



# 4-Step Approach Identifies Cause of Water-In-Basement In Kansas City, Missouri

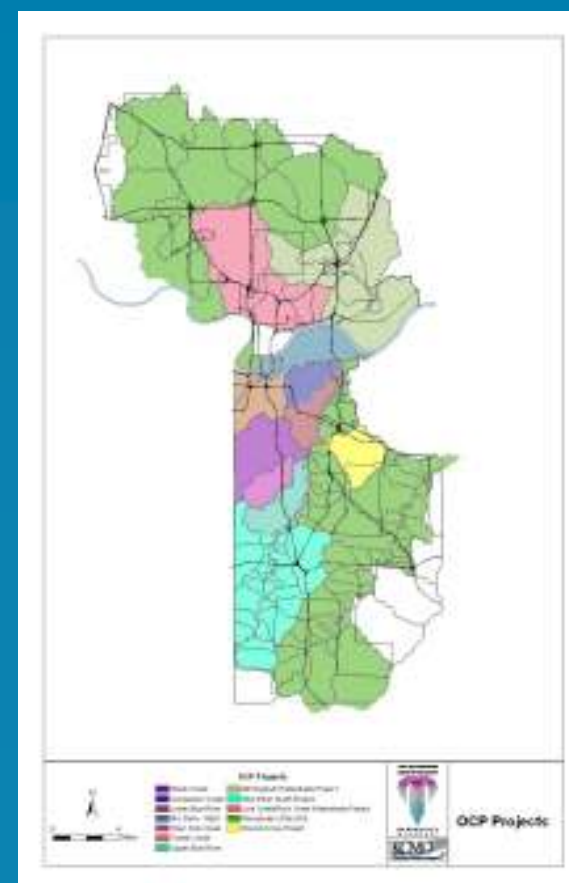
*2008 Conference  
Iowa Water Pollution Control Association*

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George Butler Associates, Inc.



# City-Wide Program

- **GOALS of Kansas City, Missouri Overflow Control Program**
  - Eliminate/Reduce Overflows
  - Eliminate/Reduce Water-In-Basement





# Water-In-Basement

- **Each Basin Consultant to Select its Own Investigation Approach for Eliminating WIB**
- **Some BC's Chose Modeling**
- **GBA Chose 4 – Step Approach**



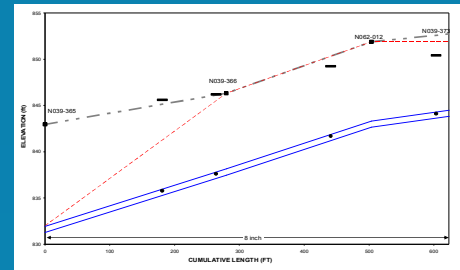
# Purpose

- **Provide information about a 4-Step Approach to Identify the Best Method to Eliminate/Reduce WIB in a Designated Area.**



# 4-Step Approach

- Flow Monitor
- Televis
- Survey and Capacity Analysis
- Select the Best Improvement Method





## Disadvantages of Modeling vs. 4-Step

- **Modeling is Broad Brush**
- **Modeling does Not Consider Condition of Sewers**
- **Modeling Usually does Not Consider Elevation of Basements.**

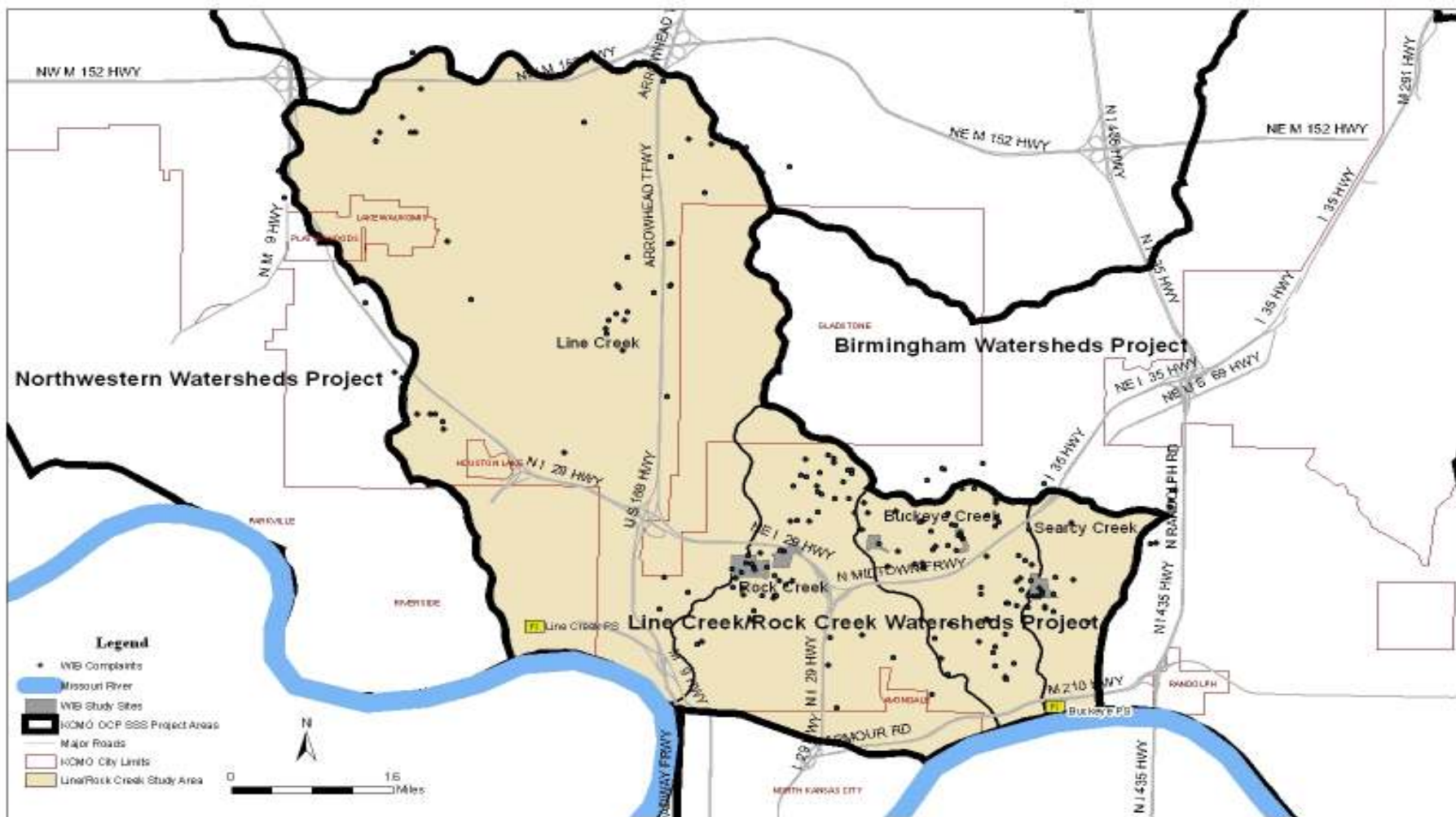


# Selection of Project Sites

- Utilized City GIS and Maintenance Records
- 202 WIB in Watersheds Related to Rain Events
- Targeted Repeat WIB in Concentrated Areas.
- Selected Five Project Sites with 19 Chronic Backups



# Project Sites

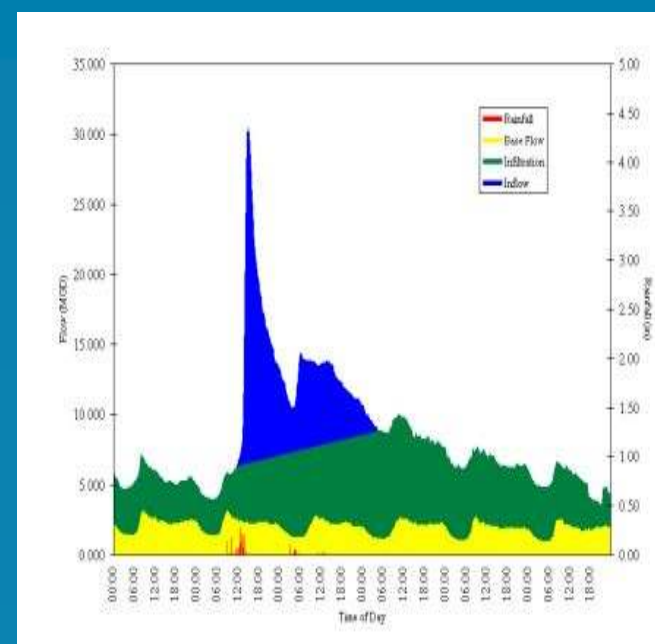






# Flow Monitoring

- 6 Flow Meters Installed
- 84 Days
- Determined Relation of Rainfall to Peak Flows





# T.V. Inspections

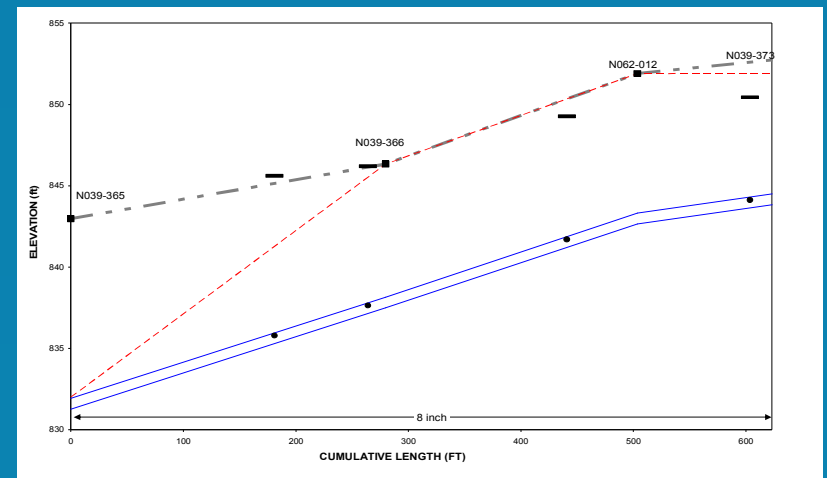
- Roots
- Collapses
- Debris
- Leaks





# Survey and Capacity Analysis

- Manholes and Inverts
- Homes that Backup



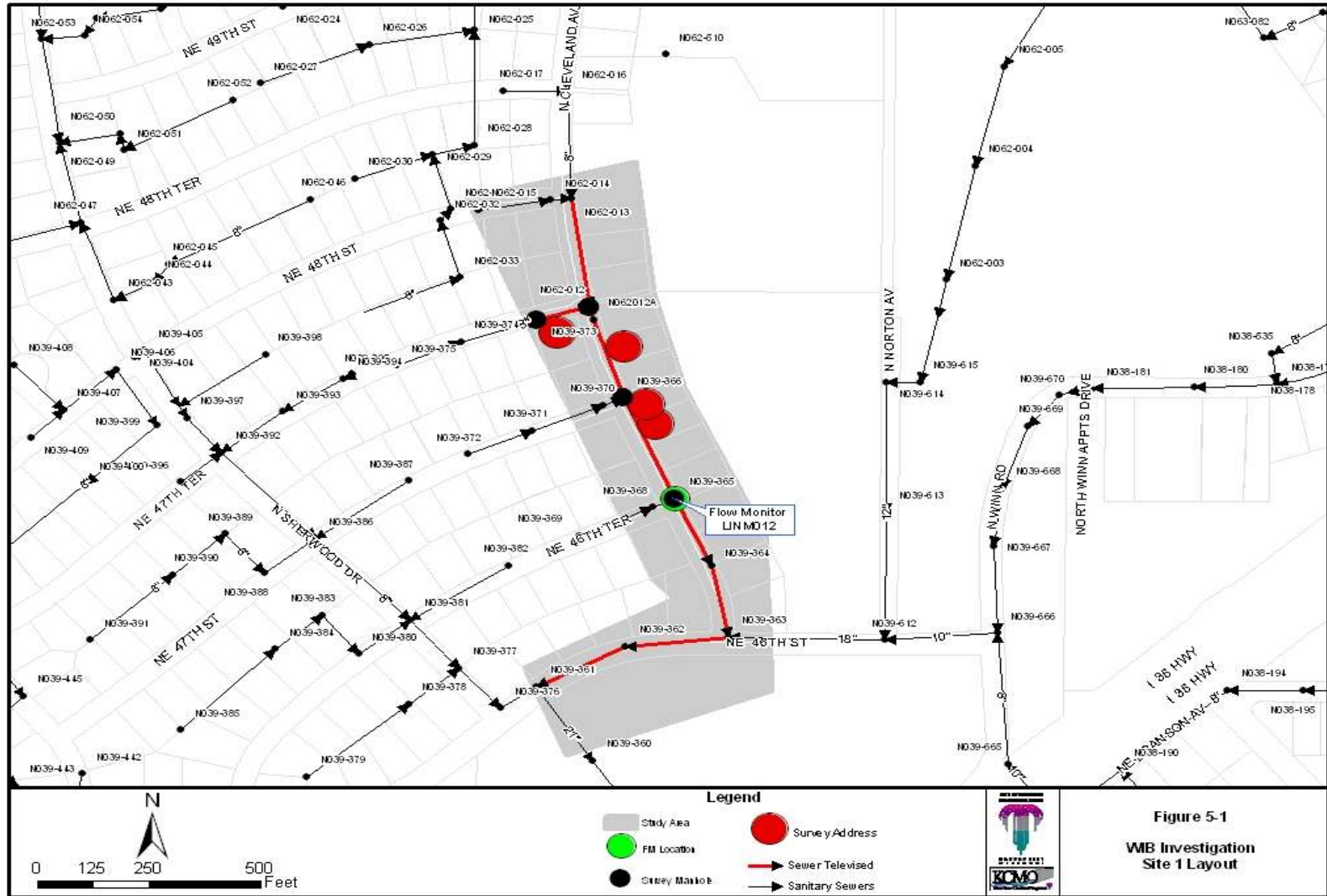


# WIB Cause and Resolution

Problem	Situation	Repair
Basement too Close to Pipe	Less than 1 foot of clearance.	Backflow preventor
Pipe Restrictions	Roots or partial collapse throughout	CIPP
	Major roots occasional	Root cut
	One or two areas partially collapsed	Point repairs
	Excessive debris, grease or sludge	Cleaning
	Sags and excessive flow depths	Replace pipe
Under Capacity	Overloaded lines corrected by CE I/I Removal	I/I removal
	Overloaded lines not corrected by CE I/I Removal	Relief sewers



# Site 1 - Work Description



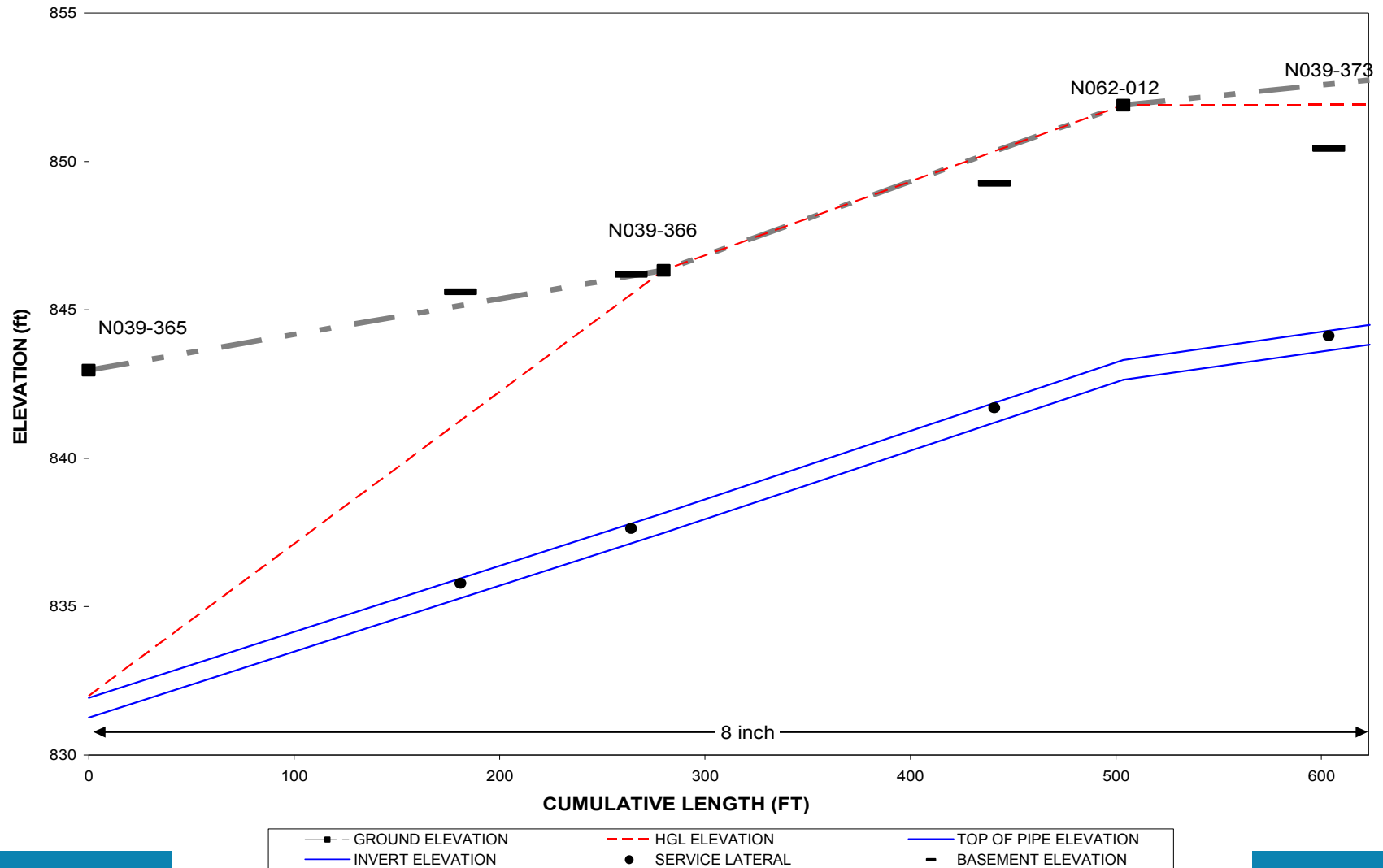


## Site 1 - Summary of Findings

- Excessive I/I
- TV Data:
  - Minor Problems in 8”
  - Major Problems in 18”
- Basement Elevations – No Problems
- Capacity Analysis – 140% Used

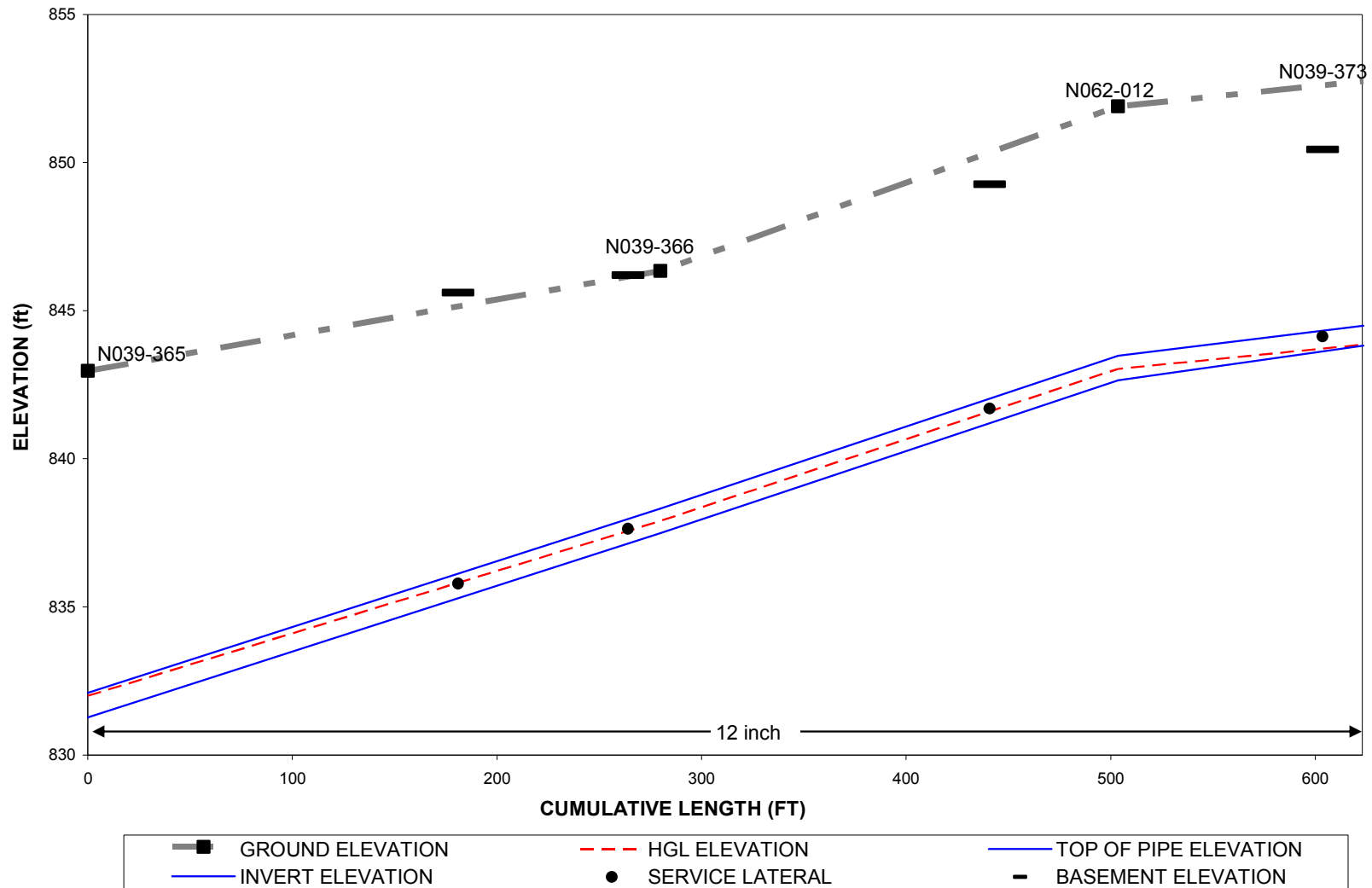


# Site 1 - Capacity Analysis Existing





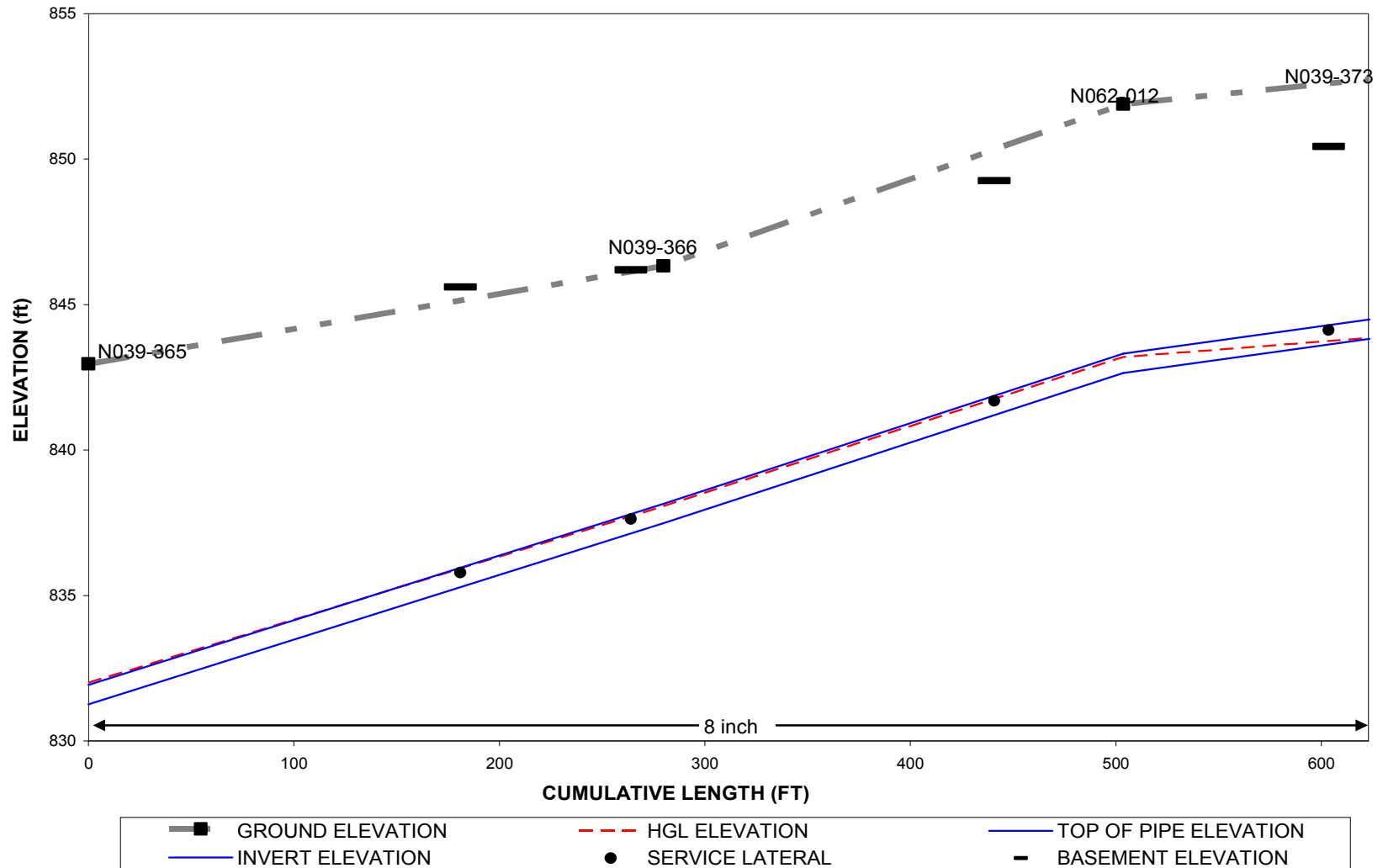
# Site 1 - Capacity Analysis Relief







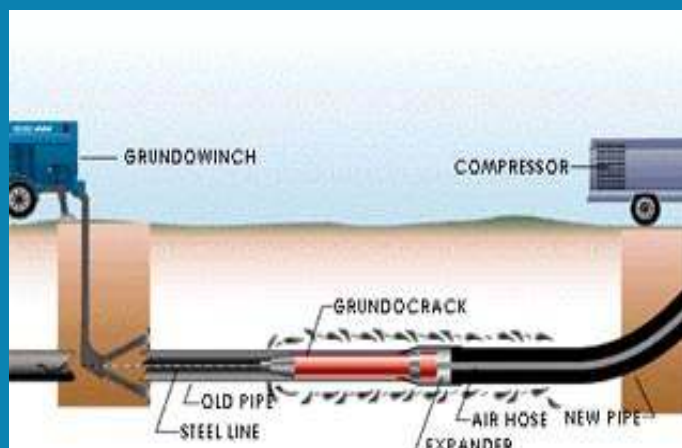
# Site 1 – Capacity Analysis 50% I/I Removal





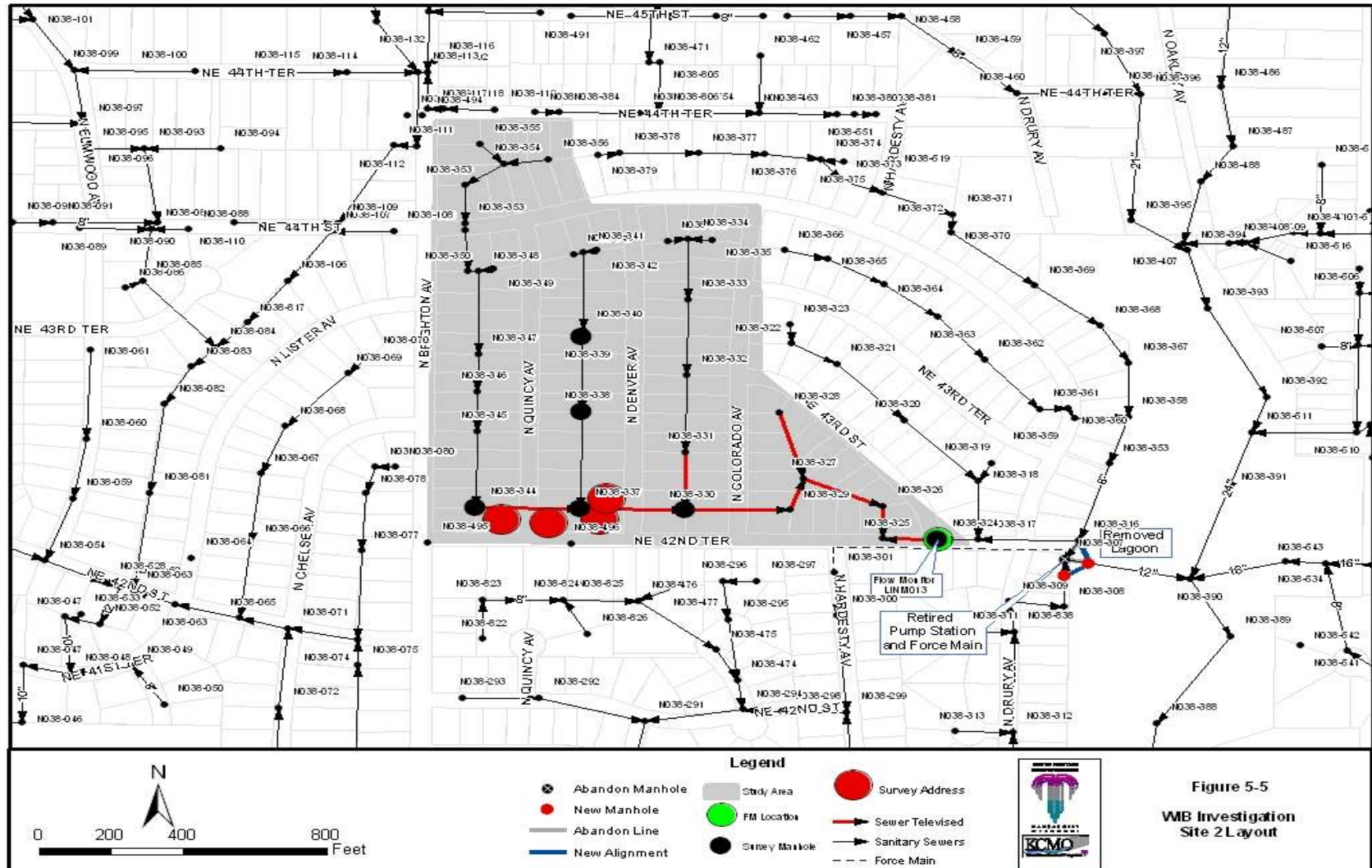
## Site 1 – Best Solution

- Replace 8” with 12” – 1,300 feet
- Or I/I Removal
- CIPP Downstream 18”





# Site 2 - Work Description



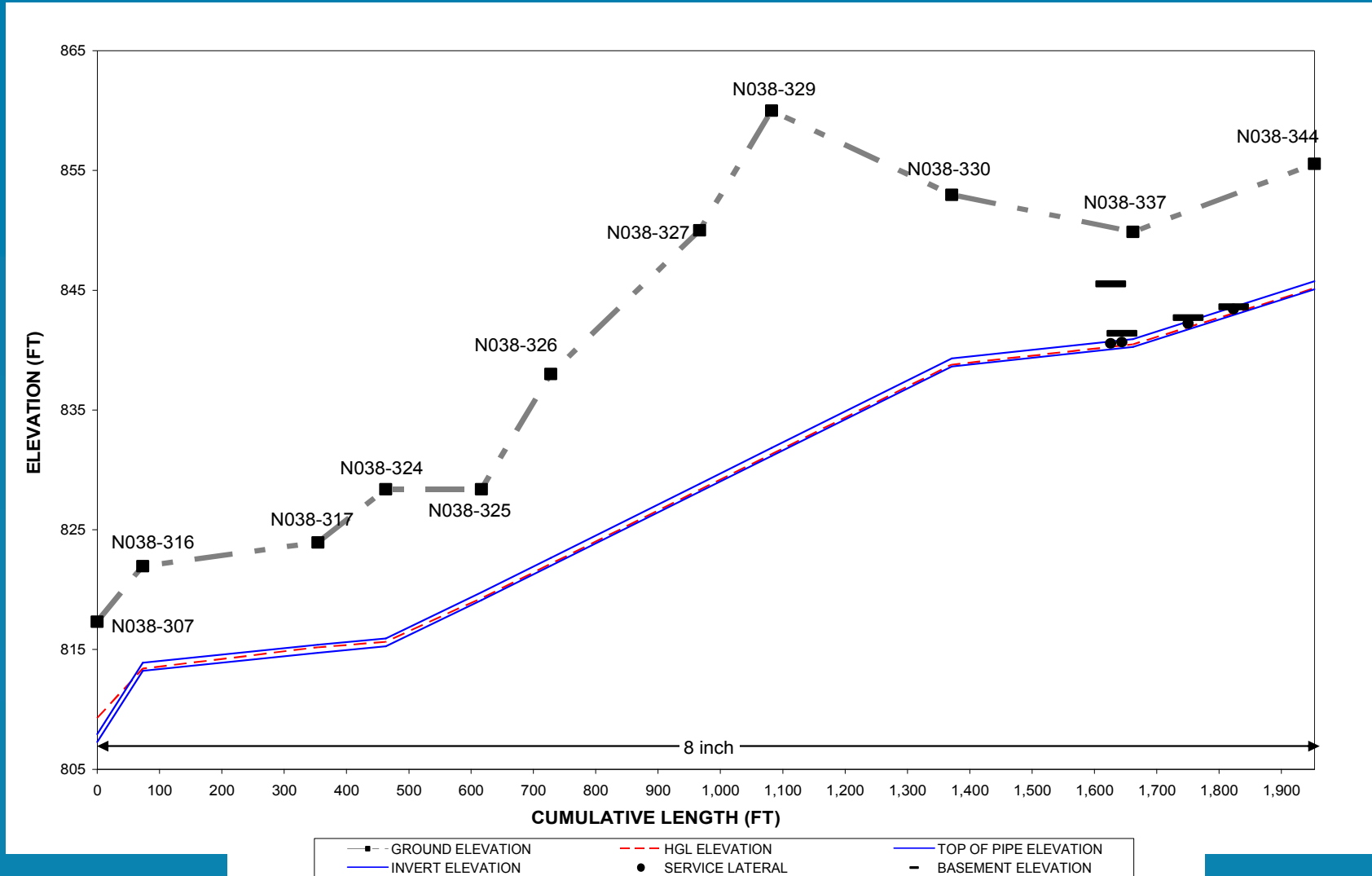


## Site 2 - Summary of Findings

- Excessive to Moderate I/I
- TV Data:
  - Major Problems with 8”
- Basement Elevations – 3 Homes at Problem Elevations
- Capacity Analysis – 60% Used
- Poor Hydraulics at Manhole N038-307

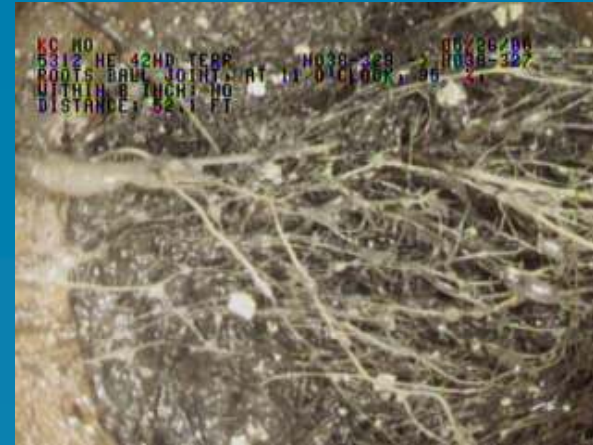


# Site 2 - Capacity Analysis Existing





# Site 2 – Pipe Restrictions





## Site 2 – Manhole Hydraulics





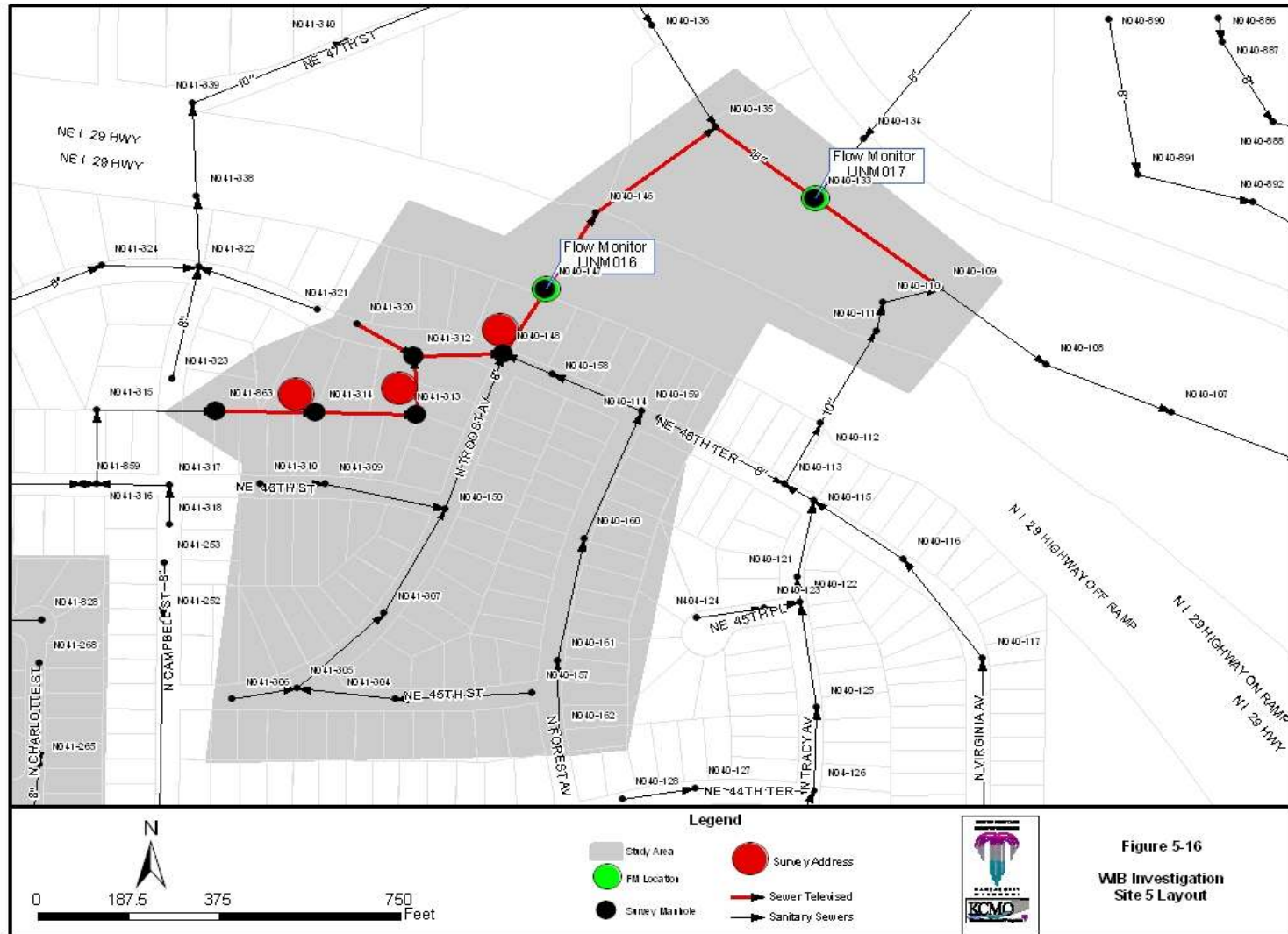
## Site 2 – Best Solution

- **CIPP 8”**
- **Realign Two Line Segments 8” for Better Manhole Hydraulics**
- **3 Backflow Preventors**





# Site 5 - Work Description



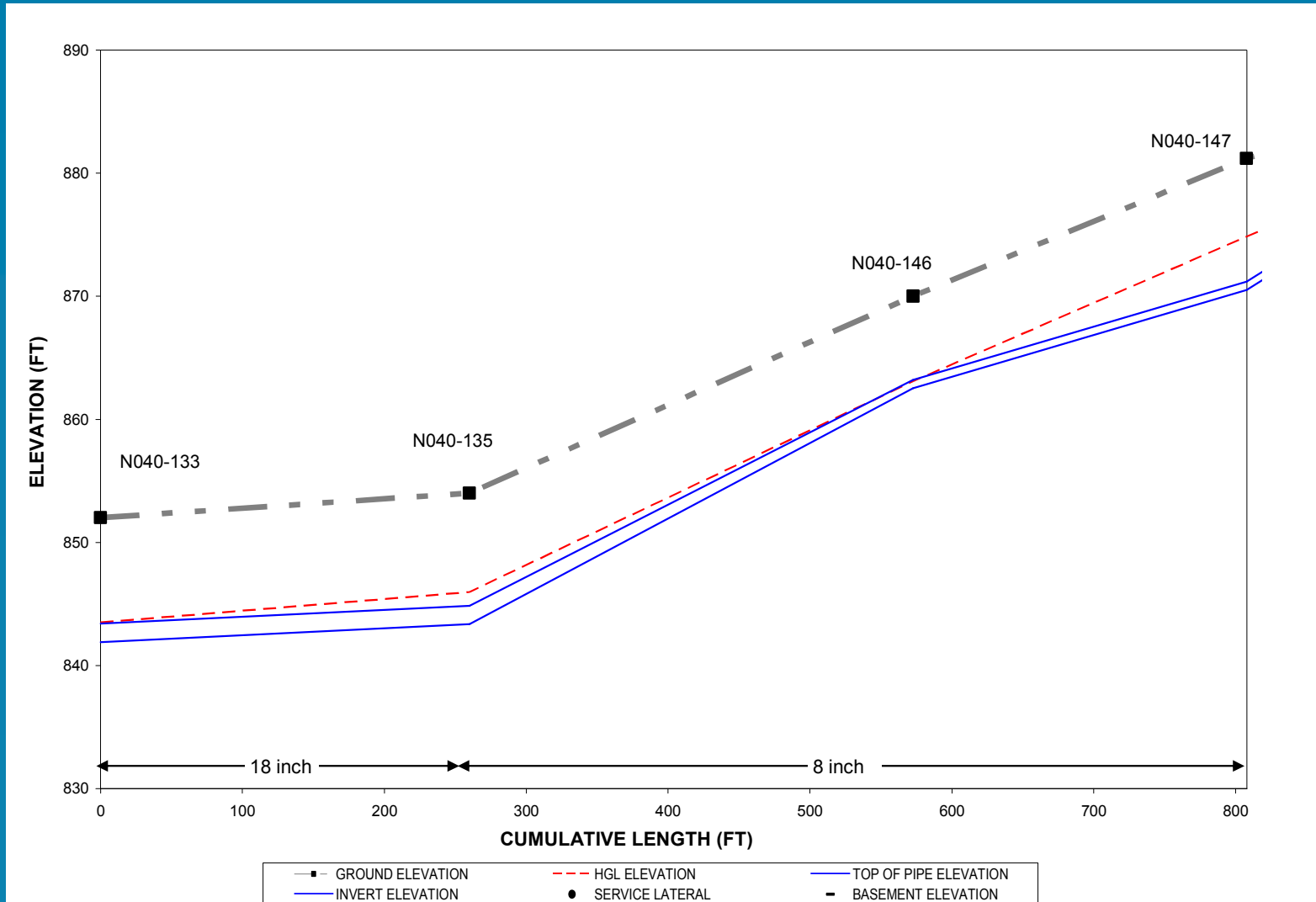


## Site 5 - Summary of Findings

- **Excessive I/I**
- **TV Data:**
  - Major Problems with all sewers
- **Basement Elevations – One Problem**
- **Capacity Analysis – 100% Used**

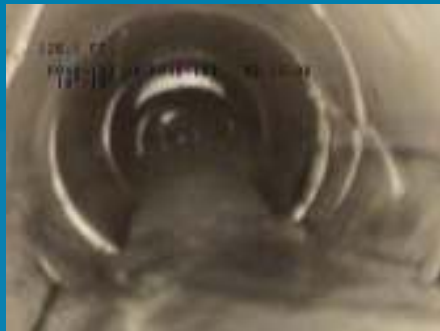


# Site 5 - Capacity Analysis Existing





# Site 5 – Pipe Restrictions





## Site 5 – Best Solution

- **System Renewal**
- **Backflow Prevention Valve (BPV) for One Address**



# Investigation Summary of All Sites

WIB Site #	Excessive I/I	Basements Within 1'	Capacity Analysis	Pipe Restricted	General Solution
1	Yes	0 out of 4	140%	No	Relief or Reduce I/I
2	Yes	3 out of 4	60%	Yes	Rehab
3	Yes	1 out of 5	80%	Yes	Rehab
4	Yes	0 out of 3	150%	Yes	Relief
5	Yes	1 out of 3	100%	Yes	Rehab



# Recommendations

WIB Site #	Sewer Dia. (in)	Repair Length (ft)	Repair	Capital Cost
1	8-18	1,847	Relief Sewers	\$388,000
2	8-12	2,030	CIPP Lining and Sewer Realignment and Three BFP	\$188,000
3	8-10	1,189	CIPP Lining and Sewer Replacement and One BFP	\$145,000
4	8-10	991	Relief Sewers	\$230,000
5	8-18	2,120	CIPP Lining and Sewer Replacement and One BFP	\$365,000
Totals		8,177		\$1,309,000



## **Additional On Site 5**

- **The City Conducted Renewal of Site 5 and other Tributary Sewers**
- **Removed 80% of I/I.**
- **Added Benefit from I/I Removal: Less Stress on System and Treatment.**
- **Total Construction Cost was Approximately \$500,000.**





# Lateral Repair Construction Site 5





# Summary of 4-Step Project

- **Investigation of 5 Sites Determined**
  - 2 Sites - Exceeded Pipe Capacity
  - 4 Sites - Capacity Robbing Restrictions
  - 3 Sites – Basements within a Foot of Top of Pipe
- **Identified Best Repair Method to Eliminate 19 Chronic Backup Locations**
- **Was Conducted Over 7 Months**



## Conclusions for 4-Step

- **Identifies Cause of Known Backup Locations**
- **Determines Best Method of Repair**
- **Improves Service to Customers**



# Limitation of 4 Step

**The Main Limitation is Considering the Big Picture**

- **Fixing Bottlenecks May Contribute to Higher Peaks Downstream**
- **Difficult to Predict How Much I/I will be Removed.**
- **Therefore Difficult to Assess the Impact on Downstream Relief and Treatment Costs**



## How Does 4-Step Fit In

- **Use Model for Big Picture**
- **Use 4-Step to Solve Backups in Isolated Areas**
- **Use 4-Step in Areas Not Designated for Nashville Approach**



# Acknowledgements

- **City of Kansas City, Missouri - Water Services Department**
- **City's Overflow Control Program**
- **HNTB Corporation**



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# Questions

