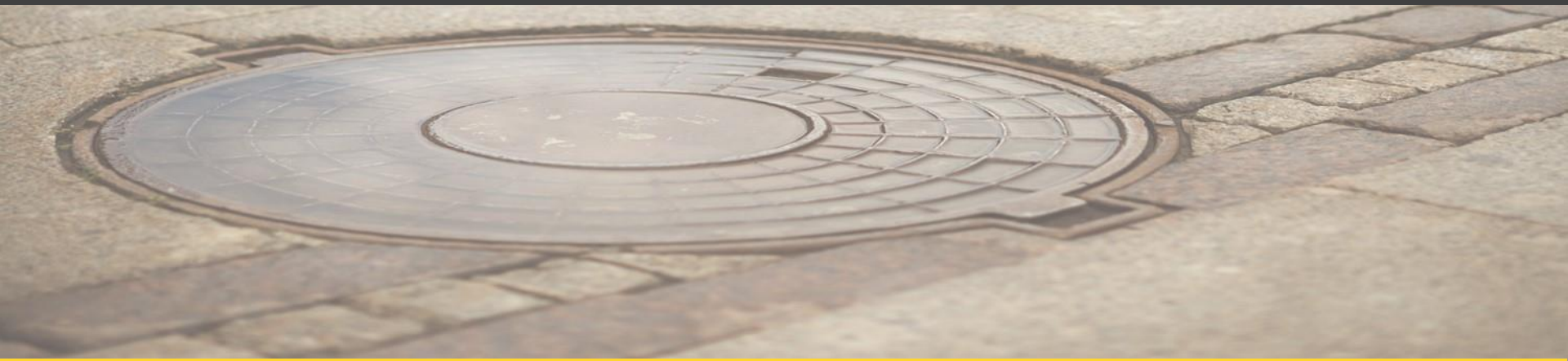
New Inspection Technologies
&
How to Utilize the Information in NASSCO MACP

Pierre Mikhail, Director

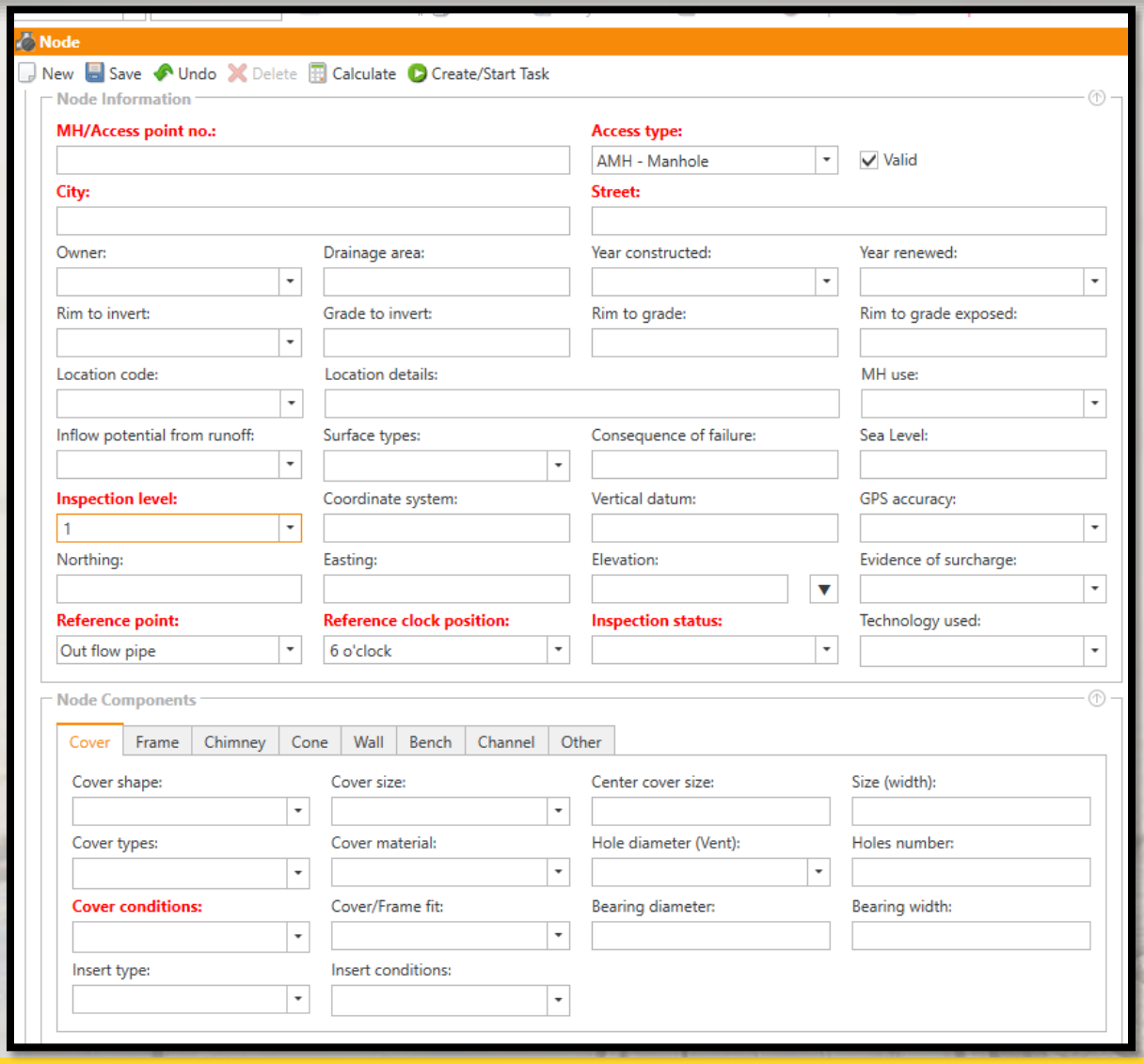


Underground Construction Technology
International Conference & Exhibition

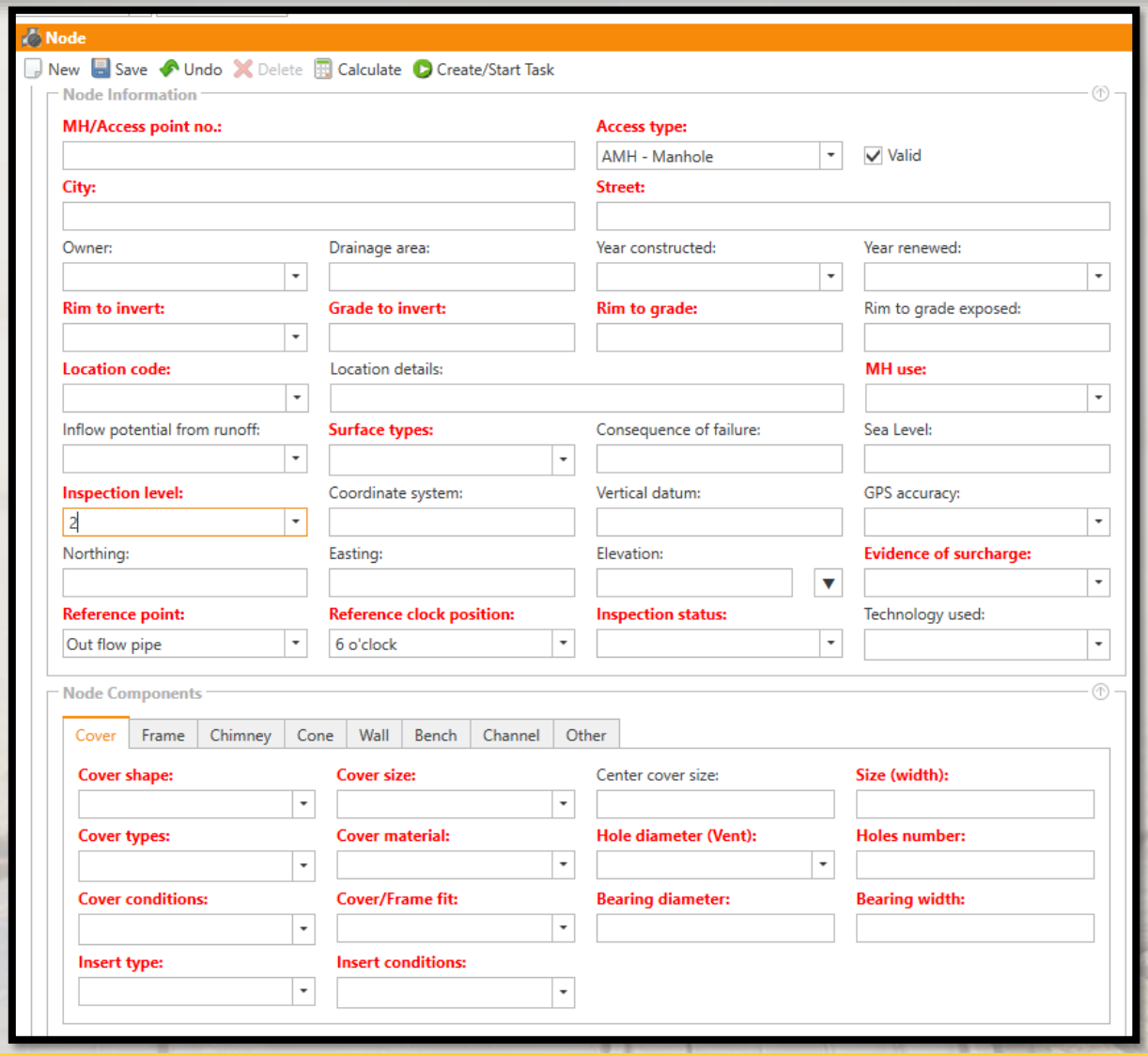
Why Inspect Manholes?

- Locate all manholes, catch basins and outfalls
- Confirm physical characteristics (size, material, etc.) and connectivity
- Identify immediate maintenance needs and structural defects
- Prioritize cleaning and in-line inspection needs
- Build/update GIS with physical and condition asset attributes
- Eliminate surprises (SSOs, pipe failures and operational issues)

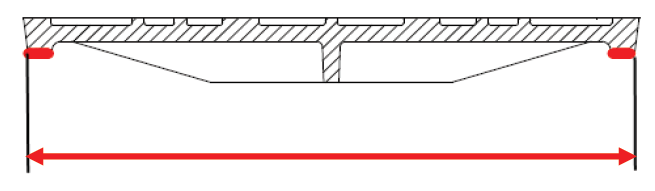
NASSCO MACP LEVEL 1

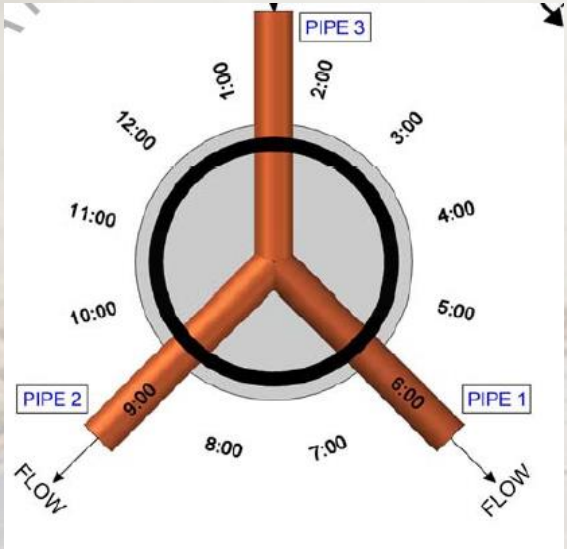


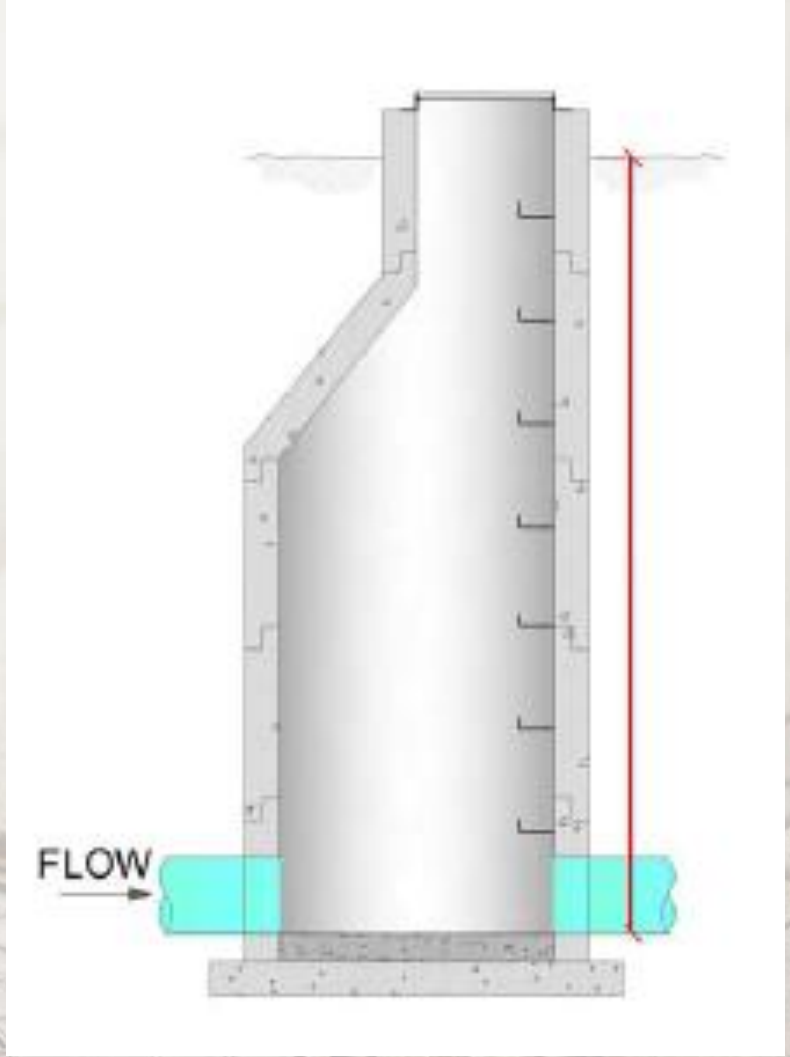
NASSCO MACP LEVEL 2



NASSCO MACP LEVEL 2



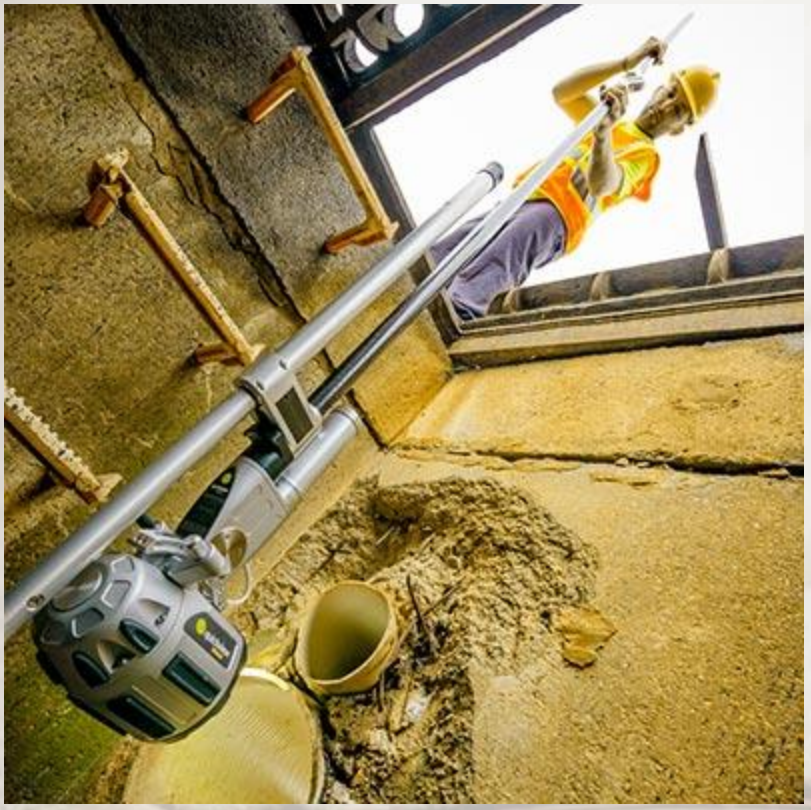




Visual Manhole Inspection

- No special equipment required
- Limited visual observations from ground level
- Possible confined space entry if required
- No video documentation
- Possible photo documentation
- Observations noted on paper forms or database

Handheld Pole Camera



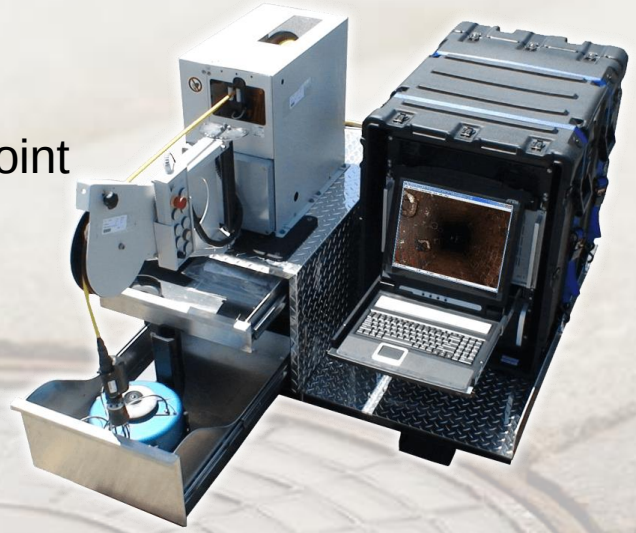
- Battery operated
- Portable, one man operation
- Inspection depth of 25 feet
- Unstable handheld panning/rotation of camera in manhole
- Better suit for screening connecting pipelines
- Inspect approximately 10 manholes per day depending on manhole depth
- Ideal for offroad, difficult to access manholes

Truck Mounted Motorized Pole Camera

- 30 ft telescopic mast
- Motorized pan/tilt control of inspection video
- Remote controlled from truck office
- Ideal for onroad inspections and connecting pipelines
- No measurements

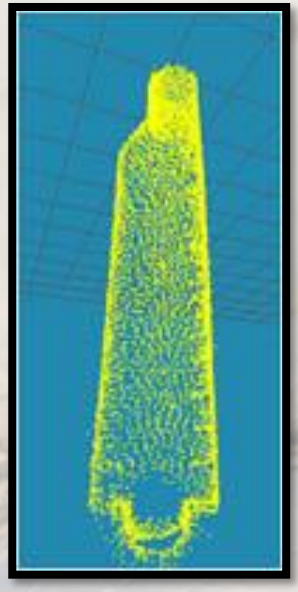
“Side Scanning” Photographic Camera

- Released 2009; 2015; 2016
- Cable deployed
- Pictures stitched together
- Produces a continuous hemispherical picture scan of the internal manhole condition
- Manhole is measured using point cloud produced from Lidar



“Side Scanning” Photographic Camera

- Point cloud has limited density
- Depth of manhole inspected relies on reel cable
- Point cloud data and imagery are separate devices
- Data is merged together using proprietary software
- System must be stable and vertical
- Zero calibration necessary (possible human error)
- Limited to point-to-point measurement



Challenges

- Easier off road manhole inspection with minimal equipment transportation
- More forgiving during inspections - consistency
- Eliminate zero calibration
- Eliminate costly cable repairs from offroad use
- Quick and stable deployments for manholes deeper than 25 ft
- Rehabilitation quality control

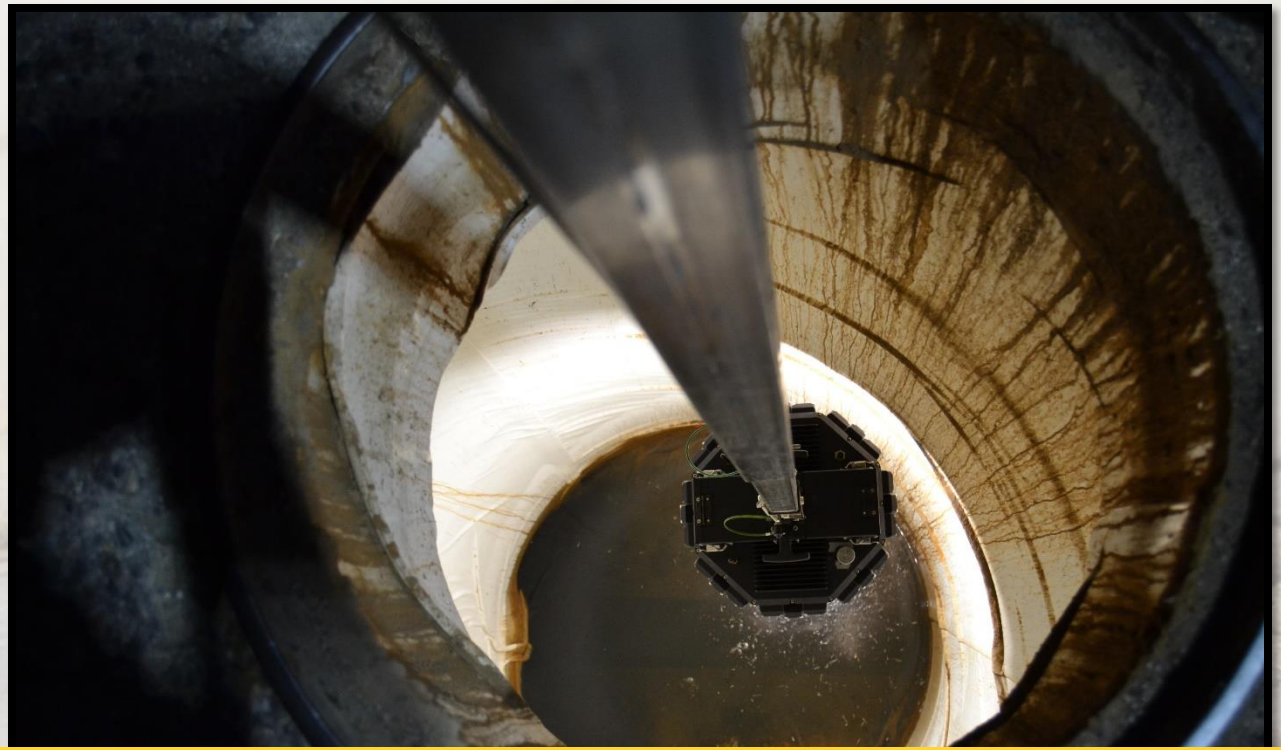
Technology Timeline

Pre-1980 – Visual Inspection

1985 to 2008 – Video Camera / Pole Camera

2009 to 2016 – 2D Side Scanning with Measurement

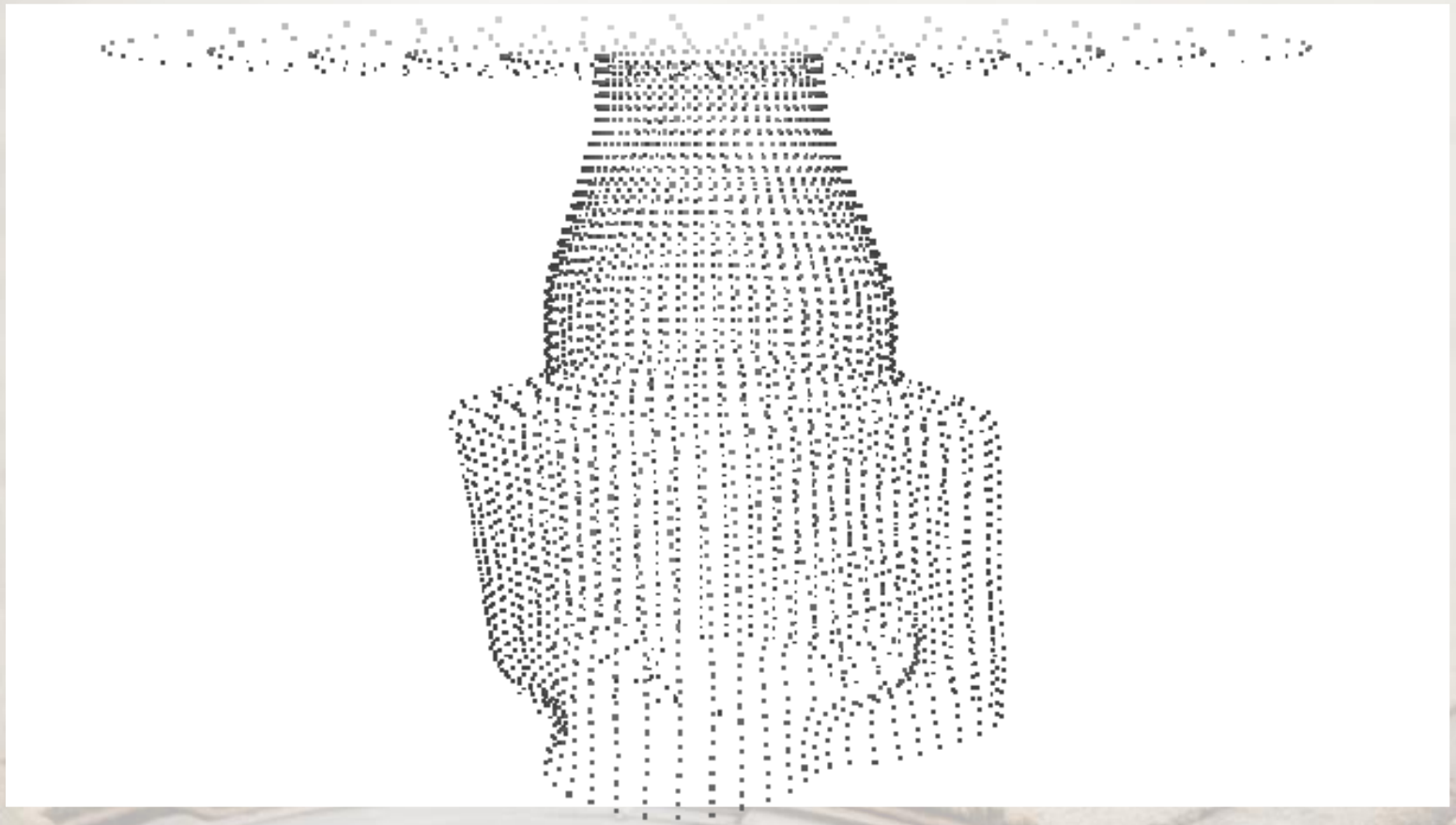
2018 – 3D Scanning / Modeling



3D Wireless Scanning

- Portable – Battery Operated
- Wireless, not tethered to power or data
- Tablet control
- High production
- Minimal site time – 10 ft/min

Side Scanning Point Cloud

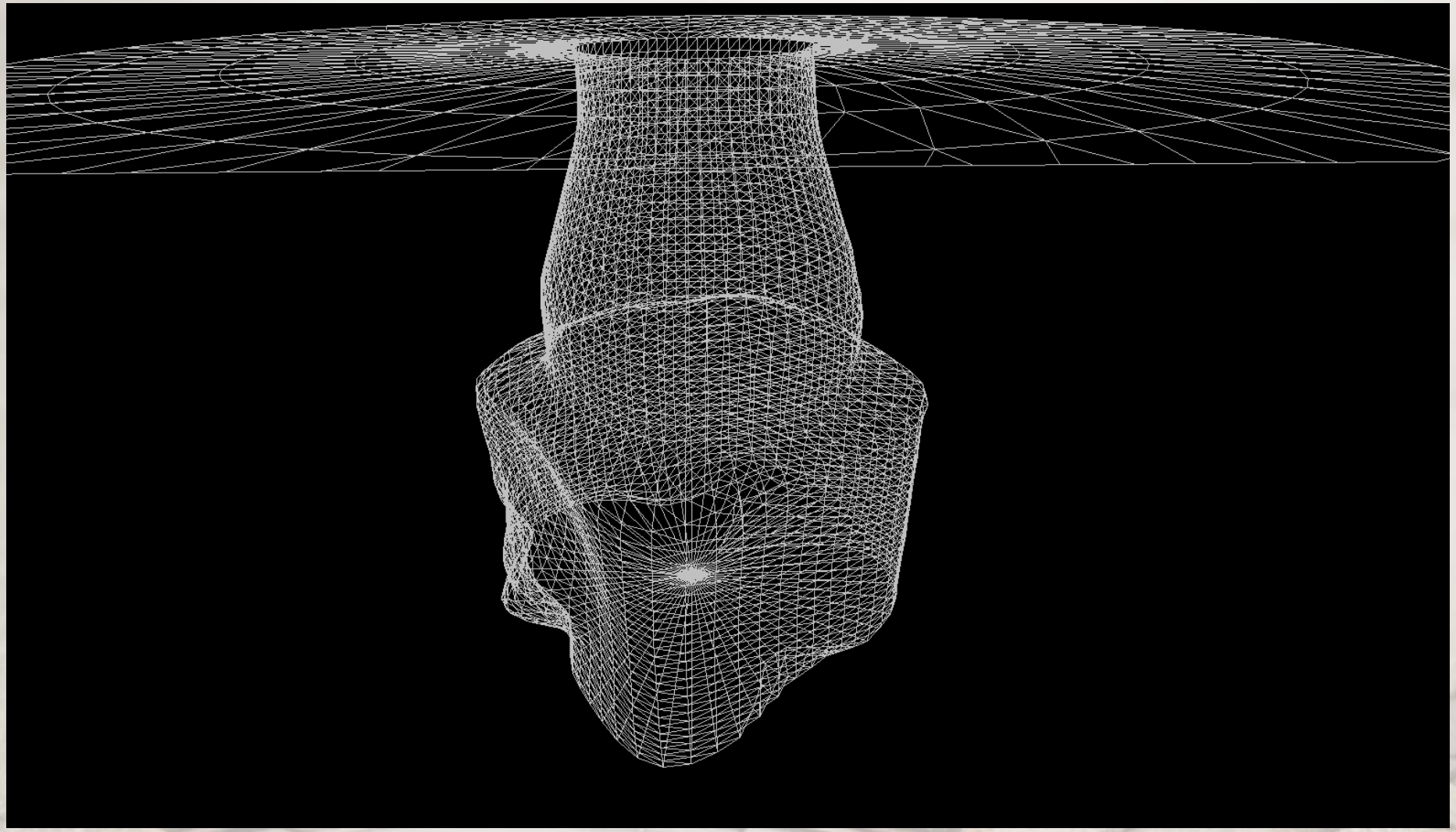


Sparse and Single Color – Made for point to point measurement

3D Scanner Point Cloud

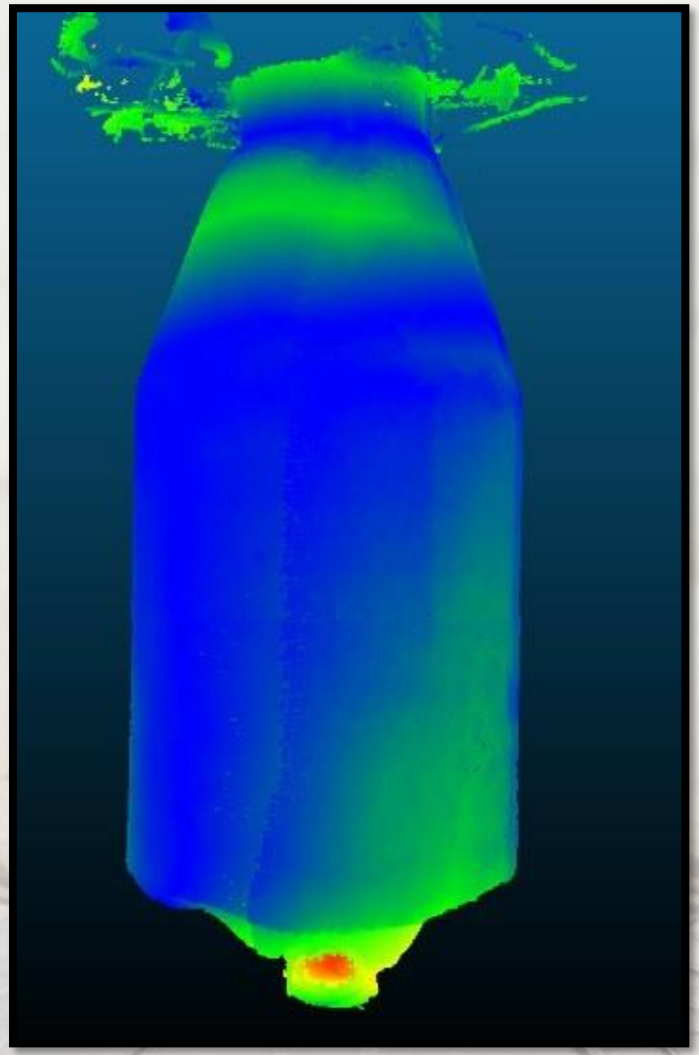
Color and **Solid** Density Point Cloud

Increased Density Equates To Increased Accuracy of Measurement – up to 1 mm



Solid Density Point Clouds Create Measurable Meshes
Instead of point to point measurement

Manhole Rehab Quality Control



Comparison of two meshes provides distance deviation of entire structure using color grading

3D Scanning and Rehab Quality….

Cured in Place Lining

- Meshes can be provided to manufacturers for better fit (reduce material waste and costs)
- Scanning before and after lining will assess if the liner has become detached and if warranty specifications have been met

Coating

- Scan at failure
- Scan after pressure washing
- Scan after coating
- Scan at end of warranty period

Results

Each scan creates a historical mesh to be recorded in the asset and meshes can be compared to determine how much the manhole has changed dimensionally between those periods. These dimensions provide coating thickness and manhole shape deviation in millimeter accuracy.

MACP Reports

MACP Inspections with Asset Connections

Surveyed by:	Certificate number:	Owner:	Customer:	Drainage area:	P/O number:	Sheet number:
CUES	U-606-3492	SPiDER Demo				

Access type:	Work order no.:	Start date/time:	Street:	City:
AMH		20171202 20:18	Easement	Carlsbad, CA

MH/Access point no.:	Rim to invert:	Grade to invert:	Rim to grade:	MH use:	Location details:
Carlsbad SPiDER Demo	16.000 ft.	15.000 ft.	1.000 ft.	SS	

Year constructe	Year renewed:	Media label:	Purpose:	Sewer category:	Pre-cleaning:	Date cleaned:	Weather:	Location code:
			D		N		1	L

Surface types:	Inflow potential from r	Northing:	Easting:	Elevation:	Coordinate system:	GPS accuracy:
Grass Dirt						

Inspection status:	Inspection level:	Evidence of surcharge:	Pressure value:
RI	2	N	

Additional info:

MACP Reports

Cover:

Cover shape:	Cover size:	Size (width):	Cover material:	Insert type:	Hole diameter (Ven	Holes number:
C	25.0 in.		CAS	N		

Bearing diameter:	Bearing width:	Cover/Frame fit:	Cover conditions:	Cover types:	Insert conditions:
25.0 in.		G	Sound	Solid	

Frame:

Adj. ring type:	Adj. ring material:	Seal inflow:	Adj. ring height:	Frame material:	Bearing width:	Frame depth:
N		N		CAS	1.0 in.	

Clear opening diam	Frame conditions:	Seal conditions:	Ring conditions:	Offset distance:	Bearing depth:
23.0 in.	Sound	Sound		0.0 in.	1.0 in.

Chimney:

First material:	Second material:	Chimney infiltration	Clear opening:	Chimney depth:	Lining interior:	Lining exterior:
CR				5.500 ft.		

Cone:

Cone type:	Cone material:	Cone depth:	Lining interior:	Lining exterior:
CC	CR	7.400 ft.		

Wall:

Wall diameter:	Wall by size:	Wall material:	Wall depth:	Lining interior:	Lining exterior:
		CR	15.100 ft.		

Bench and Channel:

Bench present:	Bench material:	Bench lining:	Channel installed:	Channel material:	Channel type:	Channel exposure:
Y	CN		Y	CN	F	F

Steps number:	Steps material:
0	

Connected Asset Information

#	Asset	Flow	Clock position	Rim to invert	Material	Pipe shape	Diam 1	Diam 2
1	Sewer Main '003'	Out	6 o'clock	15.833 ft.	PVC	C	8 in.	
2	Sewer Main '004'	In	9 o'clock	15.700 ft.	PVC	C	8 in.	
3	Sewer Main '005'	In	1 o'clock	15.500 ft.	VCP	C	6 in.	
4	Sewer Lateral '001'	In	2 o'clock	7.833 ft.	VCP	C	8 in.	
5	Sewer Main '006'	In	3 o'clock	15.500 ft.	VCP	C	6 in.	

MACP Reports

Manhole Ratings

Grade	Structural: Amount of Defects	Segment Grade	Manhole Rating	Quick Rating	MH Rating Index	O&M: Amount of Defects	Segment Grade	Manhole Rating	Quick Rating	MH Rating Index	Overall: Manhole Rating	Manhole Rating	LoF	Risk
1	3	3	36	332A	2.0	8	8	8	1800	1.0	44	1.7	3.3	
2	12	24				0	0							
3	3	9				0	0							
4	0	0				0	0							
5	0	0				0	0							

Manhole Component Grades

Grade	Structural	O&M	Grade	Structural	O&M	Grade	Structural	O&M
Hole Number			Adjustment Ring Condition			Frame Seal Inflow		1
Cover/Frame Fit		1	Frame Condition	1		Chimney I/I		
Cover Condition	1		Seal Condition	1	1	Pipe Condition (max. grade)		
Cover Insert Condition			Frame Offset Distance					

Observations

Depth	Video Ref.	Component	MACP Code	Continuous	Value Inches (mm) 1st	2nd	%	At Joint	Step	Circumferential Location At/From	To	Rating	Image Ref.	Remarks
0.0 ft.	00:00:15	CMI	MGO					☐	☐	/			-AMH 'Carlsbad SPiDER Demo'-MGO at 0.0 ft._2.png	General Picture
1.0 ft.	00:00:23	CMI	SAP	S01				☐	☐	12	11	3	-AMH 'Carlsbad SPiDER Demo'-SAP at 1.0 ft._1.png	
4.0 ft.	00:00:56	CMI	SAP	F01				☐	☐	12	11	3	-AMH 'Carlsbad SPiDER Demo'-SAP at 4.0 ft._1.png	
4.5 ft.	00:01:04	COI	SSS	S02				☐	☐	12	12	2	-AMH 'Carlsbad SPiDER Demo'-SSS at 4.5 ft..png	

MACP Reports

Observations

Distance	Video Ref.	MACP Code	Continuous S/M/L	Value Inches (mm) 1st	Value Inches (mm) 2nd	%	At Joint	Step	Circumferential Location At/From	Circumferential Location To	Image Ref.	Remarks
0.0 ft.	00:00:15	MGO					☐	☐	/		-AMH 'Carlsbad SPiDER Demo'-MGO at 0.0 ft._2.png	General Picture
												
1.0 ft.	00:00:23	SAP	S01				☐	☐	12	11	-AMH 'Carlsbad SPiDER Demo'-SAP at 1.0 ft._1.png	
												
4.0 ft.	00:00:56	SAP	F01				☐	☐	12	11	-AMH 'Carlsbad SPiDER Demo'-SAP at 4.0 ft._1.png	

Conclusion

- New manhole inspection technologies are continuously being introduced in the market to assist with manhole inspections and filling NASSCO MACP fields
- NASSCO compliant software is available to process the manhole inspection data and assist with short and long term prioritization
- Manhole inspections can range from low resolution to high resolution with production anywhere up to 50 manholes per day.

Questions

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