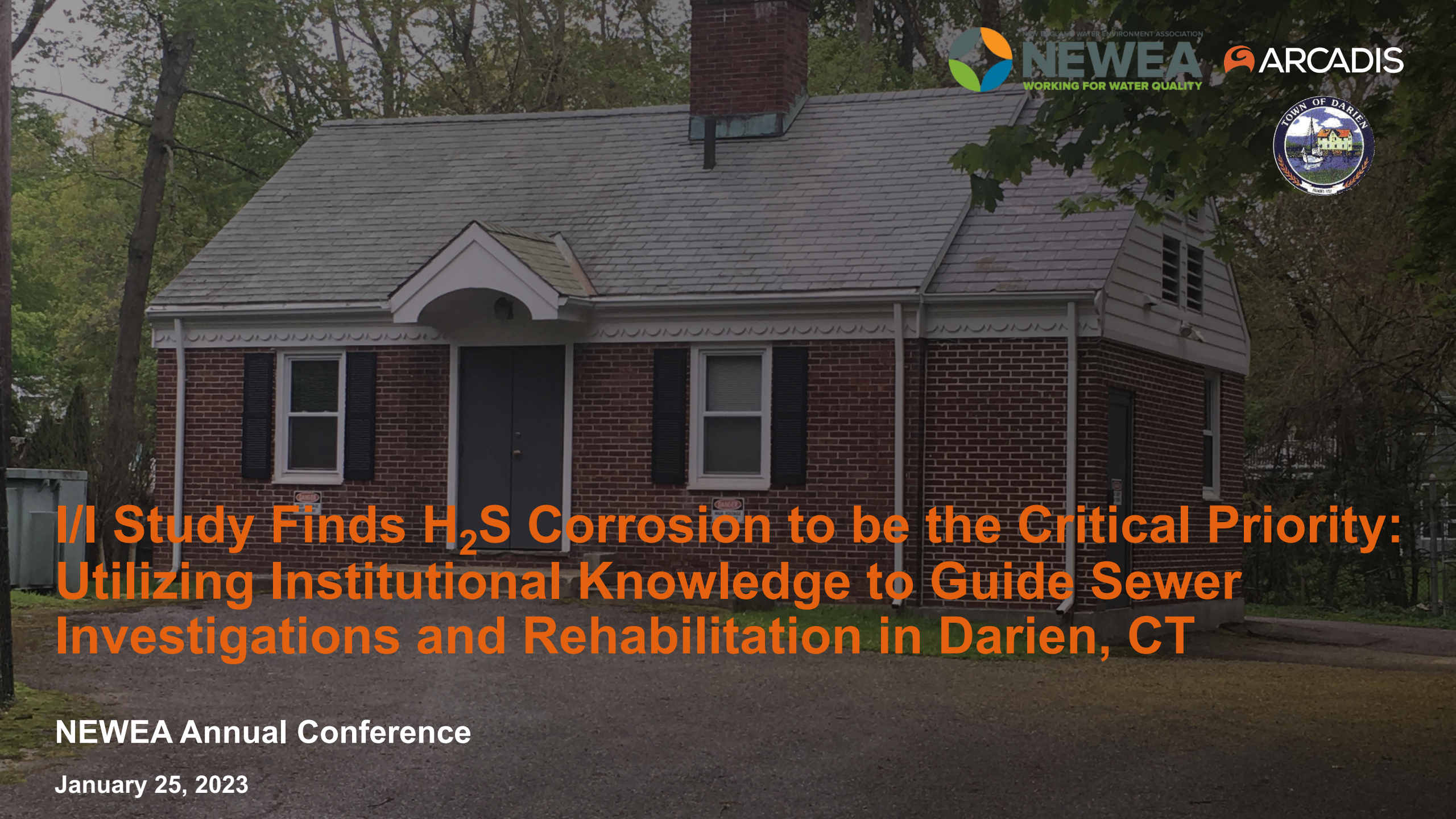


I/I Study Finds H_2S Corrosion to be the Critical Priority: Utilizing Institutional Knowledge to Guide Sewer Investigations and Rehabilitation in Darien, CT

NEWEA Annual Conference

January 25, 2023

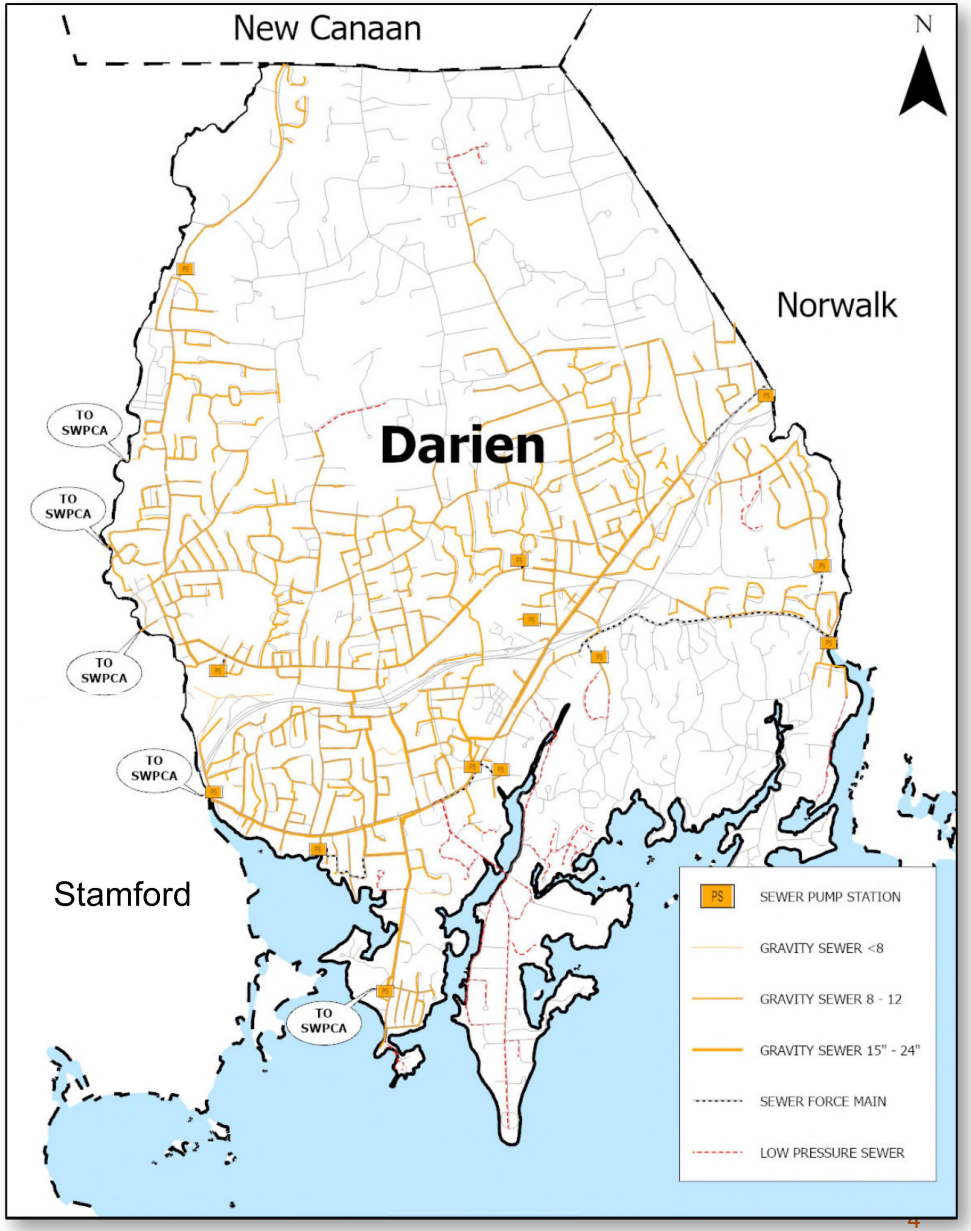
Agenda

1. Background
2. Targeted Infiltration/Inflow Program
3. Leveraging Institutional Knowledge
4. Reprioritizing Rehabilitation
5. Takeaways & Lessons Learned

Background

Get to Know Darien

- 21,500 Town Population
- 5,500 Customer Accounts
- 81 Miles Gravity Mains (8 to 24-inch)
- 14 Pump Stations
- 2.3 MGD Average Daily Flow
- Intermunicipal Agreement – Stamford WPCF
- 5 Waterbody Crossings to Stamford



Historical Issues & Areas of Concern

ARCADIS

Infiltration/ Inflow (I/I)

- Wet-Weather Events/Flooding → Inflow
- High Groundwater/Wetlands → Infiltration
- Increased PS Peak Flow Rates & Runtimes
- Surcharging/Reduced Capacity
- SSOs – O&M Issues
- Transport and Treat Costs

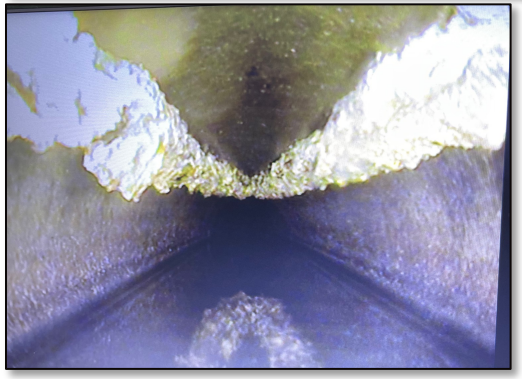
O&M Issues

- FOG – Downtown Areas; Expand Program
- Roots – Expand Program

Structural Defects

- Aging System – 1930s
- Force Main Discharges

INFILTRATION / INFLOW PROGRAM



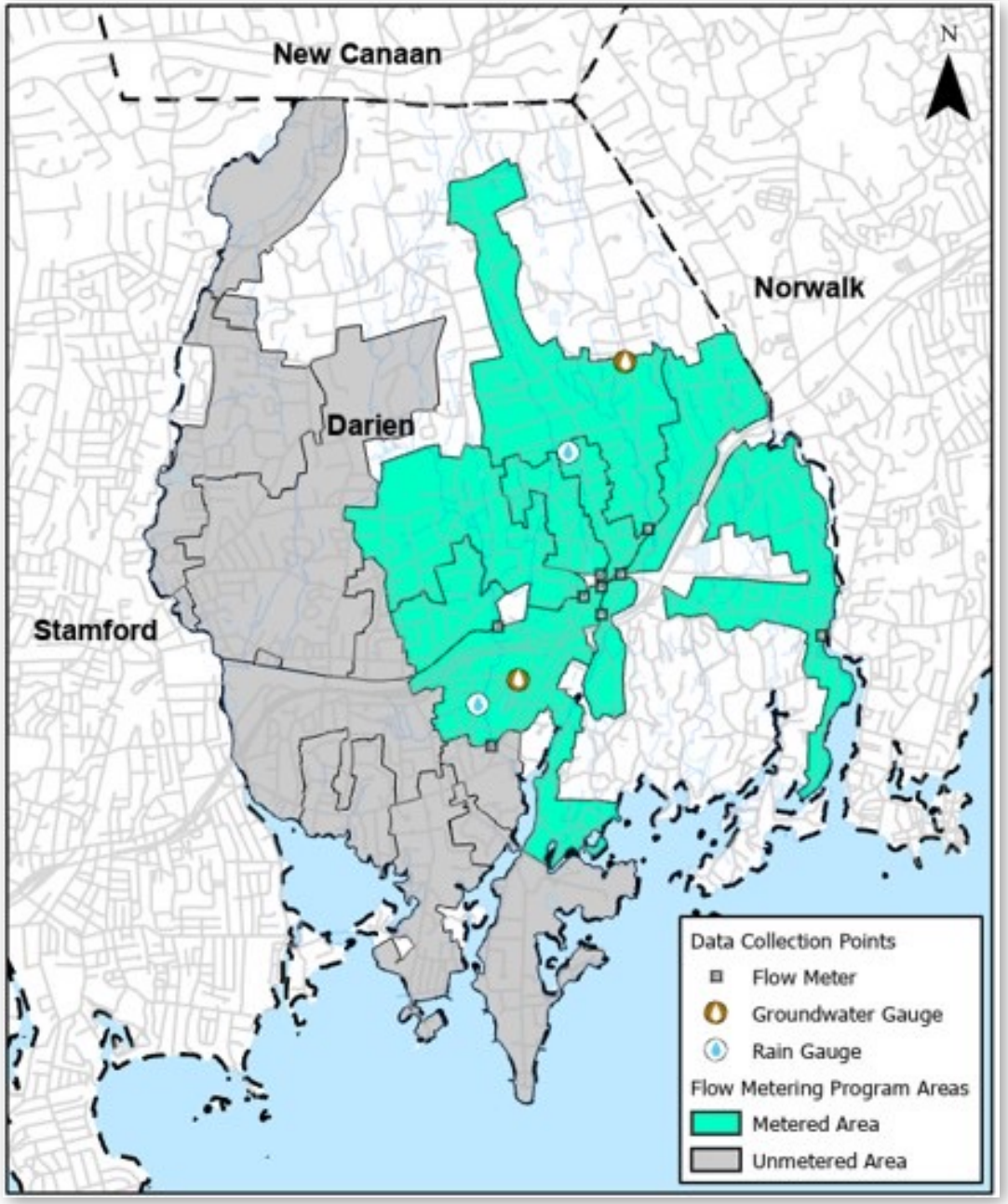
Targeted I/I Program

Hitting the I/I Target

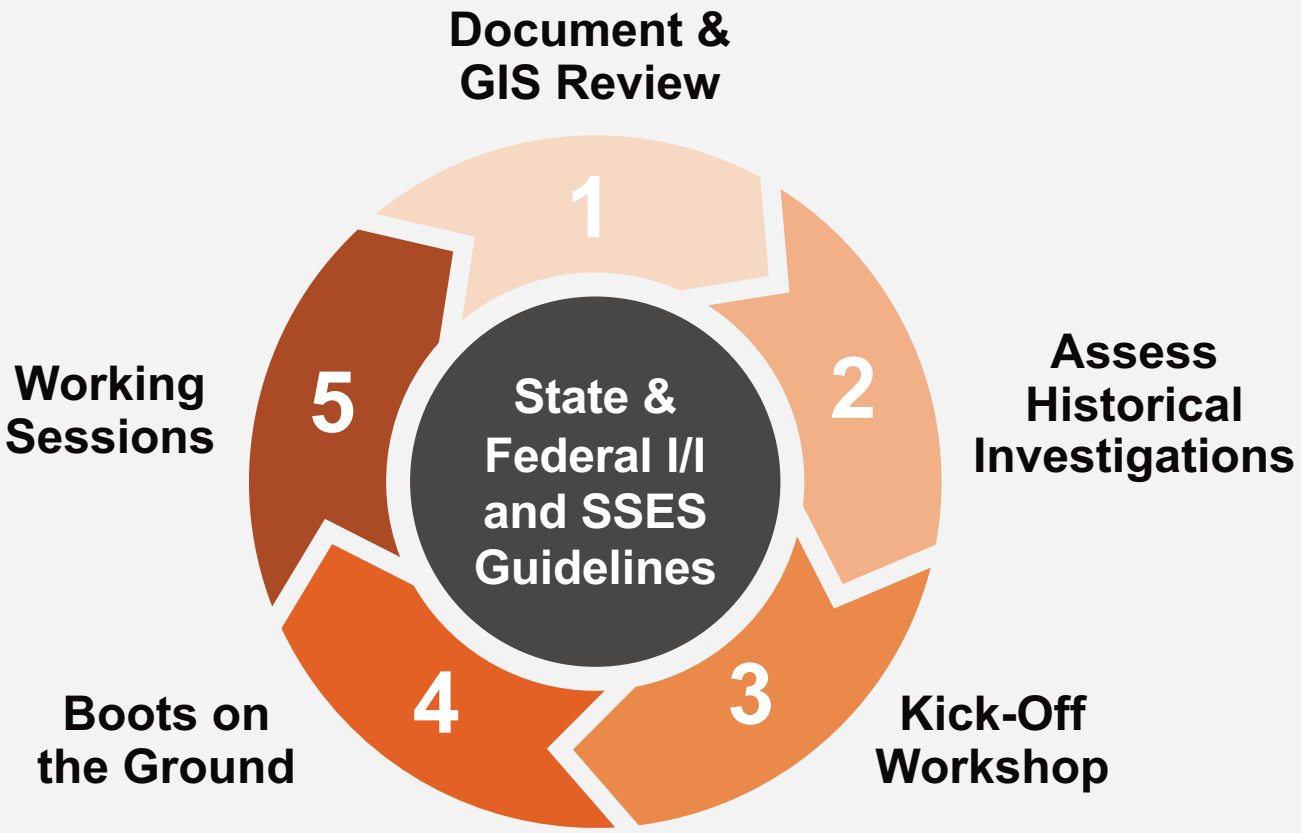
- Understand the System
- Target Known Problem Areas
- Fast-Track Sewer Rehab and I/I Removal

Stony Brook Pump Station Sewershed and Tributary Sewersheds

- *Historical Issues & SSOs*
- *2/3 Town sanitary flow*
- *11 sewersheds*
- *8 pump stations*
- *41 miles gravity pipe, 4 miles low-pressure mains, 2 miles force mains, 1,200 manholes*



How Did We Get There?



Institutional Knowledge Drives an Efficient and Effective I/I Program

Leveraging Institutional Knowledge

Put That Knowledge to Work

I/I & SSES Guidelines

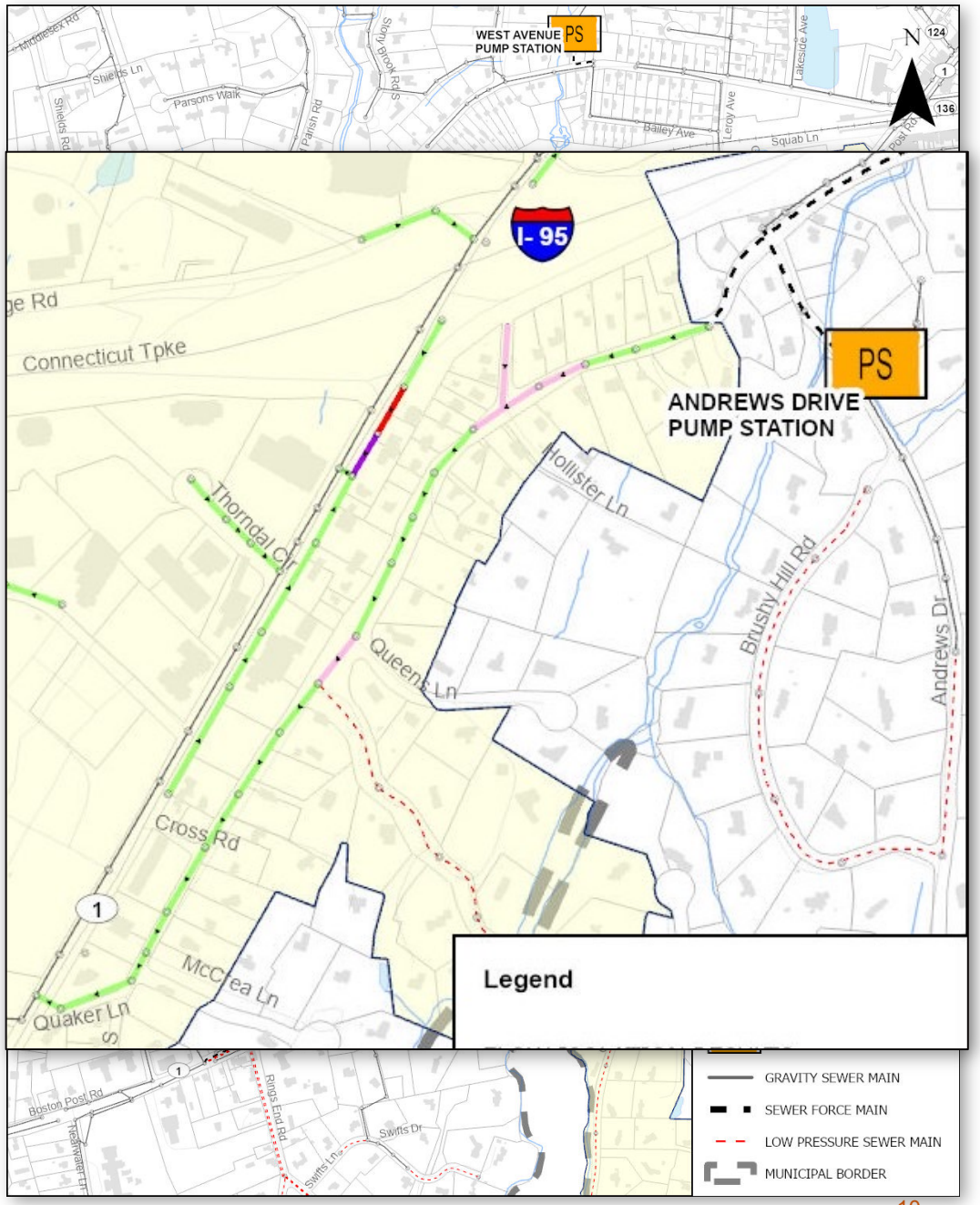
- Infiltration thresholds guide next steps
- Flow isolation results help identify follow-up CCTV inspection locations to target I/I
- Excessive Infiltration Guideline >/= 4,000 gpdim

Old Kings Highway South Findings

- Flow isolation results = 0 net flow
- Field crew noted manhole deterioration

Institutional Knowledge

- Downstream of Pump Station force main discharges → Historical Issue → H_2S
- Record Drawing Review → 1970s Asbestos Cement Pipe → H_2S Corrosion
- Added Old Kings Highway South to CCTV Program



Old Kings Highway South

Pump Station Force Main Discharge

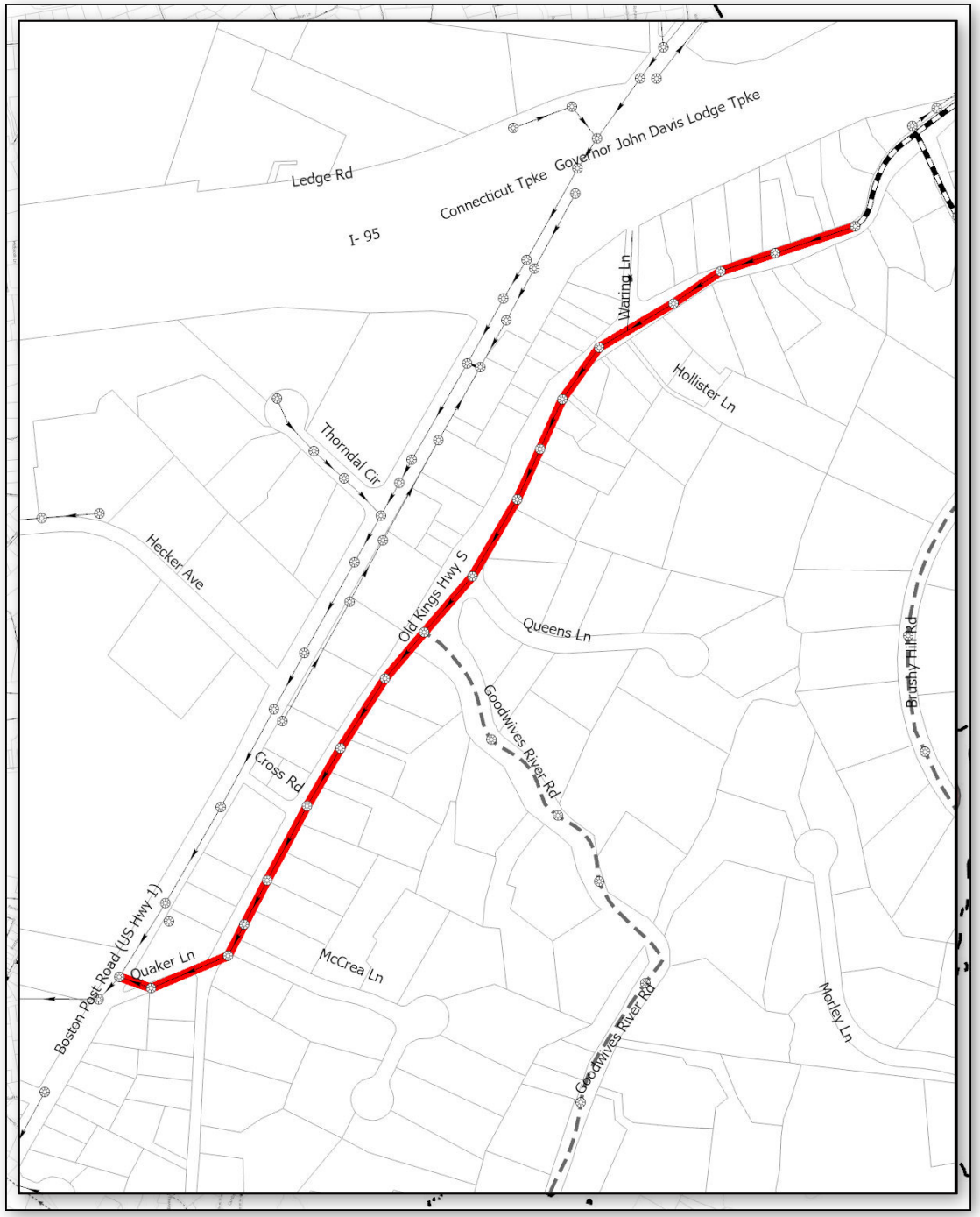
- 10-inch Ductile Iron pipe
- 1.5 miles
- 0.14 MDG ADF

Old Kings Highway South

- 3,400 linear feet (LF)
- 17 segments – 12-inch asbestos cement (AC)
- 18 manholes – precast concrete or concrete block
- 42 active service connections – majority AC
- Up to 18-feet deep in a few locations

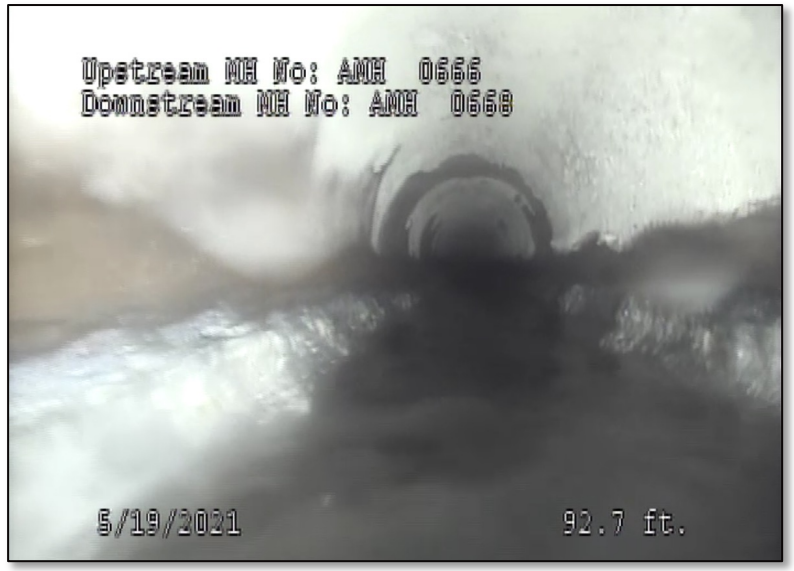
Low-Pressure System Discharge

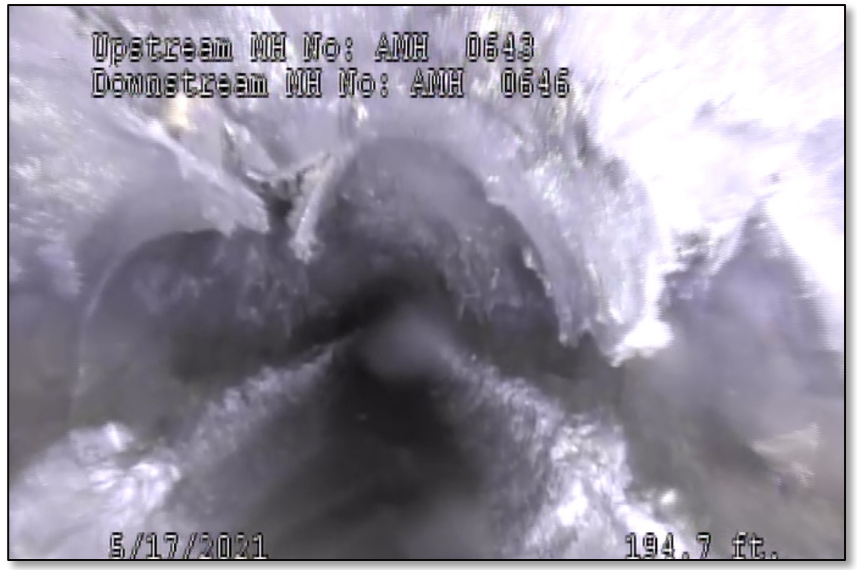
- 3-inch PVC
- 2 miles

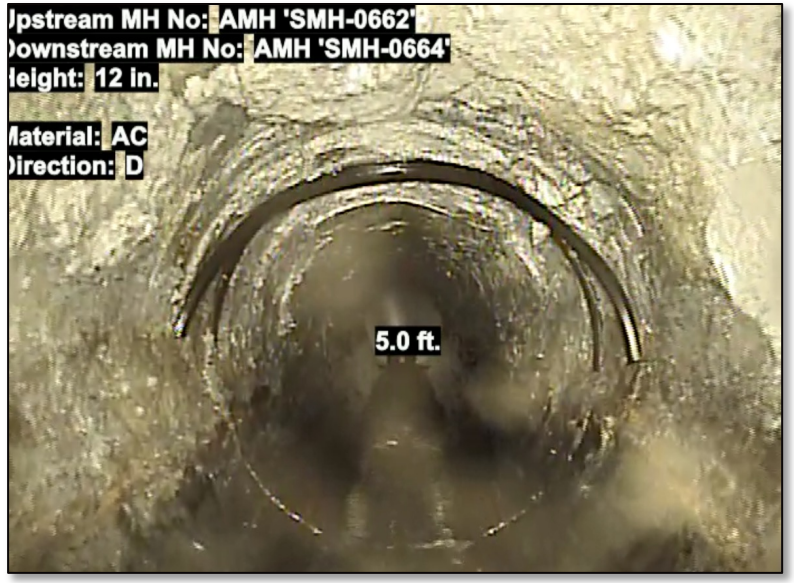


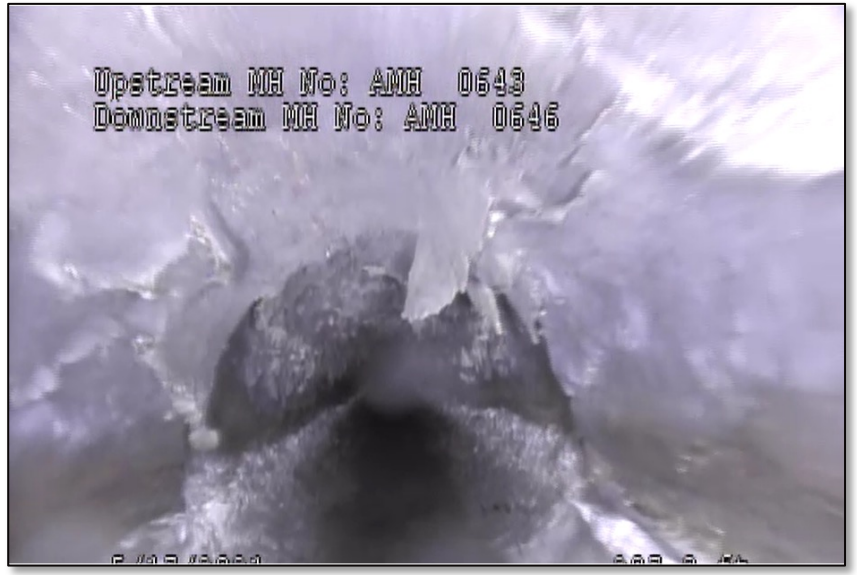
Findings – Pipes Condition

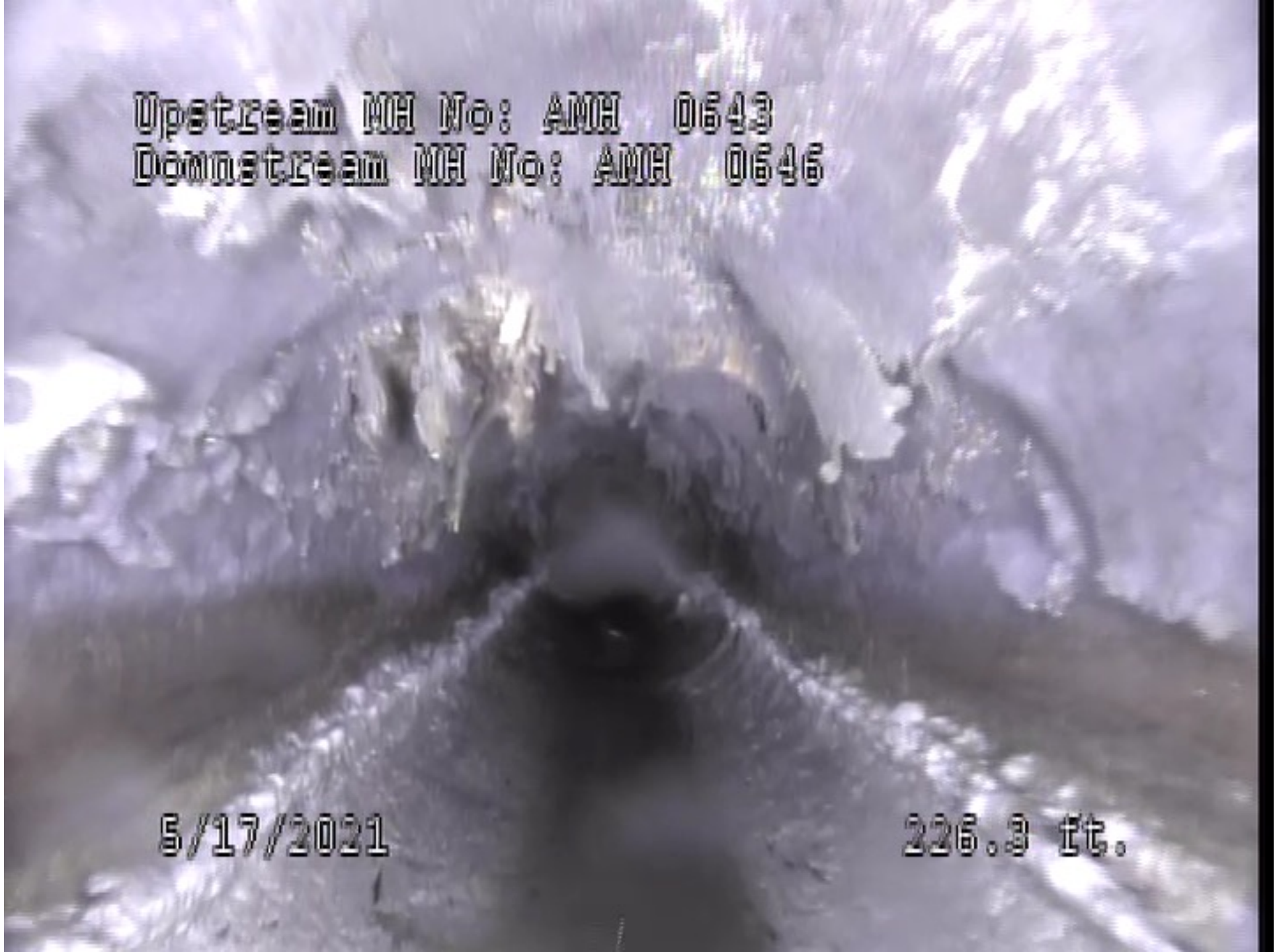
- All segments exhibiting varying degree of H_2S deterioration
  - Early deterioration – rough pipe/white deposits
  - Moderate deterioration – beginning to delaminate; isolated delamination
  - Significant deterioration – delamination; exposed gasket
- 2 segments with active infiltration at joints










Upstream MH No: AMH 0643
Downstream MH No: AMH 0646
5/17/2021
226.3 ft.

Findings – Manholes Condition

- All exhibiting varying degree of H_2S deterioration
  - Some early deterioration – white deposits on wall)
  - Some significant deterioration – loose/missing material; though no rebar exposed
- Frames/Covers
  - Covers – Minor to significant corrosion
  - Frames – Minor to moderate corrosion; cracks; chipping

Findings – Service Connections

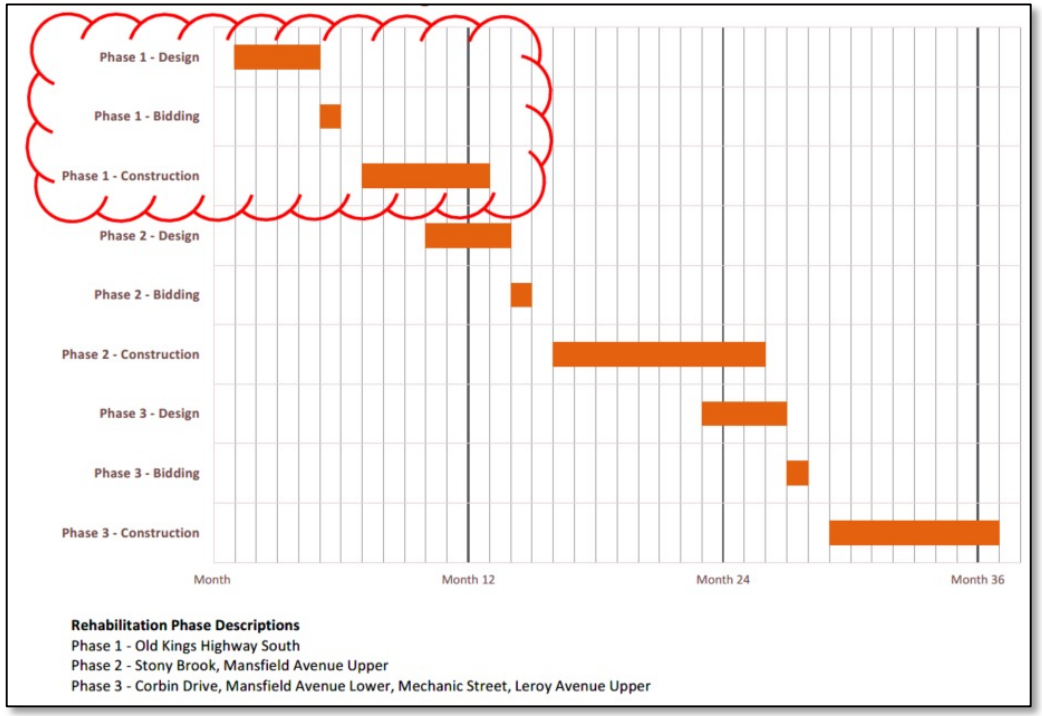
- Limited view – First few feet of SC → Performed full lateral inspections
- All SCs exhibiting varying degree of H_2S deterioration
  - Early deterioration – rough pipe/white deposits
  - Moderate deterioration – beginning to delaminate; isolated delamination
- 12 SCs – active infiltration or evidence of infiltration

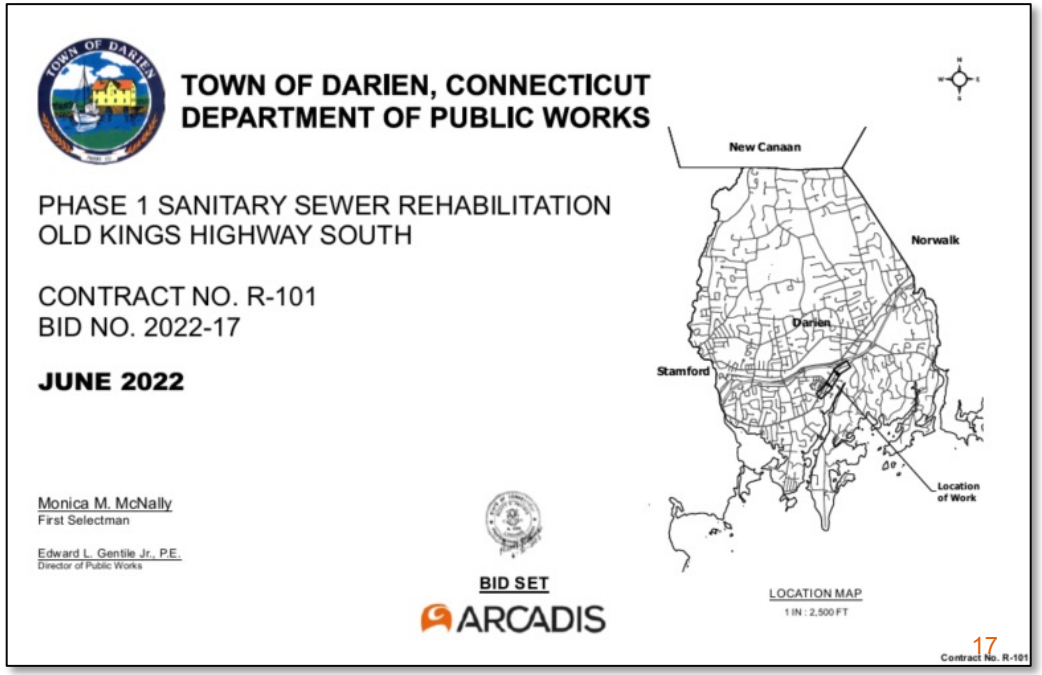
Reprioritizing Rehabilitation

Shifting the Focus

- I/I Program – 3 Rehabilitation Phases
- Highest Priority – Old Kings Highway South
- Rehabilitation Recommendations
  - 3,400 LF cured-in-place pipe lining
  - 42 lateral liners
  - 18 manhole liners (cementitious and epoxy)
  - 15 manhole frame and cover replacements

Construction Cost = $515,000 →
American Rescue Plan Act (ARPA) Funding





How Is It Going?

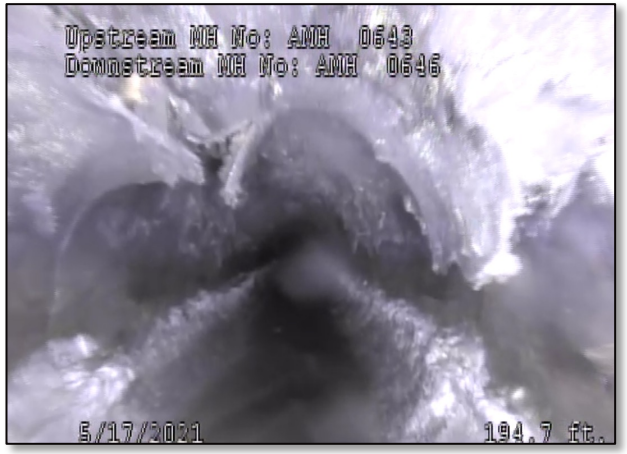
Completed

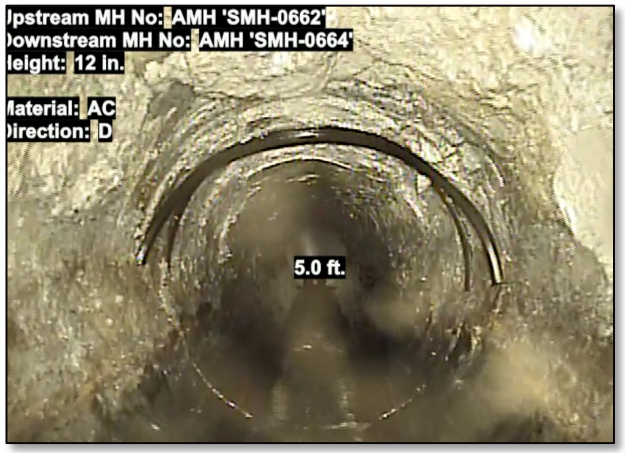
- Cured-in-place pipe lining – *NO DIGGING!* ☺
- Manhole frames and covers replacement
- Manhole benches and inverts rebuilding
- Manhole cementitious lining

Underway

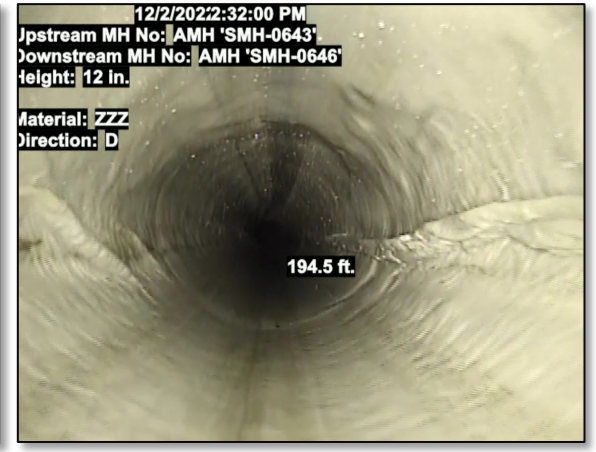
- Lateral lining – adjusted approach
- Manhole epoxy lining

Before





After



February 2023 anticipated completion!

Takeaways & Lessons Learned

- Guidelines are, well...guidelines
- Use your resources
- Documentation! Documentation! Documentation!
- Do not wait – Any investigation is better than no investigation
- Pump station force main discharges – Do not stop short
- Seek out funding – 55% is still 55%

Questions?

Contact Us

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Arcadis. Improving quality of life.

Special Thanks!

Darren Oustafine
Assistant Director Public Works

Tony Campanella
Supervisor of Facilities and Equipment

Steve Toscano
Sewer Division Foreman

Andy Annunziata
Sewer Division Mechanic

John Boccuzzi
Sewer Division Operator

Thank you!

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Reference Slides for Questions

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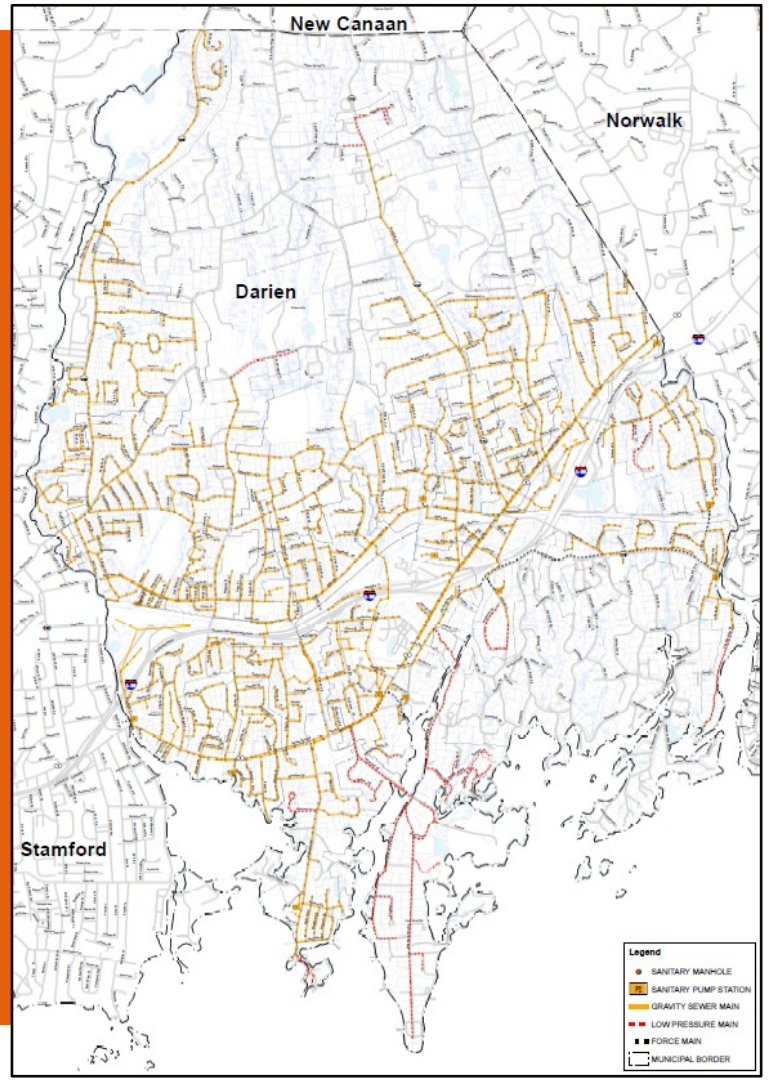
Background, Project Overview & Purpose

Background

Town Wastewater Collection System

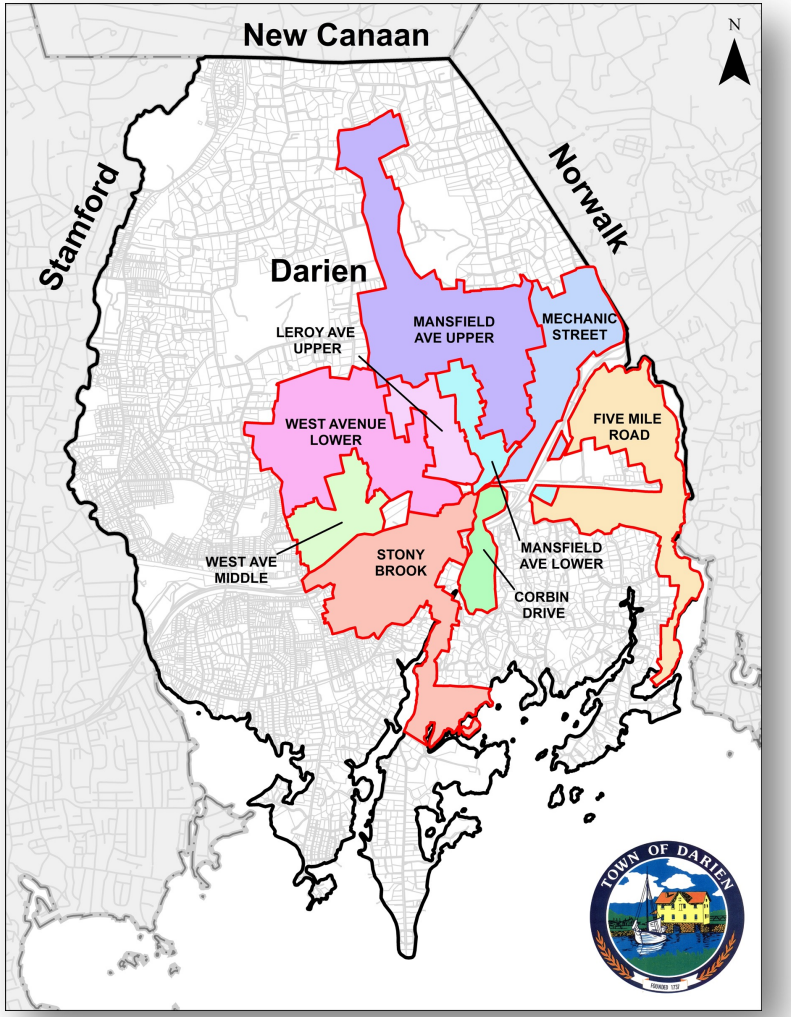
- 84 Miles of Gravity Sewer Pipes
  - 8-inch to 24-inches in Diameter
- 10 Miles Low Pressure Sewer Pipes
- 4 Miles of Sewer Force Mains
- 2,428 Sewer Manholes
- 14 Pump Stations
- 2.3 MGD of flow transported to SWPCF



Project Overview

Focused Infiltration and Inflow (I/I) Program:

- GIS Updates *(ongoing)*
- Capacity, Management, Operation and Maintenance (CMOM) Document *(ongoing)*
- Pump Station Evaluations *(complete)*
- Flow Monitoring and I/I Analysis *(complete)*
- Sewer System Evaluation Survey (SSES) Investigations *(complete)*
- **SSES Program Findings & Rehabilitation Recommendations** *(under review)*

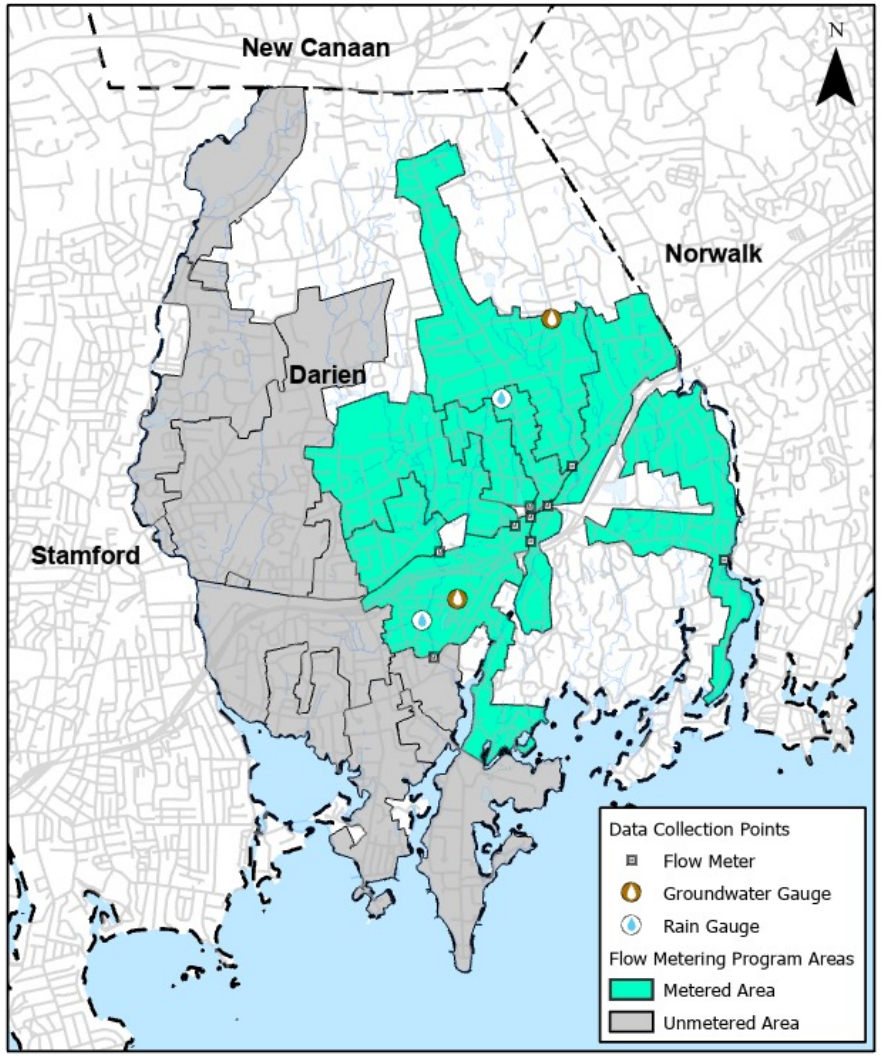


I/I Metering Program Summary

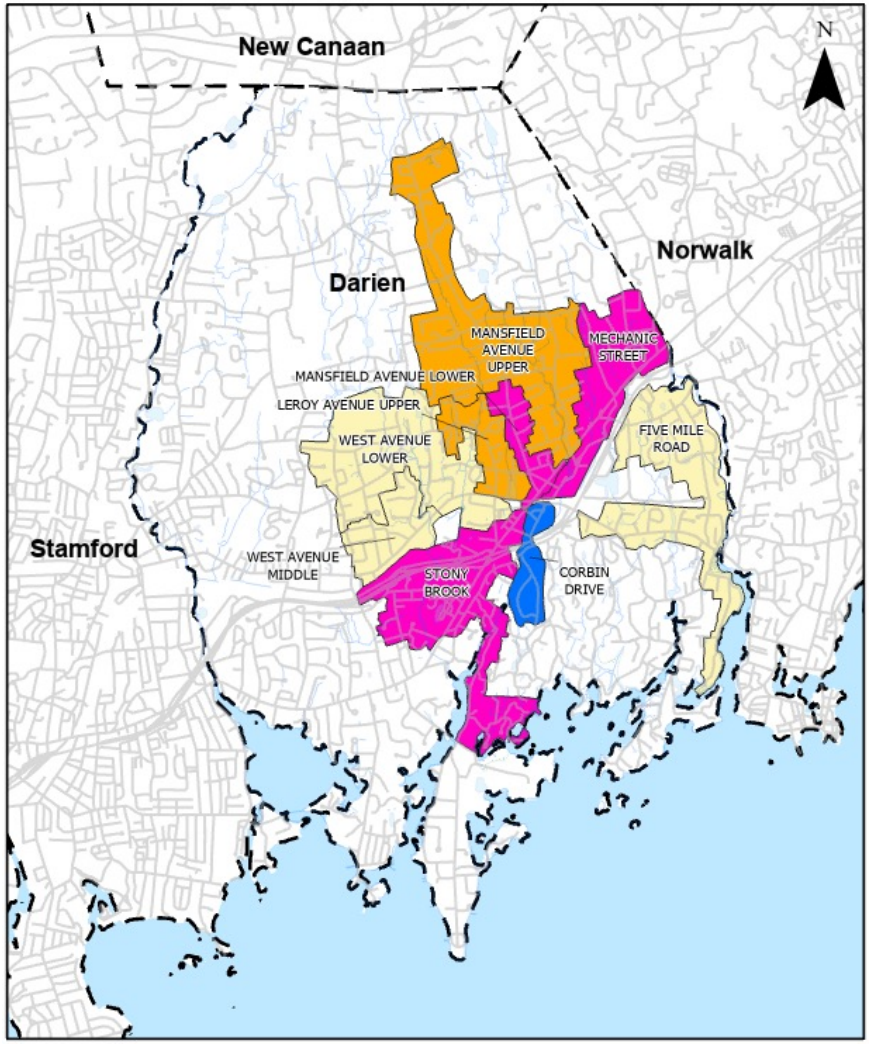
I/I Flow Metering Program Overview

2020 Metering Program

- 2 Rain Gauges
- 2 Groundwater Gauges
- 9 Meter Areas
  - 1,200 Manholes
  - 41 Miles Gravity Sewer
  - 4 Miles Low Pressure
  - 2 Miles Force Main
  - 6 Pump Stations



I/I Flow Metering Analysis Findings



Infiltration/Inflow Analysis Findings	SSES Investigations
High Infiltration and Inflow	Flow Isolation, CCTV Inspections, Manhole Inspections, Smoke Testing, and Building Inspections.
High Infiltration	Flow Isolation, CCTV Inspections, and Manhole Inspections.
High Inflow	Smoke Testing, and Building Inspections.
Low Infiltration and Inflow	Not selected for additional investigations.

SSES Investigations & Findings

SSES Investigations – CCTV Findings

Study Area	Total Inspected (LF)	Estimated Infiltration (gpd)	% of Total Estimated Infiltration	NASSCO Grade 3 or Higher (LF)	% of Pipe with NASSCO Grade 3 or Higher
Leroy Avenue Upper	5,234	44,856	8%	2,751	11%
Mansfield Avenue Lower	3,925	109,728	19%	3,925	15%
Mansfield Avenue Upper	11,228	173,880	30%	6,176	24%
Mechanic Street	8,442	92,376	16%	3,265	13%
Stony Brook	18,080	163,008	28%	9,303	37%
Total	**46,909**	**583,848**		**25,420**	**54%**

SSES Investigations – Manhole Findings

Study Area	Inspected Manholes	Active Infiltration	Evidence of Infiltration	Evidence of Inflow	Estimated Infiltration (gpd)	% of Total Estimated Infiltration	Manholes NASSCO Grade 3 or Higher	% of Manholes Grade 3 or Higher
Leroy Avenue Upper	52	14	33	23	15,840	9%	35	16%
Mansfield Avenue Lower	59	8	25	30	42,480	25%	28	13%
Mansfield Avenue Upper	129	14	41	65	15,048	9%	50	23%
Mechanic Street	41	8	25	18	18,360	11%	28	13%
Stony Brook	160	21	65	59	75,240	45%	80	36%
Total	**441**	**65**	**189**	**195**	**166,968**		**221**	**50%**

Rehabilitation Recommendations, Costs and Next Steps

Rehabilitation Recommendations – Pipeline

Study Area	CRT (LF)	GSC (ea)	CIPPL (LF)	RSC (ea)	TSS (ea)	CIPSR (ea)	CIPLL (ea)	Dig Spot Repair (ea)
Leroy Avenue Upper	0	4	2,728	45	45	0	1	1
Mansfield Avenue Lower	0	1	3,925	54	54	0	0	0
Mansfield Avenue Upper	597	5	7,290	59	59	0	4	2
Mechanic Street	0	2	4,083	41	38	2	4	1
Stony Brook	650	22	8,455	130	95	3	40	0
Totals	**1,246**	**34**	**26,481**	**329**	**293**	**5**	**49**	**4**

Notes:
CRT – Chemical Root Treatment, GSC – Grind Service Connection, CIPPL – Cured-in-Place Pipe Liner, RSC – Reinstate Service Connection, TSS – Test and Seal Service Connection, CIPSR – Cured-in-Place Spot Repair, CIPLL – Cured-in-Place Lateral Connection Liner

Rehabilitation Recommendations – Manholes

Study Area	Frame & Cover Work (ea)	Chimney Seal (ea)	Cementitious Liner (VF)	Epoxy Coat (VF)	Seal by Grout Injection (ea)	Repair Bench and Invert (ea)
Leroy Avenue Upper	3	8	37	0	29	3
Mansfield Avenue Lower	7	8	270	13	2	3
Mansfield Avenue Upper	21	40	53	8	28	3
Mechanic Street	9	7	108	0	14	2
Stony Brook	41	38	530	175	23	6
Totals	**81**	**101**	**998**	**196**	**96**	**17**

Rehabilitation Cost Estimate and Schedule

Rehabilitation Phase / Study Area		Pipe Rehabilitation (LF)	Manhole Rehabilitation (Qty)	Estimated Infiltration (gpd)	Construction Cost Estimate (1)	Total Project Cost Estimate (2)
Phase 1	Old Kings Highway South (Stony Brook)	3,230	18	12,528	$494,532	$861,228
Phase 2	Stony Brook	6,942	80	220,680	$559,087	$973,649
Phase 3	Mansfield Avenue Upper	8,251	54	188,496	$537,188	$935,513
Phase 4	Mansfield Avenue Lower & Mechanic Street	8,778	57	262,368	$634,442	$1,104,881
Phase 5	Leroy Avenue Upper	2,962	35	60,120	$233,179	$406,081
	Totals:	**30,059**	**244**	**743,922**	**$2,458,428**	**$4,281,352**

Note:

(1) The construction cost estimate is based on 2022 construction costs, including a 15 percent allowance for police and mobilization costs.

(2) The total project cost estimate includes the estimated construction cost, escalated to the midpoint of construction; construction contingency (20%); engineering services including design, construction administration, and full-time onsite inspection services (25%); legal and administrative costs (2%); and interest during construction (2%).