

Man-Entry vs Multi-Sensor CCTV Inspections of Large Diameter Sewers and Manholes

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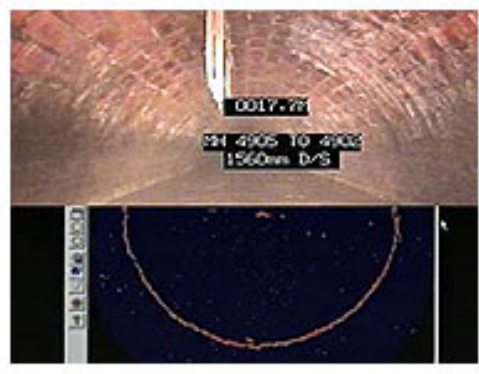
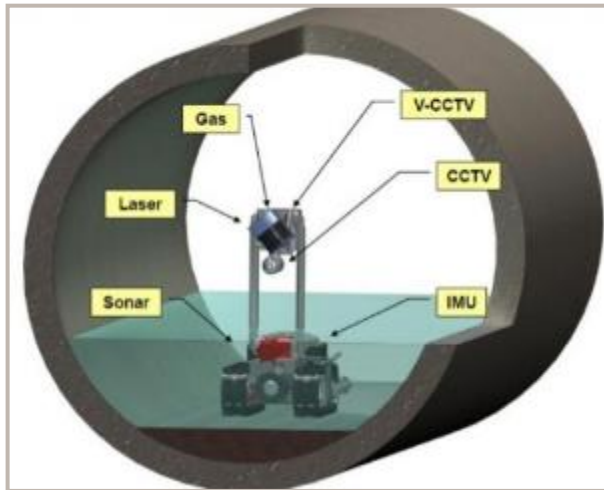
**CDM
Smith**



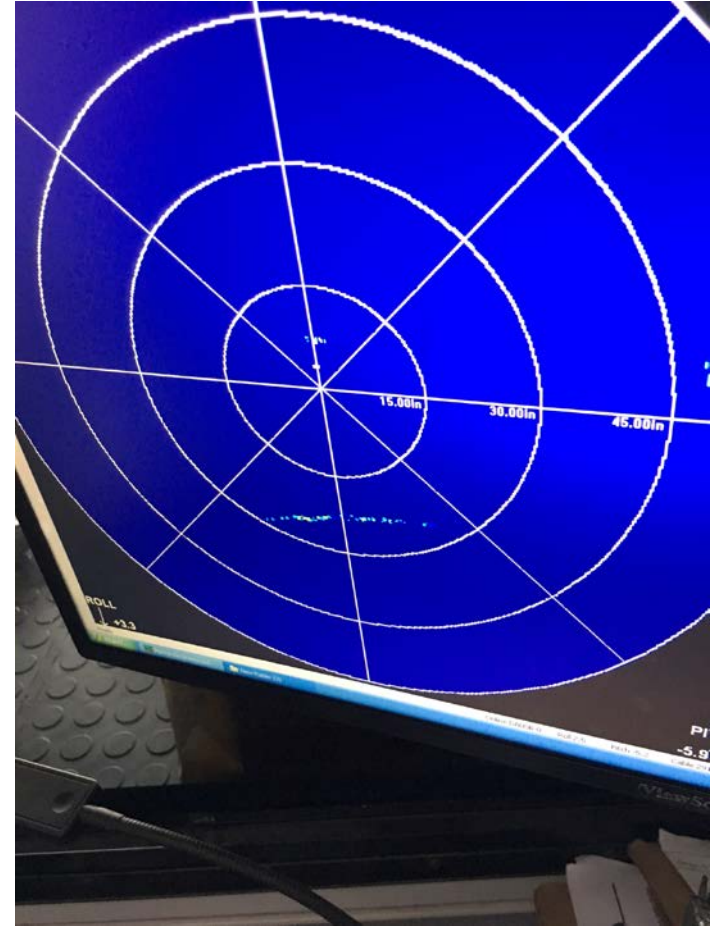
Agenda:

- Large Sewer Inspection with MSI Technologies
 - Traditional CCTV
 - Laser Profiling
 - Sonar Profiling
 - Pipe Penetrating Radar (PPR)
- Alternative Techniques for Sewer and Manhole Inspections
 - Man-Entry Action Camera Video
 - Manhole Inspections
 - Odologgers
- Data Management and Deliverables

Multi-Sensor Sewer Inspections CCTV, Laser Profiling, & Sonar



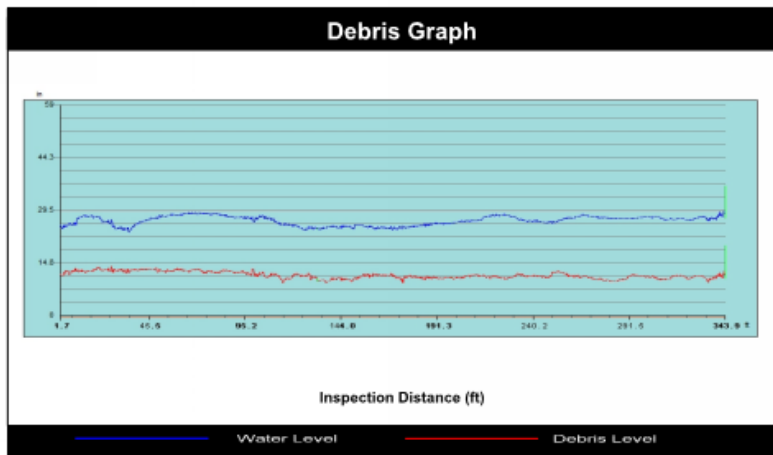
Multi-Sensor Sewer Inspections CCTV, Laser Profiling, & Sonar



Sonar Data / Graph Review

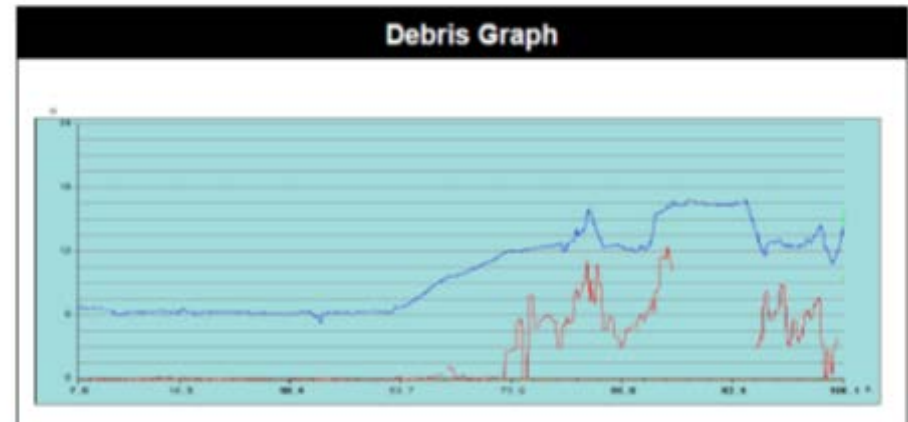
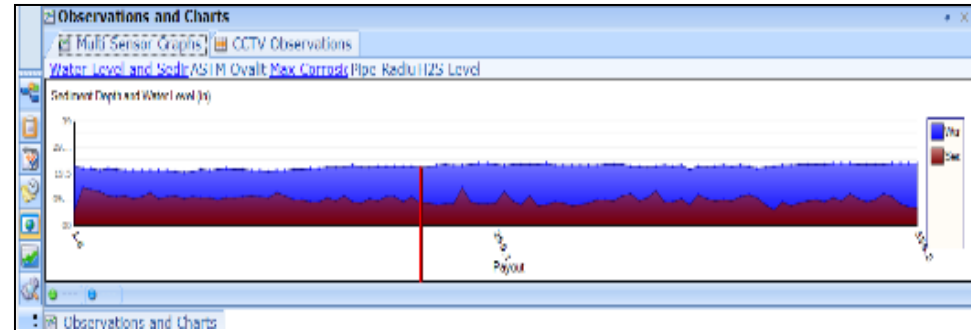
PCI-74B - PCI-75			
Asset Number	PCI-74B - PCI-75	Length	343.9 ft
Upstream MH	PCI-74B	Dimensions	48" x 59"
Downstream MH	PCI-75	Material	Reinforced Concrete Pipe
Survey Direction	Downstream	Shape	Other
Date Installed		Match to Reference *	312.7 ft
Date Profiled	09 September 2014	Operator	

Observations	
Average Debris Depth	12 in
Average Water Level	27 in
Debris Volume	895.4 cubic feet



* The match to reference is the point that best indicates the shape and size of the original condition of the pipe.

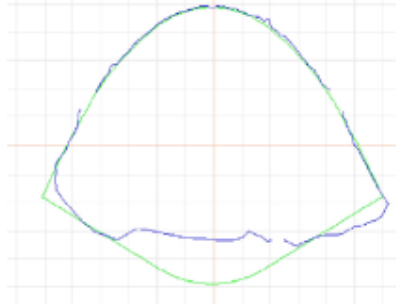
94



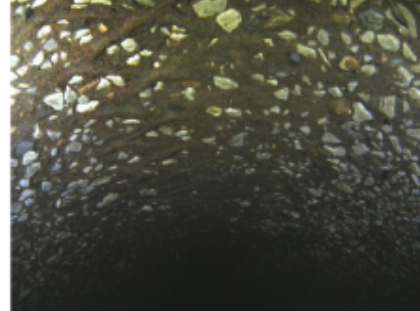
CCTV & Laser Review

Observation Report

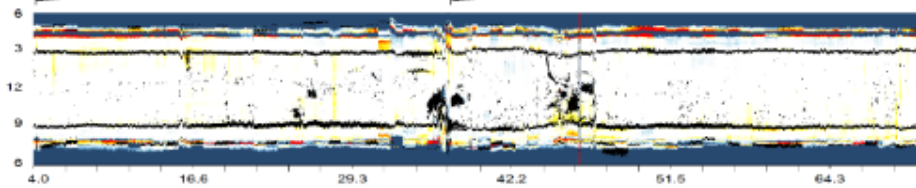
4.2ft General Observation - Measurement outside reference to 1.2", Debris to 8.3"



4.2ft General Observation - Measurement outside reference to 1.2", Debris to 8.3"



37.4ft
- 48.6



73.8 ft

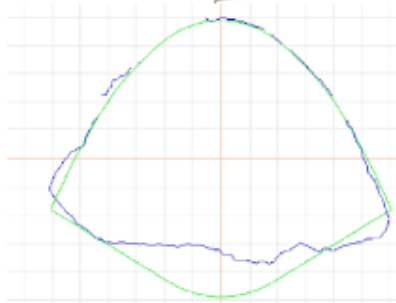
PCI-72A

Height	Code	Grade	Description
14.0	SMH	4	Smoke for
17.5	MGO	0	General
45.0	MGO	0	General
48.0	MGO	0	General
48.0	MGO	0	General
55.0	SMH	4	Smoke for
77.0	SMH	4	Smoke for
77.0	MGO	0	General
88.0	SMH	4	Smoke for
88.0	SMH	4	Smoke for
88.0	MGO	0	General
88.0	MGO	0	General
88.0	MGO	0	General
92.0	SMH	4	Smoke for

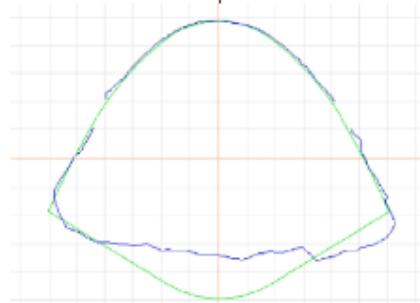
PCI-73

Observations and Charts

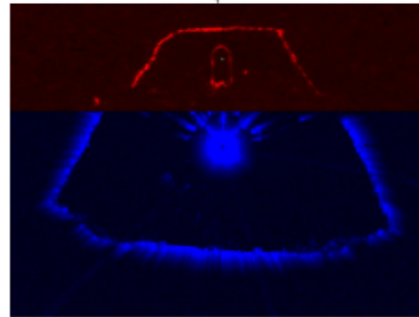
90 | No Data



45.7ft Maximum measurement outside reference - To 1.6"



49.9ft General Observation - Measurement outside reference to 0.6", Debris to 8.0"



77.7ft Point of Interest - Pipe Deformation

Rehab Ph. 1 : CCCPL / Geopolymer

\$9M / 13k = \$700/ft

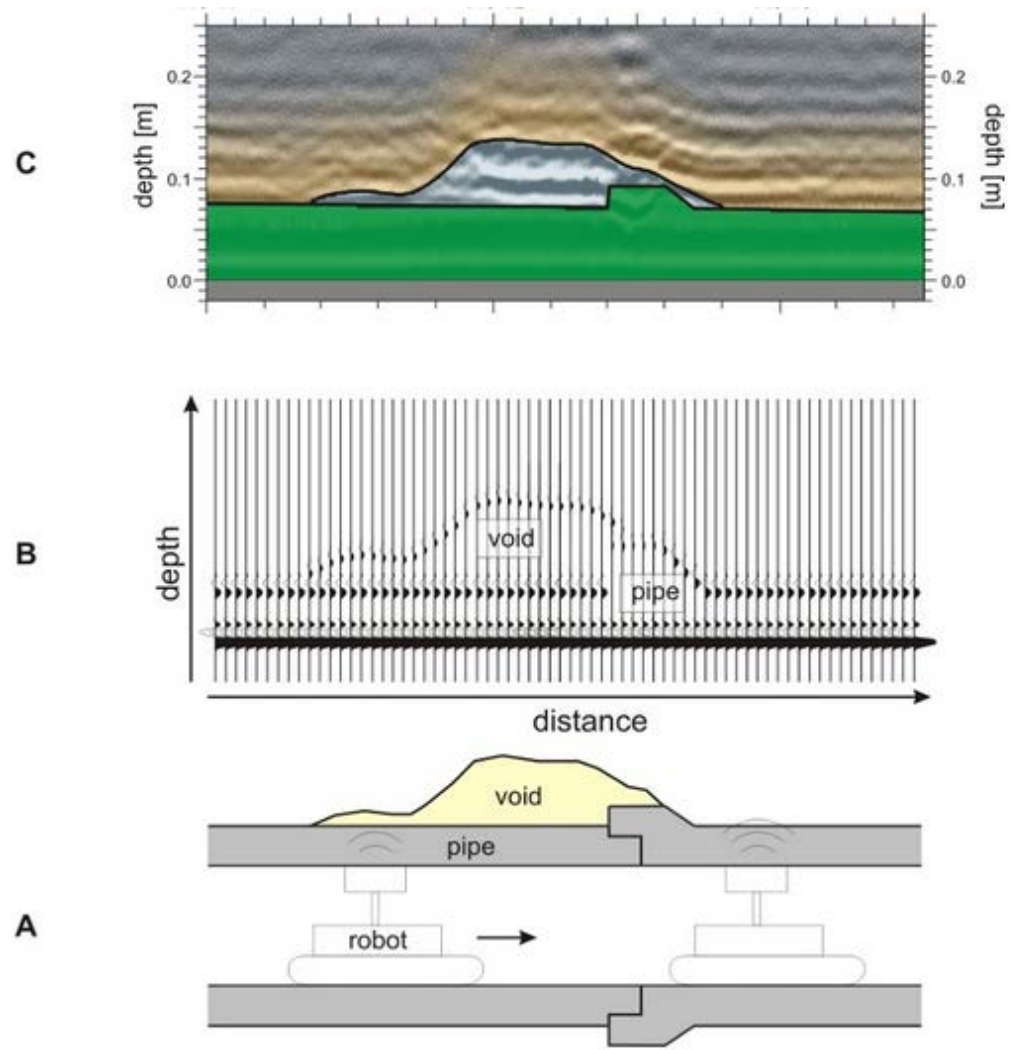
Pipe Penetrating Radar (PPR) Case Study: Cochella Valley CA

- SewerVue
 - In-Pipe Ground Penetrating Radar
 - Identify and quantify voids behind the pipe wall
 - Approximates wall thickness
 - Robot rotated sensors between 9 o'clock & 12 o'clock
 - Rotated sensors between 10 o'clock and 2 o'clock on return



Pipe Penetrating Radar (PPR)

- SewerVue
 - In-Pipe GPR
 - Can identify and quantify voids outside/behind the pipe wall
 - ~\$10 per foot

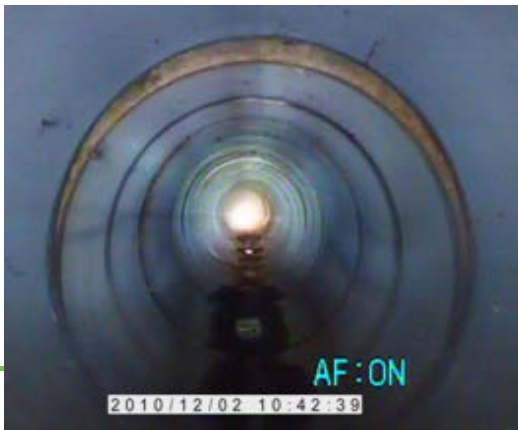


Multi Sensor Inspections (MSI) Pros and Cons

- Pros:
 - Detailed pipe information on dimensions and debris
 - Equipment can tolerate unsafe and toxic gases
 - Multiple sensors/equipment can collect information simultaneously
 - Can float equipment on top of high flow conditions
- Cons:
 - Relatively expensive (\$4 to \$10 per linear foot)
 - Time to collect, process, and analyze data
 - Coordination with limited specialty contractors who are typically very busy
 - Data can be challenging to interpret and sometimes misleading

Man-Entry Sewer and Manhole Inspections

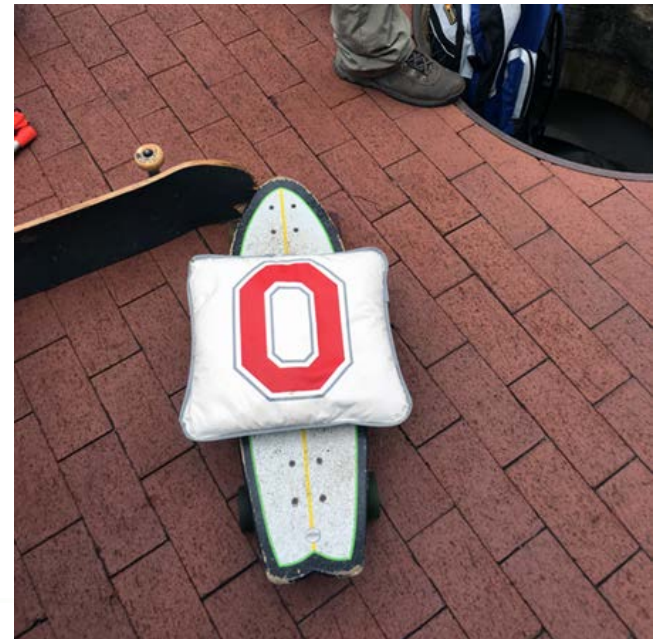
- Storm and Combined Sewer with Action Cameras and Zoom Cameras
 - Provides good alternatives to CCTV
 - Can be done in NASSCO PACP formatting with post processing
- Manhole Inspections with tablets, pole-mounted action camera connected via bluetooth cell phone
 - Allows detailed photos and video that meet MACP Level 2 Inspections



Man-Entry Equipment

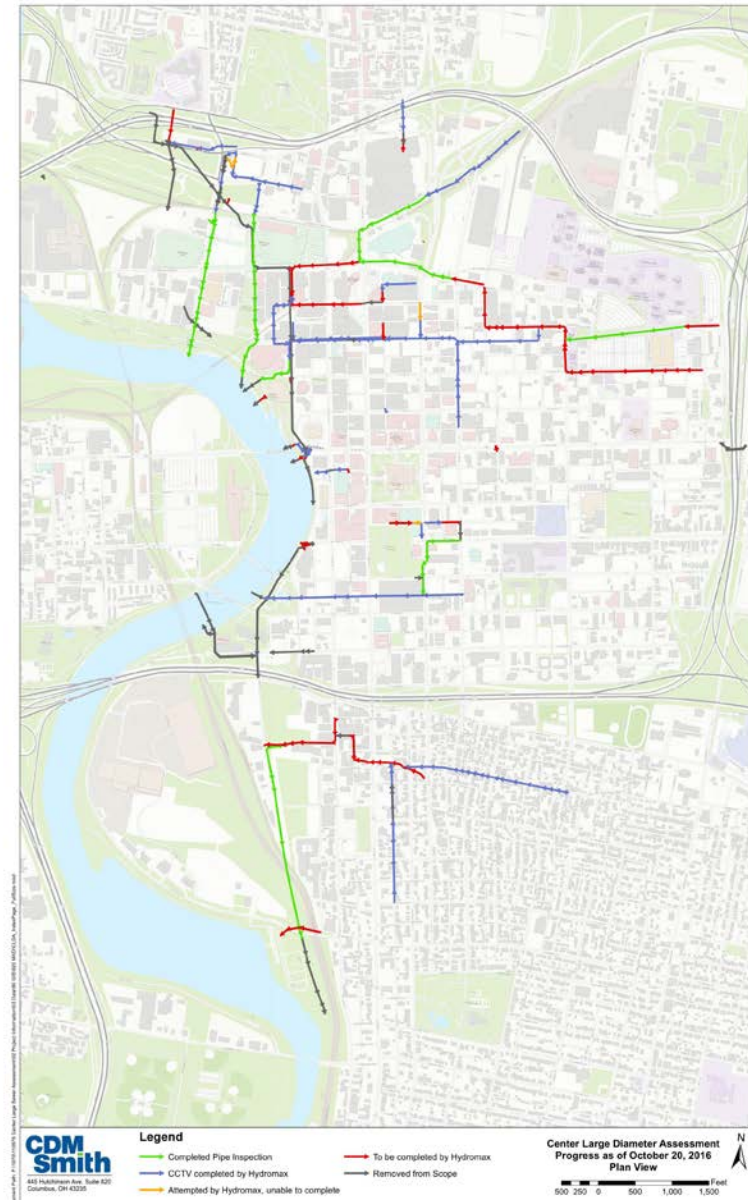


Man-Entry Inspection Equipment (cont.)



Man-Entry GoPro Inspections

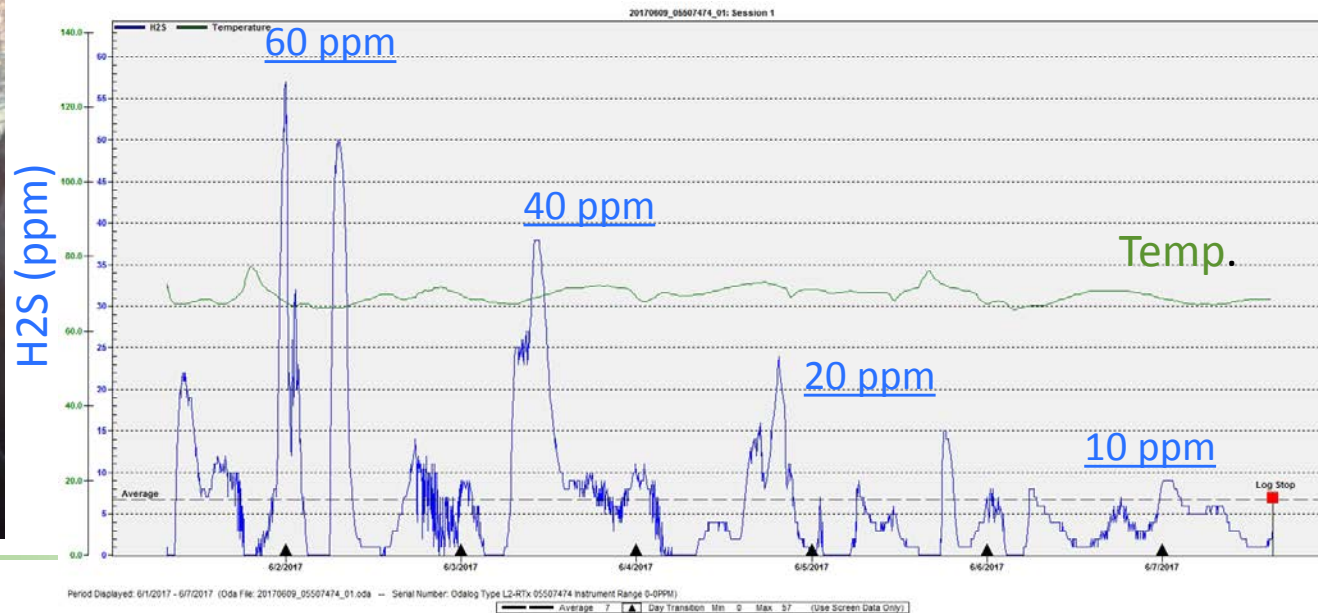
- Man-entry pipe inspections during the summer of 2016
- 14,060 LF of Man-entry inspections
- 33,750 LF of traditional CCTV
- Man-entry: \$2.00 to \$3.00 per LF
- MSI: \$4.00 to \$5.00 per LF



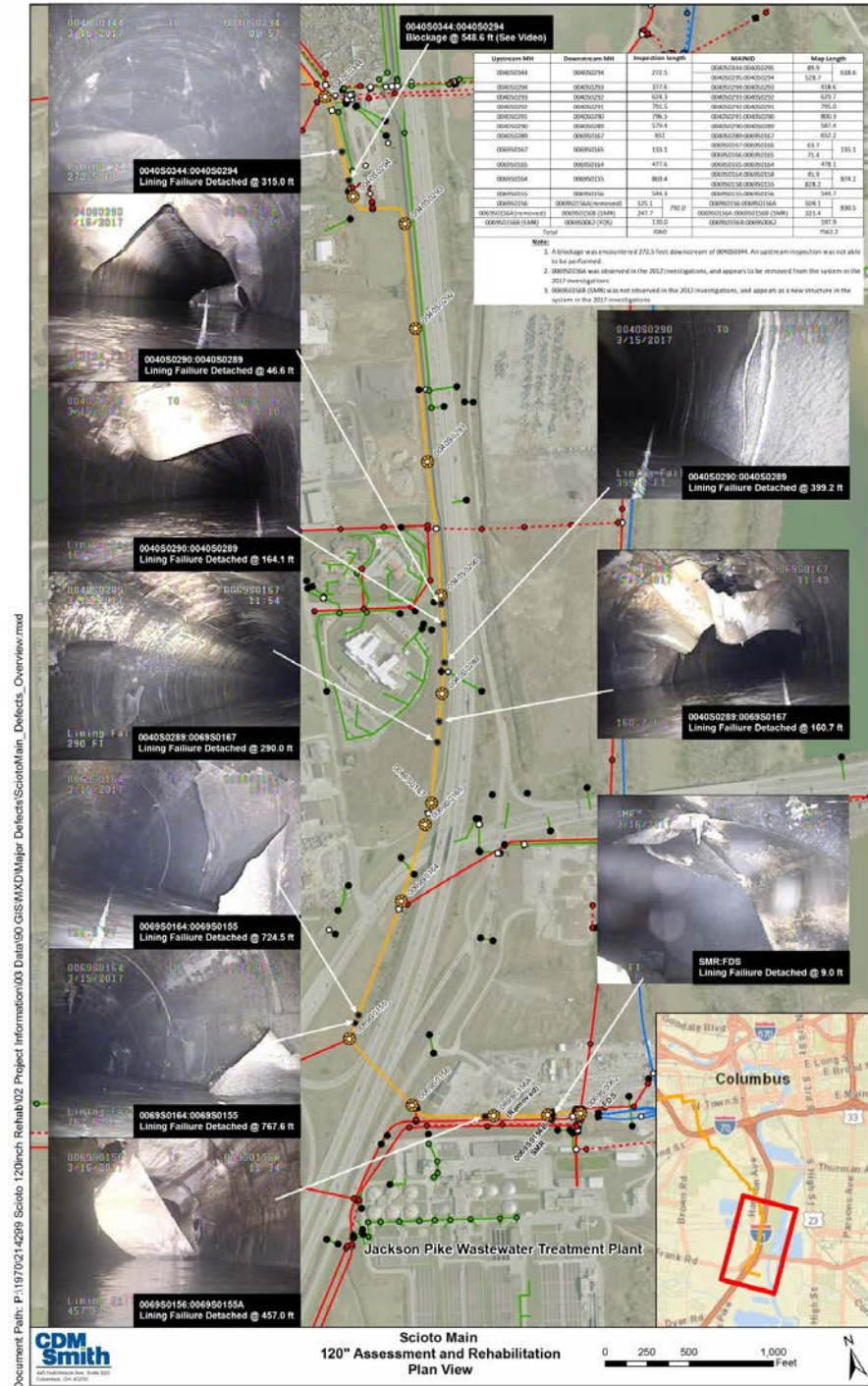
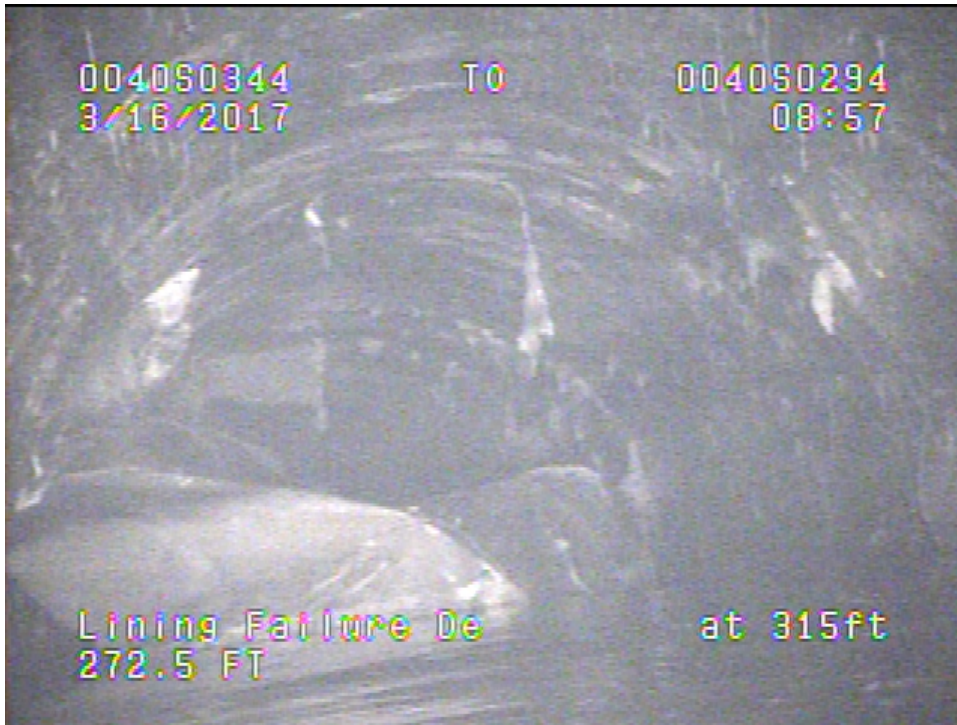
Man-Entry GoPro Inspections



Manhole Inspection and Assessment



Scioto Main 120" Assessment and Rehabilitation Project



Columbus, OH Man-Entry with Diving Team

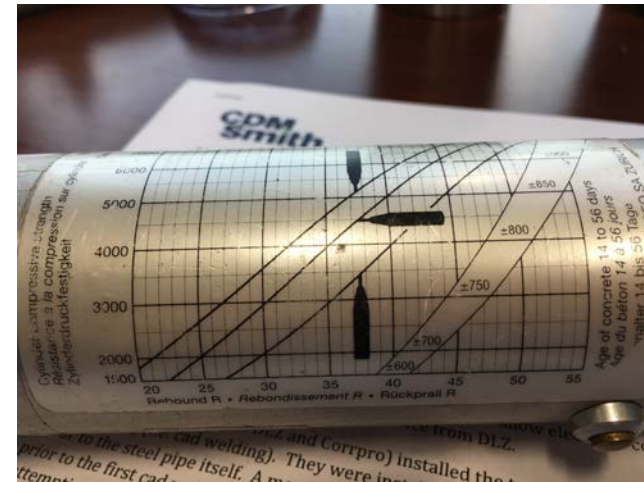


Columbus, OH Man-Entry with Diving Team



Columbus, OH Man-Entry with Diving Team

- Schmidt Hammer Test
- Six test on each side of pipe
- Avg. 54 = 7700 psi
- Avg. 50 = 6700 psi



Columbus, OH Man-Entry with Diving Team

- Successfully performed Schmidt Hammer test
- Confirmed pipe wall is sound
- Removed portion of failing liner
- Determined length of blockage ~44 ft



Man-Entry Pros and Cons

- Pros:
 - Hands-on assessment of pipe condition by experienced engineers
 - NDT Testing (ie. Schmidt Hammer)
 - Measuring Taps, Debris etc.
 - Low cost mobilization and deployment
 - Less Scheduling Conflicts
 - Multiple platforms to collect data
 - Crews are able to navigate obstacles (debris, drops etc.)
 - No Distance Restrictions
 - Better control of lighting and camera location / panning
- Cons:
 - Large onsite crew for safety; Safety Training;
 - Must purchase wide variety of Camera, CSE, Traffic, Safety equipment
 - Can't perform all pipes due to flow and gas conditions
 - More issues with weather
 - No on-screen display of distances and codes were manually written



Questions?