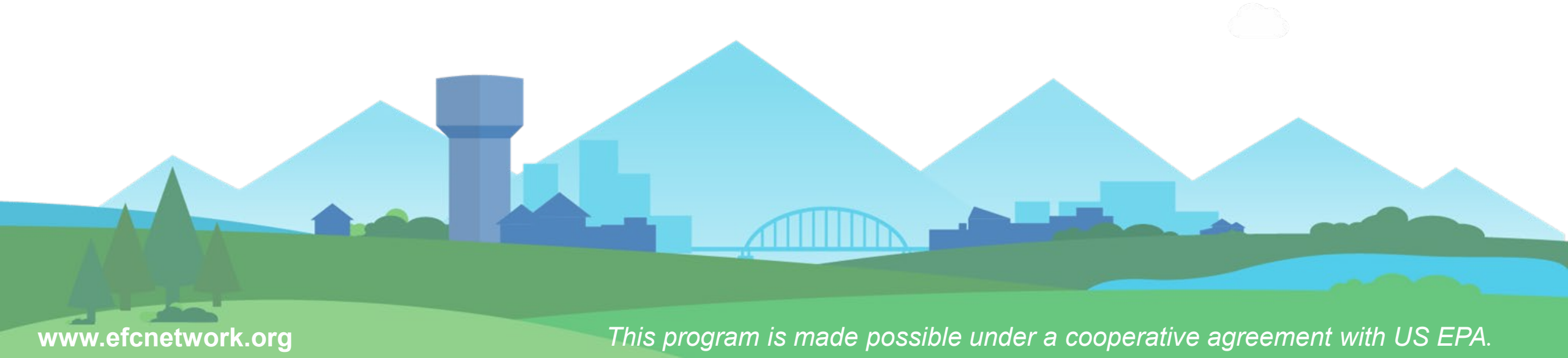
Wastewater Collection System Maintenance and Condition Assessment

Thursday, Sept 25, 2025



This program is made possible under a cooperative agreement with US EPA.

Logistics

Opening the control panel

Show your control panel

All phones/microphones are muted for the duration of the webinar

Toggle between full screen/window screen view

Using the control panel

Audio: please choose between computer audio or phone call

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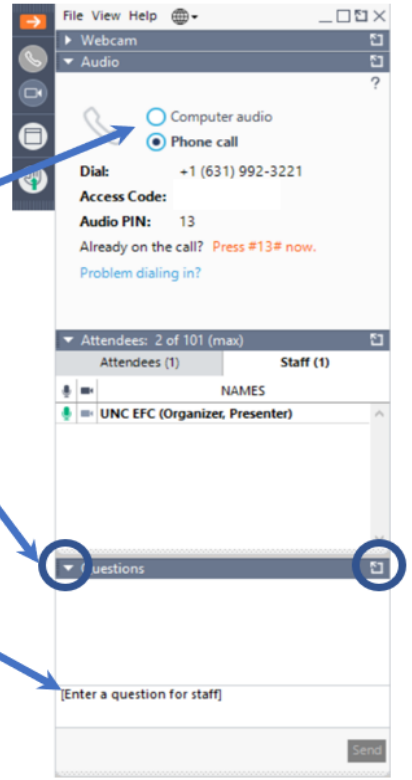
Click to open in Control Panel

Submit **questions** in the Questions box at any time, and press [Send]



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Certificate of Completion

This session has **NOT** been submitted for pre-approval of Continuing Education Credits, but eligible attendees will receive a certificate of attendance for their personal record.

To receive a certificate:

- You must attend the entire session
- You must register and attend using your real name and unique email address - group viewing credit will not be acceptable
- You must participate in polls
- Certificates will be sent via email within 30 days

If you have questions or need assistance, please contact smallsystems@syr.edu.

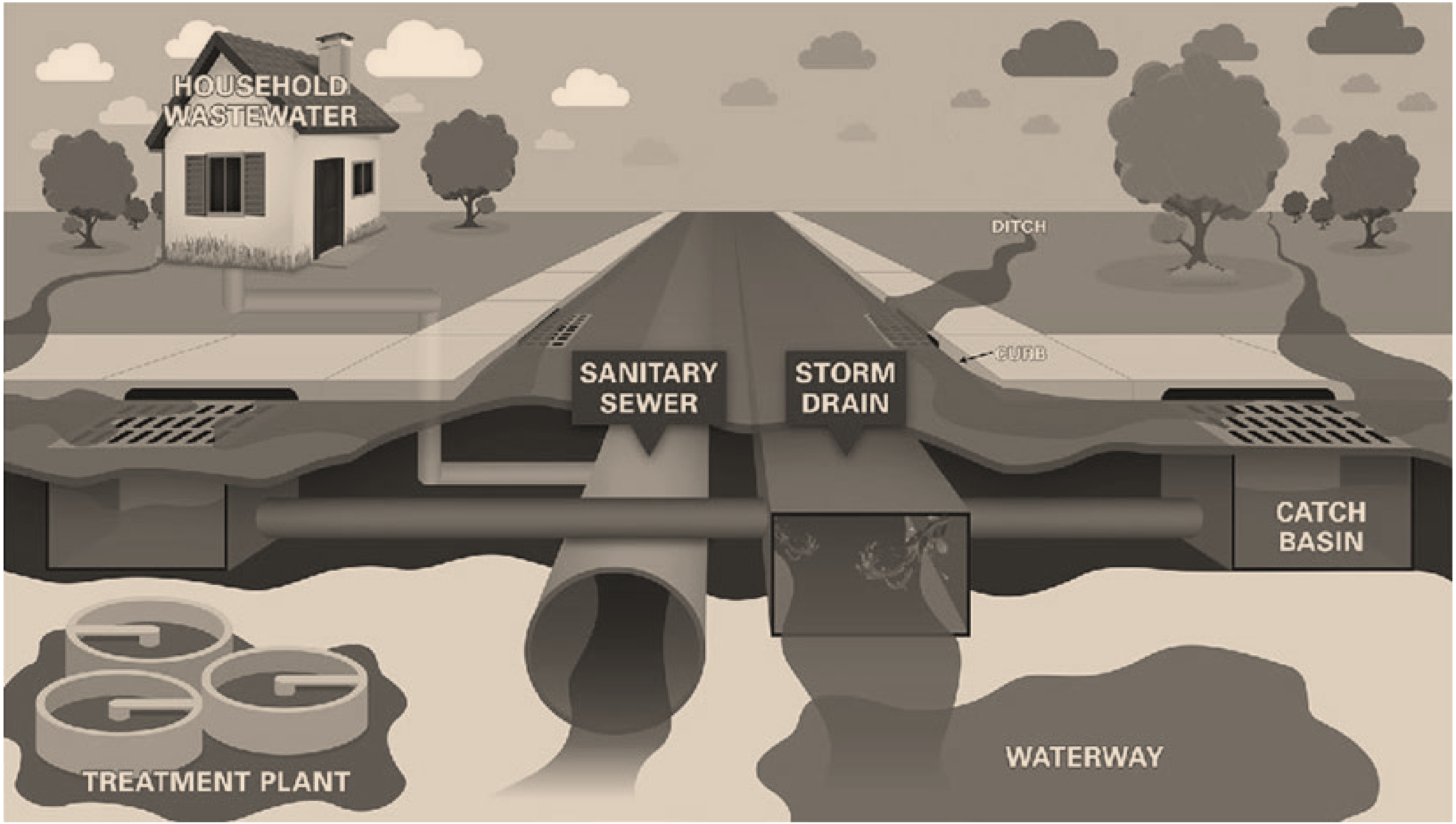
EFCN
environmental finance center network

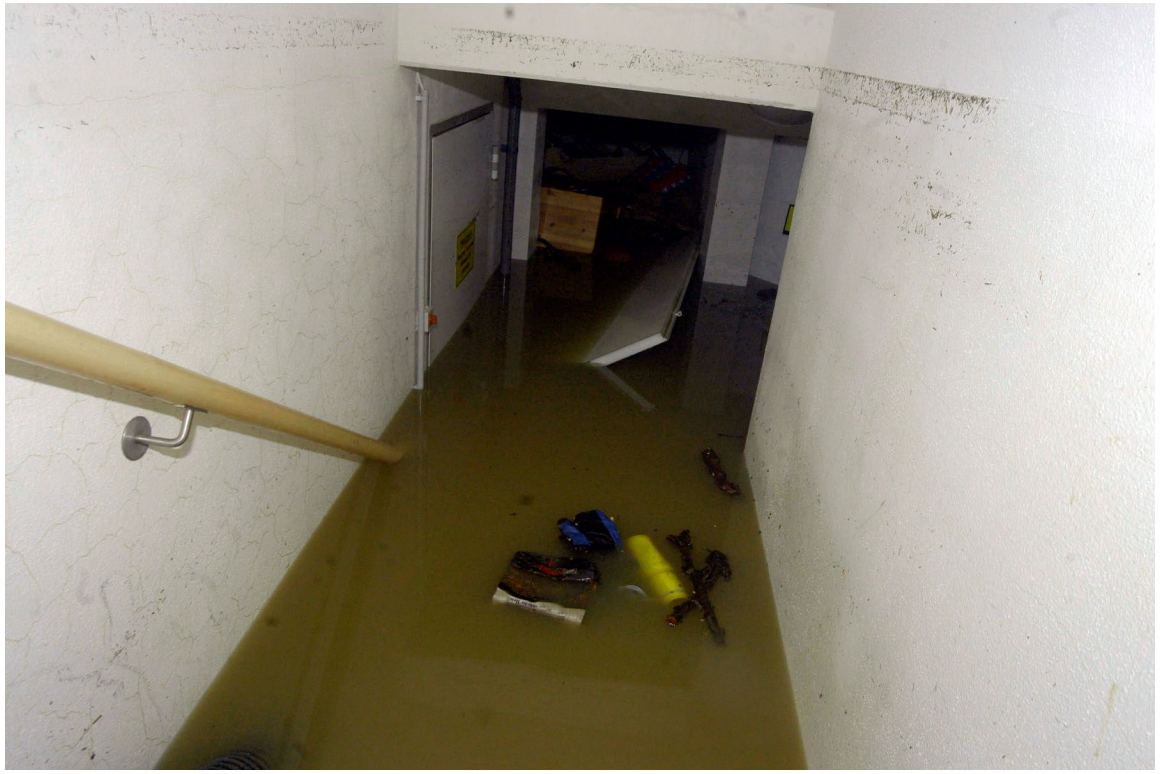
About Us

The **Environmental Finance Center Network (EFCN)** is a university- and non-profit-based organization creating innovative solutions to the difficult how-to-pay issues of environmental protection and water infrastructure.

The EFCN works collectively and as individual centers to address these issues across the entire U.S, including the 5 territories and the Navajo Nation. The EFCN aims to assist public and private sectors through training, direct professional assistance, production of durable resources, and innovative policy ideas.

Collection System Maintenance and Condition Assessment


HOUSEHOLD WASTEWATER
DITCH
CURB
SANITARY SEWER
STORM DRAIN
CATCH BASIN
TREATMENT PLANT
WATERWAY



Sanitary sewer overflows (SSO's)

Deficiencies in Operation & Maintenance

Can indicate Infrastructure Problems

Can result in environmental violations and legal issues

F.R.O.G. WILL CLOG

NEVER PUT THESE DOWN THE DRAIN

FATS

butter, shortening, margarine, nut butter, meat trimmings, cheeses, milk, cream, sour cream, ice cream

RAGS

wipes, diapers, paper towels, cotton balls

OILS

salad dressings, all food based oils (like vegetable, canola, corn, olive)

GREASE

gravy, mayonnaise, coconut oil, melted meat fat (from products like bacon and sausage)

Give Us Your Grease

Recycle your used oil or dispose in the trash. The City of Tallahassee's Alternative Fuel Program promotes sustainability and saves money by making biofuel from used cooking oil to power many City trucks and vehicles.

How to Recycle Used Cooking Oil

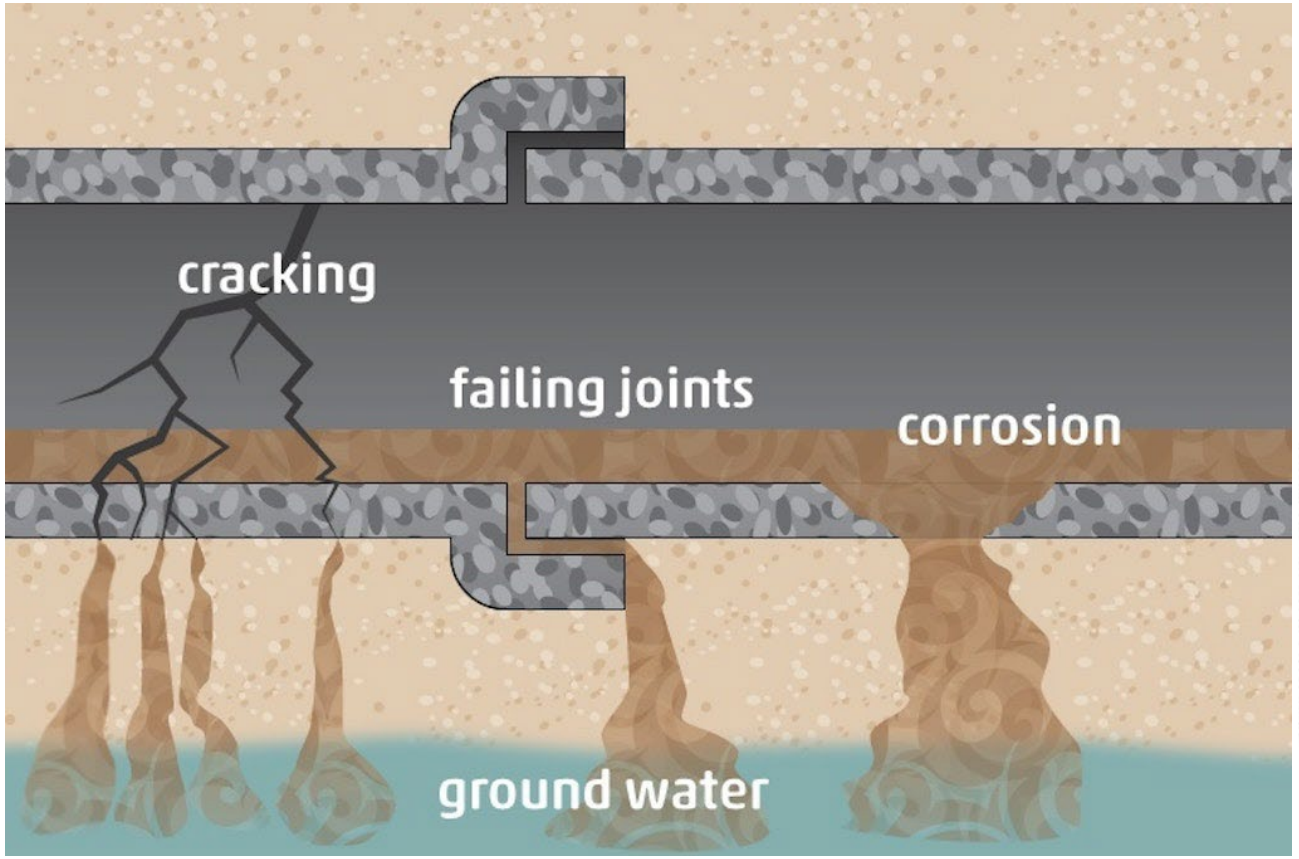
1 COOL
Allow cooking oil to cool

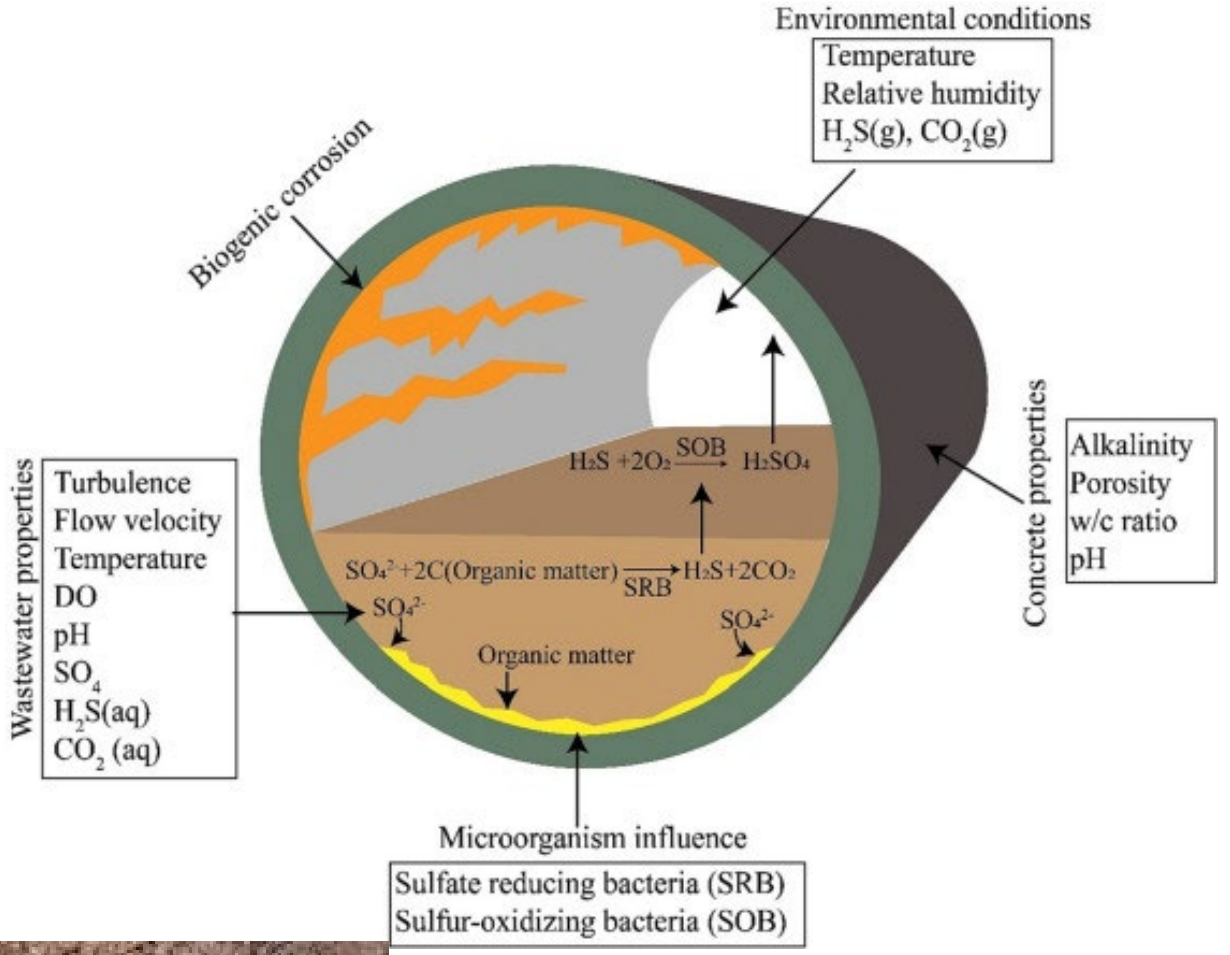
2 COLLECT
Pour cooled oil into non-breakable containers

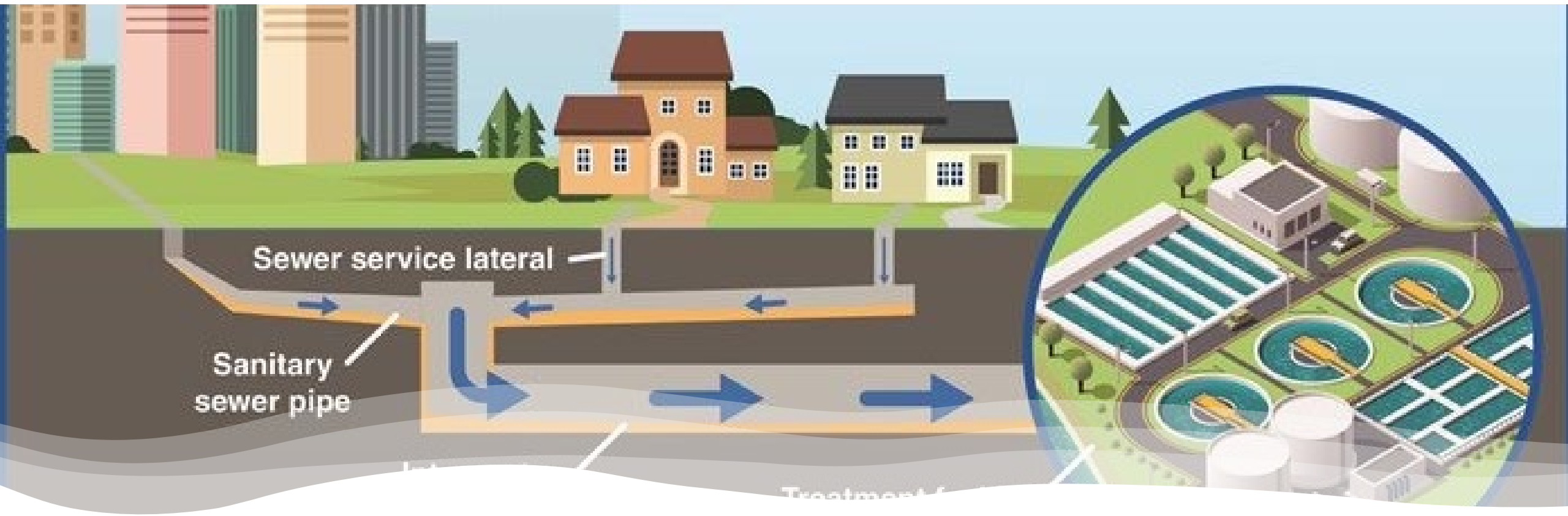
3 CONTRIBUTE
Drop off at any of our collection sites

Fuel Program Recycling Sites:

- City of Tallahassee Fleet Management Department, 400 Dupree Street
- City of Tallahassee Community Beautification and Waste Management Facility, 2727 Municipal Way
- Fort Braden Rural Waste Service Center, 2485 East Joe Thomas Road
- Woodville Rural Waste Service Center 549 Henry Jones Road
- Miccosukee Rural Waste Service Center 13051 Miccosukee Road


cracking
failing joints
corrosion
ground water


Environmental conditions
Temperature
Relative humidity
$H_2S(g)$, $CO_2(g)$
Biogenic corrosion
Wastewater properties
Turbulence
Flow velocity
Temperature
DO
pH
SO_4
$H_2S(aq)$
CO_2 (aq)
$H_2S + 2O_2 \xrightarrow{SOB} H_2SO_4$
$SO_4^{2-} + 2C(\text{Organic matter}) \xrightarrow{SRB} H_2S + 2CO_2$
SO_4^{2-}
SO_4^{2-}
Organic matter
Concrete properties
Alkalinity
Porosity
w/c ratio
pH
Microorganism influence
Sulfate reducing bacteria (SRB)
Sulfur-oxidizing bacteria (SOB)



Design Factors

Minimum flow velocity

Gravity sewers are sloped to have a **minimum flow velocity**

- Minimum velocity: **2.0** ft/sec to **2.5** ft/sec (dry weather flows)

1. Keeps solids in suspension so they don't settle out in pipes
2. Reduces ammonia formation
3. Reduces H2S corrosion
4. Reduces odors

Max velocity: (around 10 ft/sec) to prevent erosion/pipe damage

Slope and velocity

Manning's Equation is used to design the correct slope (and size) of collection mains to obtain a minimum 2.5 ft/sec velocity

$$Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$$

- Q = Flow rate in ft^3/sec
- n = roughness coefficient
- A = Area of flow in ft^2
- R = hydraulic radius
- S = Slope in ft/ft

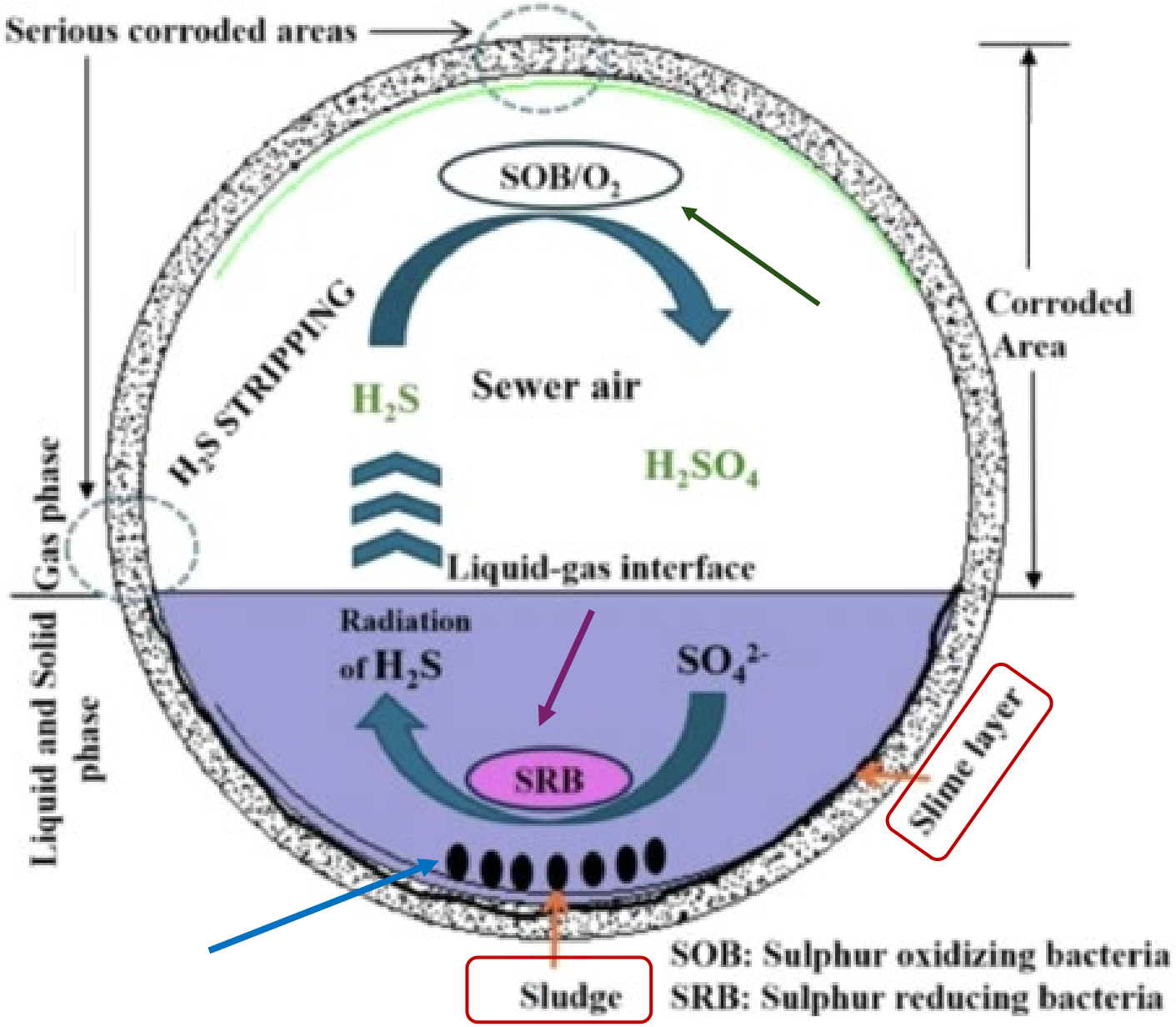
Minimum and Maximum Slopes for Storm Sewers

(Manning's "n" = 0.013)

Pipe Size	Minimum % of Grade (V = 2.5 ft/sec)	Maximum % of Grade (V = 10 ft/sec)
12"	0.32	4.88
15"	0.24	3.62
18"	0.20	2.84
21"	0.16	2.30
24"	0.14	1.94
27"	0.12	1.66
30"	0.10	1.44
36"	0.08	1.12
42"	0.06	0.92
48"	0.06	0.76
54"	0.04	0.60
60"	0.04	0.54
66"	0.04	0.48

The constant 1.486 is a conversion for n which was originally developed using SI units. It would be 1/n when using meters instead of feet.

Hydrogen Sulfide Corrosion



1. Settled debris create an environment for anaerobic bacteria
2. Sulfur reducing bacteria produce hydrogen sulfide gas (H_2S).
3. Sulfur-oxidizing bacteria convert H_2S gas into sulfuric acid (H_2SO_4).

Affects:

- metal pipe
- concrete pipe
- cement at joints of clay pipe

Ammonia levels can also increase

Poll 1

Why do flow velocities in wastewater collection mains need to be at least 2 to 2.5 ft/second?

a) So that grit will be shaken out of flow prior to entering pumps
b) To pressurize the collection main so water can be lifted
c) To prevent solids from settling in the collection main
d) All of the above.

Routine Maintenance

Routine monitoring

Visual checks of flow at key points in the collection system

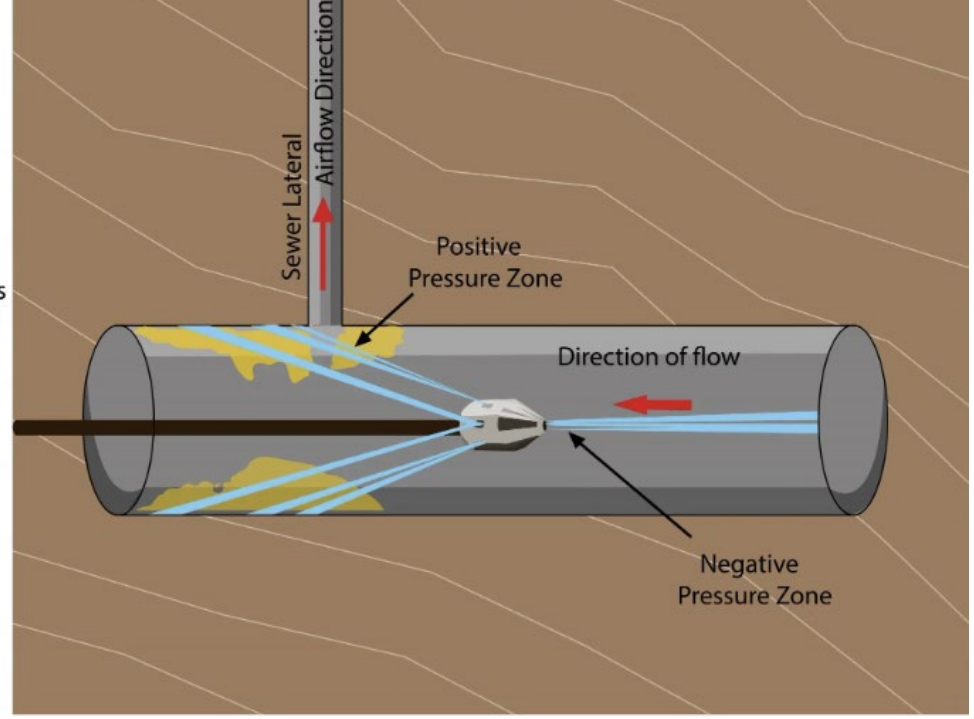
- Depth and velocity of flow
- Unusual conditions (blockages or surcharging
- Catch problems before they happen (Grease, rags, outages)

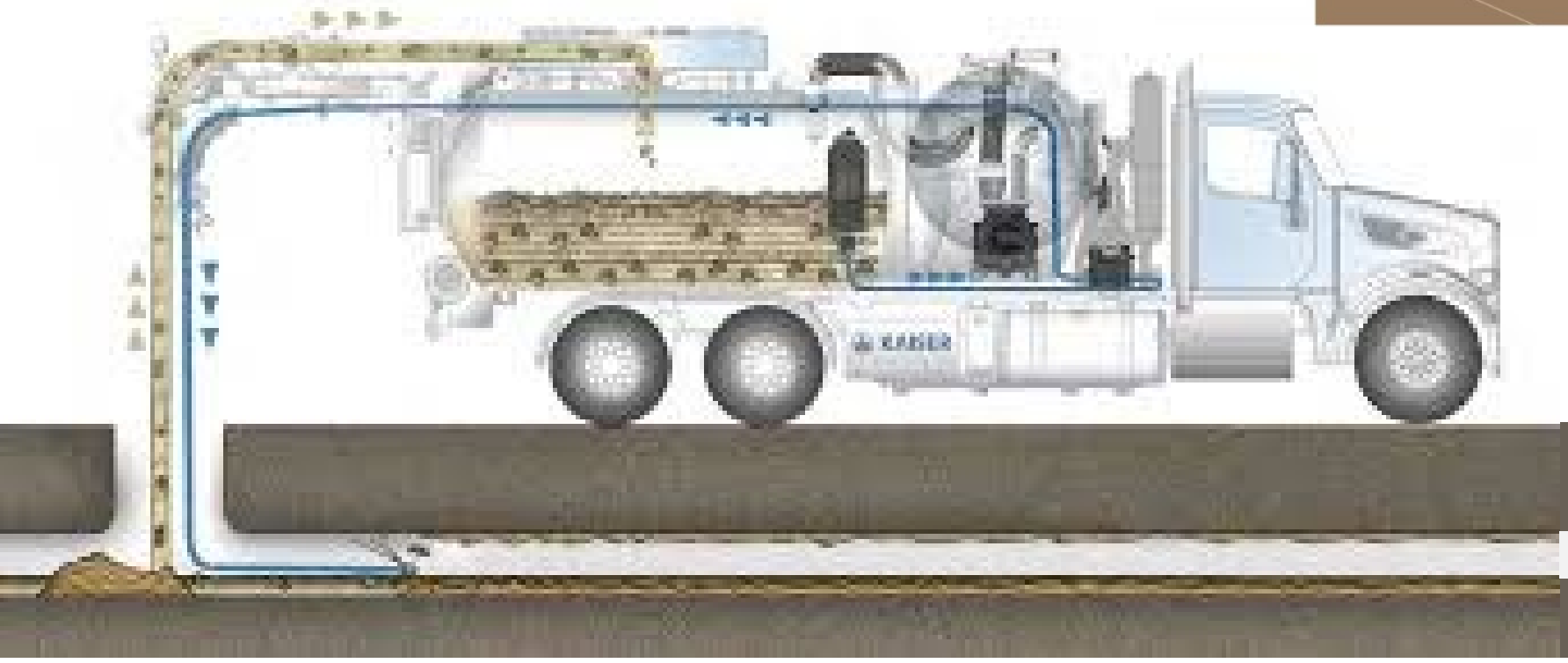
Know your system

Combination sewer cleaning truck

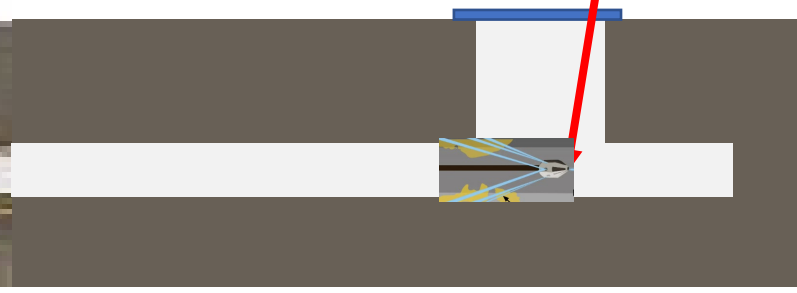
Jetting head

Vac removing clog of rags and grease





Start head here and pull backwards to clean

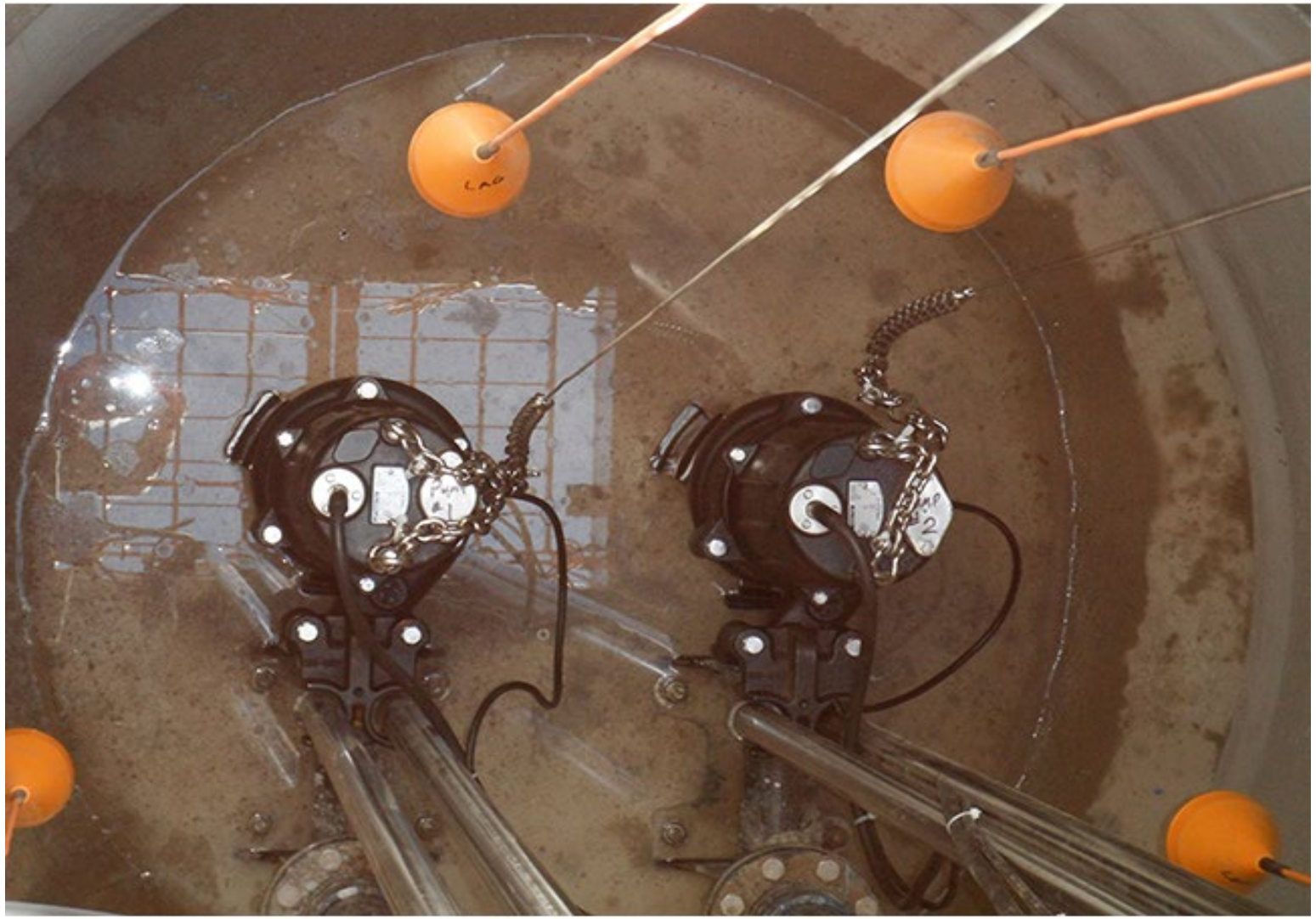


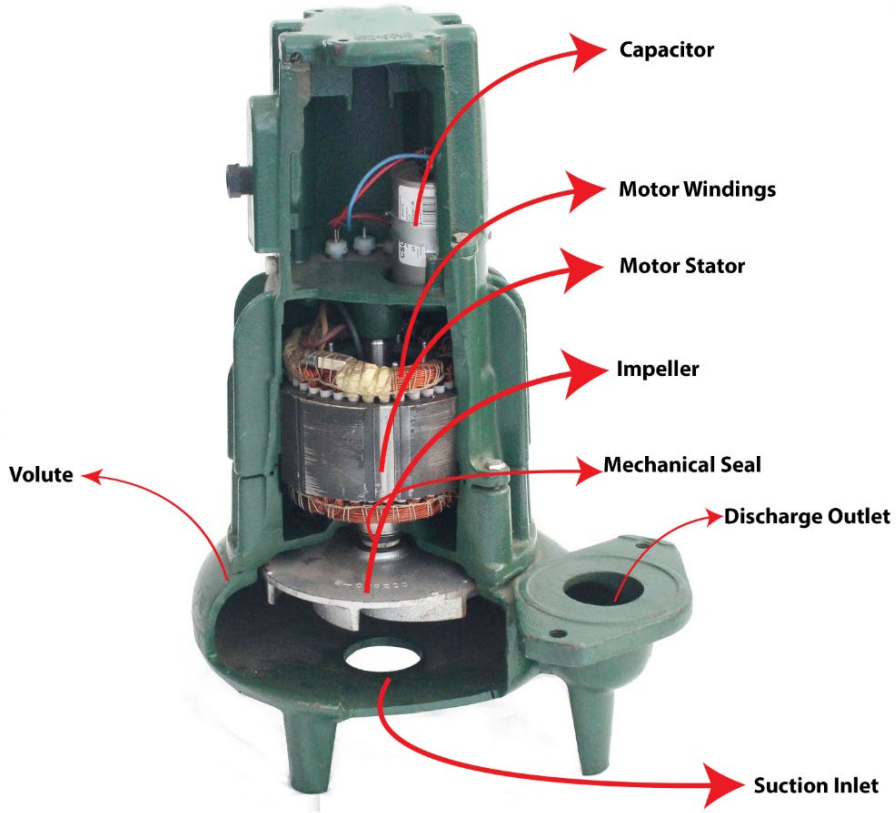
Roots

Duplex pump installation

Two pumps in the lift station provides redundancy

Floats should be cleaned and tested periodically





- Pump inside diameter to allow the average size of waste solids to pass through. Normally 2.5 inches or larger
- Cutting and grinding impellers can make solids pass without clogging
- Screening can protect pumps from rags

Hour meter readings should be within 10% of each other
If more than 10% difference it can indicate a clog or motor problem

Condition assessment

Inflow and infiltration (I&I)

Inflow: rainwater that enters a wastewater collection system through deliberate connections

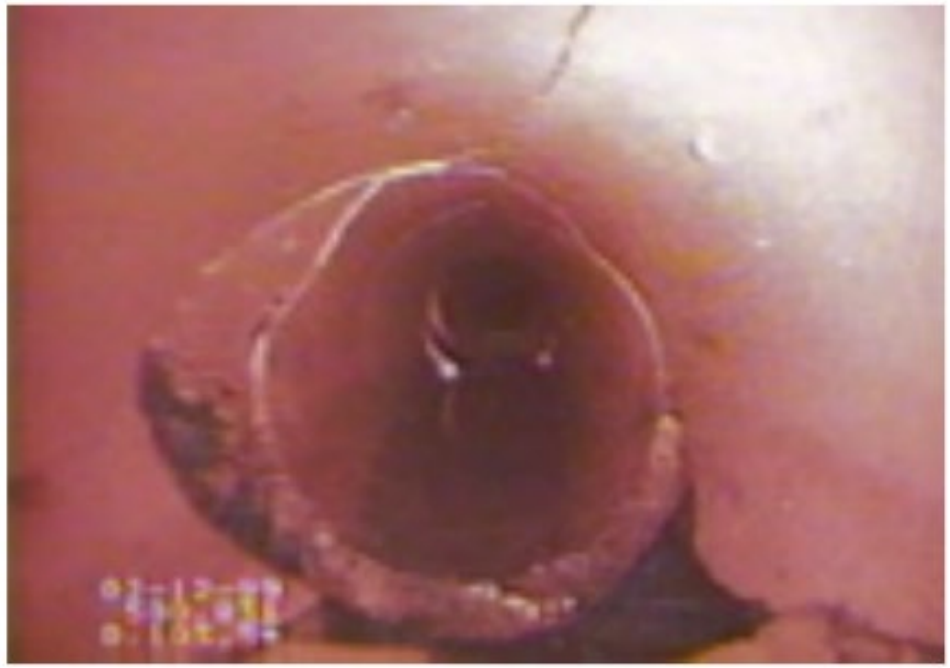
- downspouts, sump pumps, yard drains
- cross connections between stormwater lines

I&I can significantly reduce the capacity of the wastewater collection system

Inflow and infiltration (I&I)

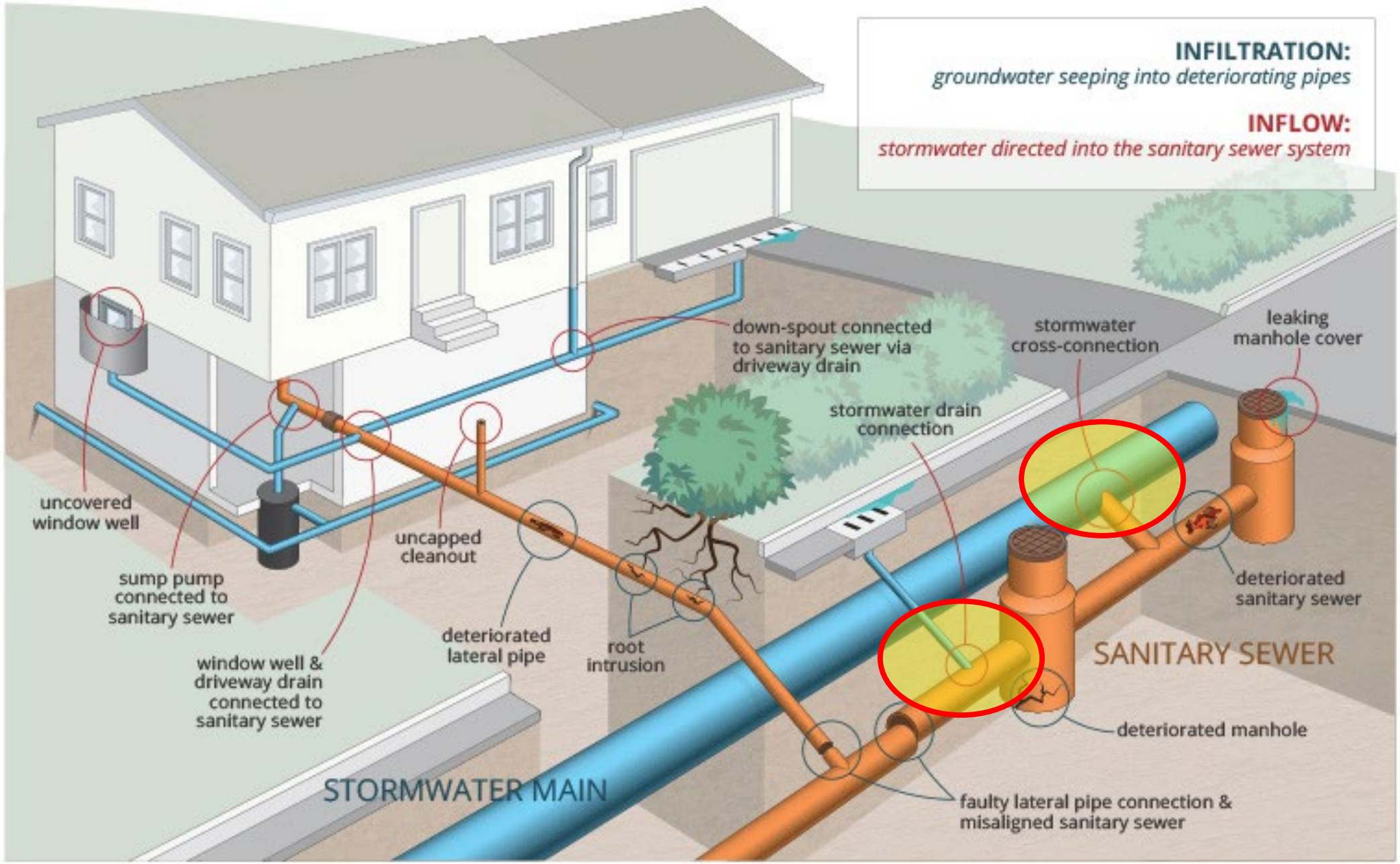
Infiltration: ground water entering the wastewater collection through defects

- damaged pipes, offset joints, damaged manhole structures



Damaged sewer pipe

Infiltration through pipe joint



https://www.sbwrd-ut.gov/inflow-and-infiltration/

Inflow and Infiltration Studies for Sewers

Average Daily Dry Weather Flow: Average flow (gpd)of wastewater produced during dry months based on actual inflow to the treatment headwords.

Base Wastewater Flow is wastewater actually coming out of households, based on metered water flow to indoor plumbing. (About 100 gpd per person)

Groundwater infiltration is determined by subtracting the estimated Base Wastewater Flow from the Average Daily Dry Weather Flow.

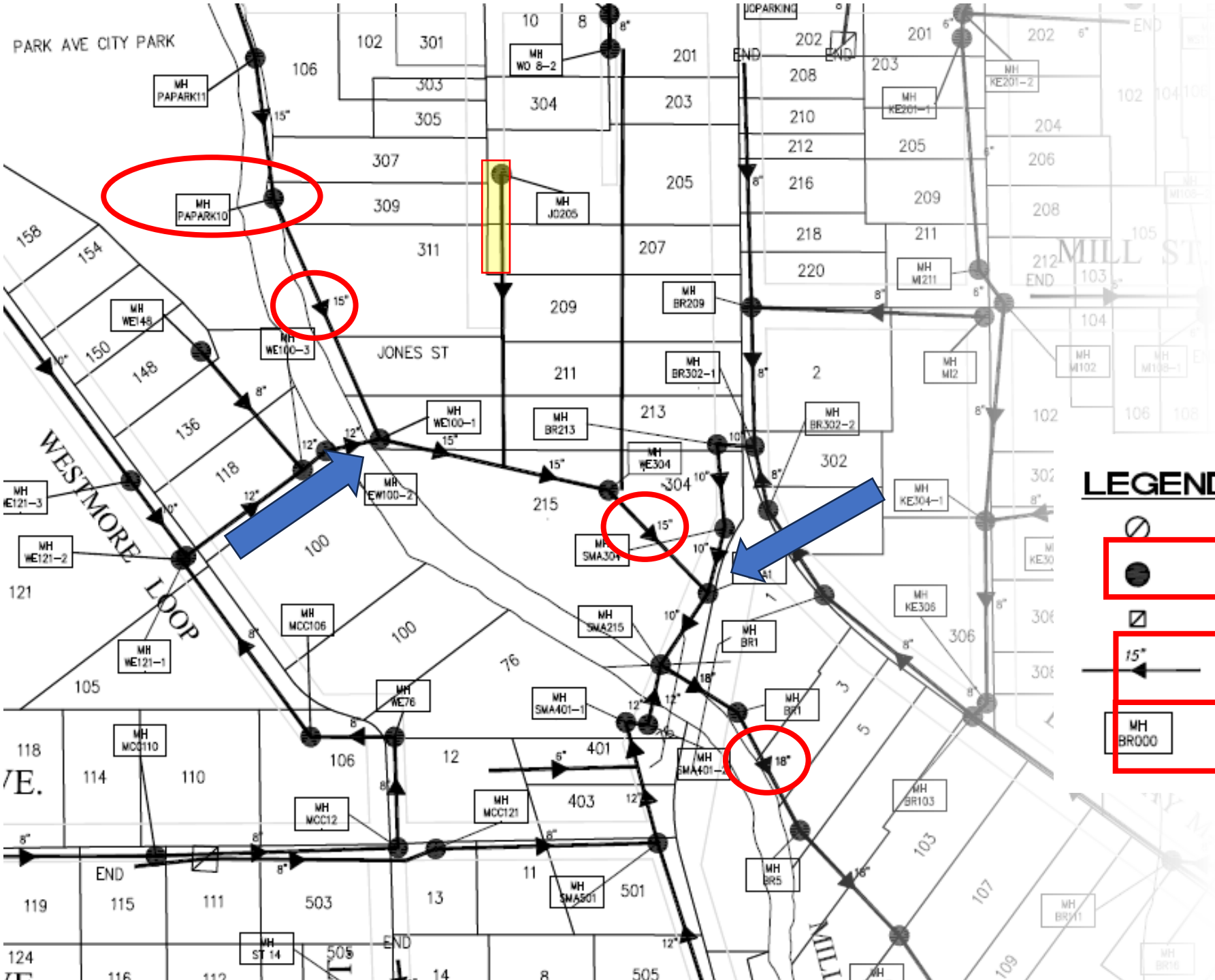
Average Daily Dry Weather Flow – Base Wastewater Flow = Groundwater infiltration

160,000 gpd – 150,000 gpd = 10,000 gpd

Inflow is determined by subtracting the Average daily dry weather flow from wet weather flows

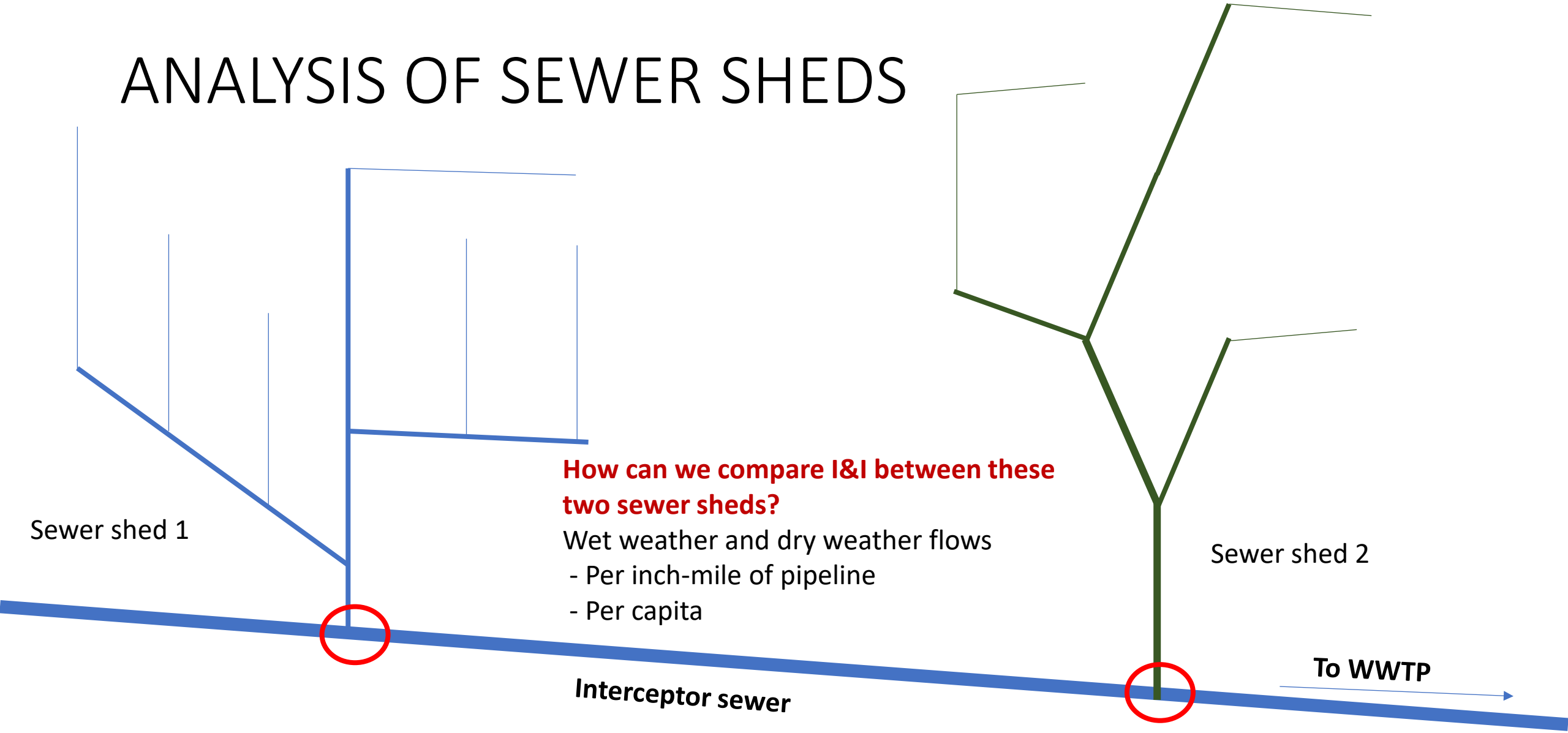
Average Wet Weather Flow – Average Daily Dry Weather Flow = Inflow

180,000 gpd – 160,000 gpd = 20,000 gpd



As-built maps for sanitary sewers

ANALYSIS OF SEWER SHEDS



How can we compare I&I between these two sewer sheds?

Wet weather and dry weather flows
- Per inch-mile of pipeline
- Per capita

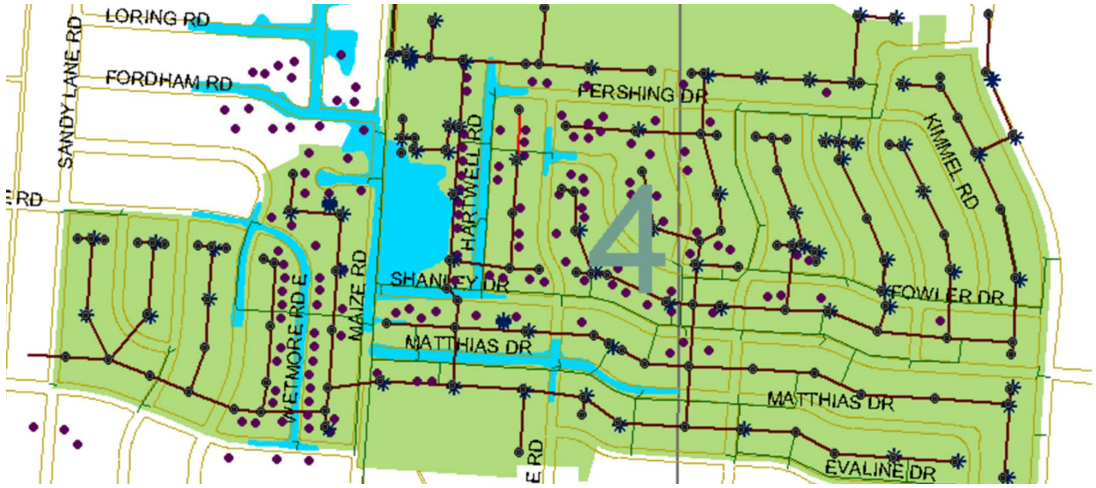
GPD/IDM

GPD/IDM = Gallons per day
Inch-diam x Mile

Gallons per day is the total flow in gallons over a 24-hour period at a point in the system.

Inch-diameter mile – the diameter of a pipe in inches times the length in miles

Over **1,500 GPD/IDM** is considered excessive I&I requiring some type of corrective action. This is a general benchmark.



Comparing I&I: gpd/idm

A small collection system consists of 2 sewer sheds that flow to a final interceptor main. Which sewer has a higher priority for inspection and rehabilitation?

- **Sewer shed 1 is a concrete sewer that has:** | 4 miles of 8-inch pipe | 2 miles of 12-inch pipe| and |1 mile of 15-inch pipe|. Average flow is 251,000 gpd.
- **Sewer shed 2 is a clay sewer than has: |**5 miles of 8-inch pipe |2 miles of 10-inch pipe | 4 miles of 12-inch pipe |and |3 miles of 15-inch pipe|. Average flow is 352,000 gpd.

Step 1: Calculate the total inch diameter-miles (idm):

(4 miles x 8 inch) + (2 miles * 12 inch) + (1 mile * 15 inch) = **71 inch-mile**

(5 miles x 8 inch) + (2 miles * 10 inch) + (4 miles x 12-inch) + (3 miles x 15 inch) = **153 inch-mile**

Step 2: Calculate the gpd/idm (divide the total daily flow by the total idm)

gpd/idm(1) = 251,000 gpd ÷ 71 idm = **3,535 gpd/idm.**

gpd/idm(2) = 352,000 ÷ 153 idm = **2,300 gpd/idm**

EPA benchmarks for excessive I&I

EPA Standards consider infiltration excessive if

- average dry weather flow is more than 120 gallons per capita per day (infiltration)
- Average wet weather flow is more than 275 gallons per capita per day (inflow)
- Average flow ÷ number of people served

Poll 2

A small portion of a collection system consists of ½ mile of 12-inch pipe, 1 mile of 8-inch pipe, and 2 miles of 6-inch pipe. The average flow is 38,000 gallons per day. Calculate gal/day per inch-mile.

a) 1,461 gpd/in-mile
b) 1,689 gpd/in-mile
c) 2,876 gpd/in-mile
d) 3,487 gpd/in-mile

Poll 2

A small portion of a collection system consists of ½ mile of 12-inch pipe, 1 mile of 8-inch pipe, and 2 miles of 6-inch pipe. The average flow is 38,000 gallons per day. Calculate gal/day per inch-mile.

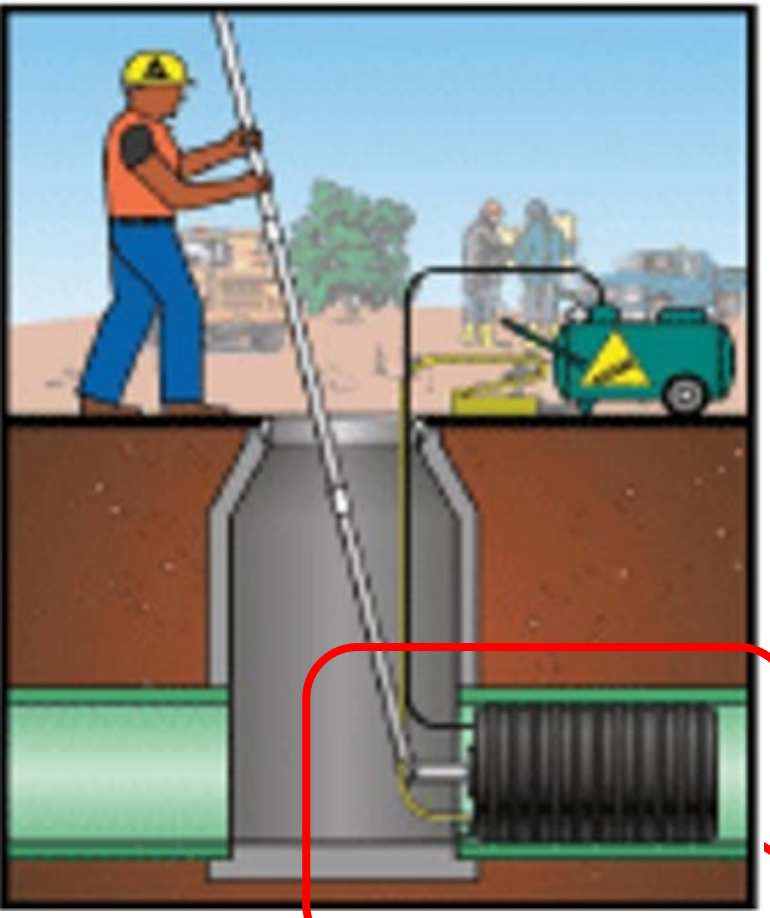
(½ mile x 12 in) + (1 mile x 8 in) + (2 miles x 6 in) = **26 in-mile**

$$\frac{\text{38,000 gal/day}}{\text{26 in-mile}} = \textbf{1,461.5 gpd/in-mile}$$

Sources of information for condition assessment of collection mains

1. Inflow and infiltration studies
2. **Smoke testing data**
3. Flow monitoring
4. CCTV inspection

Smoke testing



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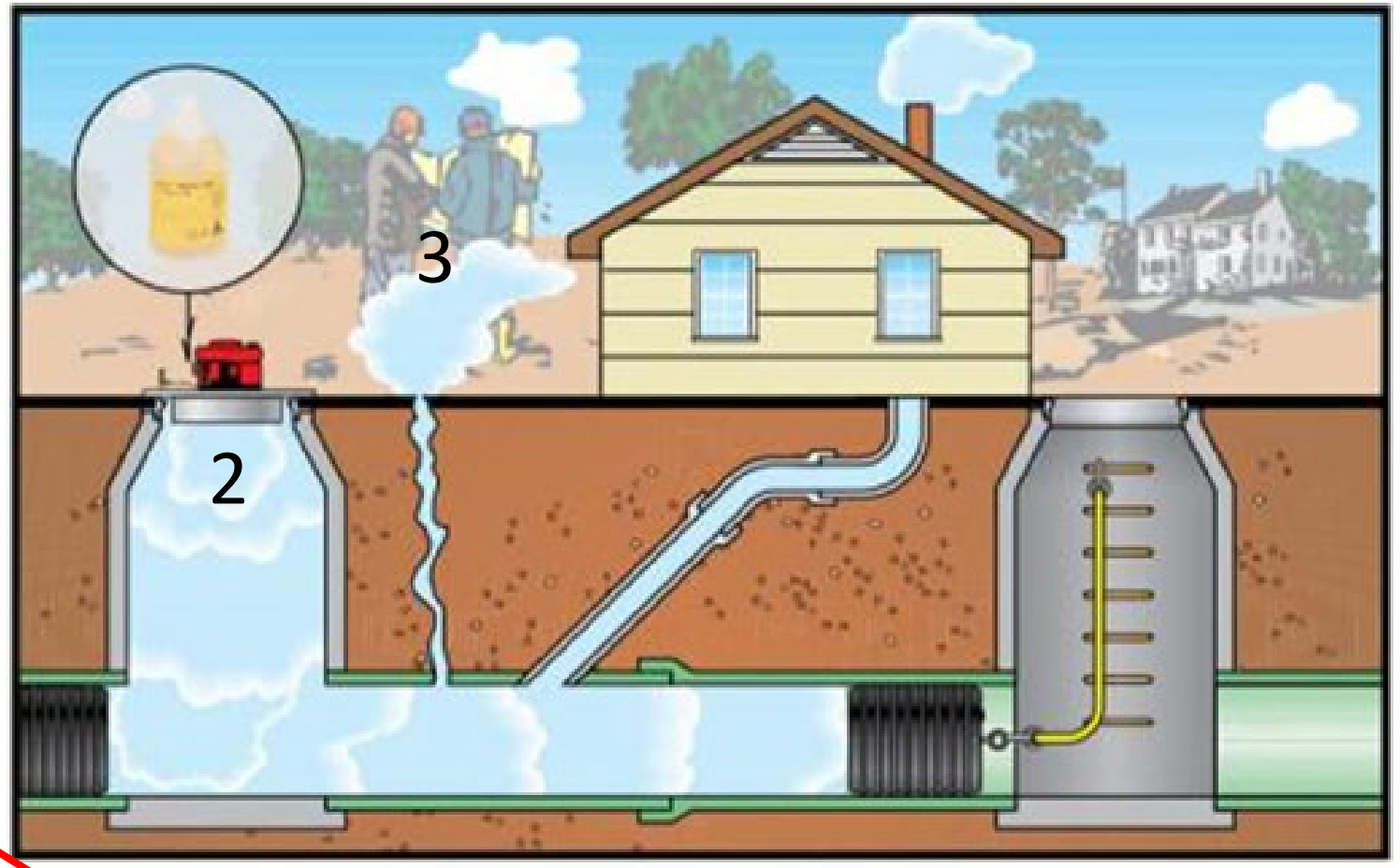
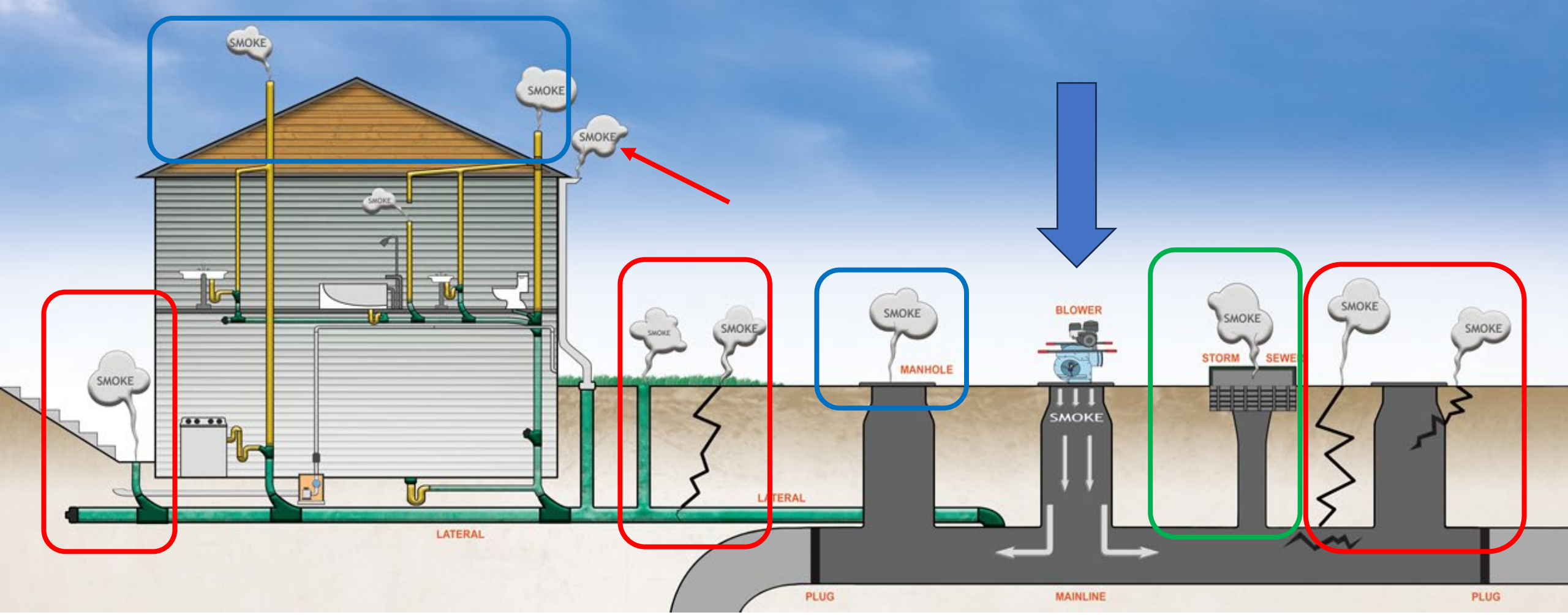


1. Use sewer plugs to isolate test volume
2. Place smoker on manhole with liquid smoke chemical
3. View and record results



- ❑ Smoke from roof vents and through manhole covers is normal
- ❑ Smoke from rain gutters is a source of inflow.
- ❑ Smoke from lawn areas can indicate an uncapped cleanout or broken lateral.
- ❑ Smoke along the sewer between manholes can indicate collection main damage.
- ❑Smoke from storm sewer indicates a potential cross connection for sanitary sewers

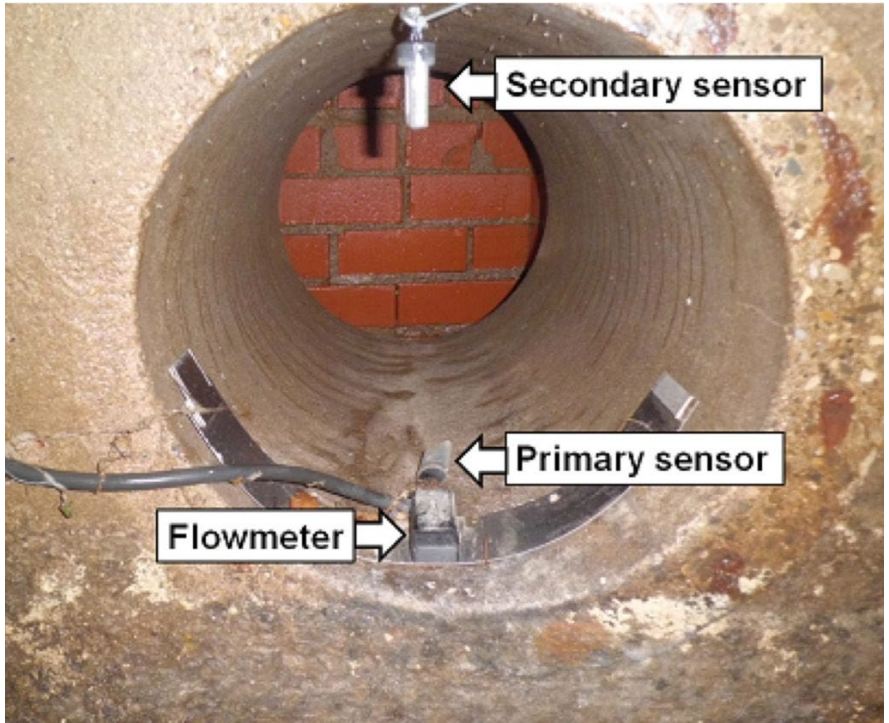
Sources of information for condition assessment of collection mains

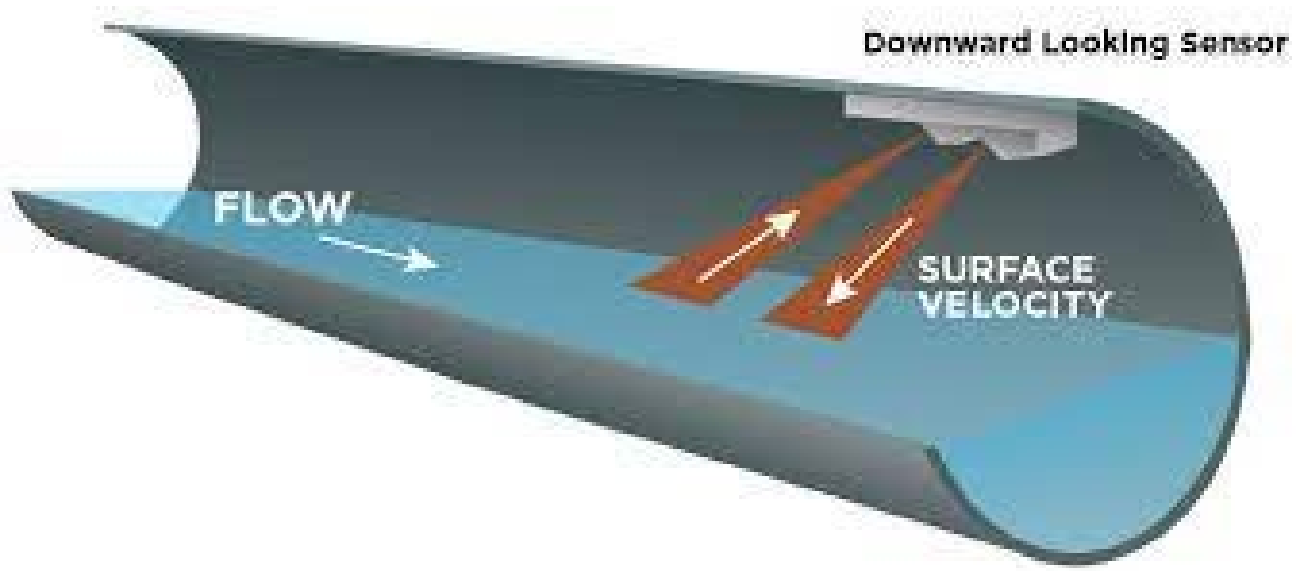
1. Inflow and infiltration studies
2. Smoke testing data
3. **Flow monitoring**
4. CCTV inspection

Flow monitoring

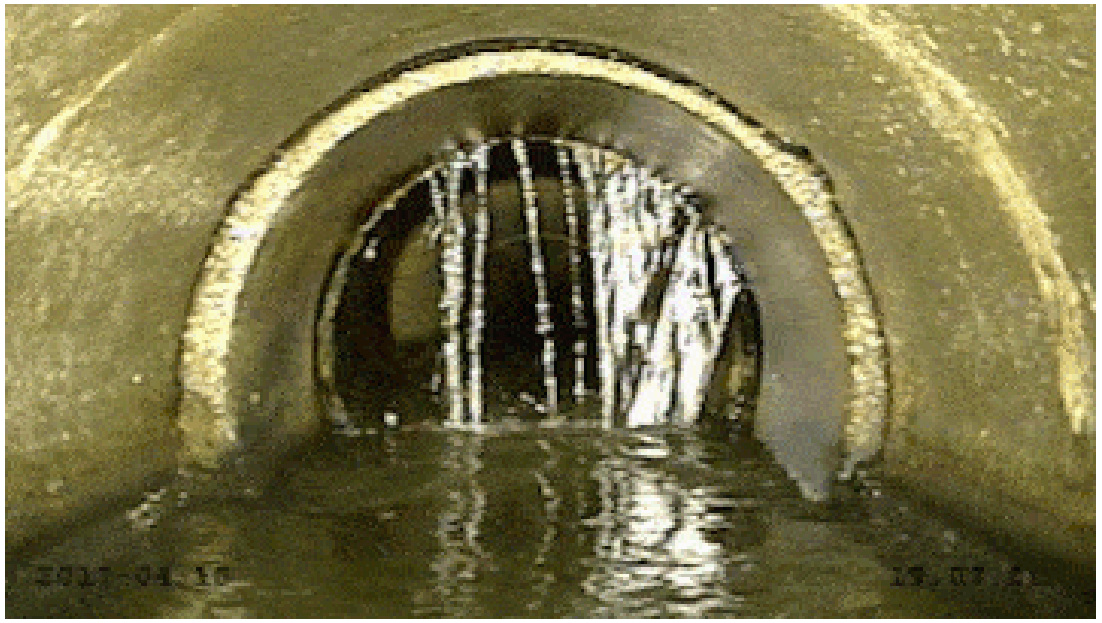
Looks at depth of flow and flow velocity in sewer pipes.

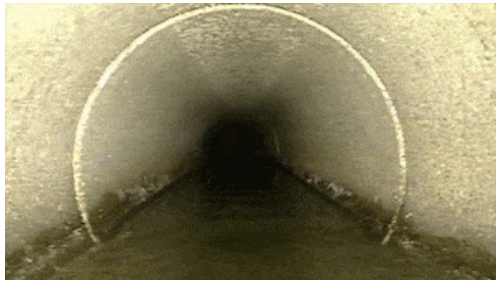
- If depth of flow is higher than normal for a given flow rate, it could indicate a restriction, negative slope, or a surcharging.
- Used to measure daily flows at manholes





CCTV inspection





Control panel and CCTV screen

Self-propelled “mud-monster” camera carrier

Truck launches cameral into sewer

Louisville/Jefferson County Metropolitan Sewer District (MSD)

CCTV inspection results example

The distance into the main is recorded (Pos = position)

RJ = Roots at joint

OJL = Open joint large

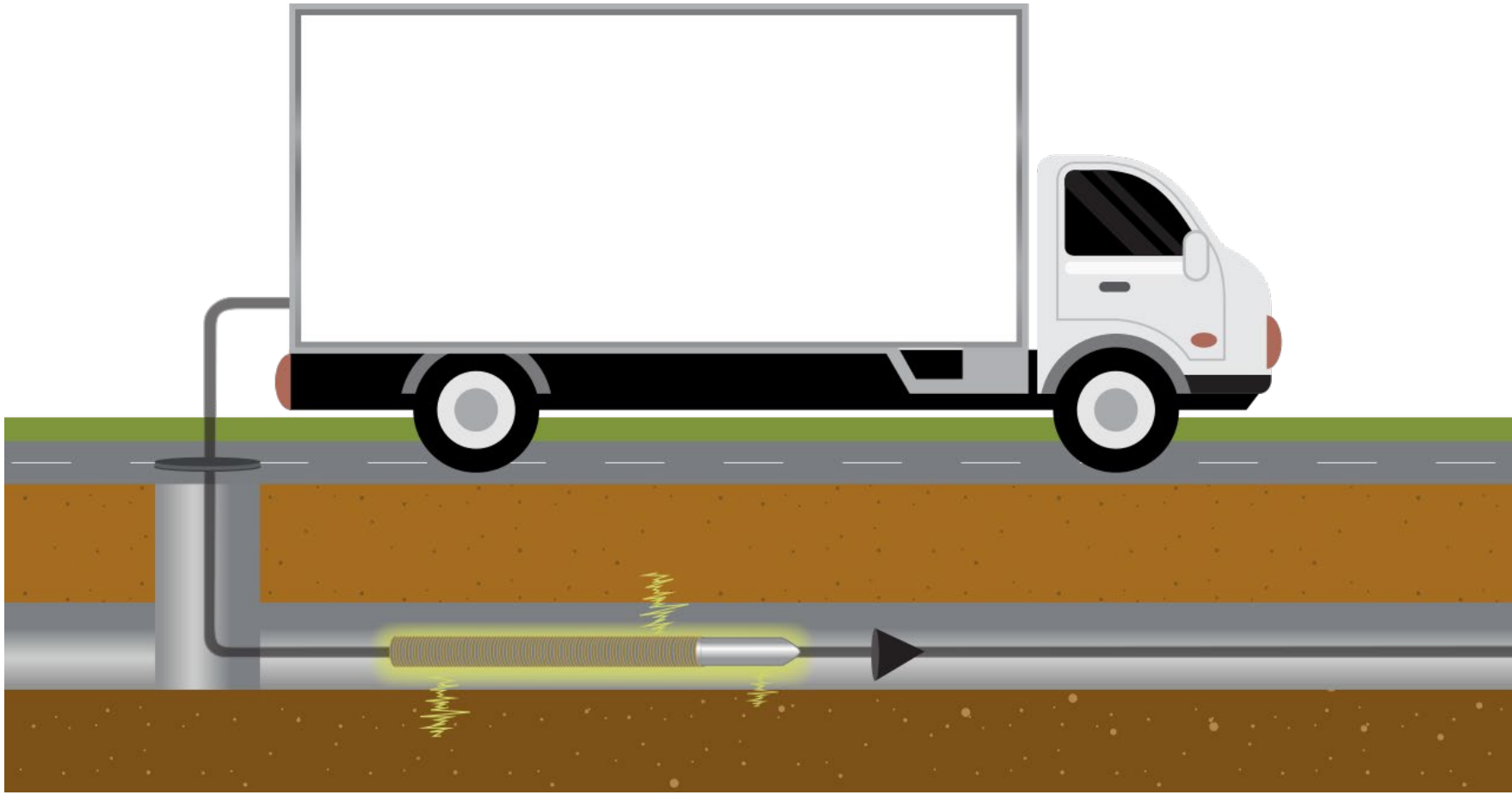
Also, should specify information such as
Type and length of cracks and other damage

Pos	Video Ref	Code	Description	Image
03.30m	0:00:32	RJ	Roots at joint - Severity 3	Image Provided - Ref: 1_7 
04.60m	0:00:44	RJ	Roots at joint - Severity 3	Image Provided - Ref: 1_8 
06.50m	0:01:03	OJL	Open joint large - Severity 4	Image Provided - Ref: 1_9 

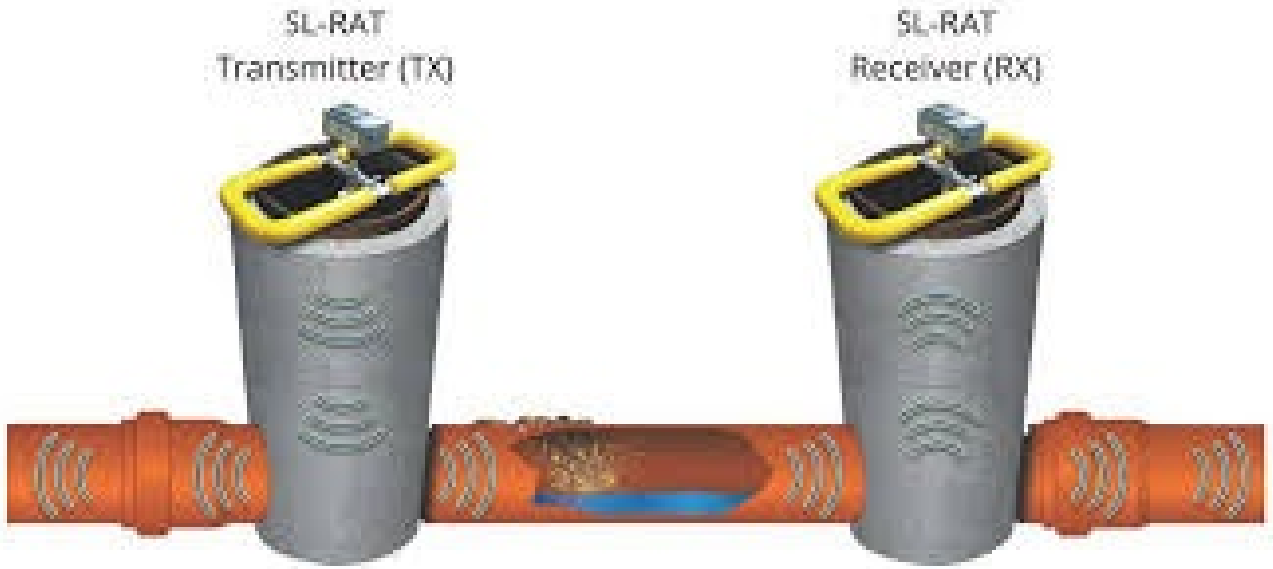
Electrical Scanning technology

Sends low-voltage electrical current through non-metal pipes.

Measures the variation in current passing through any pipe defects.



https://www.sehinc.com/insights/6-ways-identify-ii-including-3-warning-signs



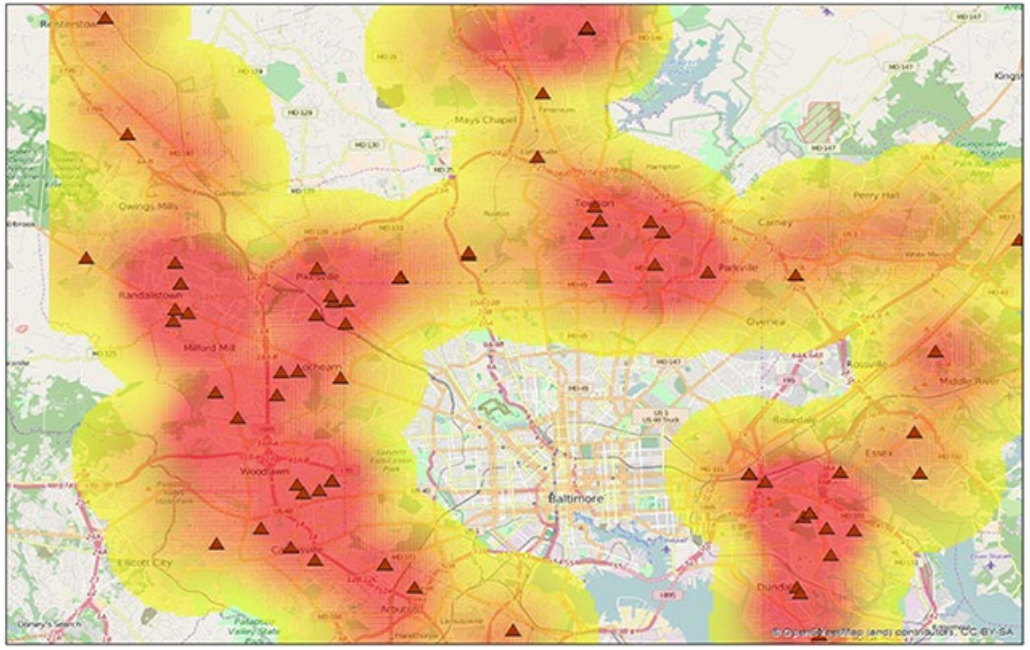
Sewer Line Rapid Assessment Tool

Identifies blockages using sound waves

Two operators can assess 10,000 to 20,000 ft per day

Using GIS Mapping

- Geographic Information System (GIS) mapping can provide visualization of proximity of assets to critical or sensitive features
- This information can be used to prioritize inspection and rehabilitation activities.
- Example: *A large force main next to a sensitive water way or under a highway would likely be prioritized for inspection and rehab.*



GIS analysis for potential Sanitary Sewer Overflow impacts in Baltimore

Steps following condition assessment

1. **Conduct maintenance based on inspection findings**

a) Sewer cleaning

b) Root Removal

2. Prioritize repair, rehab, and replacement based on condition assessment results

a) Use I&I, smoke testing, CCTV and other data to determine which sections are in greatest need of repair

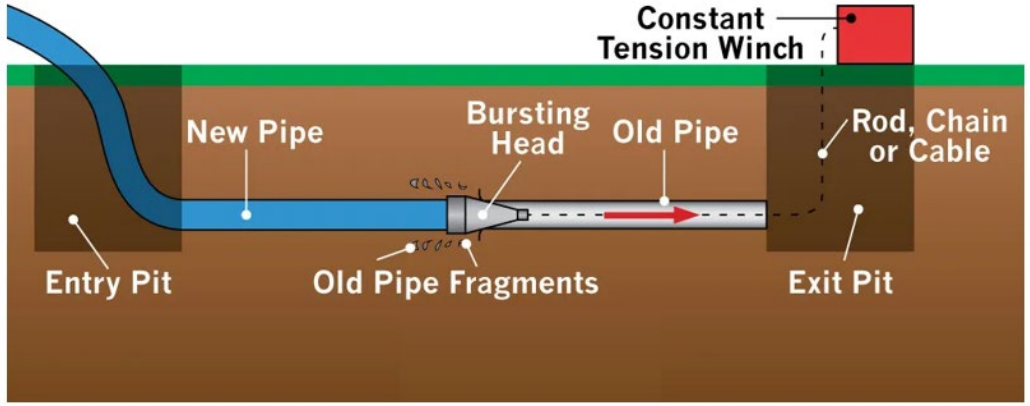
b) Consider location in relation to transportation, population, and environment to prioritize actions

Rehab – replacement options

Slip lining – a smaller pipe is pulled into the damaged pipe

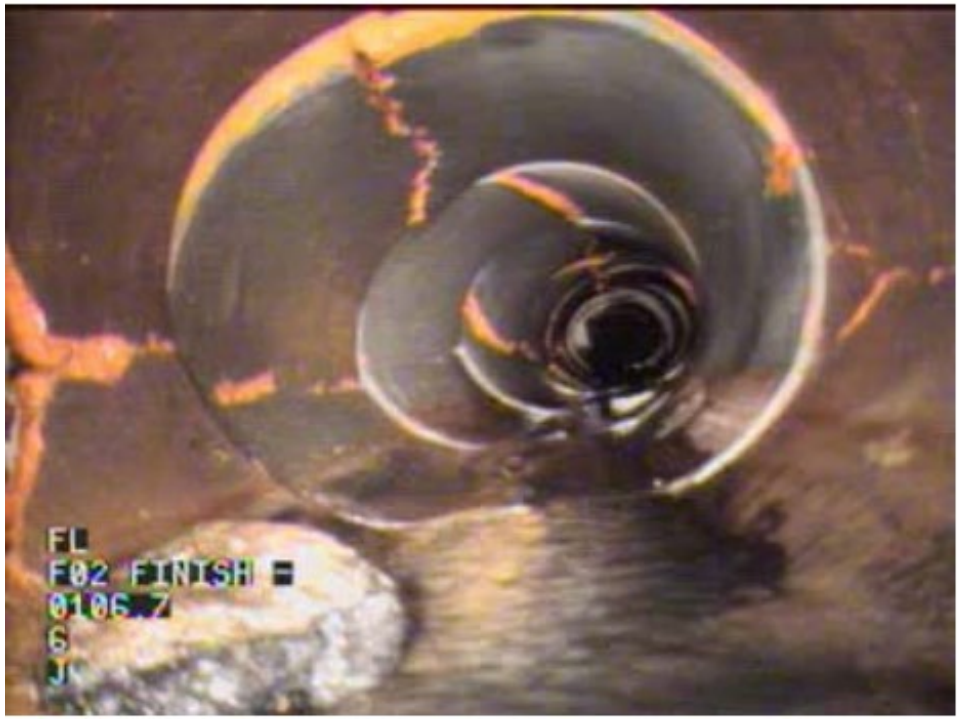
Cured in Place Pipe (CIPP) – a flexible liner is inserted into pipe and cured for a new interior surface

Pipe Bursting – Old pipe is destroyed by a bursting head as a new pipe is pulled into the same location.



Poll 3

You CCTV two large trunk mains. One is a 30 year old clay pipe with several cracks and deformations but is not leaking. The second is a 100-year old brick sewer in good condition. Which main has a higher priority for replacement?



A

B.

C. Depends

D. Not enough information

Change in culture

Condition assessment and proactive maintenance practices can transform your utility

"We were just reading about a waterborne illness caused by a sanitary sewer overflow that occurred in a nearby town. What can we do to prevent that from happening to us?"

"Perhaps the first step is to develop a condition assessment program so we can target resources toward prioritized maintenance & rehabilitation"

"Yes, I see here that there are several methods we can use to assess our collection mains including smoke testing and CCTV"

Thank you for participating

Share 1 thing you enjoyed learning about today in the chat

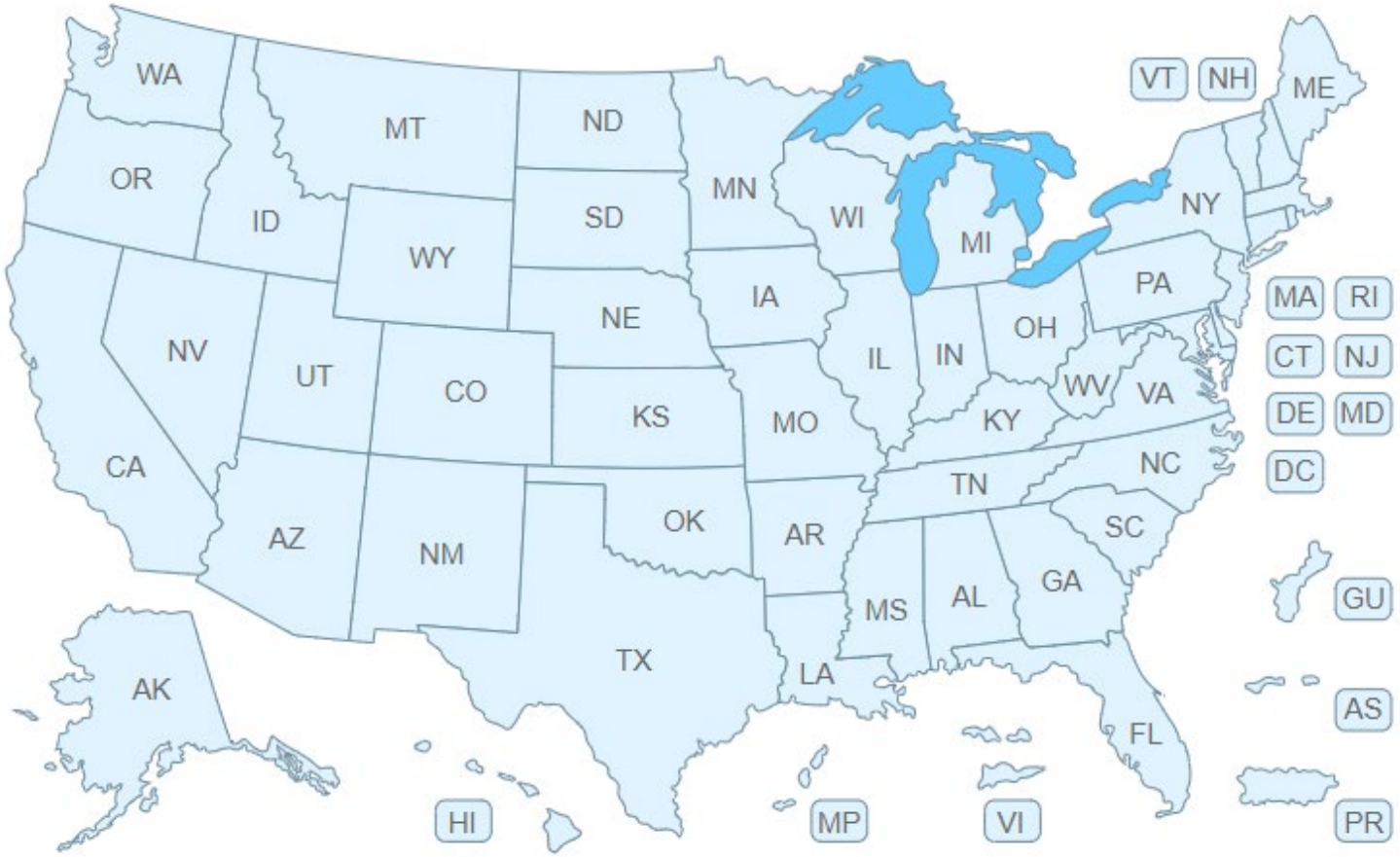
We're now open for questions

EFCN Funding Sources by State or Territory

https://efcnetwork.org/resources/funding-tables/

Provides

- Current loan and grant programs
- Eligibilities and terms
- Contact information



Contacts

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