

Utilizing MDOT's Bridge High Flow Event Monitoring Site

Website: [Bridge High Flow Event Monitoring](#)

Purpose: This document was designed to help aid the utilization of the newly released MDOT Bridge High Flow Event Monitoring website.

As per the Michigan Structure Inspection Manual (MiSIM), a Scour Plan of Action (POA) is required for all bridges where Item 113 is coded ≤ 3 or U. In addition, structures that are owned by MDOT and have Item 113 coded 7 will also have a POA developed. The Bridge High Flow Event Monitoring site displays existing stream gauges and weather patterns within the vicinity of Michigan structures that are rated scour critical, have unknown foundations or have existing countermeasures to prevent additional scour.

The site is linked with U.S. Geological Survey (USGS) and the National Oceanic and Atmospheric Association (NOAA) data to provide past and present rain events, stream flows and water heights. This information can be monitored before, during and after events. It allows bridge owners to establish a more robust POA and more efficient monitoring programs. It should be understood that this information should not be a substitute for field reviews and verification of conditions.

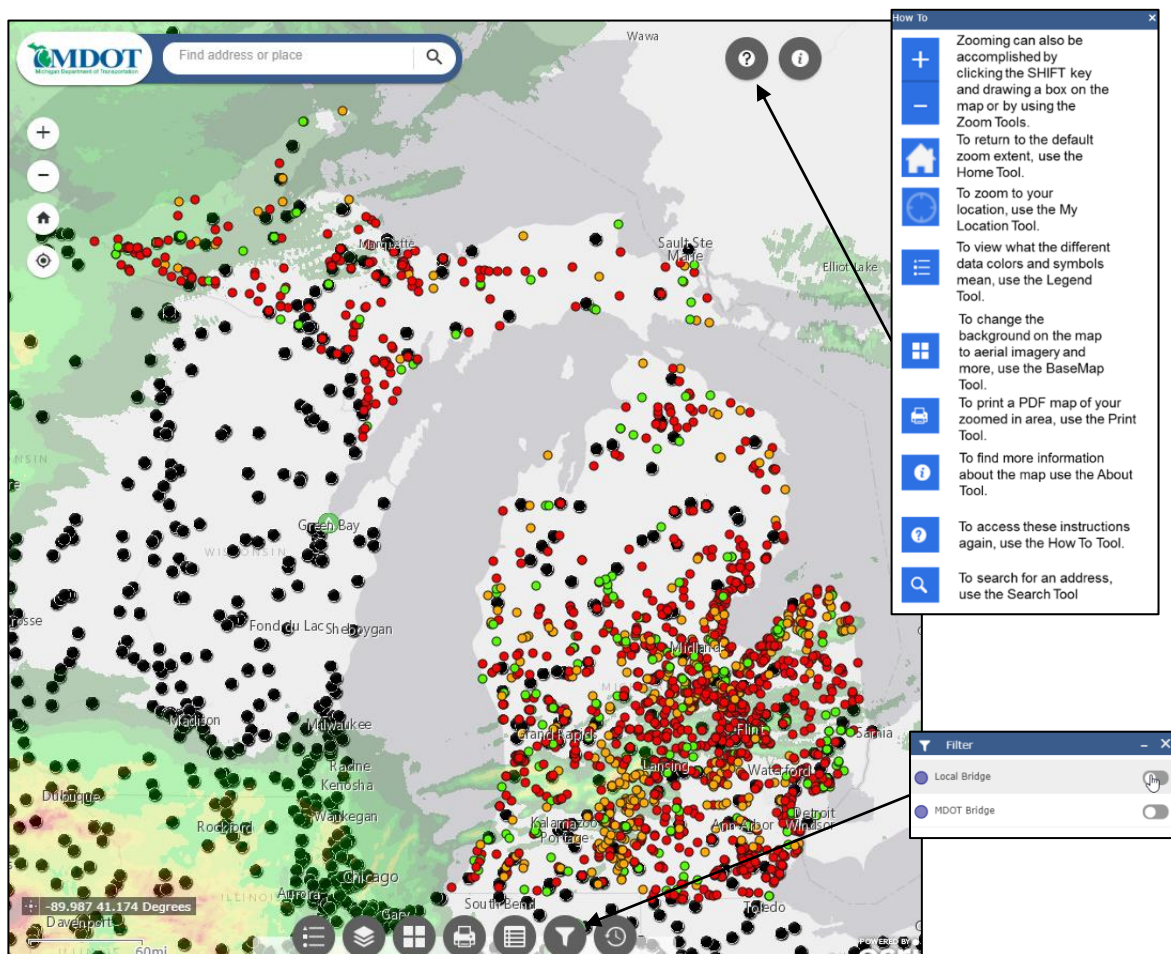



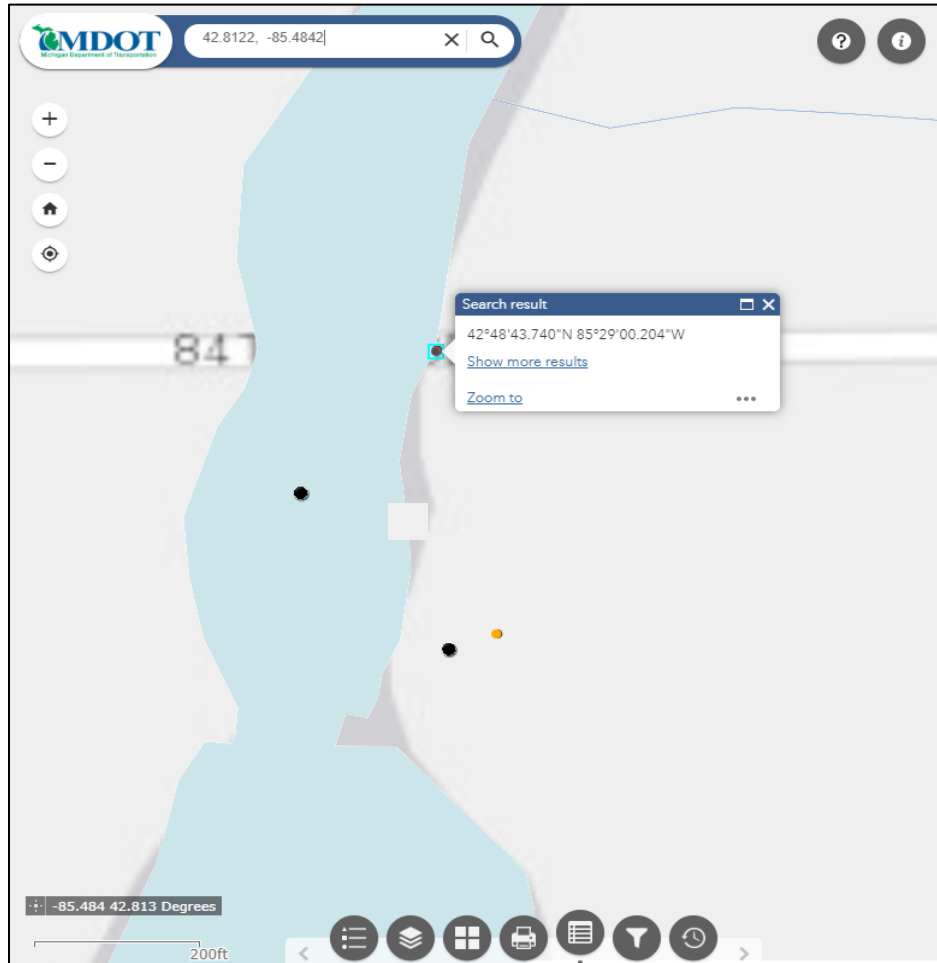
Figure 1: Points marking Michigan structures and stream gauges (Red – 3, Scour Critical; Green – 7, Countermeasures installed, no longer Scour Critical; Orange – U, Unknown foundation has not been evaluated, Black = USGS/NOAA Steam Gauge)

1. Locating a Structure of Interest:**Option 1: GPS**

Utilize the *Find address or place* search box in the top left corner adjacent to the MDOT logo.

Input GPS coordinates of desired structure.

Press enter or click . Note: The map will locate the desired point of interest and may cover the point designating the structure.



View of GPS search (covering structure point)

Option 2: Attribute Table

Utilizing the *Attribute Table* icon in the bottom menu, the list will contain all bridges visible within the window. The list in the *Attribute Table* can be filtered to easily find the structure of interest based on any of the columns present.

MDOT Bridge High Flow Event Monitoring

Find address or place

Scour Critical Bridge Live Stream Gauges Live Stream Gauges NHD Springs and Wells NHD Point WBD Hydrologic Unit 12 WBD Hydrologic Unit 12

Options Filter by map extent Zoom to Clear selection Refresh

OWNER	FACILITY	FEATINT	STRC_NUM	COUNTY	REGION	AREA	CLEAR_RDWY	LANES	ADT	YEARBUILT
Bay County	CHIP ROAD	N BR KAWKAWLIN RIVER	677	Bay	Bay	1,546	24.00	2	438	1930
Bay County	FRASER ST	KAWKAWLIN RIVER	678	Bay	Bay	4,379	24.00	2	784	1959
Bay County	BEAVER ROAD	WALDO DRAIN	679	Bay	Bay	622	22.00	2	1,075	1932
Bay County	BEAVER ROAD	KAWKAWLIN RIVER	682	Bay	Bay	2,064	40.00	2	2,870	1987
Bay County	BEAVER ROAD	KAWKAWLIN RIVER	683	Bay	Bay	1,624	22.00	2	3,404	1928
Bay County	GARFIELD ROAD	WALDO DRAIN	697	Bay	Bay	779	28.50	2	2,253	1931
Bay County	MONITOR ROAD	HILL POND DRAIN	710	Bay	Bay	1,217	38.10	2	796	1972

207 features 1 selected

View of Attribute Table

Utilizing *Filter* within the *Options*, click on *Add Expression* to allow for filtering based on multiple criteria.

Filter

Add expression Add set

Display features in the layer that match the following expression

:CTID (Number) is

OBJECTID (Number)
FID (Number)
Structure Number (Number)
ID (String)
Owner (String)
Facility (String)
Feature Intersects (String)
COUNTY (String)
Region (String)
Area (Number)
Clear Roadway (Number)
Lanes (Number)
ADT (Number)
Year Built (Number)
Year Reconstruct (Number)
Main Structure Type (Number)
Inspection Date (Date)

3,343 1936 0
359 1965 0
286 1986 0
690 1988 0

Adding filters to Attribute Table

In this example, the filter is used to show data for a specific County.

The filter dialog shows the expression: County (String) is Midland. The table below lists bridge data for Midland County.

OWNER	FACILITY	FEATINT	STRC_NUM	COUNTY	REGION	AREA	CLEAR_RDWY	LANES	ADT	YEARBUILT	YE
MDOT	M-20	CHIPPEWA RIVER	6889	Midland	Bay	9,159	82.00	5	14,220	1940	1.4
MDOT	N-50	PEARL CREEK	6890	Midland	Bay	2,111	81.70	5	16,108	1938	1.4
MDOT	US-10 EB	BLUFF CREEK	6899	Midland	Bay	7,704	32.60	2	4,500	1962	2.0
MDOT	US-10 WB	BLUFF CREEK	6900	Midland	Bay	7,704	32.60	2	4,500	1962	2.0
Midland County	REDSTONE ROAD	PINE RIVER	6927	Midland	Bay	4,566	29.90	2	618	1979	0.9
Midland County	FREELAND ROAD	JO DRAIN	6932	Midland	Bay	1,076	36.00	2	2,318	1910	1.0
Midland County	PINE RIVER ROAD	PINE RIVER	6935	Midland	Bay	6,545	36.10	2	2,115	1970	0.9
Midland County	SHAFER ROAD	BLUFF CREEK	6939	Midland	Bay	870	29.90	2	1,404	1930	1.0
Midland County	COLEMAN ROAD	CHIPPEWA RIVER	6943	Midland	Bay	3,618	24.90	2	2,648	1962	0.9
Midland County	HERIDIAN ROAD	BULLOCK CREEK	6949	Midland	Bay	826	30.80	2	5,390	1935	0.9

Clicking on the left margin of a row will highlight the bridge of interest on the list and the map.

Additional filters can be added to reduce the number of visible points such as Owner.

For either search method, clicking on the point of interest will display a summary of the structure attributes which can be scrolled through.

The map shows stream gauges and associated information. Two popups are visible:

Thornapple River Near Caledonia, MI [USGS]

- Last Update: August 20, 2019
- Height: 3.57
- Flow: [Graph]
- Station Page: [More info](#)

Thornapple River at Caledonia [NOAA]

- Last Update: August 20, 2019
- Height: 3.62
- Flow: 390.00
- Station Page: [More info](#)

The map also shows a search bar with coordinates 42.8122, -85.4842 and a zoom level of 12.813 Degrees.

In this case, both USGS and NOAA have stream gauges in the area. Clicking on the image will display a larger image of current conditions. Clicking on *More info* will redirect users to the associated websites with additional stream gauge data collected in the past.

Plan of Action Benefit: If a stream gauge exists near a structure, this information should be recorded in the *Monitoring Program*. Include comments such as the general location of the device.

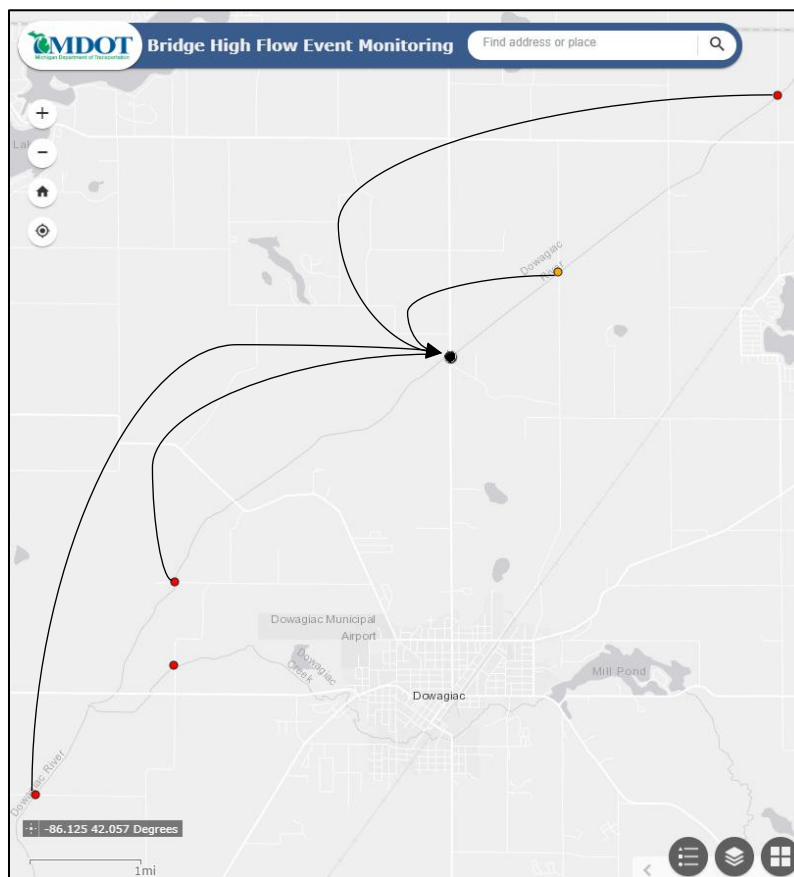
- NOAA/USGS Stream gauges “Muskegon River at Evert” present downstream of bridge

Plan of Action Benefit: Real-time stream data allows bridge owners to compare data to the existing Plan of Action for a structure and know when on-site monitoring or closures may be necessary. Additionally, bridge owners can correlate existing stream data to a specific frequency event (i.e. 100-yr event), to understand what calculated scour is predicted to occur during that event, in order to make more educated decisions.

2. Locating Structures based on Stream Gauges Nearby:

Viewing the map with the *Scour Critical Bridge* and *Live Stream Gauges* layers visible can allow bridge owners to associate nearby stream conditions with multiple structures in the area.

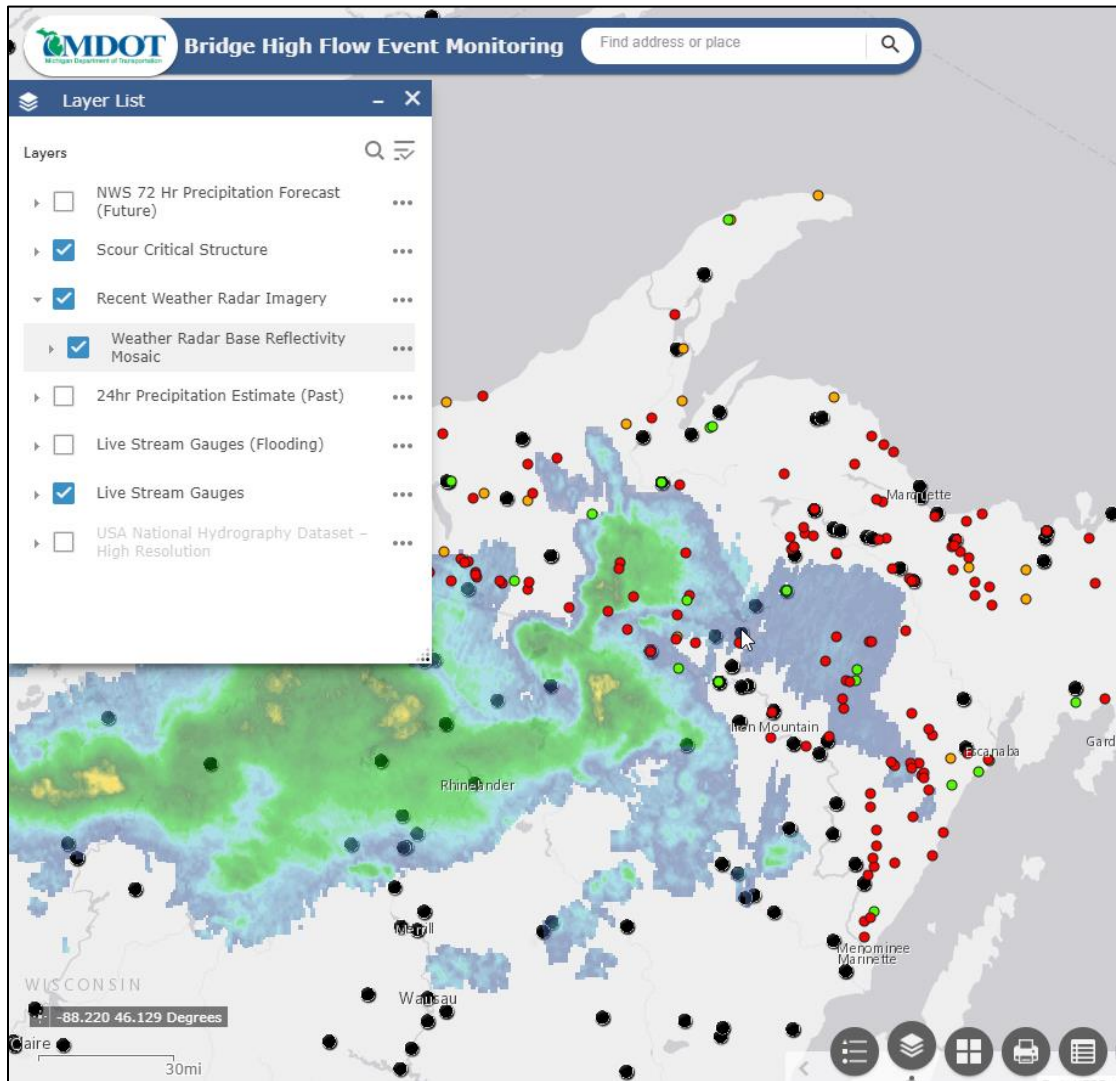
Plan of Action Benefit: Although a gauge may not exist in the waterway a specific structure crosses, the data can be used to help aid with monitoring during rain events. Include notes in the POA for future reference during High Flow Events. If additional structures should be monitored during the same event, include such notes in the comments to act as reminders of different bridge locations (including bridge numbers) along a waterway.



Multiple structures along same waterway

3. Utilizing Recent Weather Radar Imagery Layer:

Activating the *Recent Weather Radar Imagery* layer will display the current weather conditions as captured by radar.

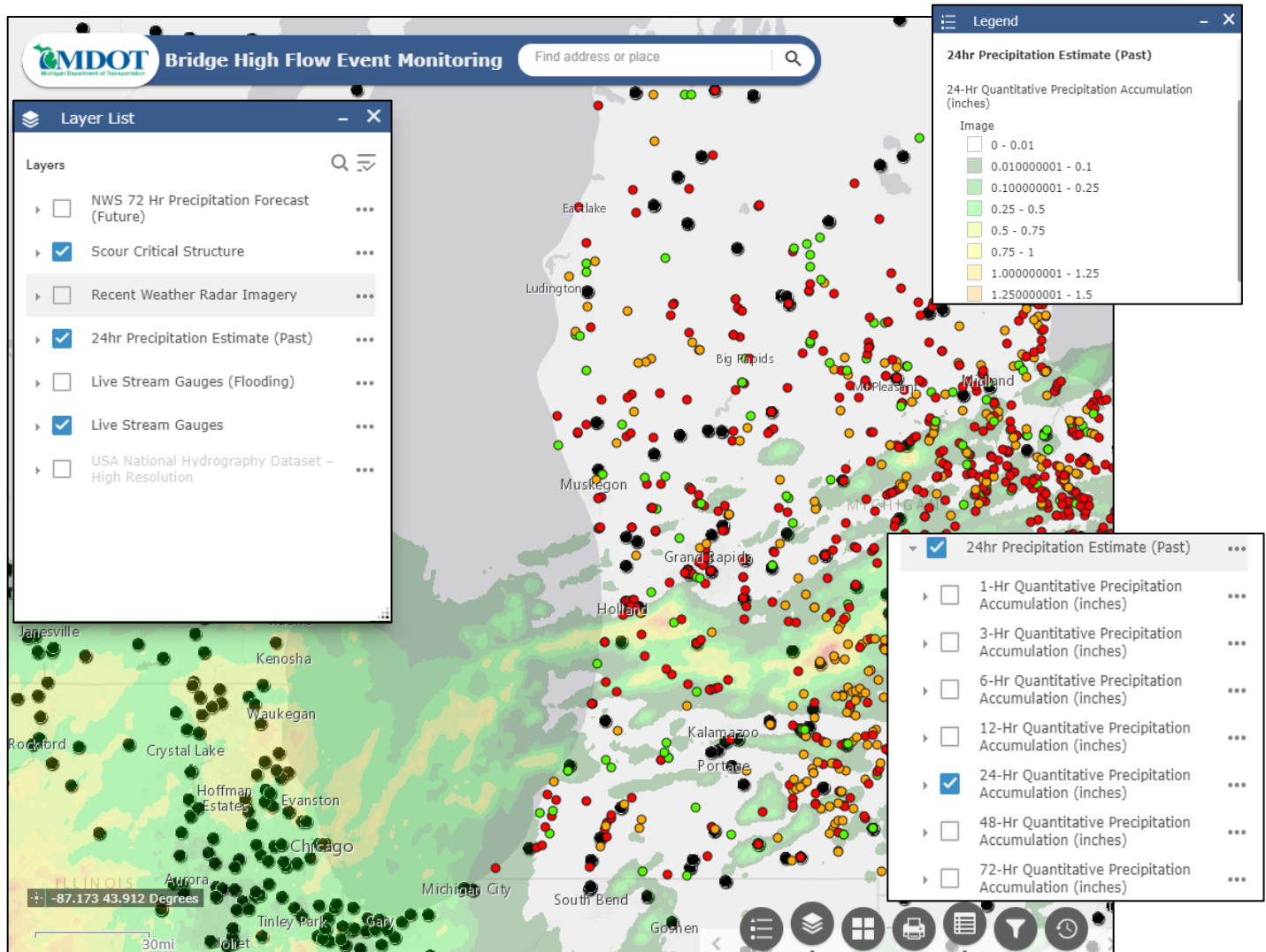


Radar Imagery Layers

Plan of Action Benefit: In the case of continuously monitoring a structure during high flow events, current weather forecasts can be viewed in relation to structures and existing stream gauges. This information can help when making decisions to continue monitoring or consider alternate intervals.

4: 24hr Precipitation Estimate Layer:

Switching to the *24hr Precipitation Estimate (Past)* view, the map will show the amounts of rain that has fallen over the past. Time ranges of the layers can be toggled between 1-Hr and 72-Hr.



View of 24hr Precipitation Layers

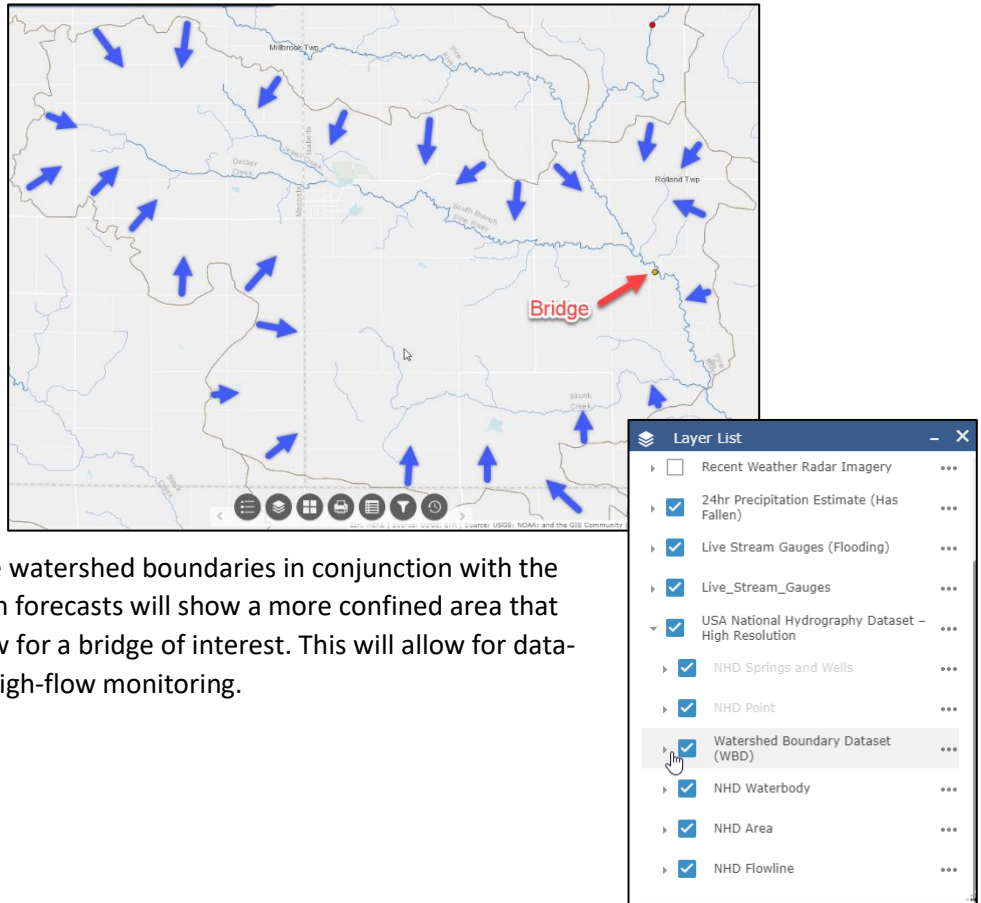
Plan of Action Benefit: When recording *High Flow Event* inspections in MiBridge, this layer can be utilized to accurately note the amount of rainfall over a recorded amount of time for a given structure or area.

Plan of Action Benefit: Previous high-flow events recorded in MiBridge, specifically the amount of rainfall that resulted in scour, erosion or undesired changes to the bridge site, can aid in setting benchmarks for monitoring.

5. Utilizing Watershed Boundaries

Ensure the *Watershed Boundary Dataset (WBD)* item is activated under the *USA National Hydrography Dataset* layer. Zooming into an area or structure will allow the boundary lines to appear.

For example, rain events over this area will directly contribute to the increase of flow in tributaries, creeks and rivers leading to this structure crossing over Pine River.



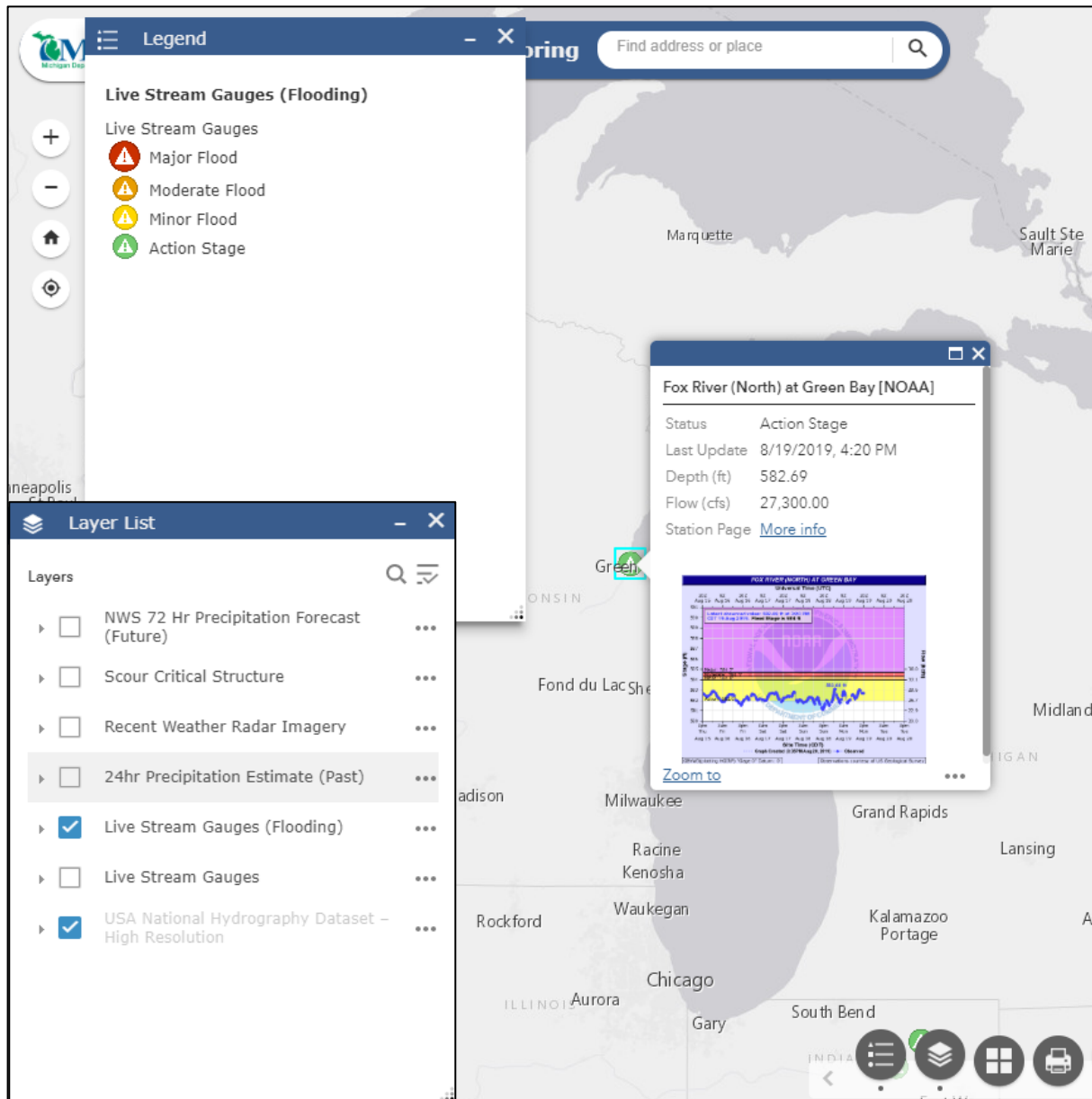
Plan of Action Benefit: Utilizing the watershed boundaries in conjunction with the past, present or future precipitation forecasts will show a more confined area that will contribute to higher streamflow for a bridge of interest. This will allow for data-driven decision making related to high-flow monitoring.

6. Locating Structures based on Stream Gauge Flood Stage:

Viewing the map at any time may show stream gauges experiencing varying levels of flooding. Ensure the *Live Stream Gauges (Flooding)* layer is active. As rain events occur, they may change paths or intensities.

Plan of Action Benefit: Utilizing this layer can help bridge owners locate unsuspected flooding or areas that are experiencing more significant flooding. This will help prioritize which bridges should be monitored first.

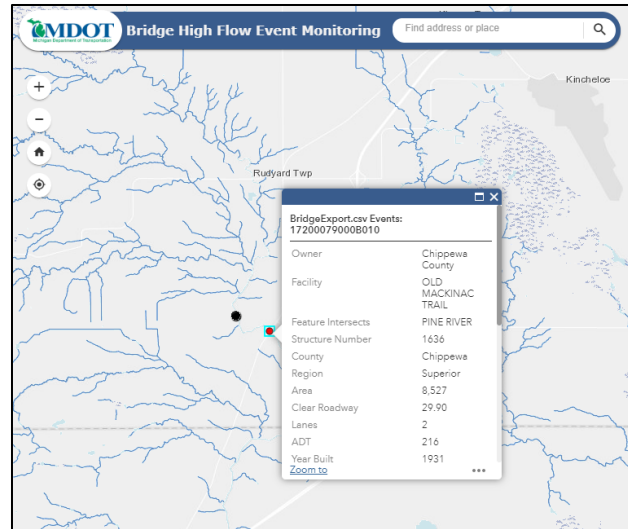
Disclaimer: It should be understood that the number of stream gauges and locations are limited. If there are no Live Stream Gauges flagged, it does not mean flooding is not occurring, but that there may not be a gauge in that area. Bridge owners should use other resources available to aid in monitoring such as precipitation estimates and watershed boundary layers.



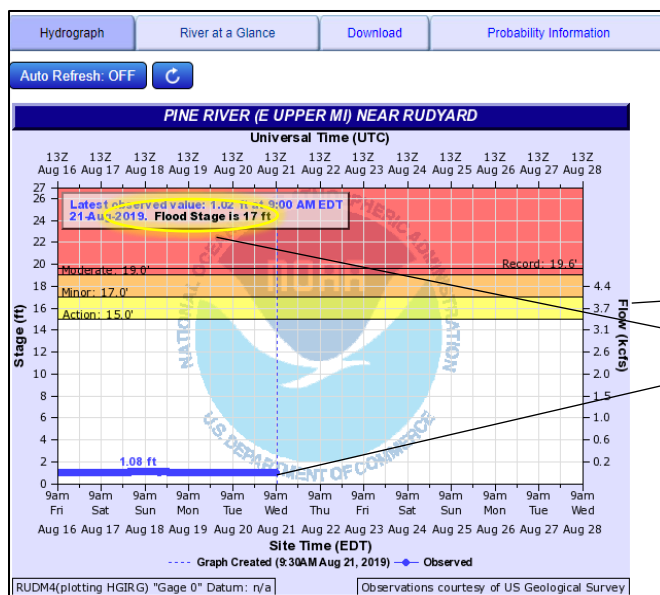
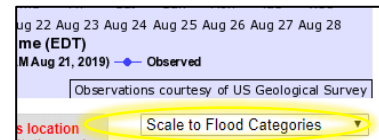
7. Example: Improving Scour Plan of Action

The information available on the *Bridge High Flow Event Monitoring* site can significantly improve the details required within the Scour POA. Below is example of what information can be included.

The chosen structure currently has item 113 rated as 3-Scour Critical, and per MiSIM already has a Plan of Action in place within MiBridge. Utilizing the Bridge High Flow Event Monitoring site, USGS and NOAA stream gauges can be located approximately one mile upstream of the structure. Clicking on *more data* on the NOAA stream gauge popup will open the website for this specific stream gauge.



Changing the view to the *Scale to Flood Categories* provides a graph of current conditions as compared to different flood stages. In this case, *Flood Stage is 17ft*, or approximately 4050 ft³/sec. At this elevation, the water surface will be at the bottom of the Prairie Road bridge (adjacent to the stream gauge). Knowing the bridge carrying the Old Mackinac Trail is approximately one mile downstream of the gauge, it is possible that additional storm runoff could be acquired along this stretch. During high flow events, checking the status of the flow of this stream gauge can help avoid making numerous trips to the site.



Within the Plan of Action, bridge owners can update the *Flood Monitoring* details by including specific flows at which monitoring shall be initiated.

Flood Monitoring - Initiate monitoring when any of the following occur		
<input type="checkbox"/> NOAA Flood Warning (This includes both Flash Flood and Flood Warnings)		
Flow Information		
<input type="checkbox"/> Discharge	cfs	
<input type="checkbox"/> Rainfall	in/hr	
<input type="checkbox"/> WS Elevation	ft	Measured from
<input type="checkbox"/> Pressure Flow		

In some instances, NOAA contains photographs of the stream gauge location and past flood events. These photographs can be useful in comparison to present and future high flow events.

Setting up USGS WaterAlert Notifications for Specific Stream Gauges:

[USGS WaterAlert](#) enables users to receive emails and text (SMS) messages based upon specific parameters set by a user, based on real-time data collected by USGS owned stations.

Example:

Once a stream gauge has been determined to be useful for monitoring streamflow at a bridge, the station number can be obtained in two ways:

- Clicking on *More info* will direct users to the USGS site: Reference the title of the table.

The screenshot displays the MDOT Bridge High Flow Event Monitoring web application. The interface includes a search bar at the top, a layer list on the left, and a map showing the Cass River area. A popup window titled "Cass River At Wahjamega, MI [USGS]" provides details about the station, including the last update date (September 5, 2019), height (3.01), and flow. A "More info" link is provided for further details.

Layer List:

- ☐ NWS 72 Hr Precipitation Forecast (Future)
- ☒ Scour Critical Structure
- ☐ Recent Weather Radar Imagery
- ☒ 24hr Precipitation Estimate (Past)
- ☒ Live Stream Gauges (Flooding)
- ☒ Live Stream Gauges
- ☐ USA National Hydrography Dataset - High Resolution

USGS 04150800 CASS RIVER AT WAHJAMEGA, MI

Available data for this site: [SUMMARY](#)

Stream Site

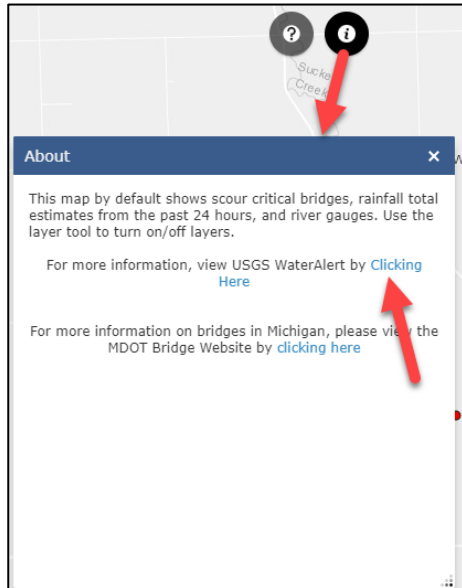
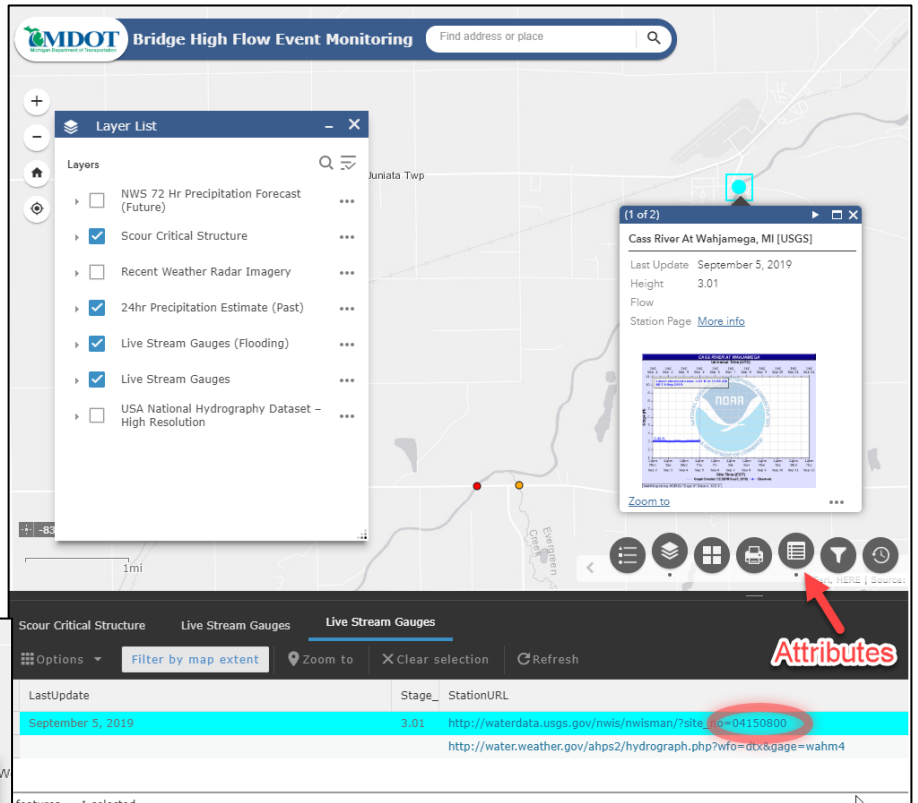
DESCRIPTION:

Latitude 43°27'02", Longitude 83°26'29" NAD27
 Tuscola County, Michigan, Hydrologic Unit 04080205
 Drainage area: 645 square miles
 Datum of gage: 632.58 feet above NGVD29.

AVAILABLE DATA:

Data Type	Begin Date	End Date	Co
Current / Historical Observations (availability statement)	1989-10-01	2019-09-05	

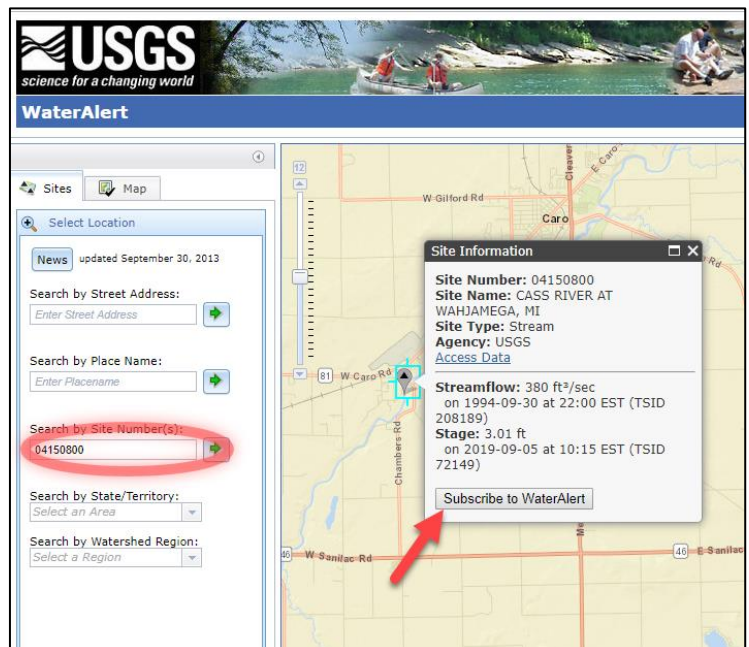
- Utilizing the *Attributes Table* will list gauges visible in the area: Reference the USGS URL.



With the stream gauge number available, the link to USGS *WaterAlert* can be found under the **o** icon in the top right corner of the *Bridge High Flow Event Monitoring* site.

Within the *WaterAlert* site, enter the gauge number into the search box on the left margin and click enter.

Clicking on the marker for the located stream gauge will display a popup containing the *Subscribe to WaterAlert* link.



The *Subscription Form* allows users to be notified via mobile phone or email at different intervals based on discharge or gauge height.

The *Streamflow Parameters* offer charts displaying the highest values of discharge and gauge heights recorded at the site.

In this example, two of the bridges downstream have 100-yr flood values in excess of 2,000cfs recorded in the scour POA. Choosing a value such as 1800cfs can allow for time between being notified through WaterAlert and beginning monitoring via the MDOT High Flow Event site, or on-site monitoring if necessary.

Subscription Form

Site Info:

Number: 04150800
 Name: CASS RIVER AT WAHJAMEGA, MI
 Agency: USGS
 Transaction ID: cGDqk

Send Notification To: [about this...](#)

☐ My mobile phone
☒ My email address

Notification Frequency: [about this...](#)

Hourly ☐
 Daily ☐

Streamflow Parameter(s): [about this...](#) **Recent value:**

Discharge, in ft³/s ☒ 380 [\[peak chart\]](#)
 Gauge height, in ft ☐ 3.01 [\[peak chart\]](#)

Alert Threshold Condition: [about this...](#)

☒ Greater than (>)
☐ Less than (<)
☐ Outside a range (< or >)
☐ Inside a range (> and <)

Real-time value is greater than: ft³/s

☒ I have read and acknowledge the [Provisional Data Statement](#) and [Disclaimer](#).

Calculated Values					
Scour Analysis Frequency	25 Year	50 Year	100 Year	500 Year	Comments
Anticipated Surface Elevation (ft)	0.0	0.0	643.78	0.0	
Distance Below Bottom Chord (ft)	0.0	0.0	-6.62	0.0	
Anticipated Flow (cubic ft/sec)	0.0	0.0	22600.0	0.0	
Anticipated Pressure Flow (Y/N)					

Calculated Values					
Scour Analysis Frequency	25 Year	50 Year	100 Year	500 Year	Comments
Anticipated Surface Elevation (ft)			614.4		
Distance Below Bottom Chord (ft)			25.6		
Anticipated Flow (cubic ft/sec)			21000.0		
Anticipated Pressure Flow (Y/N)					

If an existing POA does not exist, utilizing any past High Flow Events recorded in MiBridge can also help in choosing a streamflow volume to monitor.

Lower threshold alerts can also be established to ensure High Flow Events are recorded and potentially followed up with site visits.

Notes can be included in the comments section of the Scour POA to notify others that a WaterAlert has been established.