CREATING A CAPITAL PLAN USING MST AND THE NASSCO PIPELINE ASSESSMENT PROGRAM

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T&M Associates

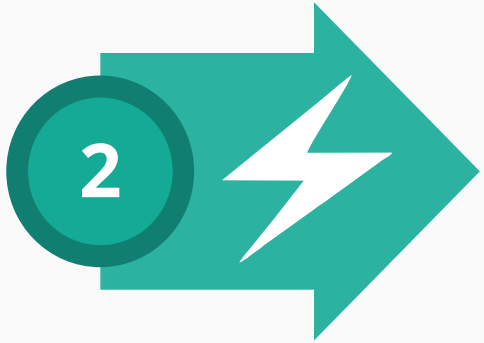
AGENDA

1. Overview of Multi-Sensor Technology (MST)
2. Project Description
3. NASSCO Pipe Line Assessment Program
4. Creating a Capital Plan

OVERVIEW OF MULTI-SENSOR TECHNOLOGY

CCTV

High Resolution with
Pan & Tilt Capabilities



LASER

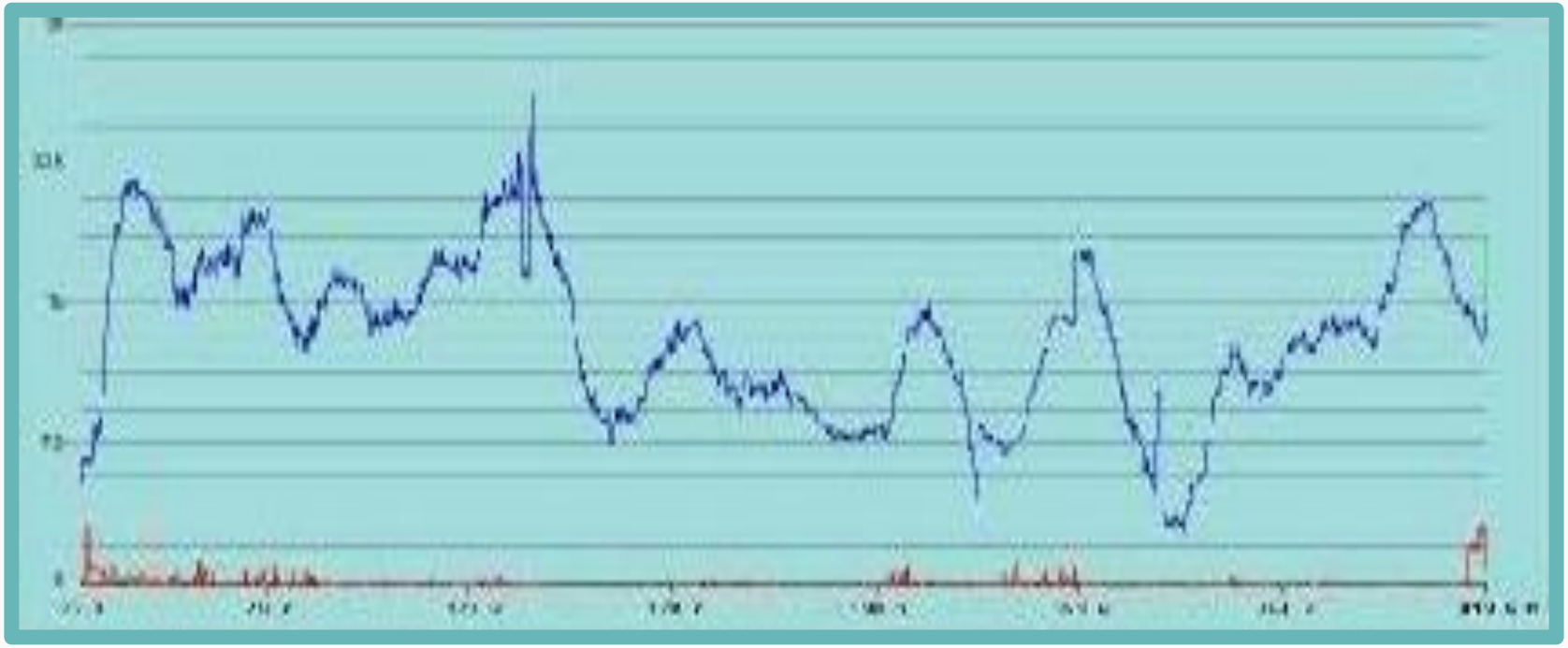
Detects Corrosion
and Deformation

SONAR

Detects Debris and
Deformation

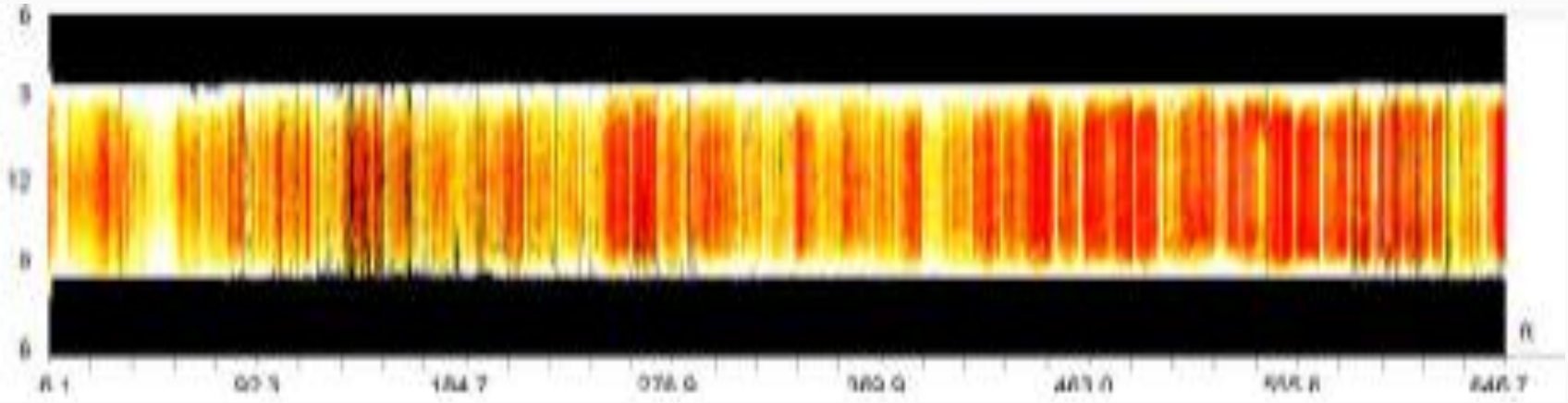
MULTI-SENSOR TECHNOLOGY REPORTING

Debris Graphs



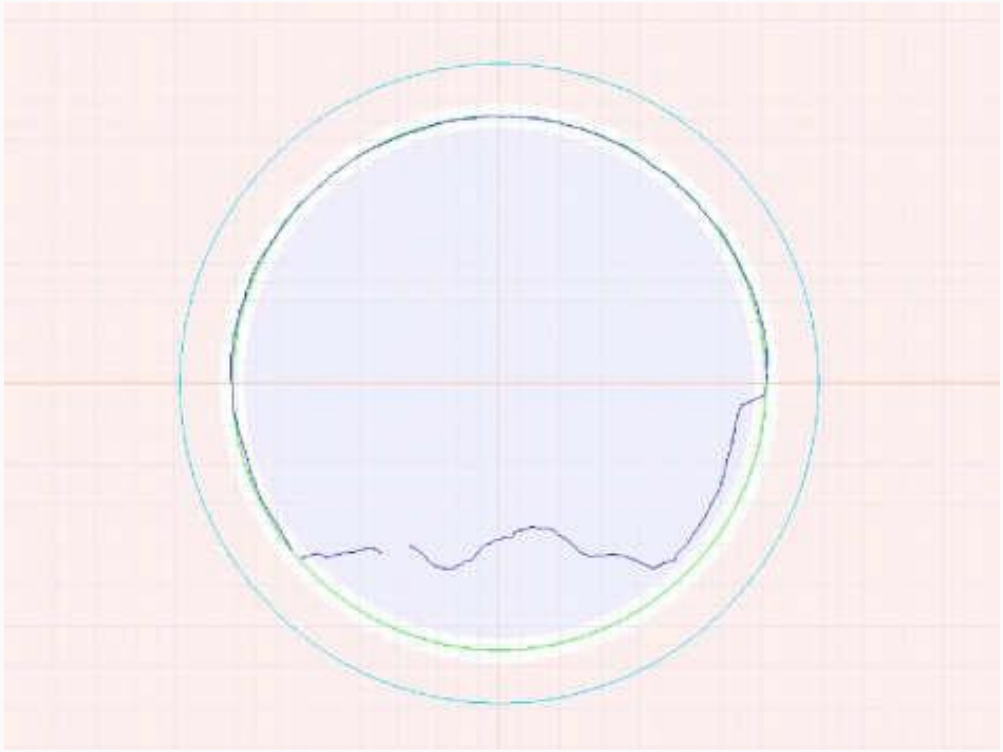
MULTI-SENSOR TECHNOLOGY REPORTING

Flat Graphs



MULTI-SENSOR TECHNOLOGY REPORTING

Cross Sections



Debris to 13.7”

MULTI-SENSOR TECHNOLOGY REPORTING

Line Report

Profile/Photo Observation Report

Date:	06/25/2017	Weather:	Dry	Coding:	PACP 4.2
Pipe Length (ft):	440.2	Owner:	WVSA	Pre Clean:	No Pre-Cleaning
P.O.#:		Surveyor:	Jen Costello	PSR:	I-7_I-6
Customer:		Clean Date:		Shape:	C

Street:	Levee Easement	Flow Control:	Not Controlled
City:		Year Renewed:	
Location:	Other	Tape/Media #:	
Purpose:	Routine Assessment	Dia/Height:	78"
Use:	Sanitary	Material:	RCP
Drain Area:		Lining:	
Category:	NA		
Comment:			
Location Details:		Direction of Survey:	Downstream

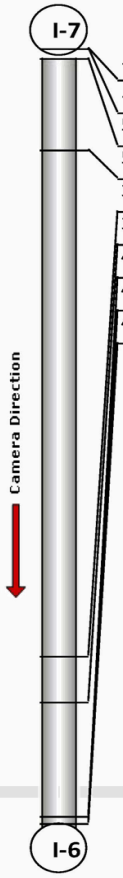
US MH: I-7 DS MH: I-6 Total Length Surveyed (ft): 440.2

O&M Index:	1.00	O&M Quick:	1N00	O&M Rating:	76
Structural Index:	2.98	Structural Quick:	3P22	Structural Rating:	262
Overall Index:	2.06	Overall Quick:	3P22	Overall Rating:	338

MULTI-SENSOR TECHNOLOGY REPORTING

Line Report

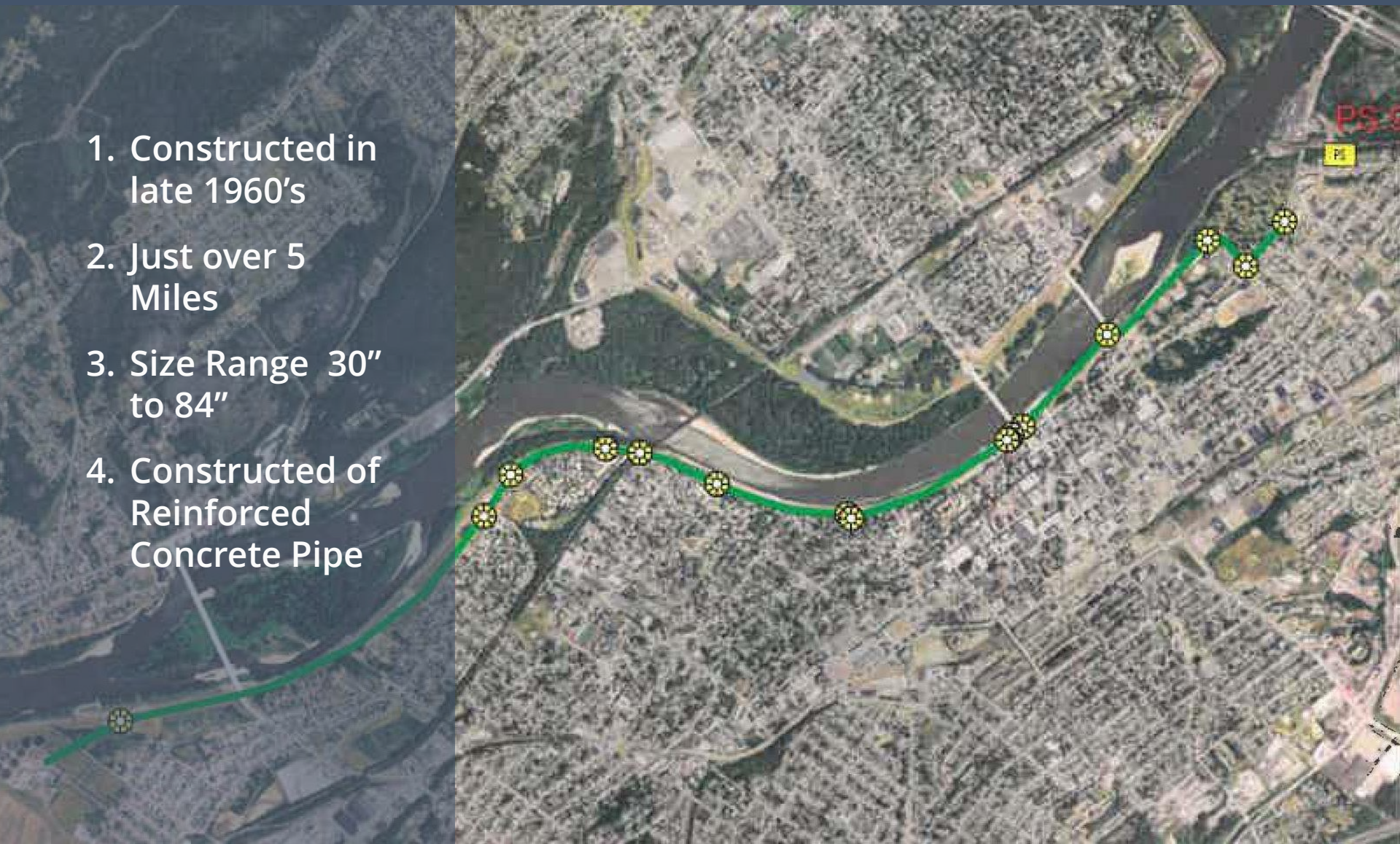
Position	Code	Observation	Video (sec)	Grade
.0	AMH	Manhole	10	NA
.0	MWL	Water Level	21	NA
5.7	SAV(S01)	Surface Aggregate Visible	44	S 3
57.3	RFJ(S02)	Roots Fine Joint	158	M 1
345.0	CL	Crack Longitudinal	745	S 2
371.4	CL	Crack Longitudinal	810	S 2
436.5	SAV(F01)	Surface Aggregate Visible	951	S 3
436.5	RFJ(F02)	Roots Fine Joint	963	M 1
440.2	AMH	Manhole	981	NA



OVERVIEW OF INTERCEPTOR

OVERVIEW OF INTERCEPTOR

1. Constructed in late 1960's
2. Just over 5 Miles
3. Size Range 30" to 84"
4. Constructed of Reinforced Concrete Pipe



NASSCO PIPELINE ASSESSMENT PROGRAM

A Typical Report Summary will consist of a Database which includes this information:

- Pipe ID
- MH ID
- Diameter
- Length
- Water Depth
- Debris Depth
- Debris Volume
- Corrosion
- Structural Quick Score
- OM Quick Score

NASSCO PIPELINE ASSESSMENT PROGRAM

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- Debris Volume
- Corrosion
- Structural Quick Score
- OM Quick Score

NASSCO PIPELINE ASSESSMENT PROGRAM

A Typical Report Summary will consist of a Database which includes this information:

Pipe and Inspection Information							Sonar Data				Laser Data	
Pipe ID	Upstream MH	Dnstream MH	Pipe Height /Diam (in)	Structural Score	OM	Length Surveyed	Water Depth (in)	Max Debris Depth (Inches)	Avg. Debris Depth (Inches)	Debris Volume (cu. Ft)	Avg. Corrosion (in)	Max. Corrosion (In)
I-48_I-47	I-48	I-47	30	5A35	0000	94	16.8	2.9	0.1	0.5	0.1	0.8
I-47_I-46	I-47	I-46	30	543P	211J	422.7	11	0	0	0	0.1	1.1
I-46_I-45	I-46	I-45	30	3H00	2300	231.6	14.2	0	0	0	0	0.8
I-45_I-44	I-45	I-44	30	5X35	0000	649.4	8.5	0	0	0	0.2	2.2
I-44_I-43	I-44	I-43	30	5B00	0000	94.2	9.4	0	0	0	0.6	2
I-43_I-42	I-43	I-42	30	5O32	251K	411	14.9	0	0	0	0.3	1.5
I-42_I-41A	I-42	I-41A	30	5A3D	0000	179.7	13.4	0	0	0	0.6	1.4
I-41A_I-41	I-41A	I-41	30	3100	4100	14.1	0	0	0	0	0	2.3
I-41_I-40A	I-41	I-40A	30	553E	0000	154.7	12.4	0	0	0	0.3	1
I-40A_I-40	I-40A	I-40	30	3100	0000	9.1	0	0	0	0	0	0
I-40_I-39A_DS	I-40	I-39A	30	5637	0000	35.5	6.6	0	0	0	0.3	2.1
I-40_I-39A_US	I-40	I-39A	30	5637	0000	35.5	6.7	0	0	0	0.5	1.9
I-39A_I-39	I-39A	I-39	30	3O00	0000	416.3	13.3	4.2	0.2	2.5	0.2	0.7
I-39_I-38	I-39	I-38	30	3E00	2111	157	12	3.2	0.5	4.9	0.1	1.9
I-38_JC-4	I-38	JC-4	30	3200	4100	6	10.8	0	0	0	0	0.3
JC-4_I-37	JC-4	I-37	48	5S33	3214	509.4	25.1	7.8	1.1	69.3	0.6	2.9

NASSCO PIPELINE ASSESSMENT PROGRAM

Pipe and Inspection Information						
Pipe ID	Upstream MH	Dnstream MH	Pipe Height /Diam (in)	Structural Score	OM	Length Surveyed
I-48_I-47	I-48	I-47	30	5A35	0000	94
I-47_I-46	I-47	I-46	30	543P	211J	422.7
I-46_I-45	I-46	I-45	30	3H00	2300	231.6
I-45_I-44	I-45	I-44	30	5X35	0000	649.4
I-44_I-43	I-44	I-43	30	5B00	0000	94.2
I-43_I-42	I-43	I-42	30	5O32	251K	411
I-42_I-41A	I-42	I-41A	30	5A3D	0000	179.7
I-41A_I-41	I-41A	I-41	30	3100	4100	14.1
I-41_I-40A	I-41	I-40A	30	553E	0000	154.7
I-40A_I-40	I-40A	I-40	30	3100	0000	9.1
I-40_I-39A_DS	I-40	I-39A	30	5637	0000	35.5
I-40_I-39A_US	I-40	I-39A	30	5637	0000	35.5
I-39A_I-39	I-39A	I-39	30	3O00	0000	416.3
I-39_I-38	I-39	I-38	30	3E00	2111	157
I-38_JC-4	I-38	JC-4	30	3200	4100	6
JC-4_I-37	JC-4	I-37	48	5S33	3214	509.4

NASSCO PIPELINE ASSESSMENT PROGRAM

Pipe and			Sonar Data				Laser Data		
Pipe ID	Upstream MH	Dnstream M	Water Depth (in)	Max Debris Depth (Inches)	Avg. Debris Depth (Inches)	Debris Volume (cu. Ft)	Debris Volume (cu. Ft)	Avg. Corrosion (in)	Max. Corrosion (In)
I-48_I-47	I-48	I-47	16.8	2.9	0.1	0.5	0.5	0.1	0.8
I-47_I-46	I-47	I-46	11	0	0	0	0	0.1	1.1
I-46_I-45	I-46	I-45	14.2	0	0	0	0	0	0.8
I-45_I-44	I-45	I-44	8.5	0	0	0	0	0.2	2.2
I-44_I-43	I-44	I-43	9.4	0	0	0	0	0.6	2
I-43_I-42	I-43	I-42	14.9	0	0	0	0	0.3	1.5
I-42_I-41A	I-42	I-41A	13.4	0	0	0	0	0.6	1.4
I-41A_I-41	I-41A	I-41	0	0	0	0	0	0	2.3
I-41_I-40A	I-41	I-40A	12.4	0	0	0	0	0.3	1
I-40A_I-40	I-40A	I-40	0	0	0	0	0	0	0
I-40_I-39A_DS	I-40	I-39A	6.6	0	0	0	0	0.3	2.1
I-40_I-39A_US	I-40	I-39A	6.7	0	0	0	0	0.5	1.9
I-39A_I-39	I-39A	I-39	13.3	4.2	0.2	2.5	2.5	0.2	0.7
I-39_I-38	I-39	I-38	12	3.2	0.5	4.9	4.9	0.1	1.9
I-38_JC-4	I-38	JC-4	10.8	0	0	0	0	0	0.3
JC-4_I-37	JC-4	I-37	25.1	7.8	1.1	69.3	69.3	0.6	2.9

NASSCO PIPELINE ASSESSMENT PROGRAM

Pipe and Inspection In			
Pipe ID	Upstream MH	Dnstream MH	Pipe Heig /Diam (i
I-48_I-47	I-48	I-47	30
I-47_I-46	I-47	I-46	30
I-46_I-45	I-46	I-45	30
I-45_I-44	I-45	I-44	30
I-44_I-43	I-44	I-43	30
I-43_I-42	I-43	I-42	30
I-42_I-41A	I-42	I-41A	30
I-41A_I-41	I-41A	I-41	30
I-41_I-40A	I-41	I-40A	30
I-40A_I-40	I-40A	I-40	30
I-40_I-39A_DS	I-40	I-39A	30
I-40_I-39A_US	I-40	I-39A	30
I-39A_I-39	I-39A	I-39	30
I-39_I-38	I-39	I-38	30
I-38_JC-4	I-38	JC-4	30
JC-4_I-37	JC-4	I-37	48

Laser Data	
Avg. Corrosion (in)	Max. Corrosion (In)
0.1	0.8
0.1	1.1
0	0.8
0.2	2.2
0.6	2
0.3	1.5
0.6	1.4
0	2.3
0.3	1
0	0
0.3	2.1
0.5	1.9
0.2	0.7
0.1	1.9
0	0.3
0.6	2.9

Sonar Data			Laser Data	
Max Debris Depth (Inches)	Avg. Debris Depth (Inches)	Debris Volume (cu. Ft)	Avg. Corrosion (in)	Max. Corrosion (In)
2.9	0.1	0.5	0.1	0.8
0	0	0	0.1	1.1
0	0	0	0	0.8
0	0	0	0.2	2.2
0	0	0	0.6	2
0	0	0	0.3	1.5
0	0	0	0.6	1.4
0	0	0	0	2.3
0	0	0	0.3	1
0	0	0	0	0
0	0	0	0.3	2.1
0	0	0	0.5	1.9
4.2	0.2	2.5	0.2	0.7
3.2	0.5	4.9	0.1	1.9
0	0	0	0	0.3
7.8	1.1	69.3	0.6	2.9

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A Typical Report Summary will consist of a Database which includes this information:

- Pipe ID
- MH ID
- Diameter
- Length
- Water Depth
- Debris Depth
- Debris Volume
- Corrosion
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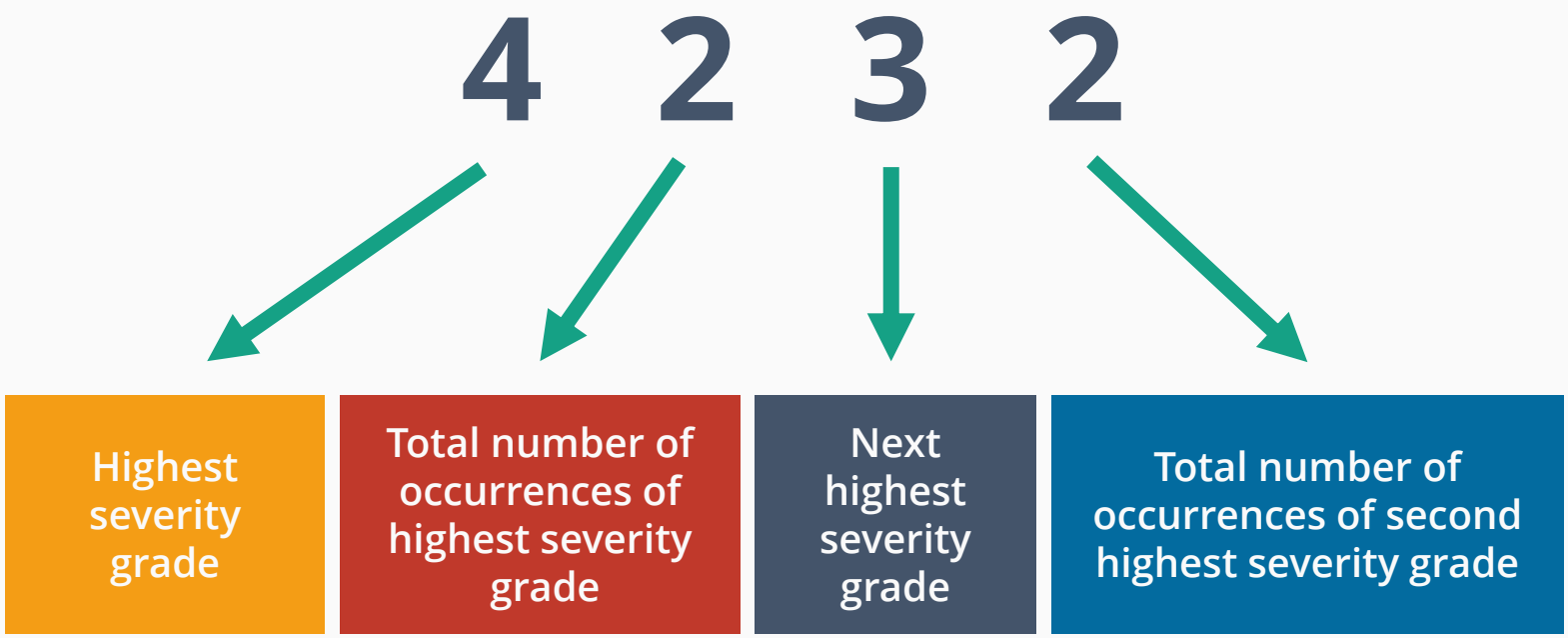
- OM Quick Score

NASSCO PIPELINE ASSESSMENT PROGRAM

PACP Grading System

Grade 5	**Immediate**	Pipe has failed or will likely fail.
Grade 4	5-10 Years	Pipe has severe defects.
Grade 3	10-20 Years	Pipe has moderate defects.
Grade 2	20-30 years	Pipe has minor defects.
Grade 1	**30+ Years**	Pipe has minor defects.

STRUCTURAL QUICK SCORE



NASSCO PIPELINE ASSESSMENT PROGRAM

Pipe and Inspection Information						
Pipe ID	Upstream MH	Dnstream MH	Pipe Height /Diam (in)	Structural Score	OM	Length Surveyed
I-48_I-47	I-48	I-47	30	5A35	0000	94
I-47_I-46	I-47	I-46	30	543P	211J	422.7
I-46_I-45	I-46	I-45	30	3H00	2300	231.6
I-45_I-44	I-45	I-44	30	5X35	0000	649.4
I-44_I-43	I-44	I-43	30	5B00	0000	94.2
I-43_I-42	I-43	I-42	30	5O32	251K	411
I-42_I-41A	I-42	I-41A	30	5A3D	0000	179.7
I-41A_I-41	I-41A	I-41	30	3100	4100	14.1
I-41_I-40A	I-41	I-40A	30	553E	0000	154.7
I-40A_I-40	I-40A	I-40	30	3100	0000	9.1
I-40_I-39A_DS	I-40	I-39A	30	5637	0000	35.5
I-40_I-39A_US	I-40	I-39A	30	5637	0000	35.5
I-39A_I-39	I-39A	I-39	30	3O00	0000	416.3
I-39_I-38	I-39	I-38	30	3E00	2111	157
I-38_JC-4	I-38	JC-4	30	3200	4100	6
JC-4_I-37	JC-4	I-37	48	5S33	3214	509.4

PIPELINE CONDITION SUMMARY

Pipe and Inspection Information							Sonar Data				Laser Data	
Pipe ID	Upstream MH	Dnstream MH	Pipe Height /Diam (in)	Structural Score	OM	Length Surveyed	Water Depth (in)	Max Debris Depth (Inches)	Avg. Debris Depth (Inches)	Debris Volume (cu. Ft)	Avg. Corrosion (in)	Max. Corrosion (In)
I-48_I-47	I-48	I-47	30	5A35	0000	80	16.8	**2.9**	0.1	0.5	0.1	0.8
I-47_I-46	I-47	I-46	30	543P	2111	400	11	0	0	0	0.1	1.1
I-46_I-45	I-46	I-45	30	3H00	2300	250	14.2	0	0	0	0	0.8
I-45_I-44	I-45	I-44	30	5C35	0000	650	8.5	0	0	0	0.2	2.2
I-44_I-43	I-44	I-43	30	5B00	0000	100	**9.4**	0	0	0	0.6	2
I-43_I-42	I-43	I-42	30	5O32	251K	420	**14.9**	0	0	0	0.3	1.5
I-42_I-41A	I-42	I-41A	30	5A3D	0000	200	13.4	0	0	0	0.6	1.4
I-41A_I-41	I-41A	I-41	30	3100	4100	50	0	0	0	0	0	2.3
I-41_I-40A	I-41	I-40A	30	553E	0000	125	12.4	0	0	0	0.3	1
I-40A_I-40	I-40A	I-40	30	3100	0000	15	0	0	0	0	0	0
I-40_I-39A_DS	I-40	**I-39A**	30	5637	0000	40	6.6	0	0	0	0.3	2.1
I-40_I-39A_US	I-40	**I-39A**	30	5637	0000	40	6.7	0	0	0	0.5	**1.9**
I-39A_I-39	**I-39A**	**I-39**	30	3O00	0000	400	13.3	4.2	0.2	2.5	0.2	0.7
I-39_I-38	**I-39**	I-38	30	3E00	2111	150	12	3.2	0.5	**4.9**	0.1	**1.9**
I-38_JC-4	I-38	JC-4	30	3200	4100	10	10.8	0	0	0	0	0.3
JC-4_I-37	JC-4	I-37	48	5533	3214	500	25.1	7.8	1.1	**69.3**	0.6	**2.9**
I-37_I-36	I-37	I-36	48	5F31	1E00	150	26	3.6	0.4	6.2	0.6	1.6
I-36_I-35	I-36	I-35	48	5C00	1500	150	25.4	3	0.3	2.6	0.5	1.8
I-35_I-34	I-35	I-34	60	5D30	1X00	600	**29**	18.5	6.2	806	0.2	2.8
I-34_I-33A	I-34	I-33A	60	3P00	211P	400	30.5	7.3	**4.9**	346.5	0.3	**1.9**
I-33A_I-33	I-33A	I-33	60	3G00	1F00	200	28.3	13.7	6.7	274.2	0.3	1.7
I-33_I-32	I-33	I-32	60	3A00	1300	50	28.6	6.3	1.6	8.3	0.1	2.3
I-32_I-31	I-32	I-31	?	5A00	1100	30	MSI Data Missing					
I-31_I-30	I-31	I-30	72	3200	0000	80	32.5	**9.2**	4.5	7.5	0	1.6
I-30_I-29	I-30	**I-29**	72	3200	1X00	500	35.6	26.1	15.1	**3669.9**	0	0.2
I-29_I-28	**I-29**	I-28	72	0000	1T00	600	25.5	8.1	0.4	21.3	0.3	1.3
I-28_Val-1	I-28	Val-1	72	3S00	1100	500	24.8	7.4	2.1	177.6	0.2	0.7
Val-1_I-25	Val-1	I-25	72	3S00	0000	450	31.7	17	6.1	825.6	0	0.4
I-25_I-24	I-25	I-24	72	3P00	0000	460	36.3	**19.7**	14.4	1755.6	0	0.5
I-24_I-23	I-24	I-23	72	3B00	0000	120	24.7	0.4	0.1	0.1	0.2	0.5
I-23_I-53	I-23	I-53	72	513I	0000	225	33.3	18.8	6.2	431.8	0.4	**0.9**
I-53_I-19	I-53	**I-19**	72	3Z21	0000	1000	**29.5**	17.8	8.6	2404.4	0.1	1.1
I-19_I-21	**I-19**	I-21	72	3200	211K	800	37.1	**19.2**	11.2	2402.3	0.1	10.6
I-21_I-20	I-21	I-20	72	3700	0000	50	**28.9**	7.8	5.8	36.7	0.3	1.2
I-20_I-18_DS	I-20	I-18	72	3I00	0000	250	**29.8**	**6.9**	2	**161.9**	0.1	0.4
I-20_I-18_US	I-20	I-18	72	3I00	0000	325	25.7	4.8	**0.9**	21.6	0.1	0.4
I-18_I-17	I-18	I-17	72	3100	0000	600	**30.9**	11.6	5.7	642.4	0	0.8
I-17_I-16	I-17	I-16	72	3T00	2111	500	**29.7**	7.5	**0.9**	**79.5**	0.3	2.5
I-16_I-15A	I-16	I-15A	72	3R00	1H00	500	30.1	0.4	0	0.5	0.1	1.6
I-15A_I-15	I-15A	I-15	72	3O00	1N00	400	31.2	**2.9**	0	1.1	0.2	**0.9**
I-15_I-14	I-15	I-14	72	3X22	1T00	625	32	8.6	0.3	**29.9**	0.3	1
I-14_I-13A	I-14	I-13A	72	3T21	0000	500	34.8	5.4	0.2	7.4	0.1	0.5
I-13A_I-13	I-13A	I-13	72	3I00	0000	275	36.4	7.1	0.5	21.3	0.3	0.7
I-13_I-12	I-13	I-12	72	3B00	0000	100	37.6	1.1	0.1	0.5	0.2	0.7
I-12_I-11	I-12	I-11	72	3V00	1N00	600	33.6	0.8	0.1	2.1	0.1	0.8
I-11_I-10	I-11	I-10	72	3U00	0000	550	33.7	5.4	0.1	3.8	0.2	0.8
I-10_I-9	I-10	**I-9**	72	3S00	0000	500	36	**9.8**	0.3	17	0.2	0.8
I-9_I-8	**I-9**	I-8	72	3V21	1100	550	**35.9**	3	0.2	4.8	0.1	0.6
I-8_I-7	I-8	I-7	72	3T00	1N00	500	36.3	**9.8**	0.5	**30.9**	0	0.7
I-7_I-6	I-7	I-6	72	3P22	1N00	450	34.5	8.7	0.7	44.1	0.1	0.7
I-6_I-5	I-6	I-5	72	3X22	1V00	650	34.6	2.8	0.2	6	0.2	0.8
I-5_I-4	I-5	I-4	72	3X00	1100	650	**38.9**	7	0.4	**21.9**	0.1	0.6
I-4_I-3	I-4	I-3	72	3Z21	0000	750	32.4	1.2	0.1	3.8	0.2	1.8
I-3_DC-1	I-3	DC-1	72	3200	0000	1200	30.5	0.5	0	0.5	0	0.5
DC-1_I-2	DC-1	I-2	78	5A3E	2100	450	32	2.2	0.1	1.6	0.3	1.8
I-2_I-1	I-2	I-1	78	513E	1Q00	550	35	8.7	0.4	21.1	0	0.5
I-1_I-0	I-1	I-0	78	5R31	1R00	500	35.7	4.4	0.4	13.6	0	0.7
I-0_I-00	I-0	I-00	78	513V	1S00	650	40.2	4.7	0.5	25.1	0	8
I-00_I-000	I-00	I-000	84	5C41	1100	150	40.3	1.3	0.2	1	0.1	0.7
I-000_Wet Well	I-000	Wet Well	84	3800	0000	75	40	2.1	0.3	0.6	0	0.5
III-6_III-5	III-6	III-5	36	3I00	312B	300	21.7	13	11.2	**495.3**	0	0.1
III-5_III-4	III-5	III-4	36	3R00	312H	500	21.5	14.5	**9.8**	756.7	0	0.3
III-4_III-3A	III-4	III-3A	36	3C00	1100	150	21.7	11.8	10.1	225.6	0	0.4
III-3A_III-3	III-3A	III-3	36	413Q	1P00	475	**19.6**	11.8	7.3	482.5	0.1	0.4
III-3_III-2	III-3	III-2	36	0000	1L00	400	17.3	5.2	1.6	52.4	0	0.1
III-2_III-1	III-2	III-1	36	3D00	1D00	150	21.3	10.2	**3.9**	**62.9**	0	0.3
III-1_III-OP	III-1	III-OP	36	3C00	2200	100	21.8	**7.9**	5	32.1	0	0.4
III-OP_I-00	III-OP	I-00	72	3M00	0000	400	25.5	22.2	12	**1197.2**	0.1	0.5

CAPITAL PLANNING

Severity Grade	No. of Pipe Segments	Total Feet
5	20	6,010
4	1	475
3	45	17,635
2	0	0
1	2	1,000

CAPITAL PLANNING

Severity Grade	Pipe Diameter	Feet	Cost Per Foot Low	Cost Per Foot High	Total Cost Low	Total Cost High
5	30	2,055	$200	$350	$411,000	$719,000
	48	800	$400	$500	$320,000	$400,000
	60	630	$600	$750	$378,000	$473,000
	72	225	$750	$1,000	$169,000	$225,000
	78	2,150	$850	$1,200	$1,828,000	$2,580,000
	84	150	$900	$1,400	$135,000	$210,000
	To be rehabilitated in 0 to 5 years				**$3,241,000**	**$4,607,000**
3	30	875	$200	$350	$175,000	$306,000
	36	1,200	$300	$400	$360,000	$480,000
	60	650	$600	$750	$390,000	$488,000
	72	14,835	$750	$1,000	$11,126,000	$14,835,000
	84	75	$900	$1,400	$68,000	$105,000
	To be rehabilitated in 10 to 20 years				**$12,119,000**	**$16,214,000**

SUMMARY

1. Use Technology to more efficiently to inspect large diameter sewers.
2. Use Industry Standards to assess pipeline conditions.
3. Develop a long-term capital and financing plan to accomplish your goals.

QUESTIONS

Presenter

Michael Schober, PE, BCEE
Regional Client Service Manager
T&M Associates
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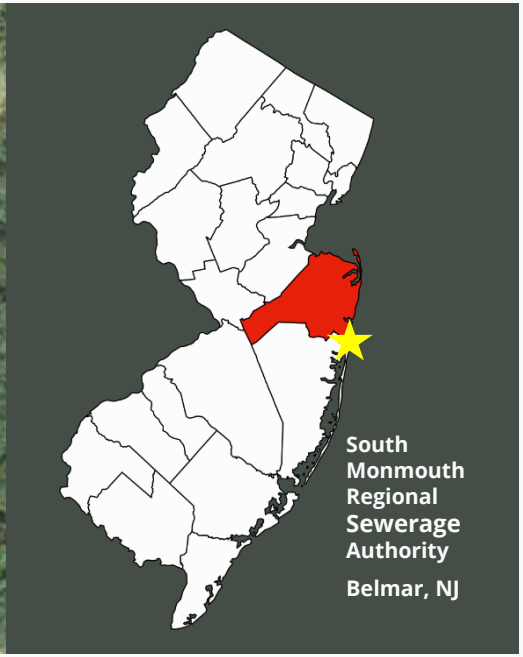
SOUTH MONMOUTH REGIONAL SEWERAGE AUTHORITY

(SMRSA)



SERVES 8 MUNICIPALITIES

MAJOR ASSETS

- 9.1 MGD Wastewater Treatment Plant
- 11 pump stations
- 12 miles of force main

CLIMATE DRIVES PROJECTS

Three Major Storm Events

SMRSA's Cost of Rehabilitation after:

2009 NOR'EASTER	2011 HURRICANE IRENE	2012 SUPERSTORM SANDY
$1.8 Million	$2.5 Million	$1.8 Million

CLIMATE RELATED CHALLENGES

SPRING LAKE'S PENNSYLVANIA AVENUE PUMP STATION | SANDY, DAY 8

LAKE COMO PUMP STATION | SUPER STORM SANDY

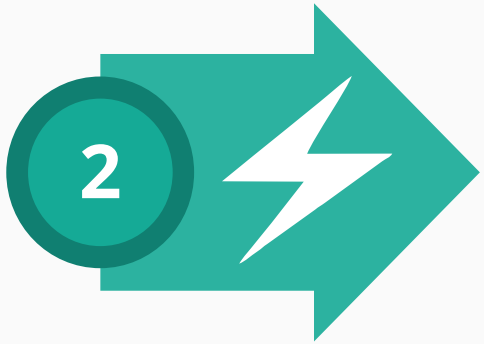
Impacts of extreme wet weather events:

- Temporary loss in Sanitary Sewer Service
- Damage to assets and infrastructure
  - Flooding
  - Wind Damage
  - Storm Surge
- Power Outages
- Potential increase in service rates for customers

OVERVIEW OF MULTI-SENSOR TECHNOLOGY

CCTV

High Resolution with
Pan & Tilt Capabilities



LASER

Detects Corrosion
and Deformation

SONAR

Detects Debris and
Deformation

RAPID RESPONSE/RECOVERY:

Pump Station Mobile Enclosure

SEA GIRT PUMP STATION MOBILE ENCLOSURE

- **The enclosure consists of two rooms**
  - One sound-attenuated room for the emergency generator
  - Another climate-controlled room for the electrical equipment including controls, alarm systems, variable speed drives and SCADA System
- **Electrical and control connections between the enclosure and the pump station and its equipment are made with cables and plugs that can be opened to permit removal of the enclosure and transport it to a safe location.**

Climate Resilience Evaluation & Awareness Tool

CREAT

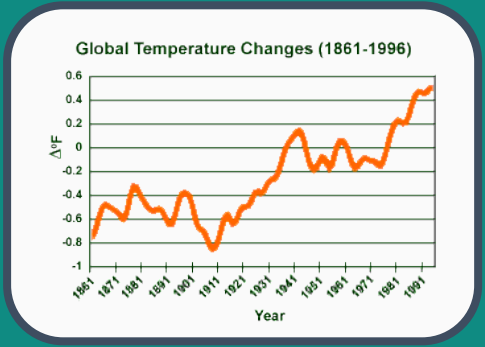
When selecting a resiliency option, SMRSA recognized that there is a need for:

1. Long-term climate conditions
2. Timing of climate events to prioritize planning
3. Long term planning to protect critical assets in a cost effective manner.

re-sil-ience
[re'ziyens]

noun

The capacity to recover quickly from difficulties



Climate Resilience Evaluation & Awareness Tool

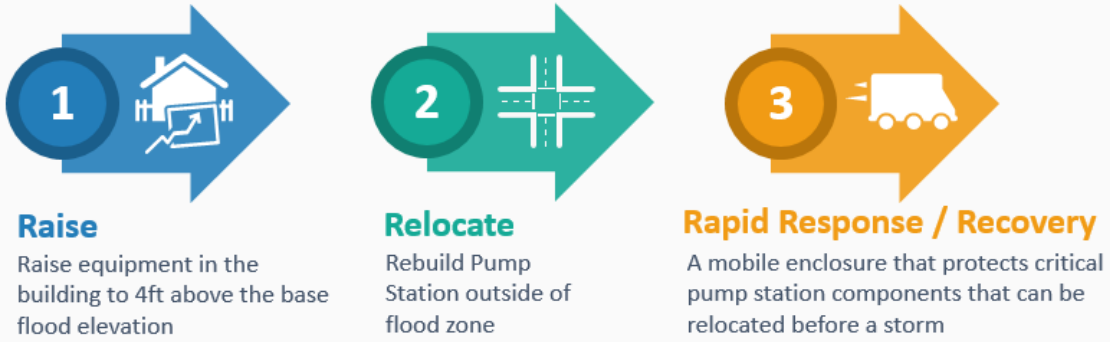
CASE STUDY

Belmar Pump Station

- CREAT identified potential climate change threats to the pump station based on location:
  - Storm Surge, Flooding
- CREAT provided multiple future climate scenarios

Climate Resilience Evaluation & Awareness Tool

- Performs **BASELINE RISK ASSESSMENT** of the pump station's current resilience to these threats
  - What is the utility's current level of risk for the pump station?
  - DO NOTHING Scenario
- Provides strategies that build resiliency into projected climate changes
  - Populated CREAT with strategies and associated capital costs

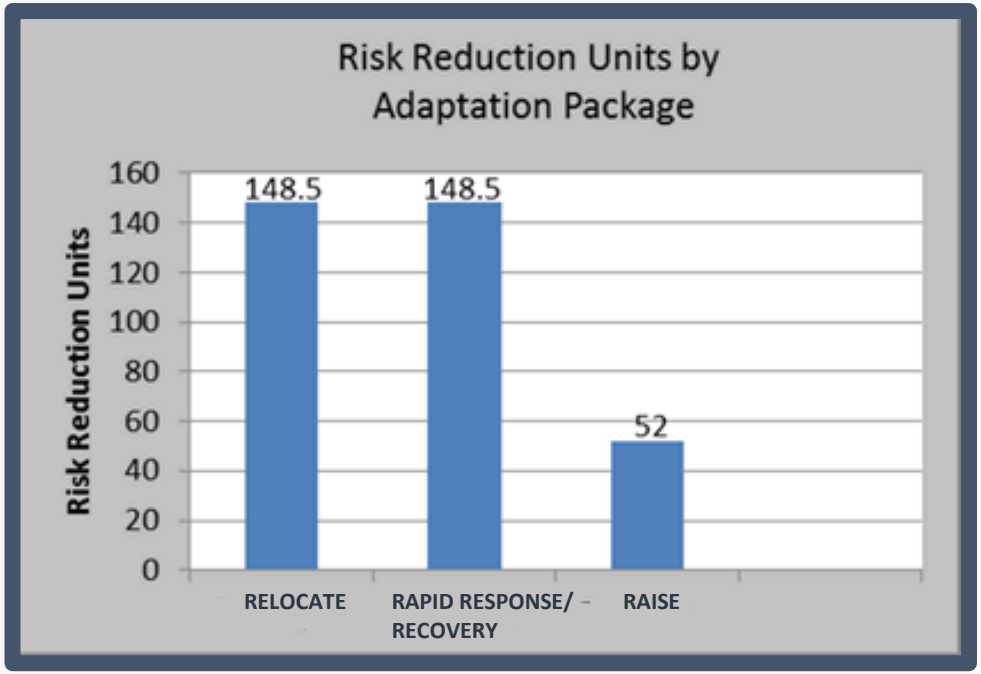


- Performs a second assessment: **Resilience Assessment**
  - Risk assuming Raise, Relocate or Rapid Response/Recovery is implemented

Climate Resilience Evaluation & Awareness Tool

CREAT

- CREAT calculates risk reduction based on the difference between baseline conditions and resilience conditions
- The adaptive measures are compared and prioritized on the basis of risk reduction and cost.



$4.4 M **$1.9 M**

Mobile Enclosure Version 2.0: Pitney Avenue Pump Station

Adaptive Measures

- Mobile Pump Station
- All electrical equipment above 500 year flood elevations

Cost: $1.6 Million | Risk Reduction Units: 101

BEFORE

AFTER

BEFORE

Mobile Enclosure Version 3.0: Belmar Pump Station

Adaptive Measures

- Mobile Pump Station
- All electrical equipment above 500 year flood elevations
- Submersible Pumps

Cost: $1.6 Million
Risk Reduction Units: 101.4

AFTER

BEFORE

Lake Como Pump Station

Adaptive Measures

- Relocate building
- Extend force main and sewer line

Cost: $3.2 Million
Risk Reduction Units: 145

AFTER

BEFORE

AFTER

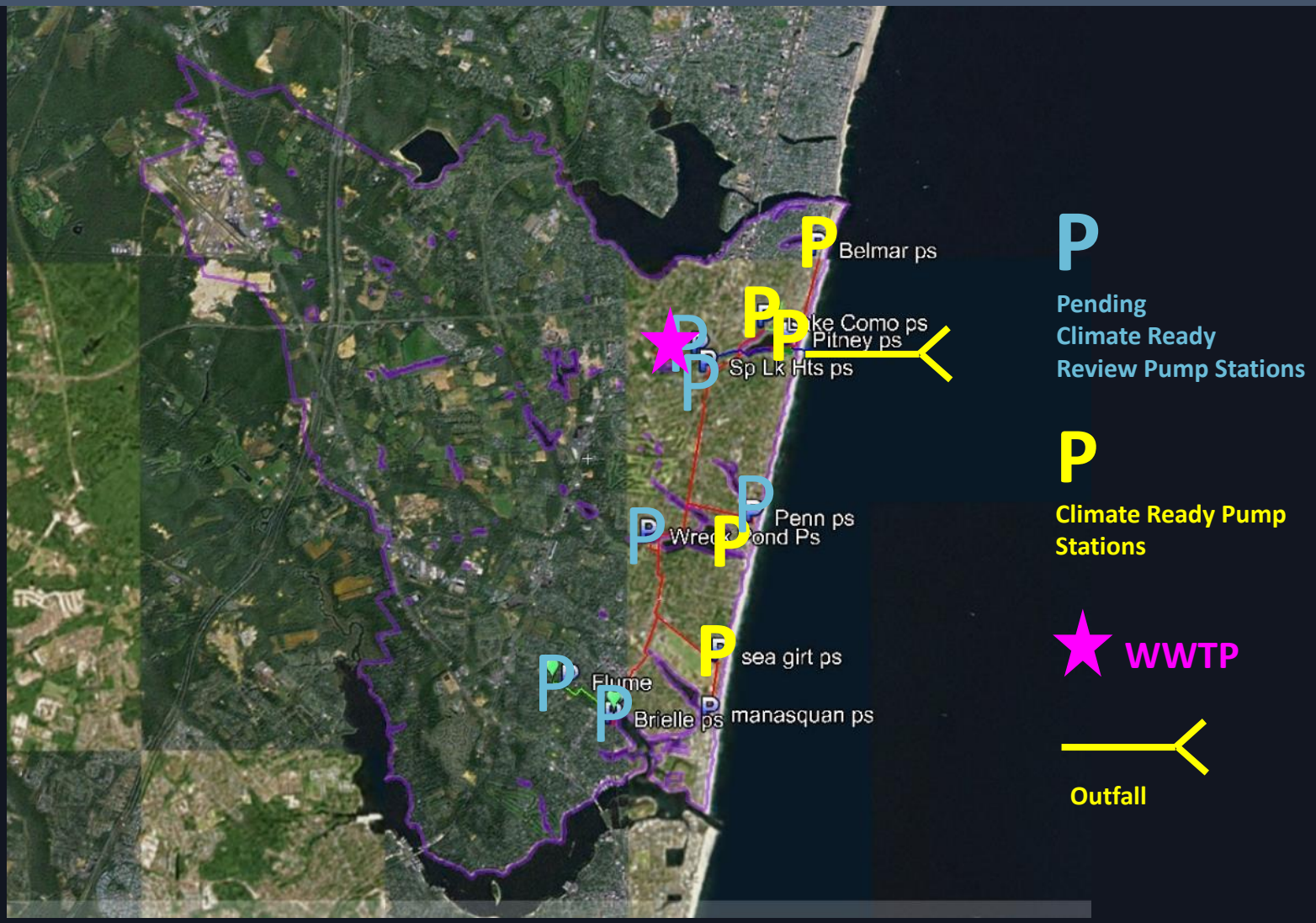
Penn Avenue Pump Station

Adaptive Measures

- RAISE
- All electrical equipment raised 4 feet above 500 year flood elevation

Cost: $2.4 Million
Risk Reduction Units: 54

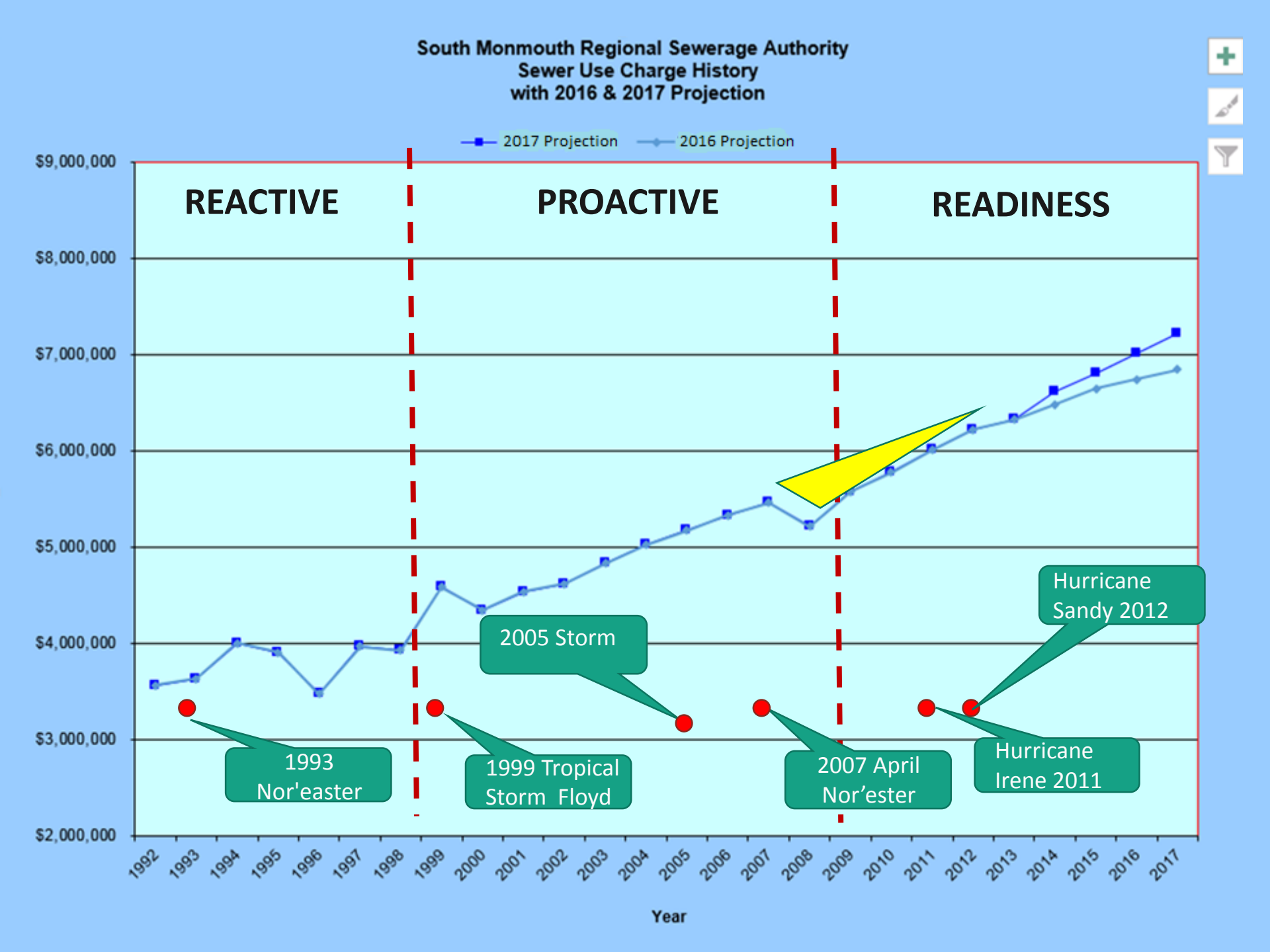
SMRSA's Regional Resiliency Plan



Funding for a Climate Readiness Program

Internal Funding Mechanisms:

1. Dedicated, set aside fund for:
   - Disaster funding
   - Climate Readiness
   - Asset Management
2. Funding for set aside funds is accumulated through an annual rate increase
   - 2-3 percent annually
   - Rate stabilization
   - Predicable, reasonable, necessary strategy
3. Implement capital improvements with a high potential for resiliency


South Monmouth Regional Sewerage Authority
Sewer Use Charge History
with 2016 & 2017 Projection
2017 Projection
2016 Projection
REACTIVE
PROACTIVE
READINESS
$9,000,000
$8,000,000
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
1993 Nor'easter
1999 Tropical Storm Floyd
2005 Storm
2007 April Nor'ester
Hurricane Irene 2011
Hurricane Sandy 2012

Mobile Enclosure Version 3.0: Belmar Pump Station

FUNDING:

- State funded
- NJEIT
- SAIL Program
- 19% Principal Forgiveness Loans
- Authority Reserves

Lake Como Pump Station

FUNDING:

- 90% FEMA
- Authority Reserves
- NJEIT
- SAIL Program

Penn Avenue Pump Station

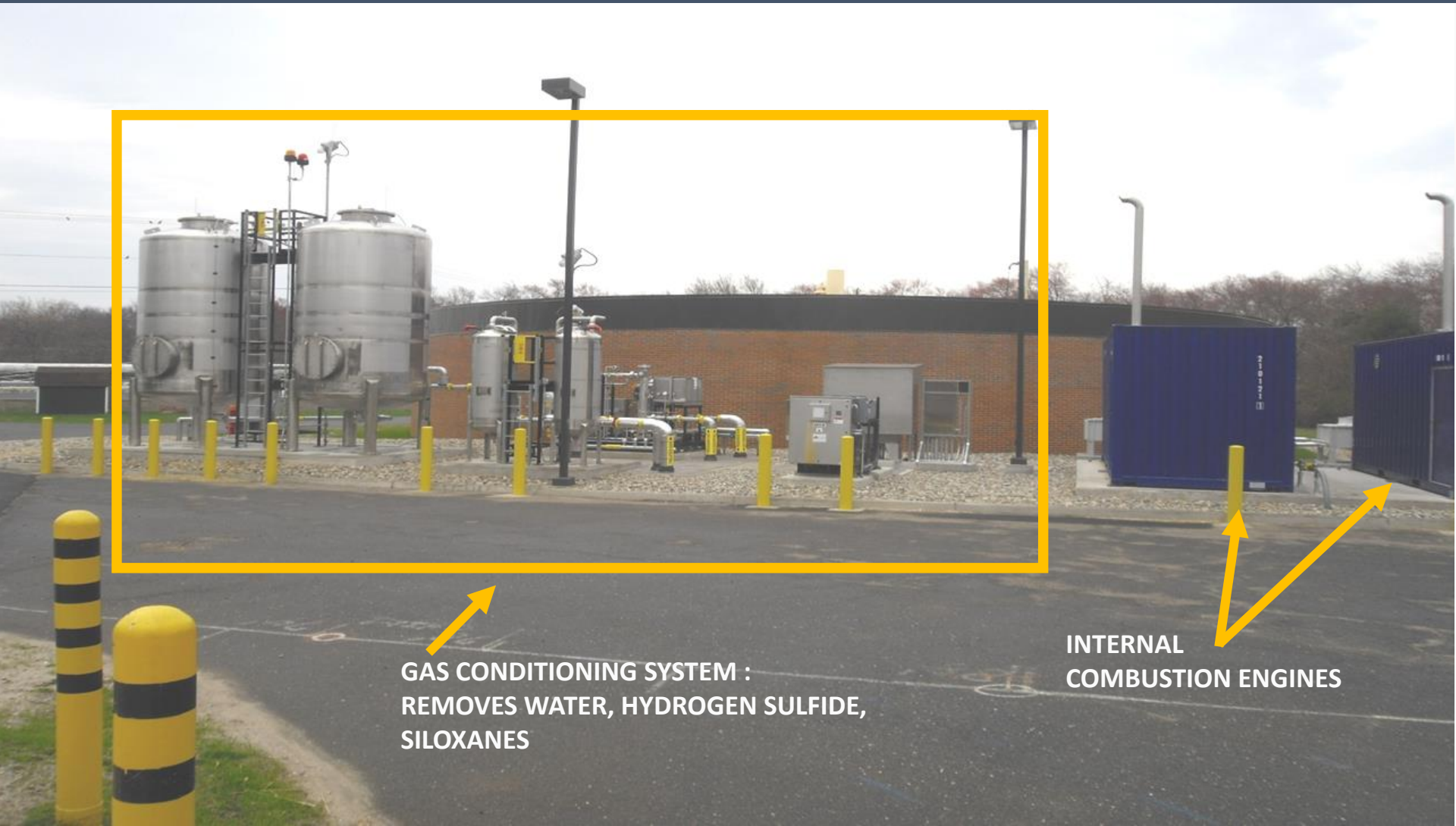
FUNDING: 100% Authority Reserves

Always tell your story...

Financial Strategies

- Consistent, persistent dialogue with state and federal agencies
- Be prepared to support your proposal with data
- Transparency with customers

Climate Change Readiness for the Wastewater Treatment Plant Cogeneration System



Cogeneration: WWTP Emergency Response Plan

When there is a power outage…

- The cogeneration system produces approximately 42-52% of the electricity
- Auxiliary Generators provide the balance
  - 1,200 kW Primary Generator
  - 500 kW Secondary Generator

COGENERATION

Future Operations

Normal Operation:

- Cogen system provides about 60% of the plant's energy
  - Utilize 270 kW Dual Fuel Engine
- Authority will purchase 40% of remaining required energy

During a Power Outage:

- Cogen system provides about 100% of the plant's energy
  - The plant becomes a "Island"
  - Utilize 270 kW Dual Fuel Engine
  - Utilize the two 160 kW Dual Fuel Engines
- Utilize auxiliary generators

Funded by New Jersey Energy Resiliency Bank

- Total Project Cost : $3,390,000
- Total Grant Portion: $2,847,674
- Loan Portion: $1,070,326