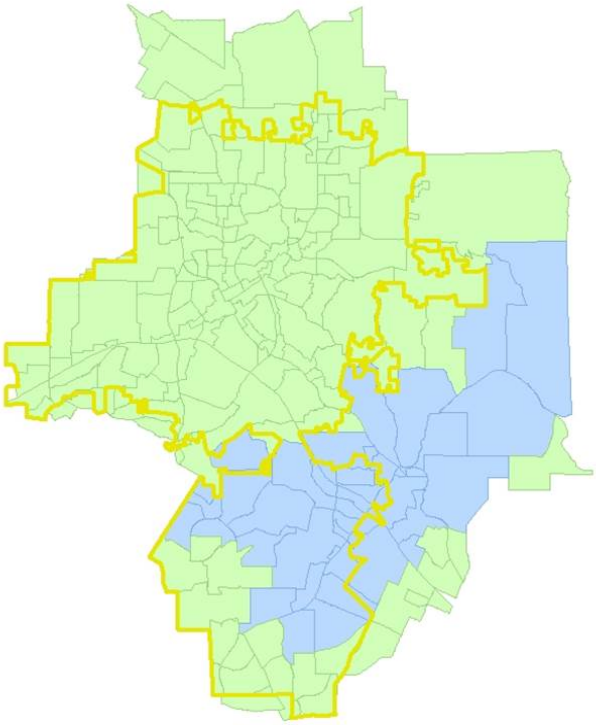

Asset Management Plan

City of Vista Comprehensive Sewer Management Plan

August 2017

Prepared for

City of Vista
Buena Sanitation District

Asset Management Plan Update Log

For use by City of Vista and Buena Sanitation District Staff for regular Asset Management Plan Updates

Version No.	Update Date	Summary of Updates	Updated By
1	8/2017	Initial Asset Management Plan	HDR

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1 Introduction

1.1 Purpose of the Asset Management Plan

The City of Vista (City) operates, maintains, and renews sanitary collection facilities for both the City and the Buena Sanitation District (District). The replacement cost of this infrastructure is estimated to be over $500 million (excluding pump station and treatment plant facilities and force main infrastructure, which were not included in this study). As the system continues to age and deteriorate, the City seeks to cost effectively sustain high quality services levels through continuous improvement.

This Asset Management Plan (Plan) provides a strategic and actionable path forward to implement continuous improvement in the collection system and documents condition assessment and renewal business decision logic, results and forecasts. The initial version of this Plan was completed as part of the 2016 Comprehensive Sewer Management Plan (CSMP) Project, which includes updating the sewer master plan, developing a Programmatic Environmental Impact Report (PEIR), completing a rate study, and conducting a Sewer System Management Plan (SSMP) audit.

This Plan is intended to be a living document that is updated as City and District wastewater programs evolve.

1.2 Approach and Plan Organization

The Plan was initially developed through a series of workshops with City staff and is divided into the following sections:

- **Section 2 - Continuous Improvement Plan.** The continuous improvement plan includes information on assessment of the City and District's asset management programs, development and prioritization of opportunities for improvement, and development of an initiative roadmap for continuous improvement that balances resource constraints with the strategic path forward.
- **Section 3 - Renewal Business Decision Logic.** The renewal business decision logic documents how data is leveraged to make transparent, defensible, repeatable, and prioritized condition assessment and renewal recommendations for gravity sewers that balance level of service, cost and risk.
- **Section 4 - Inspection and Renewal Forecast.** The inspection and renewal forecasts were developed by applying the renewal business logic to City and District data. The forecast includes condition assessment and renewal quantities, costs, and resource needs programmatically and for specific gravity sewers.

1.3 Program Participants

The Asset Management Program development team includes City staff members from the Wastewater Engineering and Public Works divisions and HDR staff. This team is referred to as the Asset Management Team. City participants include the following:

- Elmer Alex, Principal Engineer
- Chris Dzwigalski, Public Works Supervisor
- Alfred Pedroza, Senior Engineer
- Roger Brenzel, Engineering Tech
- Lisa Carter, Program Assistant
- Daniel Guerra, Wastewater Worker III (crew leader)
- Cirilo Mariscal, Wastewater Worker III (crew leader)
- David Brookbank, Wastewater Worker III (crew leader)
- Rob O'Donnell, GIS Coordinator
- Jonathon (Dante) Lee, Information Technology Technician

Asset Management Plan development was supported by HDR and HDR Participants including:

- Jennifer Duffy, Project Manager
- Dave Spencer, Asset Manager
- Eric Scherch, Asset Management Support
- Peter Moody, Business Decision Logic Programming
- Aria Heraypur, Project Engineer

1.4 Overview of Wastewater Collection System and Programs

Included below is a summary of key assets owned by the City and District related to the wastewater collection system that represent the majority of infrastructure management costs and drive operations and infrastructure renewal programs. Table 1-1 includes count, length, and replacement cost, where applicable and readily available for the City and District's key wastewater infrastructure based on GIS information provided by the City in March 2016.

The City and District's Sewer System Management Plan (SSMP) provides a detailed overview of the wastewater collection system and programs. The SSMP, available on the City's website, is required by the State of California Waste Discharge Requirements and documents current practices and management strategies for many collection system programs.

Table 1-1. Asset Summary

Asset Type	City of Vista			Buena Sanitation District			Notes
	Asset Count	Length of Assets (Feet)	Approximate Replacement Cost Forecast ($)	Asset Count	Length of Assets (Feet)	Approximate Replacement Cost Forecast ($)	
Gravity Sewers	5,858	1,137,118	262,000,000	2,400	531,587	108,000,000	A single gravity sewer asset typically includes all sewer pipe segments from manhole to manhole.
Manholes	4,918	N/A	120,000,000	2,090	N/A	48,000,000	--
Force Mains	29	9,247	See Notes	116	44,431	See Notes	Refer to the 2016 Pump Station Rehabilitation Plan developed by the City and District for information on force main costs.
Pump Stations	3	N/A	See Notes	1	N/A	See Notes	Refer to the 2016 Pump Station Rehabilitation Plan developed by the City and District for information on pump station costs.
Access Roads	N/A	37,000	2,500,000	N/A	19,842	1,100,000	The asset register for access roads was developed for approximately 40 access roads along critical sewers and force mains during the CSMP.

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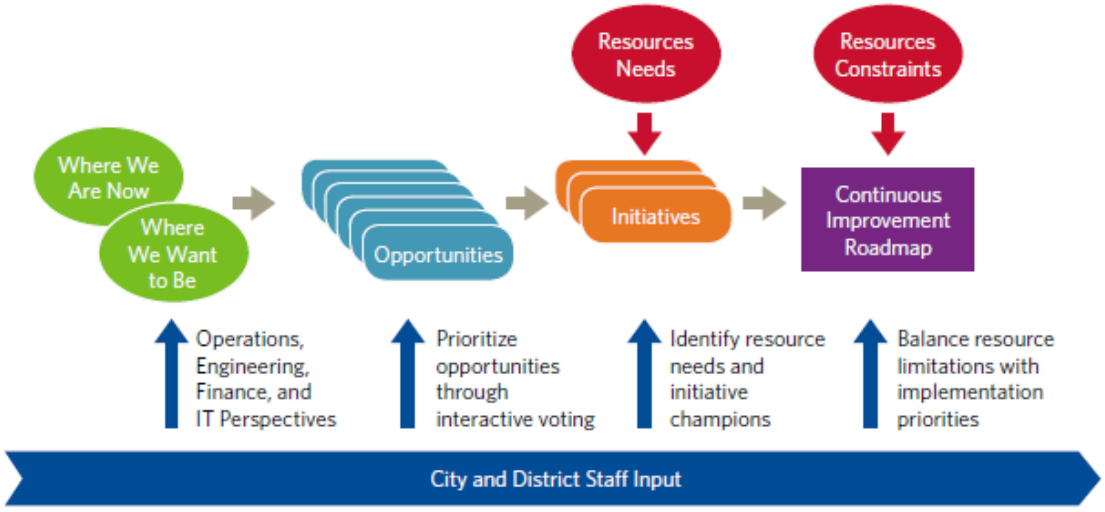
2 Continuous Improvement Plan

The City has implemented programs that have resulted in high performance with respect to Sanitary Sewer Overflows (SSOs), a leading indicator of collection system program performance. In order to continue meeting regulatory requirements and balance cost, risk and level of service in the future, the Asset Management Team developed this Continuous Improvement Plan to guide the collection system asset management program. The Continuous Improvement Plan includes a summary of program assessment findings, identification of incremental opportunities improvements, grouping of opportunities into actionable initiatives, workload forecasts, and culminates with the continuous improvement roadmap. The continuous improvement roadmap provides a schedule of initiatives that can be used as a checklist for the asset management program over time. Figure 2-1 shows the Continuous Improvement Plan process, which incorporates input by City staff at each step in the process.

Figure 2-1. Continuous Improvement Plan Process



2.1 Assessment

The Asset Management Team conducted an SSMP Audit and developed the SSMP Audit Report on July 13, 2016, which is included in Appendix A. The SSMP Audit Report includes assessment of City and District wastewater collection system programs and includes program strengths, implementation accomplishments, and deficiencies with respect to Waste Discharge Requirements.

The initial assessment findings that resulted in opportunities for improvement are based on information from program interviews and SSMP Audit interviews that were conducted throughout 2016 on March 17, April 13, April 20, May 10, May 12, May 16, July 13, August 10, and October 27. The initial assessment is organized into the following City programs:

- Cleaning
- Condition Assessment
- Asset Renewal
- Staffing
- Data Management and Systems
- Asset Registry
- Sewer System Management Plan
- Easements
- Fats, Oils & Grease (FOG)

Key assessment findings that led to opportunities for improvement and notes from interviews are included in Appendix B.

2.2 Opportunities for Continuous Improvement

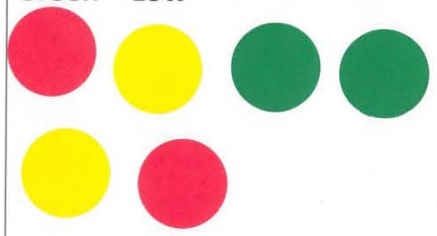
After completing initial assessment interviews, the Asset Management Team conducted a series of workshops with City staff (see Section 1.3 Program Participants) to identify, refine, and prioritize opportunities for continuous improvement. An initial workshop was conducted on February 2, 2017 for City staff to identify and discuss opportunities for improvement. These opportunities for improvement were refined and prioritized through City staff voting on February 14, 2017. Through this process 74 opportunities for improvement were identified and categorized. The voting and prioritization occurred in three steps.

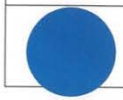
During the first step, the City staff voted to accept, modify, or reject each opportunity. No opportunities were rejected at this step, and five opportunities were modified prior to the next step. During the second step, staff was allowed to vote on the opportunities, which were displayed around the room. City staff prioritized each opportunity by placing a colored dot sticker on each opportunity. City staff was provided an approximately equal number of red, yellow and green voting sticker dots. Red dots were used by staff to identify high priority opportunities, yellow dots were used to identify medium priority opportunities, and green dots were used to identify low priority opportunities. Figure 2-2 includes an example opportunity voting sheets with dots from City staff. During the third step, opportunities were sorted by approximate priority. Where consensus did not occur (i.e. several red and several green dots), the group discussed those opportunities to understand various perspectives within the organization and finalize the priority.

Opportunities for continuous improvements were given a priority score based on City staff voting. Red dots received a score of 3, yellow dots a score of 2, and green dots a

score of 1. The average of these scores was used to support prioritization. Appendix C includes a table of the 74 opportunities and priority scores.

Figure 2-2. Opportunity for Improvement Voting Example.

Description of Opportunity for Improvement	Vote #2: Priority
48 **Renewal: Decision Making: Decision Making SOPs** Multiple parties including engineering and operations are making renewal decisions on pipe infrastructure. Create a system/process to track who is assessing which pipes in the system and to ensure proper coordination. Develop SOPs for staff making decisions that includes roles and responsibilities, frequency to run business decision logic (easy button), sequential steps to perform work, process for mining data, ad-hoc request intake, decision making process, prioritization process, documentation process including the generation of a WO, project packaging, backlog management, monitoring execution status, contractor coordination, in-house repair coordination, generation of reports to document program status/accomplishment, and other activities. SOPs should define sequential steps to perform this work and be written to the level of detail that the SOP can be used for training purposes. Consider also including the information needed to make a decision (GIS, video, attribute, condition, etc.), coordination with other programs, information system used for work (CMMS, CIP), pipe monitoring program execution support.	Red = High Yellow = Medium Green = Low 

Vote #1:		
Accept	Modify	Reject
		

2.3 Implementation Initiatives

After prioritizing opportunities for improvement, the Asset Management Team staff conducted a workshop on April 3, 2017 to group opportunities into actionable initiatives and discuss resource needs and limitations. Opportunities with implementation synergies, similar priorities, and sequencing relationships were grouped together into initiatives. Through discussion between the, 23 initiatives were identified. These initiatives are shown in Table 2-1 with the unique initiative number, initiative name, and the average priority score from the opportunities that make up the initiative. The average priority field is color coded from green to red with red being high priority and green being low priority. A description of the scope of each initiative is based on the opportunities that make up the initiative as documented in Appendix D. A more detailed description of each opportunity is included in Appendix C.

Table 2-1. Continuous Improvement Plan Initiatives

Initiative No.	Initiative Name	Average of Priority Score
1	Work Order Data Entry	2.2
2	SSMP SSO Response Plan Update	3.0
3	CCTV Software Implementation[1]	2.6
4	CCTV SOP Update, Training & QC Program	2.5
5	Field IS Connectivity and Performance	2.6
6	SSMP Update & Compliance Monitoring	2.3
7	Renewal Decision Making (Phase 1 – InfoMaster Implementation)	2.0
8	Access & Repair Notifications	2.4
9	Refine Work Generation Process	2.1
10	Staff Retention	2.3
11	Enhance Non-SSMP Reporting	1.9
12	Renewal Decision Making (Phase 2 - Refinement)	2.0
13	Streamline Data Entry & Access	1.6
14	Cleaning SOP Update, Training & QC Program	2.0
15	Repair SOP Update, Training & QC Program	2.0
16	Document Non-Core Work in CMMS/GIS	1.4
17	Develop Manhole Decision Making Process	1.4
18	Workload & Resource Planning	1.6
19	Asset Registry Updates	1.9
20	FOG Program Updates	1.4

[1] Initiative No. 3 includes the best practices manual for CCTV coding and data management.

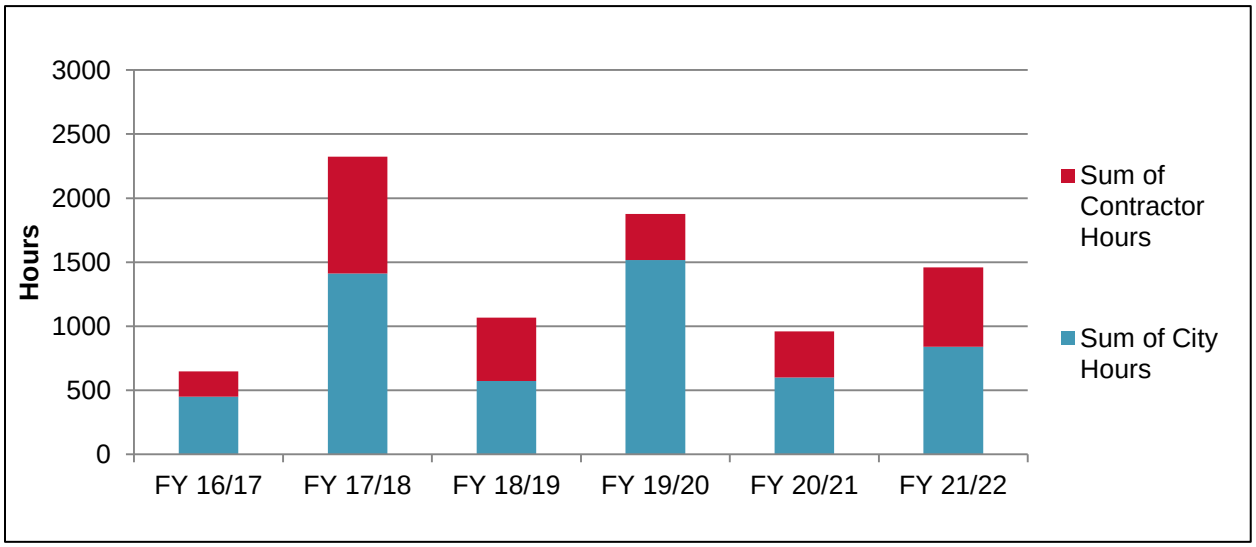
Table 2-1. Continuous Improvement Plan Initiatives

Initiative No.	Initiative Name	Average of Priority Score
21	Pipe Deterioration Studies[2]	1.2
22	Data Management SOP	1.7
23	Access Road Condition Assessment	1.0

2.4 Continuous Improvement Roadmap

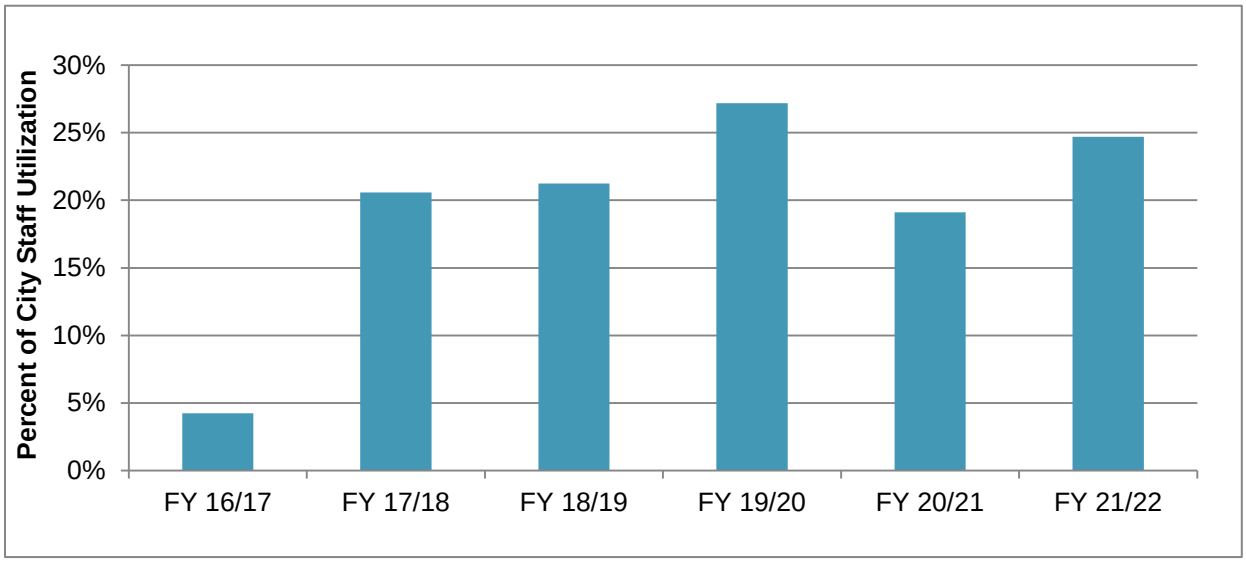
The continuous improvement roadmap includes a schedule for each initiative, tracks initiative progress and identifies dependent initiatives. The Asset Management Team identified a workload forecast for each initiative to support initiative implementation schedule development. The Asset Management Team selected a 5-year period for the roadmap to coincide with the typical 5-year schedule for the wastewater master plan update. The workload forecast includes an assumption of hours required to implement each initiative. Some initiatives are assumed to be supported by contractors with City oversight. The hours for City staff and contractors were normalized to a percentage utilization based on an assumed full time equivalent (FTE) employee hours per year of 1,700 hours. The utilization forecast intent is an order of magnitude forecast for use in balancing the workload for initiative implementation over a 5-year period. Actual hours and staff utilization for implementation of the 23 identified initiatives will vary. Figure 2-3 shows the workload forecast by hours for City staff and contractors. Figure 2-4 shows the workload forecast with City staff utilization.

Figure 2-3. Initiative Implementation Workload Forecast Hours



[2] Initiative No. 21 includes development of gravity sewer decay curves.

Figure 2-4. Initiative Implementation Workload Forecast City staff Utilization



The detailed workload forecast is included in Appendix E.

After balancing the workload from year to year to eliminate years with very high utilization of City staff, a continuous improvement road map was developed to communicate the schedule and interrelationships between initiatives. This roadmap is intended for use as a checklist for the asset management plan to track progress towards continuous improvement. The continuous improvement plan roadmap is shown in Figure 2-5.

In addition to the continuous improvement initiatives, the roadmap includes key asset management program milestones for SSMP audits, SSMP updates, and regular review and update of the Asset Management Plan. Initiatives completed as part of CSMP are shown to have occurred in FY16/17. These completed initiatives include:

- Asset Registry Updates - Asset registry updates were made and gaps were identified for future update by the City.
    - There was previously no asset registry for sewer access roads; however an asset registry was developed for access roads and populated with approximately 40 sewer access roads along critical sewers.
    - Identified the gravity sewer material field is incomplete for 19 miles or 6 percent of wastewater collection system pipe.
    - Identified that manhole (MH) depths are incomplete for approximately 4 percent of MHs.
- Gravity Sewer Structural Risk Scoring (see Section 3 and 4 of this Plan)
- Renewal Business Decision Logic and Renewal Forecasting (see Section 3 and 4 of this Plan)
- Closed Circuit Television (CCTV) Defect Severity Code Updates
    - The Asset Management Team identified and the City updated approximately 1,700 blank defect severity codes that are critical to highly confident renewal business decision logic outputs.

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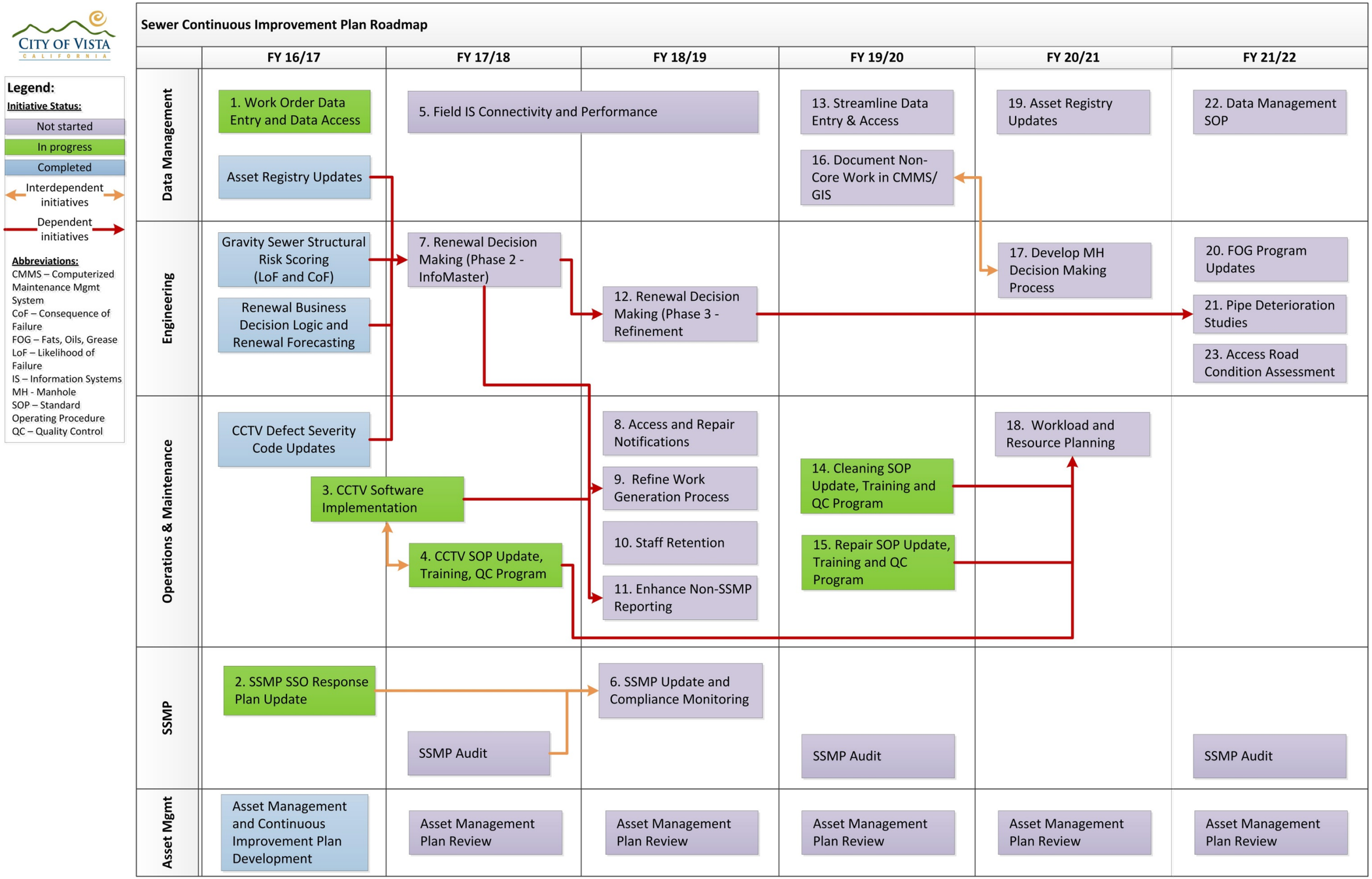
Figure 2-5. Continuous Improvement Plan Roadmap



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2.5 Recommendations for the SSMP

Included in the opportunities for improvement are specific opportunities related to updating the SSMP and tracking performance related to the SSMP.

The SSMP opportunities for continuous improvement listed in Table 2-2 have been excerpted from Appendix C, Opportunities for Continuous Improvement, and include the following fields:

- **No.** – Unique opportunity number
- **Activity –** The program activity associated with the opportunity such as Cleaning or CCTV
- **Opportunity Name –** Unique opportunity name
- **Description –** Brief description of opportunity
- **Priority Group –** Priority grouping identified in the third voting step
- **Priority Score –** The average priority score for the opportunity based on City staff voting

The City plans to update the SSMP in fiscal year (FY) 2018/19.

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Table 2-2. SSMP Opportunities for Improvement

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
63	FOG	FOG Program Updates	Update the FOG Section of the SSMP and FOG Source Control Program to reflect the next evolution in the FOG program.	Low/ Medium	1.5
68	SSMP	Update Overflow Response Plan	Complete the update currently in progress to the Overflow Emergency Response Plan and provide training on the updated plan to staff and field employees responsible for sewer overflow response, notification, and reporting.	High	3.0
67	SSMP	Encina MOU	Develop memorandum of understanding with Encina for lift station operations and maintenance. This memorandum could include the following: • Level of service expectations, O&M plan and reports, critical equipment list and failure plan, site specific SSO and contingency plans, access to condition assessment and operations data • Consider documenting critical replacement parts or spares in the City and District SSMP	Medium/High	2.3
69	SSMP	Refine SSMP Commitments	On 5/17/2016, a summary of commitments made in the SSMP and historic compliance with those commitments was provided to the City. In general, commitments made in the SSMP were aligned with operational targets based on assumed improvement in output. Due to a number of factors (aggressive goals, equipment downtime, staff turnover, etc.), many of the SSMP commitments are not regularly achieved. Even though Vista provides a high level of service to customers and the environment, failing to achieve these commitments exposes the City to unnecessary risk, particularly if a spill occurs on a pipe that is out of compliance with SSMP commitments. To reduce this risk, consider establishing a policy to sustain 100% compliance with SSMP commitments. The City should consider refining commitments to reflect system need and adjusting resources as needed to achieve 100% compliance. With the exception of achieving 100% compliance, decouple SSMP commitments with internal operational goals. For example, consider establishing a 5-year system wide cleaning schedule in the SSMP but define a more aggressive operational goal outside the SSMP. Actual cleaning need may be justified based on roots, grease, debris levels as determined by cleaning, CCTV, customer calls, and staff institutional knowledge.	High	2.5
70	SSMP	SSMP Minor Updates	Implement the low effort SSMP updates. This includes the following findings numbers from the 2016 audit: 1, 6, 7, 8, 9, 12, and 13. Also address the finding "Since adoption of the SSMP, the City and District have resolved all known issues with manholes that pose elevated risk of vandalism through mechanically locking those manholes. Therefore, this objective should be considered for removal from the SSMP." and "The City and District should add revision notes for design guidelines and sewer notes to track updates to standard drawing or specification files."	Medium	2.2

Table 2-2. SSMP Opportunities for Improvement

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
71	Data Management and Systems	SSMP Compliance KPIs	Develop KPIs for all SSMP commitments. If there is a distinct and more aggressive Operational Goal, report performance relative to both the SSMP commitment and the operational goal. The base data for current reports comes from the hand written journals. Excel spreadsheets are provided from the crew chiefs and are transferred to excel. Discrepancies exist between the reports and the data in the City's database of record (e.g. CityWorks, GIS, Granite). Change the basis of reporting to databases of record.	Medium/High	2.3
73	Data Management and Systems	SSMP Compliance Forecast	For activities with a defined asset schedule (e.g. Cleaning, CCTV, MH Inspection), create a report that summarizes assets that are non-compliant or approaching non-compliance with enough lead time that O&M can develop a plan to execute work before the work leads to a compliance issue.	High	2.8

3 Renewal Business Decision Logic

The renewal business decision logic for gravity sewers provides a transparent, defensible, and consistent approach for renewal decision makers and is used to communicate risk, level of service, and cost to stakeholders. The renewal business decision logic is used to develop highly confident renewal forecasts.

The renewal business decision logic will leverage the City's CCTV inspections and other readily available data for gravity sewers to recommend a renewal or condition assessment action, identify risk associated with each inspected gravity sewer, associate a cost with each recommended mitigation action, and recommend whether City crews or contractors will perform the renewal work. City staff will review and update recommendations made by the renewal business decision logic when packaging renewal projects. The renewal business decision logic is based on best professional and engineering judgment, but it does not replace review by skilled professionals.

The purpose of this section is to document the development process, decision logic inputs and methodology for assessing risk and the appropriate risk mitigation action. The City will refine the initial business decision logic over time based on adaptive management principals and lessons learned through implementing the renewal business decision logic.

3.1 Development Process

A series of workshops were conducted in 2016 with City staff to develop the initial business decision logic on July 13, August 10, and October 27. The first workshop included gathering information about the City's current renewal decision making policies and practices. The Asset Management Team discussed structural risk scoring including likelihood of failure (LOF) and consequence of failure (COF) risk. The second workshop included:

- Detailed review of gravity sewer pipe defects
- Grouping of defects by severity and renewal methods (e.g. replacement, point repair, lining)
- Review of consequence of failure mapping of gravity sewers for calibration
- Initial review of business decision logic

The third workshop included a final review of business decision logic updates, risk scores, unit costs and condition assessment and renewal forecasts.

Software is required to automate the business decision logic. The Asset Management Team performed a review of software alternatives including custom software and "off-the-shelf" software. The City has chosen to implement InfoMaster software by Innovyze in the future to automate the business decision logic recommendations and integrate the logic with existing information systems such as CityWorks, GIS, and CCTV software.

3.2 Inputs

The business decision logic includes three key inputs including CCTV inspection data, gravity sewer cleaning frequencies from the City's CityWorks CMMS, and GIS data. Each input is described in the sub-sections below.

3.2.1 CCTV Data

The City's ongoing CCTV inspection program is comprised of the following inspection programs:

- Proactive Monitoring – The City proactively inspects gravity sewers with CCTV inspection. The majority of CCTV inspection data is collected through this program.
- Special Requests – Referrals resulting from sanitary sewer overflows, customer calls, and City crews are examples of how CCTV inspections are generated in the Special Requests program
- Construction Acceptance – After completion of new construction, repairs, rehabilitation or replacement of gravity sewers, the renewal work is inspected using CCTV.

As of spring 2016, the City has CCTV data on approximately 92 percent of the system. The City historically utilized PipeLogix CCTV software and a custom CCTV defect coding system[3]. The CCTV data includes defect codes that identify structural condition defects in gravity sewer pipes. This CCTV is a primary input that drives the renewal decision logic and quality is important. Asset Management Team staff reviewed existing CCTV data quality and the City made updates to populate gaps in approximately 1,700 CCTV defect severity codes to produce high quality input data that will yield highly confident renewal forecasts.

3.2.2 Cleaning Data

CCTV data documents pipe condition at the time of inspection. However, gravity pipes can deteriorate at different rates. In particular, gravity sewer cleaning can result in pipe deterioration. The City and District's gravity sewer cleaning frequencies range from 1 month to 5 years. Therefore, gravity sewer cleaning frequencies from CityWorks were used to approximate deterioration rates within the risk assessment and decision making logic.

3.2.3 GIS Data

The City has extensive GIS data for their assets including gravity sewers. This data, along with publically available GIS information for waters of the state, and satellite imagery are incorporated into the business decision logic.

[3] The City plans to move to WinCan VX CCTV software and National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) CCTV defect coding system in summer of 2017.

A description of how these data inputs were utilized is included in the following section.

3.3 Structural Risk Score Assessment

All inspected pipes are prioritized for further renewal or monitoring action based on the Structural Risk Score (SRS). The SRS is a numerical value representing the relative structural risk for each pipe that has been inspected based on the condition assessment findings, cleaning frequency, and consequence of failure. A SRS of 100 represents the highest possible risk. A SRS of 0 represents the lowest possible risk. The SRS calculation was developed specifically for the City based on a combination of existing City decision making processes, staff input, and experience with other industry leading utilities.

During business decision logic calibration, the SRS thresholds that trigger specific risk mitigation actions (Repair, Rehabilitate, Replace, etc.) were refined and set at the level necessary to balance budget and level of service targets. These thresholds may be adjusted by the City over time as additional condition assessment data is gathered and the program is refined.

The SRS is determined by the pipe's likelihood of failure (LOF) and consequence of failure (COF). During development workshops, the Asset Management Team determined the relative weighting that the renewal business decision logic would place on each of these components. The SRS is comprised of the individual components listed in Table 3-1.

Table 3-1. Structural Risk Score Components and Weights

Structural Risk Score Component	Percent of Structural Risk Score (%)
Likelihood of Failure	
Defect Score	60
Count of Defects Score	15
Cleaning Frequency Score	5
Subtotal	*80*
Consequence of Failure	
Pipe Diameter	8
Proximity to Waters of the State	8
Pipe Depth	3
High Visibility Area	1
Subtotal	*20*
Total	**100**

The Asset Management Team has deliberately chosen to place a higher importance on the likelihood of failure score than the consequence of failure. This ratio was determined based on lessons learned from other industry leading utilities with mature decision making processes. A risk mitigation action typically reduces the likelihood of failure significantly but has limited or no impact on the consequence of failure. When

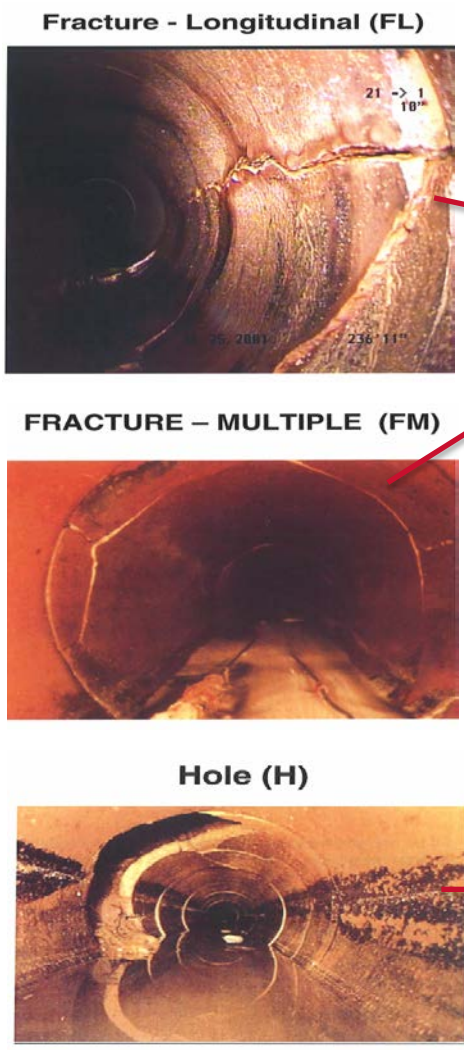
consequence of failure is weighted higher, gravity sewers in good condition that are located in high consequence areas can be prioritized higher than gravity sewers in very poor condition.

Weighting the condition assessment findings in this manner ensures that the pipes with the greatest risk of structural failure will be scored higher and prioritized for renewal, while still adequately factoring consequence of failure into the decision making process.

Some industry guidance such as such as ISO55000 and WERF SIMPLE consider multiplying likelihood and consequence of failure scores to determine the SRS. The additive approach outlined above was selected by the Asset Management Team because calibrating the additive approach to match actual risk identification practices is simpler, more efficient, and more effective. Figure 3-1 illustrates this concept.

Figure 3-1 shows two fracture defects and one large hole defect with three different LoF and CoF scores, one additive as described above and two multiplicative. The large hole is the most severe defect and the longitudinal fracture is the least severe based on City and typical industry practices. Adding the CoF and LoF scores produces a total score that matches the City's practices for identifying risk. Put simply, CoF is still a factor, but CoF does not outweigh LoF. Of the two multiplicative examples shown in Figure 3-1, Example A shows that multiplying COF and LOF results in the same SRS of 300 for the three defects, which is not in line with City practices for identifying gravity sewer risk. Example B uses an equation for SRS equal to 1 + COF / 100 multiplied by LOF, which produces results that are closer to City practices, but do not result in COF having any significant impact on the SRS. A third method could be used for the multiplicative approach that would yield accurate results, but this would require developing a custom weighting system for different defects and extensive calibration. However, the additive approach was found to be the best and most effective approach for the City.

Figure 3-1. Additive SRS versus Multiplicative SRS



LoF + CoF is Easier to Calibrate than LoF x CoF

LoF Score	CoF Score	CoF + LoF	Example A CoF x LoF	Example B (1 + CoF/100) x LoF
20	5	25	100	21
20	10	30	200	22
20	**15**	**35**	**300**	**23**
20	20	40	400	24
30	5	35	150	32
30	**10**	**40**	**300**	**33**
30	15	45	450	35
30	20	50	600	36
40	5	45	200	42
40	10	50	400	44
40	15	55	600	46
40	20	60	800	48
50	5	55	250	53
50	10	60	500	55
50	15	65	750	58
50	20	70	1000	60
60	**5**	**65**	**300**	**63**
60	10	70	600	66
60	15	75	900	69
60	20	80	1200	72

3.3.1.1 Defect Score

A primary component driving the likelihood of pipe failure is the worst structural defect present on the pipe. Therefore, the worst defect present in a pipe is the most heavily weighted factor used to rank and prioritize pipes based on risk.

Defects identified through CCTV are grouped by severity of defect into 6 groups. Defect Severity Group is primarily based on the structural severity of the defect, with Group 1 generally being the most severe and highest priority and Group 6 the least severe and lowest priority. The City's custom defect coding system includes a severity modifier of small, medium, or large for most defect codes. Also, some defect codes are more severe than others (e.g. collapsed pipe defect is more severe than a cracked pipe defect). The Asset Management Team used images of defects to group typical condition defects by severity using the following general criteria:

- Group 1 – Defect could potentially result in an emergency repair by contractor
- Group 2 – Defect could potentially be prioritized to the top of the City crew repair list
- Group 3 – Most defects could be prioritized for a CIP project and others may be monitored in the future
- Group 4 – Some defects could be prioritized for a CIP project and others could be monitored in the future
- Group 5 – Most defects could be monitored in the future others could result in a CIP project
- Group 6 – Defect could potentially be monitored in the future

The defect severity group for each defect code is included in Appendix F.

3.3.1.2 Count of Defects Score

The Count of Defects Score represents the component of the SRS determined by the total number of defects present on a pipe. The Count of Defects Score assigns a maximum of 15 points based on the number of Defect Severity Group 1 – 6 defects present in a pipe. The basis for calculating this score is presented in Table 3-2.

Table 3-2. Count of Defects Score

Number of Defect Severity Group 1 - 6 Defects	Defect Count Score
1	0
2	1
3	2
4	3
5	5
6	7
7	9
8	11
9	13
10 or More	15

3.3.1.3 Cleaning Frequency Score

The Cleaning Frequency Score is based on the pipe's scheduled cleaning frequency, as cleaning activities can increase the rate of a pipe's deterioration or the severity of a defect. The Cleaning Frequency Score detail is included in Table 3-3.

Table 3-3. Cleaning Frequency Score

Scheduled Cleaning Frequency	Cleaning Frequency Score
1-5 years	0
Less than 1 year (Enhanced Maintenance Area)	5

3.3.1.4 Consequence of Failure Score

A workshop was conducted with City staff to identify factors for consequence of failure and to weight each factor. The COF is 20 percent of the total SRS score. COF is calculated using the following factors and weights:

COF = (8/20 * Proximity to Waters) + (8/20 * Pipe Diameter) + (3/20 * Depth) + (1/20 * Located in High Visibility Area)

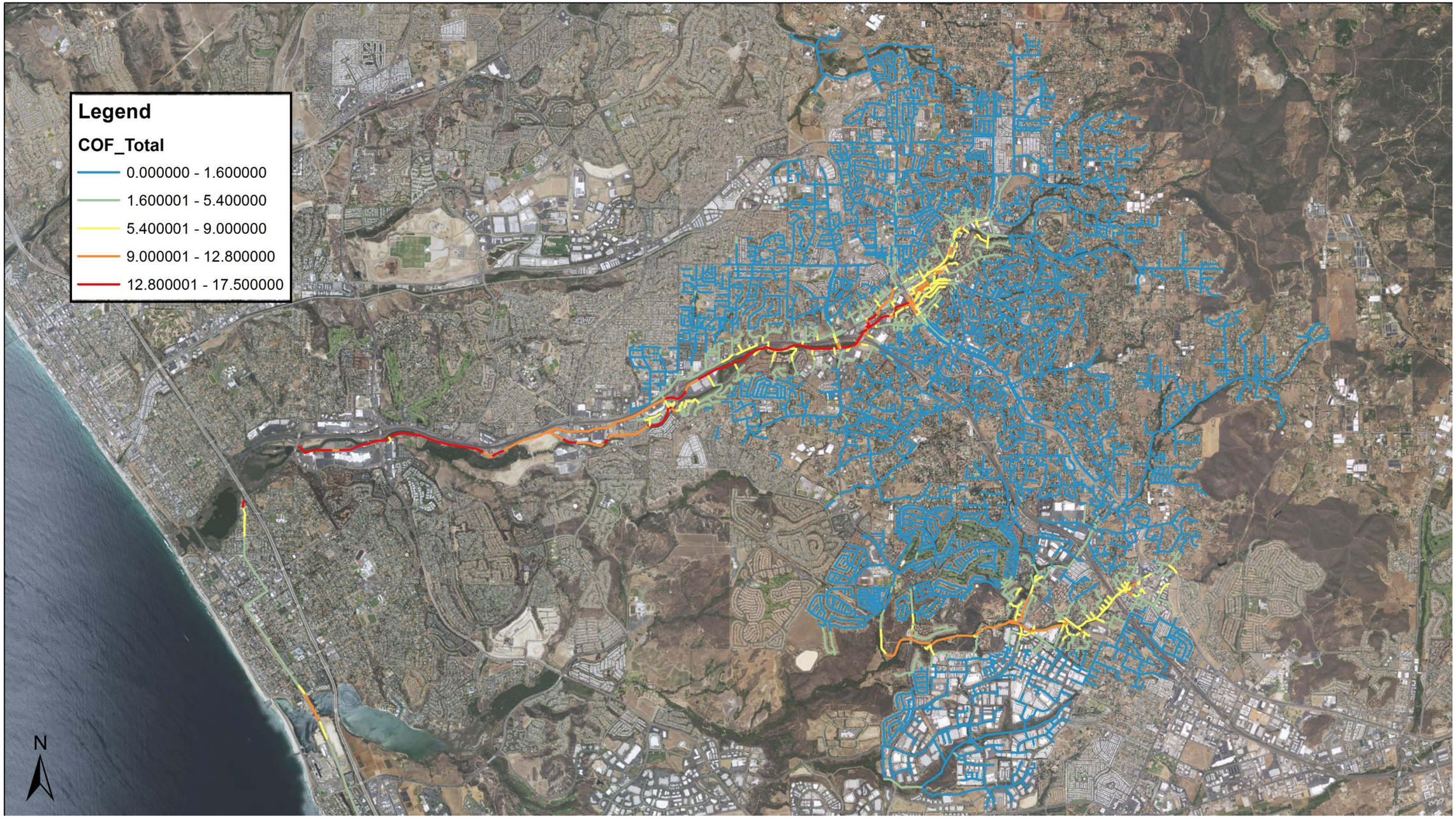
Table 3-4 includes the scoring detail for each COF factor. The high visibility area is located in downtown City of Vista in an area bordered by the following roadways: Vista Village, Civic Center, Ocean View, and Santa Fe.

Table 3-4. Consequence of Failure Scoring Detail

Pipe Diameter		Proximity to Waters of the State		Pipe Depth		High Visibility Area	
Score	Diameter (Inches)	Score	Distance to Pipe (Feet)	Score	Depth (Feet)	Score	Pipe Location
0	<=12	10	0- 100	0	0 – 12	10	In Area
2	Unknown	8	100 – 200	2	Unknown	0	Outside of Area
4	14 – 21	6	200 - 500	5	12 – 25		
7	24 – 30	4	500 – 1000	10	>25		
10	36	0	> 1,000				

The Consequence of Failure scores were mapped for review with City staff and are shown in Figure 3-2. The initial scoring incorrectly identified golf hazards as waters of the state and adjustments were made to correct this.

Figure 3-2. Gravity Sewer Consequence of Failure Scores



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3.3.2 Structural Risk Score Calibration

Prior to finalizing the SRS percentages presented in Table 3-1, the Asset Management Team reviewed the SRS to determine whether the scoring reflected actual risk. An example scenario reviewed by the Asset Management Team included the following SRS component percentages:

- Defect Score = 50 percent
- Count of Defects Score = 25 percent
- Cleaning Frequency = 5 percent
- Large root defects were given a Defect Score of 25

This scenario produced inaccurate results with four defects having a similar SRS. Specifically, a large roots defect, slight deformation defect, collapsed pipe defect, and large lining defect received a similar SRS. This outcome is not consistent with City findings and industry experience for risk identification. A Large roots defect is lower risk than the other defects and a collapsed pipe defect is higher risk than the other defects. The Asset Management Team made adjustments to the SRS, which are presented in Table 3-1 so that the resulting SRS are in line with City findings and industry experience for risk identification.

3.3.3 Risk Management Action

This section summarizes the methodology for determining the appropriate risk mitigation action for each pipe that is inspected. The output is divided into two categories Primary Action and Secondary Action. The primary action documents the primary risk management action for the pipe and is typically divided into small diameter (SD) and large diameter (LD) because renewal and monitoring is planned and executed differently. The secondary action includes addressing maintenance and access issues. The secondary action may be independent of the primary action. For example, a pipe may have severe roots at 100 feet and a single large hole at 200 feet. The primary action may be to repair the large hole and the secondary action may be to accelerate the cleaning frequency of this pipe.

Primary actions include:

- Replace – replacement of gravity sewer by contractor
- Contractor Point Repair – gravity sewer point repair by contractor
- Crew Point Repair – gravity sewer point repair by City crew
- Cured In Place Pipe Lining (CIPP) – gravity sewer rehabilitation by contractor
- Point Repair and CIPP – gravity sewer point repair by City crew and CIPP by contractor
- Cut Tap or Obstacle – robotic cutting of tap or obstacle by City crew
- 15-Year No Defects Monitor SD – Gravity sewer does not have structural defects and is recommended for reinspection within 15 years.

- 10-Year Monitor – Gravity sewer may have minor structural defects and is recommended for reinspection within 10 years.
- 5-Year Monitor – Gravity sewer has minor structural defects and is recommended for reinspection within 5 years.

Secondary actions include:

- SA-Abandoned – Abandoned CCTV inspection, review cause.
- DND–Dead End – Gravity sewers with dead ends vs. clean outs or MHs, used for clean out upsizing program forecasting
- CO-Clean – Gravity sewers with clean outs (CO) vs. MHs or dead ends, used for clean out upsizing program forecasting
- Manhole Buried – Gravity sewers with buried MHs, review for potential MH raise to grade
- Manhole Review – Gravity sewers with bends or restricted channels that may be good candidates for a new MH
- Manhole Undocumented – MHs that are not currently documented in GIS, review GIS
- Maintenance Review – Gravity sewers with medium or large grease, roots, or debris findings that may be good candidates for near term cleaning
- Deep Pipe – Gravity sewers with downstream invert elevations greater than or equal to 25 feet below grade, review primary action accordingly

CCTV defects are grouped by typical primary action types in order to associate appropriate renewal recommendations with each defect. These structural defect renewal types are categorized A – E and include:

- Type A – Defects that are typically addressed by lining.
- Type B – Defects that typically are addressed through replacement.
- Type C – Defects that are typically addressed by a point repair or pipe replacement.
- Type D – Defects that are typically addressed through robotic cutting.
- Type E – Inspections that were forced to be abandoned.

Appendix F lists the City's custom defect codes by defect renewal type.

The flow diagram shown in Figure 3-3 documents the renewal business decision logic. Primary actions are represented by circles at the end of the flow diagram in bold and underlined text, secondary actions are represented by circles at the beginning of the flow diagram in regular font text, and decision points are represented by diamonds in the flow chart.

Additional description of some decision points in the renewal business decision logic includes:

- Count of Defect Severity Group 1-4 defects determine whether a pipe will be point repaired or replaced. Vitrified clay pipe (VCP) with greater than six Defect Severity Group 1-4 defects will be replaced. Other material pipe with a count of Defect Severity Group 1-4 defects greater than three will be replaced. This approach is more economical and based on City practices for typical point repair vs. full pipe replacement.
- Point repairs on gravity sewers installed deeper than 12 feet below grade and gravity sewers with greater than 24 inches in pipe diameter will be performed by contractors.
- Gravity sewers with less than three replacement type (Type B) defects are recommended for point repair and CIPP renewal. This approach is more economical and in line with existing City practices.
- Gravity sewers with pipe diameter equal to 6 inches or smaller will not be renewed with CIPP.

SRS thresholds are critical decision points in the renewal business decision logic. These thresholds are used to determine whether a gravity sewer is recommended for a renewal action or future condition assessment monitoring action. If the SRS threshold is set to 30, for example, gravity sewers with a SRS greater than 30 will be recommended for renewal or more frequent monitoring. Setting and adjusting the renewal thresholds allows the City to balance cost, risk and level of service appropriately and deliver the most value to ratepayers. The SRS thresholds vary by renewal action to deliver the most value per dollar spent on renewal. Higher thresholds are used for more costly renewal actions and lower SRS thresholds are used for cheaper renewal actions. This approach mitigates the most risk at the lowest cost. The following example scenario illustrates this approach.

Example Scenario: Eleven gravity sewers have a SRS of 40. One of those gravity sewers is recommended for a small diameter replacement which could cost over $20,000. The remaining 10 pipes are recommended for a City crew point repair, which could cost $2,000 each or $20,000 total. Setting the SRS threshold to 45 for the small diameter replacement renewal and the SRS threshold to 30 for the crew point repair renewal will result in the renewal business decision logic recommending spending $20,000 on crew point repairs and mitigating the risk on 10 gravity sewers, vs. spending $20,000 on mitigating the same risk on one gravity sewer.

A description of the SRS thresholds for the City's renewal business decision logic is included in Section 4.

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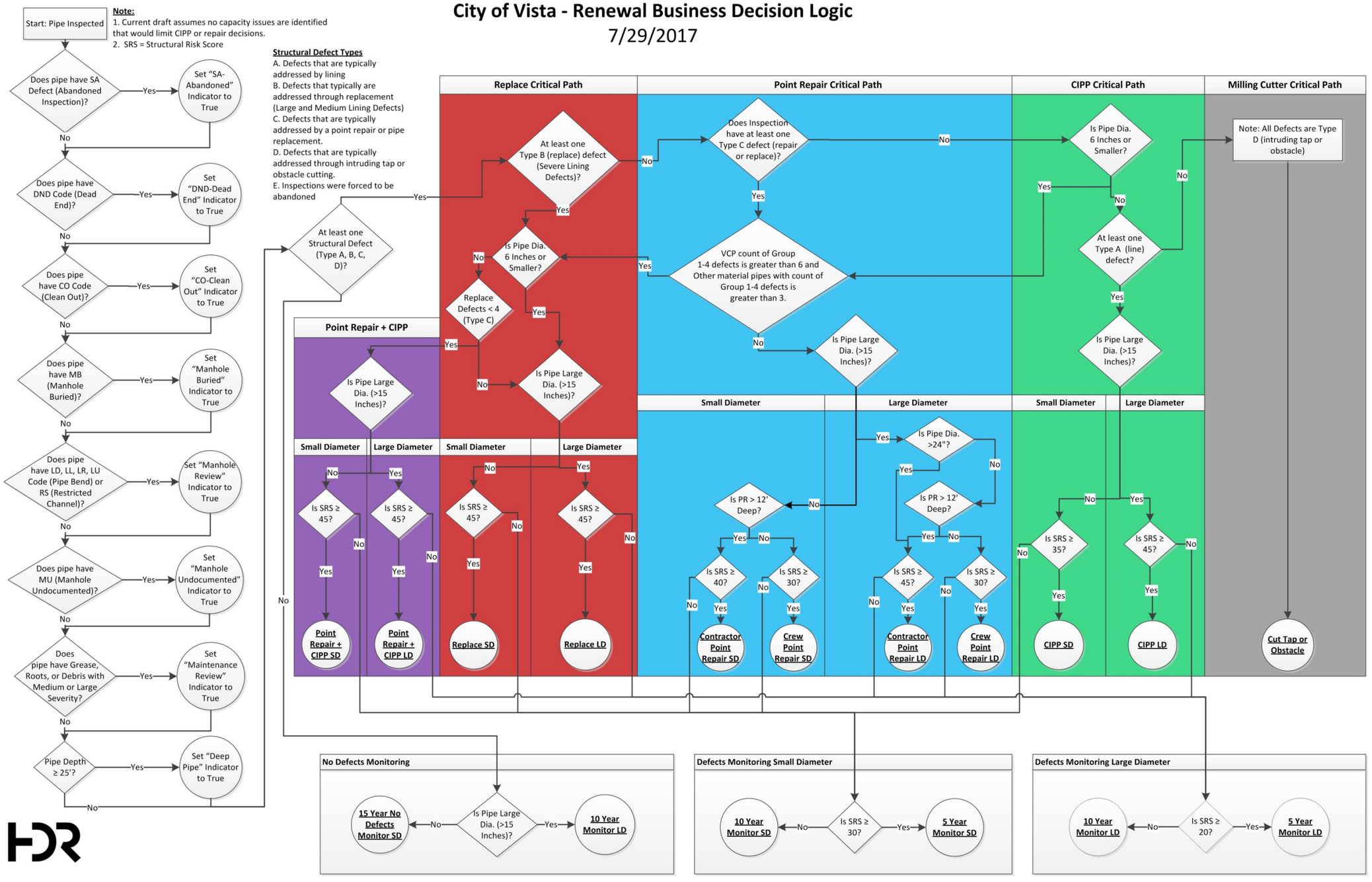
Figure 3-3. Renewal Business Decision Logic Flow Diagram



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4 Inspection and Renewal Forecast

This section presents the results and forecasts based on the renewal business decision logic. Results include a summary of SRS for gravity sewers and SRS thresholds, renewal action recommendation summaries including costs, and monitoring recommendation summaries included City resource projections. Forecasts for a 5-year Capital Improvement Program (CIP) are also included in the results. The City's calibrated and high quality data inputs result in high confidence renewal business decision logic results and forecasts.

4.1 Structural Risk Score Results

The SRS is a numerical value representing the relative structural risk for each gravity sewer that has been inspected and includes the sum of likelihood and consequence of failure scores. A summary of the SRS results is presented in Table 4-1.

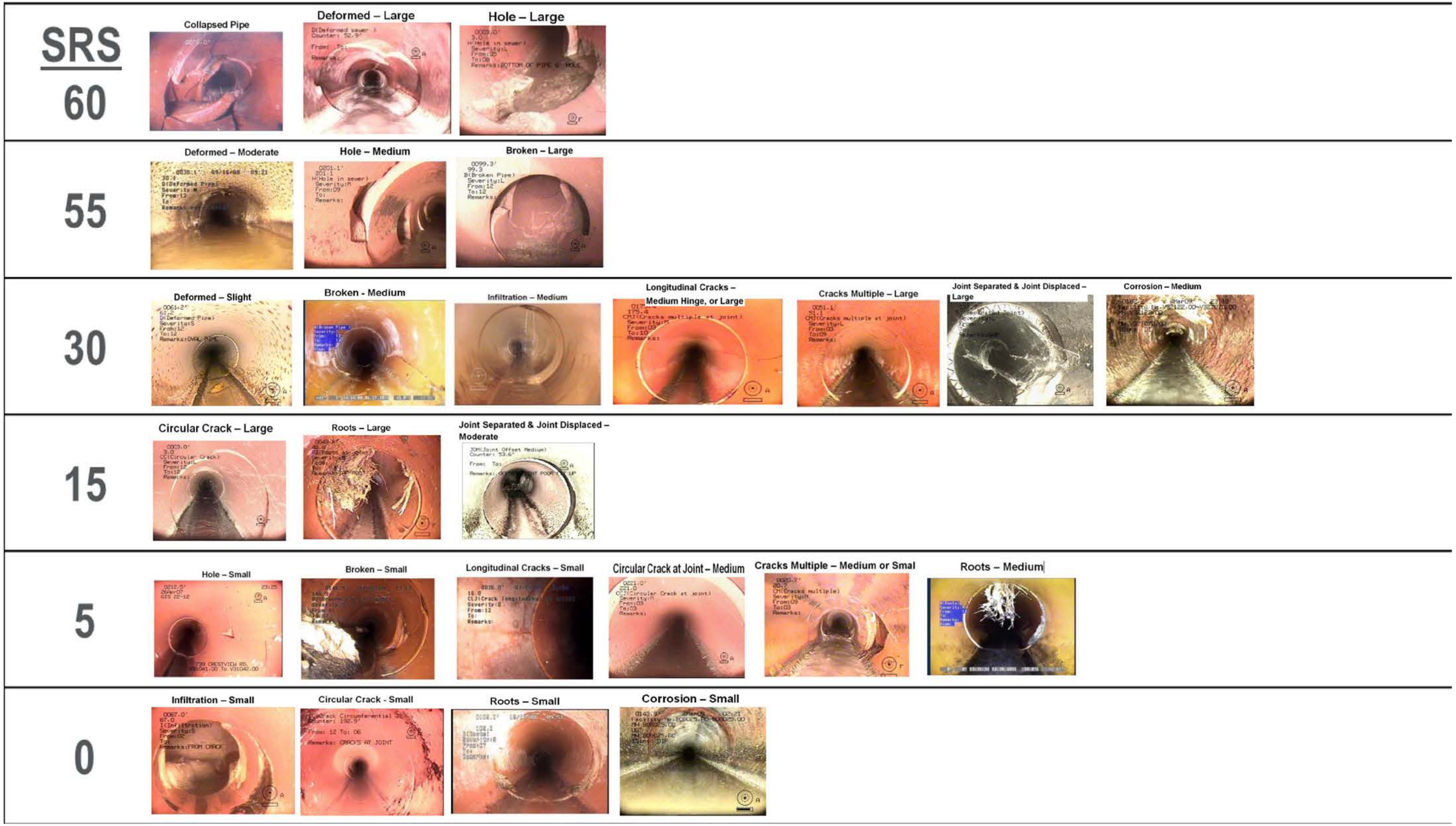
Table 4-1. Structural Risk Score Summary

SRS	Count of Gravity Sewer Mains	Length of Gravity Sewer Mains (Feet)	Percent by Length (%)
0-5	5,003	906,538	56
5-10	1,138	220,016	14
10-15	337	81,376	5
15-20	474	104,345	6
20-25	222	51,160	3
25-30	52	12,669	1
30-35	302	66,603	4
35-40	121	27,082	2
40-45	73	17,920	1
45-50	98	24,320	2
50-55	23	5,426	0
55-60	111	23,140	1
60-65	85	18,873	1
65-70	59	13,264	1
70-75	104	27,578	2
75-80	49	13,135	1
80-85	6	1,464	0
85-90	1	116	0
Total	**8,258**	**1,615,026**	**100**

4.1.1 Examples of Structural Risk Scores

In order to visualize the relative levels of risk associated with the SRS, it is useful to view examples. The following example defects shown in Figure 4-1 were used during the initial renewal business decision logic model calibration and projections to aid in setting the SRS thresholds. These examples do not show all types of defects potentially present in gravity sewers, but represent key defects that drive the renewal business decision logic.

Figure 4-1. Defect Score Images Used for Structural Risk Score



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4.2 Renewal and Condition Assessment Forecasts

This section documents the unit cost assumptions, SRS thresholds, and results of the renewal business decision logic recommendations.

4.2.1 Unit Costs Assumptions

Unit costs were developed based on recent costs from in-house and contracted renewal within the City's collection system and industry experience. Unit costs are calculated by summing the following costs for each gravity sewer pipe diameter and renewal type:

- **Material Cost** – Typically the cost provided on a construction project bid tabulation
- **Installation Factor** – Assumed to address costs such as mobilization, fittings, excavation, bedding, backfill, traffic control, by-pass pumping, equipment, labor, pavement or non-ROW patching or improvements.
- **MH Factor** – Assumed to address the cost of manhole renewal for MHs associated with gravity sewer renewal work such as replacement and CIPP lining based on typical City MH renewal practices.
- **Capital Cost Factor and Easement Contingency Factor** – Assumed to address costs related to agency administration, design, construction management, construction contingency and costs associated with pipe that require easement acquisition. When packaging renewal work for CIPP lining projects, it is common to include gravity sewers in between or adjacent to recommended renewal work in order to reduce the potential for multiple construction project impacts over a short period of time to residents and businesses. An additional 20 percent yield factor is applied to address this for small diameter CIPP renewal unit costs.

The unit costs and cost factors are included in Appendix G.

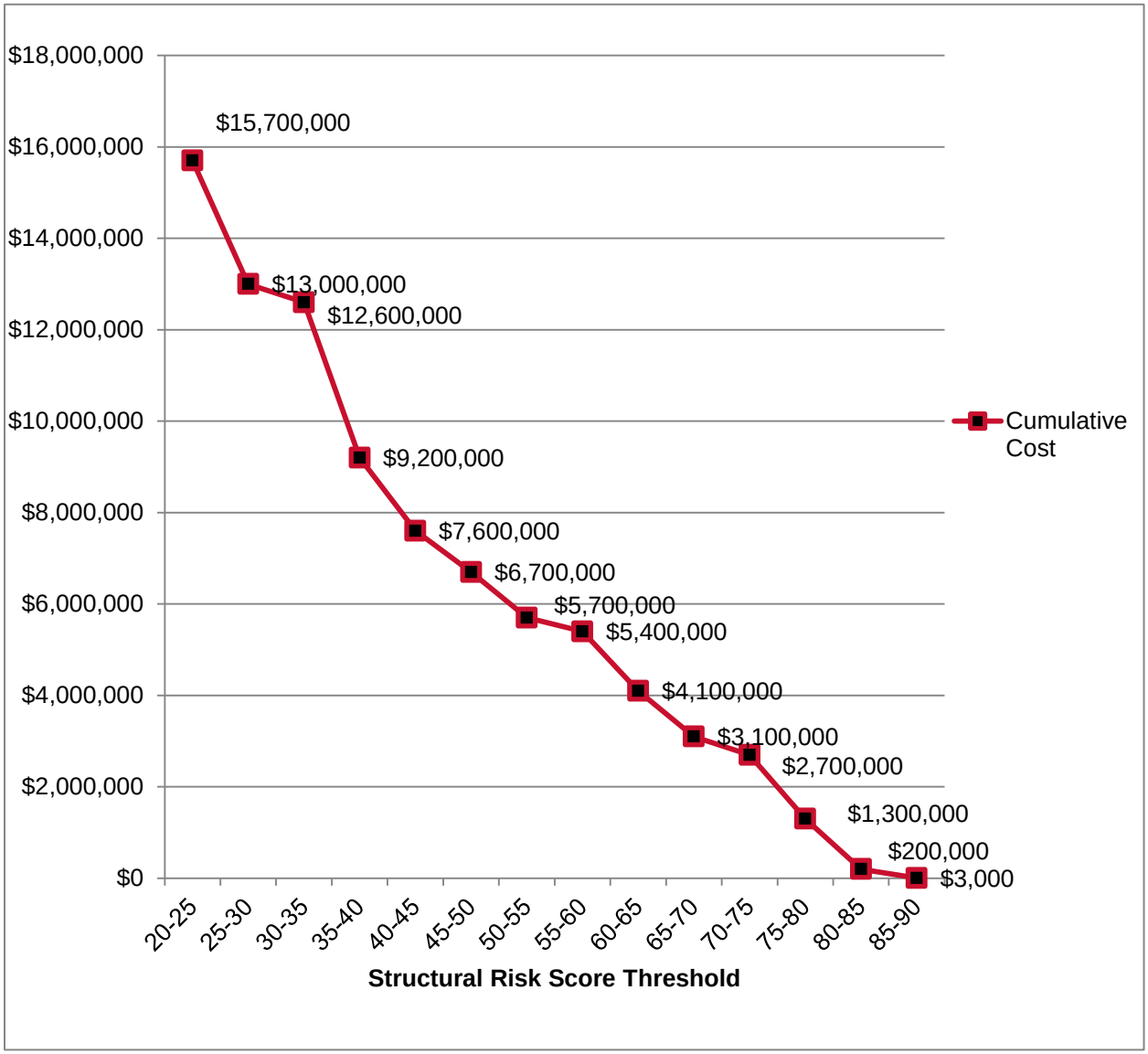
4.2.2 Structural Risk Score Thresholds

Using the renewal business decision logic and unit costs, a dashboard tool in Microsoft Excel was developed to provide results in real time with adjustments to SRS thresholds. This tool was used to evaluate initial SRS thresholds for the City based on the distribution of SRS scores for the City's sewer pipelines. This section presents the development of SRS thresholds.

Gravity sewers with a SRS greater than the SRS threshold are recommended for renewal or future condition assessment monitoring by the renewal business decision logic. Figure 4-2 shows the cost to renew gravity sewers at different SRS thresholds. The cost shown at each SRS threshold is the forecasted cost to perform the renewal actions identified for the business decision logic for gravity sewers with a SRS greater than the threshold. An example is the cost forecast to complete all renewal identified by the business decision logic for gravity sewers with an SRS greater than 30 is $12,600,000. Similarly, the cost to complete all renewal identified by the business

decision logic for gravity sewers with an SRS greater than 40 is $7,600,000. These costs and the defects shown in Figure 4-1 were used to develop a starting point for SRS threshold development.

Figure 4-2. Cost to Renew Gravity Sewers by Structural Risk Score Threshold



Adjustments were then made to assign different SRS thresholds for each renewal type. This allows the City to focus on lower cost renewal methods and consequently provide the most risk mitigation per rate payer dollar spent. More expensive renewal actions are assigned a higher SRS threshold and less expensive renewal actions are assigned a lower SRS threshold as shown in Table 4-2. One exception to this in Table 4-2 is the Point Repair + CIPP renewal type. This renewal type is set up in the renewal business decision logic as an alternative to replacement renewal. As a result, the SRS thresholds are the same for both renewal types even though Point Repair and CIPP is a less expensive renewal type.

Table 4-2. Renewal Action Structural Risk Score Thresholds

Renewal Action	Structural Risk Score Threshold	Renewal Cost Examples ($)
Replace SD	45	80,000
Contractor Point Repair LD	45	57,000
CIPP LD	45	54,000
Point Repair and CIPP SD	45	16,000
Contractor Point Repair SD	40	26,000
CIPP SD	35	13,000
Crew Point Repair SD	30	2,000
Cut Tap or Obstacle	15	Nominal Capital Cost

Note: Renewal cost examples for SD renewal actions assume 8 inch diameter pipe. Renewal cost examples for LD renewal actions assume 24 inch diameter pipe. Renewal cost examples assume the renewal action is performed on approximately 200 feet of gravity sewer.

A similar approach was used to determine condition assessment monitoring SRS thresholds. Instead of cost, number of crews forecasted is used along with risk and level of service to determine the thresholds. Table 4-3 shows the SRS thresholds for future CCTV monitoring frequencies. An SRS of 0 indicates there is no threshold and the action applies to all gravity sewers with the recommended action. Large diameter gravity sewers recommended for monitoring with a SRS greater than 20 are recommended for inspection within 5 years versus 10 or 15 years.

Table 4-3. Condition Assessment Monitoring Structural Risk Score Thresholds

Condition Assessment Monitoring Action	Structural Risk Score Threshold
5-Year Monitor LD	20
5-Year Monitor SD	30
10-Year Monitor LD	0
10-Year Monitor SD	0
15-Year No Defects Monitor SD	0

The SRS thresholds shown in Table 4-2 and Table 4-3 are used near the end of the business decision logic flow chart shown in Figure 3-3 and are used in the forecasts presented in Section 4.2.4.

4.2.3 Remaining Useful Life

Determining a remaining useful life is challenging for gravity sewers because the time of failure is typically not known. Failure may occur when the gravity sewer is installed or later in the gravity sewers life due to cleaning caused degradation over time or a contractor dig-in. The City's CCTV data provides a snapshot in time of the condition of a majority of the City's gravity sewer pipes. Based on the SRS thresholds selected by the

Asset Management Team, gravity sewers with a renewal recommendation are assumed to exceed their useful life within the next 5 to 10 years. Gravity sewers recommended for monitoring are expected to exceed their useful life sometime beyond 5 to 10 years. These assumptions may change as the City performs repeat inspections of gravity sewers and determines more accurate remaining useful life.

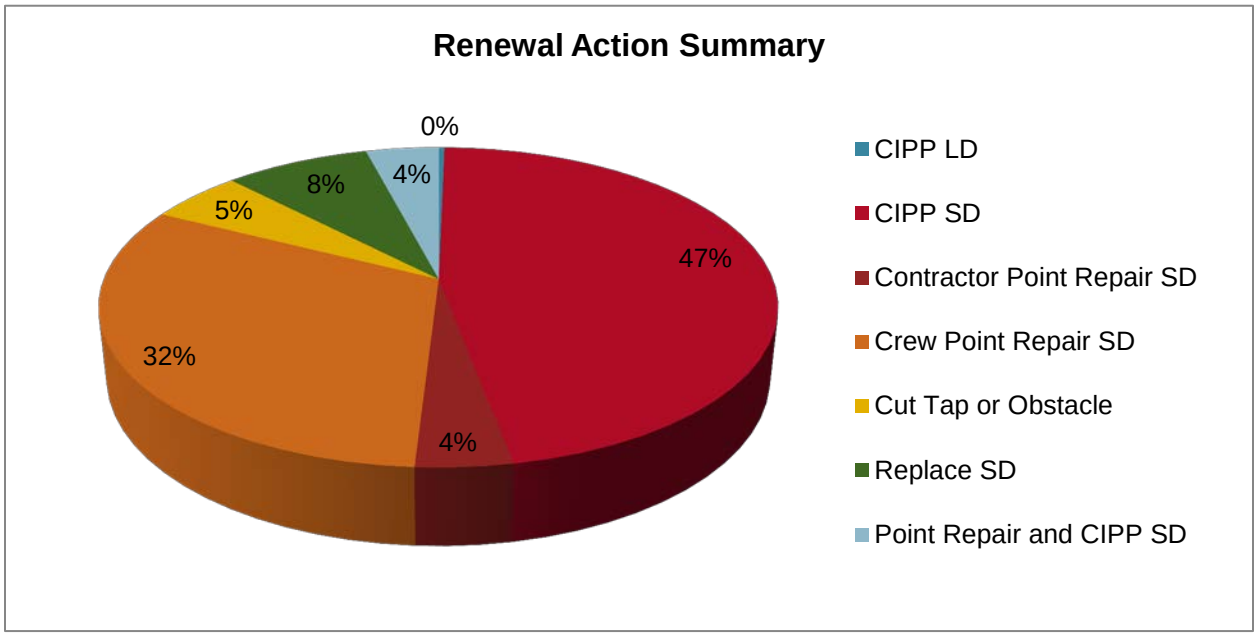
4.2.4 Forecasts

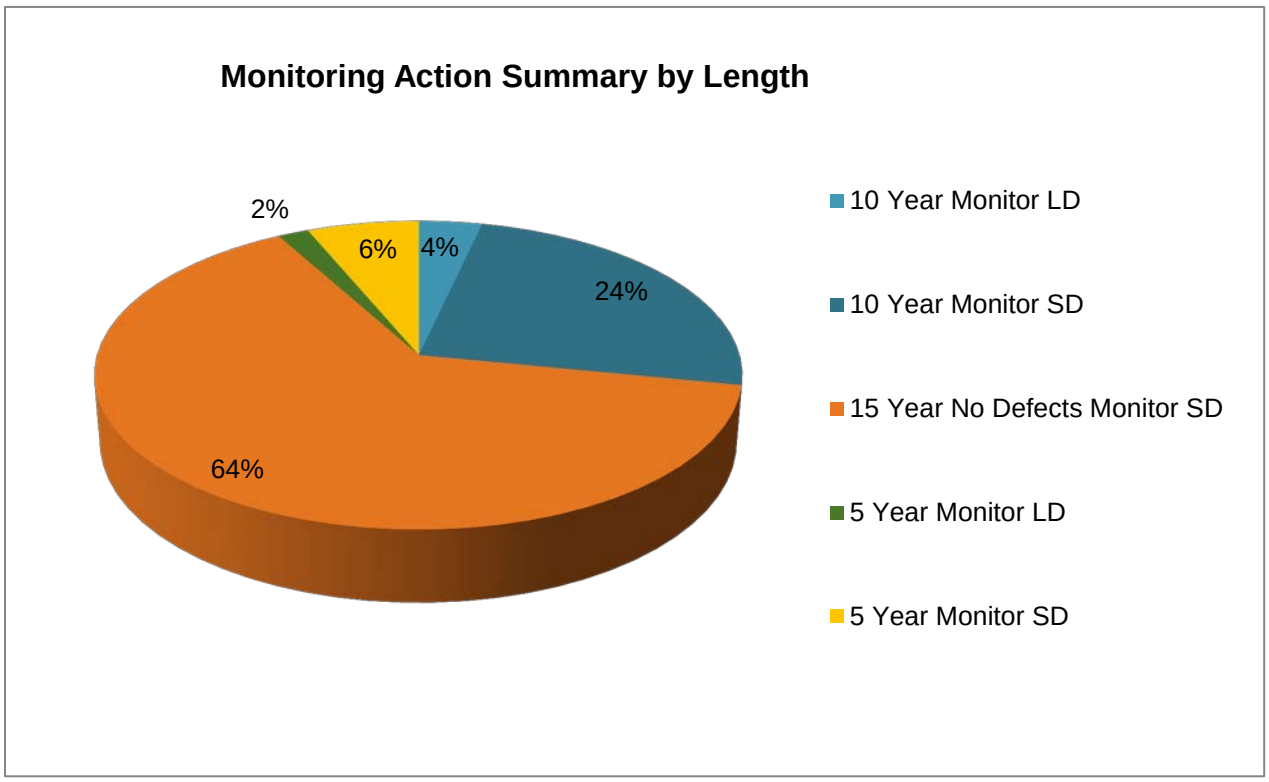
The SRS thresholds in Table 4-2 and Table 4-3 and the decision logic in Figure 3-3 were used with the dashboard tool to forecast renewal recommendation quantities, condition assessment monitoring resource needs and costs for use in operations planning and as part of the CSMP projects 5-year CIP, rate study, and PEIR. These recommendations from the renewal business decision logic will cost effectively meet the City's desired renewal and monitoring program policies. Table 4-4 summarizes the actions by length and percentage. Figure 4-3 presents the percentage by length of gravity sewers recommended for renewal actions and monitoring actions. The No Inspection Data action identifies the quantity of gravity sewers that do not have CCTV inspection data readily available in the City's CCTV database of record. Potential capacity projects from the CSMP were included in the results shown in Figure 4-3. Attachment A includes the decision logic renewal actions by gravity sewer.

Table 4-4. Renewal and Monitoring Action Results

Renewal and Monitoring Action	Gravity Sewer Length (Feet)	Percent by Length (%)
10-Year Monitor LD	57,259	4
10-Year Monitor SD	277,928	17
15-Year No Defects Monitor SD	1,030,952	64
5-Year Monitor LD	296	0
5-Year Monitor SD	38,254	2
CIPP LD	380	0
CIPP SD	55,283	3
Contractor Point Repair SD	4,635	0
Crew Point Repair SD	37,288	2
Cut Tap or Obstacle	6,239	0
No Inspection Data	91,739	6
Replace SD	9,667	1
Point Repair and CIPP SD	4,851	0
Capacity Project	253	0

Figure 4-3. Renewal and Monitoring Action Results





Costs forecasts for CIP renewal actions for the City and District are shown in Figure 4-4 and Table 4-5.

Figure 4-4. CIP Renewal Cost Forecast Results

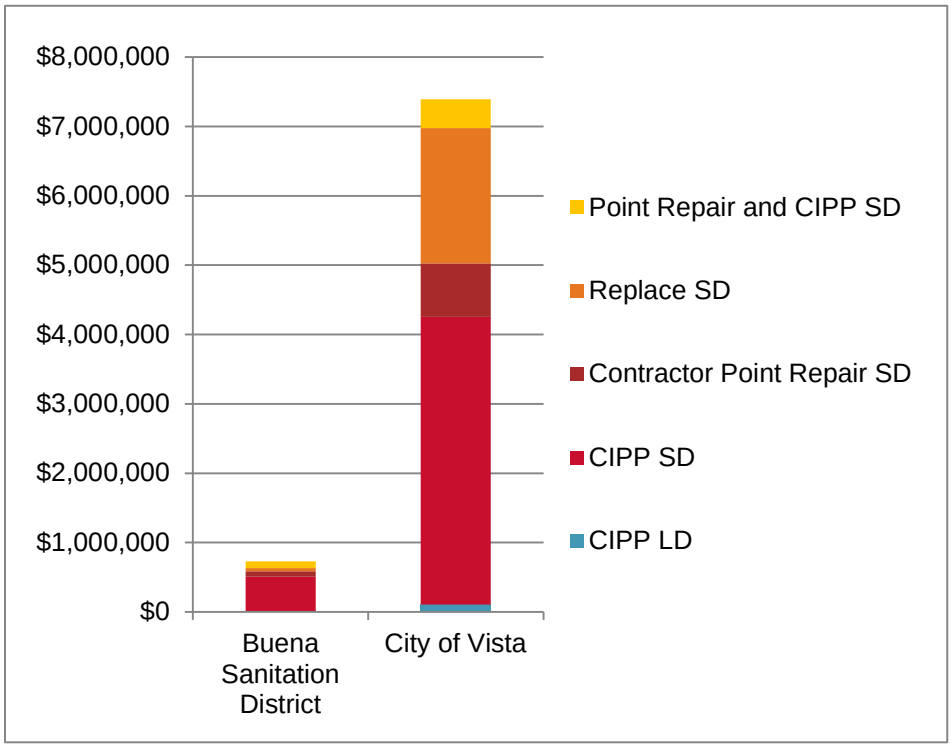


Table 4-5. CIP Renewal Cost Forecast Results

CIP Renewal Action Type	Buena Sanitation District ($)	City of Vista ($)	Total ($)
CIPP LD	0	105,251	105,251
CIPP SD	509,684	4,149,229	4,658,912
Contractor Point Repair SD	76,522	772,914	849,436
Replace SD	43,817	1,951,581	1,995,398
Point Repair and CIPP SD*	92,540	385,278	477,818
Total	722,563	7,364,252	8,086,815

*Does not Include Crew Point Repair Costs

Results for forecasted work to be performed by City crews including point repairs, robotic cutting, and CCTV monitoring inspections are shown in Figure 4-5, Figure 4-6, and Figure 4-7, respectively. These figures present resource forecasts rather than cost forecasts because the resource forecasts are more useful for operations and maintenance planning. Point repair resource forecasts assumes completion of approximately 28 point repairs with one point repair crew per year and approximately 1.5 excavations per point repair. Robotic cutting resource forecasts assume approximately two robotic cuttings performed for a CCTV crew and cutting crew per day. Proactive CCTV monitoring forecasts assume a City CCTV crew can complete

approximately 160,000 linear feet of CCTV inspection per year. Pipes with no inspection data were assumed to be on a 5-year inspection frequency. Pipes with renewal action recommendations were assumed to be on a 10-year inspection frequency.

Figure 4-5. Point Repair Crew Resource Forecast

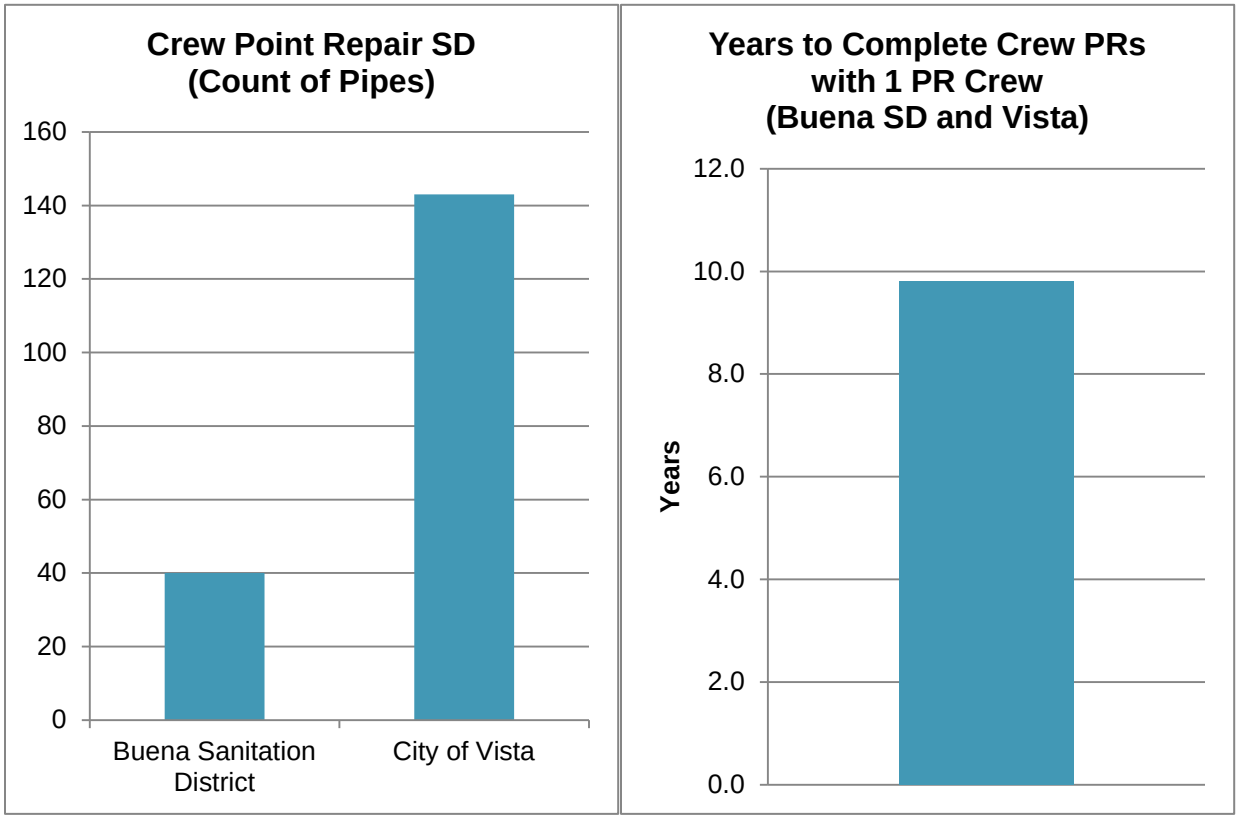


Figure 4-6. Robotic Cutting Crew Resource Forecast

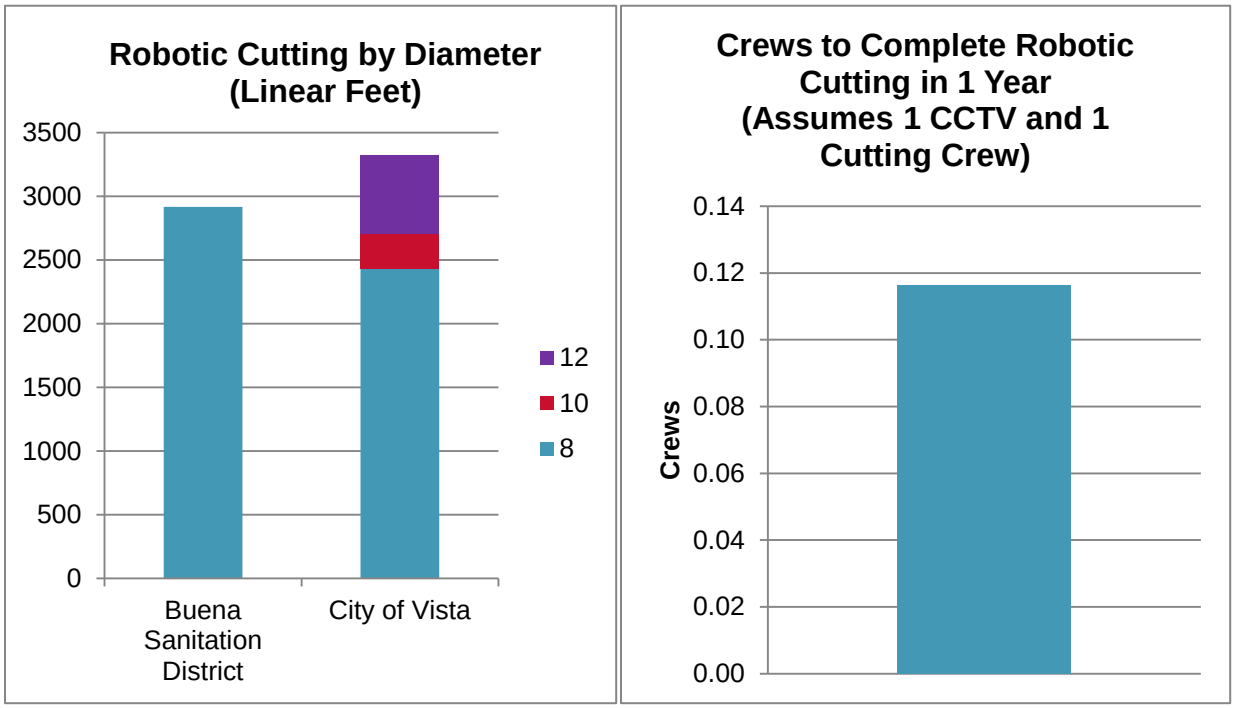
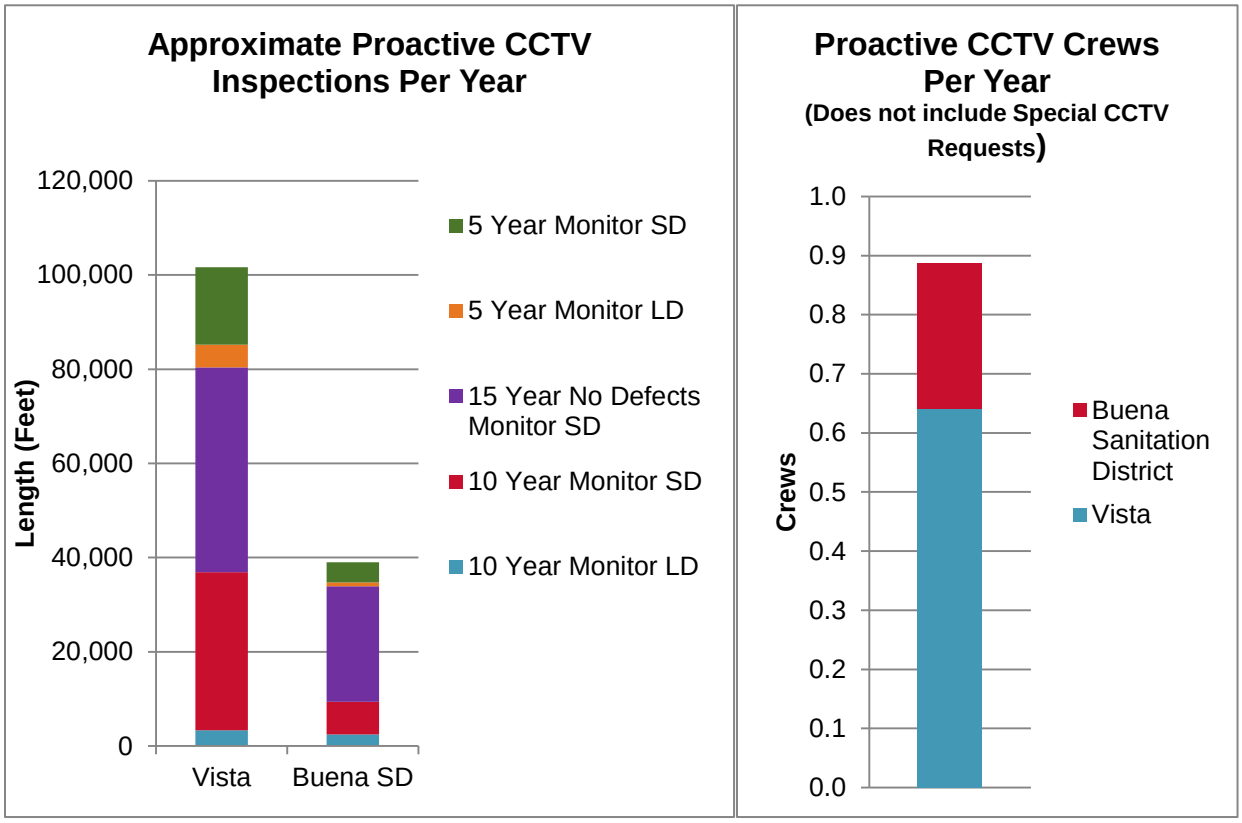


Figure 4-7. CCTV Inspection Crew Resource Forecast



4.3 5-Year Annual CIP Forecasts

The overall program CIP forecasts include a 5-year average annual CIP forecast. The 5-Year Average Annual CIP forecast includes the renewal business decision logic CIP cost forecast in Table 4-5 distributed equally over 5 years. Table 4-6 presents the 5-year average annual CIP for gravity sewer and MH renewal.

Table 4-6. 5-Year Gravity Sewer CIP Renewal Forecast

	FY17/18 ($)	FY18/19 ($)	FY19/20 ($)	FY20/21 ($)	FY21/22 ($)
City of Vista	1,472,850	1,472,850	1,472,850	1,472,850	1,472,850
Buena Sanitation District	144,513	144,513	144,513	144,513	144,513

The City developed a Pump Station Rehabilitation plan under a separate contract that includes pump station and force main rehabilitation CIP costs and a prioritization for implementation. CIP cost forecasts for pump station, force main, MHs, and gravity sewers including capacity upgrades were combined in the CSMP and documented in master plan update and rate study.

4.4 System for Structural Risk Score Updates

Historical risk scores based on the City's custom coding system will be replaced as new CCTV inspection is performed and as risk scoring methodology is updated in the future based on adaptive management principals. New CCTV inspections on previously CCTV'd gravity sewers will create a new SRS based on the new inspection and any updates to the risk scoring methodology for the inspected gravity sewer. These updates will be stored in the renewal business decision logic output.

The City is transitioning to NASSCO PACP coding in summer 2017 and plans to implement InfoMaster automated renewal decision logic software. Coordination between the historical custom coding system and NASSCO PACP is anticipated to occur as part of Initiative Number 7 in Table 2-1 and Figure 3-2.

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Appendix A. 2016 SSMP Audit Report

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SSMP Audit Report

July 2016 SSMP Audit

Subject:	SSMP Audit Report, September 2013 through June 2016
Prepared For:	City of Vista and Buena Sanitation District
Prepared by:	Jennifer Duffy, HDR Michael Flores, HDR David Spencer, HDR Eric Scherch, HDR
Reviewed by:	Dean Gipson, HDR
Date:	July 13, 2016

1 Purpose

The purpose of this document is to report the results of the Sewer System Management Plan (SSMP) Audit conducted for the City of Vista (City) and Buena Sanitation District (District) covering September 2013 to June 2016. This report was prepared pursuant to the requirements included in the State Water Resources Control Board Order No. 2006-0003 – Statewide General Waste Discharge Requirements for Sanitary Sewer Systems (WDR). The audit requirements are:

"As part of the Sewer System Management Plan (SSMP), the Enrollee shall conduct periodic internal audits, appropriate to the size of the system and the number of SSOs. At a minimum, these audits must occur every two years and a report must be prepared and kept on file. This audit shall focus on evaluating the effectiveness of the SSMP and the Enrollee's compliance with the SSMP requirements identified in this subsection (D.13), including identification of any deficiencies in the SSMP and steps to correct them."

This audit serves as the City and the District's 2016 SSMP audit. This audit was scheduled and completed within two years from adoption of the updated SSMP in June 2014.

2 Background

The City of Vista operates and maintains both its own sanitary collection system and the Buena Sanitation District's sanitary collection system. Each sewer collection system is a distinct legal entity and both convey sewage for treatment by Encina Wastewater Authority (EWA). Both are primarily gravity systems, although there are three pump stations in the City of Vista sewer system and one pump station in the Buena Sanitation District.

Both the City and the District are member agencies of EWA. All pump stations, three (3) in the City and one (1) in the District, are operated and maintained by the EWA under various MOUs and agreements. City of Vista shares ownership of two pump stations with the City of Carlsbad.

The City of Vista's sanitary collection system consists of approximately 215 miles of public sewer and force main pipelines. The Cities of Vista and Carlsbad share ownership of the outfall interceptor sewer, which routes sewage approximately 7.5 miles through two pump stations and force mains to the Encina Water Pollution Control Facility. The Buena Sanitation District sanitary collection system consists of approximately 101 miles of public sewer and force main pipelines.

3 SSMP Audit

This audit reviews the period between September 2013 and June 2016 and is the third SSMP Audit performed to meet WDR requirements for completion of an audit a minimum of once every two years. The previous audit was completed on September 2013. In June 2014 a revised SSMP was approved by City Council for Vista and the Board of Directors for the District. This audit assesses the current state of SSMP compliance with the provisions included in the WDR including Provision D.13, identifies any deficiencies found in the SSMP, and recommends corrective actions. In addition, the audit provides an evaluation of SSMP effectiveness. The City and District intend to use the audit results to improve SSMP compliance and performance in reducing sewer overflows.

HDR conducted the audit on behalf of the City and District through a series of meetings with staff involved with implementation of activities required by provisions included in Provision D.13 of the WDR. The HDR Audit Team members and staff supporting the audit interviews and audit process are identified in **Table 1**and **Table 2**.

Table 1: Audit Team Members

Team Member	Organization	Role
Michael Flores	HDR	Lead Auditor
David Spencer	HDR	Technical Expert
Jennifer Duffy	HDR	Technical Expert
Eric Scherch	HDR	Technical Expert

Table 2: Audit Interviewees

Name	Title
Alfred Pedroza	Senior Engineer
Chris Dzwigalski	Wastewater Supervisor
Elmer Alex	Principal Engineer, Project Manager
Lisa Carter	Program Assistant

SSMP audit interviews were performed over a two-week period starting on May 10, 2016 and concluding on May 16, 2015. The order of the audit interviews, WDR provisions audited, and District staff interviewed is documented in **Table 3**:

Table 3: SSMP Audit Participants

Date	WDR Provision Section	Topics	Participants
5/10/16	D.13 (i) D.13 (ii) D.13 (iii) D.13 (ix) D.13 (x) D.13 (xi) D.9	Goal Organization Legal Authority Monitoring, Measurement, and Program Modifications SSMP Program Audits Communication Program Financial	Elmer Alex, Chris Dzwigalski, Lisa Carter
5/12/16	D.13 (v) D.13 (vii)	Design and Performance Provisions FOG Control Program	Elmer Alex, Alfred Pedroza, Roger Brenzel
5/12/16	D.13 (viii)	System Evaluation and Capacity Assurance Plan	Elmer Alex, Alfred Pedroza
5/16/16	D.13 (vi)	Overflow Emergency Response Plan	Elmer Alex, Chris Dzwigalski, Lisa Carter
5/16/16	D.13 (iv)	Operations and Maintenance Program	Elmer Alex, Chris Dzwigalski, Lisa Carter

4 Evaluation of SSMP Effectiveness

Overall, based on analysis of the sanitary sewer overflow (SSO) trends between September 2013 and June 2016 and the results of the SSMP audit, the overall program for managing the sewer systems has been effective and continues to operate at a high level of performance. The average SSO rate for the City and the District over the audit period is 0.23 SSOs per 100 miles of sewer system per year. The City and District have maintained a SSO rate using the 12-month rolling average of less than 1.89 SSOs per 100 miles of sewer pipelines per year consistently between September 2013 and June 2016 as shown in **Figure 1**. Over the last five years, the City and District have consistently operated below 1.99 SSOs per 100 miles per year as shown in Figure 1.

4.1 Sewer Overflow Performance

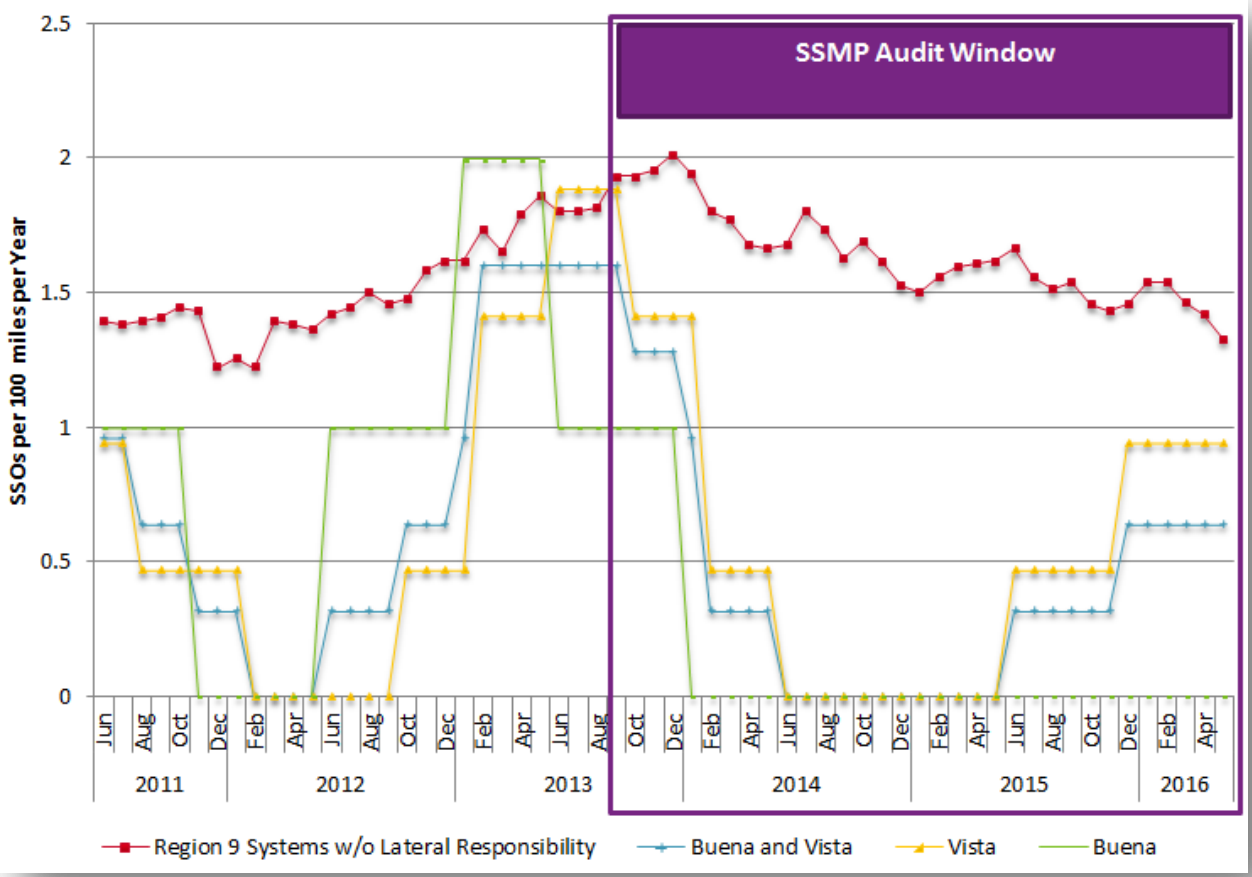
The primary measure of the effectiveness of the SSMP is sewer overflow performance. This section reviews the City and District's recent sewer overflow performance through analysis of the sewer overflow data reported to the State Water Resource Control Board (SWRCB) California Integrated Water Quality System (CIWQS) SSO database.

4.1.1 Sanitary Sewer Overflow Rate

The City and District operates within the Regional Water Quality Control Board's San Diego Region, otherwise known as Region 9. Between September 2013 and May 2016 the City and District have experienced two (2) sanitary sewer overflows and an average SSO rate of 0.23 SSOs per 100 miles of sewer system per year over this period. This SSO rate is well below the average annual SSO rate during the same period of the other thirty-five (35) Region 9 agencies that do not have sewer lateral responsibility. Figure 1 shows the 12-month rolling average of SSOs per 100 miles of pipelines per year from June 1, 2011 through May 24, 2016.

This excellent level of SSO performance in the sewer systems is accomplished through a combination of aggressive cleaning cycles, focused Enhanced Maintenance Area (EMA) cleaning, CCTV inspection in the sewer system for condition assessment, force main appurtenance maintenance and pump station maintenance.

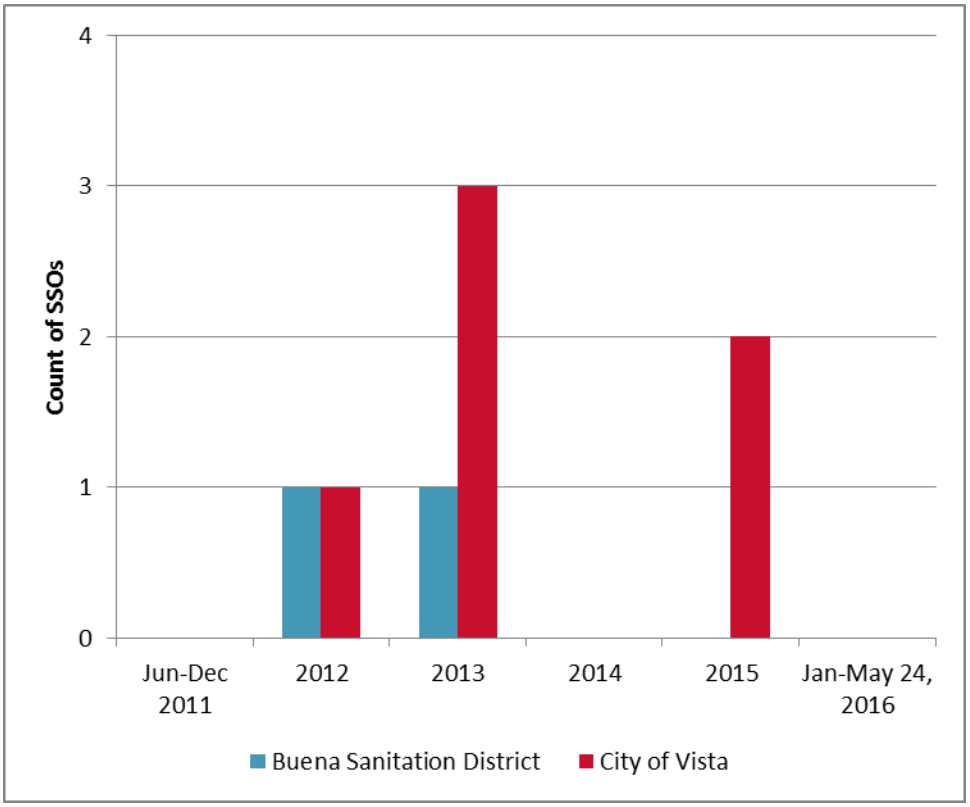
Figure 1: 12-Month Rolling Average of SSOs per 100 Miles of Sewer Pipelines per Year



4.1.2 Number and Size of Sewer Overflows

Over the past five years, the City and District have experienced 8 SSOs. The average SSO volume for 7 of the 8 SSOs is less than 340 gallons per SSO and each SSO was less than 1,000 gallons. There was one spill with an SSO volume of 17,000 gallons. Over the past five years, the unrecovered SSO volume is 305 gallons or an average of less than 40 gallons unrecovered per SSO. The number, volume and volume recovered from SSOs in the City and District can be seen in **Figure 2**.

Figure 2: Number of SSOs and SSO Volume (6/1/2011 – 5/24/2016)



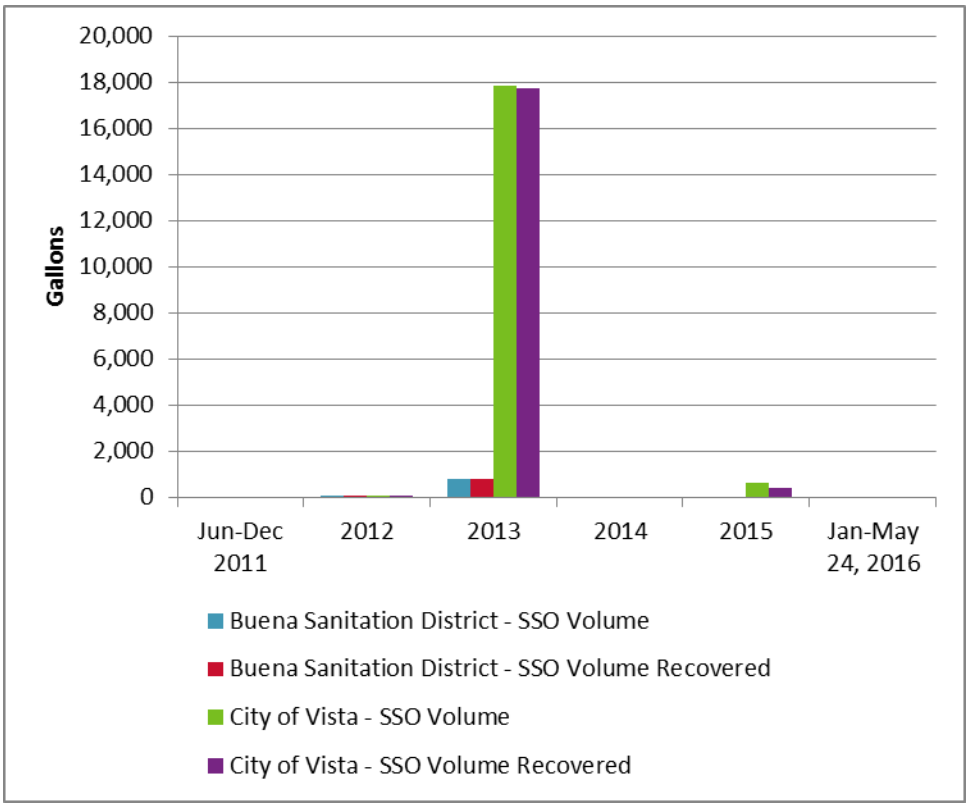


Table 4 and 5 show the number and size of SSOs occurring in the City and District sewer systems over the past 5 years.

Table 4: Number and Size of SSOS (6/1/2011 – 5/24/2016) in City of Vista

Size of SSO (gallons)	Jun-Dec 2011	2012	2013	2014	2015	TOTAL
Greater than 10,000	0	0	1	0	0	**1**
From 1,000 to 9,999	0	0	0	0	0	**0**
From 100 to 999	0	0	1	0	1	**2**
From 10 to 99	0	0	1	0	1	**2**
From 1 to 9	0	1	0	0	0	**1**
Total	**0**	**1**	**3**	**0**	**2**	**6**

Table 5: Number and Size of SSOS (6/1/2011 – 5/24/2016) in Buena Sanitation District

Size of SSO (gallons)	Jun-Dec 2011	2012	2013	2014	2015	TOTAL
Greater than 10,000	0	0	0	0	0	**0**
From 1,000 to 9,999	0	0	0	0	0	**0**
From 100 to 999	0	0	1	0	1	**1**
From 10 to 99	0	0	0	0	1	**0**
From 1 to 9	0	1	0	0	0	**1**
Total	**0**	**1**	**1**	**0**	**0**	**2**

4.1.3 Causes of SSOs

SSOs caused by roots (4), grease (0), and debris (1) accounted for approximately 63 percent of SSOs occurring from the City and District's sewer systems over the previous 5 years between June 1, 2011 and May 24, 2016 as shown in **Table 6**. Of the remaining three (3) SSOs, two (2) were caused by broken water mains operated by Vista Irrigation District, which is a separate agency not connected to the City or the District, and one (1) was caused by force main air relief valve failure.

Table 6: Causes of SSOs (6/1/2011 – 5/24/2016)

Cause of SSO	Number of SSO in City of Vista System	Number of SSOs in Buena Sanitation District System	Total Number of SSOs	Percent of Total
Blockage:				
Roots	3	1	4	50%
Grease	0	0	0	0%
Debris	1	0	1	12.5%
Subtotal for Blockage	4	1	5	62.5%
Flow Capacity Deficiency	0	0	0	0%
Inflow and Infiltration	0	0	0	0%
Pump Station-Related	0	0	0	0%
Construction-Related	0	0	0	0%
Structural	0	0	0	0%
Other: Force Main Air Relief Valve	0	1	1	12.5%
Other: Water Main Break	2	0	2	25%
TOTAL (ALL)	**6**	**2**	**8**	**100%**

4.2 Review of Effectiveness of SSMP Elements

The following sections focus on evaluating the effectiveness of each element of the SSMP.

4.2.1 Element 1 - Goal

WDR Requirement: *The goal of the Sewer System Management Plan (SSMP) is to provide a plan and schedule to properly manage, operate, and maintain all parts of the sanitary sewer system. This will help reduce and prevent SSOs, as well as mitigate any SSOs that do occur.*

Audit Finding: The City's and District's 2014 SSMP includes the WDR goal for the SSMP along with 6 additional goals for operation, maintenance, and management of the sanitary sewer system. Achievement of these goals is being measured through SSO performance, SSO notification and reporting compliance, and through analysis of sewer system flow response to wet weather events. The City's and District's goal element is in compliance with the WDR.

4.2.2 Element 2 – Organization

WDR Requirement: The Sewer System Management Plan (SSMP) must identify:

a. *The name of the responsible or authorized representative as described in Section J of this Order.*

b. The names and telephone numbers for management, administrative, and maintenance positions responsible for implementing specific measures in the SSMP program. The SSMP must identify lines of authority through an organization chart or similar document with a narrative explanation; and

c. The chain of communication for reporting SSOs, from receipt of a complaint or other information, including the person responsible for reporting SSOs to the State and Regional Water Board and other agencies if applicable (such as County Health Officer, County Environmental Health Agency, Regional Water Board, and/or State Office of Emergency Services (OES)).

Audit Finding: Section 3.1 and Section 3.2 of the 2014 SSMP indicates the Vista City Manager is designated as the authorized representative for both the City of Vista and Buena Sanitation District, yet does not indicate the name of the current person filling the position. Similarly, Section 3.3 of the SSMP includes an organization chart clear lines of authority for management, administrative, and maintenance positions responsible for implementing specific measures in the SSMP program, yet does not include names and phone numbers. Section 3.3 indicates that current names and contact information for all positions is available at the City of Vista. These findings represent a minor non-conformance.

Section 3.4.5 provides a summary of the chain of communication for reporting SSOs from receipt of complaint and identifies the positions responsible for various response, notification, and reporting activities. The City has adequately addressed identification of the chain of communication.

The City should consider including an attachment indicating the names and telephone numbers of the management, administrative, and maintenance positions indicated in the SSMP organization chart as responsible for implementing specific measures of the SSMP program. This attachment could be updated as names, phone numbers, or positions responsible for implementing specific measures of the SSMP program change. The City should consider including a paragraph in the attachment indicating the person responsible for keeping the organization chart, names, phone numbers, and positions updated and the location of the updated table on the City's servers.

4.2.3 Element 3 – Legal Authority

WDR Requirement: *Each Enrollee must demonstrate, through sanitary sewer system use ordinances, service agreements, or other legally binding procedures, that it possesses the necessary legal authority to:*

a. Prevent illicit discharges into its sanitary sewer system (examples may include I/I, stormwater, chemical dumping, unauthorized debris and cut roots, etc.);

b. Require that sewers and connections be properly designed and constructed;

c. Ensure access for maintenance, inspection, or repairs for portions of the lateral owned or maintained by the Public Agency;

d. Limit the discharge of fats, oils, and grease and other debris that may cause blockages, and

e. Enforce any violation of its sewer ordinances.

Audit Finding: Chapter 4 of the SSMP details the City's and District's compliance with the WDR requirement for legal authority. The City of Vista Municipal Code is the source of legal authority for the City of Vista. Buena Sanitation District's legal authority is derived from the District's Code of Regulations. **Table 7** summarizes legal authorities for the City and District along with appropriate references to the City of Vista Municipal Code and the Buena Sanitation District Code of Regulations.

In addition to the City of Vista Municipal Code and Buena Sanitation District Code of Regulations, both the City and District systems discharge to the Encina Wastewater Authority (EWA) collection system and operate under EWA's Pretreatment Ordinance requirements. EWA's Pretreatment Ordinance includes authorities to:

- Prevent illicit discharges into the wastewater collection system (Section 2.1);
- Limit the discharge of fats, oils, and grease and other debris that may cause blockages (Section 2.1); and

- Limit the discharge of groundwater or surface runoff into the collection system (Section 2.7).

Both the City of Vista and Buena Sanitation District have the appropriate legal authorities to meet the requirements of the WDR.

Table 7: Summary of Legal Authorities

Requirement	Reference in Vista Municipal Code	Reference in BSD Code	Meets WDR Requirements?
PREVENT ILLICIT DISCHARGES			
Prevent illicit discharges into the wastewater collection system	Chapter 14.02.090	Section 2.090	Yes
Limit the discharge of fats, oils, and grease and other debris that may cause blockages	Chapter 14.12.050	Section 12.050	Yes
Control infiltration and inflow (I/I) from private service laterals	Chapter 14.14	Section 2.090	Yes
PROPER DESIGN AND CONSTRUCTION			
Require that sewers and connection be properly designed and constructed	Chapter 14.08 Chapter 14.14 Chapter 16.32	Section 2.020 Section 8.040	Yes
ACCESS TO LATERALS			
Clearly define District responsibility and policies	Chapter 14.14	Section 2.020	Yes
Ensure access for maintenance, inspection, or repairs for portions of the service lateral owned or maintained by the Agency	N/A	N/A	N/A
FOG SOURCE CONTROL			
Requirements to install grease removal devices (such as traps or interceptors)	Chapter 14.12.060	Section 12.060	Yes
Design standards for the grease removal devices	Chapter 14.12.090	Section 12.090	Yes
Maintenance requirements, BMP requirements, record keeping and reporting requirements for grease removal devices	Chapter 14.12.100	Section 12.100	Yes
Authority to inspect grease producing facilities	Chapter 14.12.140	Section 12.140	Yes
ENFORCEMENT			
Enforce any violations of its sewer ordinances	Chapter 1.16 Chapter 14.12.090	Section 1.110 Section 12.090	Yes

4.2.4 Element 4 – Operation and Maintenance Program

WDR Requirement: *The Sewer System Management Plan (SSMP) must include those elements listed below that are appropriate and applicable to the Enrollee's system:*

a. Maintain an up-to-date map of the sanitary sewer system, showing all gravity line segments and manholes, pumping facilities, pressure pipes and valves, and applicable stormwater conveyance facilities;

b. Describe routine preventive operation and maintenance activities by staff and contractors, including a system for scheduling regular maintenance and cleaning of the sanitary sewer system with more frequent cleaning and maintenance targeted at known problem areas. The Preventative Maintenance (PM) program should have a system to document scheduled and conducted activities, such as work orders;

c. Develop a rehabilitation and replacement plan to identify and prioritize system deficiencies and implement short-term and long-term rehabilitation actions to address each deficiency. The program should include regular visual and TV inspections of manholes and sewer pipes, and a system for ranking the condition of sewer pipes and scheduling rehabilitation. Rehabilitation and replacement should focus on sewer pipes that are at risk of collapse or prone to more frequent blockages due to pipe defects. Finally, the rehabilitation and replacement plan should include a capital improvement plan that addresses proper management and protection of the infrastructure assets. The plan shall include a time schedule for implementing the short- and long-term plans plus a schedule for developing the funds needed for the capital improvement plan;

d. Provide training on a regular basis for staff in sanitary sewer system operations and maintenance, and require contractors to be appropriately trained; and

e. Provide equipment and replacement part inventories, including identification of critical replacement parts.

Audit Finding: Overall, the City and District are in compliance with the Operation and Maintenance Program element of WDR Provision D.13(iv). The primary measure of the effectiveness of the operation and maintenance program is SSO performance. The City and District operates within the Regional Water Quality Control Board's San Diego Region, otherwise known as Region 9. Over the timeframe of this audit (past two years and nine months) the City and District have experienced two (2) sanitary sewer overflows and an average SSO rate of 0.23 SSOs per 100 miles of sewer system per year over this period. This SSO rate is well below the average annual SSO rate during the same period of the other thirty-five (35) Region 9 agencies that do not have sewer lateral responsibility. The Operation and Maintenance Program is a key contributor to the high level of SSO performance achieved through the following efforts:

- Paper and electronic maps are regularly updated for all known related infrastructure (sanitary sewer system, showing all gravity line segments and manholes, pumping facilities, pressure pipes and valves, and applicable stormwater conveyance facilities). When a discrepancy exists between the maps and field conditions, staff (including field crews) have the ability to identify and submit the discrepancy to the GIS group for updates. The spatial location of work orders is identified on tablets in the field to limit the chances of performing work on the wrong asset and to improve data quality.
- The City and District have adopted an aggressive proactive cleaning program. This includes proactively cleaning all small diameter pipe (15-inches and less) which consists of approximately 289 miles on a 12 month schedule and all large diameter pipe (greater than 15 inches) which consists of approximately 15 miles on a 60 month schedule. Pipes with historic maintenance issues or in known problem areas are proactively cleaned on a more frequent basis of between 1 month and 6 months. The Computerized Maintenance Management System (CMMS) shows that

over the past 12 months (4/15/2015 through 4/14/2016), 212 miles of small diameter pipe have been cleaned (27% behind schedule). Based on all substantially complete data in the CMMS (3.1 years), 11.7 miles have been cleaned (25% ahead of schedule). While the City and District are not meeting their SSMP objective for small diameter pipe cleaning, performance data suggests that this has not led to elevated SSO risk exposure. In addition to being among the highest performing utilities in Region 9 in terms of SSO rate, over 99% of all cleaning work is characterized as proactive cleaning (i.e. not associated with an overflow, complaint, or other issue).

- The City and District CCTV inspect pipes to identify system deficiencies that will be addressed. Data is stored in a centralized database of record using a consistent observation coding system. As of 1/22/2016 (last date data was available at the time of this audit), 92% of the system has been inspected since 2005. The City and District have adopted an aggressive proactive schedule that calls for proactively CCTV inspecting all pipe on a 60 month schedule. Over the past 5 years (1/23/2001 through 1/22/2016), the City and District have inspected 92 miles of pipe (70% behind schedule). While the City and District are not meeting their SSMP objective for CCTV inspection, performance data suggests that this has not led to elevated SSO risk exposure. This may be due to the City and District inspecting the vast majority of their infrastructure (92%) coupled with industry experience that tells us that gravity pipe typically deteriorate slowly with most observed deficiencies likely being cause by construction issues.
- The City and District visually inspect and identify manhole deficiencies that should be addressed during cleaning activities. The City and District have adopted an aggressive proactive manhole inspection program that aligns with the cleaning schedule.
- The City and District developed a short and long term plan to address system deficiencies identified through CCTV inspection, manhole inspection, and other activities. This includes evaluation of this data to identify and prioritize system deficiencies based on engineering and operational judgement. The City and District have committed to mechanically lock 15 manholes per year. Since adoption of the SSMP, the City and District have resolved all known issues with manholes that pose elevated risk of vandalism through mechanically locking those manholes. Therefore, this objective should be considered for removal from the SSMP. The City and District have committed to repair 6 red flag conditions per year. The CMMS shows that over the past 12 months (4/15/2015 through 4/14/2016), the City and District have repaired 33 pipes and manholes (550% ahead of the commitment). Additionally, the City and District have addressed over 20 miles of pipe deficiencies through Cured in Place Pipe (CIPP) over the past 2 years. This level of investment shows that the City and District are committed to identifying and addressing system deficiencies. Currently, the City is evaluating long term investment needs and will be updating the short and long term investment plan based on system needs.
- The City and District currently operate the following cleaning equipment:
    - 3 - 1" hose Vactors. Staff reports good cleaning power – primary cleaning trucks
    - 1 – ¾" hose Vactor – older with less power – only used when the 1" hose vactor is down.
    - 1 – Rodder ("Hard Rodder")
    - 1 – Trailer Mounted Mini Jetter – ½" hose – only used for difficult to access pipes (e.g. MH's in backyards); works best on smaller pipes.
    - 4 – JetScan Units
    - Heavy bottom dweller nozzles are rented or demoed to clean the pipes larger than 18 inches
- The City trains collection system staff using the following approaches:
    - Internal tailgates meetings

  - Equipment training performed by equipment vendors
  - California Water Environment Association training classes at the local, regional, and state level
  - Internal safety trainings
  - On-the-job training
  - Inter-agency SSO response training drills

- Training activities are documented with sign-in sheets including both attendees and a summary of the training provided.
- The City of Vista owns three sewer pump stations, two of which are jointly owned with the City of Carlsbad. These pump stations are operated and maintained by Encina Wastewater Authority.
- Buena Sanitation District owns one pump station that is operated and maintained by the Encina Wastewater Authority.
- Encina operates and maintains pump stations owned by the City and the District through memorandums of understanding and other agreements. The City and District are ultimately responsible for the performance of these pump stations and it would be helpful for the City and District to have better visibility and understanding of the condition, capacity, operations and maintenance of these pump stations. Design review and acceptance of construction is performed by the City and the District. An assessment study is being performed on the pump stations which will provide more visibility for the City and District. Encina maintains a Remote Comprehensive Asset Management Plan (R-CAMP) for the pump stations owned by the City and District which is updated every two years. Additional visibility could be provided through receiving the back-up data and condition assessment information used in the R-CAMP, summary reports on pump station performance, access to pump station operations and maintenance data for the City and District, and an enhanced process for review of pump station performance and condition. Defining the level of service for operation of the pump stations through a memorandum of understanding could provide clearer expectations for pump station performance.

The City and District are the owners of four pump stations which are operated and maintained by Encina Wastewater Authority. The City and District should consider either identifying the critical replacement parts for these facilities or have Encina Wastewater Authority identify and provide the list. The list should be documented in the City and District SSMP. The City and District should also consider obtaining documentation from Encina Wastewater Authority that any critical replacement parts for the lift stations are either purchased and stored, readily available through other means, or require EWA to create a contingency plan to address or mitigate the risk posed by the potential failure of the critical spare part.

Moving forward the City and District may want to specify level of service expectations for lift station operations and maintenance. This might include the documentation of a plan for operations and maintenance of the lift stations. This might also include the documentation of site-specific sewer overflow response and contingency plans for the lift stations in the case of failure.

4.2.5 Element 5 – Design and Performance Provisions

WDR Requirement:

a. *Design and construction standards and specifications for the installation of new sanitary sewer systems, pump stations and other appurtenances; and for the rehabilitation and repair of existing sanitary sewer systems; and*

b. Procedures and standards for inspecting and testing the installation of new sewers, pumps, and other appurtenances and for rehabilitation and repair projects.

Audit Finding: The City of Vista has developed a Standard Specifications and Procedures for Private Constructed Wastewater Facilities, referred to as the Vista Standard Specs. This document is based upon and references the latest edition of the Standard Specifications for Public Works Construction, otherwise referred to as the Greenbook.

- The City and District perform inspections using City construction management staff after completion of construction and have a warranty inspection process to identify any construction or material related defects. The City and District will put a hold on a portion of the construction bonds until warranty inspections are complete.
- The City and District update design and construction documents on an as needed basis. Using County Standard Drawings and sewer notes for developer worked well for the city and District. The City and District should add revision notes for design guidelines and sewer notes to track these updates.

The City and the District are in compliance with the Design and Performance Provisions elements of WDR Provision D.13 and has appropriate design and construction standards and specifications as well as procedures and standards for inspection and testing of new sewers and rehabilitation and repair projects.

4.2.6 Element 6 – Overflow Emergency Response Plan

WDR Requirement: *Each Enrollee shall develop and implement an overflow emergency response plan that identifies measures to protect public health and the environment. At a minimum, this plan must include the following:*

a. Proper notification procedures so that the primary responders and regulatory agencies are informed of all SSOs in a timely manner;

b. A program to ensure an appropriate response to all overflows;

c. Procedures to ensure prompt notification to appropriate regulatory agencies and other potentially affected entities (e.g. health agencies, Regional Water Boards, water suppliers, etc.) of all SSOs that potentially affect public health or reach the waters of the State in accordance with the MRP. All SSOs shall be reported in accordance with this MRP, the California Water Code, other State Law, and other applicable Regional Water Board WDRs or NPDES permit requirements. The Sewer System Management Plan (SSMP) should identify the officials who will receive immediate notification;

d. Procedures to ensure that appropriate staff and contractor personnel are aware of and follow the Emergency Response Plan and are appropriately trained;

e. Procedures to address emergency operations, such as traffic and crowd control and other necessary response activities; and

f. A program to ensure that all reasonable steps are taken to contain and prevent the discharge of untreated and partially treated wastewater to waters of the United States and to minimize or correct any

adverse impact on the environment resulting from the SSOs, including such accelerated or additional monitoring as may be necessary to determine the nature and impact of the discharge.

Audit Finding: The City and District are not in compliance with this element. Findings include:

- ***Notification Procedures***: The City and District have created a quick reference SSO response guide focused on ensuring adequate internal and external notification. Notification procedures are documented in a Quick Reference guide provided to staff and field crews.
- ***Program to Ensure Appropriate Response***: Appropriate response relies upon involvement of the Wastewater Supervisor or knowledgeable maintenance crew leads having the experience to respond effectively. The operation has effectively responded to both large and small events and, based on performance, appears to be effectively responding to sewer overflow events. The City and District are in the process of updating the Overflow Emergency Response Plan.
- ***Appropriate Training on Overflow Emergency Response Plan***: An up-to-date Overflow Emergency Response Plan does not exist. Crews are trained how to respond through on-the-job experience and tailgates. The City and District need to update the Overflow Emergency Response Plan and provide training as soon as practicable. Staff attend interagency SSO response training annually. This training includes field response drills testing response to mock spill scenarios. This is a best practice.
- ***Procedures to Address Emergency Operations***: An up-to-date Overflow Emergency Response Plan does not exist. Crews are trained how to respond through on-the-job experience and tailgates. The City and District need to update the Overflow Emergency Response Plan and provide training as soon as practicable.
- ***Program to Ensure Reasonable Steps Taken***: The City and District have an appropriate program in place to ensure reasonable steps are taken to contain and prevent SSO discharges.

The City and District are in the process of updating the Overflow Emergency Response Plan. The current plan is too voluminous to use as a practical guide in the field. Once the City and District update the Overflow Emergency Response Plan, training should be provided on the updated plan as soon as practicable.

4.2.7 Element 7 – FOG Control Program Plan

WDR Requirement: *Each Enrollee shall evaluate its service area to determine whether a FOG control program is needed. If an Enrollee determines that a FOG program is not needed, the Enrollee must provide justification for why it is not needed. If FOG is found to be a problem, the Enrollee must prepare and implement a FOG source control program to reduce the amount of these substances discharged to the sanitary sewer system. This plan shall include the following as appropriate:*

a. An implementation plan and schedule for a public education outreach program that promotes proper disposal of FOG;

b. A plan and schedule for the disposal of FOG generated within the sanitary sewer system service area. This may include a list of acceptable disposal facilities and/or additional facilities needed to adequately dispose of FOG generated within a sanitary sewer system service area;

c. The legal authority to prohibit discharges to the system and identify measures to prevent SSOs and blockages caused by FOG;

d. Requirements to install grease removal devices (such as traps or interceptors), design standards for the removal devices, maintenance requirements, BMP requirements, record keeping and reporting requirements;

e. Authority to inspect grease producing facilities, enforcement authorities, and whether the Enrollee has sufficient staff to inspect and enforce the FOG ordinance;

f. An identification of sanitary sewer system sections subject to FOG blockages and establishment of a cleaning maintenance schedule for each section; and

g. Development and implementation of source control measures for all sources of FOG discharged to the sanitary sewer system for each section identified in (f) above.

Audit Finding: The City and District are in compliance with the fats, oils, and grease (FOG) element of WDR Provision D.13. The City and District FOG program consists of the following components:

- Consistent and effective source control of new and active permitted food service establishments (FSEs).
- Implementation of Cityworks and GIS information tools to support FOG investigations.
- Aggressive sewer cleaning of all areas known to have a history of FOG issues.
- An effective public outreach education program for proper disposal of FOG through education at public events, website, and newletters.
- A FOG ordinance providing adequate FOG enforcement authorities.
- Adequate staffing and contracting to accomplish FOG program inspections and enforcement as required.
- Close coordination between source control and collection system operations and maintenance staff to investigate FOG issues and determine appropriate source control and maintenance corrective actions to address issues.

Since June 2011, the District has not experienced a FOG-related SSO. Overall, this is an indicator that the current FOG Control Program is effective at controlling grease issues in the sewer mainlines.

The City could make the following updates to the FOG program section of the SSMP:

- Remove the cleaning information in the FOG Section of the SSMP to avoid redundancy with the Operations and Maintenance Section.
- Update the FOG Section of the SSMP and FOG Source Control Program to reflect the next evolution in the FOG program.
- Develop management reports to track FOG program activities

4.2.8 Element 8 – System Evaluation and Capacity Assurance Plan

WDR Requirement: *The Enrollee shall prepare and implement a capital improvement plan (CIP) that will provide hydraulic capacity of key sanitary sewer system elements for dry weather peak flow conditions, as well as the appropriate design storm or wet weather event. At a minimum, the plan must include:*

a. Evaluation: Actions needed to evaluate those portions of the sanitary sewer system that are experiencing or contributing to an SSO discharge caused by hydraulic deficiency. The evaluation must provide estimates of peak flows (including flows from SSOs that escape from the system) associated with conditions similar to those causing overflow events, estimates of the capacity of key system components, hydraulic deficiencies (including components of the system with limiting capacity) and the major sources that contribute to the peak flows associated with overflow events;

b. Design Criteria: Where design criteria do not exist or are deficient, undertake the evaluation identified in (a) above to establish appropriate design criteria; and

c. Capacity Enhancement Measures: The steps needed to establish a short- and long-term CIP to address identified hydraulic deficiencies, including prioritization, alternatives analysis, and schedules. The CIP may include increases in pipe size, I/I reduction programs, increases and redundancy in pumping capacity, and storage facilities. The CIP shall include an implementation schedule and shall identify sources of funding.

d. Schedule: The Enrollee shall develop a schedule of completion dates for all portions of the capital improvement program developed in (a)-(c) above. This schedule shall be reviewed and updated consistent with the Sewer System Management Plan (SSMP) review and update requirements as described in Section D. 14.

Audit Finding: Overall, the City and District's approach to system evaluation and capacity assurance has proven to be effective. Of the 25 SSOs reported to have occurred within the service area since January 2007, none of the reports identified capacity as a cause. The City and District are in compliance with the System Evaluation and Capacity Assurance element of WDR provision D.13 and is meeting its capacity-oriented goals to have adequate capacity to convey peak wastewater flows, to control inflow and infiltration (I&I) to minimize peak flows, and to minimize sanitary sewer overflows (SSOs).

As part of the 2008 Master Plan, the City and District performed a system evaluation and capacity assurance analysis and developed a plan to address deficiencies identified. The Master Plan defined the design criteria for system evaluation and capacity assurance and reviewed the capacity of Vista's 215 mile collection system and Buena Sanitation District's 101 mile collection system. Projects identified to address capacity issues in 2008, have undergone annual review and in some cases were eliminated or deferred due to reductions in flows throughout the system. The 2008 Master Plan suggests that 40,000 feet (7.5 miles) of pipe be rehabilitated annually based on a prioritized list that takes into account the age and condition of the pipelines. The City and District has contracted with a consultant to prepare a 2017 Master Plan, which includes an asset management plan, a hydraulic model update and a flow monitoring program to update the capacity assessment for current and future flows and recommend improvements.

With the help of a consultant program manager, Vista implemented a pipe rehabilitation program primarily from 2011 through 2015. To date, the City and District have successfully lined a total of 23.8 miles of pipe. (See cured in place pipe (CIPP) per year in **Table 8**.)

Table 8: Pipe Lining (CIPP) per GIS (in miles)

Year	Buena Sanitation District	City of Vista	Total
2006	0.0	0.8	0.8
2011	0.5	0.1	0.5
2012	0.0	0.1	0.1
2013	0.0	2.1	2.1
2014	0.0	10.7	10.7
2015	9.5	0.0	9.5
Total	**10.0**	**13.8**	**23.8**

The rehabilitation program focused on minimizing I&I and managing peak flows in areas with known capacity issues. The City and District now operate that program without the help of the consultant. Although there have not been any significant storms to "test" the improvements, the City and District are seeing smaller peaks in wet weather flows from the storms that have occurred. City engineering staff track rainfall and sewer flows to ensure that peak flows are not approaching capacity of main trunk sewers. The City and District do not conduct smoke testing, nor do they think it is necessary, to eliminate I&I impacts on peak wet weather flows. The City operates a double barrel siphon to convey wastewater beneath a creek. One side is plugged during normal operations, and flow is transferred when cleaning is required. Access to this facility is challenging but will be improved with the City's Rail Trail project.

The City keeps the GIS for sewer infrastructure current: record drawings of new facilities are forwarded to the City's IT Department and public asset updates are made monthly. These updates are imported into InfoSWWM hydraulic model as needed to run capacity assessments. The City does not own the software to operate the hydraulic model, but uses its consultants to update the model and to run scenarios for future projects or "what if" conditions. In 2013, the model was run to evaluate the lower per capita sewer flows that were occurring due to mandatory water conservation and new zoning associated with the City's new General Plan. No capacity constraints were identified.

The City and District's CCTV data is used to develop rehabilitation design plans. In 2008 a full review of the CCTV videos was conducted (Snap Shot Program) to red flag immediate repair issues and areas where enhanced maintenance was needed. The City evaluated 90 percent of its collection system. Red flagged pipe segments were repaired. Enhanced maintenance areas were identified and this information was also used to develop a cleaning frequency program. Recommendations for a prioritized pipe rehabilitation program included a second inspection on pipes that were not red flagged. Approximately 80 percent of the system has had a second round of inspection.

The City and District have established a goal to CCTV the system once every 5 years, or 20% per year. However, due to malfunctioning equipment and staffing constraints, less pipe was inspected in 2015. The City and District are transitioning to a risk-based inspection/monitoring program in the current effort to develop the Asset Management Plan.

Design criteria for pipe capacity in the 2008 Master Plan includes a 0.8 depth to diameter ratio, regardless of pipe size. This value is a trigger value for potential action by City and District. The 2017 Master Plan will reconsider the current design criteria and update as deemed necessary to ensure conveyance of peak wet weather flows without overflows. The sewer generation rate used for design and billing is 250 gallons per day per equivalent dwelling unit (gpd/EDU). With state mandated cuts in water use in 2015-16, these flows have fallen to less than 200 gpd/EDU. The 2017 Master Plan will evaluate the need to adjust the City and District's criteria for sewer generation rates.

The City's billing rates were last updated in 2013/14. The next update is scheduled for 2018/19. Vista rates are adjusted annually using San Diego Consumer Price Index (CPI). The District's rates are not adjusted. The Capital Expansion Fund is now called the Capital Facilities Fund, per an update to the City's Municipal Code in January 2016. The City uses the buy-in approach, versus a cost recovery approach, for connection charges. The Capital Facilities Fund can only be used for Capital projects, but there are fewer capacity projects needed now, as flows per EDU have fallen below design criteria and the City is almost fully developed. New connections are paying reimbursement to ratepayers that created the system.

The City's Capital Improvement projects are listed in a report on the City's website, with project maps, budgets and schedules. This Capital Improvement Plan (CIP) is updated annually. Adjustments to the CIP are documented in staff reports. The original CIP schedule in the 2008 Master Plan was aggressive; a number of projects were deferred to accommodate expenditures to replace the Agua Hedionda Lift Station and to fund Vista's fair share of the Encina Water Pollution Control Facility (EWPCF) Phase V Expansion, that were not included as projects in the 2008 Master Plan.

Evaluation

Through periodic updating of the sewer master plan and recalibration of the hydraulic model, the evaluation of capacity is regularly conducted. Estimates of peak flows and the ability to convey those flows through the collection system have been assessed and capacity constraints have been identified as improvement projects. Relining of pipe in areas experiencing high I&I have been conducted, resulting in lower flows and peaking factors in those sub basins.

The City should consider updating the SSMP to reflect the City and District's approach to evaluating the capacity of the system. 1) Updating of the hydraulic model as needed to address system changes or master plan updates; 2) CCTV inspection frequency goals; 3) Integration of findings with GIS for easy reference; and 4) how this information feeds into the development of CIP projects. Discussion of the City and District's asset management program could be included here as well. The City should consider eliminating Smoke testing from the SSMP as an approach to evaluating I&I locations, as this method is not currently conducted within the City or District.

Design Criteria

Design criteria are stated in the 2008 Master Plan for the evaluation and redesign of existing pipe. Design criteria stipulate the depth to diameter ratio for existing and new pipe, as follows:

- Threshold for Depth/Diameter in Peak Wet Weather Flow in existing pipe: **0.80**
- Peak Wet Weather d/D in new pipe: 12-inch and smaller : **0.50**
- Peak Wet Weather d/D in new pipe: larger than 12-inch: **0.75**

The threshold triggers action to either upsize or divert sewer flows in existing pipelines to avoid SSOs. This criteria is considered a typical industry standard and is appropriate for this service area. The City should consider updating the SSMP in the future to reflect any design criteria updates per the 2017 Master Plan Update.

Capacity Enhancement Measures

The 2008 Master Plan identified capacity enhancement projects for both the City of Vista and Buena Sanitation District. Each project was prioritized based on capacity constraints, age, material, need for relocation, I&I hot spot or CCTV condition rating. Costs were developed and a phased CIP schedule was derived. In Buena Sanitation District, 10,200 feet of pipe was found to be capacity deficient and in Vista, 22,400 feet of pipe was found to be capacity deficient under existing conditions. The approach to prioritizing and annually adjusting the CIP list is not discussed in detail in the SSMP.

The City should consider updating the SSMP to reflect the City and District's approach to developing a CIP based on master plan findings and hydraulic model updates; the approach to prioritization of CIP projects and validation with CCTV data; and annual adjustment of CIP program. The City should consider updating the SSMP to reflect the capacity related findings of the 2016 Master Plan Update.

Schedule and Funding

The 5-year CIP is updated annually. The most recent update for FY 2016-17 is dated June 14, 2016 and is posted to the City of Vista website.

http://www.cityofvista.com/services/city-departments/engineering/construction-projects/cip-projects

The CIP list indicates the project reference number and name of the project and anticipated fiscal year for the start of the project. Those projects that have been started are noted as on-going and do not include completion dates. The CIP projects could be included in the SSMP by referencing City website documents.

Funding mechanisms for the City's CIP projects are discussed in the SSMP. The City should consider updating the SSMP to reflect the renaming of the Capital Expansion Fund to the Capital Facilities Fund.

4.2.9 Element 9 – Monitoring, Measurement, and Program Modifications

WDR Requirement: *The Enrollee shall:*

a. Maintain relevant information that can be used to establish and prioritize appropriate Sewer System Management Plan (SSMP) activities;

b. Monitor the implementation and, where appropriate, measure the effectiveness of each element of the SSMP;

c. Assess the success of the preventative maintenance program;

d. Update program elements, as appropriate, based on monitoring or performance evaluations; and

e. Identify and illustrate SSO trends, including: frequency, location, and volume.

Audit Finding: The City and District are monitoring the effectiveness of the SSMP and overall program and are in compliance with the Monitoring, Measurement, and Program Modification element of the WDR.

The City maintains the relevant information required for analysis in the SWRCB CIWQS SSO database, CMMS database, CCTV database, and GIS database. The City and District primarily utilize the indicators shown in **Table 9** to monitor program performance for the key elements of the SSMP. Other indicators are analyzed on an ad hoc basis. The Principal Engineer, Wastewater Supervisor, and Program Assistant meet regularly to review and assess the success of the preventative maintenance program. The City and District also consult with third party experts at least every two years during the SSMP audit process or during sewer master planning to evaluate the program and update program elements as appropriate.

Table 9: Primary Measures of Program Performance

Program	Type	Indicator	Use
Overall Performance	Lagging Indicators	Number of SSOs SSOs per 100 miles Size of SSOs	Used to determine if overall program is effective.
Operations and Maintenance	Leading Indicator	Miles of Mainline Cleaned Percent of Annual Goal Achieved	Used to determine if cleaning goals are being met.
Operations and Maintenance	Leading Indicator	Miles of CCTV Performed Percent of Annual Goal Achieved	Used to determine if inspection goals are being met.
Fats, Oils, and Grease Control Program	Leading Indicator	Number of FSEs inspected Number of violations identified	Used to determine if FOG inspection goals are being met.
System Evaluation and Capacity Assurance Plan	Leading Indicator	Rainfall versus System Flow Volume	Used to determine sensitivity of system flows to rainfall events.

Staff relies on manual reporting processes to measure some of the key indicators such as cleaning production. This can potentially lead to inaccurate monitoring, tracking, and reporting of program progress. Moving forward, the City and District should consider increasing proficiency in analysis of data

residing in the CMMS to generate consistent and accurate management reporting from the centralized maintenance database.

During the next evaluation cycle, the City and District should consider evaluating the identification of additional indicators to support measurement of the effectiveness of SSMP program elements. Examples include SSO response time, sewer cleaning quality, CCTV inspection quality, and average system risk score.

4.2.10 Element 10 – SSMP Program Audits

WDR Requirement: *As part of the SSMP, the Enrollee shall conduct periodic internal audits, appropriate to the size of the system and the number of SSOs. At a minimum, these audits must occur every two years and a report must be prepared and kept on file. This audit shall focus on evaluating the effectiveness of the SSMP and the Enrollee's compliance with the SSMP requirements identified in this subsection (D.13), including identification of any deficiencies in the SSMP and steps to correct them.*

Audit Finding: The last SSMP audit was conducted in September 2013. The City updated the SSMP in March 2014 based on the findings of the September 2013 audit. In September 2015, staff decided to contract with a consulting firm to update the capacity assurance plan, develop and asset management plan, and perform a Sewer System Management Plan program audit. This would provide rate payers with better value by having the consultant perform the audit and evaluate improvements while developing the asset management plan.

The City and District initiated the current SSMP audit process in March 2016, two years after the March 2014 SSMP update. Technically, the City and District should have performed an audit by September 2015, two years after the previous audit. The City has not been in compliance with this element of the SSMP since September 2015. This SSMP audit brings the City and District into compliance with the SSMP Program Audit requirement of the WDR.

The City and District completed the previous SSMP audit within an appropriate timeframe.

In the future, when the City updates the SSMP, the City may want to consider performing and documenting a closeout SSMP audit to identify all of the audit findings from the previous SSMP audit that were addressed and if any remaining deficiencies exist at that time. This would serve as an SSMP audit and would reset the audit timeframe to start at the same time as the SSMP update.

4.2.11 Element 11 – Communication Program

WDR Requirement: *The Enrollee shall communicate on a regular basis with the public on the development, implementation, and performance of its SSMP. The communication system shall provide the public the opportunity to provide input to the Enrollee as the program is developed and implemented.*

The Enrollee shall also create a plan of communication with systems that are tributary and/or satellite to the Enrollee's sanitary sewer system.

Audit Finding: The City and District provide the public with the opportunity to provide input during the development and implementation of the SSMP. The City and District provide a presentation at public meetings to the City of Vista City Council and Buena Sanitation District Board to review the updated SSMP prior to certification by the governing boards. The City also provides contact information for customers to find out more information about various elements of the collection system program on a common questions webpage (webpage link below).

http://www.cityofvista.com/services/city-departments/engineering/construction-projects/common-questions

The City also has a Sewer Billing webpage providing the public with information regarding sewer rates and contact information for the public to contact the Wastewater Maintenance Division of the Public Works Department (webpage site below).

http://www.cityofvista.com/services/city-departments/finance/budgets/cafr/sewer-billing

Although the City has information regarding the sewer program on the City website, the information is not clearly provided and in some cases causes confusion. For example, the Buena Sanitation District does not have a webpage. The City of Vista website does have a Sewer Utilities webpage (site below) that explains the existence of the Buena Sanitation District, yet also refers to the City of Vista Sanitation District that does not currently exist as a legal entity any longer causing confusion.

http://www.cityofvista.com/services/city-departments/engineering/construction-projects/sewer

The City also does not clearly explain the existence of the SSMP and provide a clear message indicating the public has the opportunity to provide input into the program development and implementation. The City does provide a link to the SSMP on the website making it publicly available. The City could improve communication to the public and achieve a higher level of compliance with the Communication element of the WDR through the following:

- Update the Sewer Utilities webpage to more accurately reflect the current legal entity responsible for the City of Vista sewer system (i.e., the City of Vista Sanitation District does not exist).
- Provide a clear message welcoming on-going public input into the SSMP and SSMP implementation along with contact information. Update the message during periods where the City is actively updating the SSMP to notify the public that the City and District is in the process of updating the document and welcomes input.
- Provide a link to the City of Vista Collection System Operational Report on the SWRCB CIWQS Public Reports webpage (webpage link below)

https://ciwqs.waterboards.ca.gov/ciwqs/readOnly/publicReportSSOPerformance.jsp?wdid=9SSO10660&startDate=&endDate=

- Provide a link to the Buena Sanitation District Collection System Operational Report on the SWRCB CIWQS Public Reports webpage (webpage link below)

https://ciwqs.waterboards.ca.gov/ciwqs/readOnly/publicReportSSOPerformance.jsp?wdid=9SSO10700&startDate=&endDate=

The City of Vista and Buena Sanitation District meet monthly with the Encina Wastewater Authority and all member agencies of the Encina Wastewater Authority, which includes all agencies tributary or downstream to the City and District collection systems. These monthly meetings provide appropriate means for communication with tributary and satellite agencies.

4.2.12 Monitoring and Reporting Program

WDR Monitoring and Reporting Program Requirement: Section E.3 of the amended Monitoring and Reporting Program WQ-2013-0058-EXEC states *"Records documenting all changes made to the SSMP since its last certification indicating when a subsection(s) of the SSMP was changed and/or updated and who authorized the change or update. These records shall be attached to the SSMP."*

Audit Finding: In 2014, the City updated the SSMP and modified SSMP elements based on the findings of the September 2013 SSMP audit. The City did not include records documenting all changes made to the SSMP since its last certification as required by the amended MRP WQ 2013-0058-EXEC. The City and District should generate records documenting changes and attach them to the current version of the SSMP.

5 Strengths and Implementation Accomplishments

Documenting the strengths and implementation accomplishments of the SSMP is as important as determining the deficiencies and corrective actions. The City and District should both recognize the areas of strength in sewer system management as well as continue building upon success in these areas. **Table 10** includes the strengths and implementation accomplishment that were identified during the audit.

Table 10: Strengths and Implementation Accomplishments

WDR Provision	Strengths and Implementation Accomplishments
Overall SSO Performance	• City and District have experienced two (2) sanitary sewer overflows and an average SSO rate of 0.23 SSOs per 100 miles of sewer system per year over this period. This SSO rate is well below the average annual SSO rate during the same period of the other thirty-five (35) Region 9 agencies that do not have sewer lateral responsibility.
D.13.iv.a - Operations and Maintenance Program - Mapping	• A robust process exists to update maps discrepancies identified in the field which has resulted in highly accurate maps.
D.13.iv.b - Operations and Maintenance Program – Routine Preventive Maintenance	• The CMMS documents the vast majority of work performed. The spatial location of work orders is identified on tablets in the field to limit the chances of performing work on the wrong asset and to improve data quality. • The City and District have adopted an aggressive proactive cleaning program. Pipes with historic maintenance issues or in known problem areas are proactively cleaned on a more frequent basis of between 1 month to 6 months. • Over 99% of all cleaning work is characterized as proactive cleaning (i.e. not associated with an overflow, complaint, or other issue).

WDR Provision	Strengths and Implementation Accomplishments
D.13.iv.c - Operations and Maintenance Program – Inspection and Renewal Plan	• The City and District CCTV inspect pipes to identify system deficiencies that will be addressed. Data is stored in a centralized database of record using a consistent observation coding system. As of 1/22/2016, 92% of the system has been inspected since 2005. • The City and District visually inspect manholes and identify deficiencies that should be addressed during cleaning activities. The City and District have adopted an aggressive proactive manhole inspection program that aligns with the cleaning schedule. • The City and District developed a short and long term plan to address system deficiencies identified through CCTV inspection, manhole inspection, and other activities. Since adopting the SSMP, the City and District have resolved all known issues associated with manholes that pose elevated risk of vandalism through mechanically locking those manholes. • The City and District have shown their commitment to identifying and addressing system deficiencies. The CMMS shows that over the past 12 months (4/15/2015 through 4/14/2016), the City and District have repaired 33 pipes and manholes (550% ahead of the commitment). Additionally, the City and District have addressed over 20 miles of pipe deficiencies through Cured in Place Pipe (CIPP) over the past 2 years.
D.13.vii – FOG Control Program	• The City has not experienced a FOG-related SSO since February 2011. • The District has not experienced a FOG-related SSO in the past nine years.
D. 13 (viii) – System Evaluation and Capacity Assurance Program	• The District has not experienced any capacity-related sewer overflows in the past nine years.

6 SSMP Deficiencies and Recommended Corrective Actions

Several deficiencies were identified during the audit and are in this Section along with recommended corrective actions. Deficiencies are divided into three categories and coded with a letter. The deficiency categories are coded and defined in **Table 11**. Non-compliance deficiencies and recommended corrective actions are included in **Table 12**. Major and minor non-conformance deficiencies and recommended corrective actions are included in

Table .

Table 11: Deficiency Definitions

Deficiency Type	Deficiency Type	Deficiency Definition
A	Non-Compliance	A process or outcome resulting in the SSMP not currently being in compliance with the WDR/SSMP requirements.
B-major	Major Non-Conformance	Moderate to high risk that a statement in the SSMP is not fully conformed. Moderate to high risk to the success of the SSMP.
B-minor	Minor Non-Conformance	Low risk that a statement in the SSMP is not fully conformed. Low risk to the success of the SSMP.

Table 12: Non-Compliance Deficiencies and Recommended Corrective Actions

WDR Provision	Identified Deficiency	Recommended Corrective Action	Deficiency Type
D.13.vi – Overflow Emergency Response Plan	The current Overflow Emergency Response Plan documentation is too voluminous to use as a practical guide in the field or to support SSO response training activities.	Complete the update currently in progress to the Overflow Emergency Response Plan and provide training on the updated plan to staff and field employees responsible for sewer overflow response, notification, and reporting.	**A**
D.13.x – SSMP Program Audit	The last SSMP audit was conducted in September 2013. The City updated the SSMP in March 2014 based on the findings of the September 2013 audit. The City initiated the current SSMP audit process in March 2016, two years after the March 2014 SSMP update. Technically, the City should have performed an audit by September 2015, two years after the previous audit.	None. This SSMP audit brings the City and District into compliance with the SSMP Program Audit requirement of the WDR.	**A**
G.2 – Monitoring and Reporting Requirements, Section E.2 of Amended MRP	In 2014, the City updated to the SSMP and modified SSMP elements based on the findings of the September 2013 SSMP audit. The City did not include records documenting all changes made to the SSMP since its last certification as required by the amended MRP WQ 2013-0058-EXEC.	The City and District should generate records documenting changes and attach them to the current version of the SSMP.	**A**

Table 13: Major and Minor Non-Conformance Deficiencies and Recommended Corrective Actions

WDR Provision	Identified Deficiency	Recommended Corrective Action	Deficiency Type
D.13.ii - Organization	Section 3.1 and Section 3.2 of the 2014 SSMP indicates the Vista City Manager is designated as the authorized representative for both the City of Vista and Buena Sanitation District, yet does not indicate the name of the current person filling the position. Similarly, Section 3.3 of the SSMP includes an organization chart clear lines of authority for management, administrative, and maintenance positions responsible for implementing specific measures in the SSMP program, yet does not include names and phone numbers. Section 3.3 indicates that current names and contact information for all positions is available at the City of Vista.	The City should consider including an attachment indicating the names and telephone numbers of the management, administrative, and maintenance positions indicated in the SSMP organization chart as responsible for implementing specific measures of the SSMP program. This attachment could be updated as names, phone numbers, or positions responsible for implementing specific measures of the SSMP program change. The City should consider including a paragraph in the attachment indicating the person responsible for keeping the organization chart, names, phone numbers, and positions updated and the location of the updated table on the City's servers.	**B-minor**
D.13.iv.b – Operation and Maintenance Program – Routine Preventive Maintenance	The City and District have adopted an aggressive proactive cleaning and manhole inspection program. This includes proactively cleaning all small diameter pipe (15-inches and less) which consists of approximately 289 miles on a 12 month schedule and all large diameter pipe (greater than 15 inches) which consists of approximately 15 miles on a 60 month schedule. The CMMS shows that over the past 12 months (4/15/2015 through 4/14/2016), 212 miles of small diameter pipe have been cleaned (27% behind schedule). In addition to being among the highest performing utilities in Region 9 in terms of SSO rate, over 99% of all cleaning work is characterized as proactive cleaning (i.e. not associated with an overflow, complaint, or other issue).	Evaluate readily available cleaning, manhole inspection, and CCTV data to assess the system pipe cleaning and manhole inspection needs and update the SSMP commitments and resources (staff and equipment) to meet or exceed this commitment. The City currently has a project to evaluate these.	**B-major**

WDR Provision	Identified Deficiency	Recommended Corrective Action	Deficiency Type
D.13.iv.c – Operation and Maintenance Program – CCTV Inspection	The City and District have adopted an aggressive proactive schedule that calls for proactively CCTV inspecting all pipe on a 60 month schedule. Over the past 5 years (1/23/2001 through 1/22/2016), the City and District have inspected 92 miles of pipe (70% behind schedule). While the City and District are not meeting their SSMP objective for CCTV inspection, performance data suggests that this has not led to elevated SSO risk exposure. This may be due to the fact that the City and District have inspected the vast majority of their infrastructure (92%) couple with industry experience that tells us that gravity pipe typically deteriorate slowly with most observed deficiencies likely being cause by construction issues.	Evaluate readily available cleaning and CCTV data to assess the system CCTV inspection needs and update the SSMP commitments and resources (staff and equipment) to meet or exceed this commitment. The City currently has a project to evaluate these.	**B-major**
D.13.iv.c – Operation and Maintenance Program – Rehabilitation and Replacement Plan	The City and District developed a short and long term plan to address system deficiencies identified through CCTV inspection, manhole inspection, and other activities. This includes evaluation of this data to identify and prioritize system deficiencies based on engineering and operational judgment. The plan is almost fully executed.	Update the short and long term plan to address system deficiencies identified through CCTV inspection, manhole inspection, and other activities. Consider developing more documented and transparent decision making guidelines. The City currently has a project to evaluate these plans.	**B-major**
D.13.viii.a – System Evaluation and Capacity Assurance Plan – Evaluation	Smoke testing is listed as a method of evaluating capacity deficiencies but this method is not currently conducted within the City.	Smoke testing should be eliminated from the SSMP as an approach to evaluating I&I locations.	**B-minor**

WDR Provision	Identified Deficiency	Recommended Corrective Action	Deficiency Type
D.13.viii.c and D.13.viii.d – System Evaluation and Capacity Assurance Plan – Capacity Enhancement and Schedule	The CIP, an implementation schedule and sources of funding specific to those projects are not included or referenced in the SSMP.	Reference the website location for CIP projects with schedule and funding information (budget) in the SSMP. http://www.cityofvista.com/services/city-departments/engineering/construction-projects/cip-projects	**B-major**
D.13.viii.c – System Evaluation and Capacity Assurance Plan – Capacity Enhancement	The approach to prioritizing and annually adjusting the CIP list is not discussed in detail in the SSMP.	In a step by step manner, the SSMP should be revised to reflect the City's current approach to developing a CIP based on master plan findings and hydraulic model updates; the approach to prioritization of CIP projects and validation with CCTV data; and annual adjustment of CIP program.	**B-major**
D.13.viii.d – System Evaluation and Capacity Assurance Plan – Schedule and Funding	The City's funding mechanisms no longer include a Capital Expansion Fund.	Funding mechanisms for the City's CIP projects should be updated to reflect the renaming of the Capital Expansion Fund to the Capital Facilities Fund.	**B-minor**
D.13.ix.a – Monitoring, Measurement, and Program Modifications – Maintain relevant information	Staff rely on manual reporting processes to measures some of the key indicators such as cleaning production. This can potentially lead to inaccurate monitoring, tracking, and reporting of program progress.	Moving forward, the City and District should increase proficiency in analysis of data residing in the CMMS to generate consistent and accurate management reporting from the centralize maintenance database.	**B-minor**

WDR Provision	Identified Deficiency	Recommended Corrective Action	Deficiency Type
D.13.xi – Communication Program	The City also does not clearly explain the existence of the SSMP and provide a clear message indicating the public has the opportunity to provide input into the program development and implementation. Although the City has information regarding the sewer program on the City website, the information is not clearly provided and in some cases causes confusion. For example, the Buena Sanitation District does not have a webpage. The City of Vista website does have a Sewer Utilities webpage (site below) that explains the existence of the Buena Sanitation District, yet also refers to the City of Vista Sanitation District that does not currently exist as a legal entity any longer causing confusion.	The City could improve communication to the public and achieve a higher level of compliance with the Communication element of the WDR through the following: • Update the Sewer Utilities webpage to more accurately reflect the current legal entity responsible for the City of Vista sewer system (i.e., the City of Vista Sanitation District does not exist). • Provide a clear message welcoming on-going public input into the SSMP and SSMP implementation along with contact information. Update the message during periods where the City is actively updating the SSMP to notify the public that the City and District is in the process of updating the document and welcomes input. • Provide a link to the City of Vista Collection System Operational Report on the SWRCB CIWQS Public Reports webpage (webpage link below) https://ciwqs.waterboards.ca.gov/ciwqs/readOnly/publicReportSSOPerformance.jsp?wdid=9SSO10660&startDate=&endDate= • Provide a link to the Buena Sanitation District Collection System Operational Report on the SWRCB CIWQS Public Reports webpage (webpage link below) https://ciwqs.waterboards.ca.gov/ciwqs/readOnly/publicReportSSOPerformance.jsp?wdid=9SSO10700&startDate=&endDate=	**B-minor**

7 List of Documents Reviewed

Table 14 lists the documents reviewed over the course of the WDR audit. The documents are organized in alphabetical order.

Table 14: List of Documents Reviewed

Document	Document Date	Source
AnnualI-IMonitoring.pdf	May 31, 2016	Elmer Alex
Annual Work Plan.doc	Received 4/1/2016	City
Buena Sanitation District Code of Regulations	Various Dates	City
Cashflow and Rate Scenario Tool (reviewed tool with City Staff)	Various	City
CCTV data	Received 4/1/2016	City
Cityworks Sewer Maintenance History and Sewer Cleaning Schedule	Received 4/7/2016	City
City of Vista Municipal Code	Various Dates	Downloaded from internet
CITY OF VISTA SSORP DRAFT.doc	Revised March 2010, Revision in progress	Lisa Carter
Design Standards	Various	City
Draft FOG Fact Sheet_Comp 1	No Date	Elmer Alex
Draft FOG Poster_Comp 3-14-16.pdf	March 14, 2016	Elmer Alex
EMPLOYEE TRAINING.xlsx	May 18, 2016 timestamp	City
Encina Wastewater Authority Pretreatment Ordinance	Effective March 2012	Downloaded from internet
Example Inspection Form.pdf	No Date	Elmer Alex
FOG Control Program, Basis for Program Development, Program Components, and Policies	September 24, 2009	Elmer Alex
FOG door hanger 6-23-09 FINAL.pdf	June 23, 2009	Elmer Alex
FORM A- Lateral Report.doc	August 27, 2014	Elmer Alex
FORM B - Lateral report.doc	October 5, 2015	Elmer Alex
FY 14-15 Sewer Maintenance Inventory.xlsx	May 13, 2016 timestamp	Lisa Carter

Document	Document Date	Source
GIS data for force mains and gravity sewers	March 14, 2016 .zip filename	City
Inter-Agency Flow Diagram.pdf	May 31, 2016	Elmer Alex
MonthlyI-IMonitoring.pdf	May 31, 2016	Elmer Alex
NEW Process Diagram-Portrait-FINAL.pdf	September 18, 2016	Elmer Alex
OLD FOG Poster Final 090728.pdf	July 28, 2009	Elmer Alex
OLD FOG tri-fold 6-23-09 FINAL.pdf	June 23, 2009	Elmer Alex
OSHA Training.XLS	May 13, 2016 timestamp	City
Private Lateral Letter-Buena – FINAL.docx	October 5, 2015	Elmer Alex
Private Lateral Letter-Vista – FINAL.docx	October 5, 2015	Elmer Alex
QUICK REFERENCE FOR WW CREW.doc	May 13, 2016 timestamp	Lisa Carter
Sewer Overflow Reporting	Data downloaded on May 16, 2016	CIWQS Database
Sewer System Management Plan	March 2014	City website
SSO Chain of Communication.xls	May 13, 2016 timestamp	Lisa Carter
Standard Specifications	Various	City
Vista-Buena SSMP Audit 2011 (FINAL).pdf	August 2011	Elmer Alex
Vista-Buena SSMP Audit 2013 Rev-2-11-8 Final.pdf	September 2013	Elmer Alex
Wastewater org chart.pdf	April 7, 2016	Elmer Alex

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Appendix B. 2016 Program Assessment Findings and Interview Notes

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The 2016 assessment was organized into the following City and District programs:

- Cleaning
- Condition Assessment
- Asset Renewal
- Staffing
- Data Management and Systems
- Asset Registry
- Sewer System Management Plan (SSMP)
- Easements
- Fats, Oils & Grease (FOG)

Key assessment findings that led to initial opportunities for improvement and notes from initial interviews are included below.

CLEANING ACTIVITIES

Key cleaning activity findings that resulted in opportunities for continuous improvement include:

- Notification to property owners and tenants for difficult to access manholes is a challenge.
- Closed Circuit Television (CCTV) inspection data could potentially be used to inform cleaning crews of pipe conditions. Current PipeLogix CCTV software is not integrated with CityWorks Computer Maintenance Management (CMMS) software.
- The City and District are beginning to implement root control measures and exploring potential benefits.
- Enhanced Maintenance Areas (EMAs) include pipes that are cleaned more frequently than every year. This list of pipes is updated using staff input and SSO information. Cleaning findings and CCTV data could also potentially be used.
- The City is currently working to update Standard Operating Procedures (SOPs) for office and field procedures.
- The City does not currently have a cleaning Quality Control (QC) program.
- JetScan cleaning inspection technology may not be fully utilized.
- One cleaning truck experiences 30 percent down time. This is not preventing crews from performing work, but may in the future.

CONDITION ASSESSMENT

Key assessment findings for pipe CCTV inspection and manhole (MH) inspection that resulted in opportunities for continuous improvement include:

- Portable CCTV equipment would enable inspection of difficult to access pipes.

- Current PipeLogix CCTV software does not integrate with CityWorks or the City and Districts Geographic Information System (GIS).
- A custom defect coding system is used for CCTV. The City and District are interested in standardizing to a nationally recognized defect coding system.
- Identification and easy query of Priority 1 (high priority) inspection findings would be useful for the City and District.
- Contractor CCTV inspections are not always incorporated into the CCTV database of record due to data receipt format and an undefined business process.
- The City and District are currently working to update SOPs for office and field procedures.
- The City and District do not currently have a formal CCTV data quality control program. Some key defect coding was missing from CCTV data.
- The City has inspected over 92 percent of the system and is interesting in planning future inspection frequencies.
- Generating work orders for CCTV after repairs on weekends is a challenge.
- Manhole inspection data collection is time consuming for operations staff and is collected in paper format.

ASSET RENEWAL

Key assessment findings for pipe and MH renewal decision making and renewal work performed by City and District crews that resulted in opportunities for continuous improvement include:

- Prioritization of repair backlog and which types of repairs (MHs, pipes) to focus on is a challenge.
- The City and District developed renewal decision logic for pipelines.
- Water utility lines are not currently in GIS for use in renewal decision making.
- The City and District are interested in implementing software to automate renewal business decision logic recommendations.
- Notification of customers about renewal work is a challenge.
- The City and District are currently working to update SOPs for office and field procedures.
- The City and District do not have a formal QC plan for renewal work performed by City and District crews.
- Staff retention, knowledge retention, and staff training are a challenge.
- All MH renewal work is not currently documented in CityWorks
- The City and District are interested in exploring a proactive clean-out upsizing program to provide improved access for operations and maintenance of gravity sewer pipes.

- Pipe capacity information is not readily available for use in condition renewal decision making.

STAFFING

Staffing was discussed during each program assessment. Common findings include:

- Many City staff is new or recent employees. The City and District hire and train candidates and then the candidates leave the City and District to work elsewhere.
- Some key staff will retire in the near future
- Some performance goals are not being met such as CCTV due to staff leaving the City and District

DATA MANAGEMENT AND SYSTEMS

Data management and systems were discussed during each program assessment. Key assessment findings include:

- Crews utilize tablets in the field to access CityWorks. Connectivity is a challenge in some areas.
- Easily accessing asset work order data entry and work order history on tablets is challenge.
- Current PipeLogix CCTV software does not integrate with CityWorks or the City and Districts Geographic Information System (GIS).
- Data analysis for SSMP commitment forecasting and tracking is currently performed in CityWorks and separate spreadsheets that produce different results.

ASSET REGISTRY

The asset registry was evaluated throughout the assessment and as part of the renewal business decision logic development. Key assessment findings include:

- Pipe asset registry has two fields for length.
- Pipe material field is missing 19 miles or 6 percent of wastewater collection system pipe.
- MH depths are not populated for approximately 4 percent of MHs
- There was previously no asset registry for sewer access roads, however approximately 40 sewer access roads were identified as part of this assessment along critical sewers. Additional access roads are not documented in the asset registry.

SEWER SYSTEM MANAGEMENT PLAN

The following key assessment findings were identified from the SSMP Audit:

- General
    - The update to the SSO Emergency Response Plan is currently in progress.

- Encina Wastewater Authority operates and maintains the City and District's pump stations. There is currently no memorandum of understanding with Encina Wastewater Authority regarding level of service expectations, plans and reports, critical equipment list and failure plan, site specific SSO and contingency plans, access to condition assessment and operations data.
- Some commitments in the SSMP are out of date with the latest City and District asset management approach.

EASEMENTS

Easement work was discussed with the City and key assessment findings include:

- Easement work is not typically documented in CityWorks.
- Easement owner information is not typically documented in CityWorks.

FATS, OILS, GREASE

The City and District FOG program was discussed during the SSMP Audit. Asset management program related findings include:

- The FOG section of the SSMP and FOG Source Control program could be updated.
- FOG tracking, reporting and inspection frequencies could be updated.

Pipe Cleaning Program and Procedures Notes

CATEGORY	DESCRIPTION
Staff and Resources	The City of Vista has a 7 total cleaning staff: Three 2-person crews plus the Crew Chief. All crews operate out of the public works yard 1 crew focuses on pipes in the Buena District and the other 2 crews focus on pipes in Vista. There are currently no vacancies. There is a tablet assigned to each cleaning truck. In general, planned cleaning work takes priority over other planned activities (e.g. CCTV, Easement Maintenance, etc.). Staff retention is a challenge.

Pipe Cleaning Program and Procedures Notes

CATEGORY	DESCRIPTION
Equipment	The City of Vista has the following cleaning trucks: 3 - 1" hose Vactors. Staff reports good cleaning power – primary cleaning trucks 1 – ¾" hose Vactor – older with less power – only used when the 1" hose Vactor is down. 1 – Rodder ("Hard Rodder") 1 – Trailer Mounted Mini Jetter – ½" hose – only used for difficult to access pipes (e.g. Manholes in backyards); works best on smaller pipes. • Trucks have recently had engine maintenance issues and have spent time in the shop. Crews have been down 1 truck approximately 30 percent of the time. This seems higher than historic levels, but down trucks rarely prevents a crew from going out as there are multiple backup trucks. • With the current equipment and resources, the crew member can effectively clean pipes up to 18 inches in diameter. • Heavy bottom dweller nozzles are rented or demoed to clean the pipes larger than 18 inches. • JetScan There are four JetScan units 6 inch sleds were breaking so sleds were redesigned. • Jet scan's view is only forward facing. Video truck will be sent when more detail is necessary. • There is currently no access to video from tablets. Cleaning crew calls the Crew Chief or the Program Assistant to view video if needed • Tablet connectivity is currently the biggest issue. Areas out in hills in the Buena district have issues connecting. • Tablets do not contain GPS. • Lack of training is also a factor. • The Program Assistant can view work order and map consecutively and this cannot be done on the tablets. • •Crews mainly reference the map on tablets.
Work Order Drivers	Work orders and GIS maps can be viewed from truck tablets. There are icons that inform crew members when there are open work orders.

Pipe Cleaning Program and Procedures Notes

CATEGORY	DESCRIPTION
Proactive Cleaning	The City's performs proactive cleaning on the following schedules: • 1 month – ~1 pipe • months – ~200 pipes • month – ~1 pipe • ~12 months – all pipes 15" and less • 60 month – all pipes 16" and more Based on this schedule, Vista would need to clean approximately: 3.2 miles of large diameter pipe per year 295 mile of small diameter pipe per year A complete history of cleaning in CityWorks doesn't include the past 60 months. Therefore, this data alone can't determine the large diameter cleaning compliance rate. Complete data is available since approximately September of 2012 (43 months). Over that time, approximately 12.2 miles of the 16.2 miles of large diameter pipe has been cleaned. At this pace, CityWorks shows that the City would successfully meet the large diameter cleaning goal established in the SSMP to clean all large diameter pipes once every 60 months. Based on CityWorks data through April 14th 2016, approximately 72 percent of the active small diameter pipe the City is responsible for has been cleaned in the past 12 months. Therefore, CityWorks shows that the City is not meeting the small diameter cleaning goal established in the SSMP to clean all small diameter pipes once every 12 months.
Reactive Cleaning	Reactive cleaning is unplanned cleaning typically triggered by CCTV inspection, customer requests, or backup investigations. Reactive cleaning is prioritized ahead of proactive cleaning. In 2014 and 2015, CityWorks shows that an average of one pipe per week was cleaned reactively. This equates to approximately 1.9 miles of cleaning per year. Due to the City's effective proactive cleaning program, more costly reactive cleaning is relatively rare (less than 1 percent of all work).

Pipe Cleaning Program and Procedures Notes

CATEGORY	DESCRIPTION
Work Order Generation	The proactive schedule is broken into three geographic areas (one for each crew). Each area is further broken down into approximately 74 basins. Basins range in size from 0.1 miles to 14.4 miles with an average of 4.2 miles. The cleaning schedule is tracked by basin in paper format with the basins ordered from top to bottom hydraulically. The typical work order generation process is: Crew contacts the wastewater supervisors (WWIII) when they are close to completing their existing work WWIII contacts the Program Assistant to request generation of a work order Program Assistant reviews basin schedule and identifies the next downstream basin to be cleaned in that crew's area. Program assistant runs a query to generate the work order. Program Assistant marks on paper schedule the basin the cleaning work order was generated on. Program Assistant or WWIII assigns the work order to the crew. The work order appears on the crew's tablet. Crews attempt to complete the old work order before starting the next one. However, due to issue that may arise, work may begin on the new work order before the old one is completed. The most common issue occurs when manholes (MHs) temporarily can't be accessed (car parked over MH, on private property and can't get a hold of owner, etc.). If a pipe segment is inaccessible, the work orders remain open until it can be completed. Ultimately, if a manhole can't be accessed, the Engineering department is notified. The Engineering department sends a letter to the home owner requesting access. Accelerated pipe cleaning work (1, 3, and 6 month) is also generated by the Program Assistant. The pipes are known as Enhancement Maintenance Areas (EMA's). Both the Program Assistant and the Cleaning WWIII have a reminder in their outlook calendars for this work. When the event occurs, the Program Assistant runs a query to generate the EMA work orders. There is currently no documented decision logic or optimized process for moving pipes onto and off of the EMA list. The City does not currently leverage CCTV data to inform crews of asset condition for cleaning or repair crews.

Pipe Cleaning Program and Procedures Notes

CATEGORY	DESCRIPTION
Work Order Completion	Each morning, the cleaning wastewater operators (WWIIs) review the work assigned to them and determine which pipes will be cleaned based on available staff and equipment. Work orders are filtered to only those assigned to the particular crew's tablets. Work order editing is live in a connected environment that requires cell service. Performance could be improved as the system can be slow. Connectivity is good in town but can be a big issue in the outskirts of town, especially in the Buena service area. The City is looking into developing a disconnected solution. Crews can see their work orders in GIS. Each work order is usually associated to a single pipe. Each work order is represented as a dot. Crews navigate to the downstream manhole of the first work order and set up there to perform cleaning. Traps are commonly used on clay pipe or if roots, grease, or debris is encountered. The vacuums are rarely used. The color of each work order changes once the work is completed. The devices do not have GPS so crews only see the work orders, not where they currently are in relation to the work order. This isn't a significant issue though as the vast majority of manholes are accessible, well located in GIS, and the crews usually find them easily since they clean the entire area annually. For work orders, the GIS view and the data entry screen are on two separate tabs. Double clicking the work order in GIS did not open the data entry. Crews may have to recall the asset identifier shown on the map and then navigate to that work order in the list view. During cleaning, crews may determine whether they want to use the JetScan or not. When the JetScan is used, crews first record a white board summarizing the date and pipe associated with the work. There is no indicator on the work order regarding whether JetScan was performed. The naming convention is the upstream and downstream manhole numbers. Then the videos are uploaded to the Q drive based on the basin the pipe is in. While rare, if a JetScan is performed twice on the same pipe, the old video is overwritten (i.e. only the newest video is available). Each Wednesday night, an automated script is run, which adds the path of all JetScan videos where the video name matches a pipe asset to a field in GIS called Assessment. This allows users of the QView application to access the latest JetScan video available. Alternatively, JetScan videos can be accessed by searching the Q drive for the desired pipe. Note: JetScan video is not identified in CityWorks. Once cleaning is complete, the crews mark the work order as Complete.

Pipe Cleaning Program and Procedures Notes

CATEGORY	DESCRIPTION
Record of Findings During Cleaning	Custom data collected during cleaning is summarized below. The summary includes the values collected and in parentheses, the percentage each value occurs. Based on interviews, it is assumed that any null value means nothing was found. For example, 98.5 percent of all completed cleaning work orders have no root findings (i.e. null value), 0.8 percent have "fine" roots, 0.6 percent have "medium" roots, and 0.1 percent have heavy roots. Severity of blockage: • "Roots" are identified as either null (98.5 percent), fine (0.8 percent), medium (0.6 percent), or heavy (0.1 percent). • "Debris" is an open text field. 99.5 percent of values are null. 0.5 percent has some value but it is difficult to quantify severity because the field is open text. • "Grease" is identified as null (99.4 percent), small (0.3 percent), medium (0.2 percent), or large (0.1 percent). • "Calcium" is identified as null (99.9 percent), yes (0.05 percent), or no (0.03 percent). • "Number of passes" is a text field from 1 through 10. 1 (93.8 percent), 2 (5.3 percent), 3 (0.7 percent), 4 or more (0.2 percent). • "Lateral Roots" – Yes, No, or Null (100 percent). Note: crews could only distinguish this if JetScan used. • "Lateral Grease" – Yes (0.01 percent), No (0 percent), or Null (99.99 percent). Note: crews could only distinguish this if JetScan used. Other data: • "Critical Notice Needs Updated" – Yes (4.4 percent) or No (95.6 percent) • "Critical Notice Updated" – Yes (3 percent), No (41 percent), Null (56 percent) • "Lining" is an open text field. – Null (99.9 percent). 0.05 percent is populated. There are pictures of pipes that display what small, medium, large grease would look like. Scales were determined by RBF in previous documentation.
Coordination of Cleaning Activities with CCTV Inspections	When cleaning crews are unable to get access to an area, they attempt to contact the WWIII. If the WWIII is not available, they contact the Program Assistant. The cleaning crew does not coordinate with CCTV directly.
Contracted Cleaning	Vista does not commonly perform contracted cleaning.

Pipe Cleaning Program and Procedures Notes

CATEGORY	DESCRIPTION
Tracking Output	Each day, the cleaning WWII reports the footage they cleaned. The WWIII maintains a paper cleaning log, which includes the crew, date, whether the crew cleaned that day, and the footage cleaned. The WWIII provides this log to the Program Assistant who summarizes the logs in an excel-based report. The report summarizes output by month including the cleaning output goal. Note, since the cleaning log and CityWorks are populated independently of each other, they do not agree with each other regarding the timing and quantity of cleaning work performed. In 2015, CityWorks reported that 260 miles of pipe was cleaned while the Cleaning Log reported 283 miles cleaned. The most significant difference was in October of 2015 where CityWorks reports 23.4 miles cleaned and the cleaning log reported 33.5 miles cleaned.
Cleaning QC	The City does not have a formal cleaning QC program. However, JetScan nozzles do allow crews to self evaluate their performance.
Root Control	The City has started performing some root control and is interested in a root control program. CCTV is not currently used to identify pipes for potential root control.

CCTV Inspection and Easement Program and Procedures Notes

CATEGORY	DESCRIPTION
Staff and Resources	The City of Vista has a 4 total staff in the CCTV Inspection / Easement group: • One 2-person crew typically performs CCTV • One 2-person crew typically performs Easement work. The CCTV and Easement WWIII manages the group and also serves as the second person on the easement crew. When cleaning, CCTV, or Service & Repair do not have enough staff to perform work (due to absent staff, traffic control, or complicated work), the easement crew is often used to augment other work groups. • 2 of the 4 crew members are fully trained in operating equipment. • 1 crew member is relatively new. • All crew members are trained on codes. • • Staff retention is a challenge and retention of institutional knowledge is a concern.

CCTV Inspection and Easement Program and Procedures Notes

CATEGORY	DESCRIPTION
Work Order Drivers	Work orders must be generated when work is needed. Drivers that get crews out to inspect pipe include: • Cleaning • Customer call • Before or after repairs • Engineering requests CCTV can be completed on lines for the cleaning crew. On average there are approximately 4 a month. There are occasionally standby callouts from the weekend in cases where the cleaning crew is stuck and unable to get through pipe lines. There are customer weekend/afterhours calls. If something is plugging the line or there is an overflow, a vactor crew will clean prior to CCTV. Majority of backups are impacted by roots. When this is the case, a photo is taken. City crews go out before repair and mark out pipe and depth information so crews know where the repair is located. Training on pipe marking was identified as a concern.
CCTV Workflow and Decision Making Processes	The City's data base of record is a CCTV database in PipeLogix software. PipeLogix, CityWorks, and GIS have not been integrated together. This is a concern for the City. Selected CCTV video is attached to CityWorks. Some callouts are recorded in CityWorks. A set up typically gets 3-5 lines at a time. Older parts of town may get 2 or 3 lines per set up.
Technologies Used by City Staff/Consultants	CCTV camera, push camera and JetScan are used.
CCTV Capabilities/Limitations	The City has cameras equipped to handle every pipe diameter.

CCTV Inspection and Easement Program and Procedures Notes

CATEGORY	DESCRIPTION
CCTV Observation coding	The City uses a custom coding system, but plans to move to a nationally recognized coding system NASSCO PACP. If the camera is unable to continue in a pipe, SA (survey abandoned) is added. Cleaning crews then clean the line and CCTV is tried again. SA can be noted for a variety of reasons including: dead end, root blockage, and awaiting spot repair. History of observations noted is always kept in notes and verbally in the videos even after defects have been cleared. 'Unable to pass' is noted if there is a total blockage or collapse pipe. Manholes are named in numerical order from US to DS. MH inspection reports include 4 photos of MH. MH photos include white board with identifier. MH photos consist of: • Photo from each direction • Inside of MH facing downward • Zoomed in on the trough to see flow direction MH checklist includes count of ladders, material of ladder, measurement of total depth, measurement of cone, shaft, risers, and diameter of the ring. A drawing of the MH is also included. Pictures are added to survey information. This is completed for only MH's not cleanouts. This process is time consuming for staff.
CCTV "Red Flags" for Immediate Action	The City has a prioritization system in CityWorks to identify priority findings and red flag issues are verbally communicated.
Quality Control Inspection after Completion of Projects	Following repair, crews will inspect repair.
CCTV/Cleaning Coordination	CCTV process is similar to the cleaning process. There are a total of 52 sub areas. CCTV crews travel from basin to basin and sub area to sub area. Areas are identified and assigned by the Program Assistant. Night work is generally done in areas of high traffic.
CCTV Video Database & CMMS	Downloads are transferred from the hard drive to the network.
CCTV QC	The Program Assistant completes the QC on the data when it's received then downloads the data. QC process includes: • Viewing video quality. Choosing random videos and zooming. • Checking for spelling and making sure all fields are filled out. • Identifying black screen videos and video losses. • Checking voice over to make sure speaker is speaking clearly. • Viewing for defects and ensuring they are coded correctly. • Program Assistant has the ability and training to add or change defect coding if necessary.

CCTV Inspection and Easement Program and Procedures Notes

CATEGORY	DESCRIPTION
Easements	City Easement program includes: • Installation of MH locks done by the SNR Crew. • Clearing and spraying easements. • Easement information gets recorded in the system; there is also a daily journal, which includes footages. • There are written calendars and weekly reports completed electronically. • Excel spreadsheet includes easement name, (identified by street name) total footage for day, crew members, location, and footage cleared. • There is a GIS layer that displays easements. Easement information in GIS layer is most probably not accurate. • Easements are generally looked at prior to the cleaning crews work starts. • Larger easements are done by a contractor. Contractor is on a one year contract. • Crew members are assigned to easements including the Chief and 2 crew members are assigned to the CCTV truck. • Certain easements need haul in and repairs and is difficult to do with one operator and one crew member on the truck. 3 people total is needed for easements.

INFORMATION SYSTEMS AND DATA MANAGEMENT NOTES

- Integration of CCTV data with GIS would be beneficial and assist with better documentation.
- Assets are pulled from CityWorks and given to the CCTV crew. Every active pipe in the sub basin is populated and provided to crew members.
- Duplicate asset ID's exist in PipeLogix. City IT changed asset ID's to make them automated, which linked old to new.
- Work orders are created by selecting a pipe in CityWorks. It is then pushed to PipeLogix.
- GIS is linked to CityWorks and pipe ID's can be located in PipeLogix. City of Vista prefers that when the database is cleared up, flags go on pipes. In this case, it can get updated and everyone including engineering could utilize the information.
- CityWorks stores defects codes. It can be imported from PipeLogix back into CityWorks. City of Vista prefers PipeLogix to be day to day, historical database of record.
- CityWorks has a tool that displays the history of a pipe. City staff prefers everything on CityWorks to be accessible on one interface. City staff would prefer not to have the PipeLogix access database.
- CCTV last clean date is accessible through GIS. CityWorks information is always live and editing of attributes can be done in GIS.

- Date on some asset videos is displayed. It works off a python script that runs every Wednesday. The Wednesday automated script doesn't read the path, it goes to PipeLogix access database and looks at the view, facility ID, and checks newest data. If it's the newest data it updates the date and image name. GIS has a hyperlink.
- Information from CityWorks is printed out and individually input into PipeLogix.
- All data has to be kept for 5 years.
- Identifying or flagging the code 1's would be helpful. Code 1's are high priority issues. When Program Assistant receives the hard drive, the report is printed and given to the Crew Chief. Codes 1's are no longer a 1 after they are fixed and CCTV is completed again.
- On Geovista or CityWorks, Engineering Staff can view which pipes have had CCTV completed, the score that was given, and additional information.
- For cleanup, pipe table should have 1 record per asset. Currently there are cases when one pipe has multiple records. For example, up to 5 records will be tied to one pipe.
- A total of approximately 19-20 miles of CCTV was completed last year but only 5 miles of completed CCTV is displayed in GIS. CCTV trucks have been down often in the last year.
- There are currently 0.425 miles of recorded CCTV found in GIS for 2016. City staff said most information was not downloaded yet for 2016 and the value for 2015 seems very low.
- The Program Assistant is responsible for completing the cleaning output reports, which is a graph in excel. The base data for these reports comes from the hand written journals. Excel spreadsheets are provided from the crew chiefs and are transferred to excel graph. CityWorks data is more accurate than the excel sheets created.
- IT writes the CityWorks reports. Everything could be automated except CCTV and easements. Easements can't because there are no work orders in CityWorks and CCTV can't because the process takes an extended period of time and the information is required prior to being uploaded.
- Information such as footage and pipe material is located in GIS; the Program Assistant will adjust this information during QC if it's incorrect.
- The IT group handles new projects, as-builts and statuses. The Program Assistance informs IT if lines are abandoned or if the location needs to be changed. For example if a CityWorks work order says a line is an 8 inch, but field comments comment say it's a 6 inch, the Program Assistant will verify the information in the CCTV.
- PipeLogix video includes: image name, date, and asset ID. City requests addition of flag and distance information.

- Video names contain up to 24 characters. ‘Pre’ and ‘post’ is added at the end of the videos to differentiate.
- Permitting is to be moved into CityWorks. It is not likely that anything would move from CityWorks because of the time, funding and effort put into CityWorks implementation.
- The current largest issue is out in the field. Connectivity is often lost in the field and there is no current solution. Solution may be in about another year.
- CityWorks and PipeLogix are meant for data management and storage not decision making. Providing information such as action, risk, and cost would be beneficial. All information written back to CityWorks could be helpful.

Asset Renewal Notes

Asset Renewal Construction

In-House Work	Contractor Work
Open Cut Repairs • 20 ft. max length • 12 ft. deep	CIPP - Full pipe length (no spot or partial CIPP)
Cut Protruding Laterals • CCTV crew assists	Open Cut • 25 ft. max depth
Upsize (1 pipe size larger) or add Cleanouts at dead ends	Emergency Repairs - Expensive • 25 ft. max depth

- 3 PRs in hours are cheaper than 1 contractor PR.
- City may repair and may CIPP later if voids visible.
- Prefer to CIPP rather than repair.
- Takes approximate 1 year or up to 2 years maximum to get a CIPP project through planning, design and budgeting.
- CIPP is installed and holes are cut for laterals with 6" top hats installed.
- Pipe bursting is not a preferred technique.
- Open cut construction is rare.
- Most common technique is CIPP and crew repairs.

ASSET RENEWAL CONSTRUCTION DECISIONS

a. Over 3 point repairs, the issue is referred to engineering

b. Defects at joints vs. in the main do not typically drive renewal decisions differently

c. Laterals

   i. Break in connections - most connections in system are break-ins

      (1) If located at top of pipe, connections are not repaired

(2) If in flow line, they are considered for repair

ii. Roots around laterals

(1) If Private Lateral Spill - notify homeowner and enforce in some cases
(2) Maintain in sewer main otherwise

iii. Roots in laterals

(1) If Private Lateral Spill - notify homeowner and enforce in some cases
(2) Maintain in sewer main otherwise

d. Bends

i. If bend is not causing issues, then Vista does not install a manhole. If Vista can clean, CCTV, get access and little debris build-up, then there are no issues.

e. Buried MHs

i. Are typically raised

f. Dead ends and cleanouts that are undersized are significant concerns. Vista would like to consider proactively addressing these.

i. $2-3k for crews to perform this work per cleanout if proactive

ii. Minimal cost (materials) if completing this work as part of another repair

iii. Typically install clean-outs rather than MHs

iv. Clean-outs are upsized one size larger than sewer main

Appendix C. Opportunities for Continuous Improvement

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Based on a series of workshops the Asset Management Team developed this prioritized list of opportunities for continuous improvement. The summary table includes the following fields:

- **No.** – Unique opportunity number
- **Activity –** The program activity associated with the opportunity such as Cleaning or CCTV
- **Opportunity Name –** Unique opportunity name
- **Description –** Brief description of opportunity
- **Priority Group –** Priority grouping identified in the third voting step
- **Priority Score –** The average priority score for the opportunity based on City staff voting

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
1	CCTV	Portable CCTV unit	Two CCTV Crews with a portable unit for difficult access lines (backyards).	High	2.5
2	CCTV	Implement Monitoring Program	In the City's new CCTV program, asset specific CCTV schedules are based upon last inspection date and risk (as determined by the decision making logic). Higher risk pipes will be inspected sooner than lower risk pipes. Implement the new CCTV inspection program. This should include calculation of the next inspection date for each pipe in the system, developing work packaging tools so a crew doesn't perform planned CCTV in the same area more than once in a single year, and the ability to forecast workload over the next 5 years.	Medium/High	2.5
3	CCTV	CCTV Software	Implement WinCan CCTV software.	High	3.0
4	CCTV	PACP Training	NASSCO PACP CCTV defect coding training for crews and engineering staff. Coordinate with WinCan CCTV software implementation.	High	3.0
5	CCTV	CCTV SOP (Office)	Develop/Update SOPs for CCTV supervisor and/or non-crew CCTV staff that may include ad-hoc WO intake, WO screening process, WO creation process, WO planning process, backlog management process, WO prioritization and assignment, WO reassignment, pre-job prep, field visits, performance feedback, data quality checks, post-job follow-on activities, dependent work order management (i.e. CCTV/Cleaning/Locate) and other critical information. Include prioritization of CCTV work versus other activities.	High	2.8

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
6	CCTV	CCTV SOPs (Crew)	Document/Update Standard Operating Procedures (SOPs) for CCTV crews that may include safety procedures, productivity standards, tools, sequential steps to perform work, data collection standards and procedures, vehicle inspection and maintenance procedures, and other critical information. The document should be written to the level of detail to be used for training purposes. Equipment SOP is complete.	High	2.8
7	CCTV	CCTV Training Plan	Develop and implement a CCTV crew training program. Use the results of the CCTV QC Program to focus training on areas where staff can improve. Coordinate with PACP refresher training. Highlight the data that drives decisions. Consider cross training staff.	Medium	2.2
8	CCTV	CCTV QC Plan	Develop a formal Quality Control plan including assessment methodology, roles/responsibilities, and constructive feedback mechanism. Identify the goals and performance metrics of the program. Regularly measure and communicate performance in terms of the performance metrics. Use the CCTV SOP as the basis for the CCTV QC Plan. Renewal decisions in the future will be supported directly from completed CCTV inspections. Quality control reviews should be completed by City staff or contractors to review contractor completed CCTV or City crew completed CCTV. Review can be prioritized by video defects such that pipes in good condition can be viewed in fast forward for efficiency. Quality control reviews should be considered when implementing CCTV software. QC program may be performance driven and could include 3-10 percent or other amount determined during development.	High	2.3
9	CCTV	Coding and reviewing data that drives decisions	In addition to documenting the appropriate PACP Code, increase attention to other key data points used to make decisions such as the Percent, Length, Clock To, and Clock From fields. Incorporate in PACP training or refresher training and QC reviews.	Medium	2.2
10	CCTV	Full Pipe CCTV w/ Coding	For all pipe CCTV, ensure that the entire pipe is inspected and coded per standards. Partial pipe inspections and/or incomplete coding will skew decision making. For example, during point repair acceptance or non-emergency investigations, inspect and code the whole pipe rather than just the location of the repair/investigation.	High	2.3
11	CCTV	Code 1 (High Priority Work) Identification	Identifying or flagging Code 1's (High Priority Work) would be helpful. When Program Assistant receives the hard drive, the report is printed and given to the Crew Chief. Current information system codes everything as a "10". This is updated to "1" if high priority work is identified.	High	3.0

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
12	CCTV	Contractor CCTV and Acceptance CCTV for Contracted Structural Actions	Document specifications for contractor performed CCTV for use in renewal decision support software. Refine program to perform and assess acceptance CCTV for contracted structural actions (repair, replace, CIPP, etc.). To the extent practical, the Spec should be written to align with internal SOPs, data management procedures, and quality control program. CCTV for contractors is currently stored in a separate storage drive from City CCTV.	Medium	1.8
13	CCTV	FOG Door Hanger Tracking	Unlike cleaning crews, when a CCTV crew identifies grease in the pipe, they can identify the source. This provides an excellent opportunity for targeted FOG outreach by providing information to that customer. In this case, a door hanger is ideal. However, the current FOG door hanger is out of date and has issues with the Spanish translation. The City has addressed these issues with an updated FOG flyer. However, flyers are not ideal leave behinds as they are often blown away. Determine the best method to communicate FOG info (e.g. update door hanger or acquire door hanger that the flyer can be inserted into), stock the CCTV truck with this information, and train crews as to when to provide this information. Consider documenting this in CityWorks for use in documenting outreach.	Medium	2.3
14	CCTV / Cleaning	Access Door Hangers and Letters	Develop standard letter and send letters for property owners and tenants for difficult to access manholes. Consider updating access door hanger. Process should be as follows: 1) Hang Door Hanger 2) If customer doesn't call in 3 days then; 3) Send letter to customer	High	2.7
15	CCTV	Auto-generate CCTV Work Order After Repair	Consider opportunities to automate generation of a CCTV work order after completion of a repair work order. Incorporate into SOPs.	Medium	2.0
16	CCTV	Auto-generate CCTV Work Order After Call-out on Public Line	When the City responds to a customer call and determines there is no active overflow but there may be an issue on City infrastructure, it is standard practice to create a CCTV work order. Typically, the crew calls the office to generate the work. However, if office staff isn't available the crew must remember to call again later. When responding to multiple calls or when office staff aren't available for extended periods (e.g. after hours, on the weekend) some of these CCTV work orders may not be generated. Create a mechanism to document the need for follow up CCTV on the customer call response that would automatically trigger a CCTV work order with the appropriate information from the customer call work order transferred. Incorporate into SOPs.	Medium	1.8

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
17	Cleaning	Cleaning SOP (Office)	Develop/Update SOPs for cleaning supervisor and/or non-crew cleaning staff that may include ad-hoc WO intake, WO screening process, WO creation process, WO planning process, backlog management process, WO prioritization and assignment, WO reassignment, pre-job prep, field visits, performance feedback, data quality checks, post-job follow-on activities, dependent work order management (i.e. CCTV/Cleaning/Locate) and other critical information.	Medium	2.2
18	Cleaning	Cleaning SOP (Crew)	Document/Compile/Update Standard Operating Procedures (SOPs) for cleaning crews that may include safety procedures, quality standards, productivity standards, tools & equipment needed, nozzle selection guidelines, sequential steps to perform work, data collection standards and procedures, nozzle and equipment testing standards and procedures, vehicle inspection and maintenance procedures, and other critical information. Evaluate backups caused by roots growing through the service lateral on CIPP'd lines. The document should be written to the level of detail to be used for training purposes. Consider most appropriate way to communicate this to crew. Equipment SOP is complete.	Medium	2.2
19	Cleaning	Cleaning Training Program (Crew)	Develop and implement a cleaning crew training program. Use the results of the Cleaning QC Program to focus training on areas where staff can improve.	Medium	2.0
20	Cleaning	Cleaning QC Program (Crew)	Develop a formal Quality Control plan including assessment methodology, roles/responsibilities, and constructive feedback mechanism. Identify the goals and performance metrics of the program. Regularly measure and communicate performance in terms of the performance metrics. Use the Cleaning SOP as the basis for the Cleaning QC Program.	Medium	2.3
21	Cleaning	Communicating Asset Condition to Crew	Consider querying existing CCTV data to define critical cleaning related issues (i.e., calcium, protruding laterals, roots, offset joints, unmitigated structural defects, etc.) and place on WO in operator comments. The comment should be tied to the asset itself so that it is readily apparent to any crew working on the pipe. This information is currently in "special instructions" field. Provide information as a separate field or color so crews know which instructions are automatically generated from CCTV vs. entered by crews. Include location of issues along the line if practicable.	High	2.7
22	Cleaning	Root Control Identification	Consider automatically identifying pipes that should be added or removed from the root control program using CCTV data. Consider root control effectiveness, cost, and level of service.	Medium	2.0

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
23	Cleaning	Enhanced maintenance area optimization	Consider developing logic for whether pipes should be moved onto and off of the enhanced maintenance frequency. In addition to SSOs and staff input, consider using CCTV and/or Cleaning data.	Medium	2.2
24	Cleaning	Cleaning Truck Replacement Planning	One cleaning truck is down 30 percent of the time, but this currently does not prevent crews from cleaning. Consider longer term plan for truck replacement.	Medium	1.8
25	Cleaning	JetScan Usage & Access	Determine future usage of JetScan. There are currently issues with microSD cards and recording videos. If regularly used, add the ability to identify work orders where the JetScan was used and to be able to access the video from CityWorks.	Low/Medium	1.5
26	MH Inspection	Update MH Inspection Form	Manhole inspection forms are currently in hard copy format. The form includes many data entry fields that may not provide value for the time required to enter data in the future. Update the MH inspection form to reduce crew effort o fill out and consider incorporating in CityWorks. Consider the usefulness of data versus the time spent to collect the data. Limit the number of data points collected to only those that make business sense to collect, particularly those fields that don't change over time such as measurements.	Low	1.7
27	MH Inspection	MH Decision Making	Similar to pipes, develop decision making criteria to leverage manhole inspection data to identify and prioritize renewal activities.	Low	1.2
28	Renewal: In-house Repair	Repair Scheduling	Based on the renewal decision logic, prioritize point repairs for in-house crew repairs.	High	2.3
29	Renewal: In-house Repair	Repair SOP (Office)	Develop SOPs for in-house repair supervisor and/or non-crew repair staff that may include ad-hoc WO intake, WO screening process, WO creation process, WO planning process, backlog management process, WO prioritization and assignment, WO reassignment, pre-job prep, field visits, performance feedback, data quality checks, post-job follow-on activities, dependent work order management (i.e. CCTV/Cleaning/Locate) and other critical information.	Medium/High	2.3
30	Renewal: In-house Repair	Repair SOP (Crew)	Document Standard Operating Procedures (SOPs) for repair crews that may include safety procedures, quality standards, productivity standards, tools needed, sequential steps to perform work, data collection standards and procedures, equipment testing standards and procedures, vehicle inspection and maintenance procedures, and other critical information. The document should be written to the level of detail to be used for training purposes. Equipment SOP is complete.	Medium	2.0

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
31	Renewal: In-house Repair	Repair QC Plan	Develop a formal Quality Control plan including assessment methodology, roles/responsibilities, and constructive feedback mechanism. Identify the goals and performance metrics of the program. Regularly measure and communicate performance in terms of the performance metrics. Use the Repair SOP as the basis for the Repair QC Plan. Collect and assess a fully coded complete CCTV inspection of pipes repaired by in house crews. This will enable better quantification of the existing condition of the system and how in house crews are improving the condition. Also provide periodic feedback to repair crews.	Low/Medium	1.5
32	Renewal: In-house Repair	Repair Training Plan	Develop and implement a repair crew training program. Use the results of the repair QC Program to focus training on areas where staff can improve. Consider cross training staff on different types of repairs.	Medium	2.0
33	Renewal: In-house Repair	Repair Type Cross training	Consider the appropriate amounts of different types of repairs (Main repairs, MH repairs) so crews are well rounded and workload is balanced.	Medium	2.2
34	CCTV	Repair location marking training	Develop requirements for repair location marking (i.e. mark along the length of pipe instead of a single point). Incorporate into SOP and training for crews. Consider incorporating marking and other information into CityWorks as part of marking requirements development.	Medium/High	2.3
35	Renewal: In-house Repair	Letter Notice Prior to Repair	Develop a standard letter and send letters prior to repairs for nearby addresses. Incorporate into SOP.	Medium	2.2
36	Easement	Easement Contact Information	In CityWorks, add readily available property info (property owner, phone, etc.) to enable staff to more easily contact/coordinate with property owners, especially when staff needs to enter easement/property to complete work.	Medium	1.8
37	Easement	Easement clearing documentation	Consider incorporating easements into CityWorks for development, scheduling and tracking of work. This may help coordination with other maintenance activities such as CCTV and cleaning. Consider documentation of contractor easement clearing in CityWorks for future tracking and development of future contracts.	Low/Medium	1.7
38	Data Management & Systems	Work Order Data Entry	In CityWorks, create a function where the end user can click on a work order in the GIS view and it immediately opens the data entry screen for that work order. This will reduce the level of effort for crews (not having to remember the naming convention and select the right asset in the list view) and result in higher quality as there will be less chance that the data entered is associated to the wrong asset and will enable crews to enter data as they work instead of doing the data entry at the end of the day and trying to remember what they found on each pipe. This is a CityWorks bug that may be addressed with future service pack. Crews may need to decide on whether map view starts at street level or city-wide to utilize this functionality.	Medium	2.2

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
39	Data Management & Systems	Performance of crew tablets	Evaluate and optimize performance of CityWorks on crew tablets	High	2.6
40	Data Management & Systems	Field connectivity	Connectivity is a significant issue for field staff, particularly in the Buena service area. IT is currently evaluating options to resolve this issue including disconnected environment. Identify and implement resolution.	High	2.6
41	Data Management & Systems	Work Order History Access	In CityWorks, provide one click access to work order history on an asset listing the work order number, date of work, who performed work, type of work, summary of key findings, and work order comment. Also include key asset attributes (material, diameter, etc.) and whether the pipe is on an accelerated cleaning schedule.	Low	1.4
42	Data Management & Systems	Integration of CCTV inspections with GIS	A total of approximately 19-20 miles of CCTV was completed last year but only 5 miles of completed CCTV is displayed in GIS. This historical has been addressed, but develop a process or incorporate in WinCan implementation process so CCTV is identified accurately in GIS or other CMMS.	High	2.5
43	Renewal: Decision Making	Proactive Clean-out Upsize Program	Consider developing a proactive or opportunity clean-out upsizing program to provide better maintenance and inspection access to gravity sewers for crews.	Low/Medium	1.3
44	Overall Program	Improve Staff Retention	A large proportion of Vista O&M staff has been with the City for a short period of time. It is common for the City to hire an entry level candidate, train that person over the course of a year or more, and then lose them to another utility or contractor. This results in a significant loss of productivity and value invested in training the employee. Perform a thorough staff retention assessment to quantify the issue, identify improvements, and communicate those improvements to decision makers to determine how the City will respond to this issue.	Medium/High	2.3
45	Overall Program	Retirement planning	Develop plans for succession and retaining institutional knowledge for staff nearing retirement.	Low/Medium	1.5
46	Overall Program	Staff and Resources	Perform a workload projection to determine the appropriate number of Staff (field and office) to fully implement the program (CCTV monitoring, Cleaning, MH, Administration, Renewal). Perform this projection at regular intervals.	Low/Medium	1.8

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
47	Renewal: Decision Making	Renewal Decision Logic Pilot	Use the existing renewal decision logic output on recently collected CCTV data and perform renewal decision making on a pilot project of high risk pipe and high risk in-house repairs prior to implementation of InfoMaster. For each structural action recommended, review the video and document the appropriate Structural Action and Priority. Compare the "decision maker" value to the decision logic value. Where there are significant discrepancies, note the reason for this (CCTV coding quality, logic bug, logic update needed, other, etc.).	Medium	2.2
48	Renewal: Decision Making	Decision Making SOPs	Multiple parties including engineering and operations are making renewal decisions on pipe infrastructure. Create a system/process to track who is assessing which pipes in the system and to ensure proper coordination. Develop SOPs for staff making decisions that includes roles and responsibilities, frequency to run business decision logic (easy button), sequential steps to perform work, process for mining data, ad-hoc request intake, decision making process, prioritization process, documentation process including the generation of a WO, project packaging, backlog management, monitoring execution status, contractor coordination, in-house repair coordination, generation of reports to document program status/accomplishment, and other activities. SOPs should define sequential steps to perform this work and be written to the level of detail that the SOP can be used for training purposes. Consider also including the information needed to make a decision (GIS, video, attribute, condition, etc.), coordination with other programs, information system used for work (CMMS, CIP), and pipe monitoring program execution support.	Medium	2.0
49	Renewal: Decision Making	Record MH Renewal Work in CMMS/GIS	Similar to gravity sewer renewal work, capture rehabilitation work and date in CMMS/GIS for MHs.	Low/Medium	1.3
50	Renewal: Decision Making	Add Utilities to GIS	Add water utility lines to GIS if readily available to improve construction planning/scheduling/execution	Low	1.0
51	Renewal: Decision Making	Sewer Renewal Support Software	Implement InfoMaster software.	Medium/High	2.5
52	Renewal: Decision Making	Decision Making Training	Based on InfoMaster implementation and SOPs, train staff who will manage InfoMaster, provide staff with the appropriate software and data access. Plan for initial training and refresher training.	Medium/High	2.2
53	Renewal: Decision Making	Refine Renewal Process & Tool	Analysis of changes in recommended actions made by staff and modification to business logic to refine model to better reflect decisions staff are making.	Medium	2.0

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
54	Renewal: Decision Making	KPI: System Structural Risk Index	Create a "System Structural Risk Index" that measures the number of assets above a structural risk score threshold. Continuously monitor how this KPI changes over time to determine whether the overall condition of the system is improving, degrading, or remaining constant. Consider creating a long term goal. In this manner, we can better reflect the value the customer realizes from their investment.	Medium	2.0
55	Renewal: Decision Making	Assess Pipe Deterioration Rate	Perform a study to assess the deterioration rate of pipes over time. Various characteristics (diameter, slope, depth, material, location, cleaning frequency, etc.) would be assessed to determine the appropriate asset classes. The results of this study would be used to: • Update the useful life estimates • Develop renewal projections • Prioritize basins for CCTV inspections	Low	1.2
56	Renewal: Decision Making	Performance of CIPP	Perform a study to assess the performance of CIPP. Leverage results to refine useful life estimate, CIPP specs, acceptance procedures, and confirm that CIPP should continue to be the primary structural risk mitigation strategy employed.	Low	1.2
57	Data Management & Systems	Data Management SOP	Identify critical data management tasks and develop Standard Operating Procedures. Examples could include regular CMMS maintenance, CCTV synchronization, GIS synchronization, contractor work generation, mass ad-hoc work order creation, report generation, PM management, addition of assets, editing of asset data, abandoning assets, removing assets, and other key functions. Reference existing documentation where applicable. The City has these for GIS.	Low/Medium	1.7
58	Data Management & Systems	Pipe Capacity Information	Add Pipe Capacity information to CMMS for Engineering staff and O&M crews to use/be aware of. Populate the field with available capacity data.	Low/Medium	1.7
59	Asset Registry	Pipe Asset Registry Updates	Pipe Length: Determine which field to use for asset length for gravity sewers and force mains and document. The "Length" field has several assets with "0" length whereas the "Shape length" field from the GIS length is populated with a length. Using "Shape length" would result in a difference of approximately 6 miles added to City of Vista sewer and FM length and 1 mile subtracted from Buena Sanitation District Sewer and FM mileage. The current approach is to use "Length". Some stub-outs are documented with "0" length. Pipe Material: Material field is missing 19 miles or 6 percent. 18 of these miles are in Buena Sanitation District. Perform desktop analysis using parcel data, review of as-built records, and other readily available information to estimate material.	Medium	1.8

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
60	Asset Registry	MH Asset Registry Updates	Consider updating MH GIS with more accurate depth and invert elevation information (~3-5 percent have data gaps)	Medium	2.2
61	Asset Registry	Access Road Complete Registry	Digitize and update asset registry for remaining access roads	Medium	1.7
62	Asset Registry	Access Road Condition Assessment and Easement Maintenance Review	Perform drive through condition assessment for renewal planning. Consider how easement maintenance interrelates with access road condition assessment.	Low	1.0
63	FOG	FOG Program Updates	Update the FOG Section of the SSMP and FOG Source Control Program to reflect the next evolution in the FOG program.	Low/Medium	1.5
64	FOG	FOG Reporting	Develop management reports to track FOG program activities	Low/Medium	1.3
65	FOG	FOG Inspection Frequency Optimization	Evaluate FOG inspection frequencies to determine appropriate frequency for different risk facilities	Low/Medium	1.7
66	FOG	FOG Outreach	Provide grease cans as a handout at events	Low	1.0
67	SSMP	Encina MOU	Develop memorandum of understanding with Encina for lift station operations and maintenance. This memorandum could include the following:-level of service expectations, O&M plan and reports, critical equipment list and failure plan, site specific SSO and contingency plans, access to condition assessment and operations data-Consider documenting critical replacement parts or spares s in the City and District SSMP	Medium/High	2.3
68	SSMP	Update Overflow Response Plan	Complete the update currently in progress to the Overflow Emergency Response Plan and provide training on the updated plan to staff and field employees responsible for sewer overflow response, notification, and reporting.	High	3.0

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
69	SSMP	Refine SSMP Commitments	On 5/17/2016, a summary of commitments made in the SSMP and historic compliance with those commitments was provided to the City. In general, commitments made in the SSMP were aligned with operational targets based on assumed improvement in output. Due to a number of factors (aggressive goals, equipment downtime, staff turnover, etc.), many of the SSMP commitments are not regularly achieved. Even though Vista provides a high level of service to customers and the environment, failing to achieve these commitments exposes the City to unnecessary risk, particularly if a spill occurs on a pipe that is out of compliance with SSMP commitments. To reduce this risk, consider establishing a policy to sustain 100 percent compliance with SSMP commitments. The City should consider refining commitments to reflect system need and adjusting resources as needed to achieve 100 percent compliance. With the exception of achieving 100 percent compliance, decouple SSMP commitments with internal operational goals. For example, consider establishing a 5-year system wide cleaning schedule in the SSMP but define a more aggressive operational goal outside the SSMP. Actual cleaning need may be justified based on roots, grease, debris levels as determined by cleaning, CCTV, customer calls, and staff institutional knowledge.	High	2.5
70	SSMP	SSMP Minor Updates	Implement the low effort SSMP updates. This includes the following findings numbers from the 2016 audit: 1, 6, 7, 8, 9, 12, and 13. Also address the finding "Since adoption of the SSMP, the City and District have resolved all known issues with manholes that pose elevated risk of vandalism through mechanically locking those manholes. Therefore, this objective should be considered for removal from the SSMP." and "The City and District should add revision notes for design guidelines and sewer notes to track updates to standard drawing or specification files."	Medium	2.2
71	Data Management & Systems	SSMP Compliance KPIs	Develop KPIs for all SSMP commitments. If there is a distinct and more aggressive Operational Goal, report performance relative to both the SSMP commitment and the operational goal. The base data for current reports comes from the hand written journals. Excel spreadsheets are provided from the crew chiefs and are transferred to excel. Discrepancies exist between the reports and the data in the City's database of record (e.g. CityWorks, GIS, Granite). Change the basis of reporting to databases of record.	Medium/High	2.3
72	Data Management & Systems	Critical Non-SSMP Reporting	Currently, the City maintains reports that do not directly measure SSMP commitments. The basis for existing reports comes from the hand written journals. Discrepancies exist between the reports and the data in the City's database of record (e.g. CityWorks, GIS, Granite). Evaluate and prioritize the usefulness of each report and gaps in reporting. Develop new reports based on business needs and use the City's database of record as the basis for all reports.	Medium	1.9

Opportunities for Continuous Improvement Summary

No.	Activity	Opportunity Name	Description	Priority Group	Priority Score
73	Data Management & Systems	SSMP Compliance Forecast	For activities with a defined asset schedule (e.g. Cleaning, CCTV, MH Inspection), create a report that summarizes assets that are non-compliant or approaching non-compliance with enough lead time that O&M can develop a plan to execute work before the work leads to a compliance issue.	High	2.8
74	Laterals	CMMS Documentation	Work on laterals from call responses is documented. Document this work in the CMMS.	Low	1.3

Appendix D. Initiatives for Continuous Improvement

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Based on a series of workshops the Asset Management Team grouped opportunities for continuous improvement into initiatives and prioritized the initiatives. The initiatives for continuous improvement summary table include the following fields:

- **Init. No.** – Unique initiative number and initial sequence identified for implementation
- **Initiative Name** – Unique initiative name
- **Opportunity Name** – Unique opportunity name
- **Opp. No.** – Unique opportunity number
- **Priority Score** – The average priority score for the opportunity based on City staff voting

Initiatives for Continuous Improvement Summary

Init. No.	Initiative Name	Opportunity Name	Opp. No.	Priority Score
1	Work Order Data Entry	Work Order Data Entry	38	2.2
2	SSMP SSO Response Plan Update	Update Overflow Response Plan	68	3.0
3	CCTV Software Implementation	CCTV Software	3	3.0
		Code 1 (High Priority Work) Identification	11	3.0
		Coding and reviewing data that drives decisions	9	2.2
		Communicating Asset Condition to Crew	21	2.7
		Full Pipe CCTV w/ Coding	10	2.3
		Integration of CCTV inspections with GIS	42	2.5
		PACP Training	4	3.0
		Portable CCTV unit	1	2.5
		Contractor CCTV and Acceptance CCTV for Contracted Structural Actions	12	1.8
4	CCTV SOP Update, Training and QC Program	CCTV QC Plan	8	2.3
		CCTV SOP (Office)	5	2.8
		CCTV SOPs (Crew)	6	2.8
		CCTV Training Plan	7	2.2
		FOG Door Hanger Tracking	13	2.3
		Repair location marking training	34	2.3

Initiatives for Continuous Improvement Summary

Init. No.	Initiative Name	Opportunity Name	Opp. No.	Priority Score
5	Field IS Connectivity and Performance	Field connectivity	40	2.6
		Performance of crew tablets	39	2.6
6	SSMP Update & Compliance Monitoring	Encina MOU	67	2.3
		Pipe Asset Registry Updates	59	1.8
		Refine SSMP Commitments	69	2.5
		SSMP Compliance Forecast	73	2.8
		SSMP Compliance KPIs	71	2.3
		SSMP Minor Updates	70	2.2
7	Renewal Decision Making (Phase 1 - InfoMaster)	Add Utilities to GIS	50	1.0
		Decision Making SOPs	48	2.0
		Decision Making Training	52	2.2
		Pipe Capacity Information	58	1.7
		Renewal Decision Logic Pilot	47	2.2
		Repair Scheduling	28	2.3
		Sewer Renewal Support Software	51	2.5
8	Access and Repair Notifications	Letter Notice Prior to Repair	35	2.2
		Access Door Hangers and Letters	14	2.7
9	Refine Work Generation Process	Enhanced maintenance area optimization	23	2.2
		Implement Monitoring Program	2	2.5
		Root Control Identification	22	2.0
		Auto-generate CCTV Work Order After Repair	15	2.0
		Auto-generate CCTV Work Order After Call-out on Public Line	16	1.8
10	Staff Retention	Improve Staff Retention	44	2.3
11	Enhance Non-SSMP Reporting	Critical Non-SSMP Reporting	72	1.9
		KPI: System Structural Risk Index	54	2.0
12	Renewal Decision Making (Phase 2 - Refinement)	Refine Renewal Process & Tool	53	2.0
13	Streamline Data Entry & Access	Easement Contact Information	36	1.8
		Work Order History Access	41	1.4

Initiatives for Continuous Improvement Summary

Init. No.	Initiative Name	Opportunity Name	Opp. No.	Priority Score
14	Cleaning SOP Update, Training and QC Program	Cleaning QC Program (Crew)	20	2.3
		Cleaning SOP (Crew)	18	2.2
		Cleaning SOP (Office)	17	2.2
		Cleaning Training Program (Crew)	19	2.0
		JetScan Usage & Access	25	1.5
15	Repair SOP Update, Training and QC Program	Repair QC Plan	31	1.5
		Repair SOP (Crew)	30	2.0
		Repair SOP (Office)	29	2.3
		Repair Training Plan	32	2.0
		Repair Type Cross training	33	2.2
16	Document Non-Core Work in CMMS/GIS	CMMS Documentation	74	1.3
		Easement clearing documentation	37	1.7
		Record MH Renewal Work in CMMS/GIS	49	1.3
17	Develop Manhole Decision Making Process	MH Decision Making	27	1.2
		Update MH Inspection Form	26	1.7
18	Workload & Resource Planning	Cleaning Truck Replacement Planning	24	1.8
		Proactive Clean-out Upsize Program	43	1.3
		Retirement planning	45	1.5
		Staff and Resources	46	1.8
19	Asset Registry Updates	Access Road Complete Registry	61	1.7
		MH Asset Registry Updates	60	2.2
20	FOG Program Updates	FOG Inspection Frequency Optimization	65	1.7
		FOG Outreach	66	1.0
		FOG Program Updates	63	1.5
		FOG Reporting	64	1.3
21	Pipe Deterioration Studies	Assess Pipe Deterioration Rate	55	1.2
		Performance of CIPP	56	1.2
22	Data Management SOP	Data Management SOP	57	1.7

Initiatives for Continuous Improvement Summary

Init. No.	Initiative Name	Opportunity Name	Opp. No.	Priority Score
23	Access Road Condition Assessment	Access Road Condition Assessment and Easement Maintenance Review	62	1.0

Appendix E. Initiative Workload Forecast

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The workload forecast includes an assumption of hours required to implement each initiative. Some initiatives are assumed to be supported by contractors with City oversight. The hours for City staff and contractors were normalized to a percentage utilization based on an assumed full time equivalent (FTE) employee hours per year of 1,700 hours. The utilization forecast intent is an order of magnitude forecast for use in balancing the workload for initiative implementation over a 5-year period. Actual hours and staff utilization for implementation of the 23 identified initiatives will vary.

Init. No.	Initiative Name	Fiscal Year	Total Hours (City + Contractor)	City Hours	Contractor Hours	Notes on Workload Assumptions	Utilization of One City Staff's Time on Initiatives[1] (%)	Utilization Assumptions
1	Work Order Data Entry	FY 16/17	20	20	0	City: Assumes 20 hours for coordination between IT and Engineering / O&M	1	Assumes 100 percent of City hours for 1 staff
2	SSMP SSO Response Plan Update	FY 16/17	40	40	0	Assumes 40 hours to update	1	Assumes 25 percent of City hours for 1 staff
3	CCTV Software Implementation (Part 1)	FY 16/17	586	388	198	City: 2 days for 10 staff for PACP training and 3 days for 18 City staff for CCTV training by vendor. Assumes 1/2 day each for 8 City staff for each of 2 workshops. Assume 1 week of implementation support and testing by 3 City staff. Contractor: Hours under contract for Contractor.	2	Assumes 11 days for 1 staff
3	CCTV Software Implementation (Part 2)	FY 17/18	586	388	198	See Part 1 - Hours split between part 1 and part 2 due to work being performed in FY 16/17 and FY 17/18	2	See Part 1

Init. No.	Initiative Name	Fiscal Year	Total Hours (City + Contractor)	City Hours	Contractor Hours	Notes on Workload Assumptions	Utilization of One City Staff's Time on Initiatives[1] (%)	Utilization Assumptions
4	CCTV SOP Update, Training and QC Program	FY 17/18	768	588	180	City: City staff to update SOPs per mgmt. directive - assume 1 week for update of Crew and Office SOPs for 6 City staff and 2 days of training with 18 City staff. Fog door hanger - Assumes 60 hours to develop notification materials, automation process, perform reviews and implement, but does not include software upgrades if needed. Contractor: Support CCTV QC Plan - assume 1 workshop and 1 week by 2 Contractor staff. Consider external trainer for training plan development and training on SOPs - assume 120 hours.	7	Assumes 1 week and 2 days for update and training for 1 staff. Includes 60 hours for development of door hanger.
5	Field IS Connectivity and Performance	FY 17/18	40	40	0	City: Assume one or two workshop to review and discuss alternatives and pros/cons and identify functionality. Does not include time to update CityWorks and other programming. Assume 40 hours for coordination between IT centric resources and O&M / Engineering.	2	Assumes 100 percent of City hours for 1 staff
6	SSMP Update & Compliance Monitoring	FY 17/18	165	0	165	City: Asset Registry Updates - assume 4 hours to document policy on length and 40 hours to research materials for 19 miles of pipe. Encina MOU - assumes 20 hours to develop, review, and meet with Encina. Update SSO Response Plan - assumes 20 hours to update and 1/2 day training for 18 City staff. Refine SSMP Commitments and Minor SSMP Updates - assumes 40 hours. SSMP Compliance KPIs, Reporting, and Compliance Forecast - assumes 40 hours. Contractor: Perform SSMP Audit based on 2016 audit and some support for other opportunities.	0	Assume 25 percent of City hours for 1 staff

Init. No.	Initiative Name	Fiscal Year	Total Hours (City + Contractor)	City Hours	Contractor Hours	Notes on Workload Assumptions	Utilization of One City Staff's Time on Initiatives[1] (%)	Utilization Assumptions
7	Renewal Decision Making (Phase 1 - InfoMaster)	FY 17/18	582	212	370	City: Decision Making SOPs - Assumes initial pilot project using existing data to refine InfoMaster model 40 hours. Add water utility lines to GIS - assumes 20 hours. InfoMaster Implementation - Assumes 40 hours for programming import or export tables for use in GIS or City works for O&M and Engineering. Assumes 2 workshops with 8 City staff at 2 hours each to discuss modifying business logic to fit software and review results. Assumes 40 hours for City staff to implement data prep for input and output and input integration. Assume 20 hours to prioritize and schedule in-house point repairs based on decision logic output. Contractor: Hours in draft budget	6	GIS update not included. Assumes 50% of City hours for 1 staff.
8	Access and Repair Notifications	FY 18/19	60	60	0	City: Assumes 20 hours to develop letters and document processes. Assumes 40 hours to implement automation.	3	Assumes 75% of City hours for 1 staff
9	Refine Work Generation Process	FY 18/19	500	280	220	Assumes the following: 2 workshops and 120 hours (40 City and 80 Contractor) to develop packaging approach per year and document (includes repair and cleaning QC plan). 60 hours for City to package work for year 1. 120 hours 2 workshops (40 hours City and 80 Contractor) to train and learn to utilize InfoMaster or GIS functionality for packaging work and pushing to CityWorks. Assumes 100 hours for City to develop, document, and implement auto-generation of CCTV work order after repair and auto-generate CCTV work order after call-out on a public line. Assumes 100 hours (40 hours City and 60 hours contractor) to develop automation process for adding and removing pipes for root control.	8	Assumes 50% of City hours for 1 staff

Init. No.	Initiative Name	Fiscal Year	Total Hours (City + Contractor)	City Hours	Contractor Hours	Notes on Workload Assumptions	Utilization of One City Staff's Time on Initiatives[1] (%)	Utilization Assumptions
10	Staff Retention	FY 18/19	180	60	120	City: Assumes 60 hours for City staff (3 workshops at 2 hours each with 7 staff and time for review and presentation to management. Perform a thorough staff retention assessment to quantify the issue in terms of dollars, hours, or other measure; identify improvements; and communicate those improvements to decision makers to determine how the City will respond to this issue. Contractor: 120 hours for case study research, workshop materials development, report development.	4	Assumes 100% of City hours for 1 staff
11	Enhance Non-SSMP Reporting	FY 18/19	180	120	60	City: Assume 40 hours to develop System Structural Risk Index and develop critical non-SSMP reporting. Assume 80 hours to implement. Contractor: Assume 60 hours support for 1 workshop on reporting with 5 City staff.	5	Assumes 75% of City hours for 1 staff
12	Renewal Decision Making (Phase 2 - Refinement)	FY 18/19	147	52	95	City: Assumes 2 workshops with 8 City staff for 2 hours and 20 hours for data input and export modifications Contractor: Analysis of changes in recommended actions made by staff and modification to business logic to refine model to better reflect decisions staff are making. Assumes 1 workshop to discuss results of analysis and 1 workshop to modify business logic and discuss results	2	Assumes 50% of City hours for 1 staff
13	Streamline Data Entry & Access	FY 19/20	120	120	0	City: Assume 40 hours for ongoing easement contact information updates. Assume 80 hours for streamlining work order history access.	5	Assumes 75% of City hours for 1 staff

Init. No.	Initiative Name	Fiscal Year	Total Hours (City + Contractor)	City Hours	Contractor Hours	Notes on Workload Assumptions	Utilization of One City Staff's Time on Initiatives[1] (%)	Utilization Assumptions
14	Cleaning SOP Update, Training and QC Program	FY 19/20	648	528	180	[Similar assumptions as CCTV SOPs] City: City staff to update SOPs. Assume 1 week for update of Crew and Office SOPs for 6 City staff and 2 days of training with 18 City staff. Consider Jet Scan usage and access issues. Contractor: Support QC Plan - assume 1 workshop and 1 week by 2 Contractor staff. Consider external trainer for training plan development and training on SOPs - assume 120 hours.	7	Similar assumption as CCTV SOP initiative
15	Repair SOP Update, Training and QC Program	FY 19/20	768	588	180	[Similar assumptions as CCTV SOPs] City: City staff to update SOPs. Assume 1 week for update of Crew and Office SOPs for 6 City staff and 2 days of training with 18 City staff. Assume 60 hours Consider repair priorities and the appropriate amounts of different types of repairs (Main repairs, MH repairs) so crews are well rounded and workload is balanced. Contractor: Support QC Plan - assume 1 workshop and 1 week by 2 Contractor staff. Consider external trainer for training plan development and training on SOPs - assume 120 hours.	7	Similar assumption as CCTV SOP initiative

Init. No.	Initiative Name	Fiscal Year	Total Hours (City + Contractor)	City Hours	Contractor Hours	Notes on Workload Assumptions	Utilization of One City Staff's Time on Initiatives[1] (%)	Utilization Assumptions
16	Document Non-Core Work in CMMS/GIS	FY 19/20	280	280		City: Assumes 80 hours to input easements into CityWorks and 20 hours to document contractor completed work. Assumes documentation of MH renewal in CityWorks for City crews and GIS update based on as-built drawing process for CIP projects. Assumes 120 hours to develop process and develop understanding of ongoing level of effort. Assumes 80 hours to develop process and forms for documenting lateral work in CityWorks.	8	Assumes 50% of City hours for 1 staff
17	Develop Manhole Decision Making Process	FY 20/21	340	100	240	City: Assumes 3 workshops to develop MH decision making process with 8 City staff at 2 hours each and time for review Contractor: Assumes 240 hours to develop decision logic and report	3	Assume 50% of City hours for 1 staff
18	Workload & Resource Planning	FY 20/21	420	300	120	City: Assumes 300 hours to evaluate equipment, proactive clean-out upsize program, and retirement planning and staff workload analysis. Contractor: Assumes 120 hours for development of knowledge transfer tools and support on workload projections.	13	Assumes 75% of City hours for 1 staff
19	Asset Registry Updates	FY 20/21	200	200	0	City: Assumes 200 hours for MH asset registry updates and access road registry completion.	3	Assume 25% of City hours for 1 staff. Research and updates not included.
20	FOG Program Updates	FY 21/22	360	120	240	City: Assumes 120 hours for FOG program update, reporting, inspection frequency evaluation, and FOG outreach. Contractor: Assume 4 workshops and 240 hours to develop program update.	7	Assumes 100% of City hours for 1 staff

Init. No.	Initiative Name	Fiscal Year	Total Hours (City + Contractor)	City Hours	Contractor Hours	Notes on Workload Assumptions	Utilization of One City Staff's Time on Initiatives[1] (%)	Utilization Assumptions
21	Pipe Deterioration Studies	FY 21/22	280	80	200	City: Assume 80 hours for CIPP and pipe deterioration studies. Contractor: Assume 200 hours for data review, data analysis and report development.	5	Assumes 100% of City hours for 1 staff
22	Data Management SOP	FY 21/22	420	240	180	City: Assumes 240 hours for development of data management SOP. Contractor: Assumes 180 hours for support	11	Assumes 75% of City hours for 1 staff
23	Access Road Condition Assessment	FY 21/22	400	400	0	City: Assumes 8 access roads per day for 2 person crew and assumes 200 access roads.	2	Assumes 10% of City hours for 1 staff to coordinate with crews performing inspection and QC of data

[1] Assumes one City staff person participates in all activities and performs some initiative work. Different City staff will implement initiatives and actual utilization of staff time will vary. Full Time Equivalent Hours per year assumed to be 1,700 hours.

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Appendix F. CCTV Defect Code Renewal Types, Risk Scores, and Other Renewal Business Decision Logic Outputs

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Defect Code	Defect Code Description	Defect Severity Modifier	Defect Severity Group	Defect Score	Defect Renewal Type	Other Output for Business Decision Logic
B	Broken Pipe	L	2	55	A	--
B	Broken Pipe	M	3	30	A	--
B	Broken Pipe	S	5	5	A	--
BG	Bugs	--	--	--	--	--
BJ	Broken pipe at joint	L	2	55	A	--
BJ	Broken pipe at joint	M	3	30	A	--
BJ	Broken pipe at joint	S	5	5	A	--
C	Corrosion of CI	L	2	55	C	--
C	Corrosion of CI	M	3	30	C	--
C	Corrosion of CI	S	6	0	D	--
CB	Break in Connection	NA			N/A	--
CC	Circular Crack	L	4	15	A	--
CC	Circular Crack	M	5	5	A	--
CC	Circular Crack	S	6	0	A	--
CCJ	Circular Crack at joint	L	4	15	A	--
CCJ	Circular Crack at joint	M	5	5	A	--
CCJ	Circular Crack at joint	S	6	0	A	--
CG	Grease from	L	--	--	--	Maintenance Flag
CG	Grease from	M	--	--	--	Maintenance Flag
CG	Grease from	S	--	--	--	Maintenance Flag
CJ	Corrosion at joint	L	2	55	C	--
CJ	Corrosion at joint	M	3	30	C	--
CJ	Corrosion at joint	S	6	0	D	--
CL	Crack longitudinal	L	2	55	A	--
CL	Crack longitudinal	L	3	30	A	--
CL	Crack longitudinal	M	3	30	A	--
CL	Crack longitudinal	M	4	15	A	--
CL	Crack longitudinal	S	5	5	A	--
CLJ	Crack longitudinal at joint	L	2	55	A	--
CLJ	Crack longitudinal at joint	L	3	30	A	--
CLJ	Crack longitudinal at joint	M	3	30	A	--
CLJ	Crack longitudinal at joint	M	4	15	A	--

Defect Code	Defect Code Description	Defect Severity Modifier	Defect Severity Group	Defect Score	Defect Renewal Type	Other Output for Business Decision Logic
CLJ	Crack longitudinal at joint	S	5	5	A	--
CM	Cracks multiple	L	3	30	A	--
CM	Cracks multiple	M	5	5	A	--
CM	Cracks multiple	S	5	5	A	--
CMJ	Cracks multiple at joint	L	3	30	A	--
CMJ	Cracks multiple at joint	M	5	5	A	--
CMJ	Cracks multiple at joint	S	5	5	A	--
CN	Service Connection	--	--	--	--	--
CNI	Intruding Lateral	L	3	30	D	--
CNI	Intruding Lateral	M	3	30	D	--
CNI	Intruding Lateral	S	4	15	D	--
CO	Clean out	--	--	--	--	Clean Out Flag
CP	Plugged Connection	--	--	--	--	--
CR	Roots from lateral	L	--	--	--	Maintenance Flag
CR	Roots from lateral	M	--	--	--	Maintenance Flag
CR	Roots from lateral	S	--	--	--	Maintenance Flag
CRA	Roots around Lateral	L	4	15	A	Maintenance Flag
CRA	Roots around Lateral	M	6	5	A	Maintenance Flag
CRA	Roots around Lateral	S	6	0	A	--
CUB	Camera Submerged Begin	--	--	--	--	--
CUE	Camera Submerged End	--	--	--	--	--
CXC	Connection defective	L	2	55	A	--
CXC	Connection defective	M	6	5	A	--
CXC	Connection defective	S	6	0	A	--
D	Deformed sewer	L	1	60	C	--
D	Deformed sewer	M	2	55	C	--
D	Deformed sewer	S	3	30	A	--
DC	Diameter of sewer changes	--	--	--	--	--

Defect Code	Defect Code Description	Defect Severity Modifier	Defect Severity Group	Defect Score	Defect Renewal Type	Other Output for Business Decision Logic
DE	Debris	--	--	--	--	Maintenance Flag
DE	Debris	S	--	--	--	--
DE	Debris	L	--	--	--	Maintenance Flag
DEG	Debris (Grease)	L	--	--	--	Maintenance Flag
DEG	Debris (Grease)	M	--	--	--	Maintenance Flag
DEG	Debris (Grease)	S	--	--	--	--
DES	Debris silt	L	--	--	--	Maintenance Flag
DES	Debris silt	M	--	--	--	Maintenance Flag
DES	Debris silt	S	--	--	--	--
DF	End pipe sag	--	--	--	--	--
DND	Dead End	--	--	--	--	Dead End Flag
DS	Begin Pipe Sag	--	5	5	C	--
E	Mineral Deposits	--	--	--	--	--
E	Mineral Deposits	--	--	--	--	--
E	Mineral Deposits	--	--	--	--	--
FH	Finish of Surveys	--	--	--	--	--
GEJ	Gasket exposed at Joint	--	--	--	--	--
GO	General observation	--	--	--	--	--
GRT	Grout	--	--	--	--	--
H	Hole in sewer	L	1	60	C	--
H	Hole in sewer	M	2	55	A	--
H	Hole in sewer	S	5	5	A	--
I	Infiltration	L	2	55	A	--
I	Infiltration	M	3	30	A	--
I	Infiltration	S	6	0	A	--
IJ	Infiltration at joint	L	2	55	A	--

Defect Code	Defect Code Description	Defect Severity Modifier	Defect Severity Group	Defect Score	Defect Renewal Type	Other Output for Business Decision Logic
IJ	Infiltration at joint	M	3	30	A	--
IJ	Infiltration at joint	S	6	0	A	--
JD	Joint Displaced	L	3	30	C	--
JD	Joint Displaced	M	4	15	A	--
JD	Joint Displaced	S	6	0	A	--
LC	Lining Defect	L	2	55	B	--
LC	Lining Defect	M	2	55	B	--
LC	Lining Defect	S	6	0	B	--
LD	Bend in pipe down	--	--	--	--	Pipe Bend or Restricted MH Channel Flag
LL	Bend in pipe left	--	--	--	--	Pipe Bend or Restricted MH Channel Flag
LR	Bend in pipe right	--	--	--	--	Pipe Bend or Restricted MH Channel Flag
LU	Bend in pipe up	--	--	--	--	Pipe Bend or Restricted MH Channel Flag
MB	Manhole, buried	--	--	--	--	MH Buried Flag
MC	Material of sewer changes	--	--	--	--	--
MD	Manhole, Drop Connection	--	--	--	--	--
MH	Manhole/Node	--	--	--	--	--
MU	Manhole, Undocumented	--	--	--	--	MH Undocumented Flag
R	Roots	L	4	15	A	Maintenance Flag
R	Roots	M	5	5	A	Maintenance Flag
R	Roots	S	6	0	A	--
RJ	Roots at joint	L	4	15	A	Maintenance Flag
RJ	Roots at joint	M	5	5	A	Maintenance Flag
RJ	Roots at joint	S	6	0	A	--
RP	Reverse Pull	--	--	--	--	--

Defect Code	Defect Code Description	Defect Severity Modifier	Defect Severity Group	Defect Score	Defect Renewal Type	Other Output for Business Decision Logic
RS	Restricted Channel	--	--	--	--	Pipe Bend or Restricted MH Channel Flag
SA	Survey abandoned	--	--	--	E	Survey Abandoned Flag
SJ	Separated Joint	L	3	30	A	--
SJ	Separated Joint	M	4	15	A	--
SJ	Separated Joint	S	6	0	A	--
SR	Spot Repair	NA	N/A	N/A	N/A	--
SS	Erosion of CP	L	3	30	A	--
SS	Erosion of CP	M	4	15	A	--
SS	Erosion of CP	S	6	0	A	--
ST	Start of Survey	NA	N/A	N/A	N/A	--
V	Vermin (rats & mice)	NA	N/A	N/A	N/A	--
WL	Water level	NA	N/A	N/A	N/A	--
X	Sewer collapsed	--	1	60	C	--

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Appendix G. Cost Factors and Unit Costs

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Cost Factors

	Factor Description	Replacement		CIPP		Point Repair	
Installation Cost Factor (Applied first)	Installation Cost Factor is based on CIPP bid tabs and addresses the costs related to items such as mobilization, fittings, excavation, bedding, backfill, traffic control, by-pass pumping, equipment, labor, pavement or non-ROW patching or improvements.	Replacement	1.60	CIPP SD	1.50	Point Repair	1.2
		N/A	N/A	CIPP LD	1.60	N/A	N/A
Manhole Renewal Factor (Applied second)	Manhole Renewal Factor addresses the cost to renew a percentage of Manholes associated with replacement and CIPP projects	Assumed % of MHs Renewed in each Project for SD pipe	10%	Assumed % of MHs Renewed in each Project for SD pipe	10%	N/A	N/A
		Assumes 95% of LD pipe MHs are coated and 5% are renewed	N/A	Assumes 95% of LD pipe MHs are coated and 5% are renewed	N/A	N/A	N/A
		Apportioned Manhole cost per LF - SD	$6.90	Apportioned Manhole cost per LF - SD	$6.90	N/A	N/A
		Apportioned Manhole cost per LF - LD	$11.29	Apportioned Manhole cost per LF - LD	$11.29	N/A	N/A
Capital Cost Factor	The capital cost factor addresses the costs related to agency administration, design, construction management, and contingencies.	Replacement (Uses the sum of the below percentages)	1.40	CIPP (Uses the sum of the below percentages)	1.35	Point Repair (Uses the sum of the below percentages)	1.35
		Planning	3%	Planning	3%	Planning	3%
		Design	10%	Design	5%	Design	5%
		Legal	2%	Legal	2%	Legal	2%
		Construction Administration	10%	Construction Administration	10%	Construction Administration	10%
		Owner Administration	5%	Owner Administration	5%	Owner Administration	5%
		Contingency	10%	Contingency	10%	Contingency	10%
		Subtotal Capital Cost Factor	40%	Subtotal	35%	Subtotal	35%
Easement Contingency Factor	The Easement Contingency Factor addresses additional costs associated with an approximate percentage of pipe that may require easement acquisition.	Easement Contingency	30%	Easement Contingency	30%	Easement Contingency	30%
		Easement Contingency % - Assumed % of pipes requiring easement contingency	10%	Easement Contingency % - Assumed % of pipes requiring easement contingency	10%	Easement Contingency % - Assumed % of pipes requiring easement contingency	10%
		Subtotal Easement Contingency Factor	3.00%	Subtotal	3.00%	Subtotal	3.00%
Capital + Easement Contingency Factor (Applied third)		Replacement	1.43	CIPP	1.38	Point Repair	1.38

Unit Costs	Y	A = Z x Y	B	C = A x B	D	E = (A x B) + D	F	G = F x E	H	I = H x E
Renewal Action	Diameter	Material Cost per LF or Point Repair	Installation Factor	Construction Cost (No MHs) / LF or Point Repair [Used to check against bid tabs]	MH Cost Factor	Construction Costs / LF or Point Repair	Capital Cost Factor	Capital Costs / LF or Point Repair	Capital Cost Factor with Easement Contingency Factor	Capital Costs with Easement Contingency Factor / LF or Point Repair (Includes project packaging yield increase factor for CIPP SD)
Replace SD	0	$86	1.60	$137	6.90	$144	1.40	$202	1.43	$206
Replace SD	4	$86	1.60	$137	6.90	$144	1.40	$202	1.43	$206
Replace SD	6	$86	1.60	$137	6.90	$144	1.40	$202	1.43	$206
Replace SD	8	$86	1.60	$137	6.90	$144	1.40	$202	1.43	$206
Replace SD	10	$108	1.60	$172	6.90	$179	1.40	$250	1.43	$256
Replace SD	12	$129	1.60	$206	6.90	$213	1.40	$298	1.43	$305
Replace SD	14	$151	1.60	$241	6.90	$247	1.40	$346	1.43	$354
Replace SD	15	$161	1.60	$258	6.90	$265	1.40	$370	1.43	$378
Replace LD	16	$172	1.60	$275	11.29	$286	1.40	$401	1.43	$409
Replace LD	18	$194	1.60	$309	11.29	$321	1.40	$449	1.43	$458
Replace LD	20	$215	1.60	$344	11.29	$355	1.40	$497	1.43	$507
Replace LD	21	$226	1.60	$361	11.29	$372	1.40	$521	1.43	$532
Replace LD	24	$258	1.60	$412	11.29	$424	1.40	$593	1.43	$606
Replace LD	27	$290	1.60	$464	11.29	$475	1.40	$665	1.43	$679
Replace LD	30	$323	1.60	$515	11.29	$527	1.40	$737	1.43	$753
Replace LD	36	$387	1.60	$618	11.29	$630	1.40	$882	1.43	$901
Replace LD	42	$452	1.60	$722	11.29	$733	1.40	$1,026	1.43	$1,048
CIPP SD	0	$27	1.50	$41	6.90	$47	1.40	$66	1.43	$81
CIPP SD	4	$27	1.50	$41	6.90	$47	1.40	$66	1.43	$81
CIPP SD	6	$27	1.50	$41	6.90	$47	1.40	$66	1.43	$81
CIPP SD	8	$27	1.50	$41	6.90	$47	1.40	$66	1.43	$81
CIPP SD	10	$30	1.50	$45	6.90	$52	1.40	$73	1.43	$89
CIPP SD	12	$36	1.50	$54	6.90	$61	1.40	$85	1.43	$105
CIPP SD	14	$42	1.50	$63	6.90	$70	1.40	$98	1.43	$120
CIPP SD	15	$71	1.60	$114	6.90	$121	1.40	$169	1.43	$207
CIPP LD	16	$76	1.60	$121	11.29	$133	1.40	$186	1.43	$190
CIPP LD	18	$86	1.60	$137	11.29	$148	1.40	$207	1.43	$212
CIPP LD	20	$95	1.60	$152	11.29	$163	1.40	$228	1.43	$233
CIPP LD	21	$100	1.60	$159	11.29	$171	1.40	$239	1.43	$244
CIPP LD	24	$114	1.60	$182	11.29	$193	1.40	$271	1.43	$277
CIPP LD	27	$128	1.60	$205	11.29	$216	1.40	$303	1.43	$309
CIPP LD	30	$143	1.60	$228	11.29	$239	1.40	$335	1.43	$342
CIPP LD	36	$171	1.60	$273	11.29	$285	1.40	$398	1.43	$407

Unit Costs	Y	A = Z x Y	B	C = A x B	D	E = (A x B) + D	F	G = F x E	H	I = H x E
Renewal Action	Diameter	Material Cost per LF or Point Repair	Installation Factor	Construction Cost (No MHs) / LF or Point Repair [Used to check against bid tabs]	MH Cost Factor	Construction Costs / LF or Point Repair	Capital Cost Factor	Capital Costs / LF or Point Repair	Capital Cost Factor with Easement Contingency Factor	Capital Costs with Easement Contingency Factor / LF or Point Repair (Includes project packaging yield increase factor for CIPP SD)
CIPP LD	42	$200	1.60	$319	11.29	$330	1.40	$462	1.43	$472
Contractor Point Repair SD	0	$15,403	1.20	$18,484	N/A	N/A	1.35	$24,953	1.38	$25,507
Contractor Point Repair SD	4	$15,403	1.20	$18,484	N/A	N/A	1.35	$24,953	1.38	$25,507
Contractor Point Repair SD	6	$15,403	1.20	$18,484	N/A	N/A	1.35	$24,953	1.38	$25,507
Contractor Point Repair SD	8	$15,403	1.20	$18,484	N/A	N/A	1.35	$24,953	1.38	$25,507
Contractor Point Repair SD	10	$17,000	1.20	$20,400	N/A	N/A	1.35	$27,540	1.38	$28,152
Contractor Point Repair SD	12	$18,500	1.20	$22,200	N/A	N/A	1.35	$29,970	1.38	$30,636
Contractor Point Repair SD	14	$20,500	1.20	$24,600	N/A	N/A	1.35	$33,210	1.38	$33,948
Contractor Point Repair SD	15	$22,500	1.20	$27,000	N/A	N/A	1.35	$36,450	1.38	$37,260
Contractor Point Repair LD	16	$24,500	1.20	$29,400	N/A	N/A	1.35	$39,690	1.38	$40,572
Contractor Point Repair LD	18	$27,000	1.20	$32,400	N/A	N/A	1.35	$43,740	1.38	$44,712
Contractor Point Repair LD	20	$30,000	1.20	$36,000	N/A	N/A	1.35	$48,600	1.38	$49,680
Contractor Point Repair LD	21	$31,500	1.20	$37,800	N/A	N/A	1.35	$51,030	1.38	$52,164
Contractor Point Repair LD	24	$34,500	1.20	$41,400	N/A	N/A	1.35	$55,890	1.38	$57,132
Contractor Point Repair LD	27	$37,500	1.20	$45,000	N/A	N/A	1.35	$60,750	1.38	$62,100
Contractor Point Repair LD	30	$40,500	1.20	$48,600	N/A	N/A	1.35	$65,610	1.38	$67,068
Contractor Point Repair LD	36	$43,500	1.20	$52,200	N/A	N/A	1.35	$70,470	1.38	$72,036
Contractor Point Repair LD	42	$46,500	1.20	$55,800	N/A	N/A	1.35	$75,330	1.38	$77,004

Unit Costs	Y	A = Z x Y	B	C = A x B	D	E = (A x B) + D	F	G = F x E	H	I = H x E
Renewal Action	Diameter	Material Cost per LF or Point Repair	Installation Factor	Construction Cost (No MHs) / LF or Point Repair [Used to check against bid tabs]	MH Cost Factor	Construction Costs / LF or Point Repair	Capital Cost Factor	Capital Costs / LF or Point Repair	Capital Cost Factor with Easement Contingency Factor	Capital Costs with Easement Contingency Factor / LF or Point Repair (Includes project packaging yield increase factor for CIPP SD)
Point Repair + CIPP SD	0	Point Repair + CIPP SD = CIPP SD unit cost per LF + Crew Point Repair Cost*1.5 Point Repairs per Pipe / 195 feet average pipe length								$97
Point Repair + CIPP SD	4									$97
Point Repair + CIPP SD	6									$97
Point Repair + CIPP SD	8									$97
Point Repair + CIPP SD	10									$104
Point Repair + CIPP SD	12									$120
Point Repair + CIPP SD	14									$135
Point Repair + CIPP SD	15									$223
Point Repair + CIPP SD	16									$205
Point Repair + CIPP SD	18									$227
Point Repair + CIPP SD	20									$249
Point Repair + CIPP SD	21									$259
Point Repair + CIPP SD	24									$292
Point Repair + CIPP SD	27									$325
Point Repair + CIPP SD	30									$357
Point Repair + CIPP SD	36									$422
Point Repair + CIPP SD	42									$487

Unit Costs	Y	A = Z x Y	B	C = A x B	D	E = (A x B) + D	F	G = F x E	H	I = H x E
Renewal Action	Diameter	Material Cost per LF or Point Repair	Installation Factor	Construction Cost (No MHs) / LF or Point Repair [Used to check against bid tabs]	MH Cost Factor	Construction Costs / LF or Point Repair	Capital Cost Factor	Capital Costs / LF or Point Repair	Capital Cost Factor with Easement Contingency Factor	Capital Costs with Easement Contingency Factor / LF or Point Repair (Includes project packaging yield increase factor for CIPP SD)
Crew Point Repair SD	0	Crew Point Repair Costs provided City and District								$2,000
Crew Point Repair SD	4									$2,000
Crew Point Repair SD	6									$2,000
Crew Point Repair SD	8									$2,000
Crew Point Repair SD	10									$2,000
Crew Point Repair SD	12									$2,000
Crew Point Repair SD	14									$2,000
Crew Point Repair SD	15									$2,000
Crew Point Repair LD	16									$2,000
Crew Point Repair LD	18									$2,000
Crew Point Repair LD	20									$2,000
Crew Point Repair LD	21									$2,000
Crew Point Repair LD	24									$2,000
Crew Point Repair LD	27									$2,000
Crew Point Repair LD	30									$2,000
Crew Point Repair LD	36									$2,000
Crew Point Repair LD	42									$2,000

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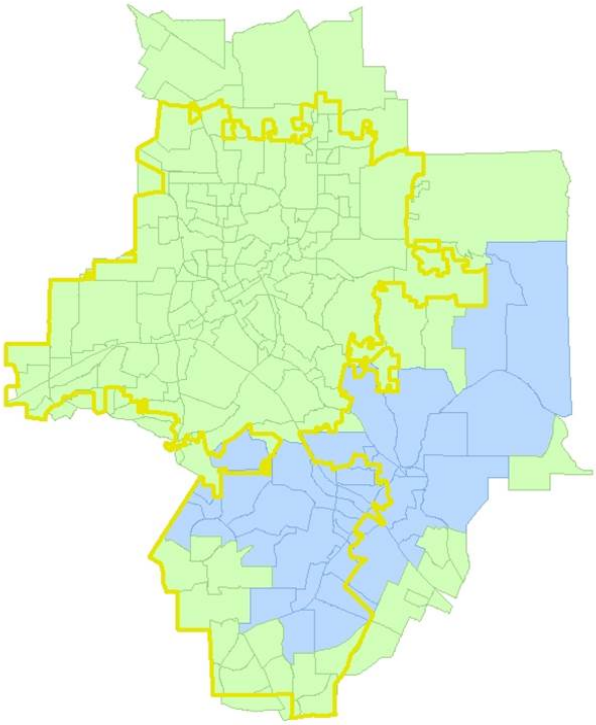

Asset Management Plan

ATTACHMENT A: DECISION LOGIC RENEWAL ACTIONS

City of Vista Comprehensive Sewer Management Plan

August 2017

Prepared for

City of Vista
Buena Sanitation District

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Attachment A is organized into two sections. The first is Engineering Renewal Actions. These renewal actions are typically reviewed, updated, and packaged by City engineering staff and include CIPP, Point Repair and CIPP, Contractor Point Repair, and Replace. The second section is Public Works Renewal Actions. These renewal actions are typically reviewed, updated and packaged by City public works staff and include Crew Point Repairs and Cut Tap or Obstacle. The tables include information from GIS and the renewal business decision logic. The structural risk score (SRS) is equal to the sum of consequence of failure (CoF) and likelihood of failure (LoF). Actual renewal actions and cost will vary based on many factors such as professional judgment of City staff, actual pipe conditions, and project site considerations. The assets in each table are organized from highest to lowest SRS.

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Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V22118-V22119	V22	280	6	VCP	0.090	3.8	80	83.8	10851	20110419	Replace SD	$57,696
V13134-V13135	V13	460	6	VCP	0.010	0.0	80	80	10017	20100405	Replace SD	$94,946
V08105-V08109	V08	323	6	VCP	0.006	4.8	75	79.8	11443	20110606	Replace SD	$66,668
V22129-V22130	V22	177	8	VCP	0.004	9.5	70	79.5	10474	20110317	Point Repair and CIPP SD	$17,119
V08037-V08134	V08	290	6		0.000	3.8	75	78.8	10725	20110607	Replace SD	$59,865
V04005-V04006	V04	263	8	VCP	0.078	1.5	75	76.5	13483	20131022	Contractor Point Repair SD	$38,261
V23177-V23178	V23	208	6	VCP	0.132	1.5	75	76.5	9412	20100727	Replace SD	$42,932
B11095-B11096	B11	160	8	VCP	0.030	0.6	75	75.6	7716	20090210	Point Repair and CIPP SD	$15,475
B13189-B13190	B13	165	6	VCP	0.018	0.6	75	75.6	12250	20101228	Replace SD	$34,098
V09028-V09029	V09	428	6	VCP	0.051	0.6	75	75.6	10639	20110301	Replace SD	$88,436
V23204-V23205	V23	210	6	VCP	0.015	0.6	75	75.6	9440	20100824	Replace SD	$43,345
V12092-V12093	V12	131	6	VCP	0.058	0.6	75	75.6	11905	20110607	Replace SD	$27,039
V31023-V31024	V31	178	6	VCP	0.000	0.6	75	75.6	14089	20150922	Replace SD	$36,740
V13122-V13123	V13	390	6	VCP	0.012	0.6	75	75.6	10012	20100406	Replace SD	$80,497
V23210-V23211	V23	379	6	VCP	0.120	0.6	75	75.6	9446	20100826	Replace SD	$78,227
V08004.A0-V08004	V08	270	6	VCP	0.089	0.6	75	76	10710	20110524	Replace SD	$55,729
V09052-V09053	V09	455	8	VCP	0.011	0.0	75	75	10667	20110307	Point Repair and CIPP SD	$44,007
V13102-V13103	V13	245	6	VCP	0.073	0.0	75	75	9993	20100308	Replace SD	$50,569
V28121-V28122	V28	399	8	VCP/CIP	0.050	0.0	75	75	6796	20070612	CIPP SD	$32,489
V22091-V22092	V22	235	6	VCP	0.164	0.0	75	75	10825	20110406	Replace SD	$48,505

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V26234-V26235	V26	364	8	VCP	0.008	0.0	75	75	11351	20110926	Point Repair and CIPP SD	$35,206
V12106-V12108	V12	306	6	VCP	0.030	0.0	75	75	14048	20150806	Replace SD	$63,159
V30055-V30056.A0	V30	152	10	VCP	0.020	0.0	75	75	6865	20080317	Point Repair and CIPP SD	$15,848
V29094-V29095	V29	162	8	VCP	0.140	0.0	75	75	6832	20071008	Point Repair and CIPP SD	$15,669
V23097-V23099	V23	203	6	VCP	0.240	0.0	75	75	9332	20100728	Replace SD	$41,900
V08089-V08090	V08	333	6	VCP	0.045	4.8	70	74.8	11427	20110526	Replace SD	$68,732
V08108-V08109	V08	245	6	VCP	0.048	4.8	70	74.8	11434	20110601	Replace SD	$50,569
V12032-V12034	V12	256	6	VCP	0.090	4.7	70	74.7	14040	20150602	Contractor Point Repair SD	$38,261
V15116-V15117	V15	399	8	VCP	0.012	1.5	73	74.5	8641	20100428	Point Repair and CIPP SD	$38,591
B04099-B04100	B04	361	8	VCP/CIP	0.100	3.2	70	73.2	10103	20110322	Point Repair and CIPP SD	$34,896
V08048-V08049	V08	250	6	VCP	0.054	3.2	70	73.2	11405	20110525	Replace SD	$51,601
V08045-V08049	V08	260	6	VCP	0.006	3.2	70	73.2	9047	20091019	Replace SD	$53,665
V05039-V05040	V05	312	8	VCP	0.040	3.2	70	73.2	6202	20080117	Point Repair and CIPP SD	$30,173
V24030-V24031	V24	188	6	VCP	-1.156	3.2	70	73.2	10586	20110330	Replace SD	$38,804
V29044-V29045.C0	V29	376	8	VCP	0.060	1.5	71	72.5	5068	20081223	Contractor Point Repair SD	$38,261
V26210-V26213	V26	117	8	VCP	0.166	1.5	71	72.5	11314	20110920	Point Repair and CIPP SD	$11,316
V03174-V03175	V03	257	8	VCP	0.043	6.3	66	72.3	7353	20090106	CIPP SD	$20,911
B04054.J0-B04054.K0	B04	47	6	VCP	0.009	3.8	68	71.8	8432	20090803	Replace SD	$9,720
V06014-V06015	V06	306	6	VCP	0.003	1.5	70	71.5	12343	20120118	Replace SD	$63,159
V16029-V16031	V16	150	6	VCP	0.000	1.5	70	71.5	14013	20150122	Contractor Point Repair SD	$38,261

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V31070-V31071	V31	182	8	VCP	0.156	1.5	70	71.5	12863	20121227	CIPP SD	$14,803
V23178-V23179	V23	300	6	VCP	0.092	1.5	70	71.5	9413	20100728	Replace SD	$61,921
V26128-V26129	V26	152	8	VCP	0.057	1.5	70	71.5	11209	20110927	CIPP SD	$12,363
V22017-V22018	V22	115	6	VCP	0.033	1.5	70	72	12791	20121010	Contractor Point Repair SD	$38,261
V31049-V31051	V31	287	8	VCP	0.017	1.5	70	71.5	8412	20090629	CIPP SD	$23,343
V24015-V24016	V24	717	6	VCP	0.010	1.5	70	71.5	13678	20140227	Replace SD	$147,991
V29098-V29099	V29	236	8	VCP	0.130	0.0	71	71	5101	20081231	CIPP SD	$19,195
V26202-V26203	V26	255	8	VCP	0.051	0.0	71	71	11306	20110830	Point Repair and CIPP SD	$24,663
V09022-V09023	V09	348	6	VCP	0.040	0.6	70	70.6	10632	20110224	Replace SD	$71,766
V09009-V09010	V09	349	8	VCP	0.005	0.6	70	70.6	10611	20110222	CIPP SD	$28,378
V09030-V09031	V09	148	6	VCP	0.086	0.6	70	70.6	10640	20110309	Replace SD	$30,469
V23164-V23165	V23	325	8	VCP	0.106	0.6	70	70.6	2383	20080609	CIPP SD	$26,434
B11077-B11078	B11	163	8	VCP	0.033	0.6	70	70.6	3876	20081008	CIPP SD	$13,258
V12009-V12011	V12	150	6	VCP	0.157	0.6	70	70.6	14050	20150617	Replace SD	$30,961
V11064-V11065	V11	315	8	VCP	0.004	0.0	70	70	6448	20080429	CIPP SD	$25,621
V10056-V10058	V10	270	8	VCP	0.024	0.0	70	70	9160	20100111	CIPP SD	$21,960
V11088.A0-V11088	V11	301	8	VCP	0.050	0.0	70	70	6459	20080429	CIPP SD	$24,481
V07053-V07054	V07	301	8	VCP	0.020	0.0	70	70	6355	20080312	Point Repair and CIPP SD	$29,113
V31068-V31070	V31	107	8	VCP	0.147	0.0	70	70	7632	20090203	CIPP SD	$8,703
V31041-V31042	V31	266	8	VCP	0.042	0.0	70	70	6904	20070426	CIPP SD	$21,635

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V31111-V31116.F0	V31	342	8	VCP	0.003	0.0	70	70	14654	20160308	CIPP SD	$27,817
V23108-V23109	V23	387	8	VCP	0.139	0.0	70	70	2325	20080605	CIPP SD	$31,477
V23093.J0-V23093	V23	135	6	VCP	0.050	0.0	70	70	9328	20100826	Replace SD	$27,770
V29099-V29100	V29	117	8	VCP	0.150	0.0	69	69	13555	20140114	CIPP SD	$9,516
V22131-V22132	V22	403	8	VCP	0.009	9.0	60	69	10476	20110321	CIPP SD	$32,778
V06068-V06069	V06	183	8	VCP	0.005	1.5	67	68.5	6297	20061218	CIPP SD	$14,884
V23171-V23172	V23	247	8	VCP	0.133	0.6	67	67.6	6701	20061128	CIPP SD	$20,090
V11123-V10141.A0	V10	308	15	VCP	0.021	3.2	64	67.2	6461	20070626	Point Repair and CIPP SD	$68,564
V26057-V26058	V26	187	8	VCP	0.070	0.0	67	67	11125	20110810	Point Repair and CIPP SD	$18,087
V22144-V22145	V22	307	10	VCP	0.029	9.0	58	67	6686	20071114	CIPP SD	$27,367
V01006-V01007	V01	201	8		0.007	0.0	67	67	1218	20080731	CIPP SD	$16,386
V31043-V31044	V31	42	8	VCP	-2.788	3.0	64	67	6906	20070430	CIPP SD	$3,416
V29129-V29139	V29	357	8	DIP	0.078	9.5	57	66.5	5067	20081219	Contractor Point Repair SD	$38,261
V05105-V05106	V05	201	10	VCP	-0.001	9.5	57	66.5	6151	20080116	CIPP SD	$17,932
V12040-V12041	V12	96	8	VCP	0.010	6.3	60	66.3	6478	20080423	CIPP SD	$7,805
V12059-V12060	V12	196	10	VCP	0.010	6.3	60	66.3	6484	20080423	CIPP SD	$17,448
V10059-V10060	V10	131	8	VCP	0.042	0.0	66	66	9165	20100111	CIPP SD	$10,643
V23007-V23008	V23	256	8	VCP	0.008	0.0	66	66	2295	20080520	CIPP SD	$20,822
V26075-V26076	V26	222	8	VCP	0.157	0.0	66	66	6735	20080116	CIPP SD	$18,019
B13103.E0-B13103.G0	B13	202	8	VCP	0.060	0.6	65	65.6	12163	20101227	Point Repair and CIPP SD	$19,501

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V15118-V15119	V15	330	8	VCP	0.010	1.5	64	65.5	8633	20100428	CIPP SD	$26,841
V29070-V29071	V29	345	8	VCP	0.053	0.6	64	64.6	5095	20081230	CIPP SD	$28,061
V29106-V29109	V29	161	8	VCP	0.004	0.6	64	64.6	2863	20080716	CIPP SD	$13,128
V22132-V22133	V22	139	8	VCP	0.021	7.4	57	64.4	7439	20090216	CIPP SD	$11,306
V02012.A0-V02012.B0	V02	345	8	PVC	0.034	0.0	64	64	1269	20080630	Point Repair and CIPP SD	$33,368
V13091-V13092	V13	290	8	VCP	0.064	0.0	64	64	1813	20080821	CIPP SD	$23,587
V29043-V29044	V29	242	8	VCP	0.050	0.0	64	64	2819	20080620	CIPP SD	$19,683
B09088-B09089	B09	293	8	VCP	0.020	0.0	64	64	7057	20090129	CIPP SD	$23,831
V22033-V22034	V22	188	8	VCP	0.057	0.0	64	64	2212	20080617	CIPP SD	$15,318
B03128-B03129	B03	277	8	VCP	0.010	0.0	64	64	11614	20111117	CIPP SD	$22,530
V03062-V03063	V03	250	8	VCP	0.121	0.6	63	63.6	7288	20081210	CIPP SD	$20,334
V18023.F0-V18023	V18	149	8	PVC	0.006	1.5	62	63.5	2062	20080813	CIPP SD	$12,087
V32049-V32162	V32	52	8	VCP	0.090	6.4	57	63.4	3210	20080924	CIPP SD	$4,229
B04047-B04048	B04	280	8	VCP	0.052	7.0	56	63	5627	20070410	CIPP SD	$22,774
V15090-V15091	V15	309	8	VCP	0.043	0.6	62	62.6	7518	20090212	CIPP SD	$25,129
V06075-V06089	V06	175	8	VCP	0.056	1.5	61	62.5	6304	20061214	Contractor Point Repair SD	$38,261
V28026-V28027	V28	163	8	VCP	0.000	0.0	62	62	13327	20130225	CIPP SD	$13,288
V13032-V13033	V13	214	8	VCP	0.089	0.0	62	62	7688	20090213	CIPP SD	$17,411
V31045-V31047	V31	178	8	VCP	0.080	0.0	62	62	6908	20070430	CIPP SD	$14,478
V29064-V29065	V29	329	8	VCP	0.045	3.0	59	62	2859	20080716	CIPP SD	$26,777

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V29024-V29031	V29	250	8	VCP	0.030	4.8	57	61.8	5079	20081226	CIPP SD	$20,334
V12022.B0-V12022	V12	399	8	VCP	0.010	4.7	57	61.7	6474	20080422	CIPP SD	$32,453
V29075-V29077	V29	157	8	VCP	0.002	1.5	60	61.5	5098	20081230	CIPP SD	$12,780
V31024-V31025	V31	294	8	VCP	0.000	1.5	60	61.5	14092	20151006	CIPP SD	$23,912
V29023-V29024	V29	216	8	VCP	0.040	3.2	58	61.2	5078	20081226	CIPP SD	$17,550
V10057-V10058	V10	255	8	VCP	-0.198	3.0	58	61	9161	20100111	CIPP SD	$20,740
V17005-V17006	V17	347	8	VCP	0.000	0.0	61	61	7259	20090107	CIPP SD	$28,223
OV4028.A0-OV4028	OV4	75	10	VCP	0.012	3.8	57	60.8	11960	20110720	CIPP SD	$6,697
V03157-V03158	V03	236	12	PVC	0.020	4.7	56	60.7	1349	20080702	Contractor Point Repair SD	$45,954
V05040-V05041	V05	28	8	VCP	-0.013	4.7	56	60.7	6203	20080130	Contractor Point Repair SD	$38,261
B04032-B04033	B04	171	8	PVC	0.065	4.7	56	60.7	375	20080623	Contractor Point Repair SD	$38,261
V08136-V08137	V08	257	8	PVC	0.006	4.7	56	60.7	1557	20080528	Contractor Point Repair SD	$38,261
V12021-V12022	V12	420	8	VCP	0.040	4.7	56	60.7	6471	20061207	CIPP SD	$34,161
V23029-V23030	V23	120	8	VCP	0.080	0.6	60	60.6	2270	20080516	CIPP SD	$9,760
V30026-V30027.E0	V30	335	8	VCP/DIP	0.005	1.5	59	60.5	8395	20090622	CIPP SD	$27,259
V10010-V10011	V10	270	8	VCP	0.071	0.0	60	60	9081	20091216	CIPP SD	$21,960
V10058-V10060	V10	60	8	VCP	0.028	0.0	60	60	9162	20100111	CIPP SD	$4,904
V13026-V13027	V13	113	8	VCP	0.140	0.0	60	60	1801	20080820	CIPP SD	$9,191
B13043-B13222.B0	B13	317	8	VCP	0.045	0.0	60	60	671	20080828	Point Repair and CIPP SD	$30,668
V29102-V29103	V29	79	8	VCP	0.010	0.0	60	60	5107	20081231	CIPP SD	$6,425

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V11014-V11015	V11	291	8	VCP	0.036	0.0	60	60	7723	20090209	CIPP SD	$23,668
V13031-V13032	V13	92	8	VCP	0.106	0.6	59	59.6	8364	20090701	CIPP SD	$7,497
V26141-V26142	V26	45	8	VCP	0.004	0.6	59	59.6	11233	20110824	CIPP SD	$3,660
V06078-V06079	V06	183	8	VCP	0.030	0.6	59	59.6	11902	20111017	CIPP SD	$14,884
B10020-B10021	B10	225	8	VCP	0.004	0.6	59	59.6	521	20080804	CIPP SD	$18,287
V09003-V09004	V09	337	8	VCP	0.005	1.5	58	59.5	6375	20061108	CIPP SD	$27,410
V29056-V29063	V29	281	8	VCP	0.005	1.5	58	59.5	2856	20080716	CIPP SD	$22,874
V33144-V33146	V33	346	15	PVC	0.004	3.2	56	59.2	3387	20080827	CIPP SD	$71,703
V20037-V20040	V20	243	8	VCP	0.007	0.0	59	59	3749	20080926	CIPP SD	$19,799
V30016-V30017	V30	300	8	VCP	0.095	0.6	58	58.6	11926	20111121	CIPP SD	$24,400
V31046-V31047	V31	100	8	VCP	-0.697	0.6	58	58.6	6909	20070430	CIPP SD	$8,156
V14077.B0-V14077.C0	V14	319	8	PVC	0.005	1.5	57	58.5	8241	20090310	Contractor Point Repair SD	$38,261
V02011-V02014	V02	259	8	VCP	0.030	1.5	57	58.5	8597	20100420	Contractor Point Repair SD	$38,261
V16022-V16023	V16	191	8	VCP	0.018	1.5	57	58.5	6507	20080421	CIPP SD	$15,535
V10003-V10006	V10	348	8	VCP	0.004	1.5	57	58.5	6409	20080309	CIPP SD	$28,305
V19087-V19088	V19	350	8	VCP	0.004	1.5	57	58.5	2168	20080908	CIPP SD	$28,467
B14171-B14172	B14	73	8	ABS	0.066	1.5	57	58.5	5009	20081027	Contractor Point Repair SD	$38,261
V29067-V29068	V29	308	8	VCP	0.030	1.5	57	58.5	8394	20090608	CIPP SD	$25,051
V07014-V07015	V07	328	8	VCP	0.023	1.5	57	58.5	1494	20080717	CIPP SD	$26,678
V01061-V32153	V32	380	24	VCP	0.004	15.1	43	58.1	5403	20081202	CIPP LD	$105,251

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V14084-V14085	V14	337	8	VCP	0.032	0.0	58	58	8231	20090303	CIPP SD	$27,410
V13057-V13058	V13	83	8	VCP	0.038	0.0	58	58	1806	20080821	CIPP SD	$6,778
V30044-V30050	V30	363	10	VCP	0.028	0.0	58	58	6844	20070802	CIPP SD	$32,328
V23060-V23061	V23	112	8	VCP	0.075	0.0	58	58	2291	20080519	CIPP SD	$9,131
V26067-V26068	V26	217	8	VCP	0.096	0.0	58	58	11134	20110810	CIPP SD	$17,650
V26146-V26147.F0	V26	43	8	VCP	0.074	0.0	58	58	11228	20110816	CIPP SD	$3,484
V23146-V23147	V23	158	8	VCP	-0.032	0.6	57	57.6	2421	20080620	CIPP SD	$12,851
V19054-V19055	V19	390	8	VCP	0.004	1.5	56	57.5	6576	20060913	CIPP SD	$31,721
V17015-V17016	V17	270	10	VCP	0.035	1.5	56	57.5	6530	20080507	CIPP SD	$24,045
V33135-V33143	V33	135	12	VCP	0.102	1.5	56	57.5	3402	20080829	CIPP SD	$14,108
V17064-V17065	V17	83	8	VCP	0.064	1.5	56	57.5	6551	20060822	CIPP SD	$6,748
V02012.H0-V02012.L0	V02	152	8	PVC	0.010	1.5	56	57.5	1227	20080625	Contractor Point Repair SD	$38,261
V22039-V22040	V22	130	8	VCP	0.010	1.5	56	57.5	2215	20080618	CIPP SD	$10,574
V23123-V23124	V23	195	8	VCP	0.003	1.5	56	57.5	7860	20090224	CIPP SD	$15,860
V15110-V15134	V15	166	12	PVC	0.007	1.5	56	57.5	8640	20100511	CIPP SD	$17,347
V05052-V05057	V05	252	8	VCP	-0.010	0.0	57	57	6214	20080114	CIPP SD	$20,473
V06072-V06074	V06	50	8	VCP	0.055	0.0	57	57	6301	20061219	CIPP SD	$4,103
V14106-V14107	V14	250	8	VCP	0.025	0.0	57	57	4396	20081001	CIPP SD	$20,334
B14078-B14079	B14	343	8	ABS	0.118	0.0	57	57	12408	20120215	CIPP SD	$27,898
V31102-V31106	V31	391	8	VCP	0.029	0.0	57	57	2976	20080910	CIPP SD	$31,802

Engineering Renewal Actions

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V13035-V13036	V13	100	8		0.025	0.0	57	57	1781	20080819	CIPP SD	$8,142
V25071-V25072	V25	156	8	VCP	0.019	0.0	57	57	2529	20080912	CIPP SD	$12,718
V23061-V23062	V23	267	8	VCP	0.031	0.0	57	57	2292	20080519	CIPP SD	$21,684
V23040-V23067	V23	309	8	VCP	0.024	0.0	57	57	2280	20080519	CIPP SD	$25,133
V04053-V04054	V04	60	8	VCP	0.004	0.6	56	56.6	13526	20131223	CIPP SD	$4,909
V14011-V14012	V14	133	8	VCP	0.117	0.6	56	56.6	8874	20100426	CIPP SD	$10,803
V26098-V26099	V26	142	8	VCP	0.065	0.6	56	56.6	11173	20110816	CIPP SD	$11,550
V19090-V19091	V19	126	8	VCP	0.004	0.6	56	56.6	2122	20080903	CIPP SD	$10,248
OV4004-OV4005	OV4	5	8	PVC	0.000	0.6	56	56.6	11965	20110718	CIPP SD	$407
V15050-V15076	V15	115	12	VCP	0.000	0.0	56	56	1922	20080813	CIPP SD	$12,033
V15077-V15078	V15	249	12	PVC	0.007	0.0	56	56	1927	20080813	CIPP SD	$26,042
V10112-V10113	V10	330	8	VCP	0.015	0.0	56	56	5152	20090106	CIPP SD	$26,841
B08065.D0-B08065	B08	54	8	PVC	0.008	0.0	56	56	8835	20100302	CIPP SD	$4,382
V15084-V15085	V15	206	8	VCP	0.033	0.0	56	56	1893	20080808	CIPP SD	$16,755
V15134-V15111	V15	176	12	PVC	0.007	0.0	56	56	8640	20100511	CIPP SD	$18,392
V23068-V23086	V23	155	8	VCP	0.044	0.0	56	56	2404	20080612	CIPP SD	$12,607
V25051-V25052	V25	321	8	VCP	0.043	0.0	56	56	12664	20120507	CIPP SD	$26,109
V23124-V23126	V23	222	8	VCP	0.003	0.0	56	56	7859	20090224	CIPP SD	$18,040
V24021.A0-V24021	V24	145	6	VCP	0.000	4.7	50	54.7	13579	20140128	Contractor Point Repair SD	$38,261
V03172-V03173	V03	332	8	VCP	0.004	7.9	45	52.9	8603	20100421	CIPP SD	$27,003

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
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V24042-V24043	V24	225	6	VCP	0.080	7.3	45	52.3	14560	20140410	Contractor Point Repair SD	$38,261
V06009-V06017	V06	94	8	VCP	-0.104	1.5	50	51.5	12338	20111228	CIPP SD	$7,682
V12114-V12115	V12	174	6	VCP	0.000	6.4	45	51.4	8476	20090805	Replace SD	$35,974
V04033-V04034	V04	172	8	VCP	0.050	0.6	50	50.6	13509	20131209	CIPP SD	$13,990
V09014-V09015	V09	199	6	VCP	0.075	0.6	50	50.6	10621	20110310	Replace SD	$41,074
V03086-V03088	V03	248	8	VCP	0.041	0.0	50	50	7299	20081210	CIPP SD	$20,171
V28037-V28038	V28	345	8	VCP	0.000	0.0	50	50	13318	20130410	CIPP SD	$28,061
V31050-V31051	V31	271	8	VCP/CIP	0.110	0.0	50	50	13639	20140213	CIPP SD	$22,013
V04023-V04024	V04	293	8	VCP	0.005	4.8	45	49.8	13500	20131216	CIPP SD	$23,831
V24081-V24082	V24	316	6	VCP	0.070	4.7	45	49.7	13766	20140225	Replace SD	$65,223
V05038-V05039	V05	100	8	VCP	0.072	3.8	45	48.8	6201	20080117	CIPP SD	$8,133
V04028.D0-V04030.C0	V04	293	8	PVC	0.080	3.2	45	48.2	6148	20071018	Replace SD	$60,476
V23161-V23162	V23	196	8	VCP	0.080	0.0	48	48	7848	20090223	CIPP SD	$15,942
V16039-V16050	V16	53	15	VCP	0.027	7.9	39	46.9	6512	20080422	Point Repair and CIPP SD	$11,788
V10118-V10119	V10	141	8	VCP	0.031	1.5	45	46.5	5159	20090112	CIPP SD	$11,468
V06030-V06031	V06	337	8	VCP	0.027	1.5	45	46.5	1465	20080714	CIPP SD	$27,410
V29103-V29104	V29	390	8	VCP	0.023	1.5	45	46.5	5075	20081223	CIPP SD	$31,721
V22059-V22060	V22	73	6	VCP	0.006	1.5	45	46.5	10948	20110331	Contractor Point Repair SD	$38,261
V28028-V28029	V28	55	8	VCP	0.027	1.5	45	46.5	13329	20130225	CIPP SD	$4,479
V31006-V31007	V31	251	8	VCP	0.017	1.5	45	46.5	14574	20160222	CIPP SD	$20,415

Engineering Renewal Actions

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V03088-V03096	V03	336	8	VCP	0.050	0.0	46	46	7297	20081210	CIPP SD	$27,329
V29040-V29041	V29	309	8	VCP	0.044	0.0	46	46	5062	20081216	CIPP SD	$25,133
V16028-V16029	V16	133	6	VCP	0.289	0.6	45	45.6	14014	20150122	Replace SD	$27,452
V11008-V11009	V11	225	8	VCP	0.007	0.6	45	45.6	6429	20080409	Point Repair and CIPP SD	$21,766
V17050-V17051	V17	325	8	VCP	0.030	0.6	45	45.6	2054	20080717	CIPP SD	$26,434
V30024-V30025	V30	196	8	VCP	0.093	0.6	45	45.6	7742	20090217	CIPP SD	$15,976
V06044-V06045	V06	341	8	VCP	0.005	0.6	45	45.6	14008	20150114	CIPP SD	$27,735
V26120-V26121	V26	207	8	VCP	-0.038	0.6	45	45.6	11188	20110822	CIPP SD	$16,836
V31033-V31034	V31	290	8	VCP	0.051	0.6	45	45.6	14576	20151223	CIPP SD	$23,587
V22082-V22083	V22	102	8	VCP	0.100	0.6	45	45.6	10815	20110405	CIPP SD	$8,329
V09044-V09045	V09	225	6	VCP	0.000	0.6	45	45.6	10654	20110316	Replace SD	$46,441
V24078-V24081	V24	210	6	VCP	0.050	6.3	39	45.3	6727	20080114	Contractor Point Repair SD	$38,261
V03077-V03080	V03	350	8	VCP/CIP	0.050	0.0	45	45	6071	20071206	CIPP SD	$28,467
V03065-V03072	V03	225	8	VCP	0.004	0.0	45	45	7290	20081210	CIPP SD	$18,300
B14095-B14097	B14	263	8	VCP	0.030	0.0	45	45	7179	20090126	CIPP SD	$21,365
V03095-V03096	V03	126	8	VCP	0.020	0.0	45	45	7296	20081210	CIPP SD	$10,237
V31107-V31108	V31	285	8	VCP	0.052	0.0	45	45	14650	20160321	CIPP SD	$23,180
V31028-V31030	V31	213	8	VCP	0.015	0.0	45	45	14117	20151012	CIPP SD	$17,324
B13213-B13214	B13	217	8	VCP	0.003	0.0	45	45	12298	20110203	CIPP SD	$17,650
V10015-V10016	V10	350	8	VCP	0.016	0.0	45	45	9122	20100128	CIPP SD	$28,495

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V31109-V31110	V31	362	8	VCP	0.024	0.0	45	45	14690	20160317	CIPP SD	$29,443
V08047-V08048	V08	200	6	VCP	0.060	0.0	45	45	10532	20110328	Replace SD	$41,281
V23152-V23153	V23	309	8	VCP	0.004	0.0	45	45	2427	20080624	CIPP SD	$25,133
V23185-V23186	V23	239	8	VCP	0.142	0.0	45	45	7852	20090223	CIPP SD	$19,439
B09074-B09075	B09	113	8	VCP	0.055	0.0	45	45	7090	20090203	CIPP SD	$9,191
V28063-V28064	V28	38	8	VCP	0.072	0.0	45	45	13363	20130318	CIPP SD	$3,088
B03060-B03061	B03	397	8	VCP	0.005	0.0	45	45	349	20080818	CIPP SD	$32,290
V23002-V23003	V23	72	8	VCP	0.101	0.0	45	45	9210	20100804	CIPP SD	$5,873
V28068-V28069	V28	108	8	VCP	0.100	0.6	44	44.6	6776	20070417	CIPP SD	$8,808
V28082-V28083	V28	140	8	VCP	0.010	1.5	43	44.5	13381	20130430	CIPP SD	$11,387
V22113-V22114	V22	221	8	VCP	0.010	4.7	39	43.7	2187	20080613	CIPP SD	$17,975
V26085-V26086	V26	190	8	VCP	0.000	0.6	43	43.6	11148	20110818	CIPP SD	$15,417
V13014-V13015	V13	181	8	VCP	0.010	1.5	42	43.5	7676	20090212	CIPP SD	$14,722
V29049-V29145	V29	303	8	DIP	0.015	9.5	34	43.5	5057	20081216	Contractor Point Repair SD	$38,261
V20014-V20015	V20	248	8	VCP	0.050	1.5	42	43.5	8257	20090302	CIPP SD	$20,196
V09051-V09052	V09	460	8	VCP	0.006	0.0	43	43	10666	20110224	CIPP SD	$37,414
V18021-V18022	V18	330	8	VCP	0.040	0.0	43	43	7545	20090126	CIPP SD	$26,841
V14002-V14003	V14	70	8	VCP	0.521	0.0	43	43	8223	20090318	CIPP SD	$5,693
V26223-V26225	V26	125	8	VCP	0.145	0.0	43	43	11332	20110914	CIPP SD	$10,167
V23120-V23121	V23	217	8	VCP	0.045	0.0	43	43	2371	20080606	CIPP SD	$17,658

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V03166.B0-V03166	V03	413	8	VCP	0.006	3.8	39	42.8	6998	20080626	CIPP SD	$33,597
B10025-B10026	B10	364	12	VCP	0.005	1.5	41	42.5	7460	20090204	CIPP SD	$38,038
B09077-B09078	B09	326	8	VCP	0.004	1.5	41	42.5	7036	20090128	CIPP SD	$26,515
V29092-V29093	V29	254	8	VCP	0.099	0.0	42	42	6830	20071008	CIPP SD	$20,659
V23104-V23105	V23	164	8	VCP	0.024	0.6	41	41.6	2359	20080606	CIPP SD	$13,342
V24024-V24025	V24	179	6		0.040	6.2	35	41.2	10089	20091117	Contractor Point Repair SD	$38,261
V10055-V10056	V10	307	8	VCP	0.044	0.0	41	41	9159	20100111	CIPP SD	$25,002
V20005-V20007	V20	325	8	VCP	0.042	0.0	41	41	6593	20080515	CIPP SD	$26,434
V14122.B0-V14122.A0	V14	324	8	VCP	0.000	0.0	41	41	4416	20081002	CIPP SD	$26,353
V13079-V13080	V13	183	8	VCP	0.017	0.0	41	41	1767	20080819	CIPP SD	$14,884
V29083-V29084	V29	241	8	VCP	0.042	0.0	41	41	5090	20081229	CIPP SD	$19,602
V32122-V32170	V32	312	8	DIP	0.028	7.9	33	40.9	8205	20090304	Contractor Point Repair SD	$38,261
V23147-V23153	V23	382	8	VCP	0.048	1.5	39	40.5	2422	20080620	CIPP SD	$31,070
V26226-V26227	V26	74	8	VCP	0.122	1.5	39	40.5	11335	20110921	CIPP SD	$6,019
V31048-V31049	V31	235	8	VCP	-0.317	3.0	37	40	14595	20151022	CIPP SD	$19,114
B02080-B02081	B02	300	12	VCP	0.007	8.0	32	40	5559	20070516	CIPP SD	$31,350
V16049-V16050	V16	66	15	VCP	0.017	7.9	32	39.9	6526	20080421	CIPP SD	$13,677
V04078-V04079	V04	223	8	VCP	-0.007	7.8	32	39.8	13704	20131231	CIPP SD	$18,100
B13105.A0-B13105	B13	162	8	PVC	0.000	0.6	39	39.6	12170	20110110	CIPP SD	$13,201
V11106-V11107	V11	324	8	VCP	0.003	0.6	39	39.6	7736	20090211	CIPP SD	$26,344

Engineering Renewal Actions

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V04044-V04060	V04	350	8	VCP	0.047	0.0	39	39	13519	20131216	CIPP SD	$28,467
V10060-V10061	V10	276	8	VCP	0.013	0.0	39	39	9164	20100111	CIPP SD	$22,448
V30062-V30078	V30	291	8	PVC	0.037	8.0	31	39	7744	20090217	CIPP SD	$23,668
V22123-V22124	V22	364	8	VCP	0.037	4.7	34	38.7	9879	20110211	CIPP SD	$29,606
V05026.A0-V05026	V05	141	8	VCP	0.020	0.6	38	38.6	12617	20120423	CIPP SD	$11,468
V14023-V14024	V14	159	8	VCP	0.000	1.5	37	38.5	8449	20090716	CIPP SD	$12,932
V12008-V12013	V12	265	8	VCP	0.098	1.5	37	38.5	5513	20090105	CIPP SD	$21,554
V28078-V28079	V28	128	8	VCP	0.127	1.5	37	38.5	13377	20130501	CIPP SD	$10,418
V23101-V23102	V23	256	8	VCP	0.027	1.5	37	38.5	2356	20080606	CIPP SD	$20,822
V12040.A0-V12040	V12	230	8	VCP	0.000	5.4	33	38.4	6479	20080423	CIPP SD	$18,724
V12066-V12067	V12	304	10	VCP	0.010	6.3	32	38.3	6488	20080428	CIPP SD	$27,038
V12036-V12037	V12	161	8	VCP	0.049	3.8	34	37.8	12424	20120326	CIPP SD	$13,095
V01024-V01050	V01	326	8	VCP	0.000	4.7	33	37.7	8527	20090711	CIPP SD	$26,515
B08030-B08032	B08	365	15	VCP	0.010	4.7	33	37.7	4182	20081104	CIPP SD	$75,640
V10111-V10113.A0	V10	200	8	VCP	0.134	0.6	37	37.6	5151	20090107	CIPP SD	$16,267
V12002-V12003	V12	72	8	VCP	0.185	0.6	37	37.6	8621	20100426	CIPP SD	$5,856
V29069-V29071	V29	12	8	VCP	0.808	0.6	37	37.6	2831	20080621	CIPP SD	$976
V26019-V26020	V26	156	8	VCP	0.010	0.6	37	37.6	11091	20110804	CIPP SD	$12,688
V03182-V03183	V03	243	8	VCP	0.064	6.4	31	37.4	7350	20090105	CIPP SD	$19,764
V05041.A0-V05041.B0	V05	189	14	PVC	0.005	6.4	31	37.4	6205	20080129	CIPP SD	$22,670

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V12067-V12068	V12	399	10	VCP	0.040	6.3	31	37.3	6489	20080429	CIPP SD	$35,534
V07052-V07053	V07	124	8		0.020	0.0	37	37	6354	20080312	CIPP SD	$10,086
V03153.C0-V03153	V03	217	8	VCP	0.000	3.0	34	37	7335	20081223	CIPP SD	$17,648
V31071-V31072	V31	77	8	VCP	0.005	0.0	37	37	12864	20121227	CIPP SD	$6,263
V14001-V14002	V14	113	8	VCP	0.010	0.0	37	37	8251	20090318	CIPP SD	$9,191
V31138-V31139	V31	103	10	DIP	0.003	3.0	34	37	14686	20150821	CIPP SD	$9,205
V23165-V23169	V23	129	8	VCP	0.045	0.0	37	37	2381	20080609	CIPP SD	$10,462
V21189-V21190	V21	231	12	VCP	0.002	4.8	32	36.8	8175	20090317	CIPP SD	$24,140
V03177-V03180	V03	181	8	VCP	0.071	4.7	32	36.7	1340	20080701	CIPP SD	$14,722
V23140-V23141	V23	273	8	VCP	0.013	1.5	35	36.5	6715	20080303	CIPP SD	$22,204
V03055-V03060	V03	179	8	VCP	0.009	1.5	35	36.5	7285	20081210	CIPP SD	$14,559
V11011-V11013	V11	406	8	VCP	0.015	1.5	35	36.5	8547	20090924	CIPP SD	$33,022
V03017-V03019	V03	320	8	VCP	0.020	1.5	35	36.5	14186	20150223	CIPP SD	$26,027
V05026-V05027	V05	163	8	VCP	0.010	1.5	35	36.5	8883	20090928	CIPP SD	$13,258
V31034-V31035	V31	90	8	VCP	0.004	1.5	35	36.5	6895	20070906	CIPP SD	$7,320
V23105-V23132	V23	270	8	VCP	0.002	1.5	35	36.5	2360	20080606	CIPP SD	$21,960
V26207-V26208	V26	130	8	VCP	0.007	1.5	35	36.5	6758	20070525	CIPP SD	$10,574
V32032-V32033	V32	196	8	PVC	0.005	5.4	31	36.4	3208	20080924	CIPP SD	$15,976
V04026-V04031	V04	98	8	VCP	0.004	4.8	31	35.8	13497	20131018	CIPP SD	$8,004
B01090-B01091	B01	96	8	PVC	0.046	4.8	31	35.8	5374	20090105	CIPP SD	$7,808

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V32027-V32029	V32	290	8	PVC	0.020	4.7	31	35.7	8198	20090303	CIPP SD	$23,607
V06043-V06045	V06	366	8	VCP	0.004	0.6	35	35.6	6282	20080408	CIPP SD	$29,769
V04001-V04002	V04	159	8	VCP	0.107	0.6	35	35.6	13199	20131014	CIPP SD	$12,950
B11034-B11035	B11	335	8	VCP	0.006	0.6	35	35.6	3782	20080929	CIPP SD	$27,247
B14183-B14184	B14	50	8		0.080	0.6	35	35.6	13960	20140905	CIPP SD	$4,067
V26065-V26066	V26	85	8	VCP	0.170	1.5	34	35.5	11132	20111006	CIPP SD	$6,913
V14019-V14020	V14	230	8	VCP	0.004	1.5	34	35.5	4444	20081008	CIPP SD	$18,707
B03156-B03157	B03	183	8	VCP	0.091	1.5	34	35.5	11639	20111121	CIPP SD	$14,891
B03157-B03166.F0	B03	123	8	VCP	0.020	1.5	34	35.5	11640	20111121	CIPP SD	$10,033
V23103-V23105	V23	261	8	VCP	0.031	1.5	34	35.5	2358	20080606	CIPP SD	$21,228
V12125-V12057	V12	229	8	VCP	0.130	5.4	30	35.4	6481	20080423	CIPP SD	$18,626
V12080-V12081	V12	116	8	VCP	0.040	3.2	32	35.2	5510	20090105	CIPP SD	$9,403
V02010-V02011	V02	325	8	VCP	0.097	0.0	35	35	1229	20080626	CIPP SD	$26,434
V03117-V03118	V03	349	8	VCP	0.082	0.0	35	35	6085	20070626	CIPP SD	$28,386
V02025.C0-V02025	V02	158	8	VCP	0.029	3.0	32	35	5991	20070820	CIPP SD	$12,879
V10123-V10124	V10	237	8	VCP	0.013	0.0	35	35	5164	20090112	CIPP SD	$19,276
V06005-V06008	V06	130	8	VCP	0.009	0.0	35	35	11973	20111228	CIPP SD	$10,552
V10046-V10047	V10	308	8	VCP	0.080	0.0	35	35	9149	20100106	CIPP SD	$25,031
B01019-B01020	B01	477	8	PVC	0.005	0.0	35	35	13007	20121008	CIPP SD	$38,759
B09002-B09003	B09	269	8	VCP	0.058	0.0	35	35	7062	20090129	CIPP SD	$21,879

Engineering Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V13029-V13030	V13	224	8	VCP	0.020	0.0	35	35	7687	20090213	CIPP SD	$18,219
V26084-V26085	V26	375	8	VCP	0.000	0.0	35	35	11157	20110818	CIPP SD	$30,475
V28023-V28037	V28	287	8	VCP	0.010	0.0	35	35	13324	20121220	CIPP SD	$23,343

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Public Works Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
Asset ID	Basin ID	Length (Feet)	Diameter (Inches)	Material	Slope	CoF Score	LoF Score	SRS	CCTV Survey ID	CCTV Inspection Date (YYYYMMDD)	Renewal Action	Cost Forecast for Action
V24044.A0-V24044	V24	116	6	VCP	0.100	5.8	80	85.8	13737	20140320	Crew Point Repair SD	$3,000
V22090-V22091	V22	100	6	VCP	-0.019	3.8	80	83.8	10824	20110406	Crew Point Repair SD	$3,000
V24021-V24025	V24	121	6	VCP	0.125	3.8	75	78.8	13580	20140128	Crew Point Repair SD	$3,000
V24020-V24021.A0	V24	126	6	VCP	0.100	3.2	75	78.2	13578	20140128	Crew Point Repair SD	$3,000
V24038.A0-V24038	V24	255	6	VCP	0.000	9.6	68	77.6	13728	20140305	Crew Point Repair SD	$3,000
V24076-V24077	V24	209	6	VCP	0.000	5.4	71	76.4	9597	20100930	Crew Point Repair SD	$3,000
V28071-V28076.B0	V28	204	8	PVC	0.000	0.6	75	75.6	6779	20070529	Crew Point Repair SD	$3,000
V08001-V08002	V08	180	6	VCP	0.090	0.6	75	75.6	10708	20110523	Crew Point Repair SD	$3,000
V24022-V24023	V24	260	6	VCP	0.010	0.6	75	75.6	13581	20140116	Crew Point Repair SD	$3,000
B04096-B04097	B04	310	6	VCP	0.086	8.6	67	75.6	11786	20110628	Crew Point Repair SD	$3,000
V09015-V09016	V09	239	6	VCP	0.075	0.0	75	75	10067	20091020	Crew Point Repair SD	$3,000
V11118-V11119	V11	350	8	VCP	0.034	0.0	75	75	1711	20080916	Crew Point Repair SD	$3,000
V24034-V24035	V24	473	6	VCP	0.070	4.2	70	74.2	13592	20140122	Crew Point Repair SD	$3,000
V22120-V22121	V22	103	6	VCP	0.010	3.8	70	73.8	10853	20110426	Crew Point Repair SD	$3,000
V31035-V31036.B0	V31	223	8	VCP	-0.131	0.0	73	73	6896	20070906	Crew Point Repair SD	$3,000
V22066-V22067	V22	77	6	VCP	0.122	0.6	70	70.6	10798	20110407	Crew Point Repair SD	$3,000
V23207-V23208	V23	215	6	VCP	0.080	0.6	70	70.6	9443	20100824	Crew Point Repair SD	$3,000
V24001-V24004	V24	80	6	VCP	0.010	0.6	70	70.6	13557	20140115	Crew Point Repair SD	$3,000
V06011-V06014	V06	353	6	VCP	0.005	0.0	70	70	12340	20120118	Crew Point Repair SD	$3,000
V22088-V22089	V22	306	6	VCP	0.010	0.0	70	70	10822	20110406	Crew Point Repair SD	$3,000

Public Works Renewal Actions

GIS Data						Renewal Business Decision Logic Output						
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V05044-V05103	V05	300	8	VCP	0.005	4.8	65	69.8	6209	20080116	Crew Point Repair SD	$3,000
V28019-V28020	V28	158	8	VCP	0.006	0.0	69	69	13320	20130115	Crew Point Repair SD	$3,000
V28081-V28082	V28	115	8	VCP	0.047	0.0	69	69	13380	20130430	Crew Point Repair SD	$3,000
B04041-B04042	B04	233	8	ABS	0.038	8.0	61	69	11716	20110622	Crew Point Repair SD	$3,000
V12039-V12040	V21	433	8	VCP	0.010	8.6	60	68.6	1732	20080729	Crew Point Repair SD	$3,000
V06008-V06009	V06	245	8	VCP	0.002	0.0	68	68	11966	20111228	Crew Point Repair SD	$3,000
V33155-V33156	V33	10	8	PVC	0.000	7.0	61	68	8398	20090629	Crew Point Repair SD	$3,000
V24064-V24066	V24	257	6	VCP	0.010	9.0	59	68	13758	20140318	Crew Point Repair SD	$3,000
V24005-V24013	V24	414	6	VCP	0.000	0.0	67	67	10090	20091021	Crew Point Repair SD	$3,000
B03109-B03110	B03	198	6	VCP	0.025	3.8	63	66.8	11596	20111213	Crew Point Repair SD	$3,000
V05074.A0-V05074	V05	100	6	VCP	0.051	0.6	66	66.6	14362	20140918	Crew Point Repair SD	$3,000
V05080-V05102	V05	363	8	VCP	0.008	3.2	63	66.2	6248	20080115	Crew Point Repair SD	$3,000
B08067-B08068	B08	245	8	PVC	0.002	0.0	66	66	7932	20090226	Crew Point Repair SD	$3,000
V13135-V13138	V13	210	6	VCP	0.028	0.0	65	65	10026	20100406	Crew Point Repair SD	$3,000
V32052-V32165	V32	40	8	DIP	0.430	8.0	57	65	8203	20090304	Crew Point Repair SD	$3,000
B03111-B03112	B03	212	6	VCP	0.025	3.8	61	64.8	11589	20111213	Crew Point Repair SD	$3,000
B13132.D0-B13132	B13	7	6	VCP	0.000	0.6	64	64.6	9680	20101203	Crew Point Repair SD	$3,000
V08061-V08138	V08	144	6	VCP	-0.565	6.2	58	64.2	11408	20110608	Crew Point Repair SD	$3,000
V03181-V03182	V03	312	8	VCP	0.085	4.8	59	63.8	10865	20111101	Crew Point Repair SD	$3,000
V11053.A0-V11054	V11	350	6	VCP	0.009	0.6	63	63.6	10534	20110329	Crew Point Repair SD	$3,000

Public Works Renewal Actions

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B14096-B14097	B14	253	6	VCP	0.030	0.6	63	63.6	10234	20100930	Crew Point Repair SD	$3,000
V28086-V28087	V28	148	6	VCP	0.184	0.6	63	63.6	6785	20070417	Crew Point Repair SD	$3,000
V14073-V14074	V14	262	8	VCP	0.068	0.6	63	63.6	4467	20081010	Crew Point Repair SD	$3,000
V26036-V26037	V26	364	6	VCP	0.008	0.6	63	63.6	11105	20110808	Crew Point Repair SD	$3,000
V05074-V05075	V05	300	8	VCP	0.034	0.0	63	63	6241	20071129	Crew Point Repair SD	$3,000
B03087-B03088	B03	316	8	VCP	0.037	0.0	63	63	11586	20111026	Crew Point Repair SD	$3,000
V26184.A0-V26184	V26	258	8	VCP	0.018	0.6	62	62.6	11287	20110912	Crew Point Repair SD	$3,000
V16012-V16014	V16	162	8	VCP	0.070	0.0	62	62	1954	20080730	Crew Point Repair SD	$3,000
V06016-V06017	V06	290	6	VCP	0.026	0.0	62	62	12345	20120119	Crew Point Repair SD	$3,000
V01015-V01016.K0	V01	221	8	VCP	0.070	0.0	62	62	7405	20090127	Crew Point Repair SD	$3,000
B14009-B14010	B14	105	8	PVC	0.048	0.6	61	61.6	10140	20100831	Crew Point Repair SD	$3,000
B13004-B13005	B13	148	8		0.000	0.6	61	61.6	12077	20101206	Crew Point Repair SD	$3,000
V02012.F0-V02012.G0	V02	145	8	PVC	0.144	0.6	61	61.6	14158	20160111	Crew Point Repair SD	$3,000
V05004.F0-V05004.G0	V05	101	8	PVC	0.010	0.6	61	61.6	13953	20140724	Crew Point Repair SD	$3,000
B04001-B04002	B04	65	8	ABS	0.030	0.6	61	61.6	11687	20110621	Crew Point Repair SD	$3,000
B08066-B08067	B08	274	8	PVC	0.000	0.0	61	61	4149	20081103	Crew Point Repair SD	$3,000
B08074-B08076	B08	218	6	VCP	0.092	0.0	61	61	11897	20101209	Crew Point Repair SD	$3,000
V32026-V32027	V32	169	8	PVC	0.010	0.0	61	61	3287	20080916	Crew Point Repair SD	$3,000
V16030-V16031	V16	191	8	VCP	0.062	0.6	59	59.6	7445	20090202	Crew Point Repair SD	$3,000
B15049-B15050	B15	260	8		0.061	0.0	59	59	13963	20140909	Crew Point Repair SD	$3,000

Public Works Renewal Actions

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V11088-V11089	V11	349	8	VCP	0.029	0.0	59	59	6458	20080429	Crew Point Repair SD	$3,000
B15050-B15051	B15	358	8		0.020	0.0	58	58	13891	20140424	Crew Point Repair SD	$3,000
V13066-V13067	V13	20	6		0.000	0.6	57	57.6	9948	20100318	Crew Point Repair SD	$3,000
V13105-V13106	V13	61	6		0.000	0.6	57	57.6	8512	20090702	Crew Point Repair SD	$3,000
V24054.H0-V24054.I0	V24	79	6	VCP	0.000	0.6	57	57.6	6722	20070622	Crew Point Repair SD	$3,000
B09081.A0-B09081	B09	224	8	VCP	0.028	0.6	57	57.6	7052	20090129	Crew Point Repair SD	$3,000
V31036.C0-V31036.D0	V31	100	6	PVC	0.000	0.6	57	57.6	14123	20151006	Crew Point Repair SD	$3,000
B03069-B03070	B03	240	8	VCP/CIP	0.128	0.6	57	57.6	11568	20111025	Crew Point Repair SD	$3,000
OV5135-OV5136	OV5	220	8	VCP	0.063	0.0	57	57	5959	20080320	Crew Point Repair SD	$3,000
B15328.D0-B15328.H0	B15	101	8		0.156	0.0	57	57	1060	20080818	Crew Point Repair SD	$3,000
V03023.A0-V03023.B0	V03	243	8	VCP	0.008	0.0	57	57	14185	20150225	Crew Point Repair SD	$3,000
B14230-B14232	B14	153	8	VCP	0.030	0.0	57	57	4892	20081016	Crew Point Repair SD	$3,000
B15155-B15156	B15	87	8	PVC	0.005	0.0	57	57	871	20080818	Crew Point Repair SD	$3,000
V26088-V26089	V26	3	6	VCP	0.352	0.6	56	56.6	11162	20110811	Crew Point Repair SD	$3,000
B14229-B14230	B14	272	8	VCP	0.055	0.6	56	56.6	4891	20081016	Crew Point Repair SD	$3,000
B14151-B14152	B14	239	8		0.118	0.6	56	56.6	4994	20081024	Crew Point Repair SD	$3,000
OV2007-OV2009	OV2	297	8	PVC	0.056	0.0	56	56	14499	20150706	Crew Point Repair SD	$3,000
B15129-B15130	B15	213	8		0.019	0.0	56	56	861	20080818	Crew Point Repair SD	$3,000
V14106.B0-V14106	V14	269	8	PVC	0.094	0.0	56	56	4399	20081001	Crew Point Repair SD	$3,000
V02020.B0-V02020.D0	V02	275	8	VCP	0.084	0.0	56	56	1245	20080627	Crew Point Repair SD	$3,000

Public Works Renewal Actions

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OV5093-OV5094	OV5	206	8	VCP	0.021	0.0	56	56	4299	20081117	Crew Point Repair SD	$3,000
V05020-V05021	V05	214	8	VCP	0.010	0.0	56	56	6186	20071026	Crew Point Repair SD	$3,000
B15270-B15278	B15	426	8	PVC	0.029	0.0	56	56	1002	20080812	Crew Point Repair SD	$3,000
V19012-V19013	V19	250	8	PVC	0.215	0.0	56	56	2110	20080902	Crew Point Repair SD	$3,000
V24054.G0-V24054.K0	V24	130	6	VCP	0.013	0.0	56	56	13750	20140109	Crew Point Repair SD	$3,000
B14192-B14196	B14	274	8	VCP	0.036	0.0	56	56	4902	20081017	Crew Point Repair SD	$3,000
V22141-V22142	V22	300	6	VCP	0.020	6.4	45	51.4	9887	20110211	Crew Point Repair SD	$3,000
V13046-V13047	V13	162	6	VCP	0.130	0.6	50	50.6	9956	20100408	Crew Point Repair SD	$3,000
V13059-V13060	V13	131	6	VCP	0.070	0.6	50	50.6	9947	20100413	Crew Point Repair SD	$3,000
V13119-V13120	V13	240	6	VCP	0.000	0.6	50	50.6	10010	20100406	Crew Point Repair SD	$3,000
V13109-V13110.A0	V13	248	6	VCP	0.060	0.0	50	50	9999	20100331	Crew Point Repair SD	$3,000
V24032-V24033	V24	179	6	VCP	0.055	4.8	45	49.8	13590	20140122	Crew Point Repair SD	$3,000
V08086-V08087	V08	300	6	VCP	0.074	0.6	46	46.6	10873	20111107	Crew Point Repair SD	$3,000
V22142-V22143	V22	152	6	VCP	0.020	7.4	39	46.4	9888	20110214	Crew Point Repair SD	$3,000
B04062-B04063	B04	195	8	VCP	0.005	0.6	45	45.6	5485	20081209	Crew Point Repair SD	$3,000
V24014-V24015	V24	250	6	VCP	0.010	0.6	45	45.6	13679	20140109	Crew Point Repair SD	$3,000
V20003-V20004	V20	248	6	VCP	0.061	0.6	45	45.6	8303	20061031	Crew Point Repair SD	$3,000
V13069-V13070	V13	160	6	VCP	0.080	0.6	45	45.6	9965	20100331	Crew Point Repair SD	$3,000
V13108-V13109	V13	328	6		0.000	0.6	45	45.6	9998	20100331	Crew Point Repair SD	$3,000
V10129-V10130	V10	257	6	VCP	-0.917	0.0	45	45	13203	20130923	Crew Point Repair SD	$3,000

Public Works Renewal Actions

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V13126-V13134.H0	V13	99	6	VCP	0.010	0.0	45	45	10016	20100401	Crew Point Repair SD	$3,000
V30049-V30050.D0	V30	142	8	VCP	0.021	0.0	45	45	6846	20080313	Crew Point Repair SD	$3,000
V22058-V22059	V22	119	6	VCP	0.070	0.0	45	45	10790	20110324	Crew Point Repair SD	$3,000
V08087-V08088	V08	209	6	VCP	0.090	3.2	41	44.2	11425	20110525	Crew Point Repair SD	$3,000
V28128-V28129	V28	210	6	VCP	0.025	0.6	42	42.6	6804	20070417	Crew Point Repair SD	$3,000
V22136-V22144	V22	388	6	VCP	0.010	9.0	33	42	9883	20110214	Crew Point Repair SD	$3,000
B13003-B13005	B13	370	6	VCP	0.030	0.0	41	41	12076	20101220	Crew Point Repair SD	$3,000
V28134-V28135	V28	373	6	VCP	0.020	0.0	41	41	13435	20130422	Crew Point Repair SD	$3,000
V21190-V21191	V21	392	12	VCP	0.010	4.8	36	40.8	9511	20100225	Cut Tap or Obstacle	$0
V22135.A0-V22135.B0	V22	103	6	VCP	0.000	9.6	31	40.6	13973	20141103	Crew Point Repair SD	$3,000
V26090-V26091	V26	103	6		0.000	0.0	40	40	10093	20091117	Crew Point Repair SD	$3,000
V12065-V12066	V12	350	6	VCP	0.120	4.8	35	39.8	6486	20080424	Crew Point Repair SD	$3,000
V28088.A0-V28088	V28	200	8	VCP	0.114	0.6	39	39.6	6788	20070417	Crew Point Repair SD	$3,000
V24063-V24064.A0	V24	208	6	VCP	0.000	9.6	30	39.6	12840	20121129	Crew Point Repair SD	$3,000
V08040-V08042	V08	221	6	VCP	0.095	0.0	39	39	11396	20110524	Crew Point Repair SD	$3,000
V24019-V24020	V24	107	6	VCP	0.170	3.8	35	38.8	13577	20140128	Crew Point Repair SD	$3,000
V08088-V08089	V08	341	6	VCP	0.020	3.2	35	38.2	11418	20110526	Crew Point Repair SD	$3,000
V02059-V02062	V02	321	6	VCP	0.070	0.0	38	38	6005	20070827	Crew Point Repair SD	$3,000
V13136-V13137	V13	279	6	VCP	0.008	0.6	37	37.6	10027	20100401	Crew Point Repair SD	$3,000
V23026-V23027	V23	118	6	VCP	0.007	0.6	37	37.6	9237	20100608	Crew Point Repair SD	$3,000

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V22146-V22147	V22	223	6	VCP	0.011	6.4	31	37.4	5113	20081219	Crew Point Repair SD	$3,000
V24029-V24030	V24	29	6	VCP	8.527	3.2	33	36.2	13549	20131230	Crew Point Repair SD	$3,000
V13050-V13051	V13	308	6	VCP	0.000	0.6	35	35.6	8549	20090929	Crew Point Repair SD	$3,000
B14081-B14083	B14	214	6		0.000	0.6	35	35.6	10213	20101018	Crew Point Repair SD	$3,000
V08035-V08036	V08	202	6	VCP	0.070	0.6	35	35.6	6364	20061009	Crew Point Repair SD	$3,000
V13124-V13125	V13	163	6	VCP	0.030	0.6	35	35.6	10014	20100405	Crew Point Repair SD	$3,000
V23129.A0-V23129	V23	261	6	VCP	0.030	0.6	35	35.6	9364	20100823	Crew Point Repair SD	$3,000
V02066-V02068	V02	179	8	VCP	0.016	0.0	35	35	6020	20070828	Crew Point Repair SD	$3,000
V17067-V17068	V17	350	8	VCP	0.014	0.0	35	35	6552	20080416	Crew Point Repair SD	$3,000
V22089-V22091	V22	225	6	VCP	0.030	0.0	35	35	10812	20110406	Crew Point Repair SD	$3,000
V13047-V13049	V13	79	6	VCP	0.010	0.0	35	35	9957	20100408	Crew Point Repair SD	$3,000
V24075-V24078	V24	265	6	VCP	0.036	4.8	30	34.8	13764	20140213	Crew Point Repair SD	$3,000
V03038-V03039	V03	172	6	VCP	0.043	0.6	34	34.6	14224	20150225	Crew Point Repair SD	$3,000
V24035-V24115	V24	425	6	VCP	0.075	4.2	30	34.2	12932	20130815	Crew Point Repair SD	$3,000
V22063-V22065	V22	125	6	VCP	0.010	0.6	33	33.6	10952	20110407	Crew Point Repair SD	$3,000
V28052-V28053	V28	116	8	VCP	0.049	0.6	33	33.6	6770	20070604	Crew Point Repair SD	$3,000
V05074.BA-V05074.BB	V05	97	8	VCP	0.083	0.6	33	33.6	1410	20080714	Crew Point Repair SD	$3,000
V11089-V11090	V11	348	8	VCP	0.009	0.0	33	33	6460	20080429	Crew Point Repair SD	$3,000
V13060-V13061	V13	332	6	VCP	0.040	0.0	33	33	9945	20100413	Crew Point Repair SD	$3,000
B14027-B14028	B14	350	8	VCP	0.019	0.0	33	33	10159	20100913	Crew Point Repair SD	$3,000

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V11045-V11046	V11	242	8	VCP	0.021	0.0	33	33	6436	20080409	Crew Point Repair SD	$3,000
V03081-V03082	V03	233	8	VCP	0.030	0.6	32	32.6	6073	20070625	Crew Point Repair SD	$3,000
B13031-B13032	B13	191	6	VCP	0.000	0.6	32	32.6	12066	20101228	Crew Point Repair SD	$3,000
B13129.A0-B13129	B13	26	6	PVC	0.000	0.6	32	32.6	12229	20101203	Crew Point Repair SD	$3,000
V25021-V25022	V25	211	6	VCP	0.006	0.6	32	32.6	11997	20120320	Crew Point Repair SD	$3,000
B13117-B13118	B13	142	8	VCP	0.163	0.6	32	32.6	12182	20110118	Crew Point Repair SD	$3,000
B12015-B12016	B12	319	8	VCP	0.071	1.5	31	32.5	578	20080922	Cut Tap or Obstacle	$0
V26053-V26054	V26	125	8	VCP	0.054	1.5	31	32.5	11229	20110809	Cut Tap or Obstacle	$0
B01007-B01010	B01	265	8		0.004	1.5	31	32.5	13042	20121004	Cut Tap or Obstacle	$0
V12018-V12020	V12	96	8	VCP	0.074	1.5	31	32.5	6468	20061204	Cut Tap or Obstacle	$0
V28146-V28148	V28	212	8	VCP	0.043	1.5	31	32.5	13445	20131002	Cut Tap or Obstacle	$0
V24040-V24041	V24	219	6	VCP	0.020	6.4	26	32.4	9608	20090921	Crew Point Repair SD	$3,000
V15092.A0-V15092	V15	251	8	VCP	0.058	0.0	32	32	1903	20080812	Crew Point Repair SD	$3,000
B01005-B01006	B01	354	8		0.006	0.0	32	32	12990	20121004	Cut Tap or Obstacle	$0
B01015-B01016	B01	400	8		0.072	0.0	32	32	13003	20121116	Cut Tap or Obstacle	$0
B13103.H0-B13103.I0	B13	190	8	VCP	0.120	0.0	32	32	12166	20110113	Crew Point Repair SD	$3,000
B14028-B14031	B14	248	8	VCP	0.018	0.0	32	32	10160	20100913	Crew Point Repair SD	$3,000
V11047-V11048.A0	V11	47	8	VCP	0.080	0.0	32	32	6438	20080409	Crew Point Repair SD	$3,000
V13107-V13108	V13	215	6		0.000	0.6	31	31.6	8511	20090702	Crew Point Repair SD	$3,000
V11039-V11040	V11	160	8	VCP	0.008	0.6	31	31.6	10538	20110309	Crew Point Repair SD	$3,000

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V10004-V10006	V10	110	8	VCP	0.180	0.6	31	31.6	9075	20091210	Crew Point Repair SD	$3,000
B13220-B13221	B13	109	6	VCP	0.050	0.6	31	31.6	12305	20110208	Crew Point Repair SD	$3,000
B13028-B13029	B13	212	8	VCP	0.000	0.6	31	31.6	12092	20101228	Crew Point Repair SD	$3,000
V11084.A0-V11084	V11	218	8	VCP	0.030	0.6	31	31.6	6454	20080401	Crew Point Repair SD	$3,000
V04012-V04014.A0	V04	79	8	VCP	-0.005	0.6	31	31.6	6146	20071017	Crew Point Repair SD	$3,000
V28096-V28097	V28	99	6	VCP	0.008	0.6	31	31.6	13395	20130327	Crew Point Repair SD	$3,000
V17035-V17036	V17	300	8	PVC/DIP	0.042	0.0	31	31	6538	20080416	Crew Point Repair SD	$3,000
V29060-V29062	V29	140	8	VCP	0.018	0.0	31	31	8460	20090729	Crew Point Repair SD	$3,000
V06095-V06096	V06	251	8	VCP	0.002	0.0	31	31	6313	20061218	Cut Tap or Obstacle	$0
B14031-B14032	B14	104	8	VCP	0.018	0.0	31	31	10163	20100913	Crew Point Repair SD	$3,000
V24054.K0-V24054.L0	V24	126	6	VCP	0.014	0.0	31	31	13615	20140203	Crew Point Repair SD	$3,000
B12050-B12051	B12	144	8	VCP	0.039	0.0	31	31	624	20080925	Cut Tap or Obstacle	$0
V21081-V21082	V21	222	10	VCP	0.034	0.0	31	31	9779	20100209	Crew Point Repair SD	$3,000
V19098.A0-V19098	V19	226	12	PVC	0.052	0.0	31	31	2120	20080903	Cut Tap or Obstacle	$0
V29057-V29058	V29	272	8	VCP	0.090	0.0	31	31	8495	20090427	Cut Tap or Obstacle	$0
V03015-V03017	V03	324	6	VCP	0.035	0.6	30	30.6	8056	20090401	Crew Point Repair SD	$3,000
V22015-V22016	V22	96	6	VCP	0.050	0.6	30	30.6	8522	20090812	Crew Point Repair SD	$3,000
V22073-V22074	V22	404	6	VCP	0.010	0.6	30	30.6	10962	20110328	Crew Point Repair SD	$3,000
V23078-V23079	V23	287	6	VCP	0.142	0.6	30	30.6	9303	20100727	Crew Point Repair SD	$3,000
V28018-V28019	V28	162	6	VCP	-0.040	0.6	30	30.6	13319	20130115	Crew Point Repair SD	$3,000

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V23095-V23096	V23	200	6	VCP	0.010	0.6	30	30.6	9330	20100419	Crew Point Repair SD	$3,000
V28126-V28127	V28	0	10	PVC	0.020	0.6	30	30.6	6800	20070606	Crew Point Repair SD	$3,000
V23093.I0-V23093.J0	V23	165	6	VCP	0.006	0.6	30	30.6	9327	20100419	Crew Point Repair SD	$3,000
V23151-V23152	V23	155	6	VCP	0.074	0.6	30	30.6	9386	20100726	Crew Point Repair SD	$3,000
V19115-V19116	V19	300	6	VCP	0.086	0.0	30	30	12907	20130411	Crew Point Repair SD	$3,000
V03039-V03041	V03	235	6	VCP	0.010	0.0	30	30	6066	20071206	Crew Point Repair SD	$3,000
V12088-V12089	V12	300	6	VCP	0.058	0.0	30	30	13544	20140113	Crew Point Repair SD	$3,000
V23088-V23089	V23	223	6	VCP	0.051	0.0	30	30	9302	20100419	Crew Point Repair SD	$3,000
V13134.H0-V13134	V13	180	6	VCP	0.010	0.0	30	30	10025	20100401	Crew Point Repair SD	$3,000
V24003-V24004	V24	90	6	VCP	0.066	0.0	30	30	13562	20140114	Crew Point Repair SD	$3,000
V22127-V22128	V22	164	8	VCP	0.012	6.4	21	27.4	7433	20090121	Cut Tap or Obstacle	$0
V22151-V22152	V22	187	8	VCP	0.016	11.0	16	27	6693	20071030	Cut Tap or Obstacle	$0
B02023-B02024	B02	340	8	PVC	0.071	3.2	17	20.2	180	20080709	Cut Tap or Obstacle	$0
V11107-V11108	V11	346	8	VCP	-0.004	0.0	18	18	1688	20080911	Cut Tap or Obstacle	$0
B13087-B13088	B13	358	8	VCP	0.003	1.5	16	17.5	718	20080908	Cut Tap or Obstacle	$0
V17027-V17028	V17	322	8	VCP	0.021	1.5	16	17.5	6535	20080507	Cut Tap or Obstacle	$0
V06090-V06091	V06	253	8	VCP	0.060	0.0	17	17	6307	20061214	Cut Tap or Obstacle	$0
B14167-B14168	B14	91	8	ABS	0.003	0.6	16	16.6	5005	20081027	Cut Tap or Obstacle	$0
B12065-B12066	B12	315	8	VCP	0.036	0.0	16	16	602	20080923	Cut Tap or Obstacle	$0
B12013-B12014	B12	331	8	VCP	0.027	0.0	16	16	576	20080922	Cut Tap or Obstacle	$0

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V29048-V29049	V29	202	8	DIP	0.017	6.3	2	8.3	5056	20081216	Cut Tap or Obstacle	$0
V35069-V35100	V35	273	10	DIP	0.010	1.5	1	2.5	8126	20090310	Cut Tap or Obstacle	$0

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