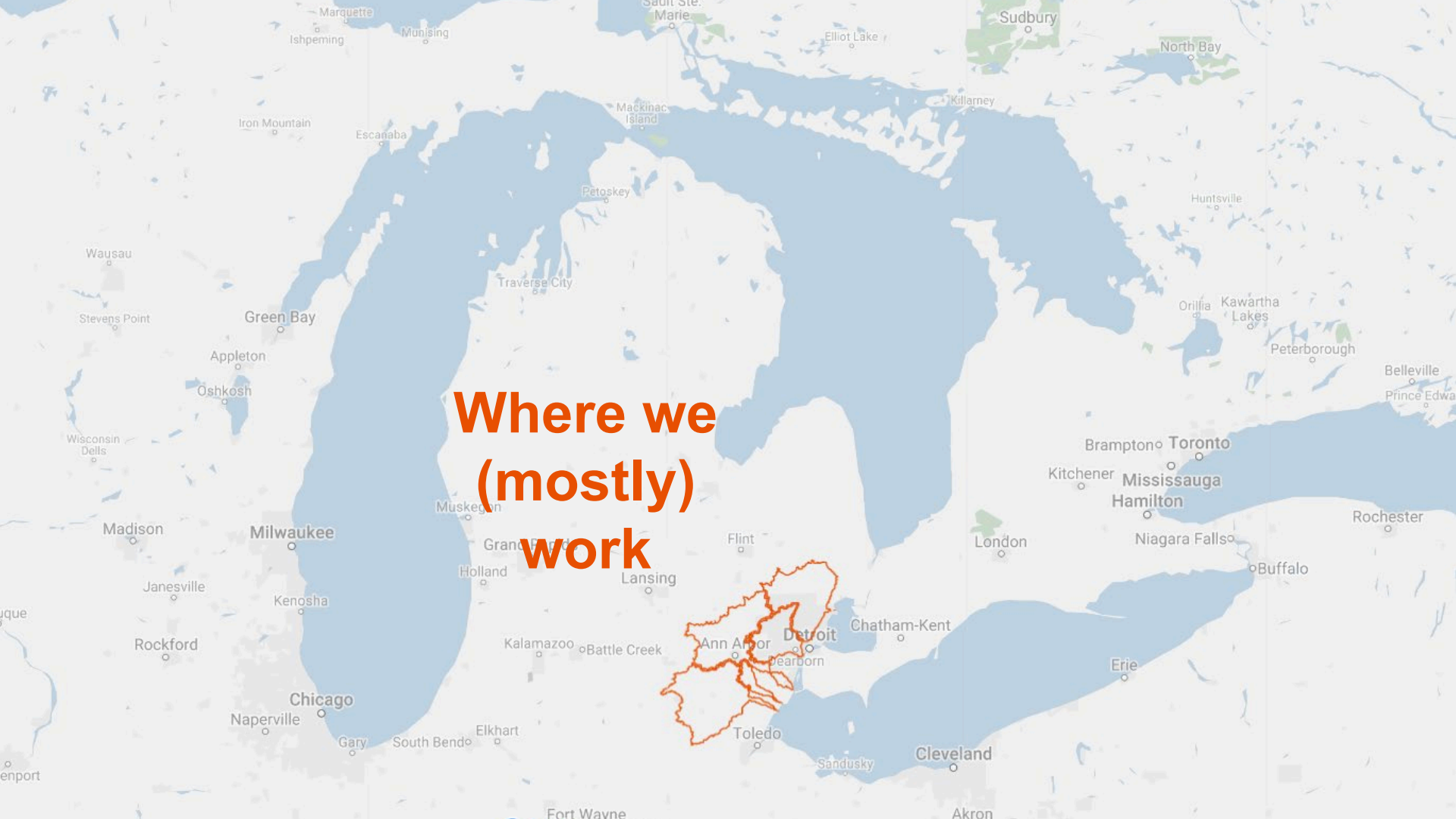
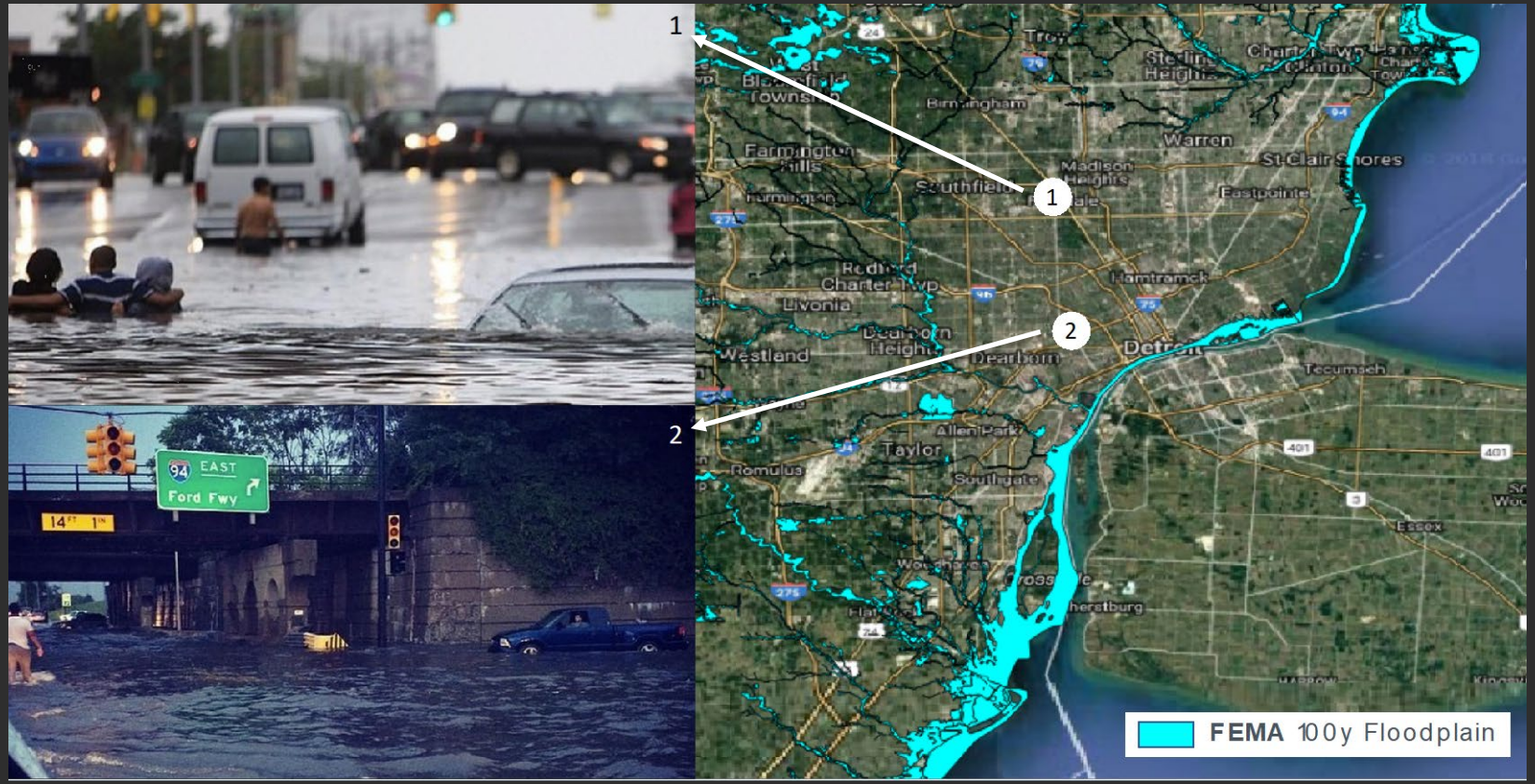
GLPF
NSF

Where we (mostly) work



SOUTH
39
MILE
3
.8

94
EAST
Ford Fwy
14 FT 1 IN


1
2
94 EAST
Ford Fwy
Warren
St Clair Shores
Eastpointe
Hamtramck
Detroit
Dearborn
Westland
Livonia
Taylor
Romulus
Southgate
Tecumseh
Essex
Birmingham
Farmington Hills
Southfield
Madison Heights
Troy
Sterling Heights
Clinton
FEMA 100y Floodplain

Runoff

Overflows

Erosion

have

have

want

have

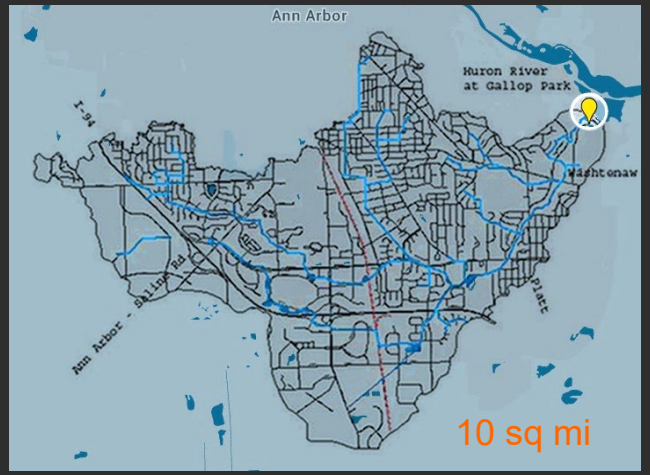
do

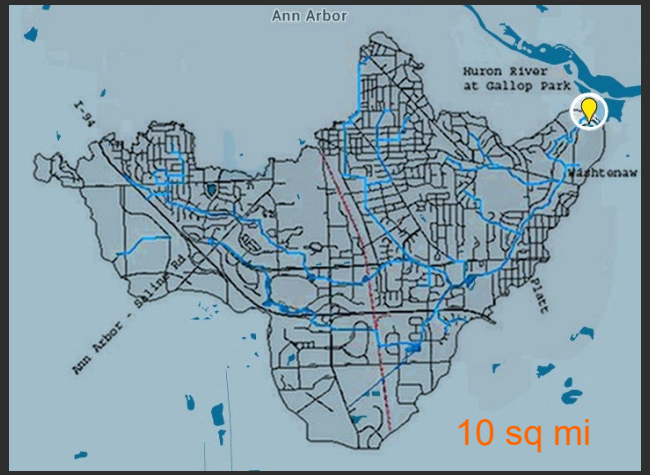
want

have

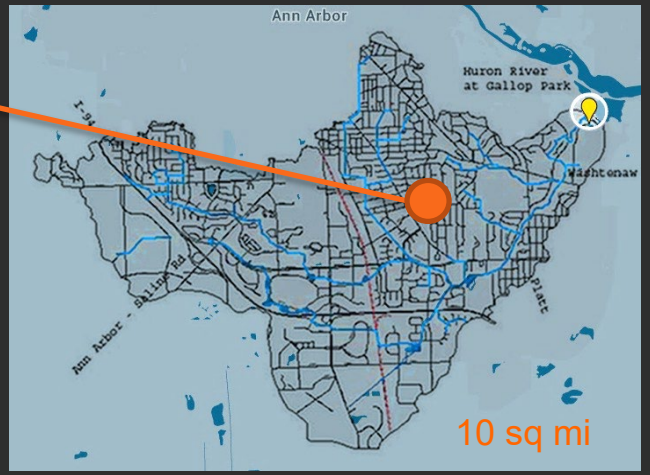
do

want

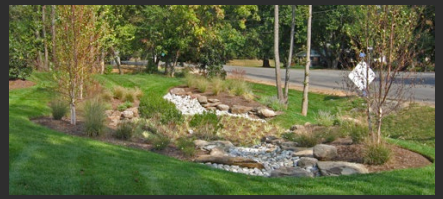

Ann Arbor
Huron River
at Gallop Park
I-94
Washtenaw
Ann Arbor - Saline Rd
Platt
10 sq mi


Ann Arbor
Huron River
at Gallop Park
I-94
Washtenaw
Ann Arbor - Saline Rd
Platt
10 sq mi

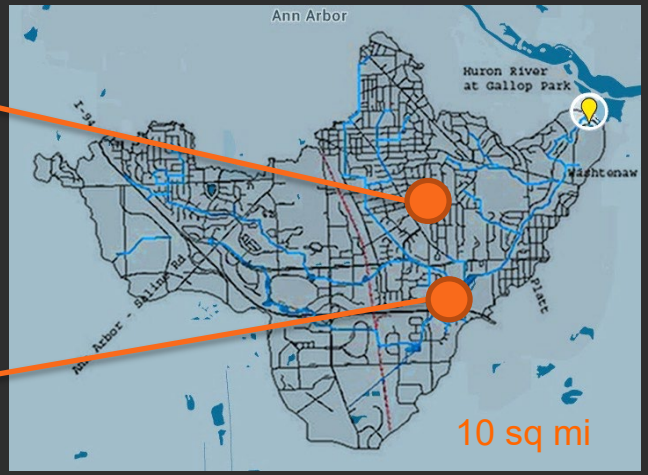
Pond


Ann Arbor
Huron River
at Gallop Park
I-94
Washtenaw
Ann Arbor - Saline Rd
Platt
10 sq mi

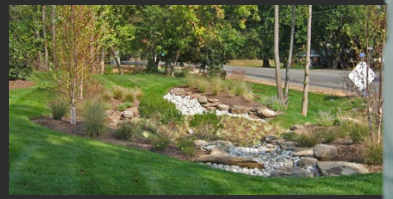
Pond



Bioswale

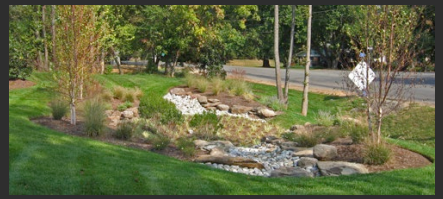


Pond



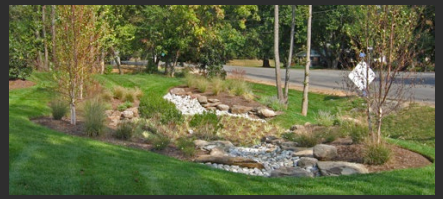
Bioswale

Pond



Bioswale

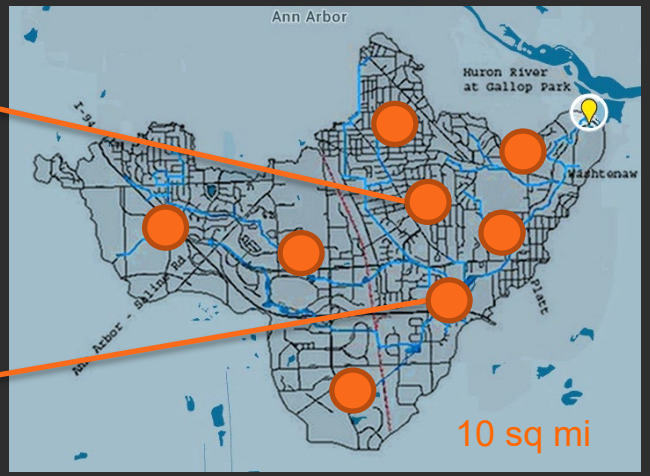
Pond



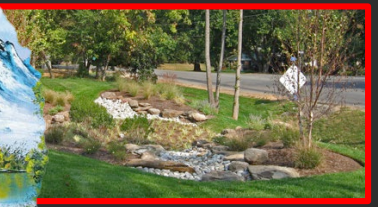
Bioswale

Pond

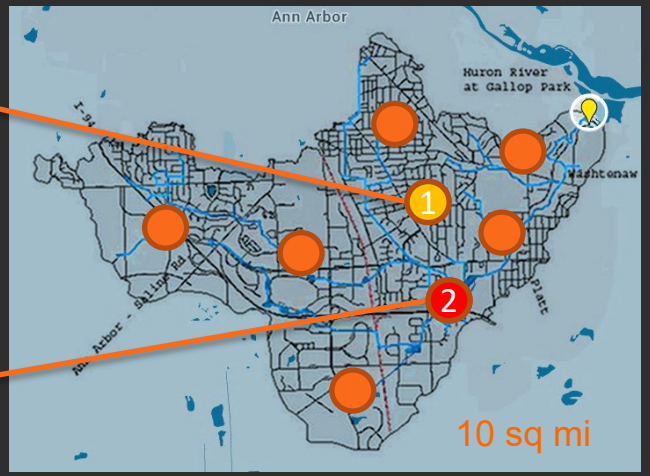
ale

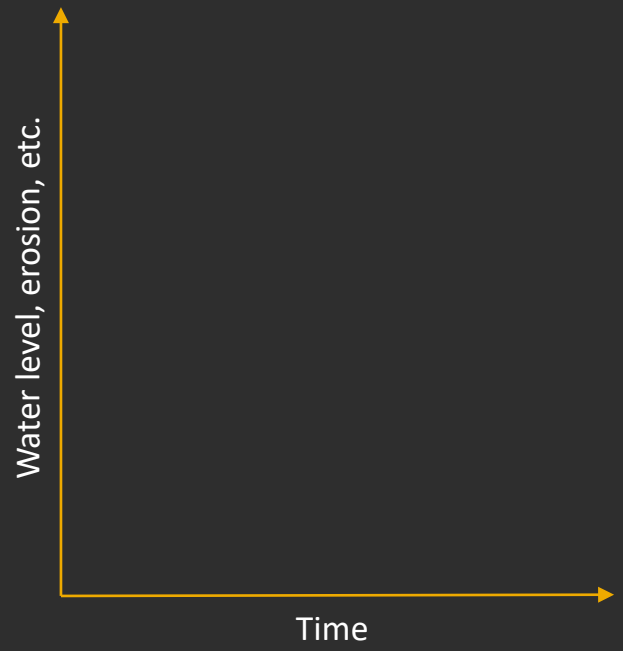


Pond



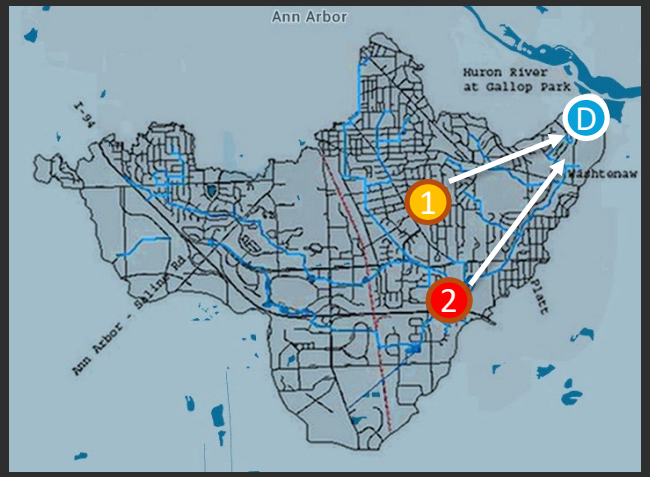
ale

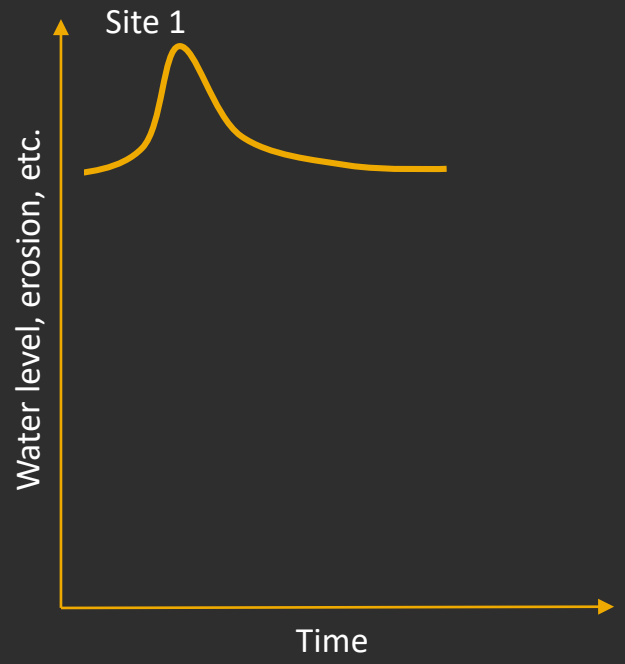




Pre-construction

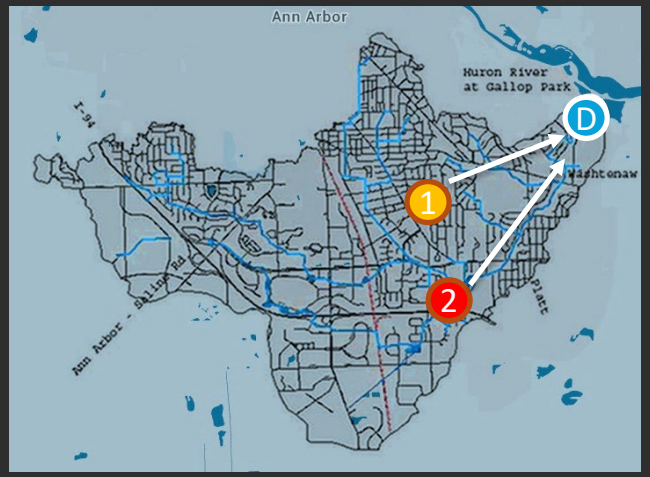
Post-construction

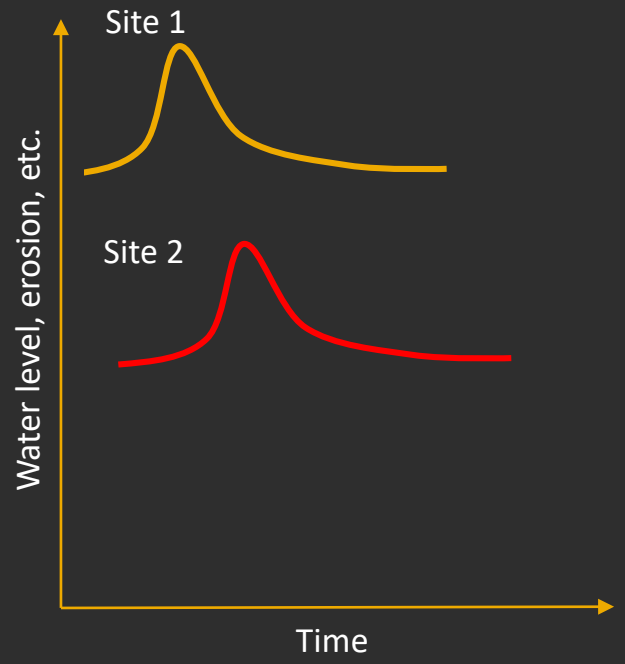


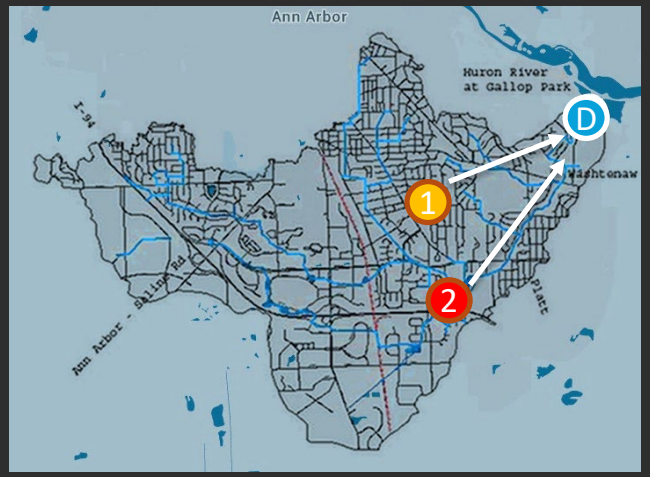


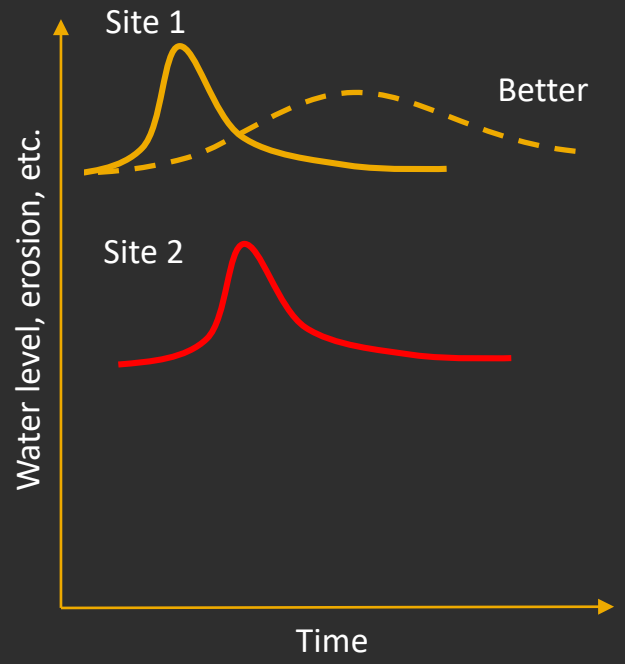
Pre-construction

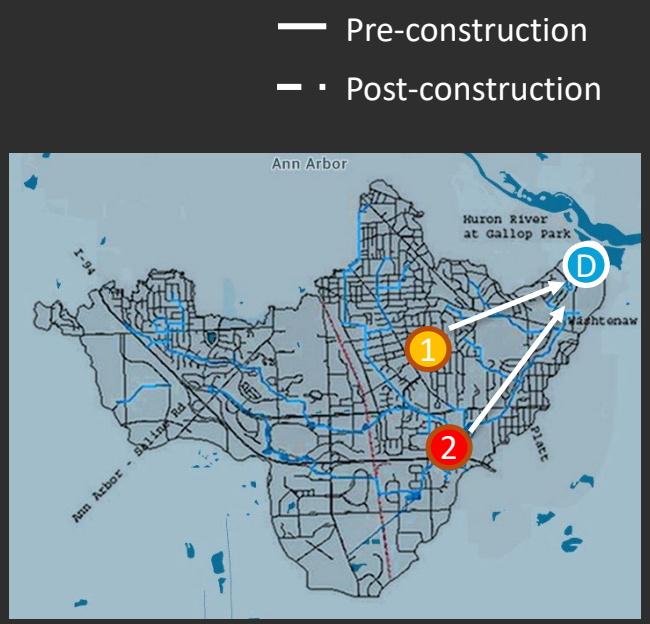
Post-construction

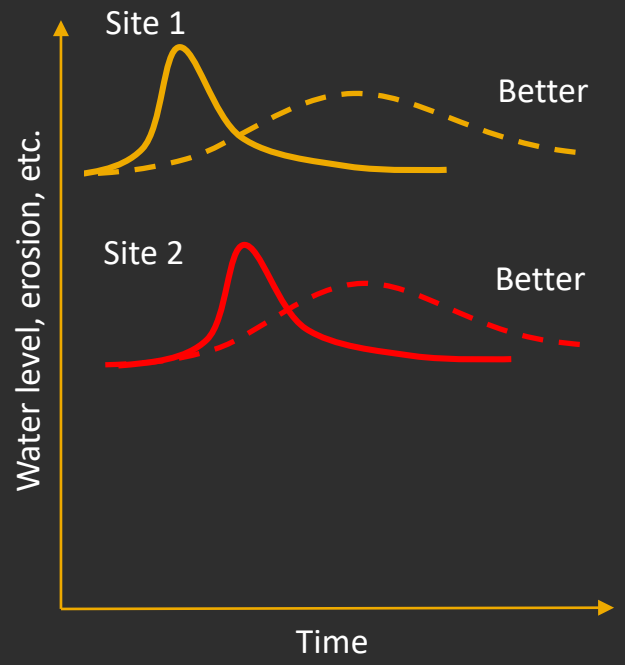


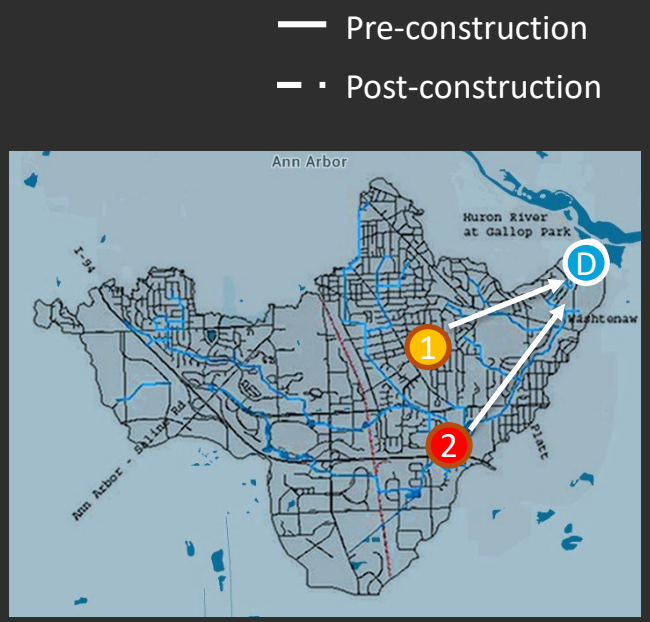

Site 1
Site 2
Water level, erosion, etc.
Time

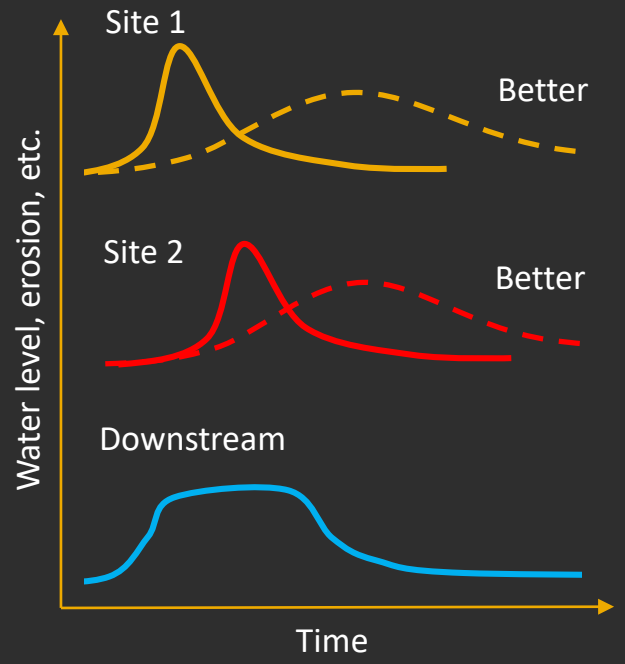

Pre-construction
Post-construction
Ann Arbor
Huron River
at Gallop Park
I-94
Washtenaw
Ann Arbor - Saline Rd
Platt
1
2
D

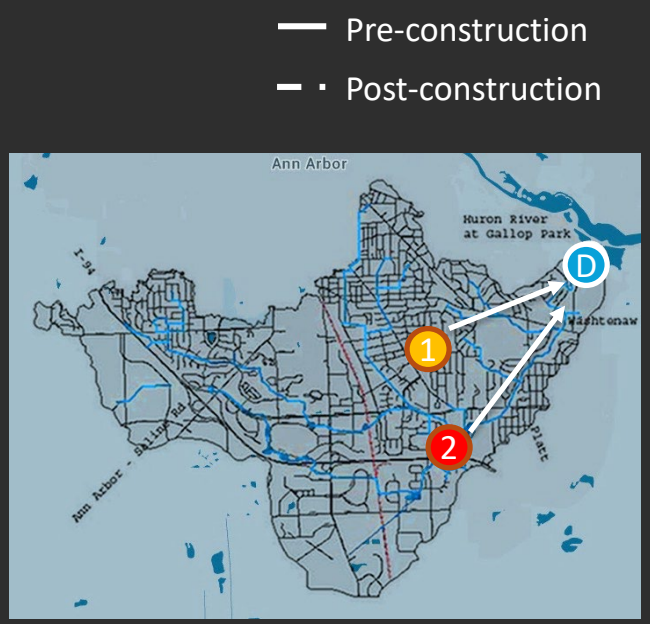

Site 1
Better
Site 2
Water level, erosion, etc.
Time

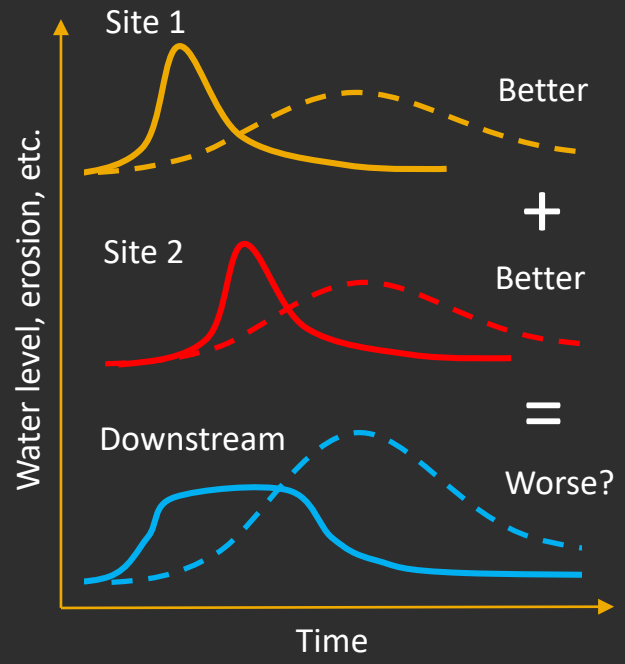

Pre-construction
Post-construction
Ann Arbor
Huron River
at Gallop Park
I-94
Washtenaw
Platt
Ann Arbor - Saline Rd
1
2
D

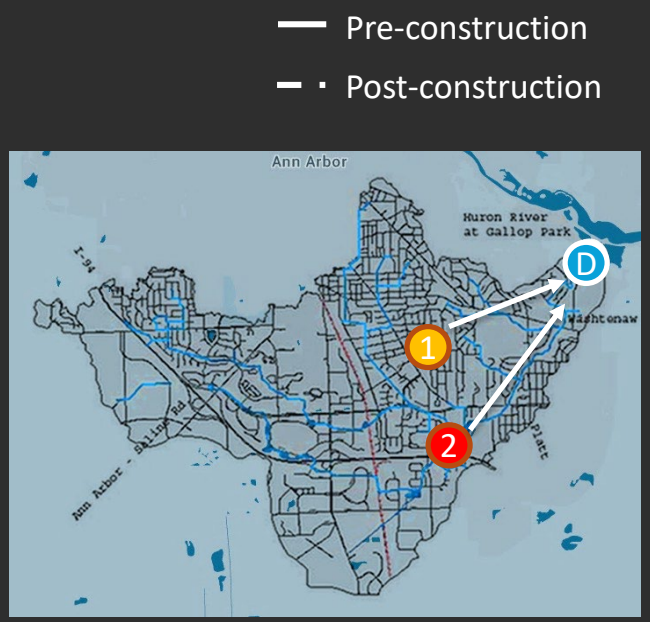

Site 1
Better
Site 2
Better
Water level, erosion, etc.
Time

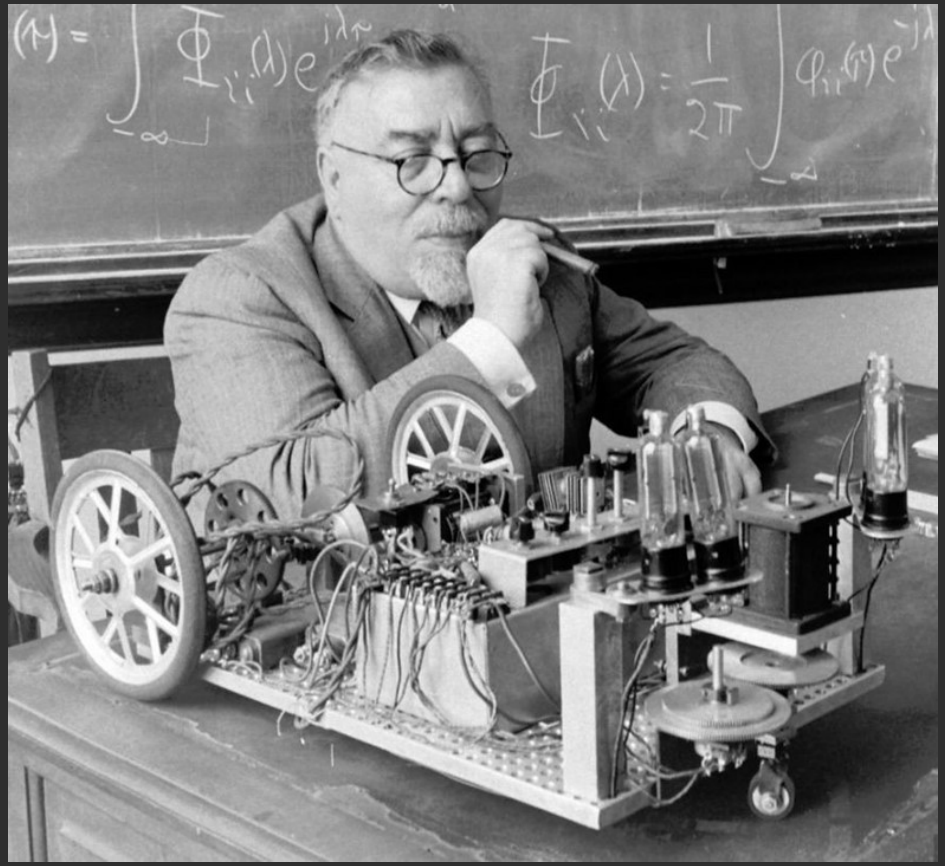

Pre-construction
Post-construction
Ann Arbor
Huron River
at Gallop Park
I-94
Washtenaw
Platt
Ann Arbor - Saline Rd
1
2
D


Site 1
Better
Site 2
Better
Downstream
Water level, erosion, etc.
Time


Pre-construction
Post-construction
Ann Arbor
Huron River
at Gallop Park
I-94
Washtenaw
Ann Arbor - Saline Rd
Platt
1
2
D


Site 1
Better
+
Site 2
Better
=
Downstream
Worse?
Water level, erosion, etc.
Time


Pre-construction
Post-construction
Ann Arbor
Huron River
at Gallop Park
I-94
Washtenaw
Platt
Ann Arbor - Saline Rd
1
2
D

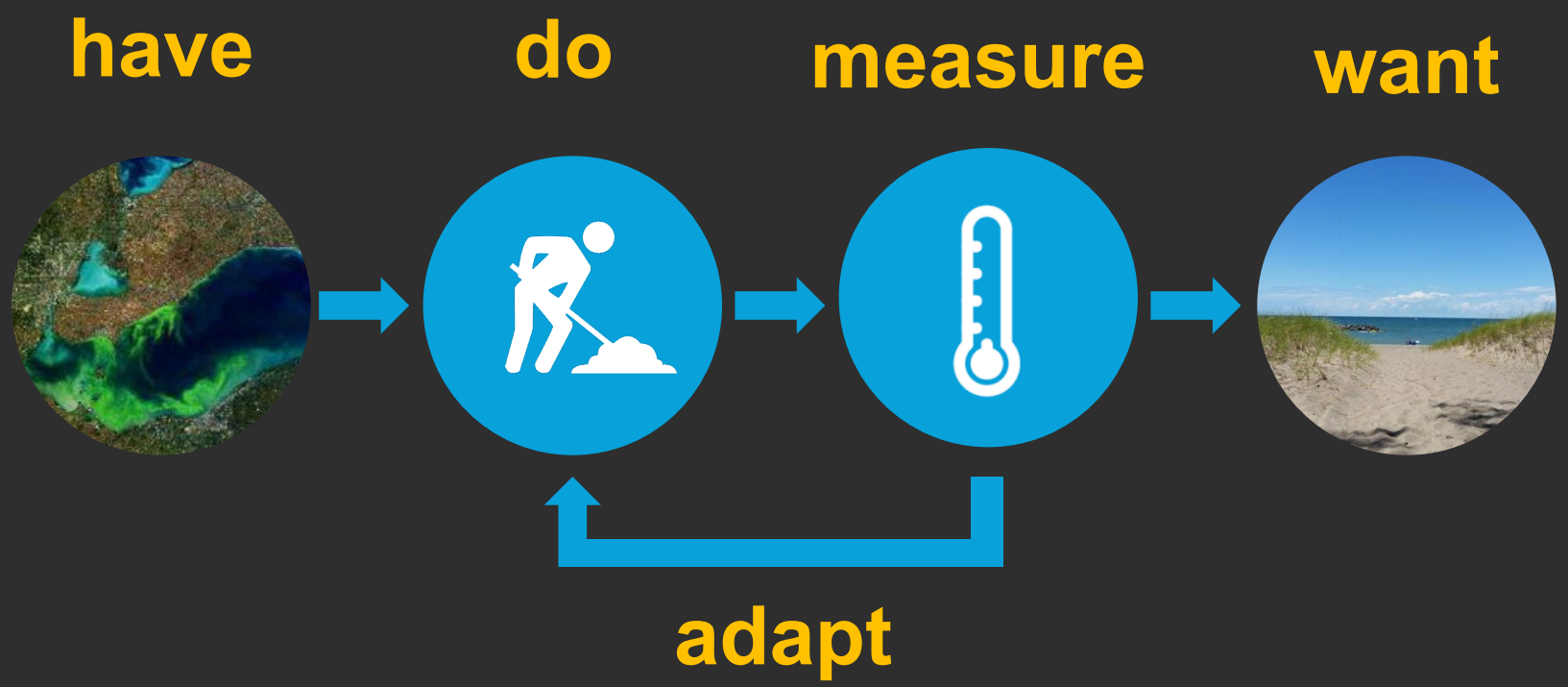


have

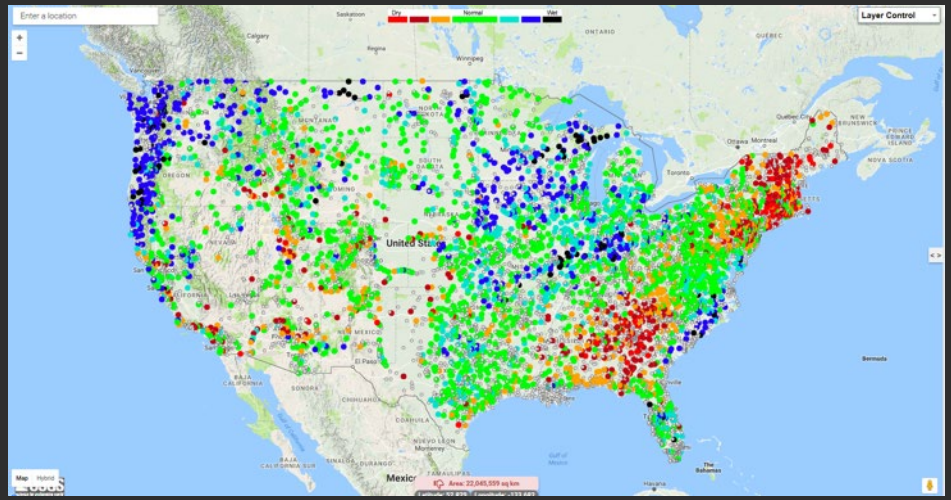
do

measure

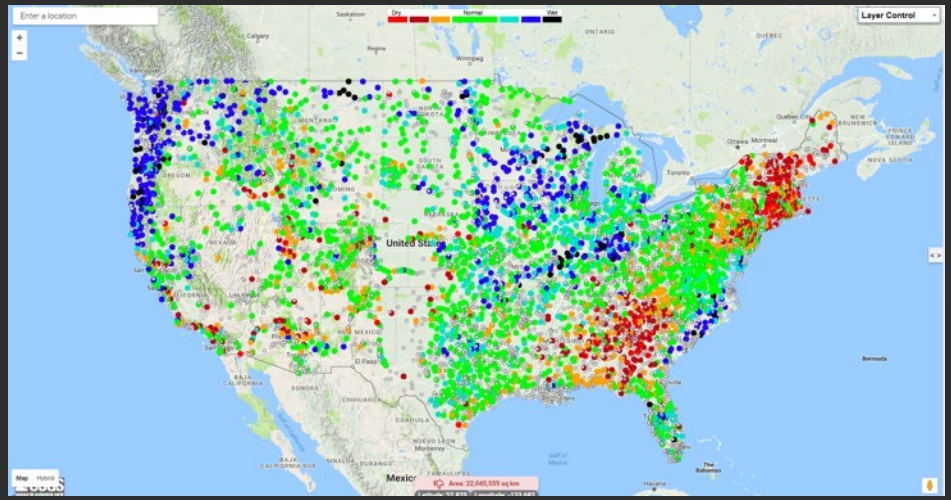
want

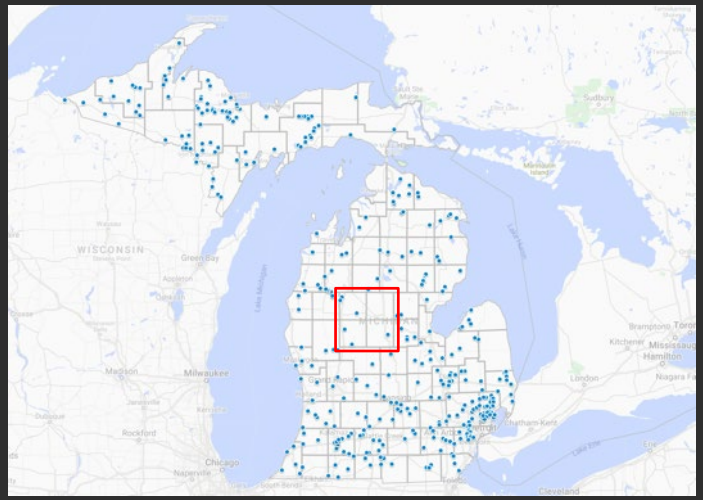

have
do
measure
want
adapt

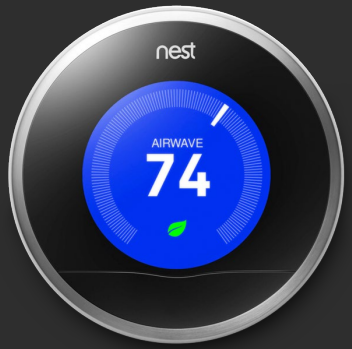
USGS


Enter a location
Layer Control
Dry
Normal
Wet
Map
Hybrid

USGS

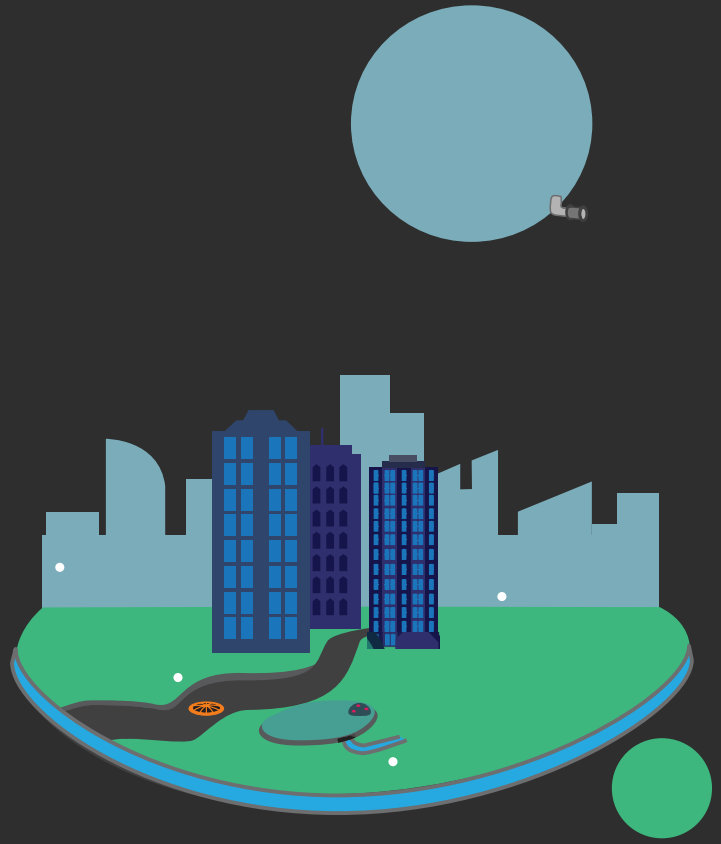

Enter a location
Dry
Normal
Wet
Layer Control
Map
Hybrid



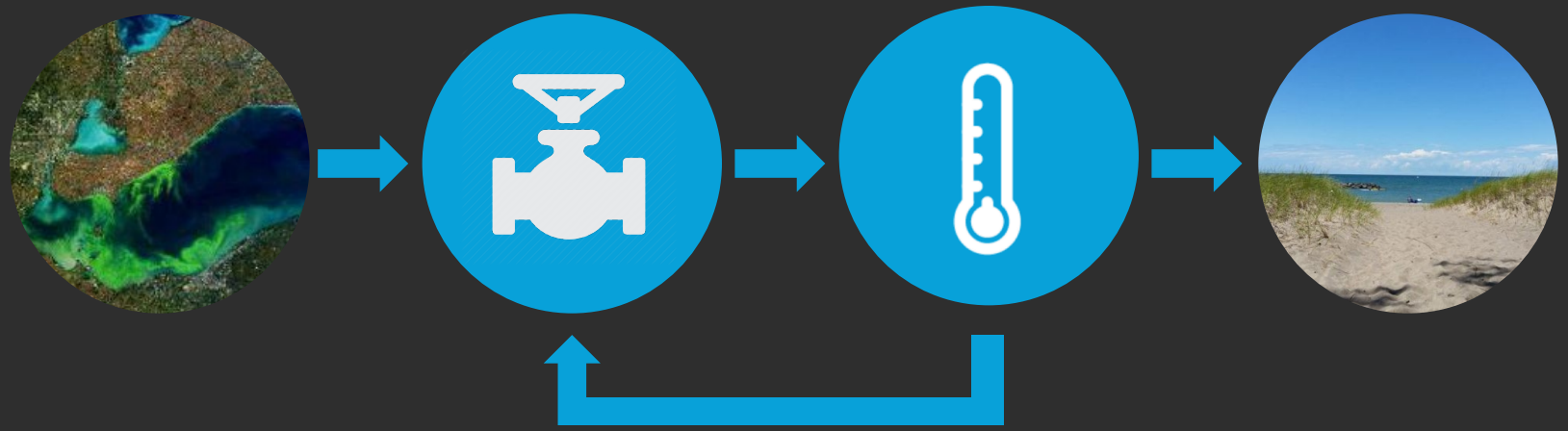

nest
AIRWAVE
74

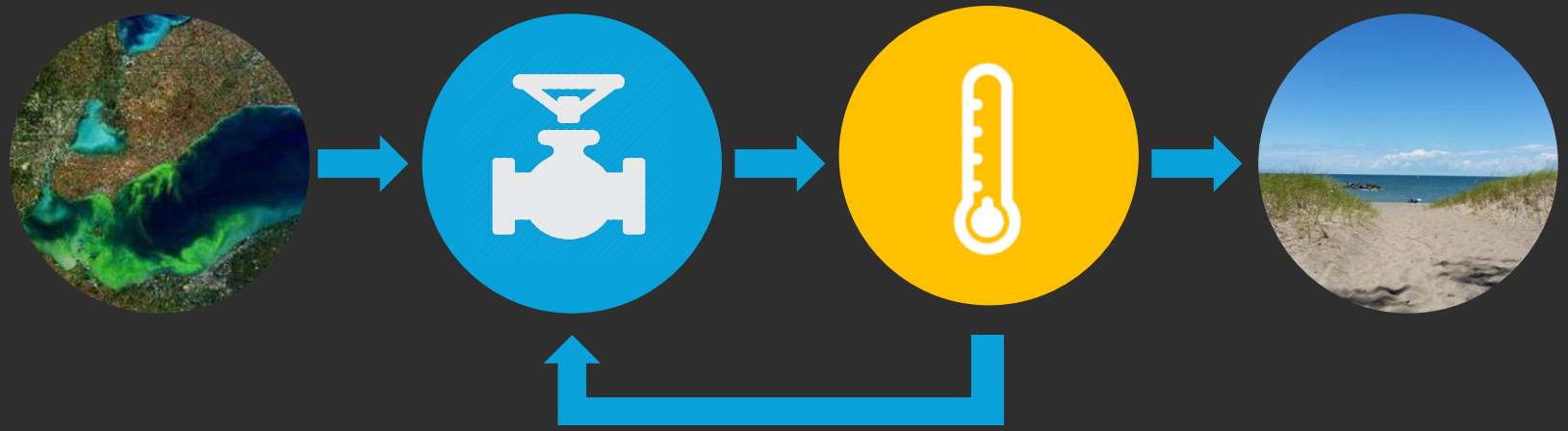
72
68
ecobee

SMART
HOME

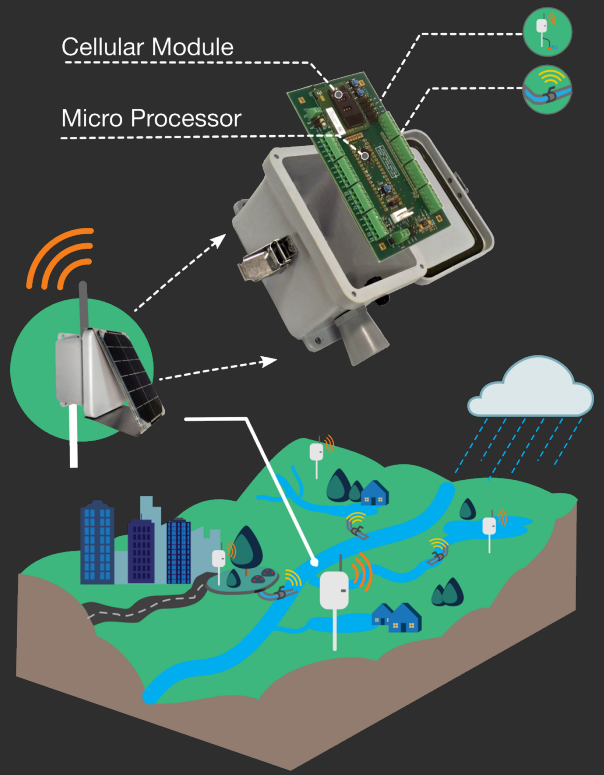


eve system-level
benefits





OPEN-STORM.ORG



Measure

Rain

Depth

Soil Moisture

Water Quality

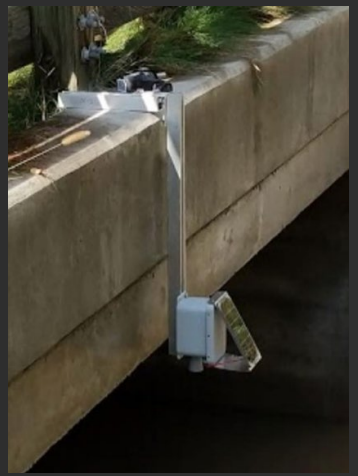
Control

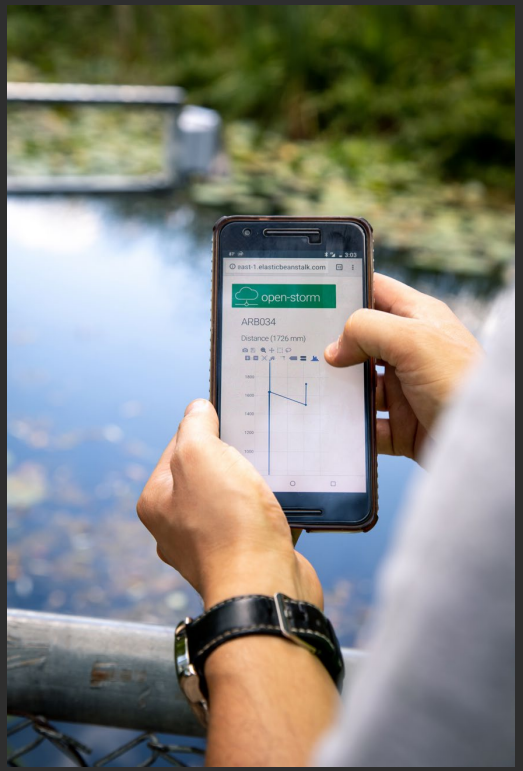
Valves

Gates

Automated Samplers

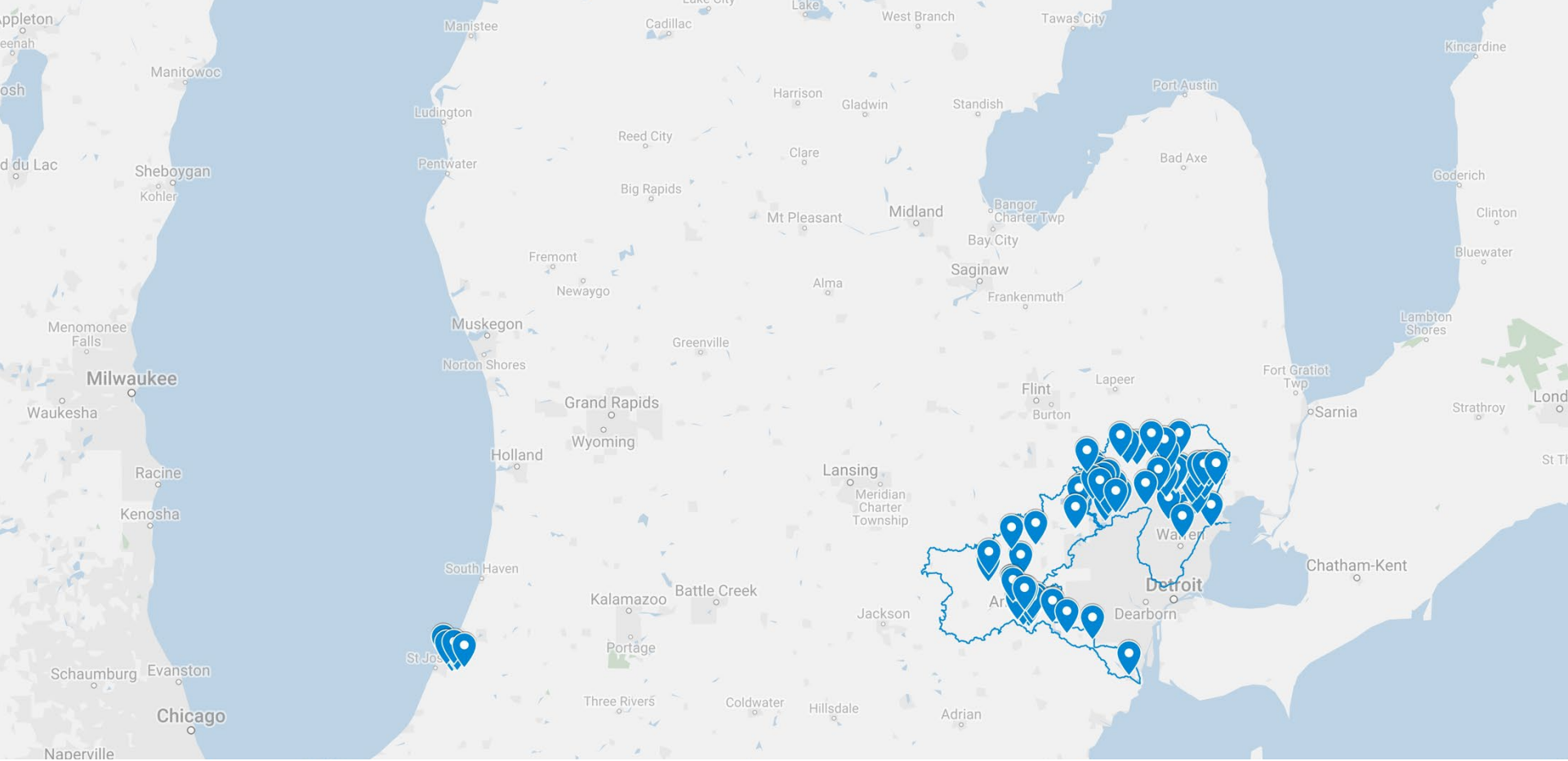
telit
DE910-DUAL
ON/OFF
TELIT




east-1.elasticbeanstalk.com
open-storm
ARB034
Distance (1726 mm)

Grafana - Clinton River Waters
Clinton River Watershed
Zoom Out
Jun 4, 2019 17:08:56 to Jun 7, 2019 09:08:57
Clinton Battery
DET001 DET003 DET004 DET008 DET012 DET015 DET016 DET022 DET023 DET024 DET020
Clinton Depth
DET001 Voltage Status
4.01 V
DET003 Voltage Status
4.05 V
DET004 Voltage Status
4.02 V
DET008 Voltage Status
4.00 V
DET012 Voltage Status
3.95 V
DET015 Voltage Status
4.02 V

open-storm
ARB030
Depth (0.005 Feet)



Great Lakes Protection Fund

City of Toledo Official Seal

University of Michigan

City of Ann Arbor Michigan

The University of Toledo 1872

Huron River Watershed Council

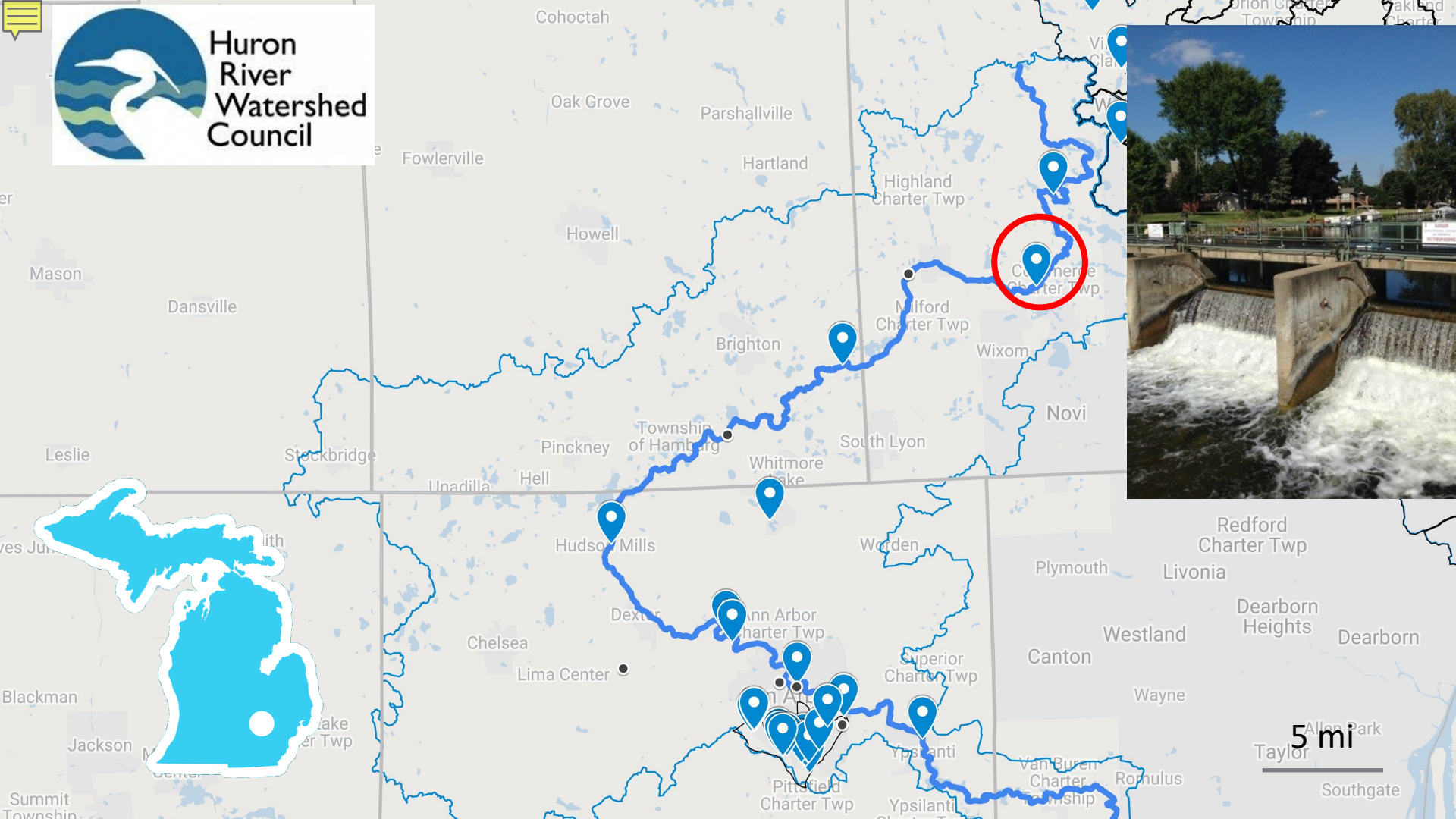
Washtenaw County Michigan 1826

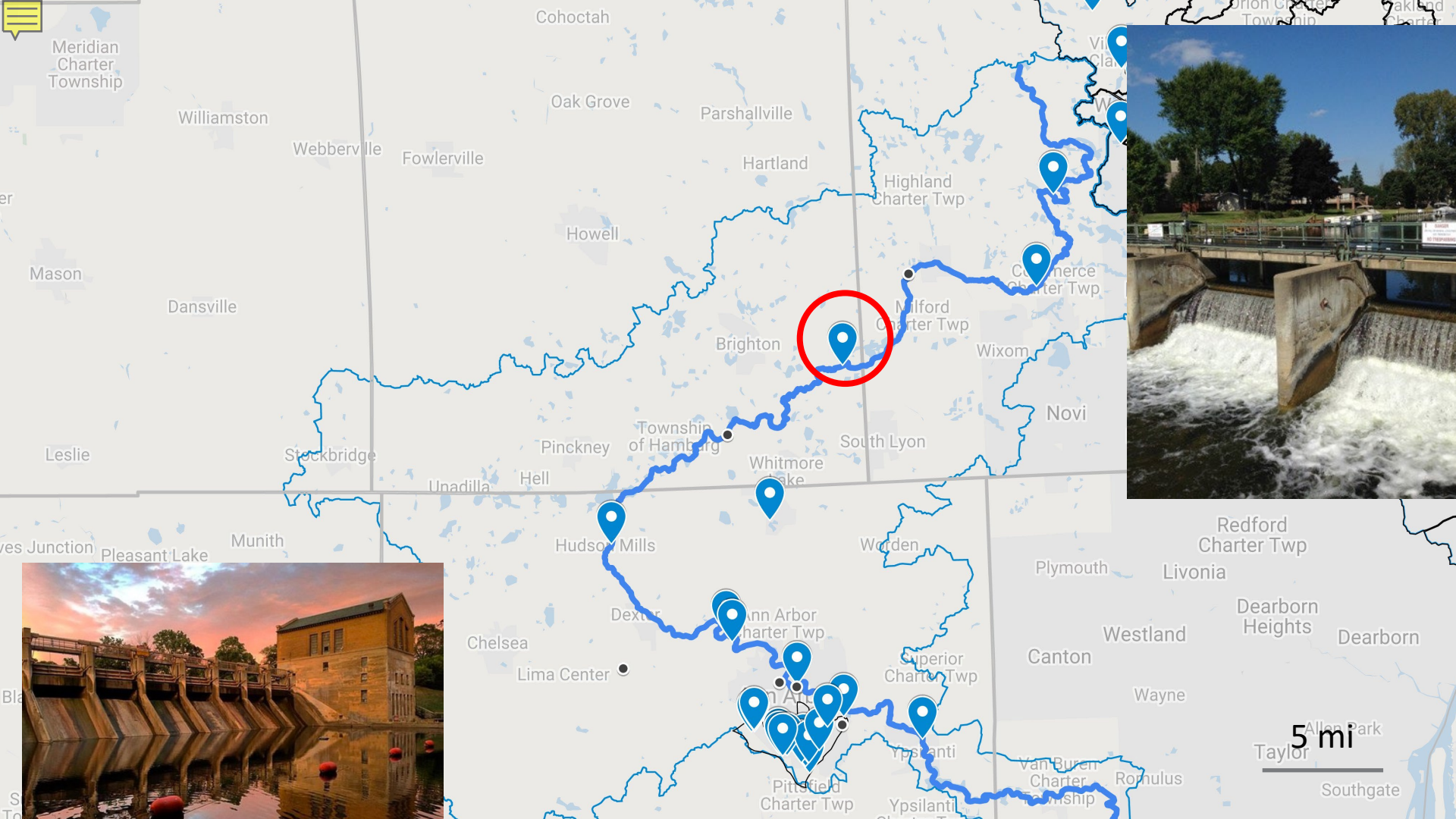
EGLE

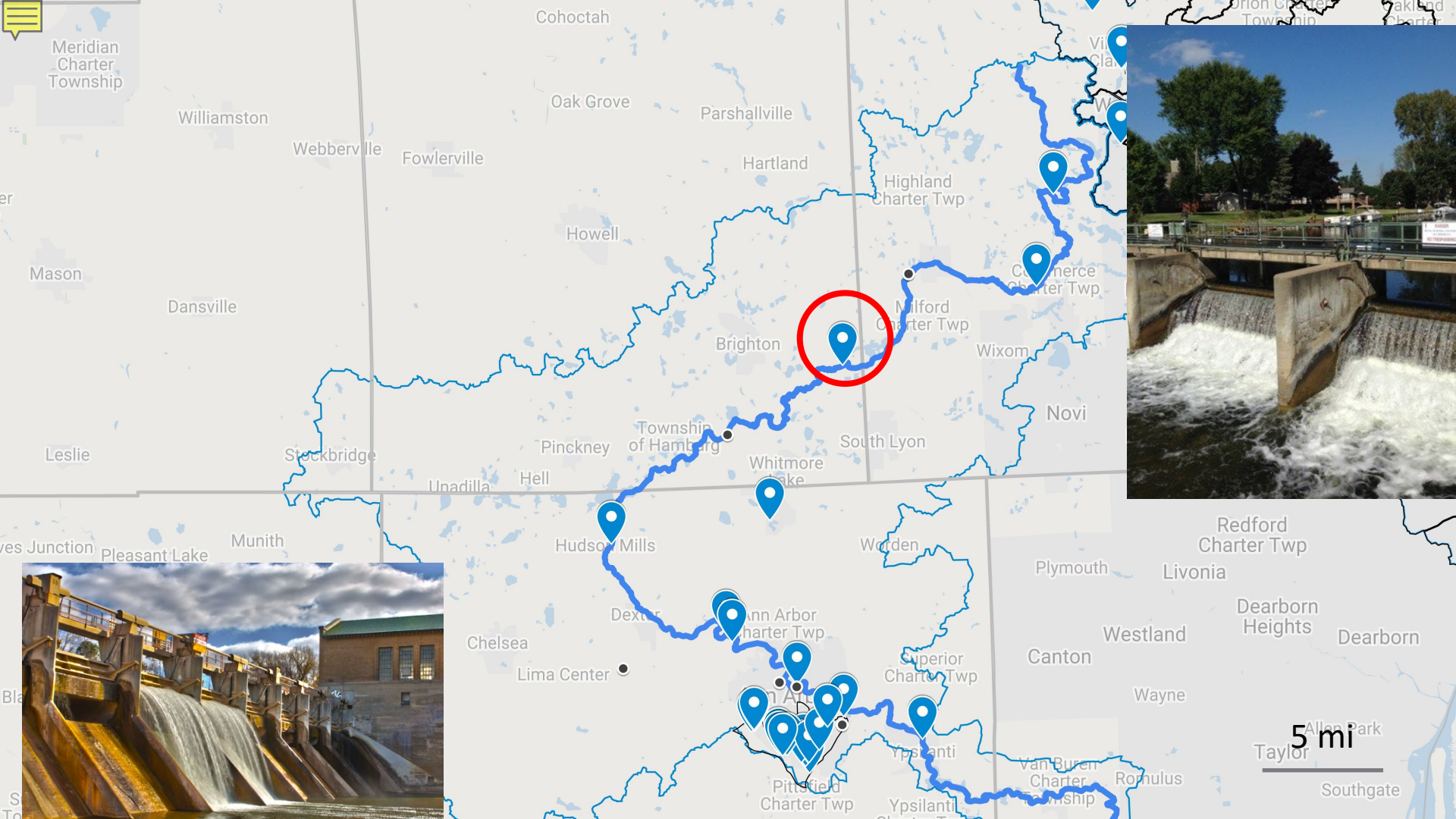
Oakland County Michigan

Macomb County Michigan 1818

CRWC Clinton River Watershed Council


Huron River Watershed Council
Cohoctah
Oak Grove
Parshallville
Fowlerville
Hartland
Highland Charter Twp
Howell
Mason
Dansville
Milford Charter Twp
Brighton
Wixom
Novi
Township of Hamburg
Pinckney
South Lyon
Leslie
Stockbridge
Whitmore Lake
Unadilla
Hell
Hudson Mills
Worden
Redford Charter Twp
Plymouth
Livonia
Dexter
Ann Arbor Charter Twp
Dearborn Heights
Dearborn
Westland
Chelsea
Superior Charter Twp
Canton
Lima Center
Blackman
Wayne
Jackson
Ypsilanti
Taylor
Van Buren Charter Township
Romulus
Pittsfield Charter Twp
Ypsilanti
Southgate
Summit Township
5 mi


Meridian Charter Township
Cohoctah
Oak Grove
Parshallville
Williamston
Webberville
Fowlerville
Hartland
Highland Charter Twp
Howell
Mason
Dansville
Commerce Charter Twp
Milford Charter Twp
Brighton
Wixom
Novi
Township of Hamburg
South Lyon
Leslie
Stockbridge
Pinckney
Whitmore Lake
Unadilla
Hell
Munith
Pleasant Lake
Hudson Mills
Worden
Redford Charter Twp
Plymouth
Livonia
Dexter
Ann Arbor Charter Twp
Dearborn Heights
Dearborn
Westland
Chelsea
Superior Charter Twp
Canton
Lima Center
Wayne
Allen Park
Taylor
Ypsilanti
Van Buren Charter Township
Romulus
Pittsfield Charter Twp
Ypsilanti
Southgate
5 mi

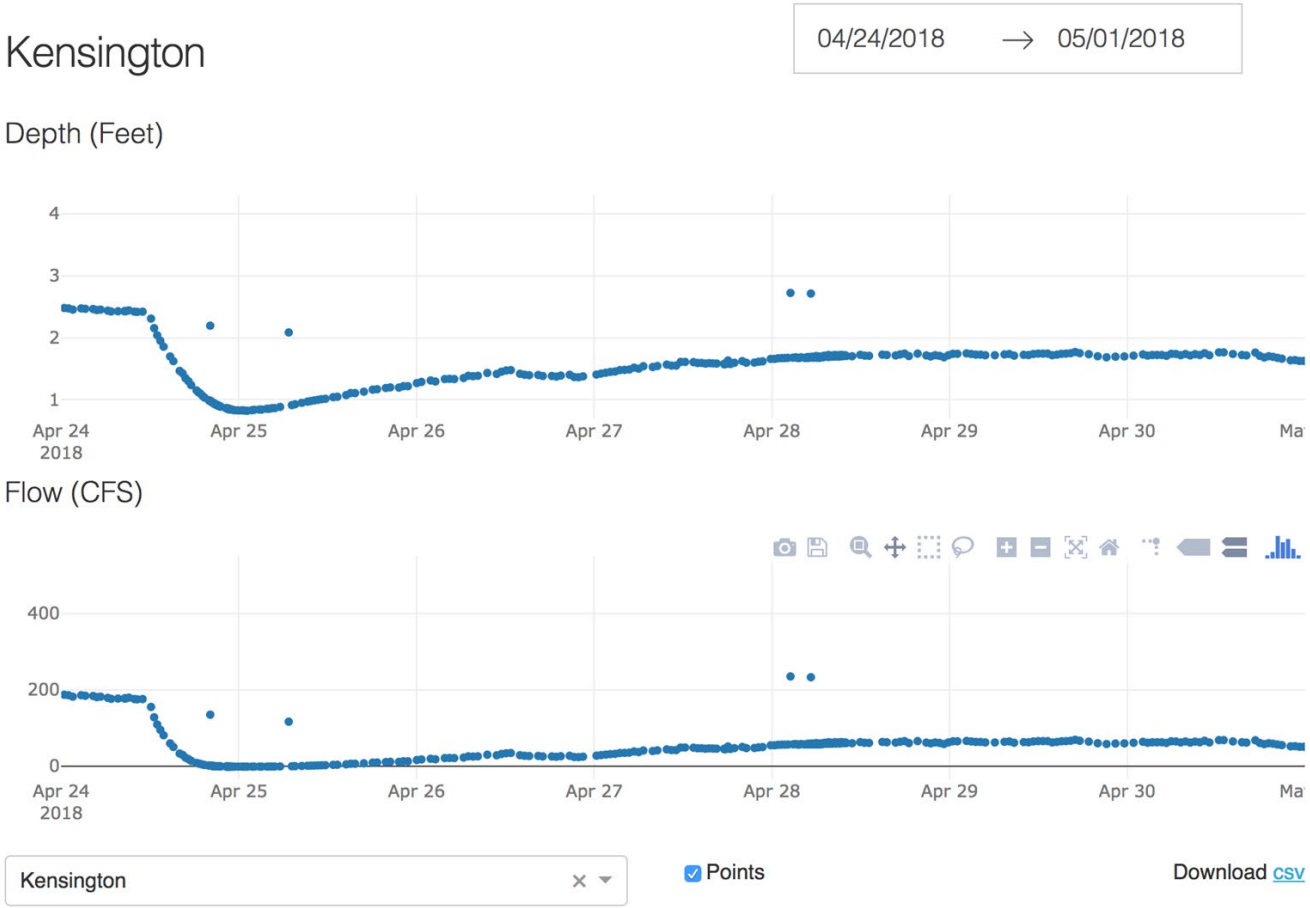

Meridian Charter Township
Cohoctah
Williamston
Oak Grove
Parshallville
Webberville
Fowlerville
Hartland
Highland Charter Twp
Howell
Mason
Dansville
Commerce Charter Twp
Milford Charter Twp
Brighton
Wixom
Novi
Township of Hamburg
Pinckney
South Lyon
Leslie
Stockbridge
Whitmore Lake
Unadilla
Hell
Munith
Pleasant Lake
Hudson Mills
Worden
Redford Charter Twp
Plymouth
Livonia
Dexter
Ann Arbor Charter Twp
Dearborn Heights
Dearborn
Westland
Chelsea
Superior Charter Twp
Canton
Lima Center
Wayne
Ypsilanti
Allen Park
Taylor
Van Buren Charter Township
Romulus
Pittsfield Charter Twp
Ypsilanti
Southgate
5 mi

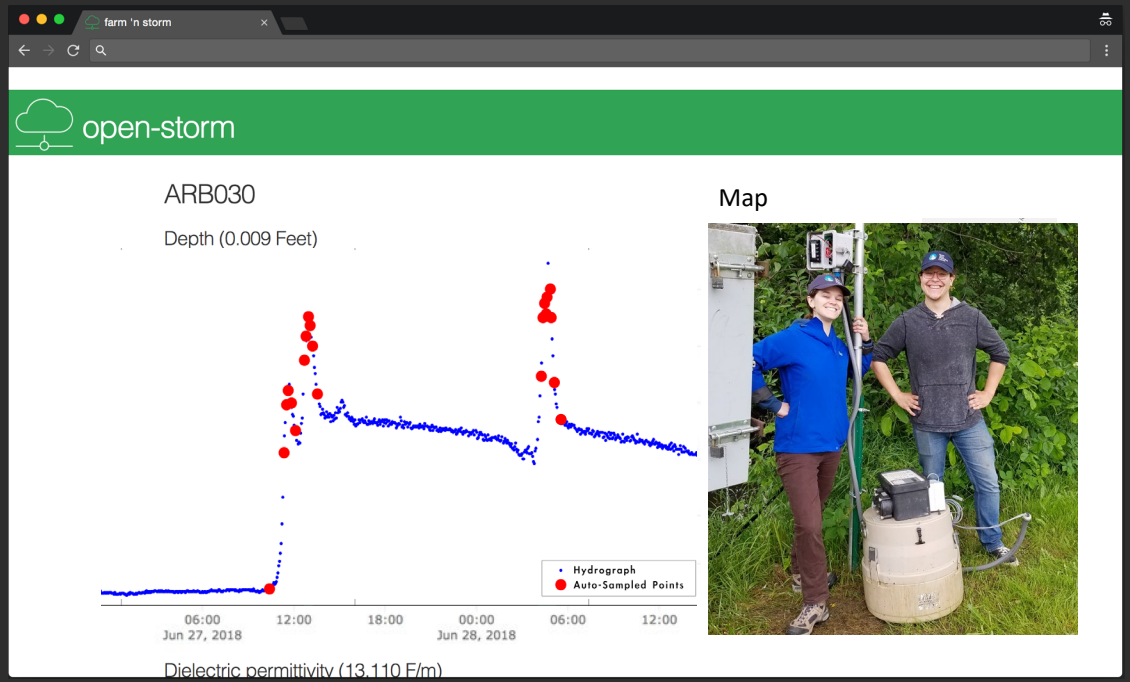
Multiuse flow management using real-time data

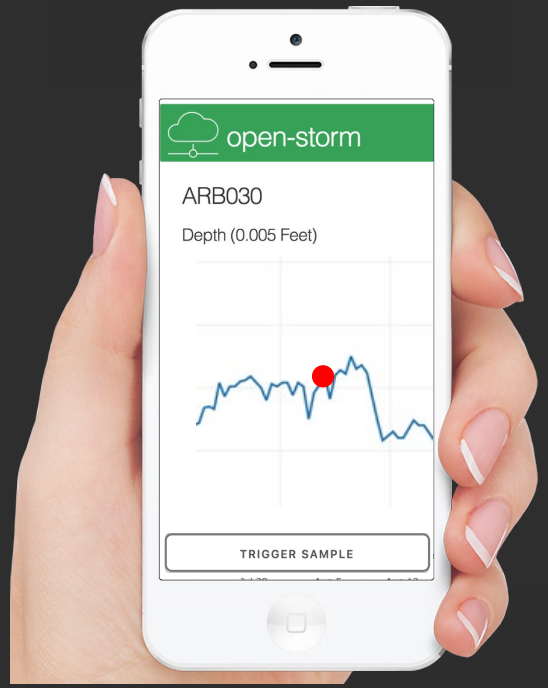
Is it possible to manage flow to stay within the natural range of variation?

Huron River Watershed Council

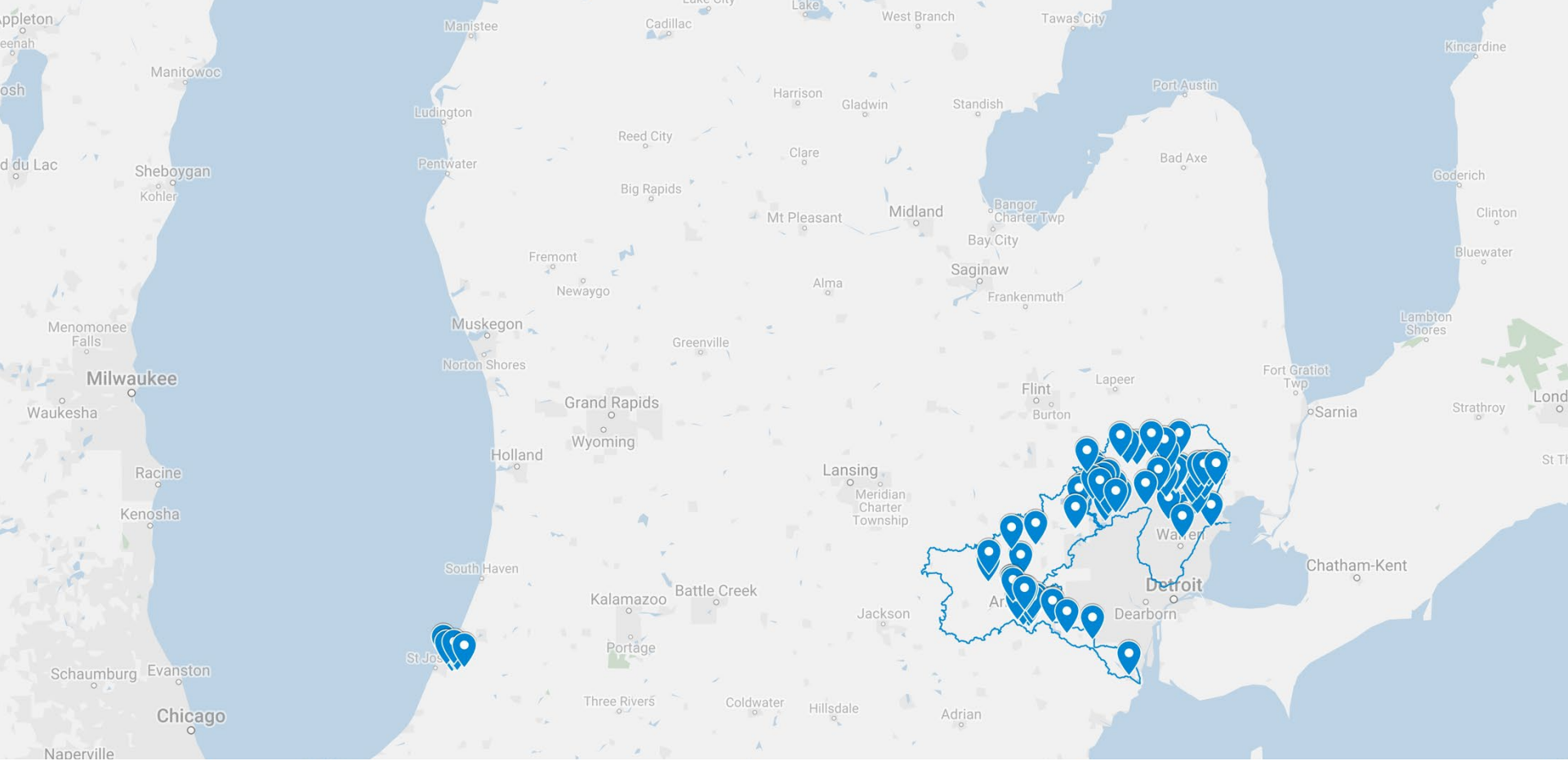
High-resolution data







Automatically trigger remote samplers as water levels change.



Great Lakes Protection Fund

City of Toledo Official Seal

University of Michigan

City of Ann Arbor Michigan

The University of Toledo 1872

Huron River Watershed Council

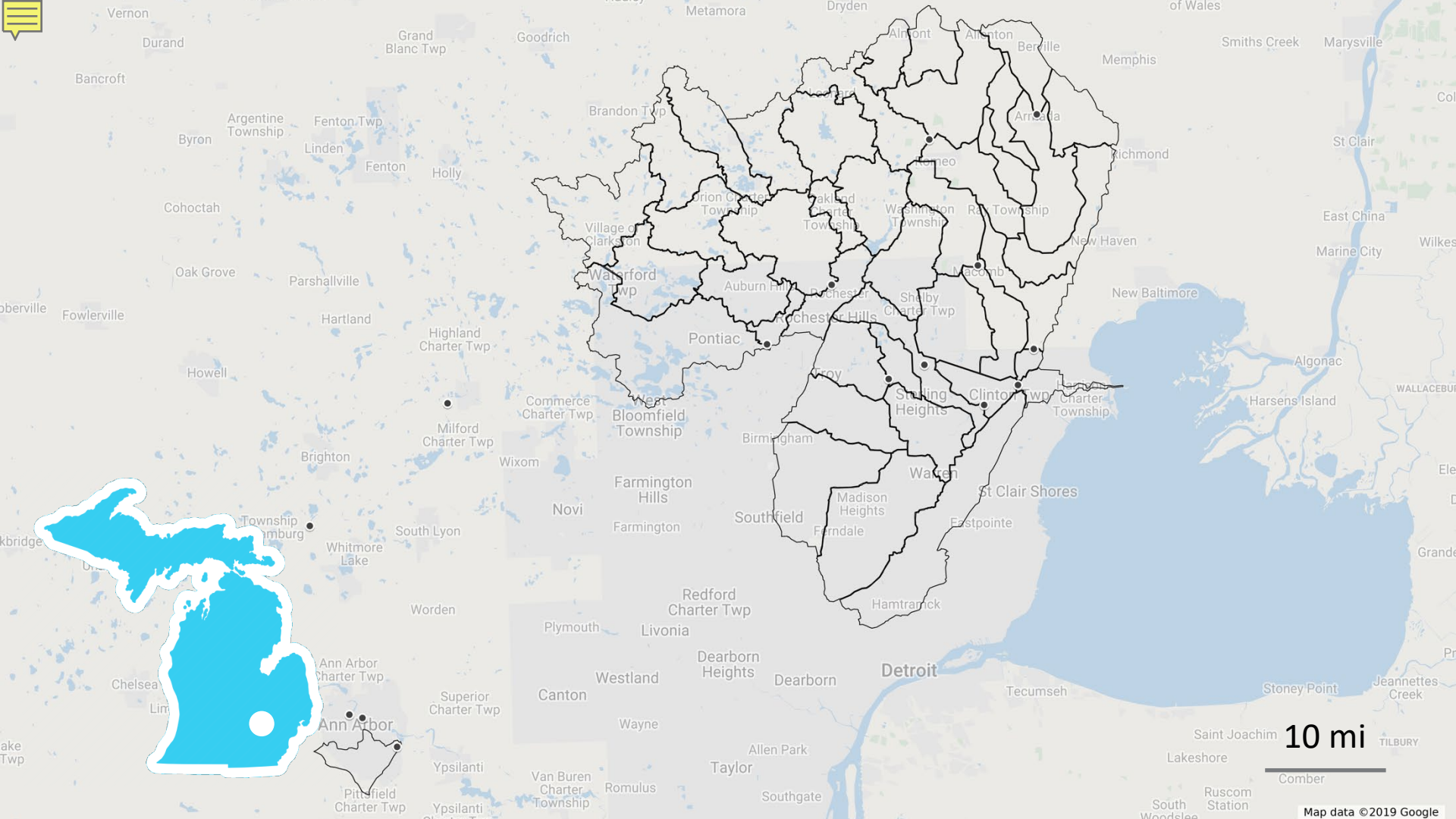
Washtenaw County Michigan 1826

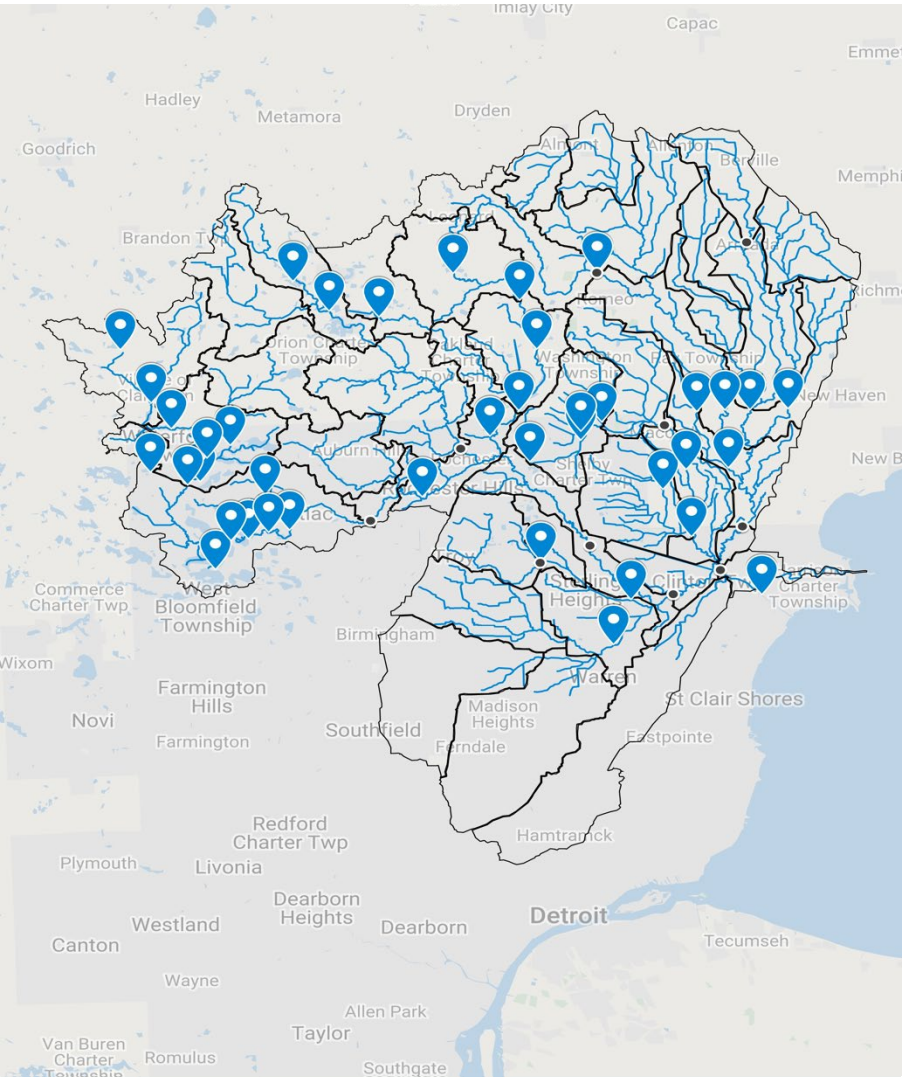
EGLE

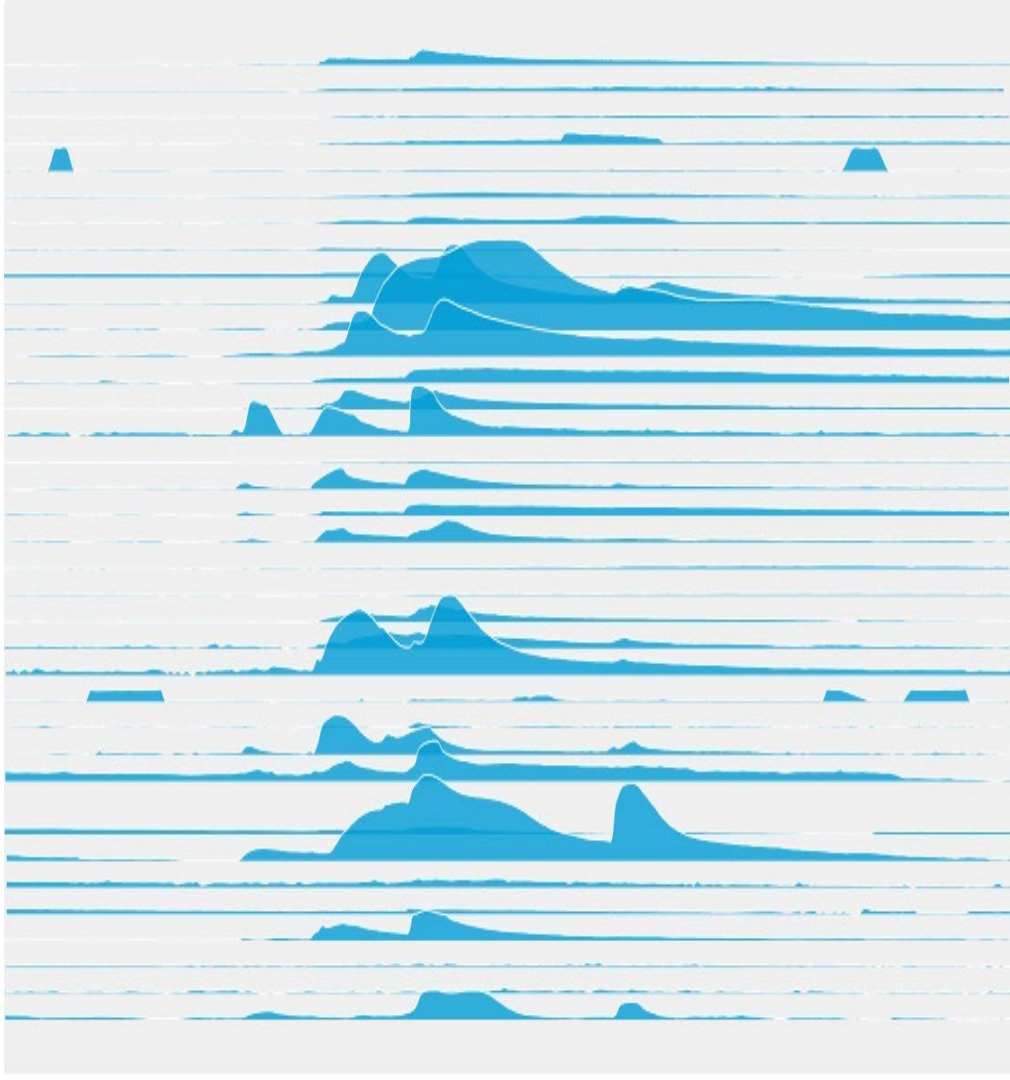
Oakland County Michigan

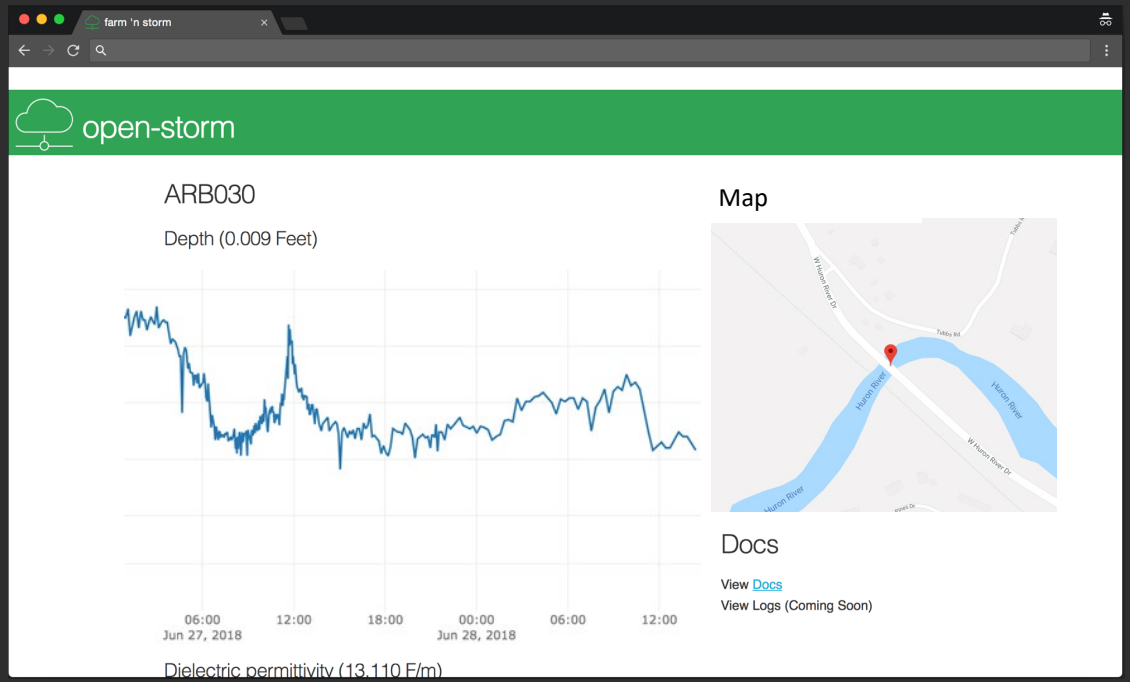
Macomb County Michigan 1818

CRWC Clinton River Watershed Council

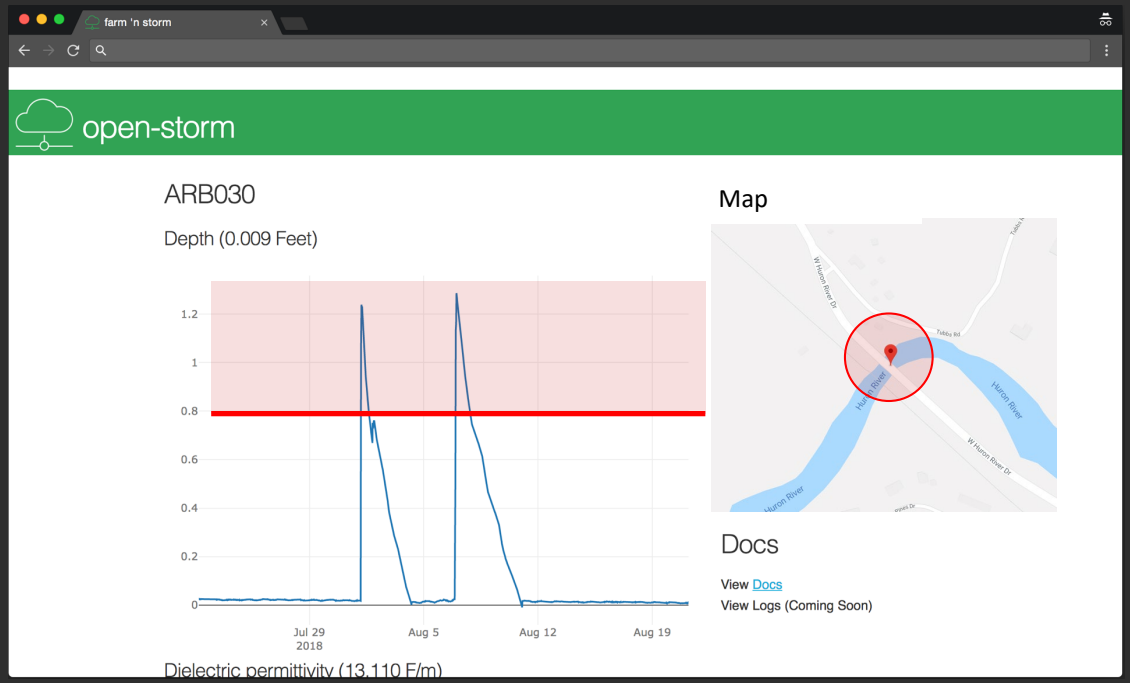

10 mi
Map data ©2019 Google
Vernon
Durand
Bancroft
Byron
Argentine Township
Fenton Twp
Linden
Fenton
Holly
Cohoctah
Oak Grove
Parshallville
Fowlerville
Hartland
Howell
Highland Charter Twp
Milford Charter Twp
Brighton
Wixom
Commerce Charter Twp
Novi
Farmington Hills
Farmington
Bloomfield Township
Pontiac
Waterford Twp
Auburn Hills
Rochester
Rochester Hills
Troy
Sterling Heights
Clinton Twp
Shelby Charter Twp
Warren
Madison Heights
Ferndale
Southfield
Birmingham
St Clair Shores
Eastpointe
Hamtramck
Detroit
Redford Charter Twp
Livonia
Plymouth
Dearborn Heights
Dearborn
Westland
Canton
Wayne
Allen Park
Taylor
Romulus
Van Buren Charter Township
Southgate
Ypsilanti
Ypsilanti Charter Twp
Pittsfield Charter Twp
Ann Arbor
Ann Arbor Charter Twp
Superior Charter Twp
Chelsea
Whitmore Lake
South Lyon
Township
Worden
Grand Blanc Twp
Goodrich
Metamora
Dryden
Almont
Berville
Memphis
Smiths Creek
Marysville
Brandon Twp
Arcadia
Richmond
St Clair
Romeo
Orion Charter Township
Oakland Charter Township
Washington Township
Ray Township
East China
Village of Clarkston
New Haven
Marine City
Lacomb
New Baltimore
Algonac
Harsens Island
Clinton Charter Township
Tecumseh
Stoney Point
Jeannettes Creek
Saint Joachim
Lakeshore
Comber
Ruscom Station
South Woodslee
TILBURY
WALLACEBURG
Fowlerville
Grande


Capac
Hadley
Metamora
Dryden
Goodrich
Brandon Twp
Orion Charter Township
Auburn Hills
Rochester
Rochester Hills
Shelby Charter Twp
Sterling Heights
Clinton Charter Township
Commerce Charter Twp
West Bloomfield Township
Birmingham
Wixom
Farmington Hills
Novi
Farmington
Southfield
Madison Heights
Ferndale
Warren
St Clair Shores
Eastpointe
Hamtramck
Redford Charter Twp
Plymouth
Livonia
Dearborn Heights
Dearborn
Detroit
Westland
Canton
Tecumseh
Wayne
Allen Park
Taylor
Van Buren Charter Township
Romulus
Southgate

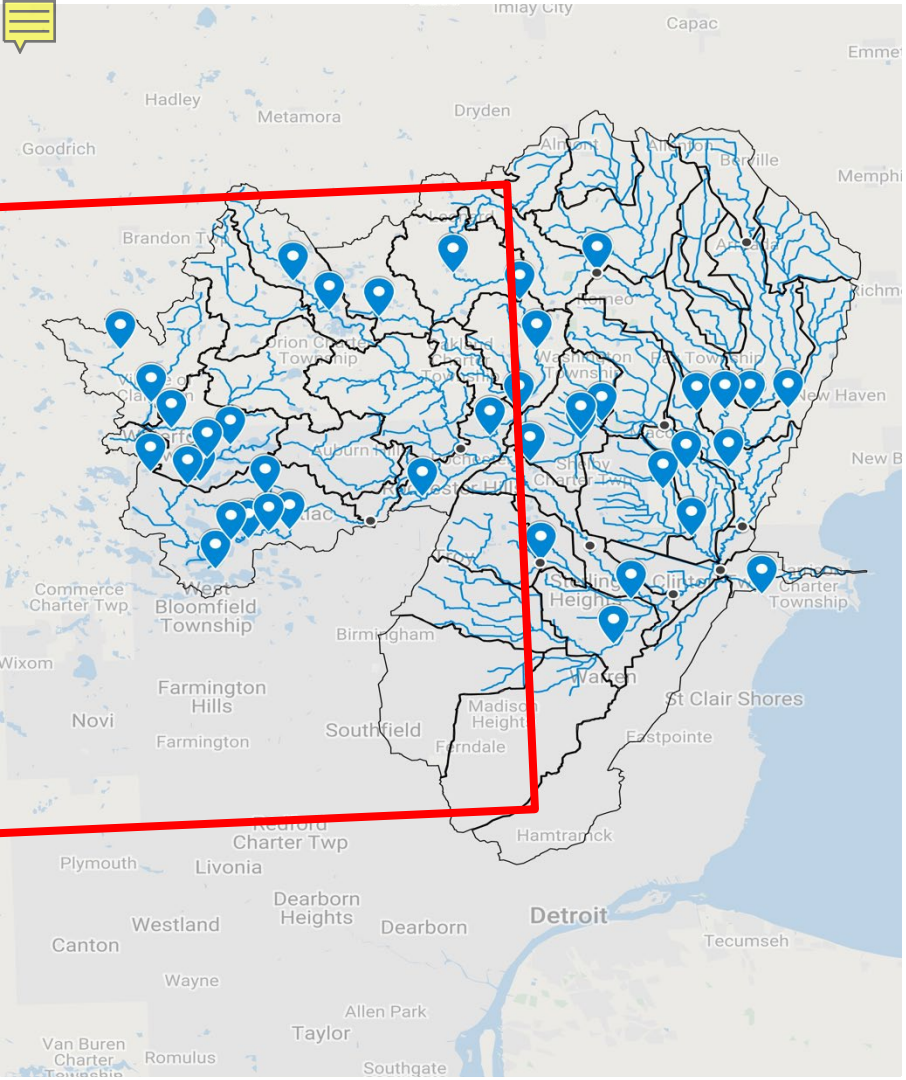




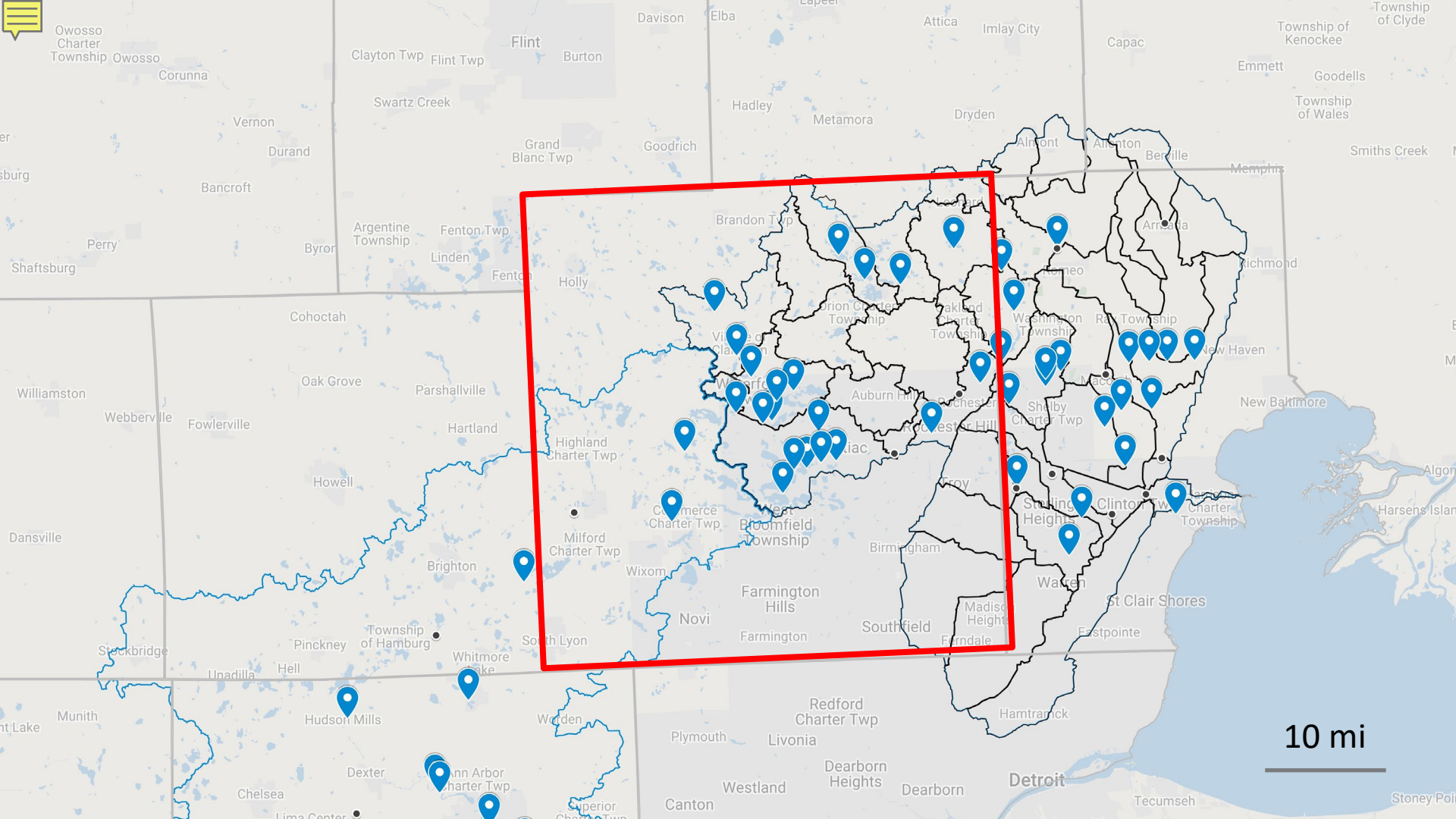
Sensors **instantly** report the water level at streams and road crossings.

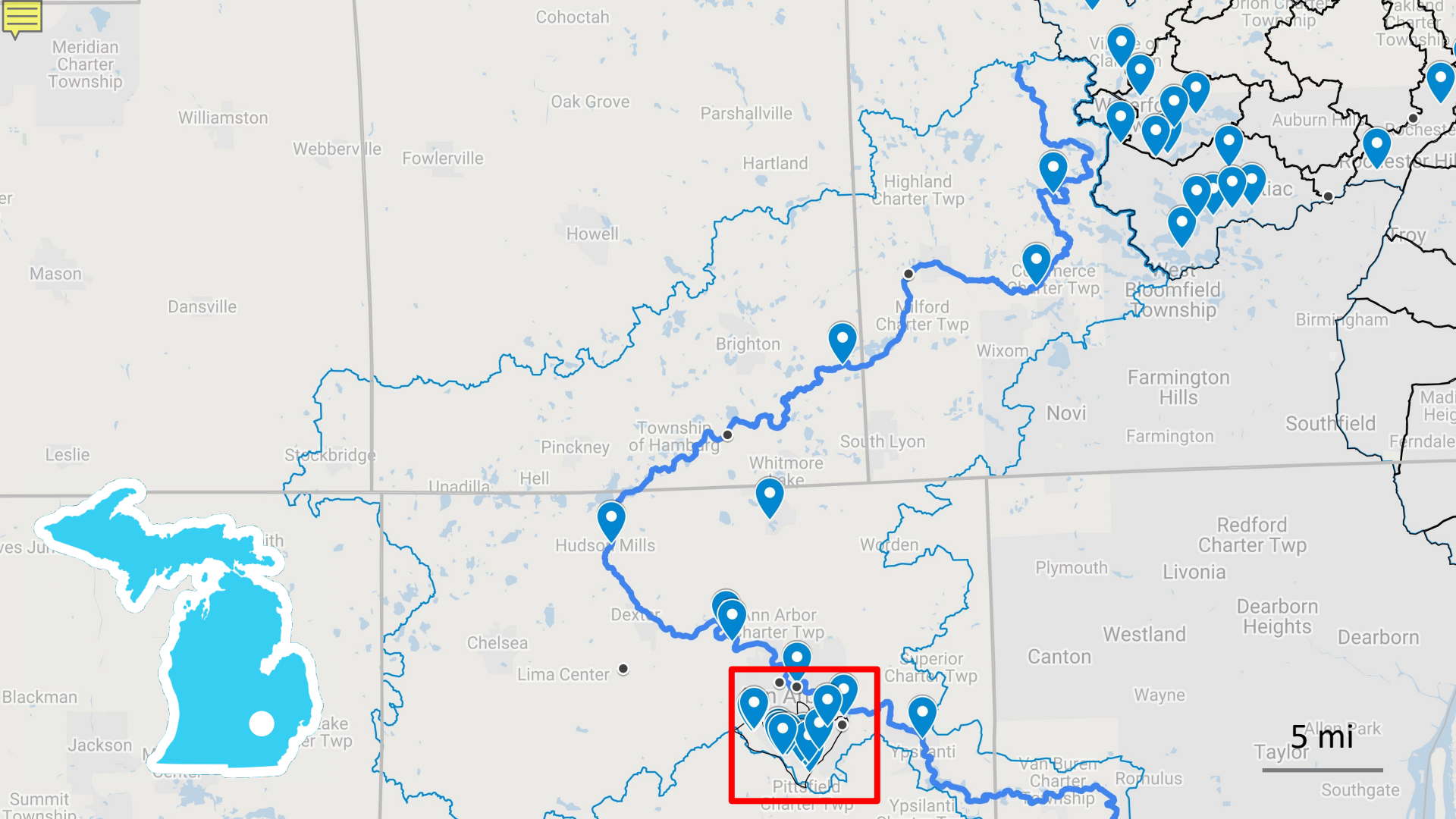


If flooding is detected, an **automatic alert** is sent immediately.

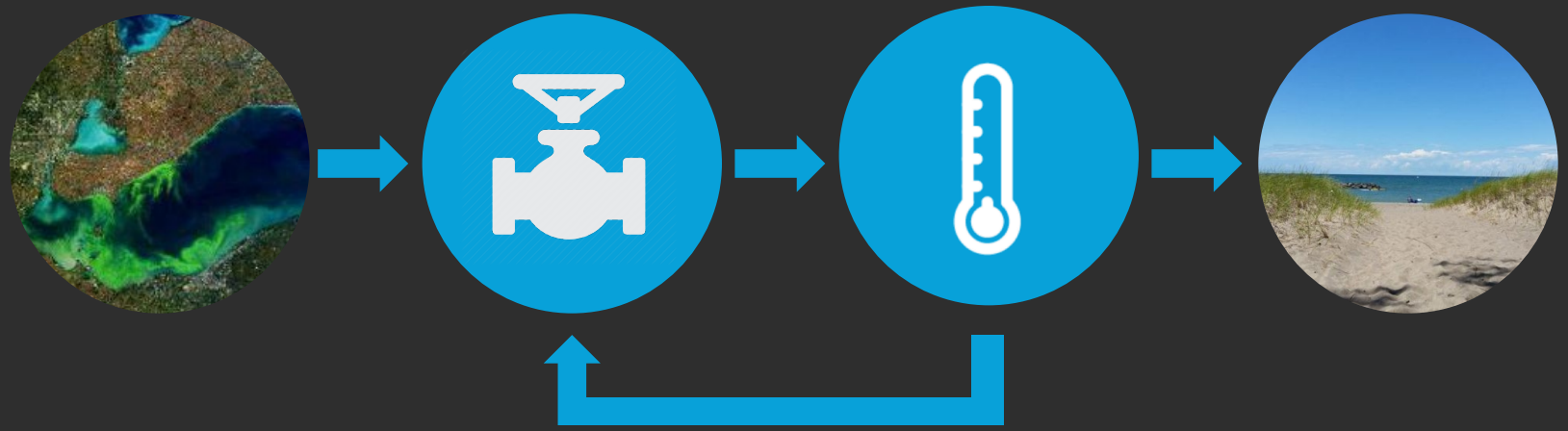

Capac
Hadley
Metamora
Dryden
Goodrich
Brandon Twp
Orion Charter Township
Oxford Charter Township
Addison Charter Township
Auburn Hills
Rochester Hills
Shelby Charter Twp
Macomb Charter Twp
Ray Township
New Haven
Commerce Charter Twp
West Bloomfield Township
Birmingham
Wixom
Farmington Hills
Novi
Farmington
Southfield
Madison Heights
Ferndale
Warren
St Clair Shores
Eastpointe
Hamtramck
Redford Charter Twp
Plymouth
Livonia
Dearborn Heights
Dearborn
Detroit
Westland
Canton
Tecumseh
Wayne
Allen Park
Taylor
Van Buren Charter Township
Romulus
Southgate

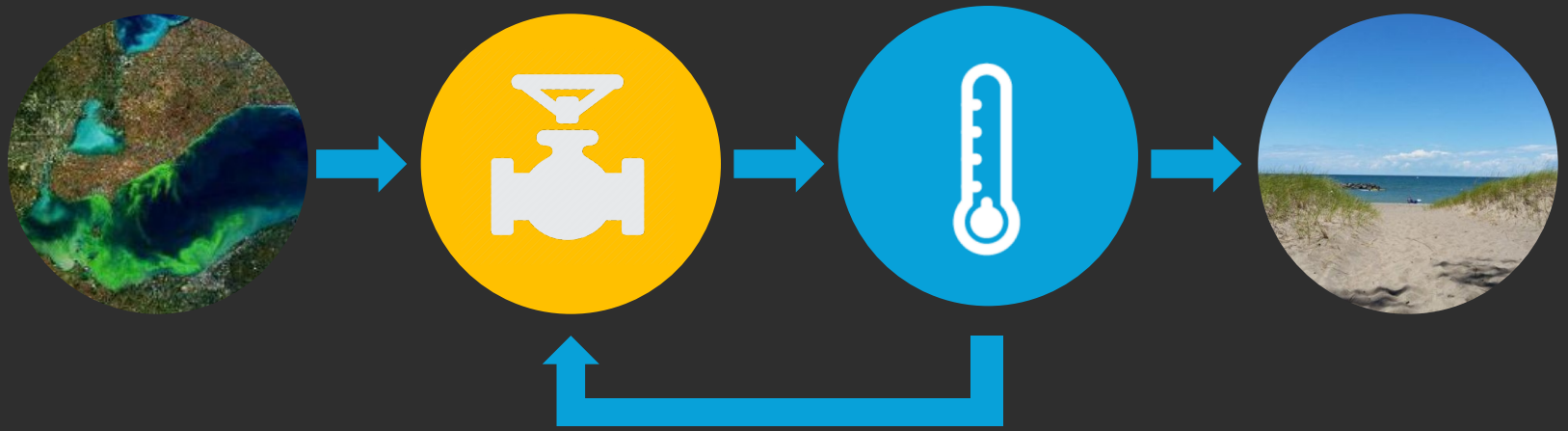
MULTI-LAKES LEVEL CONTROL
GREENS, LESTER, LOTUS, MACEDAY
AND VAN NORMAN
NORMAL LEVEL 966.70 FT.
ABOVE MEAN SEA LEVEL
UNDER JURISDICTION OF
JIM NASH
WATER RESOURCES COMMISSIONER
PENALTY FOR INTERFERENCE WITH LAKE LEVEL
$1000.00 FINE AND ONE YEAR IMPRISONMENT


10 mi
Flint
Davison
Elba
Attica
Imlay City
Capac
Township of Kenockee
Township of Clyde
Owosso Charter Township
Owosso
Corunna
Clayton Twp
Flint Twp
Burton
Emmett
Goodells
Township of Wales
Smiths Creek
Swartz Creek
Hadley
Metamora
Dryden
Vernon
Durand
Grand Blanc Twp
Goodrich
Bancroft
Argentine Township
Fenton Twp
Linden
Perry
Byron
Shaftsburg
Holly
Brandon Twp
Cohoctah
Oak Grove
Parshallville
Williamston
Webberville
Fowlerville
Hartland
Highland Charter Twp
Howell
Dansville
Milford Charter Twp
Commerce Charter Twp
West Bloomfield Township
Brighton
Wixom
Farmington Hills
Novi
Farmington
Southfield
Birmingham
Troy
Rochester Hills
Auburn Hills
Oakland Charter Township
Orion Charter Township
Washington Township
Ray Township
Shelby Charter Twp
Sterling Heights
Clinton Twp
Warren
Madison Heights
Ferndale
Eastpointe
St Clair Shores
Harsens Island
New Haven
New Baltimore
Memphis
Richmond
Armada
Romeo
Berville
Almont
Algonac
Stockbridge
Pinckney
Unadilla
Hell
Whitmore Lake
Township of Hamburg
South Lyon
Munith
Hudson Mills
Wooden
Dexter
Ann Arbor Charter Twp
Chelsea
Lima Center
Superior Charter Twp
Canton
Westland
Plymouth
Livonia
Redford Charter Twp
Dearborn Heights
Dearborn
Detroit
Hamtramck
Tecumseh
Stoney Point


Meridian Charter Township
Cohoctah
Oak Grove
Parshallville
Williamston
Webberville
Fowlerville
Hartland
Highland Charter Twp
Howell
Mason
Dansville
Commerce Charter Twp
West Bloomfield Township
Milford Charter Twp
Brighton
Wixom
Farmington Hills
Novi
Farmington
Southfield
Township of Hamburg
Pinckney
South Lyon
Leslie
Stockbridge
Unadilla
Hell
Whitmore Lake
Hudson Mills
Worden
Redford Charter Twp
Plymouth
Livonia
Dexter
Ann Arbor Charter Twp
Dearborn Heights
Dearborn
Westland
Chelsea
Lima Center
Superior Charter Twp
Canton
Blackman
Wayne
Jackson
Ypsilanti
Van Buren Charter Township
Romulus
Taylor
Allen Park
Southgate
Summit Township
Pittsfield Charter Twp
Ypsilanti
5 mi

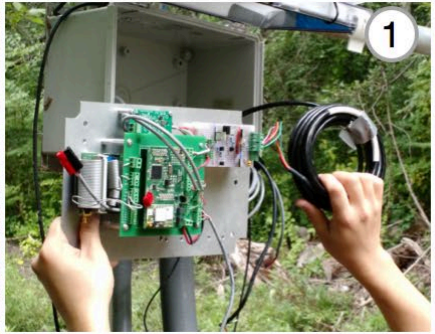
WASHTENAW COUNTY WATER RESOURCES COMMISSIONER
WATER RESOURCES
WASHTENAW
COUNTY Michigan





2

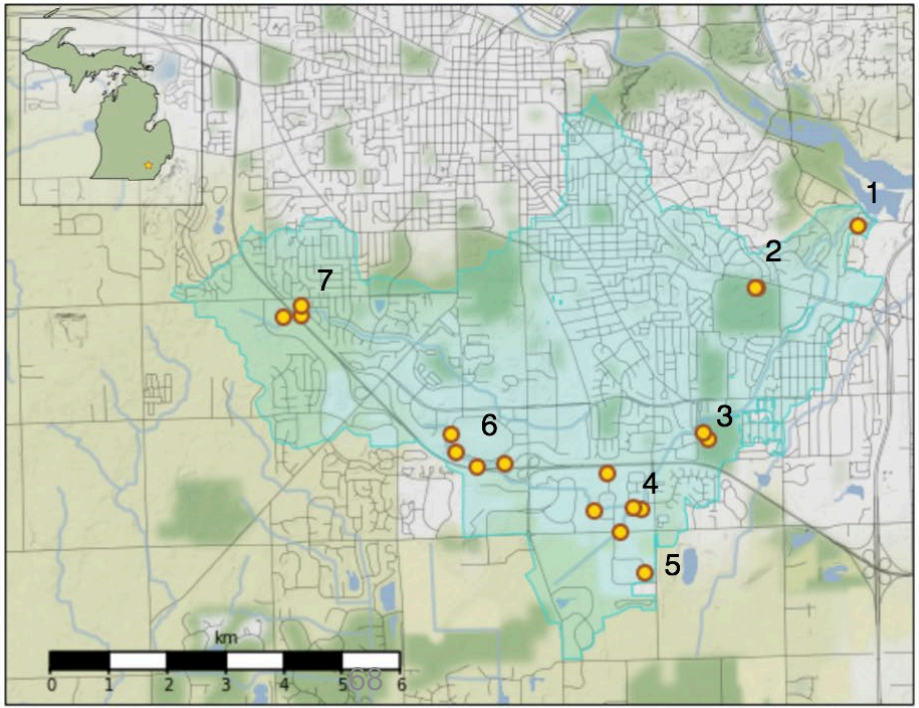
1


1

6

2

2


1
2
3
4
5
6
7
km
0
1
2
3
4
5
6

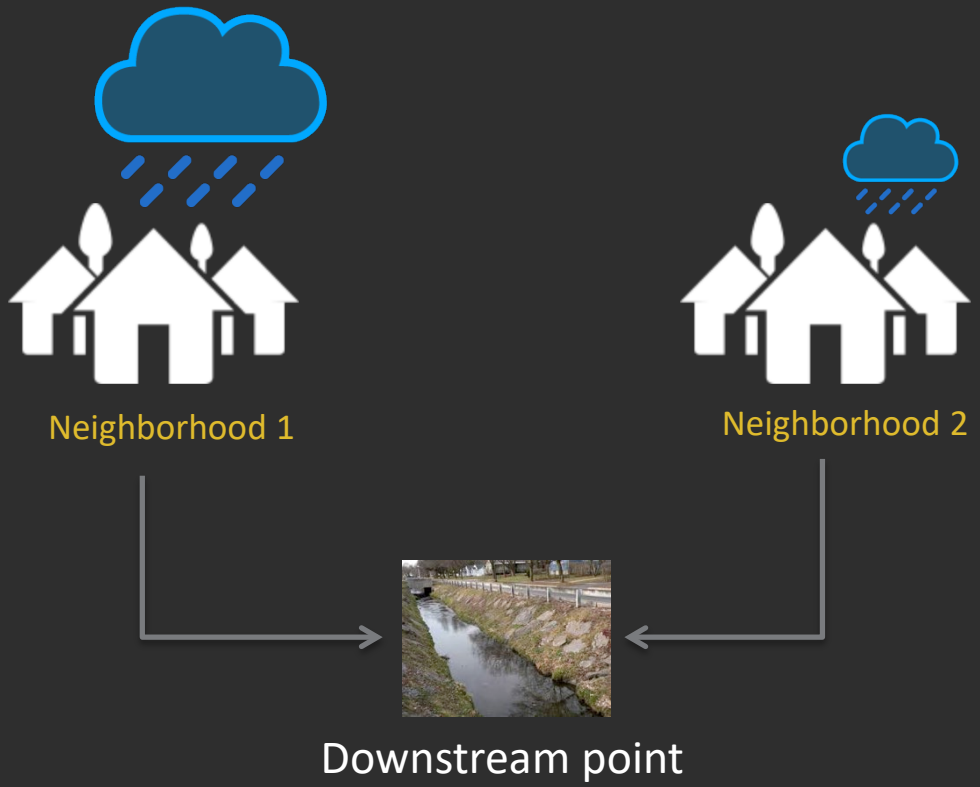
1

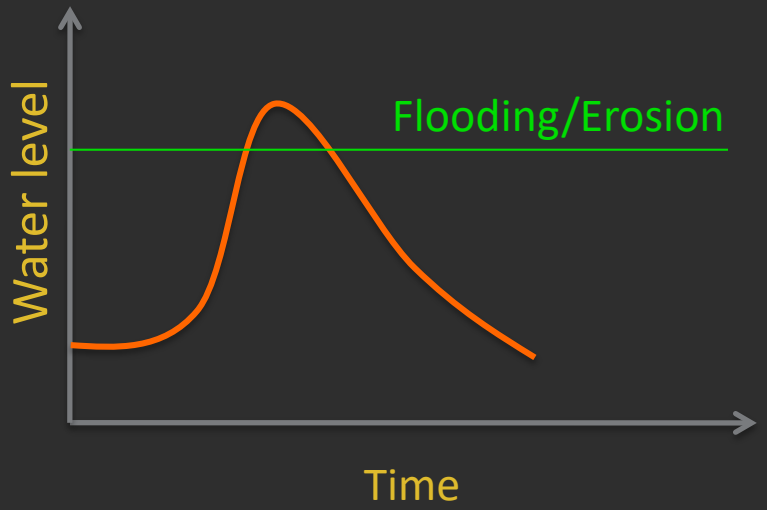
7

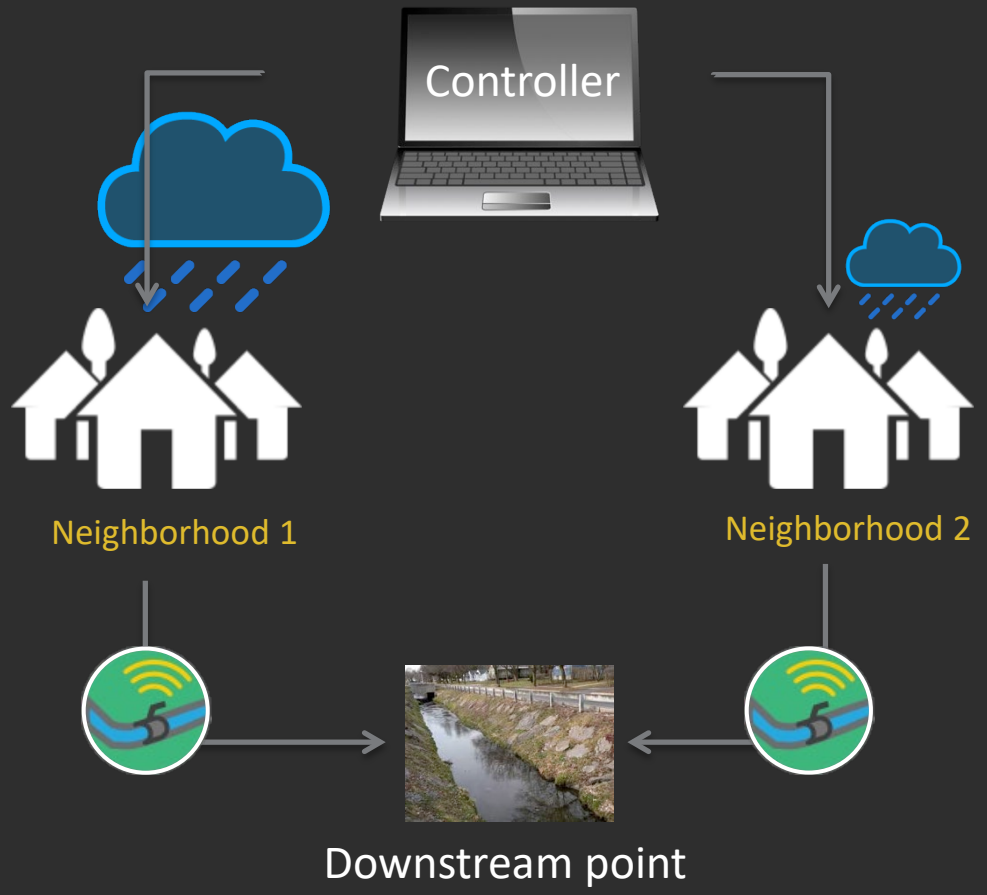
3

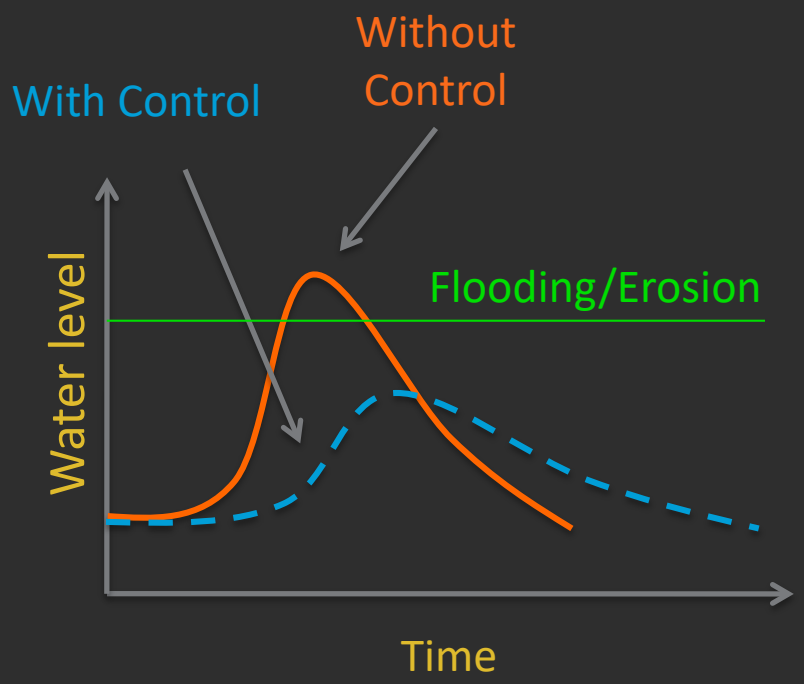
5

3

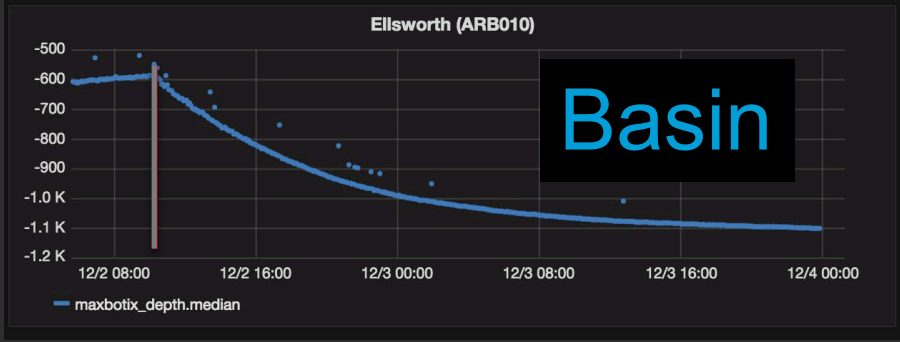

Neighborhood 1
Neighborhood 2
Downstream point

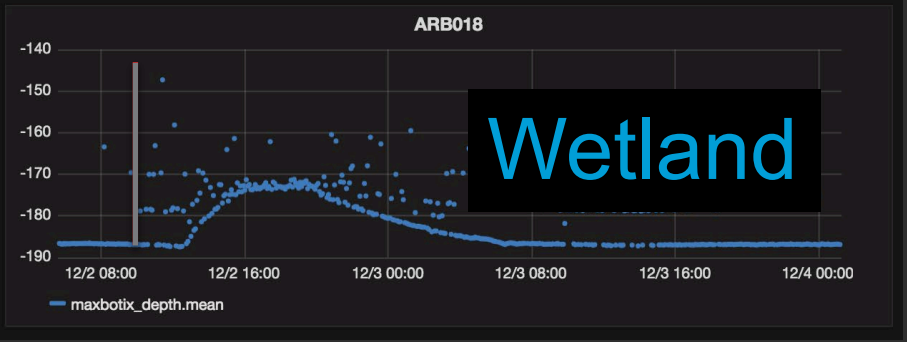

Water level
Flooding/Erosion
Time


Controller
Neighborhood 1
Neighborhood 2
Downstream point


With Control
Without Control
Flooding/Erosion
Water level
Time

~2 miles


Ellsworth (ARB010)
-500
-600
-700
-800
-900
-1.0 K
-1.1 K
-1.2 K
12/2 08:00
12/2 16:00
12/3 00:00
12/3 08:00
12/3 16:00
12/4 00:00
maxbotix_depth.median
Basin


ARB018
-140
-150
-160
-170
-180
-190
12/2 08:00
12/2 16:00
12/3 00:00
12/3 08:00
12/3 16:00
12/4 00:00
maxbotix_depth.mean
Wetland

- **Before**
- 15 Million Gallons Storage
- $22/gal
- 600 lb/yr Total P

After

- 22.5 million Gallons
- $16/gal
- 800 lb/yr Total P

- **Before**
- 15 Million Gallons Storage
- $22/gal
- 600 lb/yr Total P

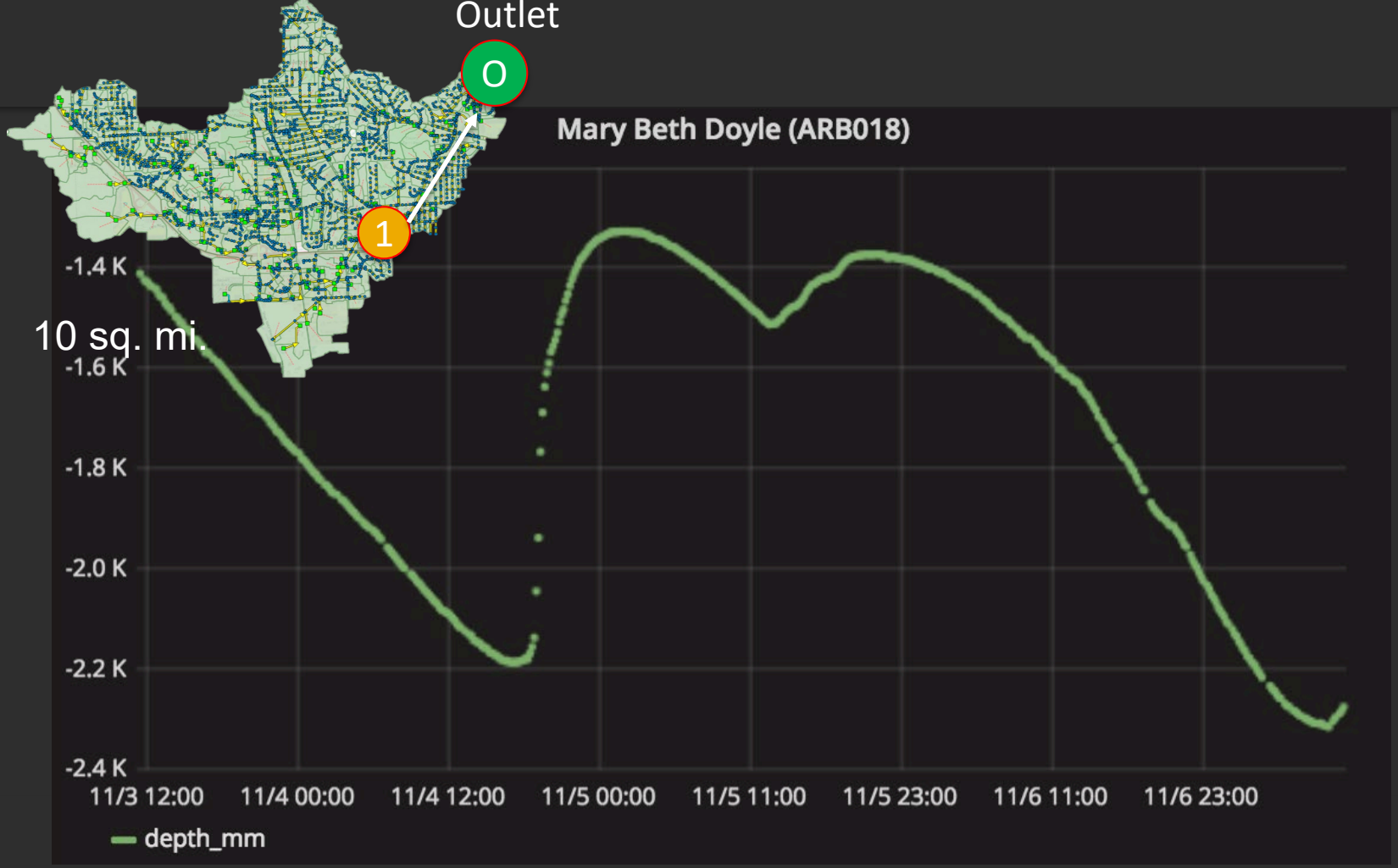
StateTech

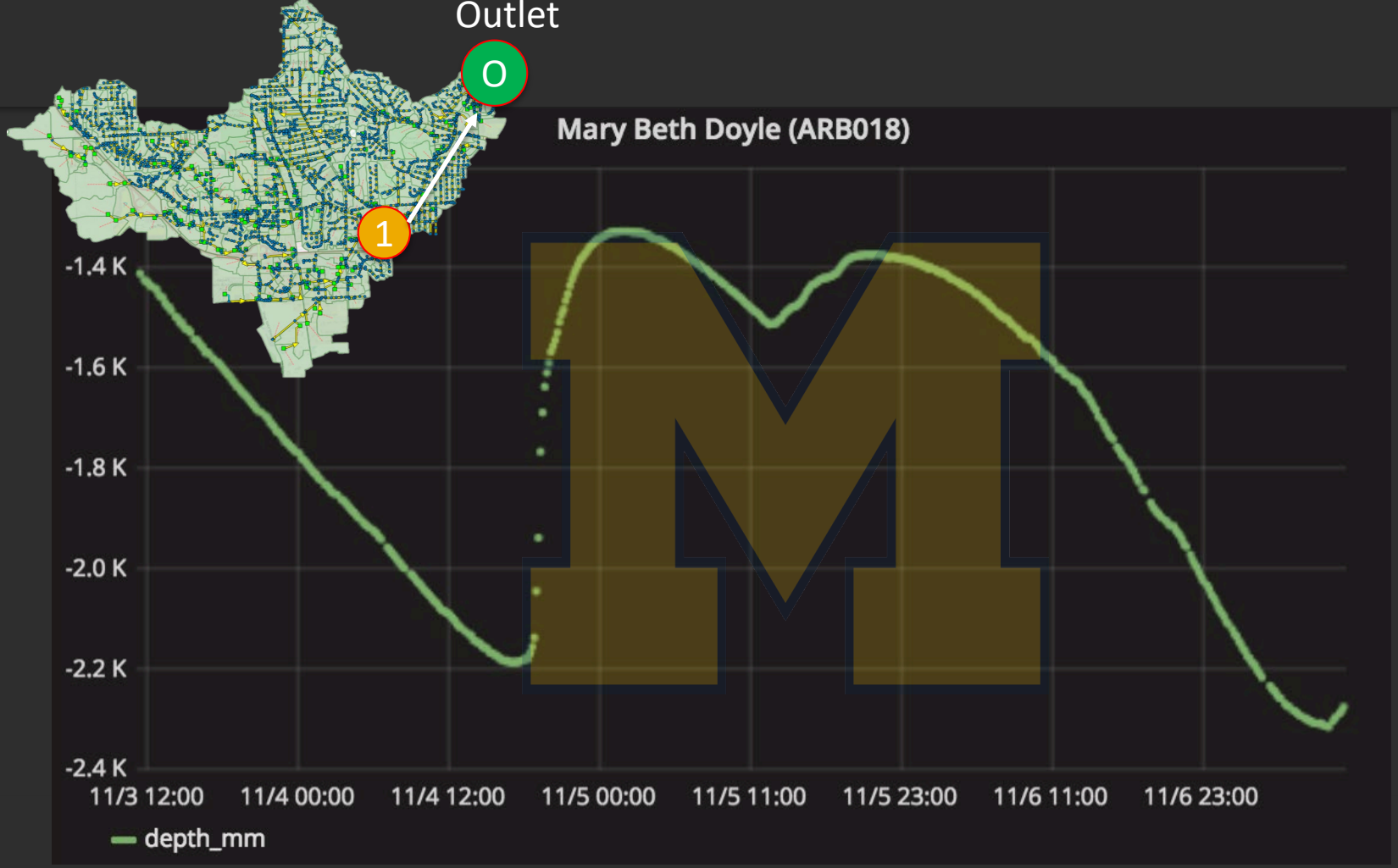
TOPICS STATES TIPS & TACTICS VOICES FEATURES VIDEO IT BLOGS MORE +

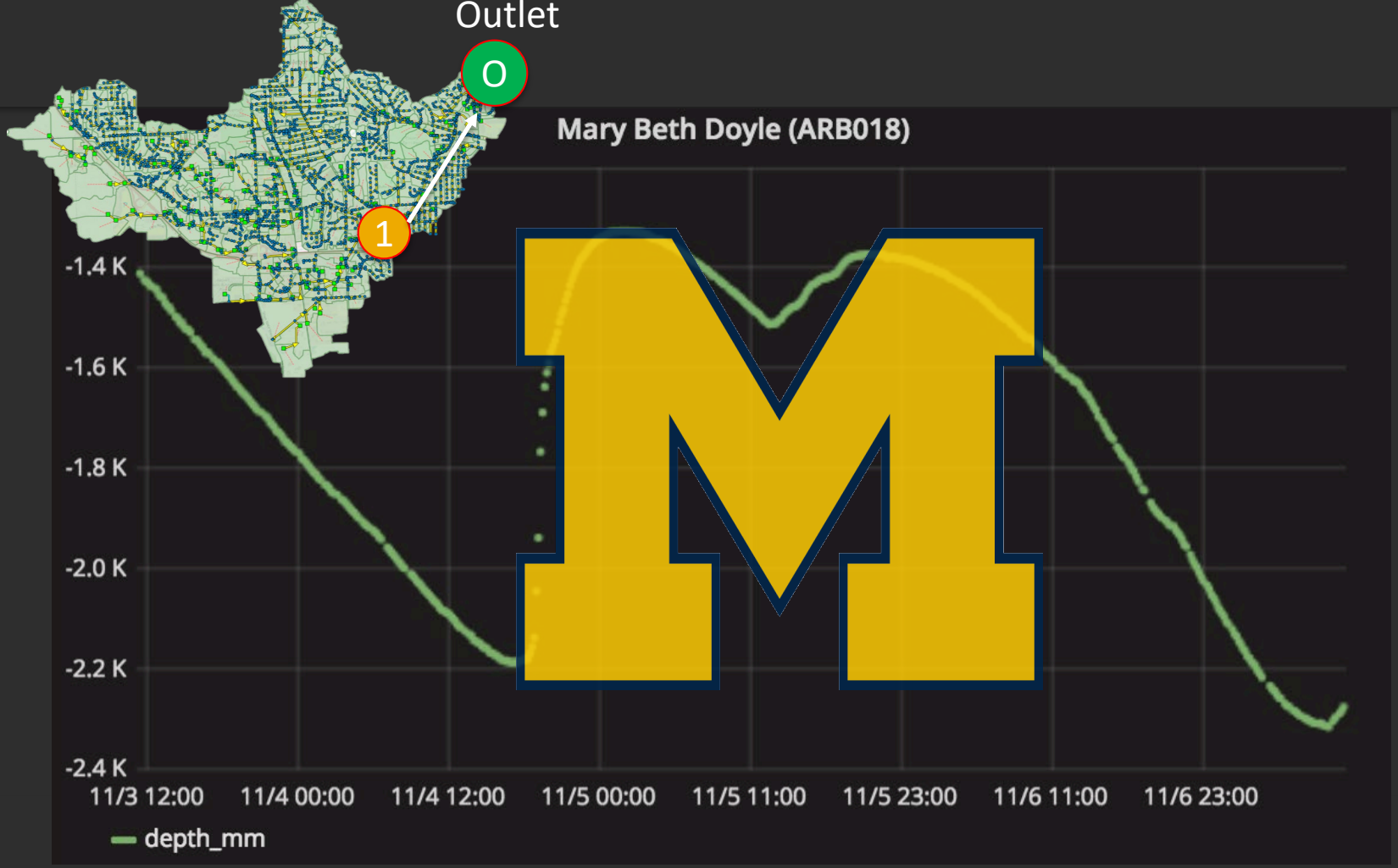
e to know what's happening in real time and have it precisely measured," said Harry Sheehan, eputy water resources commissioner, Washtenaw County Government.

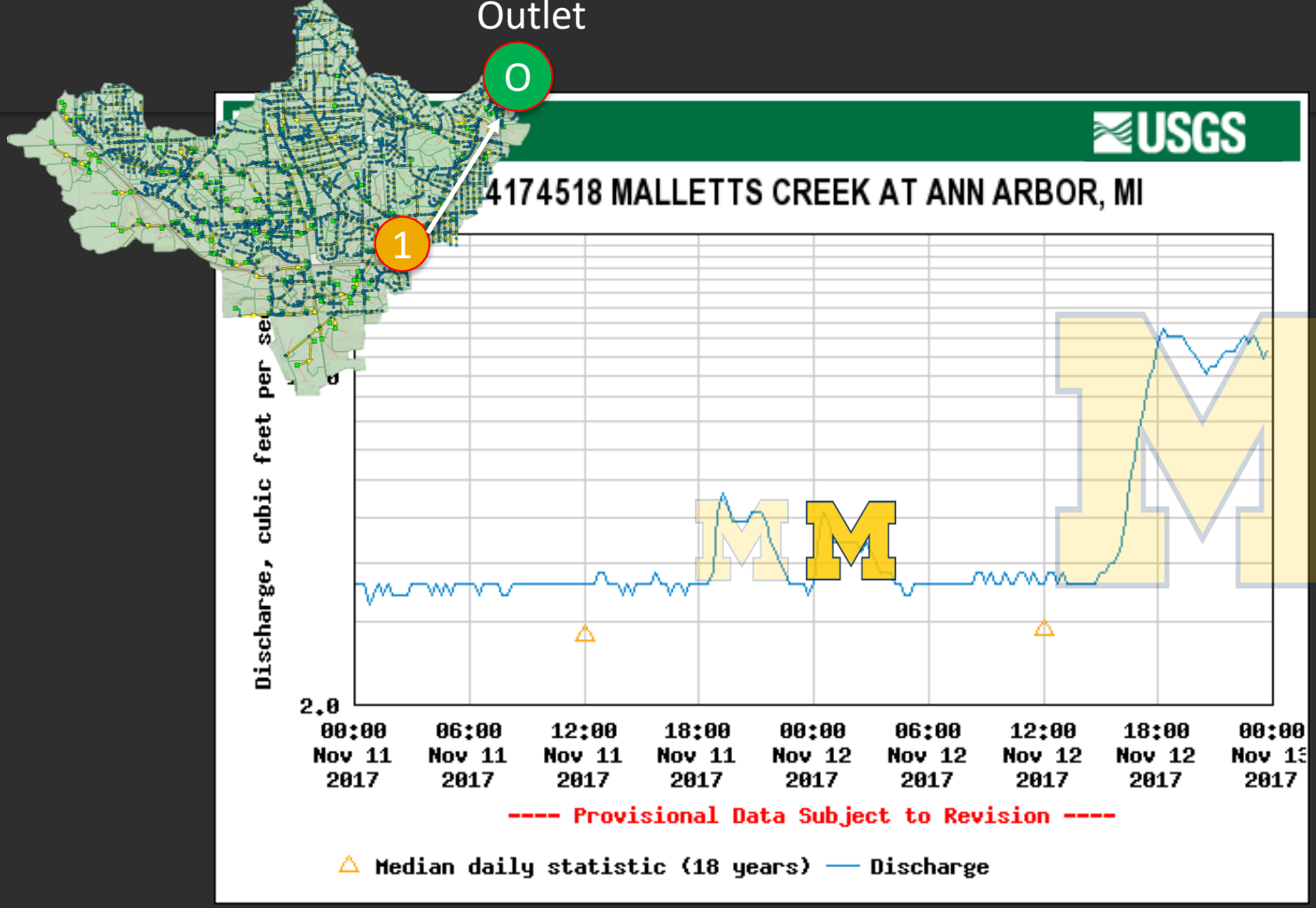
Sheehan estimated that prior to installing Open Storm, it cost Ann Arbor **$22 per gallon** to drain storm water. That cost has dropped to **$16 per gallon**, roughly **saving the city $1 million in infrastructure costs** thanks primarily to the water valve, which costs only a few thousand dollars.

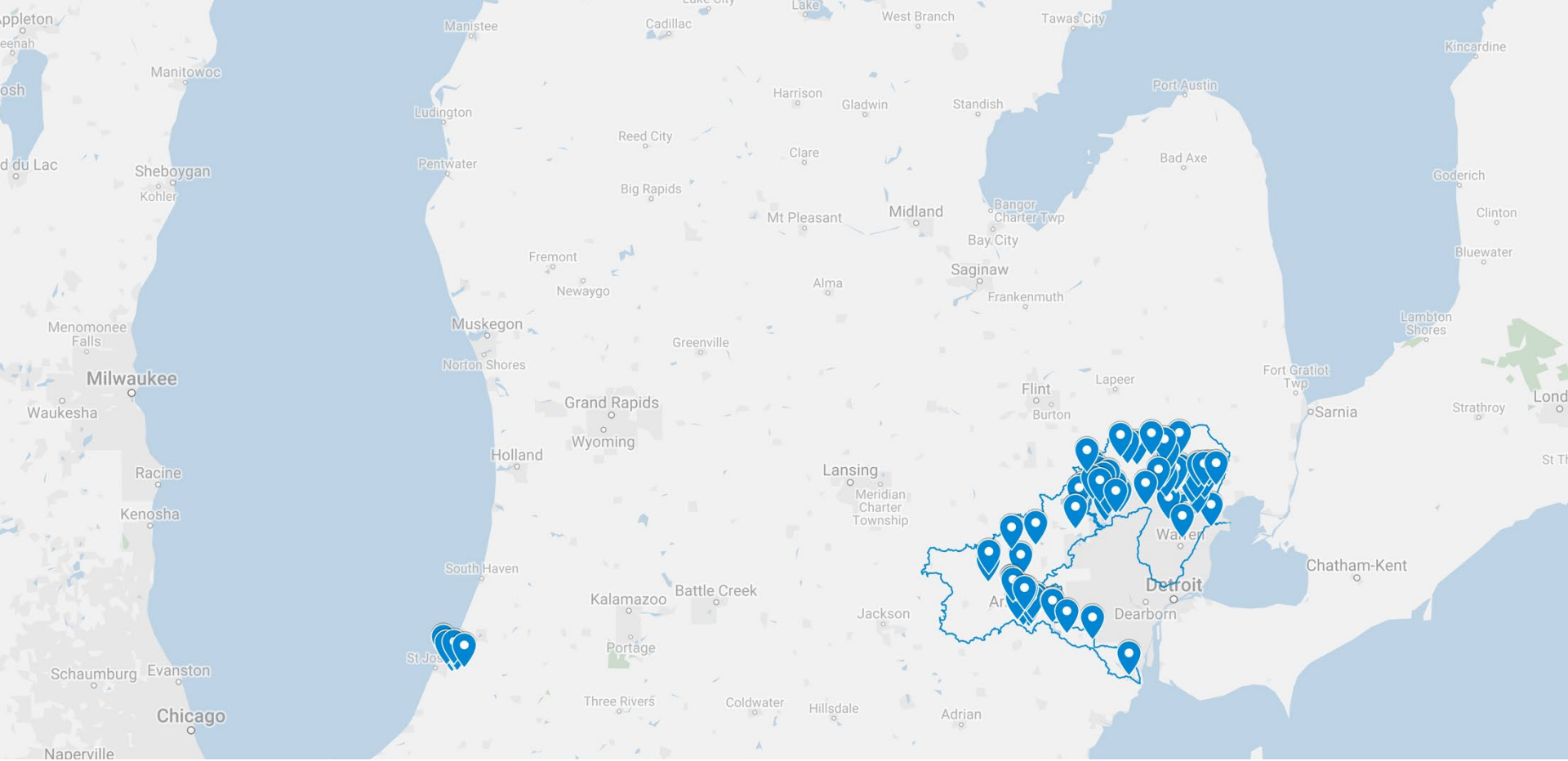
- 22.5 million Gallons
- $16/gal
- 800 lb/yr Total P


Outlet
O
1
10 sq. mi.
Mary Beth Doyle (ARB018)
-1.4 K
-1.6 K
-1.8 K
-2.0 K
-2.2 K
-2.4 K
11/3 12:00
11/4 00:00
11/4 12:00
11/5 00:00
11/5 11:00
11/5 23:00
11/6 11:00
11/6 23:00
depth_mm


Outlet
O
1
Mary Beth Doyle (ARB018)
-1.4 K
-1.6 K
-1.8 K
-2.0 K
-2.2 K
-2.4 K
11/3 12:00
11/4 00:00
11/4 12:00
11/5 00:00
11/5 11:00
11/5 23:00
11/6 11:00
11/6 23:00
depth_mm


Outlet
O
1
Mary Beth Doyle (ARB018)
-1.4 K
-1.6 K
-1.8 K
-2.0 K
-2.2 K
-2.4 K
11/3 12:00
11/4 00:00
11/4 12:00
11/5 00:00
11/5 11:00
11/5 23:00
11/6 11:00
11/6 23:00
depth_mm


Outlet
O
1
USGS
4174518 MALLETTS CREEK AT ANN ARBOR, MI
Discharge, cubic feet per se
2.0
00:00 Nov 11 2017
06:00 Nov 11 2017
12:00 Nov 11 2017
18:00 Nov 11 2017
00:00 Nov 12 2017
06:00 Nov 12 2017
12:00 Nov 12 2017
18:00 Nov 12 2017
00:00 Nov 13 2017
---- Provisional Data Subject to Revision ----
Median daily statistic (18 years)
Discharge



Great Lakes Protection Fund

City of Toledo Official Seal

University of Michigan

City of Ann Arbor Michigan

The University of Toledo 1872

Huron River Watershed Council

Washtenaw County Michigan 1826

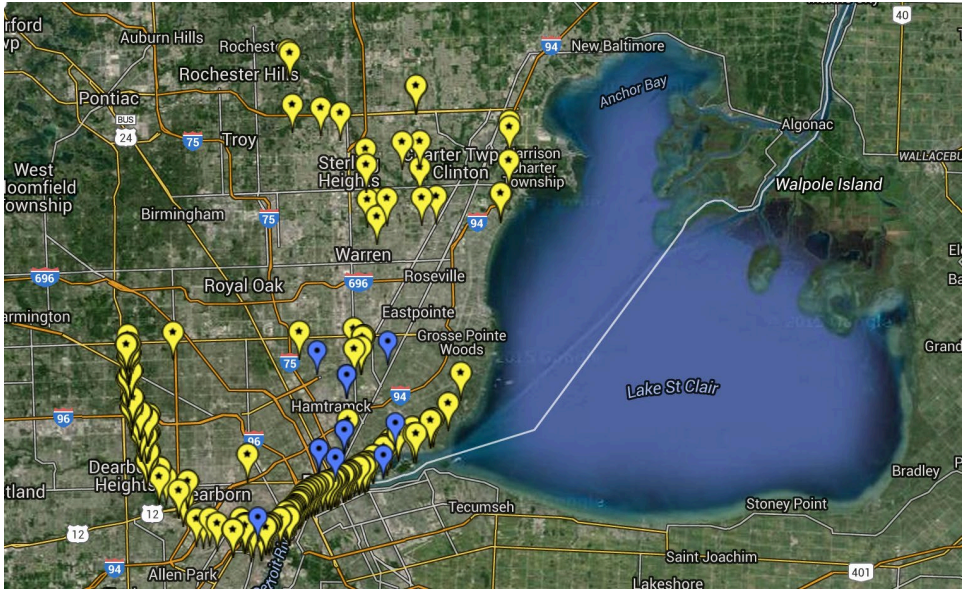
EGLE

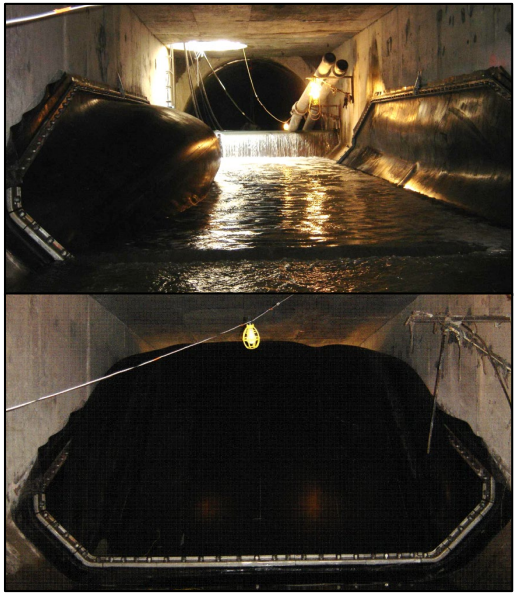
Oakland County Michigan

Macomb County Michigan 1818

CRWC Clinton River Watershed Council

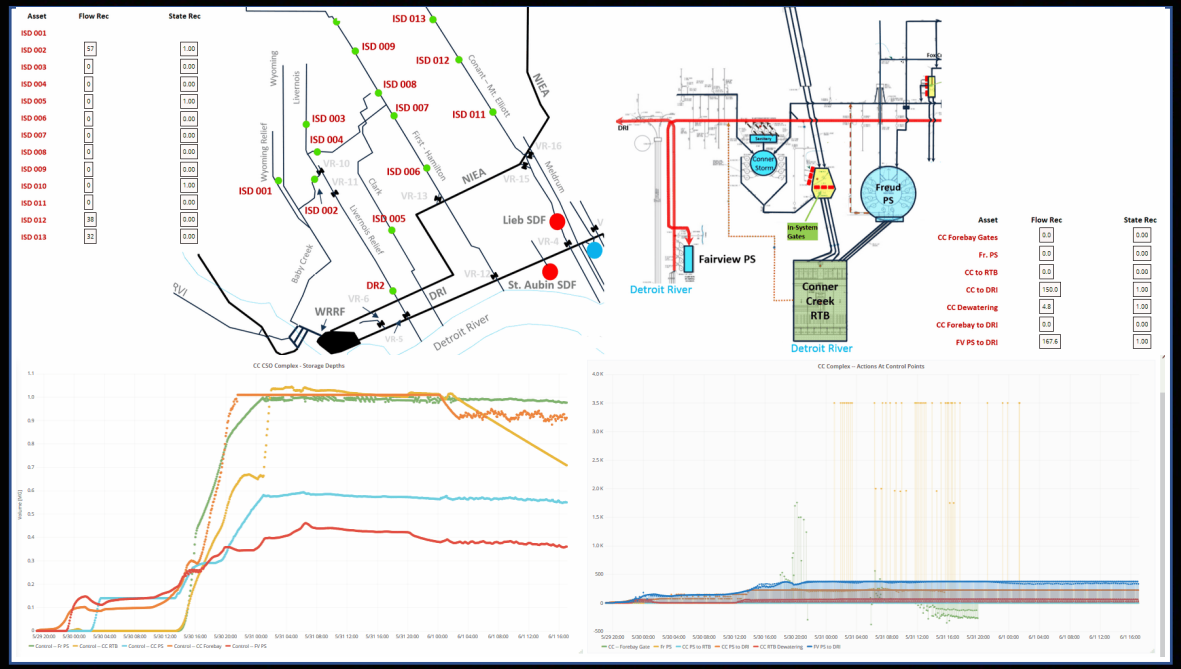
The Opportunity



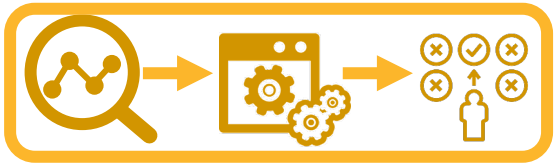


100+ Sensors

20+ Control Points


Asset
Flow Rec
State Rec
ISD 001
ISD 002 57 1.00
ISD 003 0 0.00
ISD 004 0 0.00
ISD 005 0 1.00
ISD 006 0 0.00
ISD 007 0 0.00
ISD 008 0 0.00
ISD 009 0 1.00
ISD 010 0 0.00
ISD 011 0 0.00
ISD 012 38 0.00
ISD 013 32 0.00
ISD 013
ISD 009
ISD 012
ISD 008
ISD 007
ISD 011
ISD 003
ISD 004
ISD 006
ISD 001
ISD 002
ISD 005
DR2
WRRF
Wyoming
Livernois
Wyoming Relief
Baby Creek
Clark
Livernois Relief
First - Hamilton
Count - Mt. Elliott
NIEA
Mellhorn
VR-16
VR-15
VR-14
VR-13
VR-12
VR-11
VR-10
VR-6
VR-5
Lieb SDF
St. Aubin SDF
DRI
Detroit River
Fairview PS
Conner Creek RTB
Freud PS
Detroit River
In-System Gates
Asset
Flow Rec
State Rec
CC Forebay Gates 0.0 0.00
Fr. PS 0.0 0.00
CC to RTB 0.0 0.00
CC to DRI 150.0 1.00
CC Dewatering 4.8 1.00
CC Forebay to DRI 0.0 0.00
FV PS to DRI 167.6 1.00
CC CSO Complex - Storage Depths
CC Complex -- Actions At Control Points

Reprogram the System



100 MG sewer

Overflow Reduction

VS

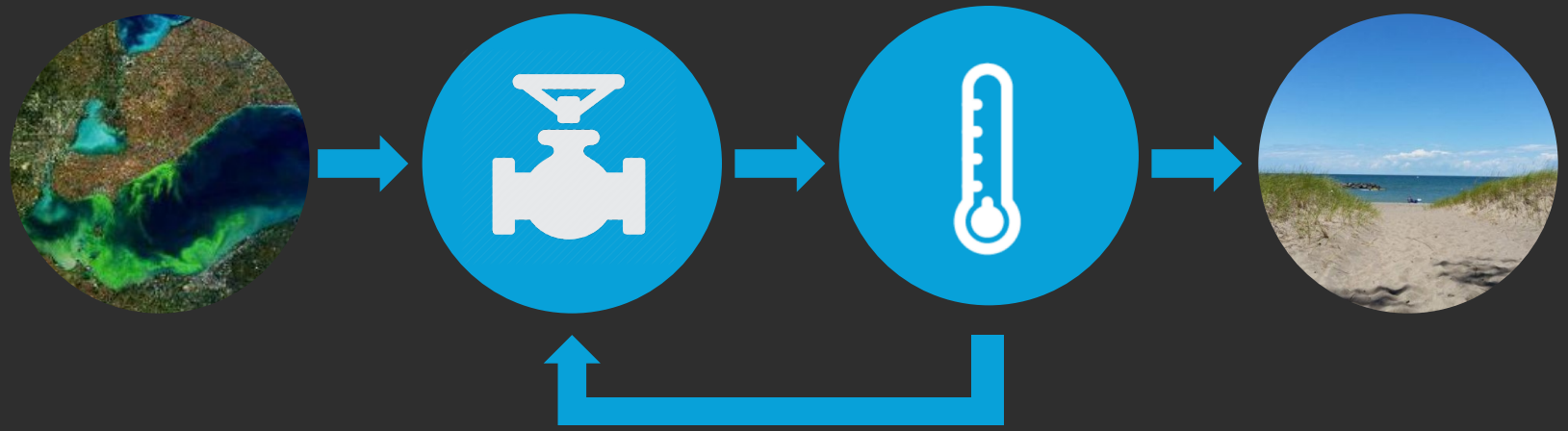
Build More

100 MG storage

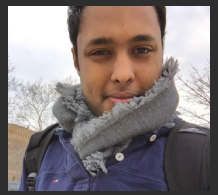
have

do

want

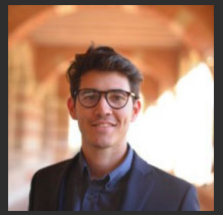
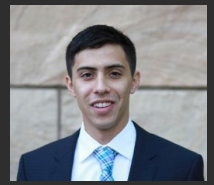


www.open-storm.org bkerkez@umich.edu



EGLE

GLPF



NSF