source of water for MCSD. There is no cathodic protection on that piping, it has never been inspected, and it is possible it may require replacement sooner than anticipated. It was recommended during Phase 2 that this critical section of pipeline be physically assessed in Phase 3 to ensure it is replaced at an appropriate time. It should be noted that a Hazard Mitigation Grant, Notice of Interest was submitted in 2018, 2020 and 2021 for the replacement of the river crossing. As of the writing of this Master Plan, the District has not heard whether this project was approved for grant funding.



 McKinleyville Community Services District Boundary

Paper Size ANSI A  
 0 0.5 1 2  
 Miles  
 Map Projection: Lambert Conformal Conic  
 Horizontal Datum: North American 1983  
 Grid: NAD 1983 StatePlane California I FIPS 0401 Feet



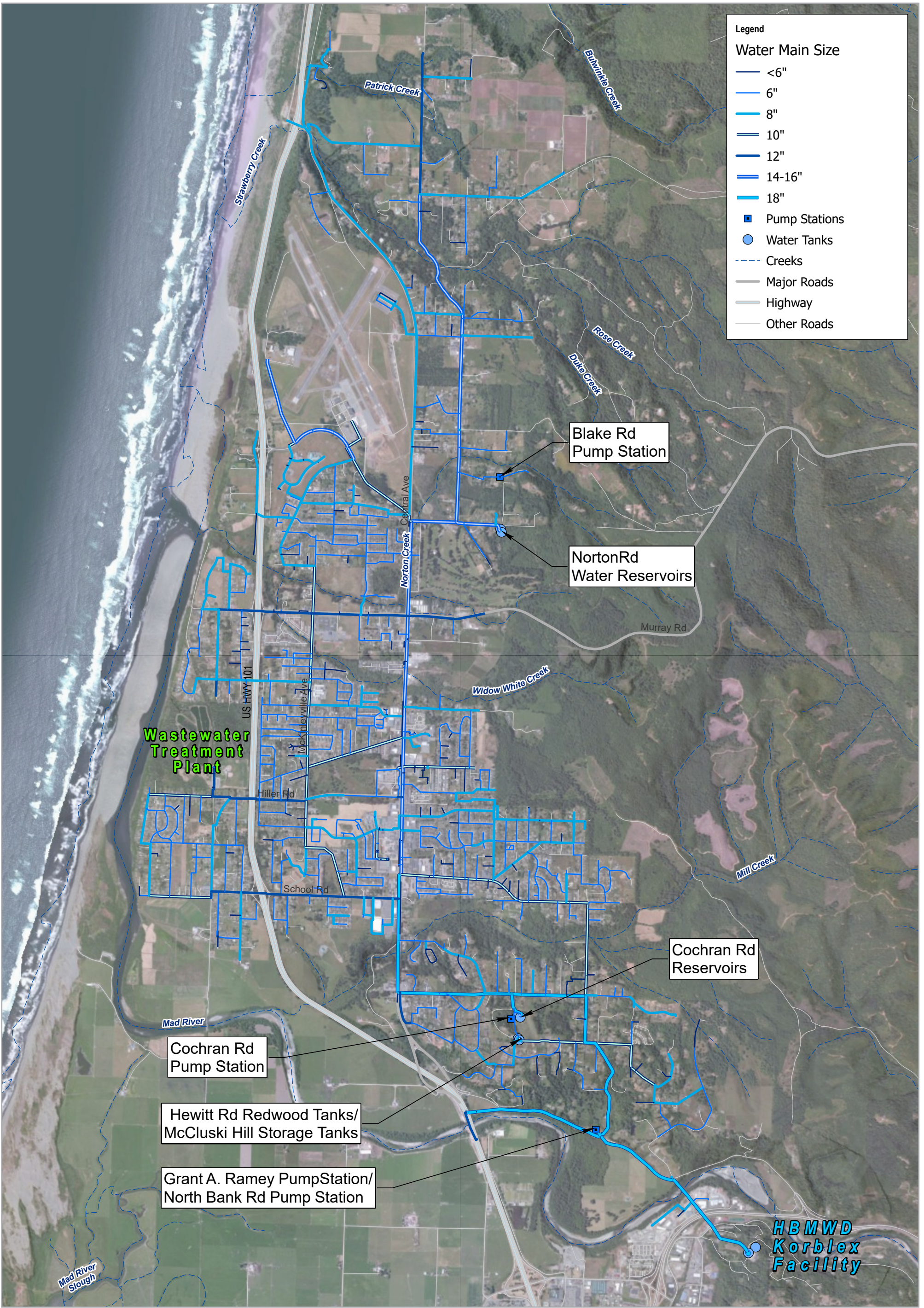
McKinleyville Community Services District  
 Water Main Line Rehabilitation Master Plan (Phase 1)

Job Number | 11125090.04  
 Revision | 1  
 Date | 17 Oct 2017

Project Vicinity and Location Map

Figure 1

718 Third Street Eureka, CA 95501 T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com  
 © 2017. Whilst every care has been taken to prepare this map, GHD make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason. Data source: ESRI: Street Map USA; Humboldt County: Community Service District boundaries. Created by: jclark2



**Legend**

**Water Main Size**

- <6"
- 6"
- 8"
- 10"
- 12"
- 14-16"
- 18"

- Pump Stations
- Water Tanks
- Creeks
- Major Roads
- Highway
- Other Roads

Blake Rd Pump Station

Norton Rd Water Reservoirs

Wastewater Treatment Plant

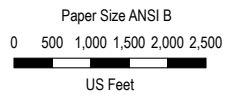
Cochran Rd Reservoirs

Cochran Rd Pump Station

Hewitt Rd Redwood Tanks/  
McCluski Hill Storage Tanks

Grant A. Ramey Pump Station/  
North Bank Rd Pump Station

**HBMWD  
Korblex  
Facility**



McKinleyville Community Service District  
Sanitary Sewer Main Line Rehabilitation  
Master Plan (Phase 3)

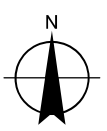
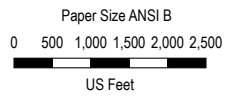
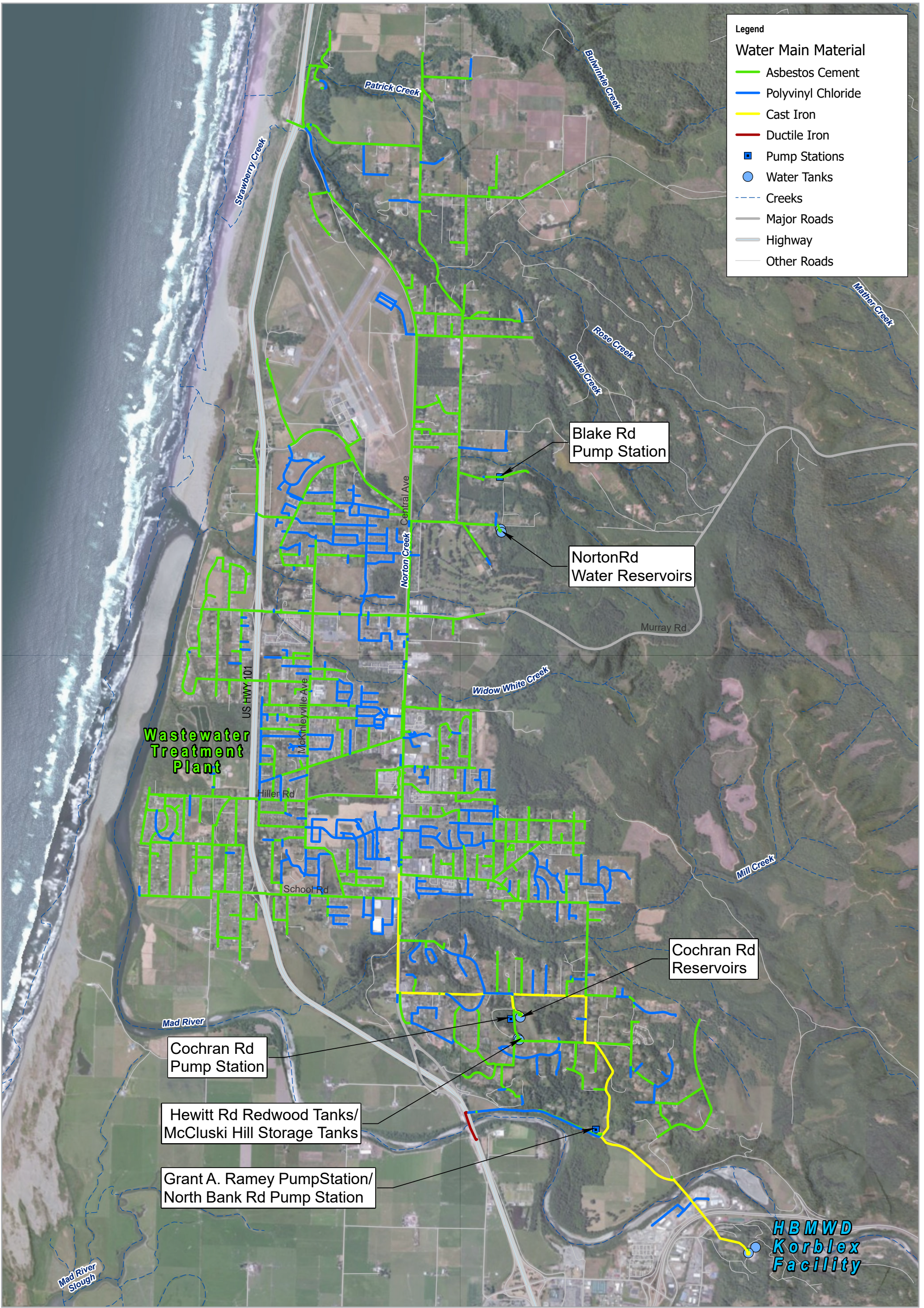
Project No. 11228420  
Revision No. A  
Date Jan 2022

**Water System Overview  
by Pipe Size**

**FIGURE 2**

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Print date: 18 Jan 2022 - 09:43

Data source: World Imagery (Clarity), Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
World\_Hillshade, Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatasysteisen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community. Created by: djones3



Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1983  
Grid: NAD 1983 StatePlane California 1 FIPS 0401 Feet



McKinleyville Community Service District  
Sanitary Sewer Main Line Rehabilitation  
Master Plan (Phase 3)

Project No. 11228420  
Revision No. A  
Date Jan 2022

**Water System Overview  
by Pipe Material**

**FIGURE 3**

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Data source: World Imagery (Clarity), Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
World\_Hillshade, Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatasysteisen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community. Created by: djoncs3



## 2. Risk Assessment and Prioritization Process

During Phase 3 of the master planning effort, GHD and the District developed a Risk Framework that was applied to all the water pipes in order to update the rehabilitation prioritization approach from Phase 2 that was based on material and diameter. This section describes the risk assessment methodology and prioritization of rehabilitation of the water distribution system.

### 2.1 Physical Testing

As part of Phase 3, soil sampling was conducted to support the assessment and development of an Engineer's opinion of present-day pipeline condition within the water (as well as sewer) system with respect to the proposed schedule for the District's future replacement. Twenty-one (21) soil samples were obtained by GHD staff on December 2, 3 and 5, 2019 and sent to an independent California certified laboratory for analysis. MCSD provided equipment and labor related to excavation.

Based on soil sample results, a pipe sample collection plan was prepared, and three (3) pipe samples obtained by GHD on April 14, 15 and 17, 2020 with excavation equipment and labor provided by MCSD. The pipe samples obtained were delivered to an independent analytical laboratory for analysis. AC pipe samples were analyzed for the following characteristics: interior and exterior hardness; pH profile; and crush strength.

Based on the laboratory evaluation of the AC pipe samples, it was concluded that:

1. Based on dimensional measurements obtained as a part of the laboratory testing, the AC pipe tested is likely pressure Class 150.
2. Internal degradation, not external degradation, of AC pipe is the limiting factor in AC pipe fitness for continued service
  - a) The exterior depth of loss of alkalinity is nominal
  - b) The exterior loss of hardness is nominal
  - c) The interior depth of loss of alkalinity, greater than 50% of total pipeline wall thickness of Sample AC3, is significant.
  - d) The interior loss of hardness of all samples tested is significant.
3. The crushing strength of the three samples varied significantly and relates, as expected, to pipeline wall thickness. The measured crushing strength relationship with respect to the design crushing strength, as itemized in Table 7, is related to pipeline wall thickness. Wall thickness increases as pipeline diameter increases. Based on the data available, pipes with nominal wall thickness of 0.635 inches or less, corresponding to pipeline diameters of 8-inches or less, have experienced significant reduction in residual crushing strength; and pipes with nominal wall thickness of 1.040 inches or more, corresponding to pipeline diameters of 12-inches or greater, have not experienced significant reduction in residual crushing strength. Although there is presently no laboratory data for crushing strength on 10-inch diameter (0.910 inch wall thickness pipe), 10-inch pipe is considered to have likely retained much of the design crushing strength and is classified along with AC pipe of larger diameters.



The establishment of, and broad delineation based on, risk categories is a result of the destructive analysis of three (3) pipe samples. The extent of laboratory analysis was limited and the resulting classifications are therefore limited. Additional destructive evaluation, specifically of pipeline crushing strength, may result in a resolution of data facilitating development of additional risk categories and/or revision to the risk categories presented herein.

In addition to the destructive sampling of AC pipe, non-destructive assessment of DI pipe was performed at two (2) locations. Ultrasonic thickness (UT) testing was performed at one location on the 18-inch water main near N. Bank Road and Hunts Drive by the Mad River Crossing. This location was selected, in part, based on the corrosivity of soils identified. Pipeline wall thickness was measured at twelve (12) circumferential locations. The UT measurement of pipeline wall thickness identified substantial remaining wall thickness and minor loss of wall thickness. CCTV was performed on a segment of sewer pipe, approximately 212 linear feet, at the middle crossing on Highway 101 near Thiel Road and Hiller East Field. CCTV footage was reviewed by a qualified engineer. Internal lining degradation of DI pipe was identified, and with respect to the extremely limited nature of the sample size, may be indicative of mortar lining performance of similar vintage and time in service.

For additional information on the physical testing and laboratory results, refer to the *Phase 3b: Water and Sewer Mainline Replacement and Rehabilitation Master Plans Letter Report* dated July 6, 2020 which is included in Appendix A.

## **2.2 Probability of Failure**

Probability of Failure (PoF) of an asset is the chance that the asset will fail to serve its intended purpose and is directly related to its failure mode. Failure may include physical failure (i.e. break, fracture, or collapse), hydraulic capacity failure, level of service failures such as odor issues or not meeting regulations, or efficiency failures when operational costs exceed alternative actions. The probability of physical breakdown and the probability of capacity reduction for a particular asset may not be similar. Asset failure modes are explained in the following subsection.

### **2.2.1 Modes of Failure**

An important component of asset management is to identify and manage the imminent and dominant failure modes of an individual asset. From an asset management perspective, assets can fail in one of four ways shown in Table 4.



**Table 4: Modes of Failure Description**

Failure Mode	Definition	Tactical Aspects	Management Strategies
Physical Mortality	Consumption of asset reduces performance below acceptable level	Physical deterioration due to age, usage, and acts of nature	O&M optimization, renewal or replacement
Capacity	Demand exceeds capacity	Growth, evolving usage, climate change	Redesign or replacement
Level of Service	Functional requirements not met	Regulations, codes, permits, safety, noise, etc.	O&M optimization, renewal or replacement
Efficiency	Operation costs exceed that of feasible alternatives	Pay-back period for alternatives	Replacement

Understanding the **imminent failure mode** of an asset allows an organization to apply the right strategy option in order to maximize the service benefit per cost spent. Each failure mode, where appropriate, has a time period associated with it. For example, an asset could have 20 years remaining before physical failure, five years before level of service failure, and 10 years before financial failure, but two years remaining before capacity failure. In this scenario, the remaining useful life of the asset would be two years, and the appropriate strategy might be to increase the capacity of the asset through redesign.

The **dominant failure mode** for an asset is the failure mode that results in the greatest consequence of failure. Generally, the dominant failure mode is physical mortality.

The risk framework was developed to evaluate MCSD’s water system and prioritize known pipe deficiencies identified in earlier phases of the master planning effort and physical mortality deficiencies based on condition assumptions from the physical testing described in Section 2.1 above.

**2.2.2 PoF Scoring Criteria**

Each linear asset was assigned a score of 1-5, with 1 being very good condition and 5 being very poor condition. The score for each asset is provided in the asset register in Appendix B. The Probability of Failure scores for each pipe were assigned as follows for consistency with scoring across systems, i.e. the water and sewer collection systems:

1. Pipes identified as having hydraulic capacity deficiencies in previous phases of the master planning effort were given a score of 5 (i.e. if they fell in CIP years 1-10). For the water system, no deficiencies were identified and therefore no pipes received a score of 5 for PoF.
2. From Phase 3 physical testing:
  - i) AC pipes with diameter of 8-inches or less were given a score of 4
  - ii) AC pipes with diameter greater than 8-inches were given a score of 3
  - iii) DI pipes were given a score of 2
  - iv) All other pipes (predominantly PVC) were given a score of 1





## 2.3 Consequence of Failure

The consequence of failure (CoF) for an asset is determined by first setting the context of a potential failure that can be expressed in Triple Bottom Line (TBL) categories as shown in Table 5 below.

**Table 5: Consequence of Failure Triple Bottom Line Elements**

Category	Associated Elements
Social / Community	Health & Safety, Loss of Service
Financial	Cost of Failure
Environmental/Regulatory	Regulatory (Permit) Compliance

### 2.3.1 CoF Scoring Criteria

Table 6 shows CoF scoring table developed for the MCSD water system. The table includes CoF elements associated with each TBL category and the associated value definitions for CoF scores of 1 to 5, with 1 indicating a low consequence and 5 indicating a high consequence. When determining thresholds for scores, it is best to begin with threshold that results in a score of 4. As an asset moves from a score of 3 to a score of 4, the asset crosses the tolerable threshold to the intolerable. The orange shading of scores 4 and 5 indicates intolerable thresholds.



**Table 6: Consequence of Failure Scoring Table – Water Distribution System**

Social / Community						
Health & safety	The direct or indirect impact on individual(s)' health & safety (including employees) as a result of the failure. This is measured in terms of the potential for detrimental impacts on individual(s) health and safety.	No impact	No impact	No impact	Potential for low impact	Potential for severe impact
	Loss of service	The maximum time an asset can be out of service due to external or internal drivers.	No impact	Asset can be out of service for extended period	Asset needs to be restored within a week	Asset needs to be restored within a day
<b>Definition</b>		1	2	3	4	5
Financial						
Cost of failure	The total direct and indirect cost (including labor, equipment, fines etc.) to restore the service as a result of the failure. This is not the replacement cost of a failed asset.	<=\$5,000	\$5,001-\$20,000	\$20,001-\$50,000	\$50,001-\$100,000	\$100,000+
	<b>Definition</b>	1	2	3	4	5
Environment / Regulatory						
Regulatory (permit) compliance	Regulatory permit compliance by Mandatory Minimum Penalty (MMP)	No impact	Potential MMP	MMP	Multiple MMP	Cease and Desist
	<b>Definition</b>	1	2	3	4	5



### 2.3.2 CoF Score Assignment

Proximity analysis using geospatial data is used to assign consequence of failure scores. Different attributes that help measure the impact associated with each of the elements shown in Table 7. In the case of buried assets (e.g., pipes), attributes shown in Table 7 can be used to estimate the consequence of failure ratings for each of the elements shown in Table 6. Not every pipe attribute applies to every element and the relationship (when exists) between the attributes and the elements are shown with an “X” in Table 7. GHD reviewed data available in the GIS database for the water distribution system, as well as data available online for the consequence of failure analysis. The findings and data availability of key layers are summarized in Table 8. The GIS data layers used for the proximity analysis are shown in Figure 6 at the end of this Chapter.

**Table 7: Consequence of Failure Scoring Element Attribute**

Attributes	Consequence of Failure Elements			
	Public Health & Safety	Loss of Service	Cost of Failure	Regulatory Compliance
Critical Customers (hospitals, schools, fire stations, etc)		X		
Proximity to other utilities (stormwater)	X		X	X
Proximity to roads (and type of road)	X		X	
Proximity to environmentally sensitive areas (rivers, streams, open water)	X		X	X
Proximity to buildings	X	X	X	
Repair costs (material, diameter, depth)			X	
Zoning and land use		X		

As part of the risk-based prioritization approach, each asset in water distribution system is scored using geospatial proximity analysis and the scoring criteria defined in the Risk Framework. All CoF scores for each pipe are provided in the asset register in Appendix B.



**Table 8: Consequence of Failure Element Attribute Data Sources**

Attributes	Source	Data Availability
Date of installation	GIS	No - Water - 1973 No - Sewer - 1976
Material	GIS	Yes
Size/Diameter	GIS	Yes
Length	GIS	Yes
Proximity to roads	GIS online	Yes
Proximity to other utilities	ArcGIS Online – Humboldt County Public Works	“McKinleyville Storm Drain 180918”
Proximity to environmentally sensitive areas (e.g., wetlands, open water)	GIS online	Yes
Critical customers (hospital, schools, fire stations, etc)	Create	None exist but could be created Fire Stations - <a href="https://humboldt.gov/276/GIS-Data-Download">https://humboldt.gov/276/GIS-Data-Download</a>
Proximity to other buildings	Remote sensing data online	Web layer created via remote sensing, many need verification

### 2.3.3 Dominant CoF Score

Assets are assigned scores from 1 to 5 for each of the four elements. The highest individual score across these elements for each asset is the Dominant CoF score. Dominant CoF score range from 1 to 5.

### 2.3.4 Triple Bottom Line CoF Score

TBL CoF score also uses the score from 1 to 5 for each of the four CoF elements, but instead of taking the highest individual CoF score, TBL adds together the highest score in each of the three triple bottom line categories, social/community, financial, and environmental/regulatory. TBL CoF score ranges from 3 to 15.

## 2.4 Risk and Rehabilitation Prioritization

The Business Risk Exposure (BRE) framework provides a process by which risk can be categorized, and activities to mitigate risk can be prioritized (i.e. rehabilitation and renewal) which helps management teams focus on high-risk assets. A BRE framework provides a set of rules for

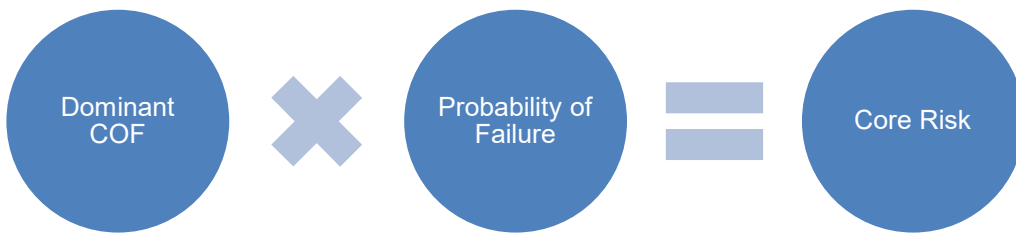


determining the direct and indirect consequences of the failure of an asset and facilitates the prioritization of assets for targeted renewal, rehabilitation, and inspection investment with available capital funds. For this project, GHD performed a risk assessment that considers Probability of Failure (PoF) and Consequence of Failure (CoF) of an asset. The probability of failure component of the risk assessment is a function of asset condition, which incorporates physical mortality (physical life), levels of service (service life; efficiency), and capacity (capacity life) related issues. Any available risk mitigation is also considered.

This section describes how Core Risk and Business Risk Exposure are calculated from the Probability of Failure and Consequence of Failure scores described in the preceding Section 3.3 and how the risk scores are used to prioritize rehabilitation of the water distribution system. All risk scores and priority ranking are provided for each pipe in the asset register in Appendix B.

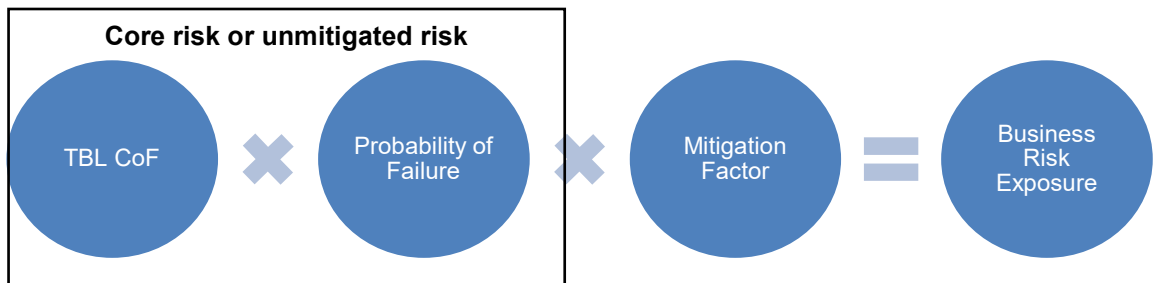
**2.4.1 Core Risk Score**

The product of the probability of failure and consequence of failure is defined as the core risk. The core risk rating assigned to the assets can be used to drive O&M activities and decisions. The dominant CoF score is used to calculate the dominant core risk score.



**2.4.2 BRE Score**

Unlike the core risk score, the BRE score uses the TBL CoF score instead of the dominant CoF score and the mitigation factor. The main mitigation factor considered is available, either installed or spare, asset redundancy. Other mitigation factors of note would be actions such as the development of emergency response plans, setting up contracts with external parties in order to facilitate faster reaction or implementing a standard operating procedure for manual operations. For linear assets, the mitigation factor is 1. When identifying management strategies, agencies might consider emergency response plans or monitoring in SCADA as a strategy to reduce risk.





### 2.4.3 Risk Zones

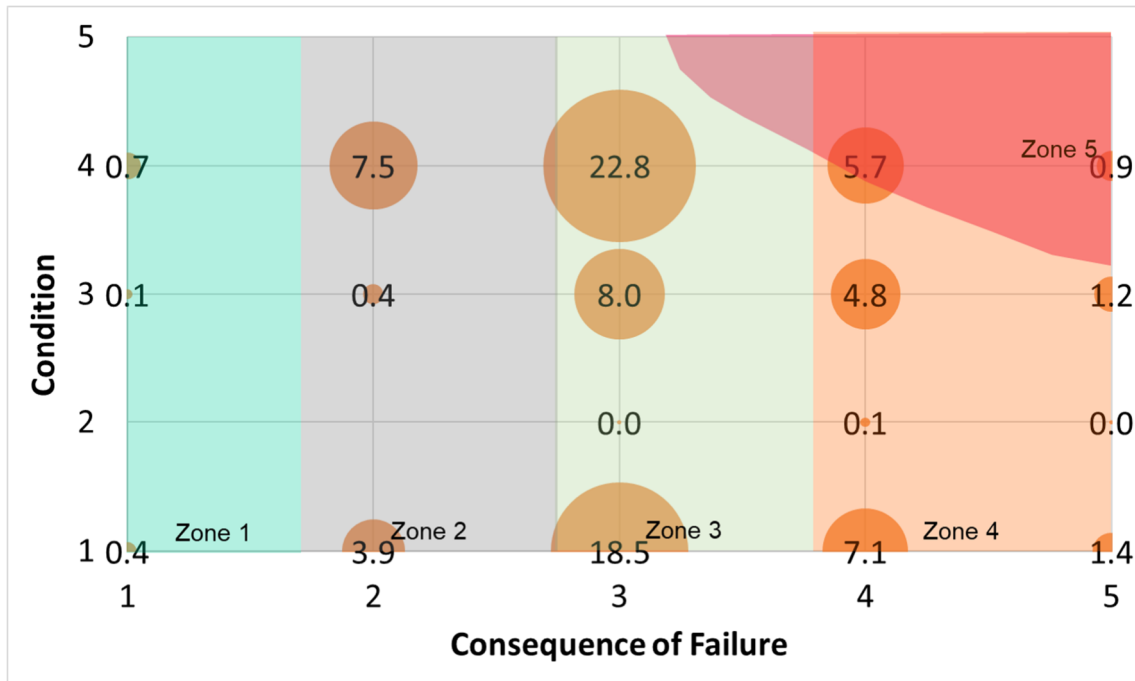
Once the non-tolerable risk is identified, a BRE chart can be plotted with the unmitigated consequence of failure on the x-axis and the probability of failure on the y-axis. The BRE chart can be segmented into management zones based on what a utility's threshold is for acceptable risk. BRE chart is then used to identify assets that fall into each management zone, including those that are in non-tolerable zones, i.e., those assets that would result in unacceptable impact on service delivery upon failure. Figure 4 shows the BRE chart as a result of the assessment of MCSD's water system and the different management strategies for each of the zones. The BRE zones are described as follows:

**Zone 5:** Non-tolerable risk zone that contains assets that their failure can impose significant risk to the organization. In general, these assets are approaching the end of their useful life and upon failure, may cause significant social, financial, and environmental impacts. Assets in this zone need to be addressed immediately. Appropriate management strategies must be carried out so that the number of assets in Zone 5 are minimized.

**Zone 4:** Contains assets that have high consequence of failure but have not deteriorated enough to be included in the non-tolerable risk zone (Zone 5). Increased visual and/or predictive condition assessments (thermal scanning, oil analysis, etc.) may be justified as their condition deteriorates and as they move vertically in the graph approaching Zone 5 over time.

**Zone 3:** Contains assets that would experience failure consequences that can be made tolerable through designed redundancy and operational mitigation such as spares and condition monitoring. Zone 3 assets can also migrate into Zone 5 over time and as such require additional focus by management.

**Zones 2 & 1:** Contains assets with lower consequences of failure. Applicable management strategies to consider for these assets may be run to fail and maintenance optimization.



**Figure 4: Business Risk Exposure Plot<sup>1</sup>**

Notes:

1. Bubble size and number correspond to the length of pipe with that combination of LOF and Dominant COF (in miles of pipe).

#### 2.4.4 Prioritization

Risk Zone is calculated from unmitigated CoF and Core Risk scores. There are five risk zones; Risk Zone 5 is the highest risk, Risk Zone 1 the lowest. In the plot shown in Figure 4:

**Risk Zone 5:** Core Risk score greater than or equal to 16

**Risk Zone 4:** CoF score greater than or equal to 4

**Risk Zone 3:** CoF score greater than or equal to 3

**Risk Zone 2:** CoF score greater than or equal to 2

**Risk Zone 1:** CoF less than 2

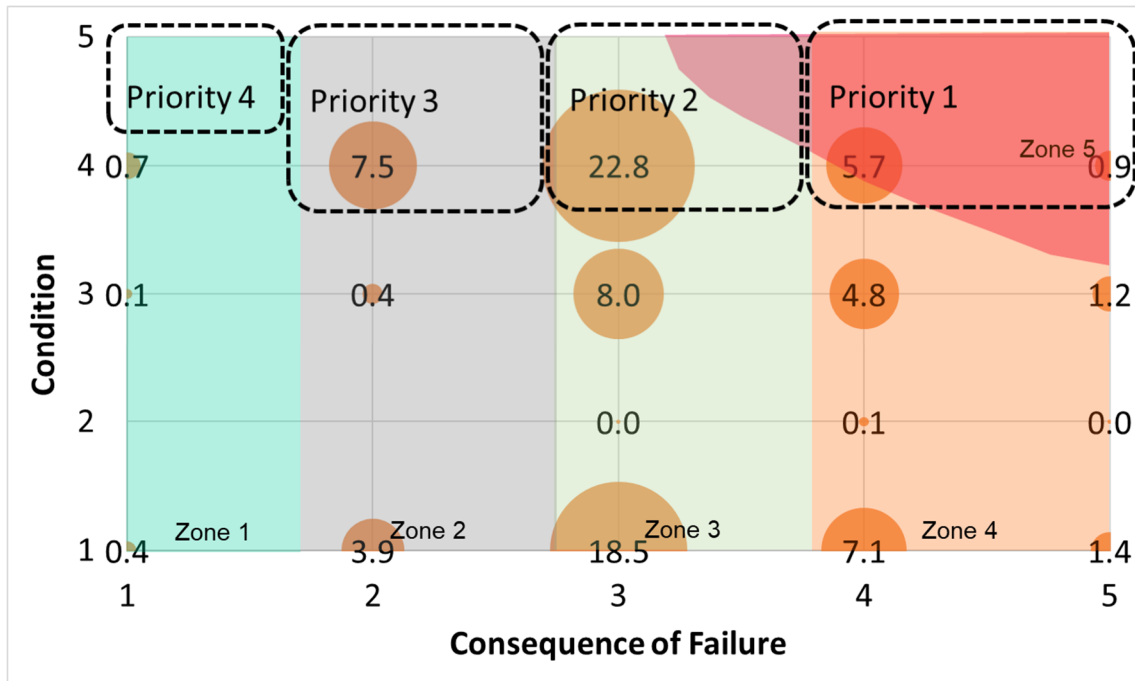
Assets are organized into four 'priority buckets' based on risk zone and condition. Assets that do not meet the requirements below are not assigned to a priority bucket. Figure 5 shows the priority buckets on the BRE Chart.

**Priority Bucket 1:** Risk Zone 5

**Priority Bucket 2:** Risk Zone 3 or 4 AND Condition greater than or equal to 4

**Priority Bucket 3:** Risk Zone 2 AND Condition greater than or equal to 4

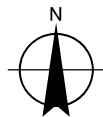
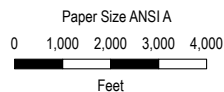
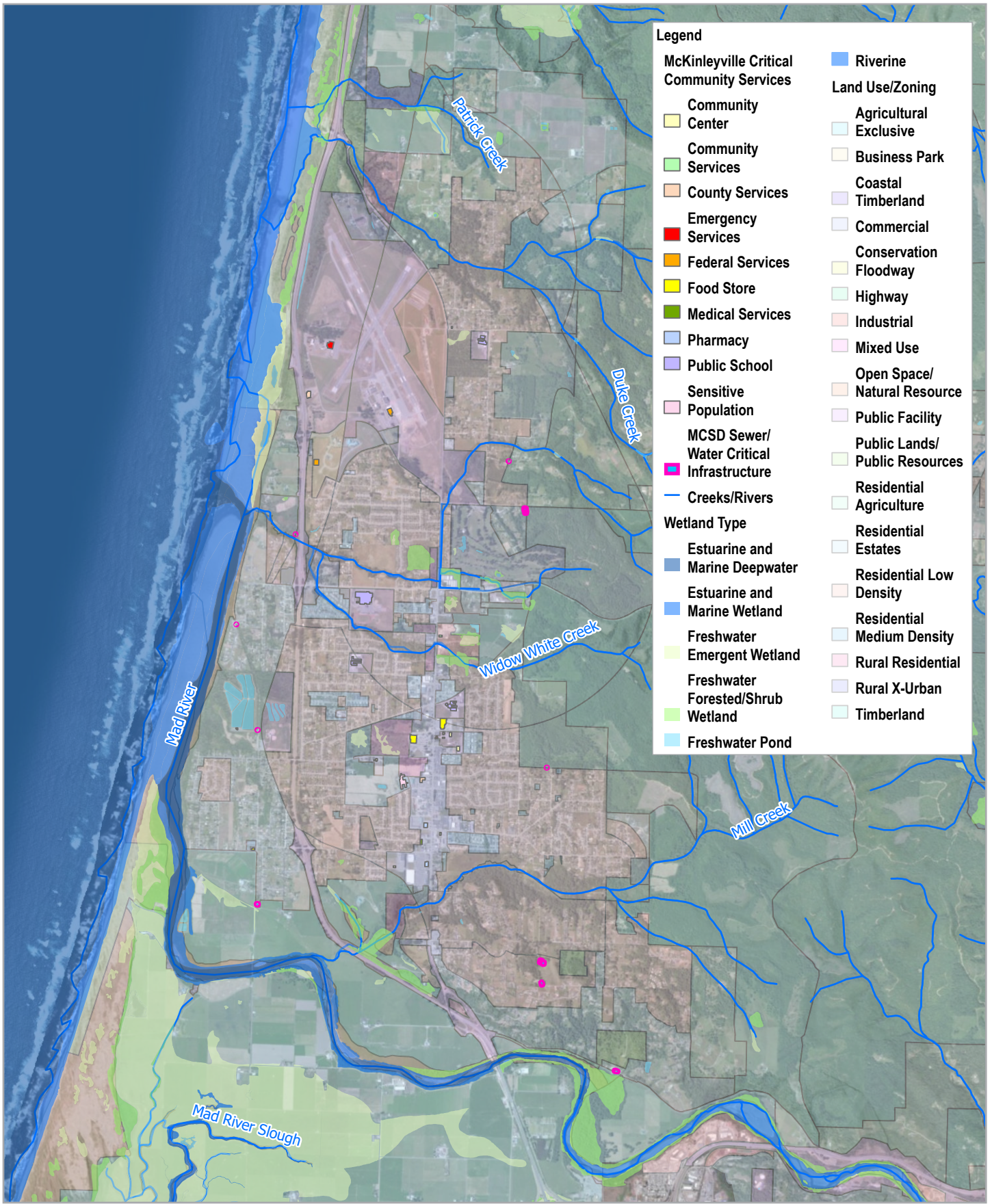
**Priority Bucket 4:** Risk Zone 1 AND Condition equal to 5



**Figure 5: BRE Plot with Priority Buckets**

Within each priority bucket, the BRE score is used to prioritize replacement. The BRE score considers all triple bottom line categories, effectively prioritizing pipes with higher combined score across all categories and not the single highest, i.e. could have social, financial and environmental consequences.





McKinleyville Community Service District  
Water Main Line Rehabilitation  
Master Plan (Phase 3)

Project No. 11218420  
Revision No. -  
Date Dec 2021

Proximity Analysis  
Attribute Layers

**FIGURE 6**



### 3. Replacement Methods and Costs

This section describes two replacement methods that were assessed for the MCSD water system rehabilitation plan, direct replacement and pipe bursting. Pipe lining was also considered initially, but the process was determined to be cost prohibitive for water distribution systems.

#### 3.1 Opinions of Probable Cost

The opinions of probable cost for each asset is included in the asset register in Appendix B and should be considered as order-of-magnitude estimates for planning purposes only. The total project cost consists of the construction cost, design and technical effort, construction management effort, and a contingency fund. Land acquisition and/or District degradation fees are not included. Construction costs are based on a Class 5 (planning-level) estimate of probable cost as defined by the Association for the Advancement of Cost Engineering, International (AACE). AACE defines the “Class 5” estimate as follows:

*Generally prepared on very limited information, where little more than proposed plan type, its location, and the capacity are known, and for strategic planning purposes such as but not limited to market studies, assessment of viability, evaluation of alternate schemes, project screening, location and evaluation of resource needs and budgeting, long-range capital planning, etc. Some examples of estimating methods used would include cost/capacity curves and factors, scale-up factors, and parametric and modeling techniques. Typically, very little time is expended in the development of this estimate. The typical expected accuracy ranges for this class estimate are -20% to -50% on the low side and +30% to +100% on the high side.*

Construction costs are based on the July 2021 Engineering News Record Construction Cost Index (ENR CCI) for San Francisco, CA (13,762.01).

#### 3.2 Direct Replacement

Direct replacement is the most traditional pipe replacement method. It involves digging a trench along the entire length of pipe to be replaced, installing a new parallel pipeline, connecting the new pipeline to the existing laterals, removing or abandoning the existing piping in place, backfilling the trench, and repaving the street. Trenching for direct replacement of piping in roadways interrupts normal traffic flow in the project area more than trenchless methods. Cutting into or removing the AC pipe also requires special handling and disposal due to the presence of asbestos, which also increases costs. Additionally, the large amount of earth movement required for trenching can add significant cost to this method as opposed to trenchless methods. Due to the higher associated costs, direct replacement costs were estimated in Phase 1 to allow for conservative scenario budgeting in the preliminary Master Planning financial analysis.

Values from the overall long-term replacement cost estimate from Phase 1 were used to develop per linear foot costs to apply to individual projects for Phase 3. There are construction costs associated with replacing MCSD main lines that would generally be represented as a percentage of the material and installation (which includes excavation and backfill) cost. The first step was determining an industry standard percentage of material and installation costs for these base cost



items. Through experience working with clients across California, GHD compiled the following assumptions for various construction activities as shown in Table 9 below.

**Table 9: Assumptions for construction costs as a percent of pipe material and install cost.**

Item	Description	Cost
1	General Conditions, including: Mobilization/Demobilization Construction Staking Temporary Traffic Control Bypass Pumping Stormwater Pollution Prevention Plan (SWPPP)	20% (Construction Subtotal)
2	Contingency (10% change order, 15% estimating allowance)	25% (Construction Subtotal)
3	Design / Survey / Geotechnical / Environmental Review / Permitting	25% (Construction)
4	Inspection / Construction Management / Engineering Services During Construction (ESDC)	20% (Construction)

Construction subtotal percentages are applied to the material and installation unit costs for pipes (\$/lf) and manholes (\$/manhole based on depth) to form the construction subtotal to which the construction percentages are then applied. The material, installation, excavation, backfill and paving costs for direct replacement are summarized in Table 10.

**Table 10: Direct replacement cost per linear foot by pipe size.**

Size (in)	Pipe & Install (\$/lf)	Excavation/ Backfill (\$/lf)	Paving (\$/lf)	Total Cost (\$/lf)
2	185	42	23	250
4	185	42	23	250
6	185	42	23	250
8	229	42	29	300
10	279	42	29	350
12	304	42	29	375
14	309	57	34	400
16	334	57	34	425
18	384	57	34	475

### 3.3 Pipe Bursting

Pipe bursting is a trenchless pipe replacement method. The process involves digging an access pit on both ends of the pipe to be replaced. Then, most typically, a pneumatic system with a pipe bursting tool breaks up the existing pipe as the new pipe is pulled into place behind the pipe bursting tool. Lastly, the access pit areas are backfilled and repaved. For this method the existing pipe is left broken up in the ground around the new pipe. This is particularly helpful in reducing



construction risk when replacing old AC pipe, which is a brittle material that is difficult to excavate around. Furthermore, this method requires approximately 80% less digging than traditional direct replacement. This significant reduction in earth movement is the reason why pipe bursting tends to cost between 15 to 35% less than direct replacement. The large variation in savings is due to variation in location, soil types, pipe depth, contractor schedules, etc. Pipe bursting costs (Table 11) were obtained from recent bid comparisons for northern California construction projects and the result is 8-31% less than the Phase 3 calculated direct replacement costs shown in Table 10.

**Table 11: Pipe bursting cost per linear foot by pipe size.**

Size (in)	Total Cost (\$/lf)
2 <sup>1</sup>	204
4	204
6	204
8	207
10	251
12	345
14	345
16	345
18	444

<sup>1</sup> Typically replaced with 4-inch pipe in pipe bursting operations



## 4. Replacement Plan

This section presents the prioritized replacement plan for systematic replacement of the District's water distribution system. The goal of the replacement plan is to include replacement of all the critical portions of the system. Replacement of AC pipe was prioritized given that half of the system is AC pipe that will be 51 years old at the proposed start of the replacement schedule in 2024 and physical testing of sample portions indicated that smaller diameter AC pipes had less wall thickness.

Rehabilitation methods presented in this master plan are used to estimate opinion of probable construction cost. For purposing of financial planning for the replacement of water mains, pipe bursting is assumed to be the replacement method if the pipe segment is less than 750 linear and not DI. For any pipe with length greater than 750 feet, or of DI material, direct replacement is assumed. The actual rehabilitation method will depend on the condition of the pipe and site conditions and therefore should be determined in the design phase. Rehabilitation method for AC pipe, which the majority of the system is, will also be impacted by the District's preferred method of handling asbestos containing pipe, i.e. pipe bursting and leaving in ground or direct replacement and removal of the asbestos containing pipe.

### 4.1 Yearly Budget

A yearly budget for the replacement plan was determined in discussions with District staff and approved by the MCSD Board of Directors during Phase 2. Based on the Phase 1 financial analysis, the initial desire was to replace the system over 100 years to minimize rate adjustments to users. The Phase 1 analysis also determined that the District does not need to replace the entire distribution system. There are sections where it would be much more cost effective to repair the occasional leak rather than replace the whole section of main line, particularly in less densely populated areas with smaller pipes. An analysis of the existing system revealed the following:

- 15% of the system is PVC that is less than 20 years old, and
- 16% of the water main lines serve 10 or fewer users.

These portions of the system were deemed less critical for replacement, per District staff recommendation the MCSD Board of Directors decided to budget for 80% system replacement over the 100-year replacement plan to reduce the total project cost. Based on the Phase 1 cost estimate, this replacement would require spending an average of \$1 million per year (in 2019 dollars).

### 4.2 Replacement Schedule

Figure 7 shows the replacement plan for all priority assets, while Figures 7.1-7.5 show the replacement plan by priority bucket, with Priority 2 further broken down into three groups based on replacing pipes with the highest BRE scores first. The costs for replacing each group are summarized in Table 12. Note that the specific ordering and grouping pipes into capital projects will be done by the District with the Priority and BRE scores as guides. The costs presented below assume each pipe segment is treated as a separate project; therefore, costs are conservative. The Asset Register is in Appendix B prioritized by descending Priority bucket and BRE score.



**Table 12: Priority Buckets based on Priority and BRE Score**

Priority	BRE Score	Length (lf)	Cost (\$)
1	All	34,677	17.4M
2	>30	63,546	32.5M
2	25-30	21,128	10.7M
2	<25	35,602	18.1M
3	All	39,586	20.4M
<b>Total</b>		<b>194,539</b>	<b>99.1M</b>

As no near-term projects were identified in Phase 1, the replacement schedule begins with the general replacement based on risk and the prioritization approach outlined in Section 2. The plan assumes that pipe-bursting is a suitable replacement method if the material is not DI and is not greater than 750 linear feet in length. Note that no DI pipe is prioritized for replacement in this plan. Pipe and site conditions will need to be evaluated prior to the design of each project to confirm replacement method. The first section chosen for replacement is aligned with the required near-term replacement of the damaged sewer line on Central Avenue to minimize road disturbance. The only deviation from this prioritization is the replacement of the water system pipes in Grace Park, Wavecrest Avenue and the area of Fernwood Drive and Parkside Drive. The water system in these areas of McKinleyville are identified as areas of concern and are therefore prioritized by the District and placed in group 2.1.

The 18-inch DI pipe from the Humboldt Bay Municipal Water District is a very critical segment of the system. The condition of the segment of pipe was assessed via ultrasonic thickness testing as part of Phase 3 of this master plan, it is recommended that the condition of the pipe be monitored every 5 years because of its criticality. There is no cathodic protection on that piping and no additional engineered measures for external corrosion control is presently recommended. It should also be noted that a Hazard Mitigation Grant, Notice of Interest was submitted in 2018, 2020 and 2021 for the replacement of the river crossing. As of the writing of this Master Plan, the District has not heard whether this project was approved for grant funding.

With the proposed replacement prioritization, 98% of the District's 8-inch or smaller AC pipe, will be replaced.

### 4.3 In-House vs Contracting Construction Projects

It was suggested in Phase 2 that completing the replacement projects in-house could reduce project construction costs by approximately 10 to 15%. The District is interested in further evaluation of the costs and feasibility of performing the construction work in-house. This section aims to summarize the factors that MCSD should consider when making this decision. These considerations include: staffing and equipment, replacement project schedule and budget.

#### 4.3.1 Staffing and Equipment

Potential crew costs per year were calculated using MCSD provided cost of \$45/hour which includes salary, retirement, and health insurance. With 260 calendar days in a year, a 6-person crew would cost approximately \$562,000/year, which is a significant portion of the annual



replacement budget. Although the productivity of a specific crew is difficult to estimate, a motivated and efficient 6-person contracted crew might complete roughly 400 feet of pipe per day. If \$562,000 is spent on labor costs, the balance of the \$1 million (2019 dollars) per year allocation could be dedicated to material. Assuming 8-inch pipe including foundation, bedding, trench zone material, and repair zone (asphalt) material at \$170/lf, the material budget would allow purchase of approximately 2,500 feet of pipe. If the crew can install approximately 400 feet per day, the installation might take two weeks. Allowing a couple of weeks at the start for layout and utility mark-out and a couple of weeks at the end for services and restoration would mean a six to seven-week project.

Excluding the percentage assumptions in Table 5 for general conditions and contingencies; assuming the same percentage of project cost applies for design, survey, geotechnical, environmental review and permitting (25%); and approximately half for inspection, construction management, engineering services during construction (ESDC) (10%); the annual cost for a crew working full time and having the materials for the work, is \$1.38M. It should be noted that smaller projects that District Staff could do and wouldn't require bidding, would have little to no Engineering, Survey, Geotech, CM etc. Costs associated with them and this overall cost may come in closer to \$1M per year. However, this cost does not include personnel management, training, equipment procurement, or operational and maintenance costs. Balancing the available funding in a given year while keeping the crew busy with materials available can be a challenge for the District. This amount exceeds the annual budget of \$1M per year for water rehabilitation. The District could consider cross training the crew for sewer system rehabilitation work, thereby splitting the labor cost between the sewer and water system budgets.

If only half of the crew cost was allocated to the annual water project, the \$1M budget would then also cover the design, survey, geotechnical, environmental review, permitting, materials testing, and project management costs associated with installation of approximately 2,500 feet of pipe. Similarly, for the sewer line installation, the crew should be able to install the annual length of pipe in less than three months. Any potential cost savings associated with using in-house staff, is lost because the crew is only productive for roughly half of the year.

Additionally, some projects require specialized skills and equipment which, assuming not all staff have the same skills, could present project delays with a particular crew members absence for training, vacation, sick leave, or other leave. Additional cost uncertainties that make construction efforts potentially risky are equipment costs. Typical equipment would include an excavator, a backhoe, material transport vehicles, a loader, pick-up trucks, shoring, dewatering pumps, and various accessories and smaller tools. A failed piece of equipment or damaged material can cause costly delays for an in-house crew while a contractor will likely have resources available for spare equipment or materials. Relationships with local suppliers will be essential for an in-house crew.

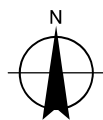
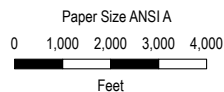
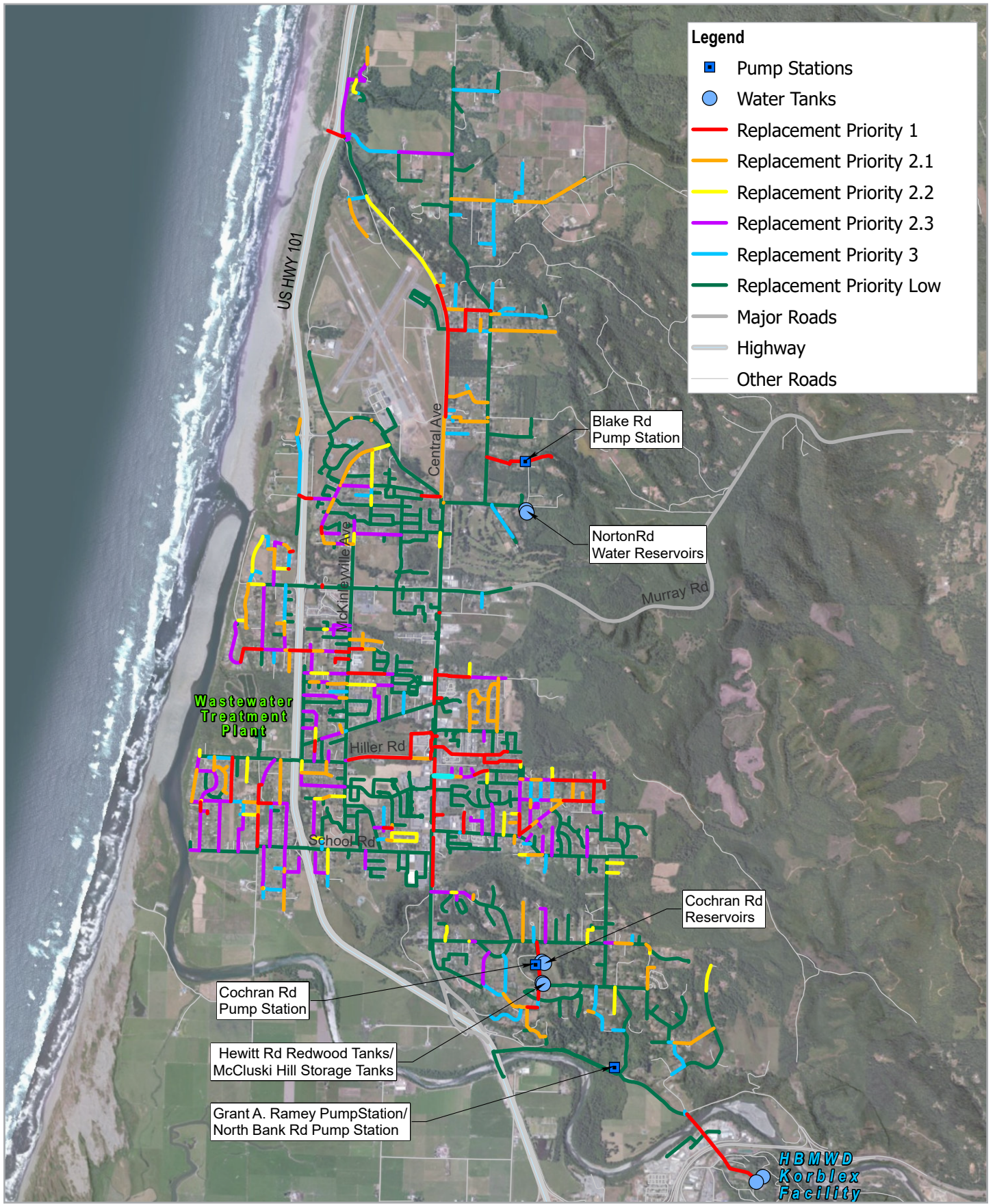
#### **4.3.2 Project Schedule and Budget**

Flexibility can be reduced when a utility has an in-house crew performing work. Projects with special circumstances may pose a challenge or risk to the in-house crew, or special equipment or training may be necessary in any given future year and may require contracting out the work. Staff costs and associated materials to maintain production are not easily reduced to accommodate special circumstances or unique projects that require specialized skills.



Note that the project schedule for the water system does not identify any projects with special circumstances; however, they may arise due to site and pipe conditions. The sewer system master plan noted a number of priority projects in the first 8 years which vary in character and require different equipment and skills. Because of the specialized skills needed and the variability, the early sewer replacement program is not well suited for completing with a small dedicated in-house team. Therefore, an in-house crew would be limited to water system projects in the near term, negating any savings from cross training crews in sewer and water projects during this period. The District could evaluate performing the construction in-house after the first 8 years of CIP projects when the sewer work becomes less varied. Sharing a crew with another near-by district might be a means of reducing labor costs and avoiding either inefficient production or idle time.



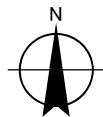
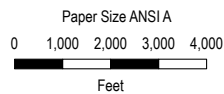
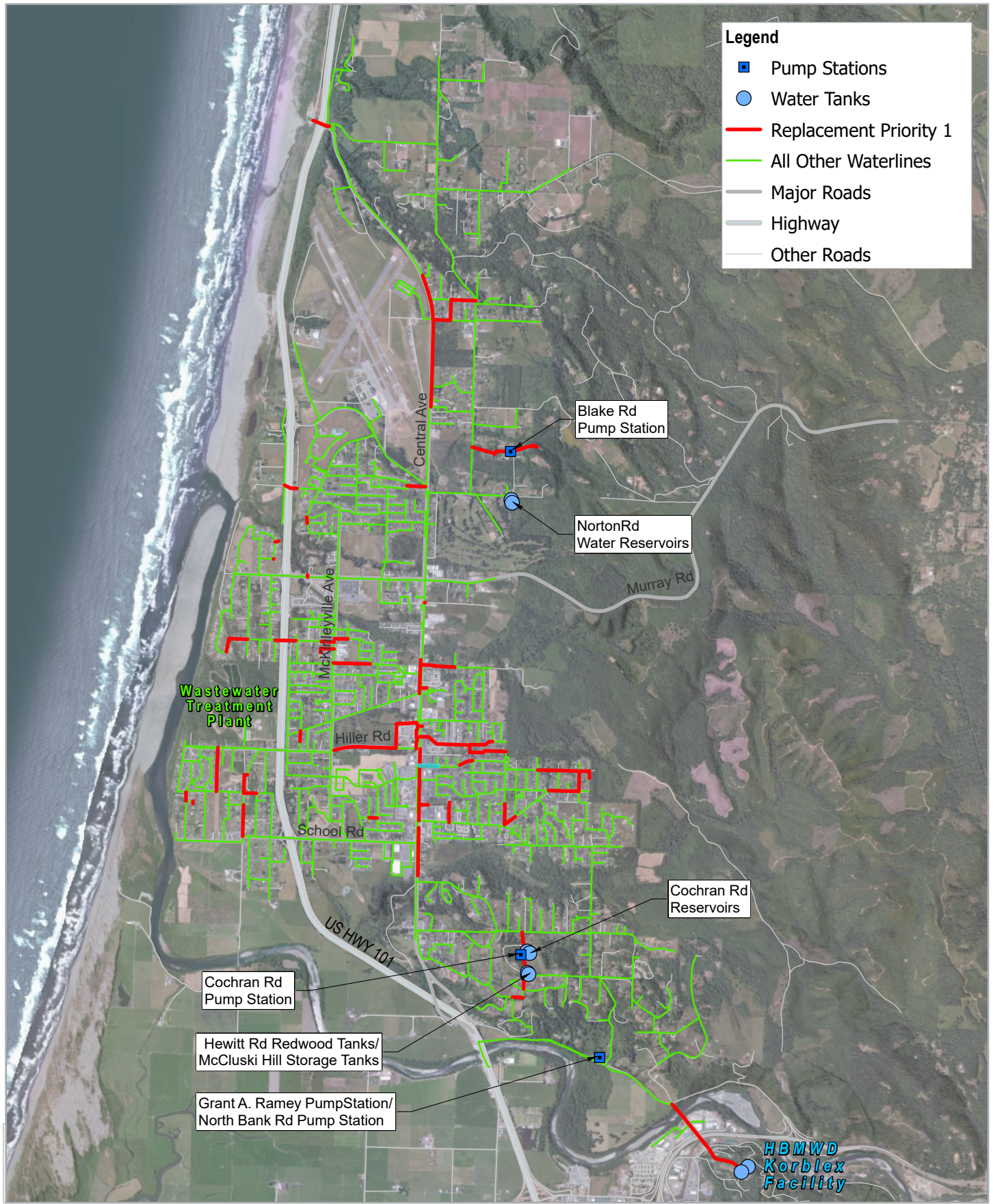


McKinleyville Community Service District  
Water Main Line Rehabilitation  
Master Plan (Phase 3)

Project No. 11218420  
Revision No. A  
Date Dec 2021

Water Replacement Analysis  
All Priority Rankings

**FIGURE 7**



Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1983  
Grid: NAD 1983 StatePlane California I FIPS 0401 Feet

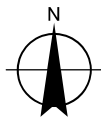
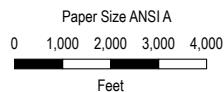
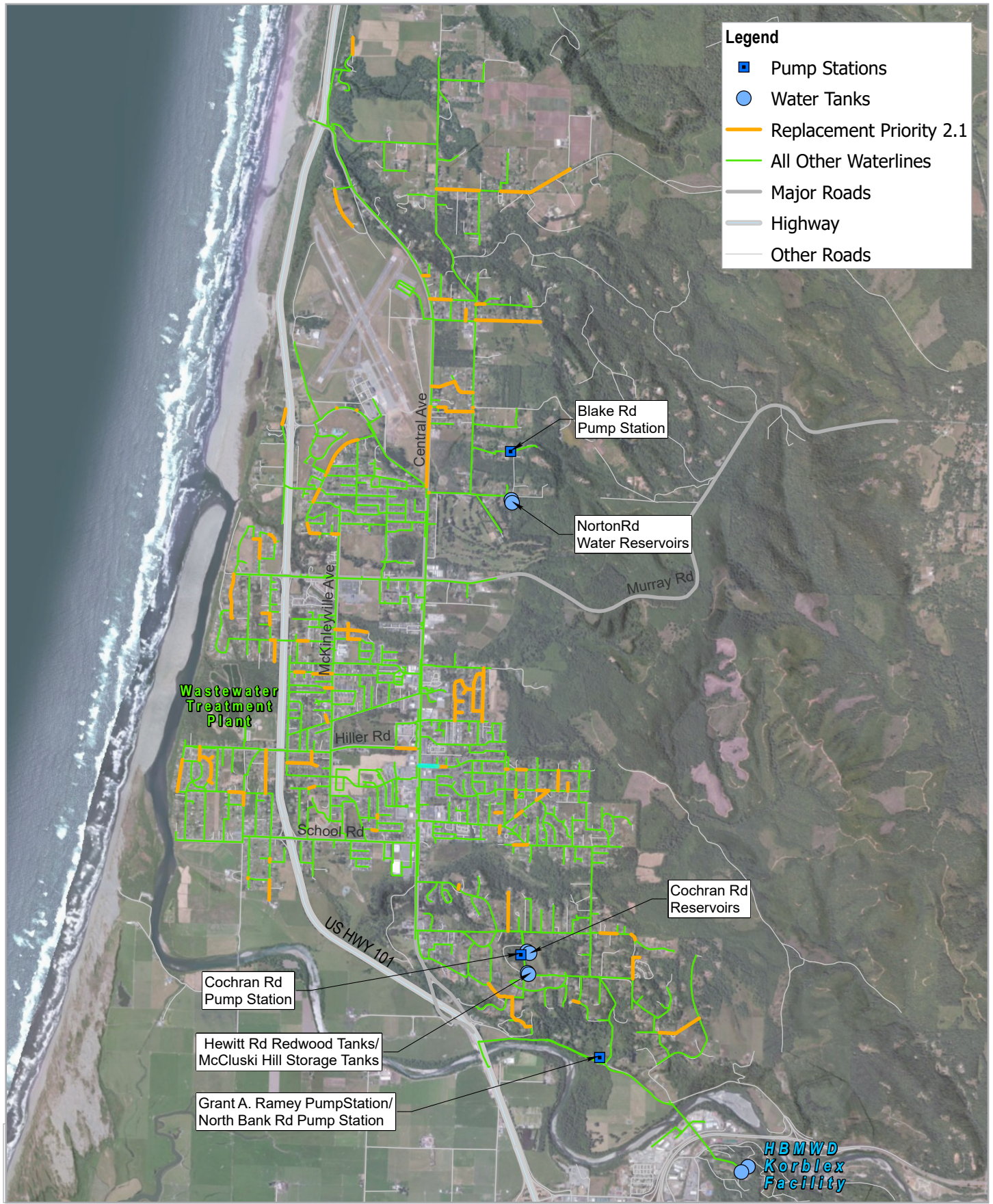


McKinleyville Community Service District  
Water Main Line Rehabilitation  
Master Plan (Phase 3)

Water Replacement Analysis  
Priority 1

Project No. 11218420  
Revision No. A  
Date Dec 2021

**FIGURE 7.1**

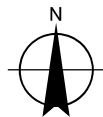
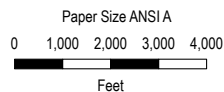
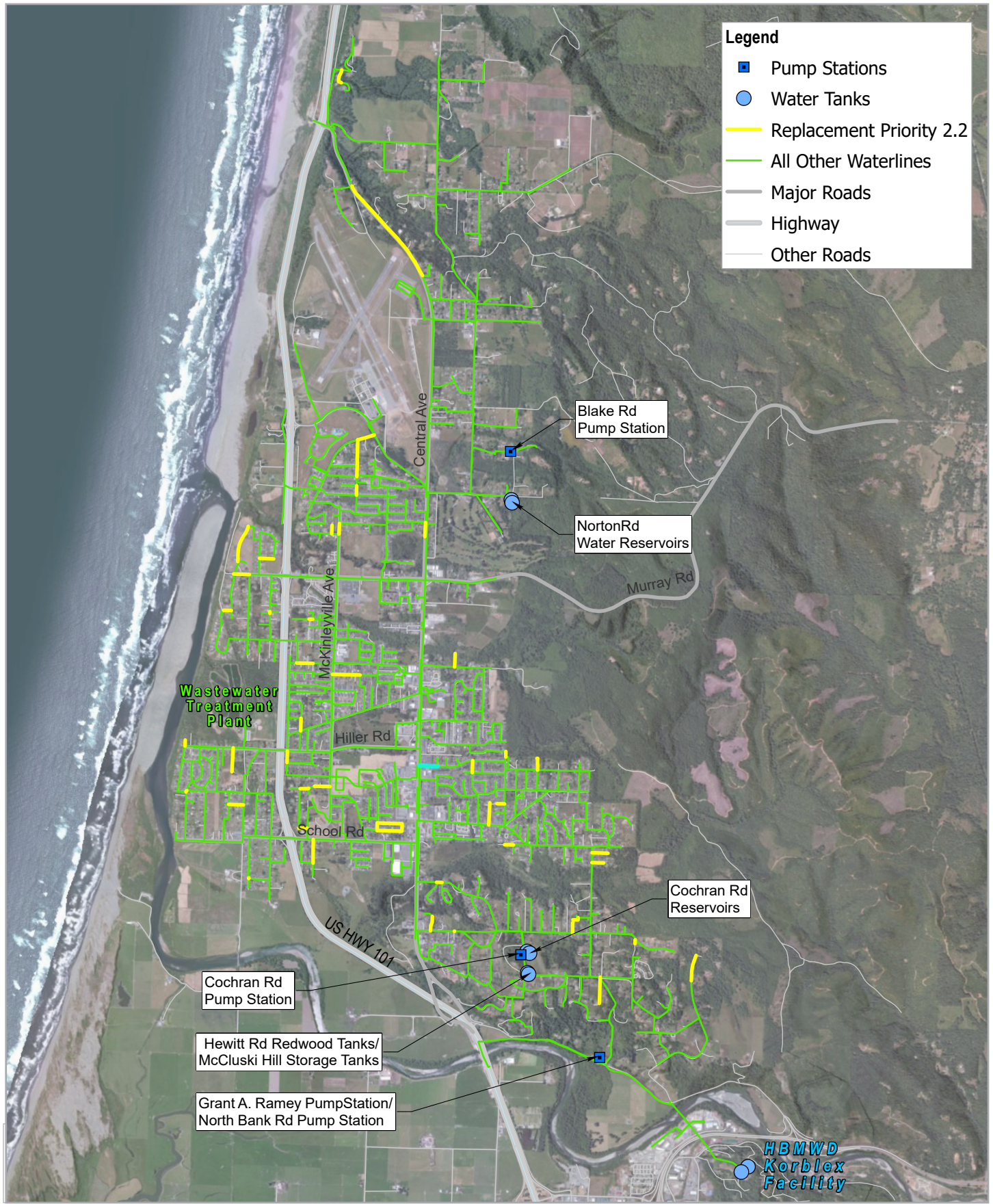


McKinleyville Community Service District  
 Water Main Line Rehabilitation  
 Master Plan (Phase 3)

Project No. 11218420  
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Water Replacement Analysis  
 Priority 2.1 BRE > 30

**FIGURE 7.2**

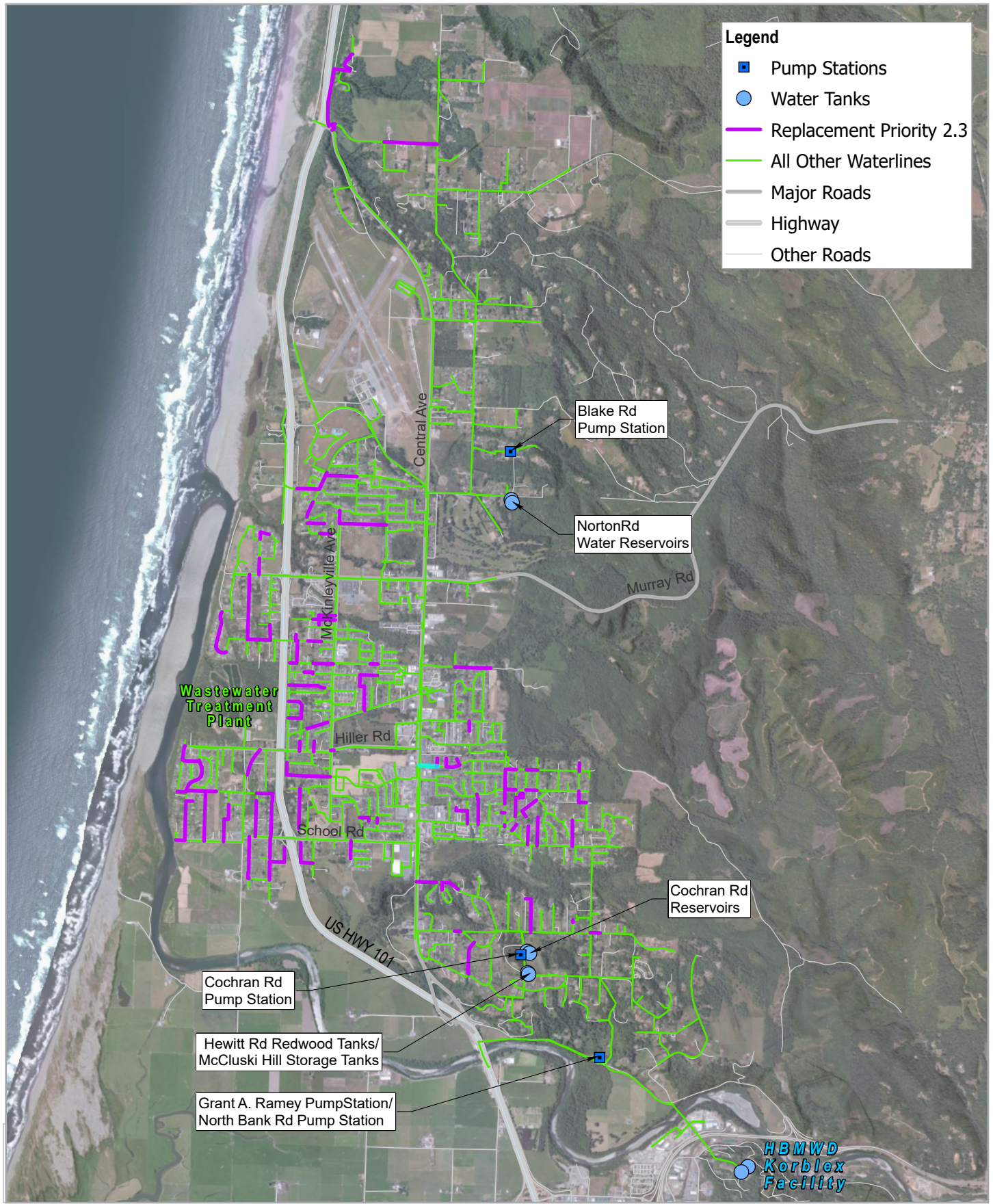


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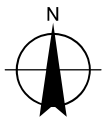
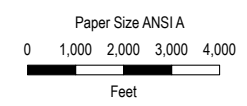
Water Replacement Analysis  
Priority 2.2 BRE 25-30

**FIGURE 7.3**



**Legend**

- Pump Stations
- Water Tanks
- Replacement Priority 2.3
- All Other Waterlines
- Major Roads
- Highway
- Other Roads



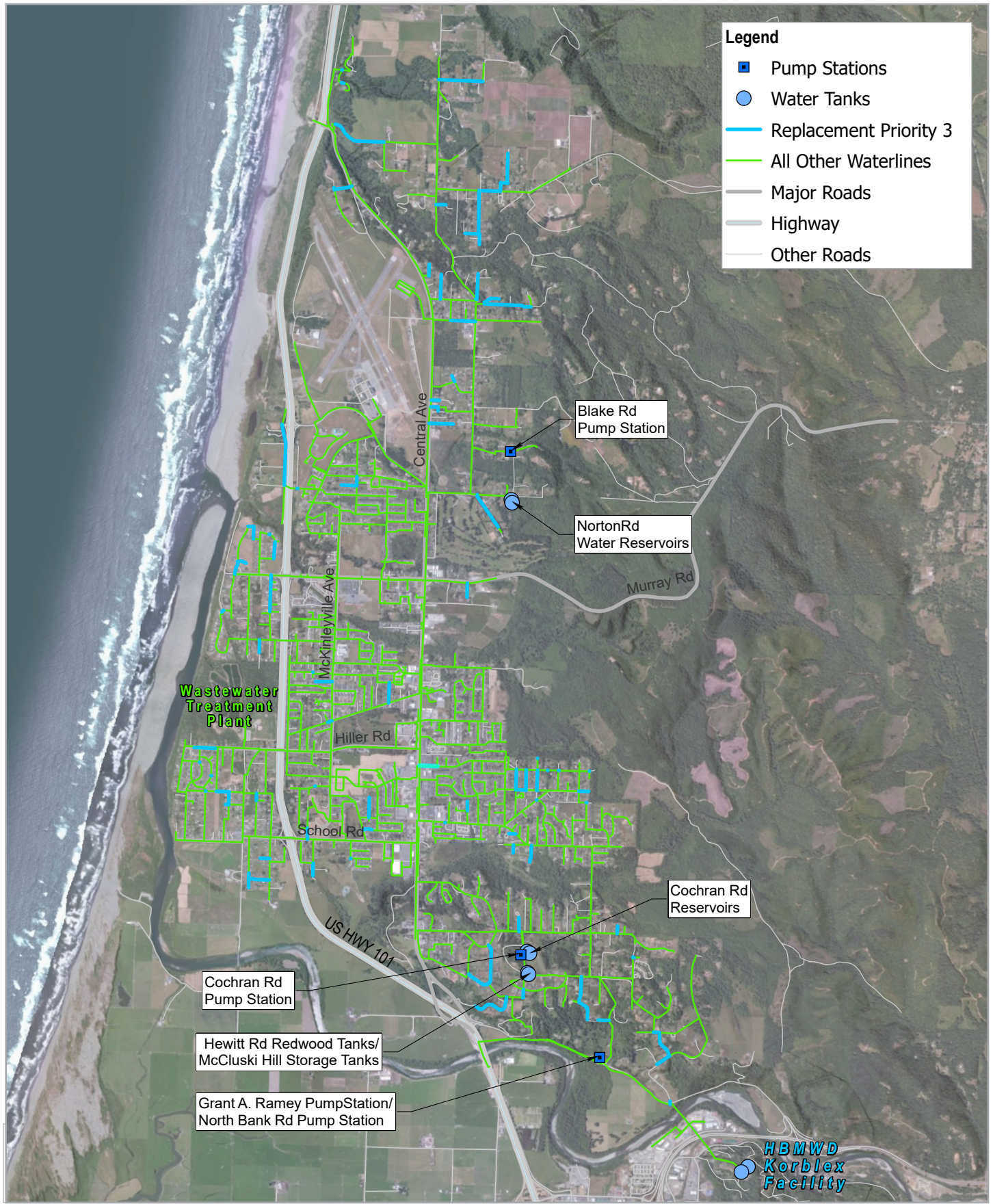
**McKinleyville Community Service District  
Water Main Line Rehabilitation  
Master Plan (Phase 3)**

Project No. 11218420  
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**Water Replacement Analysis  
Priority 2.3 BRE < 25**

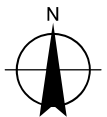
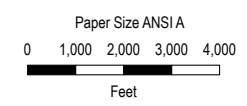
**FIGURE 7.4**

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Print date: 16 Dec 2021 - 12:58



**Legend**

- Pump Stations
- Water Tanks
- Replacement Priority 3
- All Other Waterlines
- Major Roads
- Highway
- Other Roads



Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1983  
Grid: NAD 1983 StatePlane California I FIPS 0401 Feet



**McKinleyville Community Service District  
Water Main Line Rehabilitation  
Master Plan (Phase 3)**

Project No. 11218420  
Revision No. A  
Date Dec 2021

**Water Replacement Analysis  
Priority 3**

**FIGURE 7.5**

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## 5. Financial Analysis

Willdan Financial Services (Willdan) was retained by the District to develop a multi-year pro forma analysis for the water system reflecting the potential financial impact of the long-term systematic replacement of the entire distribution system as discussed in Phase 1 of this Master Plan. The results of that analysis and the total projected project cost were used to determine a reasonable yearly budget of \$1 million (2019 dollars) for the replacement of the MCSD water system main lines over 100 years. For Phase 2 of this Master Plan, Willdan was retained to prepare a rate study to see how MCSD ratepayers will be affected by the replacement of the water distribution system main lines.

The rate study consisted of three main steps: a revenue requirement analysis, cost of service analysis, and a rate design analysis. The first step, revenue requirement analysis, provides a five-year plan comparing the utility revenues to expenses in order to determine the overall rate adjustment required to maintain the system. The second step, cost of service analysis, allots the revenue requirements established in the first step as functional components distributed to customers based upon usage. The final step is to apply the revenue allotments to propose a new rate structure that covers MCSD water system costs in both the near and long term.

Willdan produced a report that has been included as Appendix C. The report provides the following:

- The general approach of the analysis and the assumptions that were made
- Projected revenues and expenses
- Required rate adjustments to achieve a positive net income
- Distribution of expenditures with existing and proposed rates
- Proposed water rates

The rates proposed by Willdan were approved by the MCSD Board of Directors at their November 2018 meeting. A summary of the approved rates is provided in Table 13. With these rates MCSD can begin building adequate reserves to support the long-term replacement of the water system with \$1 million per year (in 2019 dollars).

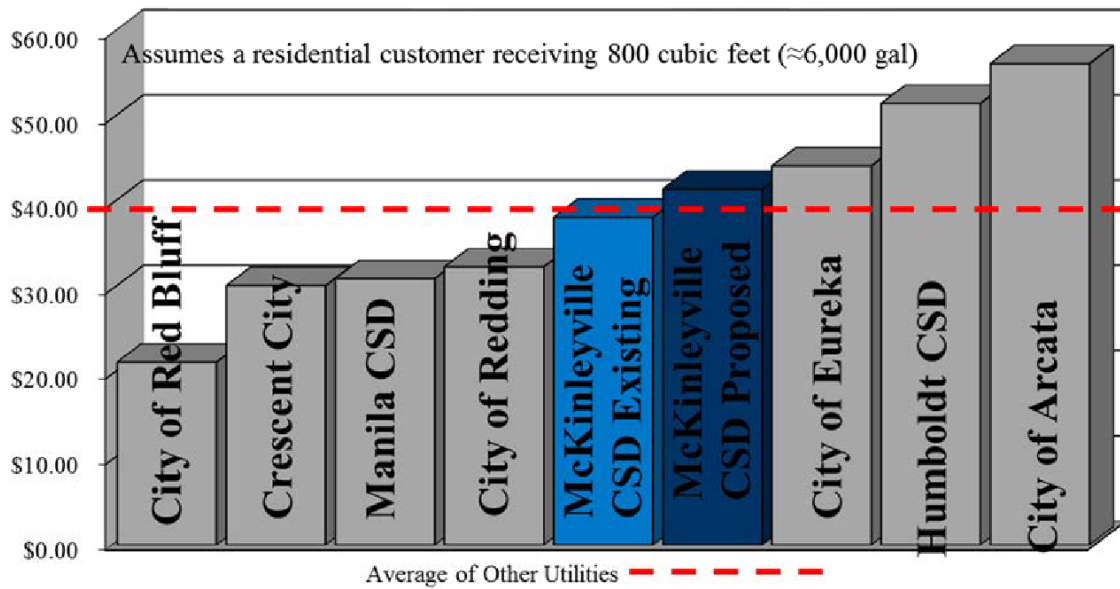
**Table 13: Approved Water Rate Structure**

	2019	2020	2021	2022	2023
<b>Monthly Base Charge:</b>					
5/8 inch	\$ 16.47	\$ 17.62	\$ 18.68	\$ 19.80	\$ 20.39
3/4 inch	\$ 22.23	\$ 24.49	\$ 26.71	\$ 29.11	\$ 30.59
1.0 inch	\$ 33.60	\$ 38.06	\$ 42.59	\$ 47.52	\$ 50.98
1.5 inch	\$ 62.09	\$ 71.89	\$ 82.01	\$ 93.06	\$ 101.95
2.0 inch	\$ 96.35	\$ 112.59	\$ 129.45	\$ 147.91	\$ 163.12



	2019	2020	2021	2022	2023
3.0 inch	\$ 179.52	\$ 214.61	\$ 251.43	\$ 291.85	\$ 326.24
4.0 inch	\$ 290.53	\$ 343.59	\$ 399.00	\$ 459.76	\$ 509.75
6.0 inch	\$ 575.46	\$ 682.07	\$ 793.53	\$ 915.75	\$ 1,019.50
8.0 inch	\$ 917.71	\$ 1,088.92	\$ 1,268.00	\$ 1,464.41	\$ 1,631.20
<b>Volumetric Per 100 Cubic Feet (CCF):</b>					
Block 1 – 0 to 8 CCF	\$ 1.57	\$ 1.68	\$ 1.78	\$ 1.89	\$ 1.95
Block 2 – All over 8 CCF	\$ 3.93	\$ 4.20	\$ 4.45	\$ 4.73	\$ 4.88
Pass-through Charge (P/CCF)	\$ 1.58	\$ 1.64	\$ 1.71	\$ 1.78	\$ 1.85

A bar graph comparing the approved rate structure to other rates in the local region for a residential customer using 800 cubic feet per month in fiscal year 2018-2019 is provided in Figure 8. The approved MCS D water rate structure has a residential customer paying slightly above average compared to the local region.



**Figure 8: Residential Customer Regional Rate Comparison (800 Cubic Feet)**





## 6. Conclusions, Recommendations, and Next Steps

This document presents a summary of all 3 phases of the MCSD Water Main Line Replacement and Rehabilitation Master Plan, a high-level assessment of the District's water distribution system for use in initial planning for rehabilitation and upgrades to the system.

Phase 3 has provided the following:

- Highlights of the Phase 1 system analysis
- Highlights of the Phase 2 information on viable replacement methods and financial analysis based on the Phase 2 proposed spending plan
- Discussion of in-house or contracting of construction work and comparison of costs
- Summary of physical testing results
- Risk Framework for evaluating the District's system
- Updated replacement plan using a risk-based prioritization approach

This final section presents conclusions, recommendations, and information on the next steps in the overall process.

### 6.1 Conclusions

This Master Plan presents a Risk Framework for evaluating and assigning priority for the replacement of MCSD's water distribution system. The District can replace the most critical portions of the MCSD water distribution system in the next 50 years with a reasonable adjustment to user rates by using the risk-based prioritization presented in this master plan.

Following the prioritization presented in this master plan, spending an average of \$1 million (2019 dollars) per year on the system will allow Priority 1 and over half of Priority 2 pipes to be replaced which equates to 18.6 miles of the District's 8-inch or smaller AC pipe in 50 years. This represents 50% of the District's 8-inch or smaller AC pipe, or 22% of the entire system. Replacement activities will help to ensure the continued high quality of service to their customers. Actual construction costs may differ and will depend on pipe conditions. Confirmation of the appropriate replacement method during the design phase of each project.

### 6.2 Recommendations and Next Steps

While there are currently no high-priority, near-term projects required for the distribution system, it is critical that the District begin planning and budgeting for upgrades and replacement of system components. The approved rates from Section 4 were made assuming that MCSD would begin putting aside \$860,000 to \$960,000 for each of the next four years starting in 2019 and then reserving the full \$1 million (2019 dollars) per year after that period. With rate adjustment approved, the project financing is securely in place and it is recommended that MCSD execute the replacement of its water system beginning with the pipe segments identified as Priority 1 followed by Priority 2 and then Priority 3. Within the Priority groups, it is recommended that BRE scores be



used to prioritize projects. The District should begin the planning and design process for the early proposed projects so construction can begin around 2024.

Asset condition for the risk assessment performed as part of this master plan is largely based on the 3 AC pipes samples collected and physically tested, one segment of DI pipe CCTV-ed, and one location of DI pipe with ultrasonic thickness testing. Results of physical testing were then extrapolated to subsets of assets based on material and diameter; however, condition within a subset can vary. Additional physical testing could be performed to refine and update the condition of the assets, as well as additional physical testing. As pipes are replaced, condition scores should be updated to reflect the improvements.

As for the feasibility of hiring more District staff and creating an in-house crew, versus a contracted crew, it can be argued both ways. For smaller projects, that don't require extensive equipment, hiring 1 or 2 more employees and utilizing part of the existing staff for a few weeks per year would be more feasible than hiring a contracted crew. It would require the District to purchase a few pieces of equipment that can also be utilized in other areas of the day-to-day operations. You could complete more of the smaller projects per year, as it would cut down on the Engineering, Survey, Geotech etc. and wouldn't require the bidding process. The 1 or 2 additional staff members would stay employed year-round and would help catch up on the work that was postponed during the month of construction.

A contracted crew would be more specialized and would have the equipment needed to complete the required replacement/rehabilitation along with the personnel trained on operating the specialized equipment. This would be ideal for bigger jobs in paved roads, with a lot of traffic that might require any method other than the trenching and replacing method. A contracted crew can also pull in more employees as needed, for flagging in busy streets etc. A potential cost savings for the District would also be to develop a list of approved Contractors and as the design of each job is completed, they could solicit costs from Contractors on the list, rather than doing a detailed bid process.

This master plan focuses on the District's capital expenditures and using the risk assessment to prioritize capital projects. However, in addition to the capital project recommendations, the District can use the risk assessment results to identify appropriate maintenance activities and intervals for the water distribution system assets depending on the criticality of the pipe segment and appurtenances. Maintenance activities should include flushing of water lines and exercising of valves to ensure best performance and functionality.

Lastly, this master plan and the associated risk model is considered a living plan that should be updated as additional condition information is known or as replacement projects are completed. Condition scores and probability of failure can be updated at the asset level to obtain updated prioritization.



# Appendices



# **Appendix A** – Phase 3b: Water and Sewer Mainline Replacement and Rehabilitation Master Plans Letter Report



July 6, 2020

Patrick Kaspari, PE  
General Manager  
McKinleyville Community Services District  
P. O. Box 2037  
1656 Sutter Rd  
McKinleyville, CA 95519

Ref: 11125090

**Re: Phase 3b: Water & Sewer Mainline Replacement & Rehabilitation Master Plans Letter Report**

Dear Mr. Kaspari,

GHD respectfully submits this summary to the McKinleyville Community Services District (MCSD) of the sub-phase, Phase 3b, of assessment related to fitness of MCSD's water and sewer systems. The overarching goal of the assessments is to develop an Engineer's opinion of present-day pipeline condition within the water and sewer systems with respect to the proposed schedule for the District's future replacement. Phase 3b is directly linked to the previous project sub-phase, Phase 3a, which included: 1) desktop analysis related to pipeline performance in environmental exposures and assessment of comparable documented pipeline performance based on environment, material, and time of exposure; 2) development of a soil sampling plan; soil sampling; laboratory analysis; corrosivity analysis of laboratory results; and 3) provision of recommendations related to scoping a destructive and non-destructive test plan for deployment in a subsequent project phase.

The Phase 3b work is focused on the assessment related to developing an Engineer's opinion of present-day pipeline condition within the water and sewer systems. In this context, "condition" is used to represent estimation of the risk of future failure based on the data available. The Phase 3b scope includes assessment of the water main under the Mad River as well as the other ductile iron (DI) and asbestos cement (AC) pipe in the water system and in the sewer collection system. Phase 3b includes: 1) the development of a destructive and non-destructive test plan for the pipe; 2) the collection and analysis of pipe samples and the non-destructive assessment of segments of pipe; and 3) the analysis and reporting of the destructive and non-destructive sample results and recommendations to review, revisit and/or revise the schedule and priorities for time-based pipeline replacement, if applicable.

**Project Overview**

The scope includes assessment of the Ductile Iron<sup>1</sup> water main in the vicinity of the Mad River crossing, forcemains from the Letz, Kelly, Fischer, and B Street lift stations, as well as the other ductile iron (DI) and asbestos cement (AC) pipe in the water and sewer systems. Attachment A and Attachment C includes a System Site Plan that includes pipe material designations. The majority of project piping is AC with a much

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<sup>1</sup> Record Drawings reference the pipe material as "Ductile Cast Iron".

lower percentage of DI and PVC piping presently in service. Based on available Record Drawings, sewer system piping was installed in 1976 and water system piping was installed in 1973, and has been in service since installation.

The findings and conclusions from the Phase 3a assessment found that the soil environment identified per the laboratory analysis is negligibly corrosive with respect to ductile iron pipe. GHD's experience, based on direct assessment of ductile iron pipe in similar soil environments over similar time of exposure scenarios, is that external corrosion-related degradation in terms of pipeline wall thickness loss, is typically nominal. However, the soil environment identified per the laboratory analysis is generally highly aggressive with respect to asbestos-cement pipe in various areas within the District boundary. The pH of the boring samples tested ranged from 4.5 to 7.8. Based on AC pipeline installation in the 1970s, the time of exposure to the soil environment is greater than 40 years. Degradation of AC pipe resulting in a reduction of pipeline strength was identified as a possible risk and destructive laboratory evaluation of AC pipe samples was recommended in order to quantify the AC pipe degradation-to-date. The focus of Phase 3b including quantification of the present-day condition of selected piping. The Phase 3b tasks included:

1. Three (3) AC pipe samples were obtained and underwent destructive laboratory evaluation. The results of the laboratory evaluation are summarized in Table 2. The laboratory evaluation included the following parameters:
  - a. Cross sectional hardness assessment was performed on the interior and the exterior of each pipeline cross section at 0.10 inch increments using a shore D durometer. The shore D durometer test results in an empirical number from 0 to 100: the higher the number the harder the material. The intent of this testing was to estimate the depth of the softer/weaker material on both the interior and exterior surfaces of each AC pipe sample.
  - b. Cross sectional pH evaluation was conducted on the entire cross section of each AC pipe sample at eight (8) locations per sample evenly spaced around the pipe circumference. The intent of this testing was to identify locations and quantify depths, on both the interior and exterior surfaces of each AC pipe sample, where the alkalinity has been reduced.
  - c. Crushing strength testing was conducted in accordance with ASTM C 500 – Standard Test Methods for Asbestos-Cement Pipe. The intent of this testing was to identify the present-day residual strength of the AC piping.
2. Ultrasonic thickness (UT) testing of ductile iron pipe was conducted at one (1) location that was selected, in part, based on consideration of the corrosivity of soils identified as a part of Phase 3a. UT data is summarized and presented in Table 3. Pipeline wall thickness was measured at twelve (12) circumferential locations.
3. CCTV was deployed on one selected ductile iron pipe runs of approximately 212 linear feet. CCTV footage was reviewed by a qualified engineer<sup>2</sup>.

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<sup>2</sup> Parastou Hooshialsadat, PE, NASSCO PACP (Pipeline Assessment Certification Program), GHD

## Introduction

Asbestos cement (AC) pipe was a popular pipe material alternative for various installations in the mid-20<sup>th</sup> century. It is estimated that more than 12% of water mains presently in service within the United States are AC pipe<sup>3</sup>. Asbestos Cement (AC) is a mixture of asbestos fibers, which serves as a reinforcing element, and cement paste, which serves as a binding agent. The conditions that lead to AC degradation may be present in the conveyed substance (internal degradation) or the surrounding soil environment (external degradation). AC pipe degrades primarily as a result of chemical reactions with the soil environment, thus degradation of AC pipe is primarily a function of the aggressiveness of the environment of exposure and the time of exposure<sup>4</sup>.

External degradation of AC is generally caused by acid or sulfate attack. Sulfate contained in the soil environment can react with hydrated calcium aluminate creating ettringite that expands and leads to the destruction of the cementitious portion of AC pipe. Internal degradation of AC is generally caused by leaching of the cementitious matrix by soft water; or sulfuric acid in the case of wastewater pipelines. Hydrogen sulfide in wastewater reacts with moisture to form sulfuric acid on the pipe wall which results in leaching of calcium, causing softening and loss of mechanical strength<sup>5</sup>. The free lime that maintains the strength of the cement matrix can be leached from the cement by liquids in contact with the pipe surface. External AC degradation, internal AC degradation, or the combination of internal and external degradation may result in a reduction in the structural integrity of the pipe cross section, which could lead to pipe failure. For the purpose of the subject assessment, the aggressiveness of the soil environment with respect to AC pipe is categorized primarily based on quantification on the sulfate ion content of the soil, reported in parts per million (ppm) and the pH of the soil. When pH increases above 7.0 (the neutral value) the conditions become increasingly more alkaline. Lower pH (more acidic) environments represent increased corrosivity with respect to buried metallic structures.

GHD developed a pipe sampling plan with the objective of obtaining and testing three (3) representative AC pipe samples. Two pipe samples, AC1 and AC2, were selected from locations with nearby available soil laboratory data, from Phase 3a, identifying the soil as highly aggressive with respect to AC pipe. Pipe sample AC3 was selected from a location where the adjacent soil data did not demonstrate highly aggressive soil. MCSD provided equipment and labor related to excavation. The three (3) pipe samples were obtained on April 14, 15, and 17 at the approximate locations depicted in Attachment B "Water Pipe Sampling Plan" and Attachment D "Sewer Pipe Sampling Plan". GHD's Daily Logs related to pipe sampling operations are included as Attachment E.

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<sup>3</sup> Ghirmay, Abiy Melles "Asbestos Cement Pipe Condition Assessment and Remaining Service Life Prediction", University of Arkansas, Fayetteville, August 2016

<sup>4</sup> Denison, Irving A. and Romanoff, Melvin "Effect of Exposure to Soils on the Properties of Asbestos-Cement Pipe", Journal of Research of the National Bureau of Standards, November 1951

<sup>5</sup> Bowker, Colin, "Corrosion of an Asbestos Cement Sewer Rising Main due to Hydrogen Sulphide", 75th Annual Victorian Water Industry Engineers & Operators Conference, September 2012

The pipe samples obtained were delivered to an independent analytical laboratory for analysis. AC pipe samples were analyzed for the following characteristics: interior and exterior hardness; pH profile; and crush strength. The report with the laboratory analysis results are included in Attachment F “Voss Laboratory Analysis Report dated April 29, 2020”.

Ultrasonic Thickness (UT) testing was used to measure pipeline wall thickness at one exposed section of ductile iron pipe in the vicinity of The Mad River Crossing in the general vicinity of pipeline Station 30+85 per Record Drawings date 1972. UT testing was conducted by GHD on April 17, 2020. Pipe wall thickness was measured using an Olympus 38 DL Plus Ultrasonic Thickness Gage Dual Transducer and glycerin couplant. The Olympus 38 DL Plus Ultrasonic Thickness Gage is factory-calibrated a minimum of one time per year; is shop-calibrated before each continuous multi-day use or approximately once every two weeks; and is field-calibrated using calibration blocks each day prior to testing. The standard resolution of the Olympus 38 DL Plus Ultrasonic Thickness Gage is one (1) mil (.001 inches). Test locations were cleaned and prepared for assessment by removing soil, contaminants and corrosion product, where appropriate. Six (6) wall thickness measurements were recorded at each of the twelve (12) test locations, which were used to determine the average thickness at each assessed location. The results of the UT testing are summarized in Table 5.

Closed Caption Television (CCTV) inspection was deployed by MCSD on one selected run of Ductile Iron Pipe of approximately 212 linear feet and provided to GHD for review. CCTV footage titled “10 Ductile Iron From Hiller Marsh to Thiel\_Mh 5-3-Mh 5—562” was reviewed in general conformance with NASSCO (National Association of Sewer Service Companies) recommended best practices. The results of the engineer’s review of the CCTV inspection footage is summarized in Table 6.

**Findings:**

Tables 1, 2, 3 and 4 summarize the laboratory findings based on the destructives testing performed on the three (3) selected AC pipe samples.

**Table 1 AC Pipe Sample Identification**

Pipe Sample ID	Sample Location	As-Received Sample Length (in.)	Sample Average Internal Diameter (in.)	Sample Average Wall Thickness (in.)
AC 1	Murray Road	13.0	9.93	1.07
AC 2	Lycoming Road	12.0	6.08	0.53
AC 3	School Road	12.75	8.00	0.63



**Table 2 Pipe Sample Interior and Exterior Hardness**

Pipe Sample ID	Interior Hardness Depth <sup>6</sup> (in.)	Exterior Hardness Depth <sup>7</sup> (in.)
AC 1	0.20	N/A
AC 2	0.10	N/A
AC 3	0.20	N/A

**Table 3 Pipe Sample pH Profile Testing**

Pipe Sample ID	Average Wall Thickness (in.)	Maximum Interior Degraded Depth <sup>8</sup> (in.)	Maximum Exterior Degraded Depth <sup>9</sup> (in.)
AC 1	1.07	0.30	0.02
AC 2	0.53	0.22	0.04
AC 3	0.63	0.36	0.03

**Table 4 Pipe Sample Crush Strength Testing**

Pipe Sample ID	Internal Diameter (in.)	Average Wall Thickness (in.)	Tested Pipe Length (in.)	Ultimate Load (lbs.)
AC 1	9.93	1.07	11.9	11,300
AC 2	6.08	0.53	11.3	3,200
AC 3	8.00	0.63	11.2	2,400

UT testing was conducted at 12 locations corresponding approximately to the hours of a clock. The baseline orientation was established as west-facing.

<sup>6</sup> The depth to which the Hardness Value is less than 85 Shore D.

<sup>7</sup> The depth to which the Hardness Value is less than 85 Shore D; N/A indicates that values were greater than 85 Shore D.

<sup>8</sup> The depth to which the measured pH is less than 9.5.

<sup>9</sup> The depth to which the measured pH is less than 9.5.

**Table 5 12" Diameter Ductile Iron Pipe Ultrasonic Thickness Testing Results<sup>10</sup>**

No.	12 O'c	1 O'c	2 O'c	3 O'c	4 O'c	5 O'c	6 O'c	7 O'c	8 O'c	9 O'c	10 O'c	11 O'c
1	0.403	0.423	0.408	0.401	0.393	0.397	0.368	0.402	0.408	0.413	0.407	0.403
2	0.402	0.422	0.409	0.401	0.408	0.393	0.372	0.401	0.409	0.412	0.414	0.404
3	0.404	0.426	0.410	0.399	0.408	0.395	0.369	0.401	0.408	0.415	0.416	0.408
4	0.404	0.431	0.410	0.398	0.408	0.395	0.371	0.401	0.410	0.416	0.417	0.406
5	0.405	0.438	0.410	0.379	0.405	0.393	0.407	0.400	0.409	0.417	0.415	0.395
6	0.406	0.437	0.407	0.380	0.412	0.404	0.406	0.400	0.408	0.416	0.415	0.404
Avg.	<b>0.404</b>	<b>0.429</b>	<b>0.409</b>	<b>0.393</b>	<b>0.406</b>	<b>0.396</b>	<b>0.382</b>	<b>0.401</b>	<b>0.409</b>	<b>0.415</b>	<b>0.414</b>	<b>0.403</b>

CCTV footage was assessed by a NASSCO accredited engineer. It was noted that the CCTV was not performed per NASSCO standards; primarily based on the level of the lighting. Video Internal pipeline defects/damage noted based on review of CCTV footage is characterized as a combination of minimal, moderate and significant damage scenarios as summarized in Table 6. The significant damage locations to the pipeline lining are noted along the pipeline invert from 104 ft. to 123 ft. General degradation and surface damage including erosion were noted in the vicinity of the flow line for the majority of the pipeline run. Lining damage in the vicinity of the pipeline crown, suspected due to hydrogen sulfide (H<sub>2</sub>S) attack, was noted along the length of the pipe run. Aside from the defects itemized; the following pipeline characteristics were noted:

- No lateral connection
- No crack, fracture or hole
- No joint displacement/offset
- No infiltration
- No root intrusion
- No coating/lining
- No material or size change

<sup>10</sup> Adjusted data based on calibration and velocity factors

**Table 6 Summary of CCTV Inspection Review: 10-inch Ductile Iron Pipe**

Upstream Manhole	Downstream Manhole	Pipe Diameter (inches)	Assessed Pipe Length (ft.)	Defects Noted
MH5-2 at 2280 Thiel Avenue	MH5-3 at Hiller East Field	10	214	<ol style="list-style-type: none"> <li>1. Minor deposits at pipe joints at: 54.6 ft., 147.9 ft. and 211.2 ft.</li> <li>2. Minor surface deterioration at: 90.3 ft. and 200.4 ft.</li> <li>3. Continuous erosion at invert from: 104 ft. to 123 ft.</li> </ol>

**Discussion**

The soil environment identified per the laboratory analysis of Phase 3a identified various zones of soil based on aggressiveness with respect to asbestos cement pipe. The majority of the soil data obtained within the MCSD service area can be generalized as highly aggressive with respect to AC pipe and negligibly aggressive with respect to ductile iron pipe. Based on AC pipeline installation in the 1970s and the time of exposure to the soil environment the lifespan is expected to be greater than 40 years. External degradation of AC pipe resulting in a reduction of pipeline strength is expected. GHD’s experience, based on direct assessment of ductile iron pipe in similar soil environments over similar time of exposure scenarios, is that external corrosion-related degradation in terms of pipeline wall thickness loss, is typically nominal. However, anomalous conditions may exist which include concentrations of corrosive soils or DC current pickup from foreign sources and related current discharge.

The previous project phase, Phase 3a, quantified soil aggressiveness throughout MCSD’s water and sewer system with respect to ductile iron pipe and asbestos cement pipe; based on the hypothesis that a correlation existed between soil composition and external pipe condition; i.e., that pipes located in highly aggressive soil conditions may have experienced a greater degree of external corrosion-related degradation to-date than pipelines in less aggressive or negligibly aggressive soil environments. Phase 3a was limited to evaluation of noted factors related to external pipeline corrosion-related degradation; internal pipeline degradation was not included in the scope of the evaluation. In general, the soil was determined to be negligibly aggressive to DIP and highly aggressive to AC pipe.

A key objective of Phase 3b was to quantify the present day condition of selected samples of DIP and AC pipe; an ancillary objective of which was to investigate the hypothesized correlation between soil aggressiveness and pipe condition. A sampling and test plan was developed which was subsequently scaled back, based on directive from MCSD, to include, as noted: CCTV of a limited run of DIP; UT testing of wall thickness at one exposed section of DIP; and destructive laboratory evaluation of three AC pipe

samples; two from areas identified as having highly aggressive soil conditions. Based on the results of the laboratory evaluation, the key metric available to serve as a leading indicator of risk of AC pipeline failure is the loss of crushing strength as evidenced by the present-day crushing strength of samples analyzed versus the design crushing strength. A correlation between soil environment and AC pipeline condition, as evidenced in loss of pipeline external alkalinity and/or loss of external hardness, was not established based on the limited data available as the internal degradation of each of the AC pipe samples analyzed was significantly more advanced than the external degradation. Table 2 reports the interior and exterior hardness of each of the three samples based on the depth to which the hardness is less than an established value (0.85 Shore D). The interior depth ranges from 0.1 inch to 0.2 inch; the exterior depth is reported as "N/A" indicating that it was not less than the established value at any depth tested. The anticipated, nominal, internal and external value for new AC pipe is "N/A". Table 3 reports the interior and exterior depth to which the measured pH of each of the three samples is less than an established value (9.5). The interior depth ranges from 0.22 inch to 0.36 inch; the exterior depth ranges from 0.02 inch to 0.04 inch. The anticipated, nominal, internal and external value for new AC pipe is "N/A".

Laboratory analysis revealed a direct correlation between crushing strength, or loss of crushing strength, and wall thickness. As AC pipeline wall thickness increases, crushing strength increases. As AC pipeline wall thickness decreases, crushing strength decreases. Furthermore; there is a direct correlation between AC pipeline wall thickness and pipe diameter. Two categories of AC pipe, Category 1 and Category 2, were developed in order to represent the risk of pipeline failure based on the destructive laboratory analysis performed. The risk of failure of the Category 1 Pipe (8-inch diameter and less) is significantly greater than Category 2 Pipe (10-inch diameter and greater) based on consideration of the crushing strength (only). The existing in-service AC pipe may be categorized according to wall thickness based on the following two categories: 1) pipelines with 8-inch diameter or less; and 2) pipelines with 10-inch diameter or greater. There is approximately 131,965 linear feet of Category 1 piping in MCSD's sewer system which composes 34.1% of the total sewer system pipe and 67,264 linear feet of Category 2 piping which composes 17.4% of the sewer system pipe. There is approximately 215,930 linear feet of Category 1 piping in MCSD's water system which composed 45.3% of MCSD's water system pipe and 87,154 linear feet of Category 2 piping which composes 18.1% of MCSD's water system pipe. The establishment of, and broad delineation based on, risk categories is a result of the destructive analysis of three (3) pipe samples. The extent of laboratory analysis was limited and the resulting classifications are therefore limited. Additional destructive evaluation, specifically of pipeline crushing strength, may result in a resolution of data facilitating development of additional risk categories and/or revision to the two risk categories presented herein.

## **Conclusions**

Asbestos Cement Pipe: The extent of internal degradation of both asbestos-cement pipe and ductile iron pipe was previously unknown; and in both cases it was assumed that external degradation is the controlling factor in pipeline degradation. The findings, based on the laboratory evaluation of AC pipe, include:

1. Based on dimensional measurements obtained as a part of the laboratory testing, the AC pipe tested is likely pressure Class 150<sup>11</sup>.
2. Internal degradation, not external degradation, of AC pipe is the limiting factor in AC pipe fitness for continued service
  - a. The exterior depth of loss of alkalinity is nominal
  - b. The exterior loss of hardness is nominal
  - c. The interior depth of loss of alkalinity, greater than 50% of total pipeline wall thickness of Sample AC3, is significant.
  - d. The interior loss of hardness of all samples tested is significant.
3. The crushing strength of the three samples varied significantly and relates, as expected, to pipeline wall thickness. The measured crushing strength relationship with respect to the design crushing strength, as itemized in Table 7, is related to pipeline wall thickness. Wall thickness increases as pipeline diameter increases. Based on the data available, pipes with nominal wall thickness of 0.635 inches or less, corresponding to pipeline diameters of 8-inches or less, have experienced significant reduction in residual crushing strength; and pipes with nominal wall thickness of 1.040 inches or more, corresponding to pipeline diameters of 12-inches or greater, have not experienced significant reduction in residual crushing strength. Although there is presently no laboratory data for crushing strength on 10-inch diameter (0.910 inch wall thickness pipe), 10-inch pipe is considered to have likely retained much of the design crushing strength and is classified along with AC pipe of larger diameters.

**Table 7 Pipe Sample Crush Strength vs. Design Crush Strength<sup>12</sup>**

Pipe Sample ID	Internal Diameter (in.)	Average Wall Thickness (in.)	Ultimate Load (lbs.)	Design Load (lbs.)	Percent (%) of Design Load
AC 1	9.93	1.07	11,300	7,600	149%
AC 2	6.08	0.53	3,200	5,400	59%
AC 3	8.00	0.63	2,400	5,400	44%

<sup>11</sup> AWWA C400-03 "Asbestos-Cement Pressure Pipe, 4 In. Through 16 In. (100 mm Through 400 mm), for Water Distribution Systems

<sup>12</sup> AWWA C400-03, Table 2 "Design internal pressure and design external load"

Ductile Iron Pipe: Internal lining degradation of ductile iron pipe was identified, and with respect to the extremely limited nature of the sample size, may be assumed to be indicative of mortar lining performance of similar vintages and time in service. The UT measurement of pipeline wall thickness identified substantial remaining wall thickness and minor loss of wall thickness.

### **Recommendations**

Asbestos Cement Pipe: The results of the Phase 3b efforts have established a direct relationship between crushing strength and nominal wall thickness. A risk of pipe failure, based on residual crushing strength, is thus considered to have an inverse relationship to nominal pipe diameter as discussed; which lead to development of Category 1 and Category 2; based on presumed risk of failure. Category 1 and Category 2 piping is depicted in Attachment B. GHD recommends that the subsequent project phase, Phase 3c, establish multiple classifications, numerical or otherwise, in order to quantify the consequence of AC pipe failure. The Consequence of Failure may be based on a number of factors including: 1) number, quantity and regularity of service outages; 2) environment impact including contamination; 3) increased cost; 4) access for repair; 5) legal penalties based on non-compliance; and 6) other collateral damage. The ASCE-published paper "Consequence-of-Failure Model for Risk-Based Asset Management of Wastewater Pipes Using AHP"<sup>13</sup> "presents a consequence-of-failure model using a weighted-sum multi-criteria decision-making method to evaluate the economic, social, and environmental consequences of wastewater pipe failure. The model incorporates 14 factors consisting of pipe characteristics and demographic parameters arranged into a hierarchical model to determine one final consequence-of-failure score". There are many such studies available on the topic; a multi-criteria model such as that mentioned in the referenced study is recommended. The quantification of consequence of failure should be applied to both Category 1 and Category 2 piping. The remaining useful service life, and inversely the time-based phasing of replacement, of asbestos cement pipe throughout the greater MCS D service area, may be prioritized according to the risk of failure (Category 1 or Category 2) weighted according to the Consequence of Failure. The existing time-phased plan for AC pipeline replacement may then be reviewed in parallel with the priority rankings sorted by the two wall thickness/residual crushing strength categories to determine if modifications to the replacement scheduling are prudent.

Ductile Iron Pipe: Based on the time in service of the ductile iron pipe, 48 years at the time of this memorandum, additional engineered measures for external corrosion control of ductile iron pipe are not presently recommended. Repair or remediation of lining and internal surfaces should be investigated and lining repair work initiated prior to widespread lining failure.

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<sup>13</sup> ASCE Technical Papers, Greta J. Vladeanu, Ph.D., A.M.ASCE; and John C. Matthews, Ph.D., A.M.ASCE

GHD appreciates the opportunity to provide corrosion engineering services. Should you have any questions, comments, please do not hesitate to contact us directly.

Respectfully submitted,



GHD Inc.

Jeff Knauer, PE, NACE Specialist  
Senior Corrosion Engineer  
Attachments:

- Attachment A: Water Soil Sampling Plan
- Attachment B: Water Pipe Sampling Plan
- Attachment C: Sewer Soil Sampling Plan
- Attachment D: Sewer Pipe Sampling Plan
- Attachment E: Daily Observation Logs
- Attachment F: Voss Laboratory Analysis Report dated April 29, 2020



Patrick Sullivan, P.E.  
Project Manager

**Legend**

**Soil Aggressiveness**

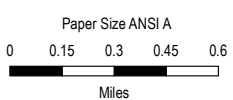
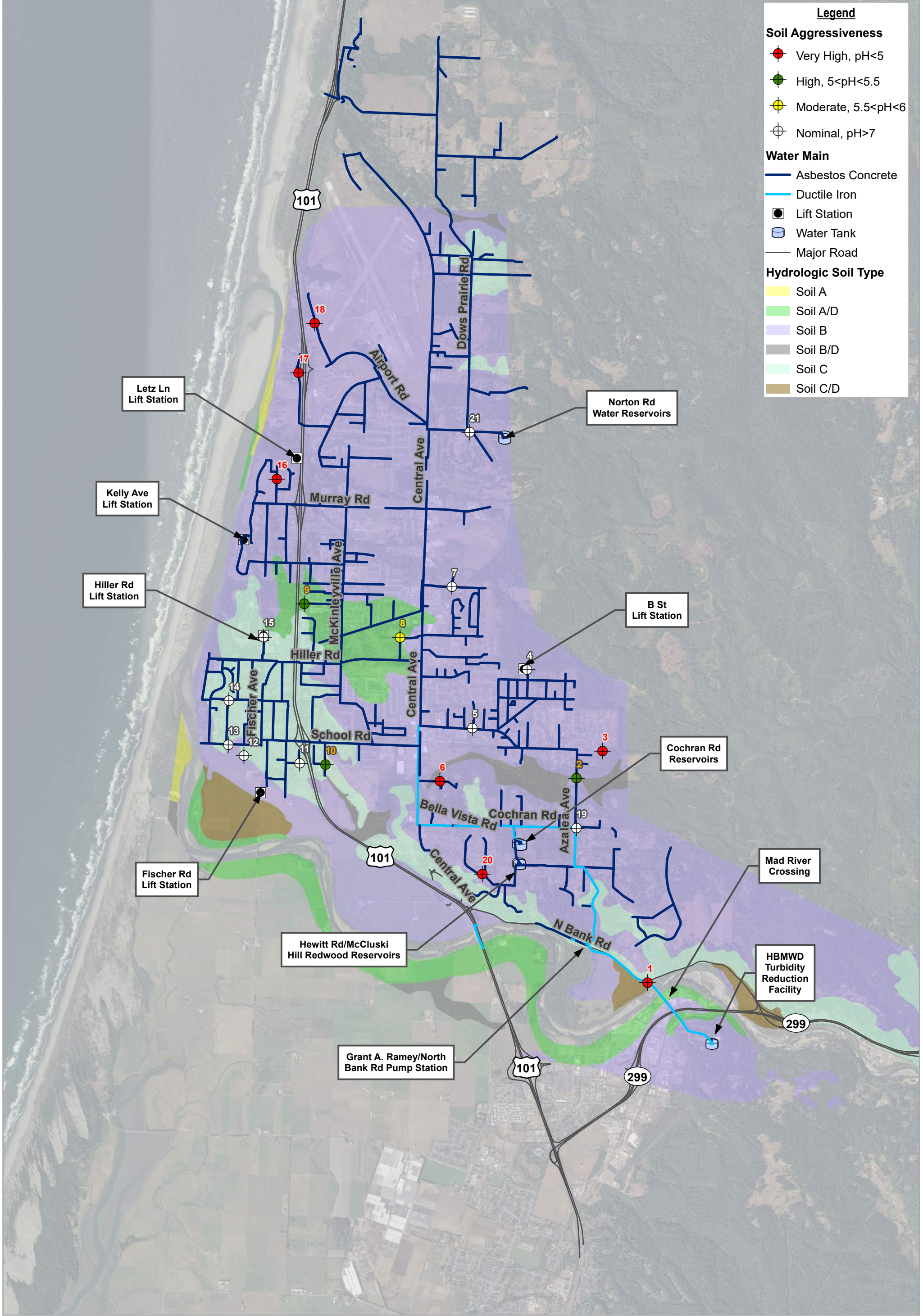
- Very High, pH<5
- High, 5<pH<5.5
- Moderate, 5.5<pH<6
- ⊕ Nominal, pH>7

**Water Main**

- Asbestos Concrete
- Ductile Iron
- Lift Station
- Water Tank
- Major Road

**Hydrologic Soil Type**

- Soil A
- Soil A/D
- Soil B
- Soil B/D
- Soil C
- Soil C/D



McKinleyville Community Services District  
Water Sewer Master Plan

Project No. 11125090  
Revision No. -  
Date Jan 2020

Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1983  
Grid: NAD 1983 StatePlane California I FIPS 0401 Feet

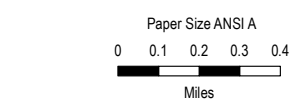
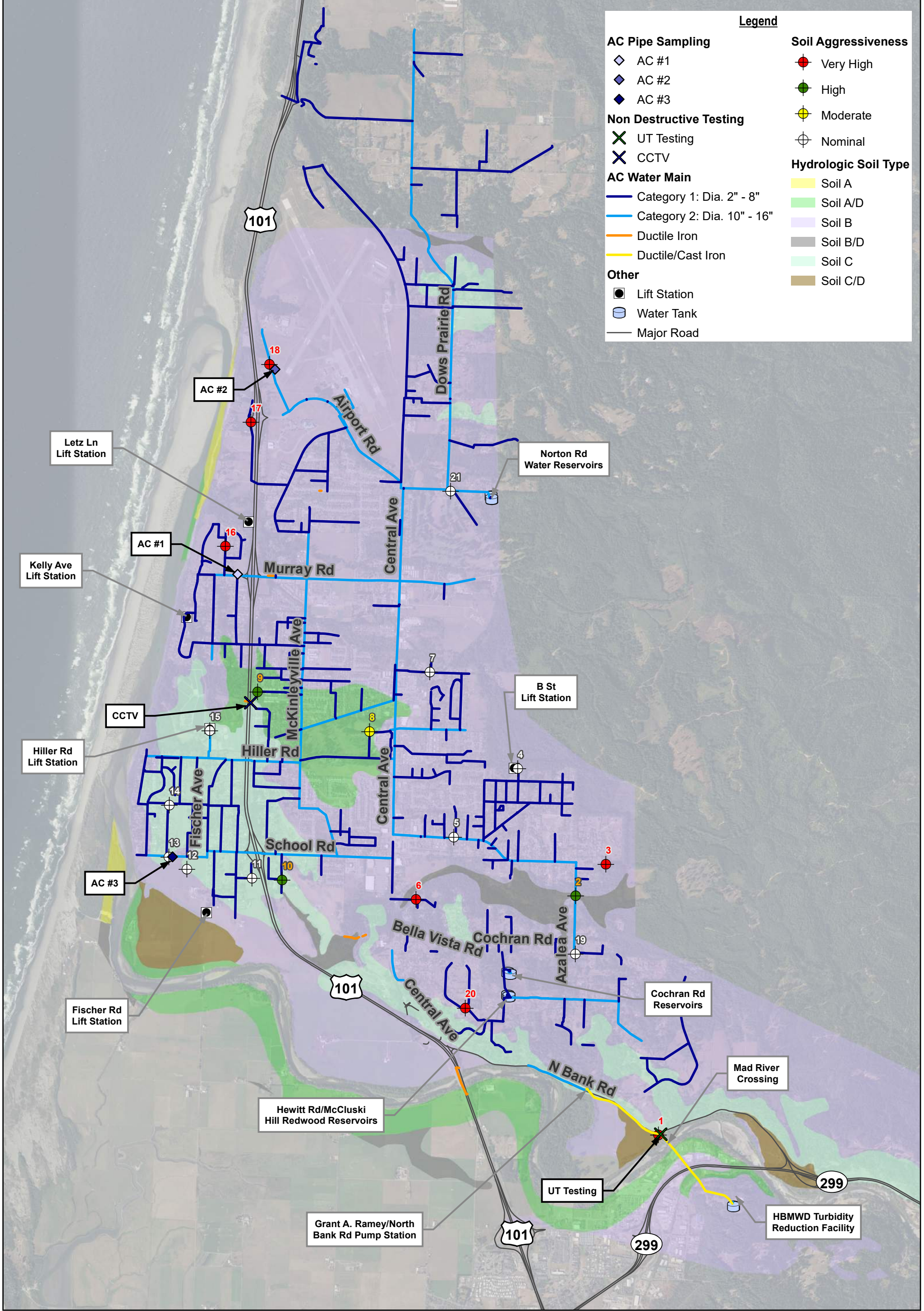
**Water Soil Sampling Site Plan**

**ATTACHMENT A**

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McKinleyville Community Services District  
Water Sewer Master Plan

**Water Pipe Sampling Plan**

Project No. 11125090  
Revision No. -  
Date June 2020

**ATTACHMENT B**

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**Legend**

**Soil Aggressiveness**

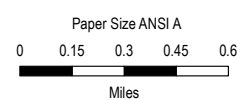
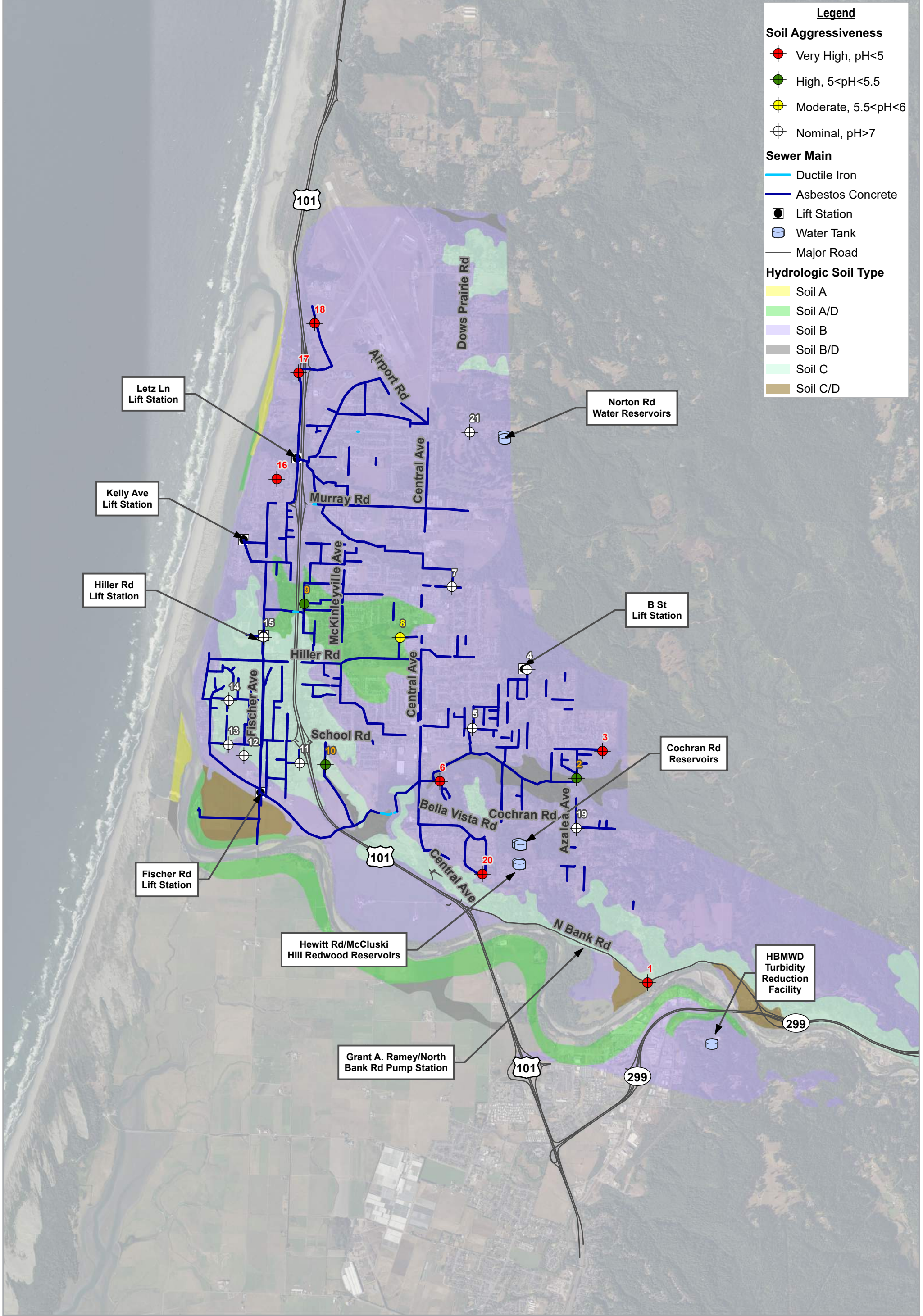
- Very High, pH<5
- High, 5<pH<5.5
- Moderate, 5.5<pH<6
- ⊕ Nominal, pH>7

**Sewer Main**

- Ductile Iron
- Asbestos Concrete
- Lift Station
- Water Tank
- Major Road

**Hydrologic Soil Type**

- Soil A
- Soil A/D
- Soil B
- Soil B/D
- Soil C
- Soil C/D



McKinleyville Community Services District  
Water Sewer Master Plan

Project No. 11125090  
Revision No. -  
Date Jan 2020

Map Projection: Lambert Conformal Conic  
Horizontal Datum: North American 1983  
Grid: NAD 1983 StatePlane California I FIPS 0401 Feet

**Sewer Soil Sampling Site Plan**

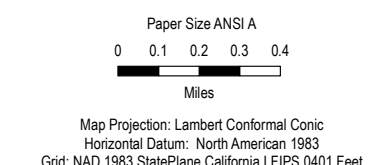
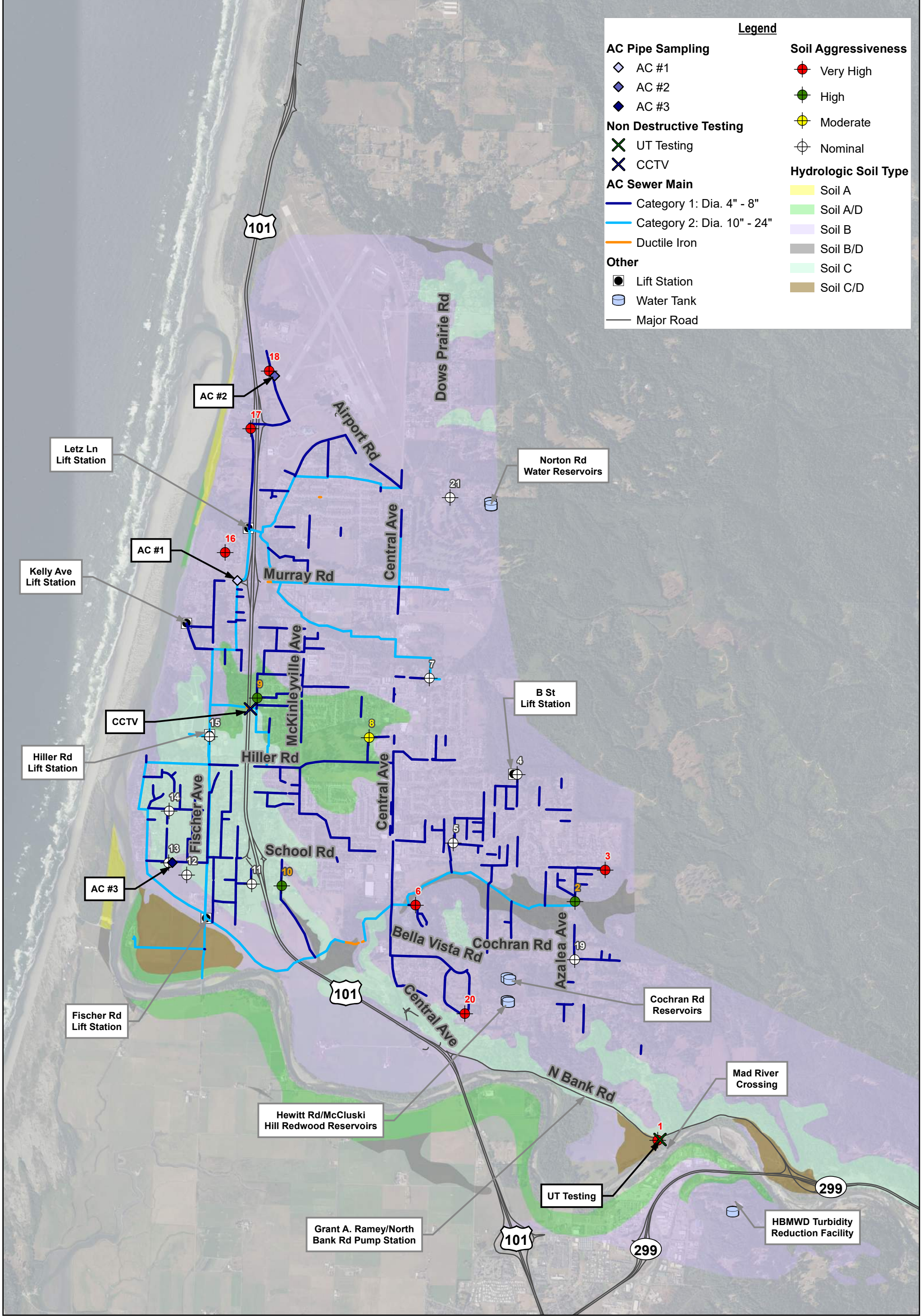
**ATTACHMENT C**

N:\US\Eureka\Projects\1111125090 MCSD-Water Sewer Master Plan\08-GIS\Map\Deliverables\PhaseMasterPlanning\11125090\_SewerSoilSampling.mxd  
Print date: 01 Jul 2020 - 16:39

Data source: - Created by: mgonzales

**Legend**

<b>AC Pipe Sampling</b>	<b>Soil Aggressiveness</b>
◇ AC #1	● Very High
◆ AC #2	● High
◆ AC #3	● Moderate
<b>Non Destructive Testing</b>	⊕ Nominal
✕ UT Testing	<b>Hydrologic Soil Type</b>
✕ CCTV	■ Soil A
<b>AC Sewer Main</b>	■ Soil A/D
— Category 1: Dia. 4" - 8"	■ Soil B
— Category 2: Dia. 10" - 24"	■ Soil B/D
— Ductile Iron	■ Soil C
<b>Other</b>	■ Soil C/D
● Lift Station	
○ Water Tank	
— Major Road	



McKinleyville Community Services District  
Water Sewer Master Plan

**Sewer Pipe Sampling Plan**

Project No. 11125090  
Revision No. -  
Date June 2020

**ATTACHMENT D**

N:\US\Eureka\Projects\1111125090 MCSD-Water Sewer Master Plan\08-GIS\Map\Deliverables\PhaseMasterPlanning\11125090\_SewerPipeSamplingPlan.mxd  
Print date: 01 Jul 2020 - 18:12

Data source: - Created by: mgonzales

# DAILY OBSERVATION REPORT

TITLE AND LOCATION: <p style="text-align: center; margin: 0;">MCS D – Work Plan Phase 3B</p>	DATE: <p style="text-align: center; margin: 0;">4/14/20</p>
---	--

<b>Status</b>	<b>WORKING?</b>	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>	IF NO, WHY NOT: _____
	WEATHER CONDITIONS:		SITE OBSERVATION HOURS:	
	AM: FOG RAIN OVC <span style="background-color: yellow;">CLEAR</span>	10:40 – 12:30		
PM: FOG RAIN OVC <span style="background-color: yellow;">CLEAR</span>				

<b>Check Points</b>		YES	NO	REMARKS:
	SUPERINTENDENT ON SITE?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	ANY SUBCONTRACTORS ON SITE?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	EQUIPMENT ONSITE?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	(1) MCS D F-250, (1) MCS D F-250 W/TRAILER, BACK HOE 580 SUPER-M, (1) MCS D VAC TRUCK
	VISITORS ONSITE?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
	AS-BUILTS CURRENT?	<input type="checkbox"/>	<input type="checkbox"/>	NA
	SUBMITTALS APPROVED FOR ONGOING WORK?	<input type="checkbox"/>	<input type="checkbox"/>	NA
	MEETINGS HELD?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	QUICK UPDATE ON WHAT WAS DONE BEFORE I ARRIVED AND WHAT THE PLAN IS

WORK OBSERVED/DEFICIENCIES NOTED/SAFETY ISSUES DISCUSSED/MATERIAL TESTS AND RESULTS:	
Schedule Activity No/Time	OBSERVATIONS/LOCATIONS:
10:40	ARRIVED AT AC #3 ON SCHOOL ROAD. SETH, CHRIS, CHRIS, AND LANCE ON-SITE. PIPE IS READY FOR SNAPPING/CRUSHING AS THE TRENCH IS DUG OUT AND SHORED.
10:50	SOIL SAMPLE COLLECTED FROM EXCAVATED PILE FROM DIGGING UP TRENCH. SOIL SAMPLE STORED IN ZIP-LOCK AND LABELED AC #3, SCHOOL ROAD, 4/14/2020 10:50AM.
10:50	SETH AND CHRIS PLUG THE UPSTREAM PIPE WITH A PRESSURIZED AIR PLUG VALVE.
11:00	UPSTREAM PIPE IS PLUGGED, AND THE DOWNSTREAM PIPE IS READY TO BE SNAPPED.
11:00	CHRIS DOWN IN THE TRENCH. WRAPPING THE PIPE WITH A MANNUAL PIPE SNAP CUTTER. ISSUES WITH USING THIS TOOL, AS THE TRENCH WAS NOT WIDE ENOUGH TO EXPAND AND CONTRACT THE SNAP CUTTER.
11:10	CHRIS OFF-SITE TO RETRIEVE THE HYDRAULIC PIPE SNAP CUTTER.
11:30	CHRIS BACK ON-SITE, AND STARTING TO SET UP THE HYDRAULIC PIPE SNAP CUTTER.
12:00	PIPE SUCCESSFULLY SNAPPED. PIPE BAGGED AND DUCT TAPED W/ LABEL STATING: AC #3 SCHOOL ROAD, 4/14 NOON.
12:30	MALIA OFF-SITE

MALIA GONZALES	4/14/2020
SITE OBSERVER _____	DATE _____

# DAILY OBSERVATION REPORT

TITLE AND LOCATION: <div style="text-align: center; font-weight: bold;">MCS D – Work Plan Phase 3B</div>				DATE: <div style="text-align: center; font-weight: bold;">4/15/20</div>	
Status	<b>WORKING?</b>	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>	IF NO, WHY NOT: _____	
	WEATHER CONDITIONS:			SITE OBSERVATION HOURS:	
	AM: FOG RAIN <b>OVC</b> CLEAR PM: FOG RAIN OVC CLEAR			9:00 – 10:30	
Check Points		YES	NO	REMARKS:	
	SUPERINTENDENT ON SITE?	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	ANY SUBCONTRACTORS ON SITE?	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	EQUIPMENT ONSITE?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	(2) MCS D F-250, (1) MCS D F-250 W/TRAILER	
	VISITORS ONSITE?	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	AS-BUILTS CURRENT?	<input type="checkbox"/>	<input type="checkbox"/>	NA	
	SUBMITTALS APPROVED FOR ONGOING WORK?	<input type="checkbox"/>	<input type="checkbox"/>	NA	
MEETINGS HELD?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	QUICK UPDATE ON WHAT WAS DONE BEFORE I ARRIVED AND WHAT THE PLAN IS		
WORK OBSERVED/DEFICIENCIES NOTED/SAFETY ISSUES DISCUSSED/MATERIAL TESTS AND RESULTS:					
Schedule Activity No/Time	OBSERVATIONS/LOCATIONS:				
9:00	ARRIVED AT AC #2 ON LYCOMING AVE. SETH, CHRIS, AND LANCE ON-SITE. PIPE IS READY FOR SNAPPING/CRUSHING AS THE TRENCH IS DUG OUT AND SHORED.				
9:15	SOIL SAMPLE COLLECTED AROUND PIPE. STORED IN ZIP-LOCK BAG AND LABELED: AC#2, LYCOMING AVENUE, 4/15/2020 9:15 AM.				
9:25	CHRIS PLUGGED THE UPSTREAM PIPE WITH A PRESSURIZED AIR PLUG VALVE.				
9:30	UPSTREAM PIPE IS PLUGGED, AND THE DOWNSTREAM PIPE IS READY TO BE SNAPPED.				
9:45	SETH DOWN IN THE TRENCH. WRAPPING THE PIPE WITH A HYDRAULIC PIPE SNAP CUTTER.				
10:00	PIPE SUCCESSFULLY SNAPPED. PIPE BAGGED AND DUCT TAPED W/ LABEL STATING: AC #2 LYCOMING AVENUE, 4/15 10 AM.				
10:30	MALIA OFF-SITE				
MALIA GONZALES		4/15/2020			
SITE OBSERVER		DATE			

# DAILY OBSERVATION REPORT

TITLE AND LOCATION: <div style="text-align: center; font-weight: bold;">MCSD – Work Plan Phase 3B</div>				DATE: <div style="text-align: center; font-weight: bold;">4/16/20 &amp; 4/17/2020</div>	
Status	<b>WORKING?</b>	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>	IF NO, WHY NOT: _____	
	WEATHER CONDITIONS: AM: <span style="background-color: yellow;">FOG</span> RAIN    OVC    CLEAR PM:    FOG    RAIN    OVC    CLEAR			SITE OBSERVATION HOURS: 4/16: 1:30 – 2:00 PM 4/17: 5:30 – 7:45 AM	
	<b>Check Points</b>		YES	NO	REMARKS:
SUPERINTENDENT ON SITE?		X	<input type="checkbox"/>		
ANY SUBCONTRACTORS ON SITE?		<input type="checkbox"/>	X		
EQUIPMENT ONSITE?		X	<input type="checkbox"/>	(2) MCSD F-250; (1) MCSD F-250 W/PORTABLE LIGHT GENERATOR TRAILOR; (1) PRIVATE VEHICLE	
VISITORS ONSITE?		<input type="checkbox"/>	X		
AS-BUILTS CURRENT?		<input type="checkbox"/>	<input type="checkbox"/>	NA	
SUBMITTALS APPROVED FOR ONGOING WORK?		<input type="checkbox"/>	<input type="checkbox"/>	NA	
MEETINGS HELD?		X	<input type="checkbox"/>	QUICK UPDATE ON WHAT WAS DONE BEFORE I ARRIVED AND WHAT THE PLAN IS	
WORK OBSERVED/DEFICIENCIES NOTED/SAFETY ISSUES DISCUSSED/MATERIAL TESTS AND RESULTS:					
Schedule Activity No/Time	OBSERVATIONS/LOCATIONS:				
4/16/2020 1:30 PM	ARRIVATED AT AC #1 ON MURRAY ROAD. LANCE ON-SITE. TRENCH AND SHORE DONE. PIPE IS EXPOSED. NO CUTTING TODAY SINCE TOOK ALL DAY TO FIND PIPE - TRENCHED IN MULTIPLE LOCATIONS TO FIND THE PIPE.				
4/16/2020 1:30 PM	SOIL SAMPLE COLLECTED FROM EXCAVATED PILE. STORED IN ZIP-LOCK BAG AND LABELED: AC #1, MURRAY ROAD, 4/16/2020 1:30 PM.				
4/16/2020 2:00 PM	MALIA OFF-SITE				
4/17/2020 6:00 AM	ARRIVED AT AC #1 ON MURRAY AVE. ERIK, CHRIS, AND LANCE ON-SITE. HYDRAULIC PIPE SNAP CUTTER ALREADY WRAPPED AROUND PIPE AND READY FOR SNAPPING/CRUSHING.				
4/17/2020 6:10 AM	ERIK CONTACTED SETH AND CHRIS TO TURN PUMPS OFF AT LETZ LANE LIFT STATION.				
4/17/2020 6:20 AM	JAMES ON-SITE				
4/17/2020 6:30 AM	LANCE AND CHRIS IN TRENCH. PIPE SUCCESSFULLY SNAPPED BY THE HYDRAULIC PIPE SNAP CUTTER.				
4/17/2020 7:00 AM	LANCE AND CHRIS INSTALLING NEW PVC PIPE AND STEEL MECHANICAL COUPLING ADAPTER.				
4/17/2020 7:15 AM	PIPE SUCESSFULLY PUT BACK TOGETHER.				
4/17/2020 7:30 AM	PIPE BAGGED AND DUCT TAPED W/ LABEL STATING: AC #1 MURRAY ROAD, 4/17 6:30 AM.				
4/17/2020 7:45 AM	MALIA OFF-SITE. STOPPING BY MCSD OFFICE TO COLLECT SOQ FOR 4.5MG RESERVOIR PROJECT.				
MALIA GONZALES <hr style="border: 0; border-top: 1px solid black; margin: 0;"/> SITE OBSERVER				4/17/2020 <hr style="border: 0; border-top: 1px solid black; margin: 0;"/> DATE	

April 29, 2019

VL Project No. 20017

Mr. Jeff Knauer  
GHD  
6001 Shellound Street, Suite 850  
Emeryville, CA 94608

Re: Laboratory Testing of AC Pipe Samples  
McKinleyville, California

Dear Mr. Knauer:

Voss Laboratories, Inc. has completed laboratory testing of materials from the above referenced project. The purpose of the testing was to determine material properties and provide this information to assist future remedial work, etc. This report includes a description of laboratory procedures and test results.

### **LABORATORY TESTING**

#### **Visual Examination/ Dimensional Measurement of Samples**

The following examination and/or measurements were performed on each AC sample:

- i) Visual inspection of pipe section for defects, deposits, and other visible anomalies. Each sample was photographed in the as-received condition.
- ii) Measurement of the length and inside diameter of the AC samples. Wall thickness measurements were made at 8 locations evenly spaced around the circumference.

A summary sheet containing photographs and pertinent data is compiled for each AC pipe sample and included in Appendix A. A summary of measurements is shown in Table 1.

#### **Cross Sectional Hardness Assessment**

At eight locations evenly spaced around the circumference a series hardness tests were performed from the interior to the exterior of the pipeline cross section. Testing was performed at 0.10 inch increments. A shore D durometer was used for these measurements. The intent of this testing is to estimate the depth of the softer/weaker material on both the interior and exterior surfaces of each pipe sample. The test gives an empirical number from 0 to 100. The higher the number the harder the material. Degraded area was classified of having a hardness value less than 85. A summary of results is shown in Table 2.



### pH Cross Sectional Evaluation

A section of pipeline is trimmed to create a smooth surface for staining. The entire cross section of the pipe sample was stained. At eight locations evenly spaced around the circumference the areas with pH lower than 9.5 were measured at the interior and exterior of the pipe surfaces at each of the eight locations. Results are summarized in Table 3 with complete tabulated results shown in Appendix B. Photos of stained samples are shown in the Appendix A summary sheets.

### Crushing Strength of AC Samples

The crushing strength testing on the submitted samples was determined in accordance with ASTM C 500 – *Standard Test Methods for Asbestos-Cement Pipe*. A section of pipe is placed in a saddle and loaded along the length to determine the crushing strength. The test method specifies a 12-inch-long section of pipe to be used. Some pipe sections that were submitted for testing were shorter than 12 inches. Short samples were tested using the same test method. Results are summarized in Table 4.

If you have any questions, please call.

Very truly yours,

VOSS LABORATORIES, INC.

Thomas A. Voss.  
Civil Engineer



**TABLE 1: AC PIPE SAMPLE DIMENSIONAL MEASUREMENTS**

Sample ID	Location	As-Received Length (in.)	Average Internal Diameter (in.)	Average Wall Thickness (in.)
AC 1	MURRAY ROAD	13.0	9.93	1.07
AC 2	LYCOMING	12.0	6.08	0.53
AC 3	SCHOOL ROAD	12.75	8.00	0.63

**TABLE 2: AC PIPE SAMPLE HARDNESS**

Sample ID	Location	Average Wall Thickness (in.)	Interior Hardness Depth (<85 Shore D Reading) (in.)	Exterior Hardness Depth (<85 Shore D Reading) (in.)
AC 1	MURRAY ROAD	1.07	0.20	N/A
AC 2	LYCOMING	0.53	0.10	N/A
AC 3	SCHOOL ROAD	0.63	0.20	N/A

\* Exterior hardness measurements were consistently greater than 85 Shore D

TABLE 3: AC PIPE SAMPLE pH TESTING

Sample ID	Location	Average Wall Thickness (in.)	Max. Interior Degraded Depth (in.)	Max. Exterior Degraded Depth (in.)
AC 1	MURRAY ROAD	1.07	0.30	0.02
AC 2	LYCOMING	0.53	0.22	0.04
AC 3	SCHOOL ROAD	0.63	0.36	0.03

TABLE 4: AC PIPE SAMPLE CRUSH STRENGTH TESTING

Sample ID	Location	Internal Diameter (in.)	Average Wall Thickness (in.)	Tested Pipe Length (in.)	Ultimate Load (lbs)
AC 1	MURRAY ROAD	9.93	1.07	11.9	11,300
AC 2	LYCOMING	6.08	0.53	11.3	3,200
AC 3	SCHOOL ROAD	8.00	0.63	11.2	2,400

\*Test results from pipe sections shorter than 12 inches are not in accordance with ASTM C500



## Appendices

- A. Visual Examination Sheets
- B. pH Cross-Section Tabulated Results

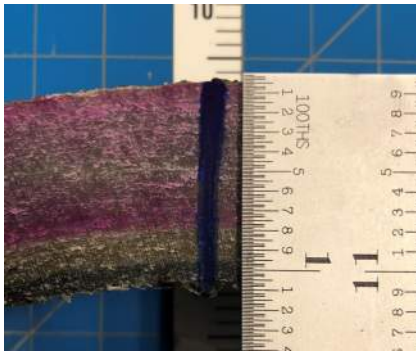
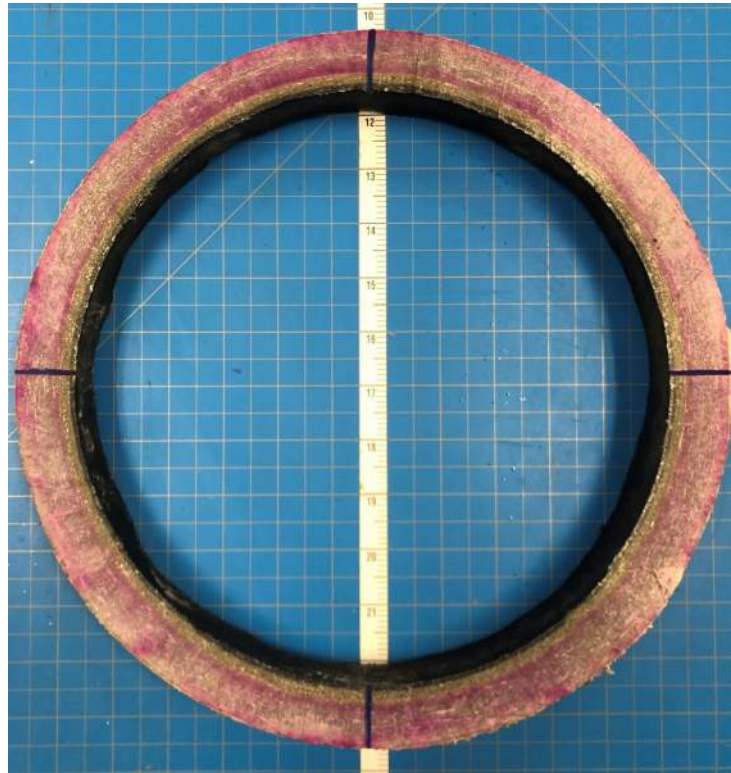


## Appendix A

### Visual Examination Sheets

# AC Pipe Data Sheet

Client: GHD	Internal Dia. 9.93"	Pipe Length (in.): 13.0"
Date: 4/29/20	Wall Thick. 1.07"	
Pipe ID: #1	Ext. Corrosion 0.02"	Int. Corrosion 0.30"
Location Murray Road	Crush Test Length 11.9"	Crushing Strength 11,300lbs

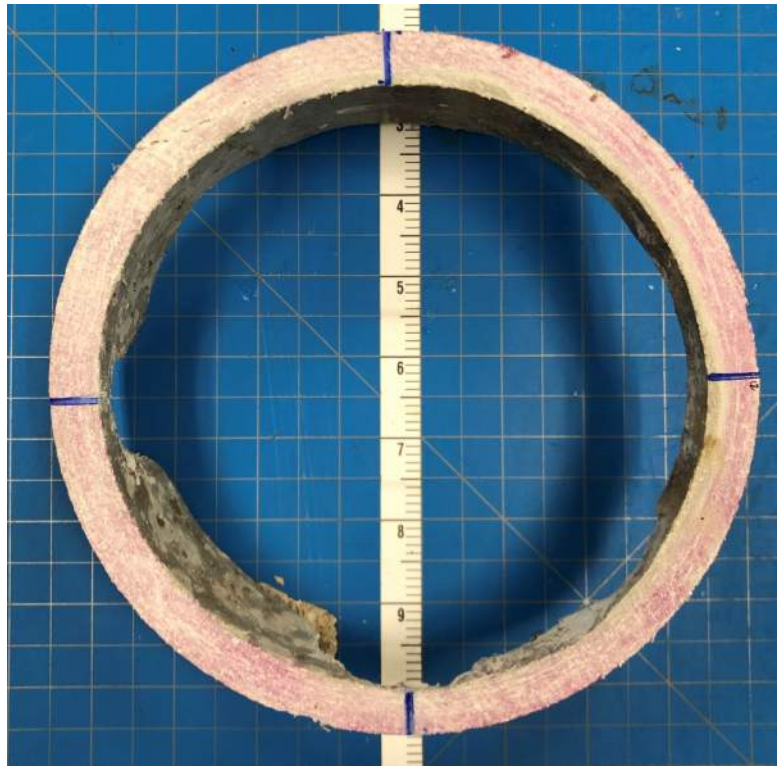


The sample ends were fractured as received. The ends were sawcut and stained.



# AC Pipe Data Sheet

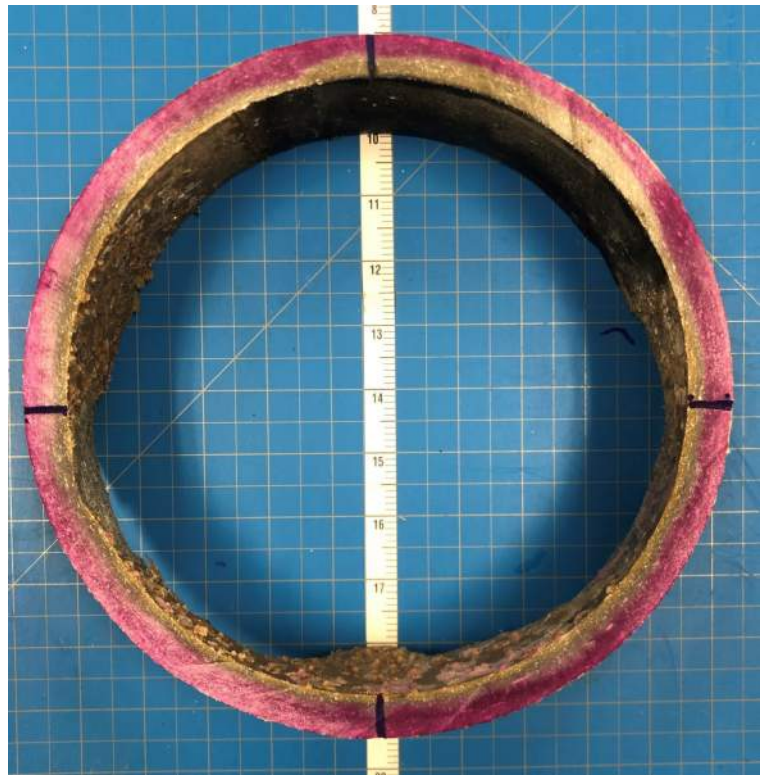
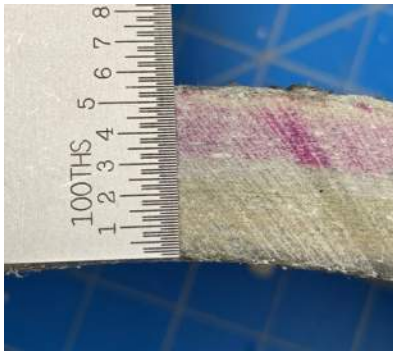
Client: GHD	Internal Dia. 6.08"	Pipe Length (in.): 12.0"
Date: 4/29/20	Wall Thick. 0.53"	
Pipe ID: #2	Ext. Corrosion 0.04"	Int. Corrosion 0.22"
Location Lycoming Road	Crush Test Length 11.3"	Crushing Strength 3,200lbs



The sample ends were fractured as received. The ends were sawcut and stained.

# AC Pipe Data Sheet

Client: GHD	Internal Dia. 8.00"	Pipe Length (in.): 12.8"
Date: 4/29/20	Wall Thick. 0.63"	
Pipe ID: #3	Ext. Corrosion 0.03"	Int. Corrosion 0.36"
Location School Road	Crush Test Length 11.2"	Crushing Strength 2,400lbs



The sample ends were fractured as received. The ends were sawcut and stained.



## Appendix B

### pH Cross-Section Tabulated Results



VL Sample #	PIPE DIAMETER	LOCATION	Length of pipe (in)	pH Cross Sectional Inner/Outer (in)																	
				12:00		1:30		3:00		4:30		6:00		7:30		9:00		10:30		Max Interior	Max Exterior
1	10	Murray Road	13.0	0.30	0.00	0.24	0.01	0.26	0.02	0.24	0.00	0.28	0.00	0.22	0.00	0.26	0.01	0.28	0.00	0.30	0.02
2	6	Lycoming Road	12.0	0.22	0.01	0.14	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.01	0.12	0.00	0.22	0.04
3	8	School Road	12.8	0.20	0.01	0.15	0.03	0.23	0.00	0.24	0.00	0.30	0.00	0.36	0.03	0.25	0.00	0.24	0.00	0.36	0.03



## **Appendix B – Asset Register)**











UniqueID	Length (ft)	Dia (in)	Material	Replacement Method	Service Laterals	Flow (CFS)	Valves	Ph 3 Material & Install Cost (\$)	Final Const Cost (\$)	Land Use Type	Proximity to Critical Customers	Type of Critical Customer	ProxToRoad (ft)	RoadType	Customer Count	Proximity to a Building	ProxToSewerM (ft)	Proximity to a Storm Drain	Proximity to a Dish Feature	Prox. To ESA	Type of ESA	Critical Customers	Proximity to and Types of Roads	Proximity to Other Utilities	Proximity to Environmentally Sensitive Areas	Proximity to Buildings	Repair Costs	Land Use	CO1 Health and Safety	CO2 Loss of Service	CO3 Cost of Failure	CO5 Regulatory Impact	Dominant GDP	COF	Core Ret.	Mitigation Phase	Risk Score	Priority	TBL Cof	RTE	COE Drive							
1141	12.2310951	6	ACP	Burst	15	0	0	11,495.13	24,168.50	AE	10000	No Critical Facility within 250 Feet.	0	Local	50	64.9406854	10000	10000	10000	10000	N/A	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	4	4	1	1	Low	3	12	Buildings, Land Use	Critical Customers, Proximity to and Types of Roads, Proximity to Other Utilities, Proximity to Environmentally Sensitive Areas, Proximity to Buildings, Land Use		
1142	13.1837856	6	ACP	Burst	0	0	0	2,690.02	5,655.77	AE	10000	No Critical Facility within 250 Feet.	4.416635438	Local	50	111.2946753	10000	10000	10000	10000	N/A	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	4	4	1	1	Low	3	12	Buildings, Land Use	Critical Customers, Proximity to and Types of Roads, Proximity to Other Utilities, Proximity to Environmentally Sensitive Areas, Proximity to Buildings, Land Use
1215	418.772189	6	ACP	Burst	0	0	1	90,429.63	190,128.31	RA	10000	No Critical Facility within 250 Feet.	0	Local	50	121.338619	10000	10000	10000	10000	N/A	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	4	4	1	1	Low	3	12	Buildings, Land Use	Critical Customers, Proximity to and Types of Roads, Proximity to Other Utilities, Proximity to Environmentally Sensitive Areas, Proximity to Buildings, Land Use
1216	557.178893	6	ACP	Burst	0	0	1	118,664.49	249,492.10	RA	10000	No Critical Facility within 250 Feet.	0	Local	50	163.3565131	10000	10000	10000	10000	N/A	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	4	4	1	1	Low	3	12	Buildings, Land Use	Critical Customers, Proximity to and Types of Roads, Proximity to Other Utilities, Proximity to Environmentally Sensitive Areas, Proximity to Buildings, Land Use
1217	994.206687	6	ACP	Direct	0	0	1	253,551.67	533,092.39	RA	10000	No Critical Facility within 250 Feet.	0	Local	50	92.68236199	10000	10000	10000	10000	N/A	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	4	4	1	1	Low	3	12	Buildings, Land Use	Critical Customers, Proximity to and Types of Roads, Proximity to Other Utilities, Proximity to Environmentally Sensitive Areas, Proximity to Buildings, Land Use	
1220	6.33744566	2	ACP	Burst	11	1	1	18,892.84	39,722.19	AE	10000	No Critical Facility within 250 Feet.	247.920113	Local	100	10000	10000	10000	10000	200.4899598	Long Term River	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	4	4	1	1	Low	3	12	Buildings, Land Use	Critical Customers, Proximity to and Types of Roads, Proximity to Other Utilities, Proximity to Environmentally Sensitive Areas, Proximity to Buildings, Land Use







Table with columns: UniqueID, Length (ft), Dia (in), Material, Replacement method, Service laterals, Blow Count, Valves, Ph 3 Material & Install Cost (IG), Final Cost (IG), Land Use Type, Proximity to Critical Customers, Type of Critical Customer, Proximity to a Road (ft), Road Type, Customer Count, Proximity to a Building, Proximity to a Sewer Main (ft), Proximity to a Storm Drain, Proximity to a Storm Feature, Proximity to a Storm Feature, Proximity to a Storm Feature, Critical Customers, Proximity to and Types of Roads, Proximity to Other Utilities, Proximity to Environmentally Sensitive Areas, Proximity to Buildings, Repair Costs, Land Use, CO1 Health and Safety, CO2 Loss of Service, CO3 Cost of Failure, CO6 Regulatory Impact, Dominant COF, COF, Core Req, Mitigation, Risk Eval, Priority, TBL Col, BRE, COE Owner.





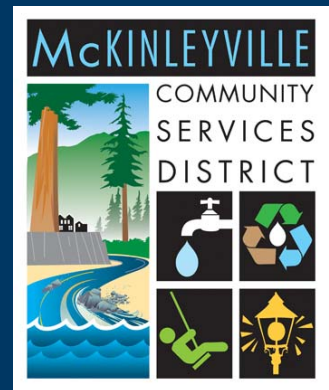
## **Appendix C** – MCSD Water & Wastewater Rate Study (Willdan Financial Services, 2018)

# McKINLEYVILLE COMMUNITY SERVICE DISTRICT



## Water & Wastewater Rate Study

SEPTEMBER  
2018



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# Introduction

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In 2018, McKinleyville Community Services District (“MCSD” or the “District”) commissioned Willdan Financial Services (“Willdan”) to perform a water and wastewater rate analysis and financial plan. This analysis provides financial recommendations that focus on two key objectives consisting of: 1) short and long-run financial health and stability for MCSD water and wastewater operations; and, 2) equitable cost-of-service rates that reflect the benefit provided while maintaining Proposition 218 compliance.

Based on the analyses performed for this study, MCSD’s existing rates will not generate sufficient revenue to fund existing and projected expenditures (operations, maintenance, and capital) and reserve targets (e.g. the \$1 million annual capital reserve transfer for each system). While MCSD currently maintains moderate reserve levels, the existing rates are not sustainable as both utilities are not generating sufficient revenues and are subsequently running net losses.

MCSD purchases its wholesale water supply from the Humboldt Bay Municipal Water MCSD, which diverts water from its million-gallon tank on Essex Hill, under the Mad River, to MCSD’s Grant A. Ramey Pump Station at North Bank and Azalea Roads. Water is then pumped to storage tanks at McCluski Hill, Cochran Road and Norton Road; MCSD’s six storage tanks have a combined capacity of 5.25 million gallons, approximately a 36-hour supply for its 6,705 customers.

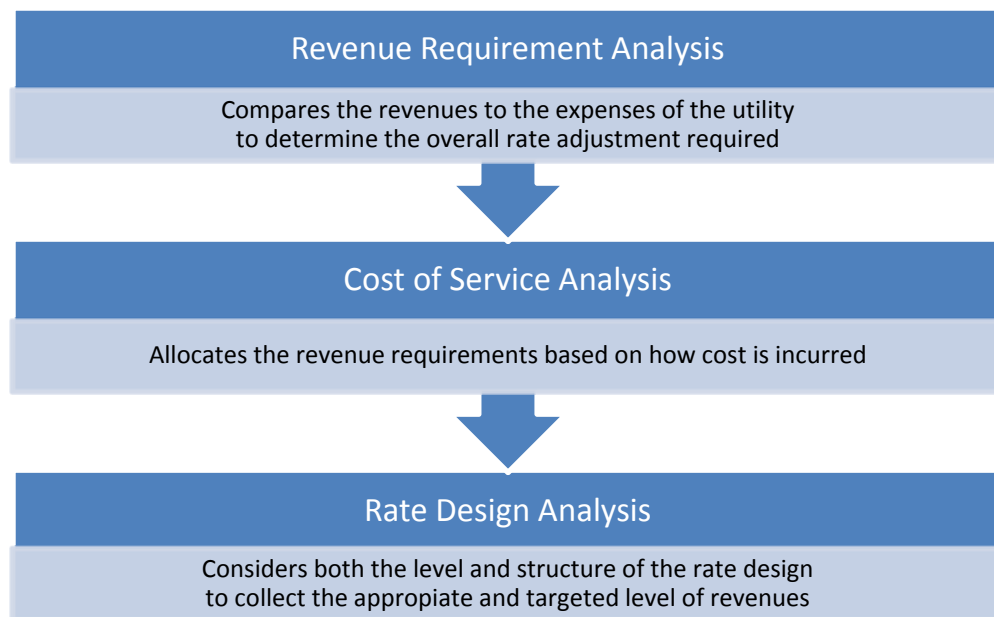
All sewage for MCSD’s customers is treated at the wastewater Management Facility at Hiller Park. MCSD maintains approximately 65 miles of wastewater mains. MCSD recycles treated wastewater for agricultural irrigation at the Fischer Irrigation Site and at Hiller Park. MCSD is committed to maintaining its sewage collection, treatment and disposal systems as a model for other communities.

This report details the methodology, approach, and results of this analysis. Based on discussion with MCSD staff, guidance and direction from the MCSD Board throughout the process, this report presents the recommended revenue adjustments and the corresponding rate impacts.

## Overview of the Rate Setting Process

The scope of this study included the development of cost-based water and wastewater user charges through a comprehensive cost of service and rate design analysis. Utility rates must be set at a level where a utility's operating and capital expenses are met with the revenues received from customers. This is a significant point, as failure to achieve this level could lead to a situation where insufficient funds are available to adequately maintain the system. A comprehensive rate study typically consists of following three interrelated analyses.

- I. **Financial Planning/Revenue Requirement Analysis:** Creation of a five-year plan to support a financially prudent program of on-going maintenance and operating costs, capital improvement and replacement activities, debt financing, and retirement of any outstanding debt. In addition, the long-term plan should fund and maintain reserve balances to adequate levels based on industry standards and MCSD fiscal policies.
- II. **Cost of Service Analysis:** Identifies and apportions annual revenue requirements to customers based on their demand on the utility system.
- III. **Rate Design:** Develops an equitable and proportionate fixed/variable schedule of rates to recover the costs of the utilities. This is also where other policy objectives can be achieved, such as discouraging wasteful water use. The policy objectives are harmonized with cost of service objectives to achieve the delicate balance of equity, financial stability and resource conservation goals.



# Rate Setting Principles

The primary objective when conducting this comprehensive rate and financial analysis was to determine the adequacy of the existing rates (pricing, structure, and revenue sufficiency) and provide the basis for any necessary adjustments to meet the MCSD’s operating and capital needs and policy objectives. MCSD desires a rate structure that fully funds operations, maintenance, and capital costs while providing long term funding of reserves.

## Financial Management, Policies and Rates

A financial plan revolves around the development of a proper long and short-term balance of revenues and expenditures. The following provides an outline of MCSD’s financial targets and policies, and the financial foundation of the cost of service and rate analysis. Over the past years, many generally accepted principles or guidelines have been established to assist in developing utility rates. The purpose of this section of the report is to provide a general background of the methodology and guidelines used for setting cost-based utility rates, in order to provide a higher-level understanding of the rate setting approach detailed later in this report.

As a practical matter, there should be a general set of principles used to guide the development of water and wastewater rates. For water rates, the American Water Works Association (AWWA) establishes these principles in the M1 Manual – *Principles of Water Rates, Fees and Charges*. For wastewater rate setting, the Water Environment Federation (WEF) establishes similar guidelines. These guiding principles help to ensure there is a consistent global approach that is employed by all utilities in the development of their rates (water and water-related utilities, including wastewater and reclaimed water). Below is a summary listing the established guidelines, which public utilities should consider when setting their rates. These closely reflect MCSD’s specified objectives.

Rates should be cost-based, equitable, and set at a level such that they provide revenue sufficiency			
Rates and process of allocating costs should conform to generally accepted rate setting techniques	Rates should provide reliable, stable and adequate revenue to meet the utility’s financial, operational, and regulatory requirements	Rate levels should be stable from year to year	Rates should be easy to understand and administer

These guidelines, along with the MCSD’s objectives, have been utilized within this study as a framework to help develop utility rates that are cost-based and equitable.

## Overview of Rate Setting Environment, Objectives & Process

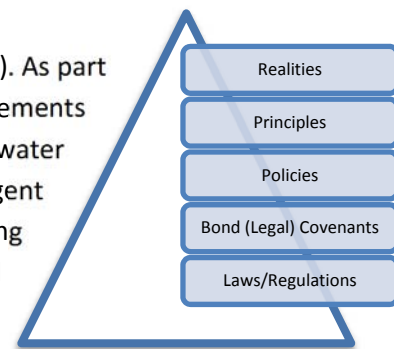
Rate analyses are typically performed every five years to ensure that revenues from rates are adequately funding utility operations, maintenance, and future capital needs. In California, rate analyses also require compliance with the cost-of-service principles imposed by Proposition 218 to ensure that rates correlate to how costs are incurred. Beyond the laws, regulations, and guiding principles, the rates ultimately need to be approved and implemented by the MCSD Board.

## Considerations in Setting Revenue Requirements

There are a multitude of considerations, ranging from financial to political to legal, which must be analyzed or discussed during the revenue requirements process of a rate analysis. This section, along with the accompanying graphic, provides an overview of the considerations that are reviewed during this process.

### Capital Budgeting and Financing

Capital needs are defined by MCSD's Capital Improvement Plan ("CIP"). As part of its budget and planning process, MCSD identifies capital improvements that are necessary for the continued delivery of clean, safe, drinking water and treatment of wastewater in accordance with increasingly stringent wastewater standards. The CIP is funded by a variety of sources including water and wastewater rates, connection (impact) fees, and capital reserves. Recent economic realities, including slower than anticipated growth and usage, have reduced funding and/or delayed funding of critical system improvements.



### Capital Funding: Debt vs. PAYGO

The selection of the most appropriate funding strategy for capital projects is primarily a policy decision between use of cash ("Pay-as-you-go financing" aka PAYGO), the issuance of debt (bonding), or a combination thereof. PAYGO is the use or build-up of cash to fund capital improvements. With debt financing, capital improvements are paid for with borrowed funds (usually through the issuance of bonds) with the obligation of repayment, typically with interest, in future years. Each funding mechanism has a different impact on water rates in the short and long run, different net present values, risks, and legal obligations. Due to the borrowing costs associated with debt, cash funding can be cheaper; however, debt typically ensures greater generational equity for larger and longer lasting capital projects.

Willdan's review of MCSD's CIP revealed that the utility system does not have sufficient funds on hand to meet its planned capital investments without an increase to rates.

Our recommendation, which is consistent with the MCSD funding policy of MCSD, is that MCSD continues to balance the use of all financing options by using debt in the near-term to mitigate the impact on rates, and cash funding in the long-term for ongoing replacement projects.

## Revenue Requirements

The method used by most public utilities to establish their revenue requirements is called the “cash basis” approach of setting rates. As the name implies, a public utility combines its cash expenditures over a period to determine their required revenues from rates and other forms of income. Figure 1-1 below presents the “cash basis” methodology.

Figure 1: Overview of the “Cash Basis” Design

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+ Operation and Maintenance Expenses  
+ Debt Service (Principal and Interest)  
+ Capital Additions Funded with Rate Revenue  
= Total Revenue Requirements

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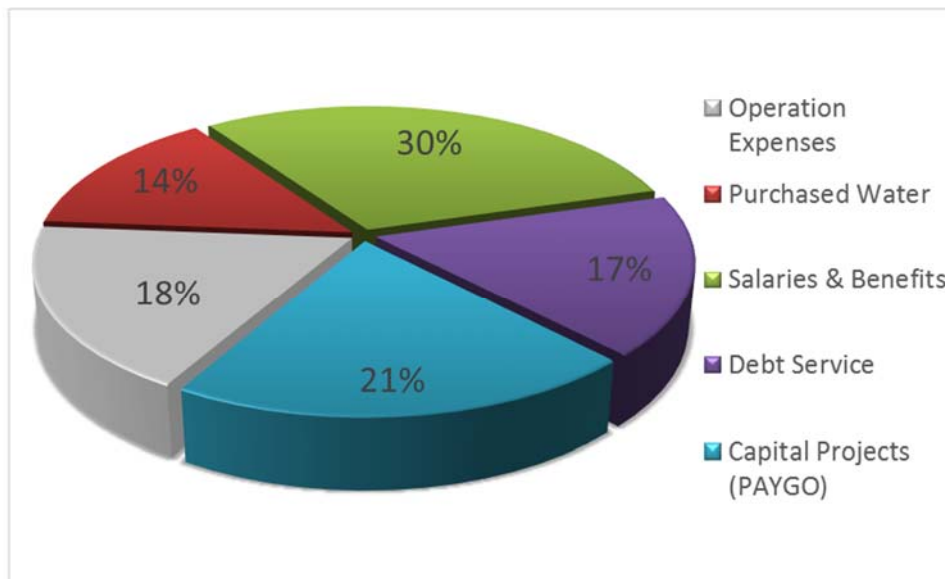
Based on the revenue requirement analysis, the utility can determine the level of revenues needed to meet the overall expenditures.

## MCSD Expenditures – Water & Wastewater

To achieve long-term financial health, a utility’s revenues must be sufficient to meet total expenditures or cash-flow obligations. This “required revenue” includes all incurred costs related to operation and maintenance, capital improvement programs, and principal and interest payments on existing or anticipated debt.

As demonstrated in Figure 2, Water & Wastewater Fund expenditures were categorized into five major classifications: (1) Operation; (2) Purchased Water; (3) Salaries & Benefits; (4) Debt Service; (5) Capital Projects (PAYGO). The pie chart below demonstrates the relative size of the various expense categories for the study test year of FY 2019.

Figure 2: Water & Wastewater Fund - Cost Distribution by Expenditure Classification



Through the study period, debt service (principal and interest) represents a large percentage of the total expenditures (21%). Revenues must be targeted to ensure MCSD meets its debt service coverage requirements of 1.25 times on its existing and future debt service.

In addition, in an effort to establish a reserve fund specifically for funding ongoing renewal and replacement (R&R) projects, MCSD has set a goal to reserve transfer of \$1 million per year for each utility system. This reserve will be utilized to support PAGO funded capital as well as long-term Repair and Replacement (R&R).

## Financial Planning

In the development of the revenue requirements, certain assumptions are utilized to project future expenditures, growth in customers and consumption, and necessary revenue adjustments. MCSD's budget documents are used as the baseline and are then projected over a five-year planning period to account for assumed changes in costs from year to year, as well as adjustments to debt service payments.

Reasonable growth assumptions and prudent financial planning are fundamental in rates that will generate adequate rate revenue to meet the needs of the system. The developed financial model considers the MCSD's existing debt service coverage ratio and operating cash balances (cash on hand). In addition, as part of the financial planning, municipal bond financing is incorporated into the model to fund necessary capital improvements. As debt is redeemed, additional bonds may be utilized to fund additional capital improvements required due to aging infrastructure.

## Rate Setting Principles Summary

In meeting the objectives of MCSD, the rate design must also conform to the State Constitution and the State's Water Code. More specifically, Proposition 218 requires that property related fees and charges, such as water and wastewater rates, not exceed the reasonable cost of providing the service associated with the fee or charge and shall also not exceed the proportional cost of the service attributable to the parcel that is subject to the fee or charge.

In conjunction with Proposition 218, Article X (2) of the State Constitution institutes the need to preserve the State's water supplies and discourage the wasteful or unreasonable use of water by encouraging conservation. Article X (2) is broad in its declarations; however, the Water Code provides guidance to its application for developing water rates. Section 106 declares that the highest use of water is for domestic purposes, and irrigation is secondary. In connection with meeting the objectives of Article X, Water Code Sections 370 (AB2882) and 375 authorize a water purveyor to utilize its water rate design to incentivize the efficient use of water; or stated differently, to encourage conservation.

Although incentives to conserve water could be provided by implementing a higher rate for water as consumption increases, a nexus between rates and cost incurred to provide water at those rates must be developed to achieve compliance with Proposition 218. Therefore, in our analysis, when developing a tiered rate structure, we analyzed the consumption and peaking characteristics of each defined tier to determine the proportional share of cost incurred by each tier. The cost is then divided by consumption to derive a rate per unit of water for each tier. Doing so synchronizes the objectives of Article X (2) and Article XIID (6) in developing a cost of service tiered rate structure.

Besides ensuring compliance with State law, another key principle for a comprehensive rate study is found in economic theory, which suggests that the price of a commodity must roughly equal its cost or value if equity among customers is to be maintained – i.e. cost-based. For example, capacity-related costs are usually incurred by a water utility to meet peak use requirements. Consequently, the customers causing peak demands should pay for the demand-related facilities in proportion to their contribution to maximum demands.

Through refinement of costing and pricing techniques, consumers of a product are given a more accurate price point, representative of what the commodity costs to produce and deliver, to meet their needs, in this case, for water use. The above fundamentals have considerable foundation in economic literature and correlate to the cost of service principles of Proposition 218. This “price-equals-cost” theory provides the basis for much of the subsequent analysis and comment. This theory is particularly important as the proposed rate structure has been developed to encourage the efficient use of water while maintaining economic and cost of service principles.

## Rate Design

The final element, the rate design process, applies the results from the revenue requirements to develop rates that achieve the general guidelines, policies and objectives of MCSD, and compliance with the provisions of law. These objectives are achieved through the development of cost-based rates but may also account for adjustments to expenditures or the level of cash reserves to balance rate shock, continuity of past rate philosophy, conservation objectives, ease of administration, and legal requirements. This section of the report incorporates the general principles, techniques, and economic theory used to set utility rates. These principles, techniques, and economic theory were the starting point for this rate study and the groundwork used to meet MCSD’s key objectives in analyzing and redesigning their utility rates.

This rate study is performed to allocate the costs of providing service to users with rates that are equitable and in compliance with Proposition 218 requirements. The total cost of serving MCSD customers is determined by distributing each of the utility cost components based upon the service demands placed on the MCSD by its customers. Therefore, a cost of service rate study enables a utility to adopt rates based on the costs incurred to serve its customers and corresponding accounts. The purposes of this cost of service study include defining the proportional allocation of the costs of service to users and deriving unit costs to support the development of rates.



# Water Rate Analysis

## Water Consumption and User Characteristics

Willdan examined multiple years of historical billing data to identify various customer classes and applicable growth trends within each class. Based on the data, MCSD currently provides water to approximately 7,140 customer accounts. The billing data was used to determine seasonal demand patterns and overall consumption characteristics. The consumption analysis revealed that MCSD customers have a lower than average use of water, when compared to similar California agencies, which is likely due to its coastal climate.

## Existing Water Revenues

The water utility derives revenue from a variety of sources. Annually, MCSD expects nearly 92% of the Water Fund's revenue to be generated from rate revenues (monthly user rates). In Fiscal Year 2017-2018, MCSD generated nearly \$3.3 million in operating rate revenue, compared with \$280 thousand in non-operating revenue, such as miscellaneous service charges, interest income and capacity fees.

## Existing Water Expenditures

To achieve long-term financial health, a utility's revenues must be sufficient to meet total expenditures or cash obligations. All incurred costs related to operation and maintenance, debt service, and capital costs must be funded. MCSD estimates approximately \$3.8 million in total system expenditures.

Figure 3 provides the Baseline Scenario for the Water Funds. This represents current and projected financial conditions of the water utility excluding any rate/revenue adjustments over the next 5 years. As the figure illustrates, existing revenue levels are not sufficient to meet the projected expenditures.

Figure 3: Water Fund - Baseline Financial Scenario

Description	Existing Rates	Projected For Fiscal Year Ending June 30:				
		2019	2020	2021	2022	2023
<b>Revenues:</b>						
User Rate Revenues	\$ 3,301,951	\$ 3,309,788	\$ 3,388,683	\$ 3,474,574	\$ 3,562,649	\$ 3,654,076
Other Revenues	280,758	280,758	294,493	308,856	324,077	339,989
<b>Total Revenues</b>	<b>\$ 3,582,709</b>	<b>\$ 3,590,546</b>	<b>\$ 3,683,176</b>	<b>\$ 3,783,430</b>	<b>\$ 3,886,726</b>	<b>\$ 3,994,065</b>
Percentage Rate Adjustment		0.00%	0.00%	0.00%	0.00%	0.00%
<b>System Expenditures:</b>						
O&M Costs	\$ 2,459,940	\$ 2,459,940	\$ 2,577,596	\$ 2,693,922	\$ 2,821,799	\$ 2,957,276
Debt Service (P&I)	263,724	263,724	486,928	686,122	740,245	812,927
R&R Transfer	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
<b>Total Operating &amp; Non-Operating</b>	<b>\$ 3,723,664</b>	<b>\$ 3,723,664</b>	<b>\$ 4,064,524</b>	<b>\$ 4,380,044</b>	<b>\$ 4,562,043</b>	<b>\$ 4,770,203</b>
<b>Revenue Excess (Deficiency)</b>	<b>\$ (140,955)</b>	<b>\$ (133,118)</b>	<b>\$ (381,348)</b>	<b>\$ (596,614)</b>	<b>\$ (675,317)</b>	<b>\$ (776,138)</b>
<b>Debt Service Coverage</b>	<b>4.26</b>	<b>4.29</b>	<b>2.27</b>	<b>1.59</b>	<b>1.44</b>	<b>1.28</b>

## Projected Operating Results

Given the existing financial condition of the utility, without near term revenue adjustments, MCSD's water fund will not be able to meet its targeted objectives without rate adjustments. As such, Willdan worked with MCSD staff for the development of a financial plan and rate structure that provides gradual adjustment to provide continued financial stability throughout the study period. Numerous financial scenarios were analyzed and presented over the course of the study. The results and recommendations provided in the analysis were presented in August 2018 and account holders were subsequently mailed a Proposition 218 Noticed in September. The recommended financial scenario was developed and analyzed to achieve a positive net income within the five-year study period and to maintain compliance with the MCSD's Debt Coverage Ratio.

Figure 4 provides a summary of the projected operating results for the water system and the corresponding impact of the proposed rate adjustments.

Figure 4: Water - Projected Operating Results

Description	Projected For Fiscal Year Ending June 30:				
	2019	2020	2021	2022	2023
<b>Revenues:</b>					
User Rate Revenues	\$ 3,394,078	\$ 3,650,743	\$ 3,917,744	\$ 4,190,549	\$ 4,434,226
Other Revenues	295,758	310,243	325,393	341,442	358,222
Total Revenues	\$ 3,689,836	\$ 3,960,986	\$ 4,243,137	\$ 4,531,990	\$ 4,792,447
Percentage Rate Adjustment	<b>7.00%</b>	<b>7.00%</b>	<b>6.00%</b>	<b>6.00%</b>	<b>3.00%</b>
<b>System Expenditures:</b>					
O&M Costs	\$ 2,459,940	\$ 2,577,596	\$ 2,693,922	\$ 2,821,799	\$ 2,957,276
Debt Service (P&I)	263,724	486,928	686,122	740,245	812,927
R&R Transfer	960,000	890,000	860,000	960,000	1,000,000
Total Operating & Non-Operating	\$ 3,683,664	\$ 3,954,524	\$ 4,240,044	\$ 4,522,043	\$ 4,770,203
<b>Revenue Excess (Deficiency)</b>	<b>\$ 6,172</b>	<b>\$ 6,462</b>	<b>\$ 3,094</b>	<b>\$ 9,947</b>	<b>\$ 22,244</b>
<b>Debt Service Coverage</b>	<b>4.66</b>	<b>2.84</b>	<b>2.26</b>	<b>2.31</b>	<b>2.26</b>

## Cost of Service Analysis

Following the consumption and revenue requirement analysis, the next stage was to distribute costs (revenue requirements) to functional components, and ultimately, to customers. The cost of service analysis is a systematic process by which revenue requirements are allocated by function to generate a classification of equitable costs in proportion to the service received by each account. The cost of services analysis combines the Water Consumption and Usage Characteristics analysis with the Revenue Requirements and expenditure analyses. This section of the report discusses the methodology of allocating expenditures to the functional cost components.

### Cost Allocation by Function

To equitably allocate the cost to customers in proportion to their usage and peaking demands, costs first need to be allocated to functional cost components. The cost of service allocation completed in this study is established on the base-extra capacity method endorsed by the American Water Works Association (AWWA). Under the base-extra capacity method, revenue requirements are allocated based on the demand placed on the water system. Allocations to functional cost components are established on average day (base) usage, maximum day (peak) usage, meters and services, and billing and collection. Use of this methodology results in an AWWA-accepted cost distribution to customers and a means of calculating and designing rates to proportionately recover those costs.

A water system COS analysis is a detailed study that allocates the Revenue Requirements of the system to individual customer classes. This process involves four basic steps as follows:

- **Revenue Requirement** - The revenue requirement determines the costs to be supported by monthly user rates. The amount is developed based on a projection of expenses for FY 2019 (the Test Year) as developed by utility staff. Sources for the financial projections include the currently budgeted expenditures for operations and capital improvements. Projections for customer growth, operation and maintenance costs, and capital paid from current earnings are based on information provided by MCSD.
- **Cost Functionalization** - The cost functionalization process categorizes the revenue requirement by basic utility function and service. In this analysis, the water costs separated into Supply/Treatment, Transmission, Distribution, Administration and Customer functions.
- **Classification** - Once functionalized, the costs are classified into the fundamental cost categories that directly influence the nature and type of cost. For MCSD, costs are classified into based demand-related (fixed costs), systemwide max-day, distribution specific max-day and customer-related costs.
- **Allocation** - Based on these cost classifications, costs are then allocated to the individual customer classes based on their usage characteristics. For example, since the max-day costs are variable in nature, they are allocated to the various customer classes based on billable flows.

## Current Budget and Revenue

The determination of the monthly user rates and charges to be applied to water customers is based upon the estimated revenue requirements of the system. Revenue requirements consist of the operating, maintenance, debt service, capital and other monetary expenditures necessary to provide, maintain and perpetuate quality services to meet the goals and objectives of the utility system.

## Methodology

The rate analysis performed herein utilizes the projected water system budget for fiscal year 2018/19 (the "Water Budget" for fiscal year ending June 30, 2019) as the basis for developing the revenue requirements to be recovered from user rates. The Water Budget, as prepared by MCSD, has certain expenditures that are allocated between identifiable functional components, as well as expenditures that are associated with the combined system operations. In developing the rate analysis, certain adjustments are made such that the expenditures are categorized into either Operating and Maintenance (O&M) expenses or Non-Operating expenses (e.g. debt service, capital reserves, general fund transfer, etc.).

## Classification of Costs

The allocation of functionalized water system costs to service characteristics follows the base-extra capacity cost allocation method included in AWWA Manual M-1. Applying this methodology, costs are classified into the following categories:

**Base** capital costs and O&M expenses associated with service to customers under average demand conditions. This category does not include any costs attributable to variations in water use resulting from peaks in demand. Base costs tend to vary directly with the total quantity of water used.

**Max Day** (Extra Capacity) costs attributable to facilities that are designed to meet peaking requirements. These costs include capital and operating costs for additional plant and system capacity beyond that required for average usage. For the purpose of this analysis, the max/extra capacity costs are further separated into systemwide facilities and distribution facilities. Such a separation is done to provide a basis to exclude the allocation of distribution costs from wholesale customers that operate their own distribution facilities for their customers.

**Humboldt Bay Municipal Water MCSD** costs which are attributable to the direct and indirect costs of purchased water.

**Customer Service** costs include those related to the maintenance and servicing of customer accounts, and meter service related costs. Customer account costs are uniform to all customers and include such costs as meter reading, billing, accounting, and administration. Meter service costs include maintenance and capital costs associated with meters and services related costs.

Figure 5 shows a summary distribution of the utility’s expenditures for the test year of the study period. To generate this data, MCSD’s budget was analyzed line-item by line-item and expenditures were distributed based on a variety of demand factors: average day (base), maximum day (peak) usage, meters and services, and customer accounts.

Figure 5: Distribution of Expenditure by Function

Description	Costs 2019	Projected Revenues	Difference	
			\$ Amount	Percent
<b>Total Cost of Service:</b>				
Base	\$ 926,235			
Max Day/Extra Capacity	672,263			
Sub-Total Non Customer	\$ 1,598,498			
Customer	981,499			
Total	\$ 2,579,997			
<b>EXISTING RATES</b>				
<b>Customer Class:</b>				
Residential	\$ 1,776,493	\$ 1,641,030	\$ (135,463)	-8%
Multifamily	495,357	537,280	41,923	8%
Nonresidential	308,148	245,200	(62,948)	-20%
Total	\$ 2,579,998	\$ 2,423,510	\$ (156,488)	-6%
<b>PROPOSED RATES</b>				
<b>Customer Class:</b>				
Residential	\$ 1,773,678	\$ 1,699,940	\$ (73,738)	-4%
Multifamily	493,410	556,050	62,640	13%
Nonresidential	312,909	257,650	(55,259)	-18%
Total	\$ 2,579,997	\$ 2,513,640	\$ (66,357)	-3%

Once the system cost causation analysis is complete, the next step is to design the most equitable and appropriate rate structure to recover those revenues.

### Rate Design Analysis

In an effort to meet the objectives of establishing rates that are administratively efficient, equitable and based upon the cost of service provided, the analysis developed herein includes a review of the existing rate structure. In reviewing the rate structure, primary consideration is given to the overall equity of the rate structure as it applies to various customers and customer classes. Consideration is also given to administrative efficiency, water conservation goals, the comparativeness of the rate structure with other regional utility systems, as well as common industry standards for water utility rates. Upon review, certain rate structure modifications are proposed. A general description of the proposed rate structure revisions is provided in the following discussions.

## Criteria and Considerations

In determining the appropriate rate level and structure, Willdan, in conjunction with MCSD staff, analyzed various generated financial scenarios concerning the proposed adjustments and the implications attributed to those decisions.

A simplified list of some of the rate design considerations that were reviewed is listed:

- Clear and understandable
- Easily administered
- Cost of service principles
- Revenue stability
- Prudent financial planning
- Capital Funding Options
- Equity
- Comply with legal and regulatory requirements

Every consideration has merit and plays an important role in a comprehensive rate study. When developing MCSD's proposed rates, all the criteria were taken into consideration, in addition to the objective of minimizing rate shock. Determining the appropriate balance is crucial, as some of the criteria sometimes conflict with one another, i.e. the conservation measures and cost-based. In designing rates, there will always be a goal of achieving balance between the various objectives as well as policy decisions made by the MCSD Board.

## Existing Rate Structure

The existing rate structure has a two-tier rate structure for residential and non-residential customers. The structure is comprised of the following cost components.

**Base Charge:** Charge is per month and is based on the size of water meter. This component of the water rate reflects the cost of metering support, customer service, and maintaining the account.

**Commodity Charge:** Charge is \$1.47 for the first 800 cubic feet (CF) used per month; \$3.66 for anything over 800 CF. This supports the variable cost of the system that brings the water to homes or businesses.

**Humboldt Bay Pass-through:** The pass-through rate recovers cost increases outside the control of MCSD, such as increased cost of purchased water, pursuant to Government Code Section 53756. The current pass-through rate is \$1.40 per 100 CF.

## Proposed Rate Structure

Since the existing rates are not expected to generate adequate revenue to support the MCSDs expenditure needs, Willdan recommends certain modifications to the existing rates and rate structure. Below are the proposed components of the recommended rate structure.

**Base Charge:** Although MCSD applies a practice of incrementing the base monthly charges for larger connections, the incrementing equivalency factors are not consistent with industry standards. As such, it is proposed that MCSD revise the current methodology related to the equivalency factors for the various meter sizes. The proposed methodology for incrementing the monthly availability charge is based upon standardized meter/capacity criteria established by the American Water Works Association (AWWA) relative to the size of the water meter. The AWWA equivalent meter capacity criteria are commonly used to establish a standard unit of measure for customers referred to as an Equivalent Residential Unit (ERU). Based upon the established standards, an ERU is equal to one single-family residential connection with a 5/8x3/4-inch water meter. The applicable ERU factors for larger water meters are based upon the incremental increase in potential capacity of those meters as compared to the standard meter size. These factors are derived from actual flow testing results as performed and defined by the AWWA, and commonly utilized by the water and wastewater utility industry. In fact, many state public service commissions have adopted the AWWA meter equivalency basis as the required structure for rate-making by the private utility systems within their regulatory jurisdiction. Similar to the current practice utilized by MCSD, the AWWA equivalency factors can be applied to the monthly base charge for a 5/8x3/4-inch meter in order to calculate the applicable base charges for each meter size.

**Commodity Charge:** Charge is applied to all units of water used per month and split between two tiers. Starting in January 2019, all users will be charge \$1.57 cents for the first 800 CF and \$3.93 for anything over 800 CF.

**Humboldt Bay Pass-through:** The pass-through rate will be adjusted annually to reflect and recover cost increases outside the control of MCSD, such as increased cost of purchased water, pursuant to Government Code Section 53756. This will ensure appropriate cost recovery without the possibility of overcharging customers for assumed increases. The water adjustment charge will be calculated as necessary to reflect cost increases implemented by HBMWD. The pass-through rate starting in January 2019 will be \$1.58 per 100 CF.

# Recommended Water Charges

The proposed revenue adjustments as a percentage do not equal or necessary correlate to an equivalent percentage increase to rates or monthly bills. The results of the cost-of-service analysis and rate redesign will affect users differently, based on meter size and water consumed.

## Base Charge

In accordance with the existing rate structure, the base charges are applied by the size of the water meter for residential and nonresidential customers. For multi-family customers, the base charges are billed by the number of dwelling units. Figure 6 provides a breakdown of the projected water customer accounts/units by customer class.

Figure 6: Total Water Accounts/Units

Description	Estimated 2018	Projected For Fiscal Year Ending June 30:				
		2019	2020	2021	2022	2023
<b>WATER SYSTEM</b>						
<b>Accounts - Inside:</b>						
Residential	4,860	4,872	4,884	4,897	4,910	4,924
Multi-Family	1,965	1,971	1,977	1,983	1,989	1,998
Nonresidential	295	295	295	295	295	295
Subtotal	7,120	7,138	7,156	7,175	7,194	7,217
<b>Accounts - Outside:</b>						
Residential	6	6	6	6	6	6
Multi-Family	0	0	0	0	0	0
Nonresidential	20	20	20	20	20	20
Subtotal	26	26	26	26	26	26
<b>Accounts - Combined:</b>						
Residential	4,866	4,878	4,890	4,903	4,916	4,930
Multi-Family	1,965	1,971	1,977	1,983	1,989	1,998
Nonresidential	315	315	315	315	315	315
Total	7,146	7,164	7,182	7,201	7,220	7,243



The projected base charge revenue related is approximately \$1.4 million dollars for fiscal year 2019. Figure 7 provides the projected base charge revenue by customer class for the projection period.

Figure 7: Projected Base Charge Revenue

Description	Proposed Rates 2019	Projected For Fiscal Year Ending June 30:			
		2020	2021	2022	2023
<b>WATER REVENUES</b>					
<b>Monthly Base Charges - Inside:</b>					
Residential	\$ 951,760	\$ 1,024,280	\$ 1,097,410	\$ 1,170,670	\$ 1,230,520
Multi-Family	376,790	404,380	431,910	459,220	481,800
Nonresidential	84,040	96,600	109,970	124,150	137,330
Total	\$ 1,412,590	\$ 1,525,260	\$ 1,639,290	\$ 1,754,040	\$ 1,849,650
<b>Monthly Base Charges - Outside:</b>					
Residential	\$ 1,580	\$ 1,750	\$ 1,930	\$ 2,100	\$ 2,260
Multi-Family	0	0	0	0	0
Nonresidential	9,910	11,370	12,930	14,570	16,090
Total	\$ 11,490	\$ 13,120	\$ 14,860	\$ 16,670	\$ 18,350
<b>Monthly Base Charges - Combined:</b>					
Residential	\$ 953,340	\$ 1,026,030	\$ 1,099,340	\$ 1,172,770	\$ 1,232,780
Multi-Family	376,790	404,380	431,910	459,220	481,800
Nonresidential	93,950	107,970	122,900	138,720	153,420
Total	\$ 1,424,080	\$ 1,538,380	\$ 1,654,150	\$ 1,770,710	\$ 1,868,000

Rates related to Meters and Services are distributed on an equivalent meter factor, as endorsed by the AWWA. Larger meters place a higher demand on the utility due to a higher capacity and total flow rate, which in turn cause higher maintenance costs.

Estimated revenue related to the volumetric charges is approximately around \$1.9 million dollars for fiscal year ending 2019. Figure 8, highlights volumetric, pass-through and bulk water rate revenue through 2024.

Figure 8: Projected Volumetric Revenues

Description	Proposed Rates 2019	Projected For Fiscal Year Ending June 30:			
		2020	2021	2022	2023
<b>WATER REVENUES</b>					
<b>Volumetric Rates - Inside:</b>					
Residential	\$ 742,100	\$ 810,770	\$ 881,330	\$ 954,880	\$ 1,020,640
Multi-Family	179,260	192,220	205,170	218,220	229,270
Nonresidential	155,160	166,180	176,840	187,690	196,490
Pass-through Charge	855,990	902,960	957,010	1,012,640	1,070,290
Bulk Water	17,528	19,103	20,914	22,859	24,946
Total	\$ 1,950,038	\$ 2,091,233	\$ 2,241,264	\$ 2,396,289	\$ 2,541,636
<b>Volumetric Rates - Outside:</b>					
Residential	\$ 4,500	\$ 4,820	\$ 5,130	\$ 5,440	\$ 5,700
Multi-Family	0	0	0	0	0
Nonresidential	8,540	9,140	9,720	10,320	10,800
Pass-through Charge	6,920	7,170	7,480	7,790	8,090
Total	\$ 19,960	\$ 21,130	\$ 22,330	\$ 23,550	\$ 24,590
<b>Total Volumetric Combined:</b>					
Residential	\$ 746,600	\$ 815,590	\$ 886,460	\$ 960,320	\$ 1,026,340
Multi-Family	179,260	192,220	205,170	218,220	229,270
Nonresidential	163,700	175,320	186,560	198,010	207,290
Pass-through Charge	862,910	910,130	964,490	1,020,430	1,078,380
Bulk Water	17,528	19,103	20,914	22,859	24,946
Total	\$ 1,969,998	\$ 2,112,363	\$ 2,263,594	\$ 2,419,839	\$ 2,566,226

Figure 9 provides the proposed base charges, volumetric rates and pass-through rate. The pass through will be adjusted as necessary to reflect the adjustments in the wholesale water charges established by HBWMD. This mechanism enables MCSD to only pass-through the actual costs of purchased water; while providing an increase in financial stability and certainty to MCSD.

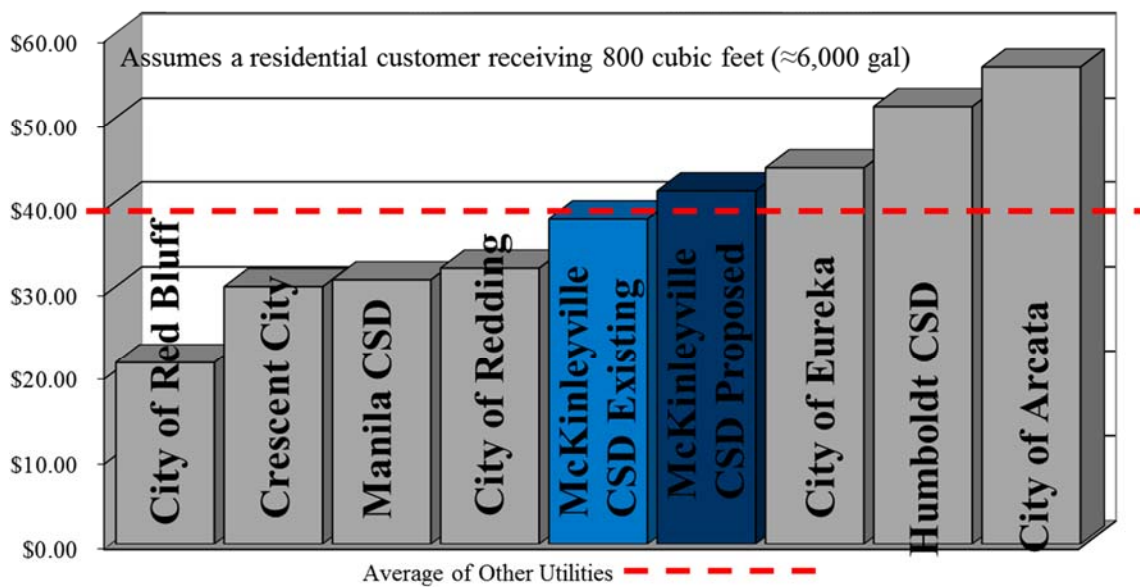
Figure 9: Proposed Rates

TABLE 1 PROPOSED RATES - WATER						
Description	Year 2019	Year 2020	Year 2021	Year 2022	Year 2023	
<b>Monthly Base Charge:</b>						
5/8 Inch	\$ 16.47	\$ 17.62	\$ 18.68	\$ 19.80	\$ 20.39	
3/4 Inch	\$ 22.23	\$ 24.49	\$ 26.71	\$ 29.11	\$ 30.59	
1.0 Inch	\$ 33.60	\$ 38.06	\$ 42.59	\$ 47.52	\$ 50.98	
1.5 Inch	\$ 62.09	\$ 71.89	\$ 82.01	\$ 93.06	\$ 101.95	
2.0 Inch	\$ 96.35	\$ 112.59	\$ 129.45	\$ 147.91	\$ 163.12	
3.0 Inch	\$ 179.52	\$ 214.61	\$ 251.43	\$ 291.85	\$ 326.24	
4.0 Inch	\$ 290.53	\$ 343.59	\$ 399.00	\$ 459.76	\$ 509.75	
6.0 Inch	\$ 575.46	\$ 682.07	\$ 793.53	\$ 915.75	\$ 1,019.50	
8.0 Inch	\$ 917.71	\$ 1,088.92	\$ 1,268.00	\$ 1,464.41	\$ 1,631.20	
<b>Volumetric Per 100 CF:</b>						
Block 1 - 0 to 8 CCF	\$ 1.57	\$ 1.68	\$ 1.78	\$ 1.89	\$ 1.95	
Block 2 - All Over 8 CCF	\$ 3.93	\$ 4.20	\$ 4.45	\$ 4.73	\$ 4.88	
Pass-through Charge (P/HCF)	\$ 1.58	\$ 1.64	\$ 1.71	\$ 1.78	\$ 1.85	

## Rate Comparison

While the cost structure and facilities vary greatly between water utilities, rate comparisons provide stakeholders a barometer of its rates in relation to surrounding communities. For increased application, the figure below compares agencies where HBMWD is the wholesale service provider. Figure 10 provides the estimated monthly bill for a typical residential customer (800 CF). As the figure demonstrates, holding rates level, the Proposed FY 2018-19 rates will still be among the average in the region.

Figure 10: Single Family Regional Rate Comparison (800 Cubic Feet)



# Wastewater Rate Analysis

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The wastewater utility is in a similar financial position when compared to the water fund. Although starting with higher reserves, the Wastewater Fund is facing significant future capital expenditures and increased costs related to operations and a need to repair and replace aging infrastructure. This section of the report outlines the details of the analysis and the approach to developing the recommendations.

## Wastewater Discharge and User Characteristics

As wastewater usage (discharge) is not metered, an examination of seasonal water consumption plays a critical role in ensuring equitable and revenue sufficient rates. Willdan examined multiple years of historical billing data to identify various customer classes and applicable growth trends within each class. Furthermore, billing data was analyzed to determine seasonal demand patterns and overall consumption characteristics. These discharge assumptions were cross-analyzed against treatment plant information (gallons treated) to confirm the appropriateness of the user discharge analysis.

## Customer Statistics

During the Fiscal Year 2017, an analysis of the wastewater data identified service to an estimated 6,253 accounts across 26 different customer land use classifications and discharging an estimated 429,000 CF of wastewater. A projection of customers and flows is necessary in the development of rates.

## Existing Wastewater Revenues

Like water, the Wastewater Fund receives a majority of its revenues from rates. In Fiscal Year ending 2017, the Wastewater Fund yielded \$3.3 million in operating rate revenue, compared with \$196 thousand in non-operating revenue.

## Existing Wastewater Expenditures

To achieve long-term financial health, a utility's revenues must be sufficient to meet total expenditures or cash obligations. This "required revenue" includes all incurred costs related to operation and maintenance, debt service, and capital costs. MSCD estimates approximately \$3.8 million in total system expenditures.

Figures 12 demonstrates the Baseline Scenario for the Wastewater Fund. This represents current and projected financial conditions of the water utility excluding any revenue adjustment (increases) over the next 5 years.

Figure 12: Wastewater Fund - Baseline Financial Scenario

Description	Existing Rates	Projected For Fiscal Year Ending June 30:				
		2019	2020	2021	2022	2023
<b>Revenues:</b>						
User Rate Revenues	\$ 3,303,500	\$ 3,303,390	\$ 3,348,770	\$ 3,394,720	\$ 3,443,480	\$ 3,492,970
Other Revenues	181,164	181,164	187,686	194,443	201,443	208,695
Total Revenues	\$ 3,484,664	\$ 3,484,554	\$ 3,536,456	\$ 3,589,163	\$ 3,644,923	\$ 3,701,665
Percentage Rate Adjustment		0.00%	0.00%	0.00%	0.00%	0.00%
<b>System Expenditures:</b>						
O&M Costs	\$ 1,858,870	\$ 1,858,870	\$ 1,935,682	\$ 2,009,794	\$ 2,087,439	\$ 2,171,401
Debt Service (P&I)	947,439	947,439	1,233,749	1,266,129	1,262,129	1,256,023
R&R Transfer	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Total Operating & Non-Operating	\$ 3,806,309	\$ 3,806,309	\$ 4,169,431	\$ 4,275,923	\$ 4,349,568	\$ 4,427,424
Revenue Excess (Deficiency)	\$ (321,645)	\$ (321,755)	\$ (632,975)	\$ (686,761)	\$ (704,645)	\$ (725,760)
Debt Service Coverage	1.72	1.72	1.30	1.25	1.23	1.22

### Projected Operating Results

Given the existing financial condition of the utility, without near term revenue adjustments, MCSD’s water fund will not be able to meet its targeted objectives without increases in the future. As such, Willdan worked with MCSD staff to seek input for the development a financial plan and rate structure that provides gradual adjustment to provide continued financial stability throughout the study period. Numerous financial scenarios were analyzed and presented over the course of the study. The results and recommendations provided in the analysis were presented in August 2018 and stakeholders were subsequently mailed a Proposition 218 Noticed in September. The recommended financial scenario was structured and analyzed to achieve a positive net income within the five-year study period and to maintain be in compliance with the MCSD’s Debt Coverage Ratio.

Figure 13 provides a summary of the projected operating results for the wastewater system and the corresponding impact of the proposed rate adjustments.

Figure 13: Wastewater - Projected Operating Results

Description	Existing Rates	Projected For Fiscal Year Ending June 30:				
		2019	2020	2021	2022	2023
<b>Revenues:</b>						
User Rate Revenues	\$ 3,303,500	\$ 3,419,690	\$ 3,835,860	\$ 4,004,460	\$ 4,181,750	\$ 4,371,210
Other Revenues	196,164	196,164	203,226	210,542	218,122	225,974
Total Revenues	\$ 3,499,664	\$ 3,615,854	\$ 4,039,086	\$ 4,215,002	\$ 4,399,872	\$ 4,597,184
Percentage Rate Adjustment		7.00%	7.00%	3.00%	3.00%	3.00%
<b>System Expenditures:</b>						
O&M Costs	\$ 1,858,870	\$ 1,858,870	\$ 1,935,682	\$ 2,009,794	\$ 2,087,439	\$ 2,171,401
Debt Service (P&I)	947,439	947,439	1,233,749	1,266,129	1,262,129	1,256,023
R&R Transfer	800,000	800,000	860,000	930,000	1,000,000	1,000,000
Total Operating & Non-Operating	\$ 3,606,309	\$ 3,606,309	\$ 4,029,431	\$ 4,205,923	\$ 4,349,568	\$ 4,427,424
Revenue Excess (Deficiency)	\$ (106,645)	\$ 9,545	\$ 9,655	\$ 9,079	\$ 50,304	\$ 169,760
Debt Service Coverage	1.73	1.85	1.70	1.74	1.83	1.93

\*Note revenue projections may slightly increase assuming the “Brewery” land use class is implemented.

## Cost of Service Analysis

Following the discharge and revenue requirement analysis, the next stage is to distribute costs (revenue requirements) to functional components, and ultimately, to each customer class. The cost of service analysis is a systematic process by which revenue requirements are allocated by function to generate a classification of equitable costs in proportion to the service received for each user class.

This section of the report discusses the allocation of operating and capital costs to the applicable Flow, parameters, the determination of unit rates, and the calculation of user class cost responsibility. Similar to water, a wastewater system COS analysis is a detailed study that allocates the Revenue Requirements of the system to individual customer classes. This process involves three basic steps as follows:

- **Revenue Requirement** - The revenue requirement determines the costs to be supported by monthly user rates. The amount is developed based on a projection of expenses for FY 2019 (the Test Year). Sources for the financial projections include the currently budgeted expenditures for operations and capital improvements. Projections for customer growth, operation and maintenance costs, and capital paid from current earnings are based on information provided by MCSD.
- **Cost Functionalization** - The cost functionalization process categorizes the revenue requirement by basic utility function and service. In this analysis, the wastewater costs separated into Treatment, Collection, Administration and Customer functions.
- **Allocation** - Based on these cost functionalization, costs are then allocated to the individual customer classes based on their usage characteristics.

## Current Budget and Revenue

The determination of the monthly user rates and charges to be applied to wastewater customers is based upon the estimated revenue requirements of the system. Revenue requirements consist of the operating, maintenance, debt service, capital and other monetary expenditures necessary to provide, maintain and perpetuate quality services to meet the goals and objectives of the utility system.

## Methodology

The rate analysis performed herein utilizes the projected wastewater system budget for fiscal year 2018/19 (the "Wastewater Budget" for fiscal year ending June 30, 2019) as the basis for developing the revenue requirements to be recovered from user rates. The Wastewater Budget, as prepared by MCSD, has certain expenditures that are allocated between identifiable functional components, as well as expenditures that are associated with the combined system operations. In developing the rate analysis, certain adjustments are made such that the expenditures are categorized into either Operating and Maintenance (O&M) expenses or Non-Operating expenses (e.g. debt service, capital reserves, general fund transfer, etc.).

## Cost Allocation by Function

The cost of service allocation conducted in this study is established on the flow and strength characteristics method, which is endorsed by the Water Environmental Federation (WEF). Under this method, revenue requirements are allocated to the different user classes proportionate to their use of the wastewater system. Allocations are based on customers and flow volume, and components of treatment, collection, administration and customer costs. Use of this methodology results in a generally accepted cost distribution among customer classes and a means of calculating and designing rates to proportionately recover those costs.

Figure 14 presents the allocated costs by function and customer class. This analysis is important in order to determine an equitable means of allocating costs to utility demand.

Figure 14: Distribution of Expenditure by Function

Description	Costs 2019	Projected Revenues	Difference	
			\$ Amount	Percent
<b>Total Cost of Service:</b>				
Treatment	\$ 1,151,281			
Collection	825,547			
Sub-Total Non Customer	\$ 1,976,828			
Customer	1,613,318			
Total	\$ 3,590,146			
<b>PROPOSED RATES</b>				
<b>Customer Class:</b>				
2 sewer Units/Commercial	\$ 2,663	\$ 2,810	\$ 147	5.52%
Apartment/Multi Unit (Each)	804,258	816,700	12,442	1.55%
Bakery	3,157	2,030	(1,127)	-35.70%
Barber/Beauty Shop	3,034	3,020	(14)	-0.46%
Car Wash	3,883	3,100	(783)	-20.16%
Church & Residence	894	950	56	6.26%
Churches	11,581	9,820	(1,761)	-15.21%
Coast Guard Station/Airport	40,169	25,150	(15,019)	-37.39%
Dialysis Clinic	9,997	6,050	(3,947)	-39.48%
Fire Station/School	9,791	7,380	(2,411)	-24.62%
Gas Stations (No Market)	4,084	4,090	6	0.15%
Laundromats	15,241	10,220	(5,021)	-32.94%
Market	43,986	26,620	(17,366)	-39.48%
Metered Septage Vault	20,190	12,880	(7,310)	-36.21%
Moble Homes (Each)	19,360	18,400	(960)	-4.96%
Motels/Hotels	30,626	18,790	(11,836)	-38.65%
Office Building/Post Office	42,059	46,900	4,841	11.51%
Restaurant/Tavern	135,590	82,540	(53,050)	-39.13%
Retail/Banks/Theater/Other	43,436	34,920	(8,516)	-19.61%
Round Table/Market	5,276	3,540	(1,736)	-32.90%
Sewer Only Accounts	11,182	15,560	4,378	39.15%
Sewer Units - Commercial	819	900	81	9.89%
Single Family Residential	2,322,809	2,261,240	(61,569)	-2.65%
Two Sewer Units/Business	4,947	5,000	53	1.07%
Two Sewer Units/Daycare	1,115	1,080	(35)	-3.14%
Total	\$ 3,590,147	\$ 3,419,690	\$ (170,457)	-4.75%



The separation of costs into these functional components provides the means for further allocation to the customer classes based upon their respective demand of each function. The resulting distribution percentages are utilized to allocate annual required revenue to each customer class based on the class' respective demand on the system

Once the system cost causation analysis is complete, the next step is to design an equitable rate structure to recover the revenues.

## Rate Design Analysis

The final step of the rate study is the design of the wastewater rates to collect the desired level of revenue determined in the revenue requirement analysis. During this analysis, consideration is given to the levels of the rates. This section reviews the proposed wastewater rate design for the MCSD.

## Criteria and Considerations

In determining the appropriate rate level and structure, Willdan, in conjunction with MCSD staff, analyzed various generated financial scenarios concerning the proposed adjustments and the implications attributed to those decisions.

Listed below is a simplified list of the design considerations that were reviewed:

- Consideration of the customer's ability to pay
- Clear and understandable rates
- Easily administered
- Outdoor water usage
- Revenue stability
- Efficient allocation of resources
- Capital Funding Options
- Equity
- Comply with legal and regulatory requirements

When developing the proposed rates all of the criteria were taken into consideration. Determining the appropriate balance is crucial, as some of the criteria occasionally conflict with one another, i.e. the customer's ability to pay and cost-based rates. In designing rates, there will always be concessions between the various objectives; however, the proposed rates meet all of the leading objectives of MCSD as discussed with staff and the Board.

## Existing Rate Structure

The existing rate structure is a three-tiered rate structure for residential and two-tier rate structure for non-residential classes, both of which, also includes a base monthly rate. The structure is comprised of the following cost components.

**Base Charge** is per month and is of the same for each customer class regardless of connection size. This component of the wastewater rate reflects a portion of operations, customer service, and maintaining the accounts.

**Commodity Charge** This charge reflects the cost of service related to the projected discharge and discharge characteristics for all remaining classes.

### **Proposed Rate Structure**

Willdan recommends that some components of the rate structure be modified to reflect the current analysis and allocation of the costs incurred. Below are the proposed components of the recommended rate structure – while each customer class' rate(s) is comprised of these charges, the specific rates may differ based on land use category.

**Base Charge:** A fixed and uniform rate, applied per month, regardless of customer class or connection size. This component of the wastewater rate reflects a portion of operations, customer service, and maintaining the account.

**Commodity Charge:** Charge has been updated to reflect the cost of service related to discharge strengths based on land use category. The proposed rate for the Single Family Residential land use class is \$2.55 per 100 CF. The rates for all other identified land use categories are based on loading standards developed by the California State Water Resources Control Board.

# Recommended Wastewater Charges

The proposed revenue adjustments as a percentage do not equal or necessarily correlate to an equivalent percentage increase to rates or monthly bills. The results of the cost-of-service analysis and rate redesign will affect users differently, at both the customer class and account level.

## Base Charge

In accordance with the existing rate structure, the base charges are the same for all land use classes. Figure 15 provides a breakdown of the projected wastewater customer accounts by land use category.

Figure 15: Total Wastewater Accounts

Description	Estimated 2018	Projected For Fiscal Year Ending June 30:				
		2019	2020	2021	2022	2023
<b>WASTEWATER SYSTEM</b>						
<b>Accounts:</b>						
2 sewer Units/Commercial	6	6	6	6	6	6
Apartment/Multi Unit (Each)	1,652	1,672	1,692	1,712	1,736	1,760
Bakery	1	1	1	1	1	1
Barber/Beauty Shop	6	6	6	6	6	6
Car Wash	3	3	3	3	3	3
Church & Residence	2	2	2	2	2	2
Churches	14	14	14	14	14	14
Coast Guard Station/Airport	4	4	4	4	4	4
Dialysis Clinic	1	1	1	1	1	1
Fire Station/School	7	7	7	7	7	7
Gas Stations (No Market)	8	8	8	8	8	8
Laundromats	5	5	5	5	5	5
Market	3	3	3	3	3	3
Metered Septage Vault	1	1	1	1	1	1
Moblie Homes (Each)	34	34	34	34	34	34
Motels/Hotels	2	2	2	2	2	2
Office Building/Post Office	108	108	108	108	108	108
Restaurant/Tavern	20	20	20	20	20	20
Retail/Banks/Theater/Other	43	43	43	43	43	43
Round Table/Market	2	2	2	2	2	2
Sewer Only Accounts	44	44	44	44	44	44
Sewer Units - Commercial	2	2	2	2	2	2
Single Family Residential	4,273	4,348	4,424	4,501	4,580	4,660
Two Sewer Units/Business	10	10	10	10	10	10
Two Sewer Units/Daycare	2	2	2	2	2	2
Subtotal	6,253	6,348	6,444	6,541	6,644	6,748

The projected base charge revenue related is approximately \$2.2 million dollars for fiscal year 2019. Figure 16, provides the projected base charge revenue for the projection period.

Figure 16: Projected Wastewater Base Charge Revenue

Description	Proposed Rates 2019	Projected For Fiscal Year Ending June 30:			
		2020	2021	2022	2023
<b>WASTEWATER REVENUES</b>					
<b>Monthly Base Charges:</b>					
2 sewer Units/Commercial	\$ 2,120	\$ 2,350	\$ 2,420	\$ 2,490	\$ 2,570
Apartment/Multi Unit (Each)	591,390	661,910	689,870	720,580	752,510
Bakery	350	390	400	420	430
Barber/Beauty Shop	2,120	2,350	2,420	2,490	2,570
Car Wash	1,060	1,170	1,210	1,250	1,280
Church & Residence	710	780	810	830	860
Churches	4,950	5,480	5,640	5,810	5,990
Coast Guard Station/Airport	1,410	1,560	1,610	1,660	1,710
Dialysis Clinic	350	390	400	420	430
Fire Station/School	2,480	2,740	2,820	2,910	2,990
Gas Stations (No Market)	2,830	3,130	3,220	3,320	3,420
Laundromats	1,770	1,960	2,010	2,080	2,140
Market	1,060	1,170	1,210	1,250	1,280
Metered Septage Vault	350	390	400	420	430
Moblie Homes (Each)	12,030	13,300	13,700	14,110	14,540
Motels/Hotels	710	780	810	830	860
Office Building/Post Office	38,200	42,250	43,520	44,830	46,180
Restaurant/Tavern	7,070	7,820	8,060	8,300	8,550
Retail/Banks/Theater/Other	15,210	16,820	17,330	17,850	18,390
Round Table/Market	710	780	810	830	860
Sewer Only Accounts	15,560	17,210	17,730	18,260	18,810
Sewer Units - Commercial	710	780	810	830	860
Single Family Residential	1,537,890	1,730,670	1,813,720	1,901,070	1,992,430
Two Sewer Units/Business	3,540	3,910	4,030	4,150	4,280
Two Sewer Units/Daycare	710	780	810	830	860
<b>Total</b>	<b>\$ 2,245,290</b>	<b>\$ 2,520,870</b>	<b>\$ 2,635,770</b>	<b>\$ 2,757,820</b>	<b>\$ 2,885,230</b>

\*Note projected revenues do not account for the proposed "Brewery" land use class. Additional revenue for the "Brewery" class will be minimal.

The projected revenue from volumetric rates is approximately \$1.1 million dollars for fiscal year 2019. Figure 17, provides the projected wastewater volumetric rate revenue for the projection period.

Figure 17: Projected Wastewater Volumetric Rate Revenues

Description	Proposed Rates 2019	Projected For Fiscal Year Ending June 30:			
		2020	2021	2022	2023
<b>WASTEWATER REVENUES</b>					
<b>Volumetric Rates:</b>					
2 sewer Units/Commercial	\$ 690	\$ 730	\$ 730	\$ 730	\$ 730
Apartment/Multi Unit (Each)	225,310	249,640	257,030	264,990	273,860
Bakery	1,680	2,020	2,190	2,360	2,550
Barber/Beauty Shop	900	980	1,000	1,020	1,050
Car Wash	2,040	1,630	1,230	800	360
Church & Residence	240	230	210	180	160
Churches	4,870	5,060	4,980	4,880	4,800
Coast Guard Station/Airport	23,740	24,690	24,290	23,820	23,430
Dialysis Clinic	5,700	6,690	7,170	7,610	7,990
Fire Station/School	4,900	4,950	4,770	4,580	4,510
Gas Stations (No Market)	1,260	1,240	1,170	1,100	1,030
Laundromats	8,450	8,840	8,700	8,550	8,430
Market	25,560	28,640	29,710	30,720	31,670
Metered Septage Vault	12,530	11,590	10,360	9,050	8,320
Moblie Homes (Each)	6,370	7,050	7,260	7,460	7,700
Motels/Hotels	18,080	20,020	20,790	21,600	22,560
Office Building/Post Office	8,700	9,500	9,710	9,880	10,190
Restaurant/Tavern	75,470	90,650	98,340	106,190	114,570
Retail/Banks/Theater/Other	19,710	20,500	20,170	19,780	19,450
Round Table/Market	2,830	3,140	3,230	3,320	3,420
Sewer Only Accounts	0	0	0	0	0
Sewer Units - Commercial	190	190	180	170	160
Single Family Residential	723,350	815,110	853,600	893,310	937,220
Two Sewer Units/Business	1,460	1,520	1,490	1,460	1,440
Two Sewer Units/Daycare	370	380	380	370	380
<b>Total</b>	<b>\$ 1,174,400</b>	<b>\$ 1,314,990</b>	<b>\$ 1,368,690</b>	<b>\$ 1,423,930</b>	<b>\$ 1,485,980</b>

\*Note projected revenues do not account for the proposed "Brewery" land use class. Additional revenue for the "Brewery" class will be minimal.

Figure 18 provides the proposed base charges, volumetric rates based on land use class for the wastewater system.

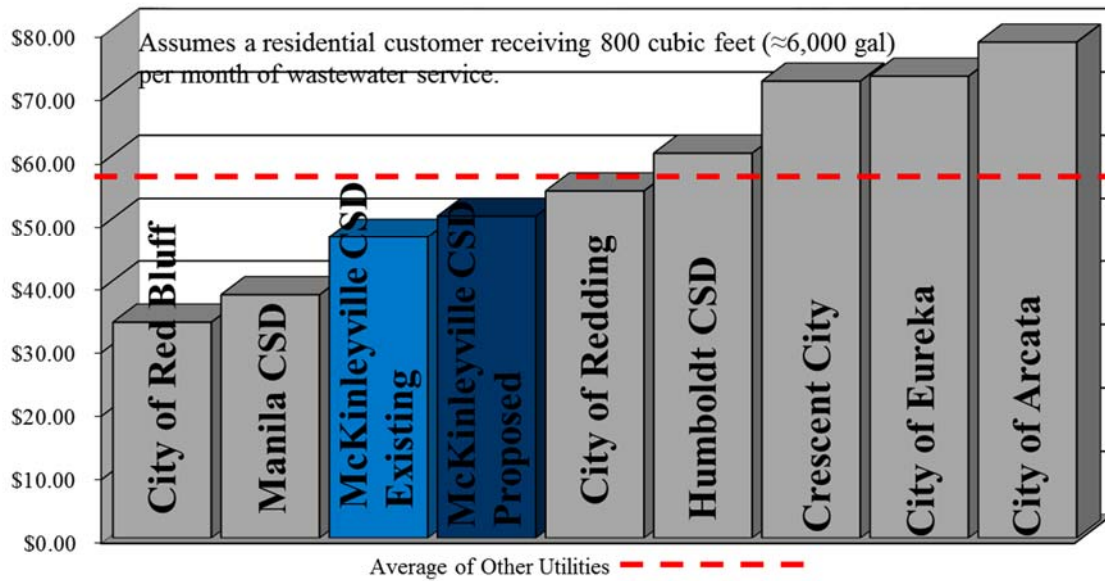
Figure 18: Proposed Wastewater Rates

TABLE 2 PROPOSED RATES - WASTEWATER						
Description	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	
<b>Monthly Base Charge:</b>						
All Customers	\$ 30.47	\$ 32.60	\$ 33.58	\$ 34.59	\$ 35.63	
<b>Volumetric Per 100 CF:</b>						
2 sewer Units/Commercial	\$ 3.06	\$ 3.14	\$ 3.09	\$ 3.03	\$ 2.98	
Apartment/Multi Unit (Each)	\$ 2.55	\$ 2.73	\$ 2.81	\$ 2.89	\$ 2.98	
Bakery	\$ 10.43	\$ 11.79	\$ 12.79	\$ 13.81	\$ 14.90	
Barber/Beauty Shop	\$ 2.63	\$ 2.78	\$ 2.84	\$ 2.89	\$ 2.98	
Car Wash	\$ 1.58	\$ 1.34	\$ 1.01	\$ 0.66	\$ 0.30	
Church & Residence	\$ 4.39	\$ 4.20	\$ 3.82	\$ 3.41	\$ 2.98	
Churches	\$ 3.06	\$ 3.14	\$ 3.09	\$ 3.03	\$ 2.98	
Coast Guard Station/Airport	\$ 3.06	\$ 3.14	\$ 3.09	\$ 3.03	\$ 2.98	
Coming Attractions	\$ 2.63	\$ 2.78	\$ 2.84	\$ 2.89	\$ 2.98	
Dialysis Clinic	\$ 2.98	\$ 3.28	\$ 3.46	\$ 3.61	\$ 3.73	
Fire Station/School	\$ 2.12	\$ 2.13	\$ 2.05	\$ 1.97	\$ 1.94	
Gas Stations (No Market)	\$ 3.29	\$ 3.25	\$ 3.06	\$ 2.86	\$ 2.68	
Laundromats	\$ 2.32	\$ 2.38	\$ 2.33	\$ 2.28	\$ 2.24	
Market	\$ 10.00	\$ 10.78	\$ 11.18	\$ 11.56	\$ 11.92	
Metered Septage Vault	\$ 4.39	\$ 4.15	\$ 3.71	\$ 3.24	\$ 2.98	
Moblle Homes (Each)	\$ 2.55	\$ 2.73	\$ 2.81	\$ 2.89	\$ 2.98	
Motels/Hotels	\$ 6.96	\$ 7.29	\$ 7.33	\$ 7.37	\$ 7.45	
Office Building/Post Office	\$ 2.63	\$ 2.78	\$ 2.84	\$ 2.89	\$ 2.98	
Restaurant/Tavern	\$ 10.43	\$ 11.79	\$ 12.79	\$ 13.81	\$ 14.90	
Retail/Banks/Theater/Other	\$ 3.06	\$ 3.14	\$ 3.09	\$ 3.03	\$ 2.98	
Round Table/Market	\$ 8.52	\$ 9.12	\$ 9.39	\$ 9.65	\$ 9.95	
Sewer Only Accounts	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
Sewer Units - Commercial	\$ 3.29	\$ 3.25	\$ 3.06	\$ 2.86	\$ 2.68	
Single Family Residential	\$ 2.55	\$ 2.73	\$ 2.81	\$ 2.89	\$ 2.98	
Two Sewer Units/Business	\$ 3.06	\$ 3.14	\$ 3.09	\$ 3.03	\$ 2.98	
Two Sewer Units/Daycare	\$ 2.96	\$ 3.03	\$ 2.98	\$ 2.92	\$ 2.98	
Brewery	\$ 5.10	\$ 10.92	\$ 16.86	\$ 23.12	\$ 29.80	

## Rate Comparison

While the cost structure and facilities vary greatly between wastewater utilities, rate comparisons provide stakeholders a barometer of the MCSD rates in relation to surrounding or similar communities. Figure 19 provides the estimated monthly bill for a typical single-family customer (800 CF).

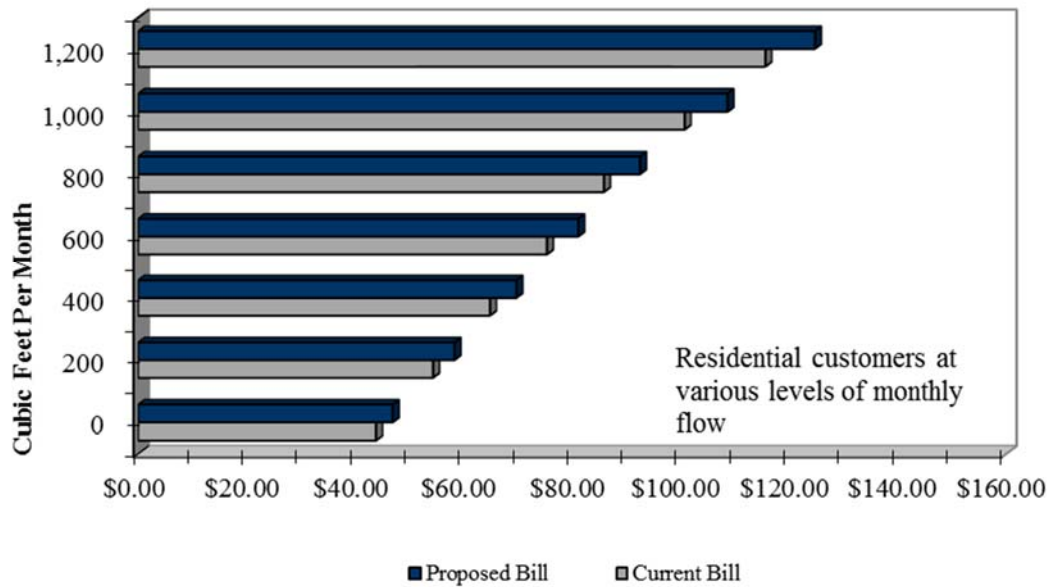
Figure 19: Single-Family Regional Wastewater Rate Comparison



# Customer Impacts

The proposed rates will provide MCSD with the necessary revenue to provide continue quality service without a significant impact on the average ratepayer. The figure below provides a combined water and wastewater sample bill for a variety of single-family consumption levels.

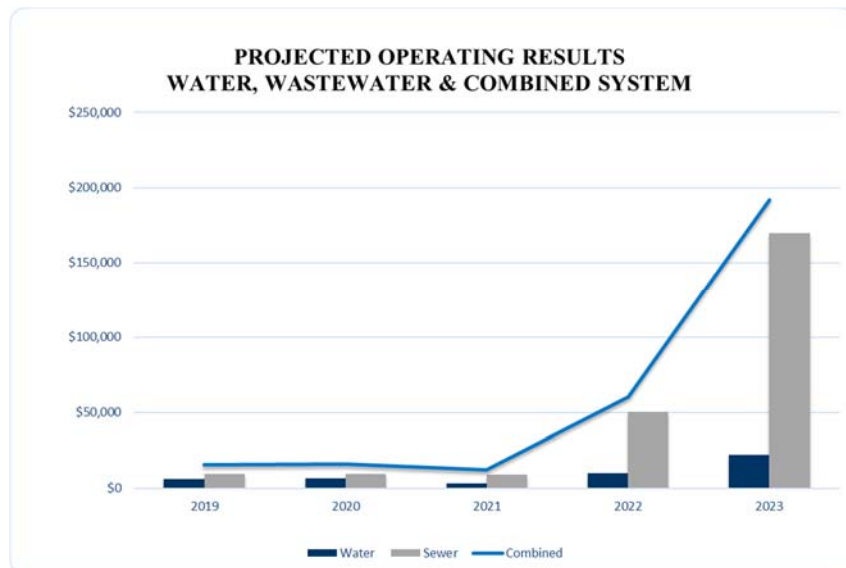
Figure 20: Single-Family Monthly Bill Comparison



## Operating Results

The projection of the combined operating results for both water & wastewater trend positive from the base year 2019 through the analysis year of 2023. Figure 21 provides a graphical illustration of the projected operating results and trends for both enterprises, as well as for the combined enterprise system.

Figure 21: Projected Operating Results





# Conclusions and Recommendations

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## Conclusions

- Projected operating revenues and operating expenses for the forecast period are developed by, and/or in consultation with, MCSD staff, and are based upon applicable assumptions;
- The projected CIP costs have been developed by MCSD staff to address the water and wastewater system renewal and replacement needs;
- Willdan is of the opinion that the financial projections presented here demonstrate the Utility's ability to meet its obligations with regard to:
  - Operating expenses;
  - Non-operating expenses (including debt service);
  - Capital project costs; and
  - Key financial policies, including debt service coverage and maintenance of at least 6 months of operating fund reserve balances.
- The proposed rates presented here are in conformance with industry standard rate-making practices, Proposition 218 and/or MCSD's rate policies with respect to:
  - The equitable recovery of costs through its water and wastewater rates;
  - Setting rates based upon the proportionate cost of providing utility services; and
  - Generating sufficient revenue to fully recover system expenditure and reserve requirements.

## Recommendations

- It is recommended that MCSD implement the proposed rates presented in this Report for FY 2018-19 through FY 2022-23.
- It is recommended that MCSD update the Revenue Sufficiency Analysis portion of this study each year to ensure projected revenues are sufficient to fund projected expenses going forward as assumptions made during this analysis may change and have a material impact upon the analysis.