GROUNDWATER WORKSHOP #1

For municipal leaders of Allegan County

HOSTED BY ALLEGAN COUNTY

PRESENTED BY:

williams&works

Hydrosimulatics

MAGNET4Water

Acknowledgements

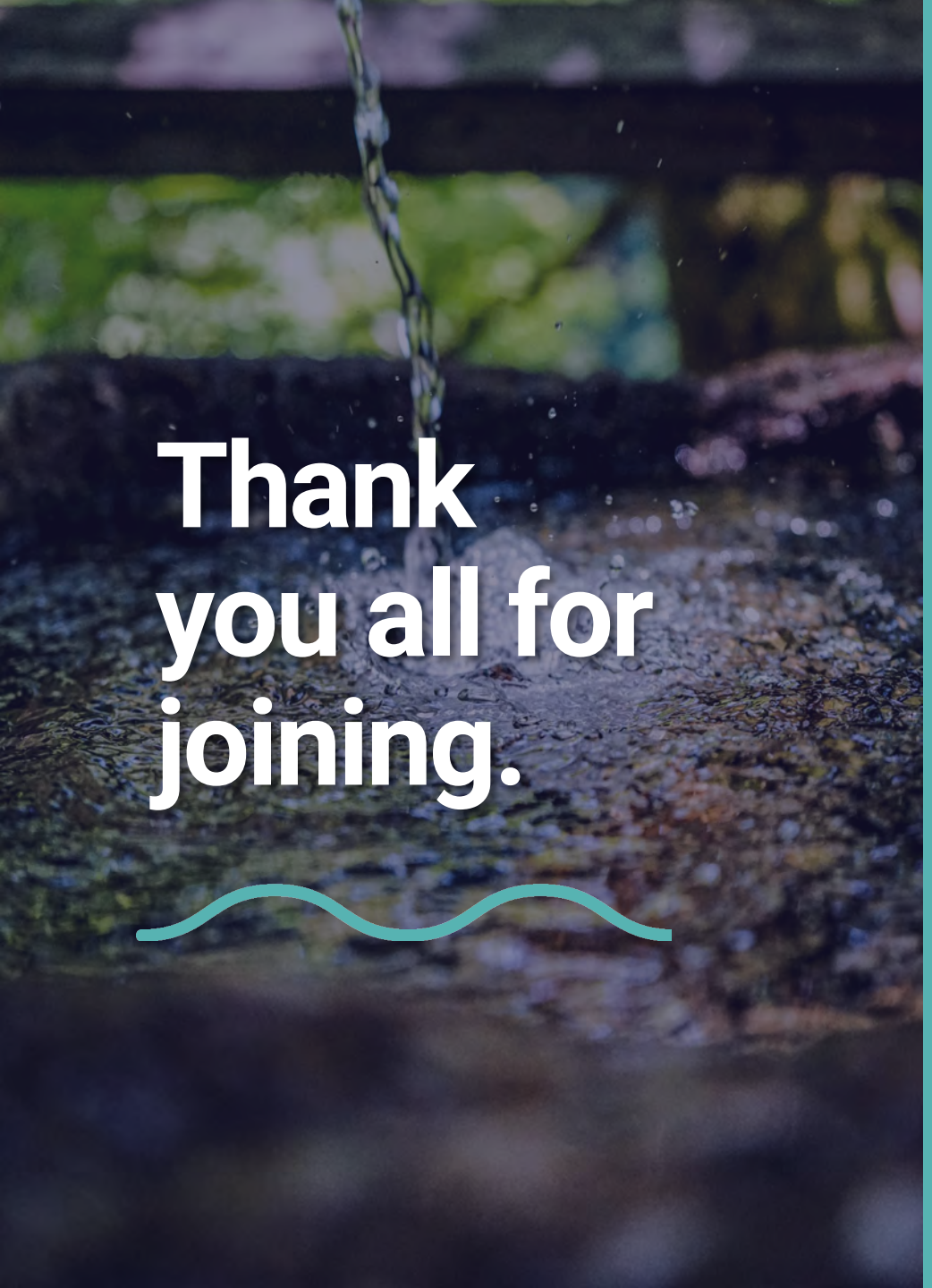
We appreciate your continued support.

Board of Commissioners:

- Jim Storey, Chair
- Dean Kapenga, Vice-Chair
- Mark DeYoung, Commissioner
- Gale Dugan, Commissioner
- Scott Beltman, Commissioner
- Robert J. Sarro, County Administrator

Groundwater Study Work Group:

- Tom Kunetz, Chair, Community Representative
- Elizabeth Binoniemi-Smith, Tribal Representative
- John Curtis, Community Representative
- Zachary Curtis, Consultant
- Jaclyn Hulst, Community Representative
- Dean Kapenga, County Commissioner Representative
- Ruth Kline-Robach, Academic Representative
- Chad Kraai, Well Driller
- Brad Lubbers, Agricultural Representative
- Brian Talsma, Conservation District Representative
- Doug Sweeris, Municipal Water Supply Representative



Thank you all for joining.

4:15	Welcome & Overview of the Process
4:30	The ABC’s of Groundwater
5:00	Areas of Concern and Water Quality Risk
5:20	Groundwater Use and Future Demand
5:45	Break / Dinner Served
6:15	Allegan County Groundwater Research Q&A Panel
7:00	Group Discussion
7:25	Next Steps

Meet our Speakers

Randy Rapp, RS, Allegan County

HEALTH SERVICES MANAGER

Dan Whalen, PE, Williams & Works

HYDROGEOLOGICAL ENGINEER

Maleah Rakestraw, PLA, Williams & Works

MEETING FACILITATOR

Jim Storey, Allegan County

CHAIR OF THE BOARD OF COMMISSIONERS

Tom Kunetz, Allegan County Groundwater Study Work Group

CHAIR, COMMUNITY REPRESENTATIVE

Zachary Curtis, Ph.D., Hydrosimulatics Inc.

HYDROGEOLOGIST

Rob Sarro, Allegan County

COUNTY ADMINISTRATOR

2019

Allegan County hosts an informational groundwater meeting to share the results of the Ottawa County Groundwater Study.

2020

The Phase 1 Groundwater Study is initiated to assess the general health of the groundwater resource.

2021

The Phase 1 Study is completed and findings are presented to the County and Local Units.

2022

The Ad-Hoc Groundwater Study Workgroup is established.

The Phase 2 Groundwater Study is initiated to identify sites of contamination.

2023

The Phase 2 Study is completed and results are presented to the Workgroup and Board of Commissioners.

Efforts to conduct a Groundwater Strategic Plan kick-off.

2024

A Groundwater Assessment Report (GAR) is drafted as part of the County's Groundwater Strategic Plan process.

The GAR

GROUNDWATER ASSESSMENT REPORT

Filled knowledge gaps from the Phase 1 & Phase 2 Studies:

- Expanded the Groundwater Protection Area Delineation
- Identified the types of contamination for the previously identified sites of concern
- Assigned values for site risks to drinking water

The GAR

GROUNDWATER ASSESSMENT REPORT

Provided new research:

- Developed a county-wide Groundwater Risk Map
- Projected groundwater demand & future use

All GAR information is presented in a digestible and user-friendly report.

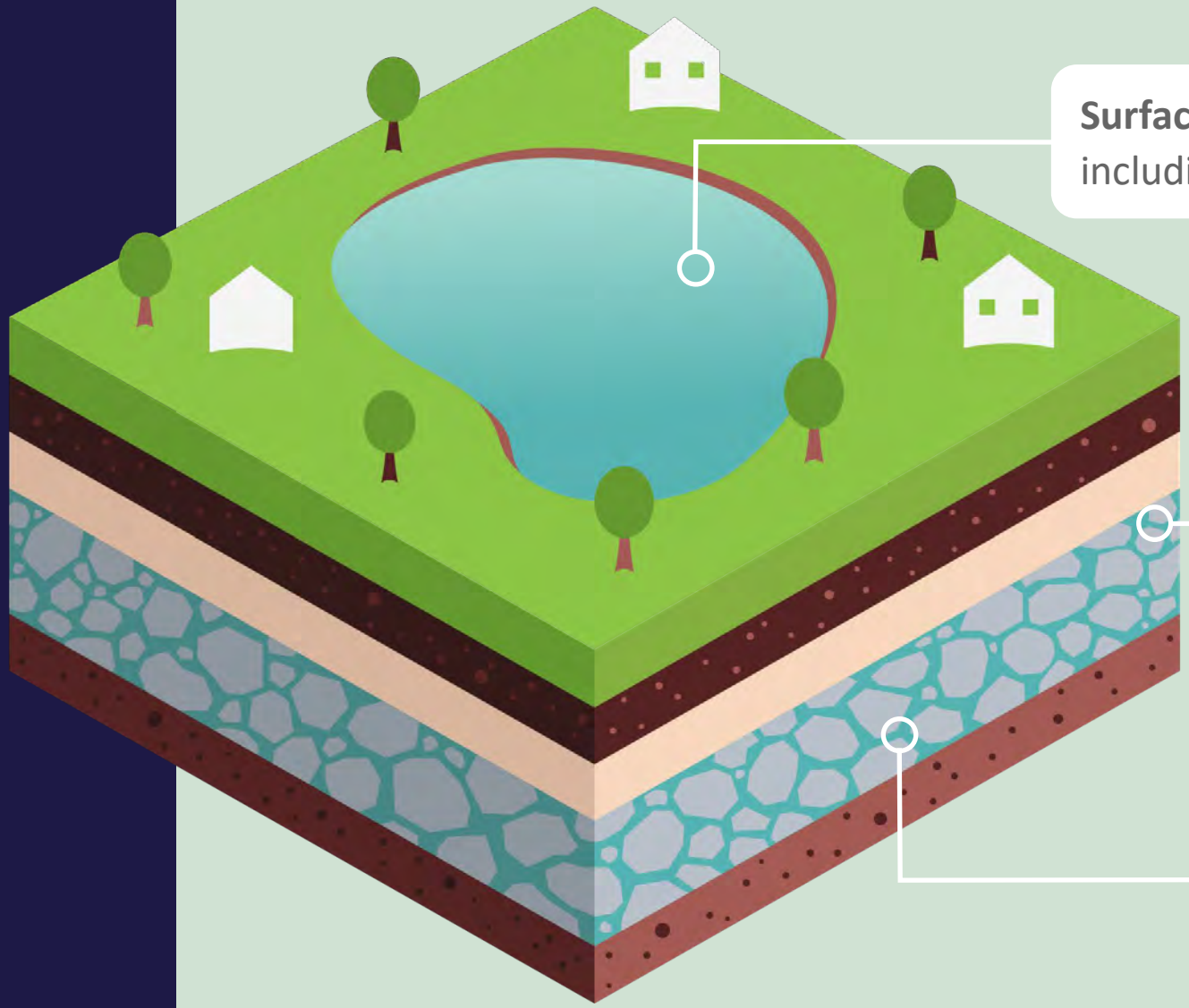
The ABC's of Groundwater

Presented by Zachary Curtis, Ph.D.,
Hydrosimulatics Inc. and
Dan Whalen, PE Williams & Works

What is groundwater?

Water that exists underground in saturated zones beneath the land surface (e.g., pore spaces in sediments, fractures in rock). This research specifically studied groundwater in Allegan County.

Groundwater vs Surface Water



Surface Water: Water bodies that exist above ground, including streams, rivers, lakes, and reservoirs.

Water Table: The upper boundary of the zone of saturation, where groundwater fills the pore spaces in soil and rock.

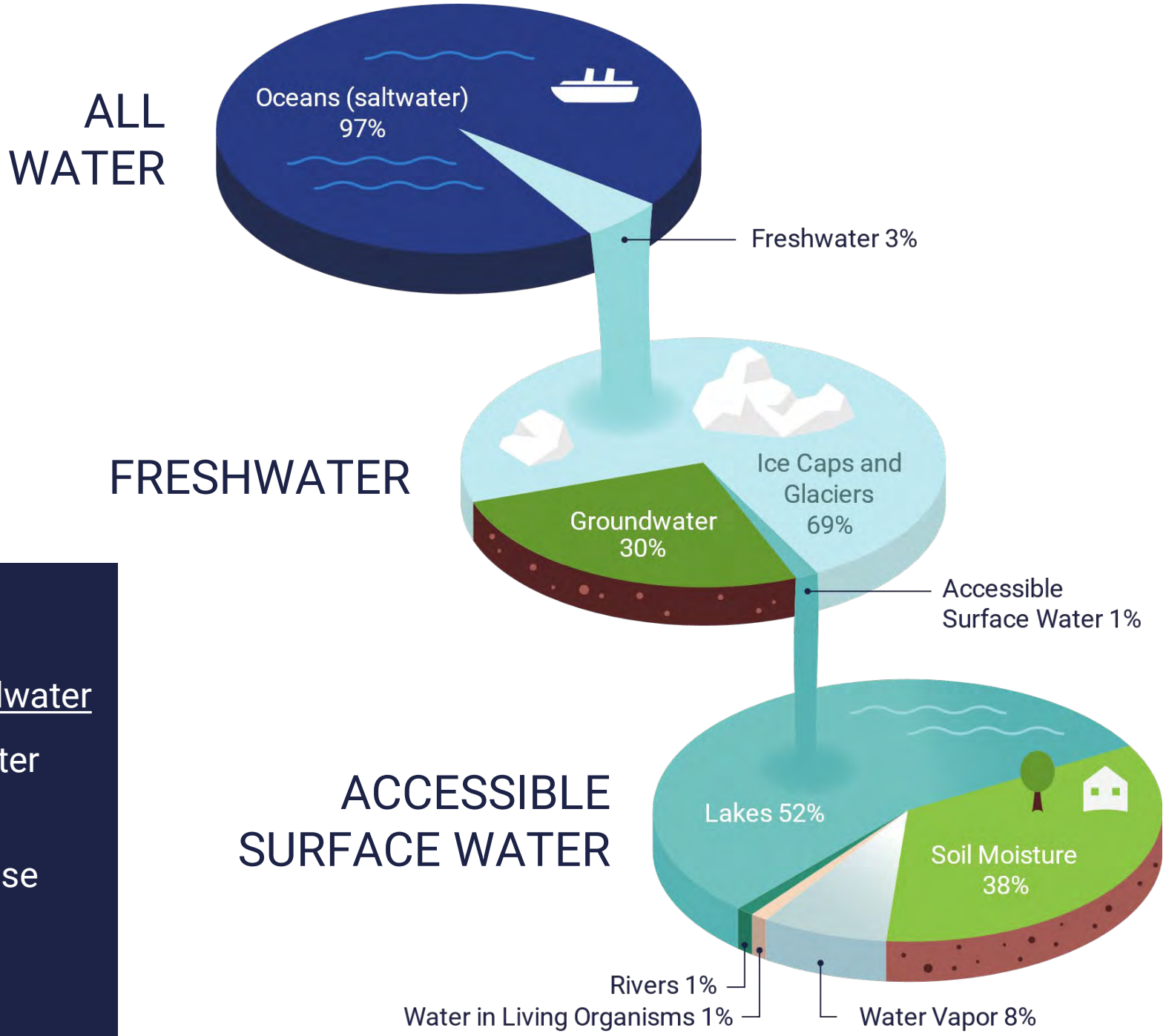
Groundwater: Water that exists underground in saturated zones beneath the land surface.

Groundwater in the "Big Picture"

Groundwater is popular in Michigan because of our extensive aquifers.

Source & Use of Water in the USA, 2015

- 37% of water used in the USA is groundwater
- Irrigation wells use the most groundwater nationally.
- Domestic wells, mining, and livestock use greater quantities of groundwater than surface water supplies.



Allegan County is rich in surface water resources

The major surface water systems include Lake Michigan, the Kalamazoo River, the Black River, the Rabbit River, and the Macatawa River, along with numerous connecting tributary streams and nearly 100 inland lakes.

But Allegan County also has a wealth of groundwater

- Like most of Michigan, Allegan County sits on large freshwater reserves (groundwater) that is tapped for water supply.
- Groundwater is source of drinking water for about ½ of Michigan's population.

The volume of fresh groundwater in the Great Lakes basin is about equal to the volume of water in Lake Huron.

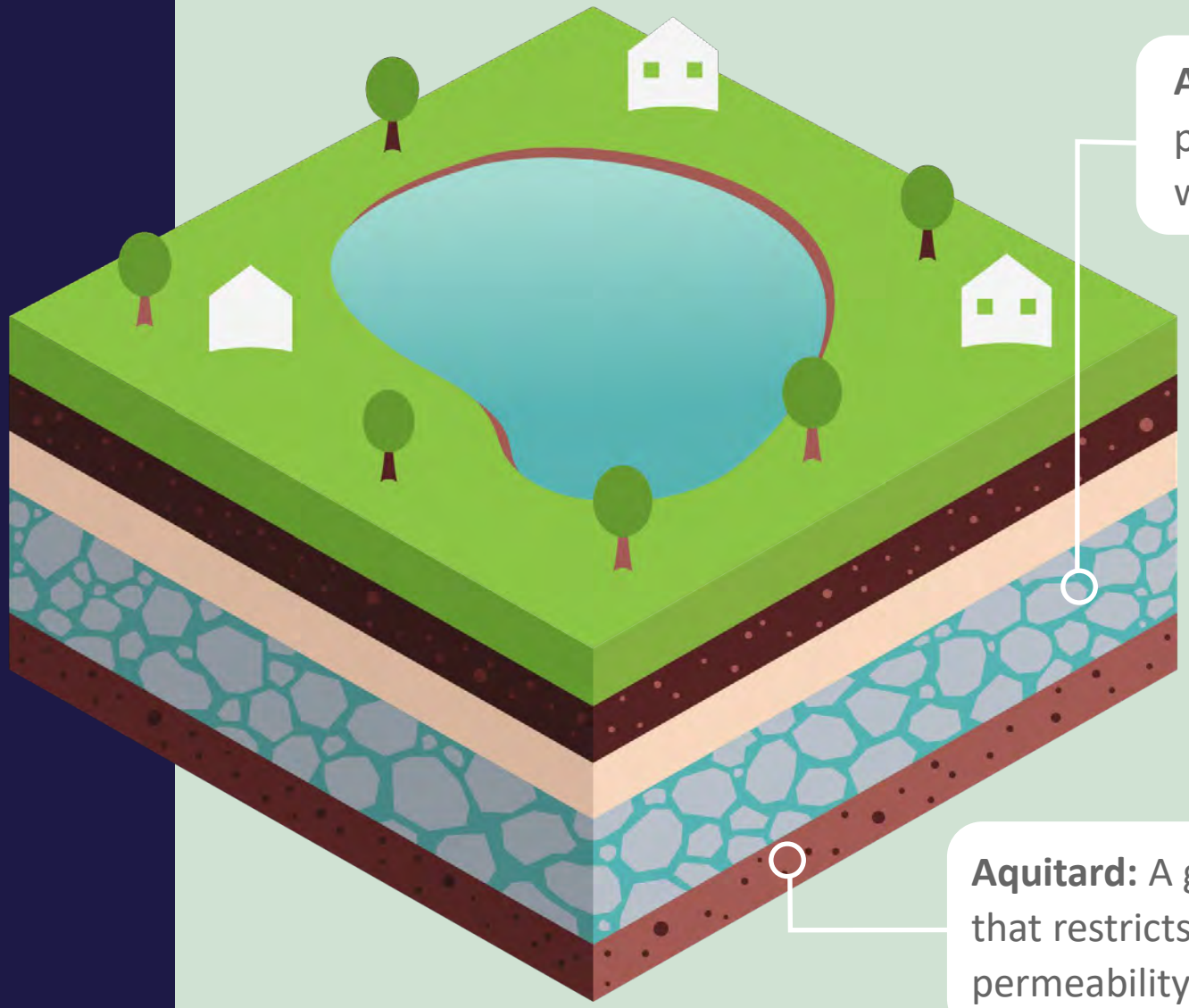
Groundwater is the preferred source of water supply because of its

- General protection from surface contaminants
- Consistent quality
- Lower vulnerability to weather events
- Reliability and cost-effectiveness

It isn’t always easy to measure or identify when groundwater needs attention.

Groundwater is often perceived as an invisible resource, something that we all need but simply turn on a tap and it appears.

Groundwater Sources



Aquifer: Underground layers of water-bearing permeable rock and/or soil that readily transmits water to wells and springs.

Subsurface: Underground, sometimes referred to as the ***subsurface geology***. Like the land above, it's important to remember that the subsurface has its own terrain and depending on the underground geological formations, water moves down through the sub-surface as well as horizontally across it.

Aquitard: A geological formation or layer of rock or sediment that restricts the flow of groundwater due to its low permeability. Sometimes referred to as a ***Confining Layer***.

Allegan’s Geologic Framework and Groundwater Hydrology

Understanding the variability in the subsurface geology of Allegan County provides valuable insights into how quickly water (and the substances it carries) moves through the ground and how much water can be pumped.

All private and municipal well owners in Allegan County draw from only two underground water sources.

Glacial Aquifer

Bedrock Aquifer

Glacial Drift Aquifers

Depth: Shallow Aquifers

Accessibility: Across all of Allegan County

Composition: Glacial Drift Formation

Use: 88% of all water wells utilize this aquifer

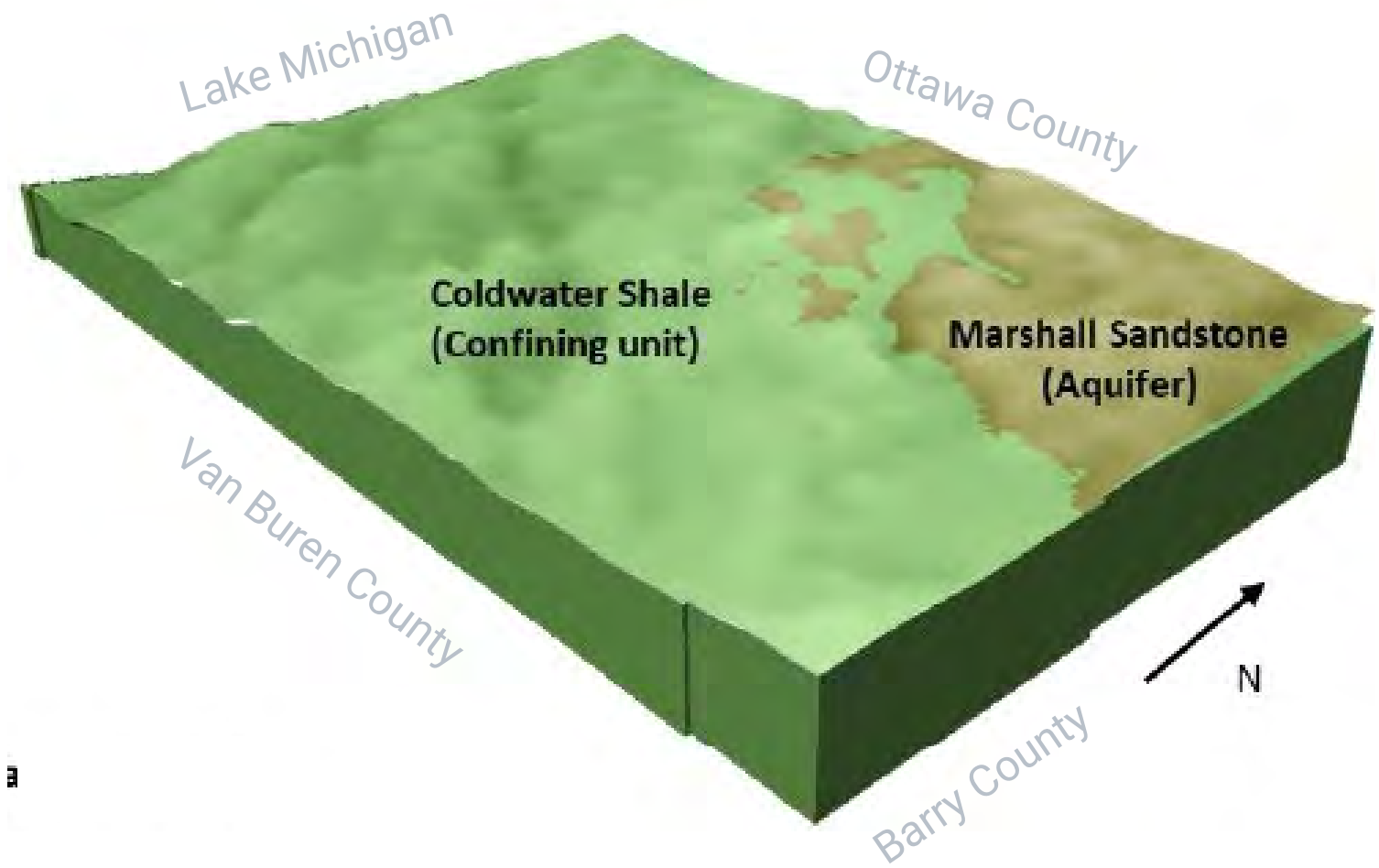
Bedrock Aquifer

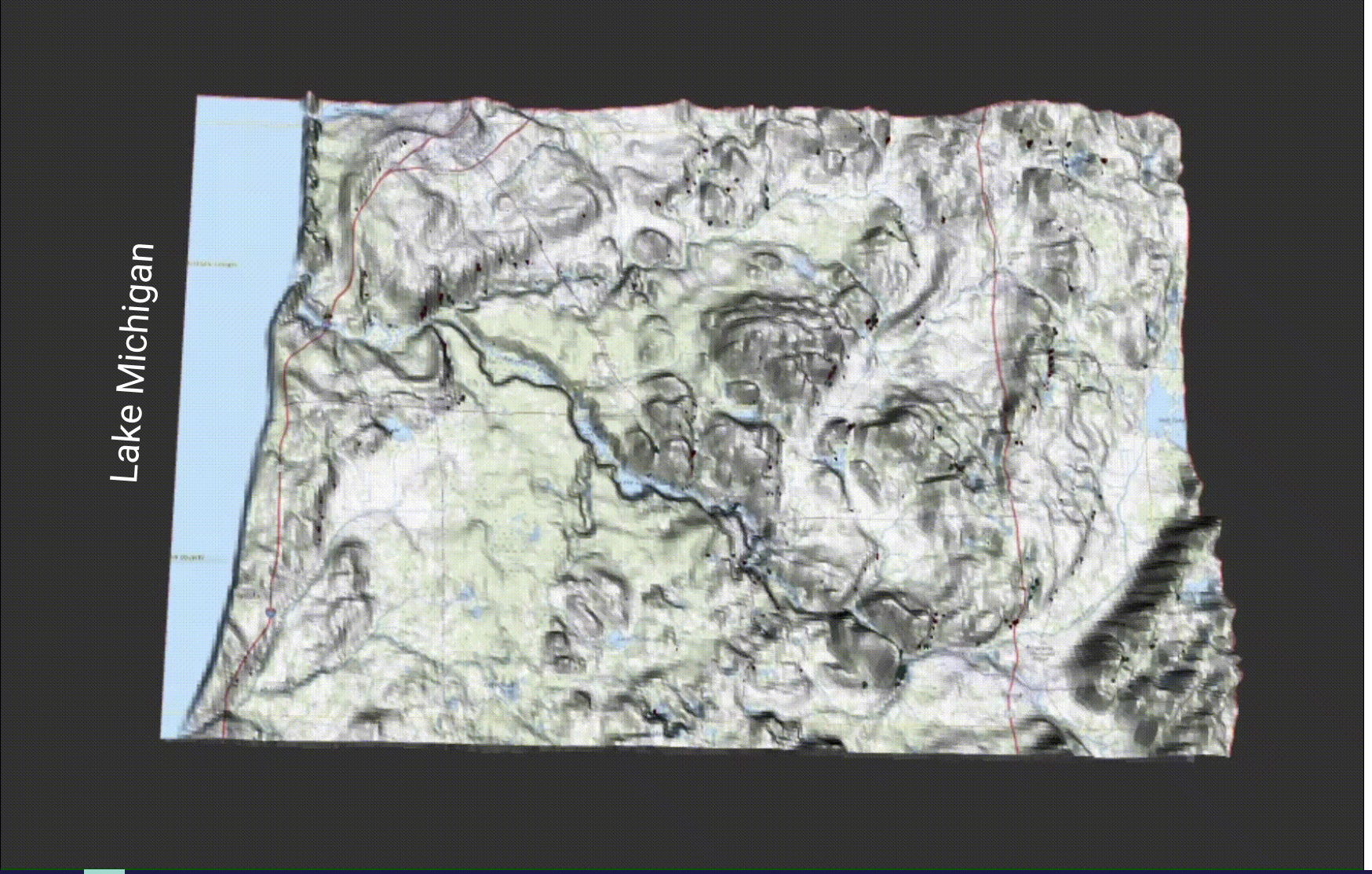
Depth: Deep Aquifer

Accessibility: NE Allegan County

Composition: Marshall Sandstone Formation

Use: 7% of all water wells utilize this aquifer





Permeable sands, gravels, etc.
(more permeable)

Fine sands, silty sands, etc.
(less permeable)

Clays, silts, etc.
(not permeable)

The glacial drift aquifer is complex (lots of spatial variation)

Groundwater availability may change quickly from one location to another (more on this later)

Detailed Lithology (Aquifer Materials)

Hydraulic Conductivity (K)

Transmissivity (T)

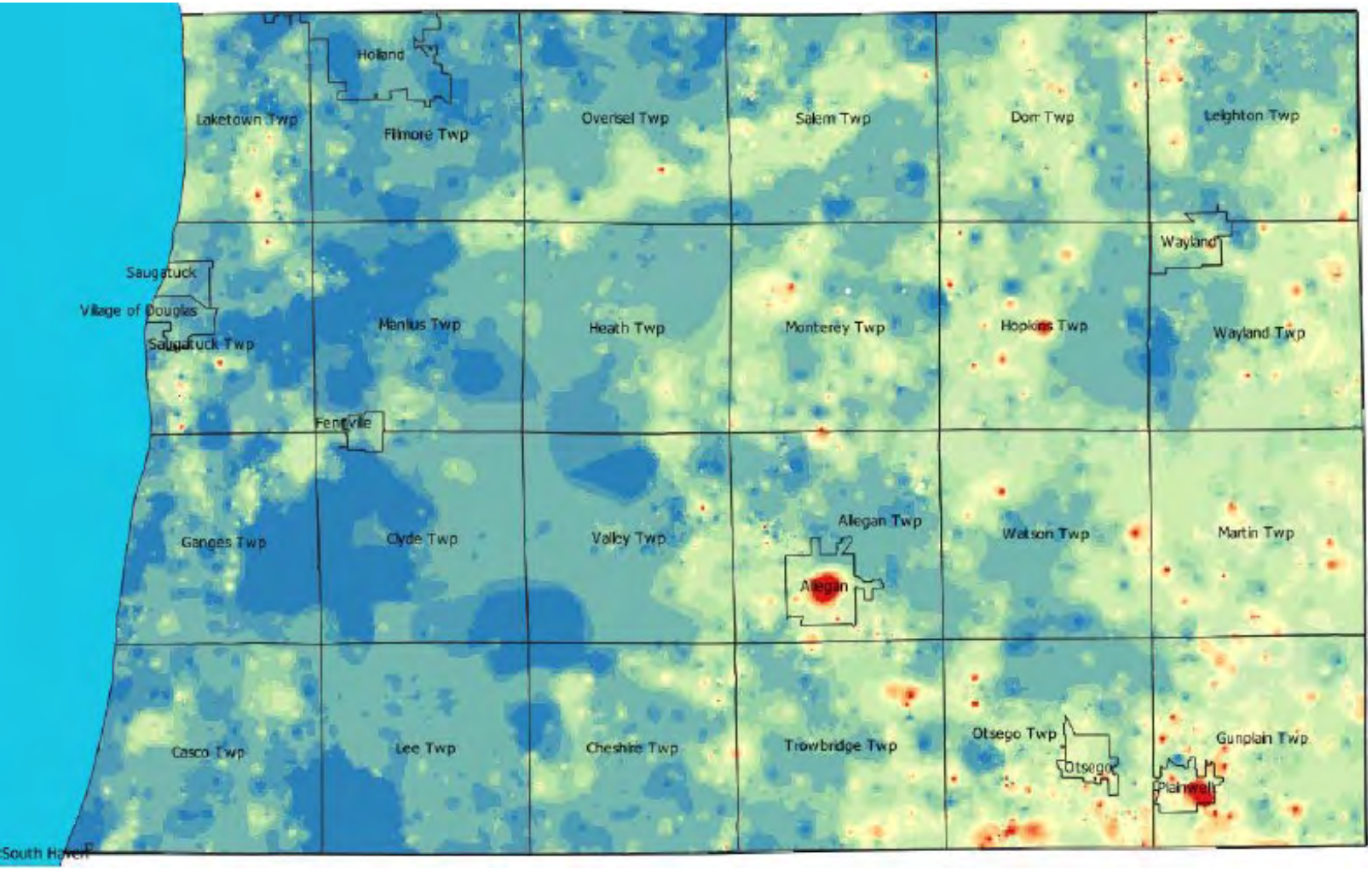
Aquifer Properties

Measures ***PERMEABILITY***, or the ability of water to move through different sediments.

Influences the ***SPEED*** of groundwater (and pollutant) movement.

Hydraulic Conductivity (K) + Aquifer Thickness.

Transmissivity controls aquifer ***PRODUCTIVITY***.



Varies significantly across the County because of the complex geology and how sediments were formed/deposited.

- More permeable materials result in higher K (faster flow)
  - Like coarse sands & gravels
- Less permeable materials result in lower K (slower flow)
  - Like clays, silts, & fine sands

Hydraulic Conductivity – Glacial Aquifer

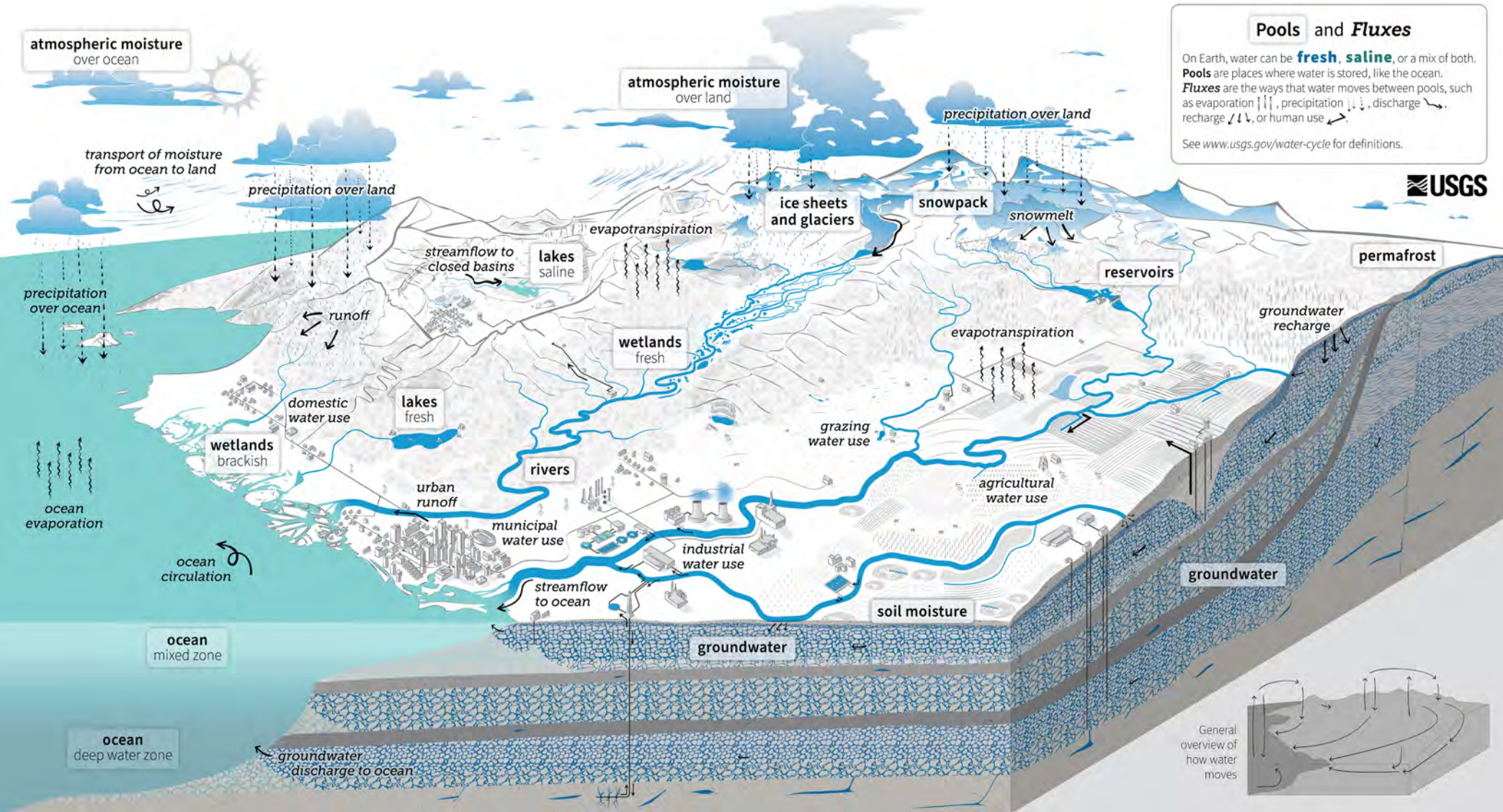
How groundwater flows doesn't just depend on geology – surface water, topography, climate, and even humans play an important role, too!

Groundwater Flow

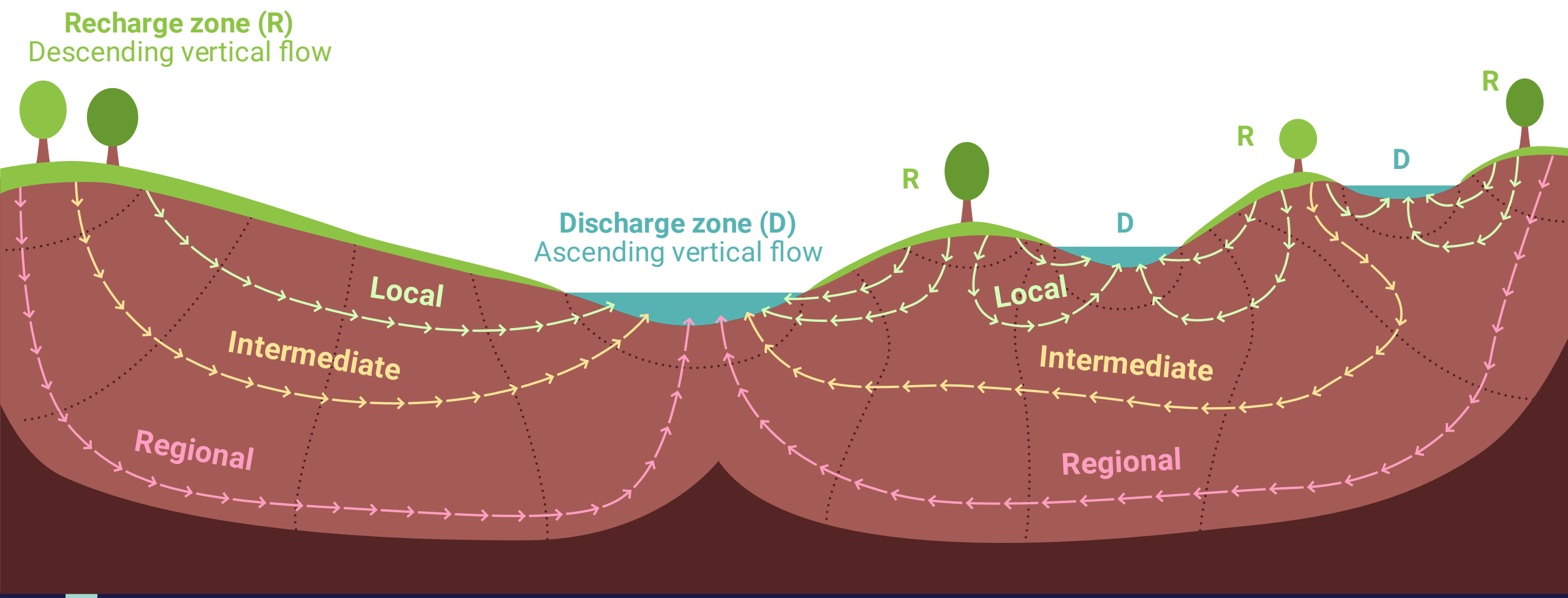
Recharge & Discharge Zones

Recharge: Net infiltration of water reaching the water table.

Discharge: groundwater leaving the aquifer to surface water or wells.



Water Cycle Refresher



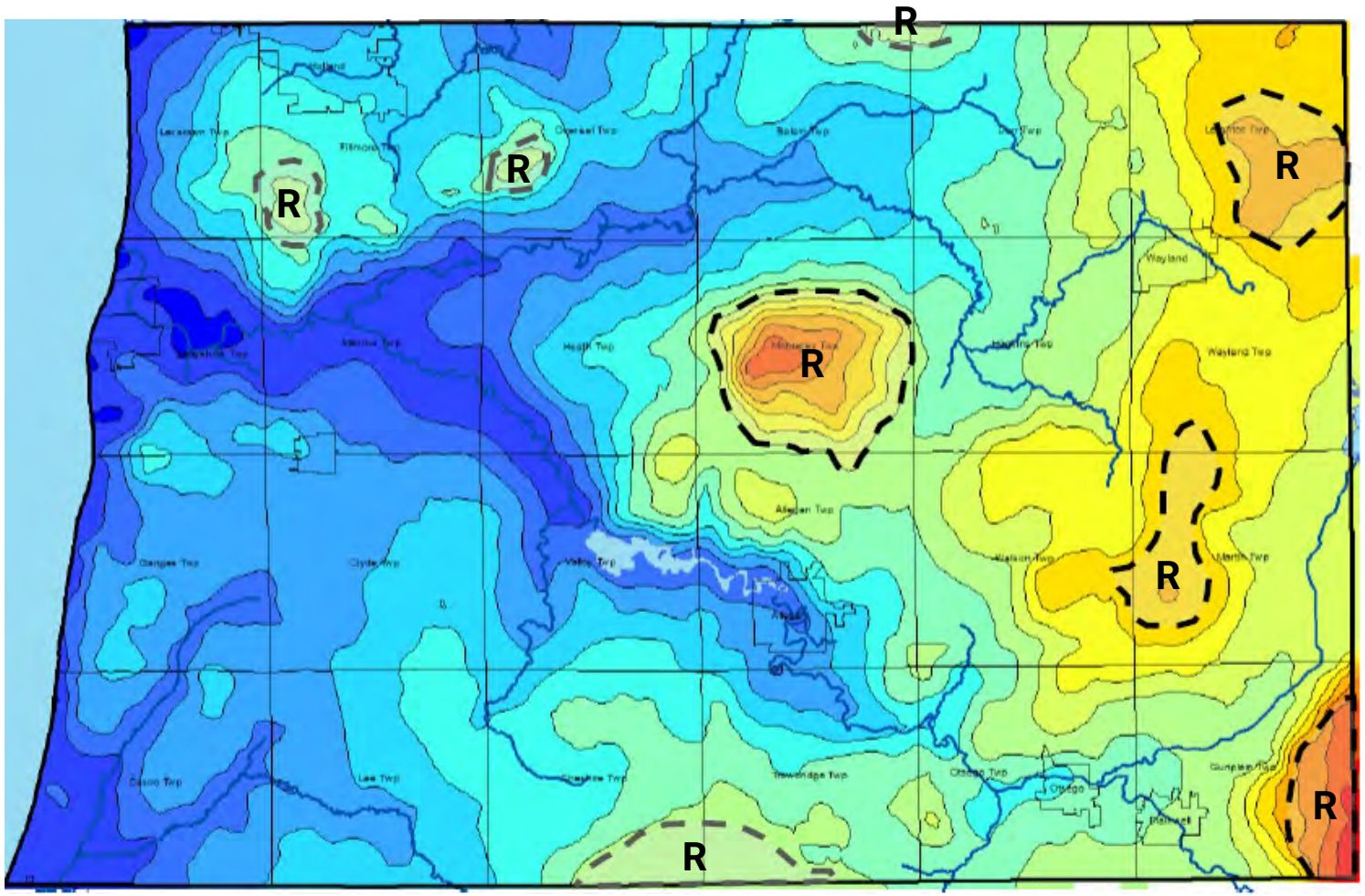
Master Discharge & Recharge Zones

Master Recharge Areas (Groundwater Mounds)

Water Level (m)

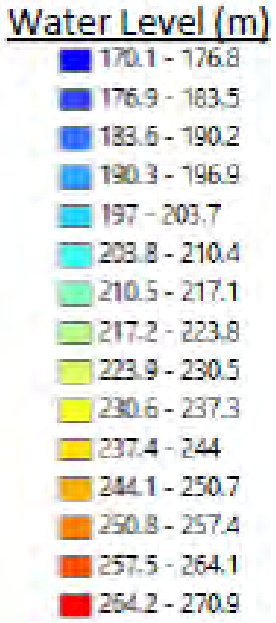
- 170.1 - 176.8
- 176.9 - 183.5
- 183.6 - 190.2
- 190.3 - 196.9
- 197 - 203.7
- 203.8 - 210.4
- 210.5 - 217.1
- 217.2 - 223.8
- 223.9 - 230.5
- 230.6 - 237.3
- 237.4 - 244
- 244.1 - 250.7
- 250.8 - 257.4
- 257.5 - 264.1
- 264.2 - 270.9

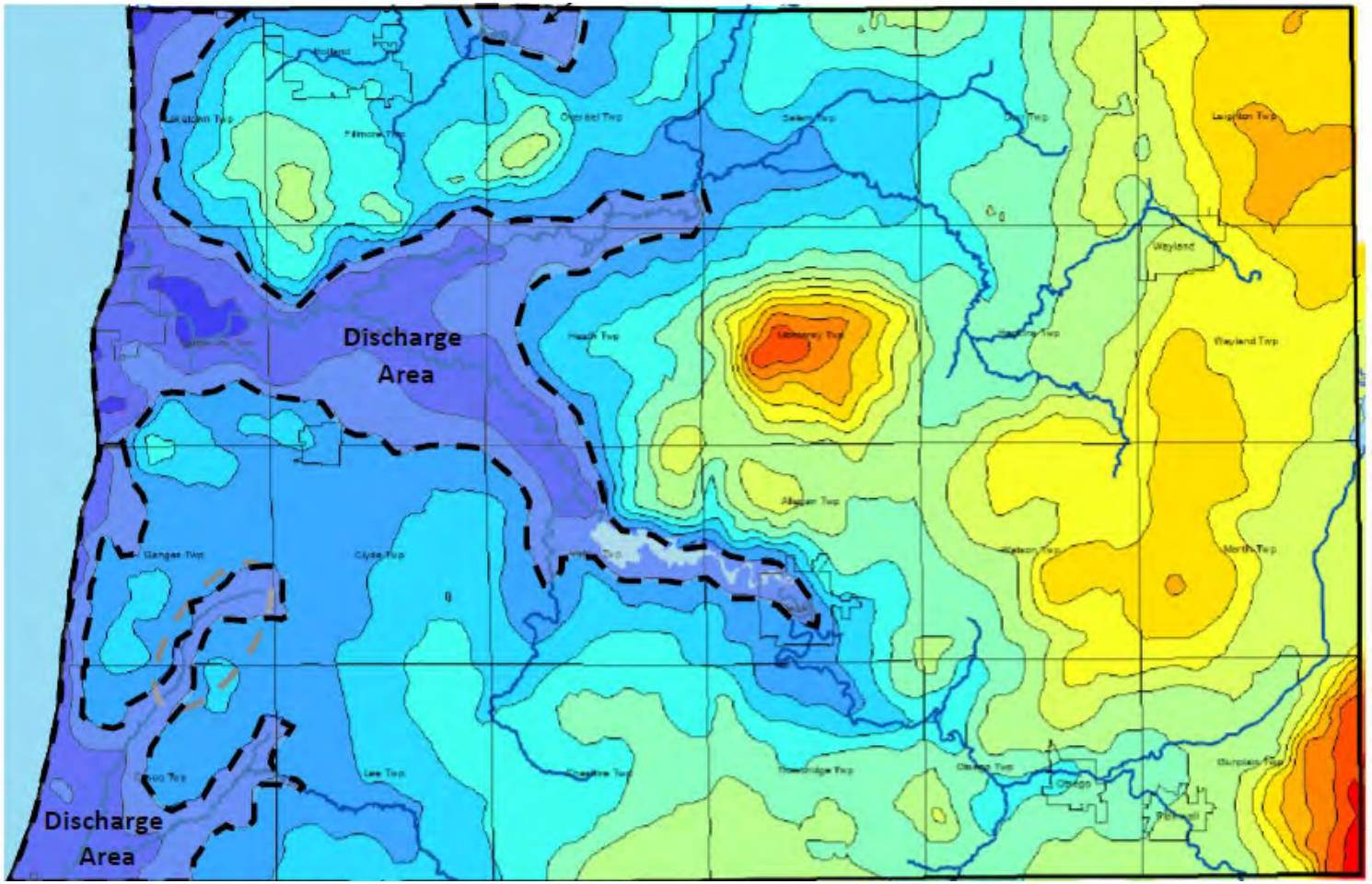
R = Recharge Area



Master Recharge Areas in Allegan County

Master Discharge Areas





Master Discharge Areas in Allegan County

To manage / protect ground-water, we need to know where it is coming from.

Source Water Areas

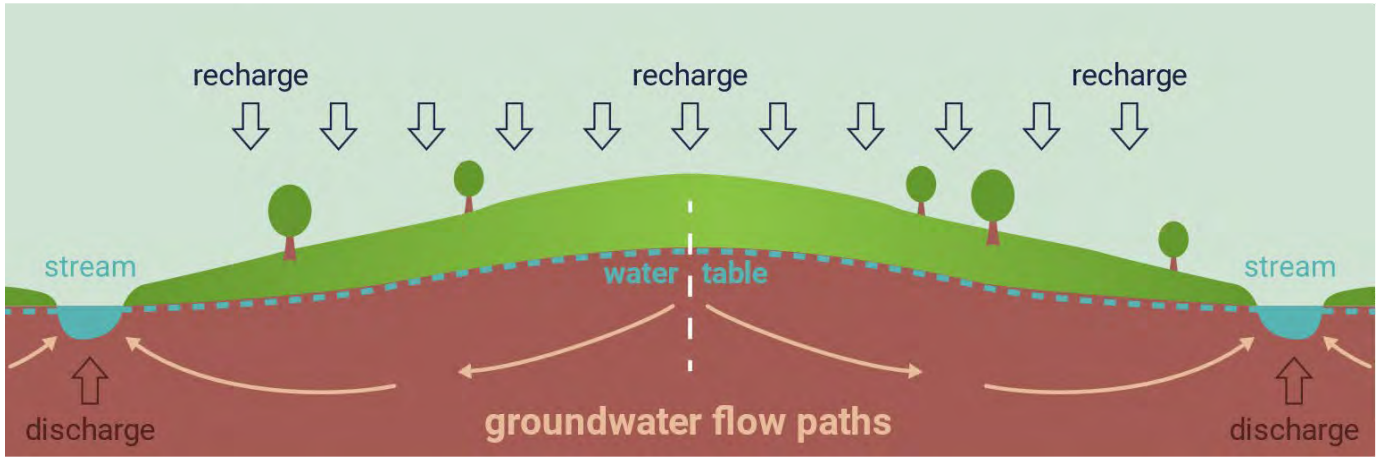
Wellhead Protection Areas (WHPAs)

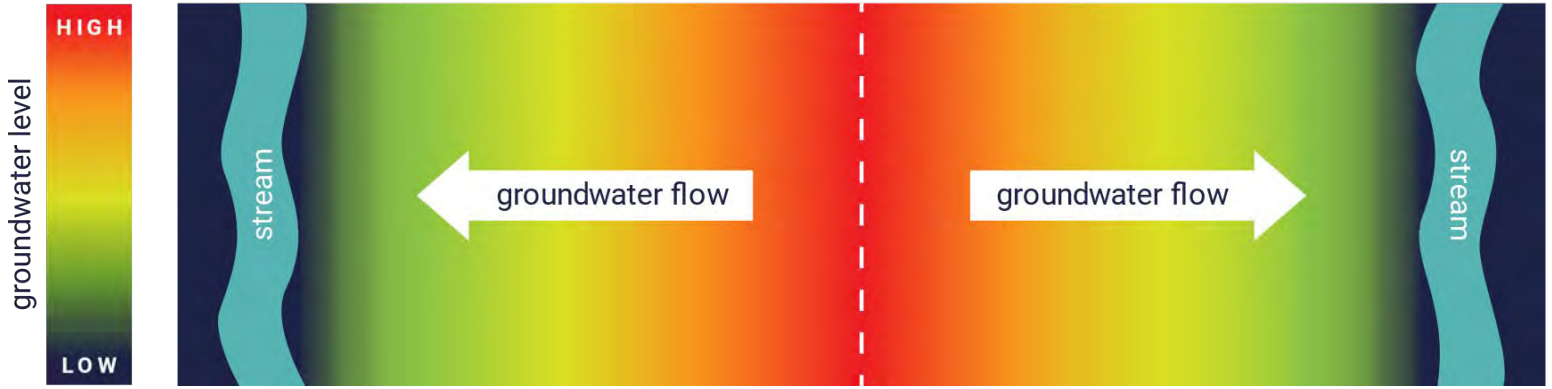
Groundwater Divides

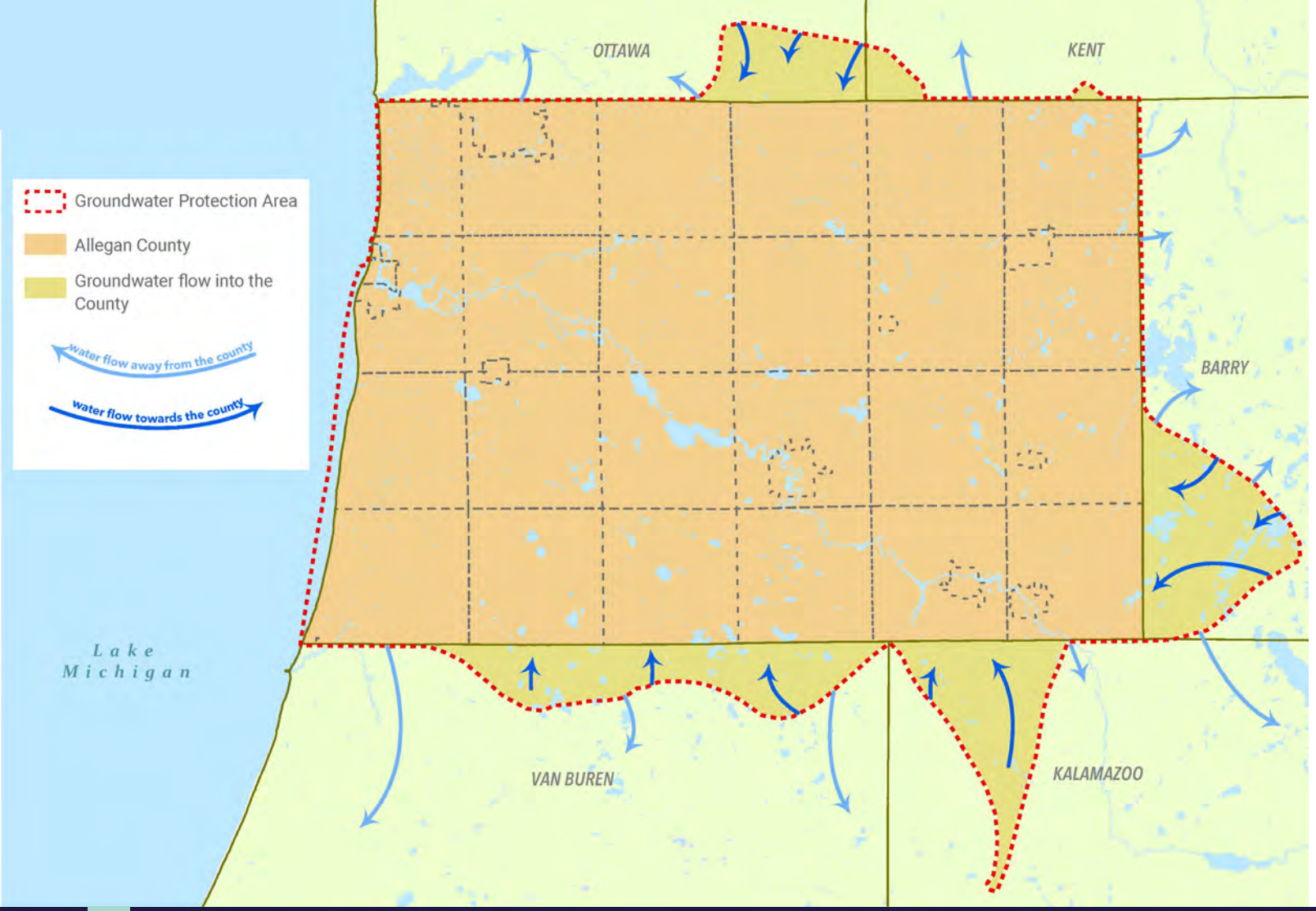
Using Flow Patterns to Delineate Source Areas

Plan View

Cross-Section View







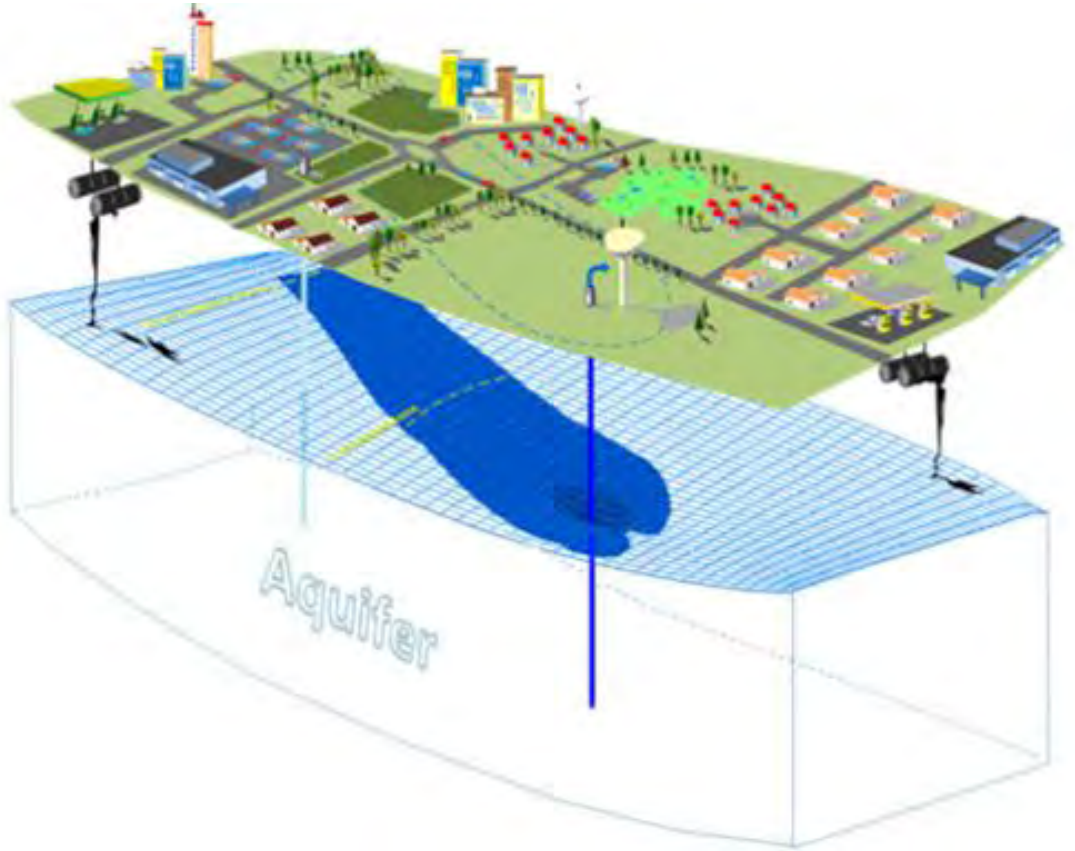
The Groundwater Protection Area also includes portions of Ottawa, Kent, Barry, Kalamazoo, and Van Buren Counties where groundwater is entering Allegan County.

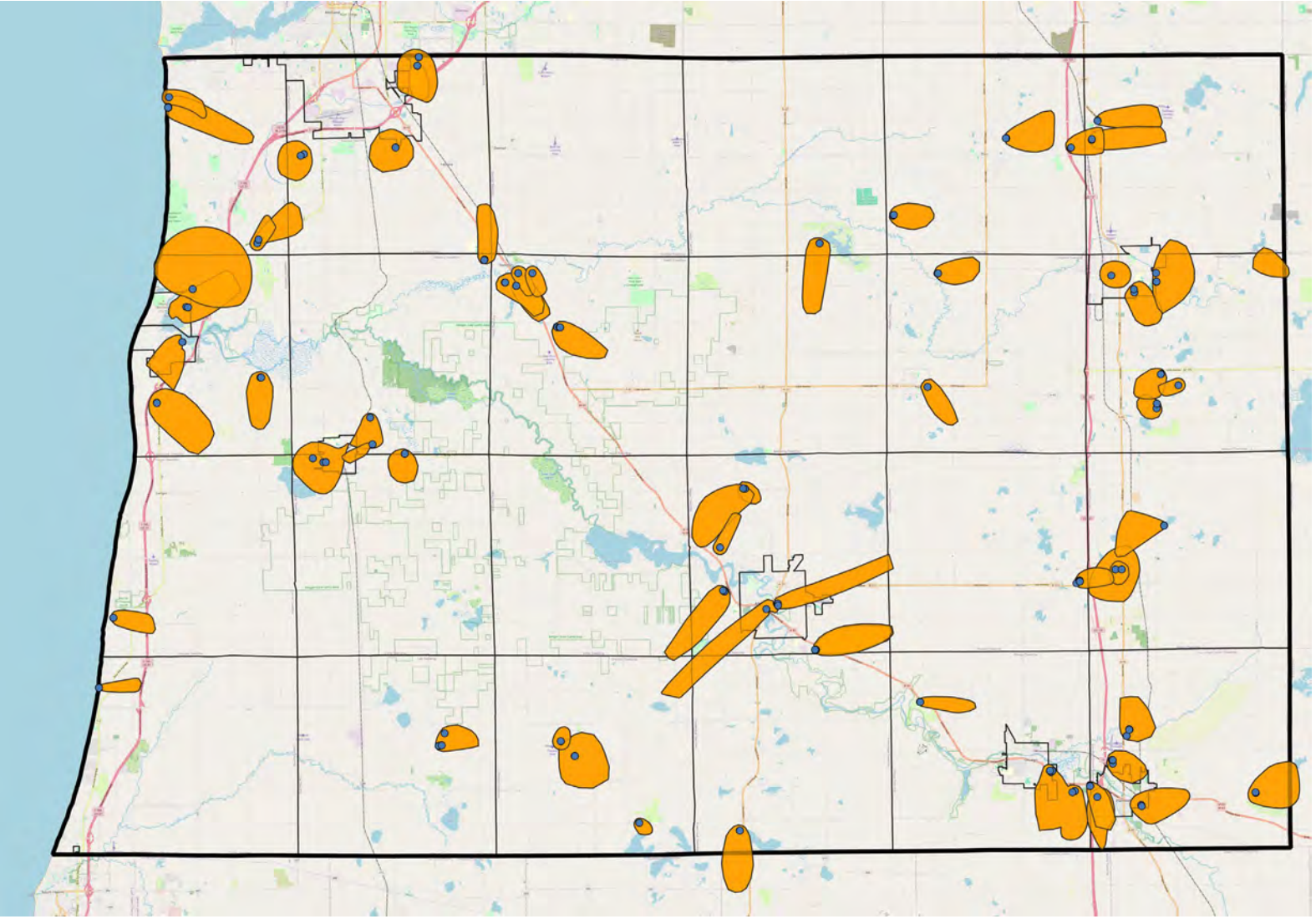
Groundwater Protection Area

Wellhead Protection Area (WHPAs)

Wellhead Protection Areas are the source water (or capture) area of individual wells or clusters of wells for 10 years of assumed travel time.

WHPA delineation helps local governments manage land use and human activities in the key source water area for drinking water wells.





Wellhead Protection Areas (WHPA) of Type 1 Public Supply Wells in Allegan County

139
Active Type 1 Wells

65
WHPAs

Map Key:

- Active Type 1 Public Supply Well
- Wellhead Protection Area (WHPA)

*Type 1 Well provides water to at least 25 residents or 15 living units year-round.

Wellhead Protection Areas – Type 1 Wells

Aquifer Yield

Ability of the aquifer to ***PRODUCE WATER***.

Aquifer yield is directly related to the aquifer's ***TRANSMISSIVITY***.

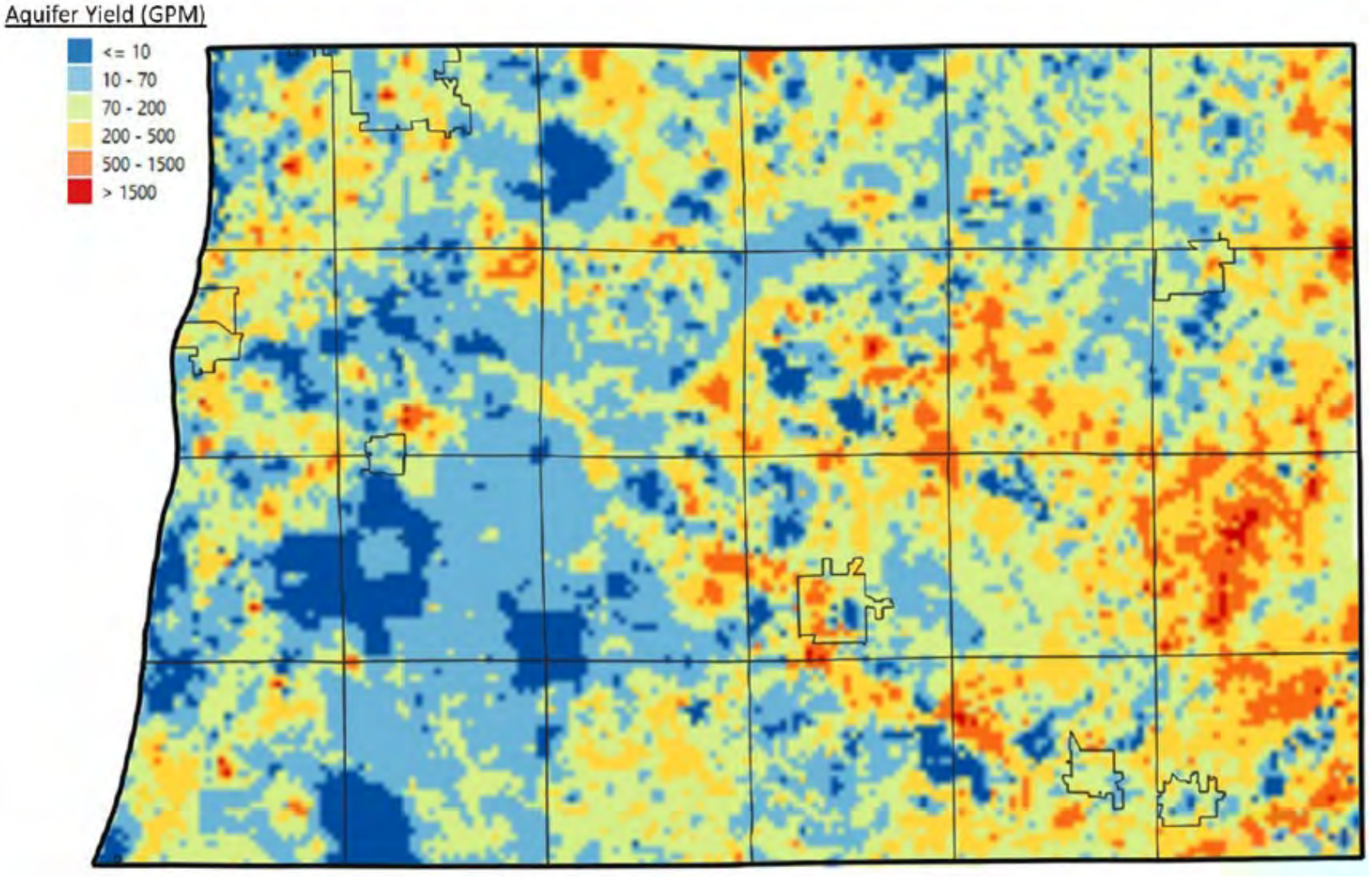
Aquifer Properties

Sustainable Yield

(More difficult to quantify)

Water withdrawals that will ***PRESERVE*** groundwater resources over the long-term.

Accounts for aquifer properties, pumping rates, well density, and long-term aquifer recharge.



Aquifer yield is large in the East.

- Martin, Gunplain, Hopkins, Otsego, and smaller areas in Monterey and Allegan Townships.

Aquifer yield is small in the Central-West.

- Manlius, Clyde, and Lee, as well as in large portions of Overisel, Heath, Valley, and Ganges Townships.

Estimated Aquifer Yield

The importance of data collection.

- State Databases (RIDE, Well Logic)
- Monitoring and Testing
- Accurate Reporting

Areas of Concern & Water Quality Risks

Presented by Zachary Curtis, PhD
Hydrosimulatics INC

Areas of Concern

Water Quality Risk Assessment

- Groundwater Pollution 101
- Point Source (PS) Pollution in Allegan County
  - Potential Sites of GW Pollution
  - Risk Analysis of PS of GW Pollution
- Non-Point Source (NPS) Pollution in Allegan County
- County-Wide Water Quality Risk Mapping

Groundwater Pollution 101

An Introduction to Groundwater Contamination

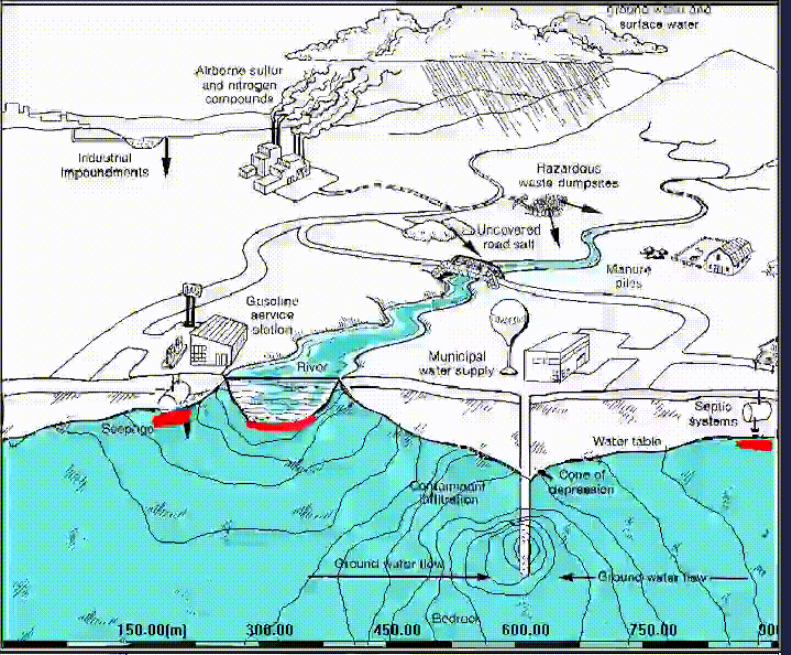
Groundwater with substances that exceed established drinking water standards related to:

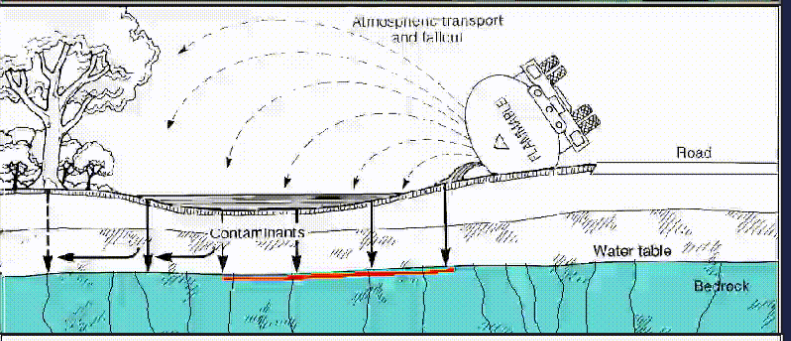
- Human health
- Aesthetic qualities, like taste, smell, or color

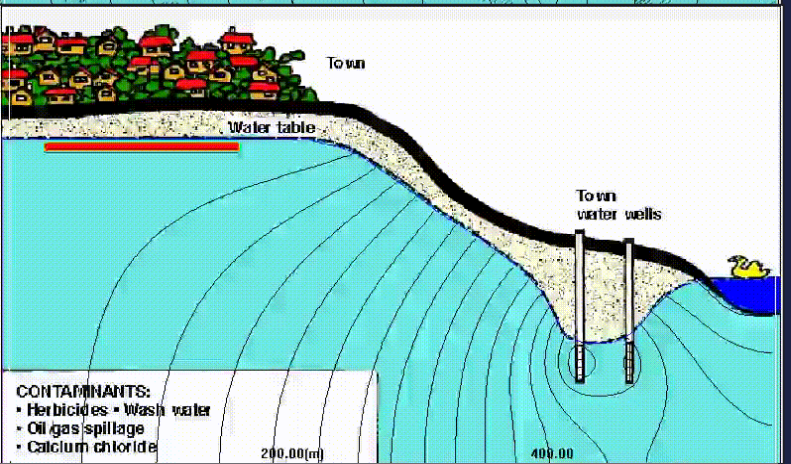
Or threaten groundwater-dependent ecosystems.

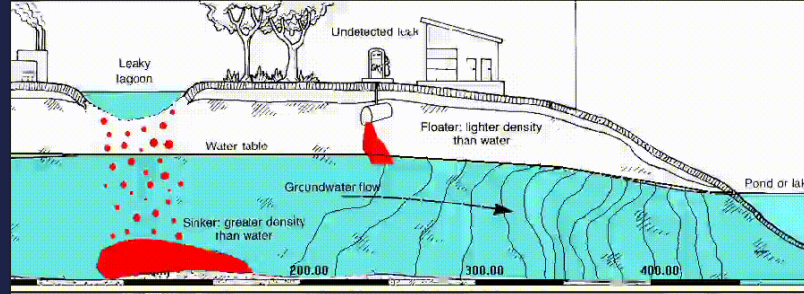
Source of pollution may be natural or cause by human activity.

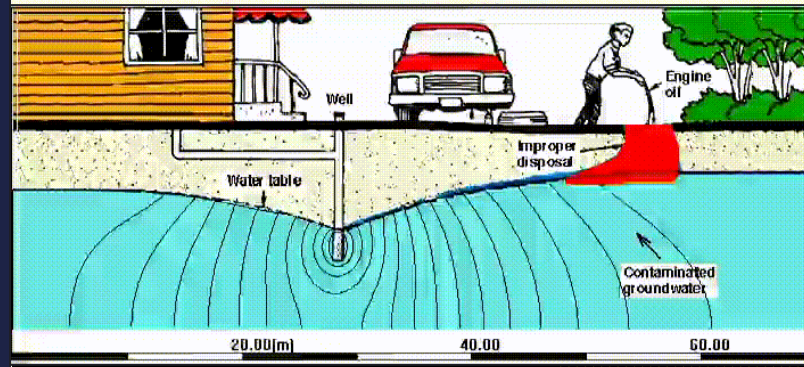
- Deep mineralized groundwater
- Agricultural fertilizers (nitrates)
- Leaky underground storage tanks
- Leaky waste lagoons
- Accidental Spills
- Improper Waste/Chemical Disposal

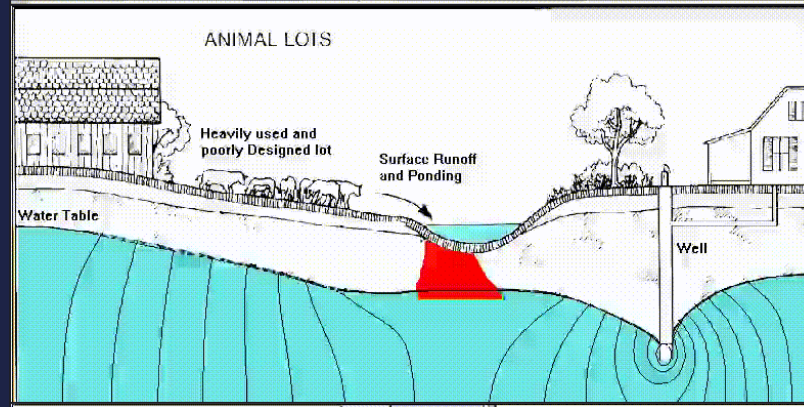


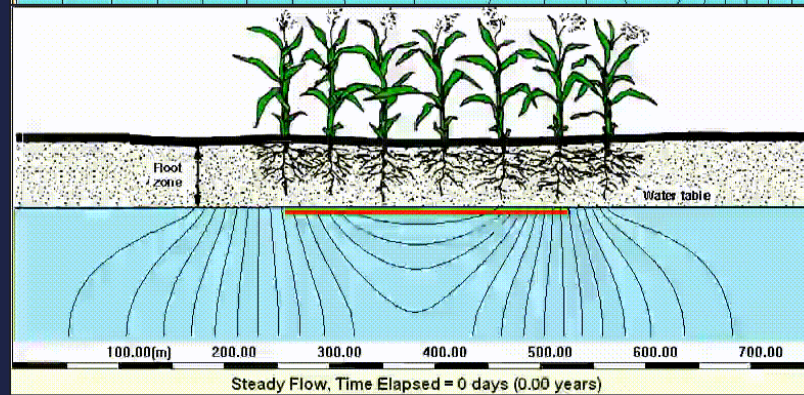












Two Types of Pollution Sources

Point Source Pollution (PS)

Pollution that originates from a single, identifiable source. Examples of point source groundwater pollution include:

- Leaky underground storage tanks (LUSTs)
- Landfills and waste handlers
- Accidental spills
- Improper disposal at industrial/commercial sites
- Legacy disposal at industrial/military sites

Non-Point Source Pollution (NPS)

Pollution that originates from many scattered sources rather than from a single, identifiable point.

- Runoff from agricultural fields
- Naturally occurring underground minerals or metals like iron or arsenic
- Road deicing
- Seawater intrusion / brine upwelling

Once groundwater is polluted, it is difficult and very expensive to clean up. Remediation can take years, if at all possible.

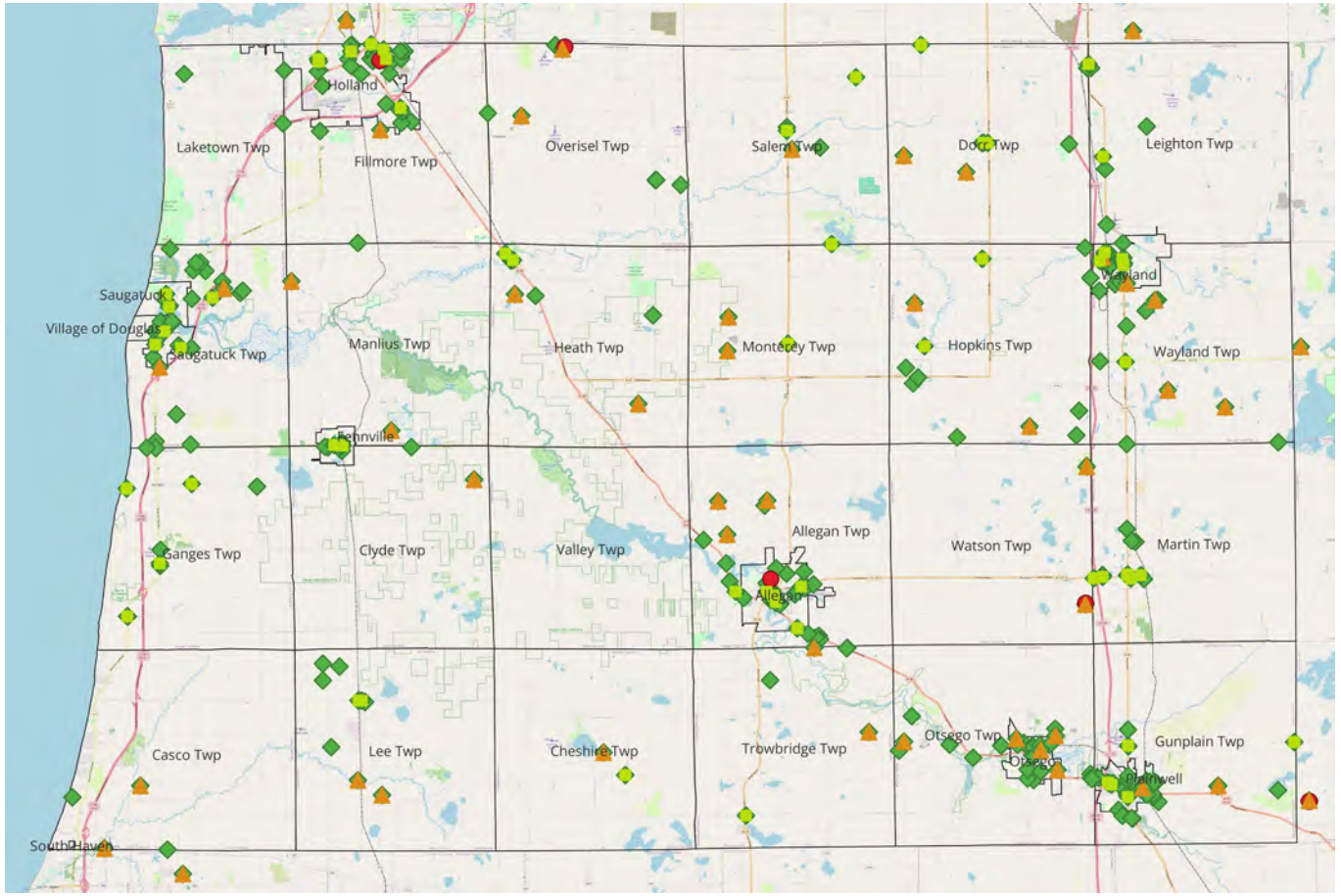
Point Source Pollution

351

Potential Point Source Pollution Sites

- Sites of Environmental Concern = 237
- Landfills / Waste Handlers = 46
- Leaky Underground Storage Tanks = 63
- Emerging PFAS Sites = 5

Source: From State of Michigan GIS Database Portals



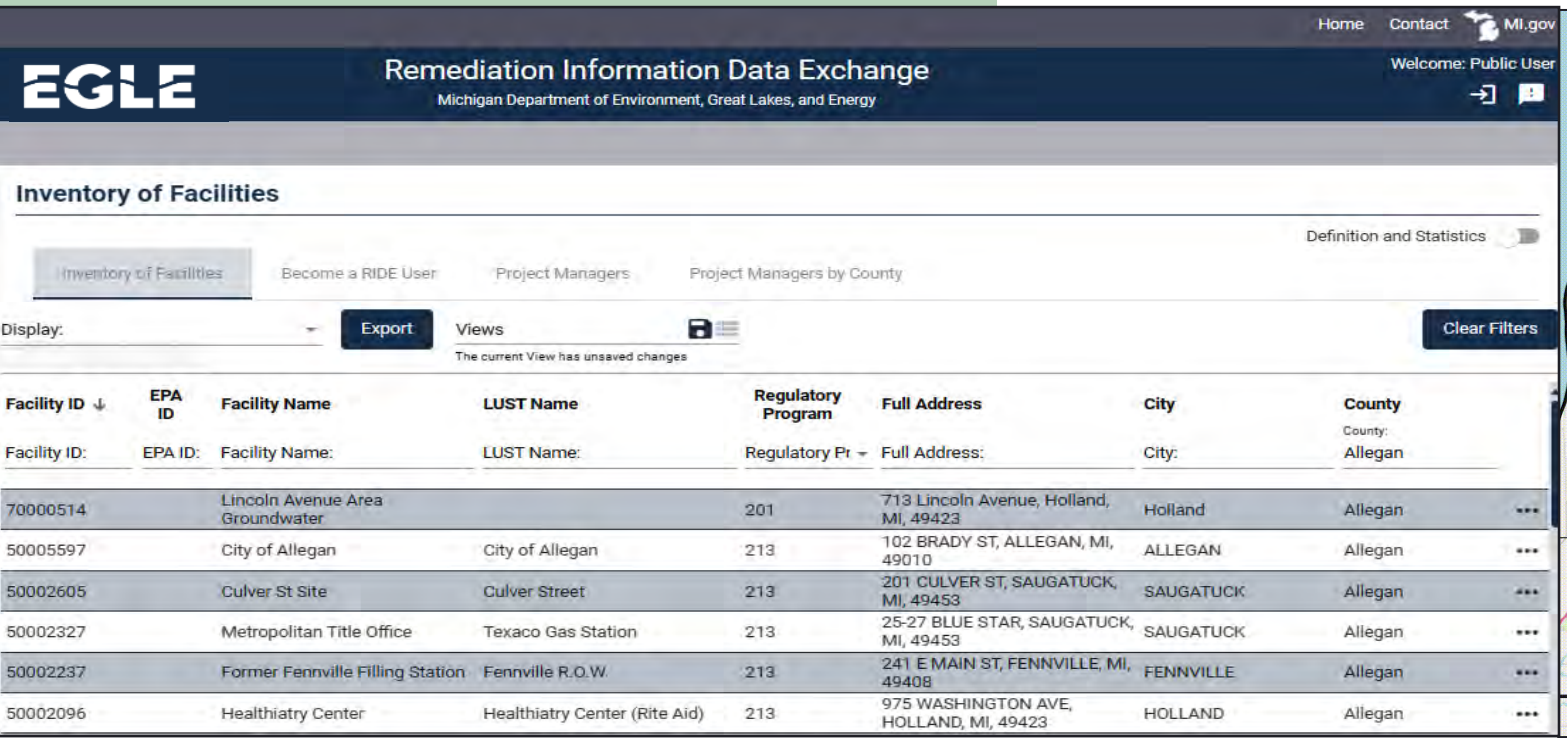
Potential Point Sources of Groundwater Pollution

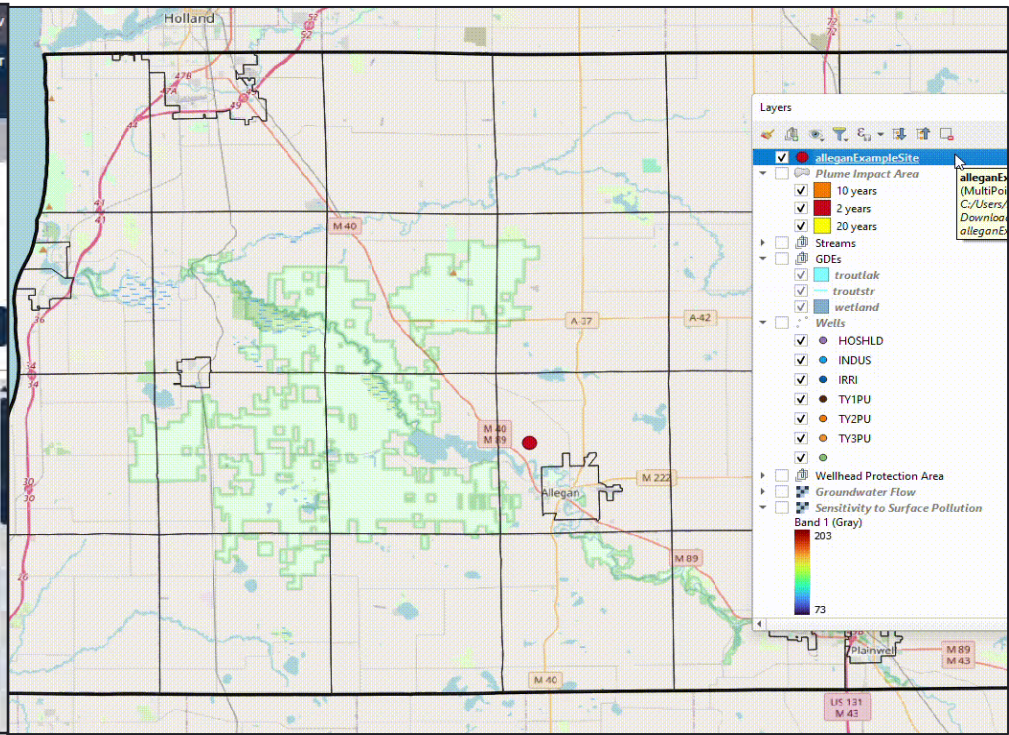
Risk-based Analysis of Point Sources

“On-site” and “Off-site” Contamination Risk Analysis at all 351 Sites

Off-Site Risk Analysis: Estimation of risk to “downstream” groundwater receptors based on plume migration pathways

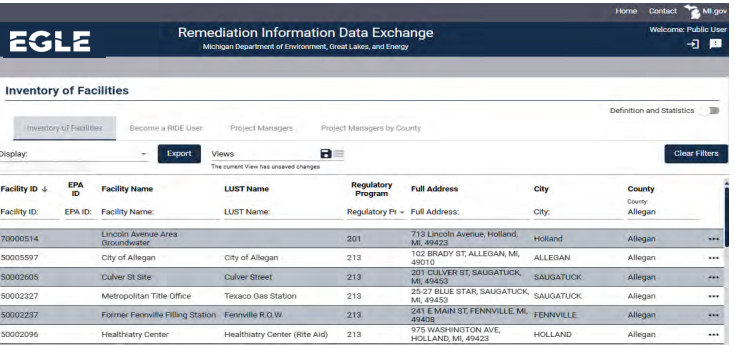
On-site Risk Analysis: Review of site history, documentation of substances present, pathways for groundwater contamination, and soil & groundwater quality data

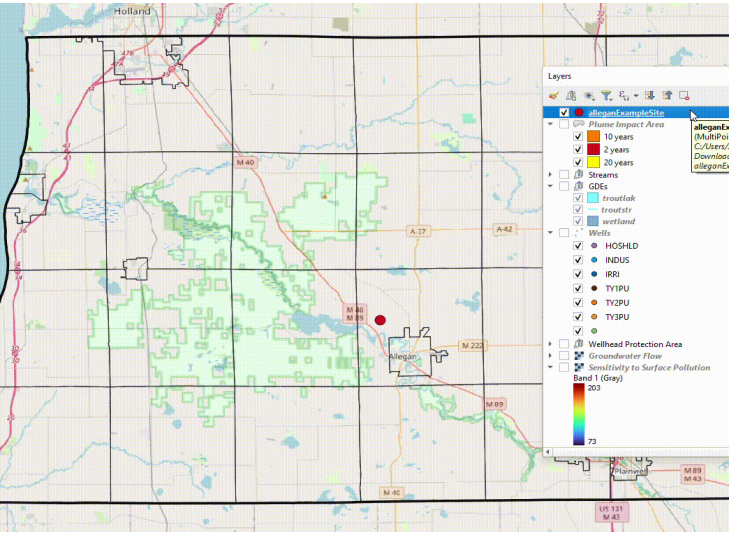




Point Source Pollution Risk Analysis Work-Flow

Coming on-site and off-site risk factors
- Potential plume migration and downstream groundwater wells
- Nature of the pollution source (chemicals, concentrations, etc.)



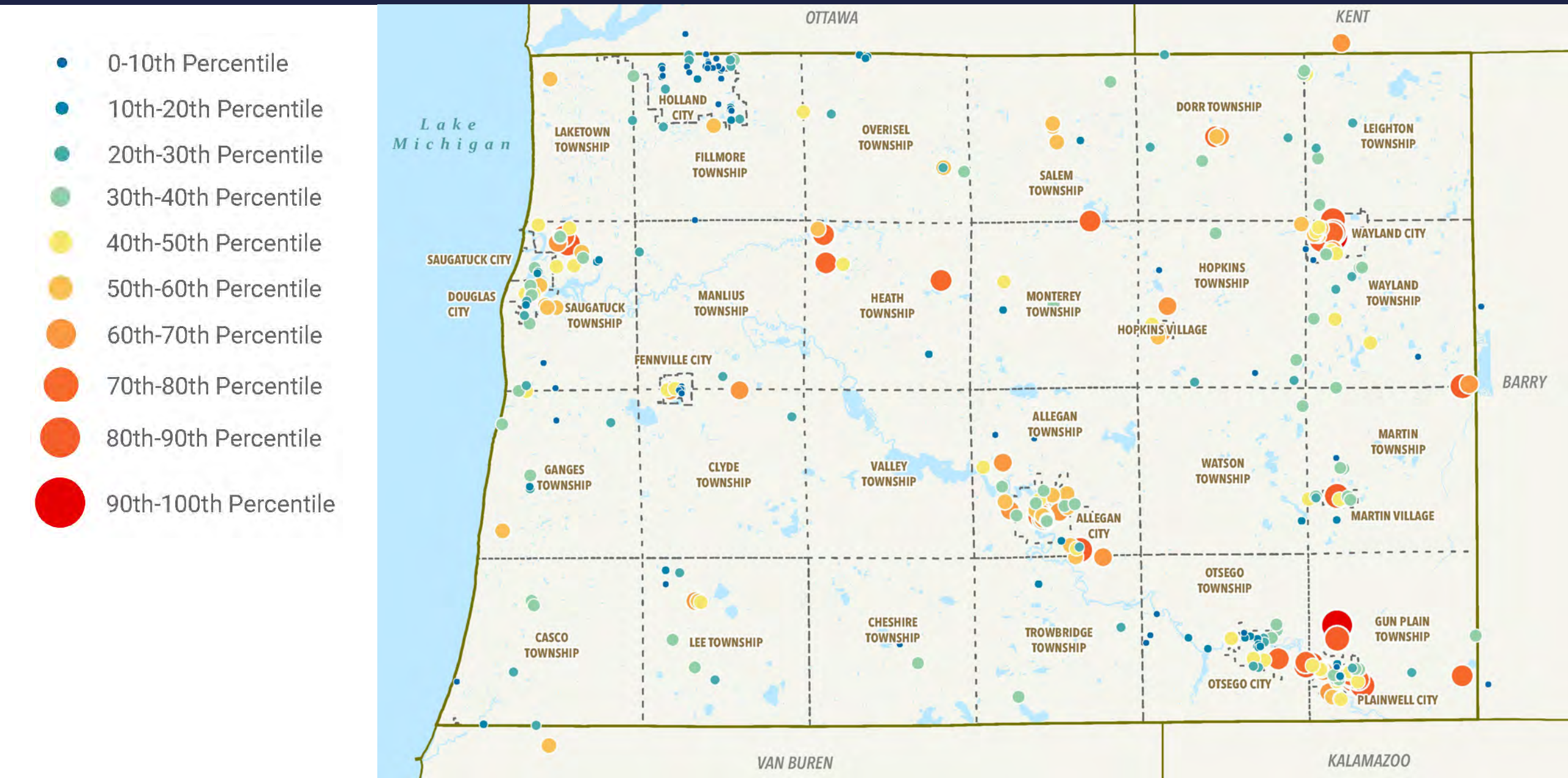


RIDE Inventory Analysis → Risk Based on Site-specific Conditions and EGLE Criteria

Plume Migration Simulators → Risk Based on Downstream Groundwater Wells and Surface Water

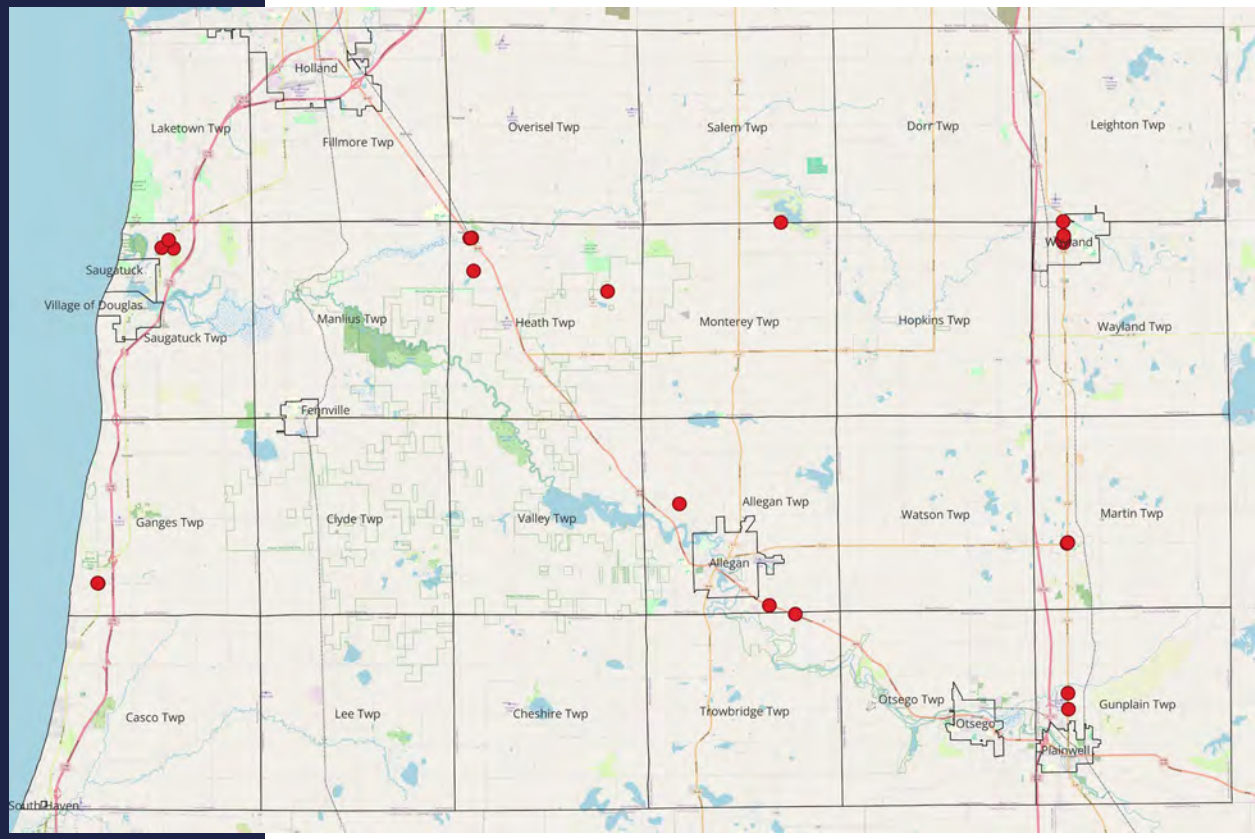
Combined Risk Ranking & Site Prioritization Map/List

Point Sources - Contamination Risk Map



Point Sources: Top 25 Sites

Ranking	Site Name	Local Government Unit
1	687 North 10th Street	Gunplain Twp. (Plainwell)
2	203 South Main Street	City of Wayland
3	Wayland Self Serve	City of Wayland
4	114 Pine Street	City of Wayland
5	585 10th St. Plainwell	Gunplain Twp. (Plainwell)
6	3603 N. Main Street	Leighton Twp. (Wayland)
7	712 East Bridge Street	City of Plainwell
8	798 E. Bridge Street Fmrly 760 E. Bridge	City of Plainwell
9	1258, 1260 Lincoln Road & Village EMH Pk	Allegan Twp.
10	150 North Main Street	City of Wayland
11	101 124th Avenue	Wayland Twp. (Shelbyville)
12	236 Hubbard Street	City of Allegan
13	1218 M-89 Highway	Allegan Twp.
14	637 West Sycamore Street, Wayland	City of Wayland
15	Ridderman Card -OP	Gunplain Twp. (Plainwell)
16	Martin (LUST Site)	Village of Martin
17	6494 Clearbrook Drive & 6402 and 6500 13	Saugatuck Twp.
18	558, 520, and 512 Water Street	City of Allegan
19	1185 M-89 Highway	Allegan Twp.
20	1227 M-89, Plainwell MI 49080	Otsego Twp.
21	East 1/2 of SE 1/4 Section 29	Gunplain Twp. (Plainwell)
22	Friendly 66 (Martin Pacific Pride)	Village of Martin
23	Angle Steel Div (Kewaunee Scientific)	City of Plainwell
24	101 Brady Street, Allegan	City of Allegan
25	111 Hubbard Street	City of Allegan



Non-Point Source Pollution

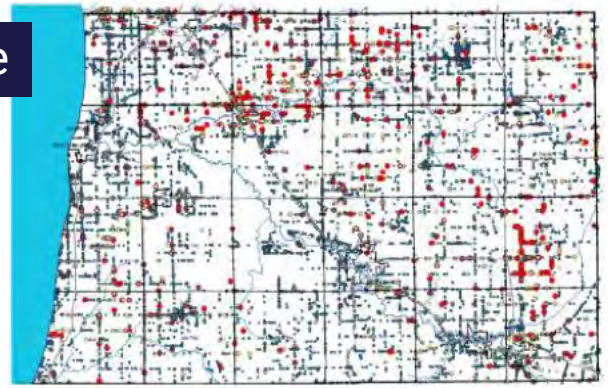
Risk-based Analysis of Non-Point Sources

Analysis of the "Impact" (resulting groundwater concentrations) from non-point source pollution

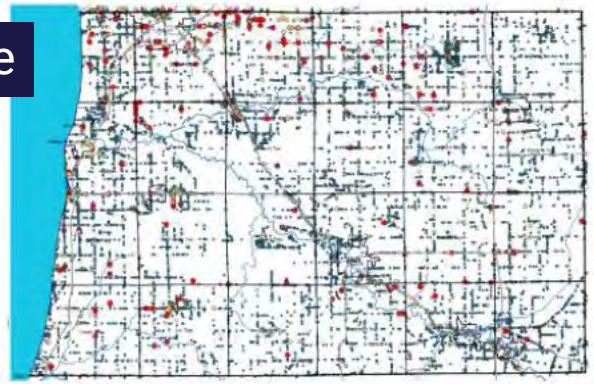
Interpretation of WaterChem Data

- Groundwater quality samples from 1983-2014
- Township-by-township statistical analysis and ranking of "average" and "elevated" concentrations (primary and secondary substances)
- Spatial mapping of elevations concentrations (point data)

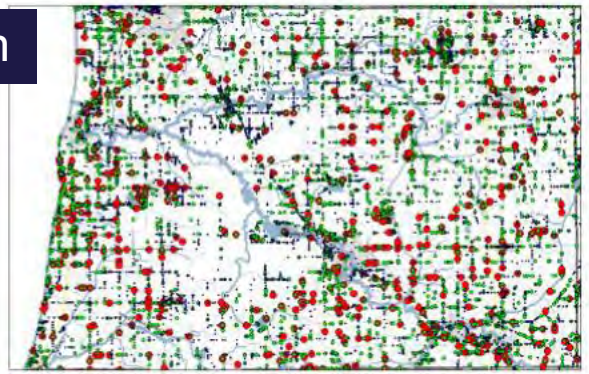
Nitrate



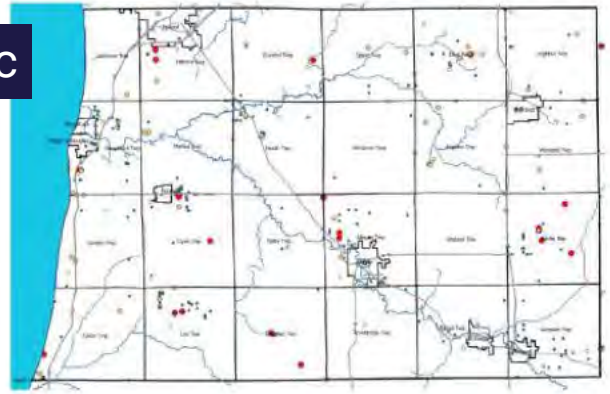
Chloride



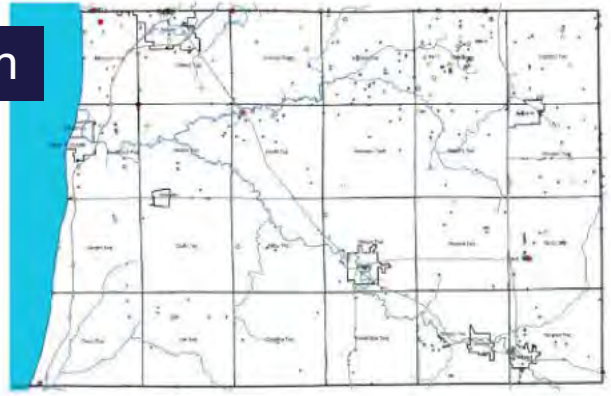
Iron



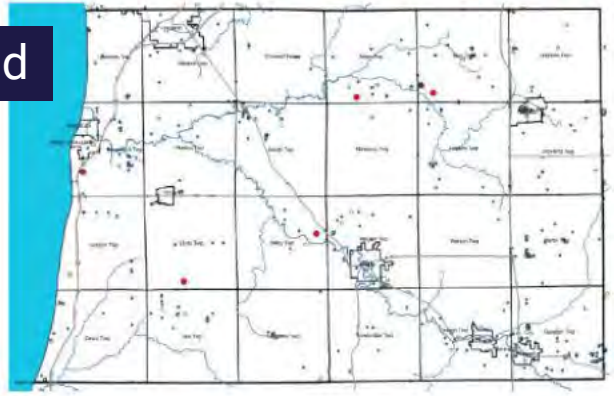
Arsenic



Sodium



Lead



Non-Point Source Pollution Indexes

Primary NPS Pollution Index

Non-Point Source contaminants known to adversely impact human health.

- **Nitrate** (+10 mg/L)
- **Lead** (+0.015 mg/L)
- **Arsenic** (+0.010 mg/L)

Secondary NPS Pollution Index

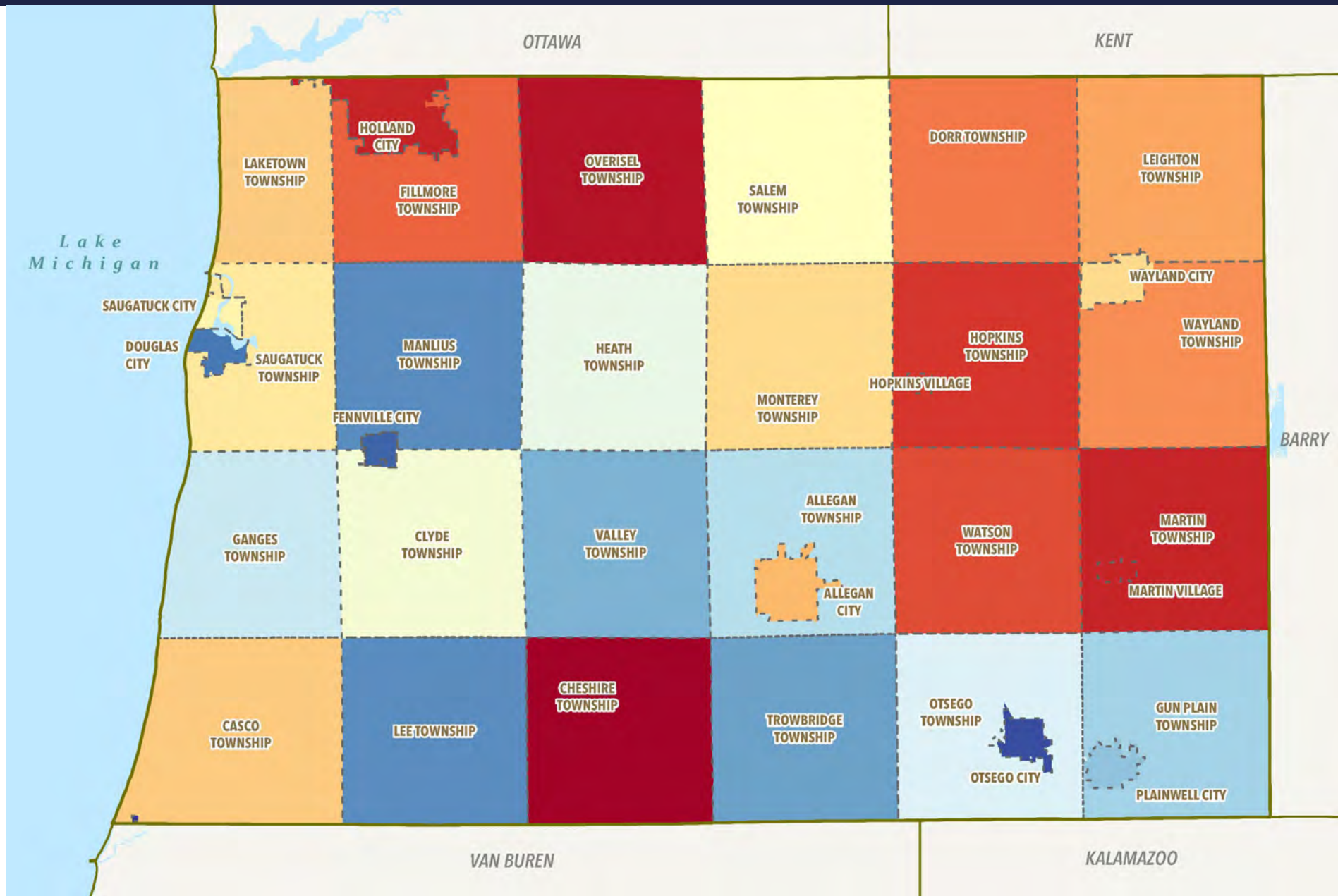
Non-Point Source contaminants with non-mandatory water quality standards, typically only influencing things like color, taste, and odor.

- **Chloride**: 250 mg/L
- **Iron**: 0.3 mg/L

Primary Non-Point Sources - Contamination Risk Map

Pollution Risk Index:
Sum of 50th and 75th percentiles normalized by substance specific MCL (nitrate, arsenic, lead)

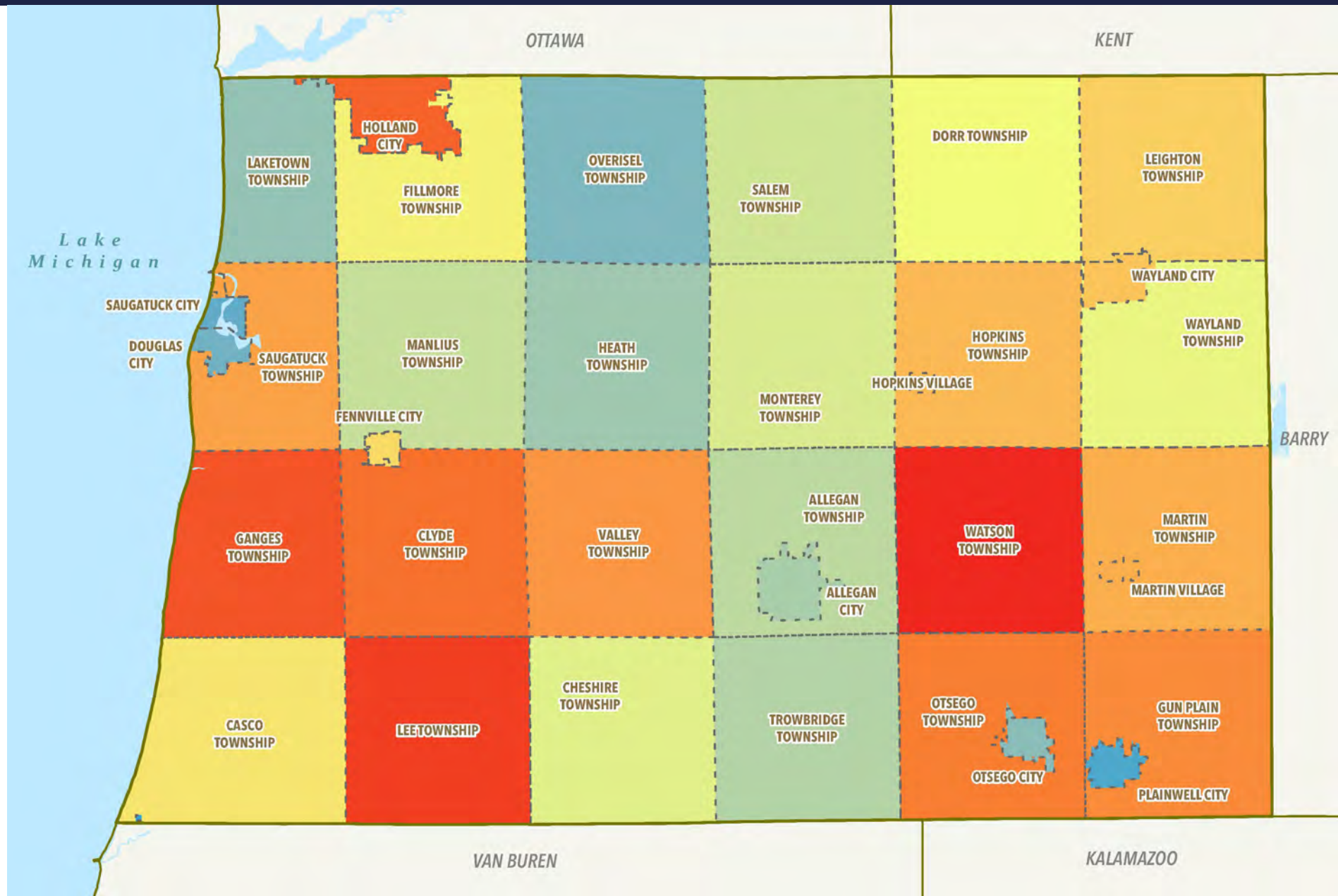
0	0.63
0.1	0.7
0.18	0.83
0.19	0.91
0.2	1
0.21	1.04
0.28	1.05
0.33	1.07
0.35	1.13
0.41	1.2
0.48	1.21
0.5	1.25
0.52	1.3
0.54	2.57
0.6	



Secondary Non-Point Sources - Contamination Risk Map

Pollution Risk Index:
Sum of 50th and 75th percentiles normalized by substance specific SMCL (chloride and iron)

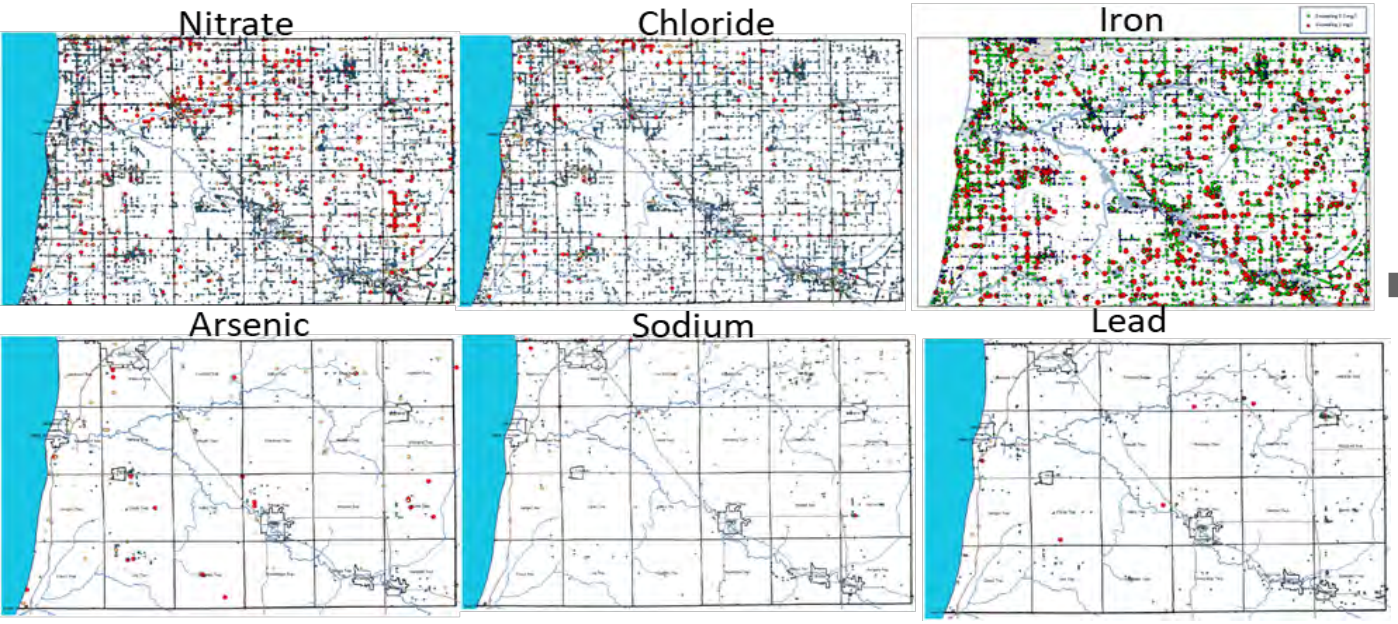
0	1.56	3.61
0.29	1.84	4.09
0.47	1.92	4.28
0.58	2.05	4.76
1.04	2.08	4.77
1.13	2.31	5.22
1.19	2.52	5.86
1.2	2.71	6.09
1.28	3.31	6.46
1.46	3.33	6.9
1.48	3.57	8.18



Groundwater Quality Risk Map

Composite Water Quality Risk Map Elements

Elevated Non-Point Source Concentrations



Point Source Risk Ranking Map

Composite Water Quality Risk Map Elements

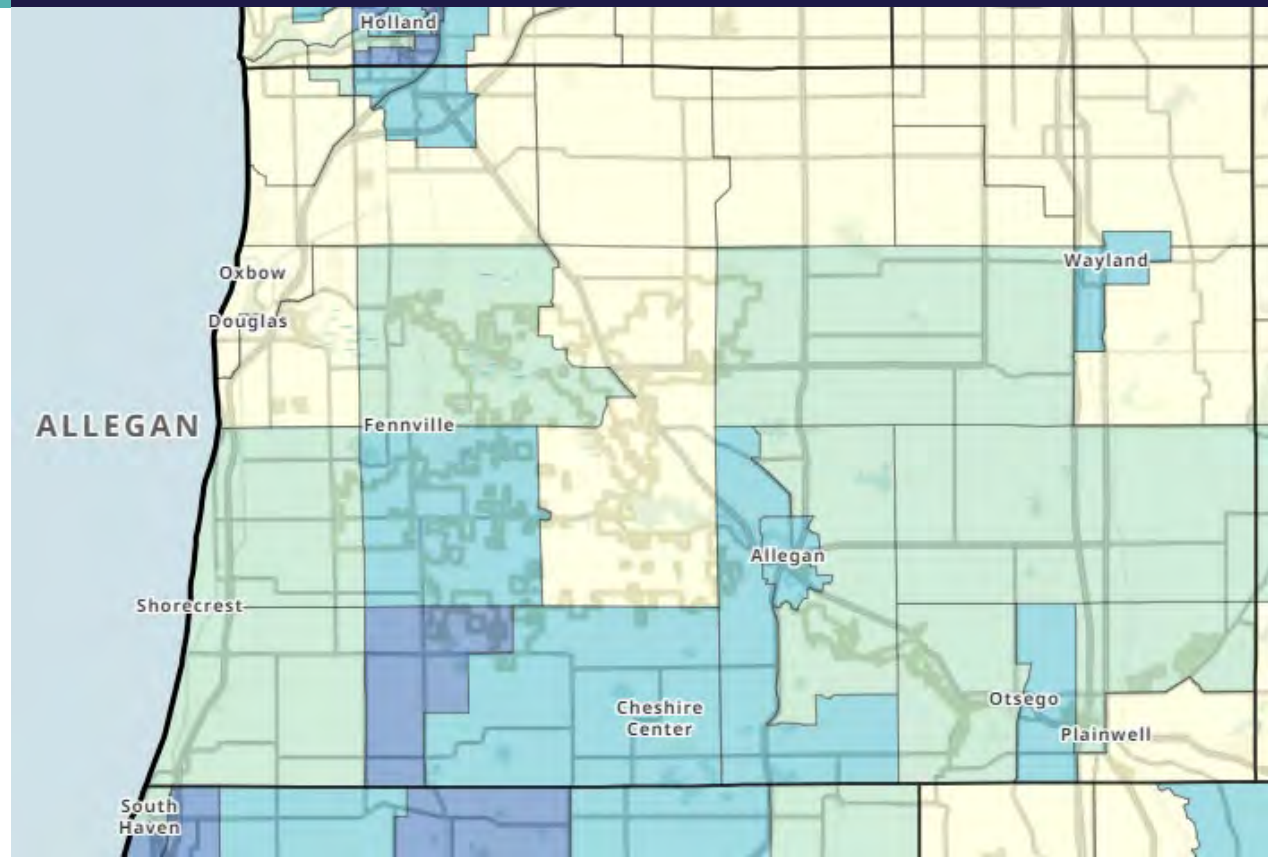
Assesses the potential negative effects on communities caused by external stresses on human health based on four themes:

- Socioeconomic Status
- Household Characteristics
- Racial & Ethnic Minority Status
- Housing Type & Transportation

Level of Vulnerability

- Low
- Low-Medium
- Medium-High
- Med-High

CDC Social Vulnerability Index Overlay



Composite Water Quality Risk Map

Point Source Contamination Risk Ranking

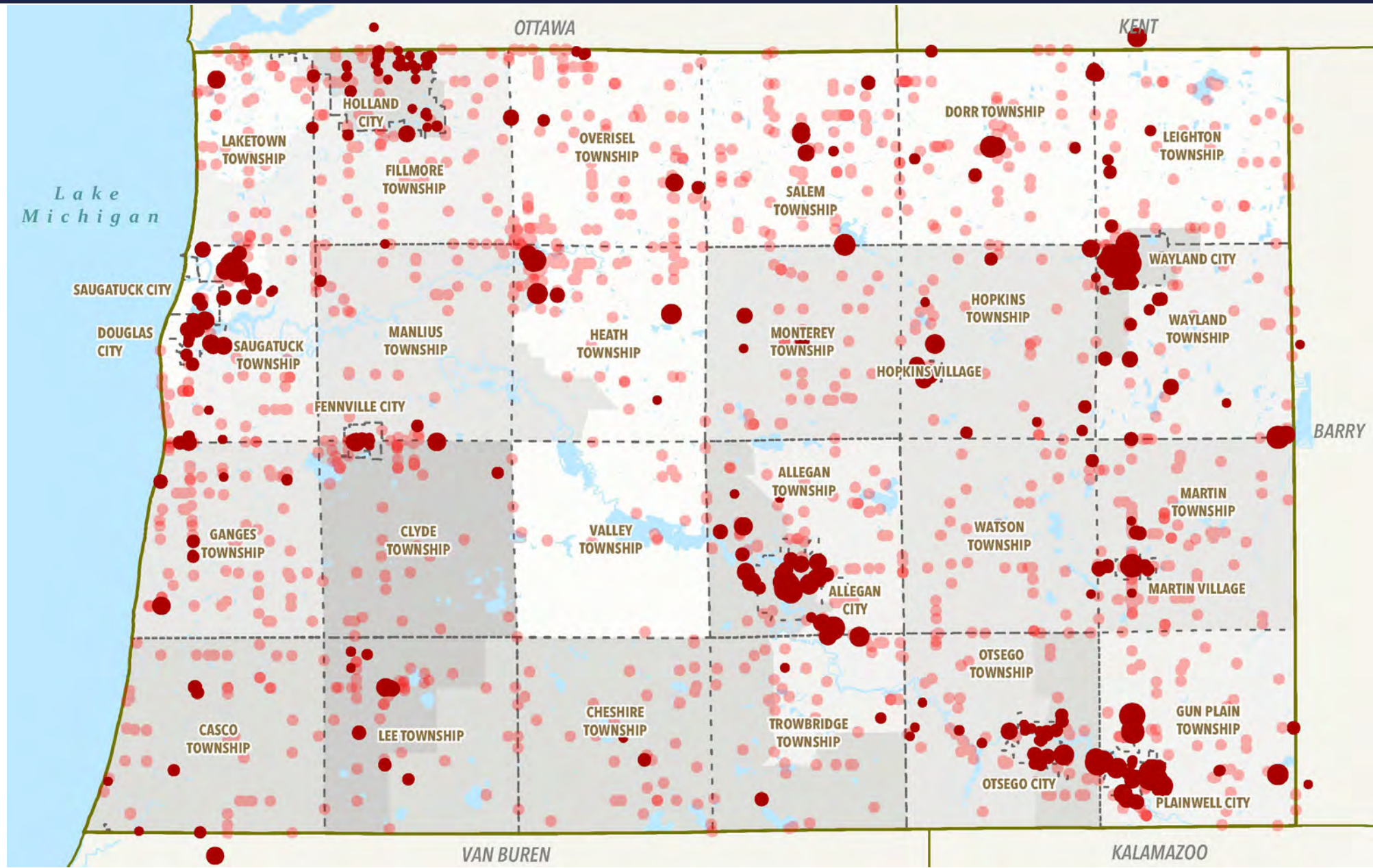
- 0 - 5th Percentile
- 95th - 100th Percentile

Nonpoint Source Pollution (Elevated Concentrations)

- Iron (Concentration > 2 mg/L)
- Chloride (Concentration > 250 mg/L)
- Nitrate (Concentration > 10 mg/L)
- Arsenic (Concentration > 0.010 mg/L)
- Lead (Concentration > 0.015 mg/L)

CDC Social Vulnerability Index (By Census Tracts)

- Low Social Vulnerability
- High Social Vulnerability



Areas of Concern

Water Quality Risk Analysis

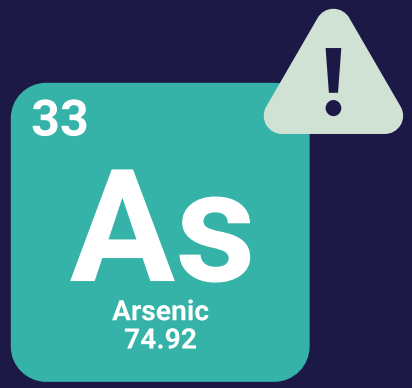
Point Source Pollution Risk

“Hot-spots” of point source water quality risk include:

The Cities of Wayland, Plainwell, Otsego, Saugatuck, Douglas, Allegan, and Allegan Township.

Areas of Concern

Water Quality Risk Analysis



Primary Non-Point Source Pollution Risk

(pollutants with adverse impacts to human health)

- Cheshire Township ranks highest in terms of Primary NPS Pollution Risk due to high arsenic concentrations, followed by Overisel Twp., City of Holland, Martin Twp., and Hopkins Twp.
- The townships of Watson, Fillmore, and Dorr also have high ranking Primary NPS Pollution Risk.

Areas of Concern

Water Quality Risk Analysis

Secondary Non-Point Source Pollution Risk

(pollutants influencing quality - color, taste, odor)

- Watson Township ranks highest in terms of secondary water quality severity index due to high iron concentrations followed by Lee, Ganges, City of Holland (relatively high iron and chloride concentrations), Clyde Township, and Otsego Township (high iron concentrations).
- The townships of Valley, Gunplain, Saugatuck, and Martine also have high ranking secondary water quality severity indexes.

Areas of Concern

Water Quality Risk Analysis

Monitoring and Testing

Water quality risk does not necessarily mean the water is contaminated today.

Given the prevalence of water quality risk across the County, routine testing is recommended.

HEALTH Department

Importance of Water Quality Testing

Routine testing is critical, given the risks identified throughout the County.

- Public suppliers test quarterly; private wells typically only tested before they are put into use (old or new wells)
- Contact local health department for help getting your groundwater tested (if private well owner)

HEALTH Department

Importance of Water Quality Testing

Options when a “bad” test result happens:

- Well treatment (e.g., chlorinating for bacteria)
- Consider additional treatment (at-home carbon filter, RO system)
- Change well location/depth
- Consider multi-source water use at home, for example:
    - Bottled water for drinking
    - Well water for bathing/washing

Anticipated Groundwater Demand & Future Use Projections

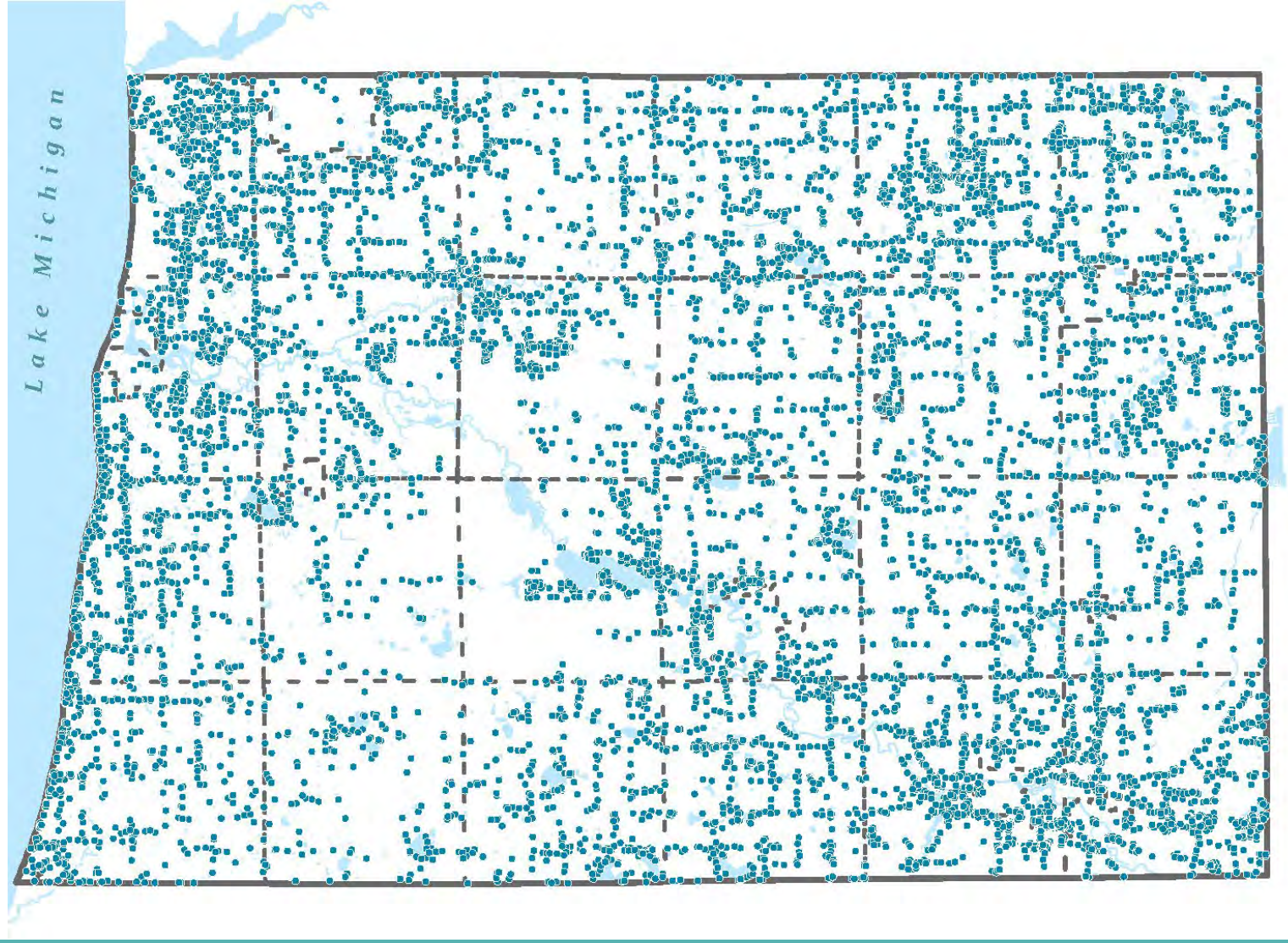
Presented by Dan Whalen, P.E.
Williams & Works

Groundwater use across Allegan County has experienced a significant increase in recent decades.

Year 2000

11,510*

Number of Wells



Water Well Network Growth

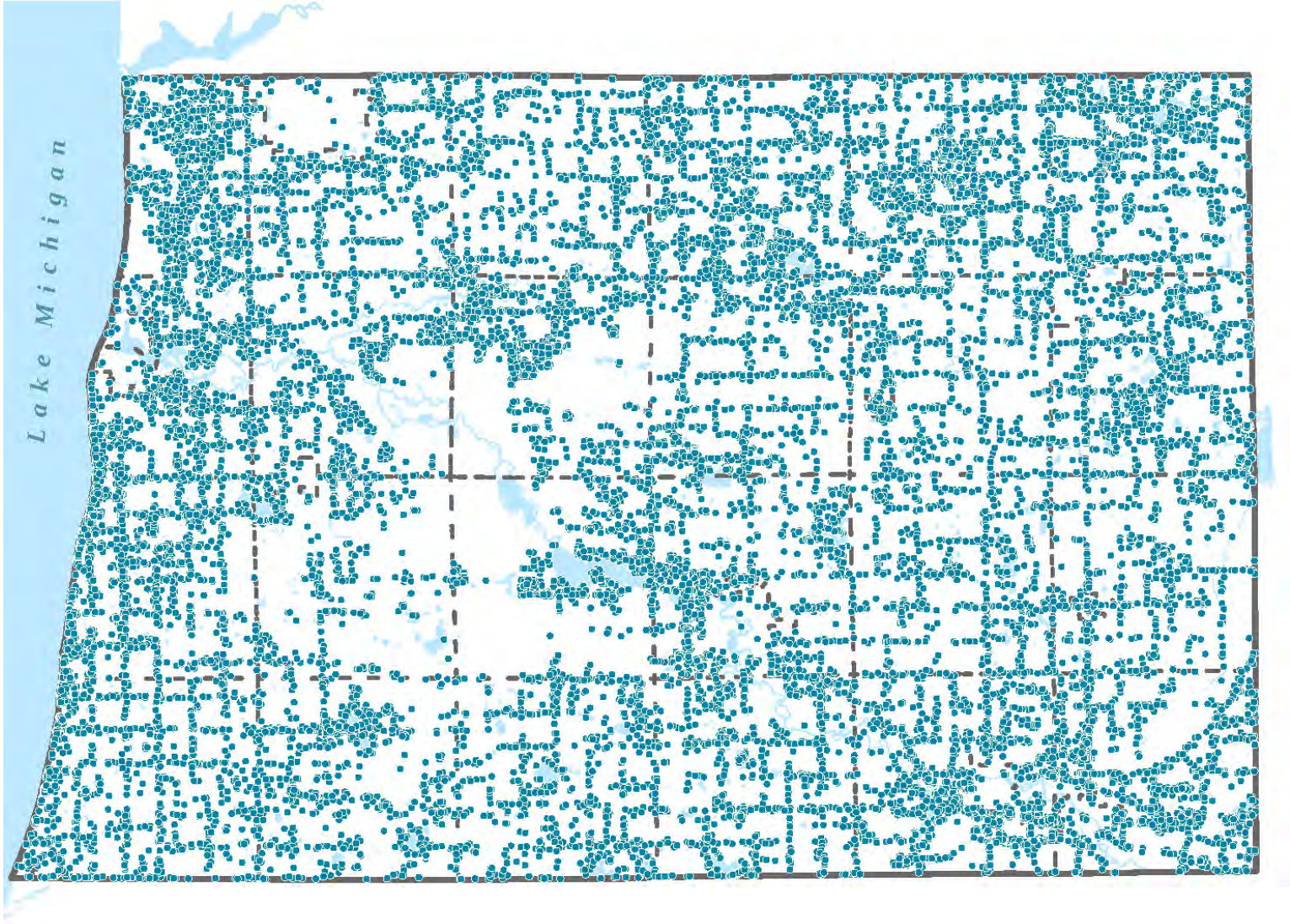
* Well logic data prior to 2000 is still being added. As a result, the number of wells may grow over time.

Year 2020

132%*
Increase in 10 years

26,700

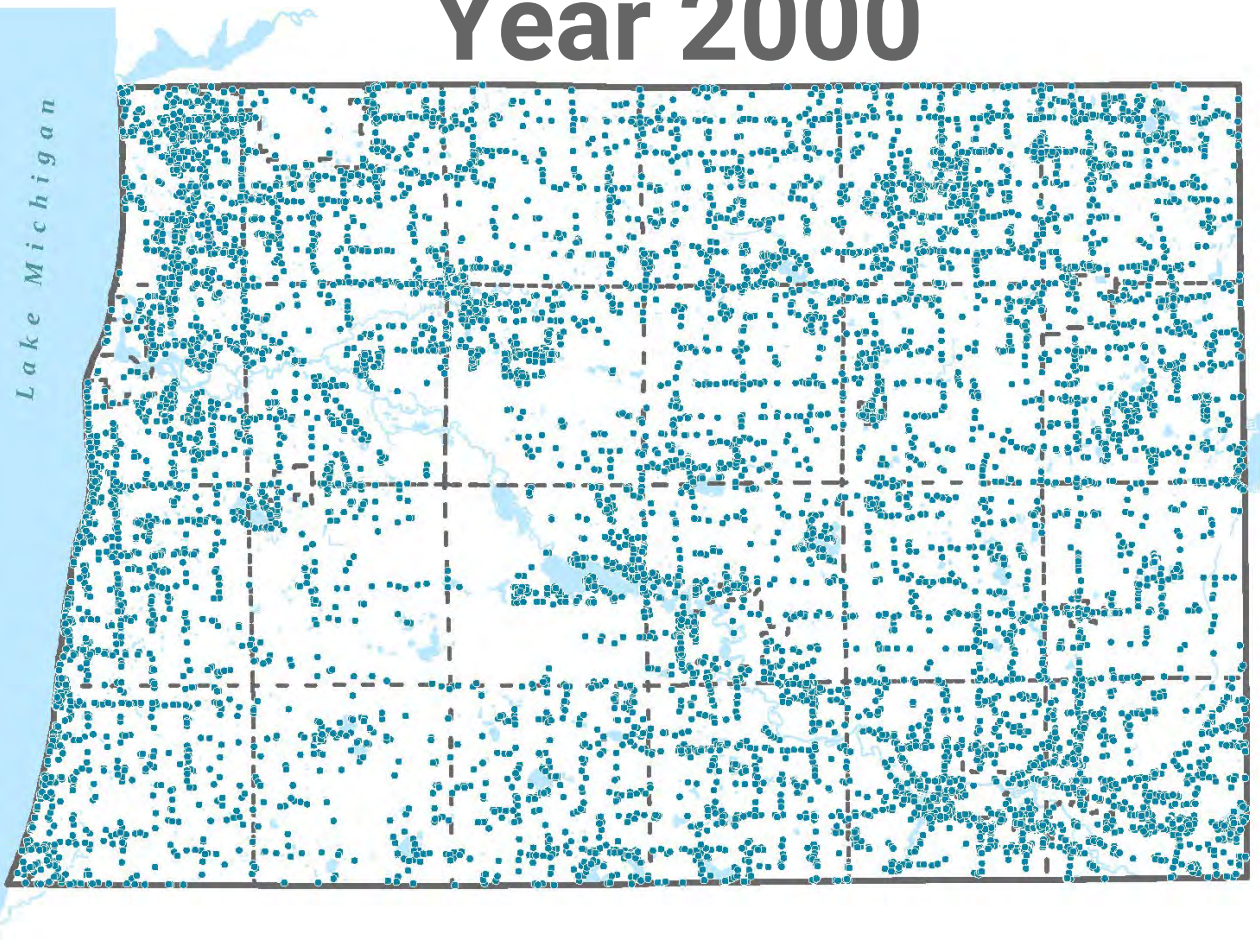
Number of Wells



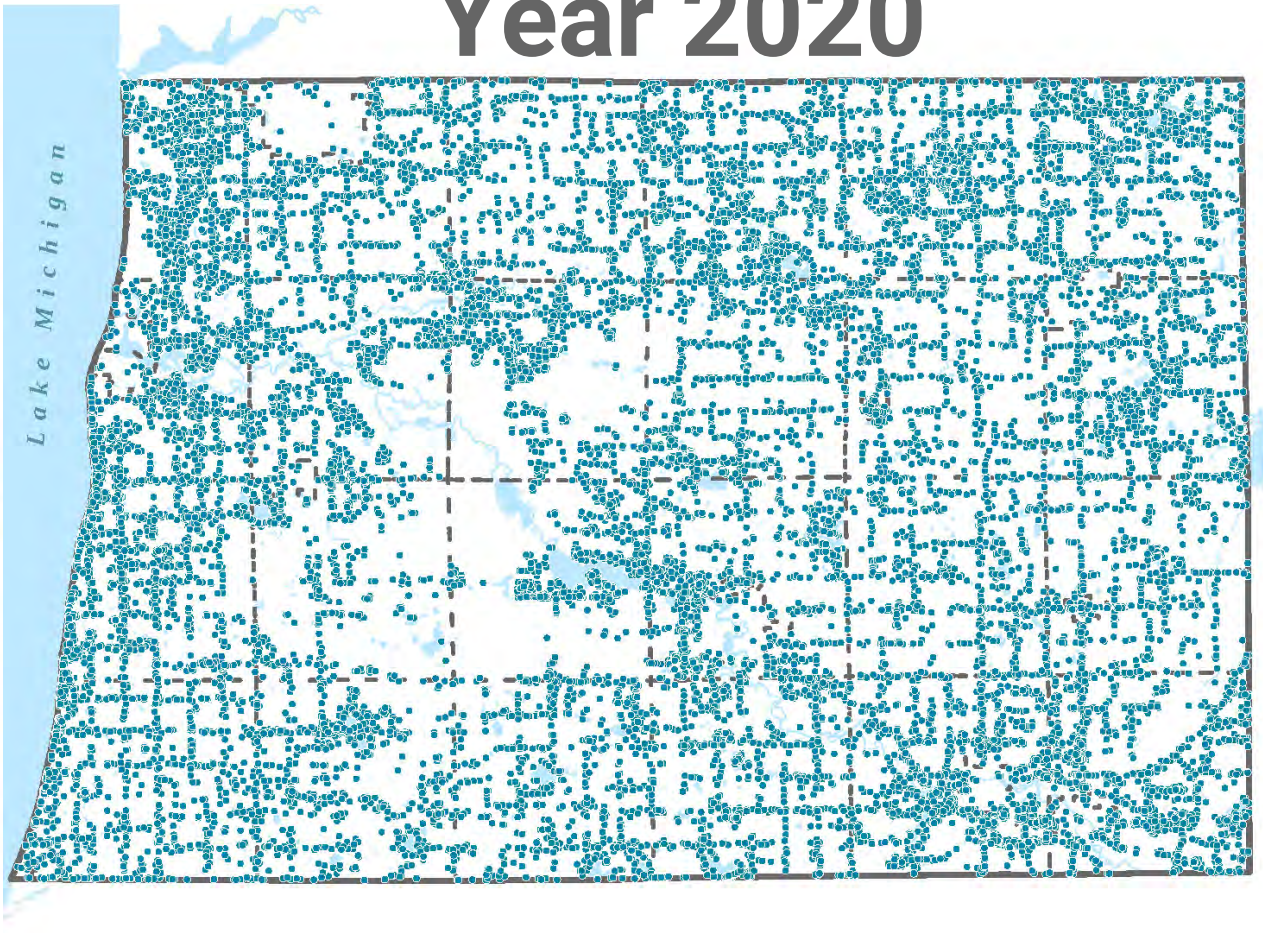
Water Well Network Growth

* Well logic data prior to 2000 is still being added. As a result, this percentage may decrease over time.

Year 2000



Year 2020



Water Well Network Growth

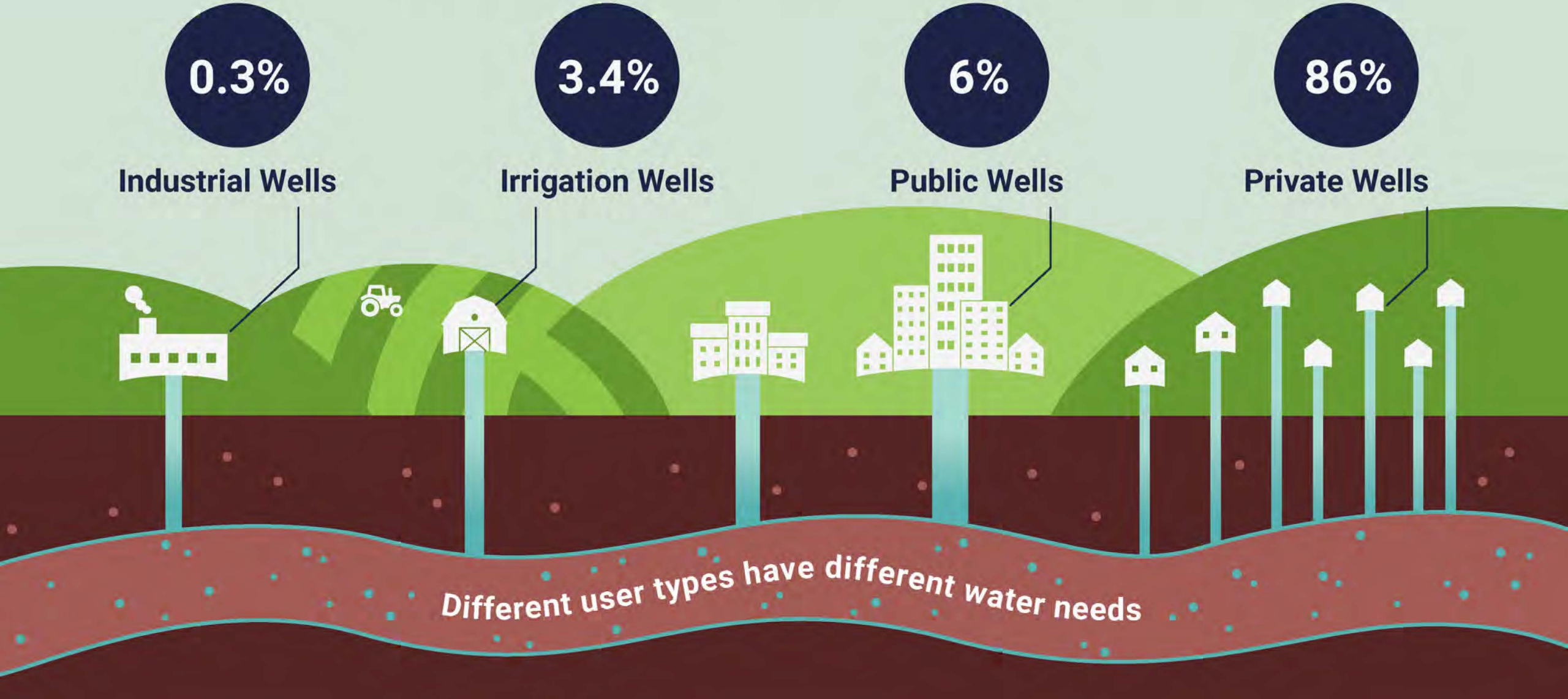
* Well logic data prior to 2000 is still being added. As a result, this percentage may decrease over time.

To determine future groundwater use, current demand must first be identified.

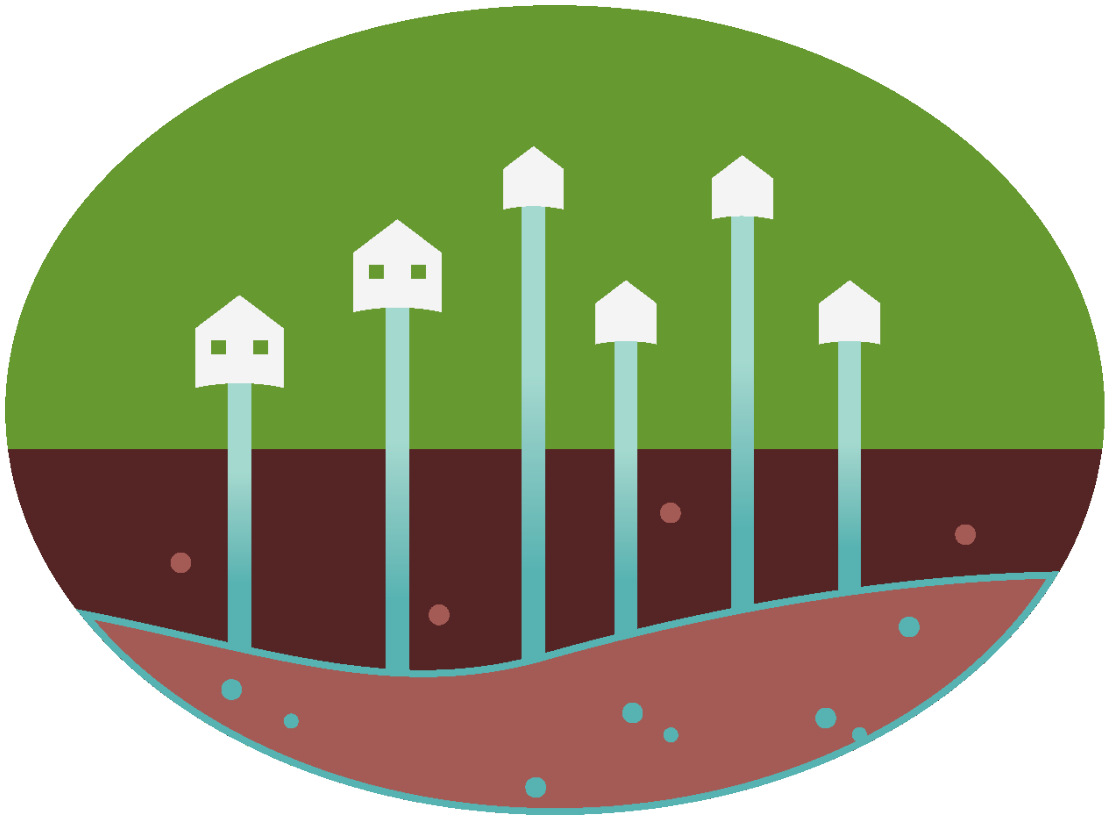
Well Types Studied

- Private Water Wells
- Type I Community and MHC Water Wells
- Irrigation Water Wells

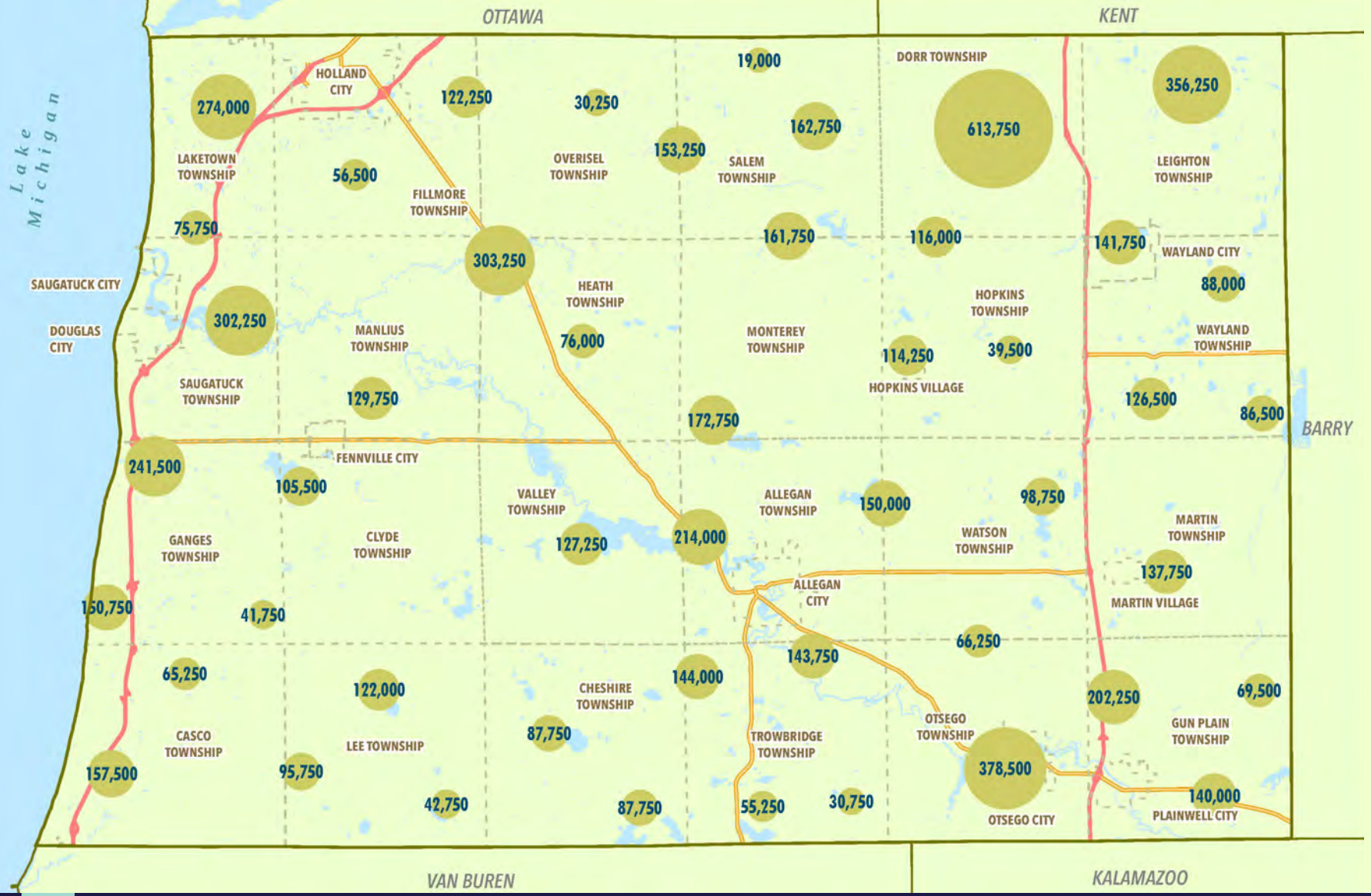
Number of Water Wells by User Type



Private Water Wells



- Largest number of wells by class in Allegan County.
- Cumulatively, comprise the bulk of groundwater withdrawals.
- Generally, distributed somewhat uniformly and singularly and do not have a negative bulk effect on aquifer capacity.
  - Except when they are concentrated in a small area.
- Fastest growing segment of water well type construction.



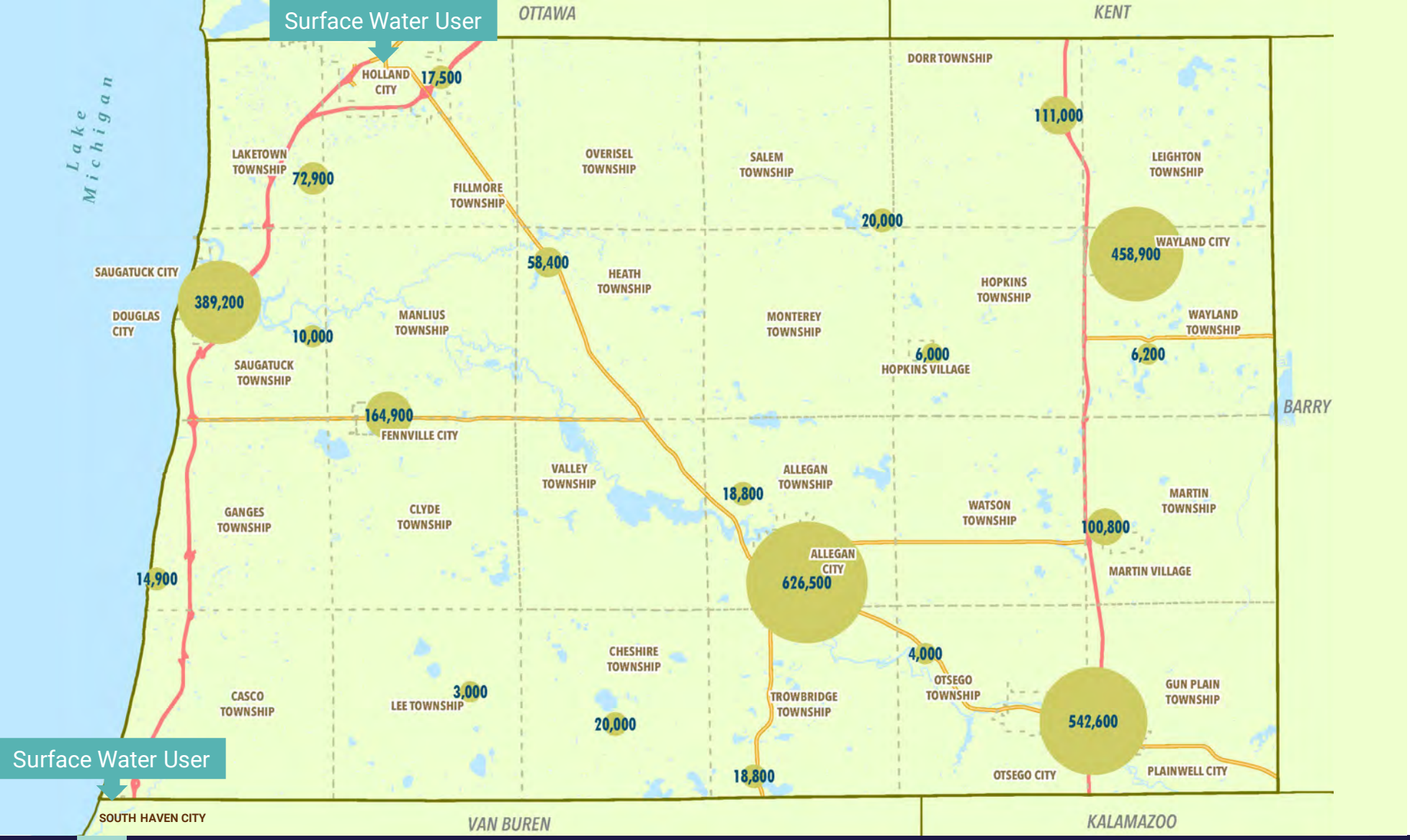
Current Demand = 250 gallons per day per private well

Lower Demand
Higher Demand
Groundwater Demand in Gallons Per Day

Private Water Wells Demand

Type I Community & MHC Water Wells

- Type I community wells are the 2nd largest number of wells by class.
- Type I wells are distributed somewhat uniformly, with the largest withdrawals occurring in population centers.
- MHC wells tend to be small and don’t have the same water use characteristics as larger community water systems.



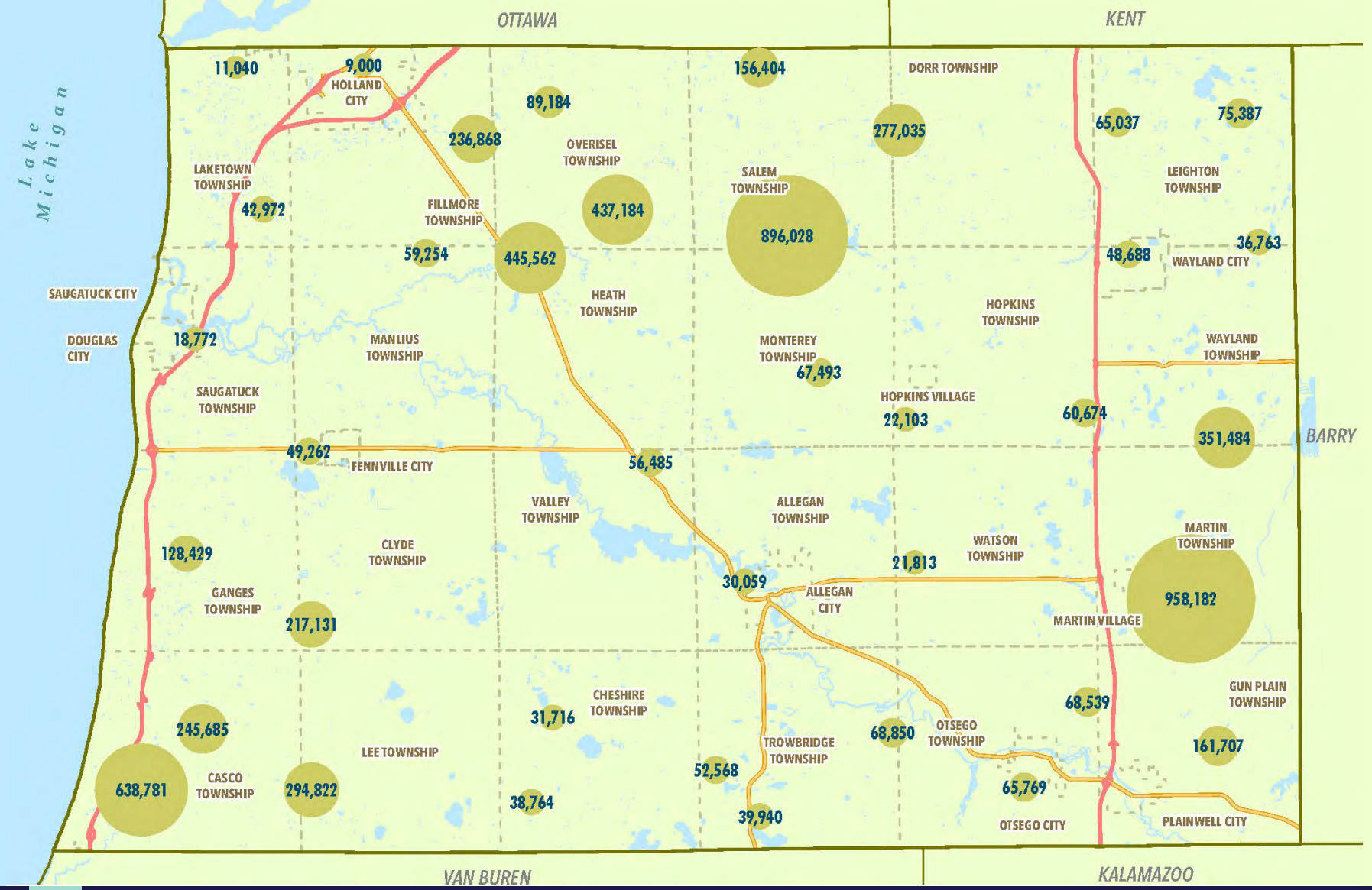
Current Demand = 100 gallons per day per capita

Lower Demand
Higher Demand
Groundwater Demand in Gallons Per Day

Type I Community & MHC Water Wells Demand

Irrigation Water Wells

- Smallest number of wells by class in Allegan County.
- Clustered in areas of the county where aquifers are conducive to larger withdrawals.
- Withdrawals are the most difficult to determine:
  - Water use is not publicly available.
  - Often operated seasonally and weather dependent.
  - Under regulated.



Irrigation withdrawals are reported annually by township.

Current Demand = 10 year Twp avg ÷ irrigation wells per Twp

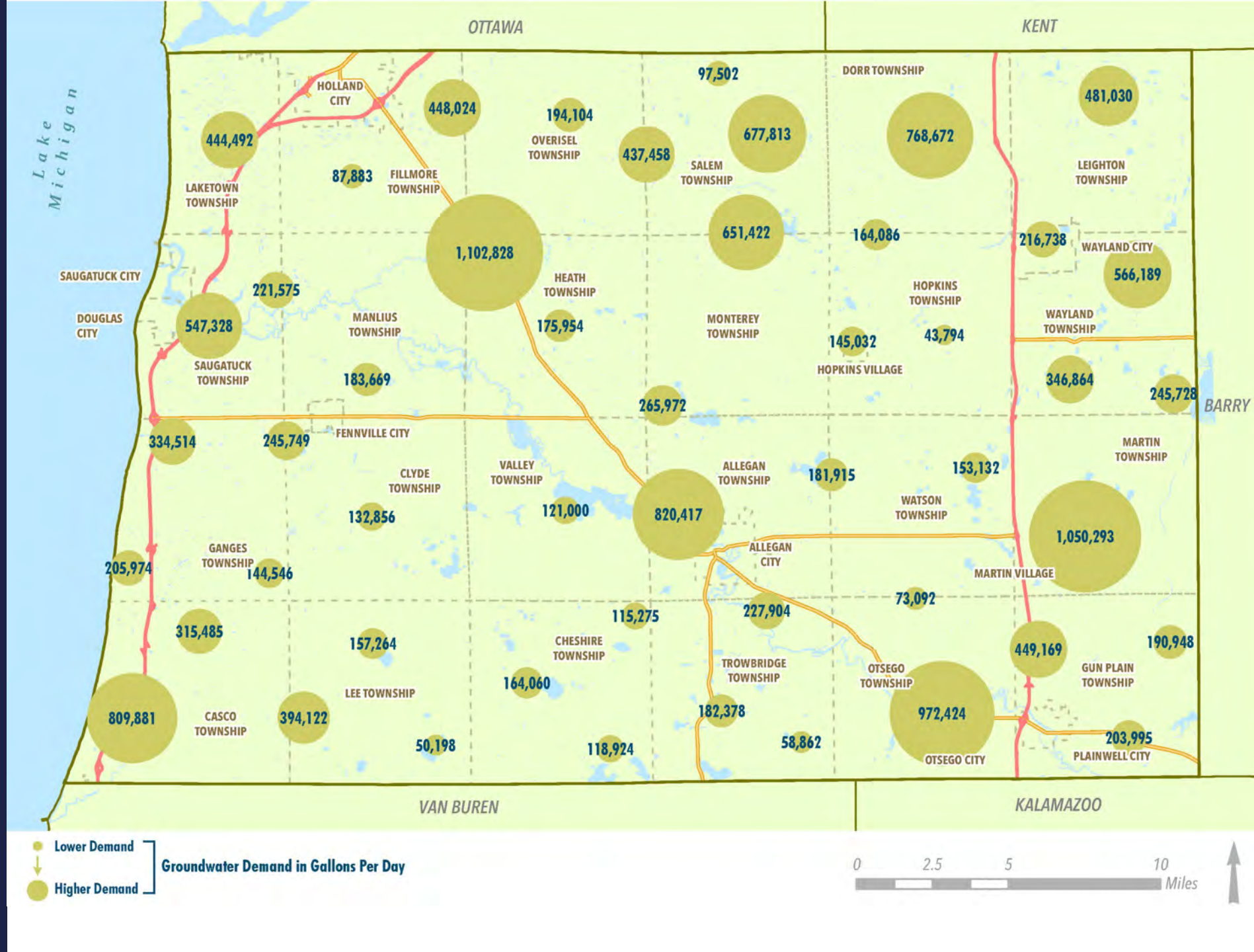
Lower Demand
Higher Demand
Groundwater Demand in Gallons Per Day

Irrigation Water Wells Demand

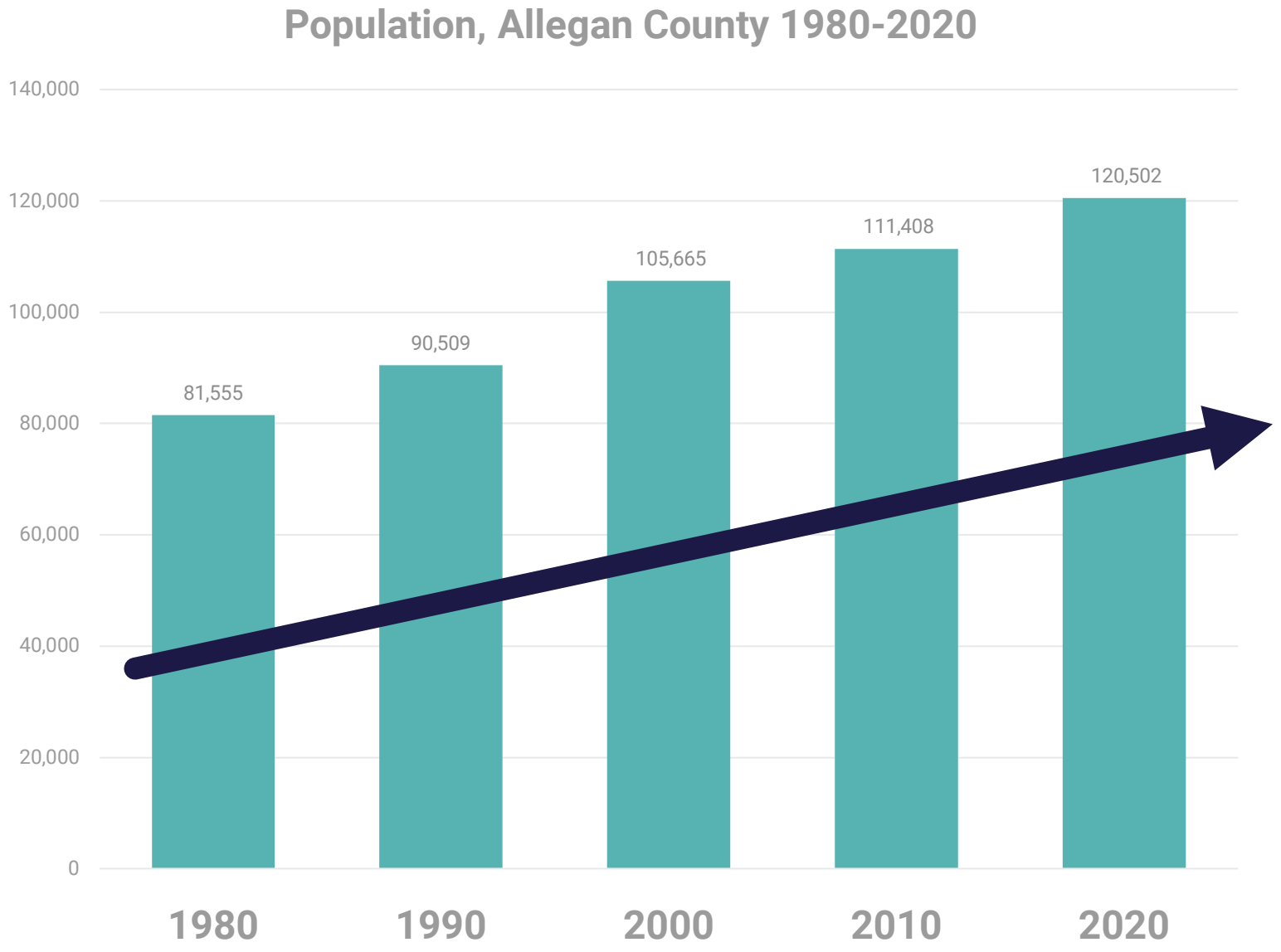
Demand All Wells

Current Cumulative Demand:

16,480,210 gallons per day



As the population grows, anticipated groundwater demand grows too.



Source: U.S. Census Bureau

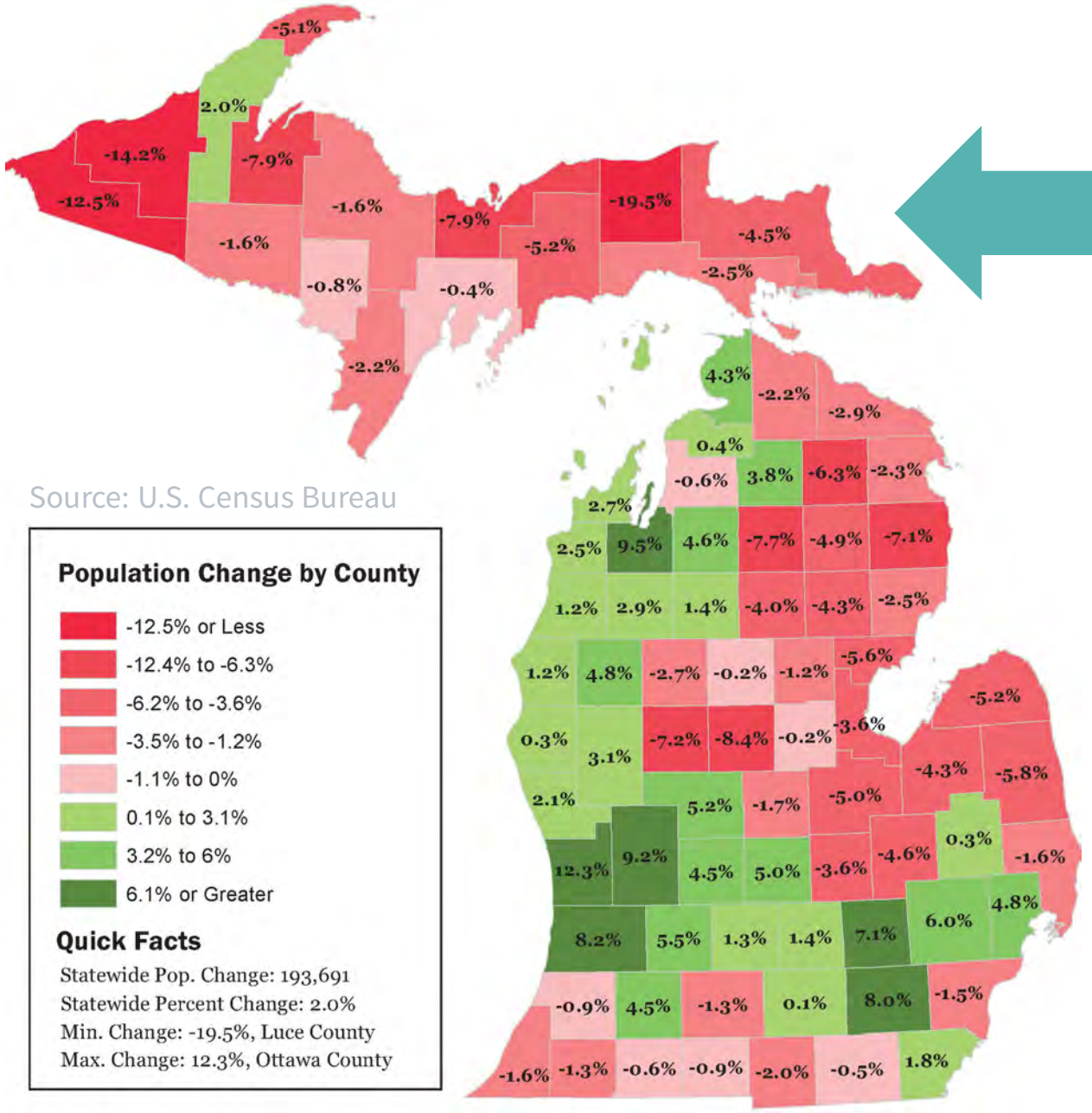
Nationally, population decline is expected over the next 20 years. The USA has an aging population and falling birth rates, meaning that deaths will likely begin to outnumber births.

Source: Population Reference Bureau

Michigan's population declined from 2000 to 2010 and was one of the slowest growing states in the nation from 2010 to 2020.

Source: Michigan Center for Data and Analytics

Populations are moving within the state.



Source: U.S. Census Bureau

Population Change by County

- -12.5% or Less
- -12.4% to -6.3%
- -6.2% to -3.6%
- -3.5% to -1.2%
- -1.1% to 0%
- 0.1% to 3.1%
- 3.2% to 6%
- 6.1% or Greater

Quick Facts

Statewide Pop. Change: 193,691
Statewide Percent Change: 2.0%
Min. Change: -19.5%, Luce County
Max. Change: 12.3%, Ottawa County

From 2010 to 2020, Allegan County experienced some of the highest population growth in Michigan at 8.2%.

Population growth for Allegan County was projected in ten year intervals to 2050.

Population Projections

Three standard methods for anticipating population trends were used, including the **Arithmetic Increase, Growth Rate, and Constant Proportion** methods. Since all three methods appear to show similar trends in population patterns, the average of all three methods was used to provide a single conclusion.

Translating Growth into Projected Groundwater Demand

(Assumes 100 GPD per capita)

- **Change in GW Demand (2020-2050)** =

Projected Population Change x 100 GPD/capita

- **Total Projected GW Demand (2050)** =

Projected Change in Demand + Present Demand

Projected Groundwater Demand

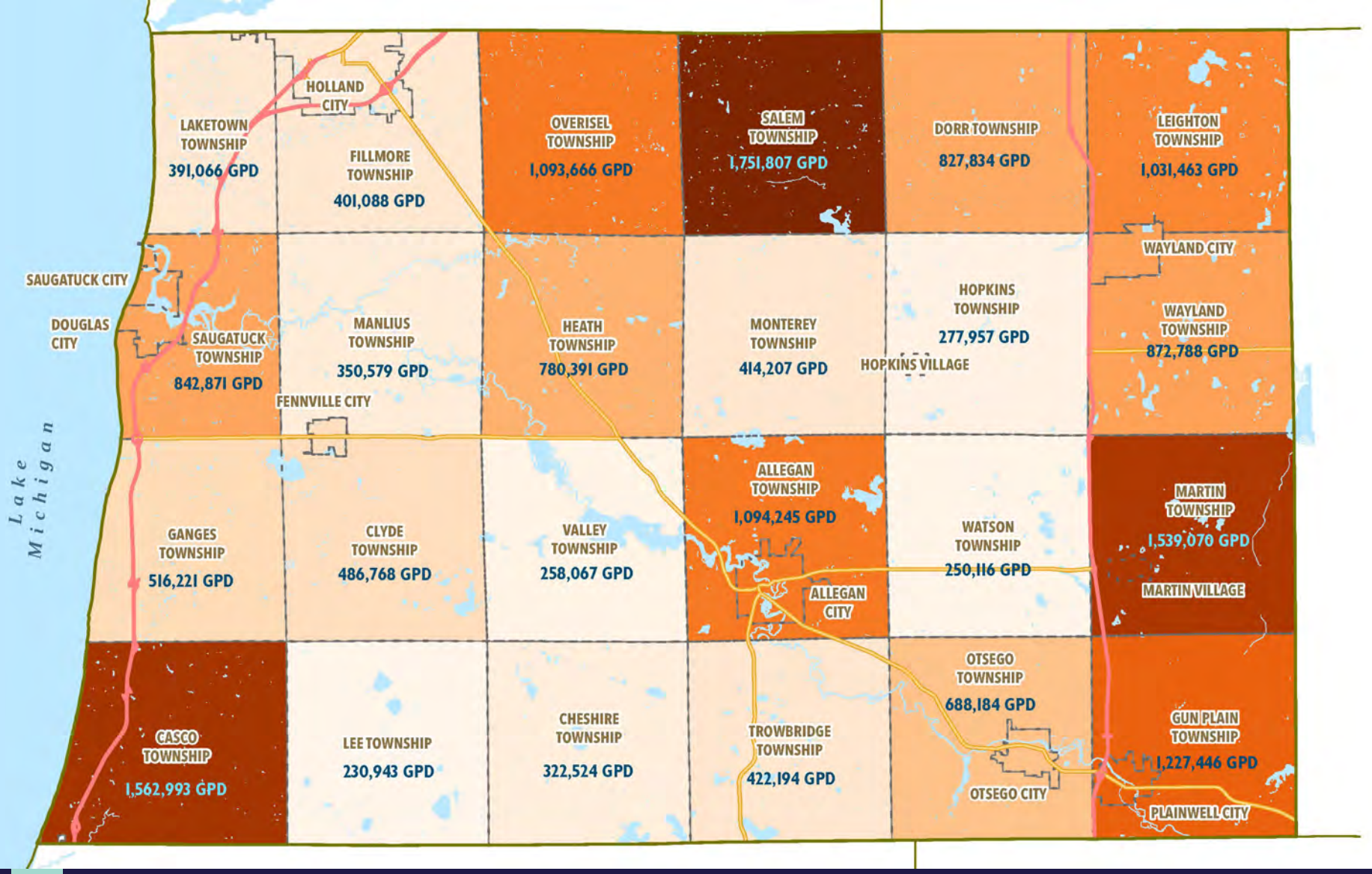
For all of Allegan County (2050)

Existing Population	120,498 People
Existing Demand	16,480,210 GPD
Projected Population Change (2020-2050)	+13,694 People
Projected Additional Demand (2020-2050)	+1,369,389 GPD
TOTAL PROJECTED DEMAND (2050)	**17,849,598 GPD**

Allegan County is projected to see modest overall growth over the next 30 years.

> **Most Local Government Units (LGU) in Allegan County are projected to see some population growth, while others in the County are expected to decrease.**

Based on projected population growth and anticipated groundwater demand, cumulative groundwater overuse doesn’t appear to be an imminent threat.



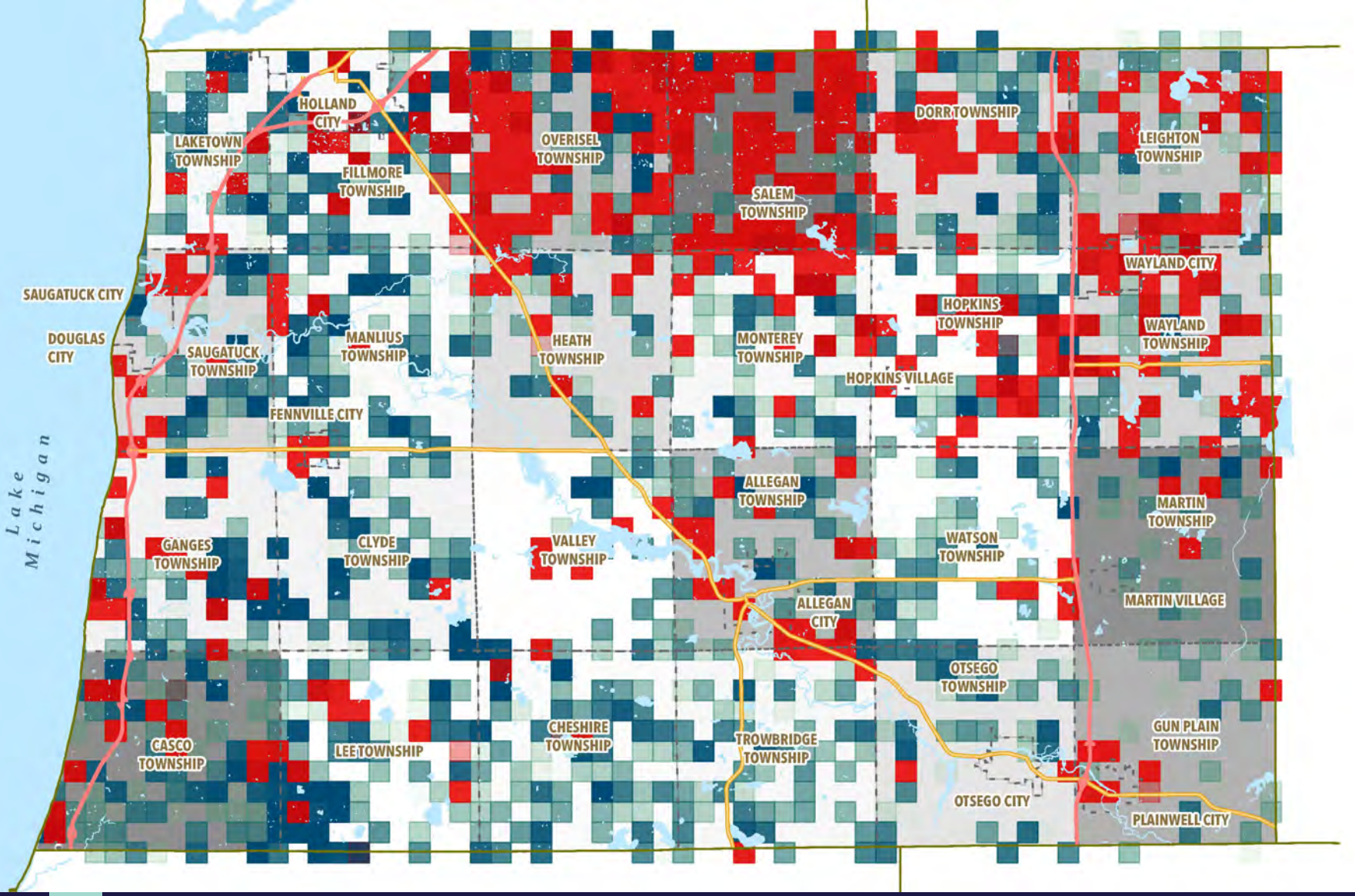
Note that the demand for cities and villages are included in their respective Township.

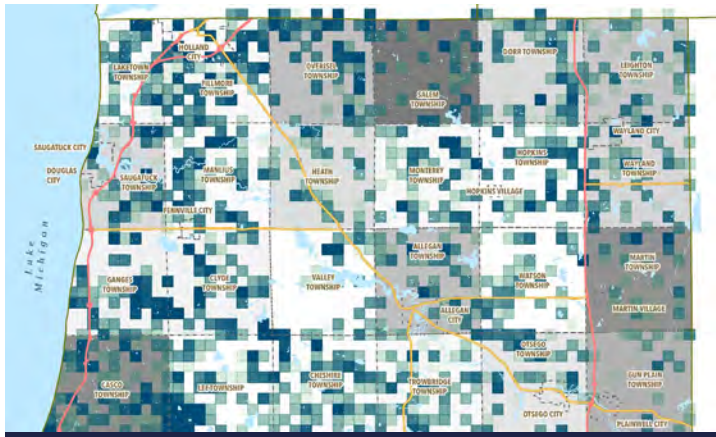
Projected Groundwater Demand

By Local Government Unit (2050)

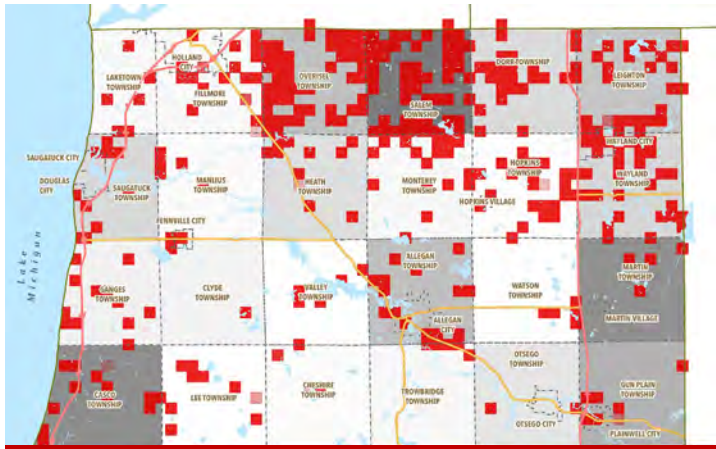
There are places within the County that are experiencing growth and are expected to continue that trend. This has the potential to put increased demand on limited local groundwater resources.

- **Salem, Martin, and Casco are projected to have the highest groundwater demand 2050.**
- **Leighton Township's increase in water use could be higher than any other Township (+287,297 GPD).**





Poor Glacial Transmissivity



Poor Bedrock Transmissivity

Project GW Demand + Transmissivity

Projected growth in certain areas of the County warrant long term monitoring and planning, particularly in areas with limited groundwater resources.

This will provide local governments with the data needed to better manage and protect their groundwater resources.

Allegan County Groundwater Research Q&A

A panel discussion.

Allegan County

Groundwater Research Q&A Panel

PANELIST:

Dan Whalen, PE, Williams & Works

Hydrogeological engineer

PANELIST:

Zachary Curtis, Ph.D., Hydrosimulatics Inc.

Hydrogeologist

PANELIST:

Randy Rapp, RS, Allegan County Health Department

Health services manager

FACILITATOR:

Maleah Rakestraw, PLA, Williams & Works

Meeting facilitator

Question 1:

What controls and procedures are currently used to protect groundwater quality?

Question 2:

What can be done if contaminants enter the aquifer?

Question 3:

What can communities do to protect groundwater from overuse?

Question 4:

How can climate impact groundwater resources in the future?

Question 5:

Allegan County placed monitoring wells in 2022 and is expanding this program.

How is monitoring helpful and what is done with the information gathered?

Questions from the audience.

As time permits. Please form a line behind the standing microphone.
We ask that participants limit their questions to one per person.

Let’s Talk!

Group discussion and small group brainstorming.

Next Steps

Moving the process forward.

Next Steps

Finalize the Groundwater Assessment Report and distribute to the local governments

Synthesize feedback gathered during this workshop and share the results with the Allegan County Groundwater Work Study Group

Develop preliminary groundwater strategies

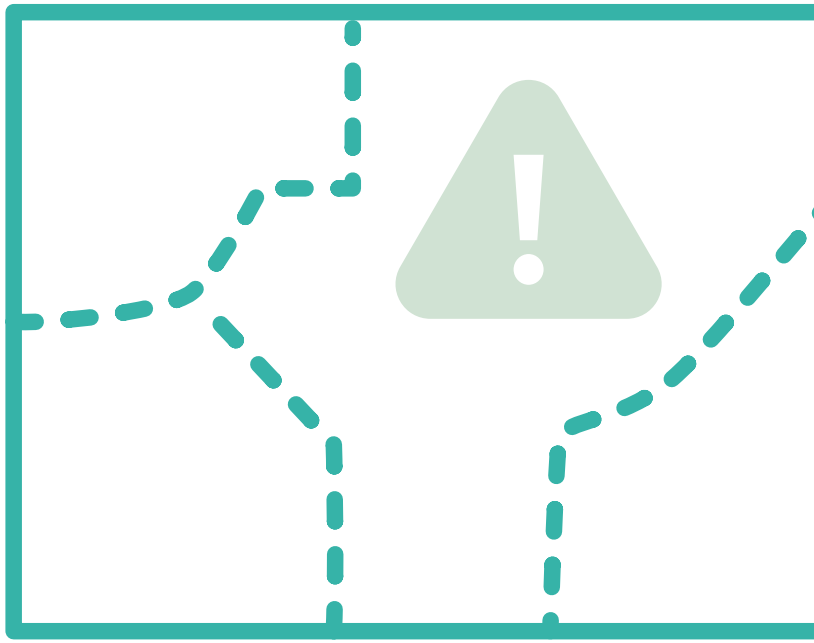
Convene a follow-up gov. workshop to discuss and refine strategies for groundwater management

The groundwater protection area encompasses all of Allegan County. Neighboring counties to the south and east have greater potential outside impacts on groundwater conditions than those to the north.

Key Takeaway

Groundwater Protection Area

The highest risk sites of groundwater concern (point source pollution) were generally clustered around population centers, while non-point source pollution concentrations were found in both urban and rural areas.



Key Takeaway

Areas of Concern & Water Quality Risks

Cumulative groundwater overuse doesn’t appear to be an imminent threat in Allegan County, although some areas are project to grow faster and have more limited groundwater resources, warranting long term monitoring and planning.

Key Takeaway

Demand & Future Projections

Thank you all for joining!