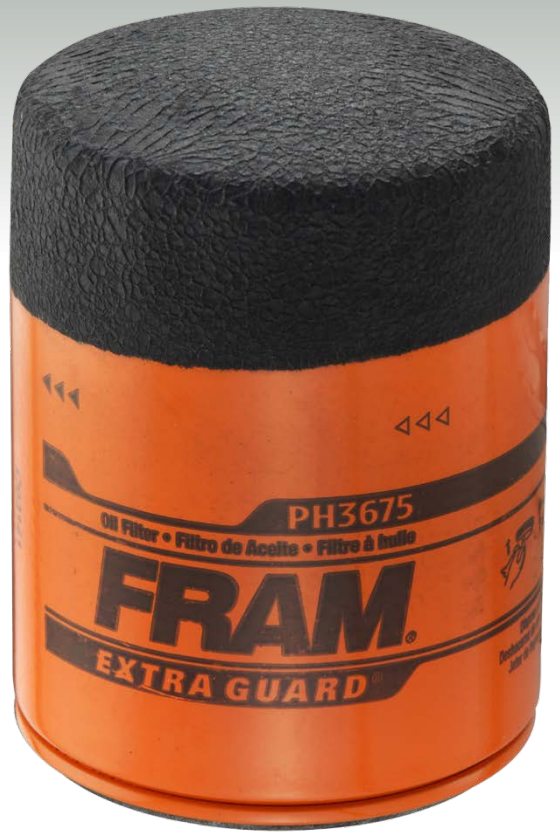
Asset Management: An I/I Case Study

How the City of Waynesboro Reduced I/I and Increased System Efficiencies

Waynesboro VIRGINIA

THOMPSON & LITTON

Asset Management 101 – What Is Asset Management?



Asset Management 101 – What is Asset Management?

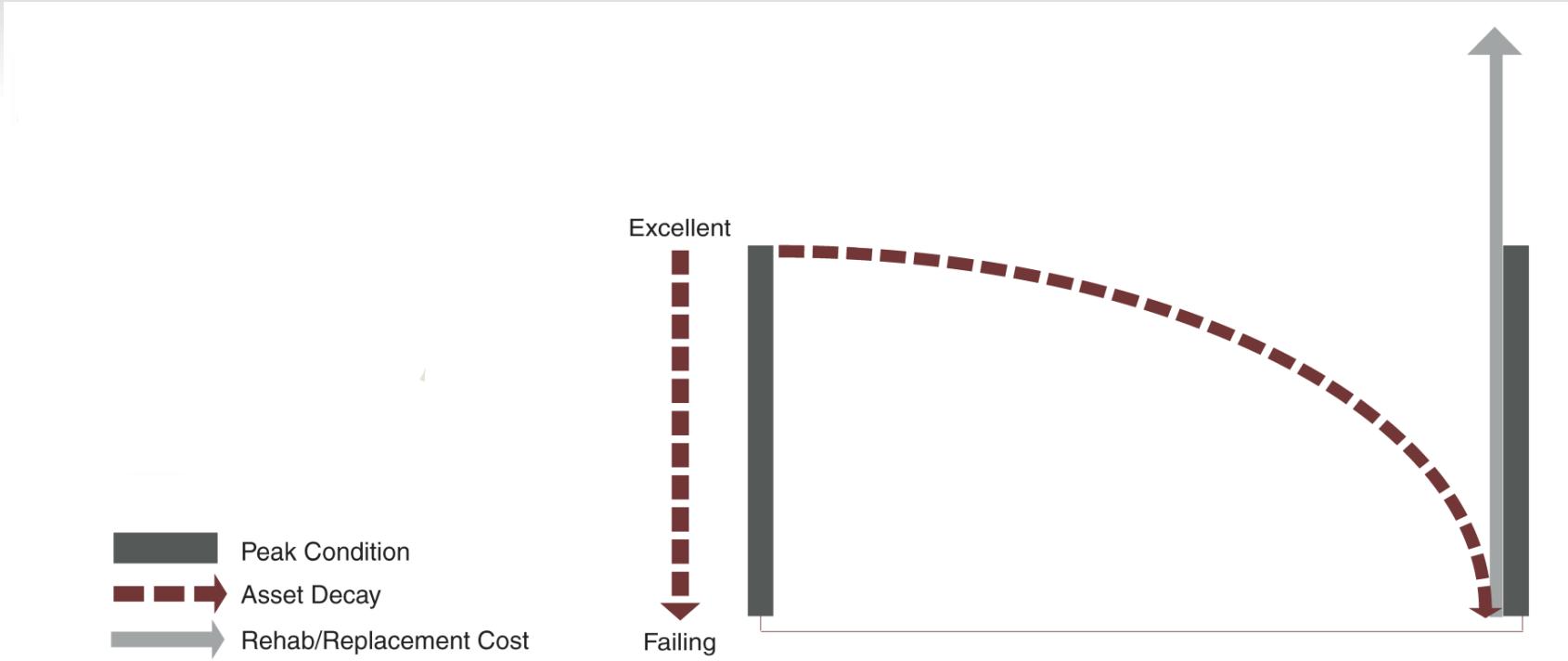
"Asset management can be defined as managing infrastructure capital assets to minimize the total cost of owning and operating them, while delivering the service levels customer desire."

"Lacking adequate focus on O&M, many collection system utilities have slipped into a reactive mode, with most of the operational resources allocated to emergency response and rehabilitation or replacement of failed components."

(EPA Fact Sheet : Asset Management for Sewer Collection Systems)

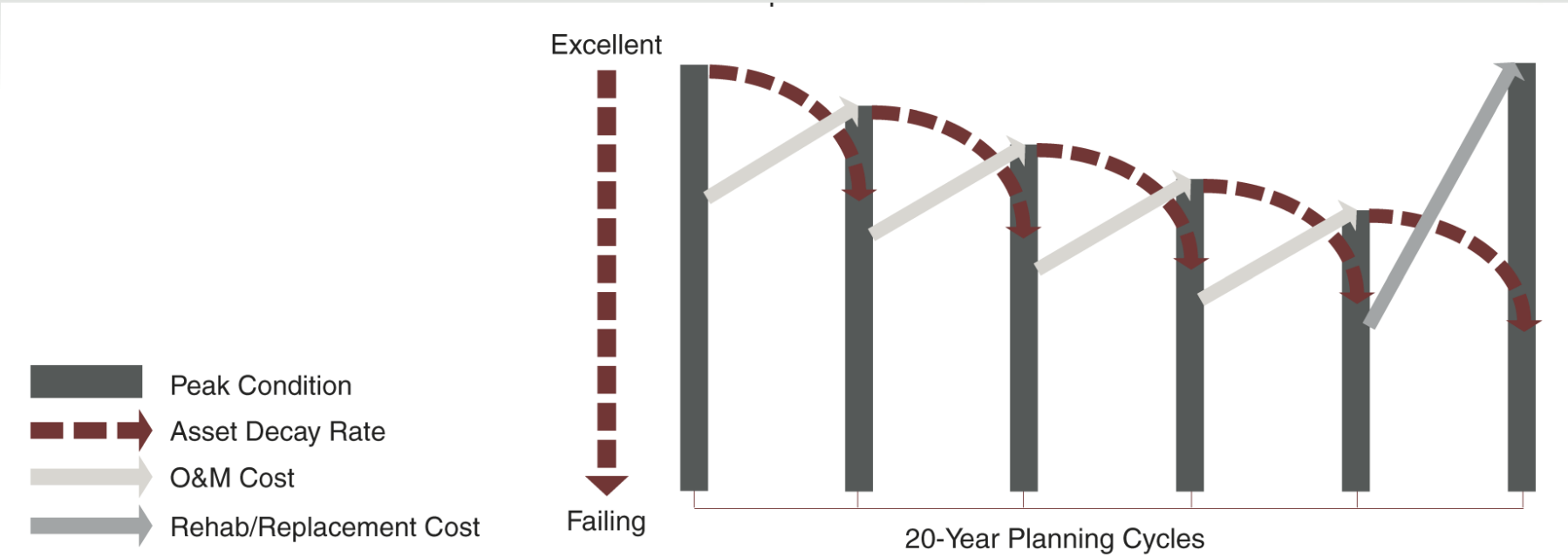
While back at the ranch . . .

- Sewers continue to age
- Defects are worsening
- The problems of next year and decade are developing
- Run-to-Failure Management Model : Sewer system assets that are not regularly maintained usually deteriorate faster than expected and lead to higher replacement and emergency response cost



Asset Management Model

- Components are regularly maintained over long planning cycles and finally replaced when deterioration outweighs the benefit of further maintenance
- Costs are well-distributed over the life of the asset



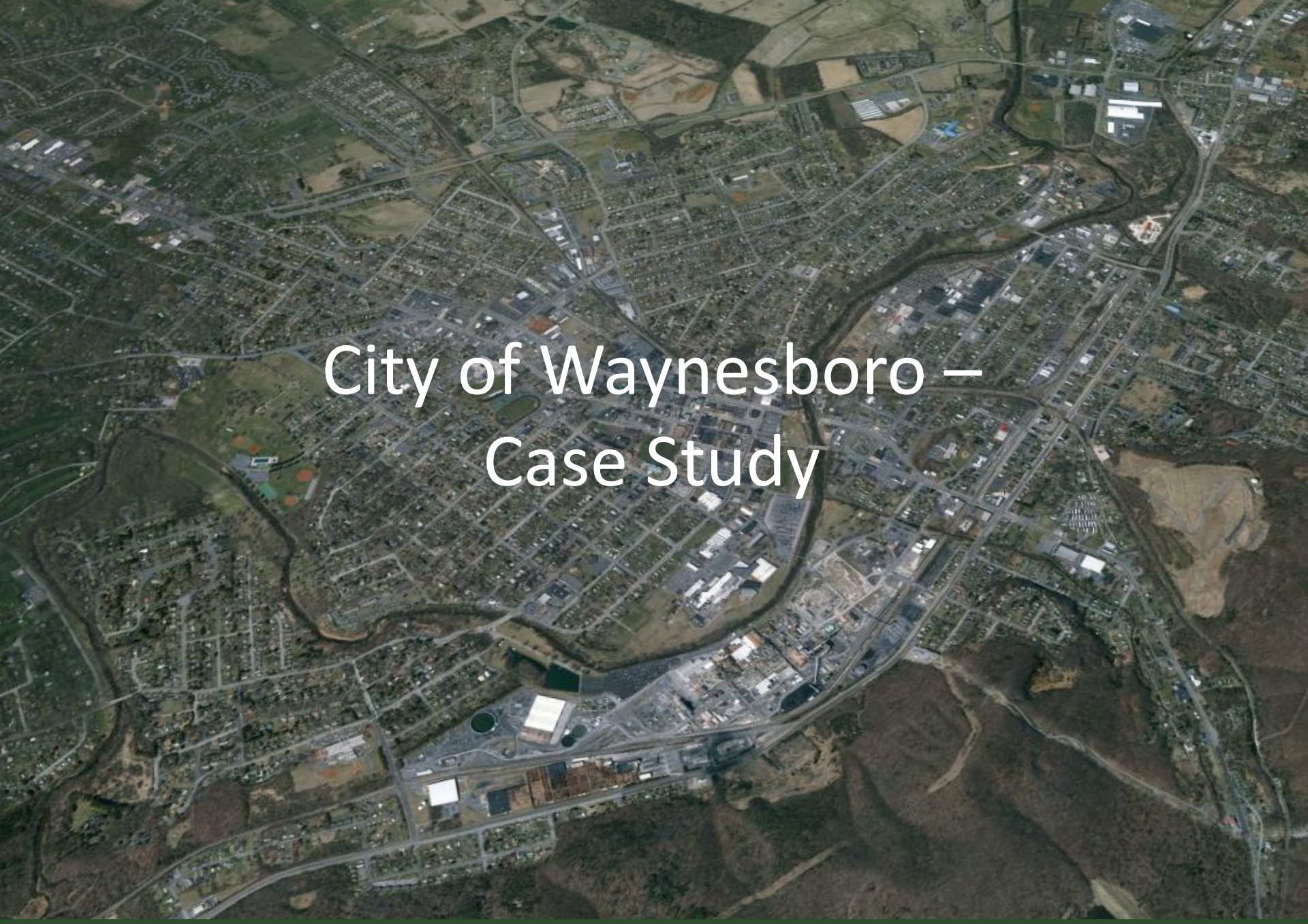
Key Elements of Asset Management

- Level of service definition
- Selection of performance goals
- Information system (basic requirements)
- Asset identification and valuation
- Failure impact evaluation and risk management
- Condition assessment ➡
- Rehabilitation and replacement planning ➡
- Maintenance analysis and planning
- Financial management
- Continuous improvement

Asset Management 101 – What is Asset Management?

- We can't afford that!!!
- "Is Doing Nothing *Really* Cost Effective?!"
- Typical vs. Proactive

"The value of a sewer system is its ability to provide service for the longest time possible for the least cost."



City of Waynesboro – Case Study

City of Waynesboro System Overview

- Designed to treat an average daily flow of 4 MGD
- 8 Sewer Pump Stations
- Approximately 120 miles of sanitary sewer mains
- Approximately 2800 man holes

System Performance Prior to Initiation of I/I Program

- Numerous bottlenecks within the overall system
- Sump pump and roof drain tie-ins to the system
- City was experiencing excessive I/I and WWTP bypasses
- During normal rain events multiple backups and overflows would be experienced
- WWTP was exceeding over 14 MGD during peak flows
- Repeated Notice of Violations issued to the City

VDEQ Consent Order Issued

- VDEQ Consent Order issued October 19, 1999

- Consent Order Requirements
  - Reduce I&I within the system
  - Construct a wastewater treatment plant capable of treating wet weather flows
  - Conduct flow testing after implementation of improvements to measure effectiveness
  - Collect wet weather flow data to utilize in WWTP design

- Consent Order has been amended/extended three times (2004, 2009, and 2014)

Work Completed Under the 1999 and 2004 Consent Orders

- Completed a Pilot Study to Determine BMPs
  - Roof drains and sump pumps removed from the system
  - Lining of mains within the Pilot Study project area
  - Detailed flow data was collected pre and post repairs
  - Plastic inserts were inserted at each manhole to reduce groundwater inflow

- Initiated I/I Implementation Plan in conjunction with other system upgrades
  - Completed 9 of the projects identified in the Implementation Plan
  - Completed a model of the entire system
  - Completed construction of a new 6 MGD WWTP (addressed nutrient loading in addition to wet weather flow issues)
  - Upgraded two pump stations and associated force mains within the system to remove bottle necks
  - Development of infrastructure data layers for the City's GIS/CAD mapping system

1999 and 2004 Consent Order Outcomes

- Total Dollars Invested
  - Pilot Study - $5.1 Million
  - I/I Implementation Projects (9 total) - $5.3 Million
  - Construction of 6 MGD WWTP - $34.0 million (Nutrient and I/I Removal)
  - Construction of Pump Stations and Force Main - $2.4 Million
  - Total Investment = $46.8 Million ➡

- City realized a significant reduction in I/I
  - Gate Regulation = WWTP Bypass
  - In 1998 the City received 43 inches in rain resulting in WWTP gate regulation of 788 hours
  - In 2003 the City received 72 inches in rain resulting in WWTP gate regulation of 380 hours

29 ADDITIONAL INCHES OF RAIN AND 408 LESS HOURS OF GATE REGULATION

Work Completed Under the 2009 Consent Order

- Updated sewer system model to account for previous I/I work completed

- Conducted system flow monitoring over a 7-month period
  - Average Base Flow at WWTP is 2.66 MGD
  - Average Wet Weather Flow at WWTP of 3.49 MGD with 0.83 attributed to I/I
  - Peak Flow at WWTP of 5.70 with 3.04 MGD attributed to I/I

- Developed the Wastewater CIP I/I Improvements Study
  - Evaluated overall system to account for completed projects and updated flow information
  - Identified and prioritized 19 projects to assist the City with I/I issues
  - Provided detailed costs and 5-Year Plan for the identified projects

- Have completed construction of 6 projects identified in the CIP with 2 projects in construction and 2 in the design phase (as of October, 2014)

2009 Consent Order Outcomes (as of October, 2014)

- Sewer System Improvements Completed (Includes 2 projects currently in construction)
  - Total line replaced = 20,085 L.F.
  - Total line rehabilitated = 28,295 L.F.
  - Total manholes replaced = 93
  - Total manholes rehabilitated = 135
  - Total cost for above improvements = $2.6 Million ➡
- Interim CIP and Plan Assessment Findings (Accounts for first 4 projects)
  - Total I/I removed from system = 618,000 GPD
  - Annual cost per 1000 gallons of I/I removed = $0.81
  - Annual City cost to treat 1000 gallons = $1.49

SAVINGS REALIZED PER 1000 GALLONS REMOVED = $0.68

Closing Out the 2009 Consent Order (as of October, 2014)

- City is completing the final 4 projects of the current 5-Year Plan
- Upon completion the City will submit a final Assessment to VDEQ for approval and will develop next 5-Year Wastewater Capital Improvements Plan
- Transition to Sewer Maintenance Plan (Asset Management) or Continue with I/I Implementation Plan

Lessons Learned from the Battle Front

- There must be organizational change to be successful (Proactive vs. Reactive)
- Metrics have to be in line with the plan (qualitative vs. quantitative)
- System Rates must be sustainable
- Shift the decisions into the hands of the decision makers
- Consent Order – Is it really all that bad?
- Develop a plan/schedule and stick to it
- Continual assessment, revaluation and plan updates are necessary
- Consent order began to cover the City's sewer maintenance plan

Brian McReynolds, PE
Director of Public Works
City of Waynesboro

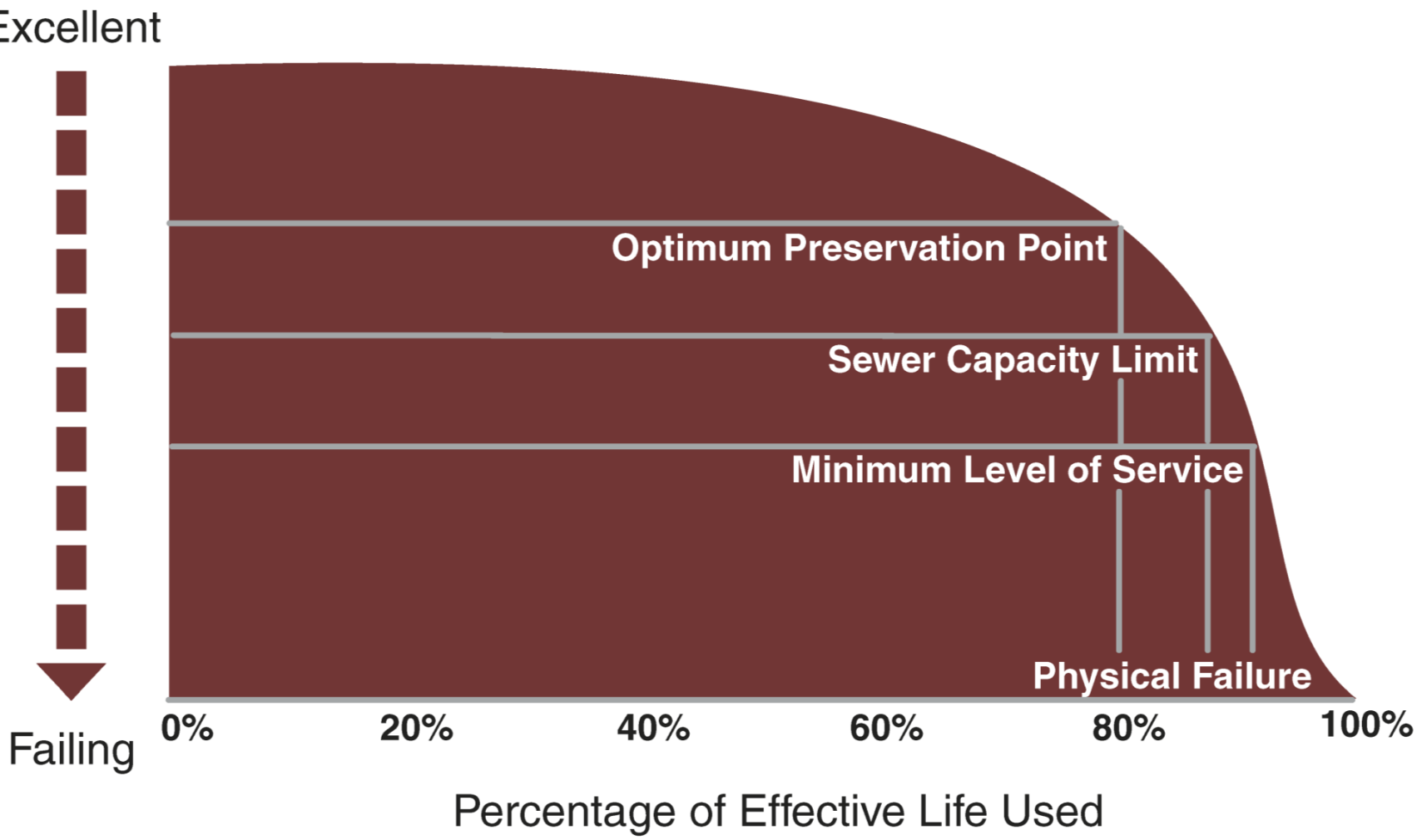
Discussion

All Slides After This One Are Linked To, From Slides Within Presentation

Simple Grading System

Grade	Condition	Description
0	Abandoned	No longer in service
1	Very Good	Operable and well-maintained
2	Good	Superficial wear and tear
3	Fair	Significant wear and tear; minor deficiencies
4	Poor	Major deficiencies
5	Very Poor	Obsolete, not serviceable

Rehabilitation and Replacement Planning

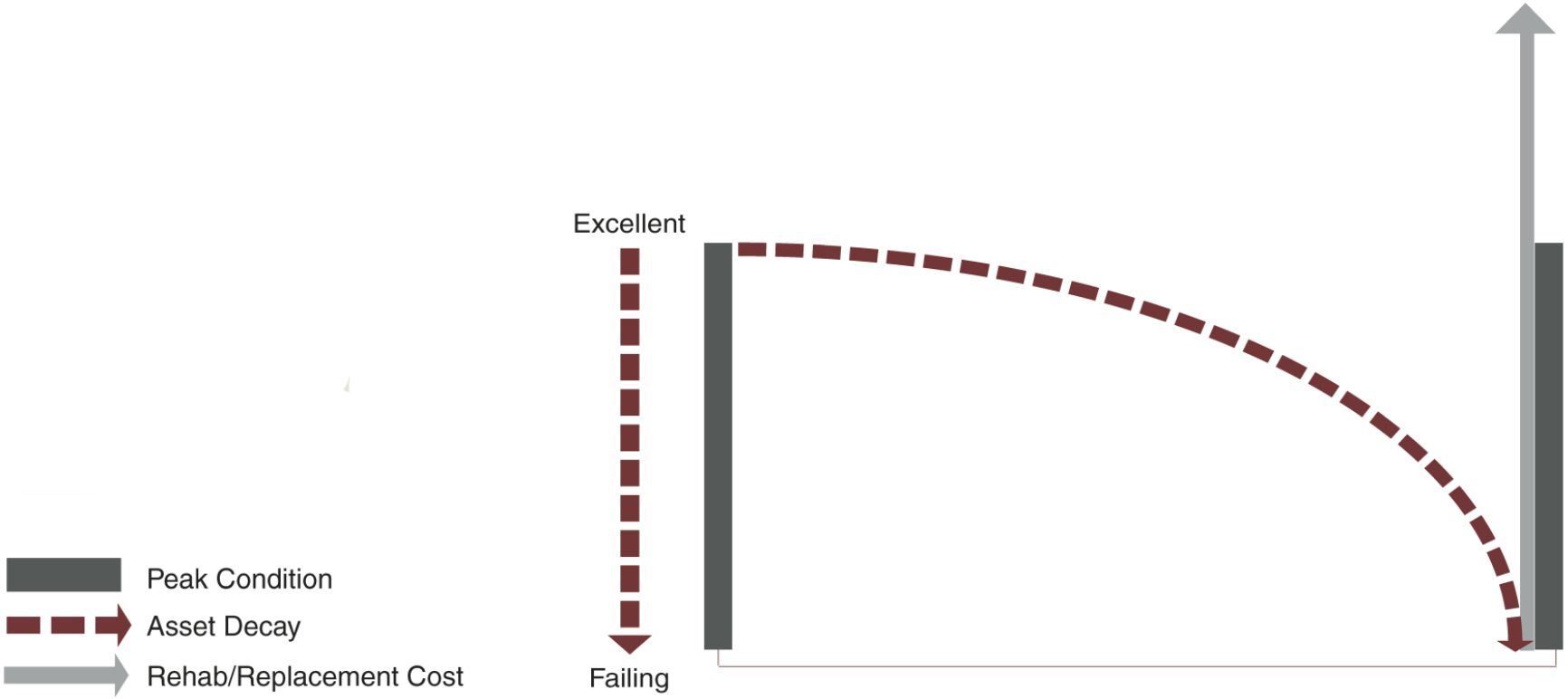


Budget / Planning Cost (Order of Magnitude) : CCTV, CIPP & Manhole Rehabilitation

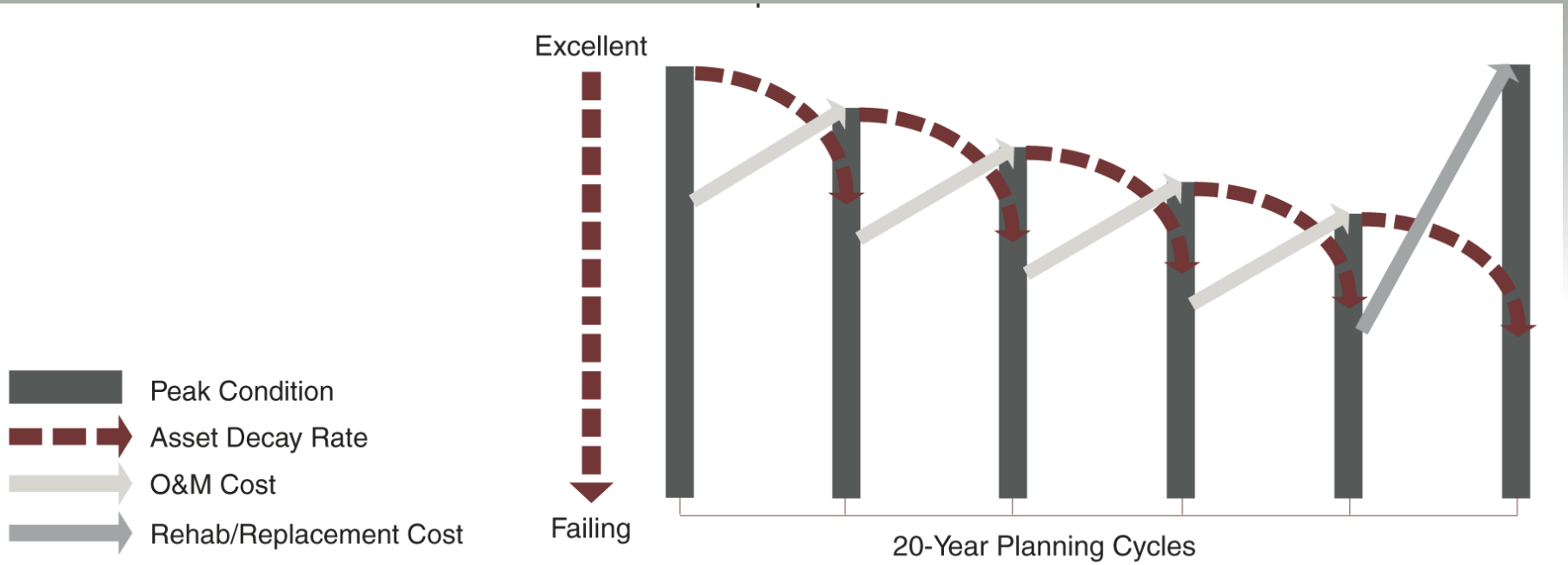
Item	Quantity	Estimated Cost
CCTV, to include, cleaning, by-pass pumping and residential traffic control.	5,000 LF	$20,000
CIPP (sewer mains 6 -10" diameter), to include, cleaning, by-pass pumping, residential traffic control and pre / post CCTV.	1,500 LF	$50,000
Manhole Rehabilitation (4' diameter, 6 vertical feet), to include, cleaning, cementitious lining and residential traffic control.	1 MH	$2,000

Smoke Test Result Examples

Run-to-Failure Management Model



Asset Management Model



All Slides After This One Are Parked, In Case They Are Needed During Q&A

Infiltration/Inflow

Infiltration

Groundwater that infiltrates a sewer system through defective pipes, pipe joints, connections or manholes. Infiltration is generally measured during seasonally high ground water conditions, during a dry period.

Causes of infiltration:

- Poor soil conditions in which sewer lines are constructed
- Poor materials, construction and workmanship
- Excessive groundwater levels
- Precipitation and percolation of surface waters
- Water retained in the surrounding soils
- Poor condition of pipes, joints, and connecting sewer structures

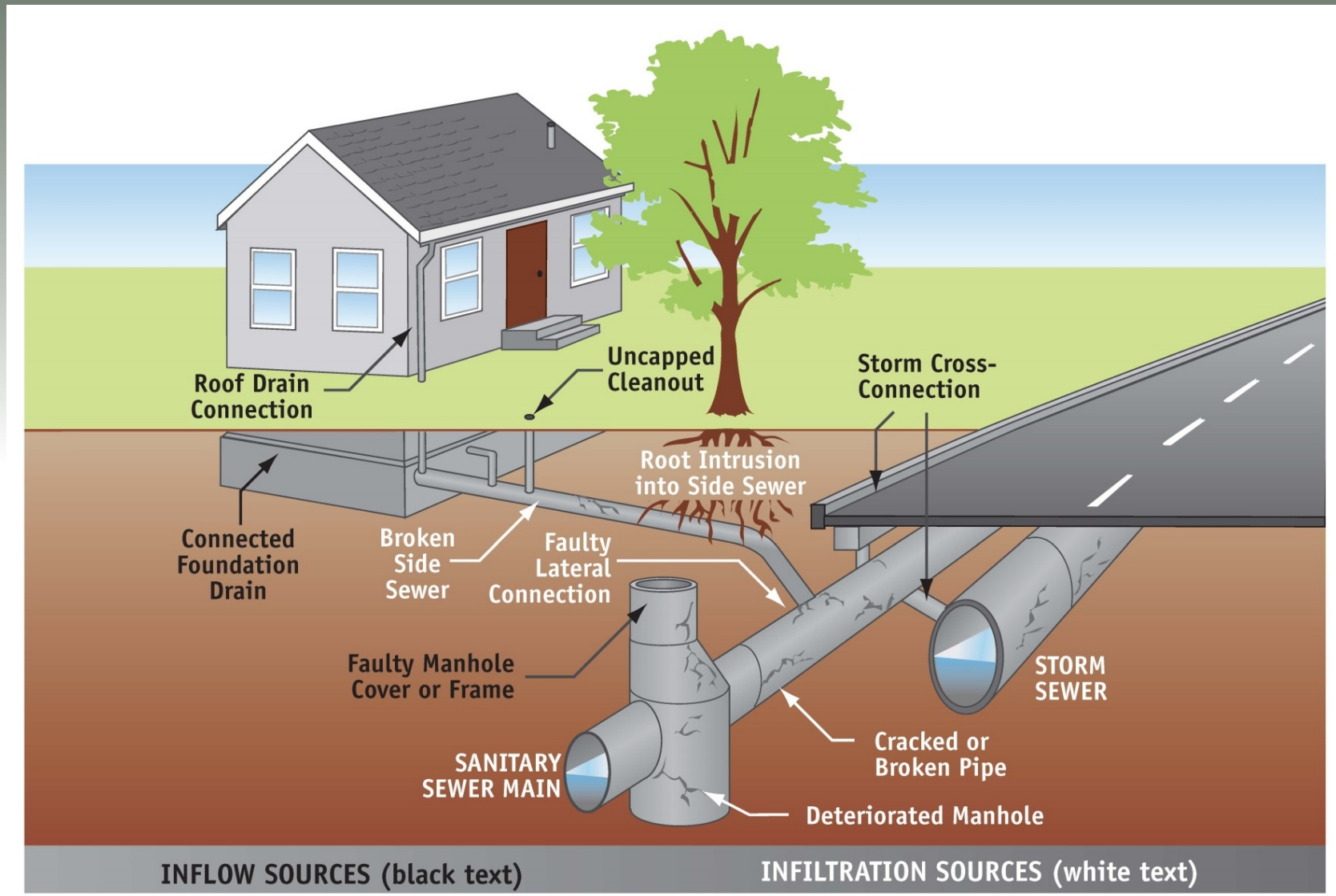
Inflow

Water other than sanitary flow that enters a sewer system from sources which include, but are not limited to, roof leaders, cellar drains, yard drains, area drains, drains from wet areas, cross connections between storm sewers and sanitary sewers, catch basins, cooling towers, stormwater, surface runoff (including leaking manhole covers), street wash-water or drainage. Inflow is generally measured during wet weather.

Causes of inflow:

- Deliberate or poorly planned connections of stormwater or other drainage water into sewer systems
- Draining of swamps, wetlands, or low-lying or flooded areas into collection systems through connections or leaky manhole covers

I/I: What is It?


Roof Drain Connection
Uncapped Cleanout
Storm Cross-Connection
Root Intrusion into Side Sewer
Connected Foundation Drain
Broken Side Sewer
Faulty Lateral Connection
Faulty Manhole Cover or Frame
STORM SEWER
Cracked or Broken Pipe
SANITARY SEWER MAIN
Deteriorated Manhole
INFLOW SOURCES (black text)
INFILTRATION SOURCES (white text)

I/I: Why Be Concerned?

- I/I **decreases the efficiency and capacity** of wastewater collection and treatment systems, which can impact potential for growth
- I/I can **increase the need for the construction** of relief sewer facilities
- I/I **contributes to the hydraulic overloading** of treatment processes, which can **affect public health and the community's compliance** with state and federal water quality standards
- I/I can **cause flooding of sewers** into streets and private properties
- I/I can **increase collection system and treatment facility operating costs** for example, adding to necessary run time for pumps and pump stations and costs for energy, maintenance and repairs

I/I: Signs of Trouble

- Greater than anticipated flows measured at WWTP
- Hydraulic overloading of WWTP indicated by “washout” or “loss of solids”
- Sewer system overflows or bypasses
- Basement floodings after rainfall events
- Lift / pump station overflows
- Excessive power costs for lift / pump stations
- Overtaxing of lift / pump stations, perhaps resulting in frequent motor replacements
- Excessive treatment costs
- Water quality problems in the community that could be associated with raw wastewater discharge
- Surcharging of manholes resulting in a loss of pipe capacity
- Overburden through defective pipe joints
- Complaints of odors
- Pipe corrosion
- Settlement, structural failure, or eventual collapse of pipe

I/I: Gather Basic Information

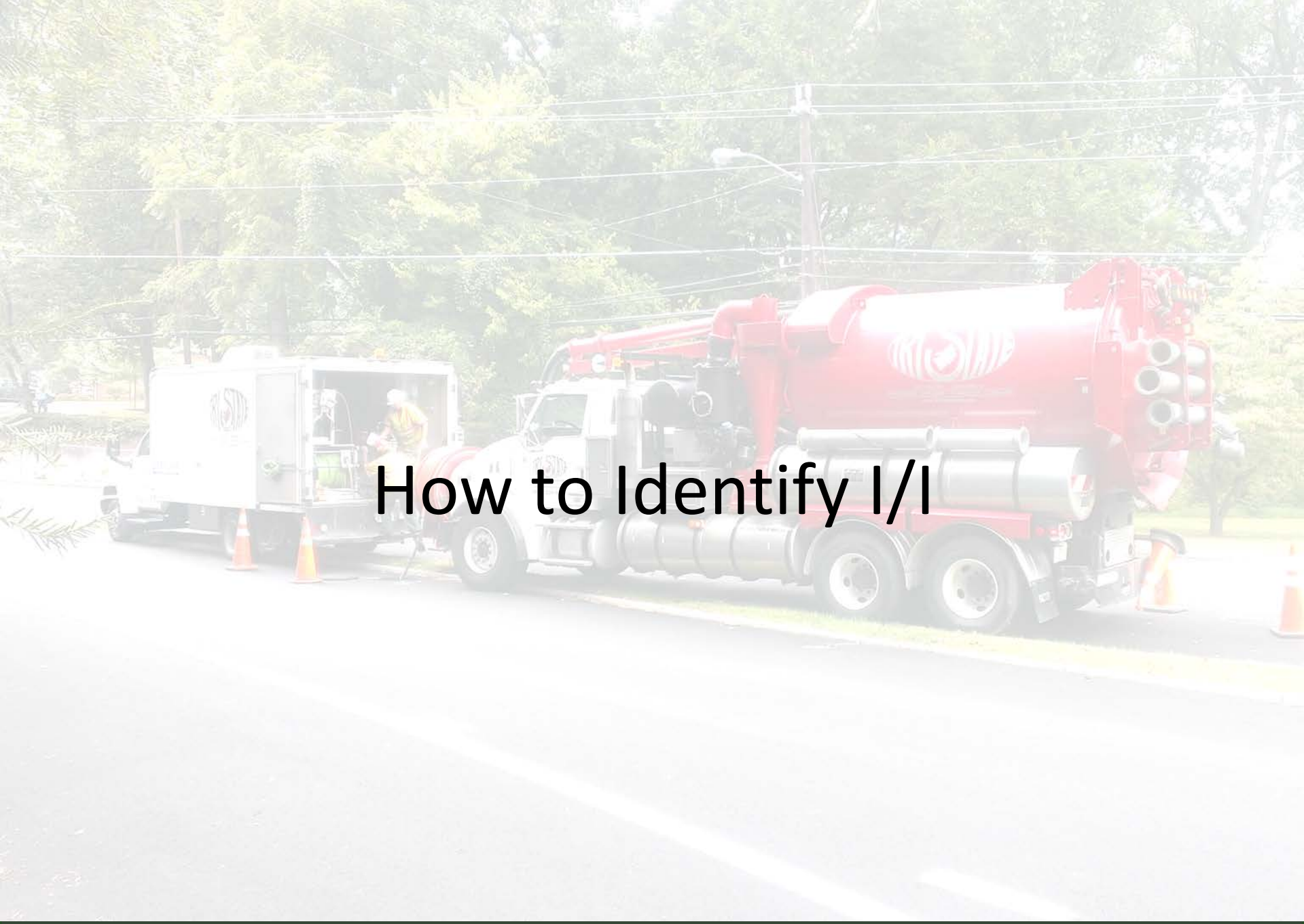
- Interviews
- Determine the Base Flow
  - Local water use
  - Population information
- DEQ Guidance – Excessive I/I
  - High ground water > 125 gpcd (14 day average)
  - Total daily flow during a precipitation event > 275 gpcd
- Analyze and update records
  - Maintain current and complete sewer maps --- VERIFY!!!!
  - Maintenance records
- Identify Likely Problem Areas

I/I: Rehabilitation Options

- Excavation & Replacement
- Chemical or Cement Grouting
- Linings & Insertions
- Coatings
- Cleaning & Root Control

I/I: Field Inspections

- Visual Inspections – WALK THE SYSTEM!!
- Timing – Inspect for infiltration during periods of high groundwater
- Flow Monitoring – WWTP flow, pump station flow / run times, install flow meters
- Smoke Tests – Common, simple and inexpensive method for detecting improper sewer connections and other possible sources of inflow ➡
- Dye Tests – Useful for locating sources of inflow from storm sewers or private properties
- Closed Circuit Television (CCTV) – Most effect method of pinpointing & evaluating sources of I/I



How to Identify I/I

Reasons for CCTV Inspection

- Routine Operational Requirements
  - Proactive inspection to identify potential failures and for planning routine O&M and renovation programs
- Troubleshooting
  - Investigation of problem incidents to select remedial or rehabilitation action
- Compliance with Mandated Programs
  - Inspection and data collection to support programs such EPA Consent Orders
- Acceptance Testing
  - Inspection of new sewers to insure construction meet specifications and to document as-built conditions

NASSCO Standards

- Standard procedures for assessing and documenting the condition of piping systems for the management of infrastructure deterioration and renewal.

PACP – Pipeline Assessment Certification Program

MACP – Manhole Assessment Certification Program

LACP – Lateral Assessment Certification Program

PACP-AI – Pipeline Assessment Certification Program Advanced Inspection

PACP – North American Standard

- Identification and Assessment of Pipeline Defects
- Conditions can be Proactively Managed
- Certification classes taught by Master Trainers
- Two-day course can range from $750 - $1,000
- Upcoming training dates – www.nassco.org

PACP Codes

Organized into 4 Families:

- Structural Defects
- Construction Features
- Operational and Maintenance Defects
- Other

Structural Performance Grades (SPG)

- Grade 1 - Acceptable structural condition
- Grade 2 - Minimal collapse risk
- Grade 3 - Collapse unlikely in near future
- Grade 4 - Collapse likely in foreseeable future
- Grade 5 - Collapsed or collapse imminent

PACP / MACP / LACP Benefits

- Contractors, municipalities, utilities, DOT's in the assessment of defects in piping structures
- Standards provide the ability to seamlessly combine data from various projects
- Certification of Software Vendors
  - Data fields conform to NASSCO standards
  - Data exported from one certified software vendor is identical to software from another software vendor
- GIS Inventory and Mapping / SSES Projects
- Rehabilitation / Replacement Projects