TECHNICAL MEMORANDUM

2017 CCTV Inspection Analysis

PREPARED FOR:	Honorable Lynn Eisentrout, Mayor Councilmember Brian Wolf, Chair – Service Committee
COPY TO:	
PREPARED BY:	CH2M
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PROJECT NUMBER:	690666
REVISION NO.:	

Inspection Results

The CCTV inspection covered 27 segments and a total of 5,567 feet of vitrified clay pipe (VCP) sanitary sewer pipeline during the 2017 inspection program.

In the field, wastewater collection system CCTV observation information was collected in the form of video recordings and an electronic data log by Flowline LLC. These electronic logs were reviewed and compiled. The inspectors in the field used the NASSCO Pipeline Assessment & Certification Program (PACP) coding system to record observations.

Typical defects found within the Minerva Park collection system during the 2017 inspections are detailed below.

Structural Issues

Broken Pipe – One type of structural problem observed was broken pipe segments with visible voids behind the break. A broken pipe section seen during CCTV inspection is shown in Figure 1. Breaks may be the result of excessive loading, improper installation, or pipe deterioration. These defects may allow leakage of raw sewage into the ground and significant inflow of groundwater which may cause sinkholes.

Figure 1
Broken Pipe in Segment MH 033 to MH 032

Fractured Pipe – Figure 2 shows a fractured pipe section. Fractures are defects where there is a clear separation between the fragments, but no hole has yet been formed. Like breaks, fractures may be the result of excessive loading, improper installation, or pipe deterioration. Left unabated, fractures can worsen over time to cause pipe deflection and collapse.

Figure 2
Fractured Pipe in Segment MH 018 to MH 005

Cracked Pipe – Figure 3 shows a crack in a pipe segment wall. Cracks are less severe than fractures, and do not have visible separation between the pieces. Over time, however, cracks can worsen into fractures and breaks.

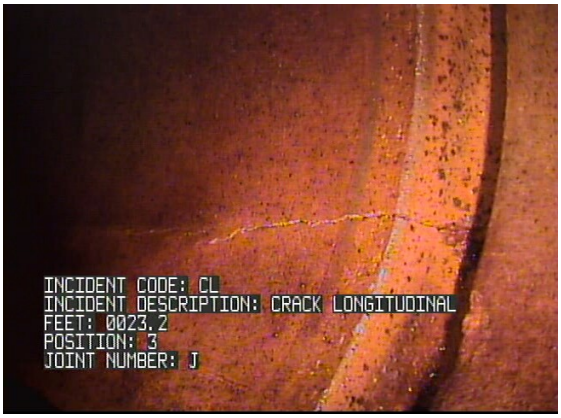

Figure 3
Cracked Pipe in Segment MH 021 to MH 019

Separated Joints – Offset joints between pipe segments can allow groundwater infiltration to occur, will contribute to uneven stresses on the pipe, and can cause further cracks and damage. This defect is considered structural and is evaluated accordingly. Figure 4 shows an example of a separated joint.

Figure 4
Offset Joint in Segment MH 072 to MH 071

Vertical Alignment Defects – Several vertical alignment defects were recorded during the inspection process. This type of defect creates hydraulic bottlenecks which reduce the system's hydraulic carrying capacity and causes elevated water levels within the pipe segment. Figure 5 shows flow conditions of a vertical alignment defect.

Figure 5
Sag in Pipe Segment MH 030 to MH 029

Attached Encrustation – Most pipe segments had light to moderate attached encrustation (DEA) along the pipe walls. The buildup can restrict the flow and reduce hydraulic performance. An example of encrustation buildup along the mainline is shown in Figure 6.

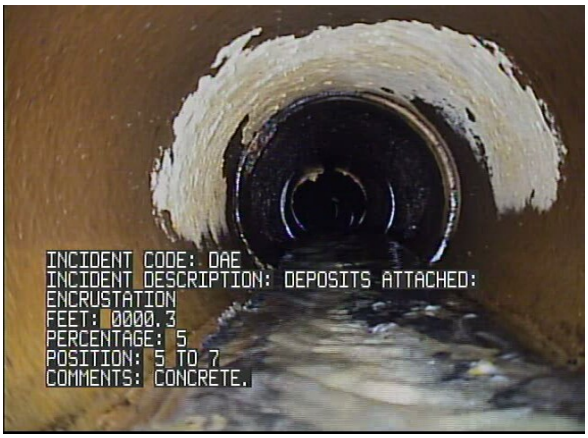

Figure 6
Deposits Attached in Pipe Segment MH 002 to MH 001

Roots – Another observed problem was light to heavy root intrusion. In some cases, heavy roots impeded the travel of the CCTV camera. Roots are a maintenance problem and must be removed through cleaning and cutting activities or chemical treatment. Roots may also cause structural damage to pipe joints and walls by growing and forcing cracks to open, requiring pipe replacement. Intrusion of roots at joints is shown in Figure 7.

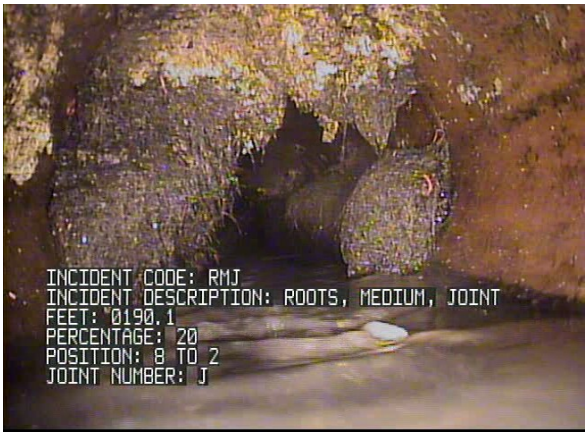

Figure 7
Root Intrusion in Segment MH 034 to MH 032

The majority of the pipe segments inspected in 2017 were in poor condition. Evaluation, analysis, and recommendations for the defects that were observed are described below.

Data Analysis

The goal of the Minerva Park condition assessment was to provide data necessary to make decisions on sewer repairs and improvements for the inspected pipe segments by quantifying the presence of defects in a pipe segment. The CCTV inspection process described previously was the first step in determining the need for improvements. The CCTV observations of pipe defects were subsequently translated into a pipe condition grade which in turn permitted prioritization and recommendations for each asset. Table 1 below summarizes the pipe condition grades used.

Table 1
Pipe Condition Grades

Condition Grade	Description
A	Pipe in sound condition. Perform routine inspection.
B	Pipe in generally good condition. Perform maintenance activities (e.g., routine inspection and cleaning) on infrequent basis.
C	Point repairs should be carried out to extend pipe life and reduce likelihood of problems. Perform routine maintenance activities.
D	Major repairs necessary to maintain service in structurally-damaged pipes. Pipe replacement or relining should be considered. Proactive maintenance required until repairs are made.
F	Imminent Failure. Replace or rehabilitate pipe as soon as possible in order to maintain service. Proactive maintenance required until repairs are made.

Source: National Association of Sewer Service Companies (NASSCO) Pipeline Assessment & Certification Program (PACP) defect coding system

The percentages of pipe segments in each of the condition grades for the pipes inspected in 2017 are listed below. Figure 8 shows the graphical representation of the distribution of the pipe segments based on overall condition grade.

Inspected Pipe Segments in 2017

- 0 percent of pipes are in Grade A condition
- 0 percent of pipes are in Grade B condition
- 4 percent of pipes are in Grade C condition
- 96 percent of pipes are in Grade D condition

The calculated pipe grades and defect information for all the inspected pipe segments in 2017 are provided in the summary table in Appendix B.

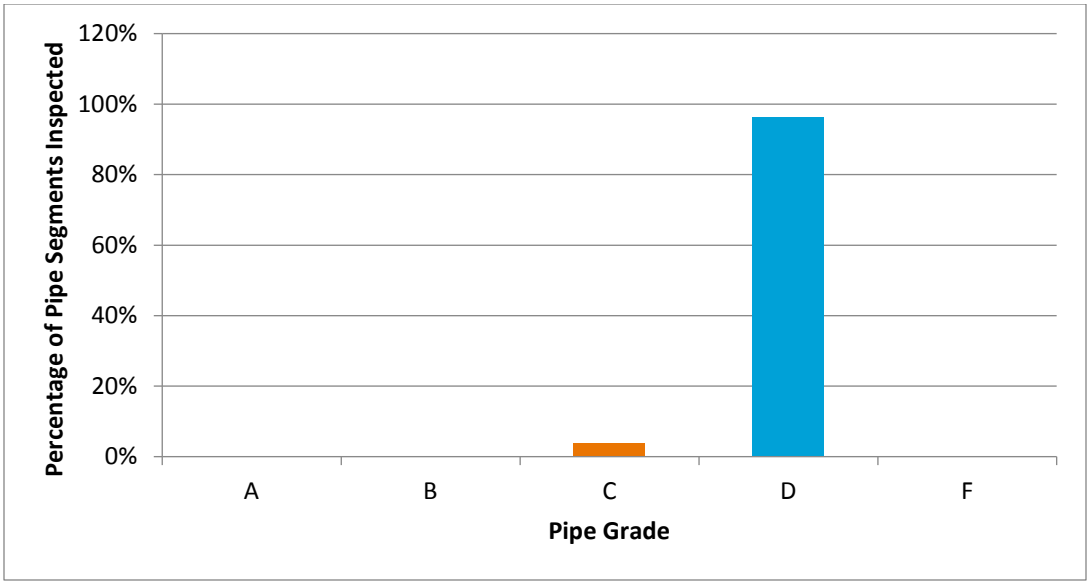

Figure 8
Pipe Grade Distribution

Pipeline Recommendations

The plan to address the issues present in the sewer collection system is based on the prioritization criteria listed in Table 2.

Table 2
Prioritization Criteria

Priority	Description
1	Address safety issues that may be present as a result of the poor condition of the sewer system.
2	Restore the original hydraulic carrying capacity of the sewer system.
3	Reinspect the pipe segments whose inspection was abandoned due to maintenance, structural issues or CCTV camera limitations in the field.
4	Address minor pipe maintenance issues as resources are available.
0	No direct action required until next regular inspection cycle.

Based on the number and degree of defects in each pipe segment, a priority rating was assigned. Table 3 below summarizes the pipe counts for each grade and corresponding prioritization, and Figure 9 displays the results graphically.

Table 3
Grade and Priority Summary Pipe Counts

	Priority				
Pipe Grade	**0**	**4**	**3**	**2**	**1**
A	0	0	0	0	0
B	0	0	0	0	0
C	0	0	0	1	0
D	0	0	0	26	0
F	0	0	0	0	0
TOTAL	**0**	**0**	**0**	**27**	**0**

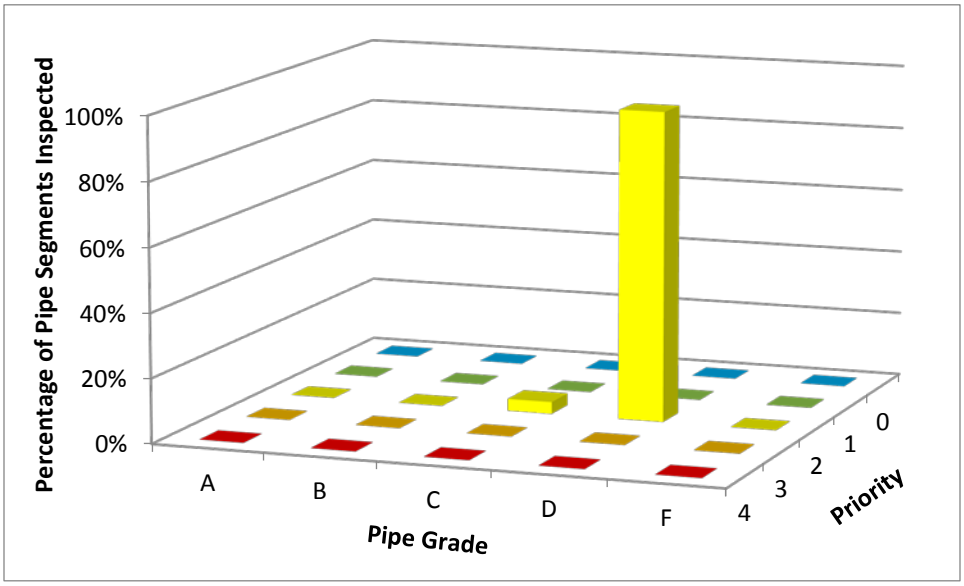

Figure 9
Grade and Priority Summary

Recommendations for each pipe segment were based on the number and severity of defects observed during each inspection. Recommendations can be summarized into the following groups:

- **Removal of attached encrustation and Root-Cutting** – Removal of attached encrustation and roots before lining of the pipe.
- **Line or Replace** – Rehabilitation lining is the restoration or improvement of the functional service of an existing pipeline system. Rehabilitation methods include cured in place pipe, sliplining, and plastic lining. Replacement refers to the construction of a new sewer, on or off the line of an existing sewer. The function of the new sewer will incorporate that of the old, but may also include other improvements or development work. This can be carried out by open cut or trenchless methods.
- **Point Repair** – Rectify damage to the structural fabric of the sewer, but reconstruction of a whole pipeline is not necessary. Robotics or mechanical methods are used to perform localized point repairs.

Table 4 and Figure 10 summarize the recommendations for all of the pipe segments inspected in 2017. A complete listing of each pipe segment and its associated grade, priority, and recommendation may be found in Appendix A.

Table 4
Recommendation Summary Table

Recommendation	Footage	% Total
Point repair	98	2%
Encrustation removal and Line	3,097	56%
Line	1,193	21%
Root Cut/Encrustation removal and Line	1,180	21%
TOTAL	**5,567**	**100%**

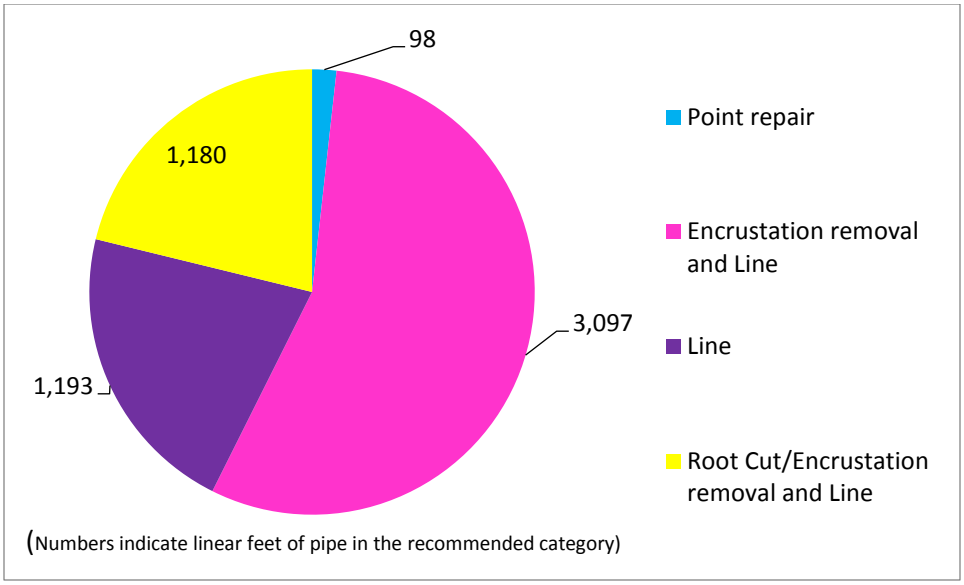

Figure 10
Recommendation Summary

It is recommended that the Village of Minerva Park implement a pipe line rehabilitation program to repair deficiencies found during CCTV inspection. Improvements have been categorized as Priority 2 or 3. No defects were identified as Priority 1 requiring immediate repair. All pipe line point repairs were identified as Priority 2 and should be scheduled for repair within 1-2 years. Pipe line rehabilitation should include two (2) point repairs on one (1) pipe lines at an estimated cost of $20,000, fourteen (14) lines need removal of encrustation and lining at an estimated cost of $205,700, eight (8) lines need to be lined at an estimated cost of $53,700, and four (4) lines need root cut with removal of encrustation and lining at estimated cost of $83,600. Total planning level cost to implement the recommended improvement program is $526,400. A summary of pipe line improvement cost is shown in Table 5. Detailed recommendations are provided in Appendix A.

Table 5
Recommended Pipe Line Improvement Summary

Recommendation	**Quantity**	**Cost ($)**
Priority 2		
Point Repairs	2	$20,000
Line	1,193 (LF)	$53,700
Encrustation removal and Line	3,097 (LF)	$205,700
Root Cut/Encrustation removal and Line	1,180 (LF)	$83,600
Sub-Total		$363,000
20% Legal, Administration, and Design		$72,600
25% Contingency		$90,800
Sub-Total		$136,300
TOTAL		**$526,400**

Appendix A – Pipe Segment CCTV Inspections Summary

APPENDIX A

Condition Grade	Type
A	No defects
B	Maintenance defects (clean and inspect regularly)
C	Defects noted (Line or point repairs)
D	Major structural defects (repair, line or replace)
F	Pipe failed or obstructed (repair or replace)

Priority	
1	Immediate action: Safety issues may be present due to poor condition
2	First phase project: Restore hydraulic capacity
3	Second phase project: Clean/re-CCTV incomplete inspections or repair,
4	Address as resources are available

Condition Assessment Minerva Park OH CCTV Inspection 2017

CCTV Review Summary

US Node	DS Node	Diam(in)	Material	Inventory Pipe Length	CCTV Length	CCTV Date	CCTV Comments	Condition Grade	Priority	Recommendation	Reviewed By	Point Repairs	Units	Unit Price	Lining (ft)	Units	Unit Price	Root Cut and/or Encrustation removal (ft)	Units	Unit Price	Total Cost
002	001	8	VCP	172	172	8/16/2017	Multiple cracks and fractures. Multiple Roots at joints. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				172	LF	$45	172	LF	2.50	$8,170
003	002	8	VCP	258	258	8/16/2017	Multiple cracks and fractures. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				258	LF	$45	258	LF	2.50	$12,255
004	003	8	VCP		272	8/16/2017	Survey abandoned 181' from MH 003 and 91' from MH 004 due to attached deposits. Multiple cracks and fractures. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				272	LF	$45	272	LF	2.50	$12,920
005	001	18	VCP	245	245	8/10/2017	Longitudinal cracks at 18.5' and 61' and 71' from MH 005. Multiple Roots at joints. Attached deposits throughout	D	2	Encrustation removal and Line	RC				245	LF	$95	245	LF	2.50	$23,888
018	005	15	VCP	405	405	8/10/2017	Multiple cracks and fractures. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				405	LF	$75	405	LF	2.50	$31,388
019	018	15	VCP	314	314	8/10/2017	Multiple cracks and fractures. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				314	LF	$75	314	LF	2.50	$24,335
020	019	8	VCP	169	169	8/10/2017	Multiple cracks and fractures. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				169	LF	$45	169	LF	2.50	$8,028
021	019	15	VCP	134	134	11/8/2016	90% of the pipe have cracks and fractures. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				134	LF	$75	134	LF	2.50	$10,385
022	021	15	VCP	150	150	8/10/2017	90% of the pipe have cracks and fractures. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				150	LF	$75	150	LF	2.50	$11,625
023	022	8	VCP	89	89	8/10/2017	Multiple cracks and fractures, broken pipe at 85' from MH 023.	D	2	Line	RC				89	LF	$45				$4,005
024	023	8	VCP	143	143	8/10/2017	Multiple cracks and fractures.	D	2	Line	RC				143	LF	$45				$6,413
025	024	8	VCP	247	247	8/10/2017	Multiple cracks and fractures.	D	2	Line	RC				247	LF	$45				$11,115
026	025	8	VCP	87	87	8/10/2017	Multiple cracks and fractures.	D	2	Line	RC				87	LF	$45				$3,893
027	024	8	VCP	255	255	8/10/2017	Multiple cracks and fractures.	D	2	Line	RC				255	LF	$45				$11,453
028	027	8	VCP	122	122	8/10/2017	Multiple cracks and fractures.	D	2	Line	RC				122	LF	$45				$5,468
029	027	8	VCP	156	156	8/10/2017	Multiple cracks and fractures.	C	2	Line	RC				156	LF	$45				$7,020
030	029	8	VCP	98	98	8/10/2017	Longitudinal cracks at 31' and 93' and 71' from MH 030.	C	2	Point repair	RC	2	EA	$10,000							$20,000
031	030	8	VCP	96	96	8/10/2017	Multiple cracks and fractures.	D	2	Line	RC				96	LF	$45				$4,320
032	022	15	VCP	345	345	8/9/2017	Multiple cracks and fractures. Roots at pipe joints throughout. Attached deposits starts at 24' ends at 110' from MH 032. (if heavy cleaning can not cou through the attached en crustation, pipe may need to be replaced before lining)	D	2	Root Cut/Encrustation removal and Line	RC				345	LF	$75	345	LF	2.50	$26,738
033	032	8	VCP	262	262	8/9/2017	Hole with soil visible at 44' and 205' from MH 033. Multiple cracks and fractures. Roots at pipe joints throughout.	D	2	Root Cut/Encrustation removal and Line	RC				262	LF	$45	262	LF	2.50	$12,445
034	032	15	VCP	297	297	8/9/2017	Multiple cracks and fractures. Roots at pipe joints throughout.	D	2	Root Cut/Encrustation removal and Line	RC				297	LF	$75	297	LF	2.50	$23,018
048	034	15	VCP	95	95	8/8/2017	Multiple cracks and fractures. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				95	LF	$75	95	LF	2.50	$7,363
070	048	15	VCP	276	276	8/8/2017	Multiple cracks and fractures. Roots at pipe joints throughout. Attached deposits at 3' and 60' from MH 070.	D	2	Root Cut/Encrustation removal and Line	RC				276	LF	$75	276	LF	2.50	$21,351
071	070	12	VCP	389	389	8/8/2017	Multiple cracks and fractures. Broken pipe at 162' ,234' and 261' from MH 071. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				389	LF	$65	389	LF	2.50	$26,258
072	071	8	VCP	212	212	8/8/2017	Multiple cracks and fractures. Separated Joint at 113' from MH 072 . Attached deposits throughout.	D	2	Encrustation removal and Line	RC				212	LF	$45	212	LF	2.50	$10,070
073	071	12	VCP	148	148	8/8/2017	Multiple cracks and fractures. Broken pipe at 93' from MH 073. Attached deposits throughout.	D	2	Encrustation removal and Line	RC				148	LF	$65	148	LF	2.50	$10,017
074	073	12	VCP	134	134	8/8/2017	Multiple cracks and fractures. Roots at pipe joints throughout.	D	2	Encrustation removal and Line	RC				134	LF	$65	134	LF	2.50	$9,011
										Sub Total		**2**			**5,469**			**4,276**			**$362,947**
										ADMINISTRATION ITEMS											
										20% Legal, Administration, and Design											$72,589
										25% Contingency											$90,737
										Administration Subtotal											$163,326
										Total Cost											**$526,273**