



SANITARY DEMONSTRATION

PROBLEM OVERVIEW

CUES was contacted by Miami-Dade Water and Sewer Department to perform a demonstration project for two sanitary sewer (gravity) 8-inch vitrified clay pipes (VCP) that have historically required regular and extensive cleaning due to surcharging, and customer back-ups. Both of these pipeline segments are located on NE 170th Street in Miami, Florida and are connected by an adjoining man-hole.

CUES APPROACH

CUES utilized the Accurate Mapping Probe (AMP™) (refer to Figure 1) in order to determine horizontal location, vertical elevation and overall inclination for sag analysis on both of these pipeline segments (MH51 – MH50, and MH50 – MH49). The AMP™ technology collects horizontal coordinates and vertical elevation measurements as it traverses within the pipeline segment at the rate of 100 readings/second through the use of onboard: Gyroscopes; Accelerometers; and Inclinometers.

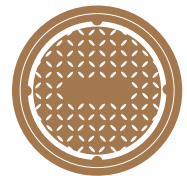
CUES affixed the AMP to a tag line that was installed via a jetter and placed the AMP™ into the manhole. A safety tag line was placed on the opposite side of the AMP™. The AMP™ was then advanced from MH51 to MH50 and back. The same process was performed for MH50 to MH49. In all, both of these pipeline segments were mapped with AMP™ and the data was processed on-site in less than 2-hours. Each of these pipeline segments

had an approximate length of 320 feet.

RESULTS

The AMP™ technology was able to achieve an accuracy of less than two tenths of a foot in each of these pipeline segments. Based on the AMP™ mapping the internal geometry of a pipeline structure this positional data can be used in developing the following deliverables: AutoCAD and PDF versions of Plan and Profiles; ESRI (.SHP) files; Google Earth Plan views, Inclination reports (custom and standard); and tabular listing of horizontal coordinates and elevations as a .CSV file. The Plan and Profiles generated from the AMP™ positional data are referenced to Florida State Plane (NAD83) with elevations referenced to NAVD 88.

Figure 2 provides the Plan and Profile for MH51 to MH50. Additionally, a custom inclination report is also provided as Figure 3. The sags are clearly evident in both pipeline segments in the profile view and can be seen in the tabular presentation of the data in the custom inclination report. Figure 4 provides the Plan and Profile for MH50 to MH49 segment, and Figure 5 presents the standard inclination report. Both of these pipeline segments are depicted in plan view within the Google Earth image provided as Figure 6.



Operational range of 3.5in ID (90mm) to 58in ID (1473mm). Whether the pipeline is made of steel, concrete, PE, or PVC, this mapping system can be used to accurately locate any pipe.

Figure 1: Accurate Mapping Probe (AMP™)



Figure 2: Plan and Profile for MH51 to MH50

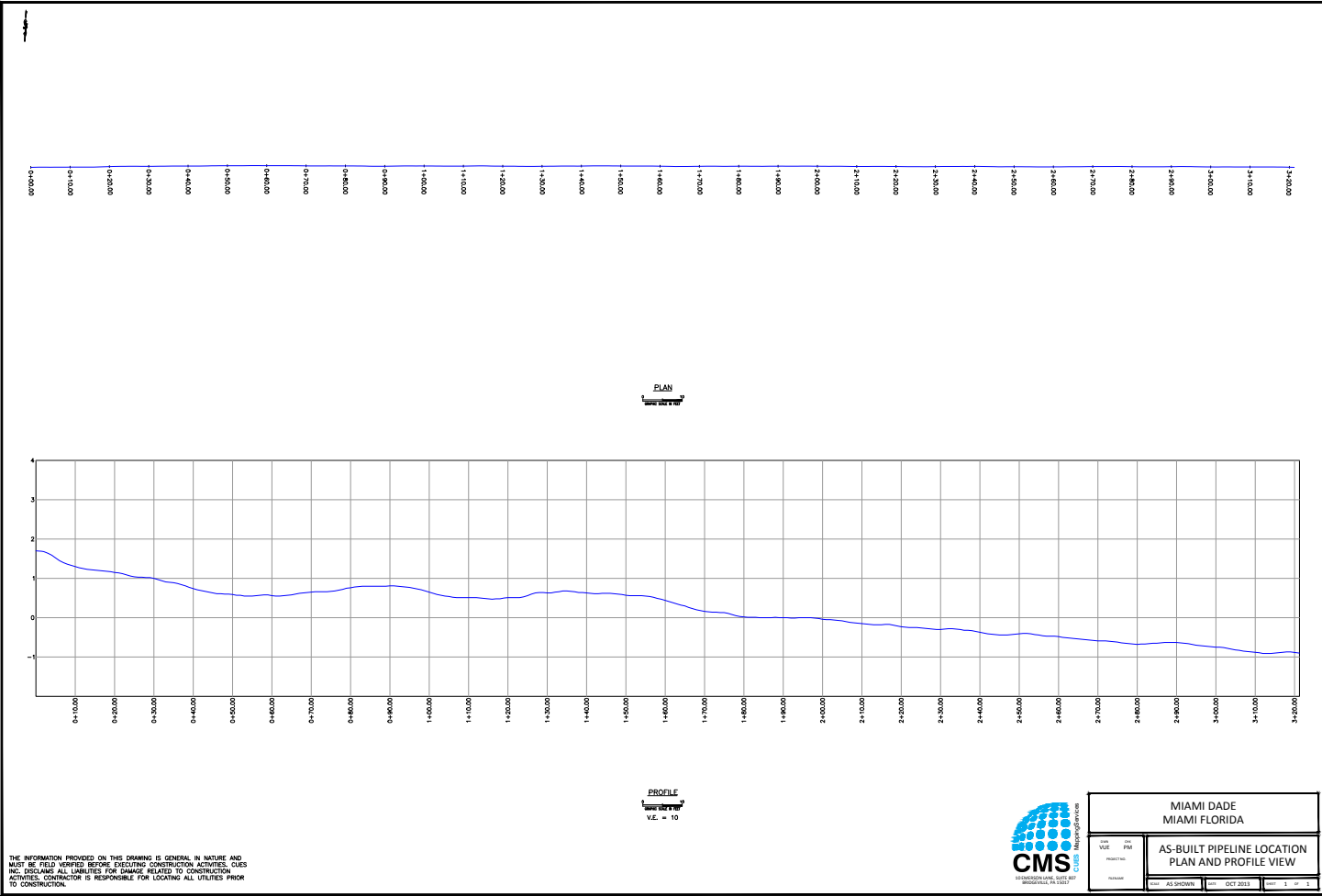


Figure 3: Custom Inclination Report

Inclination Report for Accurate Mapping Probe (AMP) Run 131014_MH51_MH50_Average_D1.xml										
This report uses the nearest point to the specified interval when measuring segment interval										
User Parameters --> Segment Interval = 5; Segment Max Grade = 0.81 %										
Point Number1	X	Y	Z	Station	Horiz Distance Between Points (ft)	Elevation Change Between Points (ft)	Segment Slope	Segment Grade (%)		
1	941008.440	583669.580	1.700	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	
6	941003.450	583669.350	1.520	4.9957	4.9953	-0.1800	-0.0360	-3.60		
11	940998.450	583669.130	1.300	10.0007	5.0048	-0.2200	-0.0440	-4.40		
16	940993.460	583668.920	1.210	14.9951	4.9944	-0.0900	-0.0180	-1.80		
21	940988.480	583668.600	1.150	19.9859	4.9903	-0.0600	-0.0120	-1.20		
26	940983.480	583668.320	1.040	24.9939	5.0078	-0.1100	-0.0220	-2.20		
31	940978.490	583668.130	1.000	29.9875	4.9936	-0.0400	-0.0080	-0.80		
36	940973.490	583667.890	0.890	34.9933	5.0058	-0.1100	-0.0220	-2.20		
41	940968.500	583667.680	0.740	39.9879	4.9944	-0.1500	-0.0300	-3.00		
46	940963.510	583667.450	0.630	44.9833	4.9953	-0.1100	-0.0220	-2.20		
51	940958.510	583667.210	0.590	49.9895	5.0058	-0.0400	-0.0080	-0.80		
56	940953.520	583666.990	0.550	54.9844	4.9948	-0.0400	-0.0080	-0.80		
61	940948.530	583666.790	0.560	59.9785	4.9940	0.0100	0.0020	0.20		
66	940943.530	583666.600	0.580	64.9822	5.0036	0.0200	0.0040	0.40		
71	940938.530	583666.450	0.650	69.9845	5.0022	0.0700	0.0140	1.40		
76	940933.540	583666.270	0.670	74.9778	4.9932	0.0200	0.0040	0.40		
81	940928.540	583666.080	0.760	79.9816	5.0036	0.0900	0.0180	1.80		
86	940923.540	583665.920	0.800	84.9843	5.0026	0.0400	0.0080	0.80		
91	940918.550	583665.760	0.810	89.9771	4.9926	0.0100	0.0020	0.20		
96	940913.550	583665.490	0.770	94.9845	5.0073	-0.0400	-0.0080	-0.80		
101	940908.560	583665.300	0.650	99.9782	4.9936	-0.1200	-0.0240	-2.40		
106	940903.560	583665.140	0.540	104.9808	5.0026	-0.1100	-0.0220	-2.20		
111	940898.560	583664.940	0.510	109.9848	5.0040	-0.0300	-0.0060	-0.60		
116	940893.570	583664.690	0.480	114.9812	4.9963	-0.0300	-0.0060	-0.60		
121	940888.580	583664.570	0.510	119.9727	4.9914	0.0300	0.0060	0.60		
126	940883.580	583664.410	0.560	124.9754	5.0026	0.0500	0.0100	1.00		
131	940878.590	583664.200	0.630	129.9702	4.9944	0.0700	0.0140	1.40		
136	940873.590	583663.950	0.680	134.9766	5.0062	0.0500	0.0100	1.00		
141	940868.600	583663.760	0.630	139.9704	4.9936	-0.0500	-0.0100	-1.00		
146	940863.600	583663.510	0.620	144.9768	5.0062	-0.0100	-0.0020	-0.20		
151	940858.600	583663.350	0.570	149.9795	5.0026	-0.0500	-0.0100	-1.00		
156	940853.610	583663.160	0.550	154.9732	4.9936	-0.0200	-0.0040	-0.40		
161	940848.610	583663.000	0.440	159.9759	5.0026	-0.1100	-0.0220	-2.20		
166	940843.620	583662.880	0.300	164.9675	4.9914	-0.1400	-0.0280	-2.80		
171	940838.620	583662.640	0.160	169.9733	5.0058	-0.1400	-0.0280	-2.80		
176	940833.630	583662.430	0.130	174.9680	4.9944	-0.0300	-0.0060	-0.60		
181	940828.630	583662.220	0.020	179.9726	5.0044	-0.1100	-0.0220	-2.20		
186	940823.640	583662.040	0.000	184.9659	4.9932	-0.0200	-0.0040	-0.40		
191	940818.640	583661.820	0.000	189.9709	5.0048	0.0000	0.0000	0.00		
196	940813.640	583661.620	0.000	194.9750	5.0040	0.0000	0.0000	0.00		
201	940808.650	583661.440	-0.040	199.9683	4.9932	-0.0400	-0.0080	-0.80		
206	940803.650	583661.260	-0.080	204.9716	5.0032	-0.0400	-0.0080	-0.80		
211	940798.660	583661.110	-0.150	209.9639	4.9923	-0.0700	-0.0140	-1.40		
216	940793.670	583660.900	-0.180	214.9584	4.9944	-0.0300	-0.0060	-0.60		
221	940788.670	583660.720	-0.230	219.9617	5.0032	-0.0500	-0.0100	-1.00		
226	940783.670	583660.570	-0.260	224.9640	5.0022	-0.0300	-0.0060	-0.60		
231	940778.670	583660.360	-0.300	229.9686	5.0044	-0.0400	-0.0080	-0.80		

Figure 4: Plan and Profile for MH50 to MH49

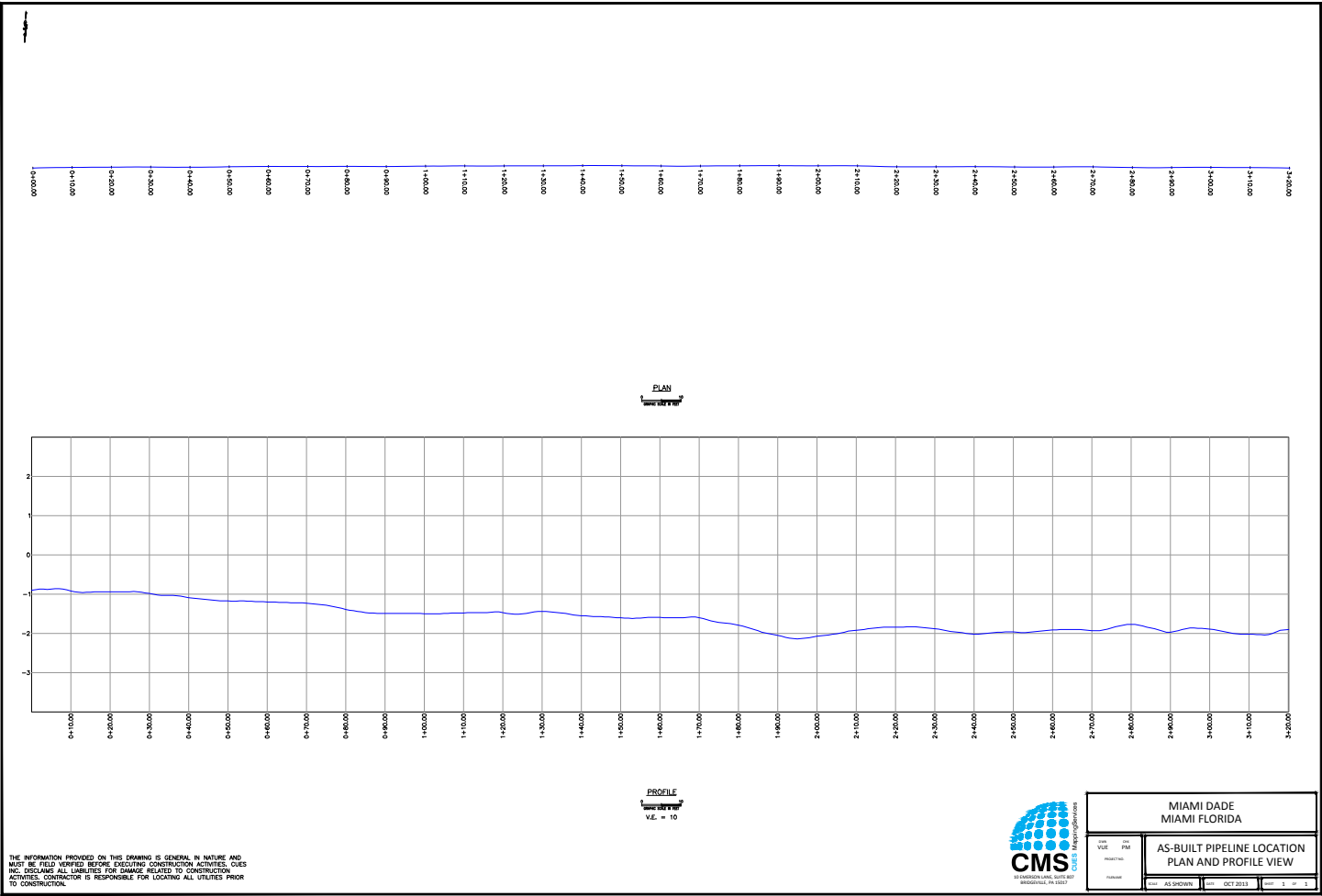


Figure 5: Standard Inclination Report

Inclination Report for Accurate Mapping Probe (AMP) Run 131016_MH50_MH49_Average_D3.xml								
Point Number	X	Y	Z	Station	Horiz Distance Between Points (ft)	Elevation Change Between Points (ft)	Segment Slope	Segment Grade (%)
1	940687.460	583656.970	-0.900	0.0000	0.0000	0.0000	0.0000	0.00
2	940686.060	583656.860	-0.880	1.4043	1.4043	0.0200	0.0142	1.42
3	940685.460	583656.830	-0.870	2.0051	0.6007	0.0100	0.0166	1.66
4	940684.460	583656.770	-0.870	3.0069	1.0018	0.0000	0.0000	0.00
5	940683.460	583656.720	-0.880	4.0081	1.0012	-0.0100	-0.0100	-1.00
6	940682.460	583656.660	-0.870	5.0099	1.0018	0.0100	0.0100	1.00
7	940681.460	583656.600	-0.860	6.0117	1.0018	0.0100	0.0100	1.00
8	940680.460	583656.560	-0.860	7.0125	1.0008	0.0000	0.0000	0.00
9	940679.460	583656.520	-0.870	8.0133	1.0008	-0.0100	-0.0100	-1.00
10	940678.460	583656.470	-0.890	9.0146	1.0012	-0.0200	-0.0200	-2.00
11	940677.460	583656.420	-0.920	10.0158	1.0012	-0.0300	-0.0300	-3.00
12	940676.460	583656.380	-0.940	11.0166	1.0008	-0.0200	-0.0200	-2.00
13	940675.470	583656.330	-0.950	12.0079	0.9913	-0.0100	-0.0101	-1.01
14	940674.470	583656.270	-0.960	13.0097	1.0018	-0.0100	-0.0100	-1.00
15	940673.470	583656.220	-0.950	14.0109	1.0012	0.0100	0.0100	1.00
16	940672.470	583656.170	-0.950	15.0122	1.0012	0.0000	0.0000	0.00
17	940671.470	583656.120	-0.940	16.0134	1.0012	0.0100	0.0100	1.00
18	940670.470	583656.080	-0.940	17.0142	1.0008	0.0000	0.0000	0.00
19	940669.470	583656.050	-0.940	18.0147	1.0004	0.0000	0.0000	0.00
20	940668.470	583656.010	-0.940	19.0155	1.0008	0.0000	0.0000	0.00
21	940667.470	583655.960	-0.940	20.0167	1.0012	0.0000	0.0000	0.00
22	940666.480	583655.920	-0.940	21.0075	0.9908	0.0000	0.0000	0.00
23	940665.480	583655.870	-0.940	22.0088	1.0012	0.0000	0.0000	0.00
24	940664.480	583655.820	-0.940	23.0100	1.0012	0.0000	0.0000	0.00
25	940663.480	583655.770	-0.940	24.0113	1.0012	0.0000	0.0000	0.00
26	940662.480	583655.720	-0.940	25.0125	1.0012	0.0000	0.0000	0.00
27	940661.480	583655.670	-0.930	26.0138	1.0012	0.0100	0.0100	1.00
28	940660.490	583655.630	-0.940	27.0046	0.9908	-0.0100	-0.0101	-1.01
29	940659.490	583655.600	-0.950	28.0050	1.0004	-0.0100	-0.0100	-1.00
30	940658.490	583655.570	-0.970	29.0055	1.0004	-0.0200	-0.0200	-2.00
31	940657.490	583655.530	-0.980	30.0063	1.0008	-0.0100	-0.0100	-1.00
32	940656.490	583655.510	-1.000	31.0065	1.0002	-0.0200	-0.0200	-2.00
33	940655.490	583655.480	-1.020	32.0069	1.0004	-0.0200	-0.0200	-2.00
34	940654.490	583655.450	-1.030	33.0074	1.0004	-0.0100	-0.0100	-1.00
35	940653.490	583655.420	-1.030	34.0078	1.0004	0.0000	0.0000	0.00
36	940652.480	583655.390	-1.030	35.0183	1.0104	0.0000	0.0000	0.00
37	940651.490	583655.360	-1.030	36.0087	0.9905	0.0000	0.0000	0.00
38	940650.490	583655.320	-1.040	37.0095	1.0008	-0.0100	-0.0100	-1.00
39	940649.490	583655.270	-1.050	38.0108	1.0012	-0.0100	-0.0100	-1.00
40	940648.490	583655.230	-1.070	39.0116	1.0008	-0.0200	-0.0200	-2.00
41	940647.500	583655.190	-1.090	40.0024	0.9908	-0.0200	-0.0202	-2.02
42	940646.490	583655.150	-1.100	41.0132	1.0108	-0.0100	-0.0099	-0.99
43	940645.500	583655.110	-1.110	42.0040	0.9908	-0.0100	-0.0101	-1.01
44	940644.490	583655.060	-1.120	43.0152	1.0112	-0.0100	-0.0099	-0.99
45	940643.500	583655.010	-1.130	44.0065	0.9913	-0.0100	-0.0101	-1.01
46	940642.500	583654.960	-1.140	45.0077	1.0012	-0.0100	-0.0100	-1.00
47	940641.500	583654.910	-1.150	46.0090	1.0012	-0.0100	-0.0100	-1.00
48	940640.500	583654.860	-1.160	47.0102	1.0012	-0.0100	-0.0100	-1.00
49	940639.500	583654.800	-1.170	48.0120	1.0018	-0.0100	-0.0100	-1.00
50	940638.510	583654.740	-1.170	49.0038	0.9918	0.0000	0.0000	0.00

Figure 6: Google Earth KML

