

Multi-sensor Robotics

November 2018

Facilities Inspection



- We want to know the condition of our facilities
- We want to make responsible improvements

Typical Inspection Processes

How Inspections Usually Work

- Isolate the facilities to be inspected
- Dewater and clean pipes and structures
- Inspect
- Replace into service



Typical Inspection Processes

Equipment Typically Used

- Bypass pumps
- Confined space entry equipment
- Cleaning trucks
- CCTV cameras
- Backhoes/hydro excavators
- Core cutters and repair sleeves



Typical Inspection Processes

Getting Back to Normal

- Fill facilities
- Disinfect system components
- Breakdown equipment
- Site clean-up

Typical Inspection Processes

Impacts to the Status Quo

- Operational Impairment
- Impacts to public
- Pressure changes/
flow direction changes



Typical Inspection Processes

What we really want

- Inspect with limited prep
- Inspect with limited impact to the Status Quo
- Inspect with reduced clean-up and disinfections
- Inspection results for the entire line

Modern Technology

Inspection options

- Robotics
 - Multi sensor inspections
 - Submersibles
 - Floatable Sensors
 - Autonomous



Pressure Flow Inspections

Valley Forge Sewer Authority

- SMARTBALL Inspection
 - Acoustic leak detection
 - Acoustic wall assessment
- Did not require excavation
- Did not require modification to facilities



Pressure Flow Inspections

Prep Work Required

- Project layout of key facilities.
- Exercising valves and cleaning facilities.
- Setup limited traffic control



Pressure Flow Inspections

Starting the Test

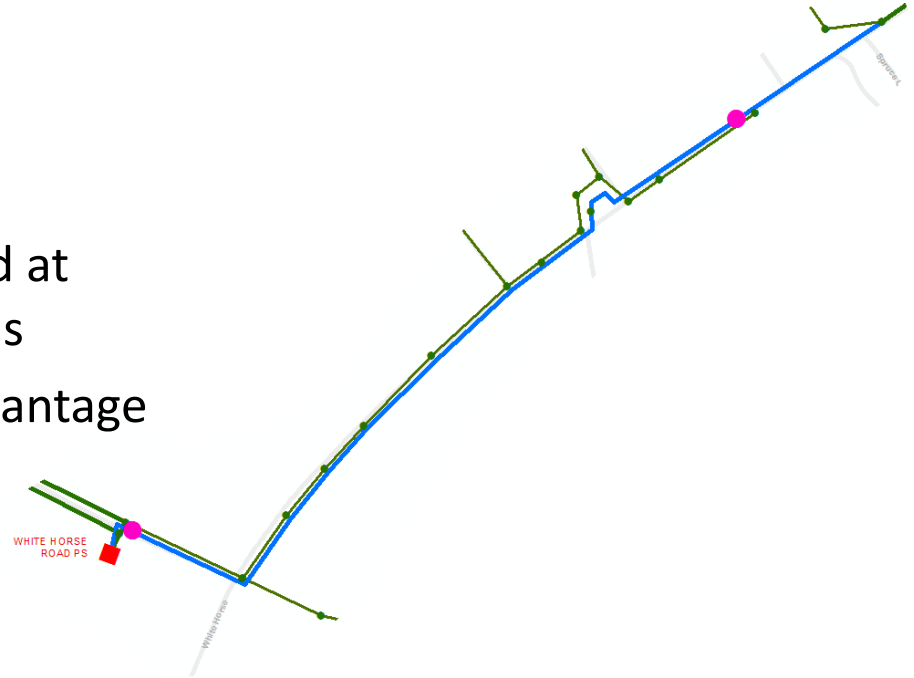
- Fill the wet well
- Insert the SMARTBALL downstream of the check valve
- Run pumps



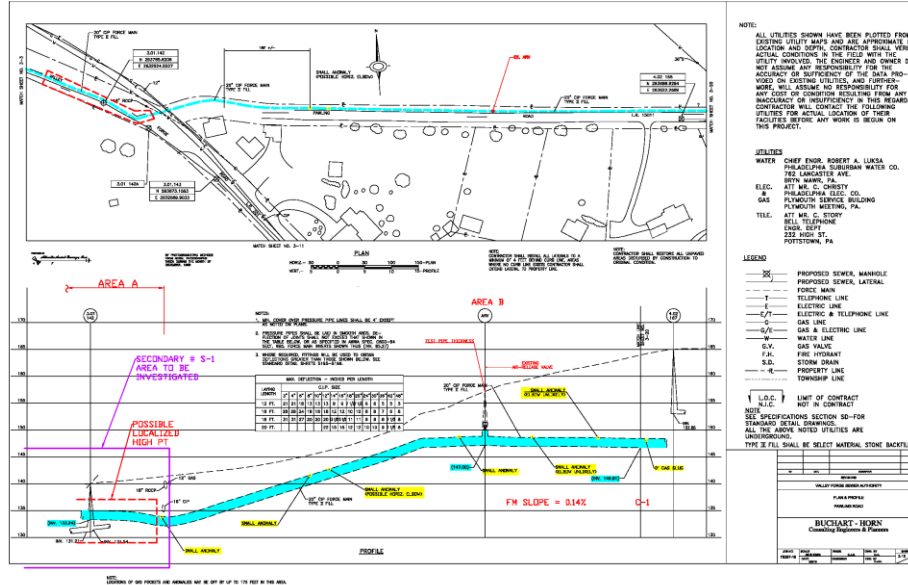
Pressure Flow Inspections

Test Constraints

- Velocity of smart ball
- Listening stations located at sufficiently close intervals
- Metallic pipe was an advantage



Pressure Flow Inspections



Test Results

- Located minor leaks
- Located gas pockets
- Located sections of pipe with thin walls.

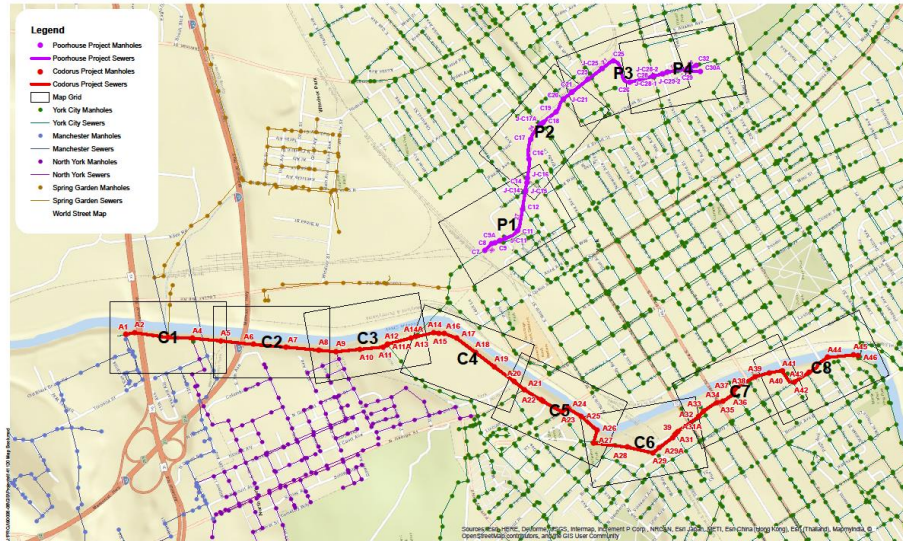
Gravity Flow Inspections



York City Sewer Authority

- RedZone multi-sensor inspection
 - CCTV inspection
 - Laser profile inspection
 - Sonar inspection

Gravity Flow Inspections



Why was multi-sensor inspection chosen

- Interceptor were large diameter interceptors
- The interceptors are long
 - Codorus Creek Interceptor 2.4 miles
 - Poorhouse Run Interceptor 1.1 miles
- The interceptors were difficult to access
- The owner wants to know how much sediment is in the pipes
- No by-pass pumping required

Gravity Flow Inspections

Accessing the Codorus Creek Interceptor

The interceptor has:

- A tunnel section that is 35 ft deep
- Several tower manholes that are more than 8 ft high
- Several high traffic locations.

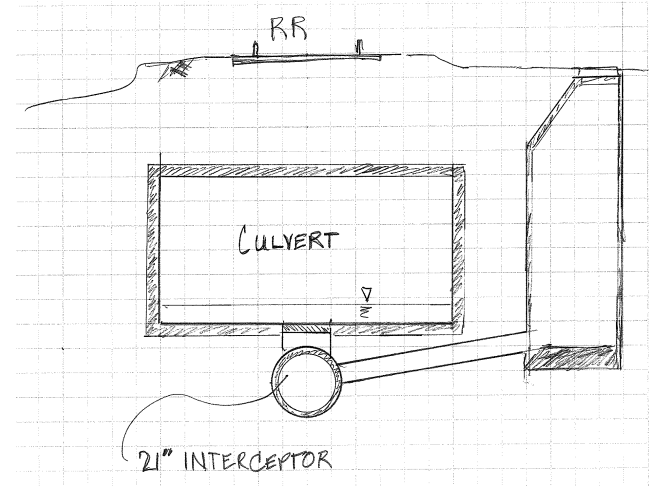


Gravity Flow Inspections

Accessing the Poorhouse Run Interceptor

The interceptor is:

- Under 1.1 miles of underground stream culvert, and...
- Under 0.6 miles of railroad tracks
- Manholes are accessible in the culvert but the stream requires by-pass pumping.



Gravity Flow Inspections

CCTV Results

- Standard CCTV reports
- Standard video and pictures



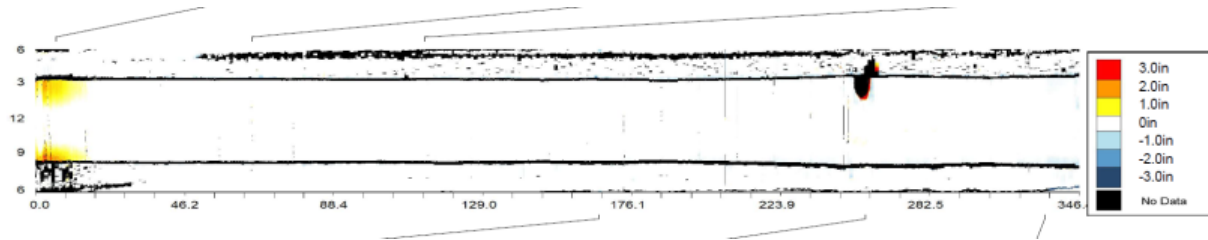
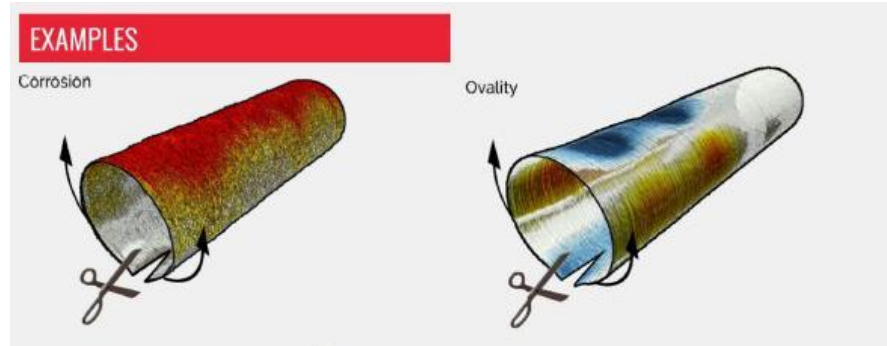
Profile/Photo Observation Report



Date:	06/16/2018	Weather:	Dry	Coding:	PACP 6.0			
Pipe Length (ft):	.0	Owner:	City of York	Pre Clean:	No Pre-Cleaning			
P.O.#:		Surveyor:	Jen Costello	PSR:	C9A;C8			
Customer:	Buchart Horn, Inc.	Clean Date:		Shape:	C			
Street:	Charles Street	Flow Control:	Not Controlled					
City:	York, PA	Year Renewed:						
Location:	Other	Tape/Media #:						
Purpose:	Routine Assessment	Dia/Height:	27"					
Use:	Sanitary	Material:	VCP					
Drain Area:		Lining:						
Category:	NA							
Comment:	SJ501847 - DEP 1-10							
Location Details:			Direction of Survey:	Downstream				
US MH:	C9A	DS MH:	C8	Total Length Surveyed (ft):	30.9			
O&M Index:	0.00	O&M Quick:	0000	O&M Rating:	0			
Structural Index:	4.00	Structural Quick:	4100	Structural Rating:	4			
Overall Index:	4.00	Overall Quick:	4100	Overall Rating:	4			

Gravity Flow Inspections

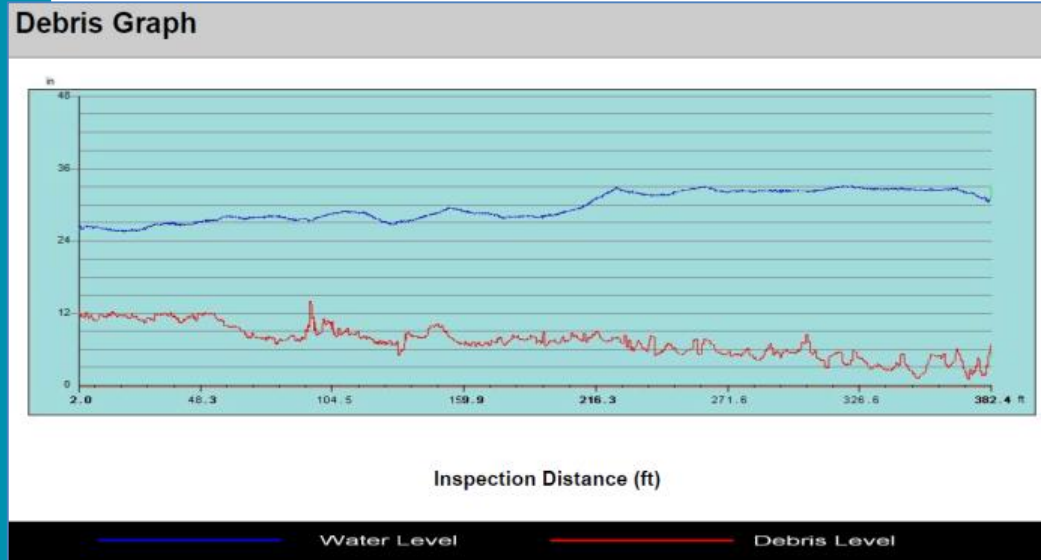
Laser Results



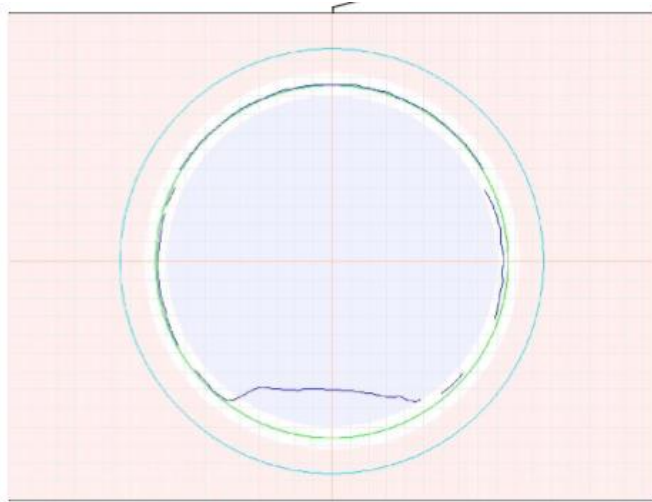
Gravity Flow Inspections

Sonar Results

- Identify the depth of sediment in the pipe
- Provide a volume of sediment



Gravity Flow Inspections



Final Results

- Identify the depth of sediment in the pipe
- Provide a volume of sediment (>5000 cuft)

The Future

Increased Emphasis on Robotic

- Robotics will be come smaller
- There will be more, better sensors
- Price to use robotics will drop

Increased Emphasis on AI

- Increased reliance on uniform reporting of results (Like NASSCO, National Association of Sewer Services Companies)
- Using AI to assess results from CCTV and various sensors



Thank You