NORTHEAST OHIO REGIONAL SEWER DISTRICT

# SEWER U

## SEWER UNIVERSITY

The history of sewers and the future of clean water in Greater Cleveland

Northeast Ohio Regional Sewer District

@neorsd #SewerU

Presentation available at
**neorsd.org/sewerU**

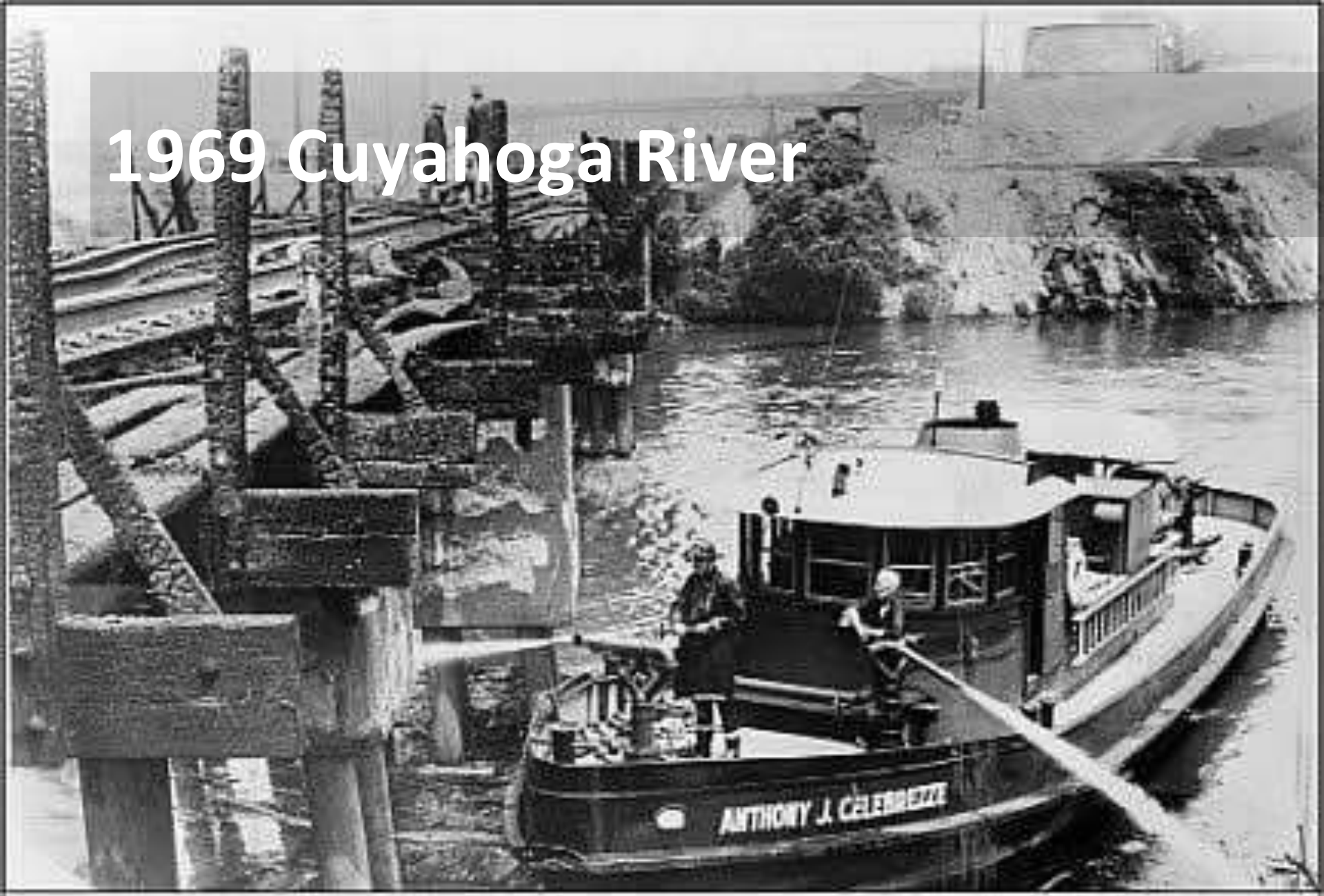
Tweet with **@neorsd #SewerU**

Save the date: Open House 2016
**Saturday, September 17, 9am-4pm**
neorsd.org/OpenHouse.


1952 Cuyahoga River


1960s Cuyahoga River

# 1969 Cuyahoga River




*The aftermath of the June 22, 1969 fire as the fire boat continues to break up oil slicks. (Photo courtesy of The Cleveland Public Library Photograph Collection.)*

# Your SewerU syllabus

- NEORSD Responsibilities
- Urban Water Cycle
- Sewer System 101
- WWTP 101
- Issues, Challenges and Solutions

# Your SewerU syllabus

- **NEORSD Responsibilities**
- Urban Water Cycle
- Sewer System 101
- WWTP 101
- Issues, Challenges and Solutions

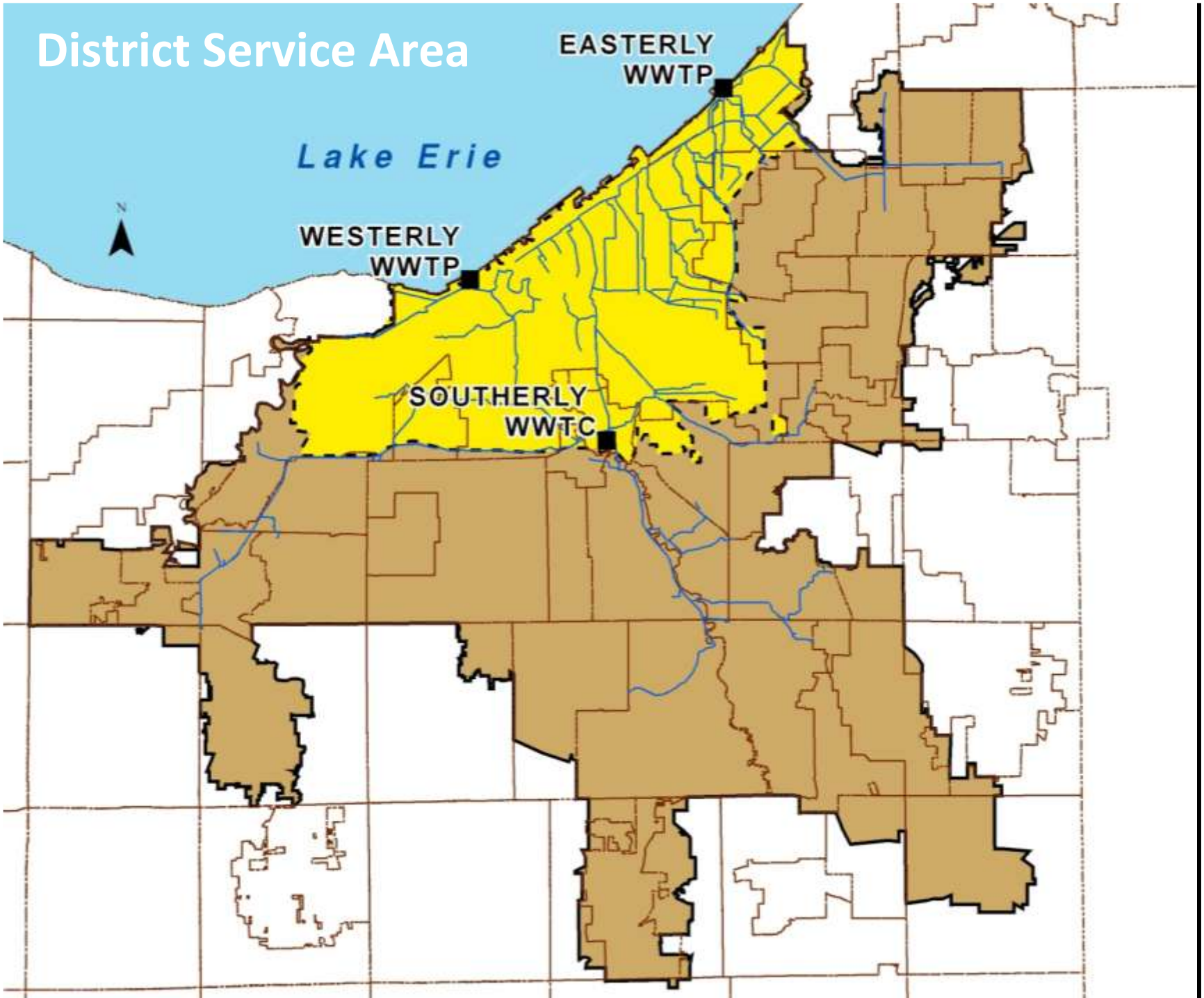
# Who We Are…

- Created in 1972 by Court Order
- Servicing all or part of 62 member communities
- 1 million customers
- 90+ billion gallons wastewater treated each year

# Key Responsibilities

- WWTP Operation
  - Easterly, Southerly, Westerly
- Combined and Separate Interceptors
  - Construction, Operation and Maintenance
- Combined Sewer Overflow (CSO) Control
- Regional Stormwater Management

# Wastewater Treatment Plants


District Service Area
EASTERLY WWTP
Lake Erie
N
WESTERLY WWTP
SOUTHERLY WWTC

# Over 40 years of investment

- Since 1972: **$4+ billion**
  - Wastewater treatment plants
  - Interceptor and relief sewers
  - CSO control and interceptor rehab
  - Other facility upgrades

# Your SewerU syllabus

- NEORSD Responsibilities
- **Urban Water Cycle**
- Sewer System 101
- WWTP 101
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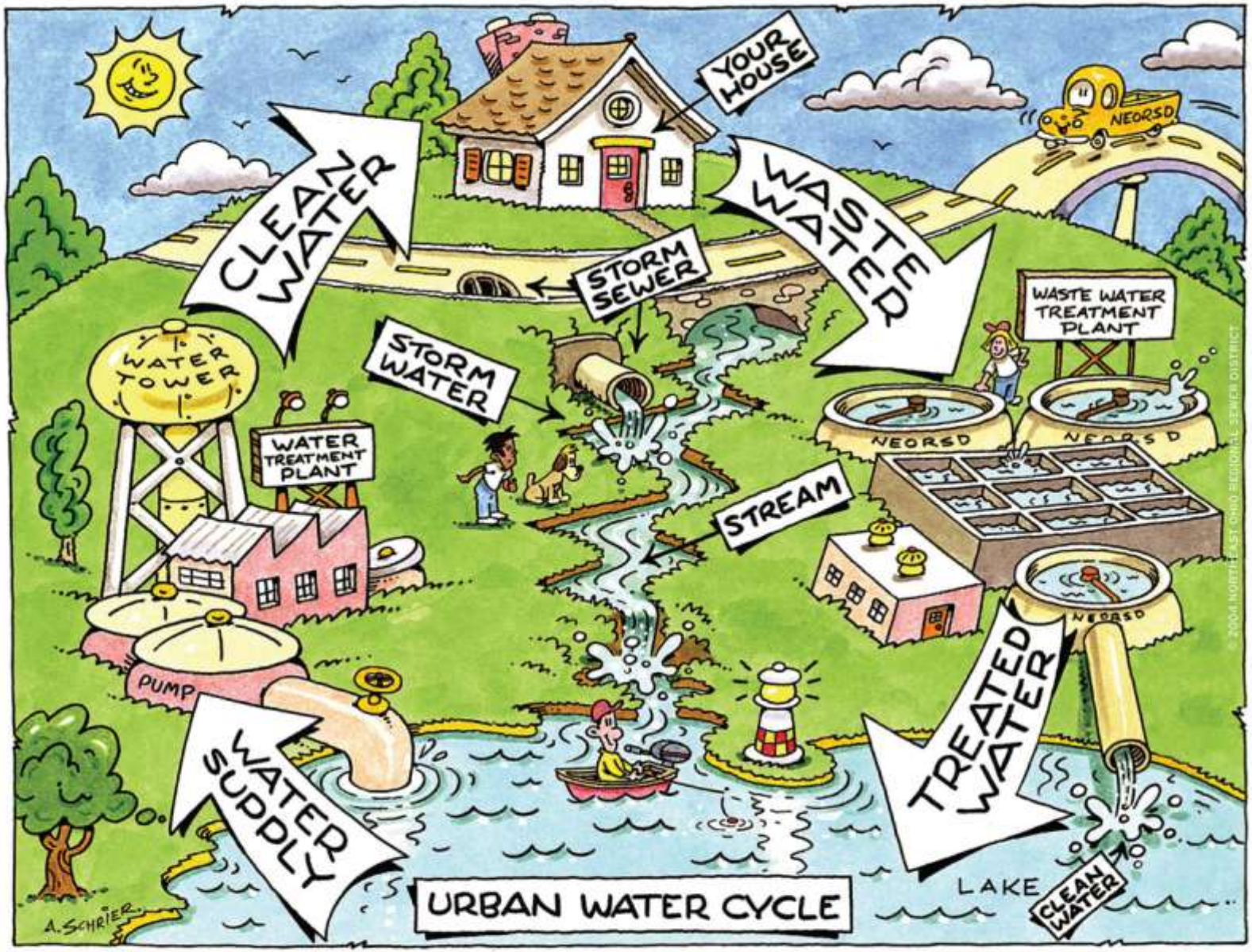


Northeast Ohio Regional Sewer District

# Your SewerU syllabus

- NEORSD Responsibilities
- Urban Water Cycle
- **Sewer System 101**
- WWTP 101
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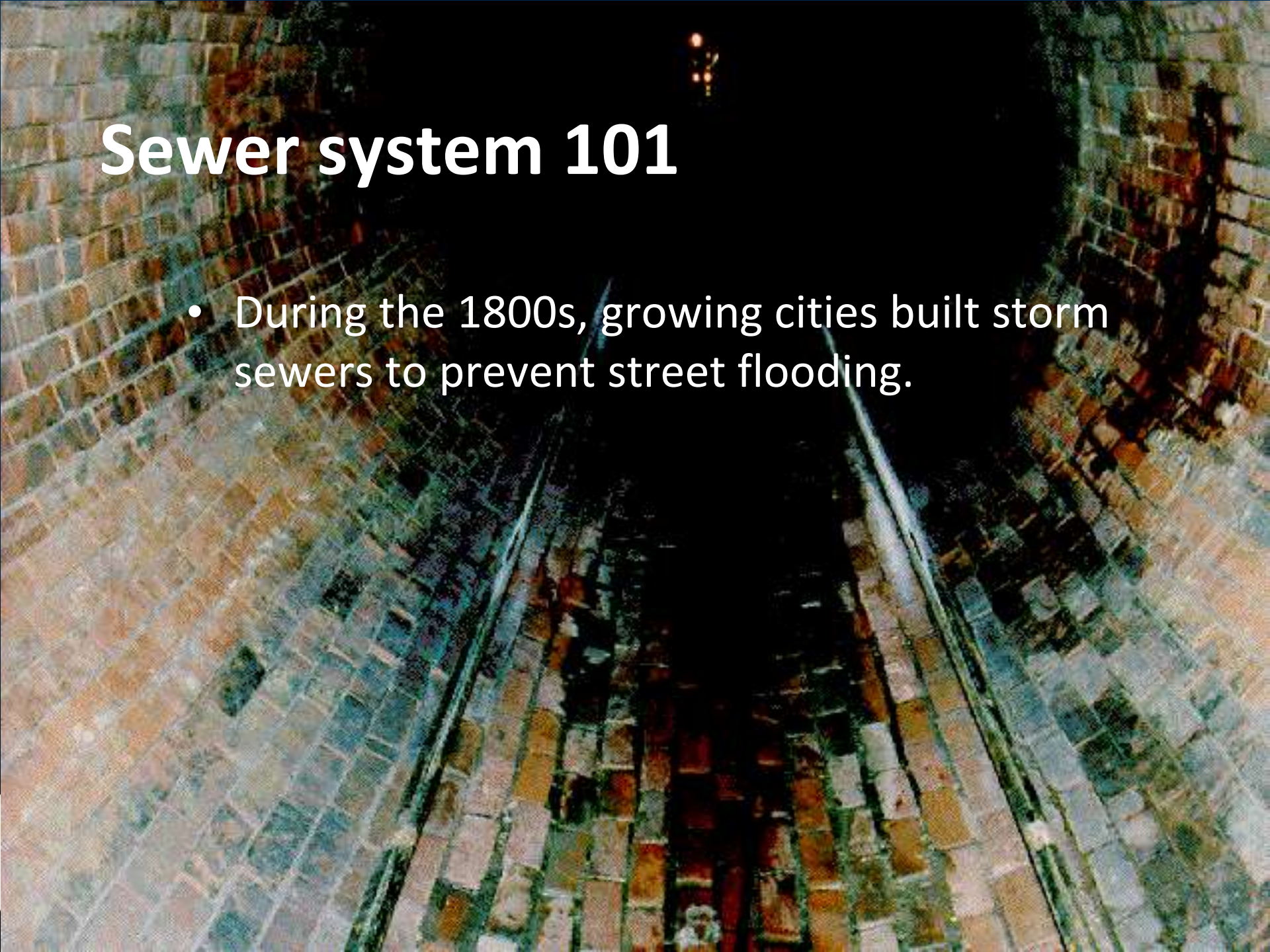
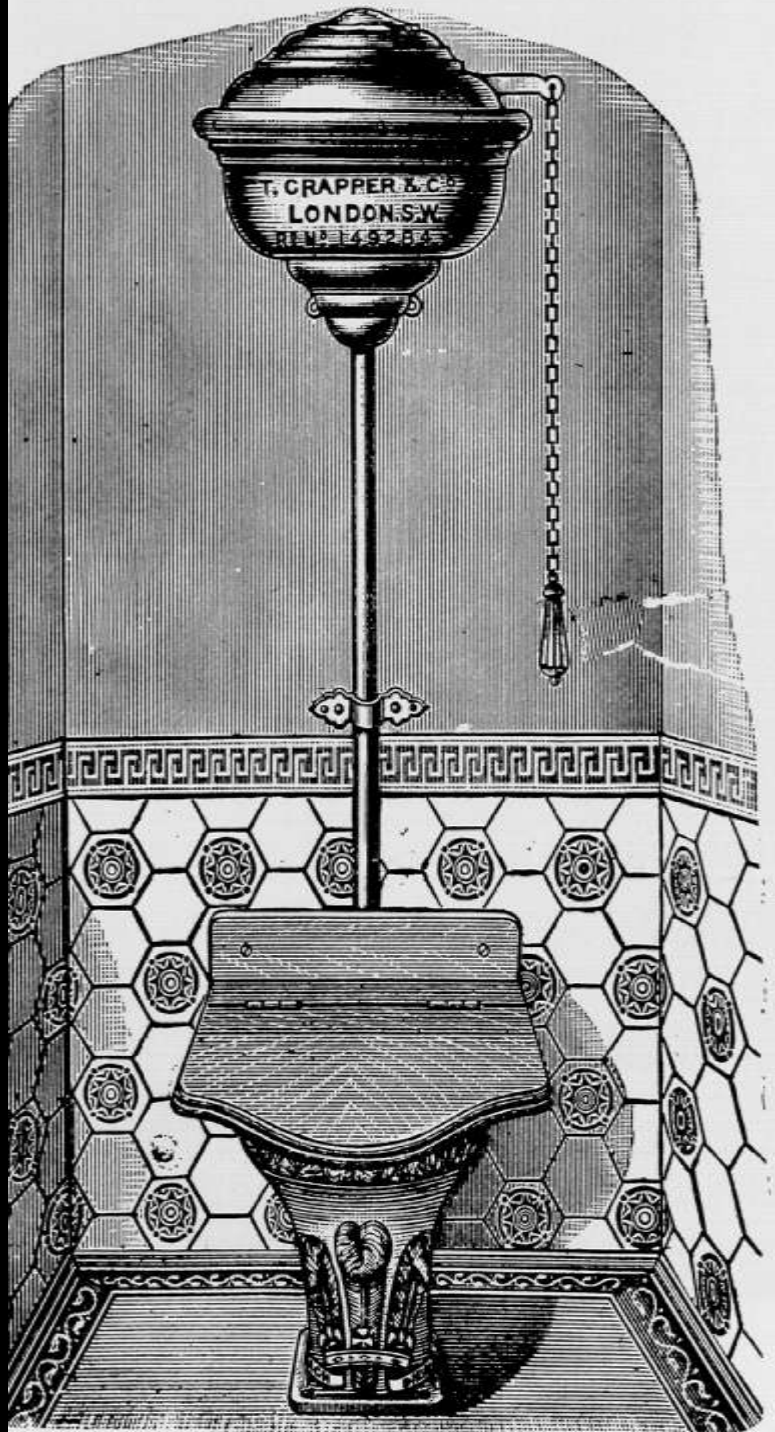


# Sewer system 101

- During the 1800s, growing cities built storm sewers to prevent street flooding.



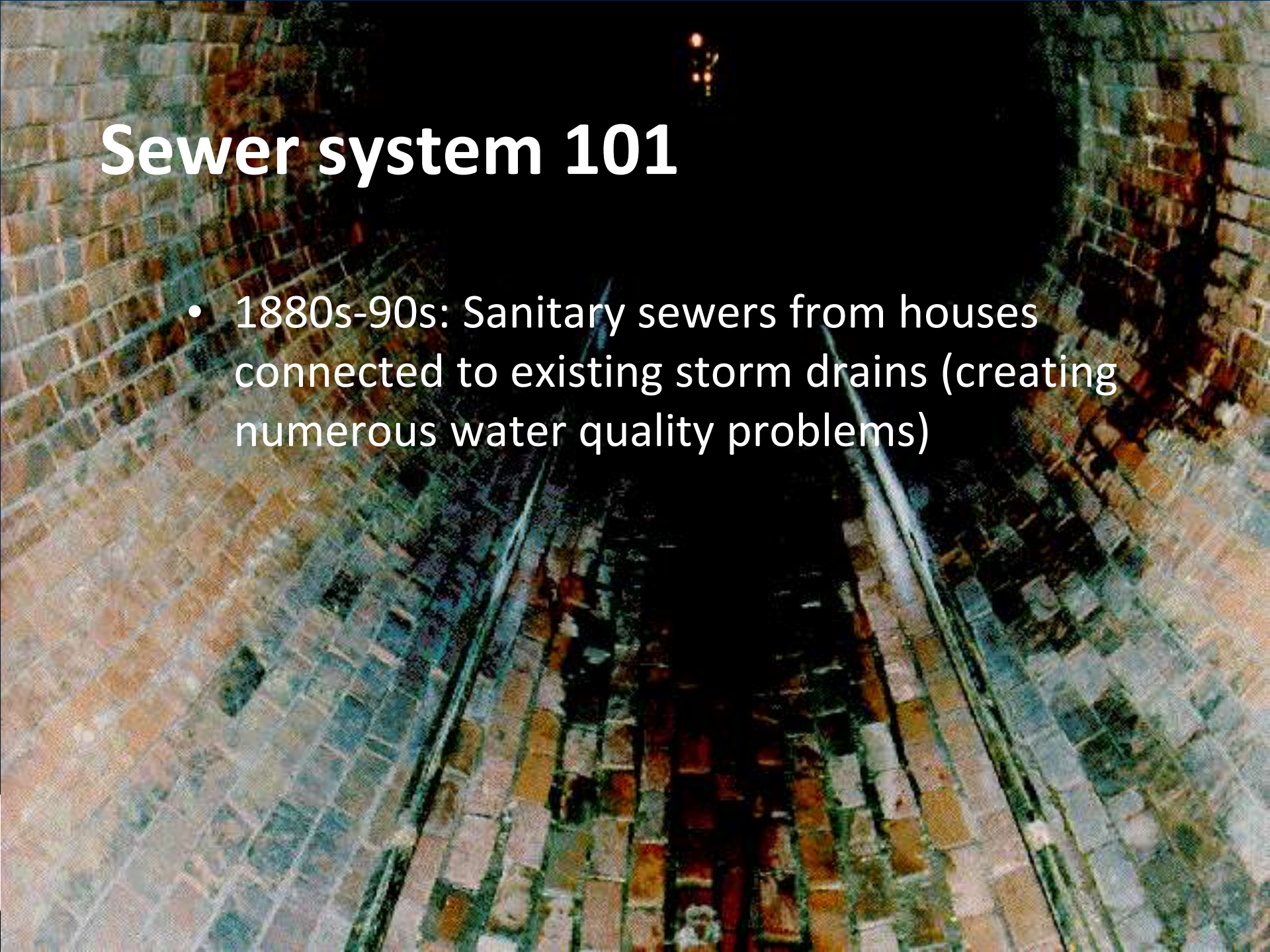

# CRAPPER'S

## Improved Registered Ornamental Flush-down W.C.

**With New Design Cast-iron Syphon Water Waste Preventer.**

No 518.

Improved Ornamental Flush-down W.C. Basin (Registered No. 145,823), Polished Mahogany Seat with flap, New Pattern 3-gallon Cast-iron Syphon Cistern (Rd. No. 149,284), Brass Flushing Pipe and Clips, and Pendant Pull, complete as shown ... ... £6 15 0



# Sewer system 101

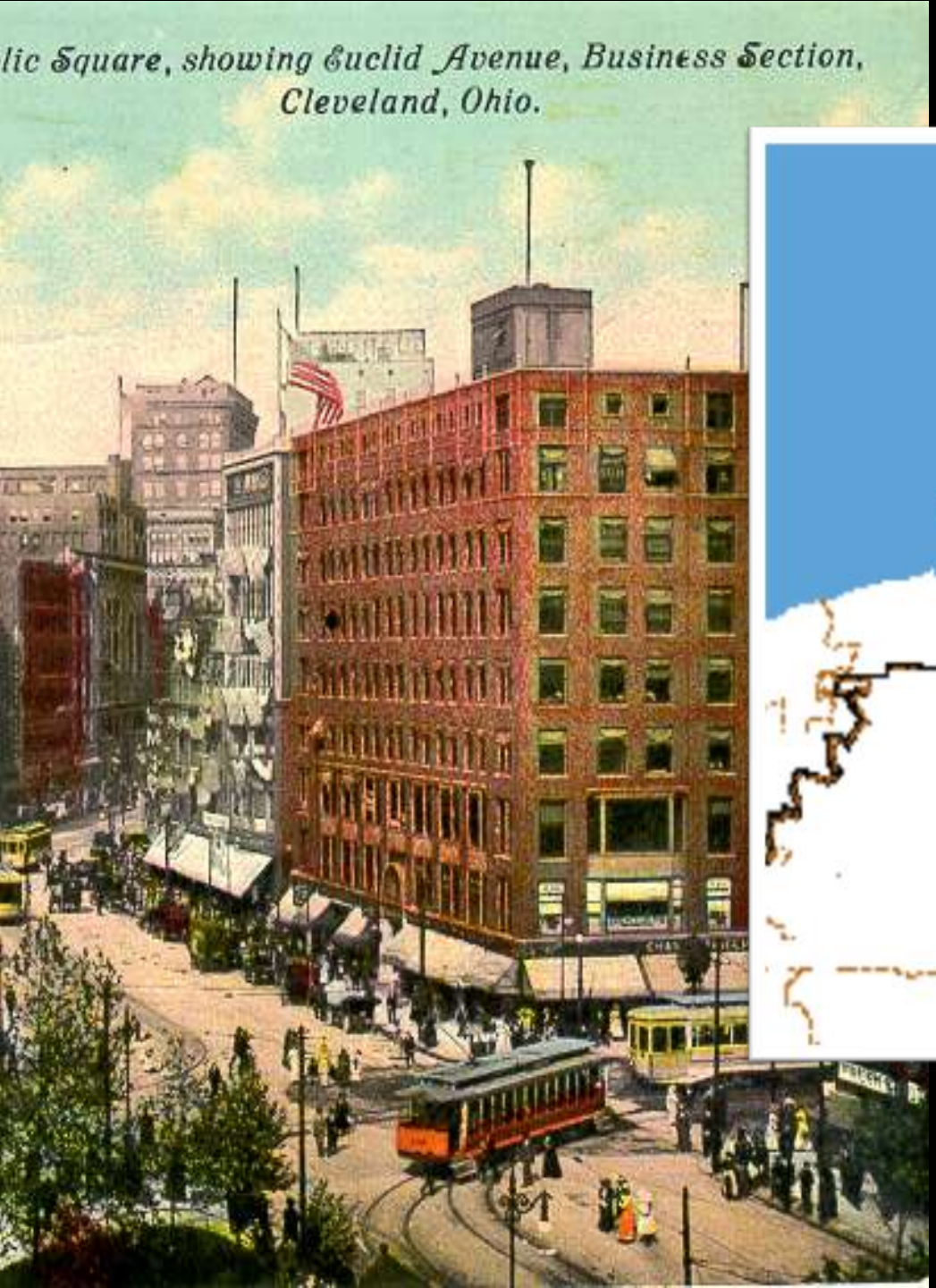
- 1880s-90s: Sanitary sewers from houses connected to existing storm drains (creating numerous water quality problems)

# Combined sewers

- Matter of evolution, then matter of choice
  - "For the closely built up sections of your city, where the streets are all paved, and much organic matter is washed away by the rain water, the separate or double system is not to be recommended, because the rain water channels would become almost as foul as the sewers and require a similar treatment, therefore making the separation uncalled for and more expensive." — R. Hering, 1882

# Sewer system 101

- 1899-1939: Construction of “Intercepting Sewers” to collect sanitary flow, and deliver it to Lake Erie and Cuyahoga River at three outfall locations (consolidate water quality problems)


lic Square, showing Euclid Avenue, Business Section,
Cleveland, Ohio.

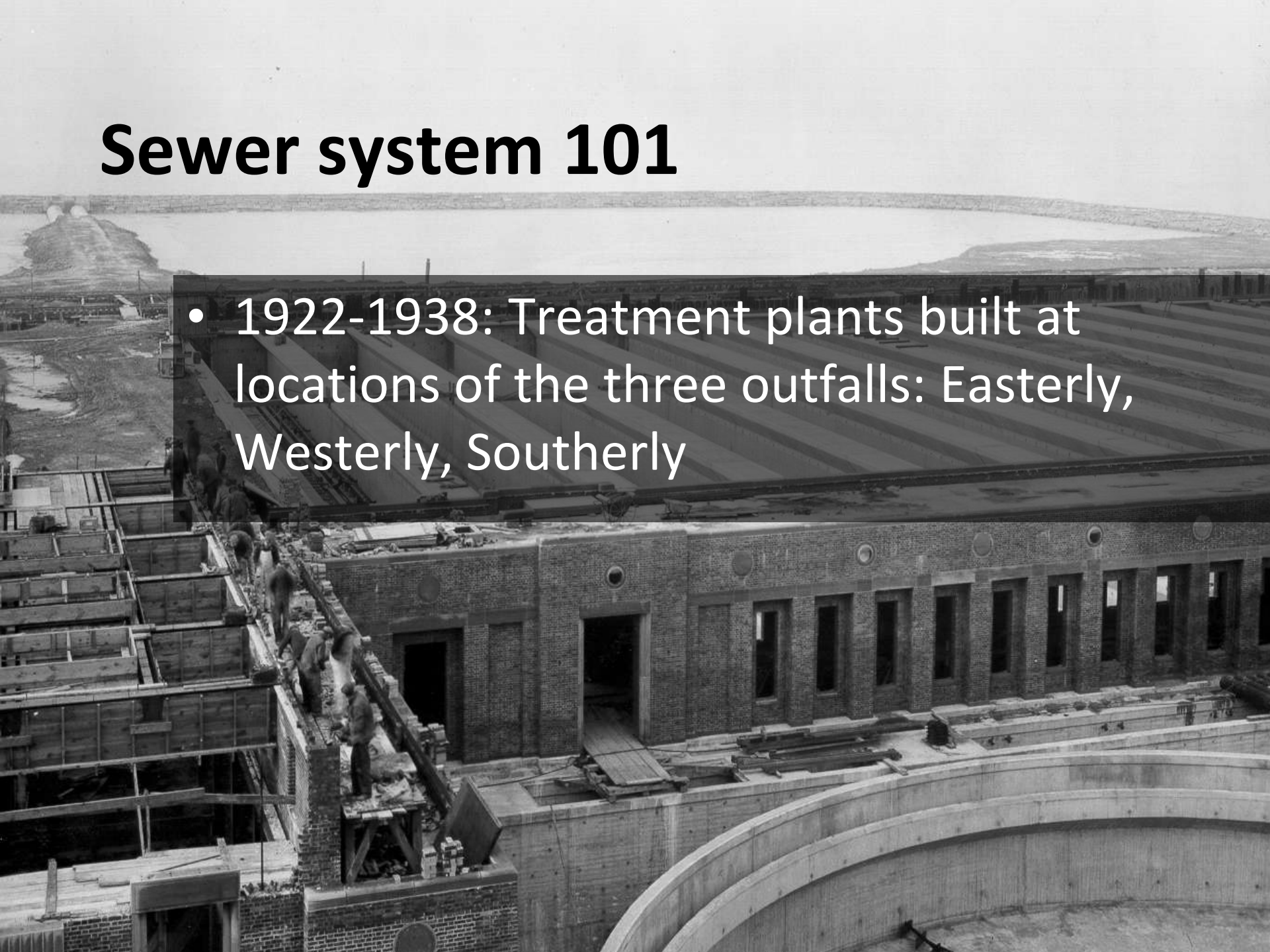

EASTERLY
WESTERLY
SOUTHERLY

# Interceptor sewers

- "Highways" of sewer system, collecting wastewater from smaller sewers serving individual streets

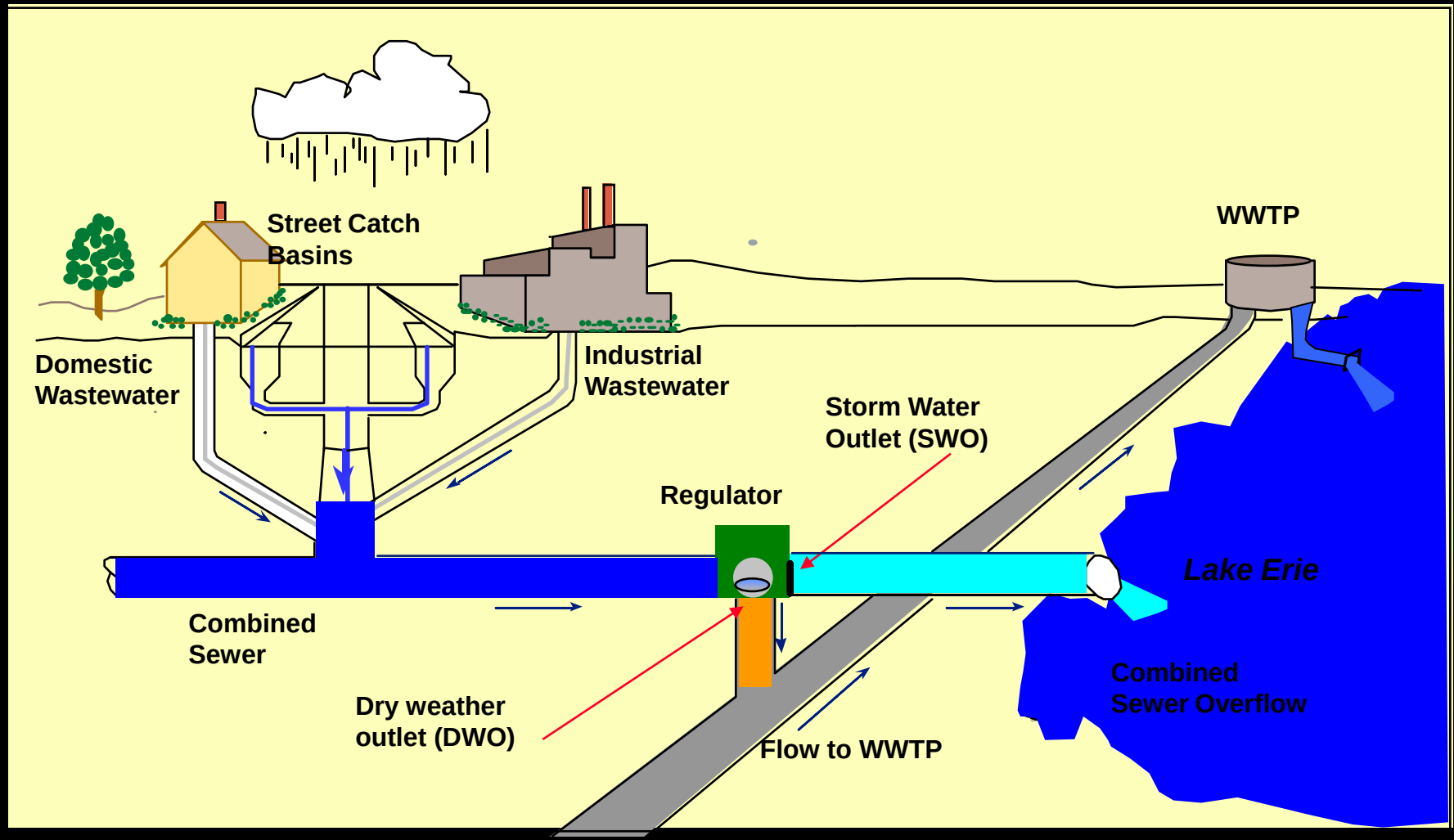
"Dilution is the solution to pollution."

# Sewer system 101



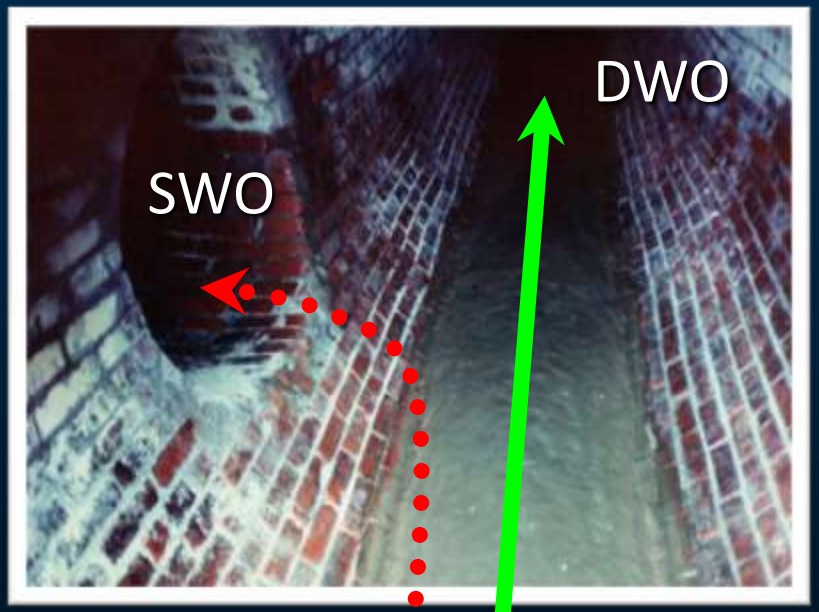
- 1922-1938: Treatment plants built at locations of the three outfalls: Easterly, Westerly, Southerly

# Combined sewer system



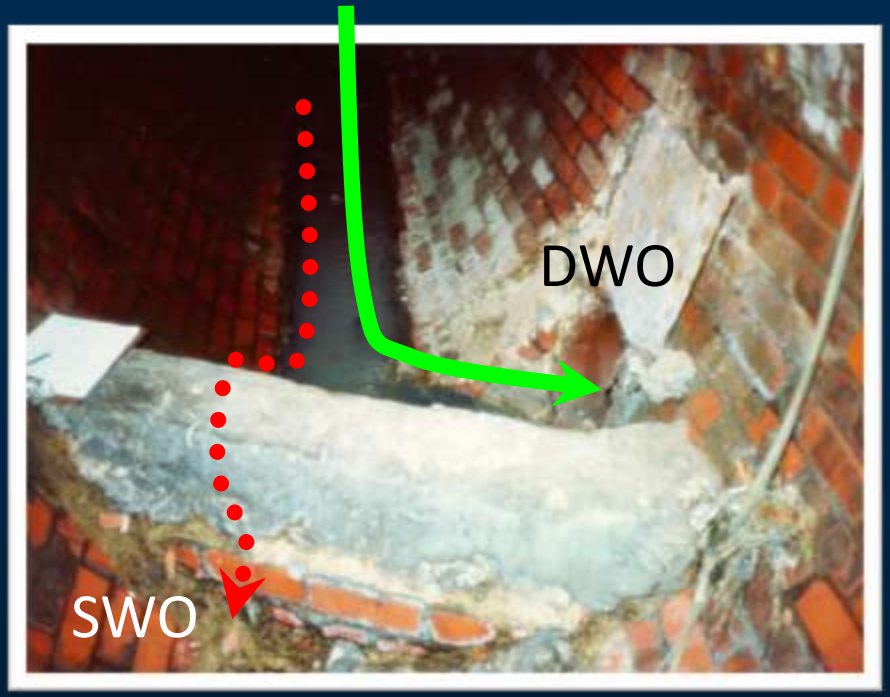
# Combined sewer system

- Regulating structures allow excess stormwater to overflow



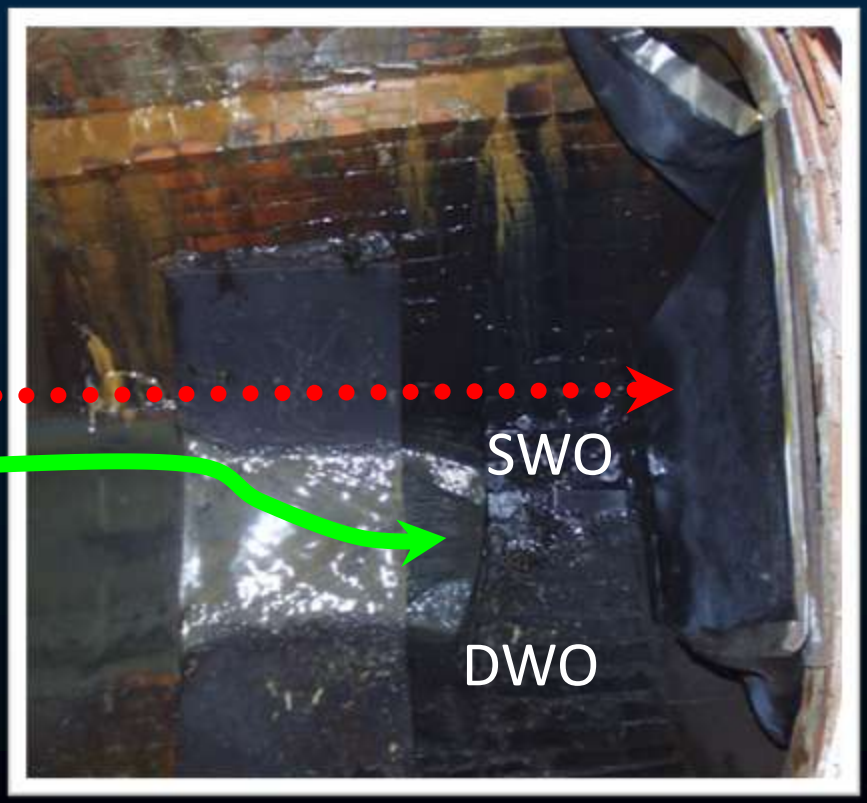

**Overflow pipe**


**Side-spill weir**

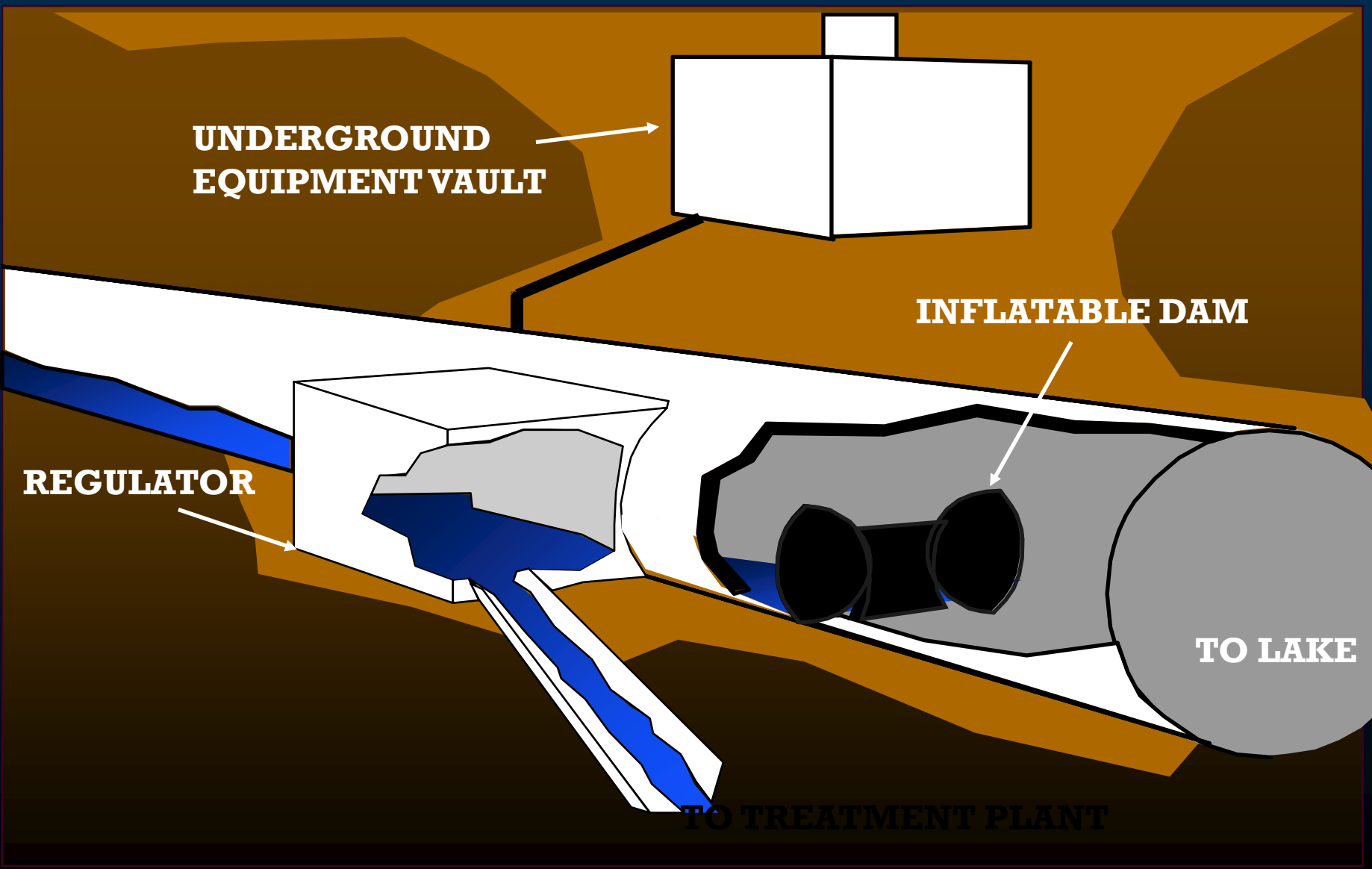



**Perpendicular weir**

**Leaping weir**

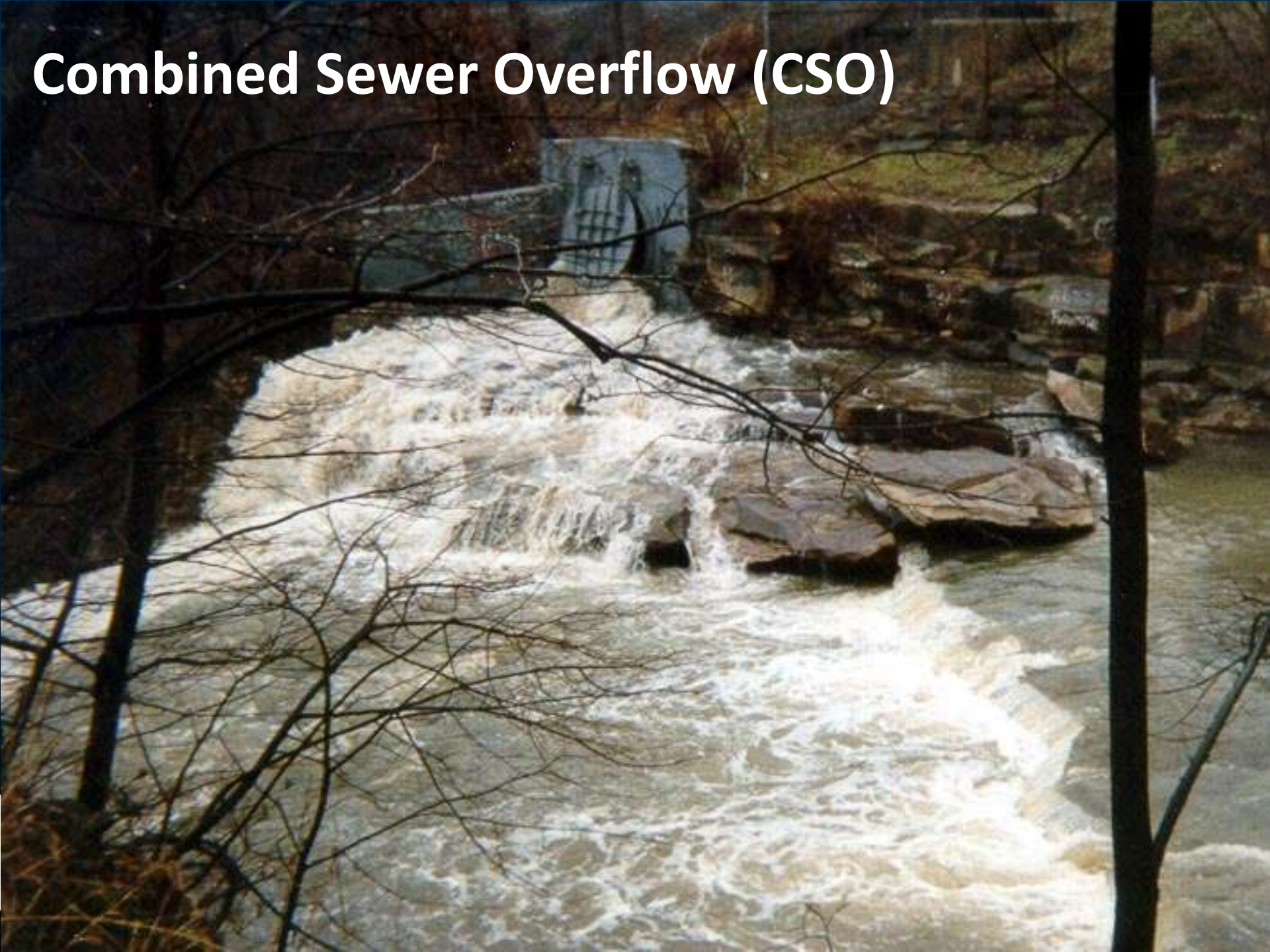


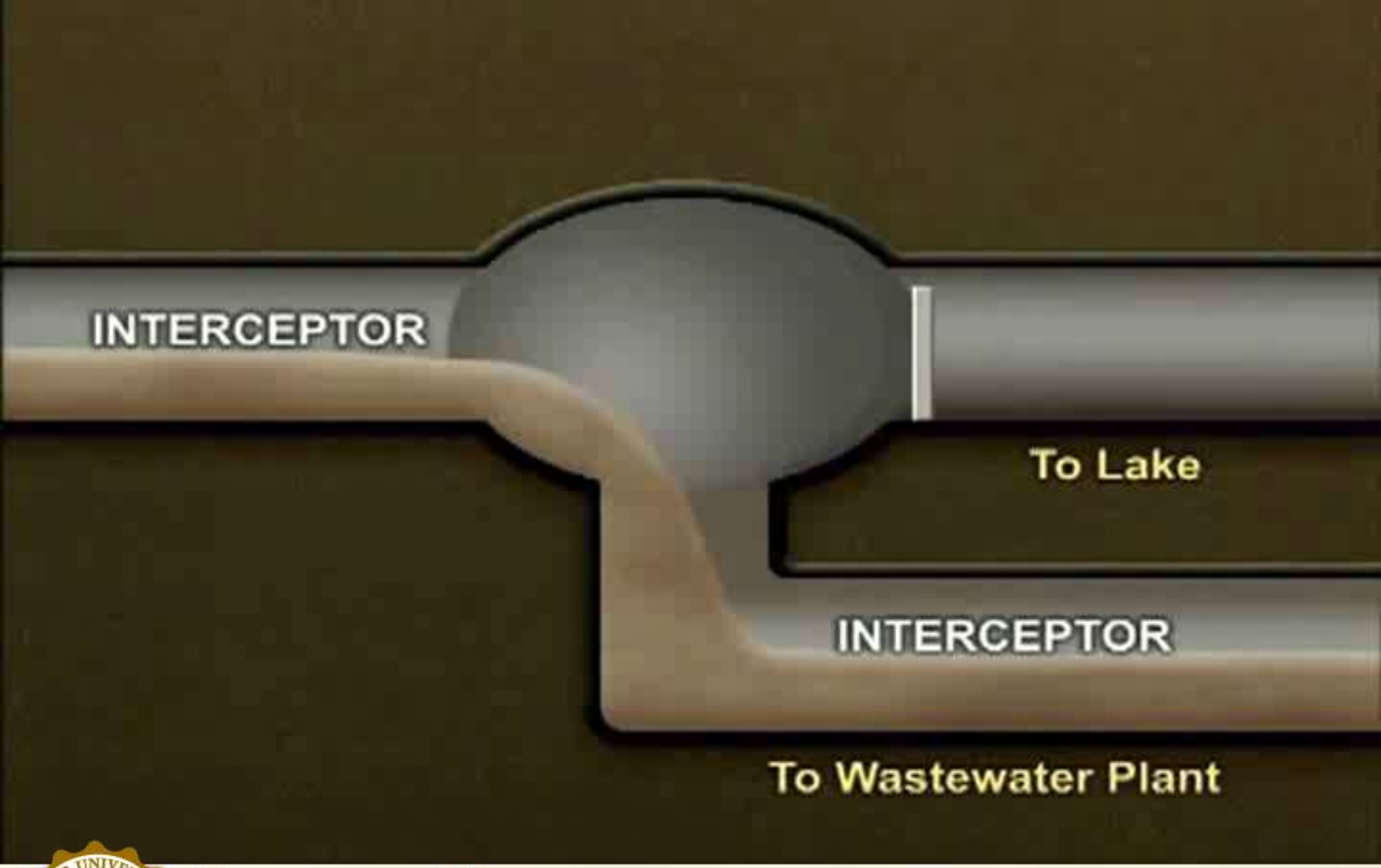
# Typical automated regulator



# Automated Regulator

# Combined Sewer Overflow (CSO)






SEWER U
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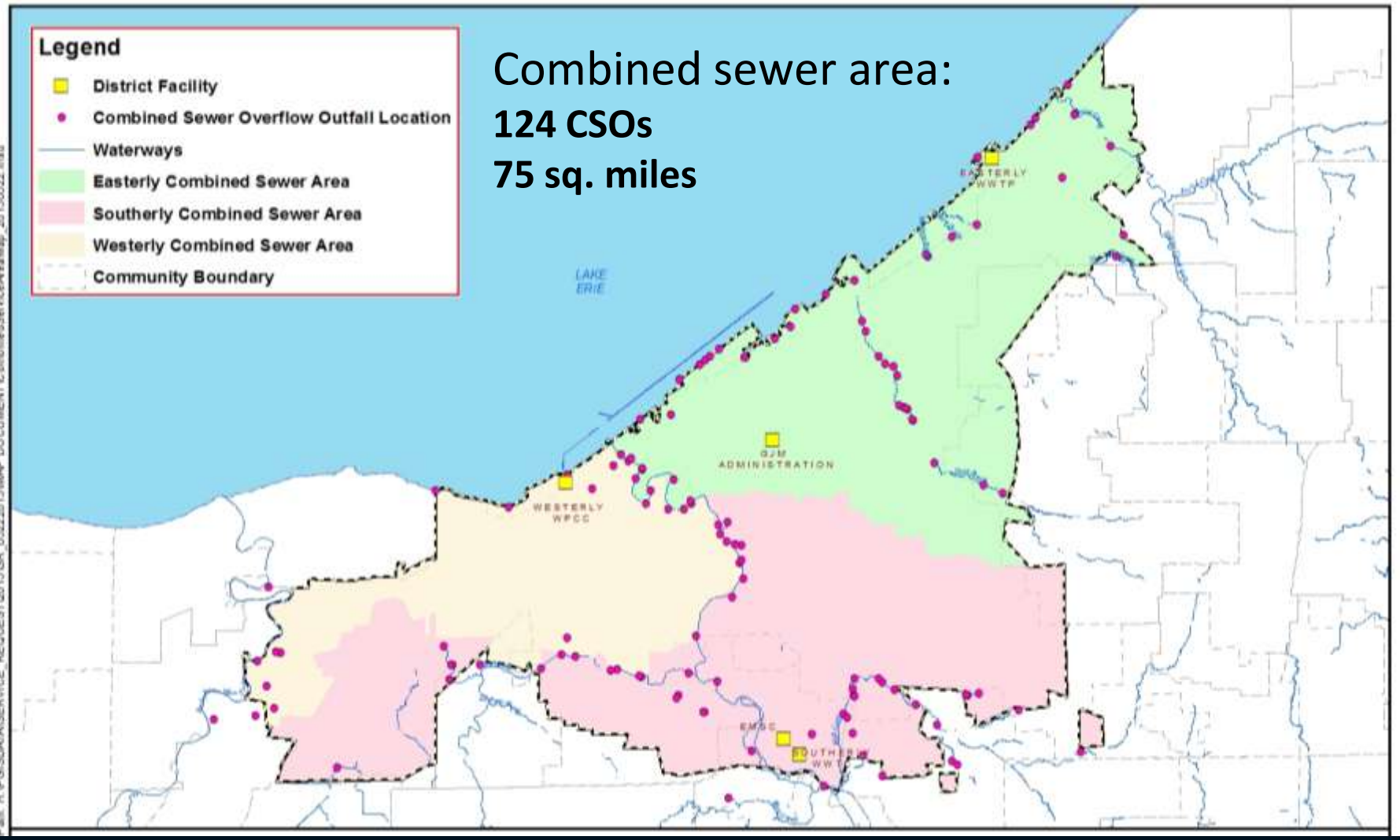
@neorsd #SewerU

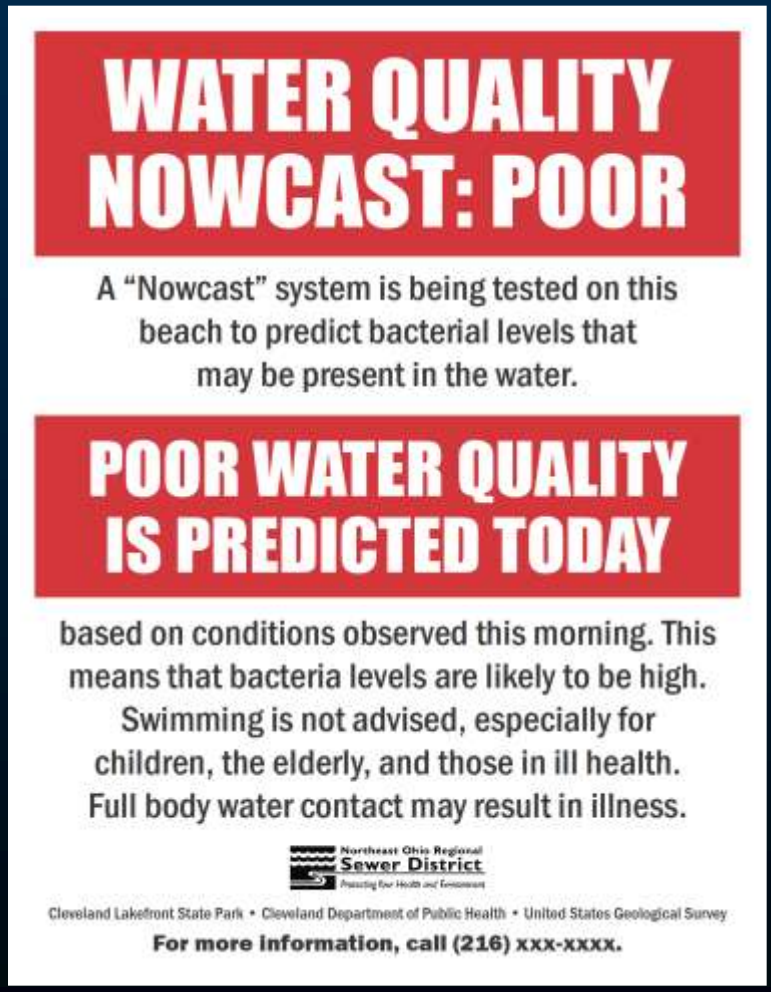
Northeast Ohio
Regional Sewer District


Legend
District Facility
Combined Sewer Overflow Outfall Location
Waterways
Easterly Combined Sewer Area
Southerly Combined Sewer Area
Westerly Combined Sewer Area
Community Boundary
Combined sewer area:
124 CSOs
75 sq. miles
LAKE ERIE
EASTERLY WWTP
ADMINISTRATION
WESTERLY WPCC
EMSC
SOUTHERLY WWTP

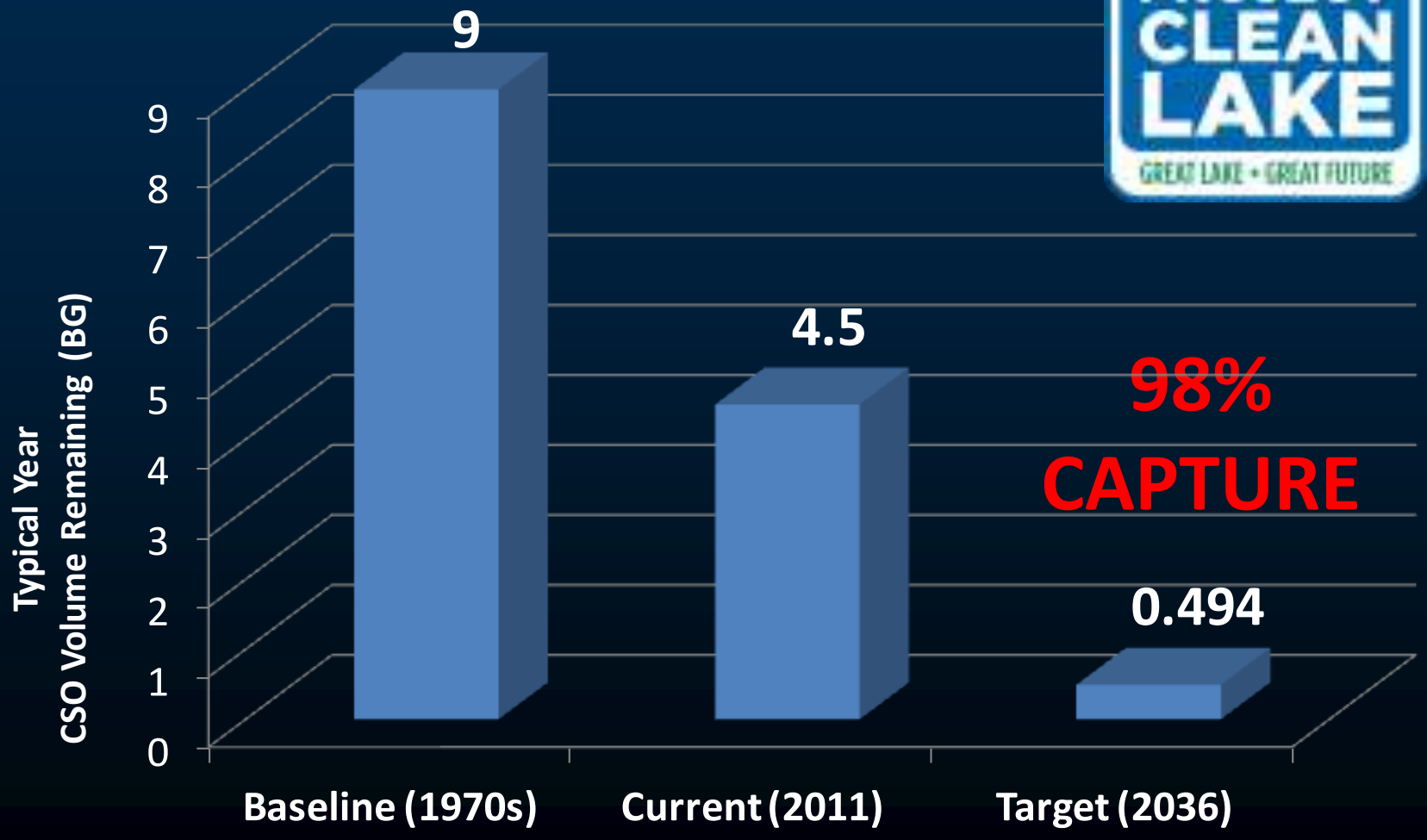
# CSOs impact water quality

- When it rains, the bacteria levels at local beaches and streams will be elevated

# Public notification

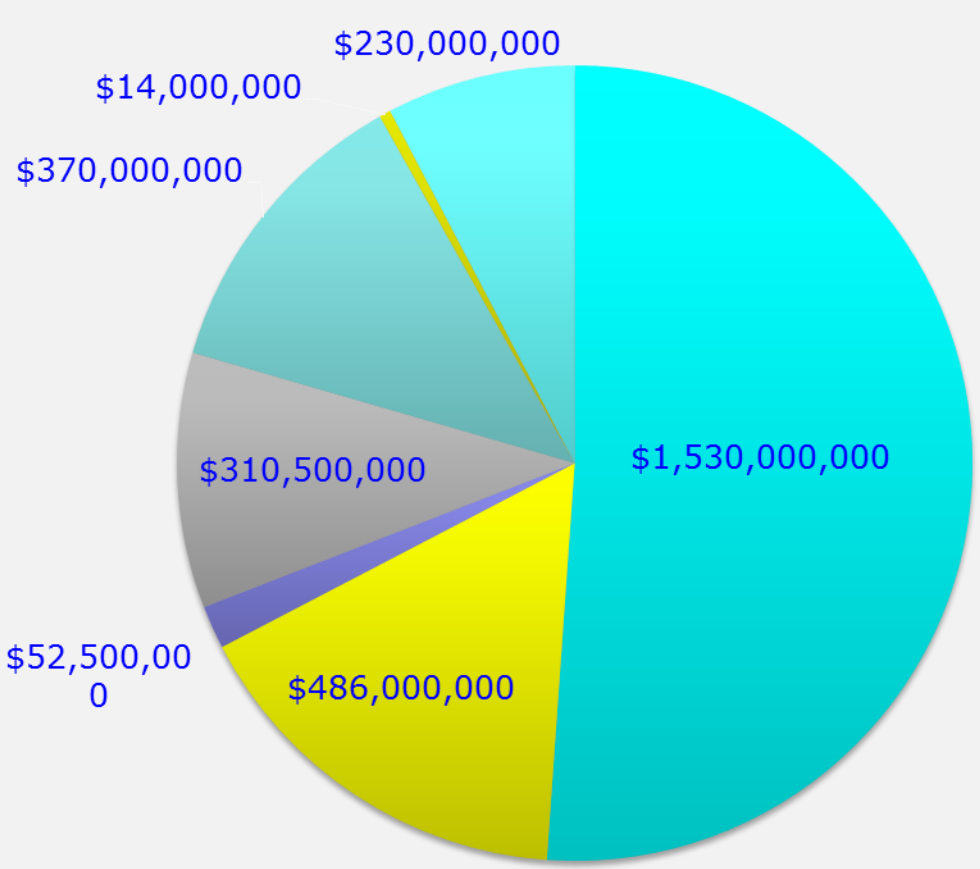



# Consent Decree significant CSO reduction in 25 years



# CSO Long-Term Control Plan Consent Decree

Estimated $3B investment in CSO control measures over 25 years




PROJECT CLEAN LAKE
GREAT LAKE • GREAT FUTURE

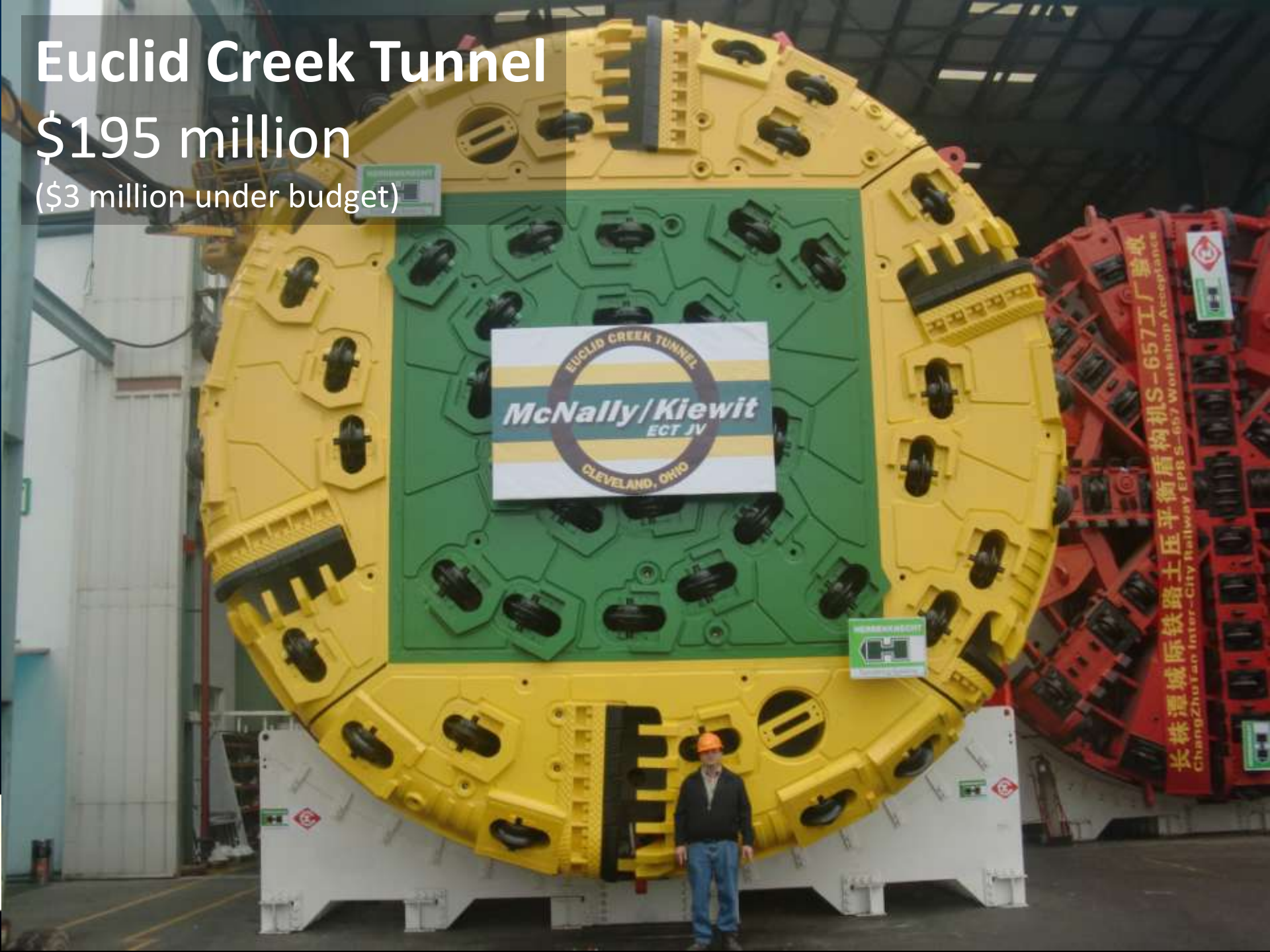

PROJECT CLEAN LAKE
TUNNELS CONSTRUCTION
SHORELINE
STORAGE TUNNEL
21' DIAMETER
16,500' LONG
2019
ADVERTISE FOR BID
WESTERLY CSO
STORAGE TUNNEL
24' DIAMETER
11,500' LONG
2018
ADVERTISE FOR BID
EUCLID CREEK & DUGWAY
STORAGE TUNNELS
24' DIAMETER
33,000+ TOTAL FT.
Euclid Creek online 2016,
Dugway online 2019
TUNNEL DEWATERING PUMP STATION
200' DEEP
160 MGD
Complete 2016
DOAN VALLEY
STORAGE TUNNEL
18' DIAMETER
10,000' LONG
2017
ADVERTISE FOR BID
BIG CREEK
STORAGE TUNNEL
18' DIAMETER
22,400' LONG
2029
ADVERTISE FOR BID
SOUTHERLY
STORAGE TUNNEL
23' DIAMETER
18,350' LONG
2024
ADVERTISE FOR BID
CLEVELAND
LINNDALE
CLEVELAND HEIGHTS
GARFIELD HEIGHTS
MAPLE HEIGHTS

# Euclid Creek Tunnel

## $195 million

($3 million under budget)


- 3+ miles long
- 24 ft. diameter
- 60 MG storage
- 300 MG CSO Reduction




# Euclid Creek Tunnel

## $195 million

($3 million under budget)

# Euclid Creek Tunnel

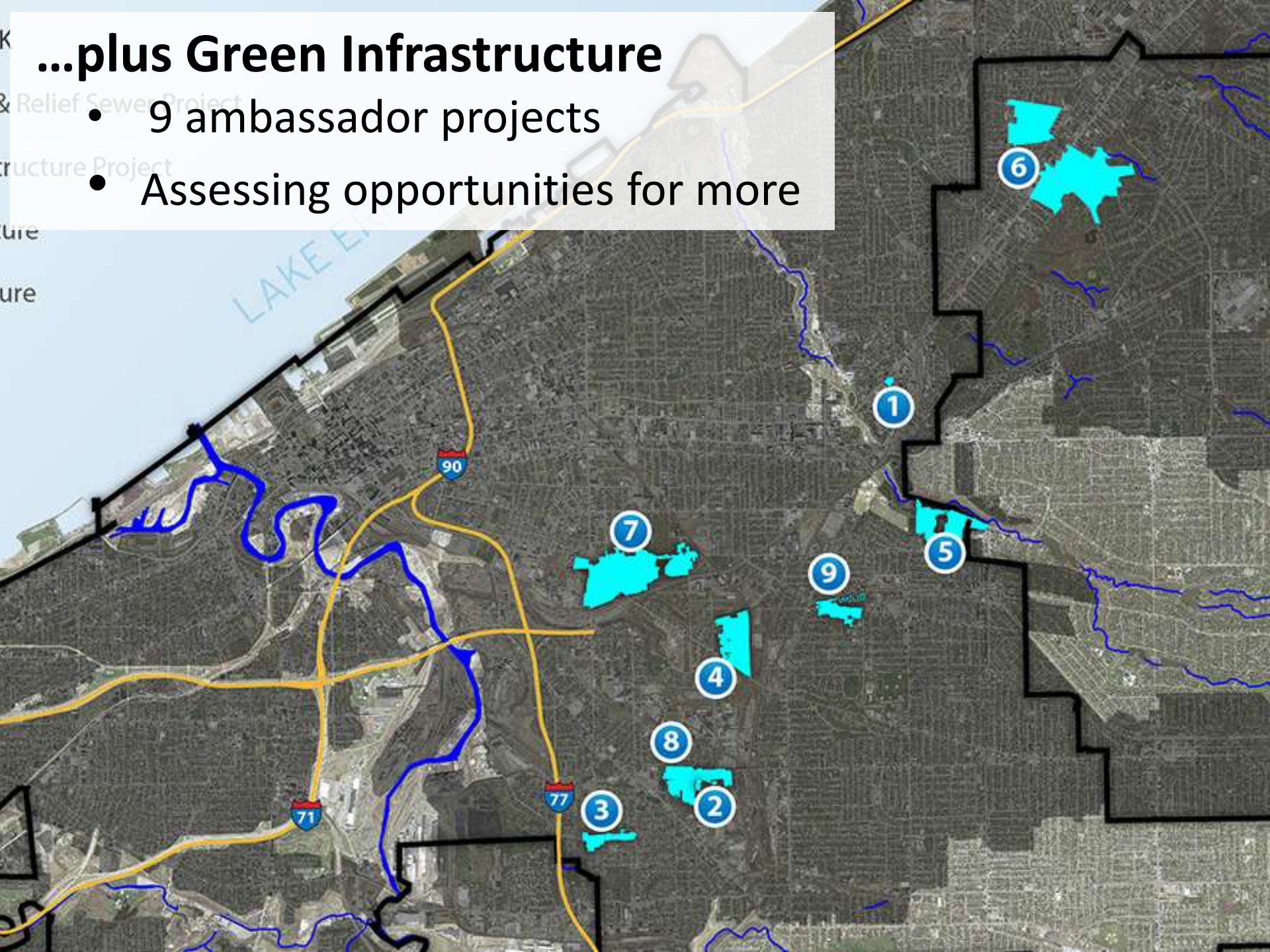
$195 million

($3 million under budget)


Euclid Creek Tunnel
$195 million
($3 million under budget)

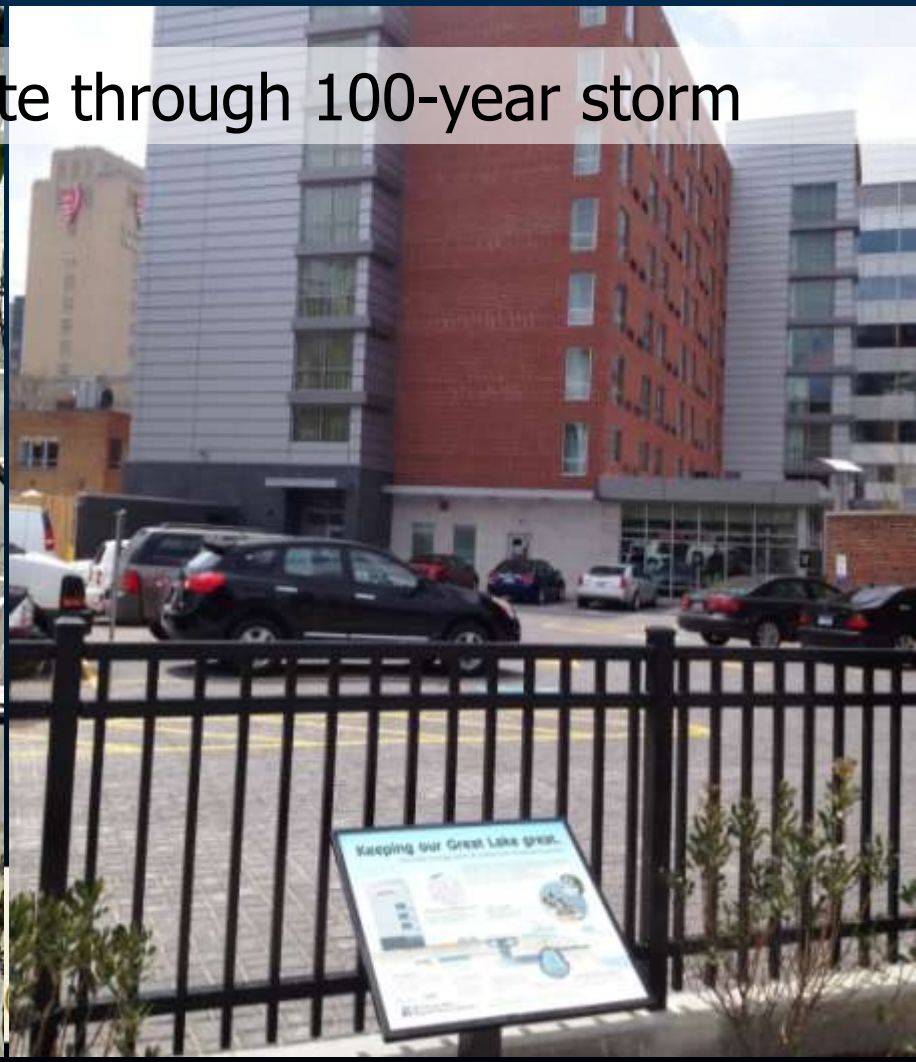
# …plus Green Infrastructure

- 9 ambassador projects
- Assessing opportunities for more



**Green Infrastructure:** Stormwater out of Combined system
Courtyard by Marriott: Redevelopment + Sand = GI Opportunity

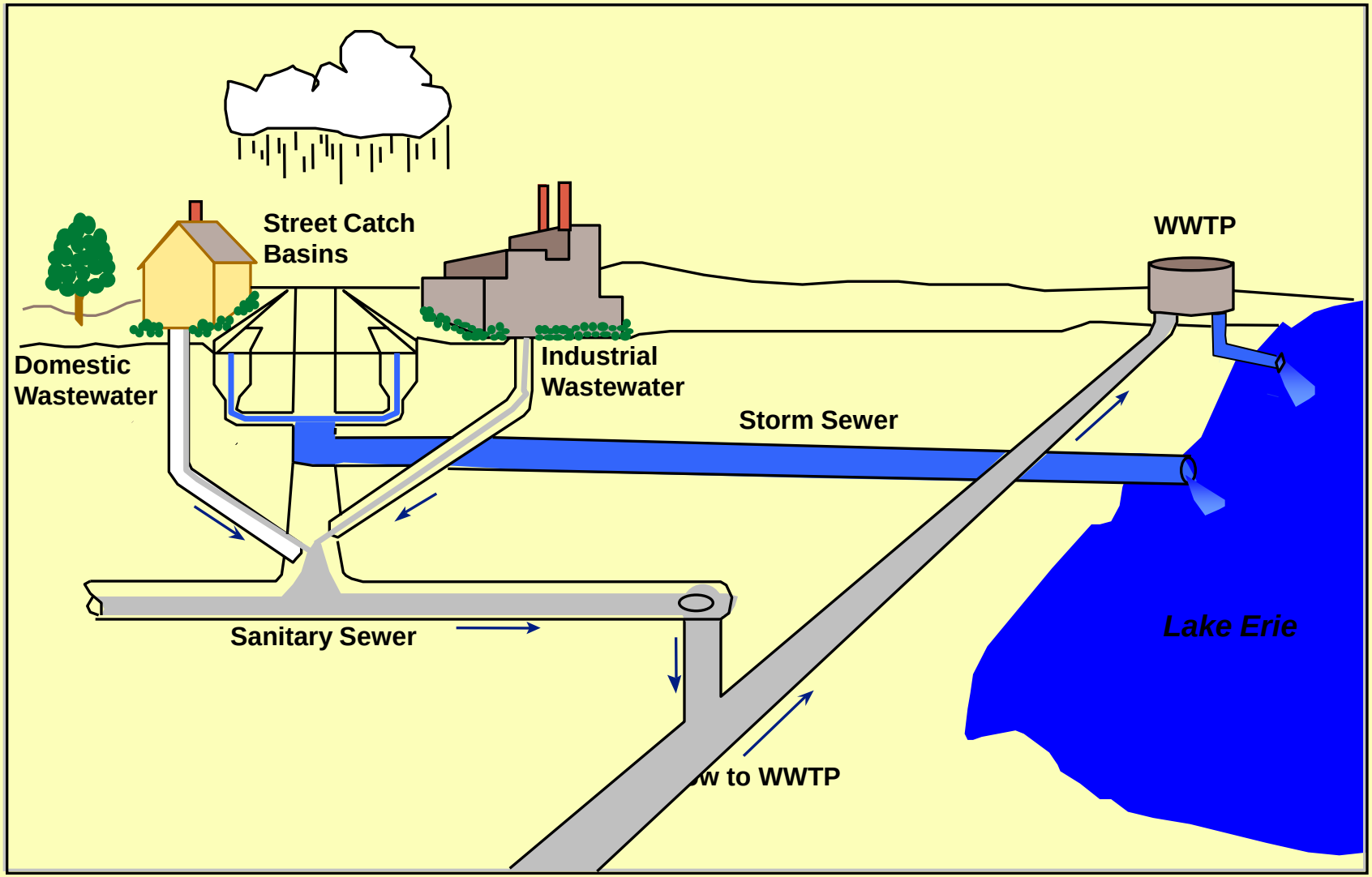

No stormwater runoff from this site through 100-year storm



Green Infrastructure

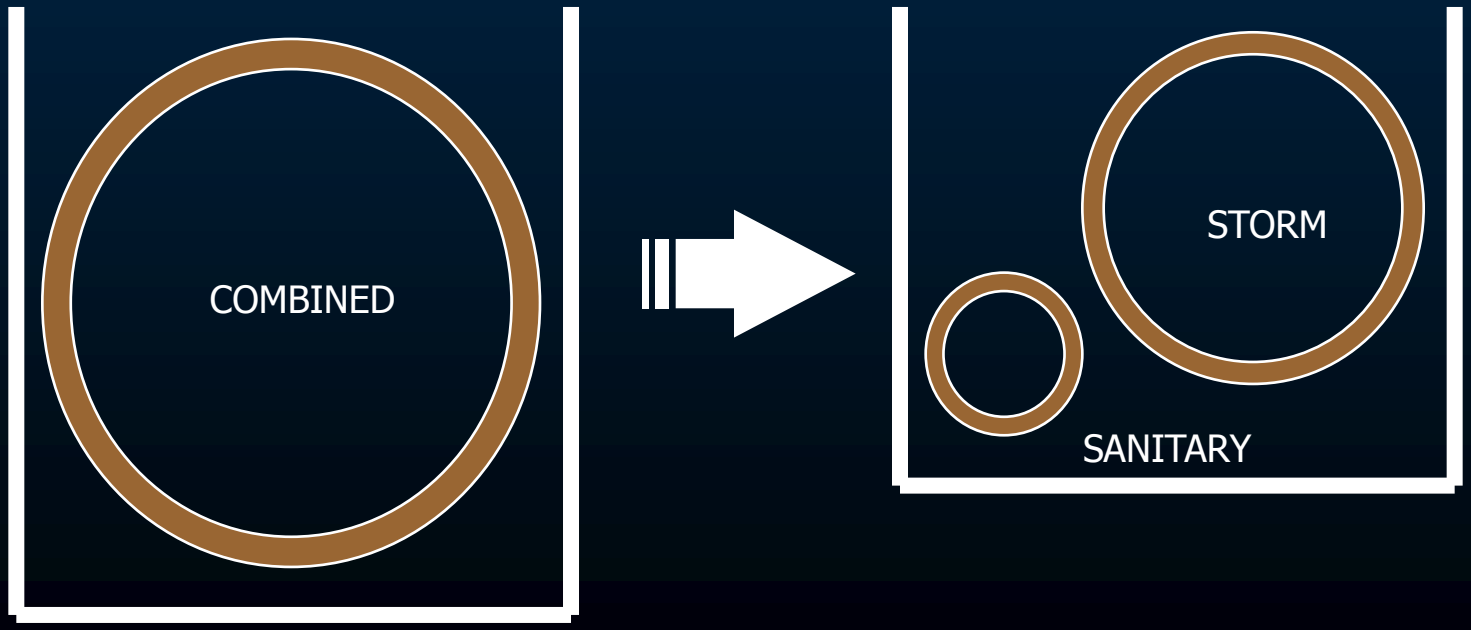
# **Funding:** Transformed Public Square

# Separate Sewer System

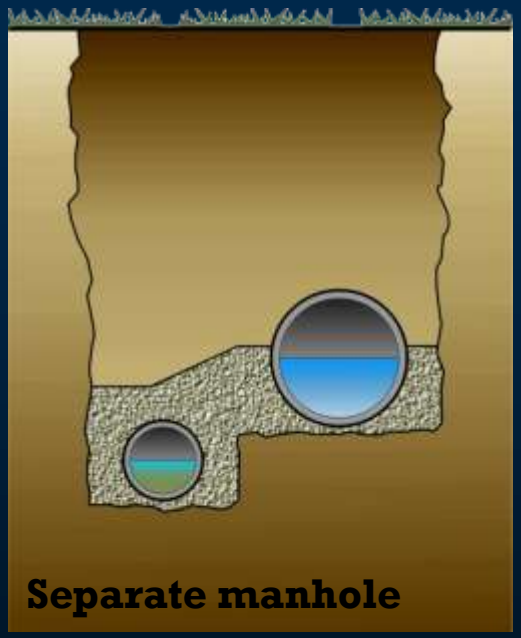


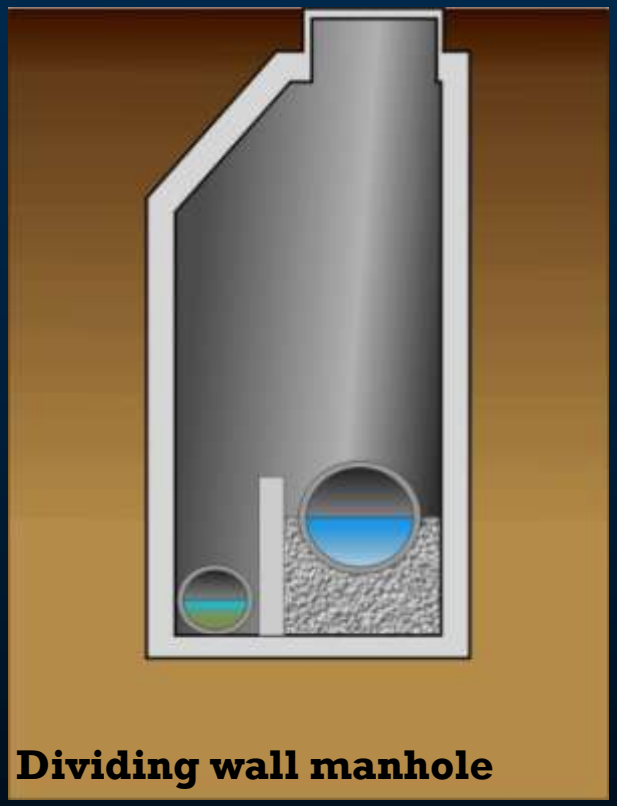
# Combined vs. Separate

- 1920s-1960s: evolution from combined sewers to separate sewers built in a common trench



# Combined vs. Separate

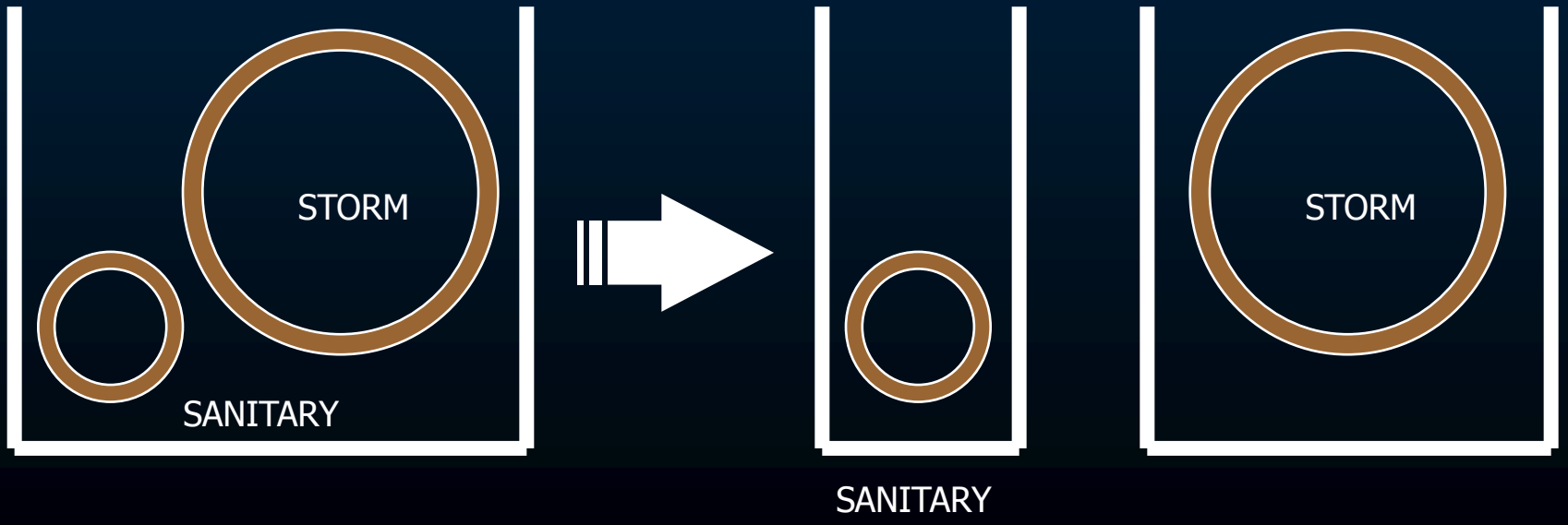


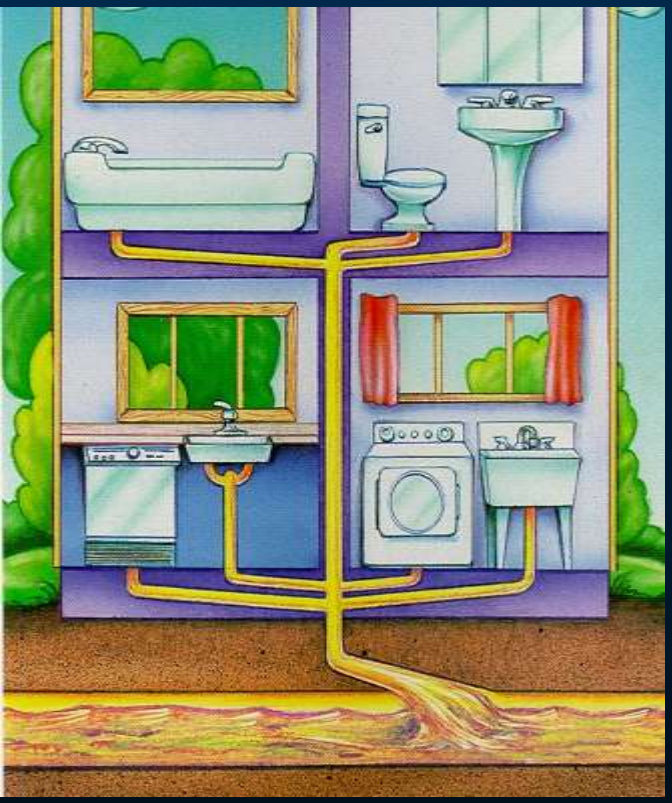

Over/under sewers use a plate in manholes to keep storm flows out of the sanitary sewer.

# Combined vs. Separate

- 1960s-today: evolution from common trench sewers to truly separate sewers in many areas



# Separate sewer problems

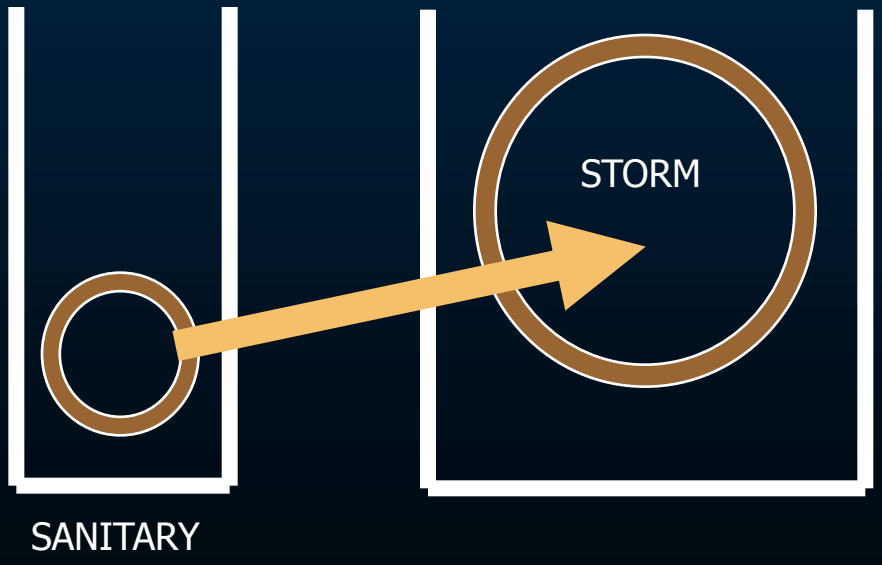


- Cross-connections (storm to sanitary or sanitary to storm)

# Illicit Connections

# Separate sewer problems

- Constructed sanitary sewer overflows to relieve full sanitary sewers during rain



# Sanitary Sewer Overflows

- SSO Structures
- Basement Flooding
- Surcharged sewers
- Common trench sewers


**What is I & I**
I & I stands for Inflow and Infiltration

**Inflow**
is the flow of stormwater into the sanitary sewer system through connections like roof drains, foundatiion drains, and basement sump pumps.

**Infiltration**
is groundwater seeping into sewer pipes, including private sewer laterals, through cracks and broken pipe joints.



Uncapped Cleanout
4" TO 6" TRANSITION
SEWER LATERAL
House
Faulty Manhole Cover or Frame
Deterioriated Manhole
STORM SEWER
SANITARY SEWER MAIN

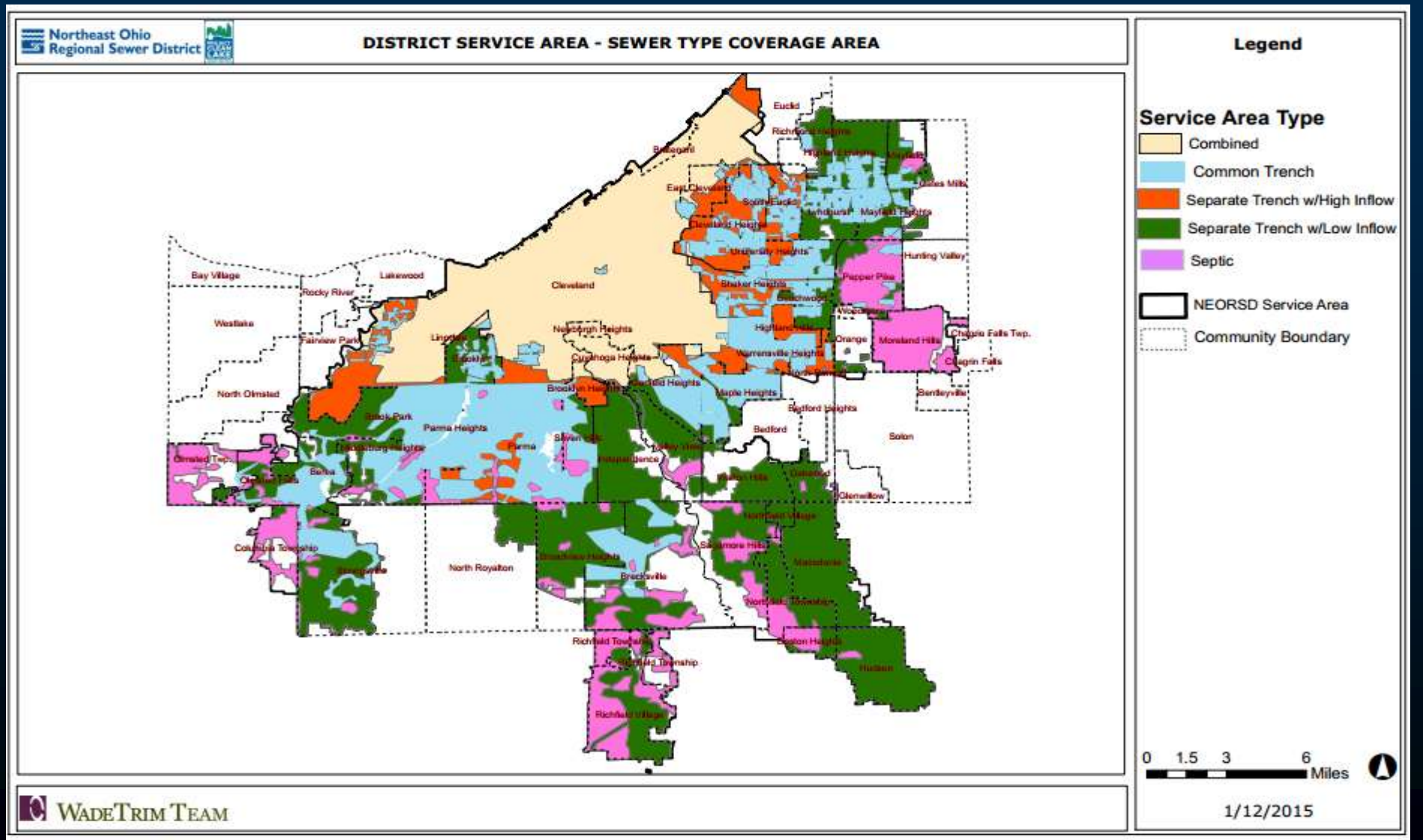
KEY
Inflow Source
Infiltration Source
maintained by village
maintained by homeowner

# Types of Sewers in the District's Service Area

- Combined
- Common Trench (storm and sanitary)
- Separate Trench (storm and sanitary)

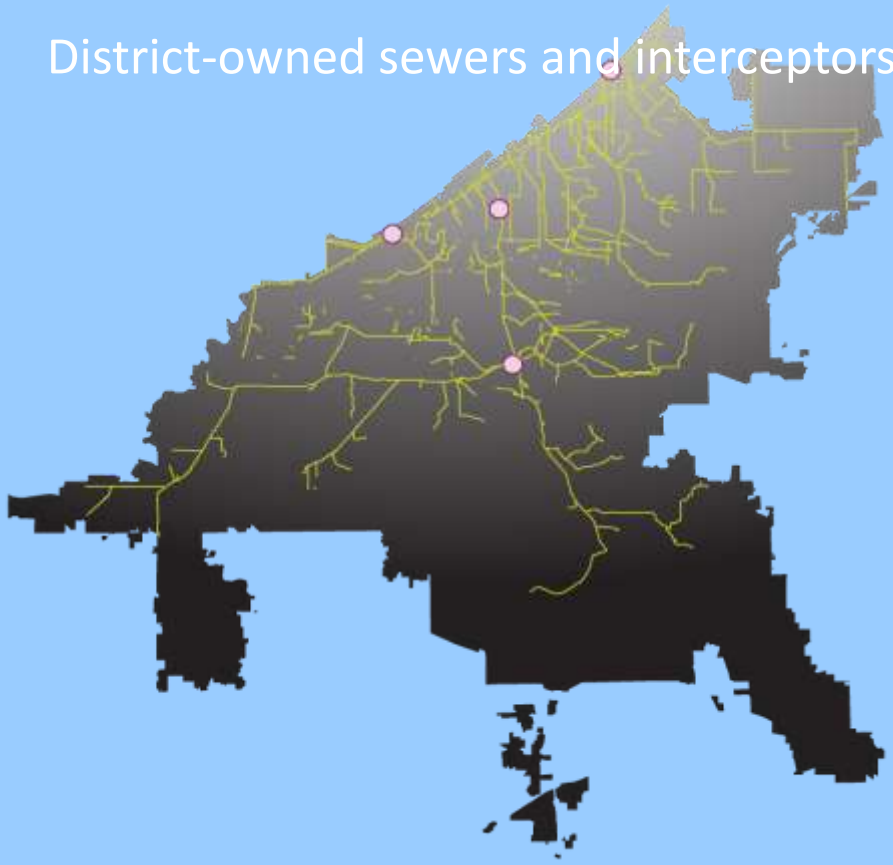
# Sewer System Types

## District Service Area



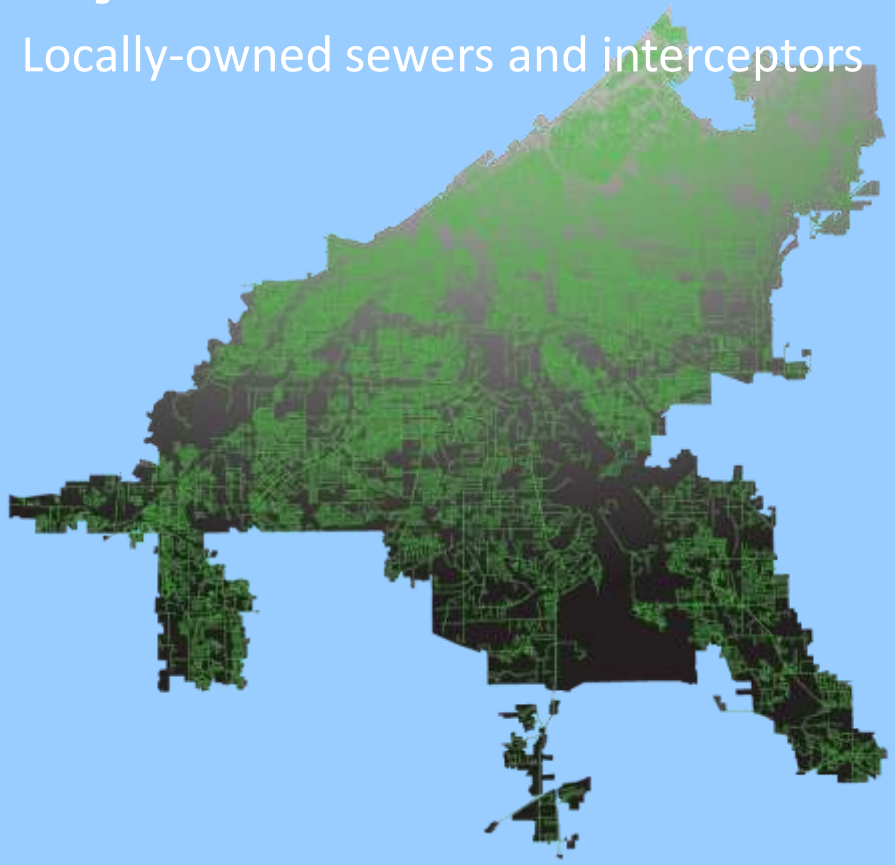
# 312 miles

District-owned sewers and interceptors



# 3,107 miles

Locally-owned sewers and interceptors



## NEORSD Obligations:

- CSOs
- WWTPs

## Local CWA Obligations:

- SSOs
- Illicit Discharges & Connections
- Stormwater Outfalls
- Septic Tanks

# Rainfall and level of service

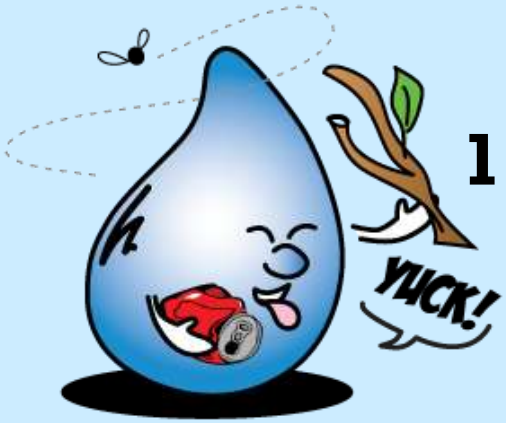
- Combined Sewer Systems
  - 5+ year storm
- Storm Sewers and Culverts
  - 5 to 50+ year storm
- Stormwater “level of service” will be a key issue

# Your SewerU syllabus

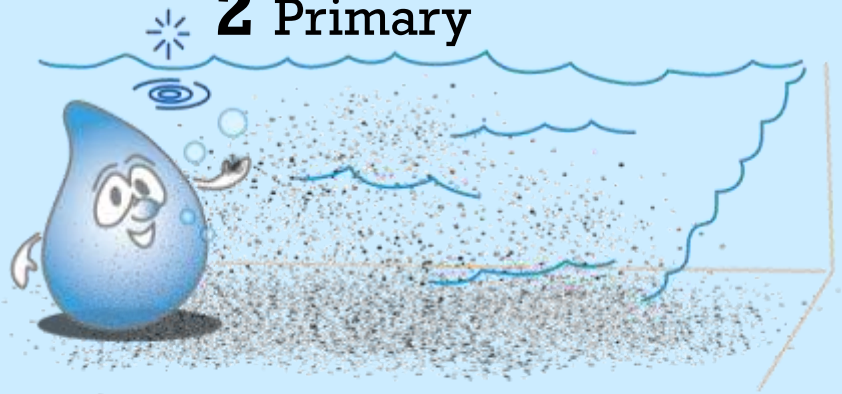
- NEORSD Responsibilities
- Urban Water Cycle
- Sewer System 101
- **WWTP 101**
- Issues, Challenges and Solutions

# Wastewater Treatment 101

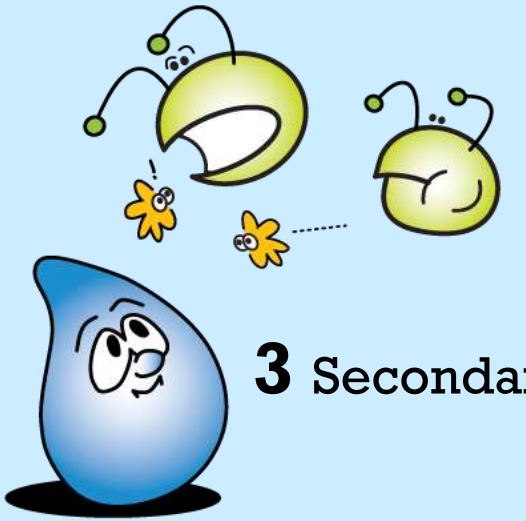
# The treatment process



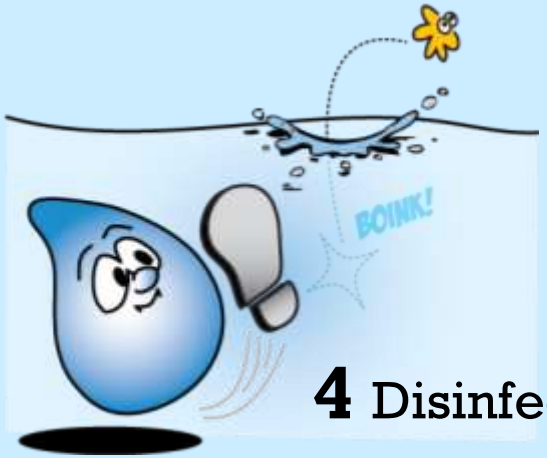

**1** Preliminary



**2** Primary



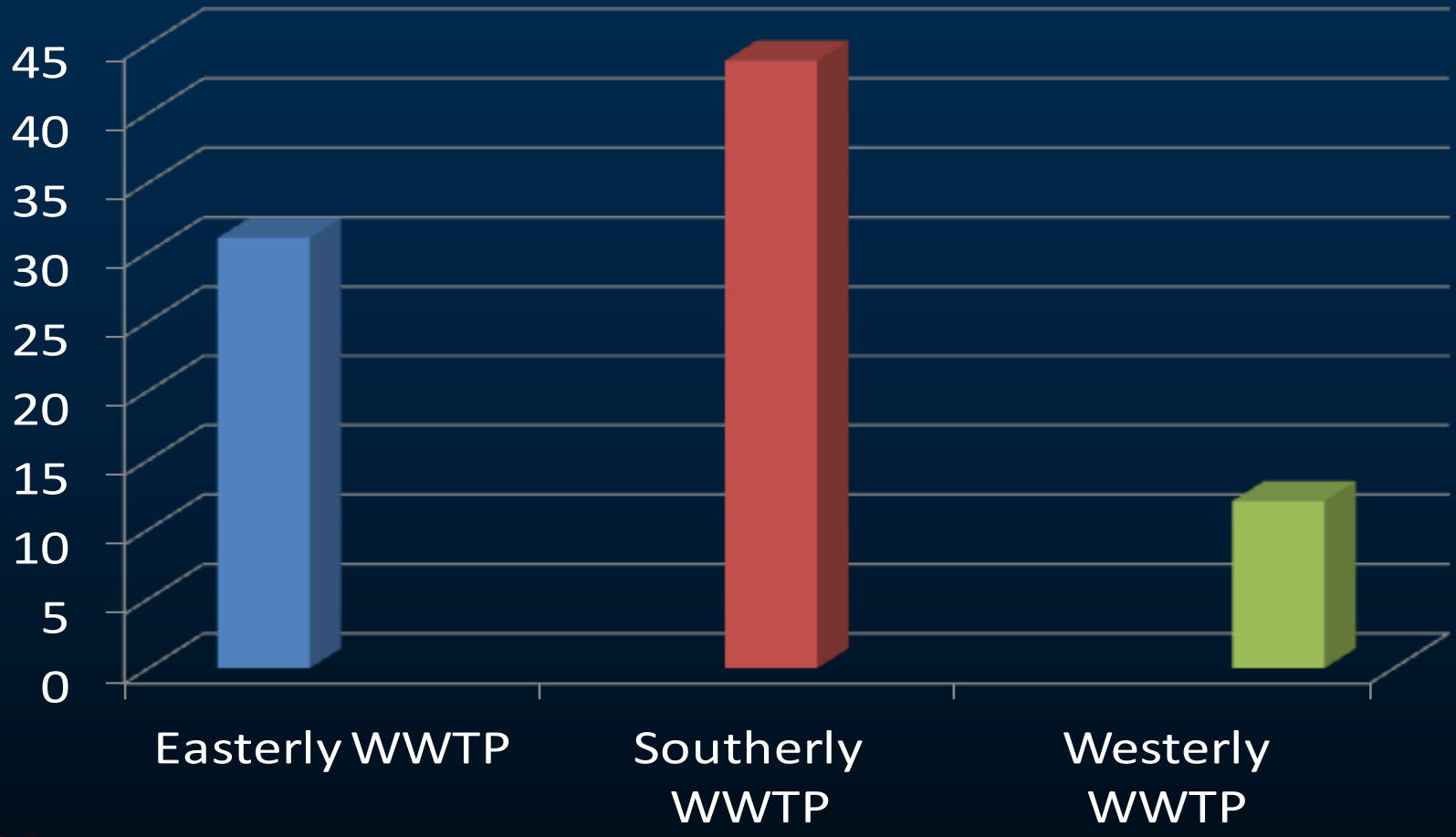
**3** Secondary




**4** Disinfection

# Wastewater Treatment Plants

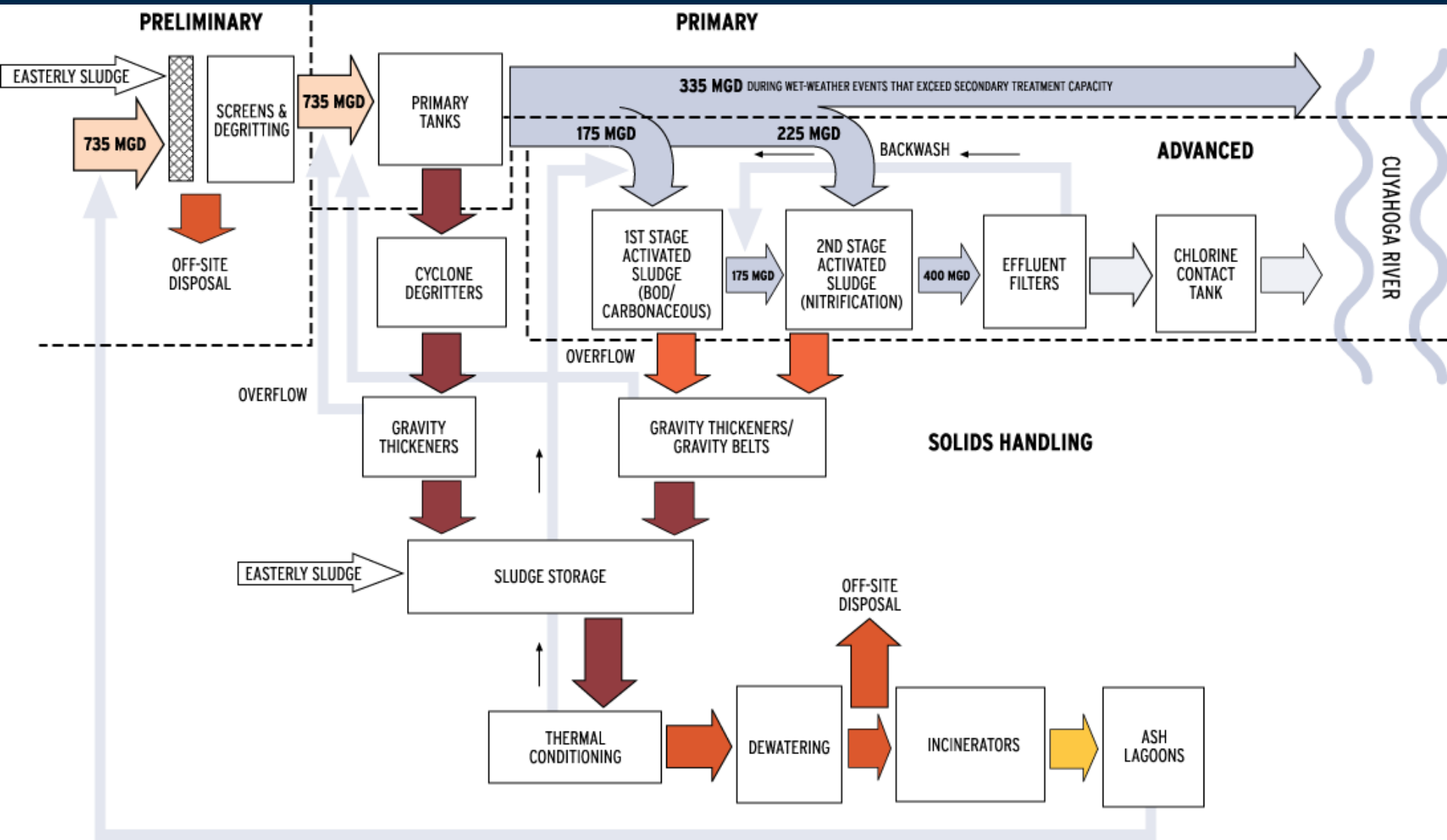
# 90 Billion Gallons Treated Annually



# Wastewater Treatment Process

- Preliminary Treatment
- Primary Treatment
- Secondary Treatment
- Disinfection
- Solids Handling

# Southerly


PRELIMINARY
PRIMARY
EASTERLY SLUDGE
735 MGD
SCREENS & DEGRITTING
735 MGD
PRIMARY TANKS
335 MGD DURING WET-WEATHER EVENTS THAT EXCEED SECONDARY TREATMENT CAPACITY
175 MGD
225 MGD
BACKWASH
ADVANCED
OFF-SITE DISPOSAL
CYCLONE DEGRITTERS
1ST STAGE ACTIVATED SLUDGE (BOD/ CARBONACEOUS)
175 MGD
2ND STAGE ACTIVATED SLUDGE (NITRIFICATION)
400 MGD
EFFLUENT FILTERS
CHLORINE CONTACT TANK
CUYAHOGA RIVER
OVERFLOW
OVERFLOW
GRAVITY THICKENERS
GRAVITY THICKENERS/ GRAVITY BELTS
SOLIDS HANDLING
EASTERLY SLUDGE
SLUDGE STORAGE
OFF-SITE DISPOSAL
THERMAL CONDITIONING
DEWATERING
INCINERATORS
ASH LAGOONS

# Preliminary Treatment

Mechanical Bar Rakes

# Preliminary Treatment

Screenings Collection

# Preliminary Treatment

Aerated Grit Channel

# Preliminary Treatment

# Primary Treatment

Primary Settling Tank

# Secondary Treatment

Trickling Filters

Stalked Ciliates

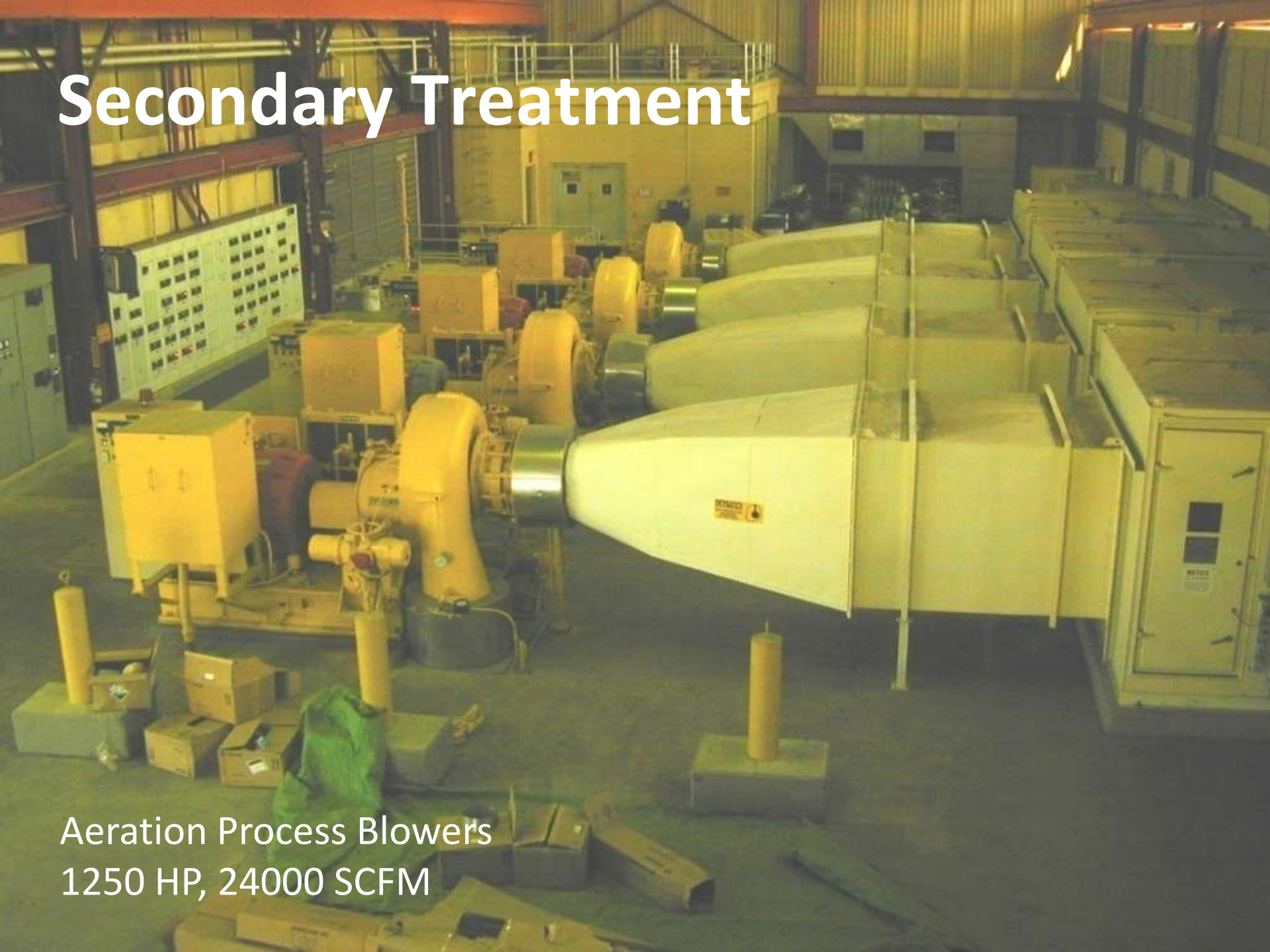
Amoeba

Rotifer

Activated Sludge – Aeration Tanks

Paramecium

# Secondary Treatment

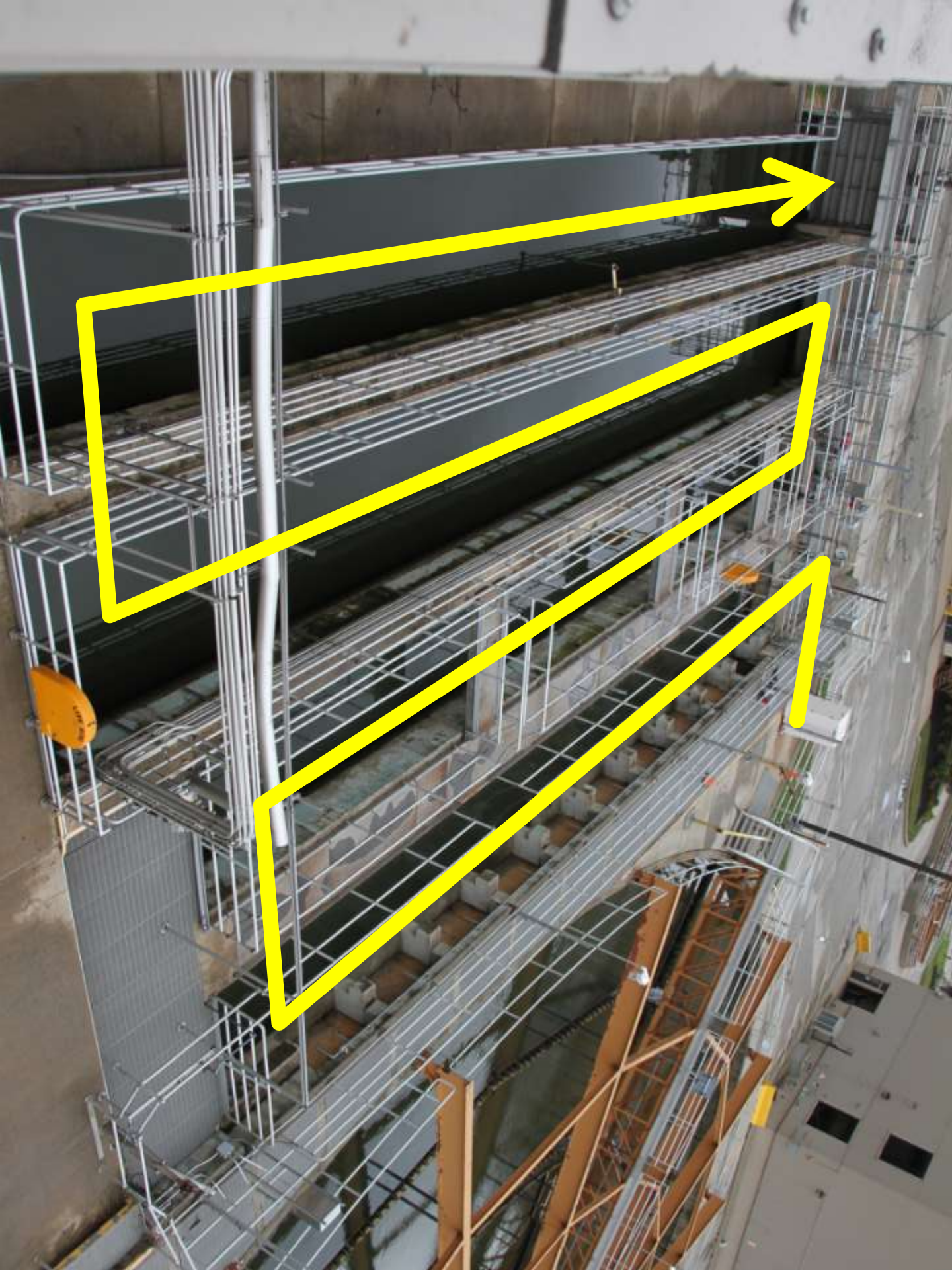


Aeration Process Blowers
1250 HP, 24000 SCFM

# Secondary Treatment

Final Settling Tank

# Disinfection and effluent



# Solids Handling


Dewatering Centrifuges

# Solids Handling

Incineration

# Your SewerU syllabus

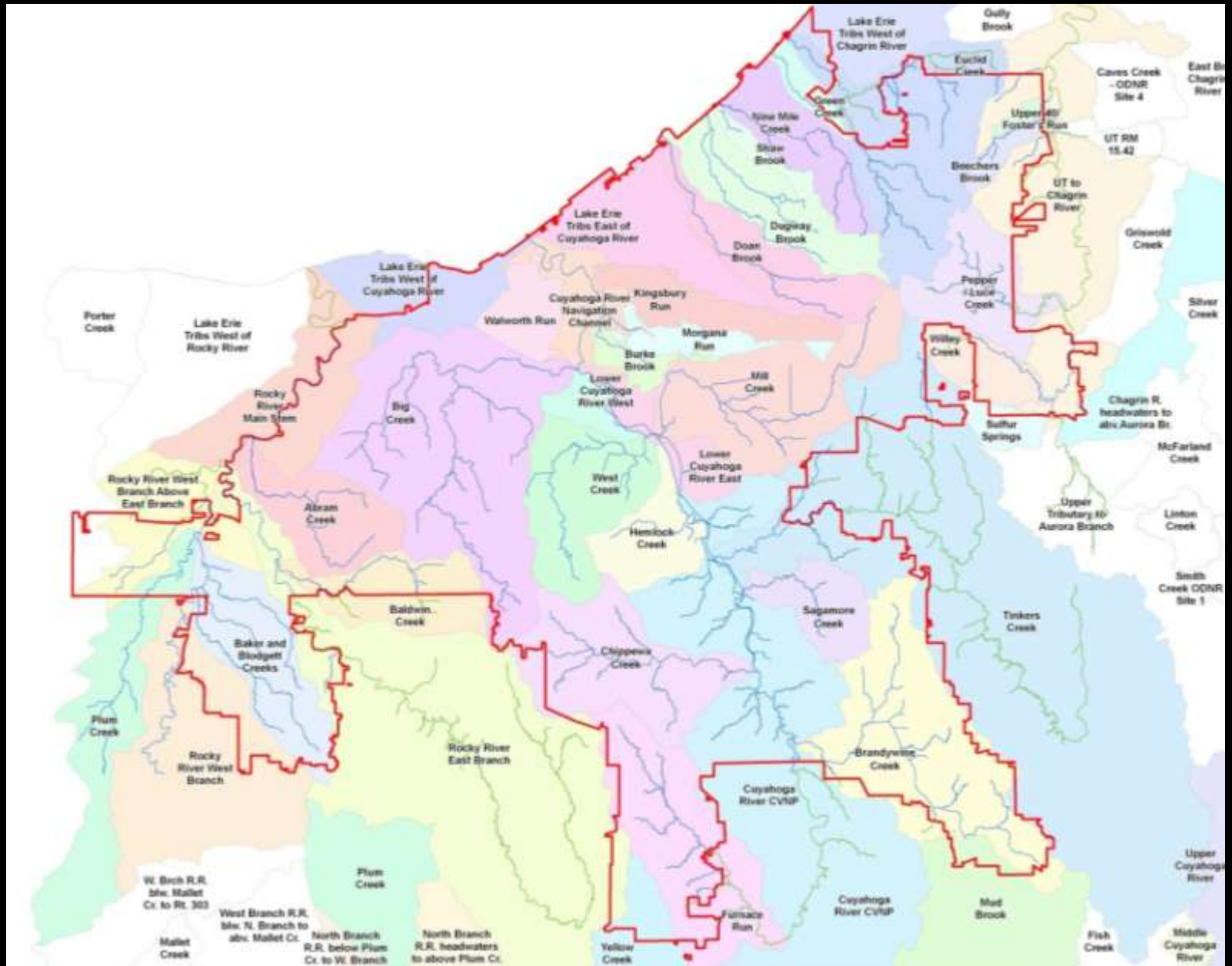
- NEORSD Responsibilities
- Urban Water Cycle
- Sewer System 101
- WWTP 101
- **Issues, Challenges and Solutions**

# What is a watershed?

- Watershed: An extent of land where water from precipitation drains downhill into a body of water, such as a river, lake, reservoir, estuary, or wetland.

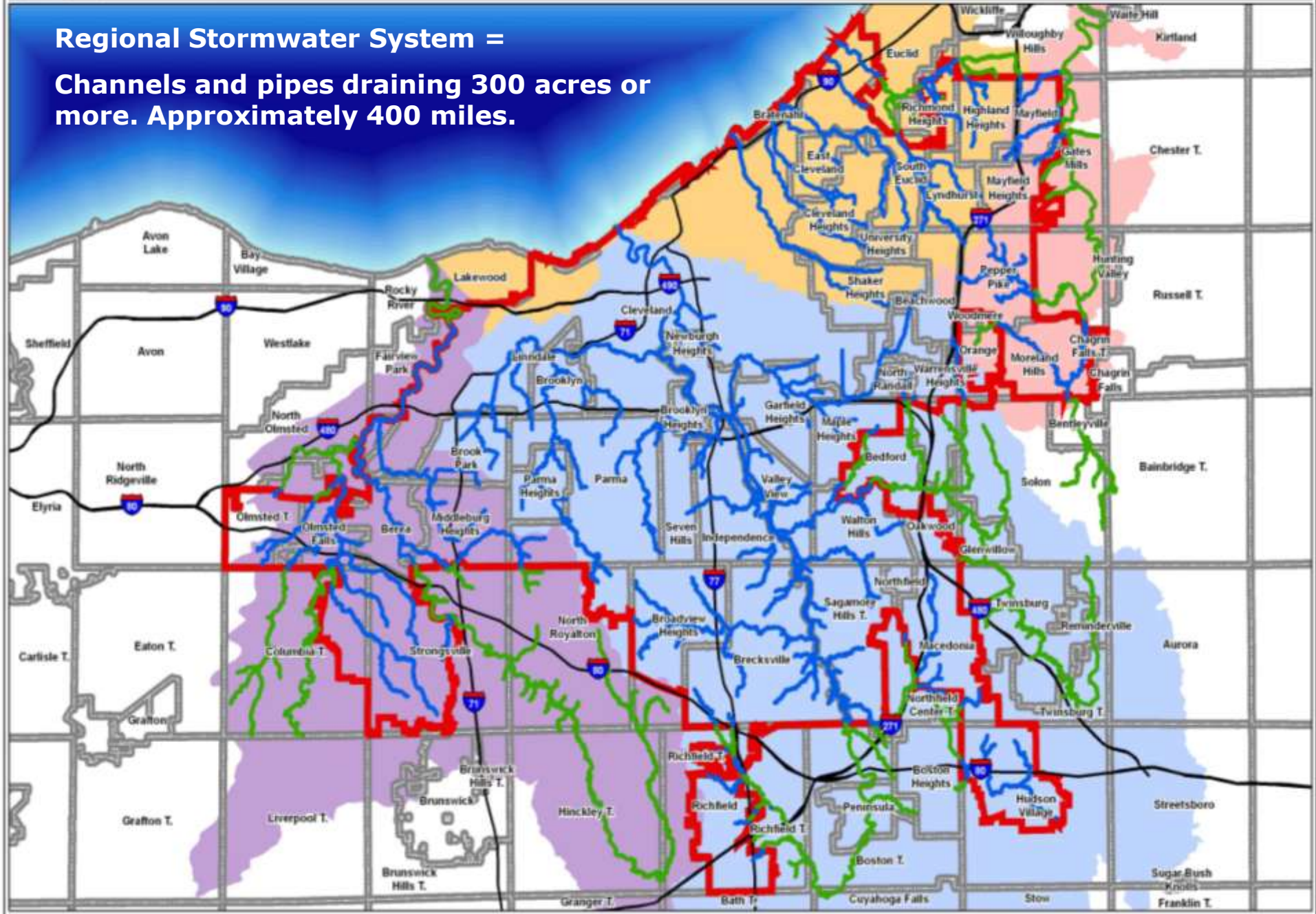
# Northeast Ohio *major* watersheds

# Subwatersheds



Northeast Ohio Regional Sewer District
Protecting Your Health and Environment

# Regional Stormwater System - March 2012



# Stormwater run-off

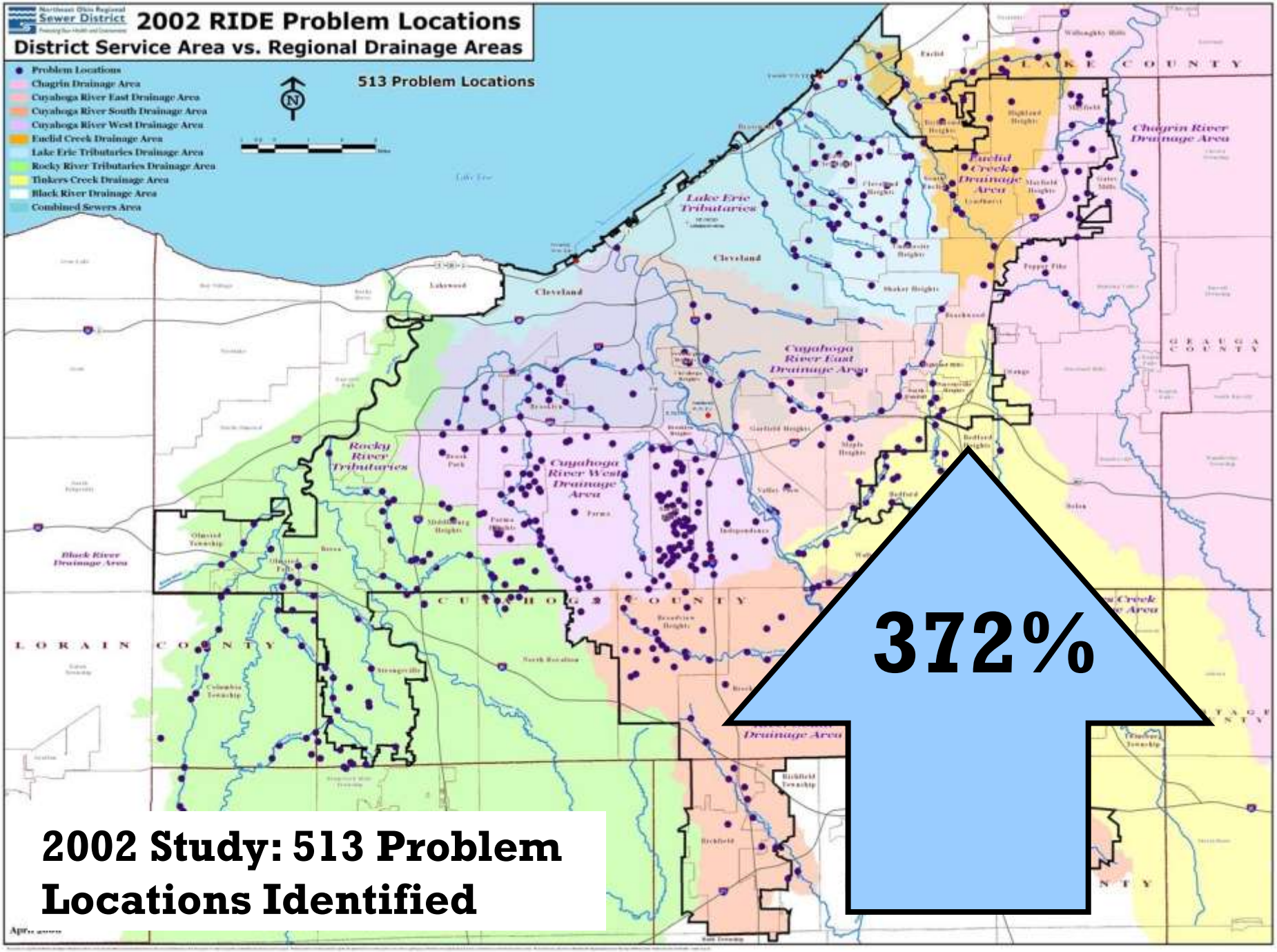
- Erosion
- Water Quality
- Flooding

# Mandate

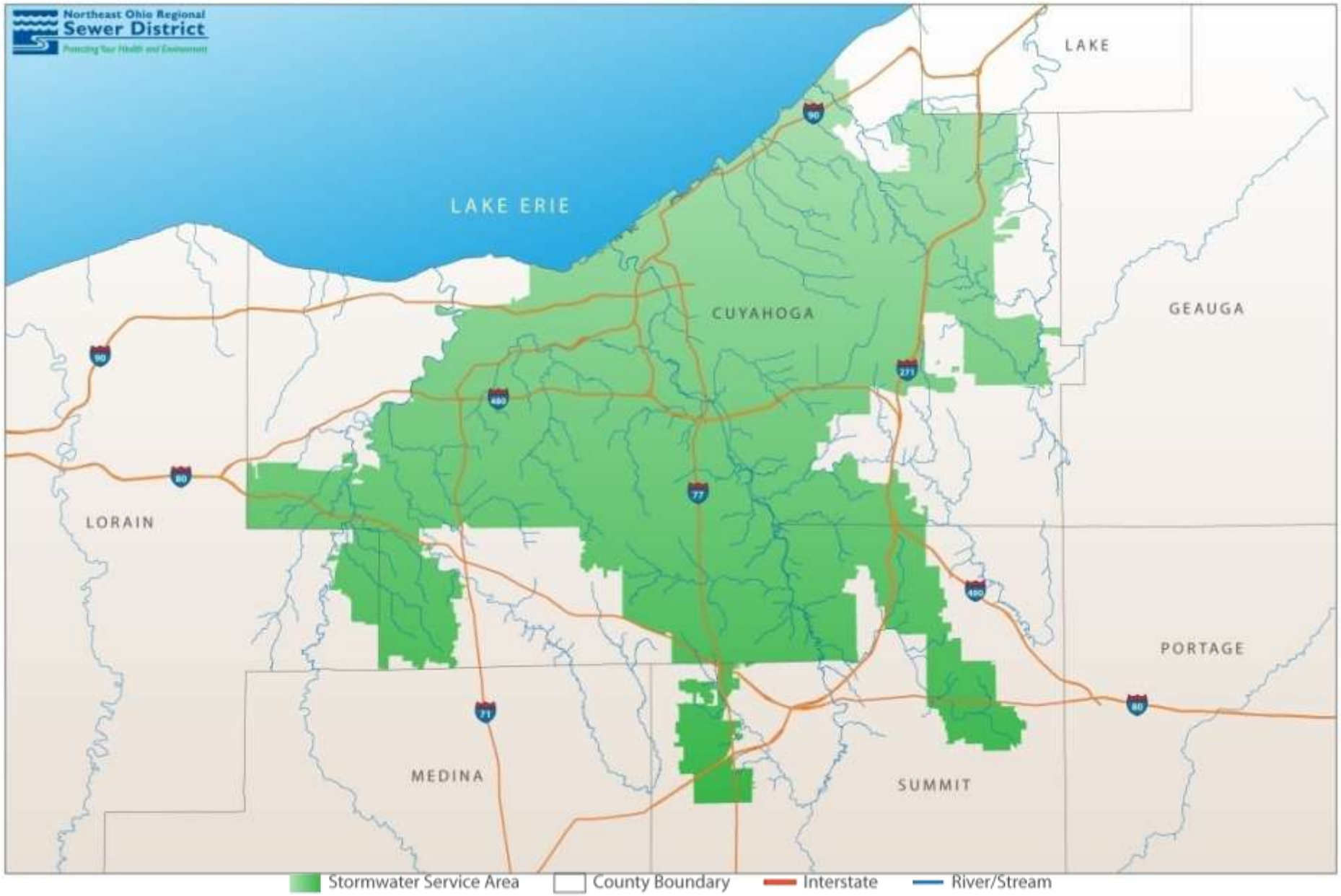
- Judge McMonagle mandated the District
  - "develop a detailed integrated capital improvement plan for regional management of wastewater collection and storm drainage to identify a capital improvement program for the solution of all intercommunity drainage problems (both storm and sanitary) in the District."

# Mandate

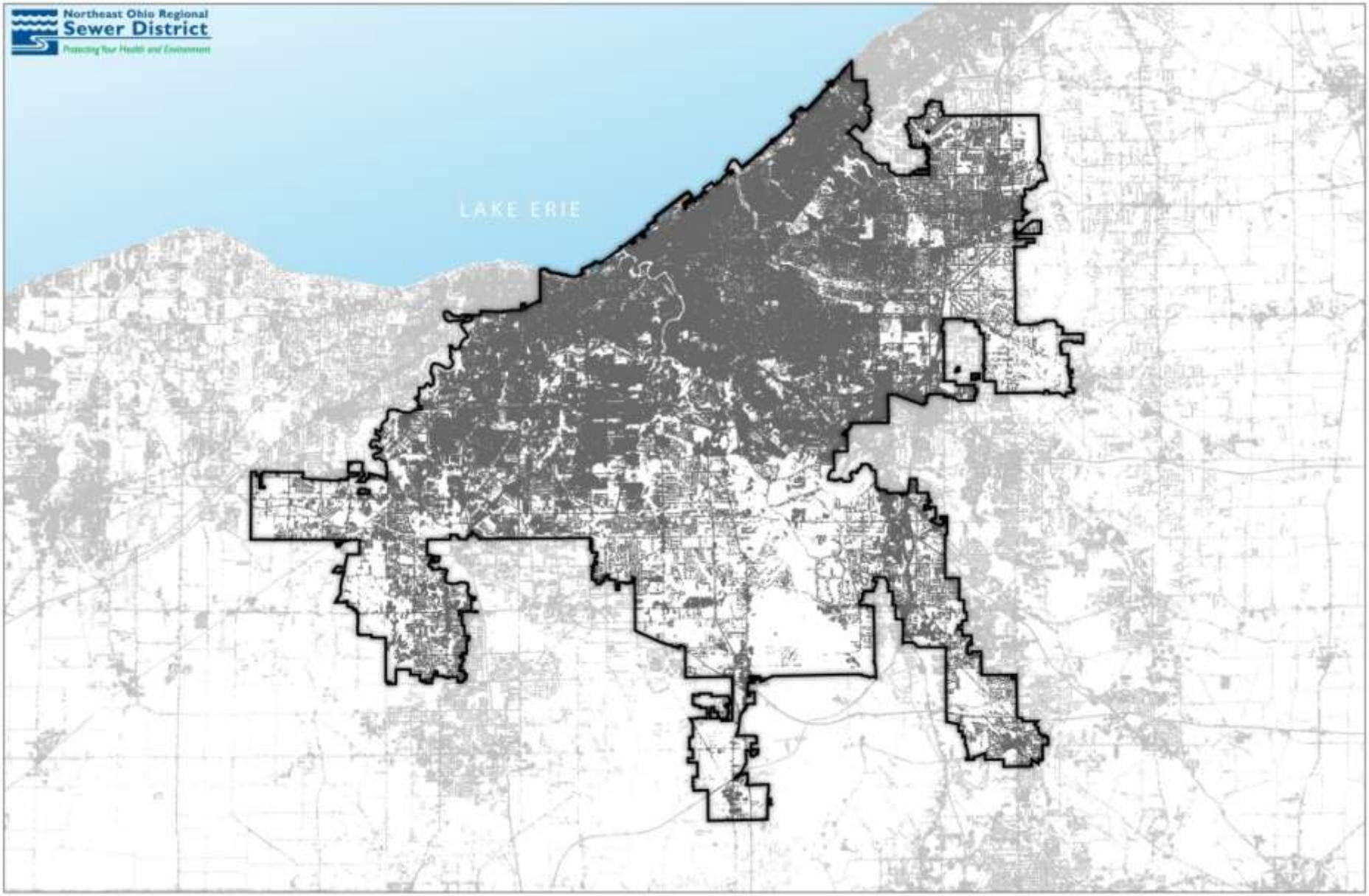
- ORC Chapter 6119 Authority
- January 7, 2010 Board approval of Title V Stormwater Management Code

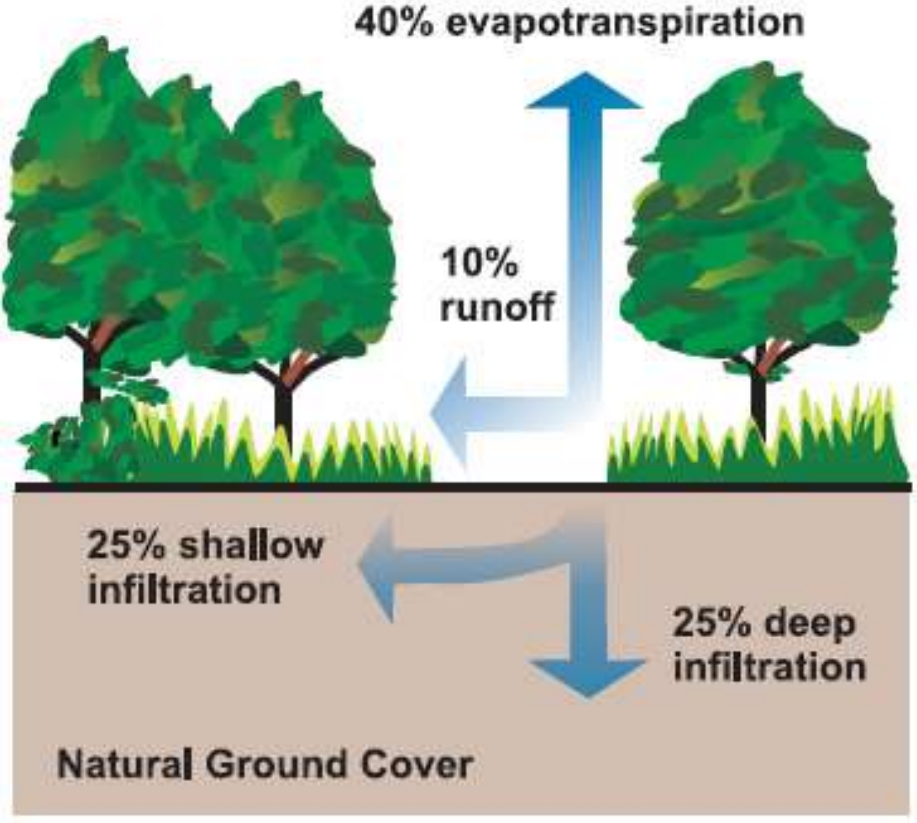

2002 RIDE Problem Locations
District Service Area vs. Regional Drainage Areas
Problem Locations
Chagrin Drainage Area
Cuyahoga River East Drainage Area
Cuyahoga River South Drainage Area
Cuyahoga River West Drainage Area
Euclid Creek Drainage Area
Lake Erie Tributaries Drainage Area
Rocky River Tributaries Drainage Area
Tinkers Creek Drainage Area
Black River Drainage Area
Combined Sewers Area
513 Problem Locations
Lake Erie Tributaries
Euclid Creek Drainage Area
Chagrin River Drainage Area
Cuyahoga River East Drainage Area
Rocky River Tributaries
Cuyahoga River West Drainage Area
Black River Drainage Area
LAKE COUNTY
GEAUGA COUNTY
CUYAHOGA COUNTY
LORAIN COUNTY
Cleveland
372%
2002 Study: 513 Problem Locations Identified

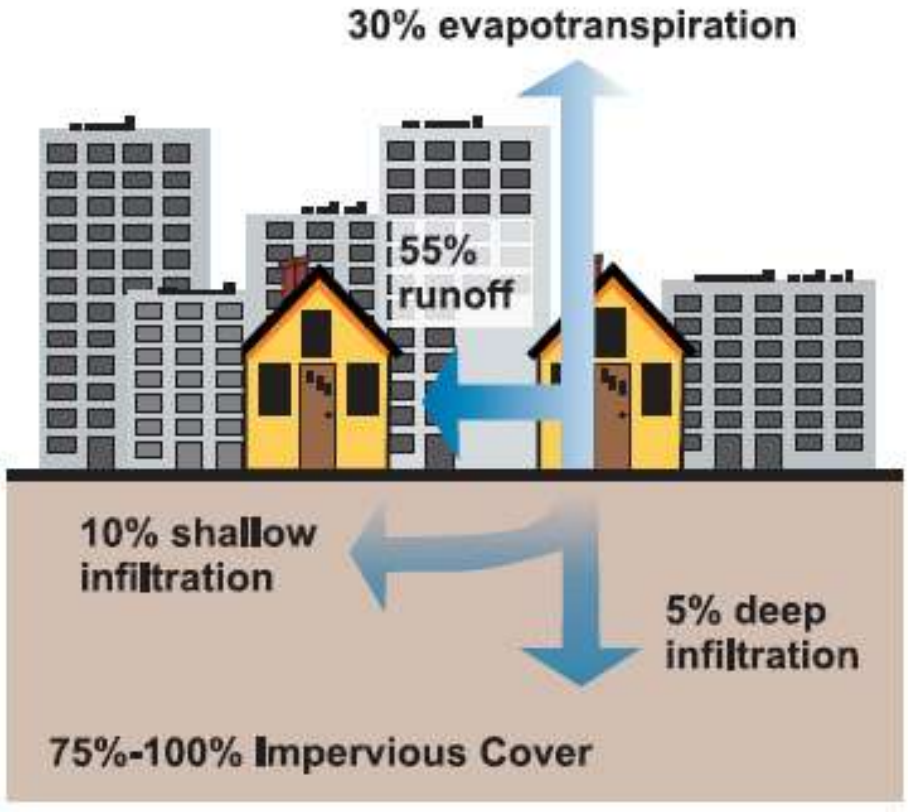
# Stormwater Service Area



# Impervious Surfaces




40% evapotranspiration
10% runoff
25% shallow infiltration
25% deep infiltration
Natural Ground Cover


30% evapotranspiration
55% runoff
10% shallow infiltration
5% deep infiltration
75%-100% Impervious Cover


Streambank erosion along Chippewa Creek


Middleburg Heights/Brook Park, Ohio
along Abrams Creek
Northeast Ohio
Regional Sewer District

Streambank erosion on Mill Creek
threatens Warner Road
in Garfield Heights, Ohio

Northeast Ohio
Regional Sewer District


Debris along Dugway Brook,
Cleveland Heights, Ohio
Northeast Ohio
Regional Sewer District


Streambank erosion along Stickney Creek


Northeast Ohio
Regional Sewer District
Streambank erosion,
Baldwin Creek, August 2011

# Regional Stormwater Management

- Funding the Solutions:
  - More than $228 million in backlogged stormwater-related projects
  - Implement fee to customers (residential and commercial) based on impervious surface

NORTHEAST OHIO REGIONAL SEWER DISTRICT
REGIONAL STORMWATER MANAGEMENT PROGRAM

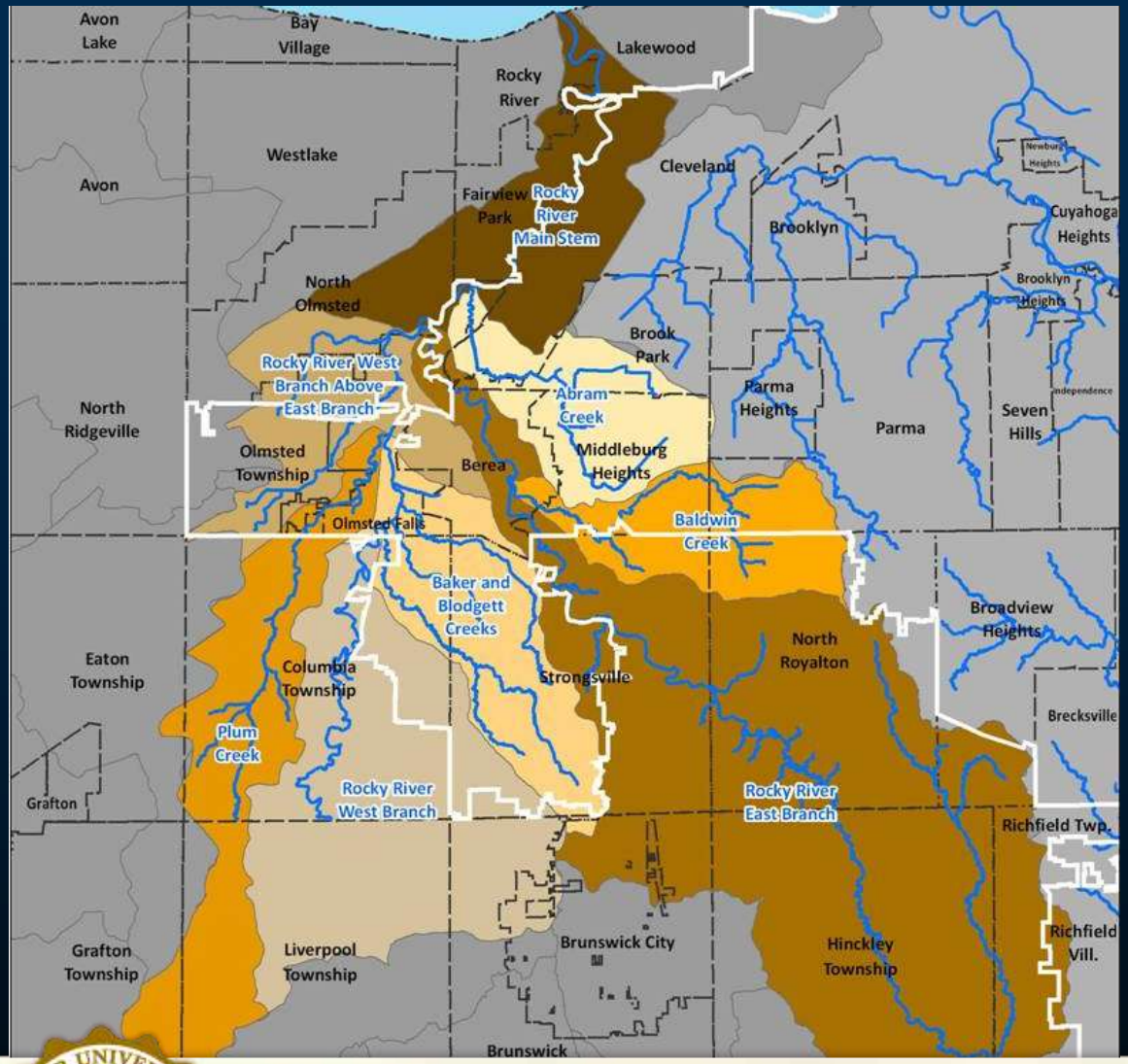
# What Will We Do?

Master Plans

Inspect & Maintain

Construct Projects

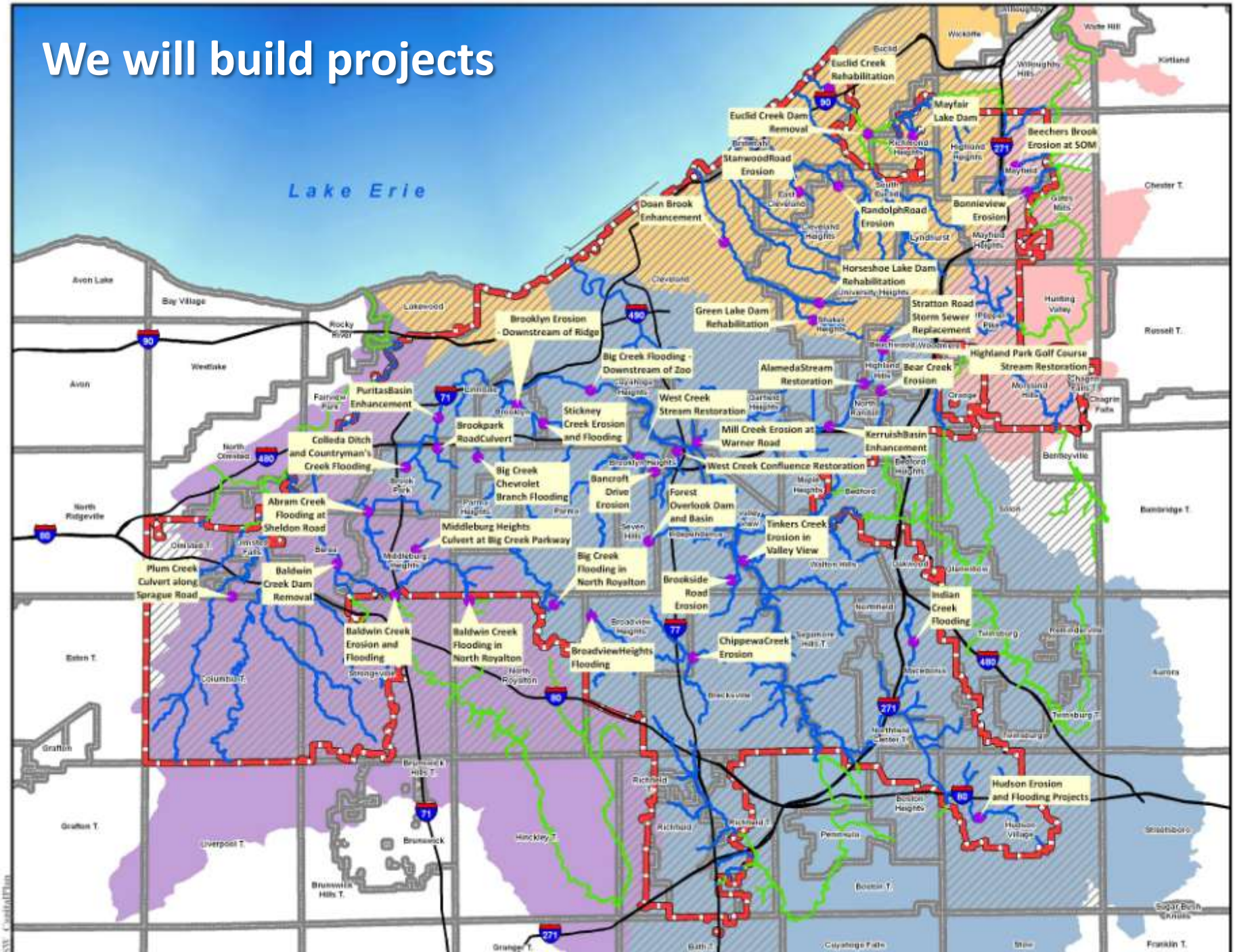
Encourage Good Practices



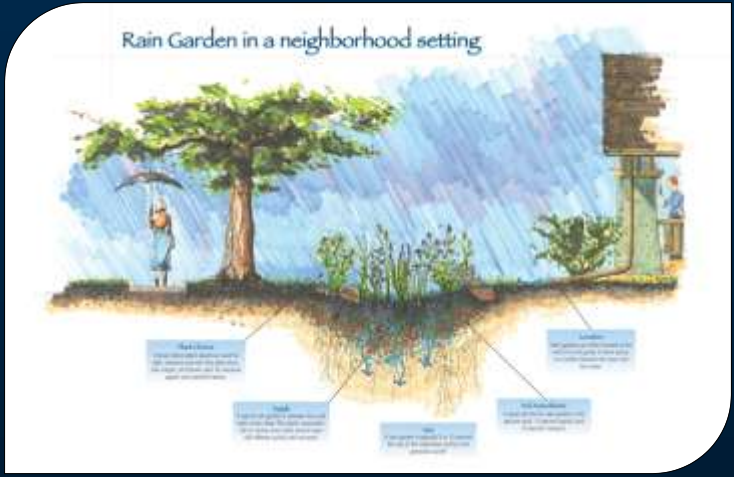

# We will develop stormwater master plans

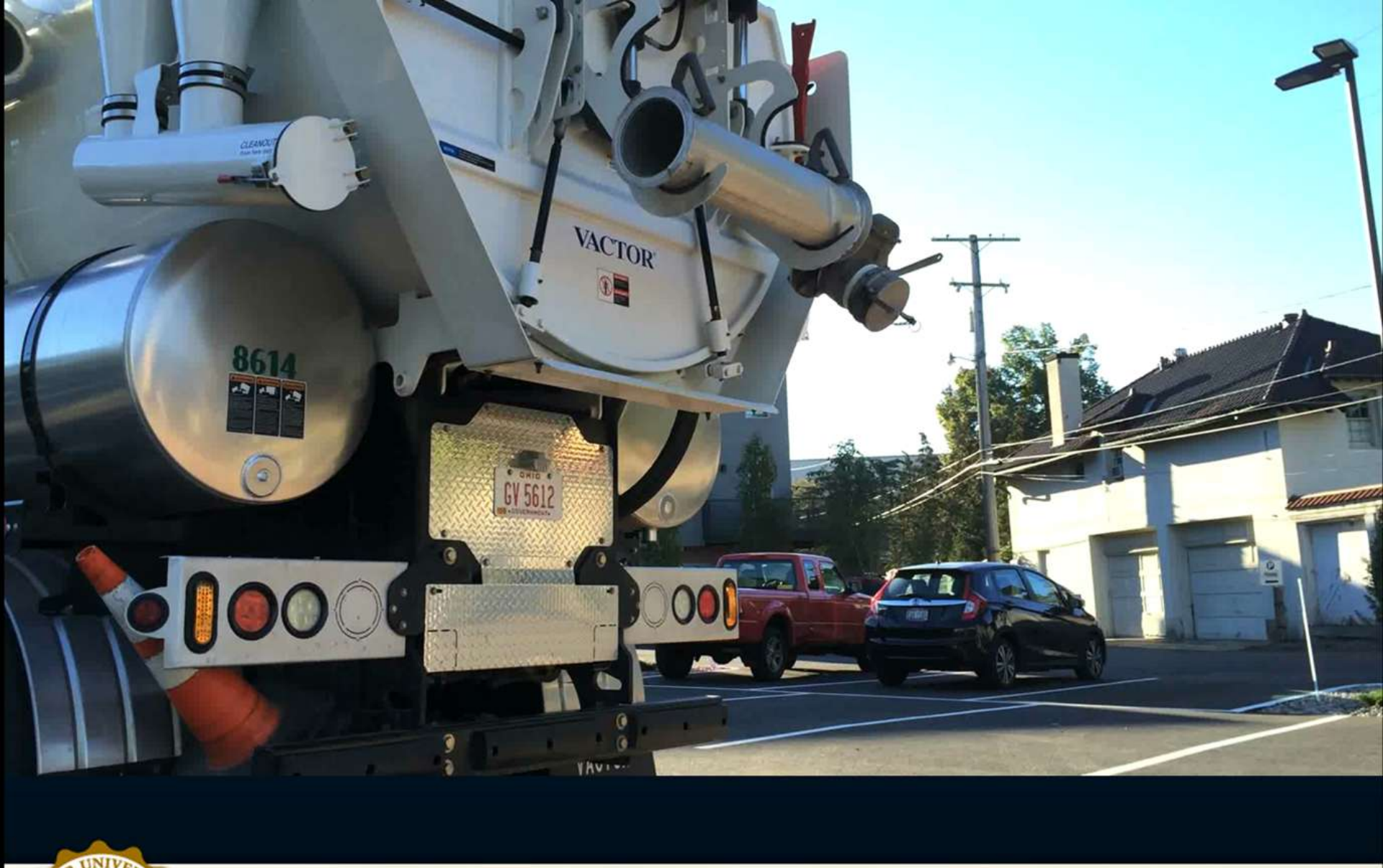

We will perform inspection
and maintenance

# We will build projects



# We will encourage good practices

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# Litigation Timeline for RSMP

- 4/21/2011: Judge Pokorny rules in favor of the District Regional Stormwater Program
- 1/1/2013: Program goes live
- 9/26/2013: 8th District Court of Appeals rules against the Program, all District Stormwater activities suspended

# Litigation Timeline for RSMP

- 2/19/2014: Ohio Supreme Court decides to hear case
- 9/10/2014: Ohio Supreme Court Hearing

**NE Oh Regional Sewer**
@neorsd

Following

BREAKING: Court has ruled we have authority to manage a regional #StormwaterProgram. Details to follow.

> **Court News Ohio** @courtnewsohio
>
> Cleveland area sewer district allowed to manage stormwater and charge a fee ow.ly /SeK3h

RETWEETS 11 FAVORITES 3


Where we were….

# Where we are today

The Cuyahoga River “is in its best shape since the Civil War”

Chuck Boucher, OEPA (Akron Beacon Journal 10/06/08)

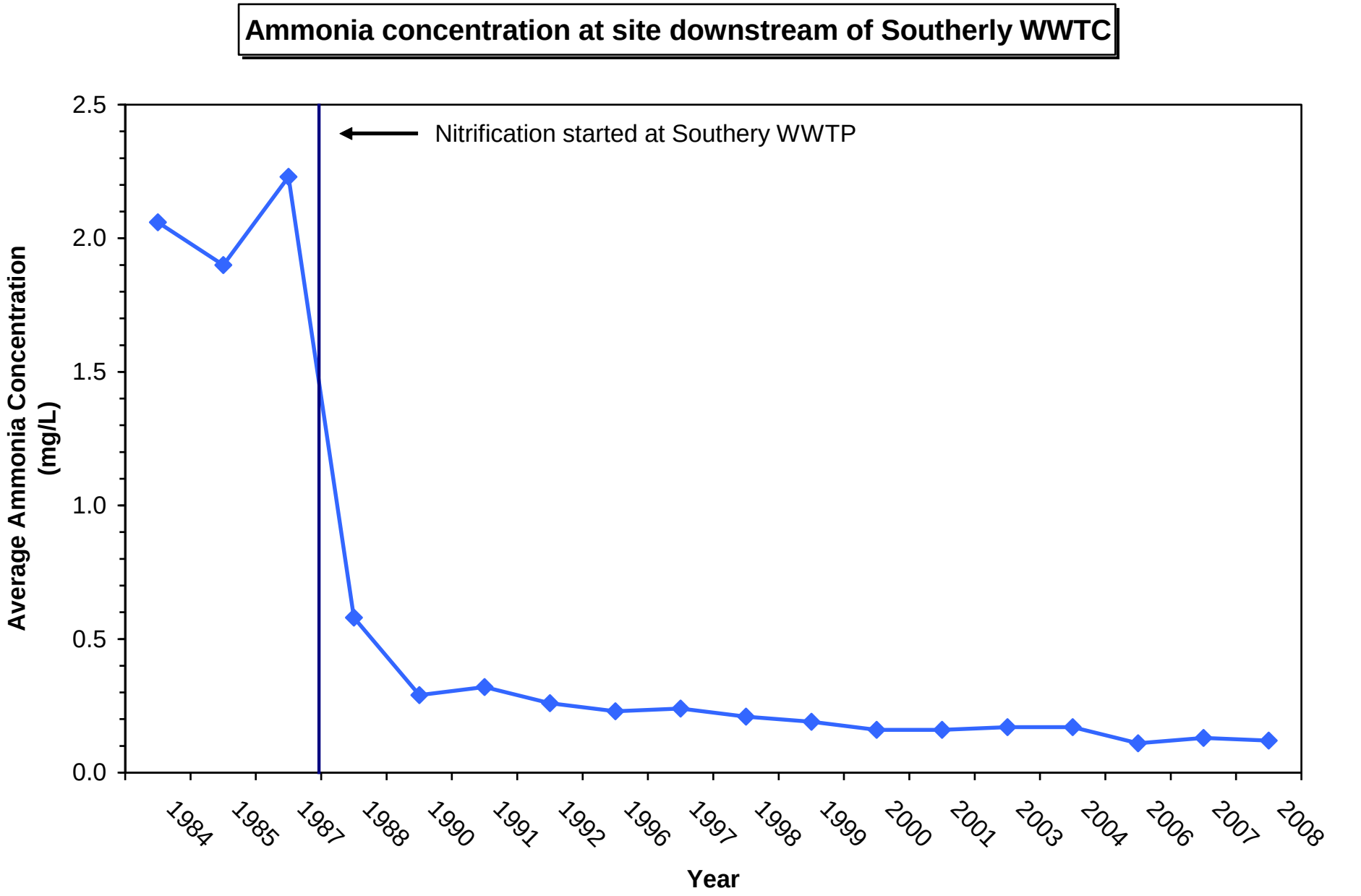
# Monitoring Stream Health

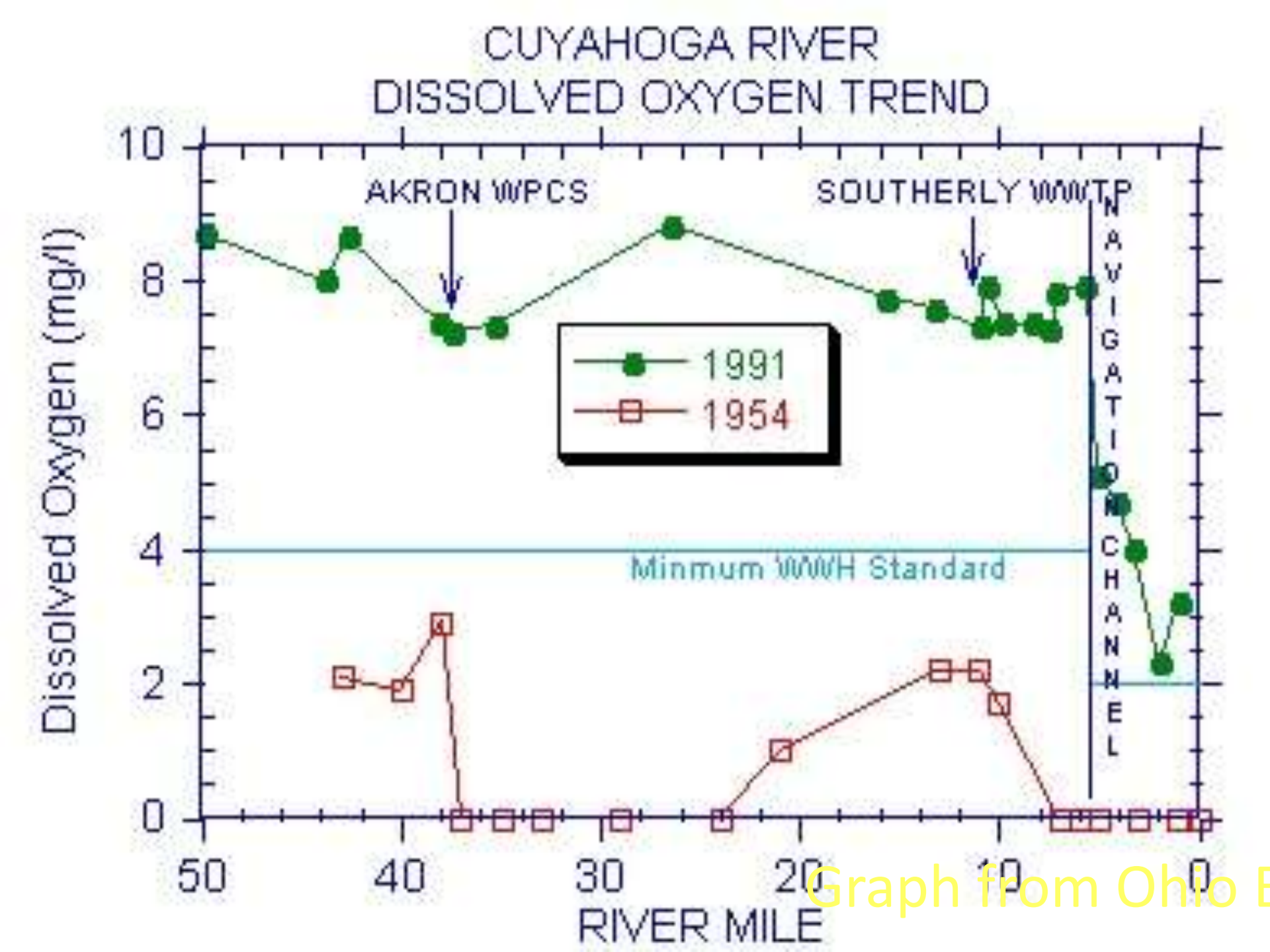
- Water Chemistry
- Habitat
- Fish
- Macroinvertebrates

# Water Chemistry Sampling

- Grab samples
- Data sondes
- Toxicity testing
- Fish tissue

# Water Chemistry Results




CUYAHOGA RIVER
DISSOLVED OXYGEN TREND
Dissolved Oxygen (mg/l)
10
8
6
4
2
0
AKRON WPCS
SOUTHERLY WWTP
NAVIGATION CHANNEL
1991
1954
Minmum WWH Standard
50
40
30
20
10
0
RIVER MILE
Graph from Ohio E

# Habitat Evaluation

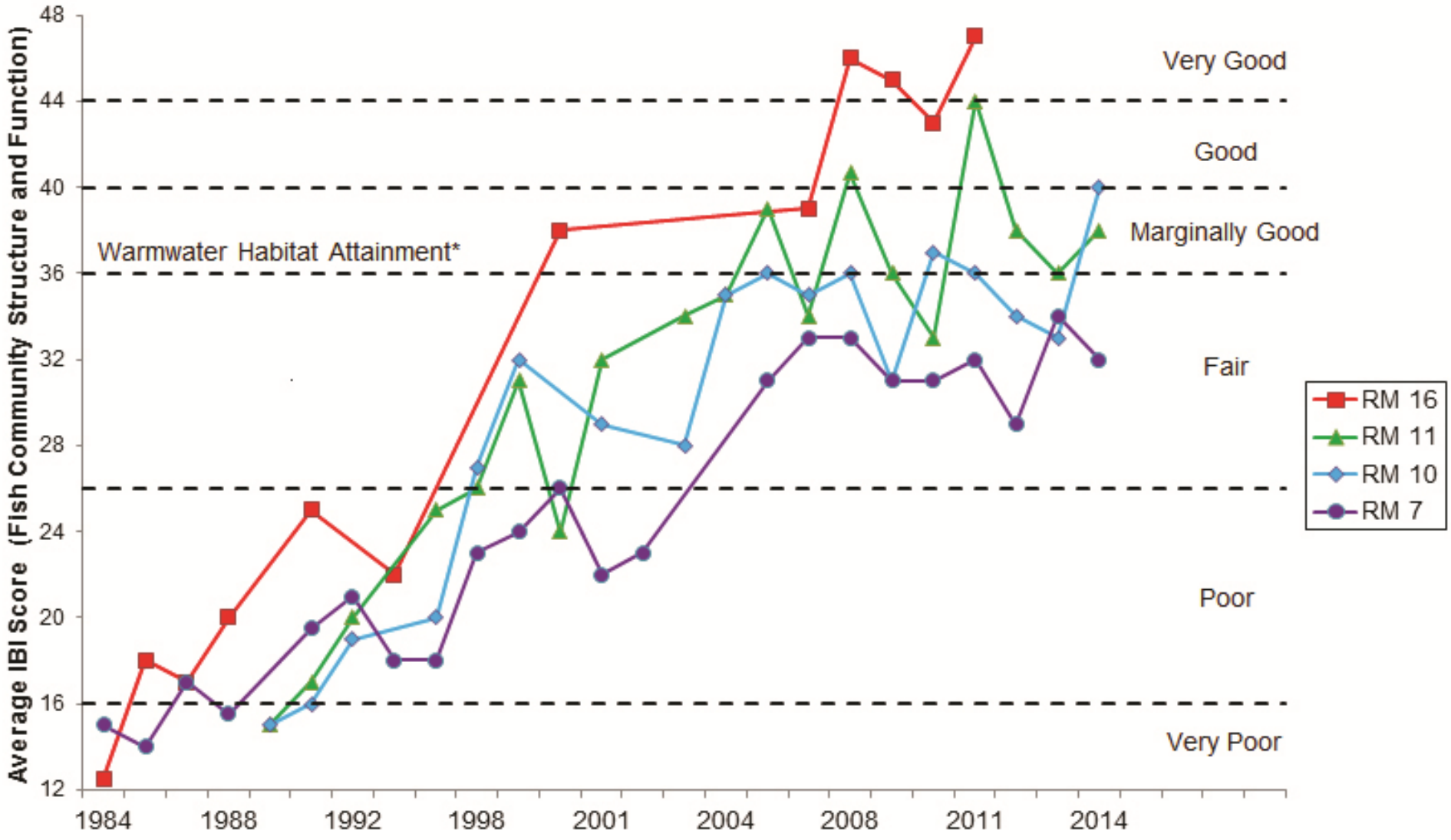
- Qualitative Habitat Evaluation Index (QHEI)
- Upstream of navigation channel = Good/Excellent
- Navigation channel = Poor
  - Artificial habitat

# Fish Community Health


- Electrofishing
  - Index of Biotic Integrity (IBI)
  - Modified Index of Well-Being (MIwb)

# Cuyahoga River Index of Biotic Integrity (IBI) Scores, 1984-2014

from Ohio Environmental Protection Agency and Northeast Ohio Regional Sewer District Data




*Non-significant departure (≤4 IBI units) from Warmwater Habitat criterion

# Pollution-Intolerant Fish

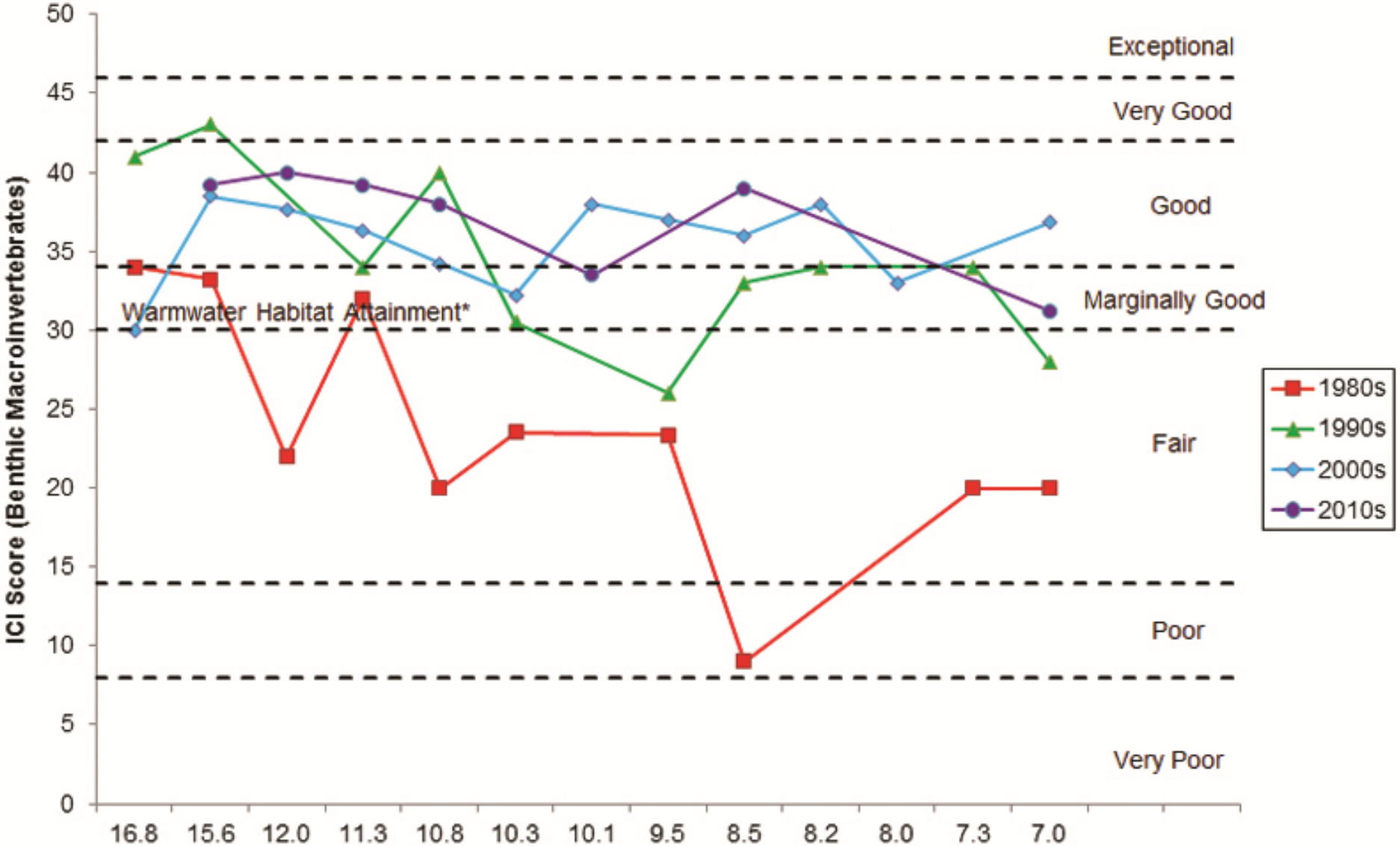
Mimic Shiner

Stonecat Madtom

# Macroinvertebrate Community Health

- Quantitative & qualitative sampling
  - Hester-Dendy sampler
  - Invertebrate Community Index (ICI)

**Cuyahoga River Invertebrate Community Index (ICI) Scores by Decade**
from Ohio Environmental Protection Agency and Northeast Ohio Regional Sewer District Data




*Non-significant departure (≤4 ICI units) from Warmwater Habitat criterion

**Sites within same reach combined; most downstream river mile shown.

# Pollution-Sensitive Macroinvertebrates

Pink Heelsplitter

# Cuyahoga River today…

# Challenges


Image courtesy Ohio Sea Grant

# Challenges

- Algae and microcystins
  - Improved monitoring. Collaboration?
- Nonpoint sources
- Pharmaceuticals
- Regulatory climate

NORTHEAST OHIO REGIONAL SEWER DISTRICT

# SEWER U

## SEWER UNIVERSITY

The history of sewers and the future of clean water in Greater Cleveland

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Presentation available at
**neorsd.org/sewerU**

Tweet with **@neorsd #SewerU**

Save the date: Open House 2016
**Saturday, September 17, 9am-4pm**
neorsd.org/OpenHouse..

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