Wastewater Collection System Evaluation Survey Basin 6W Final Report

Stephenville

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Director of Public Works

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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

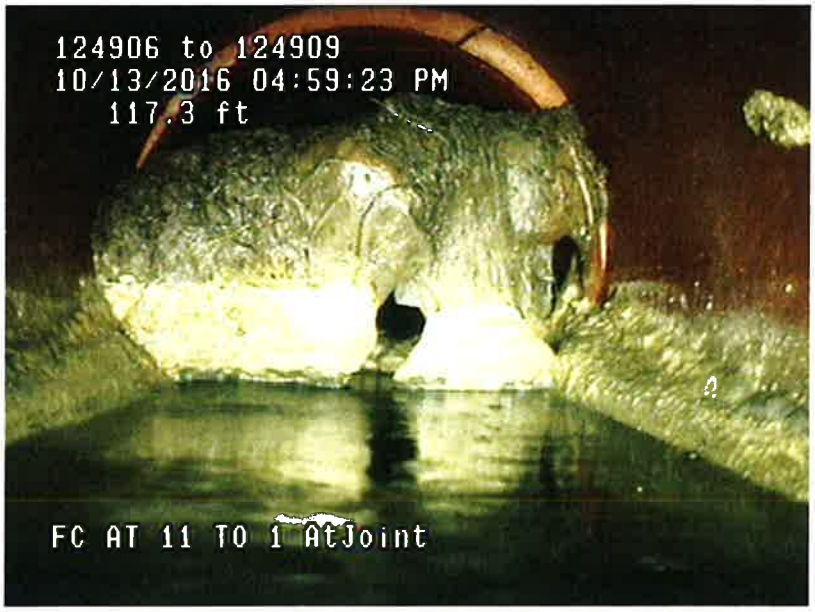
Pipeline Analysis, LLC was contracted by the City of Stephenville to implement a Phased Infiltration/Inflow Reduction Plan. The first phase of the project was the temporary flow monitoring of the collection system which resulted in delivery of the Temporary Flow Monitoring Final Report (October 2008). The flow report provided dry and wet weather flow data including the ranking of areas with high infiltration/inflow. Table 1 presents the ranking of basins from the 2008 flow monitoring final report. This report continues the evaluation process and presents the findings for the western portion of Basin 6 designated Basin 6W. Figure 1 graphically presents the various basins and depicts the study area associated with Basin 6W. Figure 2 presents the Basin 6W 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 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 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 6W 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 $76,144. The City repair crews have the expertise to perform various repairs and may consider performing many of the repairs recommended. Appendix A presents an inventory of manhole inspected and Appendix B presents a summary of manhole repairs.

2. Mainline repairs identified during this project are estimated to cost $576,320. Appendix D presents the mainline sewer recommended repairs.

3. 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 $11,550 and are presented in Appendix E.

4. Line segments observed to have high levels of debris (Appendix F) are recommended for cleaning and consist of 19,529 linear feet of mainline sewer. The estimated cost to clean these line segments is $31,136.

5. The total estimated rehabilitation cost for the Basin 6W recommendations presented is $695,150. Note that the majority of recommendations do not require immediate attention and the rehabilitation work can be scheduled as resources and funding are available. Table 3 presents a summary of the estimated cost for the repairs and improvements identified in this report

Figure 1
Study Areas

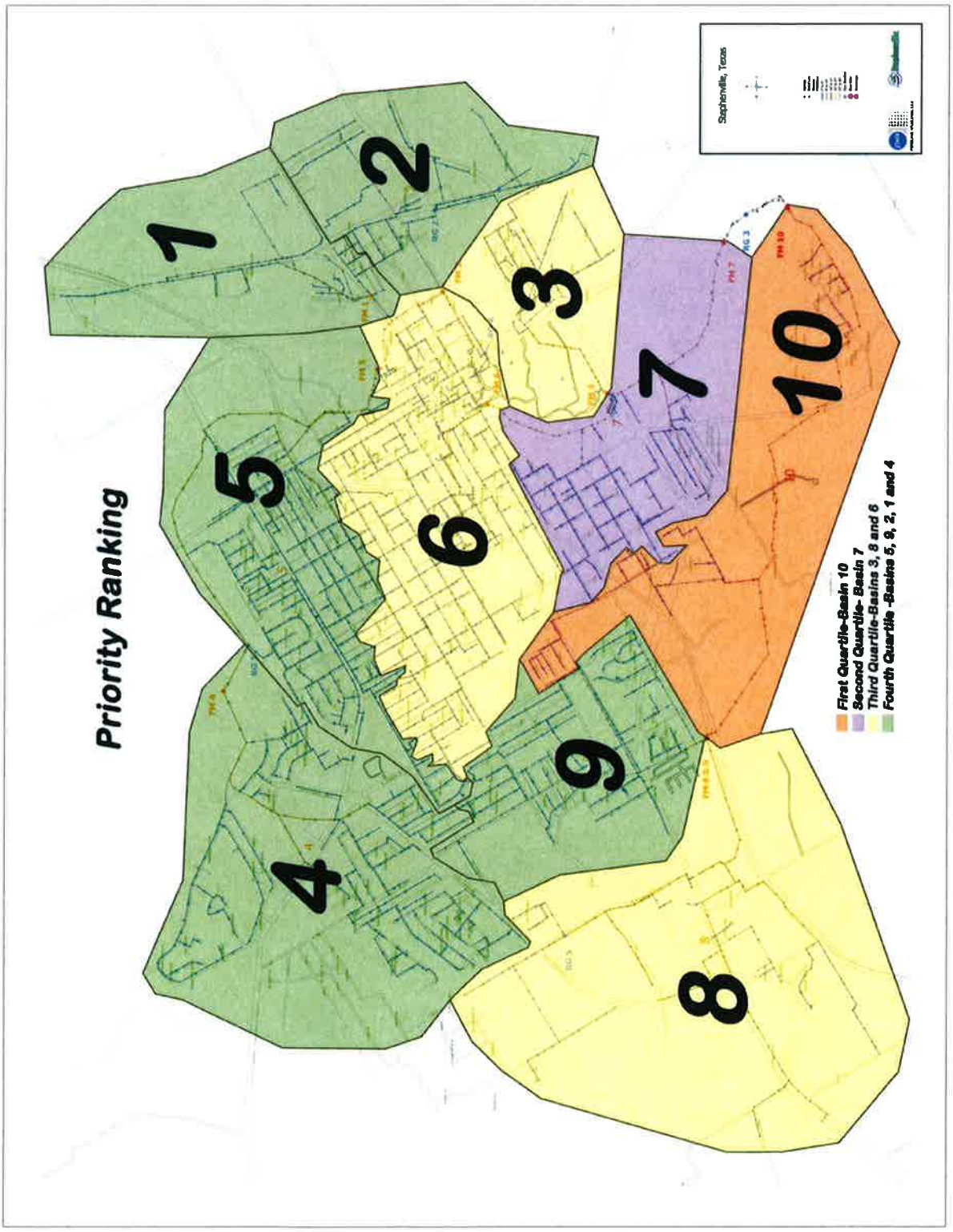


Figure 2
Basin 6W Study Area

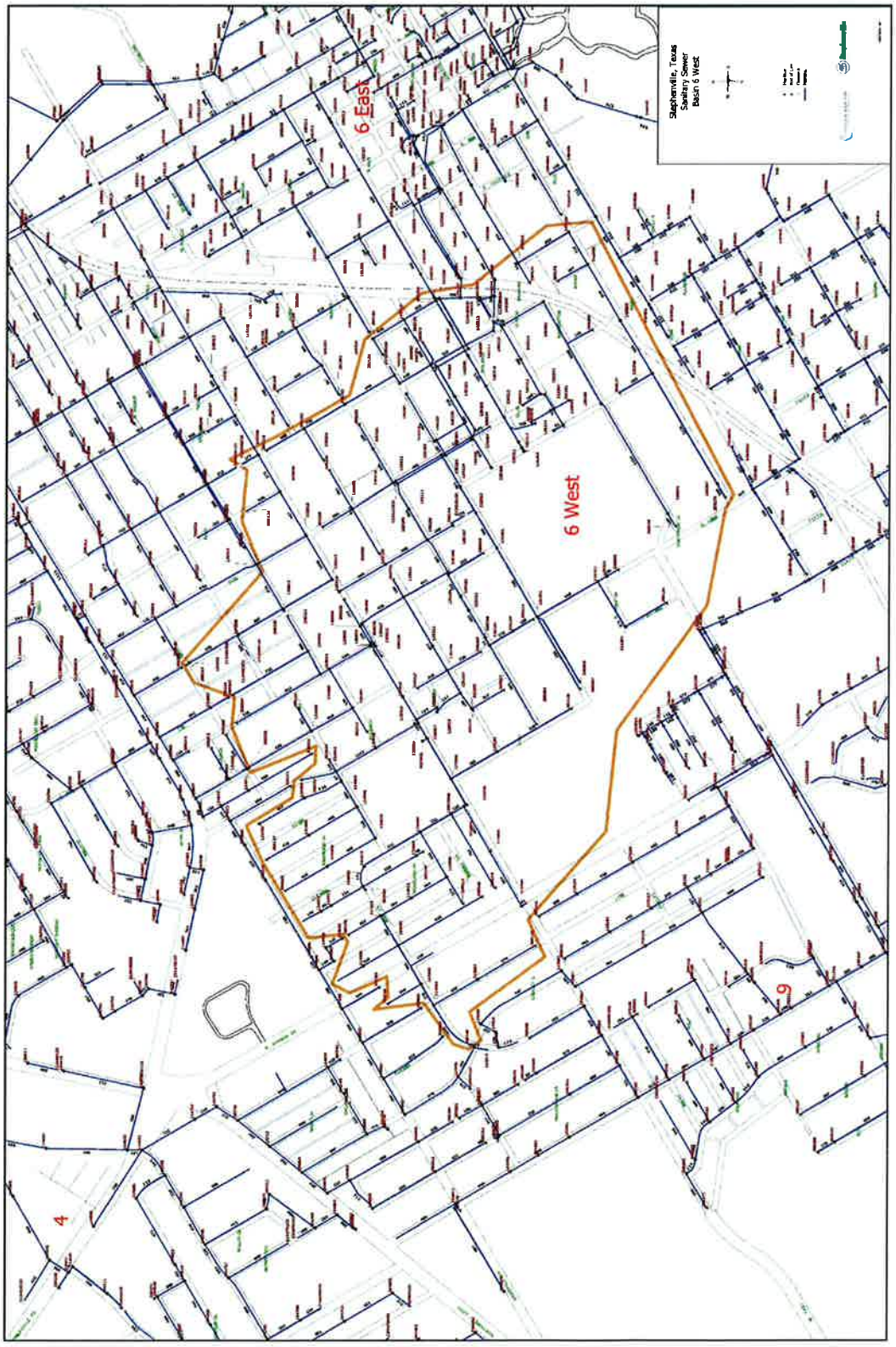


Table 2
Collection System Summary

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

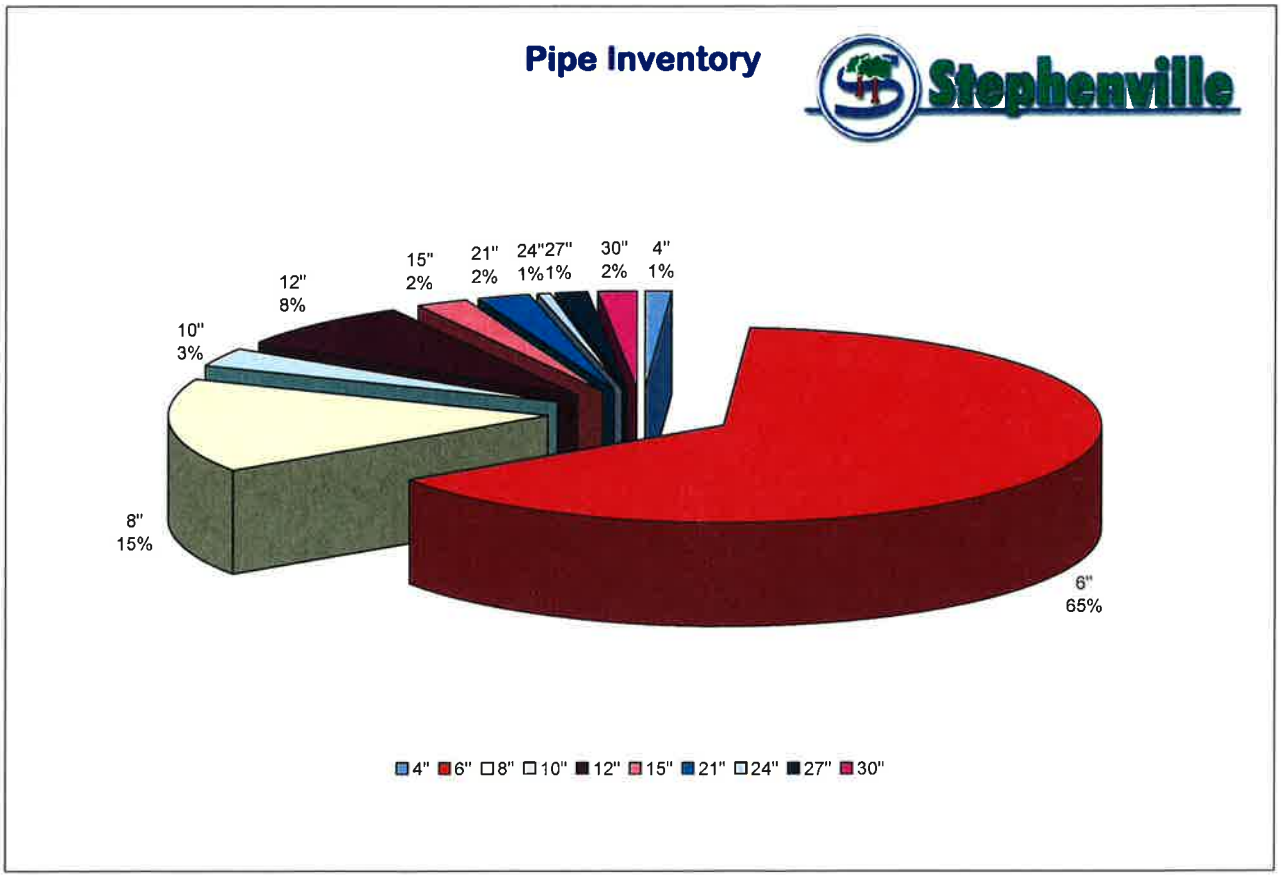


Table 3
Rehabilitation Summary

Recommended Manhole Rehabilitation (Appendix B)	Quantity	Cost
Rehab 1023: Replace Manhole Ring & Cover (Rebuild Chimney as required) -Paved $1220 ea.	3	$3,660
Rehab 1024: Replace Manhole Lid $150 ea.	2	$ 300
Rehab 1020: Realign and Seal Manhole Ring & Cover (Rebuild Chimney as required)-Unpaved $650 ea.	5	$ 3,250
Rehab 1021: Realign and Seal Manhole Ring & Cover (Rebuild Chimney as required)-Paved $950 ea.	1	$ 950
Rehab 1205: Repair Chimney and Coat - $400 ea.	18	$ 7,200
Rehab 1040: Clean Manhole, Remove any Roots, Repair as Needed and Coat<6 ft. (sq.ft.)	975	$ 21,615
Rehab 1041: Clean Manhole, Remove any Roots, Repair as Needed and Coat>6 ft. (sq.ft.)	1809	$ 34,829
Rehab 1110: Reconstruct 4 ft. diameter Manhole Bench & Invert $570 ea.	1	$ 570
Rehab 1010: Install Inflow Protector Insert $190 ea.	3	$ 570
Rehab 1047: Stop I/I, Clean, Repair Pipe Seal and/or Injection Grouting $640/Manhole (all pipes)	5	$ 3,200
	Sub-Total	$76,144

Recommended Mainline Rehabilitation (Appendix D)	Quantity	Cost
Pipe Burst or Replace (and associated costs)	5928	$557,320
Point Repairs	3	$19,000
	Sub-Total	$576,320

Recommended Service Lateral Rehabilitation (Appendix E)	Quantity	Cost
Disconnect Area Drain in Driveway	1	$ 750
No Rehabilitation Recommended	13	$ -
Point Repair	5	$ 4,800
Repair Broken Cleanout - $250 ea.	5	$ 1,250
Replace Missing/Broken Cleanout Cap - $50 ea.	65	$ 3,250
Replace Section of Service Line	1	$ 1,500
	Sub-Total	$ 11,550

Recommended Mainline Cleaning (Appendix F)	Quantity	Cost
Heavy Cleaning - Linear Feet	3,685	$7,370
Light Cleaning - Linear Feet	15,844	$ 23,766
	Sub-Total	$31,136

Estimated Total Cost	Total	$695,150

**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

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.

Line Segment 145101 to 200200
Root intrusion at pipe joint.

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 6W 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.

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. 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.

A. Manhole Inspection/Condition Assessment

Manhole inspection was performed on all accessible manholes within the designated study area. Approximately 133 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.

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 E 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. Also included in Appendix E are the location sketches for each defect identified along with documentation photographs.

C. Mainline Sewer Condition Assessment

A listing of the Basin 6W mainline sewer inventory is included on the report electronic flash drive attached to this report. 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 in Appendix D and CCTV video files are included on the report flash drive. 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 and summarized in Appendix D. Data collected during pipe inspections was also used to recommend a cleaning plan. Those line segments recommended for cleaning represent 19,529 linear feet and are summarized in Appendix F.

Positive dye test on defect identified during smoke testing. Dye test confirmed that the defect is on a private lateral connecting to the mainline sewer. Location: 300 Block of S. Lillian Street

D. Digital Photographs

Digital photographs were taken during the testing and inspection phases of the project. Figure 3 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 3
Project Photograph Summary

1) Area Photo = Manhole ID, A, Photo No.
   Example: 165604A0006.jpg
   Manhole: 165604
   A=Area Photo
   Photo No.0006
   (Note: Photo taken in direction of outgoing pipe)

2) Internal Photo = Manhole ID, I, Photo No.
   Example: 165604I0007.jpg
   Manhole: 165604
   I=Internal Photo
   Photo No.0007 (Note: North to top of photo.)

3) Manhole Defect Photo = Manhole ID, M, Photo No.
   Example: 165604M0011.jpg
   Manhole: 165604
   M= Manhole Defect
   Photo No. 0011

4) Smoke Photo = Manhole ID, S, Photo No.
   Example: 175706S0013.jpg
   Upstream Manhole: 175706
   S=Smoke Defect
   Photo No. 0013

5) Pipe Photo = Manhole ID, P, Photo No.
   Example: 165604P0008.jpg
   Manhole: 165604
   P=Pipe Photo
   Photo No. 0008

E. Rehabilitation Plan

This report provides preliminary recommendations concerning defects identified during field inspection and testing. These preliminary recommendations should be incorporated into a city-wide rehabilitation plan that reconciles capacity needs and prioritizes the rehabilitation based on other factors such as capacity improvements, street projects, etc. 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
- Point Repairs
- 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. The street address and GPS coordinates for the defects are included in the Appendix and electronically in the report flash drive. 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. Point Repairs

Point repairs will be used to correct defects on the mainline or private service lines. When associated with pipe lining, a major defect must be repaired in order to install the liner. The cost basis for the point repair is a price per each and will vary depending on pipe size, depth and cover. Some mainline point repairs can utilize sectional liners if open cut is not practical. The final rehabilitation plans and specifications should review possible utility conflicts associated with open cuts. In some instances, the CCTV inspection of particular line segments could not be completed due to an obstruction. In these instances, a point repair may be necessary followed by CCTV inspection in order to fully evaluate the pipeline.

3. 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 inflow reduction dish 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.

4. 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 6W 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 3 and is estimated at $695,150.

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 and are included on the project flash drive.