Wastewater Collection System Evaluation Survey Basin 8 Final Report

Stephenville

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Director of Public Works

May 2014

I certify that this report was prepared under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Texas.

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I. Executive Summary

Pipeline Analysis, LLC was contracted by the City of Stephenville to implement a Phased Infiltration/Inflow Reduction Plan. The first phase of the project was the temporary flow monitoring of the collection system which resulted in delivery of the Temporary Flow Monitoring Final Report (October 2008). The flow report provided dry and wet weather flow data including the ranking of areas with high infiltration/inflow. Table I-1 presents the ranking of basins from the 2008 flow monitoring final report. This report continues the evaluation process and presents the findings of Basin 8. Figure I-1 graphically presents the various basins and depicts the study area associated with Basin 8. Figure I-2 presents the Basin 8 study area map.

Priority Ranking	Meter Basin
1	Basin 10
2	Basin 7
3	Basin 3
4	Basin 8
5	Basin 6
6	Basin 5
7	Basin 9
8	Basin 2
9	Basin 1
10	Basin 4

Table I-1 Infiltration/Inflow Priority Ranking Summary

Wastewater collection systems are composed of manholes, pipelines, and pump stations that will, over a period of time, deteriorate and require rehabilitation or replacement. The City of Stephenville has approximately 109 miles of sanitary sewer within the collection system. These collection system assets have a replacement value of approximately $86.4 million. Sixty-five percent (65%) of the system is comprised of six inch pipeline, predominately vitrified clay. Table I-2 presents a summary of the gravity sewer by pipe sizes.

The most recognized result of system deterioration is high infiltration/inflow during wet weather. Infiltration/inflow is composed of groundwater and rainfall runoff that enters the collection system through broken pipelines, open pipe joints, vented manhole covers, defective manholes, unauthorized storm drain connections, roof drains, etc. The extraneous infiltration/inflow (commonly referred to as I/I) reduces the pipeline capacity to serve customers and may result in sanitary sewer overflows which are in violation of State and Federal regulations. To locate, identify the best means of repair, and estimate the cost of the most feasible alternative requires evaluation and testing of the wastewater collection system.

By implementing a systematic sewer system evaluation consisting of inspecting, testing and repairing system defects, the City of Stephenville staff will minimize repair costs and extend the life of collection system assets. Identifying manhole and pipe defects early will allow less expensive repairs and minimize wet weather infiltration/inflow. This on-going program of collection system renewal will ensure asset life will be extended at the least cost. The City should budget for system renewal and systematically perform rehabilitation on an annual basis. The recommendations for the Basin 8 service area I/I reduction are:

1. Perform manhole rehabilitation as presented in this report. The estimated cost for the manhole rehabilitation identified in this report is $86,465. The City repair crews have the expertise to perform various repairs and may consider performing many of the repairs recommended.
2. Private sector defects contribute to excessive infiltration/inflow. The City should implement a private sector repair program to address those defects. The estimated cost associated with laterals is $2,200, of which $1,950 is associated with laterals on private property.
3. Mainline repairs identified during this project are estimated to cost $109,457. Future planning should include costs for additional mainline renewal. The high percentage of 6-inch clay pipe will

continue to be very problematic for the utility department.

4. Six line segments not recommended for CCTV inspection during the project, but noted to have debris levels of 25% or more are recommended for cleaning. The estimated cost to clean these line segments is $11,066.
5. It is recommended that the City of Stephenville continue its program of system evaluation and renewal. The total estimated rehabilitation cost for the Basin 8 recommendations presented is $209,188.

Table I-3 presents a summary of the estimated cost for the repairs and improvements identified in this report.

Figure I-1
Study Areas

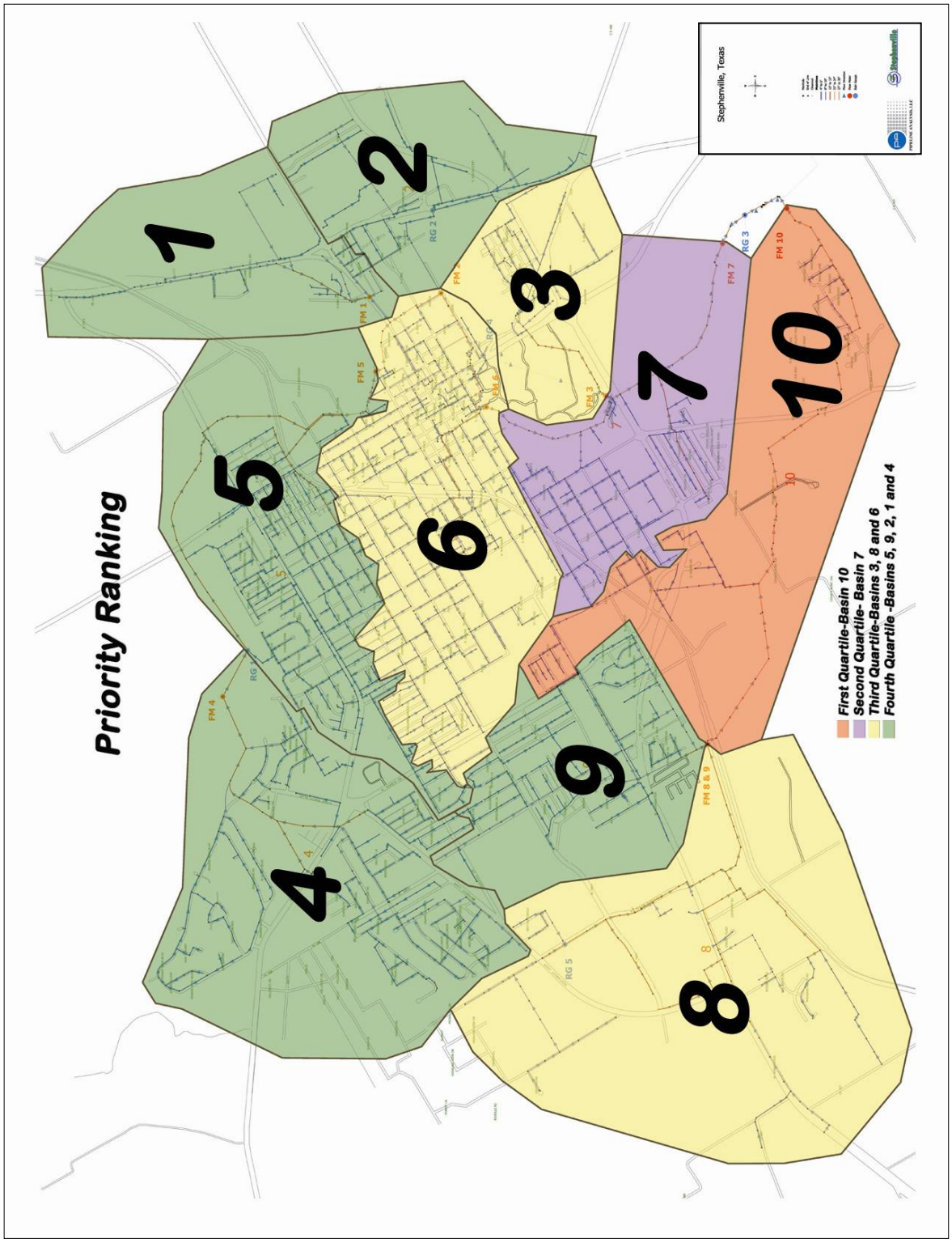


Figure I-2
Basin 8 Study Area

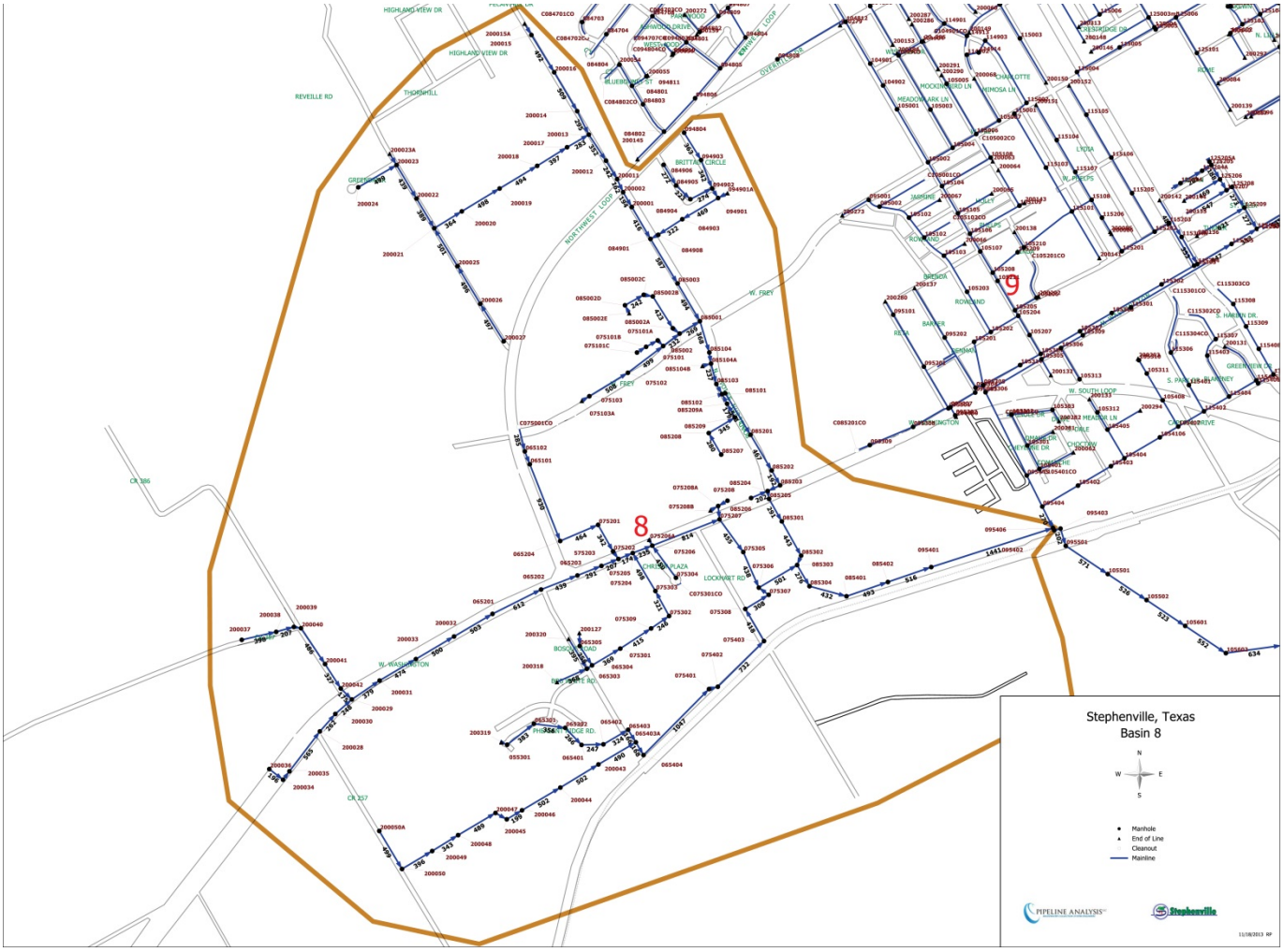


Table I-2
Collection System Summary

Pipe Size	Length	Percent
4"	6,187	1.1%
6"	372,169	64.6%
8"	88,988	15.4%
10"	17,388	3.0%
12"	45,342	7.9%
15"	13,405	2.3%
21"	11,317	2.0%
24"	3,422	0.6%
27"	8,156	1.4%
30"	10,003	1.7%
Total	576,377	100.0%

Estimated replacement value: $86.4 million

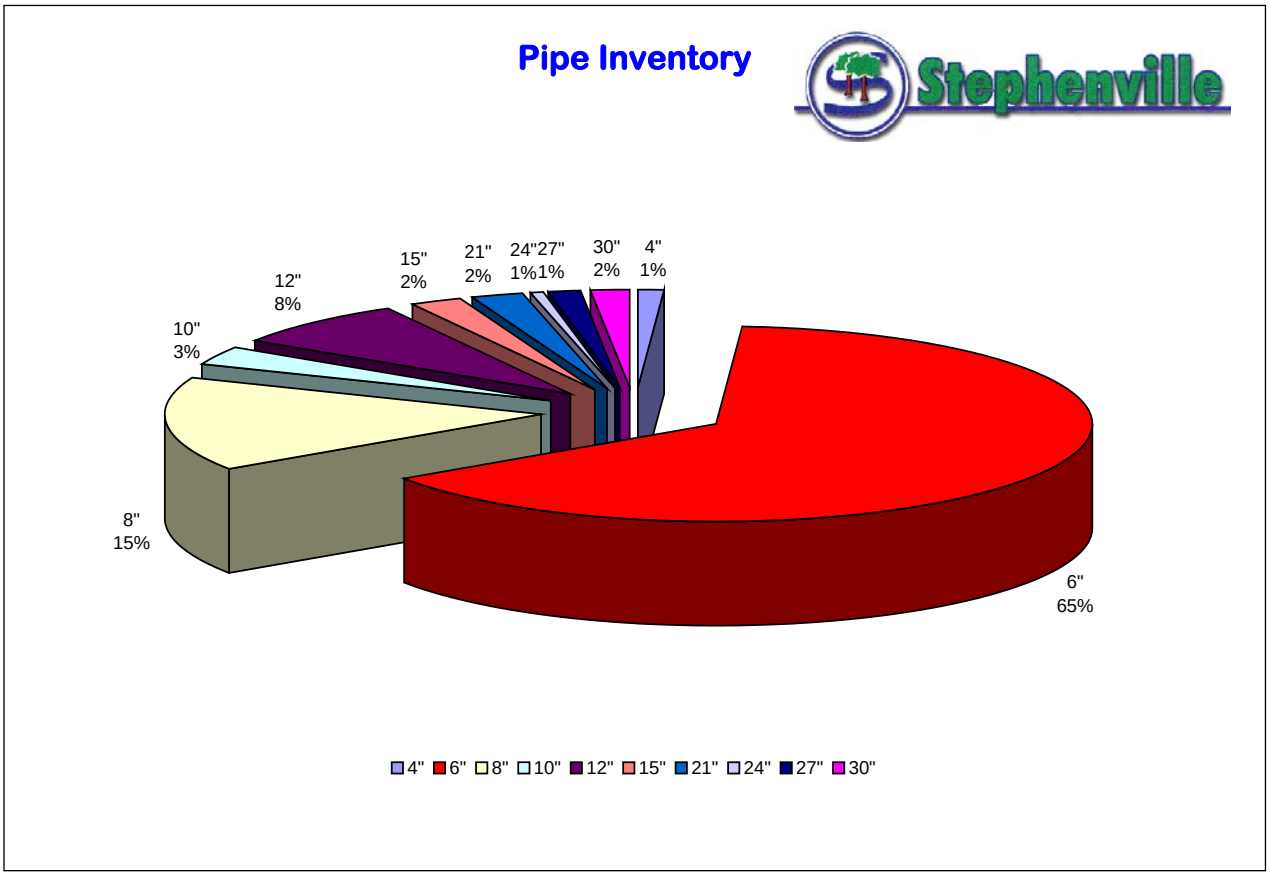


Table I-3
Rehabilitation Summary

Recommended Manhole Rehabilitation (Appendix B)	Quantity	Cost
Rehab 1: Replace Manhole Ring & Cover	2	$ 1,700
Rehab 2: Realign and Seal Manhole Ring & Cover	14	$ 9,250
Rehab 4: Repair Chimney/Cone and Coat	13	$ 5,200
Rehab 5: Clean Manhole, Repair as Needed and Coat	29	$ 68,345
Rehab 6: Repair/Construct Manhole Bench & Invert	1	$ 570
Rehab 7: Install Stainless Steel Inflow Protector Insert	4	$ 760
Rehab 8: Stop I/I, Repair Pipe Seal and Coat	1	$ 640
	Sub-Total	$ 86,465

Recommended Service Lateral Rehabilitation (Appendix C)	Quantity	Cost
Repairs from smoke testing	17	$ 2,200
	Sub-Total	$ 2,200

Recommended Mainline Rehabilitation (Appendix D)	Quantity	Cost
Cured-In-Place Liner (and associated costs)	1,456 l.f.	$ 104,832
Replace Section of Mainline (and associated costs)	25 l.f.	$ 4,625
	Sub-Total	$ 109,457

Recommended Mainline Cleaning (Appendix D)	Quantity	Cost
Lines observed to have 25% or more debris	2,012 l.f.	$ 11,066
	Sub-Total	$ 11,066

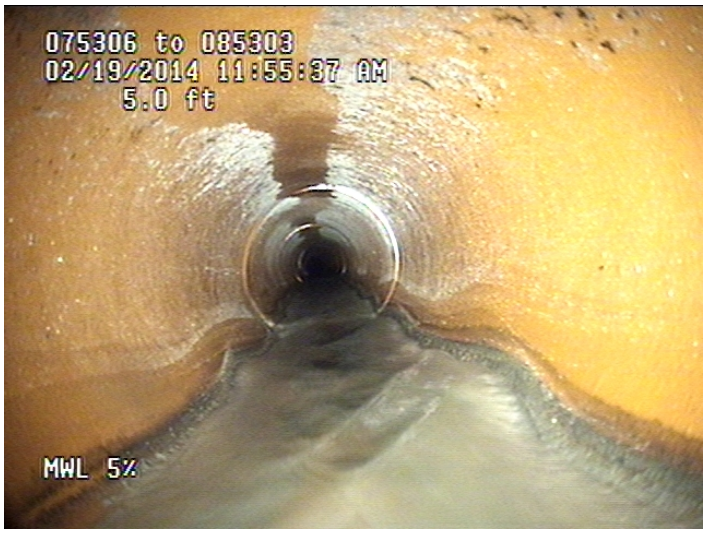
Estimated Total Rehabilitation Cost	**Total**	**$ 209,188**

**Note: Estimated costs do not include any capacity improvements.*

II. Sewer System Evaluation and Renewal Program

The approach to the Stephenville sewer evaluation was organized around the objectives for this project:

- Infiltration/Inflow Reduction
- Collection system rehabilitation (renewal)
- Regulatory compliance
- Customer satisfaction
- Cost control



Line Segment 075306-085303

Wastewater collection system assets have a useful design life of approximately 75 to 100 years. Whether manholes or pipelines reach their useful life are to a great extent based on the materials of construction, soil condition, construction bedding, hydrogen sulfide concentrations, root intrusion, and sound maintenance practices. Collection system renewal is a continual process of "finding" system defects, prioritizing them, and "fixing" them. The goal for the collection system manager may be to inspect the collection system on a 10-year cycle. (Note that critical sewers or those assets in flood prone areas may be on an annual cycle of inspection.) A ten year cycle will require inspecting/testing 10% of the collection system (57,700 linear feet) annually. The results of the inspection will generate repairs to manholes and mainline sewers. Private sector defects will also be identified requiring enforcement of local codes and ordinances. Budgeting funds to find and fix defects is the least cost solution to extend the life of the collection system. Waiting for pipeline or manhole failure will result in replacement of the assets which is the most expensive alternative.

Collections system tools used to "find" defects include flow monitoring (to prioritize areas), manhole/pipe inspections, smoke testing, and CCTV inspection. These testing tools were used in the evaluation of the Basin 8 service area.

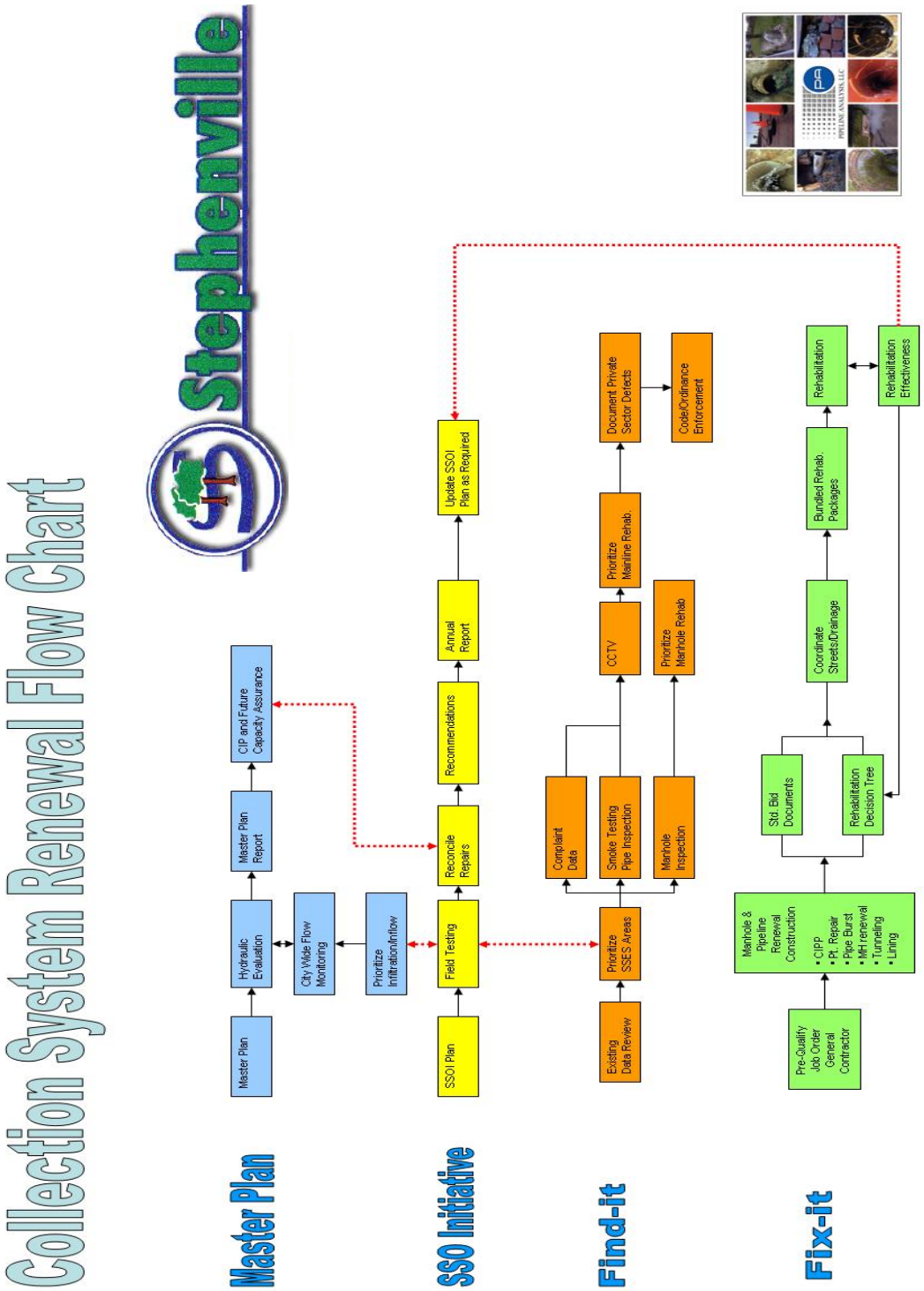
Rehabilitation methods available to extend the life of collection system assets (renewal of assets) include trenchless technologies that minimize the impact to customers. Manhole rehabilitation may include lining, sealing, installing water tight ring and covers, raising buried manholes to grade, replacing vented covers, etc. Mainline sewer rehabilitation may include cured-in-place pipe (CIPP), slip lining and upsizing or pipe replacement by pipe bursting. These "fix-it" technologies are expanding to service laterals which must be addressed by collection system managers.

Figure II-1 depicts the relationships between collection system planning and collection system rehabilitation. For example, the capacity analysis performed in a master plan will impact sewer system renewal. Knowing

when a particular pipeline will require upsizing will impact the decision to rehabilitate the pipe. It may be more cost effective to defer rehabilitation (yet maintain the pipe) and replace the pipe as part of the capital improvement plan (CIP). Also, the least cost renewal plan may require deferring some rehabilitation until sufficient quantities are identified to reduce unit repair costs. Utilization of annual term contracts for collection system renewal is gaining favor as it speeds up the process of rehabilitation, thus keeping projects within annual budgets.

The most recognized result of system deterioration is high infiltration/inflow during wet weather. Infiltration/inflow is composed of groundwater and rainfall runoff that enters the collection system through broken pipelines, open pipe joints, vented manhole covers, defective manholes, unauthorized storm drain connections, roof drains, etc. The extraneous infiltration/inflow (commonly referred to as I/I) reduces the pipeline capacity to serve facilities and may result in sanitary sewer overflows which are in violation of State and Federal regulations. To locate, identify the best means of repair, and estimate the cost of the most feasible alternative requires evaluation and testing of the wastewater collection system.

Figure II-1
Rehabilitation Flow Chart



A. Manhole Inspection/Condition Assessment

Manhole inspection was performed on all accessible manholes within the designated study area. Approximately 145 structures consisting of mainline cleanouts, manholes and end of line segments are within the study area. The following inspections were performed:

1. The casting/cone condition and manhole cover were evaluated for such items as vented covers that are in low ponding areas since casting/cone connection and covers are possible sources of inflow.

2. Manhole walls were checked for integrity and signs of root intrusion, deterioration of mortar joints, loose or missing bricks, signs of surcharge, etc.

3. The bench was checked for type and depth of debris, flow conditions thru the manhole and any signs of settlement that may impede the achievement of design flows.

4. Influent and effluent lines in each manhole were compared to existing maps and corrections noted.

5. Inspection of each influent and effluent line to determine line conditions.

6. Any silt deposits that reduces flow capacity were noted and depth of silt recorded.

Manhole inspections provide basic data including line size, depth from rim to invert, and pipeline cover (i.e. street, yard, easement, alley, etc.). Appendix A presents the summary of data collected during manhole inspections.

Defects associated with manholes were recorded and included on the report DVD. Information for each defect is summarized and the corresponding digital photograph is referenced. Each defect identified during manhole inspection was reviewed and a rehabilitation method assigned. Rehabilitation recommendations for manholes are presented in Appendix B. The estimated cost for the repair was determined and the severity of the defect prioritized. Priority 1 defects are the most severe and are recommended for immediate attention, while priority 2 defects are recommended for repair as funding allows. The total cost for Priority 1 and 2 manhole repairs is $86,465.

B. Service Lateral Condition Assessment

In order to identify defects in the pipelines, a non-toxic smoke was forced into the sewer pipes. Breaks in the sewer pipes will allow the smoke to escape. Normally one line segment upstream and downstream of the manhole is tested at one time.

Field documentation of the defects is extremely important and includes sketches of each system defect along with pertinent information for prioritizing the defects. Color digital photographs were taken to document each defect during smoke testing.

Pipeline repair recommendations are separated according to those on private property and municipal right of way. Appendix C presents the summary of recommended repairs on private service laterals. Referenced smoke sketches and photographs are included in the electronic files that accompany this report. In general, defects on private property are normally the responsibility of the property owner to repair and current city codes and ordinances should be used to ensure compliance. The recommended repair costs associated with laterals is $2,200. Also included in Appendix C are the location sketches for each defect identified along with documentation photographs.

C. Mainline Sewer Condition Assessment

A listing of the Basin 8 mainline sewer inventory is included on the report DVD. Each pipe entering and exiting the manhole was inspected and photographed. Internal color television inspection was undertaken on specific lines to visually establish the pipeline condition. Any structural problems or defects were digitally recorded along with a detailed log. The observation logs are presented in Appendix D and video files are included on the CCTV DVDs. Internal inspection of specific sewer lines determined the best repair options, which in turn, will reduce overall project costs. The total cost for repairs to municipal pipelines is estimated at $109,457. Data collected during pipe inspections was also used to recommend a cleaning plan. Six line segments are recommended for cleaning at an estimated cost of $11,066.

D. Digital Photographs

Digital photographs were taken during the testing and inspection phases of the project. Figure II-2 presents a summary of the types of photographs taken and the nomenclature used when naming the digital files. Information that can be gathered from the photographs includes right of way condition, surface cover, manhole grade, etc.

Figure II-2
Project Photograph Summary

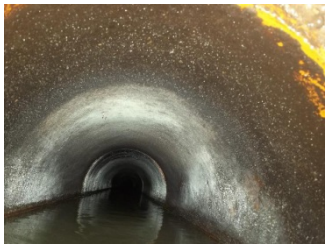
1) Area Photo = Manhole ID, A, Photo No.
   Example: 085401A0013.jpg
   Manhole: 085401
   A=Area Photo
   Photo No.0013
   (Note: Photo taken in direction of outgoing pipe)

2) Internal Photo = Manhole ID, I, Photo No.
   Example: 085401I0014.jpg
   Manhole: 085401
   I=Internal Photo
   Photo No.0014 (Note: North to top of photo.)

3) Manhole Defect Photo = Manhole ID, M, Photo No.
   Example: 085401M0016.jpg
   Manhole: 085401
   M= Manhole Defect
   Photo No. 0016

4) Smoke Photo = Manhole ID, S, Photo No.
   Example: 085401S0005.jpg
   Upstream Manhole: 085401
   S=Smoke Defect
   Photo No. 0005

5) Pipe Photo = Manhole ID, P, Photo No.
   Example: 085401P0018.jpg
   Manhole: 085401
   P=Pipe Photo
   Photo No. 0018



E. Rehabilitation Plan

This report provides preliminary recommendations concerning defects identified during field inspection and testing. A recommended repair plan for the identified deficiencies has been developed based on a priority ranking. The rehabilitation plan considered conventional rehabilitation methods including, but not limited to, the following:

- Service Line Rehabilitation
- Manhole Rehabilitation
- Cured In Place Pipe Liner (CIPP), Pipe Bursting, Open Cut Replacement

1. Service Line Rehabilitation

   These defects are generally the responsibility of the property owner to repair. To facilitate these repairs the field location sketches and digital photographs are provided electronically. The street address and GPS coordinates for the defects are included in the Appendix and in the report DVD. Note that the address listed may be an adjacent house if no house number could be determined in the field. Defect sketches, GPS coordinates and digital photographs may be used to assist in relocating defects.

2. Manhole Rehabilitation

   Manhole rehabilitation recommendations include minor repairs or complete rehabilitation of the manhole, depending on the condition of the manhole. Minor repairs include installation of inserts, realigning or replacing the casting and sealing manhole walls. More substantial repairs include stopping I/I at the pipe seal, repairing the chimney and installation of spray-on liner.

3. Municipal Mainline Rehabilitation

   Mainline rehabilitation may involve the use of multiple repair methods on a single line segment. The recommendations in this report are preliminary and may change in the final design due to utility conflicts, quantities of work to be performed and current construction costs. Supporting information for implementing repairs include CCTV logs, smoke sketches, digital photographs and digital video.

F. Recommendations

Based on the testing and evaluation of the Basin 8 service area, the following summarizes the findings and recommendations:

1. By periodically inspecting, testing and repairing defects, the City of Stephenville staff have reduced repair costs and extended the life of collection system assets. By identifying manhole and pipe defects early, the repairs tend to be less expensive and wet weather infiltration/inflow minimized. This on-going program of collection system renewal will ensure and extend asset life.

2. Staff should continue to address private sector rehabilitation using code enforcement, if necessary, to reduce infiltration/inflow from private sector defects.

3. The total estimated cost to correct defects for the study areas evaluated under this project is summarized in Table II-1 and is estimated at $209,188.

4. The City should prepare final repair recommendations based on defects identified in this report. This final design effort should address current and future capacity needs for the study area. It is anticipated that many of the repairs can be performed in house. Close inspection during construction is recommended to ensure proper repairs are made.

5. The accompanying manhole and mainline rehabilitation maps provide a visualization of the recommendations. The service area maps were updated based on field inspections and GIS updates accompanying this report.

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