



# MICHIGAN GEOLOGICAL SURVEY

## An Update on Michigan Geology Ottawa County Water Quality Forum

Why do we need the  
Michigan Geological Survey?

JOHN A. YELLICH, CPG  
DIRECTOR

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[JOHN.A.YELLICH@WMICH.EDU](mailto:JOHN.A.YELLICH@WMICH.EDU)

269-387-8649



# Travel promotions for Michigan Water is Michigan - 1950's to present





1. The complexity of the Michigan glacial geology is based on the advance and retreat of multiple glaciers across Michigan.
2. ~200,000 to 10,000 years ago glaciers covered MI during the Ice Ages.
3. Glacial geology is rock “mined” from bedrock and deposited/left behind at the surface.
4. Too many assumptions are made without geology.





# What is Michigan Geology?

What is Michigan's most critical natural resource in the LP and UP for today and future generations?

**Water!**

**Michigan Geology in the LP is:**

- Not uniform, vertically and laterally!
- Groundwater
- Surface water
- Wetlands
- Aggregates

What do we know about the water resource?

**Almost NOTHING!**



# A defensible understanding of the geology of an area is done by validating geologic data and mapping

- The Michigan Geological Survey has supported mapping since the 1970's.
- Since 1993, MGS could participate in the following **USGS** geologic mapping programs having a 1:1 \$ Match
  - STATEMAP
  - Great Lakes Geologic Mapping Coalition
  - EDMAP (Student mapping training)
- Was or is there additional funding?
- What other mapping has been done?



## **PA- 167 What is the role of a geological survey?**

- **Provide scientifically validated research and the data necessary for appropriate natural resource protection, discovery, assessment and management.**
- **Act as an independent, un-biased authority on geological matters underpinning Michigan's natural resource protection and management.**
- **Provide and preserve geologic records that can support the natural resource decision makers, public and private.**

# Michigan Mapping products- 40 years



- Selective county geologic compilations were completed in late 1970's and 80's, circa 1982.
  - Allegan
  - Kalamazoo
  - St. Joseph
  - Ingham
- These products were the result of data compilation with partial field confirmation.
- What is more recent? 2012-present
  - Calhoun
  - Barry
  - Cass
- A transition to more validated data with drilling and sample analysis.
- Other county maps, from various funding/research products can be seen and acquired at the MGS store:
- [https://secure.touchnet.net/C21782\\_ustores/web/classic/store\\_main.jsp?STOREID=76&SINGLESTORE=true](https://secure.touchnet.net/C21782_ustores/web/classic/store_main.jsp?STOREID=76&SINGLESTORE=true)



# Water issues by county

**Michigan Lower Peninsula, ~ 60 of drinking water is from glacial sediments what is important?**

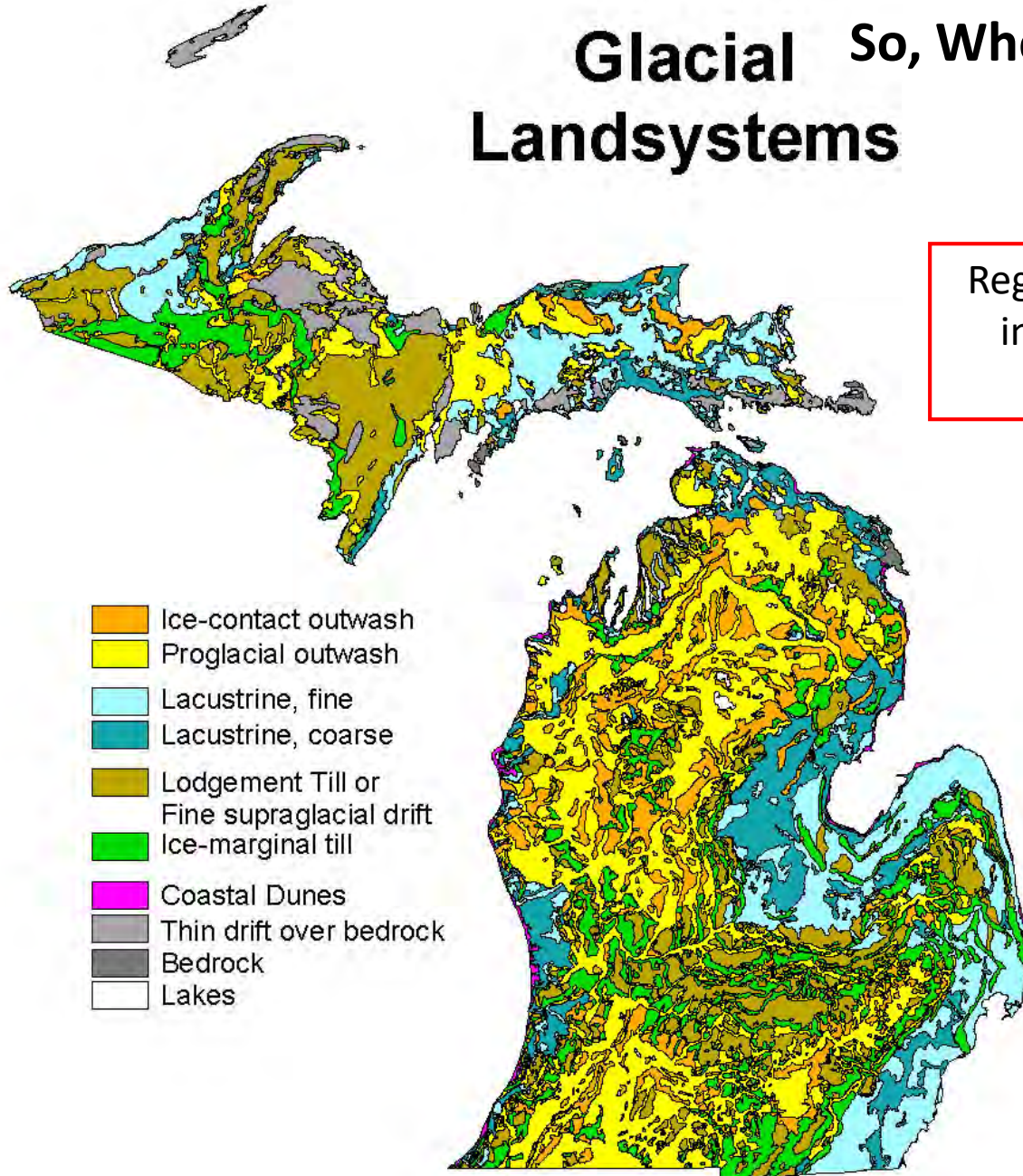
**Quality and Quantity by County or region**

- Cass
- Ottawa
- Branch
- Allegan
- Ionia
- Montcalm
- Kent
- Calhoun
- St. Joseph
- Kalamazoo,
  - to name a few, not just the western portion of Michigan



# Glacial Landsystems

## So, Where do we begin?

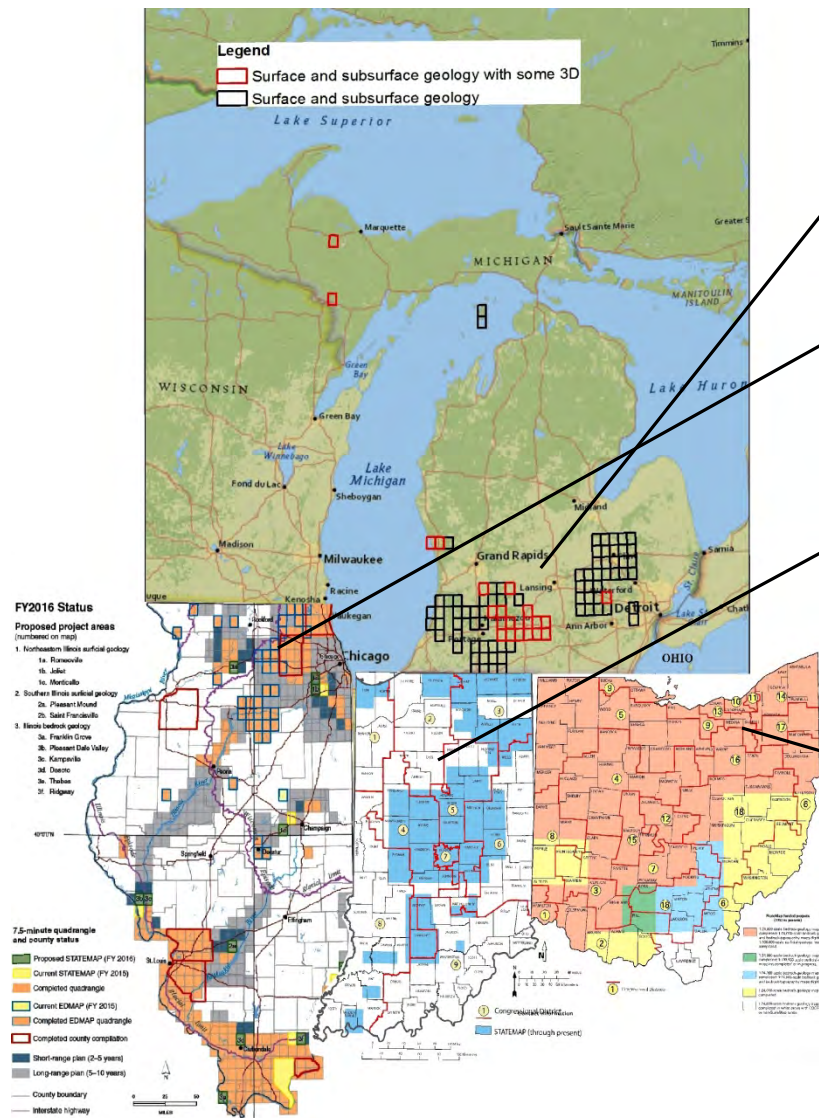


Regulatory, Consulting and Mi WWAT interpretations and decisions are made using this map.

- This surficial geology map is based on 1915 data, with minimal changes in 1955, and 1982. This is **ONLY** a surficial geology map.
- No subsurface validation.

**The role of the Survey is to provide updated mapping in priority areas.**

# Mapping-Michigan versus adjoining states!



Federal matching dollars in the last 25 years

✘ **Michigan**, no dedicated funds in 25 years, not until 2014, \$44,000 to support mapping in Cass County, < 10% mapped. (\$1.751 M = **\$72.9 K/yr**).

✘ **Illinois**, mapping in high impact and use areas, many priority areas for 3D mapping, ~ 30% mapped. (\$4.987M=**\$207.8 K/yr**).

✘ **Indiana**, mapping in high impact areas, some priority 3D mapping, ~ 40% mapped. (\$4.276 M=**\$178.2 K/yr**).

✘ **Ohio**, funding from energy and minerals, geo-hazards for mapping in addition to Fed funds ~ 80% mapped (\$3.069 M=**\$127.9 K/yr**).

✘ **Wisconsin**, mapping impact areas, \$3.762 M = **\$156.7k/ year**

✘ **Minnesota**, mapping impact areas, \$2.834 M = **\$118.3k/year**.

# Map comparison 1982 versus 2018

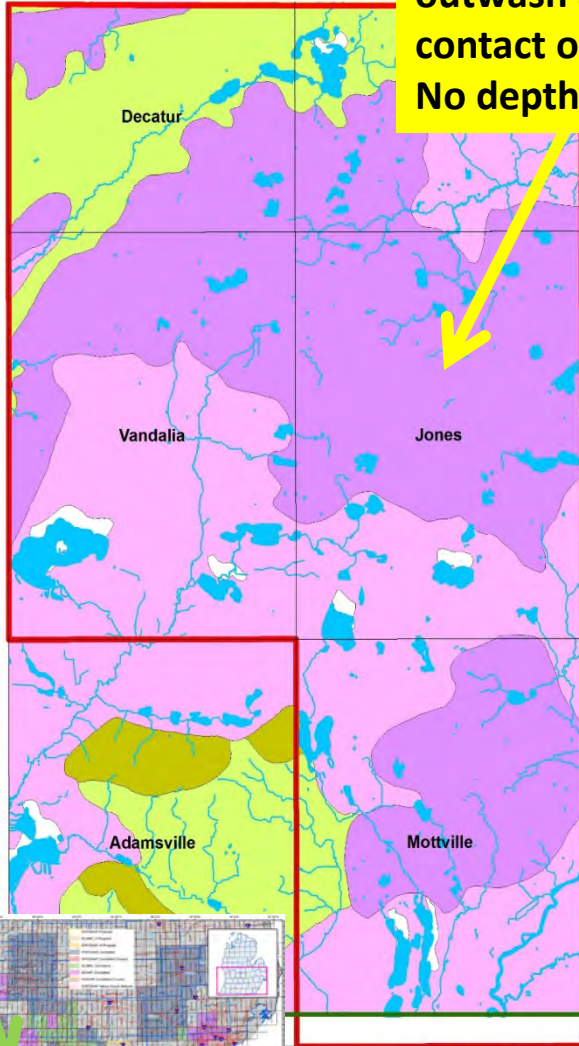


Cass County

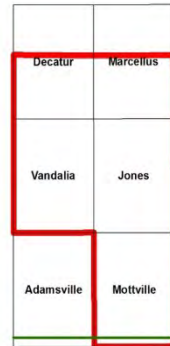
1982 interprets this as  
outwash and ice  
contact outwash.  
No depth to bedrock.

2018 Diamicton/till at the  
surface, outwash below.  
Wells 160-220' mapping  
determined 380-450'

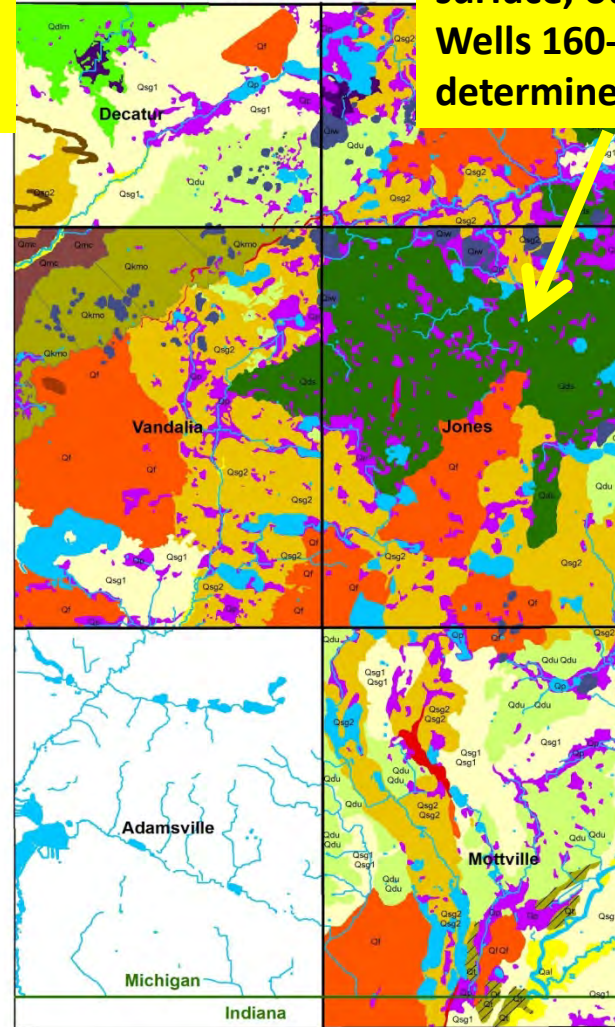
Quaternary Geology of Michigan (F)



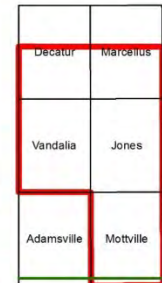
- Legend**
- Glacial outwash sand and gravel and postglacial alluvium
  - Ice-contact outwash sand and gravel
  - Coarse-textured glacial till
  - End moraines of coarse-textured till



Surficial Geology



- Legend**
- Qp Peat
  - Qal Alluvium
  - Qsg2 Outwash pitted
  - Qsg1 Outwash
  - Qe Esker
  - Qr Fan
  - Qsd Sand dunes
  - Qmc Glacial Lacustrine
  - Qdu Diamicton Undiff
  - Qds Diamicton Saginaw
  - Qk Kame field
  - Qdlm Diamicton Lake MI
  - Qkmo Outer Kalamazoo Mor
  - Qt Terrace
  - Qiw Ice Walled lake plain
  - Ql Lacustrine



# Water issues-Ottawa and Allegan Counties



## Ottawa and Allegan Counties have unique geologic settings

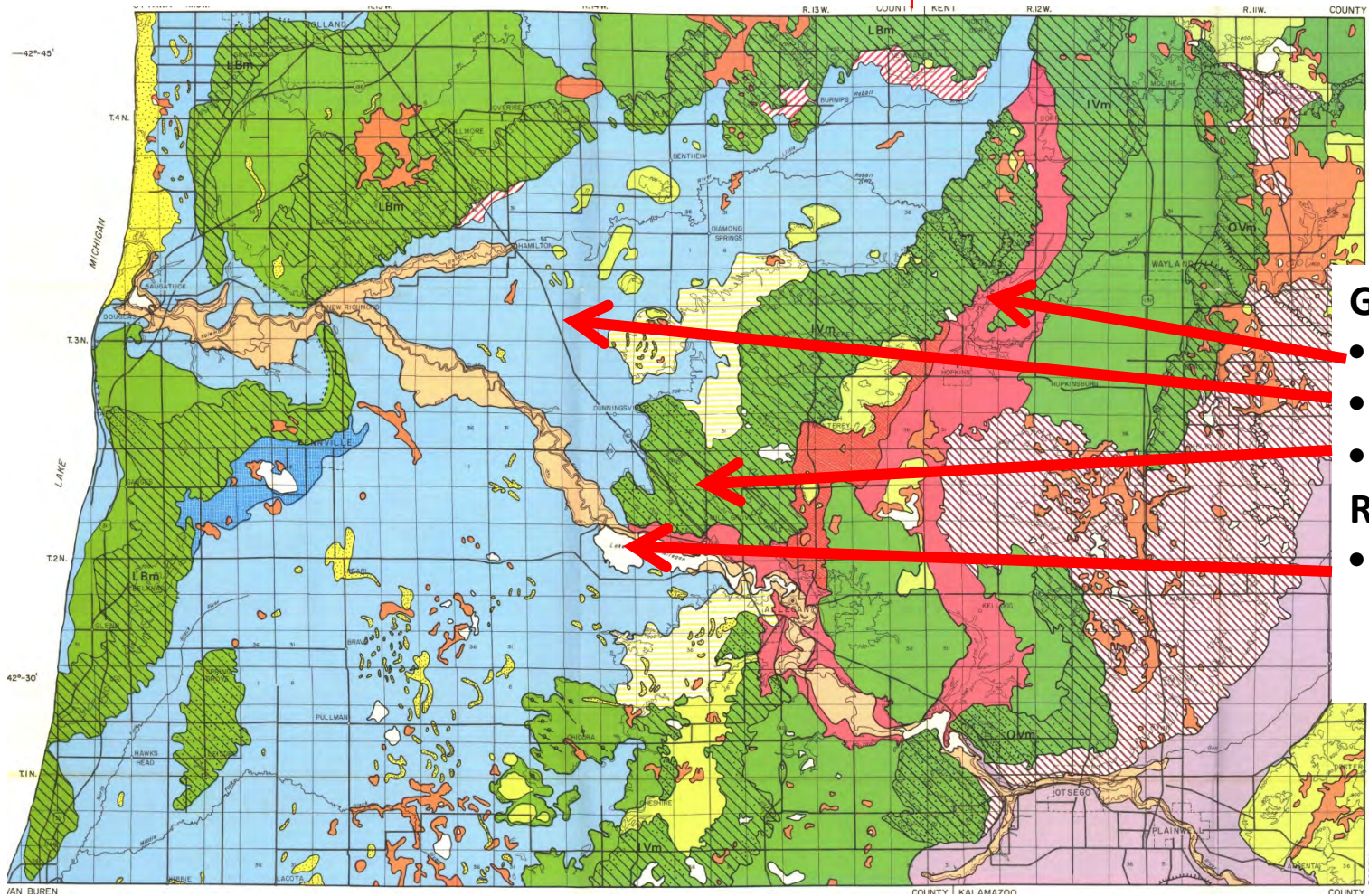
### Similar geologic characteristics.

- Groundwater is in both the glacial and bedrock (Marshall ss).
- Glacial groundwater is not ubiquitous, selective geologic environment horizontally and vertically.

### Different geologic characteristics.

- Marshall aquifer in Ottawa has been impacted by chlorides, caused by over use/withdrawals, not Allegan.
- Selective Ottawa bedrock and glacial waters have chloride impacts from early energy wells.
- Marshall aquifer hydrologic characteristics change from central Ottawa to NE Allegan, a Southeast positive trend
  - Communication with glacial system and permeability (geologic).

# 1982 Allegan County Surficial Geologic Map



## Glacial

- Outwash
- Lake Clays
- Till

## Recent

- River Gravels-Outwash

No similar mapping products for Ottawa County, just selective surficial data.



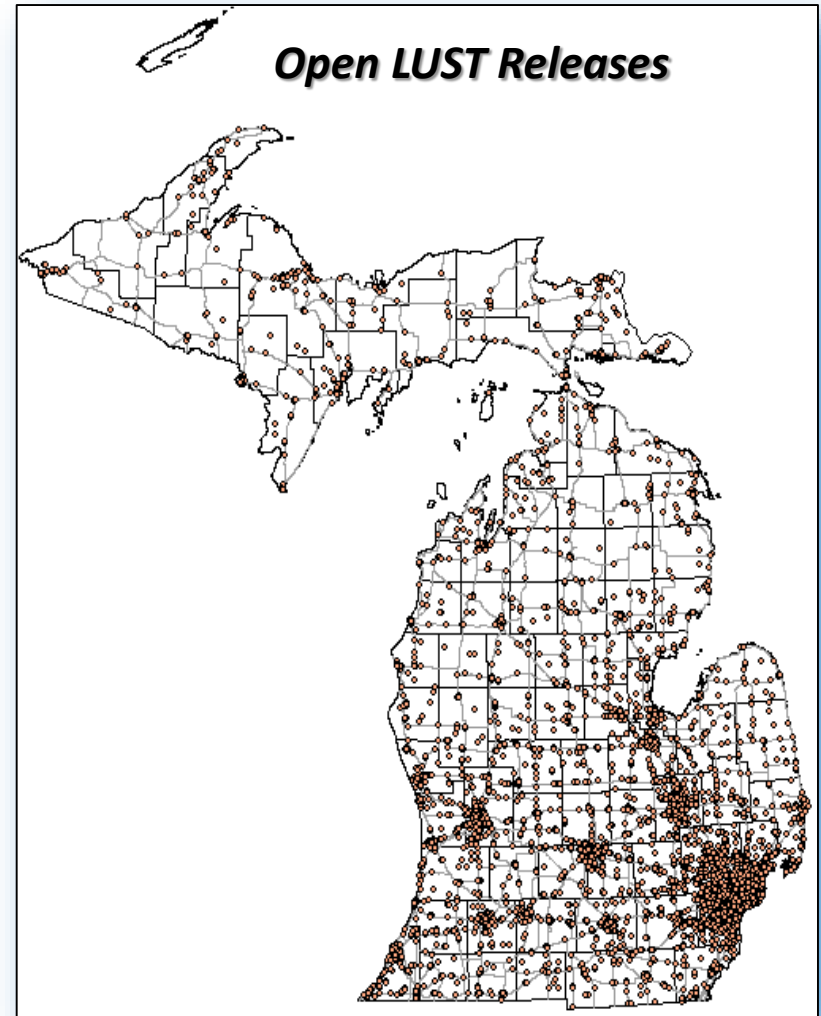
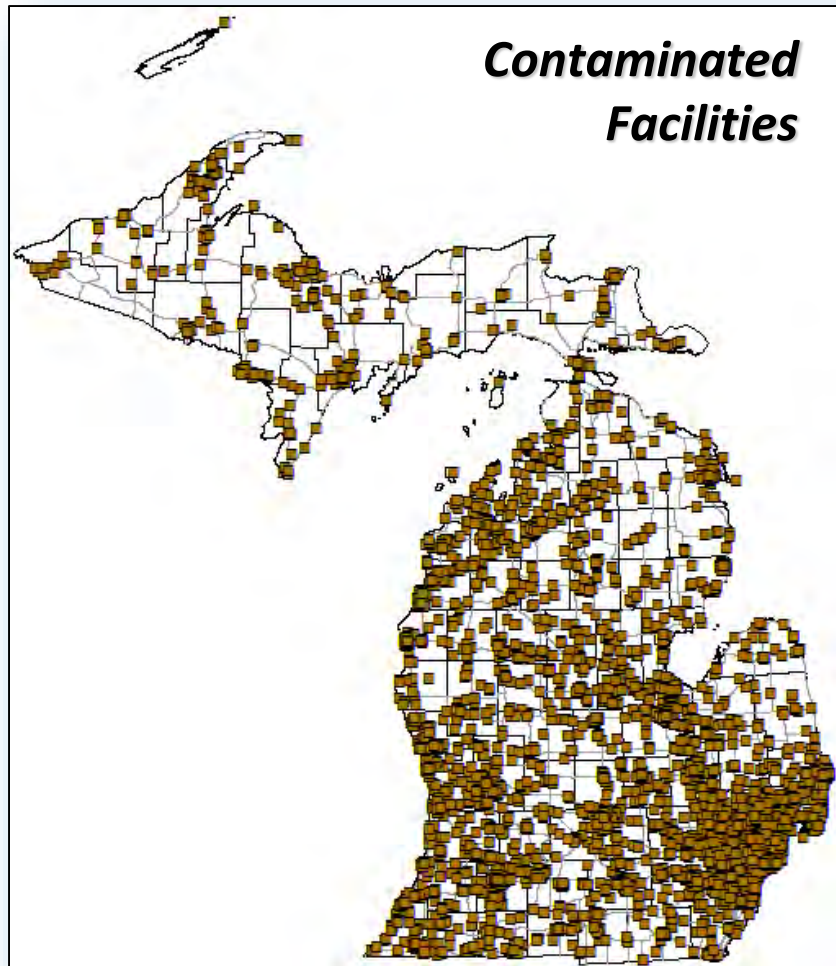


# Kicking the geology can down the road!

## 1970's - Michigan legislature did not maintain survey funding

- Legislature determined consultants and staff can provide the geologic data.
  - State could then compile the data, but did they allocate dollars?
  - No urgency in doing subsurface or surface mapping.
- So where is the “geology can” now?
  - No funding for the state departments to compile the data.
  - “Use what we have”, “no time, no money” has been the mantra for geologic data.
  - Data costs money to compile and maintain so there were no staff costs attached to data compilation. Everyone must compile it themselves.
- What did Michigan do to stimulate a greater understanding of the natural resources for the economy for the last 30 years?
  - NOTHING!
- Here are some examples of “kicking the geology can down the road”!!!

**Lets review the history of Data!**  
**EGLE -Estimated 30,000 sites**  
**Hazardous Substances**  
**Released to the Environment**



**1980's Pre – CERCLA**  
**to present-geologic data**  
**No geologic data compilation**



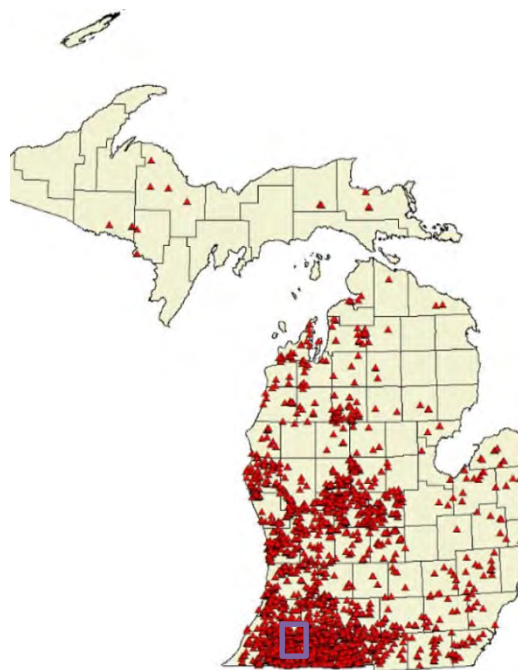


# MI WWAT Applications vs detailed GEOLOGIC Map Products

Approximately 60% of the LP groundwater comes from glacial material

Mi WWAT Applications >70 GPM through 2018 for comparison

Beginning in ~2003 (Water Withdrawal Assessment Tool- well drillers logs, non-factual model)



This is the real summary of mapping of the detailed combined surface and subsurface by MGS, USGS or others for Lower Peninsula.

Less than 10 % Detailed MGS mapping.

\* **Quads** (~56 Sq Mi)

- Black - Surface only with validation of borings
- Red - surface + some subsurface drilling / geology 3D

# Michigan must INVEST IN science

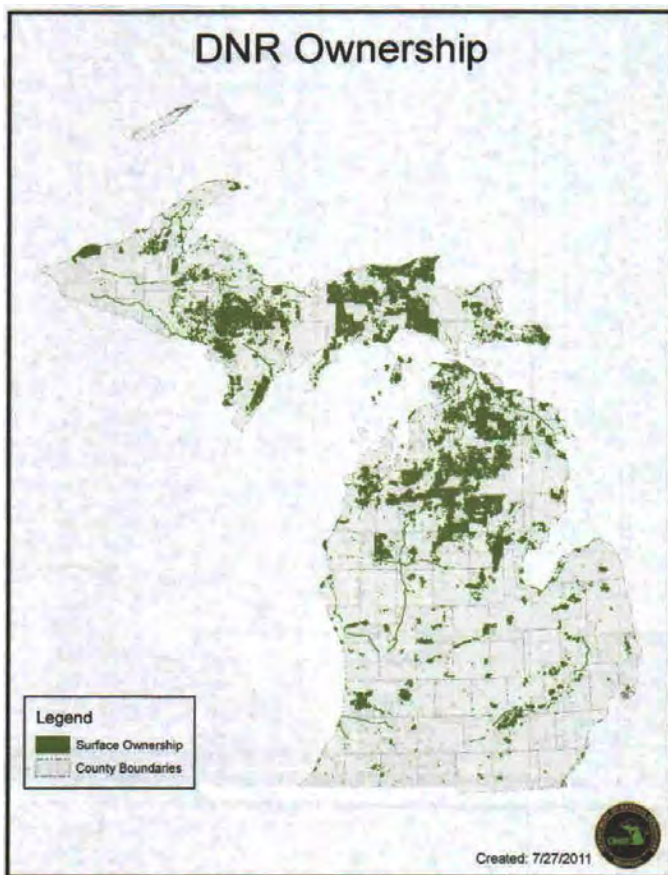


## Summary of State land vs Open file validated mapping products

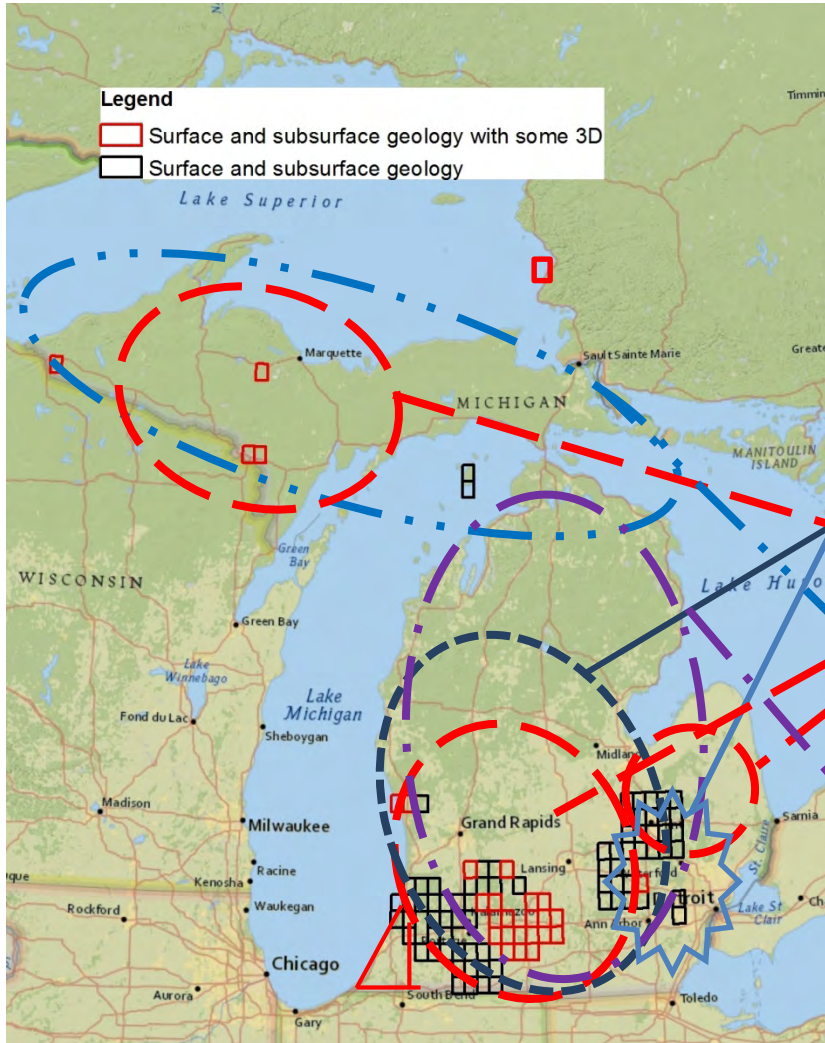
STATE LAND MANAGEMENT - Minimal open file geologic data

~4.6 MILLION ACRES


All acquisitions should have open file geologic data before purchase.



# Can MICHIGAN grasp the RESOURCE issues?




Here are the results of the 2016 MGS survey of what and where geologic and scientific data is needed?

Priority mineral, aggregate need & availability? 

Mineral, aggregate & water data required. 

Water quality and quantity data? 

Define metallic and non-metallic mineral potential. 

Energy -Development & Storage. 

## Does Michigan have the data to assess the Resources?

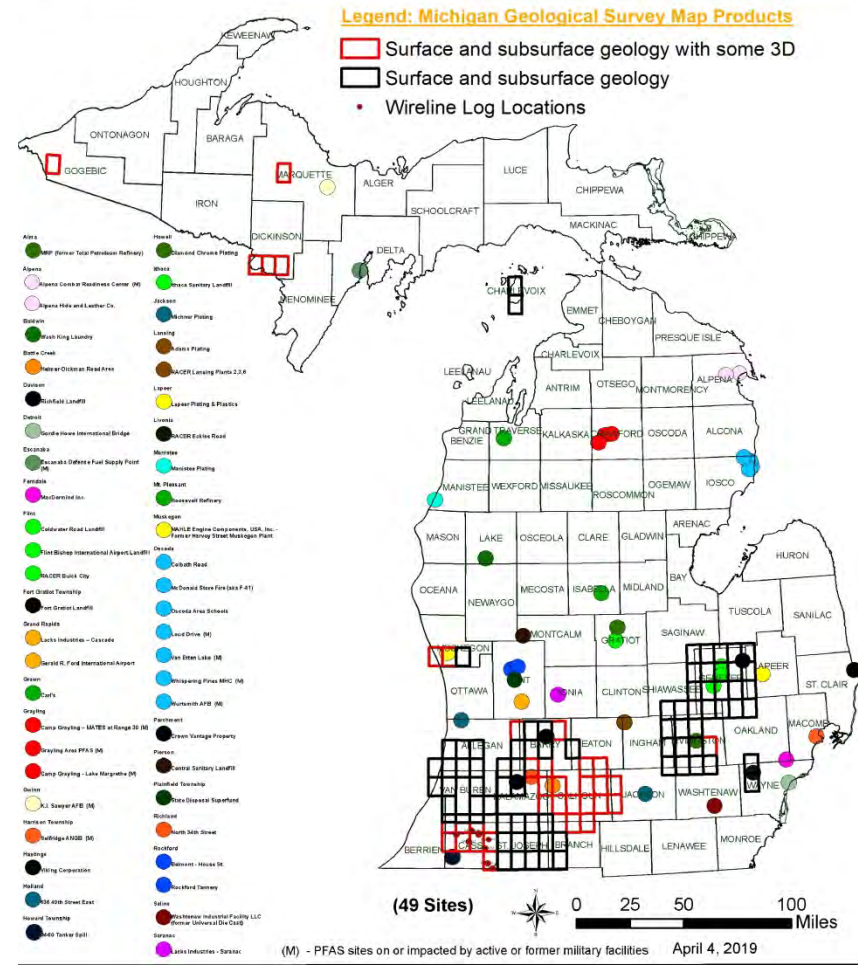


# What is the new Michigan contaminant crisis?

## Michigan –

### the Water Wonderland!

- Perfluorinated Alkyl Substances (PFAS) – Soils and water.
- Multiple locations throughout Michigan and there may be more.
- Where Michigan has open file subsurface geologic data.
- What's wrong with this picture?



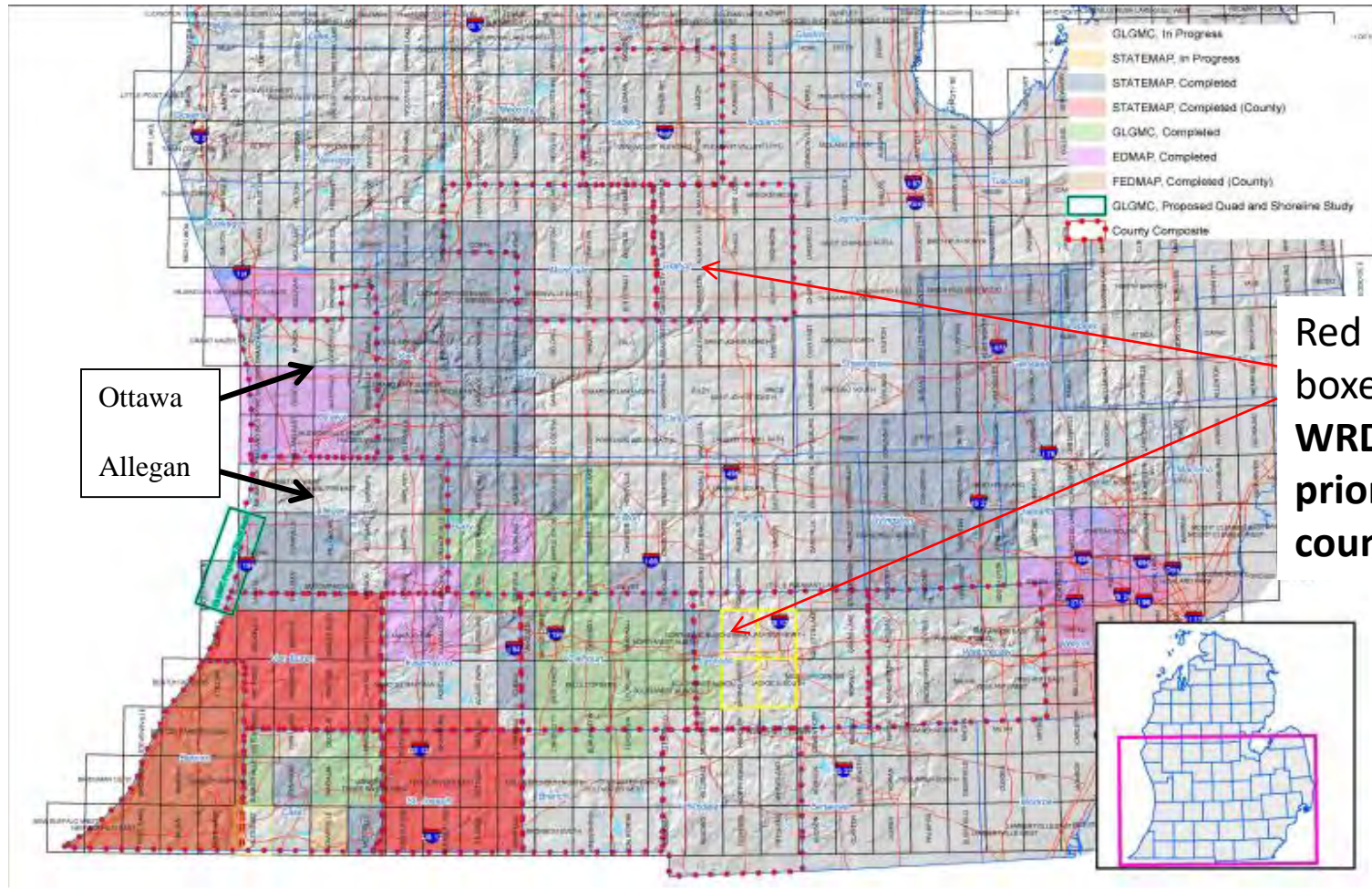
# What State Departments or Agencies have written letters of support to map – counties?



October 2019

- EGLE – Water Resource Division (WRD), 13 priority counties, for WWAT tool.
- DNR – Mineral Management Division – Aggregate resources.
- MDARD – Agriculture, understand the location and protection of the water resources.
- MFB – Farm Bureau, support for farmers and water resource identification and protection.

# Proposed initial county mapping program



Ottawa  
Allegan

Red dashed boxes  
**WRD - 13**  
priority counties



# So how can geologic info be presented today?

## Priority Driven Areas- Validated Research & Data

### Combine new and proven technologies and methods

- 3D maps and reports are needed with validated information, in real time.
- Data in formats (e.g. ArcGIS) accessed by phones, tablets, laptops, actively showing multi layers of data..... in seconds, in the field.
- Secondary mapping products of surface and subsurface data include: Water tables, water bearing zones, surface drainage, aggregates, wetlands, recharge areas, deeper subsurface research and data, etc.
- Interactive electronic standard databases to capture existing and new data.
- 21<sup>st</sup> Users: Citizen scientists, city and county planners & developers, geologists, earth scientists, engineers, consultants, industry representatives, regulators.
- Where should you get your data, Wikipedia or the Geologic Survey?

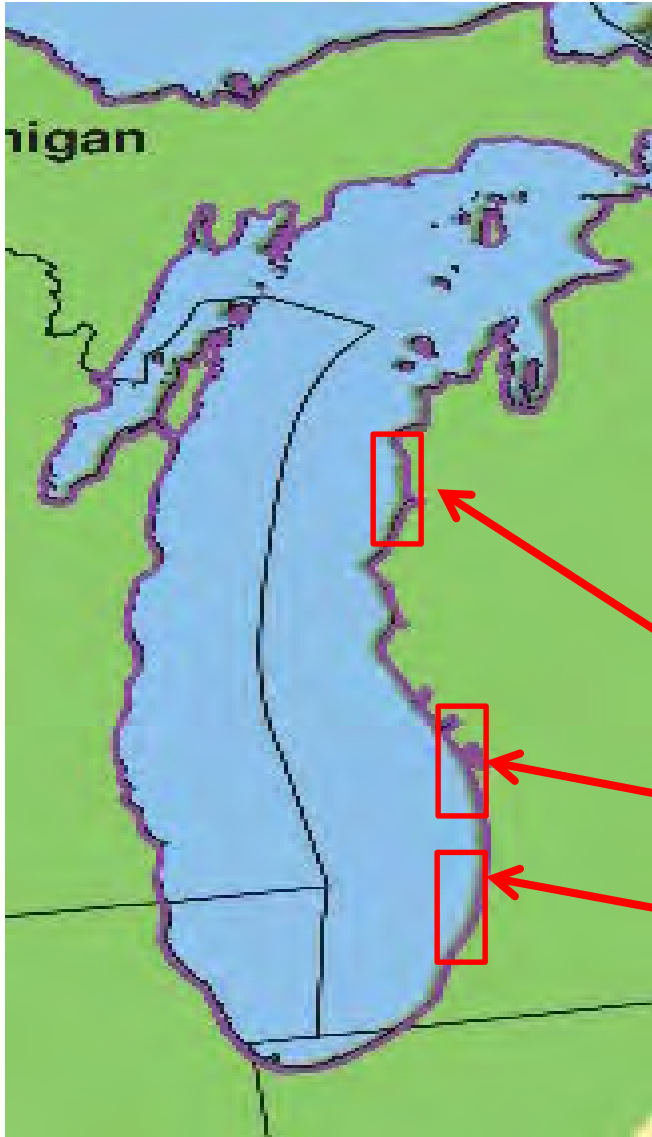
# So what is the answer to scientific data?



- **Priority driven areas!**
- **Use unbiased geological scientists, not data manipulators**
  - Scientists and public using data in open file format
- **What do we need to understand for today and future generations?**
  - **Geologic hydrostratigraphy,**
  - **3D geology, surficial down to bedrock,**
  - **Water storage and recharge,**
  - **Water Usage,**
  - **Water and aggregates occur together, and**
  - **This can support tracking the impacts from PFAS and other contaminants and identification and protection of those resources?**



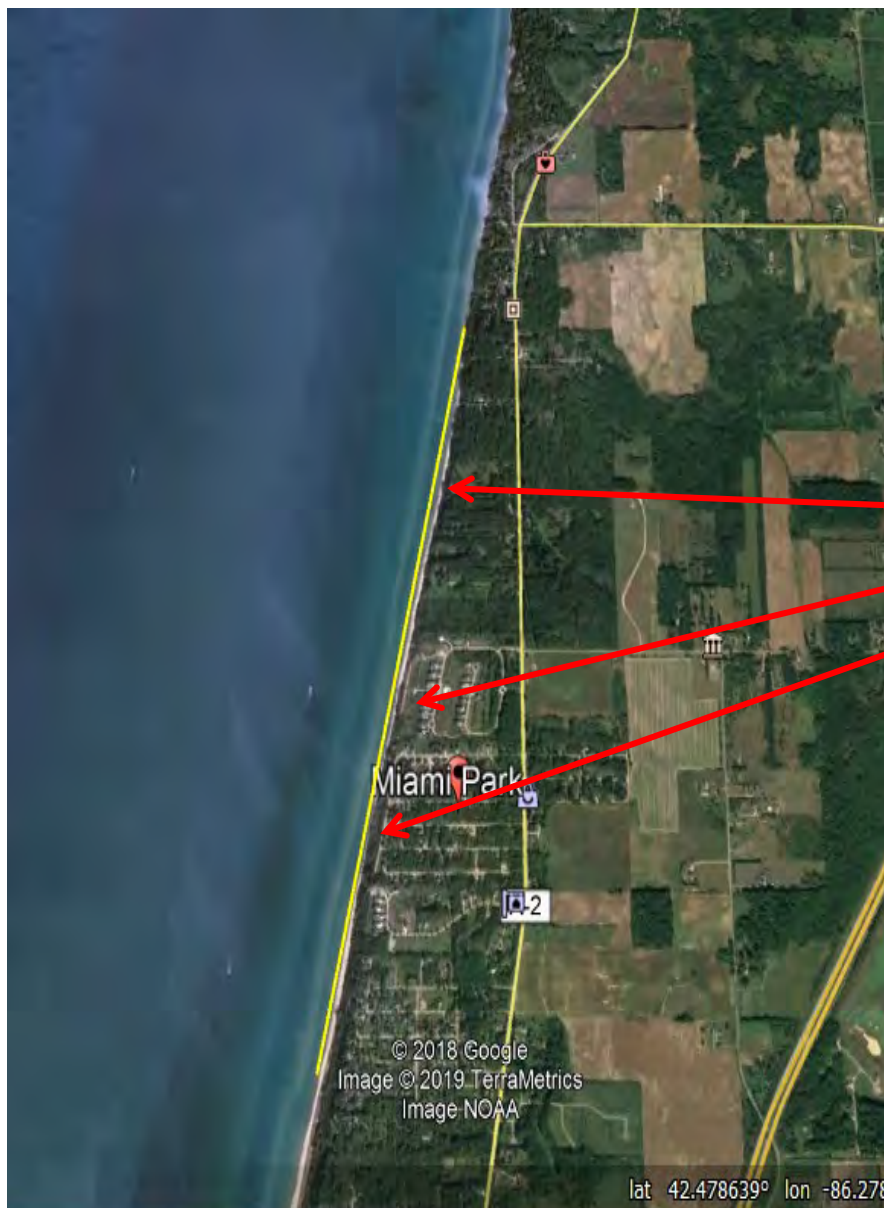
# MGS and USGS Bluff Resiliency Research



**10 year mapping research program  
Drone research to increase geologic  
mapping efficiency**

- Three bluff research areas.
- USGS collaboration with Wisconsin, Indiana, Illinois and Michigan Geological Surveys.
- What is the geology of the bluffs?
- Can geology be mapped with drones?
- Look at three areas in Michigan.
  - Ludington/Pentwater unpopulated on bluff
  - Miami Park South, Rural rentals and homes
  - St. Joseph, City, populated area

# Drone Pictures October 18, 2019



- Casco Township Nature Park
- Boardwalk
- Miami Park elevator



**October 18, 2019**

Water seeping at bluff face, failure below, Miami Park, 200 north of elevator at Lakeshore Drive

**October 18, 2019**

Dr. Ron Chase, WMU-bluff expert.  
Guzalay Sataer-PhD Candidate  
Dr. Kevin Kincare-USGS geologist



**August 29, 2019 failure, Pacific Road and Lakeshore, Miami Park, Picture Sept. 1, 2019**



Rock retainer installed July 2019, causing destruction of bluff to south. Retainer is also failing after 3 months.

**Miami Park So, October 18, Lake Shore at Miami Rd. at the elevator**



August 29 bluff failure, gone, October 18, 2018

Rock retainer installed July 2019, causing destruction of bluff to south. Retainer is also failing after 3 months.

**Looking south from Miami Park elevator rock structure.  
Miami Park So, October 18, Lake Shore at Miami Rd Looking south from elevator**



- **Boardwalk just north of Miami Park, October 18, 2019**



**Google Earth photo 9-22-18**

**Casco Township Nature Park**

**Stairway down to shoreline**





**Casco Township, Nature Park, 3,200' North of Miami Park ,Oct. 18, 2019**

# Michigan Geological Survey



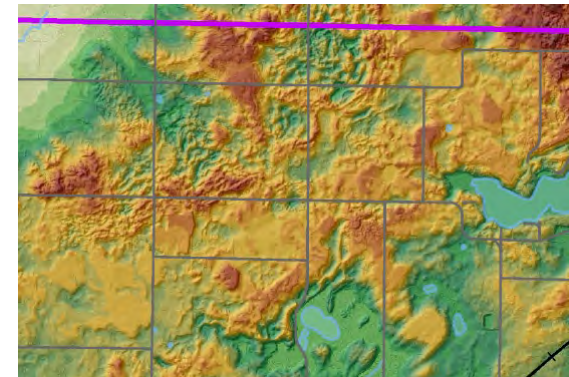
Summary as of May 1, 2015

**MICHIGAN GEOLOGICAL SURVEY (MGS) - STATE DATA SUMMARY**  
WITH DATA LOCATION NOTED

| County  | Number of BRD<br>like entries in<br>Michigan | BRD Files | Oil and Gas<br>(DOGMI) permitted<br>permits | Welllogit<br>water wells | Number of O&G<br>Wireline log<br>files, notams | Shallow bedrock<br>cored wells at<br>MGS/MI- WWMI | Drill cuttings<br>sets MGS/MI |
|---------|--|-----------|---|--------------------------|--|---|-------------------------------|
| Alcona  | 108  |           | 558   | 3,300                    | 755  | 0   | 73                            |
| Alger   | 56   |           | 0   | 2,288                    | 4  | 0   | 1                             |
| Allegan | 1,642  |           | 3,473                                       | 11,927                   | 654  | 0   | 892                           |
| Alpena  | 321  |           | 1,469                                       | 2,877                    | 1,967  | 2   | 116                           |
| Antrim  | 208  |           | 2,750                                       | 4,356                    | 2,291  | 0   | 181                           |
| Arenac  | 362  |           | 1,076                                       | 2,458                    | 437  | 0   | 711                           |



Thank you  
Questions?



269-387-8649 john.a.yellich@wmich.edu

