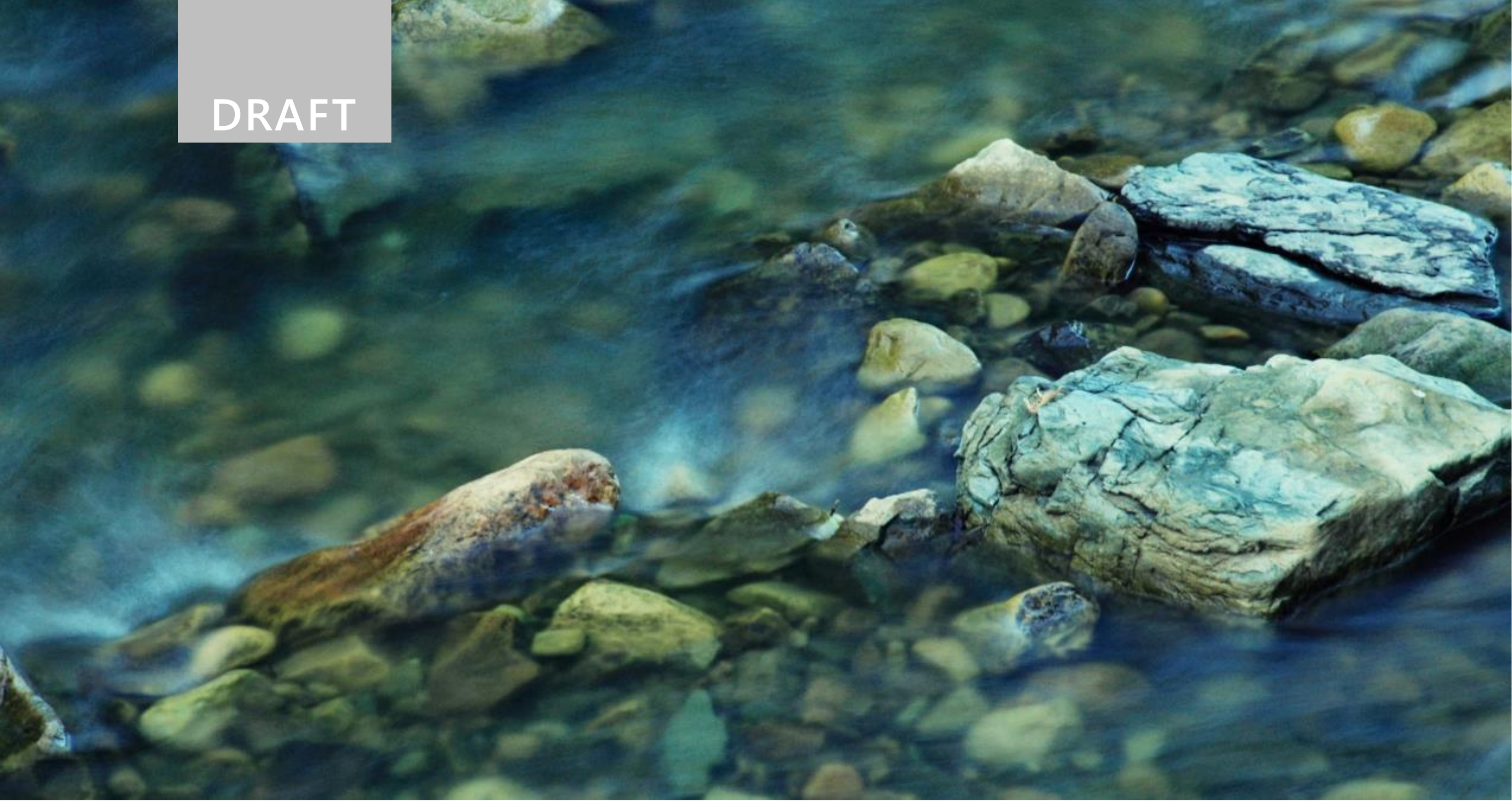

DRAFT

January 2022

Orsatti Water Consultants

St. Mary's Glacier
Long Range Plan for Buried Water and Wastewater Pipes Replacement

Prepared for St. Mary's Glacier Water and Sanitation District

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January 2022
St. Mary’s Glacier Long-Range Utilities Project

St. Mary’s Glacier
Long Range Plan for Buried Water and Wastewater Pipes Replacement

Prepared for
St. Mary’s Glacier Water and Sanitation District
C/O Pinnacle Consulting Group, Inc.
550 W. Eisenhower Blvd.
Loveland, CO 80537

Prepared by
Orsatti Water Consultants
3821 Union Ct
Wheat Ridge, CO 80033

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APPENDICES

ASSOCIATED FILE

Buried_Pipe_Databases_Dec2021.xlsx

ABBREVIATIONS

ARV	Air Relief Valve
CCC	Clear Creek County
CDPHE	Colorado Department of Public Health and Environment
CIPP	Cured-in-place pipe
District	St. Mary's Glacier Water and Sanitation District
I&I	Inflow and Infiltration
PRV	Pressure Relief Valve
PVC	Polyvinyl Chloride
WWTF	Wastewater Treatment Facility

1 Introduction and Background

The St. Mary's Glacier Water and Sanitation District (District) operates a drinking water distribution system and sanitary sewer collection system in the developed area known as St. Mary's Glacier. The existing system was originally designed and installed in the mid-1970's to serve residential developments. Both the water and sanitary buried pipes have several known operational issues related to the age of the infrastructure, extreme weather and temperatures, and outdated installation procedures. Colorado Department of Public Health and Environment (CDPHE) responded to recent sanitary discharges to the environment with a mandate for the District to develop a plan to replace all aging and defective buried potable water mains and sanitary sewer main pipes. This Long-Range Plan is intended to guide the replacement and prioritization of buried utilities throughout the St. Mary's Glacier Water & Sanitation District to comply with CDPHE requests. Additionally, this plan will reduce operation & maintenance costs and improve the long-term quality of service provided by the District to St. Mary's residents.

The District's buried pipe infrastructure consists of approximately 47,875 LF of potable water distribution mains and 45,883 LF of sanitary sewer mains. The goal of this document is to prioritize the replacement of segments of these lines, based on available evidence and information about the system. In addition, this document provides long term guidance for the District to continue to self-assess the existing buried piping systems replacement. Funding procurement and construction scheduling will determine the pace of infrastructure repair and replacement and this document intends to prioritize which segments of the water and sanitary systems would benefit most from immediate repairs and which segments make good candidates for long-term repairs or replacement.

To meet the objectives of this study, a buried pipe database (database) was developed to segment the water and sanitary systems into manageable segments. Each segment represents a length of pipe and includes currently available information regarding the lengths, starting and ending coordinates, pipe condition, known operational issues (Critical Factors), existing appurtenances and their condition, and notes from system operators. The data sources used in developing this database included previous engineering studies and reports, GIS data from previous consulting work and Clear Creek County, and information from District operators and personnel. Additional information was collected specifically for this effort, including a video survey of sanitary mains with known infiltration and inflow (I&I) issues.

Using the database, segments of both water and sanitary pipe were prioritized for either repair or replacement and recommendations are provided for how to best structure a plan for system improvements. Cost estimates for various repair and replacement options are provided along with a preliminary schedule of infrastructure replacement. This document concludes with final recommendations and conclusions based on the review of the database.

2 Buried Piping Database

To facilitate long-term pipe repair and replacement, a buried piping database was developed to organize available information into a comprehensive document. Two databases were created, one for potable water mains and one for sanitary sewer mains, and both include line items for individual pipe segments. This section describes the data used to develop the information in the databases, what information the databases contain, and the methodology used to segment the water and sanitary systems. Attachment Figures 1 and 2 provide an overview of the water distribution system and sanitary collection system, respectively. Included with this report is an attachment of the Buried Piping Databases (MS Excel© compatible file), which will be transferred to the District as a digital spreadsheet for their record keeping.

2.1 Data Sources

The following subsection describe the data used to develop the drinking water and sanitary sewer system buried piping databases. A substantial effort was made to review existing documentation on each system and the following sections provide descriptions of compiled information.

2.1.1 Survey Data from Water Improvements Project

An extensive land survey was conducted through a substantial portion of St. Mary's Glacier as part of an ongoing Water Improvements Project. This project, scheduled for completion in 2022, includes running a new transmission line to connect both sides of the drinking water distribution system, replacing two segments of sanitary sewer line, additional replacement of drinking water mains, upgrades to a booster station and water holding tank, and improvements at Well 3. Land surveys were performed in 2019 to facilitate the design of these improvements. GIS files generated in this survey provided system wide coverage for the locations of water and sanitary mains throughout the District. This land survey data was the predominant source of data for the layout and configuration for both the water mains and sanitary sewers.

2.1.2 Clear Creek County GIS

Clear Creek County's GIS department provided additional GIS data for the layout of both the water and sanitation systems (CCC, 2021). This data, which is publicly available on Clear Creeks GIS portal, was originally digitized from as-built drawings of the original water and sanitation system. Information contained in this dataset included spatial piping layouts and locations of original valves and manholes. The data from Clear Creek County GIS provided a second line-of-evidence against the information collected during the Water Improvements project. Additionally, since this information was originally compiled from as-built documentation, deviations could exist due to repairs or modifications to the system since construction. Input from District operators provided a check on the system layouts, valve and manhole locations, and flow directions.

Data collected during the Water Improvements Project and Clear Creek County GIS data, system-wide pipe diameters for the sanitary system were determined and shown below in Table 1. Sanitary lines are predominantly (90%) 8-inch diameter with some segments at 10-inches and 12-inches closer to the WWTF.

Table 1: Sanitary system pipe diameters and lengths

Pipe Diameter Size	Total Length in System (LF)
8" Sanitary	41,102
10" Sanitary	2,272
12" Sanitary	2,510
Total Length	45,883

2.1.3 Integra Engineering Documents

Integra Engineering, a water and wastewater consulting firm, provided services to the District in the 1990's in a previous effort to reduce Infiltration & Inflow (I&I), in the sanitary sewer system. Archived documents from Integra Engineering, from 1997, provided additional information for where spot repairs occurred. I&I reduction work conducted between 1993 and 1997 included (Integra 1997a, 1997b, 1997c):

- Lake Quivira Sewer Project - 1993
  - Replacement of five manholes between Silver Lake and Lake Quivira
  - Sliplining 1,600 LF of sewer between Silver Lake and Lake Quivira
- I&I Reduction Project – 1996
  - Sliplining 1,700 LF of sewer along Silver Creek Road
- Additional I&I reduction work – 1996 to 1997
  - Sliplining 600 LF of sewer (unknown locations)
  - Video inspections of 4,400 LF of sewer (unknown locations)
  - Cleaning of 2,500 LF of sewer along Silver Creek Road and Upper Forest Road
  - Point repairs and cleaning at 14 manholes (unknown locations)

A total of 3,977 LF of sanitary sewer were sliplined during projects overseen by Integra Engineers. These repairs, including prior sliplining efforts and spot repairs, are included in the database in the "Repairs" field. The District did not provide additional formal documentation of other extensive sliplining efforts on the sanitary system. It is unclear if the current conditions of these slip lining repairs and additional information will be provided on pipe integrity during forthcoming video surveys.

2.1.4 FEI Engineers Documents

FEI Engineers, another engineering consulting firm, conducted additional field studies of I&I along the sanitary sewer system around 2014 (FEI 2014). They produced a high-quality map indicating sanitary lines with Heavy Inflow, Low Inflow and No Observed Inflow. The information from the FEI map is used in the database as one line of evidence in identifying sanitary segments with known I&I issues. Table 1 summarizes the I&I status of the sanitary sewer system, which has been incorporated into the "Inflow Status" field of the sanitary database.

Table 2: Summary of inflow status from FEI Engineers (FEI 2014)

Inflow Status	No. of Segments	Total Length (LF)
Heavy Inflow	64	13,232
Low Inflow	48	10,129
No Inflow	103	22,034
NA[1]	4	668
Total Sanitary	219	46,063

1. Upon review of the FEI Engineers map, 4 segments of sanitary sewer line were not surveyed during their I&I study.

2.1.5 Interviews with District Operators

The knowledge base of District personnel provided reviews of the prepared maps, Attachment Figures 1 and 2, to provide a reality check of the data collected from the Water Improvements Project surveys, Clear Creek Counties GIS data, and the Integra and FEI information. Since some of these sources relied on as-built data, generated in the 1970's, verifying the existence and condition of system features was critical to address to current configuration of the water and sanitary systems.

Two interviews were held with Chris Oeland, District Maintenance Supervisor, on May 14 and 18, 2021, to discuss the system layouts and features. Information gathered during these interviews provided insight into some of the critical factors effecting system performance, such as known operational issues, previous spot repairs, leaks caused by failing buried pipes, and wintertime freezing issues. Additionally, the layout of pipes, valves, and manholes for both water and sanitary systems were checked against the operator's experience with the system. This information was integrated into the databases in the "Critical Factors", "Previous Repairs", and "Notes" fields.

2.1.6 Upcoming Surveys and Studies

To better inform repair and replacement recommendations for the sanitary sewer system, lines identified with known infiltration issues were conducted using utility video equipment during the summer of 2021. This included approximately 14,706 LF of sanitary sewer mains that were identified in the FEI Engineers study from 2013.

The video files and reports from the survey contractor were reviewed and the results are included in the provided database. Within each segment surveyed, data was recorded on pipe material, previous repairs, infiltration status, and current structural integrity. Where structural integrity issues are identified, they were classified by type of issue, such as stress corrosion, type of cracks or breaks, and if the deterioration has confirmed inflow or is obstructing the flow of wastewater. Information from the video investigation will be integrated into the database in the "Video File", "Start (and End) Feature Condition", "Critical Factors", and "Service Taps" fields.

A land survey is planned for the summer of 2022 around segments identified for repair or replacement in an ongoing Wastewater Improvements Project. This project intends to repair the sanitary sewer segments identified in the FEI Engineers study (2013) as "Heavy Inflow", as well as upgrades and improvements to the WWTF. Data collected in the land survey will include surface features and elevations in a 50-foot corridor around the "Heavy Inflow" sanitary lines, as well as invert elevations of pipes and manholes. Relevant data from this survey, such as invert elevations, surface features that could complicate construction, and manhole condition, will be included in the database after that information becomes available.

Information from these two surveys will provide a strong basis of information to drive decision making regarding what sanitary segments require immediate attention. Sanitary sewer segments experiencing substantial I&I will be repaired or replaced in a higher priority that segments with little to no I&I issues or structural defects.

Relatively little information is currently available on the integrity of the water distribution system. Leak testing of water mains has not been recently conducted. District operators have noted that traditional leak testing methods prove difficult in St. Mary's due to the presence of many failing isolation gate valve in the system. Additionally, numerous large rocks near water mains make conventional auditory forms of leak detection less successful. It is recommended that a program of gate valve replacement be performed before leak testing be conducted so that a continuing program of isolation and leak testing can occur throughout the system to provide current information on where leaks might be occurring.

2.2 Fields included in Database

The databases include 30 fields that contain information on each pipe segment. Every line of the database represents an individual segment of either drinking water buried pipe or sanitary sewer pipe and the various fields include individual pieces of information. Some fields are intended to be updated as additional information becomes available and as repairs are made throughout the system. In this way, the databases can be updated as time goes on and should accurately reflect the status of each segment of the system. Table 3 summarizes the fields included in the databases, along with a description and the sources used for the data.

Table 3: Summary of fields included in databases

Database Field	Water or Sanitary Database	Description	Data Source(s)
Segment ID	Water & Sanitary	Unique identification number for each segment. The Segment ID is structured as WAT_N/S_#### for water lines and SAN_N/S_#### for sanitary lines.	Generated for databases
Segment Length	Water & Sanitary	Length of the individual pipe segment in feet.	Calculated in GIS software
Inflow Status	Sanitary Only	Status of I&I within individual segments.	FEI Engineers 2014 and video survey conducted in 2021
Start Latitude	Water & Sanitary	The latitude coordinate for the start of the segment in decimal degrees. Start and end coordinates are based on flow direction, with the start at the upstream side and the end at the downstream side.	Calculated in GIS software
Start Longitude	Water & Sanitary	The longitude coordinate for the start of the segment in decimal degrees.	Calculated in GIS software
End Latitude	Water & Sanitary	The latitude coordinate for the end of the segment in decimal degrees.	Calculated in GIS software
End Longitude	Water & Sanitary	The longitude coordinate for the end of the segment in decimal degrees.	Calculated in GIS software
Service Taps	Water & Sanitary	Approximate number of service taps within a given segment of line. Service taps for the water system were estimated based on aerial imagery.	Site visits and aerial imagery
Pipe Diameter	Water & Sanitary	Diameter of pipe within each segment in inches	Water Improvements Project Survey, FEI Engineers 2014
Street	Water & Sanitary	Most water and sanitary segments fall within the public right-of-way and this field includes the street name the segment lies within. If a segment does not fall within street, additional descriptors are used to describe where the segment is located.	Assigned based on street locations
Start Feature	Water & Sanitary	The feature, such as manhole or valve, that denotes the start of the segment. Most segments are split at valves and manholes. If there is no start or end feature, the segment adjacent to the start or end is assigned.	Clear Creek County GIS, Interviews with District Operators
Start Feature Condition	Water & Sanitary	The condition or status of the start feature, such as condition of the valve or manhole.	Interviews with District operators, Video Survey

Database Field	Water or Sanitary Database	Description	Data Source(s)
Features Within Segment	Water	Features that may exist within a given water segment. These typically include various types of valves.	Clear Creek County GIS
Condition of Features within Segment	Water	The condition of the features identified in the field above.	Clear Creek County GIS, Interviews with District operators
End Feature	Water & Sanitary	The feature, such as manhole or valve, that denotes the end of the segment.	Clear Creek County GIS, Interviews with District Operators
End Feature Condition	Water & Sanitary	The condition or status of the end feature, such as condition of the valve or manhole.	Interviews with District operators, Video Survey
Pipe Composition	Water & Sanitary	Material composition of the pipe segment, such as PVC or VCP.	Interviews with District operators, Video Survey
Distance to WWTF	Sanitary Only	The distance from the start of the segment to the WWTF, used to assign priority.	Calculated in GIS software
High Pressure	Water Only	Segments that are within 100 vertical feet on the upstream side of the system from altitude valves. Segments on the upstream side of altitude valves contain higher pressures than elsewhere in the system.	Site topography
Critical Factors	Water & Sanitary	Factors critical to repair or replacement. Items typically included in this field include known operational issues	Interviews with District operators, Video Survey
Prioritization Score	Water & Sanitary	This field is a numerical score assigned based on numerous factors. A higher prioritization score indicates a high priority for repair or replacement. See Section 3.3: Prioritization Methodology for additional information.	Calculated based on prioritization methodology.
Subgrouping	Water & Sanitary	For clarity, segments have been grouped together into subgroupings. These subgroups are logical runs of pipe that would likely undergo repair or replacement within the same project. A total of 32 subgroupings were generated for both systems.	Assigned based on system layout
Subgrouping Prioritization Score	Water & Sanitary	This score is an average of individual prioritization scores for all the segments within the subgrouping. The subgrouping prioritization score effectively ranks the subgroups and subgroupings with the highest score should be repaired or replaced before subsequent groupings.	Calculated as the arithmetic average of all the segments within a subgrouping.

Database Field	Water or Sanitary Database	Description	Data Source(s)
Date Installed	Water & Sanitary	The date the current pipe was installed. This field should be updated as repairs are made throughout the systems.	Integra reports, Interviews with District operators
Video File	Sanitary Only	The name for the most recently conducted video survey of the sanitary segments.	Video survey conducted in 2021
Curvilinear Score	Sanitary Only	A score assigned to individual segments based on the orientation of the pipe. A Curvilinear Score of 1 indicates there are curved sections with the segment. A score of 0 indicates the run in linear or nearly linear in orientation.	Assigned based on system layout
Notes	Water & Sanitary	Notes include additional information not captured in any other field	Based on relevant data source
Date Created	Water & Sanitary	Date the individual features were entered into the database.	General database organization and information
Created By	Water & Sanitary	Name of the individual who added the feature to the database.	General database organization and information
Late Edit Date	Water & Sanitary	Date the individual features were edited or modified.	General database organization and information
Edited By	Water & Sanitary	Name of the individual who edited or modified the segment or feature.	General database organization and information

2.3 Segmentation

To organize the database, each system was segmented into short runs to provide adequate granularity to the collected information. Within the database, each segment is a single row that contains the data fields shown in Table 3. Segment lengths were determined by features within each system, such as valves or manholes. Every segment within both the water and sanitary systems was assigned a unique identification number that is shown in Attachment Figure 1 (Water System) and Attachment Figure 2 (Sanitary System). A target average segment length of 200 LF was selected for both systems to allow for flexibility in planning repairs.

Segmenting the sanitary sewer system resulted in 219 segments, with an average length of 210 LF. Sanitary segments were split at various features, mainly at manholes and line intersections, which would be logical for sequencing repair efforts. In instances where a long piping run occurred without intersections or manholes, the pipes were segmented in a fashion to keep the average length of segments around 200 LF. Using this methodology, occasionally certain segments run long (maximum segment length = 352 LF) or short (minimum segment length = 33 LF), depending on the layout of the system and features.

Segmenting the water system resulted in 210 segments, with an average length of 227 LF. Water segments were mainly split around line intersections, gate valves, blowoff valves, and pressure relief valves (PRVs). Like the sanitary segmentation, wherever long uninterrupted runs of pipe exist segments were subdivided to keep the average length of segments around 200 LF. The longest water segment is 416 LF and the shortest is 51 LF, which are results based on system layout.

Each segment was assigned a Segment ID, which is a unique identifier for individual segments. Water Segment ID's are structured as WAT_N/S_####, where the WAT signifies it is a water segment, the N/S indicates if it exists on the northside or the southside of the system, and the numbers are from 0001-0210. Similarly, the sanitary Segment ID's are structured as SAN_N/S_####, where the SAN signifies it is a sanitary segment and the numbers range from 0001-0221 The division between northside and southside is at the intersection of Silver Creek Road and Fall River Road. This designation provides some minor reference for where an individual segment is located. In the sanitary system, the numbers assigned to each segment generally start at 0001 at the WWTF and increase as the segments move away from the WWTF.

2.4 Subgroupings of Segments

Due to the logistics associated with project coordination and funding, it is unlikely the District would mobilize contractors to repair or replace individual segments. Once funding becomes available, projects will be developed that involve repairing and replacing groups of segments based on priority and proximity. Therefore, subgroupings of segments were created that include multiple segments that would make logical sense to repair and/or replace as single projects. Subgroupings of segments are illustrated in Attachment Figure 3 (Sanitary System) and Attachment Figure 4 (Water System).

The sanitary system was organized into 32 subgroupings, each containing between 4 and 11 individual segments. Total subgrouping lengths vary between a total of 650 and 2,240 LF of sanitary sewer. The water system was organized into 31 subgroupings, each containing between 4 and 10 segments. Total subgroup lengths vary between a total of 966 and 2,220 LF of water line.

System subgroupings can be selected by the District depending on funding availability or changes in repair priority. For example, if limited funds are available in a given year, the District could select a subgroup with a shorter total pipe length that aligns with the available budget. The subgroups were determined based on system layout and represent logical configurations of potential repair and/or replacement projects. Subgroups also provide a less granular view into the system that is provided by many individual segments. Cost estimates for repair/replacement and average prioritization scores are provided later in this document for each subgroup.

3 Repair and Replacement Prioritization

After the databases were created and fields were populated with available information, segments were prioritized to assess a range of critical repairs or replacements. The goal of prioritization is to provide the District with an informed ranking of which segments would benefit from expedited repairs or replacement and which segments will need attention at a later time. This section describes the methodology used to generate the prioritization score for segments and subgroupings of segments, as well as a discussion of these results and options for repairs and replacements.

3.1 Prioritization Methodology

3.1.1 Sanitary System Prioritization Methodology

Multiple data sources were available to guide prioritizing repairs of the sanitary sewer system. To prioritize which segments would benefit from immediate repairs, a formulation was developed that accounts for various factors. The factors considered in this formulation include:

- I&I status: Higher priority given to segments with high rates of I&I
- Known operational issues: Higher priority given to segments with known existing issues
- Pipe diameter: Higher priority given to segments with larger diameters
- Distance from WWTF: Higher priority given to segments closer to the WWTF
- Curvilinear segments: Higher priority given to segments with sharp curves

Equation 1 describes the formulation used to generate a prioritization score for each sanitary segment.

Equation 1

$$SPs = INs + DIAs + KnIs + Cs$$

where:

SPs	=	Sanitary prioritization score, 0-19, with higher values indicating high priority for repair
INs	=	I&I score, 0-6, with higher values indicating high rates of known I&I
DIAs	=	Diameter score, 1-3, with higher values indicating larger diameter pipes
KnIs	=	Known Issue Score, described in more detail below
Cs	=	Curvilinear score, 0 or 1, where 1 indicates the segment is curvilinear
CFs	=	Critical Factor Score, described in more detail below

The Known Issue Score is a result of interviews with District operators. A score of 1 is given to segments that have been repaired previously. If a segment required repair previously, it may be likely additional repairs will be required due to stresses applied on the pipe or inadequate pipe bedding. A score of 3 is given to segments that were identified as "shallow" or less than 5 feet below grade. Shallow pipes are potentially more at risk for freezing issues due to inadequate insulation. A score of 7 is applied to segments that have known operational deficiencies, such as segments known to frequently freeze or cause ice dams in winter.

The Curvilinear Score, which is either 0 (nearly linear segment) or 1 (segment contains curvilinear sections), is applied based on professional experience with buried utilities. Substantial bends in piping runs, which occur frequently within the sanitary system at St. Mary's, tend to generate leaks and I&I issues as time goes on. A higher priority is given to curvilinear segments due to the likelihood of pipe failure.

The Critical Factor Score stems from significant operational issues identified in a sanitary sewer video survey performed in the summer of 2021. The video logs of individual segments identified several concerning structural issues within the sanitary system. These issues were accounted for in the prioritization scheme using the Critical Factor Score. Segments containing "Heavy Debris", or debris in excess of 4-6", received a score of 4. Segments containing alignment issues, such as sags or bellies, or contained moderate to severe structural issues, received a score of 3. During the video survey, recommendations were made for repair methods. If the recommendation involved replacing an entire segment due to structural or alignment issues, an additional score of 2 was added. If the recommendation for repair involved sliplining, an additional score of 1 was added. Using this scheme for assigning priority based on "Critical Factors" increases the score of segments with confirmed operational issues.

The Prioritization Score is simply a sum of each of the scores outlined in Equation 1. A higher score indicates a higher priority for repair or replacement. The highest score calculated was 19, which indicates the highest priority segment. The lowest score calculated was 2, indicating segments that do not require immediate attention but will require repairs in the future. Figure 1 shows a histogram of the distribution of prioritization scores and Attachment Figure 3 shows individual Prioritization Scores for each segment. Figure 1 shows a few segments with extremely high Prioritization scores (greater than 17), with the majority of existing pipeline segments having moderate (5-17) and low (less than 5) scores. This indicates that there is a relatively small number of segments that should receive immediate repair or replacement, a moderate number of segments would benefit from near-term repair, and other segments that might require repair in the near future.

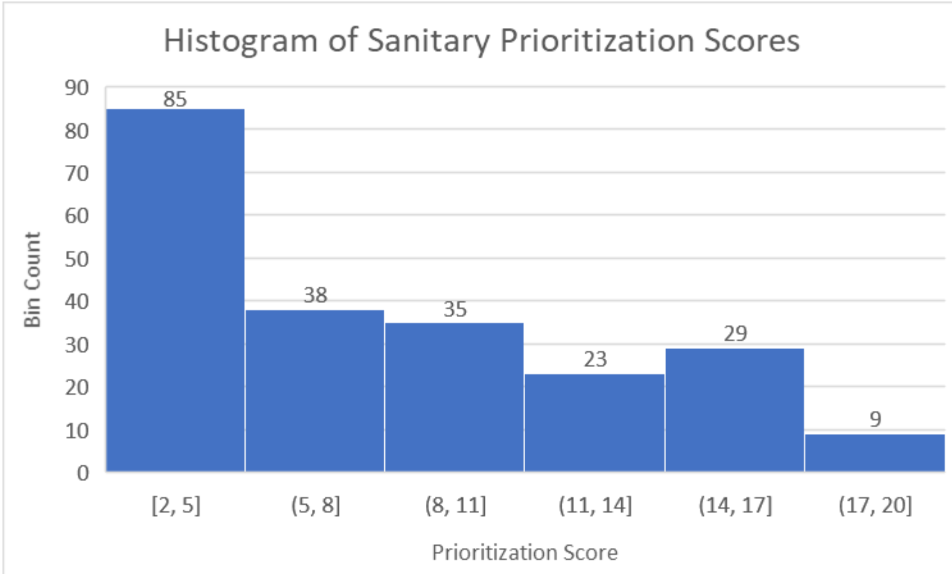

Figure 1: Histogram of Sanitary Sewer Prioritization Scores. Numbers above each bar indicate the number of segments that fall within the range shown.

3.1.2 Sanitary Sewer Subgrouping Prioritization

To provide additional information about runs of connecting segments, prioritization scores are provided for each subgrouping in the sanitary sewer system. A Subgrouping Prioritization Score was calculated as the arithmetic average of the Prioritization Scores for each segment within the subgrouping. Table 4 summarizes the Subgroup Prioritization Scores and which segments are contained within each subgroup. Subgroupings are also illustrated in Attachment Figure 3.

Table 4: Summary of subgroupings and subgrouping prioritization scores for the sanitary system. Table organized by descending priority.

Sanitary Subgrouping	Contains Segments	Subgrouping Prioritization Score
G01	001-008	17.88
G09	064-067, 133	16.00
G16	019-025	15.71
G26	152, 167-173	14.50
G10	068-074	14.50
G21	026-027, 134-137	13.17
G03	009-013	12.60
G15	014-018, 091	11.17
G05	041-045	10.00
G27	211-221	9.45

Sanitary Subgrouping	Contains Segments	Subgrouping Prioritization Score
G28	174-180	9.43
G30	193-197	9.40
G32	205-210	9.17
G17	092-097	8.67
G18	098-099, 108-113	8.38
G31	183-186, 199-204	7.90
G12	080-090	6.91
G02	028-034	6.14
G04	035-040	6.00
G06	046-052	6.00
G29	181-182, 187-192	4.88
G07	053-056	4.75
G19	100-107	4.63
G08	057-063	4.43
G24	153-159	4.29
G22	138-144	4.00
G20	114-119	3.83
G14	121-135	3.20
G23	145-151	3.00
G25	160-166	2.57
G13	126-132	2.29

A major benefit of the Subgrouping Prioritization Scores is unique scores are provided for each subgrouping. For example, Table 4 shows the ranked Subgrouping Prioritization Scores, and no two subgroupings have the same score. This provides a straightforward method of selecting groupings of segments for repair. Using Table 3, subgrouping G01 would be highest priority for repair/replacement, followed by G09.

3.1.3 Water System Prioritization Methodology

The drinking water distribution system was prioritized for repair or replacement based on known operational issues, high pressure zones due to elevation, number of existing service taps, and size of water mains. At the time of writing, substantially less information on operational issues exists and system prioritization results are anticipated to require updating as additional information is provided from subsequent gate valve replacement and leak testing. Leak testing results will provide invaluable information on the integrity of the water distribution system, like how video surveys provide information on the sanitary system. The results from leak testing will identify segments of pipe that require expedited repair.

In the absence of recent leak testing data, the system was prioritized based on available data. Segments with a significant number of service taps are prioritized over segments with few or no service taps. Segments within high pressure zones, identified as segments 100 vertical feet on the upstream side of altitude valves, are prioritized over segments that operate at lower pressures. Valves that require repair or replacement also factored into the priority scheme, segments with faulty valves are considered a higher priority than segments with fully functional valves. Like the sanitary system, water mains with larger diameters, as identified by District operators, are prioritized over segments with smaller diameters. Equation 2 shows the formulation to apply this prioritization scheme to the water system.

Equation 2

$$WPs = HPs + DIAs + STs + KnIs$$

where:

WPs	=	Water system prioritization score, 0-X, with higher values indicating high priority for repair
HPs	=	High Pressure score, 0 or 3, with 3 indicating the segment is within a high-pressure zone and 0 elsewhere
DIAs	=	Diameter score, 1-3, with higher values indicating larger diameter pipes
STs	=	Service Tap score, 0-10, where the number indicates the number of service taps on the segment
KnIs	=	Known Issue Score, described in more detail below

The High-Pressure Score is related to prioritizing segments that contain high pressures. High Pressure Scores of 3, indicating high pressure exists in the segment, was determined by using GIS topography data. Segments within 100 vertical feet of pressure relief valves, on the upstream side, are designated high pressure segments. This is a simple but conservative method of determining where high pressure zones are likely to exist, without requiring a pressure model to be constructed.

The Diameter Score includes information from District operators as to approximate diameters of pipe segments in the system. The Diameter Score is used to prioritize larger diameter water lines over smaller diameter lines, to minimize potential losses from leaks and increase the impact of repairs.

The Service Tap Score is related to the number of service taps within a given segment. Higher priority and a higher Service Tap Score is given to segments that contain many service taps. Improving water line segments within highly populated areas improves the impact of system repairs for multiple consumers.

The known Issue Score for the water system currently accounts for observed freezing issues in wintertime. This field will be updated based on leak testing results, after that information is received. For freezing issues, a value of 4 is applied to segments with known freezing issues. A value of 2 is applied to segments that were identified as having stress corrosion issues due to improper bedding or installation. Segments that do not currently have operational issues are assigned a value of 0.

The final score, referred to as the Water System Prioritization Score, indicates the relative priority level of a given segment or subgrouping of segments. A higher Prioritization Score indicates the segment or subgrouping of segments is a higher priority for repair compared to segments with lower scores. A histogram of results from prioritizing individual water system segments is shown in Figure 2.

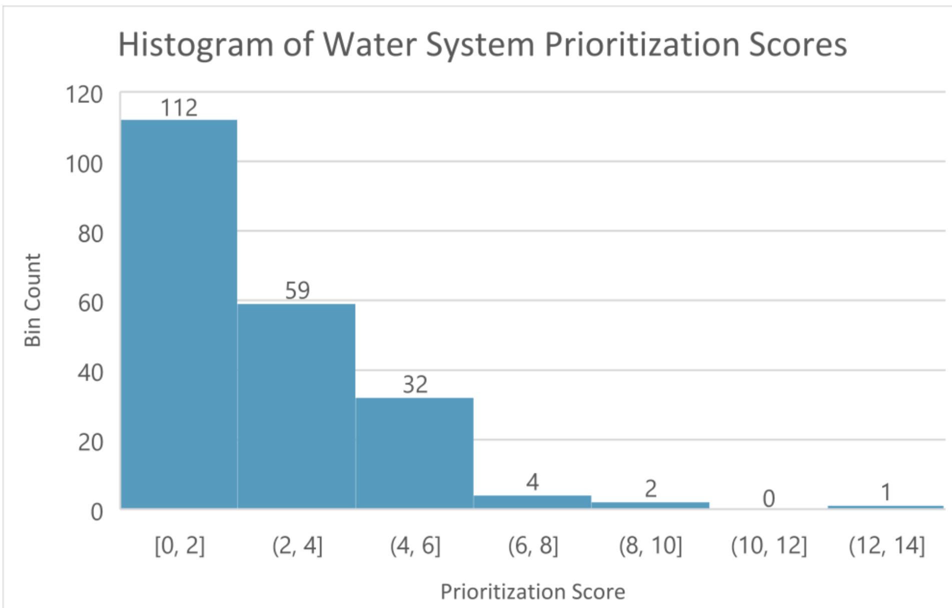

Figure 2: Histogram of water system prioritization scores

Results of prioritizing the water system using the methodology in Equation 2 indicate most segments are relatively low priority for immediate replacement. This is a result of the lack of existing conditions information on the water lines, not an indication that the water system is in a good, stable working condition. Water system leaks are a constant maintenance headache for the District and can only be resolved through long term pipe replacement and proper construction installation techniques. Once new gate valves can be installed, additional insight can be gained into what segments might contain water leaks. Periodic leak testing will greatly improve the District's ability to prioritize other segments of the water system for replacement. Prior to that valve replacement effort, the District is still able to make some informed decisions regarding which segments should be replaced before others.

3.1.4 Water System Subgrouping Prioritization

Like the procedure followed for the sanitary sewer system, a prioritization score was applied to each subgrouping of the water system. A Subgrouping Prioritization Score was calculated as the arithmetic average of the Prioritization Scores for each water segment within the subgrouping. Table 5 summarizes the Subgroup Prioritization Scores and which segments are contained within each subgroup. Subgroupings are also illustrated in Attachment Figure 4.

Table 5: Water system subgroupings and subgrouping prioritization scores

Water Subgrouping	Contains Segments	Subgrouping Prioritization Score
G30	202-205	6.75
G03	007-011	6.40
G21	141-143	5.25
G31	206-210	5.10
G18	111-114	5.00
G05	044-050	4.71
G04	037-043	4.38
G06	051-057	3.86
G22	147-159	3.57
G19	017-023, 136	3.44
G08	012-016, 134	3.00
G01	001-006, 024-025	2.89
G10	072-079	2.88
G23	149-153	2.83
G11	068-071, 089-091,120-121	2.80
G17	115-119	2.60
G25	183-189	2.29
G09	080-086	2.25
G02	027-034	2.10
G28	181-182, 192-194	2.00
G14	092-097	1.83
G13	122-127	1.43
G15	098-103	1.33
G16	104-110	1.14
G24	161-167	1.00
G07	058-067	0.90
G12	129-133	0.83

G29	195-201	0.71
G26	168-173, 191	0.60
G27	174-179	0.50
G20	137-139, 144-146	0.33

3.2 Database Findings

Based on the findings from the prioritization methodology outlined above, several conclusions can be drawn. Considering the sanitary system and focusing on subgroupings, the highest priority subgroupings are G01, G09, and G16. It is logical that G01 would have the highest priority, due to it containing large diameter mains, heavy inflow, and are located nearest to the WWTF. G09 contains segments that have heavy inflow and shallow classifications due to shallow bury depth, both increase this subgroupings prioritization score. The other higher priority groupings tend to have known operational issues, large diameter pipes, and heavy or low inflow issues. Subgroupings further away from the WWTF mostly have no known inflow issues, no operational issues, and smaller diameter (8") pipes.

Using this methodology on subgroupings in the sanitary system, there are no overlapping ranks and repairs, and replacements could theoretically follow the ranking order shown in Table 3. Since the database contains Prioritization Scores for individual segments, the District can select either higher priority individual segments for repair or select entire subgroupings with high priority rankings for repair and replacement.

Database findings for the water system indicate many subgroupings with relatively low priority. Compared to the sanitary system, relatively little information is currently available on the condition of many segments of the water system. The database still provides sufficient information to assist the District in prioritizing which segments, and subgroupings should be repaired immediately, compared to those that are better candidates for future repairs. For example, subgroups G30, G03, and G21 are considered the highest priority for replacement, due to known operational issues and their location in high pressure zones. There are also no overlapping ranks in the water system and repairs can follow the order shown in Table 5.

During system improvements and as additional data becomes available, the prioritization will change due to changing conditions. Segments and subgroupings that do not currently have any known operational issues or significant infiltration or leaks might deteriorate over time, which would increase the priority of their repair. The database is constructed in a way to be updated as additional information becomes available. Prioritization scores can then be updated or modified to reflect changing conditions. Using the database as-is, without additional information still provides the district with a robust tool to guide future system repairs.

4 Repair and Replacement Options

To maximize the impact of improvements to the sanitary sewer and potable water systems, various options should be considered for each segment where appropriate to reduce overall construction costs while providing an appropriate life cycle of 30-50 years. Replacing entire segments of pipe should be considered for segments that are extremely deteriorated, improperly bedded, or were originally installed in a curvilinear fashion (relevant to the sanitary system only). Other options such as cast-in-place pipe (CIPP), sliplining, pipe bursting, or spot repairs should be considered as viable alternatives if appropriate before entire pipe replacement is determined to be the appropriate solution.

With the time and funds available to the District, it was not possible to collect detailed assessment information on all buried line segments of the utilities currently. However, the mapping and database has been created for the District to continue to assess and inspect the buried pipelines. Upcoming data collection activities, including video surveys, elevation surveys of inverts, flow and infiltration monitoring, and leak testing, will produce sufficient information to categorize which segments would be appropriate for specific repair options. Categorizing repair options for specific segments can be performed after additional data collection activities are conducted. This section discusses various options available to the District for repair and replacement for buried pipe.

4.1 Sanitary Sewer Options

Industry standard repair options for sanitary sewer system fall into a few categories, with different repair methods being applicable for different situations. For example, segments of pipe with substantial deterioration would be good candidates for complete replacement, but segments with minor stress corrosion, cracking, or minor I&I can be repaired at a lower cost using other repair methods. Options available to the District for sanitary sewer repairs include:

- Cured-In-Place Pipe (CIPP)
- Pipe Bursting
- Sliplining (pipe-in-pipe)
- Spot Repairs
- Replacement
- Manhole repair or replacement

This section outlines these options for implementing improvements to the sanitary sewer system, including their pros and cons, applicability, and relative costs.

4.1.1 Cured-in-place pipe (CIPP)

CIPP is a trenchless method of rehabilitating pipelines using a seamless liner within an existing pipe and is one of the most widely used methods of sewer line repair. The CIPP process involves running a liner through a segment of existing pipe and curing it to a rigid liner using resins. There are various manufacturers of CIPP products that provide a range of wall thicknesses, applicability to chemical and environmental conditions, material strengths, and design lifetimes. Depending on what manufacturer is selected, liner and resins differ substantially but for application at St. Mary's it is anticipated that traditional products are likely the most applicable. Traditional CIPP products include felt or fiberglass liner materials and epoxy resins. It is common for CIPP materials to boast a 50–80-year design life and relatively low cost per linear foot for installation.

The major benefits of CIPP repair methods include a lack of excavation for pipe diameters less than 60". Compared to sliplining, CIPP does not significantly reduce the interior pipe diameter. While products vary, the thickness of cured liners can be as thin as 0.1-inch (3MM) for an 8-inch pipe repair. Depending on the material strength desired, the thickness can increase but usually not as much as a step-down in nominal pipe internal diameter. CIPP installation is very fast compared to excavation pipe replacement. Installation rates vary based on site conditions, but it is not unreasonable for CIPP contractors to be able to install up to 300-600 LF per day. This fast installation reduces service interruptions and road closures. Service line connections to mains undergoing CIPP repair must be cut out and sealed from the inside of the main to allow reconnection. This can be accomplished using methods developed by contractors and it does not require excavation of individual service line connections.

Sanitary segments that would make good candidates for CIPP include pipe segments located in areas that would be extremely difficult to do a full pipe replacement (i.e. segments 174-177 that run under Lake Quivira), segments that contain significant cracking and minor structural damage, and segments that contain many spot leaks or cracks. Most straight-line segments of pipe would be appropriate for CIPP repairs.

One common contractor for this type of work is C&L Water Solutions. A cut sheet is provided as an attachment that discusses one of their products that could be applicable for use at St. Mary's.

4.1.2 Pipe Bursting

Another common trenchless method of sanitary and water line replacement is pipe bursting. Pipe bursting involves pulling an expander head through an existing pipeline to break the existing pipe and replace it with a new pipe. This method allows the existing pipeline to be used as a pilot hole for pulling new pipe. Pipe bursting requires two pits to be excavated for each run of pipe, one at the beginning and an intercept pit at the end. Once the expander head is pulled through, HDPE or other relatively flexible pipe is pulled through the existing hole and reconnected to upstream and downstream manholes.

The main advantage of pipe bursting is the ability to increase pipe diameters and is best suited to areas of the system that require up-sizing. This is not known to be the case at St. Mary's as it appears that pipe sizes are appropriately sized for current users. The use of HDPE or equivalent pipe as the replacement material minimizes the number of required fittings and can be placed in a curved fashion due to its flexible properties. Pipe bursting has significant downsides compared to CIPP repairs. Service lines will need to be excavated to reconnect them to the new pipeline as the original connections will be blocked from the main when the new pipe is installed. Additionally, production rates for installation are considerably slower than CIPP due to pit excavation and service line connections. Pipe bursting is advantageous to excavation replacement in that it is faster and produces less traffic interruptions.

4.1.3 Sliplining

Sliplining is one of the oldest methods of trenchless sewer line repair. It involves installing a smaller diameter pipe within an existing pipeline that requires repair. Grout can be injected between the two pipes to increase rigidity and improve design life. The most common pipe materials to use include PVC, HDPE, and fiberglass-reinforced pipe, all of which have variants that are approved for use in wastewater applications.

Benefits to sliplining include relatively low cost for installation and materials. HDPE or other flexible pipe products can be installed within existing manholes, which prevents pit excavation at the start and end of segment repairs. Sliplining can provide substantially more reinforced pipe than pipe bursting due to the introduction of grout sealant between the new and existing pipe. Sliplining can be very cost effective due to a lack of trench excavation but service lines must be reconnected, which can greatly slow down installation and increase the amount of traffic and service interruptions compared to CIPP repairs. Sliplining would be appropriate for segments of sewer line that is significantly structurally deteriorated and would not be a candidate for CIPP.

Approximately 3,900 LF of sewer lines at St. Mary's were sliplined in repair efforts in the 1990's (Integra 1997a-c). These repairs occurred around Lake Quivira and Silver Lake, but the current condition of these repairs is uncertain.

4.1.4 Spot Repairs

Spot repairs for sanitary sewer typically involve repairing individual cracks, holes, and leaks in existing pipe using polymers, resin, or fiberglass reinforcement, like CIPP methods. Most spot repairs involve locating the area that requires repair using video equipment, applying a leak-stopping product in and around the crack or leak, and inflating an air bladder that reinforces the product or patch being used. Many contractors specialize in specific methods and many use proprietary products, each with their own merits and longevity. Spot repairs are a relatively low-cost method for repairing short sections of pipe that have minor leaks or stress corrosion but usually do not provide much additional rigidity. For this reason, spot repairs should only be considered for minor cracks and leaks in pipes that have overall acceptable structural integrity.

Within the database, in the "Critical Factors" field, segments that appeared to be good candidates for spot repairs were identified. Additional supporting information can be found in the "Notes" field, including where along the segment the crack or leak is located. Costs for representative spot repair products and contracting services are discussed in later sections of this report.

4.1.5 Pipe Replacement

Under various conditions, it may be in the best interest of the District to completely replace certain segments of sanitary sewer. Replacement typically involves trenching around the existing sanitary sewer, isolating the sewer between manholes using pumping and bypassing equipment, and manually replacing the existing pipe with new materials and bedding. In discussion with district operators, there has been multiple instances of significant stress corrosion, likely due to inadequate pipe bedding or large rocks and cobbles laying on the surface of the pipe. Pipe replacement has the benefit of ensuring the pipes are bedded correctly and ensure the longest design life compared to spot repairs or sliplining. Complete pipe replacement should be considered if the pipe has major structural issues, major pipe collapse, or if major obstructions cannot be removed.

Sanitary segments that would be appropriate for replacement have also been identified in the "Critical Factors" field with supporting information in the "Notes" field. Costs for pipe replacement are included in later sections of this report.

4.1.6 Manhole Repair and Replacement

Manholes, which are included in the sanitary database, will also require repair or replacement if they are found to be failing or deteriorating. Manhole inspections are recommended to be conducted regularly to assess if any leaking is occurring or if structural cracks exist. Manholes with minor cracks and leaks that do not compromise the structural integrity of the structure can be repaired using similar materials as those used in sanitary line sliplining and spot repairs. Namely CIPP materials and products can provide leak-proof methods of repairing minor cracks or leaks. Manhole repairs using liner materials require significant labor to ensure adequate flow into and out of the structures, but the labor and material costs are typically substantially lower than the costs for replacing entire manholes.

Manhole replacement might be required if significant structural deterioration has occurred or if large cracks exist in the concrete. Manhole replacement requires the connecting lines to be cut, the existing manhole is then excavated, removed, and a new replacement pre-cast concrete manhole is installed. New manholes are also recommended in areas of the sanitary system that currently have curvilinear sewer runs. The new manholes can be placed in a manner to allow only straight-line runs between manholes. This reduces the stress on sewer pipes and pipe joints, which increase the service life of buried pipes and prevents leaks in the future.

4.2 Potable Water Main Options

There are less available options for repairing pressurized drinking water lines compared to repairing sanitary sewer mains. Due to high pressures, water movement, restrictive material use for potable water, and number of service taps, pipe replacement will likely be the most common repair method. Several different construction “add-ons” were recently identified in the 2020 Water System Improvements Project. These include pipe insulation and active heat-trace insulation.

This section will describe the components of the water distribution system that will require repair or replacement as part of this Long-Range Plan.

4.2.1 Valves and Hydrants

For long-range utilities planning, it is advisable to replace all valves and hydrants. While some valves and hydrants can be repaired, newer products provide substantially greater service lifetimes and replacement can be more cost effective than repairs. Several valves, mainly gate valves and pressure relief valves, have already been identified as requiring replacement during the design phase of the 2020 Water System Improvements Project. Interviews with District operators also indicated several additional gate valves that are non-functional and require repair. These valves, 17 in total, are considered the highest priority for water system improvements and should be replaced prior to leak testing and replacing additional water mains. Valves identified for immediate replacement include:

- G01, G02 – Intersection of Silver Creek Road and Elk Road
- G05 – Intersection of Elk Circle and Silver Creek Road
- G10 – Intersection of Silver Creek Road and Aspen Road
- G15 – Intersection of Lower Forest Road and Upper Forest Road
- G19, G20, G27 – Intersection of Alice Road and Harris Drive
- G22 – Intersection of Little Creek Road and Alice Road
- G23 – Along Little Creek Road
- G26 – Intersection of Silver Creek Road and Beaver Road
- G42, G43 – Intersection of Brook Drive and Lake Road
- G53 – Along Brook Drive near Well 1
- G56 – Along Fall River Road near Silver Lake
- G57 – Along Stuart Vista Court
- G65 – Intersection of Lake Road and Club Way

Other valves and fire hydrants that do not have known operational issues are recommended to be replaced based on the water line prioritization scheme outlined in previous sections.

4.2.2 Pipe Insulation

Some areas of the drinking water system contain existing pipelines that were installed within the frost zone of the subsurface, creating the potential for lines to freeze in wintertime. Additionally, due to shallow bedrock, stormwater or stream diversion culverts, it may not be feasible to bury pipes below the frost zone and additional insulation methods might be needed.

Water lines within the St. Mary's system should be buried to a depth of no less than 9-feet BGS to ensure proper pipes do not freeze. Water pipes that cannot be buried to a depth of 9-feet BGS due to shallow bedrock or the presence of culverts, should be insulated to provide additional frost protection. Rigid insulation board can be used on the top and sides of the pipe bedding area to provide adequate insulation when pipes cannot be buried deeper than 9-feet BGS. Additionally, insulated pipe-in-pipe products, such as Kool-Kore pre-insulated C900 PVC pipe by Thermal Pipe System Inc or equivalent, can provide further protection from frost. By using insulation board and insulated pipe products, water lines could be buried between 7- to 9-feet BGS, which would reduce the cost associated with excavating through shallow bedrock and prevent lines from freezing.

4.2.3 Active Heat-Trace Insulation

In situations where bedrock is very shallow or where large diameter culverts prevent deep pipe bury, additional insulation methods may be required. A frequently used method to ensure proper frost protection utilizes powered heat-trace wire to prevent pipes from freezing. In situations where culverts cross near buried water distribution pipes, active heat-trace is recommended, in addition to using pipe-in-pipe materials and rigid insulation board around the bedding area. Active heat-trace insulation requires electrical service, a service access panel, and emergency disconnect and will need to be designed by an accredited electrical engineer. Ideally, active heat-trace would only be used for short runs of pipe in areas where bedrock or culverts are very close to the ground surface or where short runs of pipe at increased risk of freezing. Multiple strands of heat-trace wire, installed within pipe-in-pipe materials, should be employed to provide redundancy in case a single section fails.

During the planning phase for water improvements projects, the costs would need to be assessed to determine whether the costs of active heat-trace insultation, pipe-in-pipe materials, and rigid insulation board are more cost-effective than excavating through short runs of bedrock. It is recommended that a cost-benefit analysis be conducted to determine if the electrical costs and additional costs of materials and labor are justified against excavation costs and time delays during construction.

5 Cost Estimating

Construction costs were developed for pipeline improvements based on previous construction experience at St. Mary's during the ongoing Water System Improvements Project, discussions with pipeline maintenance contractors, and costs developed in the forthcoming Wastewater Project. Costs are broken down by linear-foot costs for replacement and repairs, with additional "add-ons" related to managing difficult construction situations such as shallow bedrock. These costs are intended to provide the District with planning-level estimates for each sub-grouping presented in previous sections. Further refinement of these costs will be required as additional information becomes available on the sanitary sewer system and drinking water system.

Total project costs including O & M costs, engineering and management costs are also discussed at the end of this section. The following subsections describe the assumptions and unit costs used in cost estimates for subgroupings.

5.1 Water System Cost Estimating Assumptions

To provide conservative cost estimates for the entirety of the water distribution system, several assumptions are required to account for variations in construction conditions. Major assumptions used to develop cost estimates include the following:

- It is assumed that all segments will require replacement. As described in previous sections, there are less alternatives available for repairing leaks and damaged segments of pressurized water main. For cost estimating purposes, it was decided that planning on full replacement would be most appropriate for planning and funding procurement.
- Similarly, all valves and fire hydrants are assumed to require replacement.
- Due to a lack of information regarding pipe sizes in the water distribution system, it is assumed that all lines are 8-inch diameter. This assumption will need to be revised as soon as additional information on specific pipe and valve sizes become available.
- All water lines are assumed to require a 9-foot bury depth throughout the system to provide adequate frost protection. A 9-foot bury depth is appropriate for high-altitude mountainous conditions in Colorado to reasonably protect against freezing.
- Shallow bedrock conditions may exist at numerous locations throughout the St. Mary's area and without mapping out bedrock in each utility corridor, it is assumed that alternatives to typical trench excavation to a 9-foot bury depth will be required. To account for the additional costs of bedrock mitigation and alternative insulation designs, it is assumed that bedrock could be encountered along approximately 20% of the drinking water distribution system.
  - For cost estimating, this means that 20% or approximately 9,600 LF of the water system will require additional insulation using 3-inch insulation board and insulated pipe-in-pipe lines. It is assumed that this additional insulation will be needed in shallow bedrock

areas to reduce the amount of excavation required in solid bedrock. Insulation would only be required in areas where the maximum bury depth is between 7-9 feet BGS.

- In utility corridor areas that cross large diameter culverts or contain very shallow bedrock, it is assumed that active heat-trace insulation will be required. To provide conservative cost estimates, it is assumed that 20% of the pipeline requiring standard insultation (approximately 1,900 LF) will require active heat-trace insulation. Active heat-trace insulation will require electrical service in addition to rigid insulation board and pipe-in-pipe lines. Active heat-trace wires would be placed in the insulation region of the pipe-in-pipe materials.
- Site specific investigations would be required throughout the system to identify exactly where insultation and active heat-trace insulation are required. Including insulation and active heat-trace insultation in the cost estimates provides a more conservative cost estimate.
- Insulation and active heat-trace insulation costs are incorporated into the cost estimates for individual subgroupings. For example, if a subgrouping contains 1,000 LF of water line, 200 LF (20%) will require insulation using insulation board and 40 LF (20% of 250 LF) will require active heat-trace insulation.

- The development of unit costs account for restrained pipe fittings, thrust blocks, gate valves, altitude valves, C-900 PVC pipe, fire hydrants, and reconnecting service taps back to the main.
  - Costs for these individual items were combined from a 2021 estimate for water line construction within the St. Mary's District to produce unit costs on a linear foot basis. These costs are accurate for the construction conditions and contractor fees for projects occurring in the St. Mary's area.
  - Costs developed for pipeline insulation and active heat-trace insulation are modified from additional contractor cost estimates from the 2020/2021 Water System Improvements Project. These costs also reflect construction conditions and contractor fees associated with projects at St. Mary's Glacier.

5.2 Water System Unit Costs

Table 6 outlines costs for linear-foot water pipe replacement, as well as costs for pipeline insulation and active heat-trace insultation. The linear-foot costs for pipe replacement include excavation, pipe bedding, restrained fittings, thrust blocks, valves and appurtenances, and reconnecting service taps. Construction costs, such as contractor fees, water management, traffic control, surface restoration, and mobilization, are also included in the individual unit costs to account for costs other than materials and labor. Linear-foot costs for pipeline insulation include insulated pipe-in-pipe materials and additional insulation using rigid insulation board. Active heat-trace insulation linear-foot costs include pipe-in-pipe materials, rigid insulation board, heat-trace wires, and associated electrical components. These unit costs provide conservative estimates for long-range utility planning and are used to develop system-wide replacement costs.

Table 6: Water system unit costs

Item	Description	Unit	Cost
1.1	Replace C-900 Water Distribution Pipe	LF	$200
1.2	Water Line Replacement with Pipeline Insulation	LF	$300
1.3	Water Line Replacement with Active Heat-Trace Insulation	LF	$400

5.3 Water System Subgroup Cost Estimates

Using the methodology outlined in previous sections and the unit costs in Table 6, costs estimates were developed for each subgrouping. Subgrouping cost estimates are shown in Table 7. Results show a total water system replacement cost of $11,008,000, which includes labor and materials only. Additional cost estimates that include indirect construction costs are shown in Table 10. Additional information related to cost estimating for the water system can be found in Appendix A.

Table 7: Summary of water system subgroup cost estimates

Subgroup	Total Subgrouping Length (LF)	Total Subgroup Cost ($)	Subgroup	Total Subgrouping Length (LF)	Total Subgroup Cost ($)
G01	2,213	$509,000	G17	1,073	$246,000
G02	2,218	$510,000	G18	966	$222,000
G03	1,386	$319,000	G19	1,849	$425,000
G04	1,882	$433,000	G20	1,433	$330,000
G05	1,447	$333,000	G21	1,219	$280,000
G06	1,623	$372,000	G22	2,066	$475,000
G07	2,065	$475,000	G23	1,171	$269,000
G08	1,504	$346,000	G24	1,789	$411,000
G09	1,670	$384,000	G25	1,521	$349,000
G10	1,722	$395,000	G26	1,700	$391,000
G11	1,925	$444,000	G27	1,448	$333,000
G12	1,260	$290,000	G28	1,174	$269,000
G13	1,238	$285,000	G29	1,513	$348,000
G14	1,492	$344,000	G30	984	$227,000
G15	1,448	$333,000	G31	1,366	$314,000
G16	1,509	$347,000	**Total**	**47,875**	**$11,008,000**

5.4 Sanitary System Cost Estimating Assumptions

Repairs and replacements in the sanitary sewer system have been discussed at length but for cost estimating purposes, the following assumptions were made:

- It is assumed that existing sanitary lines identified as curvilinear will be replaced. Curvilinear sanitary lines will effectively be straightened by installing additional manholes and straight-line pipe runs between manholes.
  - Along with replacing curvilinear sanitary segments, it is assumed that an additional new manhole is required within existing curvilinear sanitary segments. The additional manhole will allow for straight pipe runs or pipe runs with minimum deflection between manholes.
- The existing condition of individual manholes are not currently known. For cost estimating, it is assumed that 25% of manholes will require replacement and the remaining 75% of manholes will require rehabilitation only.
- The existing condition of all sanitary sewer segments is also unknown, which prevents making informed recommendations on which segments should be replaced entirely or repaired using sliplining methods. To remain conservative for cost estimating purposes, it is assumed that 50% of straight (non-curvilinear) segments can be repaired using sliplining methods. This is a conservative assumption as sliplining methods could likely be used more extensively throughout the system in areas without substantial structural deterioration.
- Where sliplining is utilized, it will be utilized on the entire segment length. While spot repairs might be appropriate for isolated areas, pipe segments will benefit significantly from full length repairs.
  - It is also assumed that sanitary sewer segments that run underneath Lake Quivira will be entirely sliplined. Due to the location of these segments within the extents of the lake, excavation and replacement would create an unnecessary environmental disturbance.
- Due to a lack of extensive information regarding the structural integrity of specific pipe segments, it is assumed that only one sliplining method will be used in the cost estimate. As outlined in previous sections of this report, many sliplining methods and products exist with a range of pros, cons, and costs. During the design phase of repairs, various sliplining methods should be considered for potential cost-savings but the cost estimates presented here assume that sliplining is accomplished using CIPP. This sliplining method is widely used and has a conservative cost that is appropriate for long-range planning.
- It is assumed that replacement sanitary segments will remain the same size as originally designed. District operators have not identified any pipe segments as having been undersized and population growth was originally accounted for in the design of the collection system.

5.5 Sanitary System Unit Costs

Table 8 outlines costs for linear-foot sanitary pipe replacement, manhole repair, manhole replacement, and sliplining using CIPP methods. Construction costs, such as contractor fees, water management, traffic control, surface restoration, and mobilization, are also included in the individual unit costs to account for costs other than materials and labor.

Table 8: Sanitary system unit costs

Item	Description	Unit	Cost
2.1	Replace 8" SDR 35 PVC Sanitary Pipe	LF	$160
2.2	8" CIPP Repair	LF	$60
2.3	Replace 10" SDR 35 PVC Sanitary Pipe	LF	$190
2.4	10" CIPP Repair	LF	$70
2.5	Replace 12" SDR 35 PVC Sanitary Pipe	LF	$235
2.6	12" CIPP Repair	LF	$90
2.7	Replace Manhole	EA	$8,800
2.8	Manhole Restoration	EA	$2,200

5.6 Sanitary System Subgroup Cost Estimates

Using the methodology and assumptions outlined in previous sections and the unit costs in Table 8, costs estimates were developed for each subgrouping for the sanitary system. Subgrouping cost estimates are shown in Table 9. Results show a total sanitary sewer system replacement cost of $6,857,000, which includes labor and materials only. Additional cost estimates that include indirect construction costs are shown in Table 10. Additional information related to cost estimating for the sanitary system can be found in Appendix A.

Table 9: Summary of sanitary system subgroup cost estimates

Subgroup	Manholes in Subgroup (Qty)	Total Subgroup Length (LF)	Total Subgroup Cost ($)	Subgroup	Manholes in Subgroup (Qty)	Total Subgroup Length (LF)	Total Subgroup Cost ($)
G01	6	1,848	$320,000	G17	3	1,215	$198,000
G02	5	1,256	$197,000	G18	6	1,569	$292,000
G03	3	1,080	$168,000	G19	5	1,682	$243,000
G04	3	1,599	$182,000	G20	4	1,462	$277,000
G05	3	1,127	$131,000	G21	6	1,219	$188,000
G06	6	1,953	$297,000	G22	7	1,706	$210,000
G07	2	649	$116,000	G23	5	1,814	$217,000
G08	5	1,088	$170,000	G24	7	1,409	$356,000

Subgroup	Manholes in Subgroup (Qty)	Total Subgroup Length (LF)	Total Subgroup Cost ($)	Subgroup	Manholes in Subgroup (Qty)	Total Subgroup Length (LF)	Total Subgroup Cost ($)
G09	3	994	$229,000	G25	5	1,230	$153,000
G10	3	1,529	$260,000	G26	6	1,477	$182,000
G11	4	1,277	$156,000	G27	10	2,238	$335,000
G12	11	2,128	$295,000	G28	4	1,333	$162,000
G13	4	1,451	$175,000	G29	8	1,418	$187,000
G14	4	1,172	$186,000	G30	4	816	$105,000
G15	4	1,432	$244,000	G31	6	2,056	$286,000
G16	6	1,293	$175,000	G32	4	1,363	$165,000
				Totals	**162**	**45,883**	**$6,857,000**

5.7 Construction Cost Estimate Conclusion

Planning level cost estimates for improving both the water and sanitary system are $17,865,000. This cost estimate is broken down by subgroups in Tables 7 and 9 and can be broken down further to individual segments using the outlined methodology and provided database. These cost estimates should be further refined during the planning phase of system improvements but provide the District with working estimates for how much repairs are likely to cost.

5.8 Total Project Cost Estimate

In addition to the actual cost to construct the buried infrastructure, other efforts will be required to be accomplished by the District and others to perform the necessary project planning, engineering design and construction administration to support the identified construction activities. A detailed breakdown of these activities is shown under Tasks 2 thru 6 in the Typical Project Phase Workflow Schedule presented in Appendix B. Representative costs for these activities are directly related to the cost of construction and are also affected by how the project delivery has been configured. Detailed discussion of the recommended project schedule and delivery follows immediately in Section 6 of the Plan. Based on the conditions defined in Section 6, total project costs, including planning, design and construction are provided below in Table 10. For budgeting purposes, those costs are subdivided into 4 identical Phases of project delivery as presented in Section 6. By including direct construction costs with the required supporting costs, total costs are estimated to be approximately $5.2M per Phase for a total program cost of approximately $20.7M.

Table 10: Total project costs estimate

Task	Cost Description	Phase 1 (2022-25)	Phase 2 (2026-30)	Phase 3 (2031-35)	Phase 4 (2036-40)	Task Cost Total
1	Operations, Field Testing & Investigations	$35,000	$35,000	$35,000	$35,000	$140,000
2	LRP Financial Aid Planning	$20,000	$20,000	$20,000	$20,000	$80,000
3	Preliminary Engineering	$80,000	$80,000	$80,000	$80,000	$320,000
4	Final Engineering	$360,000	$360,000	$360,000	$360,000	$1,440,000
5	Preconstruction	$75,000	$75,000	$75,000	$75,000	$300,000
6A-C	Construction Admin Services	$134,000	$134,000	$134,000	$134,000	$536,000
6D	Total Construction Cost	$4,466,250	$4,466,250	$4,466,250	$4,466,250	$17,865,000
Program Phase Subtotals		**$5,170,250**	**$5,170,250**	**$5,170,250**	**$5,170,250**	**$20,681,000**

6 Plan Implementation and Scheduling

Given the very large size of the utilities replacement effort and the small size of the District, scheduling of the proposed improvements will ultimately be guided by available State and Federal funding. Due to St. Mary's small customer base, there is no financial capacity or local support to utilize service rate increases as the sole funding method for the improvements. However, the District will likely be faced with the need to generate significant "matching funds" to maximize the availability of future State and Federal grant and loans to fund the design and construction of the water and sanitary system improvements.

There are currently 277 service connections for the water and sanitary systems. If one assumes a worst-case scenario where no outside funding sources were available, it would cost all 277 utility customers an additional $3,000/year for 25 years to cover the utility replacement costs. That funding scenario is not considered viable as many of the residents are financially disadvantaged, living on fixed income.

The District is developing a new long term financial plan that funds the planning, design and construction of the $20.7 M improvements program. This plan envisions a total of 4 phased projects spaced approximately 5 years apart that would be designed and constructed to replace all buried utilities by the end of the year 2040. This approach allows the District to spread the costs and cashflow requirements over 25 years. It also affords the residents periodic breaks between individual construction projects. This approach would allow the District to pursue the completion of other required infrastructure improvements during the same period.

Included in Appendix B are two project workflow schedules that illustrate the completion of individual work tasks over time required to complete the project. B.1, the Project Workflow Schedule provides a detailed breakdown of the anticipated tasks required to complete Phase 1 of the Long Range Replacement Plan. Task 1 includes all the current activities associated with gaining final approval of the LRP from CDPHE. Following that approval, Task 2 identifies the steps necessary for the District to apply for project funding from Colorado Water and Wastewater State Revolving Funds (SRF) and the Department of Local Affairs (DOLA). The plan also includes steps to apply for and acquire federal funds through the US Department of Agriculture (USDA). Task 3 represents the preliminary engineering required to address the application requirements for State and Federal funding listed in Task 2. Following preliminary approvals, Task 4 captures the steps of the final engineering design process required to generate plans and specifications for construction.

The District has utilized Construction Management at Risk (CMAR) as a delivery method with success on recent projects and it anticipates continuing with the CMAR delivery approach for all 4 phases of the LRP. In that context, Task 5 identifies the Preconstruction tasks associated with competitive hiring of a general contractor and the open and cooperative development of a Guaranteed

Maximum Price (GMP) for the specific project scope. After reaching a satisfactory GMP, Task 6 includes all construction related activities accomplished by the District, Engineer and Contractor. Due to the harsh mountain environment at 10,000 ft. elevation, the actual construction effort for one individual phase is anticipated to require 2 consecutive construction seasons. One individual phase of the project will require approximately 46 months to complete from start to finish.

Also provided in Appendix B is B.2, the Proposed Program Schedule. This figure presents a graphical representation of the entire Long Range Plan Program to replace all the buried utilities by the year 2040. The overall Program Schedule was compiled by repeating Tasks 2 thru 6 for each Phase, four times in series. Because of the extended time period of the Program, a one-year float period has been scheduled between each Phase to provide additional adjustability/flexibility to the ongoing planning process. Table 11 summarizes the program project phases, timeframes, and estimated subtotal costs.

Table 11: Program phase summary

Project Phase	Timeframe	Program Phase Subtotals
Phase 1	2022-2025	$5,170,250
Phase 2	2026-2030	$5,170,250
Phase 3	2031-2035	$5,170,250
Phase 4	2036-2040	$5,170,250

7 Final Recommendations

This report outlined the methodology used to guide repairs for the water distribution system and sanitary sewer collection system operated by the St. Mary's Glacier Water and Sanitation District. Both systems were broken down into segments and subgroupings that will aid in system-wide planning and improvements. Available data on both systems was incorporated into a database to assist improvements planning. The database and system segmentation were used to generate planning-level cost estimates for guide future system improvements. System segments were prioritized based on available information related to functionality and required improvements.

It is recommended that the database be used to guide repair and replacement projects at St. Mary's in the future. The database should be updated as additional information becomes available. The upcoming video survey, sanitary flow study, and land and invert survey will provide excellent information to improve repair prioritization. Additional information on the water system, such as determining pipeline sizes and leak testing results, will further guide repairs on the water system. It is recommended that the District regularly perform leak testing, video surveys, and system inspections to improve the response to deteriorating conditions that could arise in the future.

As-is, the prioritization rankings of the subgroupings in the water and sanitary systems can be used as guidance to where repairs should be conducted to maximize impact of future improvements projects. Repair options for the water and sanitary systems are presented in this report to further assist the District in assessing cost-effective means of improving the system. The database provides a means of data-driven decision making to improve service to St. Mary's residents and reduce impacts to the environment.

8 References

Integra Engineering. 1997a. "St. Mary's Glacier Water and Sanitation District, Infiltration Project Loan". Memo addressed to Mr. J. Brian Ehrle of CDPHE. Dated March 14, 1997.

Integra Engineering. 1997b. "St. Mary's Glacier Water and Wastewater District, Infiltration & Inflow Investigation". Memo addressed to Ms. Ginny Torrez of CDPHE. Dated April 1, 1997.

Integra Engineering. 1997c. "St. Mary's Glacier Water and Wastewater District, Infiltration & Inflow Investigation". Memo addressed to Mr. Derald Lang of CDPHE. Dated April 30, 1997.

FEI Engineers. 2014. St. Mary's Glacier Water and Wastewater District. Sewer Line Inflow Map. Dated 2014.

Clear Creek County (CCC). 2021. Clear Creek County Geographic Information System (GIS) Interactive Maps. Data provide by Matt Taylor, GISP of Clear Creek Counties Mapping Department on March 17, 2021 related to water and sanitary services at St. Mary's.

Figures

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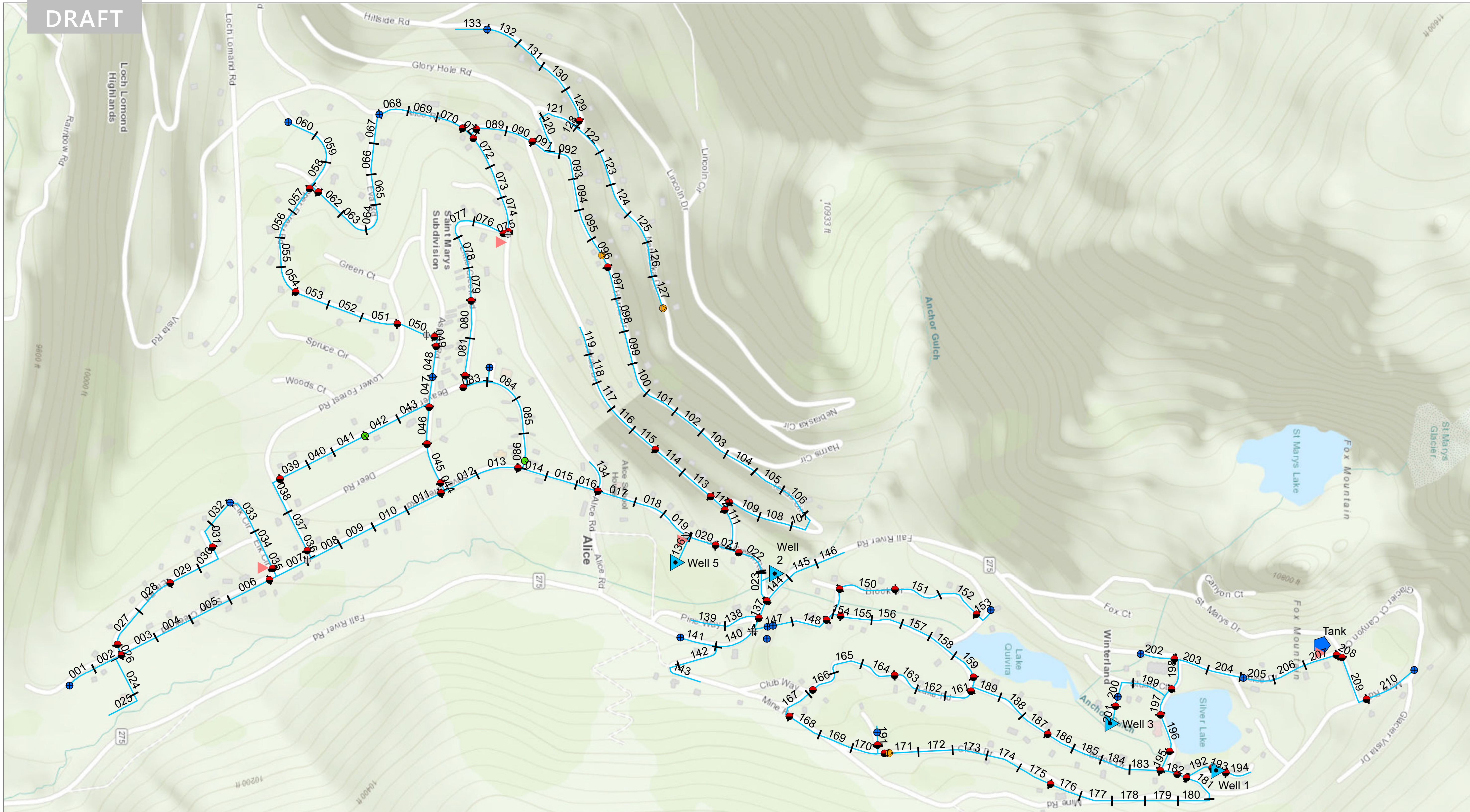

LEGEND:

- Water Segments
- Hydrants
- Water Tank
- Supply Well

Valve Type

- ARV
- BLOW
- GATE
- OL
- PRV

NOTES:
Numbers shown along segment lengths are the last 3-digits of the assigned Water Segment ID (WTR_N/S_0XXX)

0 250 500 1,000 Feet

Figure 1
Water System Segmentation
St. Mary's Water and Sanitation District
Long-Range Utilities Plan

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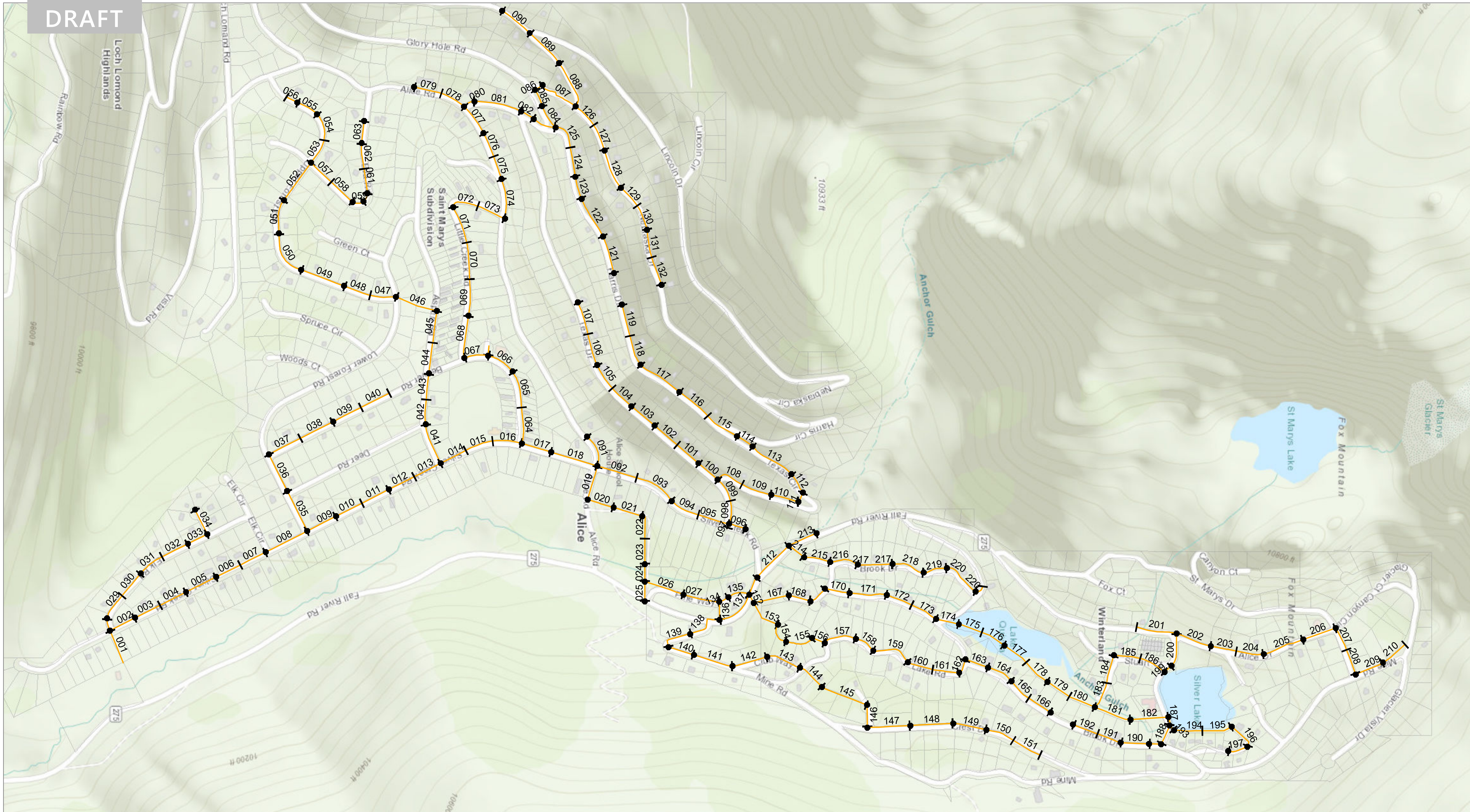

NOTES:
Numbers shown along segment lengths are the last 3-digits of the assigned Sanitary Segment ID (SAN_N/S_0XXX)

LEGEND:
- Sanitary Segments
- Manholes
- Land Parcels

0 250 500 1,000 Feet

Figure 2
Sanitary System Segmentation
St. Mary's Water and Sanitation District
Long-Range Utilities Plan

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LEGEND:

Segment Subgroupings (G##)

Land Parcels

Prioritization Score

- Lowest Priority
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 9
- 10
- Highest Priority

NOTES:

Numbers shown along segment lengths are the last 3-digits of the assigned Water Segment ID (WTR_N/S_0XXX)

Priority scores are displayed for individual segments. Segments have been grouped into 31 subgroupings, labled with G01-G31.

0 250 500 1,000 Feet

Figure 3

Water System Prioritization

St. Mary's Water and Sanitation District

Long-Range Utilities Plan

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LEGEND:

- Manholes
- Land Parcels
- Segment Subgroupings (G##)

Prioritization Score

- 2 - 4 - Low Priority
- 5 - 7
- 8 - 10
- 11 - 13
- 14 - 16
- 17 - 19 - High Priority

NOTES:

Numbers shown along segment lengths are the last 3-digits of the assigned Sanitary Segment ID (SAN_N/S_0XXX)

Priority scores are displayed for individual segments. Segments have been grouped into 32 subgroupings, labled with G01-G32.

0 250 500 1,000 Feet

Figure 4

Sanitary System Prioritization

St. Mary's Water and Sanitation District

Long-Range Utilities Plan

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Appendix A
Cost Estimating Backups

Item	Description	Unit	Cost
1.1	Water Distribution Line Replacement	LF	$200
1.2	Water Line Replacement with Pipeline Insulation	LF	$300
1.3	Water Line Replacement with Active Heat-Trace Insulation	LF	$400

Subgroup	Total Subgrouping Length (ft)	Standard Water Main Length (ft)	Insulation Length (ft)	Active Insulation Length (ft)	Standard Water Main Length ($)	Insulation Length ($)	Active Insulation Length ($)	Total Subgroup Cost ($)
G01	2213	1660	443	111	$ 332,000	$ 133,000	$ 44,000	$ 509,000
G02	2218	1663	444	111	$ 333,000	$ 133,000	$ 44,000	$ 510,000
G03	1386	1040	277	69	$ 208,000	$ 83,000	$ 28,000	$ 319,000
G04	1882	1411	376	94	$ 282,000	$ 113,000	$ 38,000	$ 433,000
G05	1447	1086	289	72	$ 217,000	$ 87,000	$ 29,000	$ 333,000
G06	1623	1217	325	81	$ 243,000	$ 97,000	$ 32,000	$ 372,000
G07	2065	1549	413	103	$ 310,000	$ 124,000	$ 41,000	$ 475,000
G08	1504	1128	301	75	$ 226,000	$ 90,000	$ 30,000	$ 346,000
G09	1670	1253	334	84	$ 251,000	$ 100,000	$ 33,000	$ 384,000
G10	1722	1292	344	86	$ 258,000	$ 103,000	$ 34,000	$ 395,000
G11	1925	1444	385	96	$ 289,000	$ 116,000	$ 39,000	$ 444,000
G12	1260	945	252	63	$ 189,000	$ 76,000	$ 25,000	$ 290,000
G13	1238	928	248	62	$ 186,000	$ 74,000	$ 25,000	$ 285,000
G14	1492	1119	298	75	$ 224,000	$ 90,000	$ 30,000	$ 344,000
G15	1448	1086	290	72	$ 217,000	$ 87,000	$ 29,000	$ 333,000
G16	1509	1132	302	75	$ 226,000	$ 91,000	$ 30,000	$ 347,000
G17	1073	805	215	54	$ 161,000	$ 64,000	$ 21,000	$ 246,000
G18	966	724	193	48	$ 145,000	$ 58,000	$ 19,000	$ 222,000
G19	1849	1387	370	92	$ 277,000	$ 111,000	$ 37,000	$ 425,000
G20	1433	1075	287	72	$ 215,000	$ 86,000	$ 29,000	$ 330,000
G21	1219	914	244	61	$ 183,000	$ 73,000	$ 24,000	$ 280,000
G22	2066	1550	413	103	$ 310,000	$ 124,000	$ 41,000	$ 475,000
G23	1171	878	234	59	$ 176,000	$ 70,000	$ 23,000	$ 269,000
G24	1789	1342	358	89	$ 268,000	$ 107,000	$ 36,000	$ 411,000
G25	1521	1141	304	76	$ 228,000	$ 91,000	$ 30,000	$ 349,000
G26	1700	1275	340	85	$ 255,000	$ 102,000	$ 34,000	$ 391,000
G27	1448	1086	290	72	$ 217,000	$ 87,000	$ 29,000	$ 333,000
G28	1174	880	235	59	$ 176,000	$ 70,000	$ 23,000	$ 269,000
G29	1513	1135	303	76	$ 227,000	$ 91,000	$ 30,000	$ 348,000
G30	984	738	197	49	$ 148,000	$ 59,000	$ 20,000	$ 227,000
G31	1366	1024	273	68	$ 205,000	$ 82,000	$ 27,000	$ 314,000
Totals	47875	35906	9575	2394	$ 7,182,000	$ 2,872,000	$ 954,000	$ 11,008,000

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Item	Description	Unit	Cost
2.1	Replace 8" SDR 35 PVC Sanitary Pipe	LF	$160
2.2	8" CIPP Repair	LF	$60
2.3	Replace 10" SDR 35 PVC Sanitary Pipe	LF	$190
2.4	10" CIPP Repair	LF	$70
2.5	Replace 12" SDR 35 PVC Sanitary Pipe	LF	$235
2.6	12" CIPP Repair	LF	$90
2.7	Replace Manhole	EA	$8,800
2.8	Manhole Restoration	EA	$2,200

Subgroup	Manholes in Subgroup (Qty)	Total Subgroup Length (ft)	Length of 8" Diameter Pipe (ft)	Length of 10" Diameter Pipe (ft)	Length of 12" Diameter Pipe (ft)	Length of Existing Curvilinear Pipe (ft)	Pipe Replacement Costs ($)	CIPP Repair ($)	Manhole Replacement ($)	Manhole Repair ($)	Subgroup Total Cost ($)
G01	6	1848			1848		$217,093	$83,142	$8,800	$11,000	$320,035
G02	5	1256	1256			204	$133,173	$37,691	$17,600	$8,800	$197,264
G03	3	1080		417	662		$117,467	$44,410	$0	$6,600	$168,477
G04	3	1599	1599				$127,916	$47,969	$0	$6,600	$182,485
G05	3	1127	1127				$90,125	$33,797	$0	$6,600	$130,522
G06	6	1953	1953			337	$210,157	$58,589	$17,600	$11,000	$297,346
G07	2	649	649			195	$83,127	$19,482	$8,800	$4,400	$115,810
G08	5	1088	1088			151	$111,184	$32,636	$17,600	$8,800	$170,220
G09	3	994	994			653	$184,040	$29,813	$8,800	$6,600	$229,253
G10	3	1529	1529			476	$198,505	$45,876	$8,800	$6,600	$259,781
G11	4	1277	1277				$102,126	$38,297	$8,800	$6,600	$155,824
G12	11	2128	2128			89	$184,549	$63,852	$26,400	$19,800	$294,601
G13	4	1451	1451				$116,043	$43,516	$8,800	$6,600	$174,959
G14	4	1172	1172			208	$127,058	$35,167	$17,600	$6,600	$186,425
G15	4	1432	242	1189		242	$171,146	$48,899	$17,600	$6,600	$244,245
G16	6	1293	628	665			$113,416	$42,115	$8,800	$11,000	$175,331
G17	3	1215	1215			303	$145,728	$36,439	$8,800	$6,600	$197,567
G18	6	1569	1569			568	$216,461	$47,073	$17,600	$11,000	$292,135
G19	5	1682	1682			196	$165,975	$50,456	$17,600	$8,800	$242,830
G20	4	1462	1462			572	$208,517	$43,867	$17,600	$6,600	$276,584
G21	6	1219	1219			157	$122,726	$36,585	$17,600	$11,000	$187,911
G22	7	1706	1706				$136,513	$51,192	$8,800	$13,200	$209,705
G23	5	1814	1814				$145,087	$54,408	$8,800	$8,800	$217,095
G24	7	1409	1409			1062	$282,673	$42,271	$17,600	$13,200	$355,744
G25	5	1230	1230				$98,423	$36,909	$8,800	$8,800	$152,932
G26	6	1477	1477				$118,151	$44,306	$8,800	$11,000	$182,257
G27	10	2238	2238			282	$224,184	$67,153	$26,400	$17,600	$335,337
G28	4	1333	1333				$106,656	$39,996	$8,800	$6,600	$162,052
G29	8	1418	1418				$113,469	$42,551	$17,600	$13,200	$186,819
G30	4	816	816				$65,247	$24,468	$8,800	$6,600	$105,114
G31	6	2056	2056			193	$195,312	$61,689	$17,600	$11,000	$285,601
G32	4	1363	1363				$109,058	$40,897	$8,800	$6,600	$165,354
Totals	162	45883	41102	2272	2510	5890	$ 4,741,304	$ 1,425,511	$ 396,000	$ 294,800	$ 6,857,614

Appendix B
Program Schedules

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St. Mary's Glacier Water & Sanitation District
Long Range Replacement Plan
for Water & Wastewater Utilities
01/10/22

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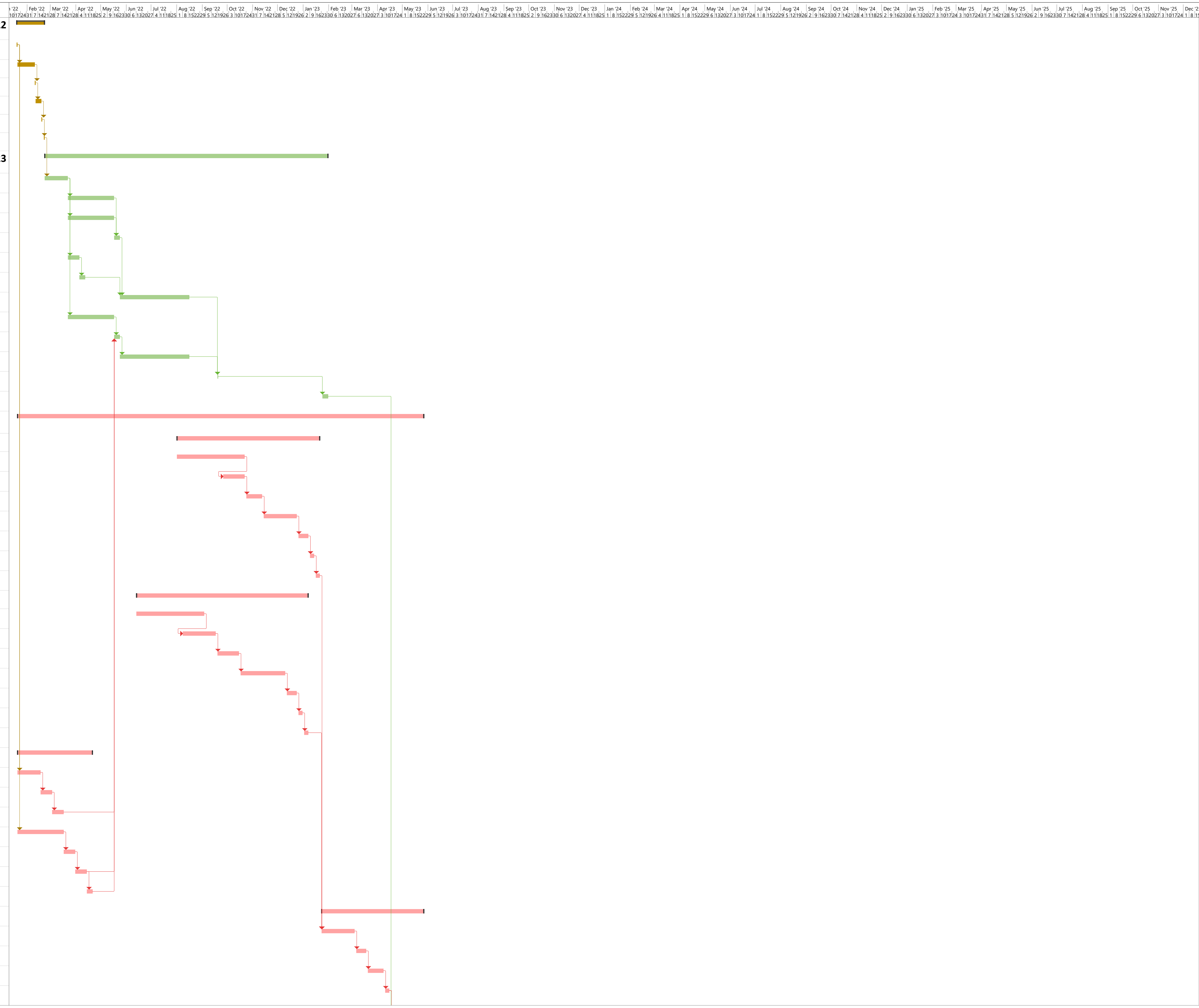
Appendix B.1
Project Workflow Schedule

ID	Task Name	Duration	Start	Finish
1	**Task 1 - Long Range Plan Approval**	**24 days**	**Wed 1/19/22**	**Mon 2/21/22**
2	Task 1.1 - District Submits Draft Long Range Plan to CDPHE	1 day	Wed 1/19/22	Wed 1/19/22
3	Task 1.2 - CDPHE Reviews Draft LRP	15 days	Thu 1/20/22	Wed 2/9/22
4	Task 1.3 - Draft LRP Review Meeting w/ District & CDPHE	1 day	Thu 2/10/22	Thu 2/10/22
5	Task 1.4 - Incorporate Review Meeting Comments	5 days	Fri 2/11/22	Thu 2/17/22
6	Task 1.5 - Deliver Final LRP to District & CDPHE	1 day	Fri 2/18/22	Fri 2/18/22
7	Task 1.6 - District Adopts Final LRP	1 day	Mon 2/21/22	Mon 2/21/22
8	**Task 2 - LRP Financial Aid Planning (Repeated for Phases 1- 4)**	**245 days**	**Tue 2/22/22**	**Mon 1/30/23**
9	Task 2.1 - District Finalizes LRP Financial Plan	20 days	Tue 2/22/22	Mon 3/21/22
10	Task 2.2 - District Prepares Colorado Water SRF Grant & Loan App	40 days	Tue 3/22/22	Mon 5/16/22
11	Task 2.3 - District Prepares Colorado Wastewater SRF Grant & Loan Apps	40 days	Tue 3/22/22	Mon 5/16/22
12	Task 2.3 - District Submits Colorado SRF Grant & Loan Apps	5 days	Tue 5/17/22	Mon 5/23/22
13	Task 2.4 - District Prepares Colorado DOLA Funding Apps	10 days	Tue 3/22/22	Mon 4/4/22
14	Task 2.5 - District Submits Colorado Water DOLA Funding Apps	5 days	Tue 4/5/22	Mon 4/11/22
15	Task 2.6 - District Confirms Colorado Project Funding Status	60 days	Tue 5/24/22	Mon 8/15/22
16	Task 2.7 - District Prepares USDA Funding Applications	40 days	Tue 3/22/22	Mon 5/16/22
17	Task 2.8 - District Submits USDA Funding Applications	5 days	Tue 5/17/22	Mon 5/23/22
18	Task 2.9 - District Confirms USDA Project Funding Status	60 days	Tue 5/24/22	Mon 8/15/22
19	Task 2.10 - Final Project Financing Public Hearing	1 day	Mon 9/19/22	Mon 9/19/22
20	Task 2.11 - Initial Project Funding Becomes Available	5 days	Tue 1/24/23	Mon 1/30/23
21	**Task 3 - Preliminary Engineering (Repeated for Phases 1 - 4)**	**352 days**	**Thu 1/20/22**	**Fri 5/26/23**
22	**Task 3A - Colorado Water SRF Funding Coordination**	**125 days**	**Mon 8/1/22**	**Fri 1/20/23**
23	Task 3A.1 - District Performs Water System Leak Testing	60 days	Mon 8/1/22	Fri 10/21/22
24	Task 3A.2 - District Updates Water System O & M Database	20 days	Mon 9/26/22	Fri 10/21/22
25	Task 3A.3 - Water System Replacement Priority Update	15 days	Mon 10/24/22	Fri 11/11/22
26	Task 3A.4 - Preparation of Draft Project Needs Assessment	30 days	Mon 11/14/22	Fri 12/23/22
27	Task 3A.5 - District Review of Draft PNA	10 days	Mon 12/26/22	Fri 1/6/23
28	Task 3A.6 - Finalize & Submit PNA to CDPHE	5 days	Mon 1/9/23	Fri 1/13/23
29	Task 3A.7 - SRF & DOLA Financial Aid Application Coordination	5 days	Mon 1/16/23	Fri 1/20/23
30	**Task 3B - Colorado Wastewater SRF Funding Coordination**	**150 days**	**Mon 6/13/22**	**Fri 1/6/23**
31	Task 3B.1 - District Performs Sewer System Video Inspections	60 days	Mon 6/13/22	Fri 9/2/22
32	Task 3B.2 - District Updates Wastewater System O & M Database	30 days	Mon 8/8/22	Fri 9/16/22
33	Task 3B.3 - Wastewater System Replacement Priority Update	20 days	Mon 9/19/22	Fri 10/14/22
34	Task 3B.4 - Preparation of Draft Project Needs Assessment	40 days	Mon 10/17/22	Fri 12/9/22
35	Task 3B.5 - District Review of Draft PNA	10 days	Mon 12/12/22	Fri 12/23/22
36	Task 3B.6 - Finalize & Submit PNA to CDPHE	5 days	Mon 12/26/22	Fri 12/30/22
37	Task 3B.7 - SRF & DOLA Financial Aid Application Coordination	5 days	Mon 1/2/23	Fri 1/6/23
38	**Task 3C - USDA Funding Coordination**	**65 days**	**Thu 1/20/22**	**Wed 4/20/22**
39	Task 3C.1 - Prepare Draft Preliminary Engineering Report (PER)	20 days	Thu 1/20/22	Wed 2/16/22
40	Task 3C.2 - District Review of Draft PER	10 days	Thu 2/17/22	Wed 3/2/22
41	Task 3C.3 - Finalize PER	10 days	Thu 3/3/22	Wed 3/16/22
42	Task 3C.4 - Prepare Draft Environmental Report (ER)	40 days	Thu 1/20/22	Wed 3/16/22
43	Task 3C.5 - District Review of Draft ER	10 days	Thu 3/17/22	Wed 3/30/22
44	Task 3C.6 - Finalize ER	10 days	Thu 3/31/22	Wed 4/13/22
45	Task 3C.7 - USDA Financial Aid Application Coordination	5 days	Thu 4/14/22	Wed 4/20/22
46	**Task 3D - Basis of Design Report (BDR)**	**90 days**	**Mon 1/23/23**	**Fri 5/26/23**
47	Task 3D.1 - Prepare Draft BDR	30 days	Mon 1/23/23	Fri 3/3/23
48	Task 3D.2 - District Reviews BDR	10 days	Mon 3/6/23	Fri 3/17/23
49	Task 3D.3 - Prepare Final BDR	15 days	Mon 3/20/23	Fri 4/7/23
50	Task 3D.4 - Submit Final BDR to CDPHE	5 days	Mon 4/10/23	Fri 4/14/23



St. Mary's Glacier Water & Sanitation District
Long Range Replacement Plan
for Water & Wastewater Utilities
01/10/22

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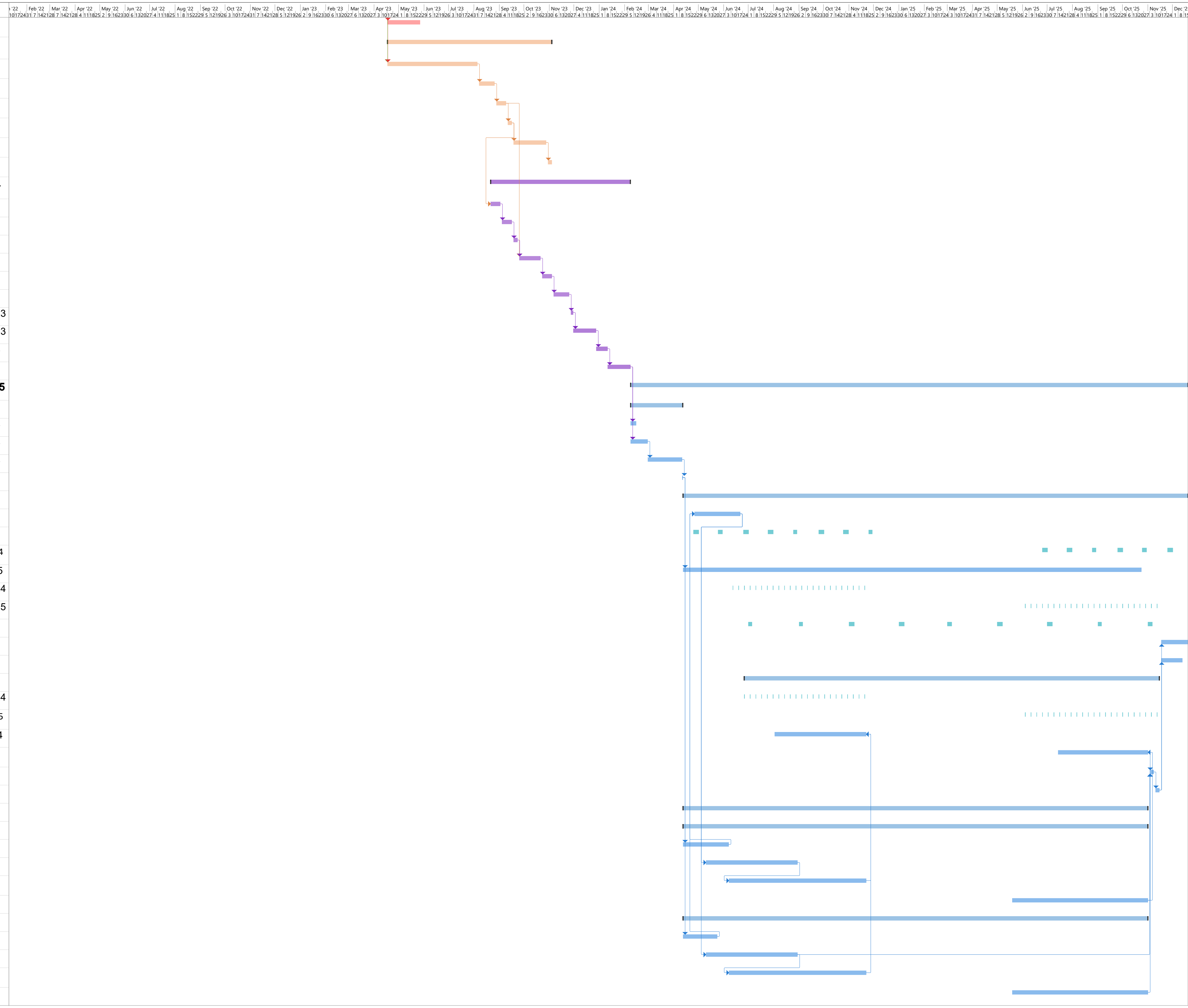
Appendix B.1
Project Workflow Schedule

ID	Task Name	Duration	Start	Finish
51	Task 3D.5 - CDPHE Approval of BDR	30 days	Mon 4/17/23	Fri 5/26/23
52	**Task 4 - Final Engineering (Repeated for Phases 1 - 4)**	**145 days**	**Mon 4/17/23**	**Fri 11/3/23**
53	Task 4.1 - Prepare Draft CMAR Plans and Specifications	80 days	Mon 4/17/23	Fri 8/4/23
54	Task 4.2 - District Reviews Draft Construction Documents	15 days	Mon 8/7/23	Fri 8/25/23
55	Task 4.3 - Prepare Final CMAR Plans and Specifications	10 days	Mon 8/28/23	Fri 9/8/23
56	Task 4.4 - Submit CMAR Plans and Specs to CDPHE & District	5 days	Mon 9/11/23	Fri 9/15/23
57	Task 4.5 - CDPHE Approval of CMAR Plans & Specs	30 days	Mon 9/18/23	Fri 10/27/23
58	Task 4.6 - Self Certification	5 days	Mon 10/30/23	Fri 11/3/23
59	**Task 5 - Preconstruction (Repeated for Phases 1 - 4)**	**123 days**	**Mon 8/21/23**	**Wed 2/7/24**
60	Task 5.1 - Prepare Draft CMAR Request for Proposals	10 days	Mon 8/21/23	Fri 9/1/23
61	Task 5.2 - District Reviews Draft CMAR RFP	10 days	Mon 9/4/23	Fri 9/15/23
62	Task 5.3 - Prepare Final CMAR RFP	5 days	Mon 9/18/23	Fri 9/22/23
63	Task 5.4 - Publicly Advertise CMAR RFP	20 days	Mon 9/25/23	Fri 10/20/23
64	Task 5.5 - CMAR Selection	10 days	Mon 10/23/23	Fri 11/3/23
65	Task 5.6 - District Executes CMAR Preconstruction Contract	15 days	Mon 11/6/23	Fri 11/24/23
66	Task 5.7 - Preconstruction Coordination Meeting w/CMAR	3 days	Mon 11/27/23	Wed 11/29/23
67	Task 5.8 - CMAR Develops Initial Guaranteed Maximum Price (GMP)	20 days	Thu 11/30/23	Wed 12/27/23
68	Task 5.9 - District Reviews Initial GMP Proposal	10 days	Thu 12/28/23	Wed 1/10/24
69	Task 5.10 - District & CMAR Negotiate Final GMP	20 days	Thu 1/11/24	Wed 2/7/24
70	**Task 6 - Construction (Repeated for Phases 1 - 4)**	**487 day:**	**Thu 2/8/24**	**Fri 12/19/25**
71	**Task 6A - Construction Contract Initiation**	**46 days**	**Thu 2/8/24**	**Thu 4/11/24**
72	Task 6A.1 - Construction Contract Preparation	5 days	Thu 2/8/24	Wed 2/14/24
73	Task 6A.2 - Construction Document Conformance	15 days	Thu 2/8/24	Wed 2/28/24
74	Task 6A.3 - Construction Contract Review and Notice to Proceed	30 days	Thu 2/29/24	Wed 4/10/24
75	Task 6A.4 - Construction Kickoff Meeting	1 day	Thu 4/11/24	Thu 4/11/24
76	**Task 6B - Construction Office**	**441 days**	**Fri 4/12/24**	**Fri 12/19/25**
77	Task 6B.1 - Construction Submittal Review	40 days	Fri 4/26/24	Thu 6/20/24
78	Task 6B.2 - Construction Pay Application Review (Season 1)	156.25 da	Thu 4/25/24	Fri 11/29/24
87	Task 6B.3 - Construction Pay Application Review (Season 2)	110 days	Tue 6/25/24	Mon 11/25/24
94	Task 6B.4 - Construction Communication	400 days	Fri 4/12/24	Thu 10/23/25
95	Task 6B.5 - Weekly Construction Meetings (Season 1)	115.25 da	Wed 6/12/24	Wed 11/20/24
120	Task 6B.6 - Weekly Construction Meetings (Season 2)	115.25 da	Wed 6/4/25	Wed 11/12/25
145	Task 6B.6 - Construction Change Management	353.25 da	Mon 7/1/24	Thu 11/6/25
155	Task 6B.7 - Project Closeout	25 days	Mon 11/17/25	Fri 12/19/25
156	Task 6B.8 - Construction Record Documents	20 days	Mon 11/17/25	Fri 12/12/25
157	**Task 6C - Construction Field**	**363 days**	**Wed 6/26/24**	**Fri 11/14/25**
158	Task 6C.1 - Construction Observation (Season 1)	105.25 da	Wed 6/26/24	Wed 11/20/24
181	Task 6C.2 - Construction Observation (Season 2)	115.25 day	Wed 6/4/25	Wed 11/12/25
206	Task 6C.3 - Quality Control Coordination (Season 1)	80 days	Fri 8/2/24	Thu 11/21/24
207	Task 6C.4 - Quality Control Coordination (Season 2)	80 days	Mon 7/14/25	Fri 10/31/25
208	Task 6C.3 - Substantial Completion Inspections	5 days	Mon 11/3/25	Fri 11/7/25
209	Task 6C.4 - Final Completion Inspections	5 days	Mon 11/10/25	Fri 11/14/25
210	**Task 6D - CMAR Construction**	**406 days**	**Fri 4/12/24**	**Fri 10/31/25**
211	**Task 6D.1 - Phase 1 Water System Improvements**	**406 days**	**Fri 4/12/24**	**Fri 10/31/25**
212	Submittals	40 days	Fri 4/12/24	Thu 6/6/24
213	Equipment & Material Delivery	80 days	Fri 5/10/24	Thu 8/29/24
214	Construction (Season 1)	120 days	Fri 6/7/24	Thu 11/21/24
215	Construction (Season 2)	120 days	Mon 5/19/25	Fri 10/31/25
216	**Task 6D.2 - Phase 1 Wastewater Collection System Improvements**	**406 days**	**Fri 4/12/24**	**Fri 10/31/25**
217	Submittals	30 days	Fri 4/12/24	Thu 5/23/24
218	Equipment & Material Delivery	80 days	Fri 5/10/24	Thu 8/29/24
219	Construction (Season 1)	120 days	Fri 6/7/24	Thu 11/21/24
220	Construction (Season 2)	120 days	Mon 5/19/25	Fri 10/31/25



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St. Mary's Glacier Water & Sanitation District
Long Range Replacement Plan
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Appendix B.2
Proposed Program Schedule

Orsatti Water Consultants

ID	Task Name	Duration	Start	Finish
1	Task 1 - Long Range Plan Approval	24 days	Wed 1/19/22	Mon 2/21/22
8	***Phase 1 (2022 - 2025)***	1022 days	Thu 1/20/22	Fri 12/19/25
9	Task 2 - LRP Financial Aid Planning	245 days	Tue 2/22/22	Mon 1/30/23
22	Task 3 - Preliminary Engineering	352 days	Thu 1/20/22	Fri 5/26/23
53	Task 4 - Final Engineering	145 days	Mon 4/17/23	Fri 11/3/23
60	Task 5 - Preconstruction	123 days	Mon 8/21/23	Wed 2/7/24
71	Task 6 - Construction	487 days	Thu 2/8/24	Fri 12/19/25
222	***Phase 2 (2026 - 2030)***	1104 days	Tue 9/29/26	Fri 12/20/30
223	Task 2 - LRP Financial Aid Planning	241 days	Tue 9/29/26	Tue 8/31/27
236	Task 3 - Preliminary Engineering	240 days	Wed 6/16/27	Tue 5/16/28
267	Task 4 - Final Engineering	145 days	Wed 4/5/28	Tue 10/24/28
274	Task 5 - Preconstruction	123 days	Wed 8/9/28	Fri 1/26/29
285	Task 6 - Construction	495 days	Mon 1/29/29	Fri 12/20/30
439	***Phase 3 (2031 - 2035)***	1110.25 day	Tue 9/23/31	Tue 12/25/35
440	Task 2 - LRP Financial Aid Planning	241 days	Tue 9/23/31	Tue 8/24/32
453	Task 3 - Preliminary Engineering	240 days	Wed 6/9/32	Tue 5/10/33
484	Task 4 - Final Engineering	145 days	Wed 3/30/33	Tue 10/18/33
491	Task 5 - Preconstruction	123 days	Wed 8/3/33	Fri 1/20/34
502	Task 6 - Construction	501.25 days	Mon 1/23/34	Tue 12/25/35
655	***Phase 4 (2036 - 2040)***	1102.25 day	Tue 9/16/36	Thu 12/6/40
656	Task 2 - LRP Financial Aid Planning	241 days	Tue 9/16/36	Tue 8/18/37
669	Task 3 - Preliminary Engineering	240 days	Wed 6/3/37	Tue 5/4/38
700	Task 4 - Final Engineering	145 days	Wed 3/24/38	Tue 10/12/38
707	Task 5 - Preconstruction	123 days	Wed 7/28/38	Fri 1/14/39
718	Task 6 - Construction	493.25 days	Mon 1/17/39	Thu 12/6/40