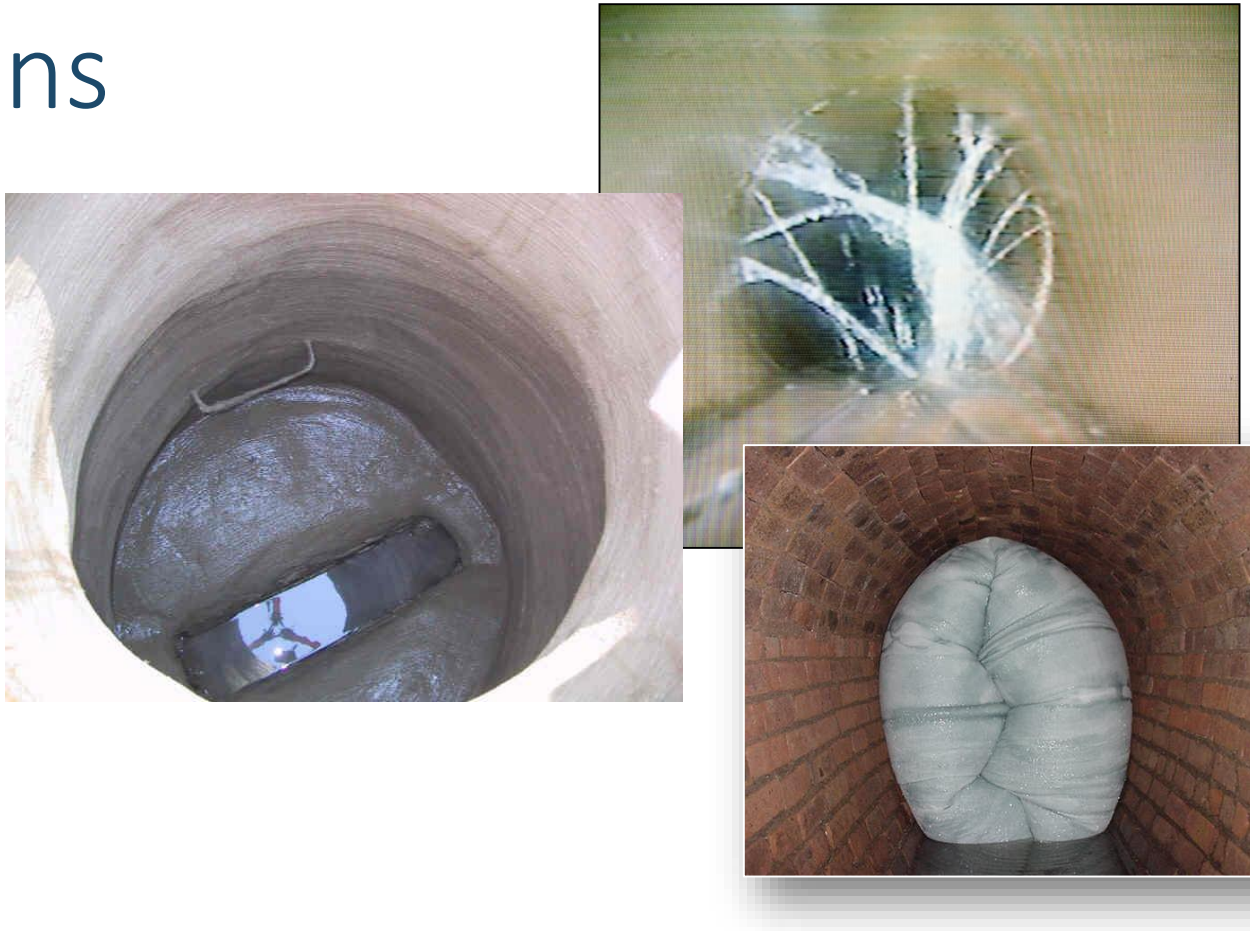
UCT The Underground Utilities Event
Underground Construction Technology | January 28-30, 2020 | Fort Worth, TX

Measuring the Effectiveness of Comprehensive Rehabilitation Recommendations

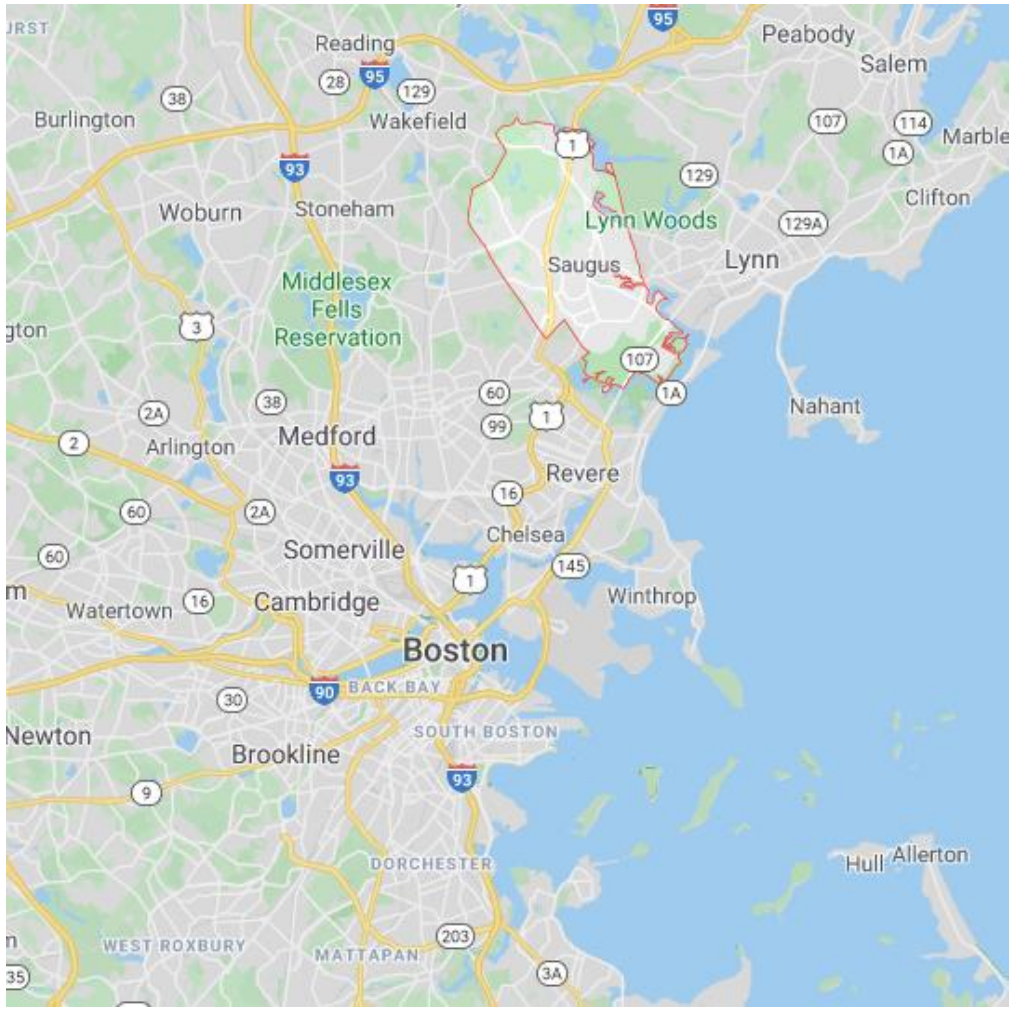
Jonathan Kunay, PE, PMP



CDM Smith

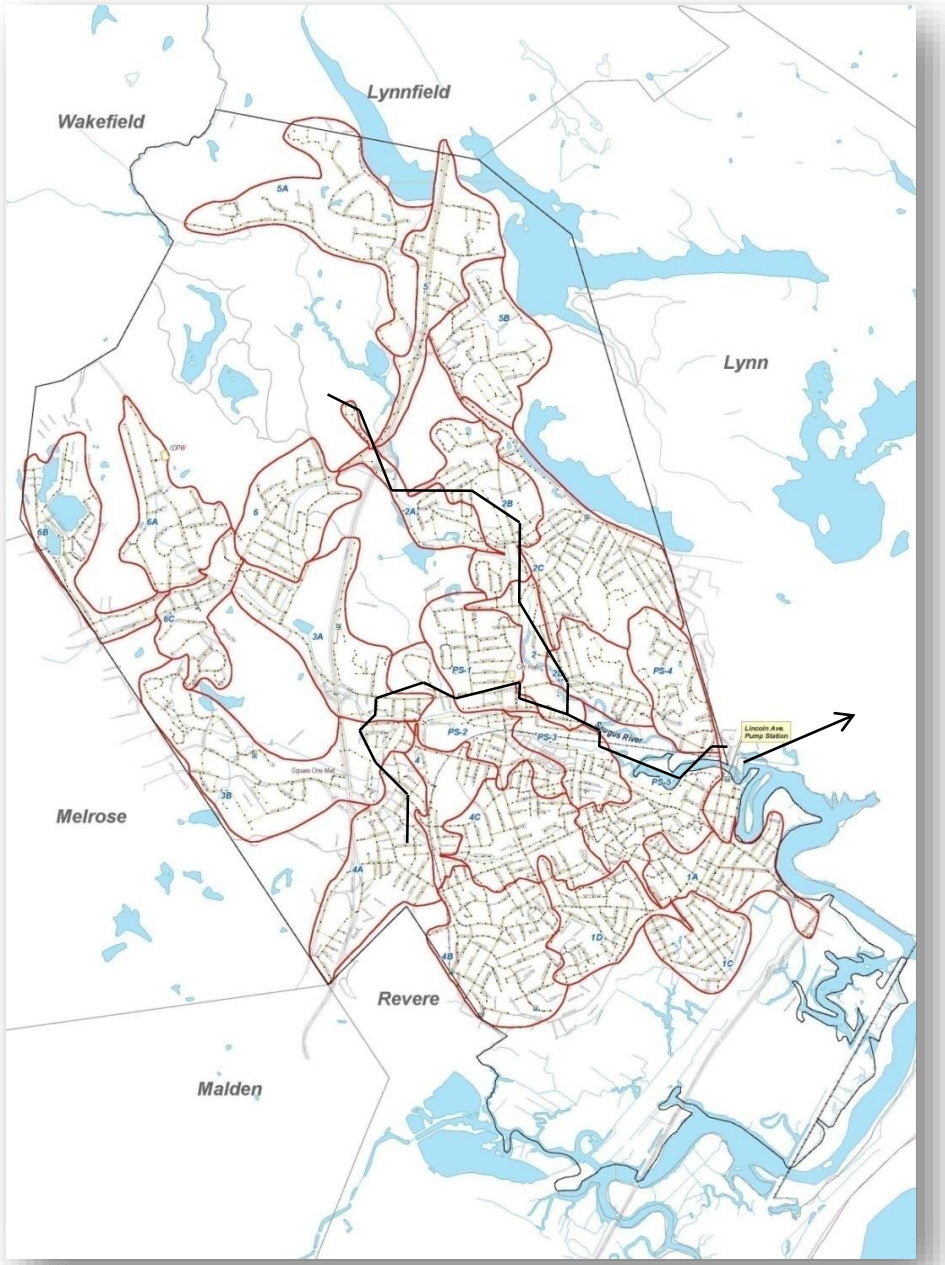
Town of Saugus, MA

- Population: 24,000
- Land Area: 12 mi^2



Town of Saugus, MA

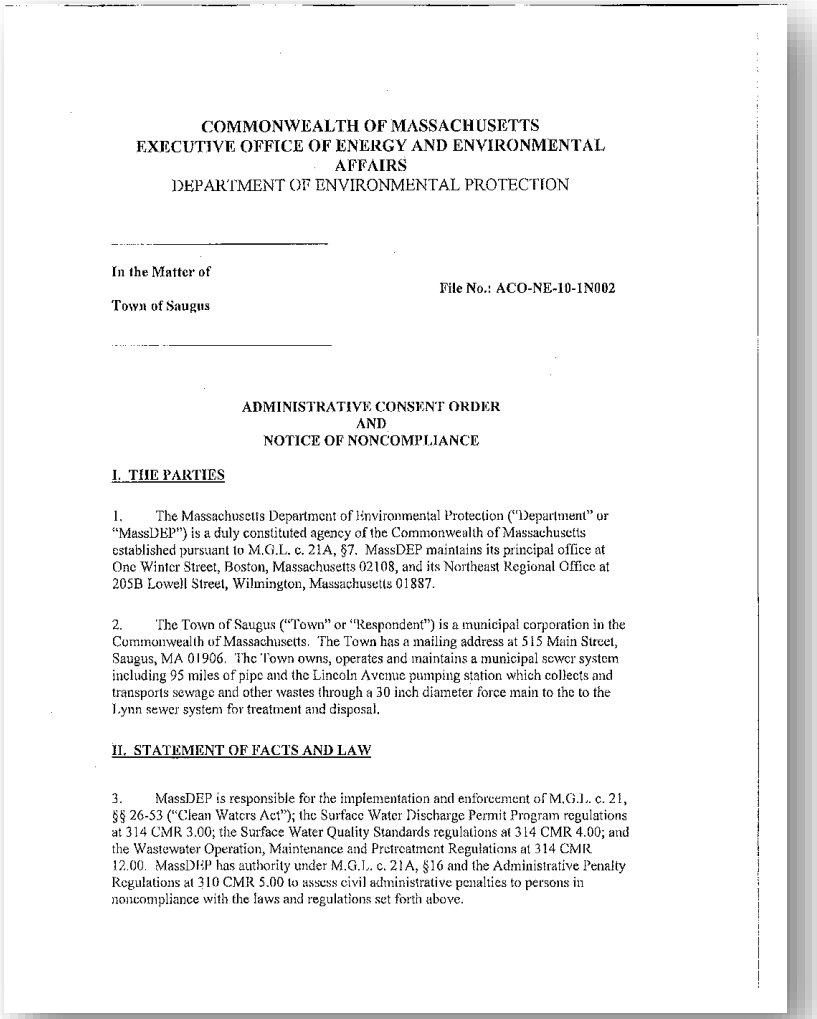
- Population: 24,000
- Land Area: 12 mi^2
- 95 Miles of Sanitary Sewers
  - Divided into 27 Subsystems
- Pipe Materials
  - Vitrified Clay Pipe
  - Asbestos Cement
  - PVC
- Main Pumping Station – Lincoln Avenue P.S.



Sanitary Sewer Overflows

MassDEP Administrative Consent Order

- Issued on April 12, 2005
- Town fined $25,000
- Requirements included:
  - Address Deficiencies in System
  - High Flow Management Plan
  - Facilities Plan to Control SSO's
  - Sewer Bank
  - Implement Control Plan Including
- Private Inflow Removal
  - Semi-Annual Reporting



COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

In the Matter of

Town of Saugus

File No.: ACO-NE-10-1N002

ADMINISTRATIVE CONSENT ORDER
AND
NOTICE OF NONCOMPLIANCE

I. THE PARTIES

1. The Massachusetts Department of Environmental Protection ("Department" or "MassDEP") is a duly constituted agency of the Commonwealth of Massachusetts established pursuant to M.G.L. c. 21A, §7. MassDEP maintains its principal office at One Winter Street, Boston, Massachusetts 02108, and its Northeast Regional Office at 205B Lowell Street, Wilmington, Massachusetts 01887.

2. The Town of Saugus ("Town" or "Respondent") is a municipal corporation in the Commonwealth of Massachusetts. The Town has a mailing address at 515 Main Street, Saugus, MA 01906. The Town owns, operates and maintains a municipal sewer system including 95 miles of pipe and the Lincoln Avenue pumping station which collects and transports sewage and other wastes through a 30 inch diameter force main to the to the Lynn sewer system for treatment and disposal.

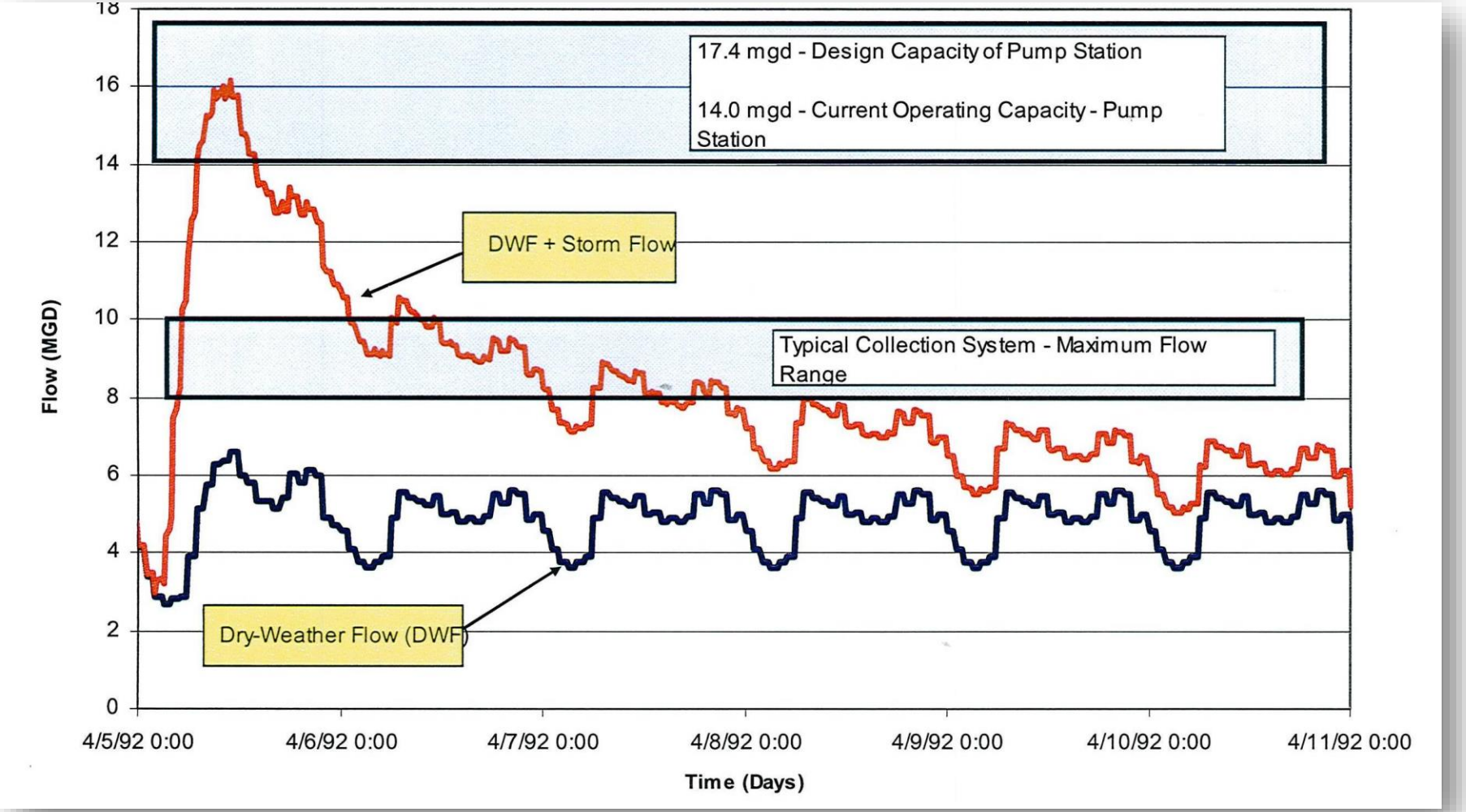
II. STATEMENT OF FACTS AND LAW

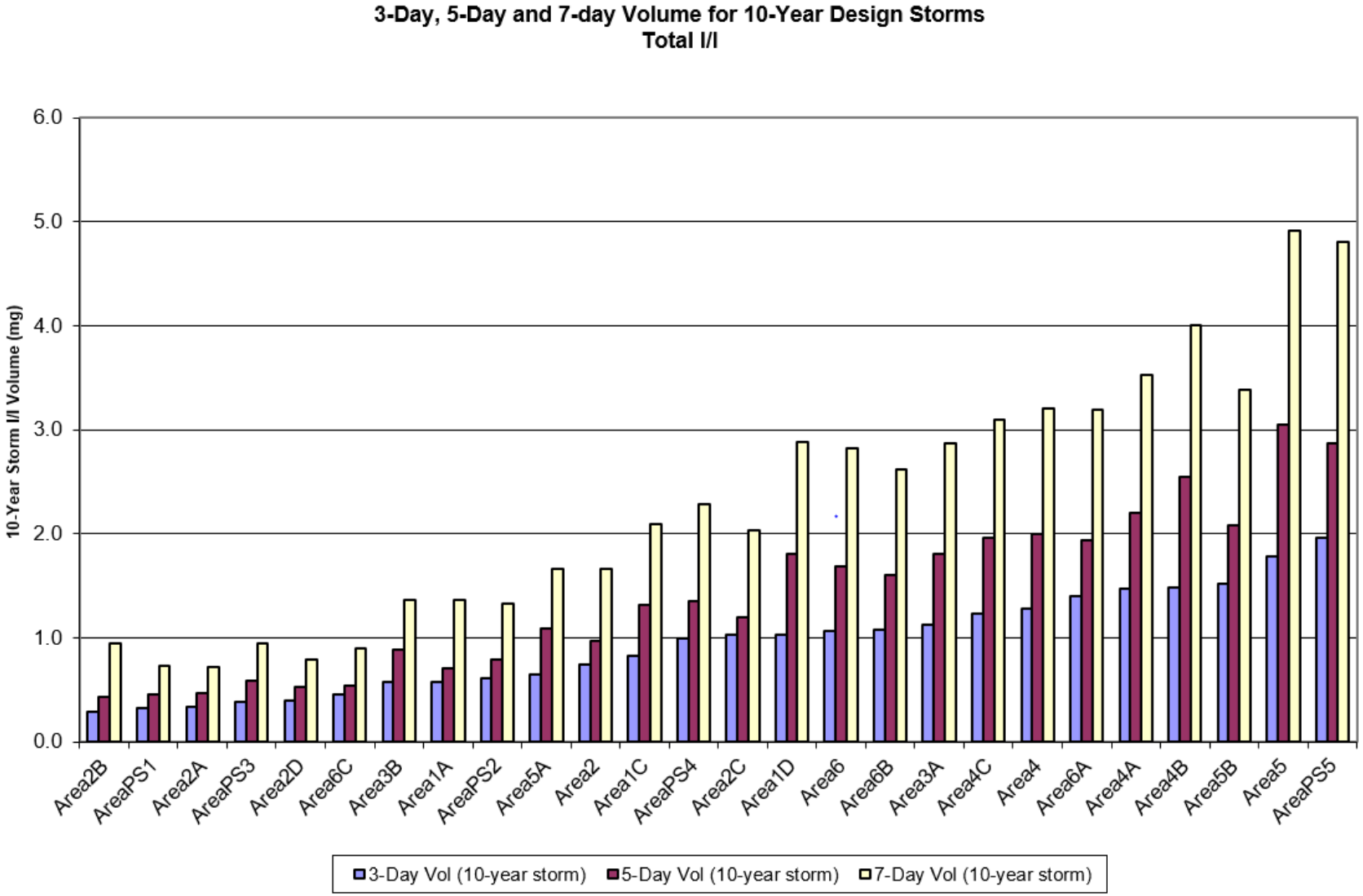
3. MassDEP is responsible for the implementation and enforcement of M.G.L. c. 21, §§ 26-53 ("Clean Waters Act"); the Surface Water Discharge Permit Program regulations at 314 CMR 3.00; the Surface Water Quality Standards regulations at 314 CMR 4.00; and the Wastewater Operation, Maintenance and Pretreatment Regulations at 314 CMR 12.00. MassDEP has authority under M.G.L. c. 21A, §16 and the Administrative Penalty Regulations at 310 CMR 5.00 to assess civil administrative penalties to persons in noncompliance with the laws and regulations set forth above.

Meeting ACO Requirements

- Installed 27 Subsystem Temporary Flow Meters
- Installed 4 Permanent Meters
  - 3 permanent rain gauges
  - 2 permanent groundwater gauges
- Developed Hydraulic Computer Model of Sewer System using SWMM

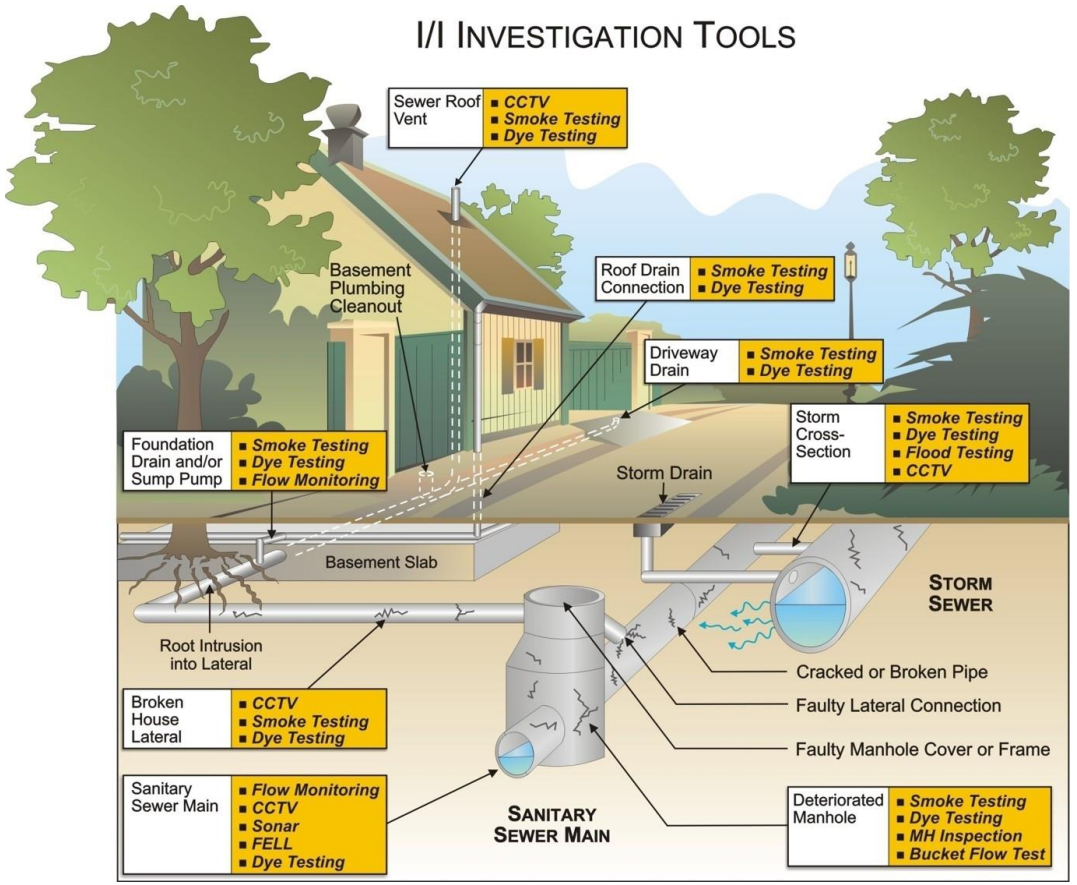
The Magnitude of the Problem




3-Day, 5-Day and 7-day Volume for 10-Year Design Storms
Total I/I
10-Year Storm I/I Volume (mg)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Area2B
AreaPS1
Area2A
AreaPS3
Area2D
Area6C
Area3B
Area1A
AreaPS2
Area5A
Area2
Area1C
AreaPS4
Area2C
Area1D
Area6
Area6B
Area3A
Area4C
Area4
Area6A
Area4A
Area4B
Area5B
Area5
AreaPS5
3-Day Vol (10-year storm)
5-Day Vol (10-year storm)
7-Day Vol (10-year storm)

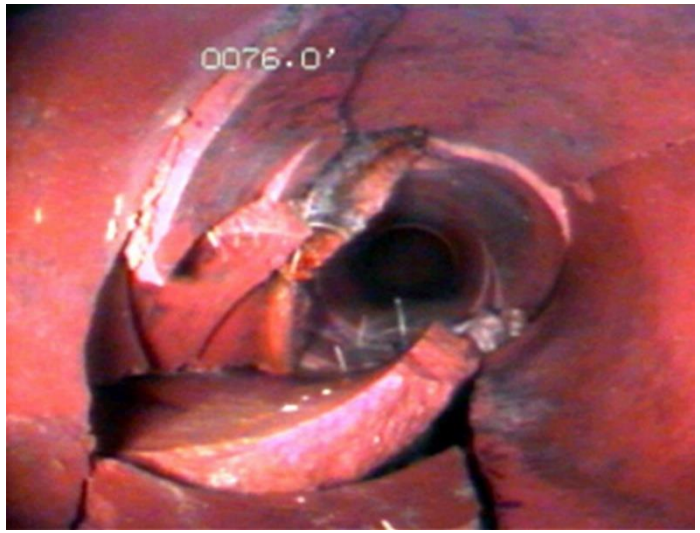
Meeting ACO Requirements

- Prioritized High I/I Subsystems
- Conducted SSES on High Priority Subsystems
  - Smoke Testing
  - Dye Water Testing
  - CCTV
  - Manhole “Zoom” Inspections
  - Flow Monitoring
  - Town-wide House-to-House Program



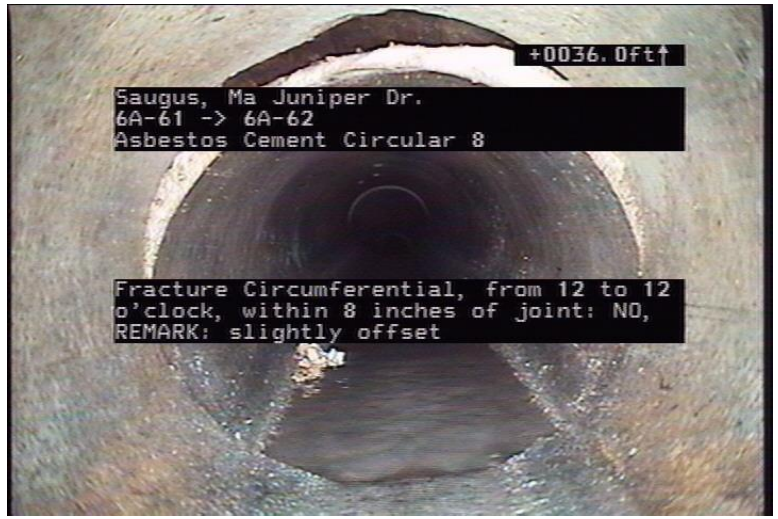
Recommended Plan

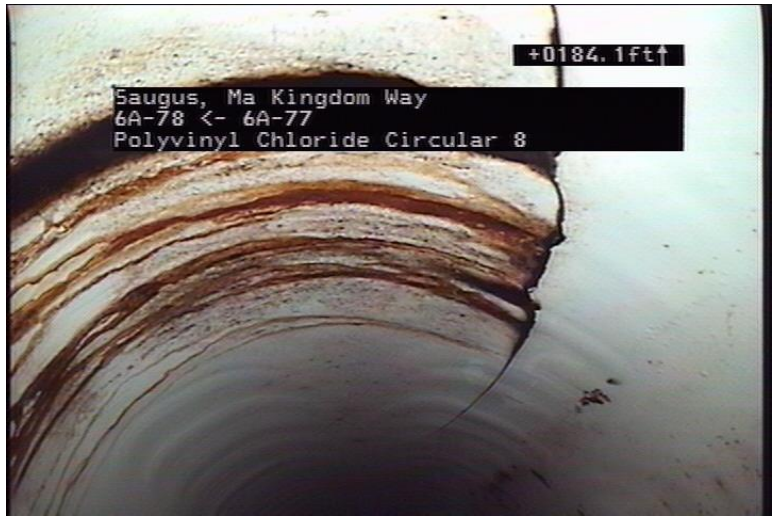
- 10 Year, $32 Million Program
- 40%-50% I/I Removal Goal in Top 9 Subsystems
  - Approximately 11 mg in 10-year storm, 24-hour
- Private Inflow Removal Town-wide
- Confirm & Report Removal Goals Each Year



Recommended Plan

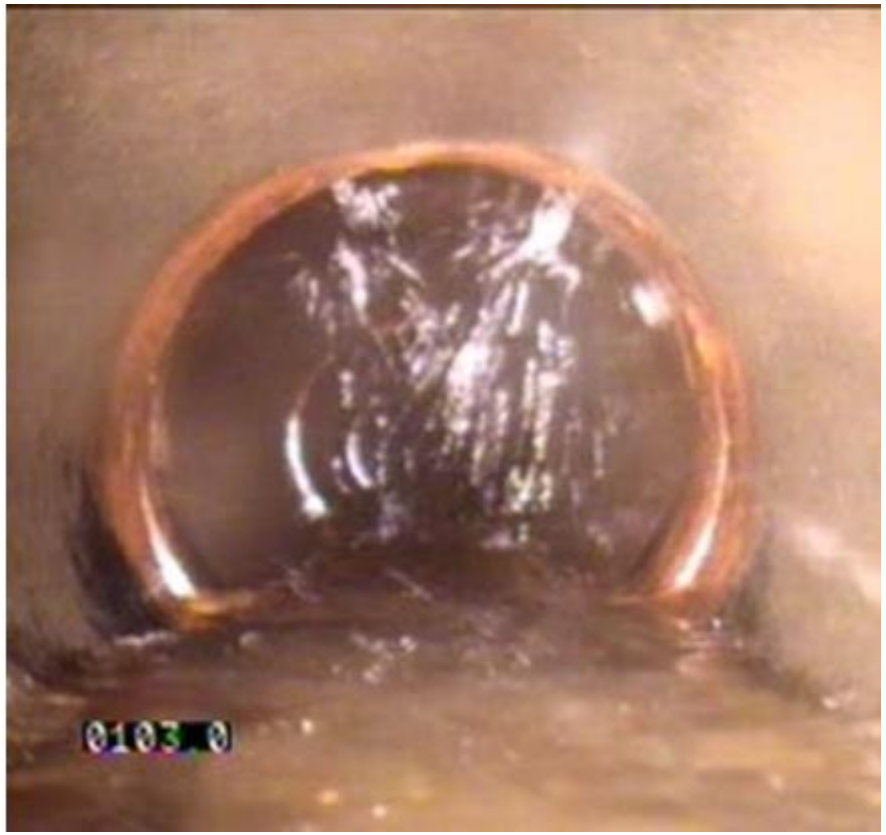
- Perform Comprehensive Rehabilitation of Public System
  - Cured-in-Place Pipe (CIPP) Lining
  - Manhole Rehabilitation
  - Service Lateral Connection Lining
- Of <u>All</u> Sewers and Manholes in a Subsystem





Recommended Plan

- Why Comprehensive?
  - Spot Repairs Historically do not Achieve 40%-50% Removal
  - Widespread Defects
  - History of AC Pipe Failures
  - More Defects Noted During Significant Rain Events
    - Re-CCTV During Mother's Day Storm (2007)
  - Extends Life of Existing Sewer System



Cured-in-Place Pipe (CIPP) Lining

Inversion Process

Manhole Rehabilitation

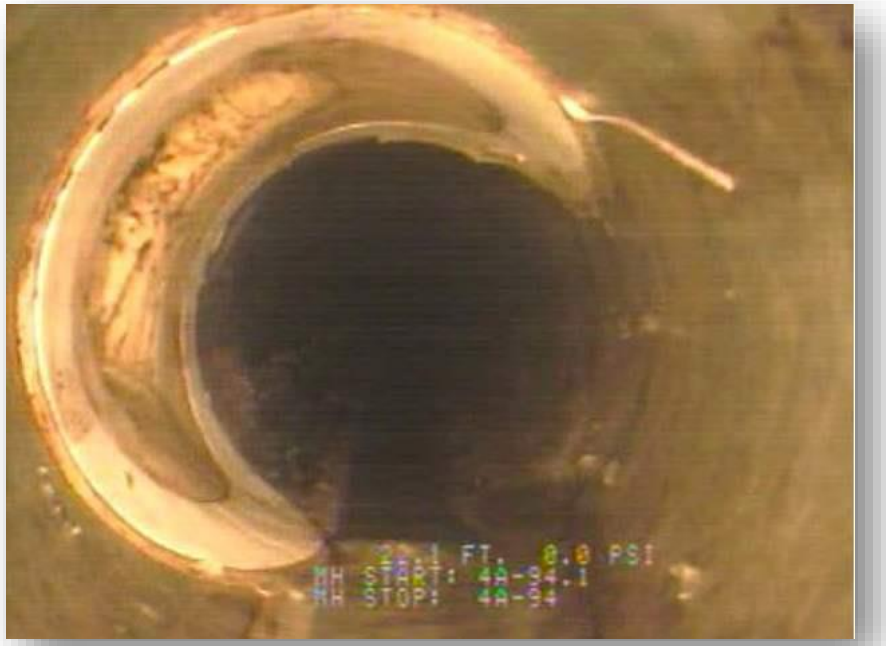
Flexible Corbel Liner

HDPE Grade Rings

Cementitious Lining

Service Lateral Connection Lining

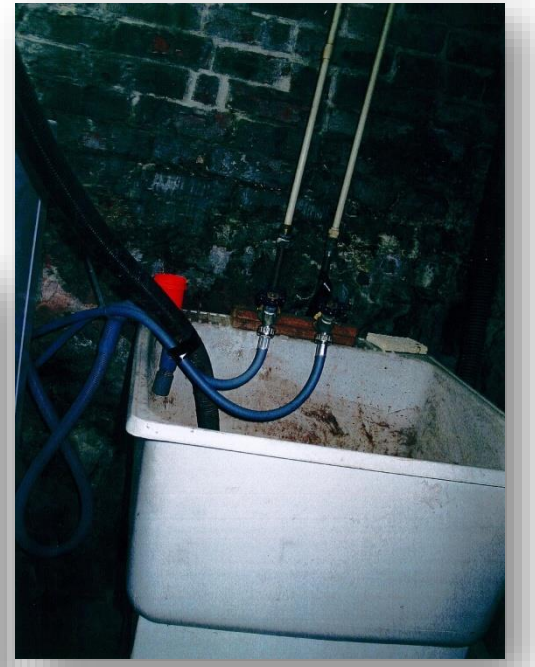
Preparation of Liner



Installed Product

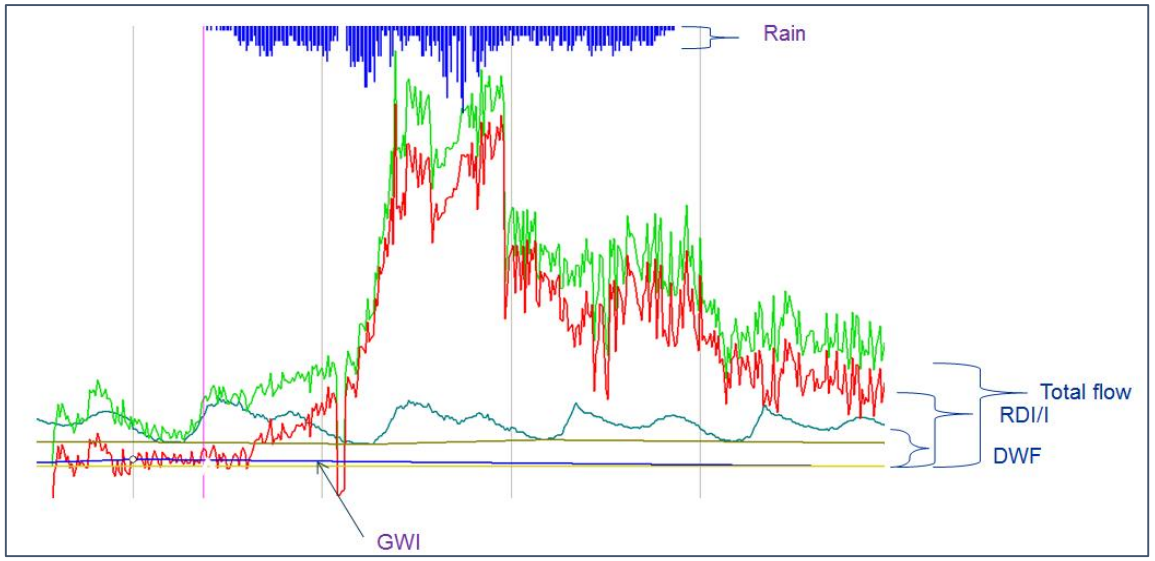
Private Inflow Removal

- Inspected 9,200 Properties
  - 164 Confirmed Sources to Sewer
  - 1,153 Suspect Sump Pumps
- Developed By-Laws
  - Required Disconnection of Confirmed Sources
  - Required Redirection of Direct Connect Sumps and Flexible Discharge Piping
  - Imposed $50/day Fine for Non-Compliance

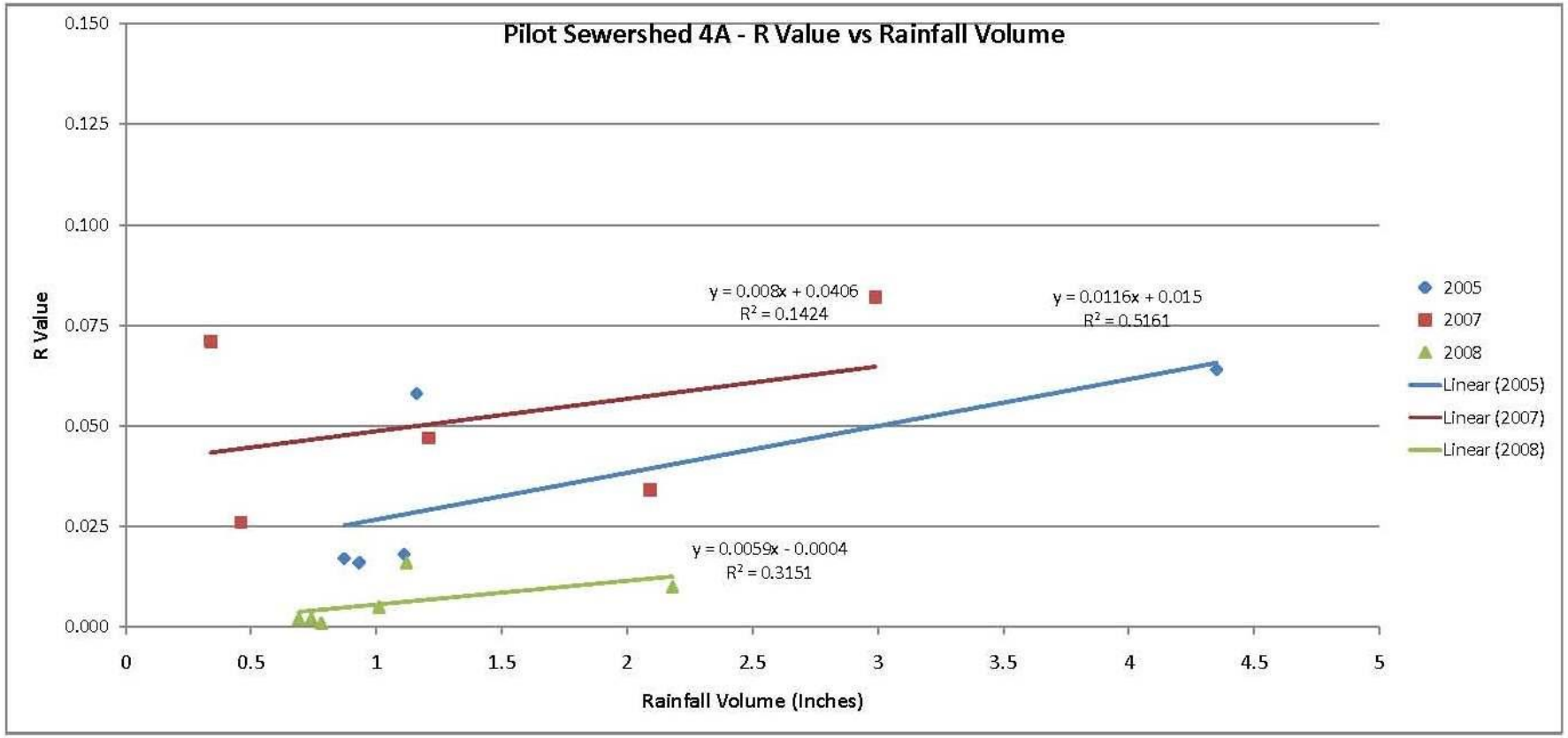


Verification of Flow Removed

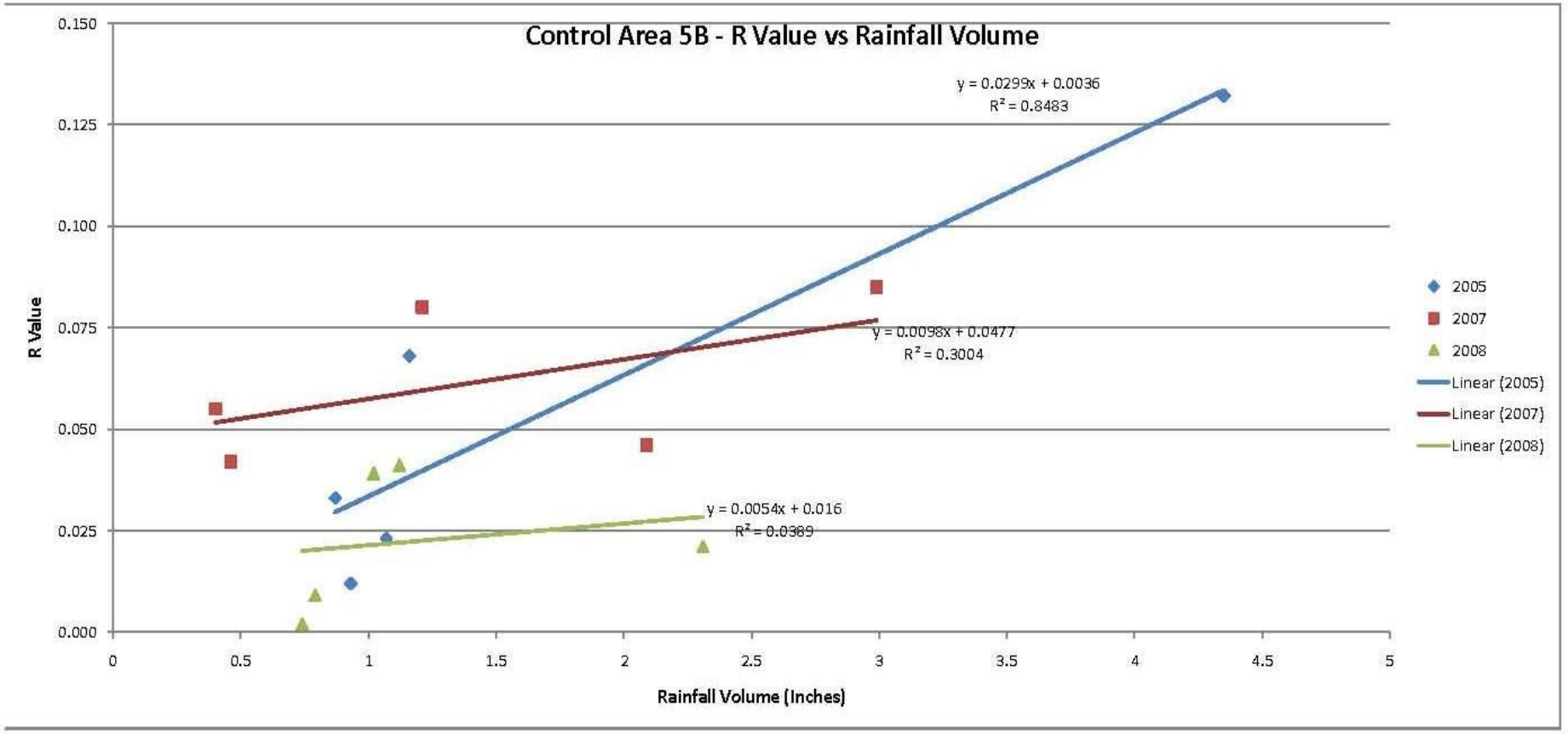
- Re-Meter Rehabilitated Subsystem & Control Area
- Analyze Groundwater Conditions Pre- & Post-Construction
- Evaluate Changes in Control Area
- Perform Regression Analysis



Regression Analysis



Regression Analysis



Extraneous Flow Removed

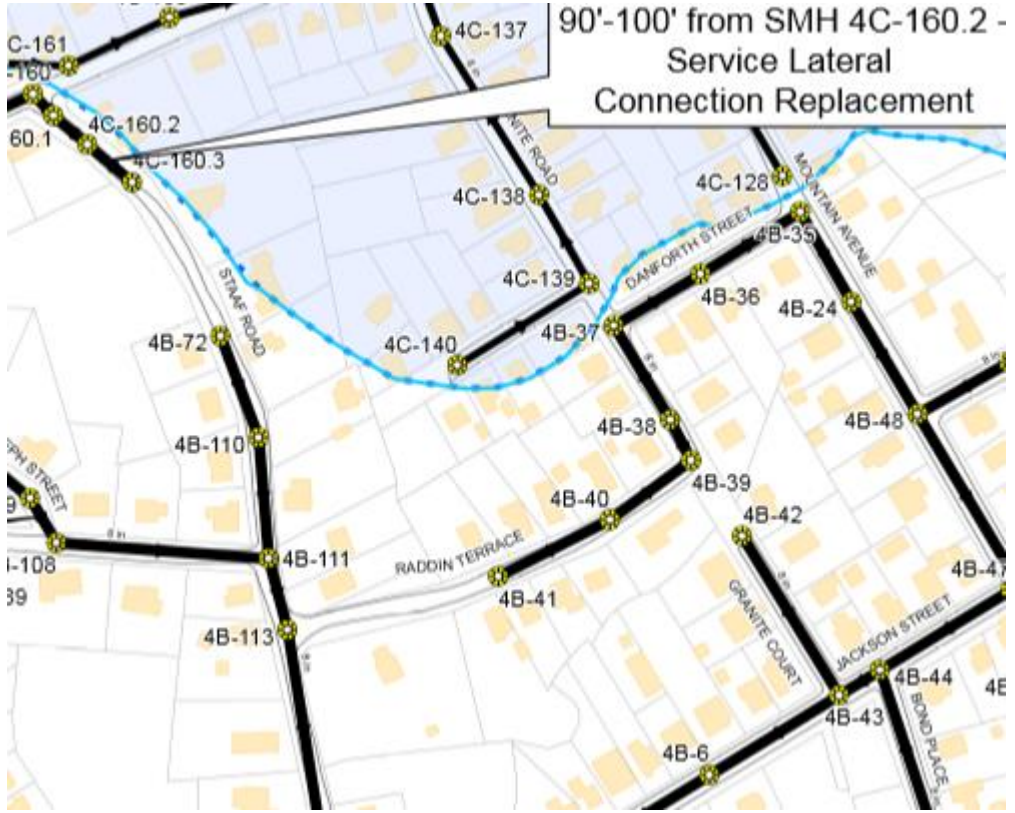
Year	Subsystem	Pre-Construction I/I Volume – 10-Year Storm (million gallons)	Post-Construction I/I Volume – 10-Year Storm (million gallons)	I/I Volume Removed – 10-Year Storm (million gallons)	Percent Removed (%)
2007	4A	2.20	1.10	1.10	50%
2008	5B	2.10	0.69	1.41	67%
2009	PS-5	2.90	1.50	1.40	48%
2010	6A	1.90	0.78	1.12	59%
2011	4C	1.95	0.95	1.00	51%
2012	6B	1.60	0.74	0.86	54%
2013	6	1.70	0.77	0.93	55%
2014	5	3.05	1.40	1.65	54%
2015	4	2.00	0.84	1.16	58%
Total I/I Volume Removed & Average Percent Removal				**10.63**	**55%**

Completed the Recommended Plan!

What Comes Next?

Time for Some Experimentation

- Realized Benefits of Annual SSES and Rehabilitation
- Could Still Apply for SRF Loans
- No Removal Goals/Standards
  - Room for Deviations & Studies



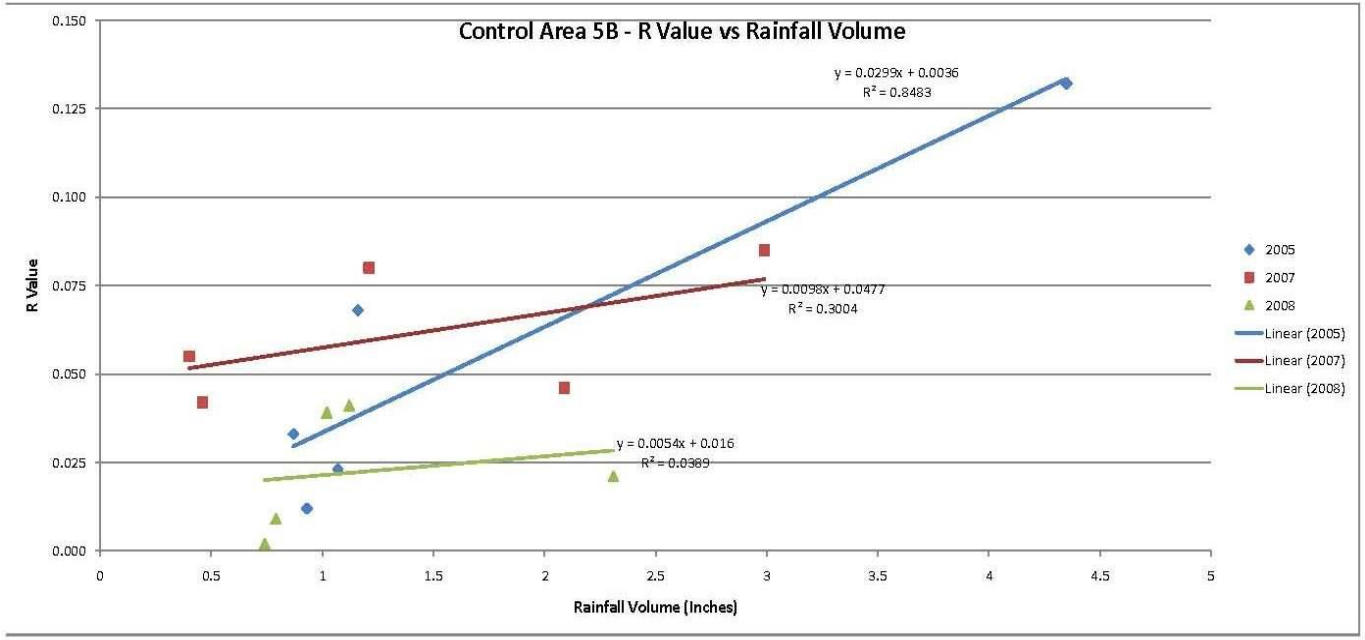
Rehabilitation Sensitivity Analysis

- Determine Effectiveness of Different Rehab Options
- Perform Comprehensive Design – Subsystem 4B
  - Rehabilitate **Only** Mainline Sewers and Manholes - 2018
  - Conduct Post-Construction Flow Metering – Spring 2019
  - Regression Analysis
    - Effectiveness of Sewer CIPP Lining & MH Rehab

Sensitivity Analysis Results – Subsystem 4B

- 23% Reduction of Extraneous Flow
  - Rehabilitation of Mainline Sewers and Manholes
    - 36,000 LF (8”-15”)
    - 265 Manholes
  - No Lateral Sealing/Grouting

Figure 2
Control Sewershed



Service Lateral Connection Lining

- Constructed Spring/Summer 2019
- 684 Laterals Lined
  - Full-Wrap in Main
  - 24-inches up Lateral

Conclusions/Next Steps

- Service Lateral Connection Lining Can More Than Double Infiltration Removal Volumes

  - Estimated 32% Additional Flow Removed

    Mainline CIPP & MH Rehab: 23%
    Service Lateral Lining: 32%
    Average Removal %: 55%

- Post-Construction Regression Analysis in 2020 to Confirm Assumptions

Thank You – Any Questions?

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CDM Smith