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

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

Tweet with @neorsd #SewerU

1952
Cuyahoga
River

1960s Cuyahoga River

1969
Cuyahoga
River

Your SewerU syllabus

- Sewer District responsibilities
- Urban water cycle
- Sewer System 101
- Wastewater Treatment 101
- Issues, challenges, and solutions

NEORSD Responsibilities

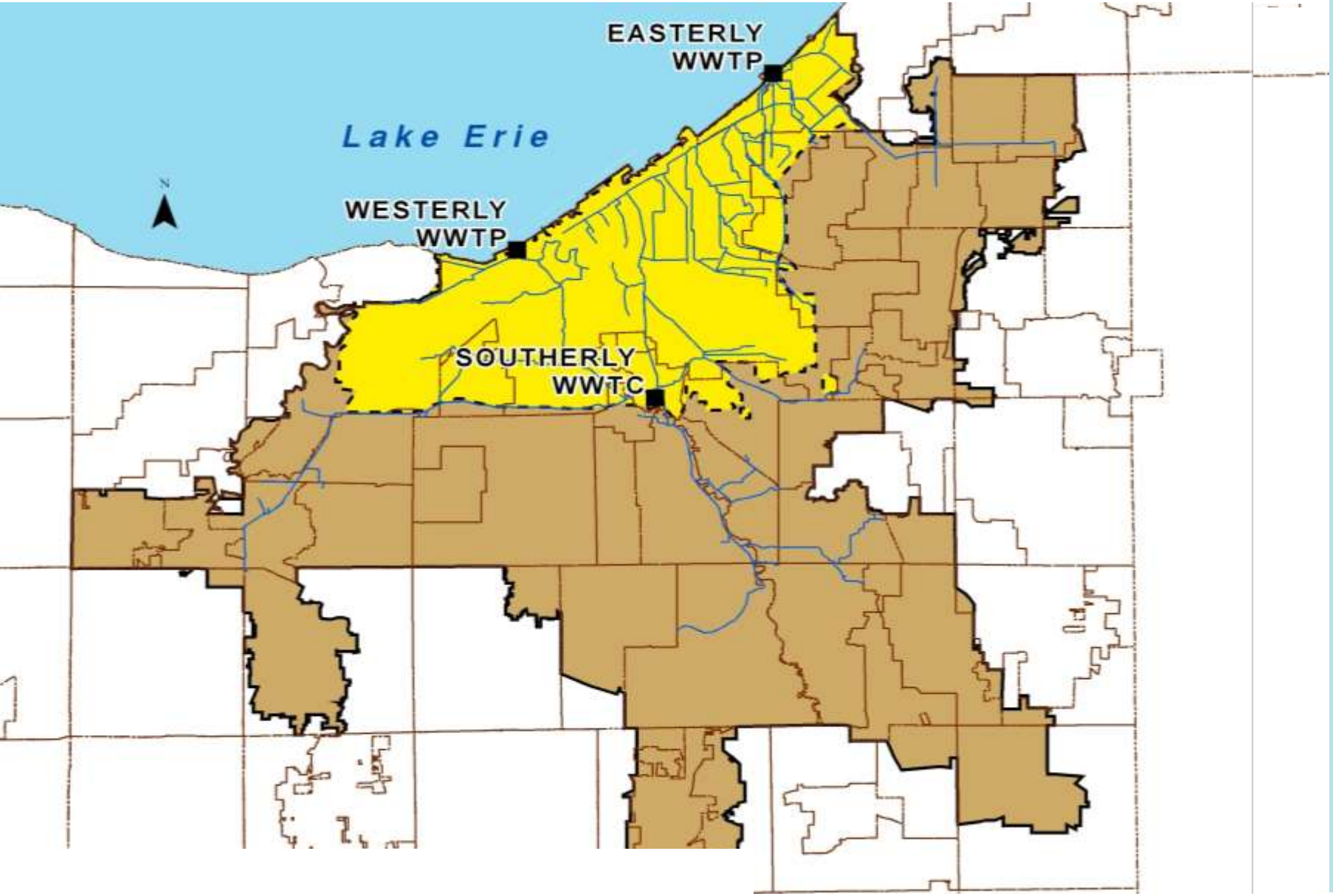
Who We Are…

- 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

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

Wastewater Treatment Plants

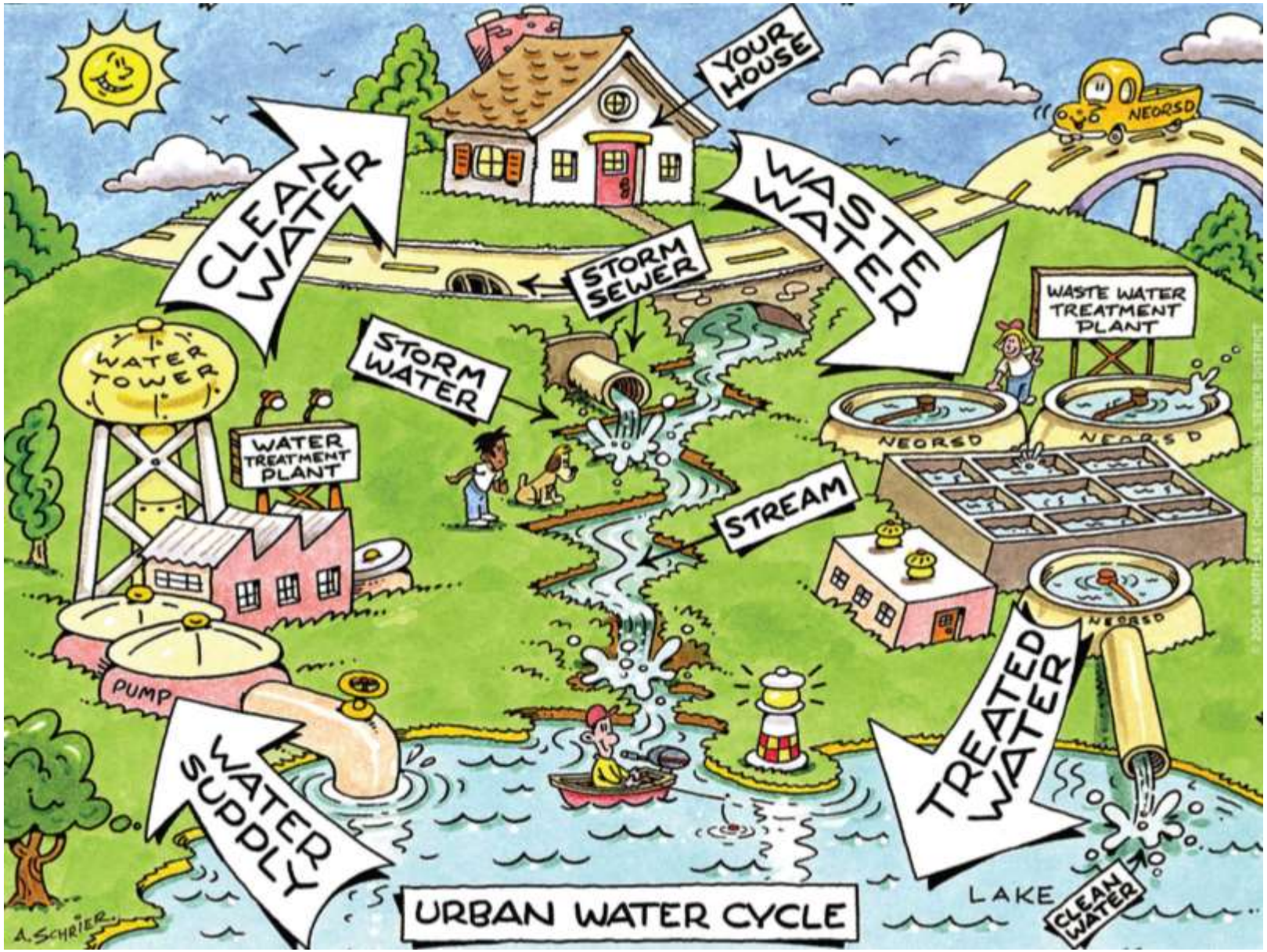


District
Service Area

Over 40 years of investment

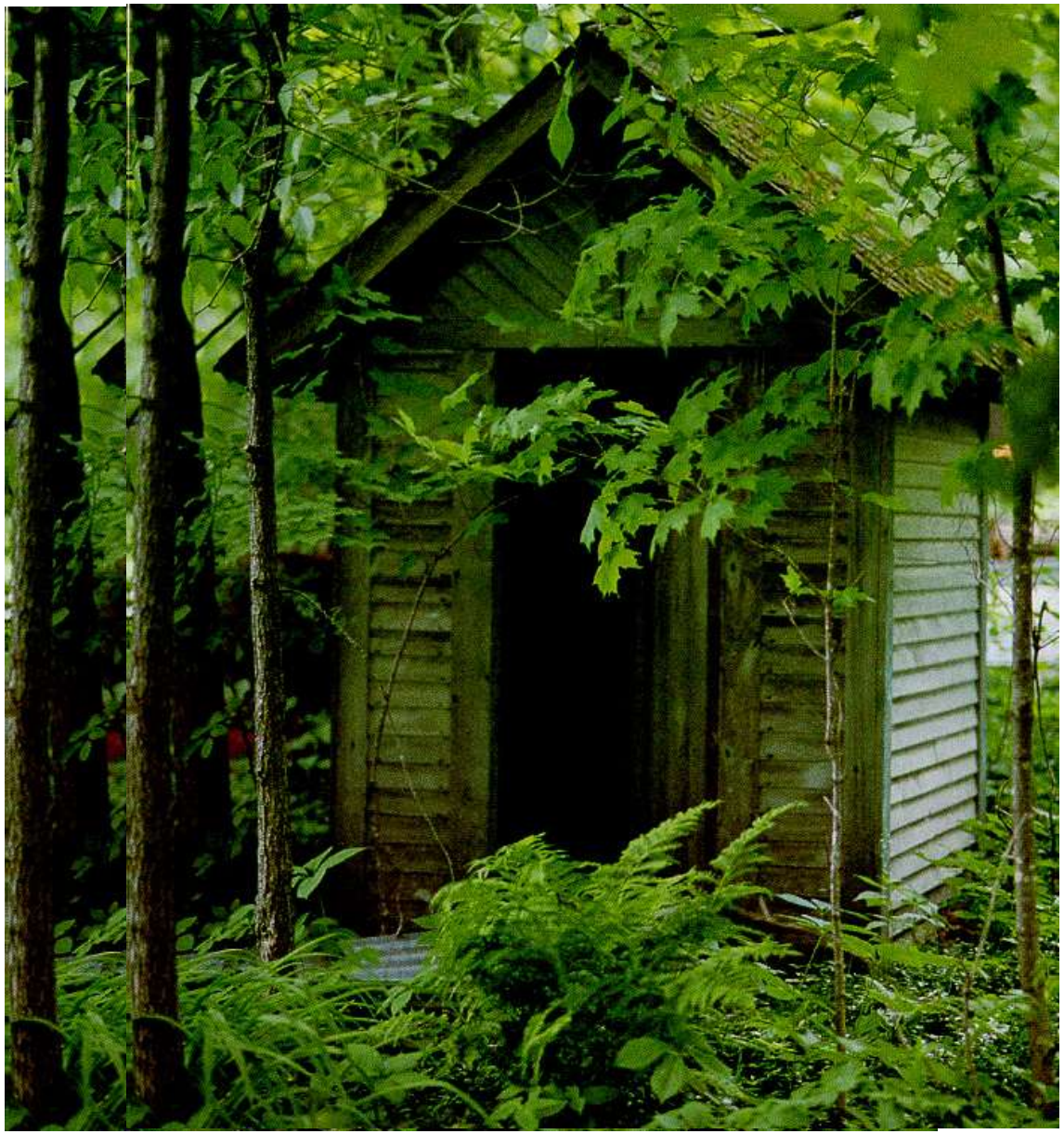
- Since 1972: **Billions invested in clean water**
  - *Wastewater treatment plants*
  - *Interceptor and relief sewers*
  - *CSO control and interceptor rehab*
  - *Other facility upgrades*

Urban Water Cycle



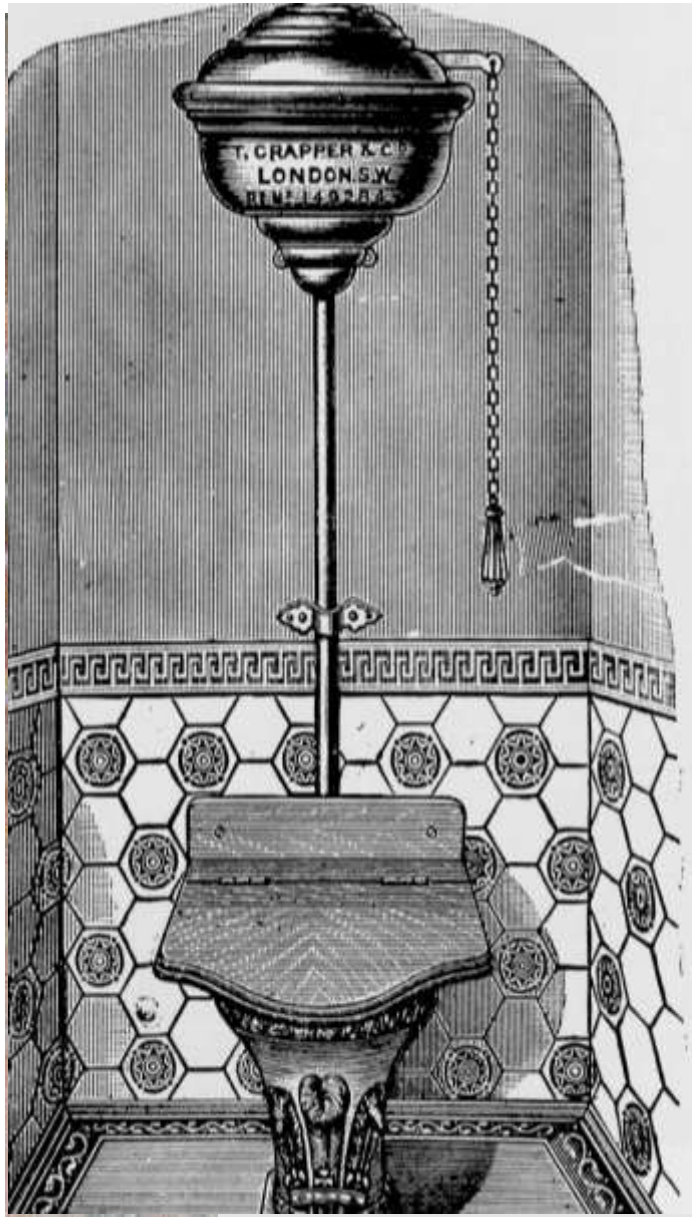
Urban Water Cycle

Sewer System 101



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

1880s-90s:

Sanitary sewers from houses connected to existing storm drains (creating numerous water quality problems)

Combined sewers

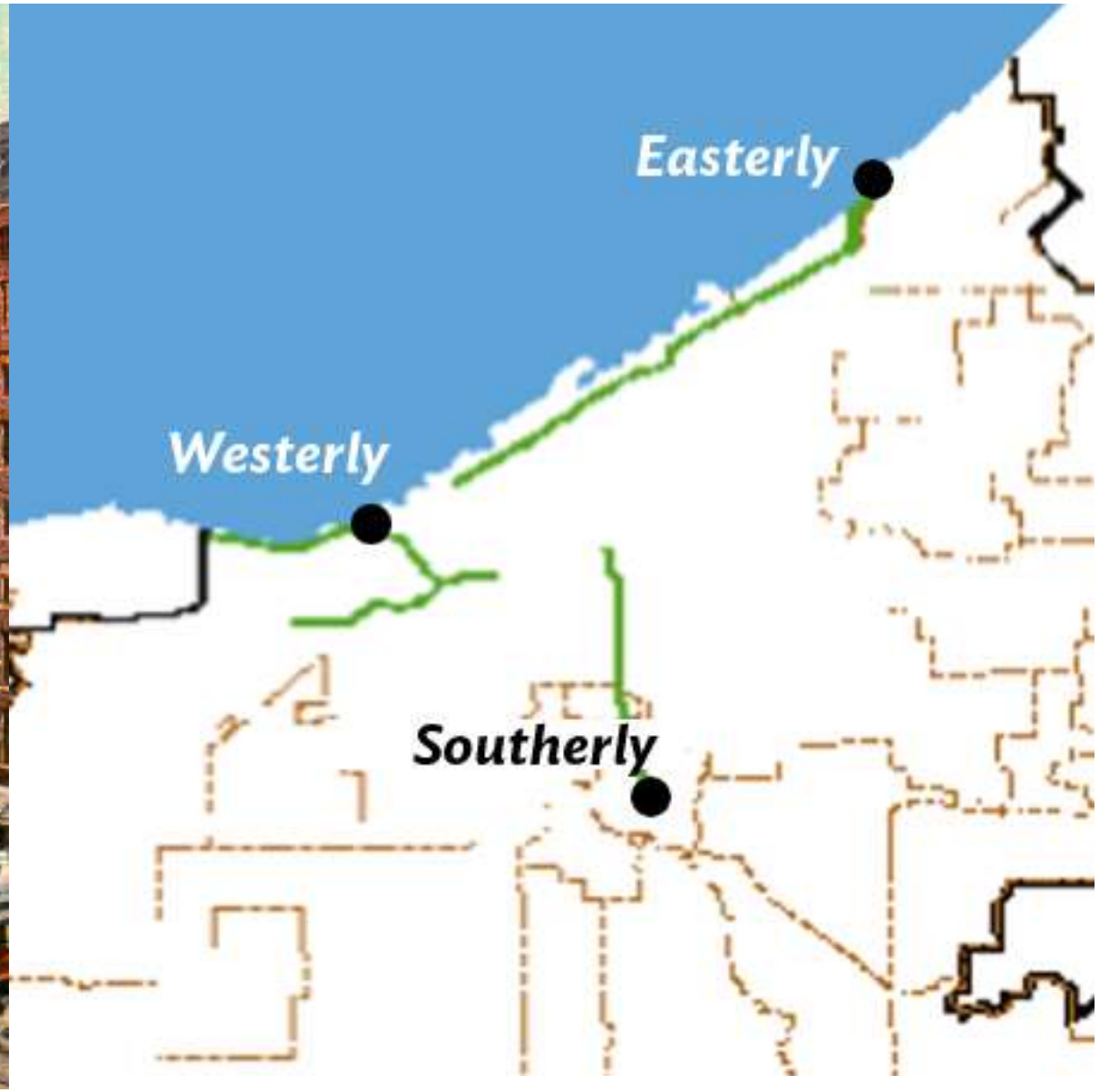
- Matter of evolution, then matter of choice

“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)


Easterly
Westerly
Southerly

Interceptor sewers

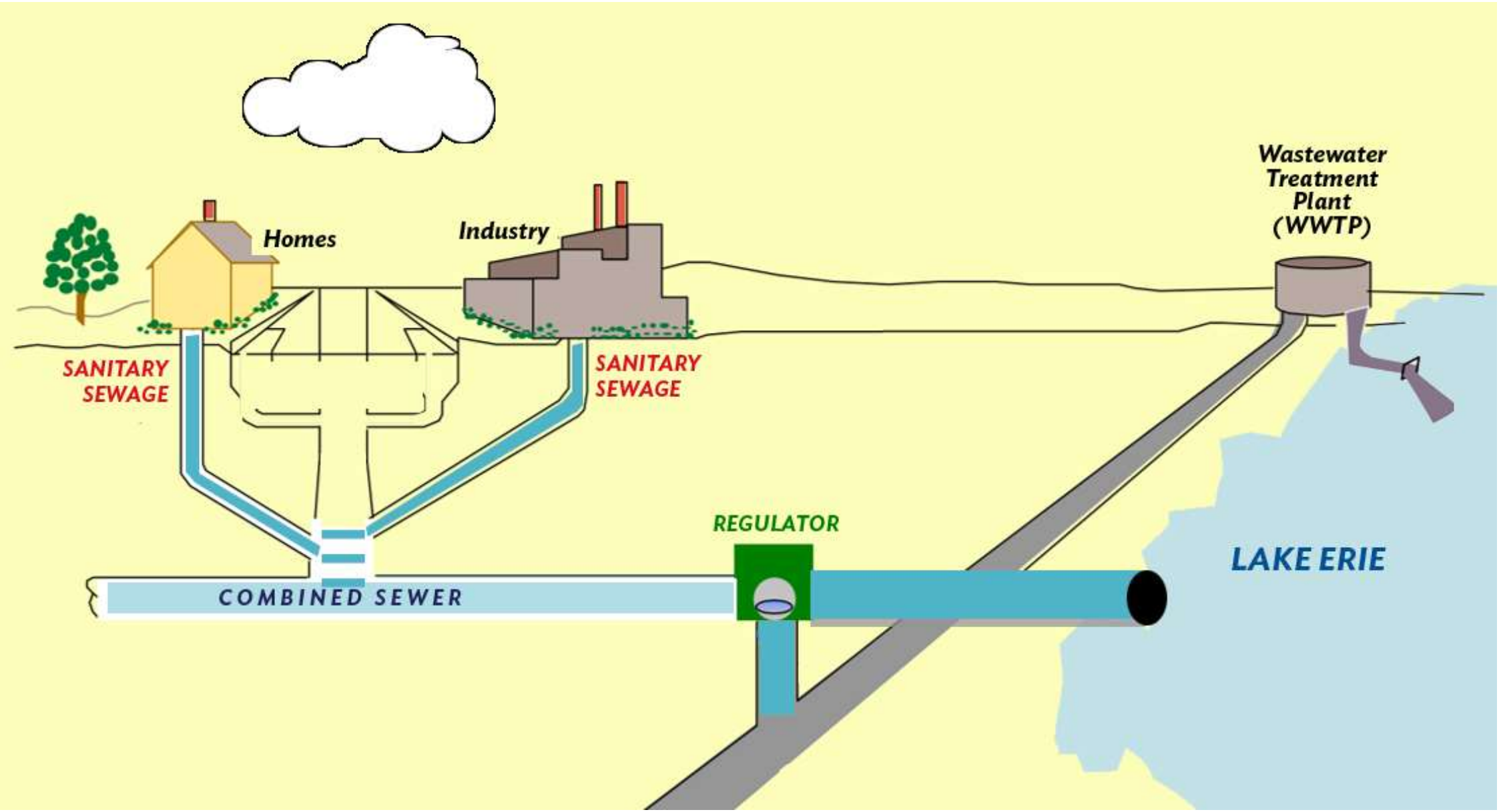
- “Highways” of sewer system, collecting wastewater from smaller sewers serving individual streets

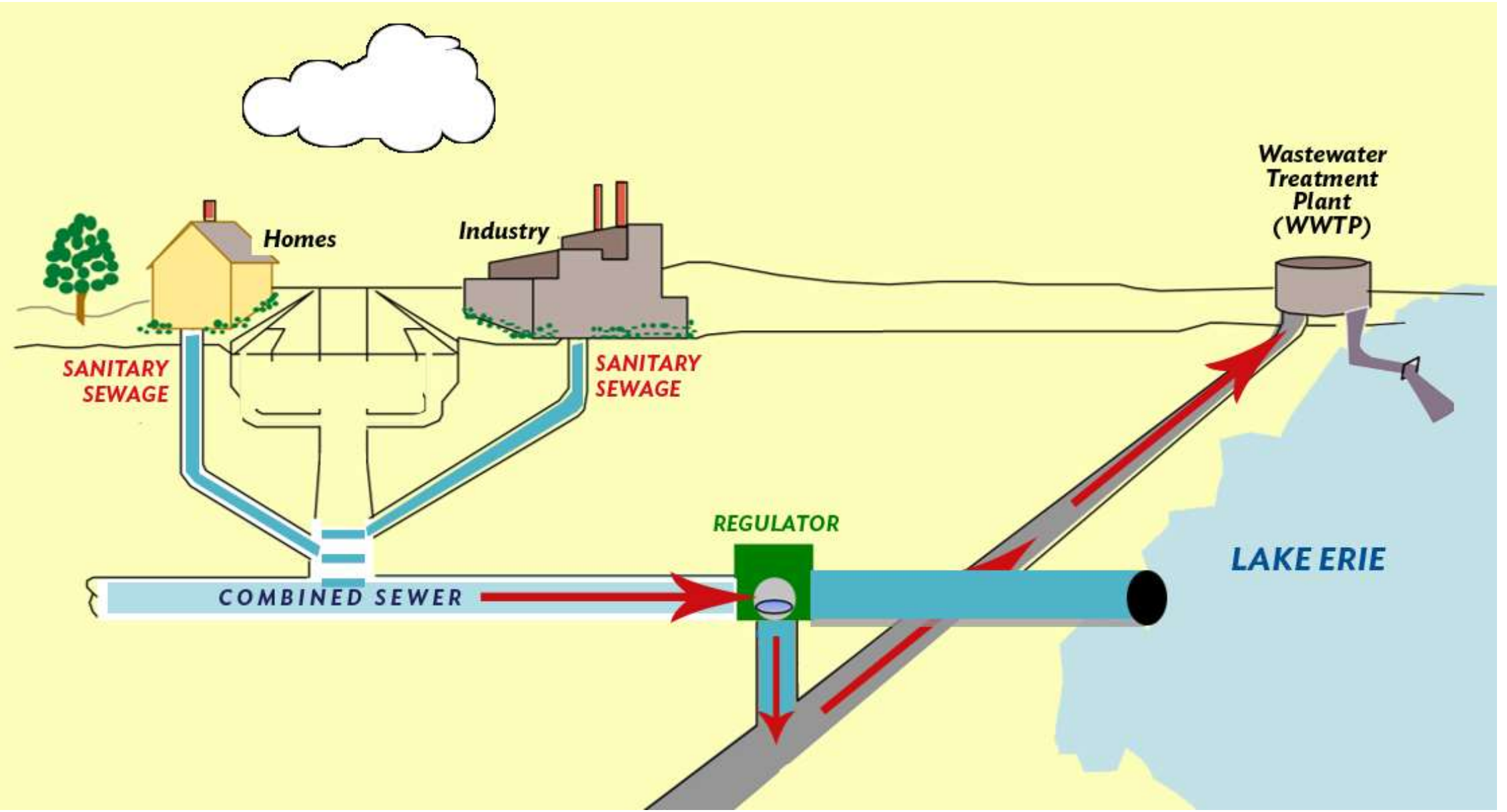
“Dilution is the solution to pollution.”

~~*"Dilution is the solution to pollution."*~~

1922-1938:

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


Homes
Industry
Wastewater Treatment Plant (WWTP)
SANITARY SEWAGE
SANITARY SEWAGE
REGULATOR
COMBINED SEWER
LAKE ERIE


Homes
Industry
Wastewater Treatment Plant (WWTP)
SANITARY SEWAGE
SANITARY SEWAGE
REGULATOR
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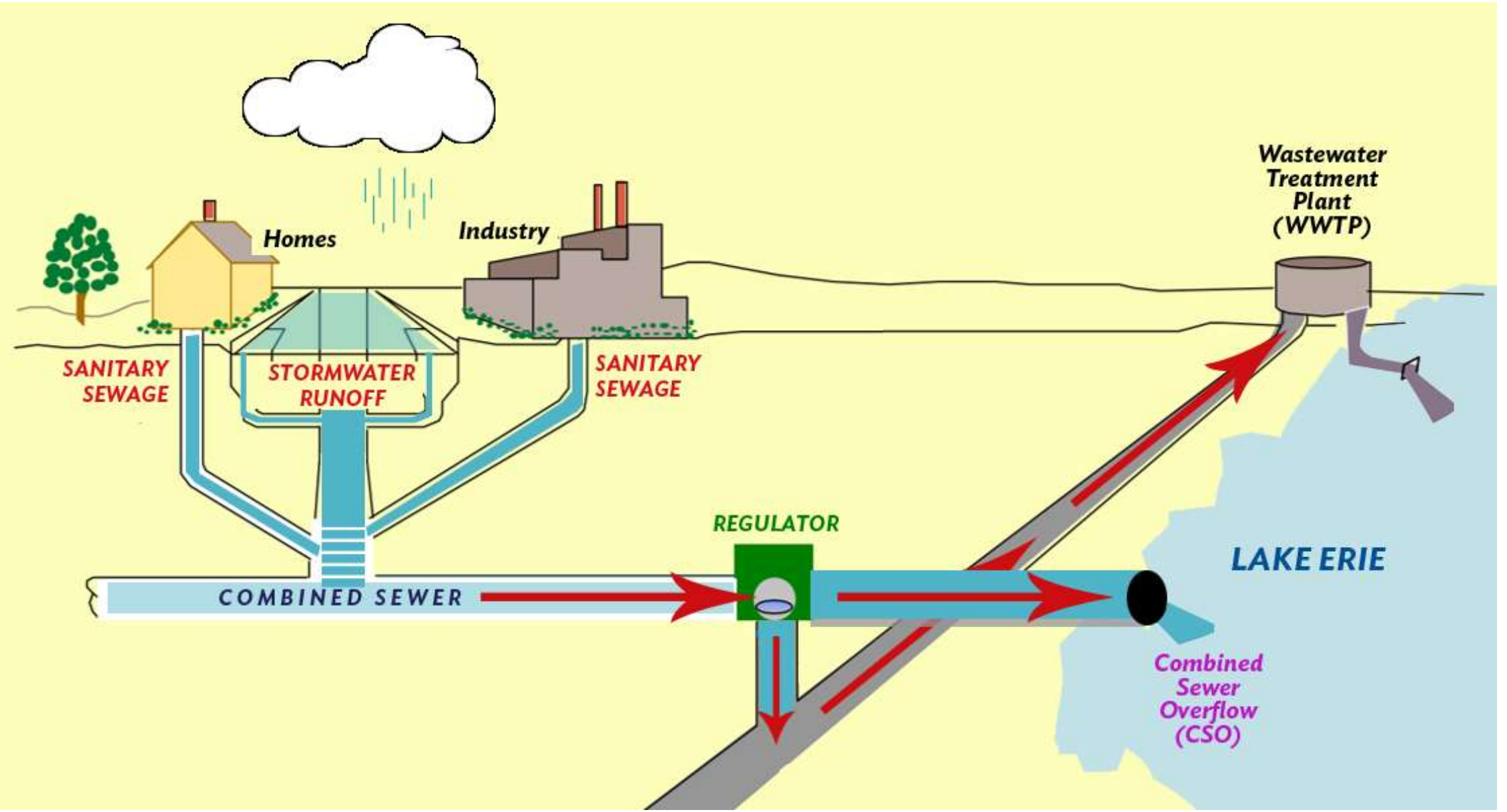
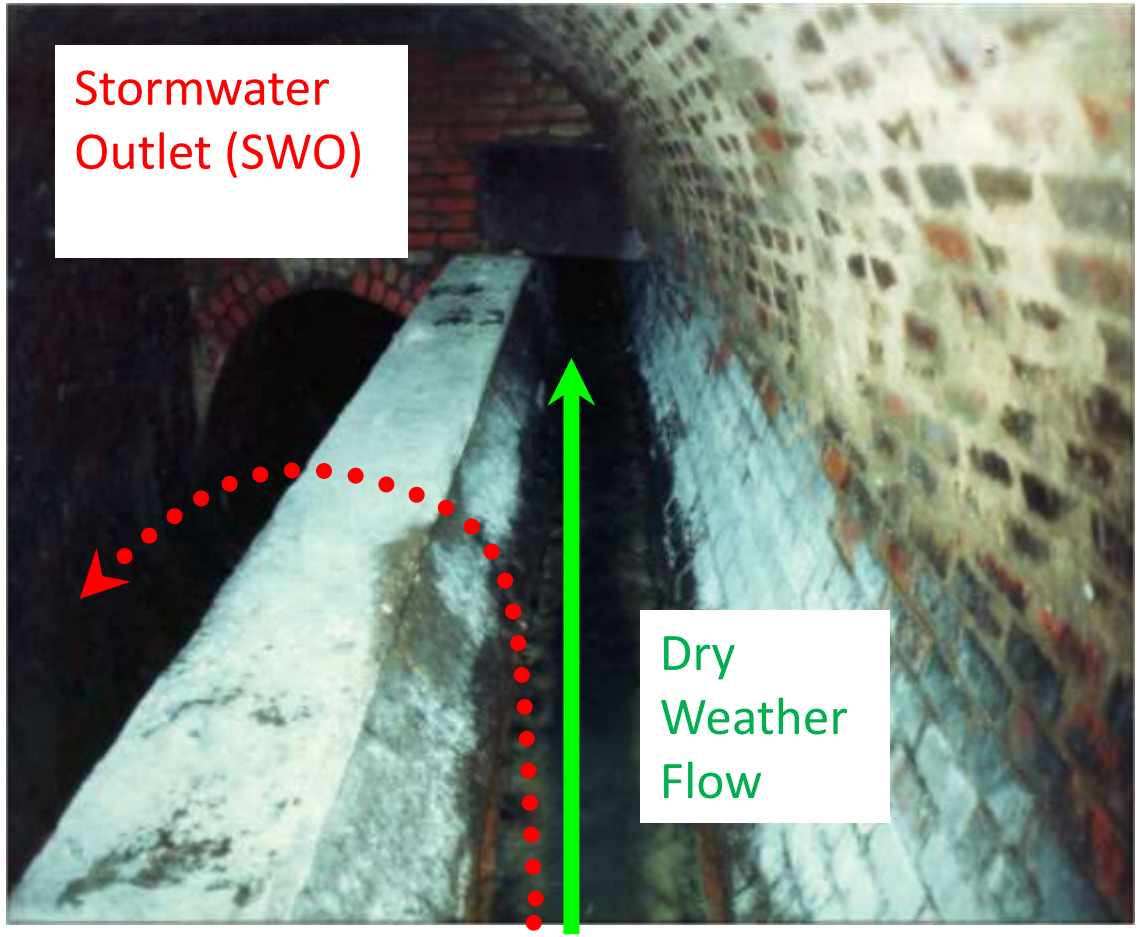
LAKE ERIE


Homes
Industry
Wastewater Treatment Plant (WWTP)
SANITARY SEWAGE
STORMWATER RUNOFF
SANITARY SEWAGE
REGULATOR
COMBINED SEWER
LAKE ERIE
Combined Sewer Overflow (CSO)

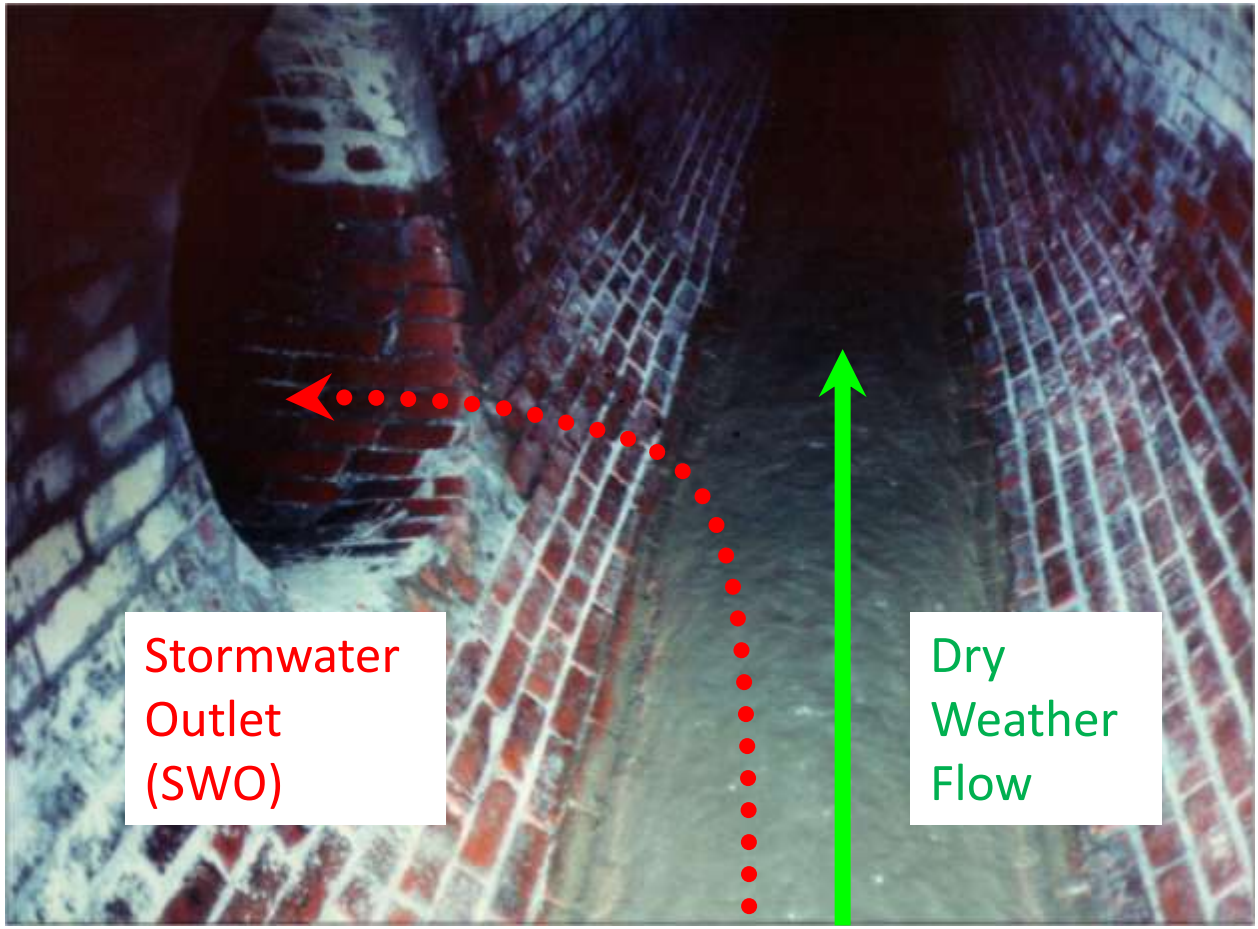
Combined sewer system

- Regulating structures allow excess stormwater to overflow

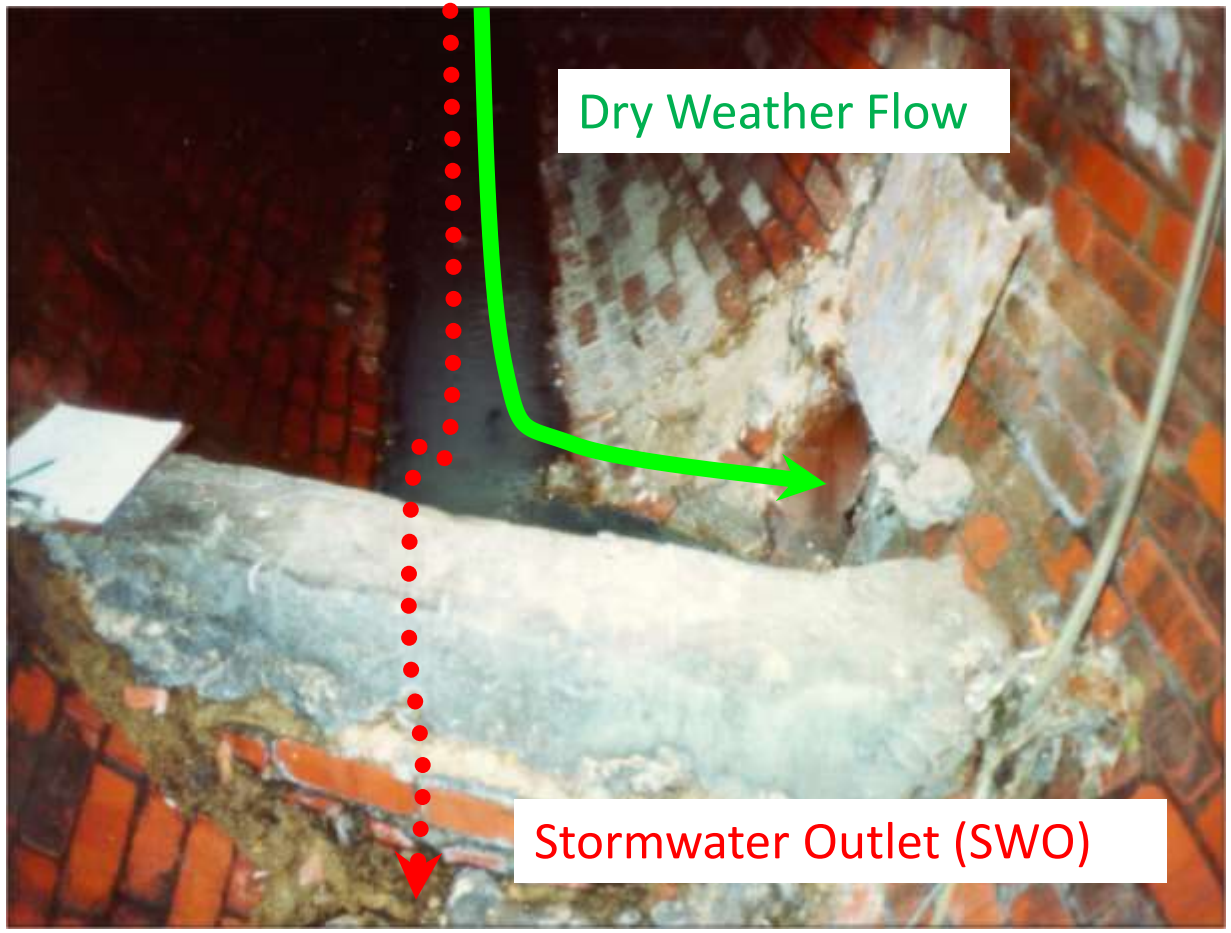
Side-spill weir



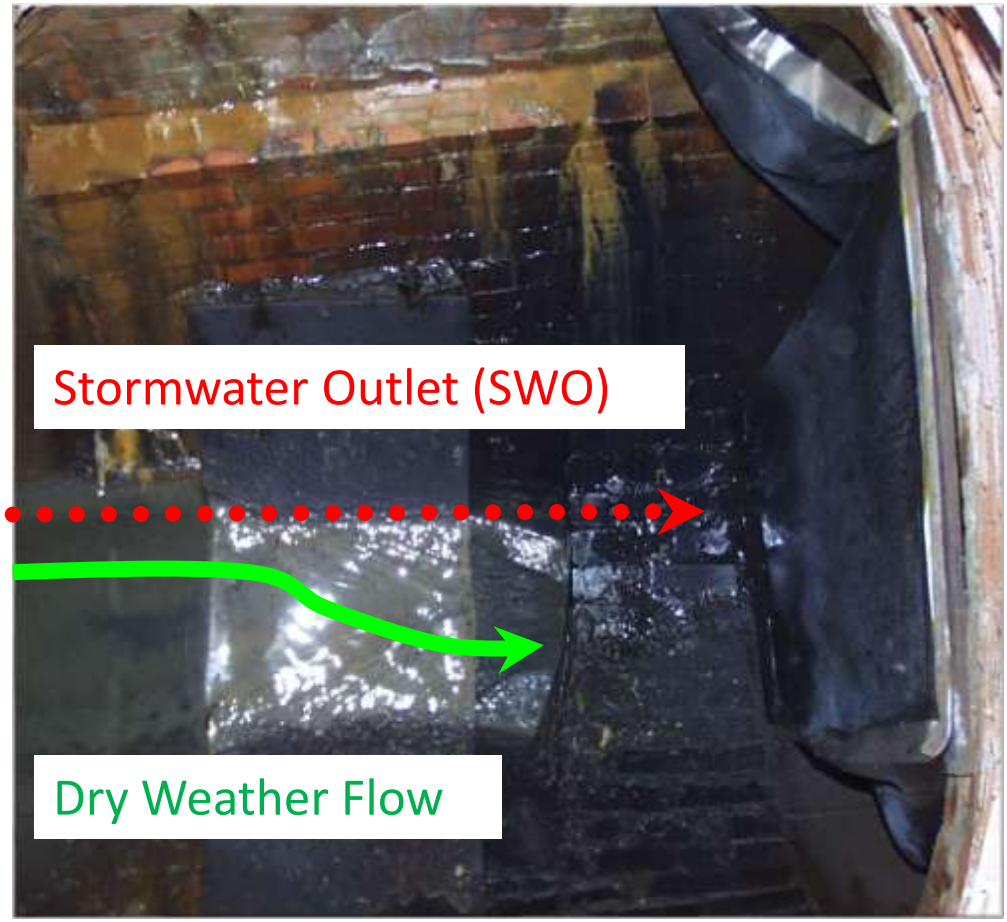
Overflow pipe

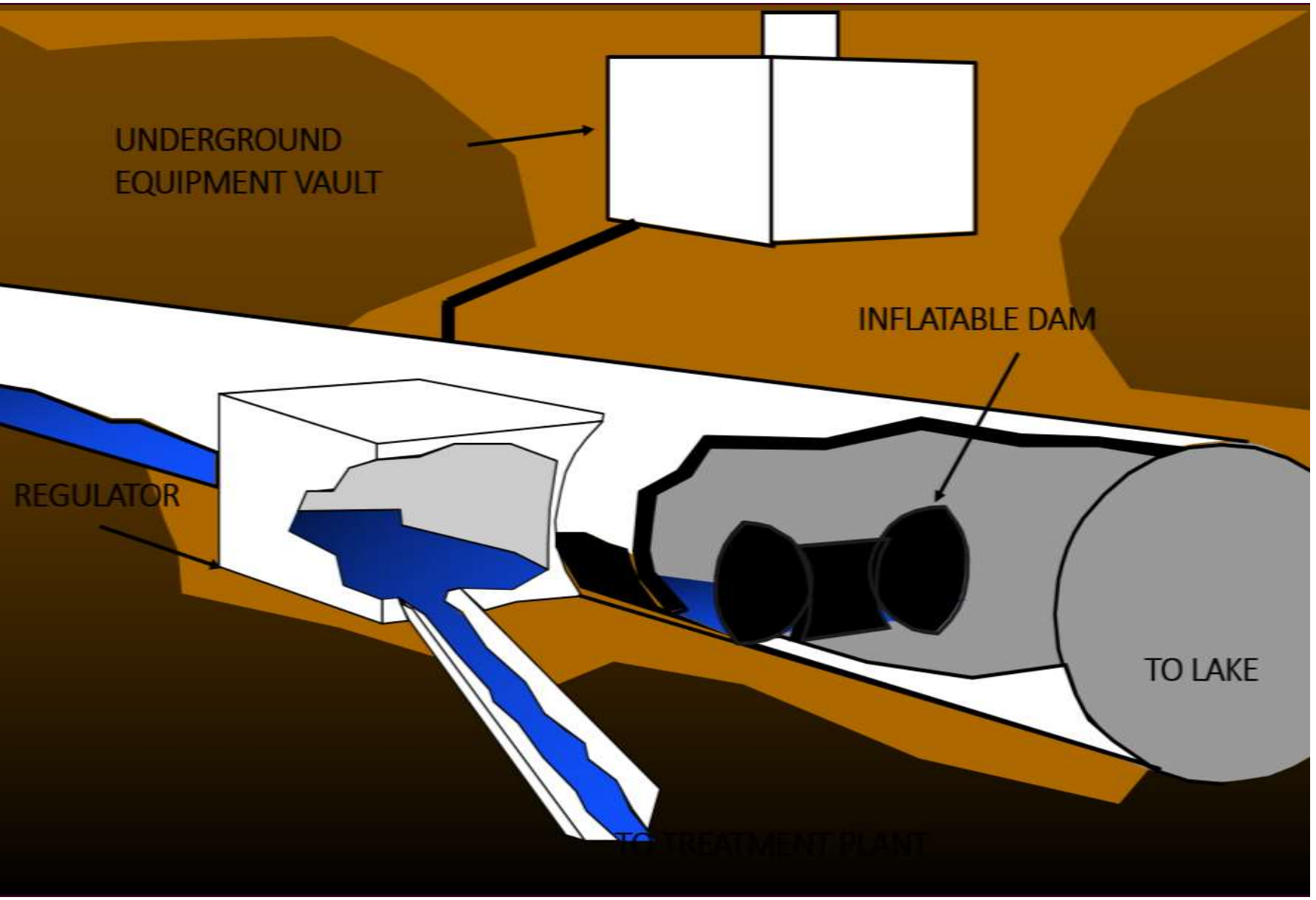


Perpendicular weir



Leaping pipe

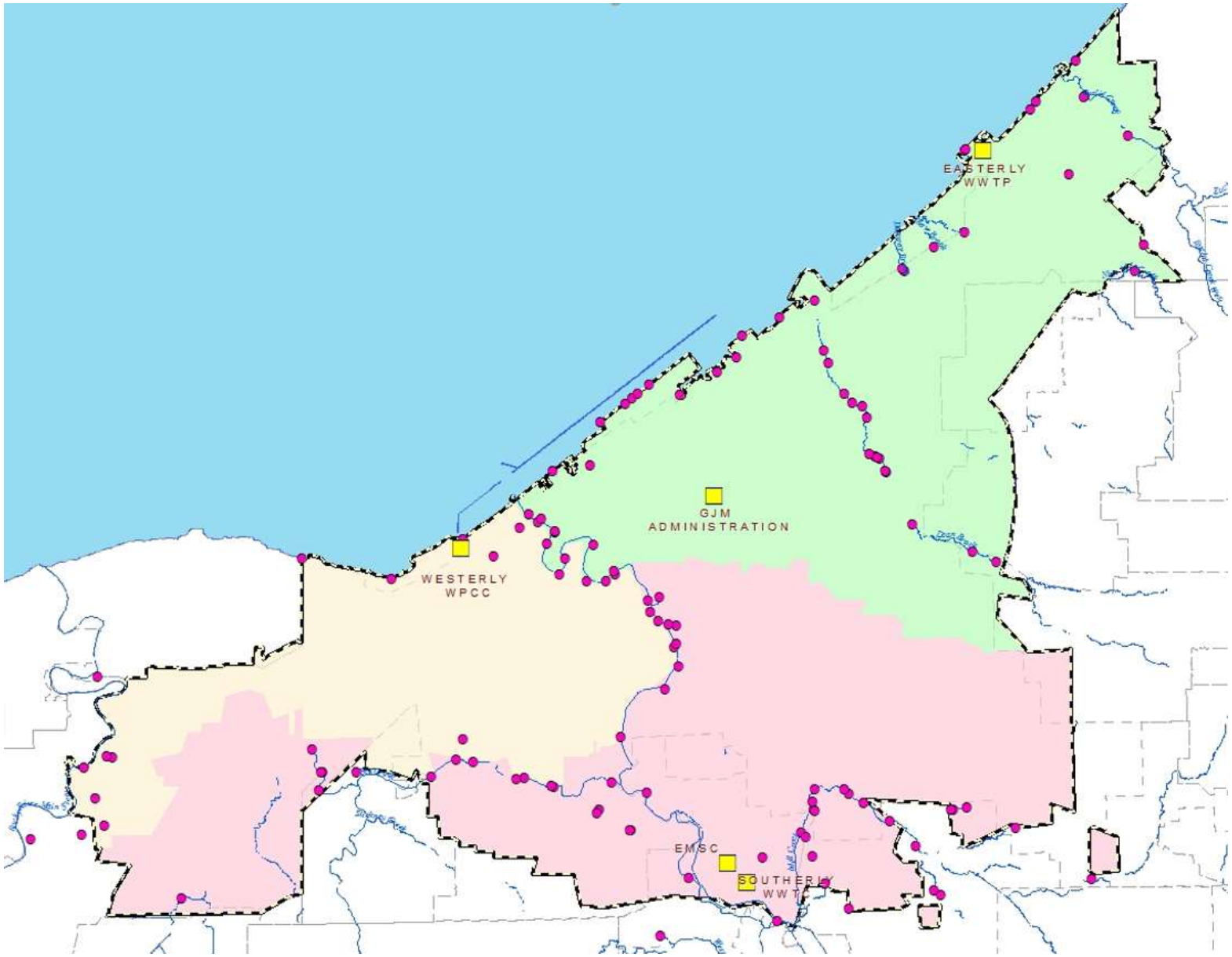




Typical automated regulator

Automated Regulator

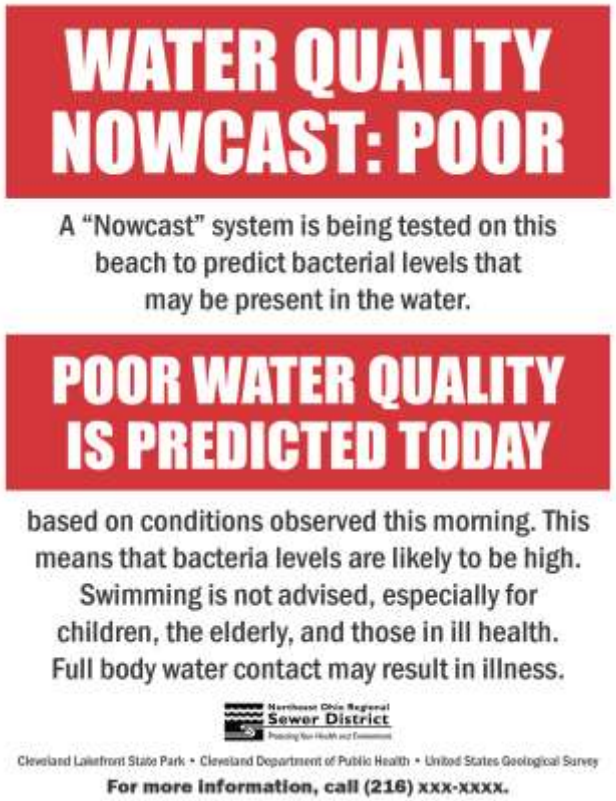
Combined Sewer Overflow (CSO)



Combined Sewer Overflow (CSO) Outfall locations

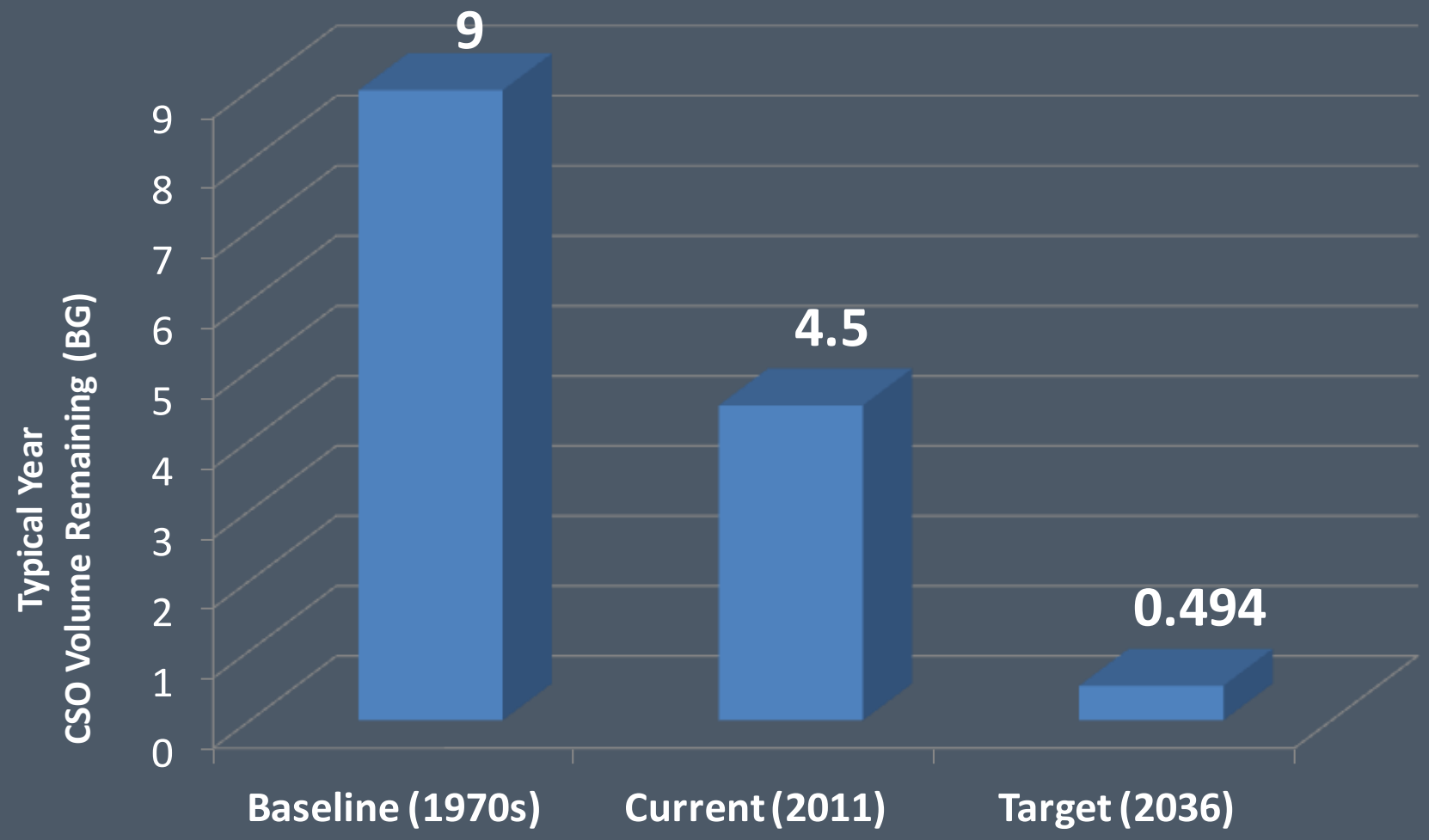
Combined Sewer Overflow impact water quality

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



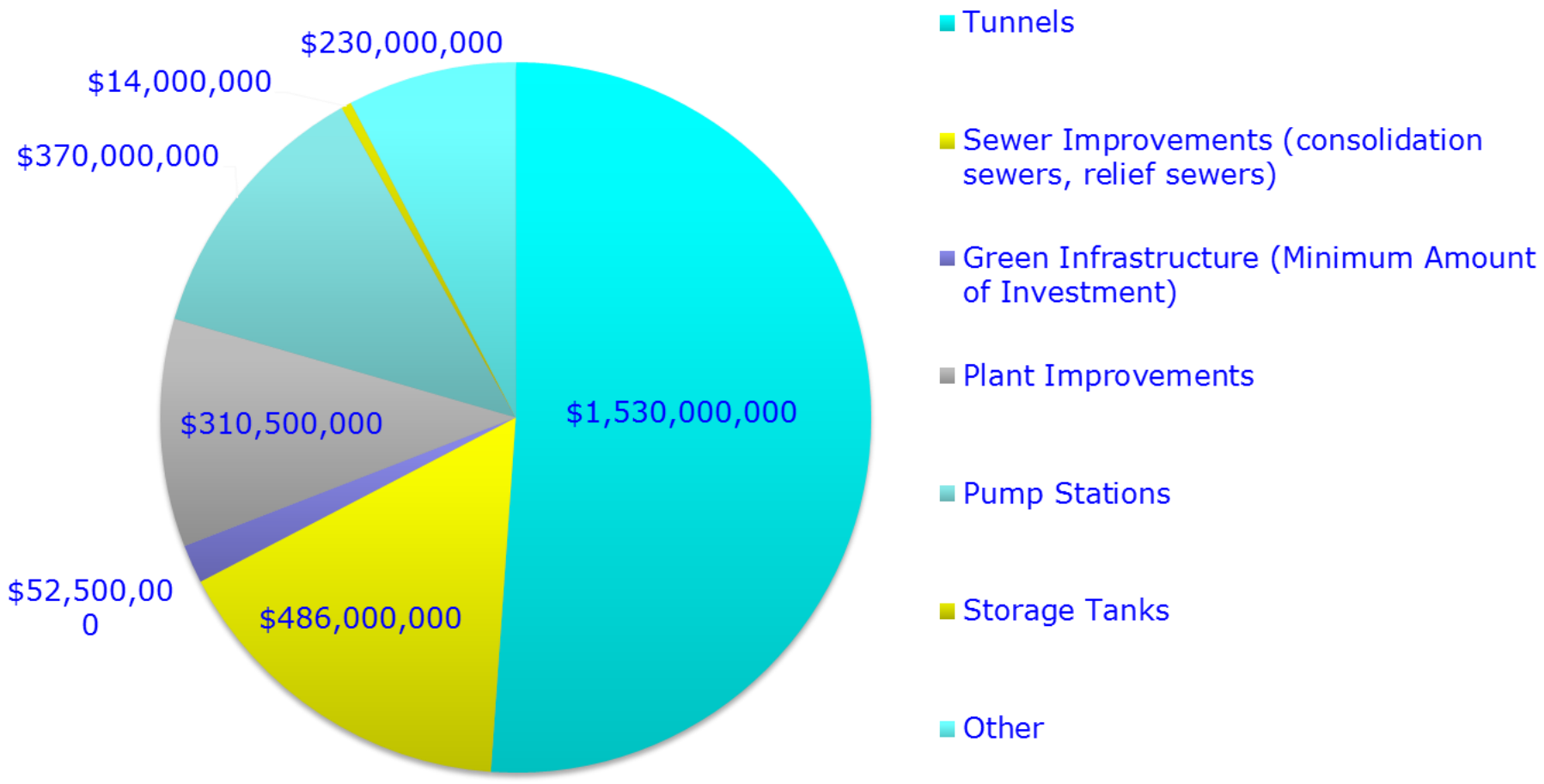
Public notification

CSO reduction in 25 years



CSO Long-Term Control Plan Consent Decree

An estimated $3 billion investment in CSO control measures over 25 years:




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
CLEVELAND HEIGHTS
LINNDALE
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

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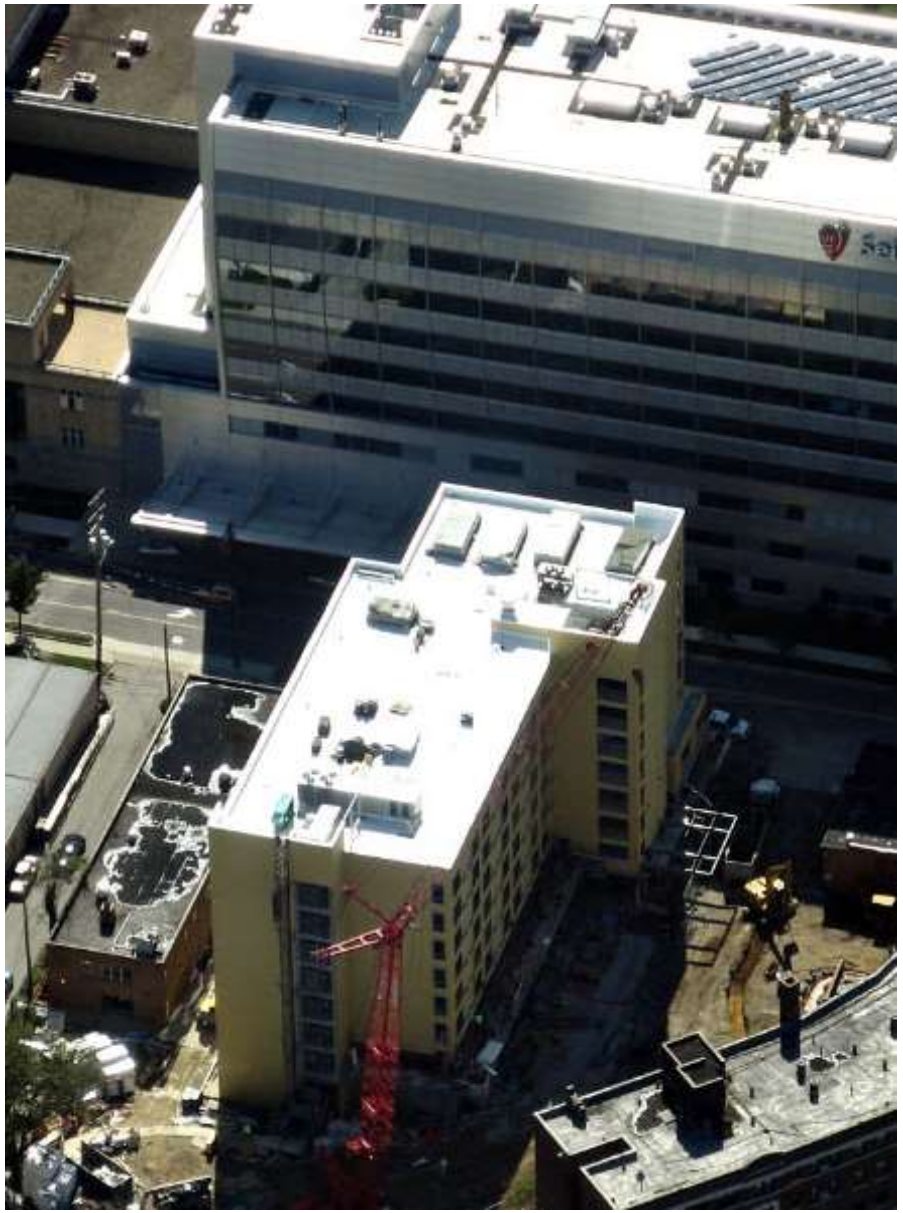
Green Infrastructure projects

Keep stormwater from entering the combined-sewer system

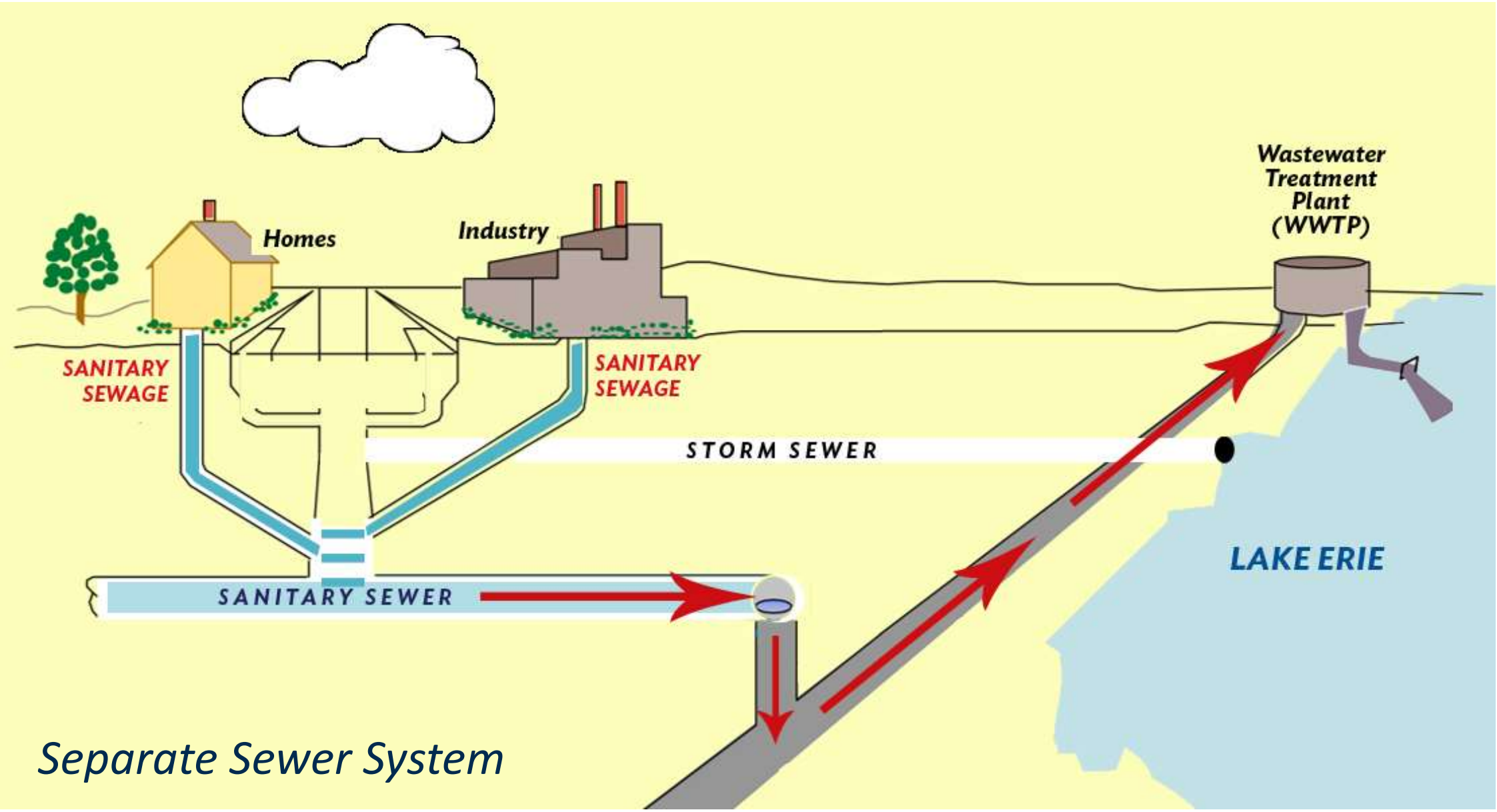


Green Infrastructure projects

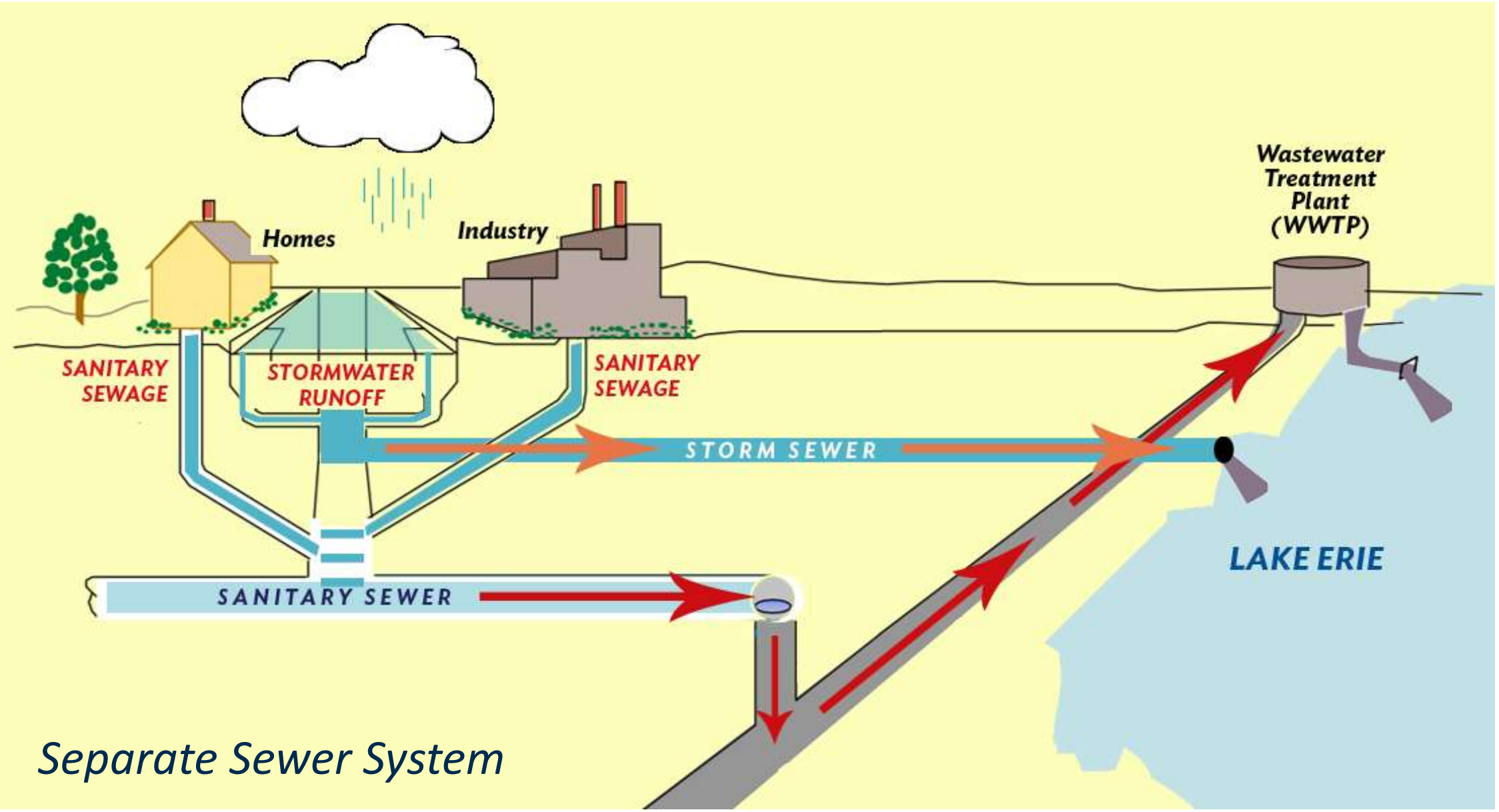
Courtyard by Marriott (University Circle): No stormwater runoff from this site through 100-year storm

Green Infrastructure projects

Public Square



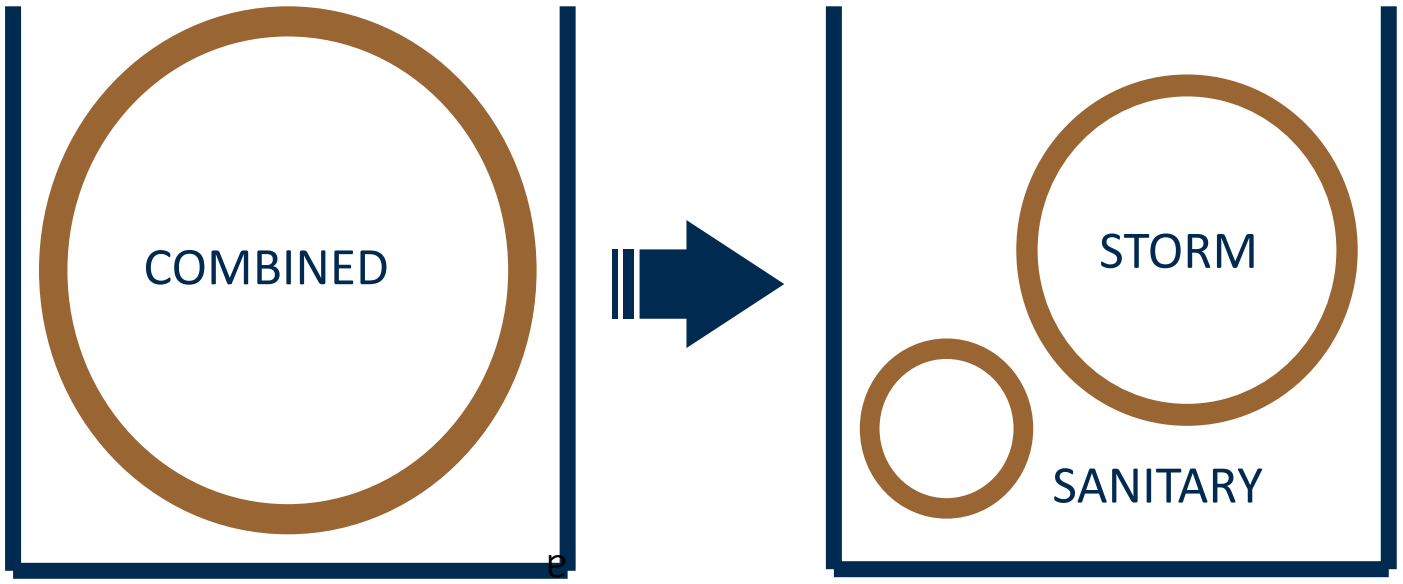
Separate Sewer System



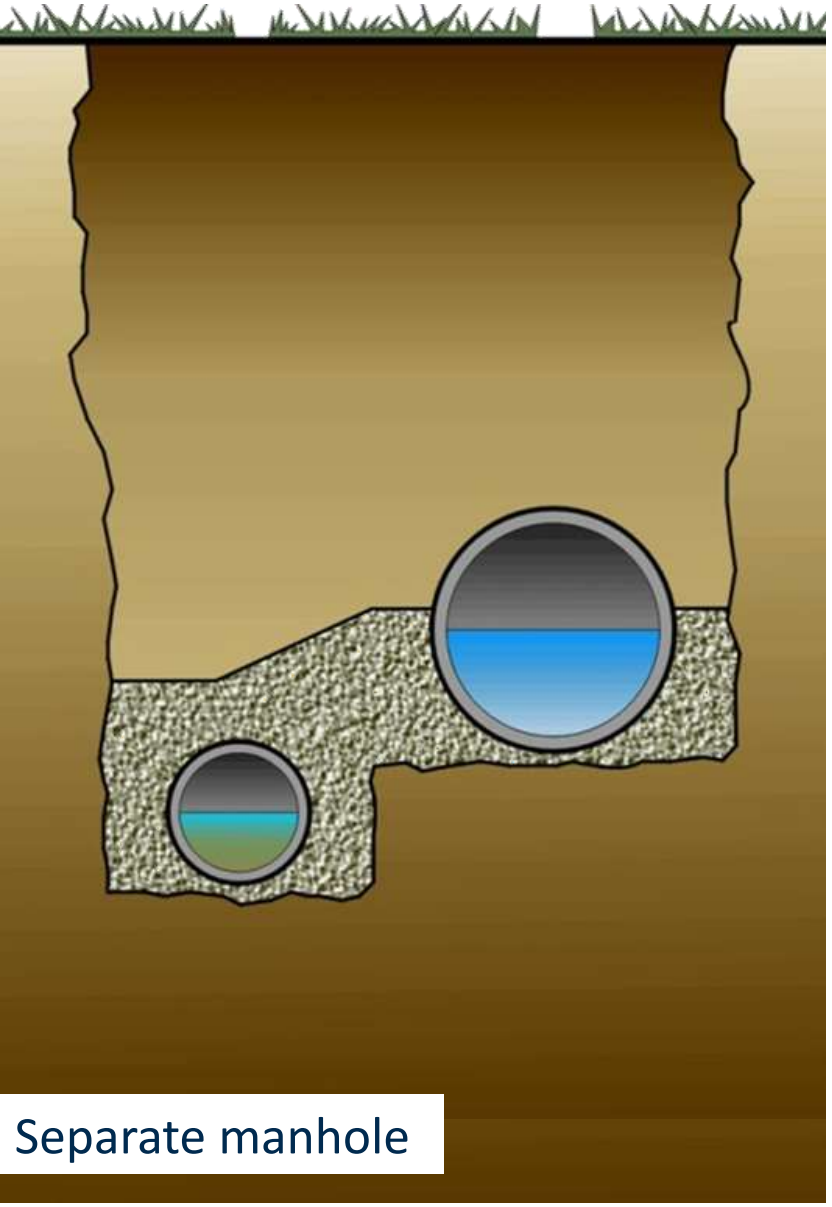
Separate Sewer System

Combined vs. Separate

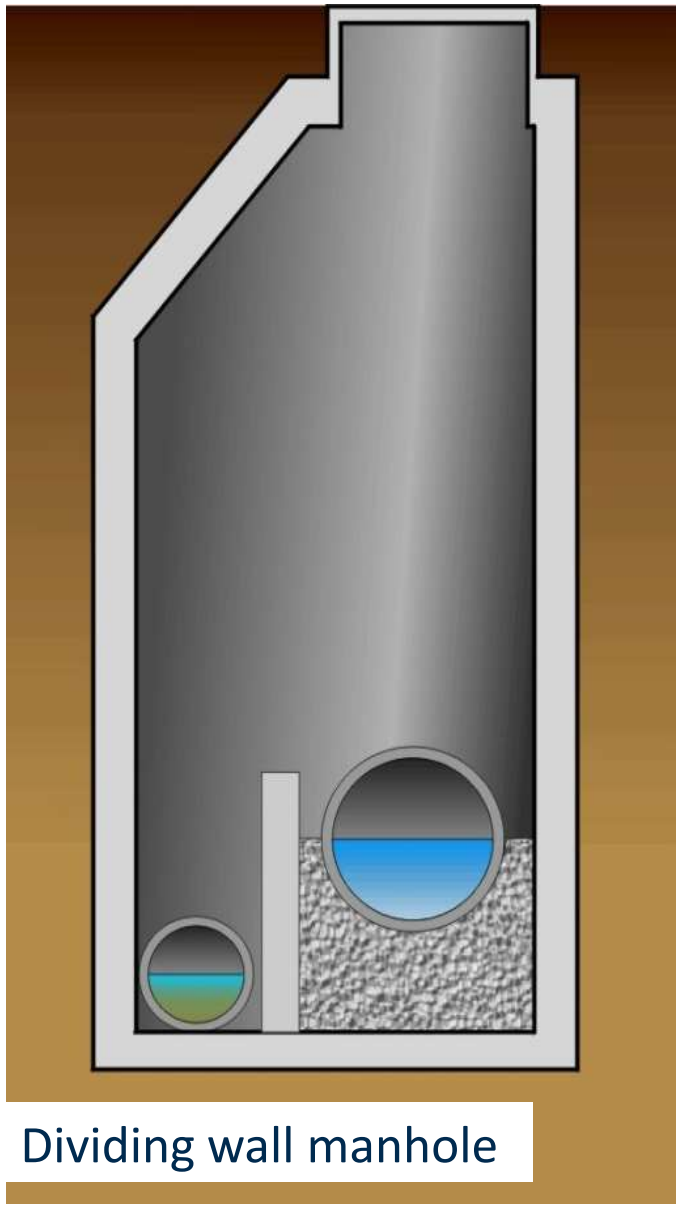
- 1920s-1960s: Evolution from combined sewers to separate sewers built in a common trench



1920s 1960s



Separate manhole

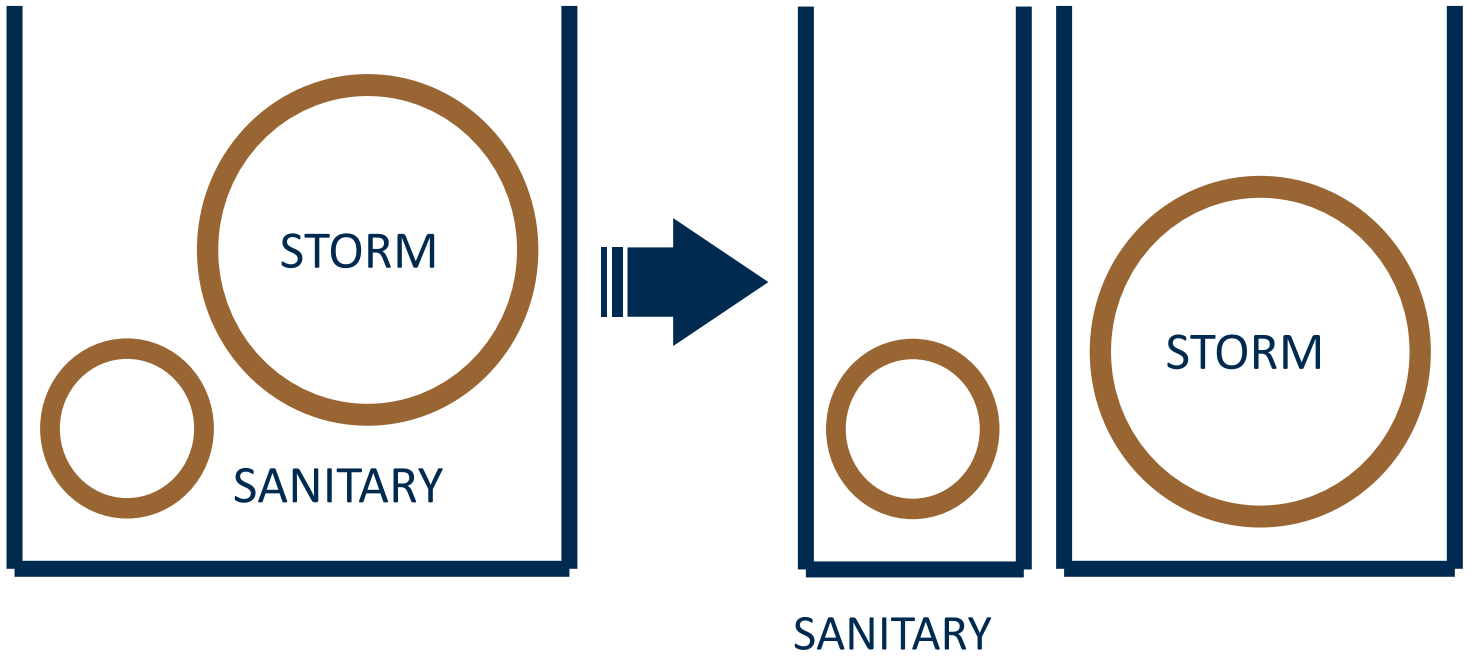


Dividing wall manhole

Over/under

Combined vs. Separate

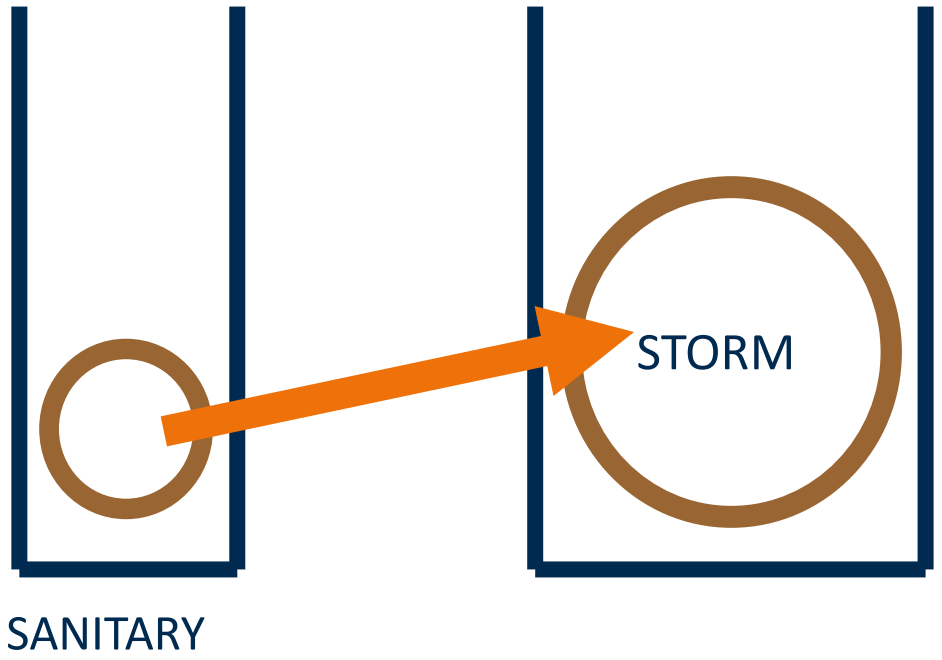
- 1960s-today: evolution from common trench sewers to truly separate sewers in many areas



Separate sewer problems

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

Illicit Connections

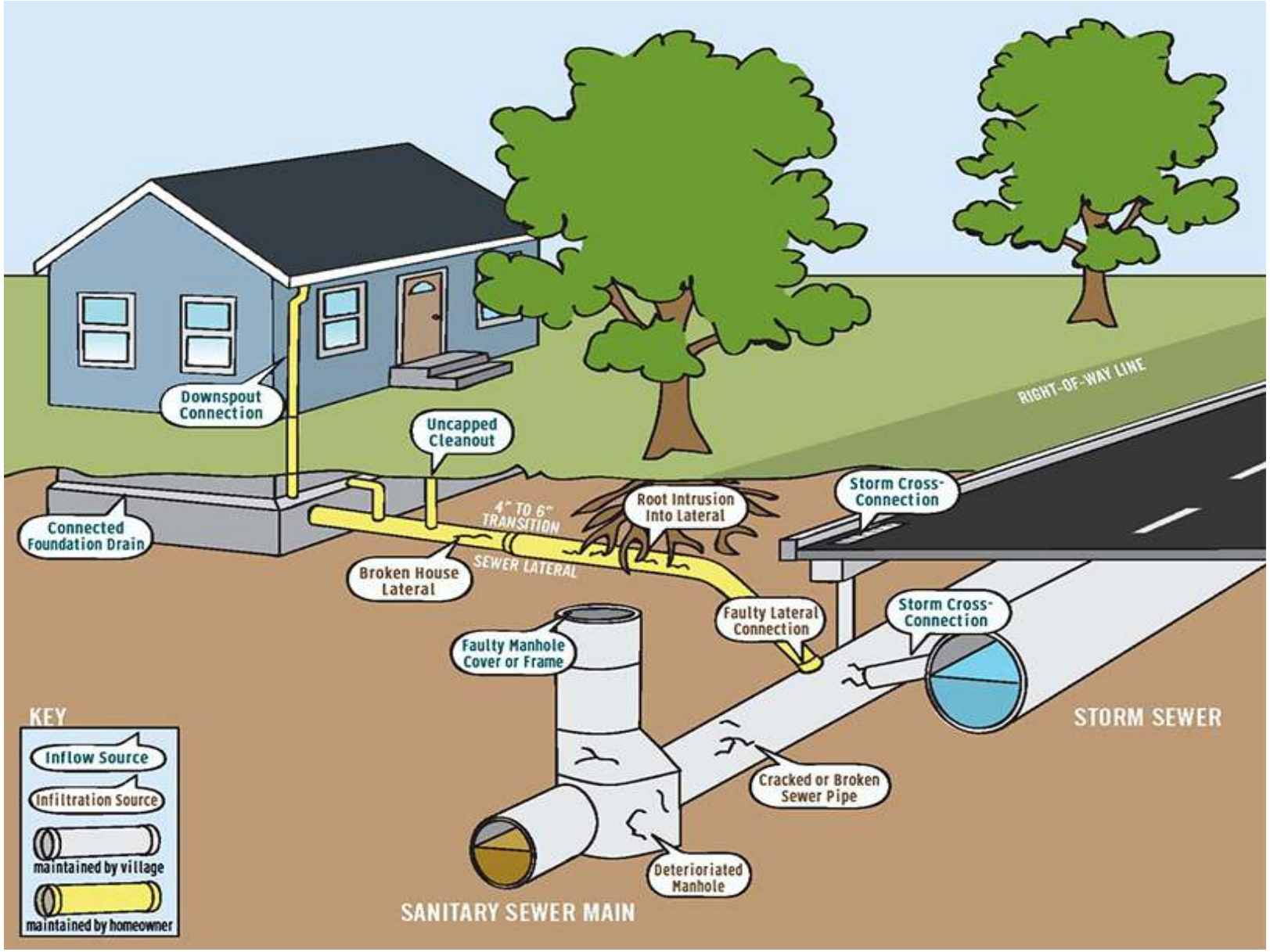


Separate sewer problems

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

Sanitary Sewer Overflows

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



Cracks and leaks

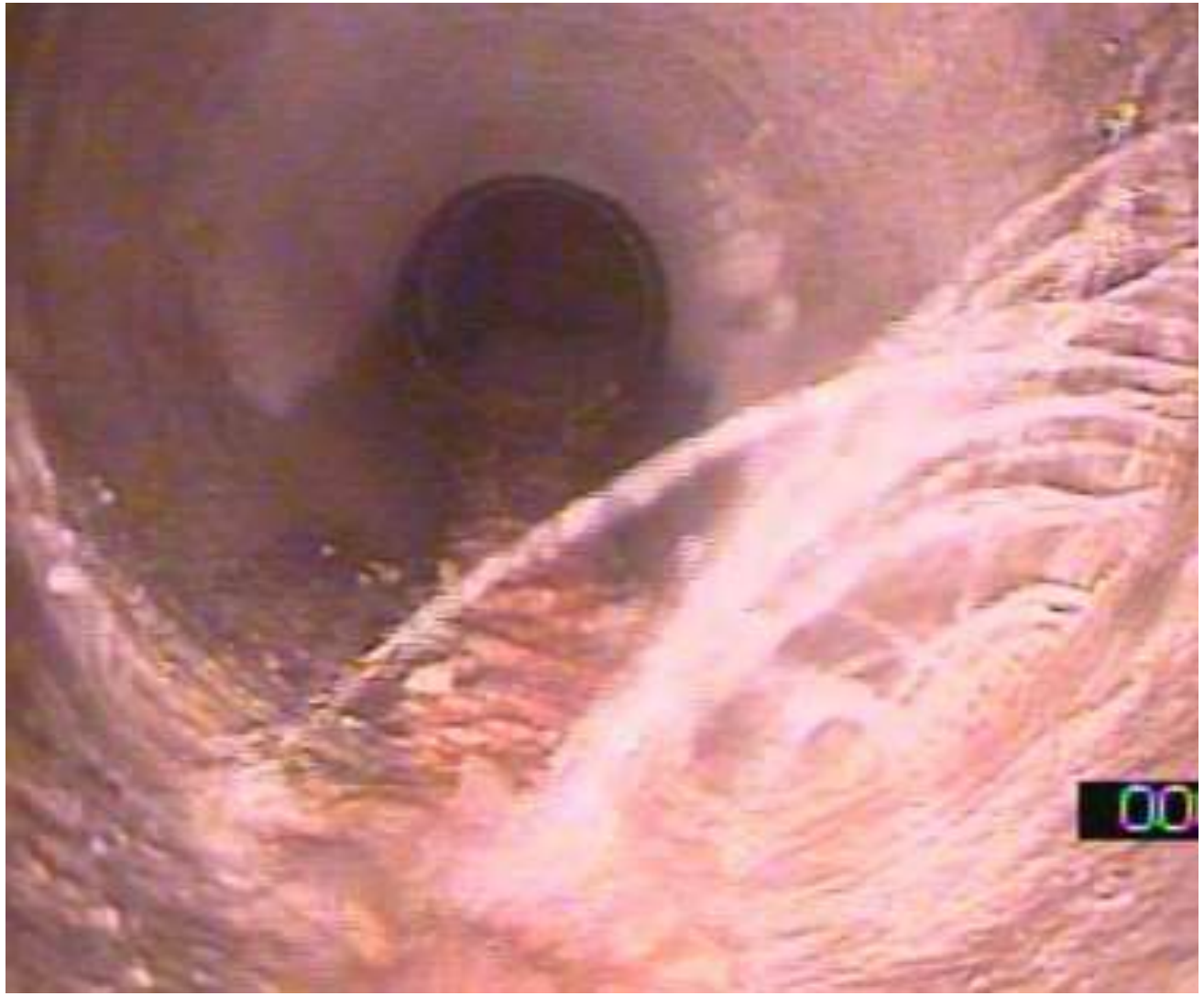
Inflow

"I & I" stands for

Inflow & Infiltration

- ***Inflow:*** the flow of stormwater into the sanitary sewer system through connections like roof drains, foundation drains, and basement sump pumps.
- ***Infiltration:*** groundwater seeping into sewer pipes, including private sewer laterals, cracks, and broken pipe joints.

Infiltration



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Inflow & Infiltration

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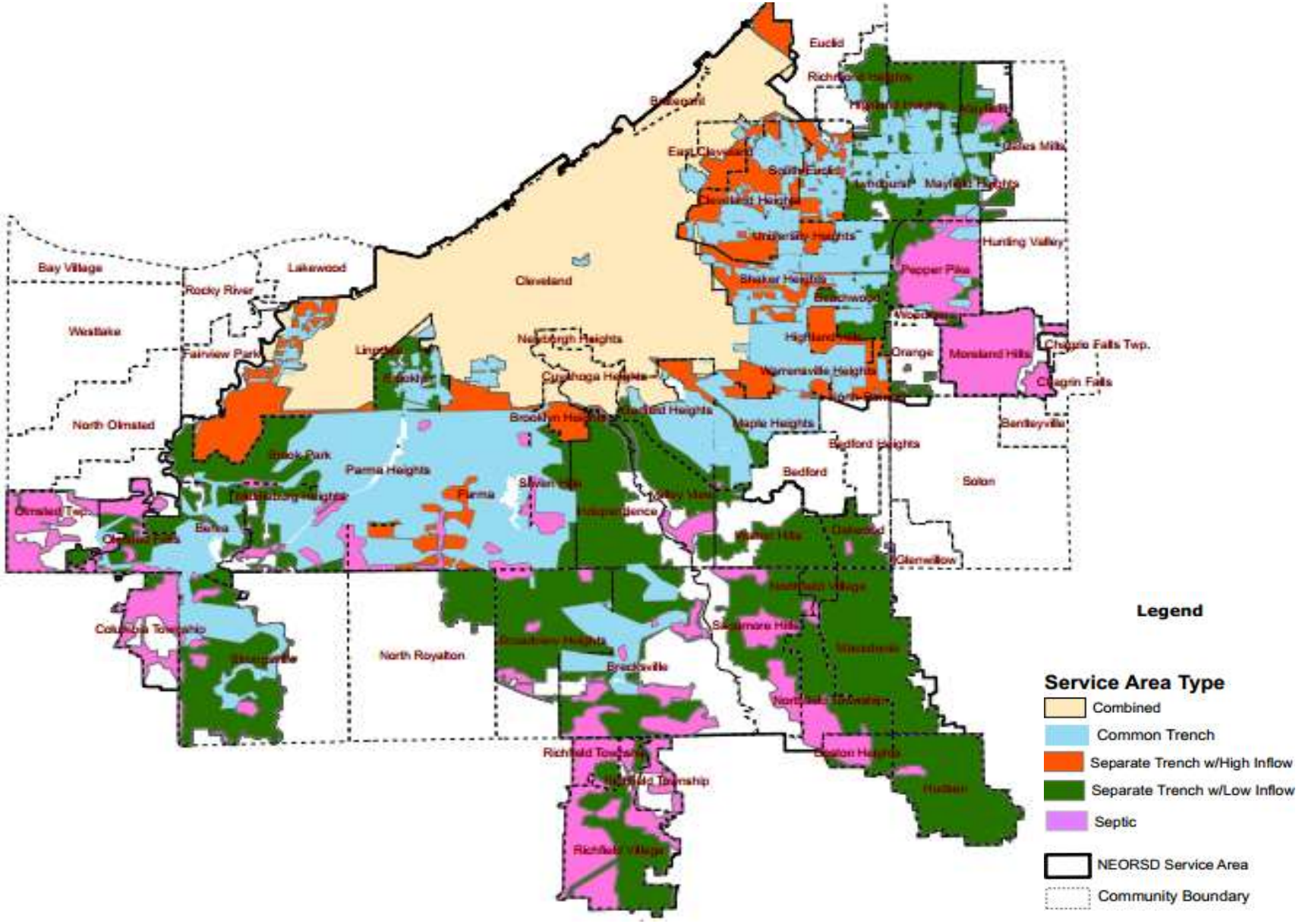
- ***Infiltration:*** groundwater seeping into sewer pipes, including private sewer laterals, cracks, and broken pipe joints.

Types of Sewers in the District's Service Area

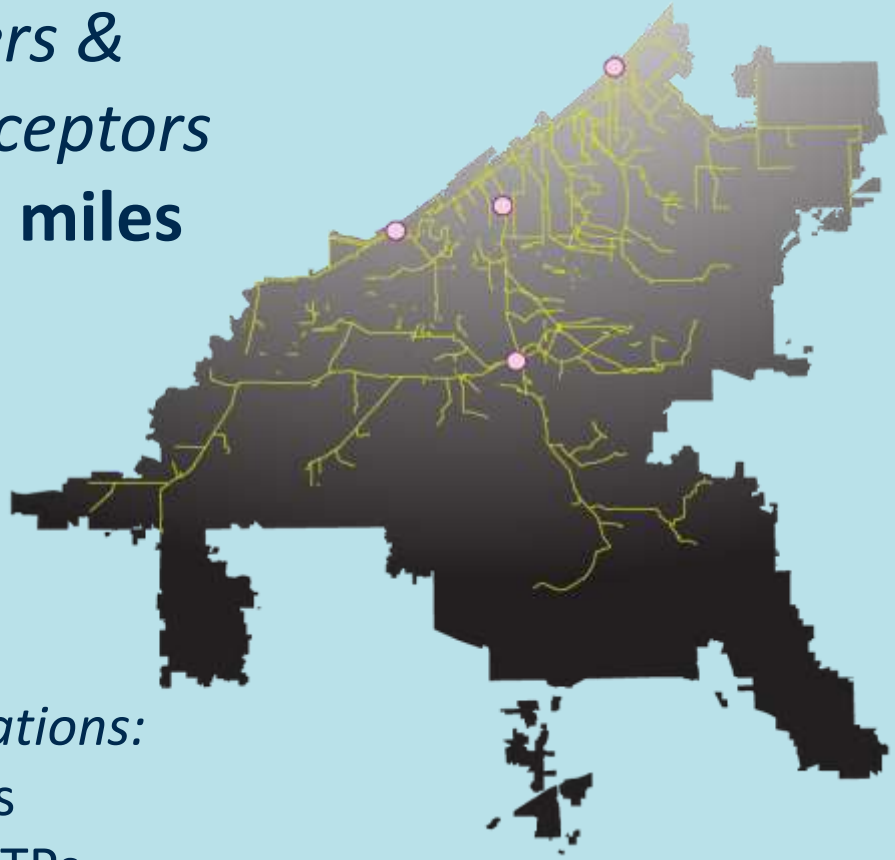
- Combined
- Common Trench (storm and sanitary)
- Separate Trench (storm and sanitary)



Sewer System Types
District Service Area

District-owned sewers & interceptors

330+ miles

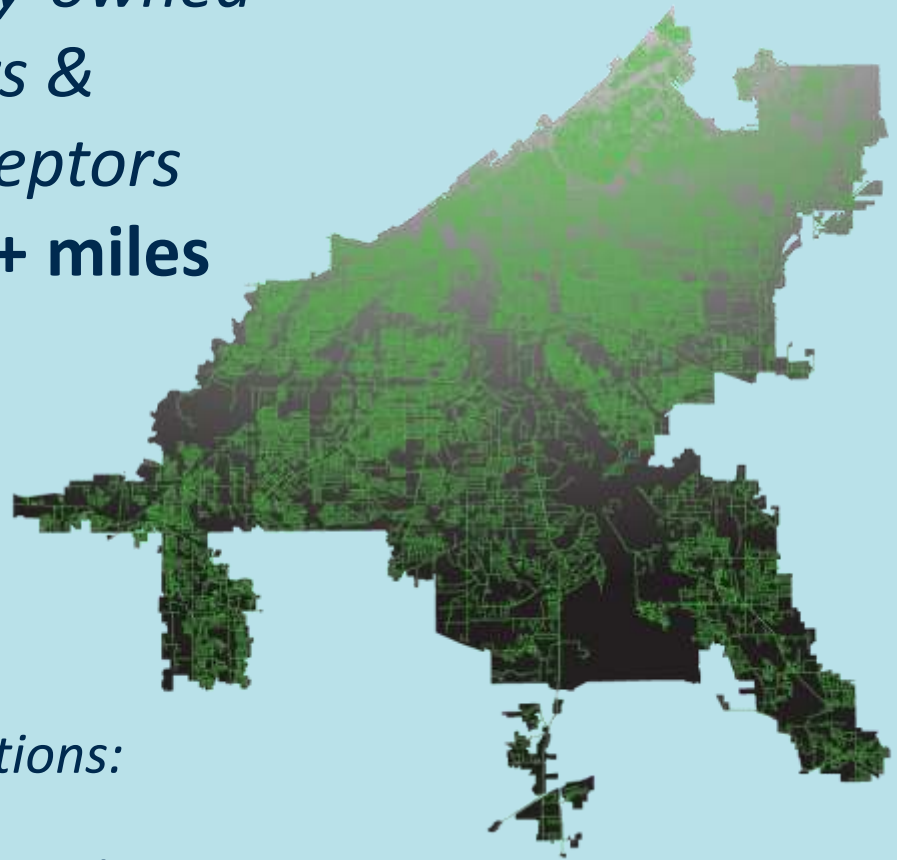


Obligations:

- CSOs
- WWTPs

Locally-owned sewers & interceptors

3,300+ miles



Obligations:

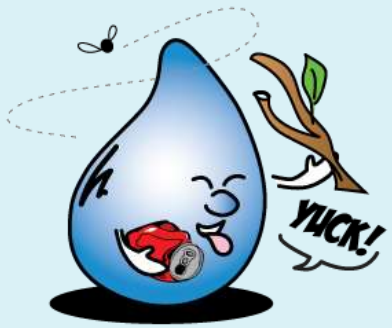
- SSOs
- Illicit Discharges & Connections
- Stormwater Outfalls
- Septic Tanks

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

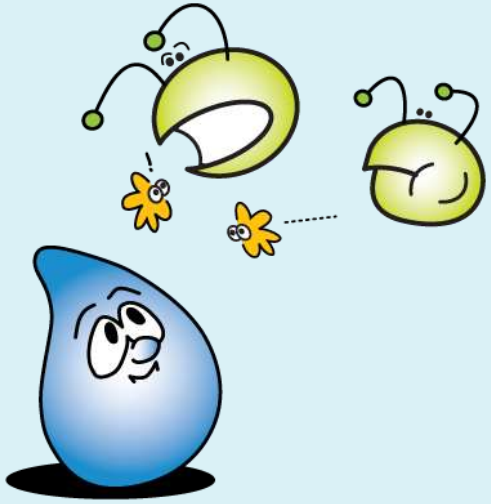
Wastewater Treatment Plant 101


Oldsmobile
Truck

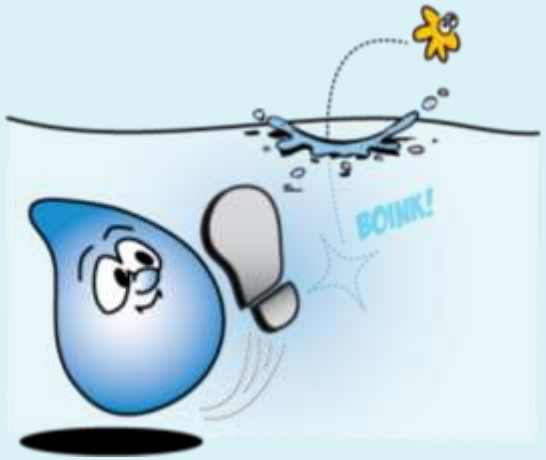


1 Preliminary

2 Primary



3 Secondary

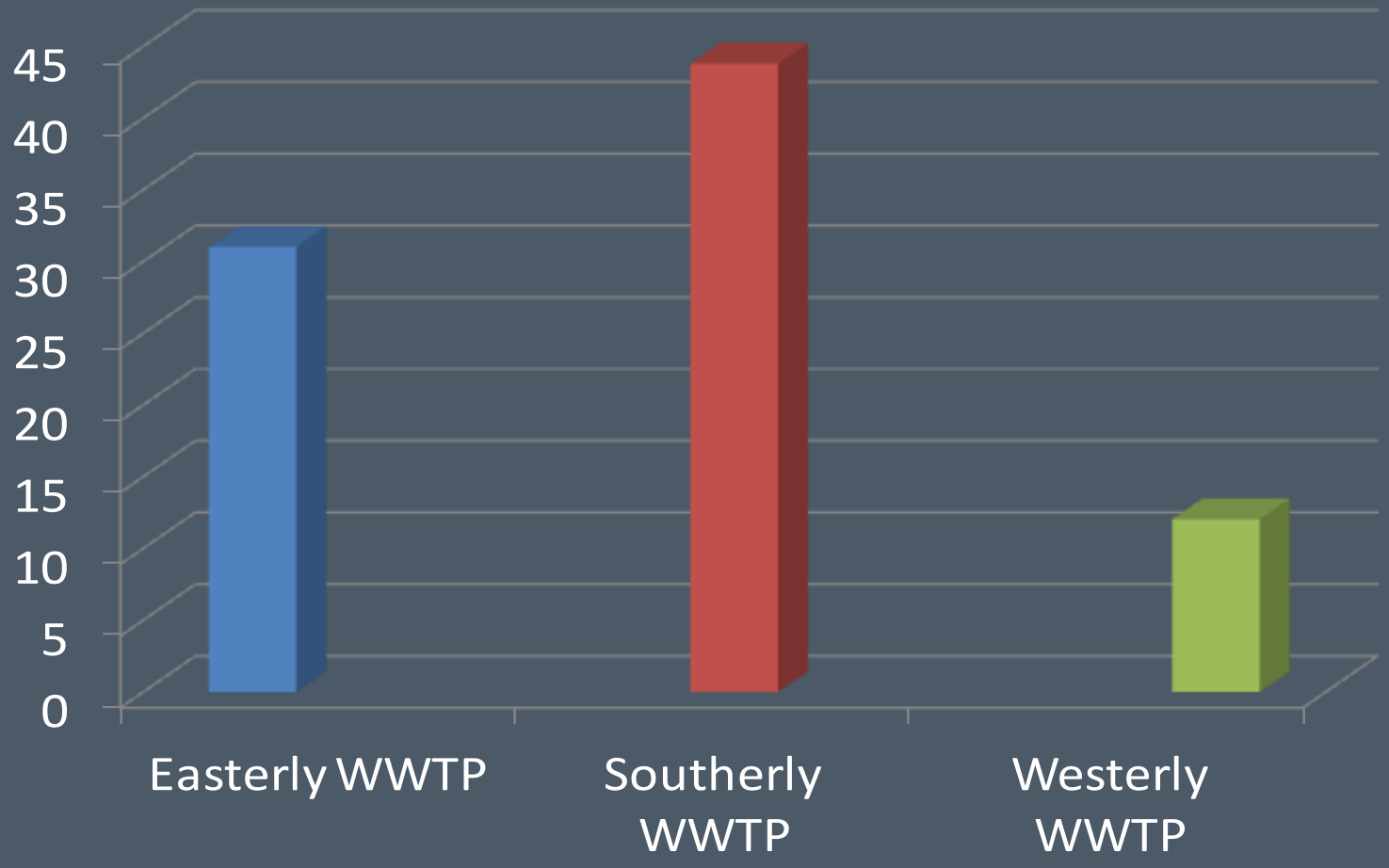


4 Disinfection

The treatment process

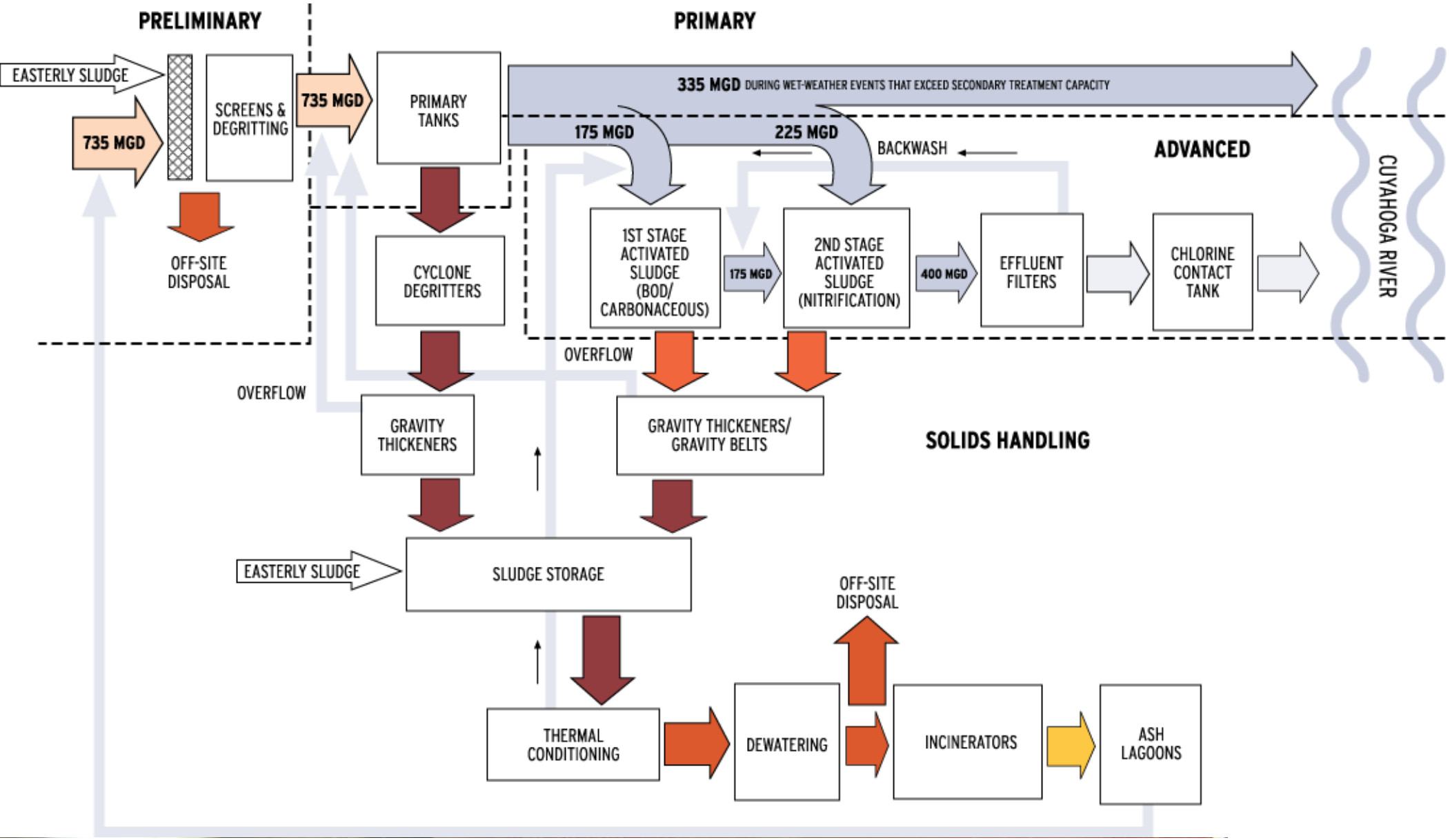
Wastewater Treatment Plants

90 billion gallons treated annually



Wastewater Treatment Process

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


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

Southerly

Preliminary Treatment Mechanical Bar Rakes

Preliminary Treatment Screenings Collection

Preliminary Treatment Aerated Grit Channel

Preliminary Treatment
Grit Collection & Disposal

Primary Treatment
Primary Settling Tank

Trickling Filters

Stalked Ciliates

Amoeba

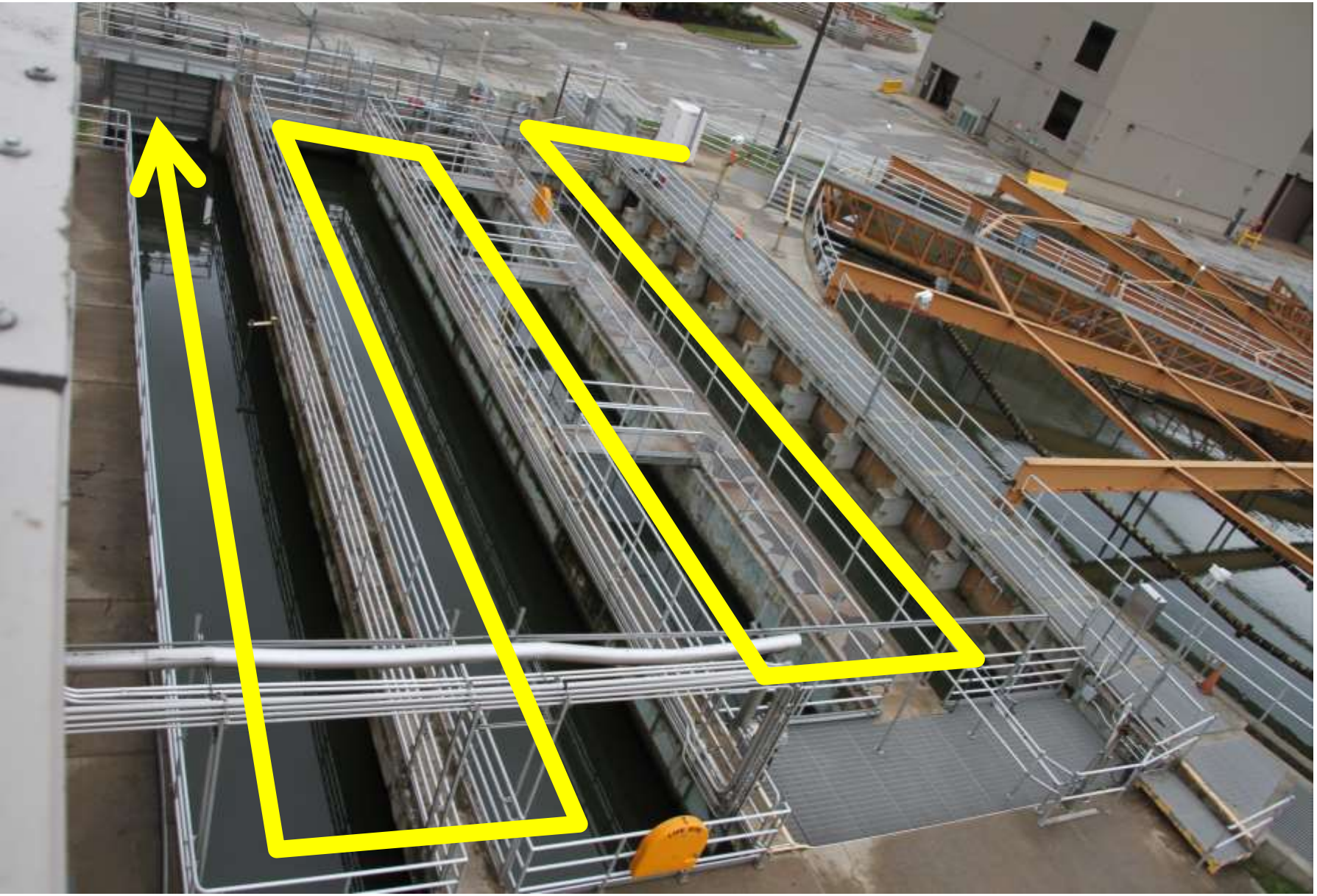
Activated Sludge – Aeration Tanks

Secondary Treatment

Secondary Treatment
Final Settling Tank

Secondary Treatment Aeration Process Blowers (1,250 HP)

Disinfection and effluent



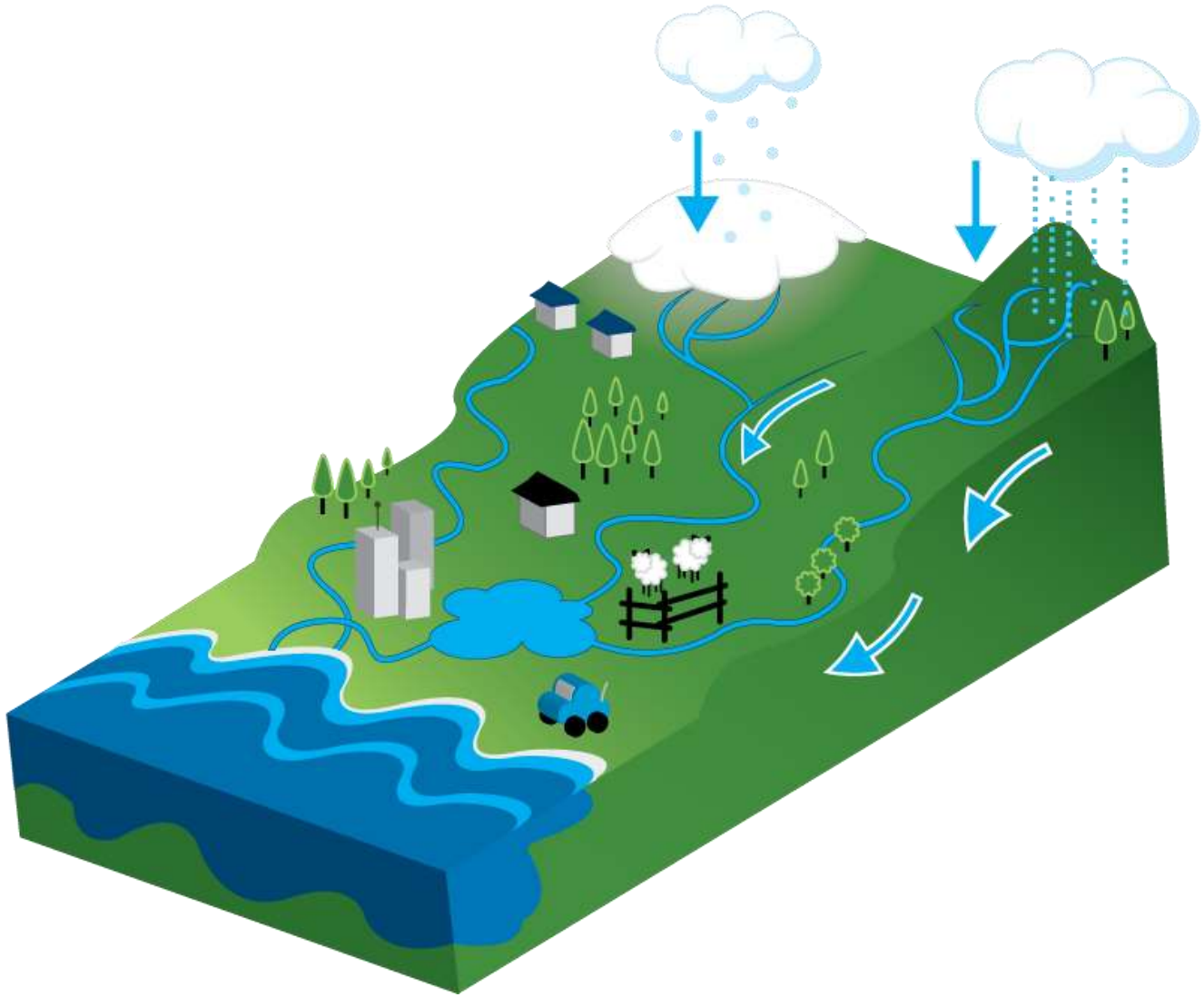
Disinfection and effluent

Solids Handling

Dewatering Centrifuges

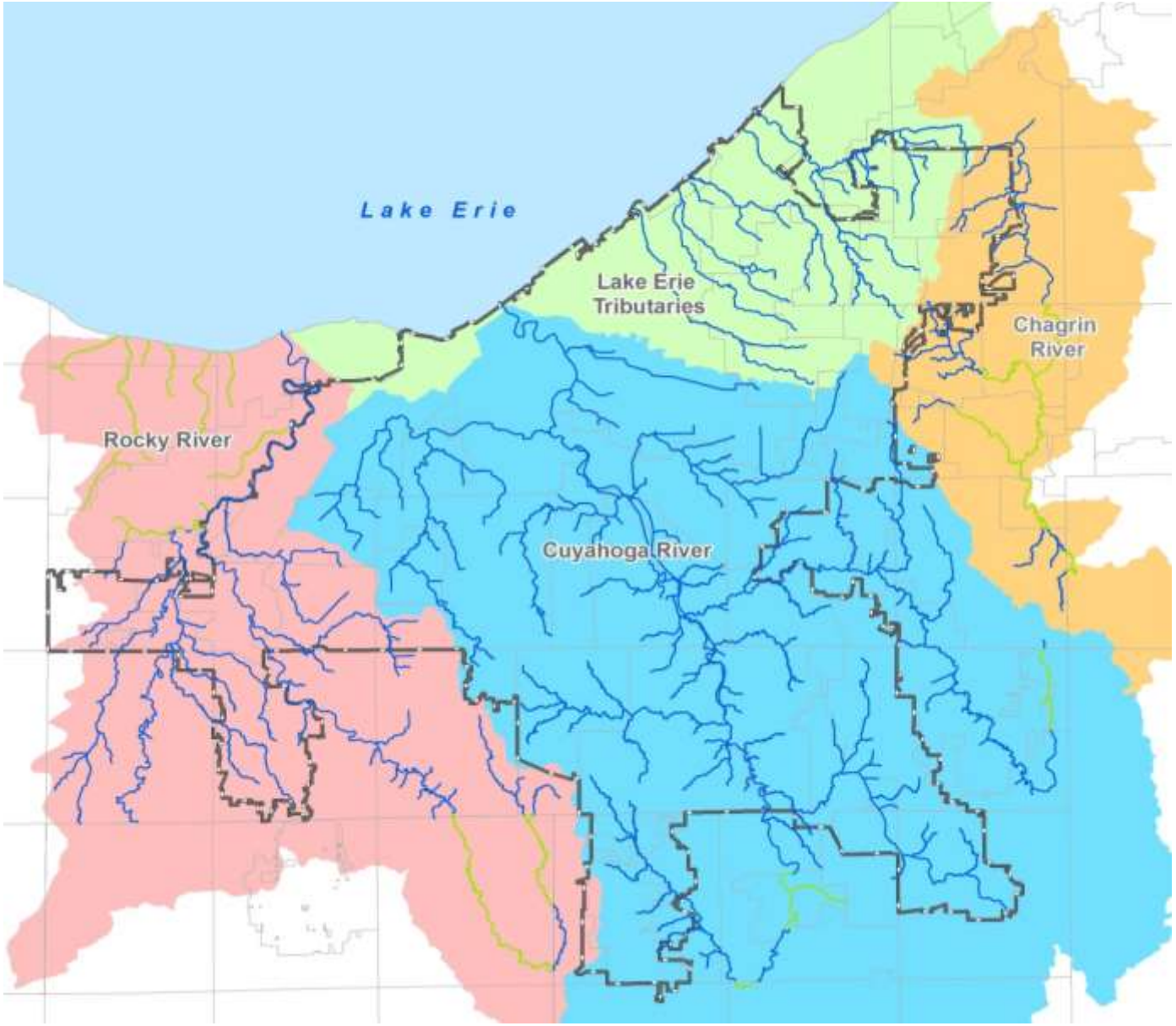
Solids Handling
Incineration

Issues, challenges and solutions

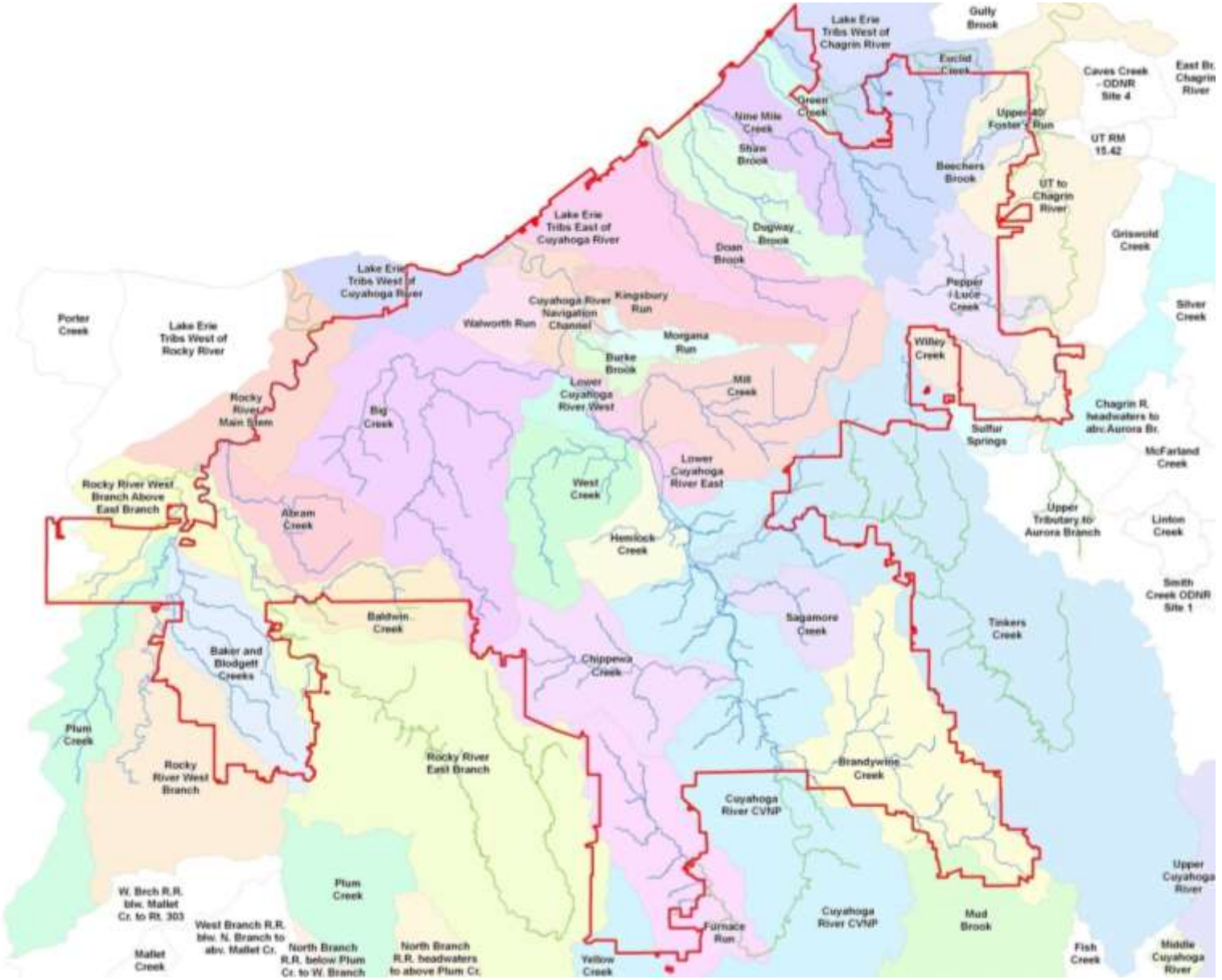


What is a watershed?

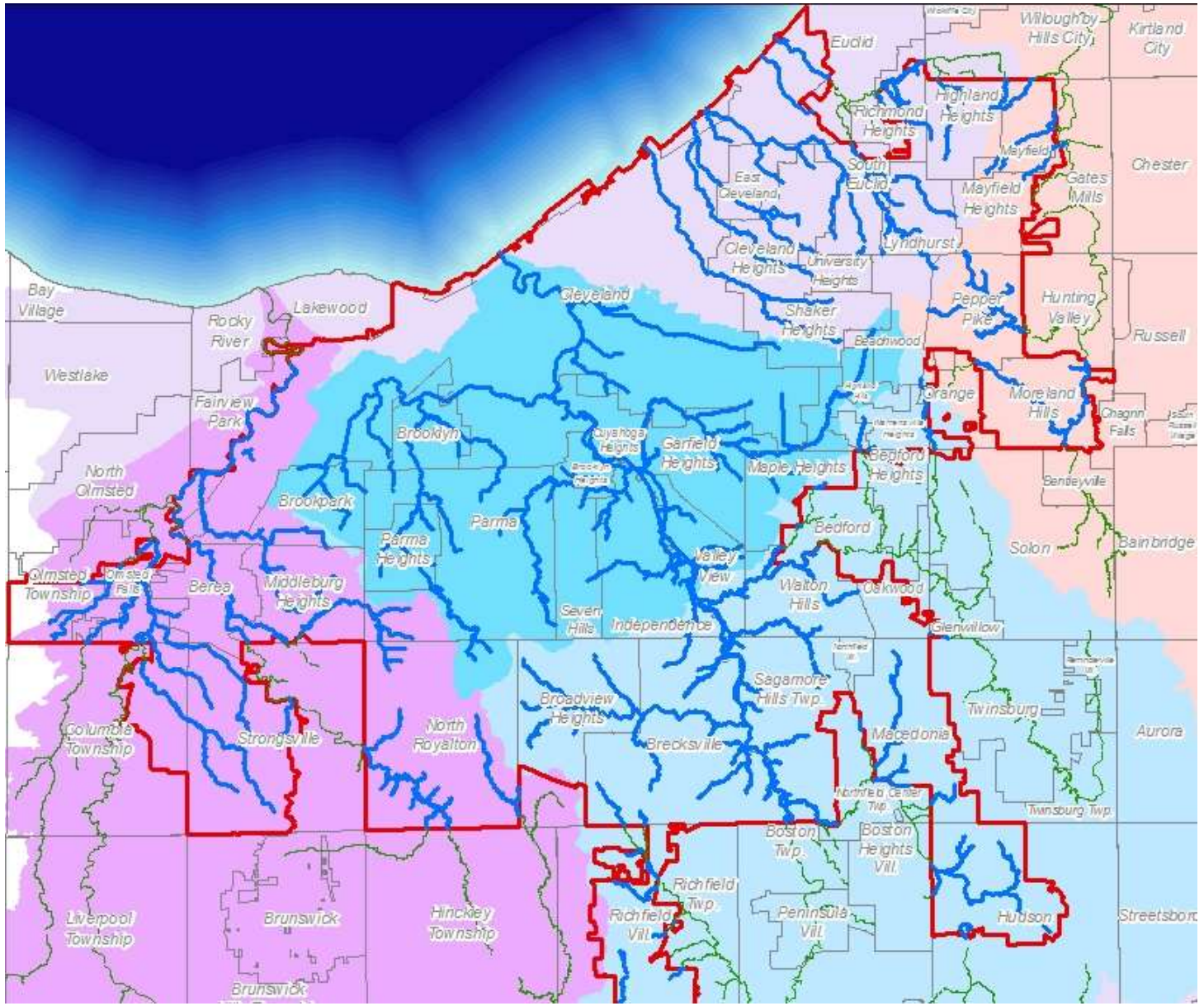
- Watershed: An extent of land where water from precipitation drains downhill into a body of water, such as a river, lake, reservoir, estuary, or wetland.



Northeast Ohio major watersheds



Subwatersheds



Regional Stormwater System

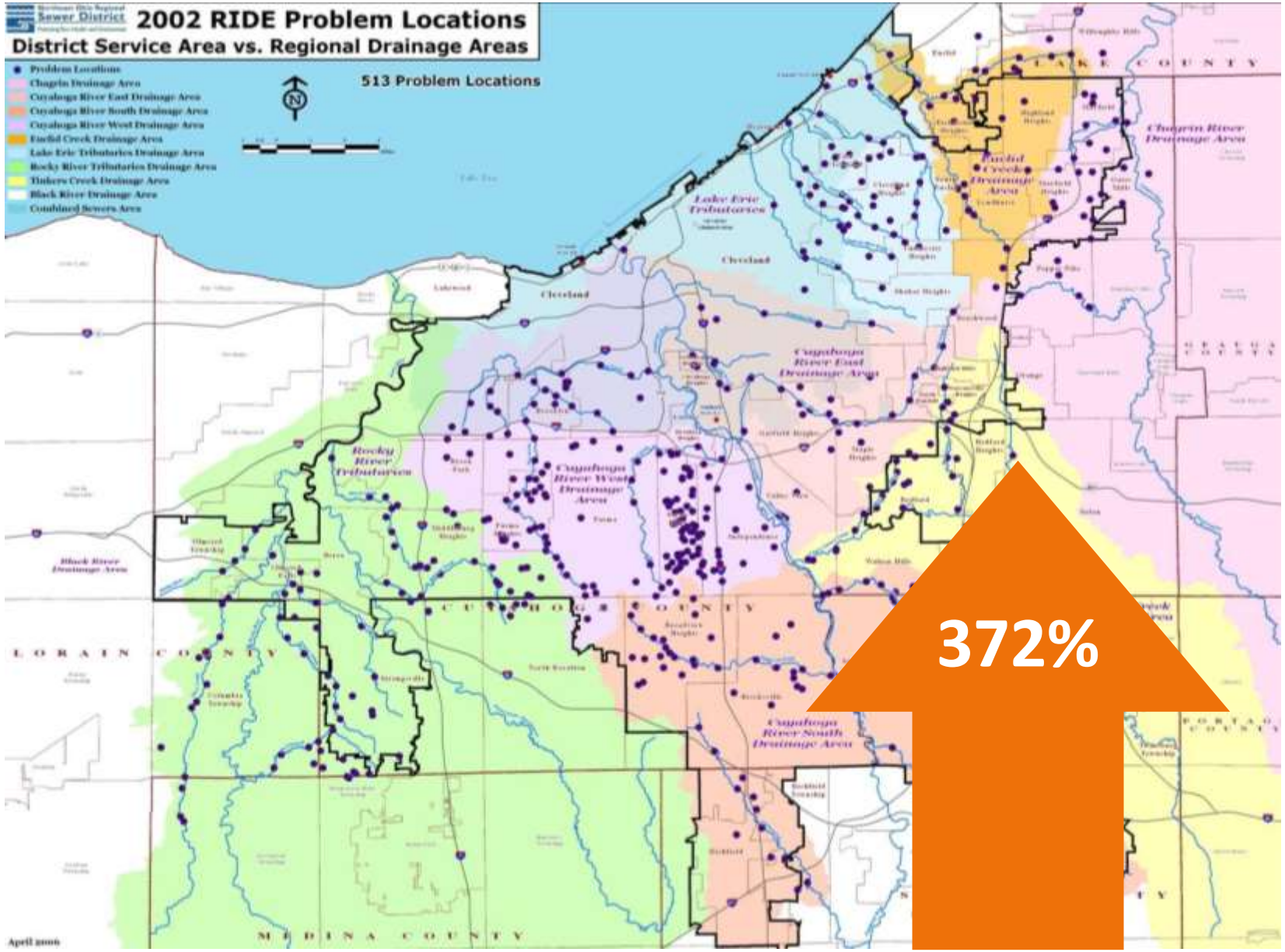
Stormwater run-off

- Water Quality
- Flooding
- Erosion

Mandate

Judge George J. McMonagle mandated the District to

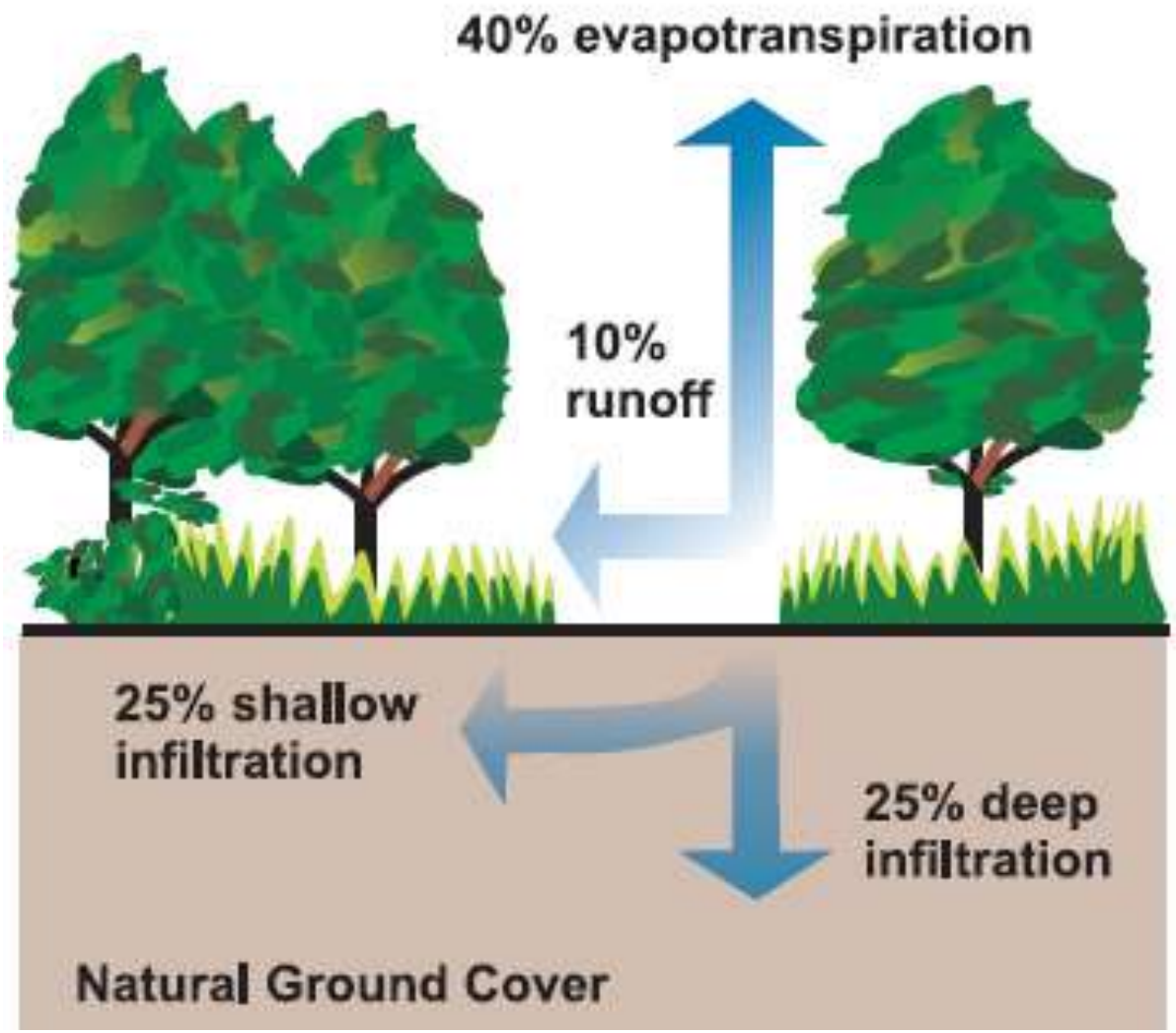
> "develop a detailed integrated capital improvement plan for regional management of wastewater collection and storm drainage to identify a capital improvement program for the solution of all intercommunity drainage problems (both storm and sanitary) in the District."

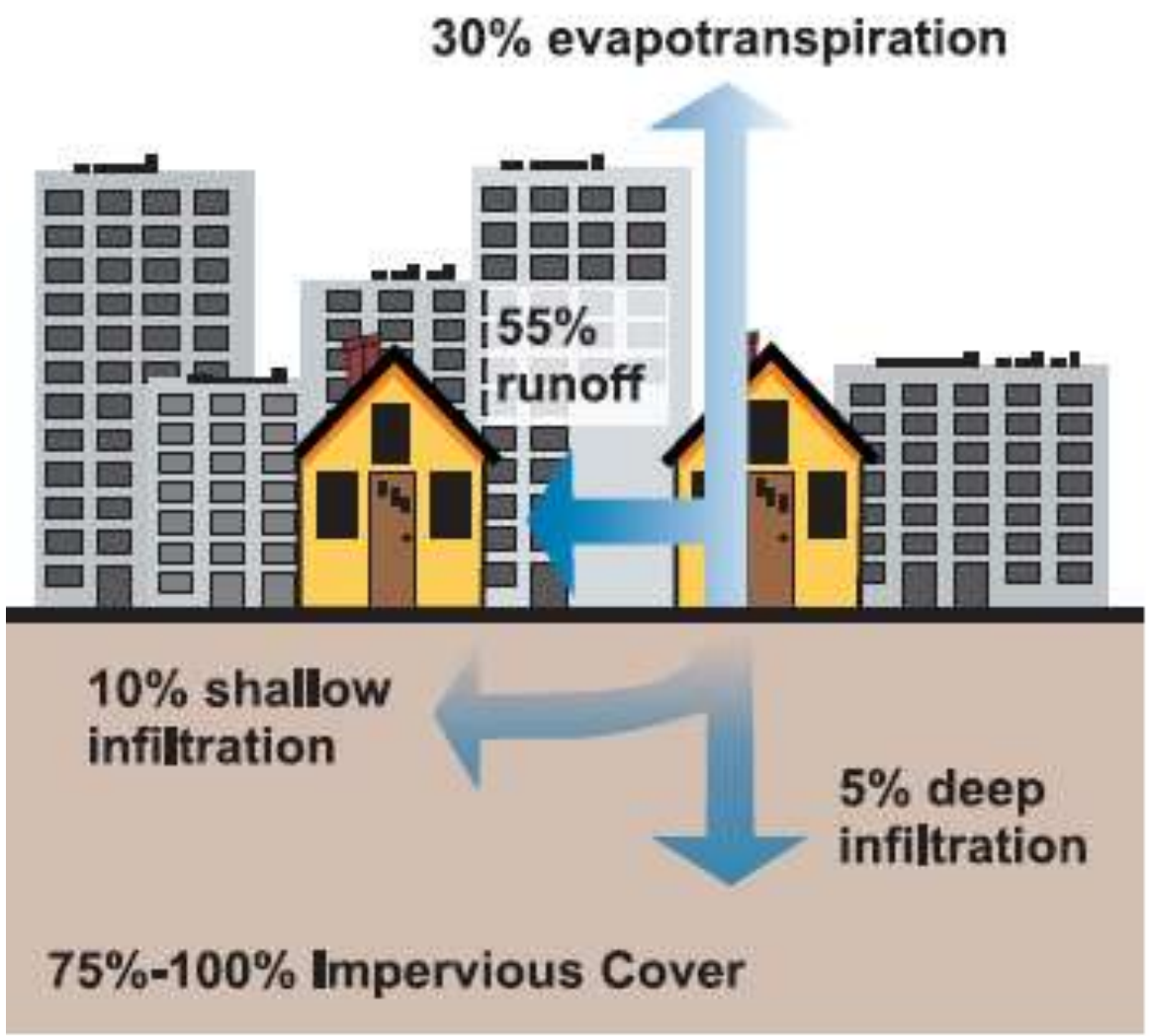


2002 Study:
513 Problem Locations Identified

Stormwater Service Area

Surface Runoff


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

Flooding
Middleburg Hts/
Brook Park, Ohio
along Abrams Creek

Streambank erosion on Mill Creek threatens Warner Rd in Garfield Hts, Ohio

Debris
along Dugway Brook
Cleveland Hts, Ohio

Streambank erosion
along Stickney Creek

Streambank erosion
Baldwin Creek
August 2011

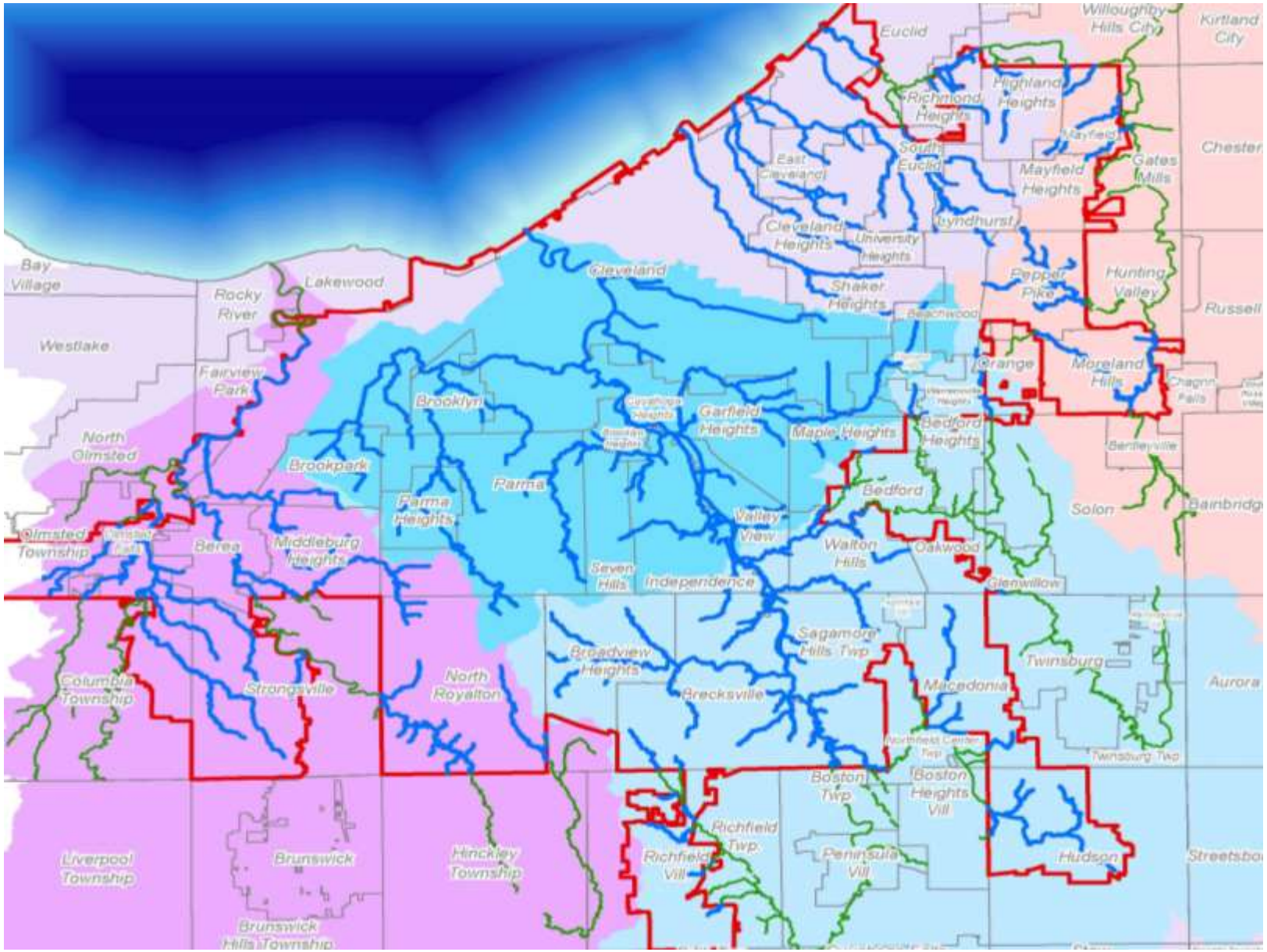
What Will We Do?

Master Plans

Inspect & Maintain

Construct Projects

Encourage Good Practices

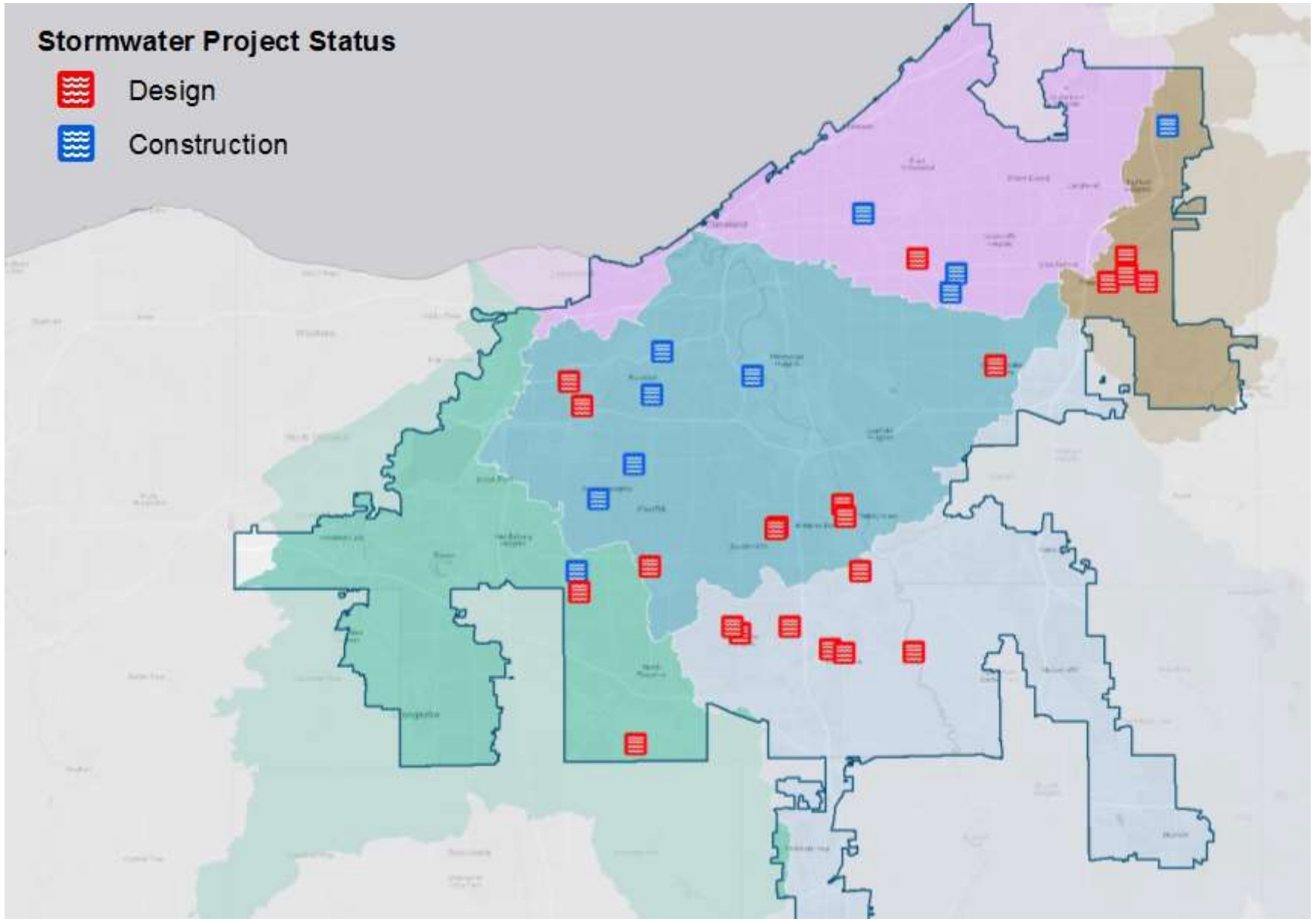


We will develop stormwater master plans

Before

After

We will perform inspection & maintenance



We will construct projects

We will encourage good practices

Where
we were . . .

Where we are today

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

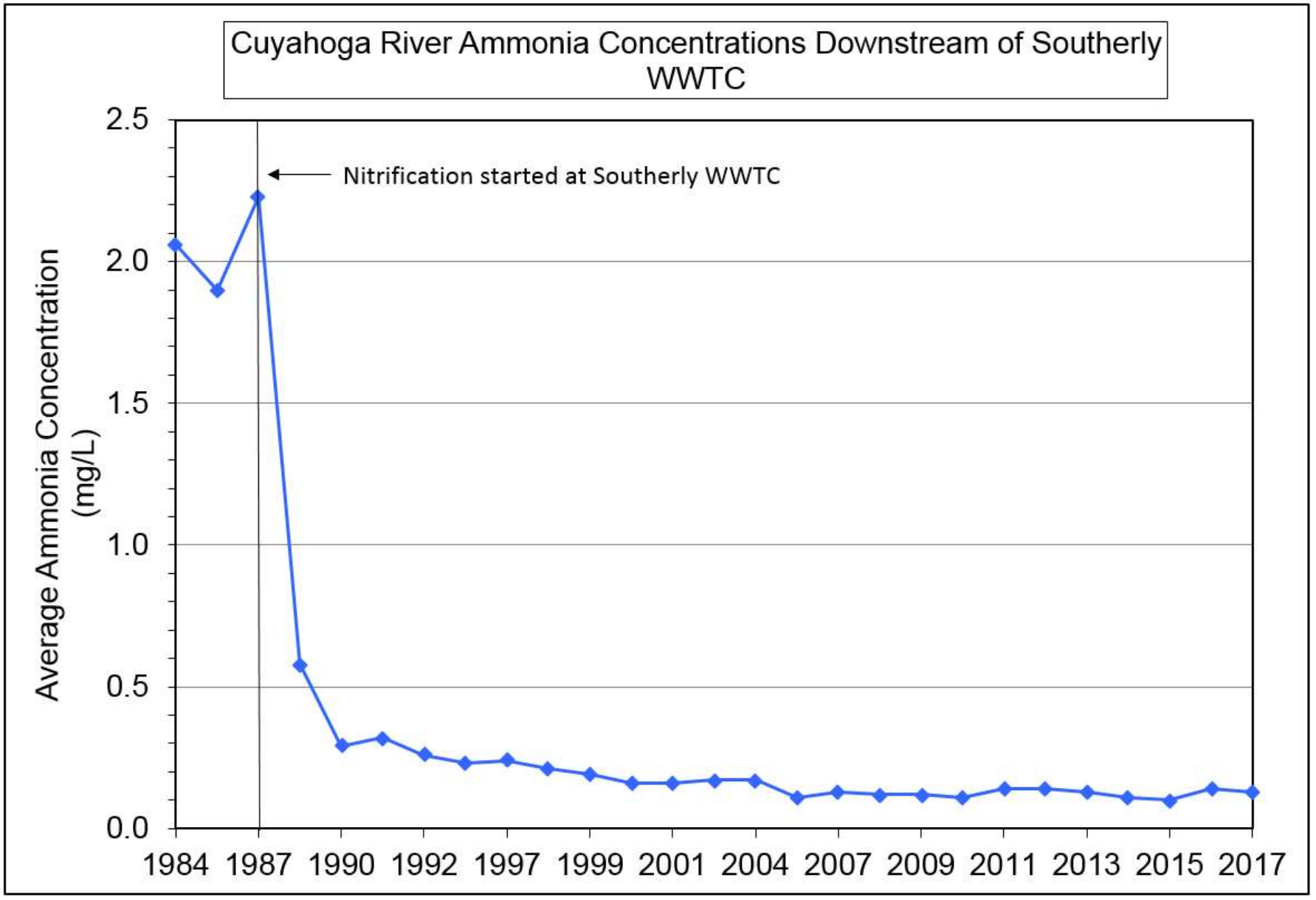
Chuck Boucher, OEPA (Akron Beacon Journal 10/06/08)

Monitoring Stream Health

- Water Chemistry
- Habitat
- Fish
- Macroinvertebrates

Water Chemistry Sampling

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

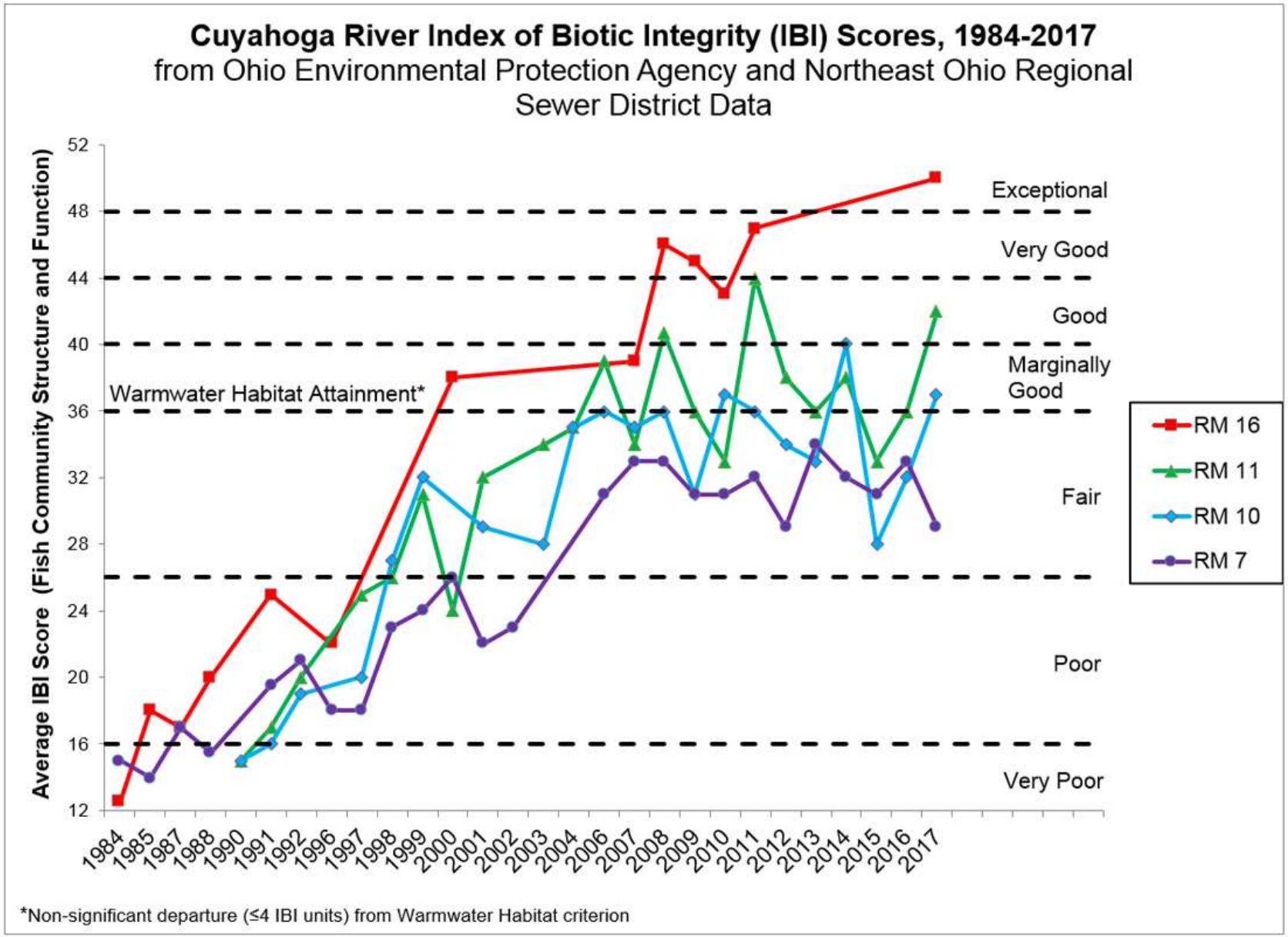


Water Chemistry Results

Habitat Evaluation

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

Electrofishing


Cuyahoga River Index of Biotic Integrity (IBI) Scores, 1984-2017
from Ohio Environmental Protection Agency and Northeast Ohio Regional Sewer District Data
Average IBI Score (Fish Community Structure and Function)
52
48
44
40
36
32
28
24
20
16
12
Exceptional
Very Good
Good
Marginally Good
Fair
Poor
Very Poor
Warmwater Habitat Attainment*
RM 16
RM 11
RM 10
RM 7
1984
1985
1987
1988
1990
1991
1992
1996
1997
1998
1999
2000
2001
2002
2003
2004
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
*Non-significant departure (≤4 IBI units) from Warmwater Habitat criterion

Pollution-Intolerant Fish

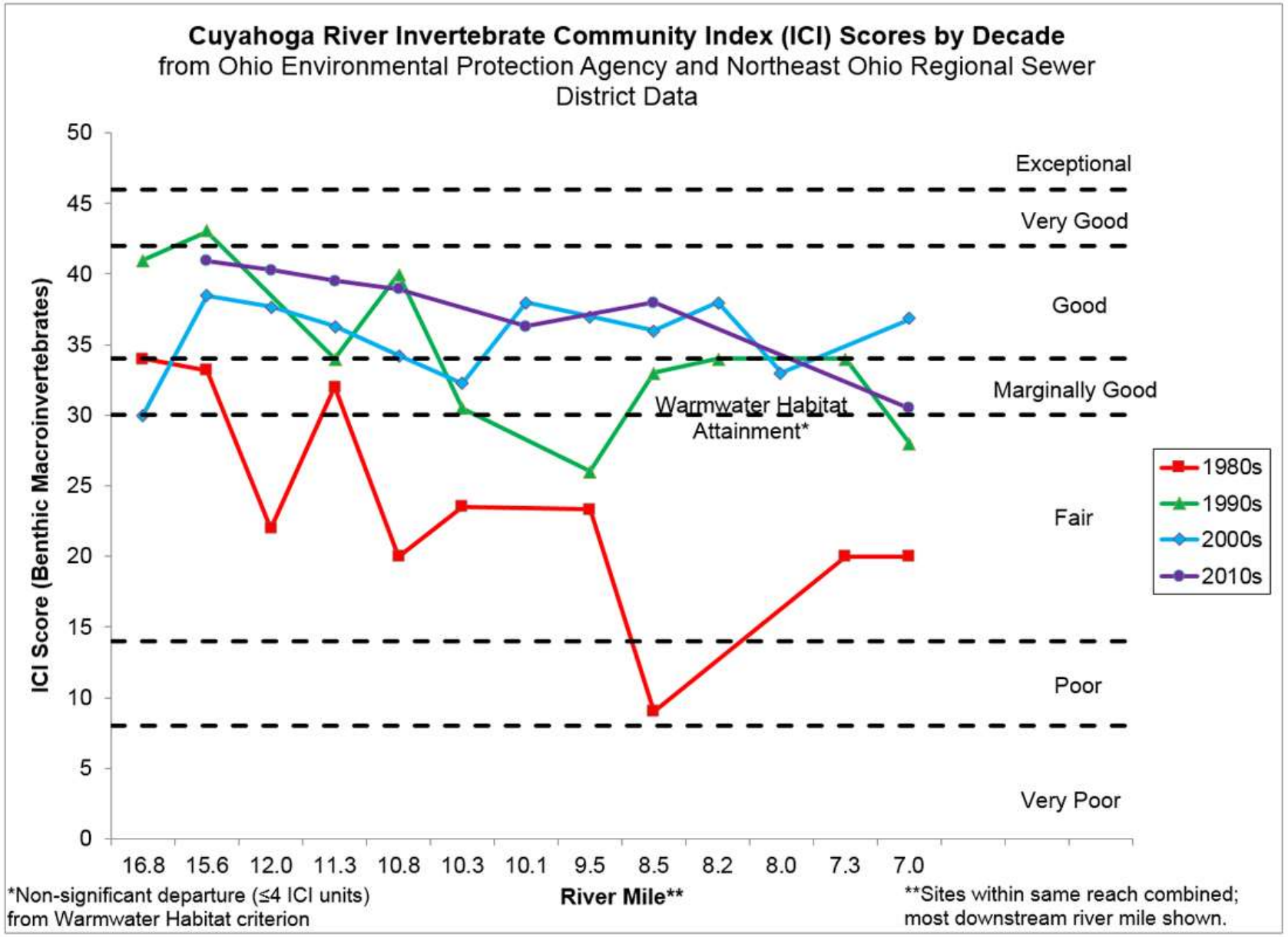
Mimic Shiner

Stonecat Madtom

Macroinvertebrate Community Health

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

Hester-Dendy samplers


Cuyahoga River Invertebrate Community Index (ICI) Scores by Decade
from Ohio Environmental Protection Agency and Northeast Ohio Regional Sewer District Data
ICI Score (Benthic Macroinvertebrates)
50
45
40
35
30
25
20
15
10
5
0
Exceptional
Very Good
Good
Marginally Good
Fair
Poor
Very Poor
Warmwater Habitat Attainment*
1980s
1990s
2000s
2010s
16.8
15.6
12.0
11.3
10.8
10.3
10.1
9.5
8.5
8.2
8.0
7.3
7.0
River Mile**
*Non-significant departure (≤4 ICI units) from Warmwater Habitat criterion
**Sites within same reach combined; most downstream river mile shown.

Pink Heelsplitter (freshwater mussel)

Cuyahoga River today . . .

Harmful Algal blooms

Challenges

- Algae and microcystins
- Basement flooding
- 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.

Northeast Ohio
Regional Sewer District