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.

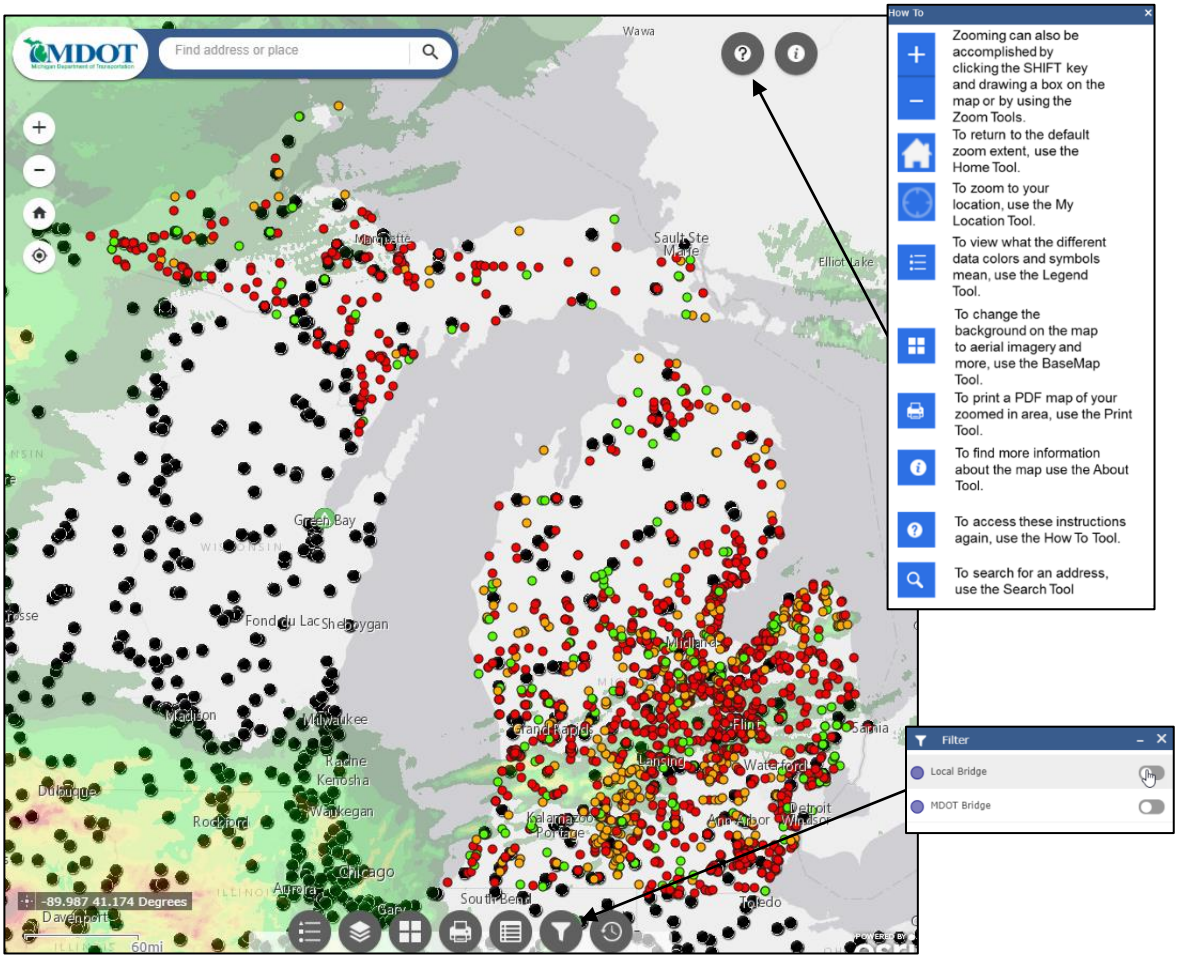


Figure 1: Points marking Michigan structures and stream gauges (Red – 3, Scour Critical; Green – 7, Countermeasures installed, no longer Scour Critical; Orange – U, Unknown foundation has not been evaluated, Black = USGS/NOAA Steam Gauge)

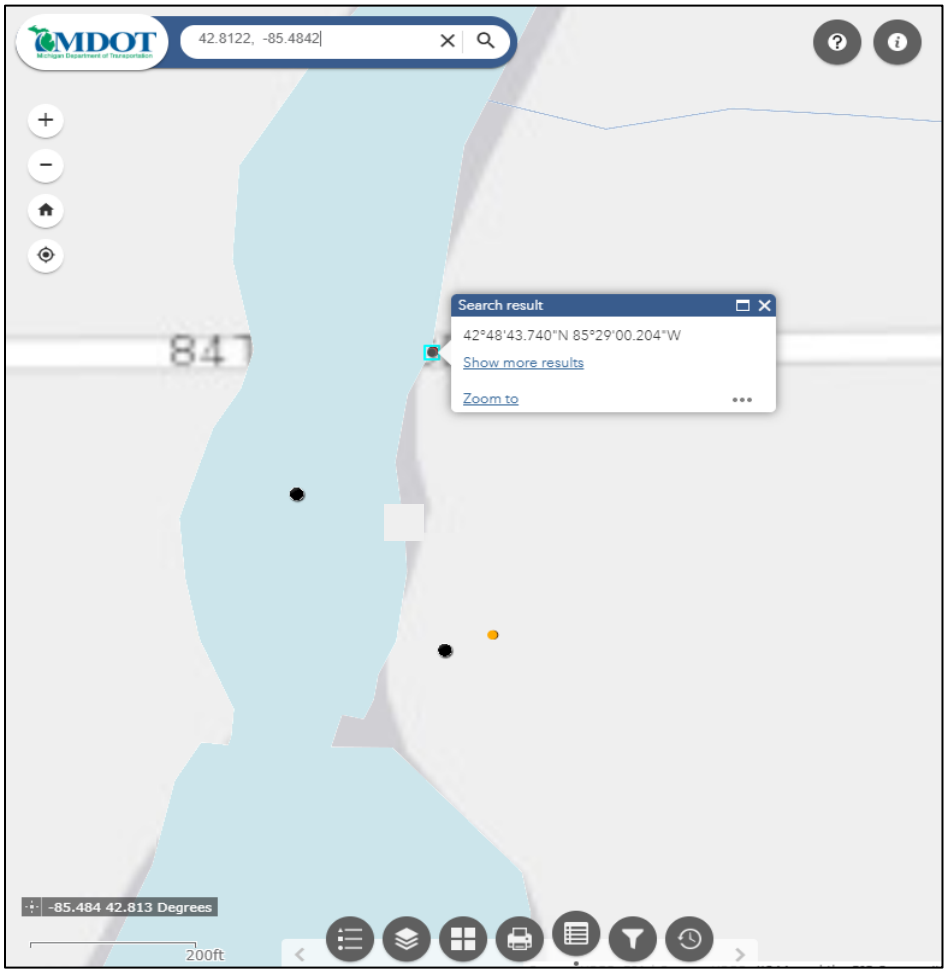
1. Locating a Structure of Interest:

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.

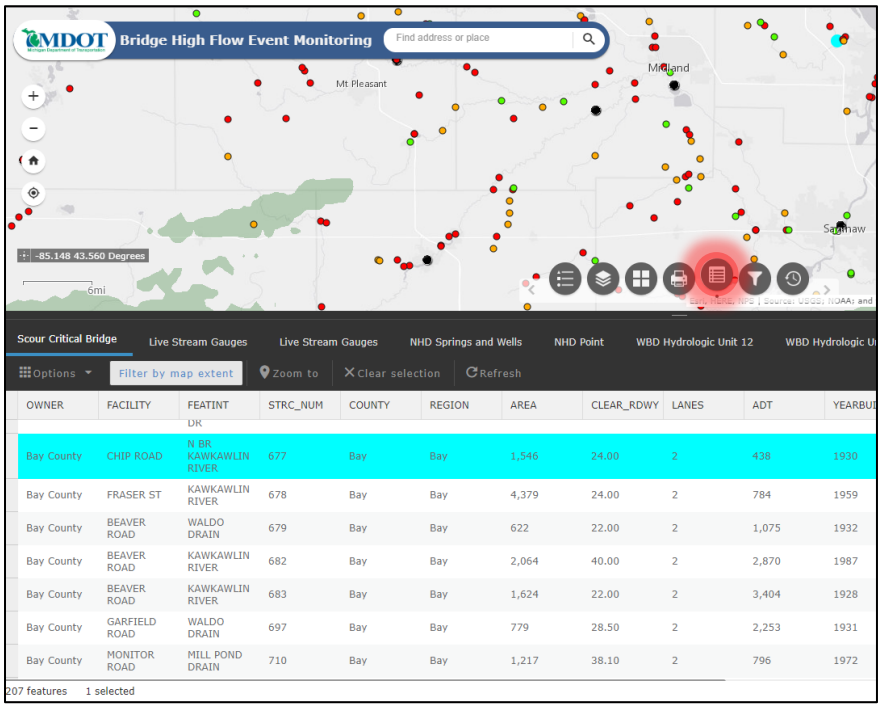
Press enter or click  . Note: The map will locate the desired point of interest and may cover the point designating the structure.



View of GPS search (covering structure point)

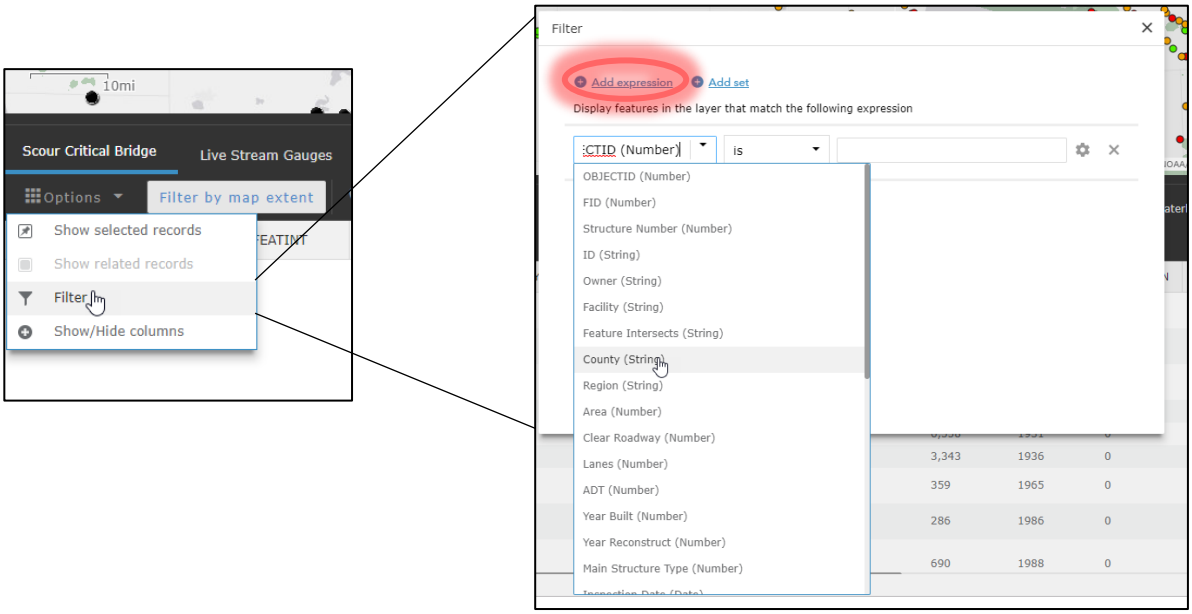
Option 2: Attribute Table

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.



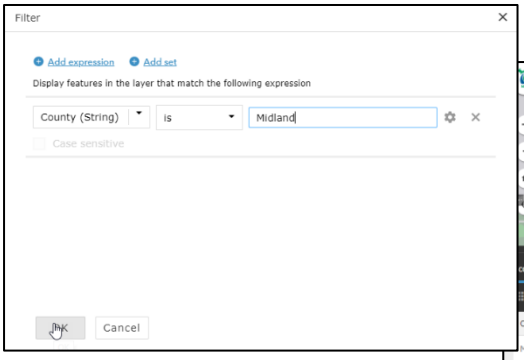
View of Attribute Table

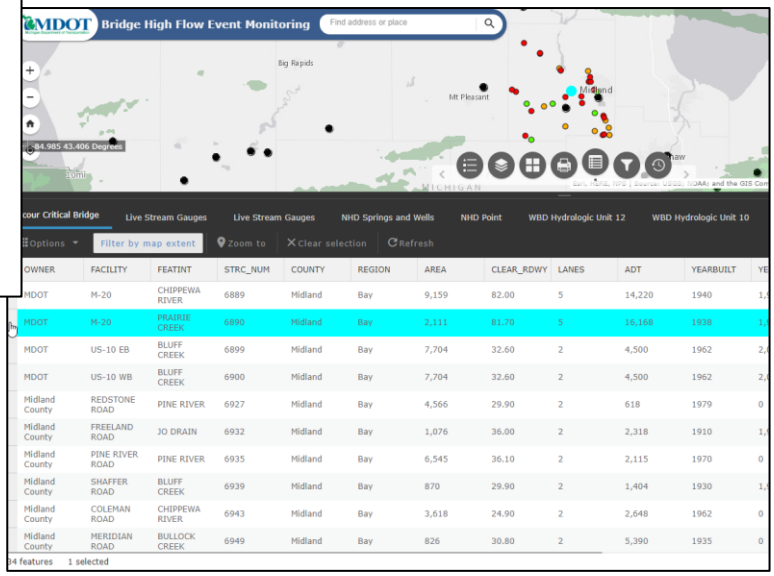
Utilizing *Filter* within the *Options*, click on *Add Expression* to allow for filtering based on multiple criteria.



Adding filters to Attribute Table

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

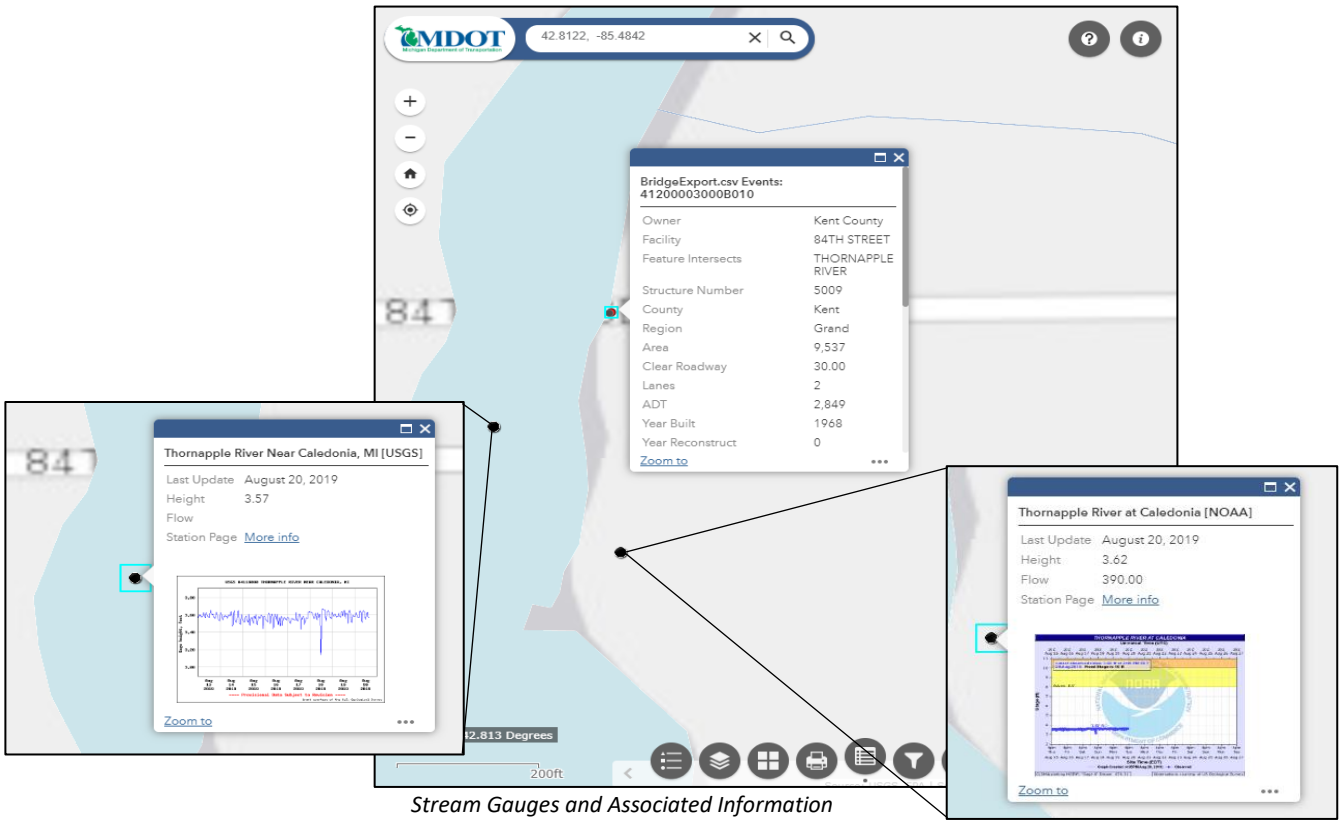




Clicking on the left margin of a row will highlight the bridge of interest on the list and the map.

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.



Stream Gauges and Associated Information

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.

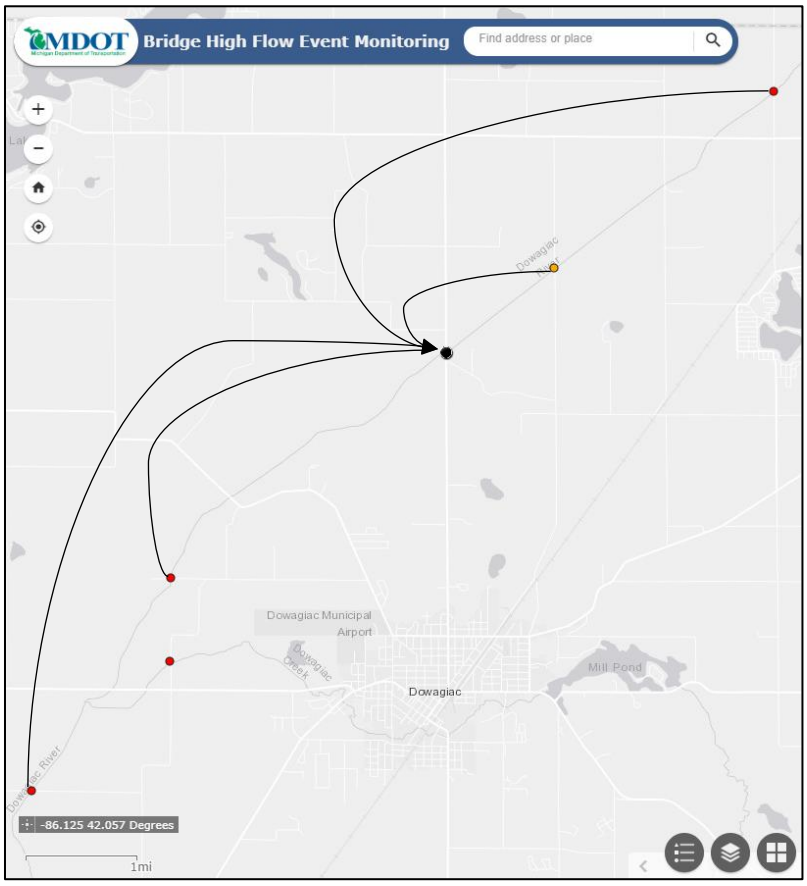
- NOAA/USGE Stream gauges “Muskegon River at Evart” present downstream of bridge

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.

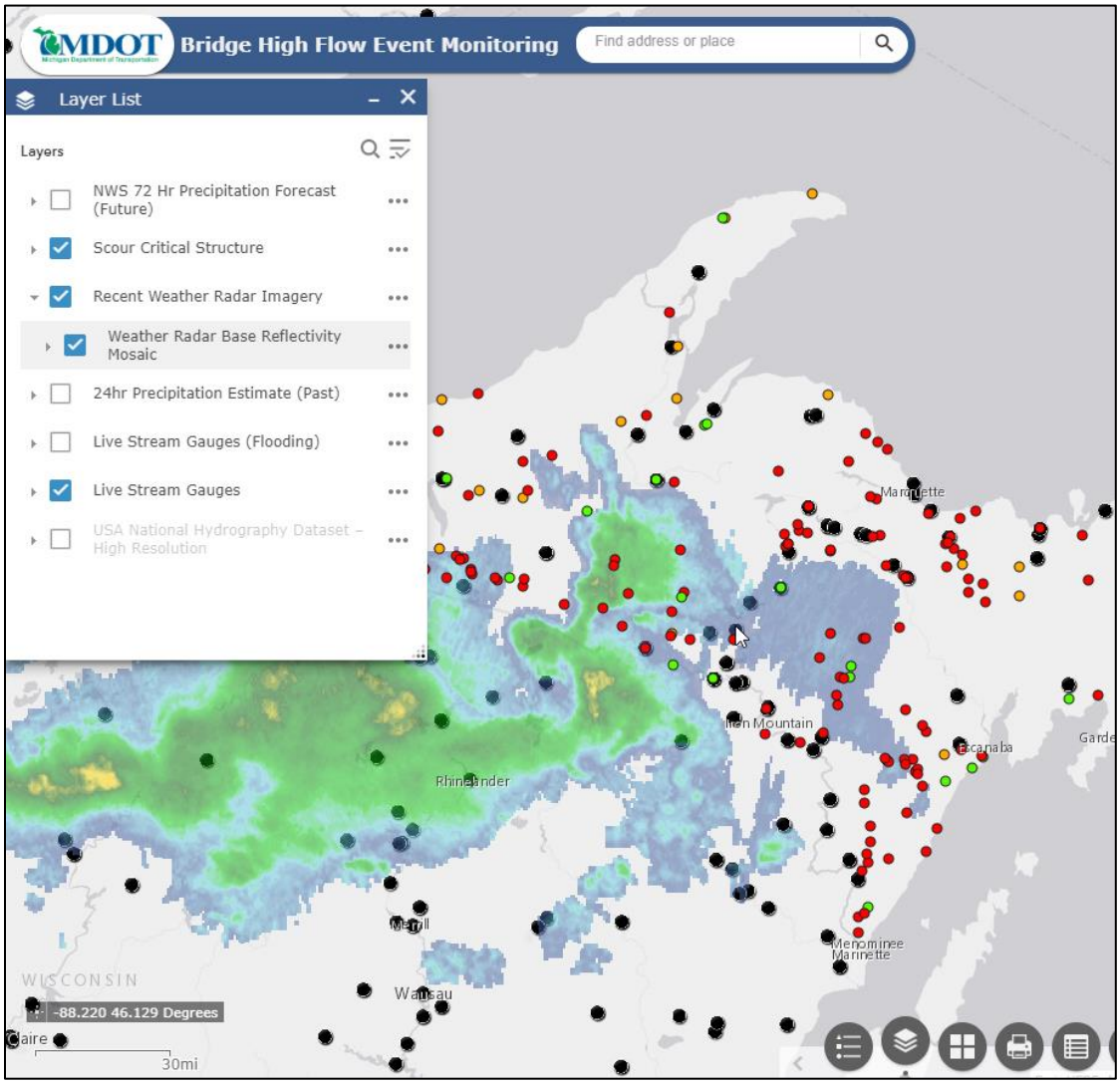
Plan of Action Benefit: Although a gauge may not exist in the waterway a specific structure crosses, the data can be used to help aid with monitoring during rain events. Include notes in the POA for future reference during High Flow Events. If additional structures should be monitored during the same 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.

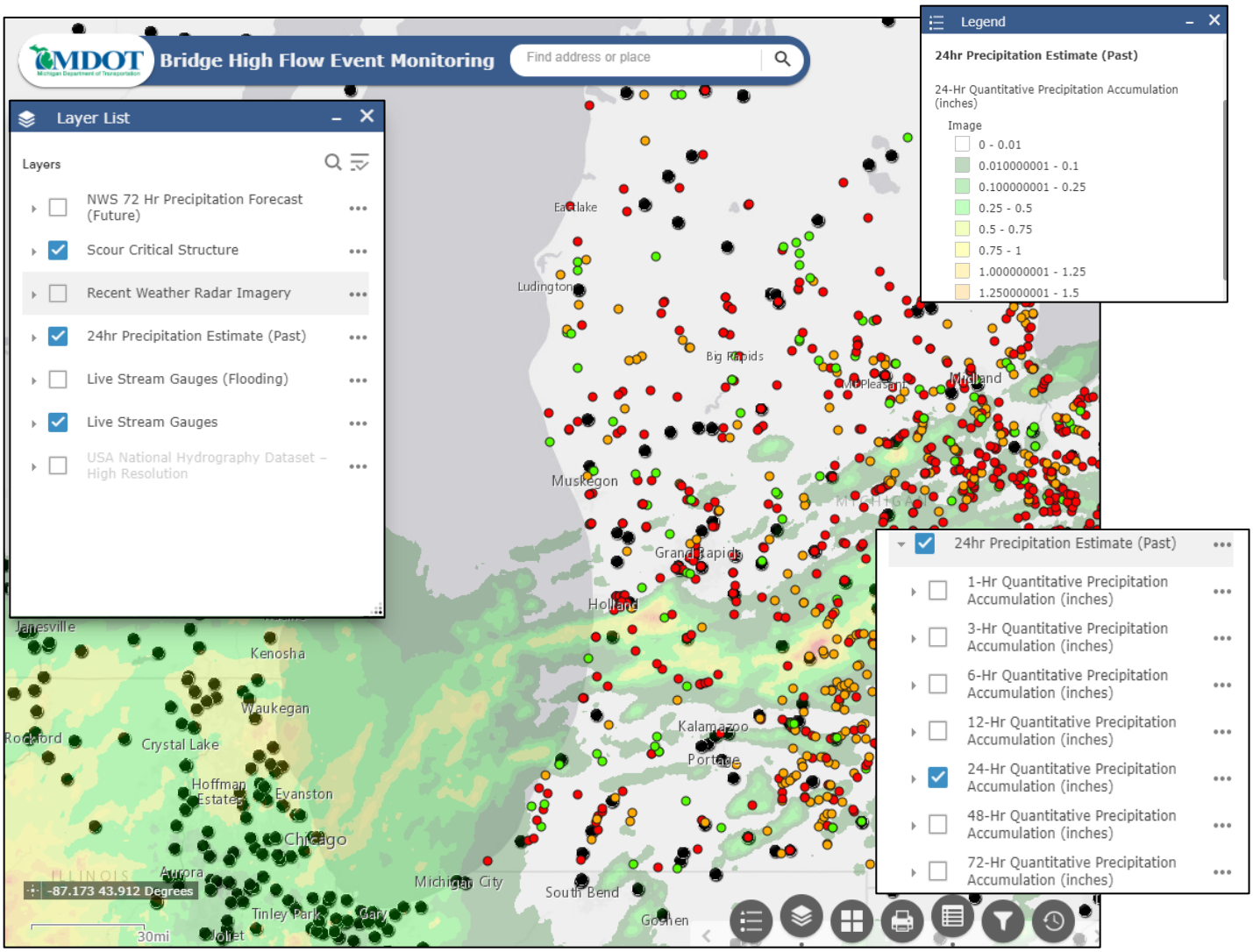


Radar Imagery Layers

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

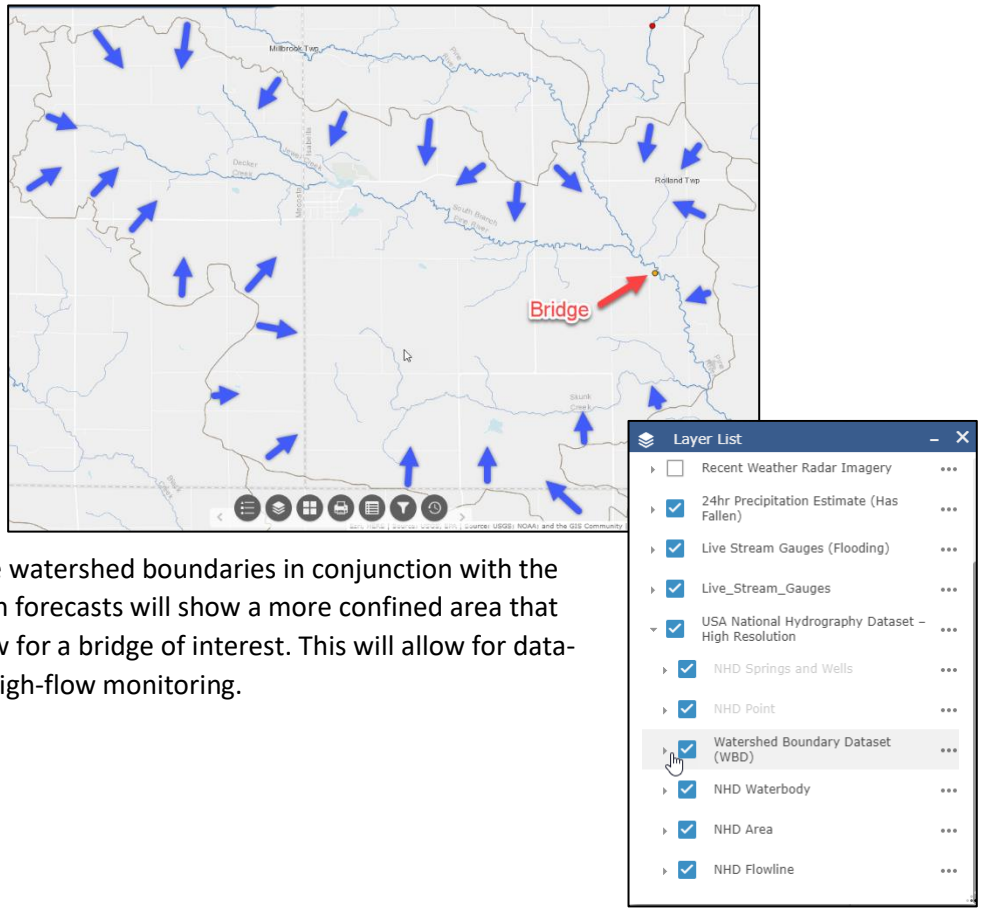
Plan of Action Benefit: When recording *High Flow Event* inspections in MiBridge, this layer can be utilized to accurately note the amount of rainfall over a recorded amount of time for a given structure or area.

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.



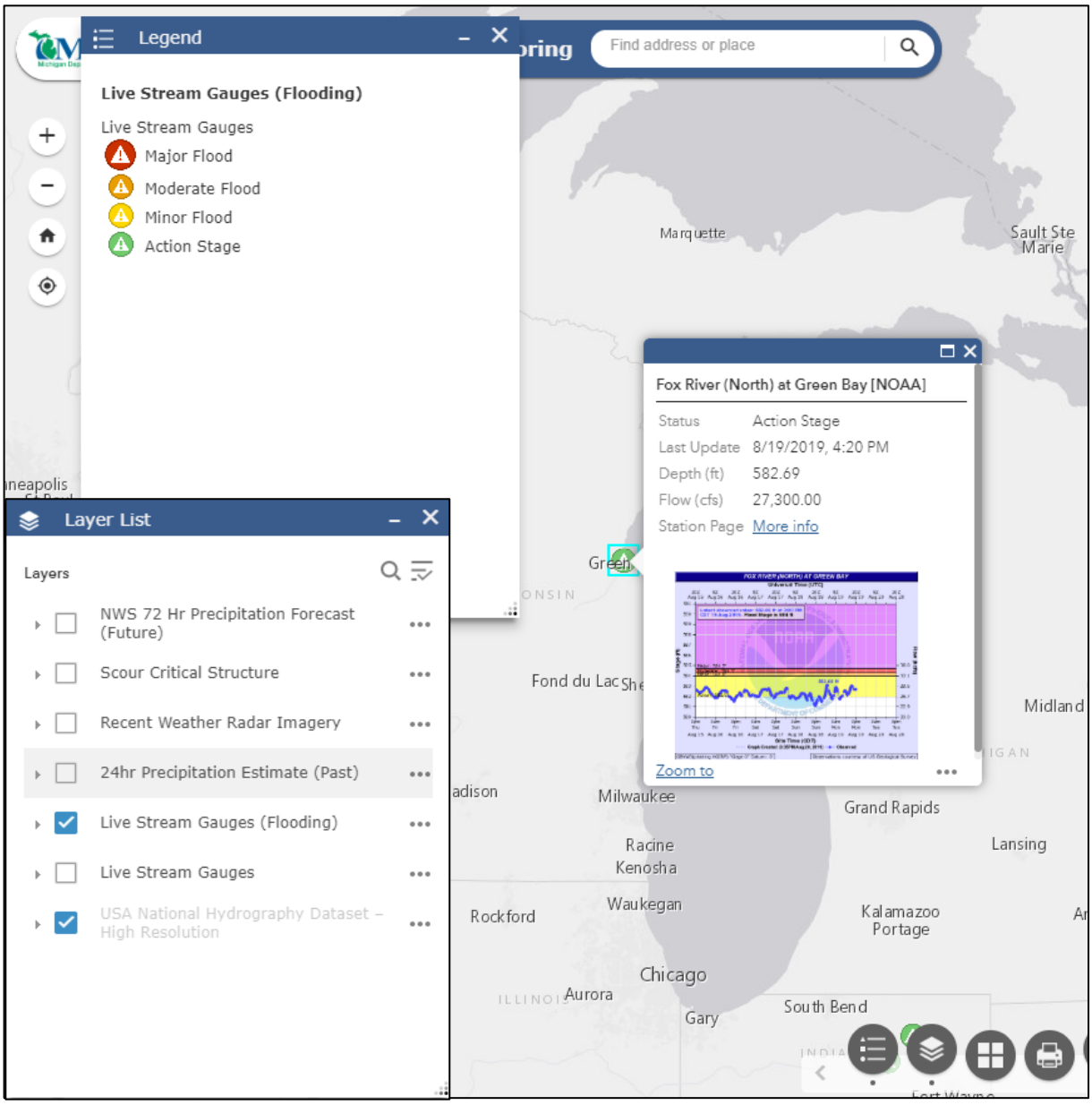
Plan of Action Benefit: Utilizing the watershed boundaries in conjunction with the past, present or future precipitation forecasts will show a more confined area that will contribute to higher streamflow for a bridge of interest. This will allow for data-driven decision making related to high-flow monitoring.

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.

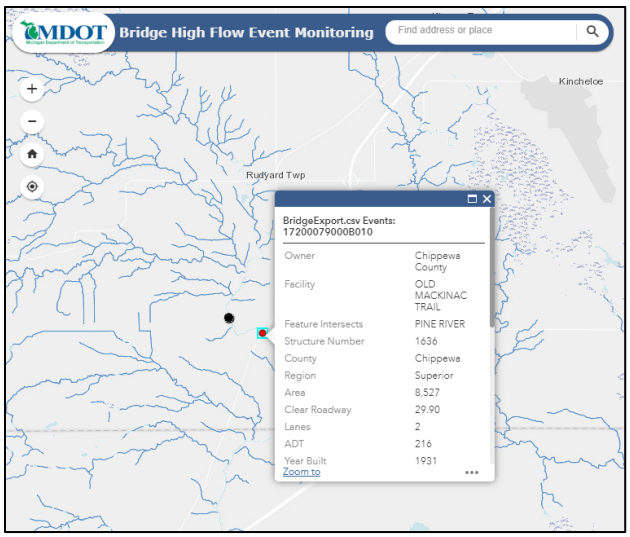
Plan of Action Benefit: Utilizing this layer can help bridge owners locate unsuspected flooding or areas that are experiencing more significant flooding. This will help prioritize which bridges should be monitored first.

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.

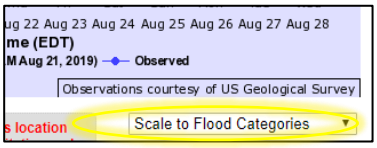


7. Example: Improving Scour Plan of Action

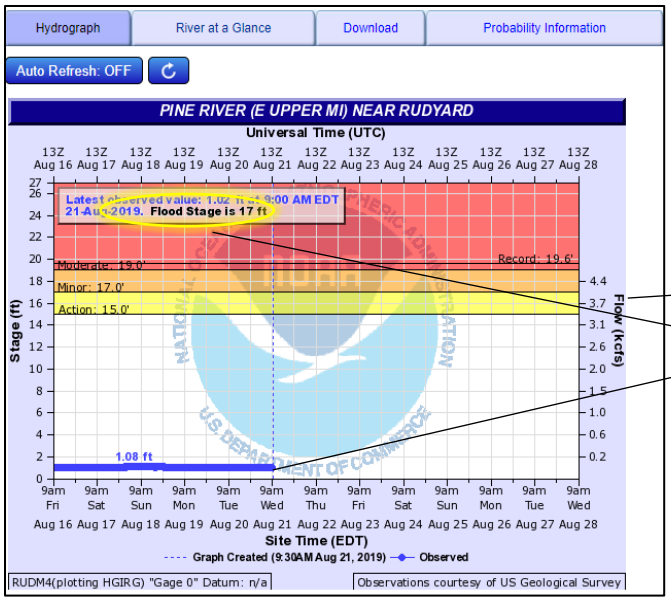
The information available on the *Bridge High Flow Event Monitoring* site can significantly improve the details required within the Scour POA. Below is example of what information can be included.



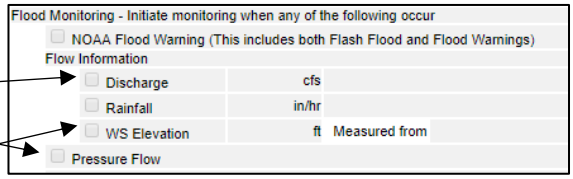
The chosen structure currently has item 113 rated as 3-Scour Critical, and per MiSIM already has a Plan of Action in place within MiBridge. Utilizing the Bridge High Flow Event Monitoring site, USGS and NOAA stream gauges can be located approximately one mile upstream of the structure. Clicking on *more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



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

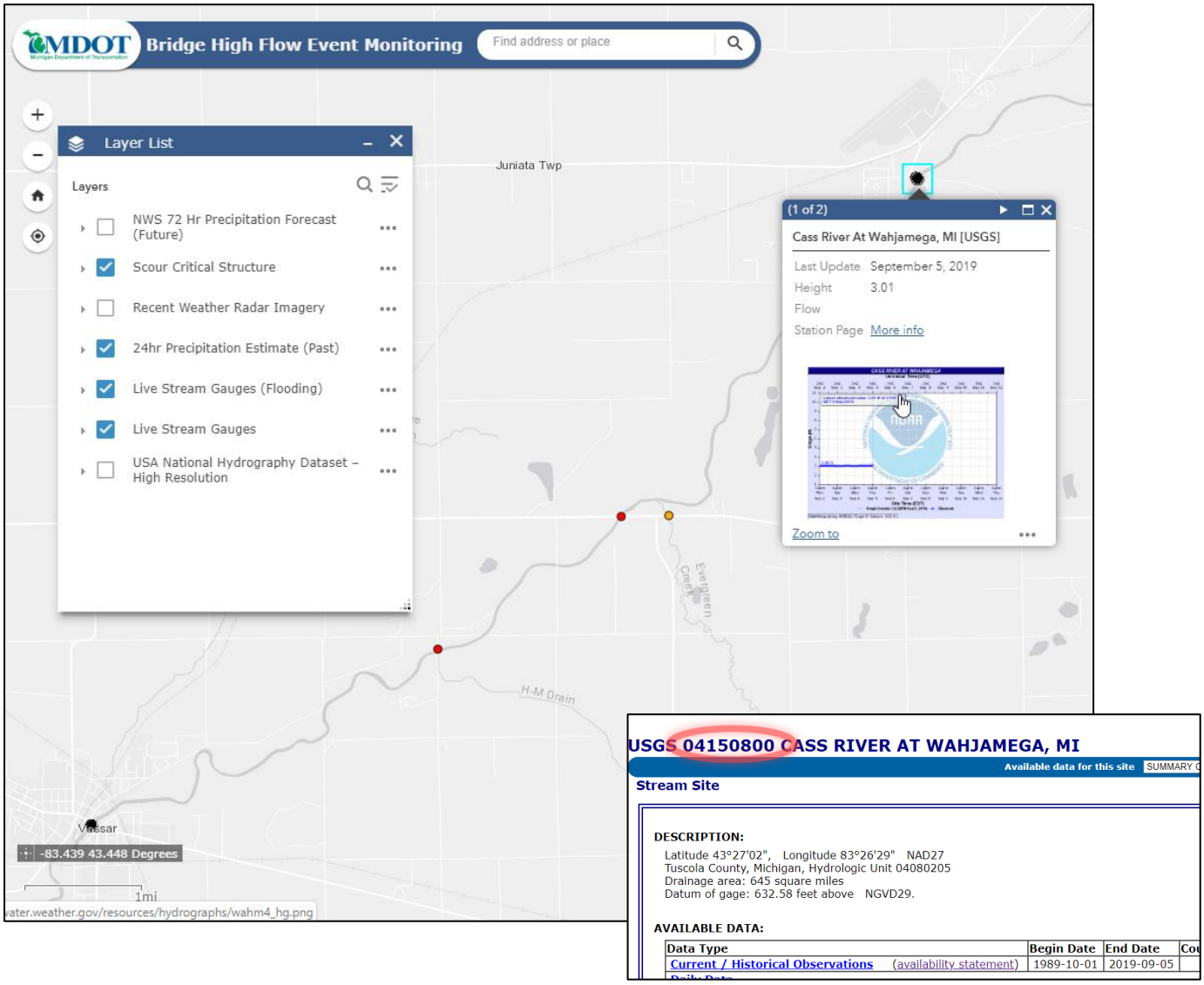
Setting up USGS WaterAlert Notifications for Specific Stream Gauges:

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.

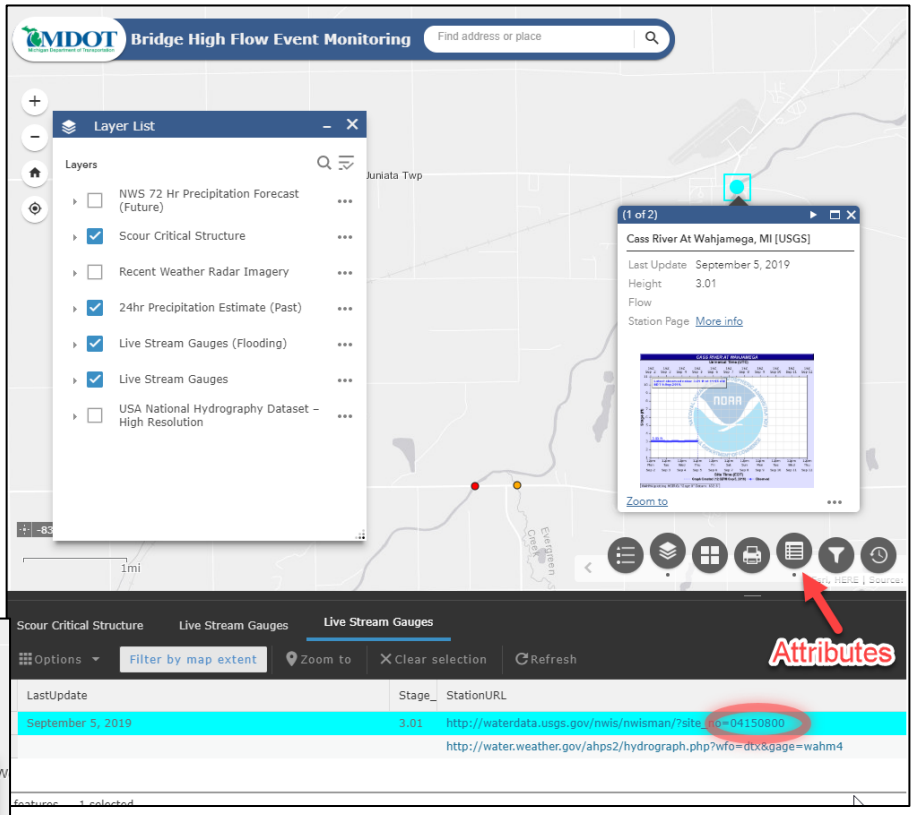
Example:

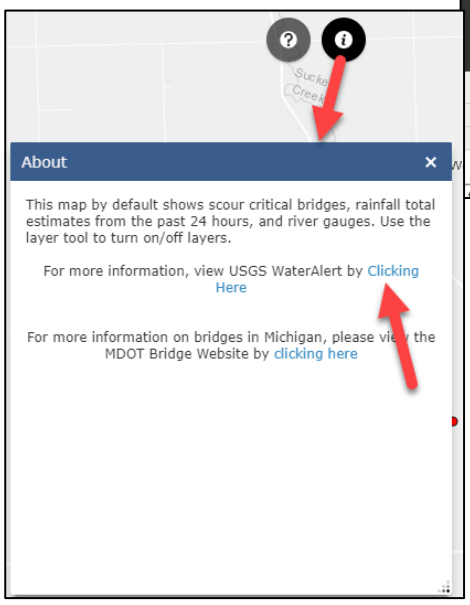
Once a stream gauge has been determined to be useful for monitoring streamflow at a bridge, the station number can be obtained in two ways:

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



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

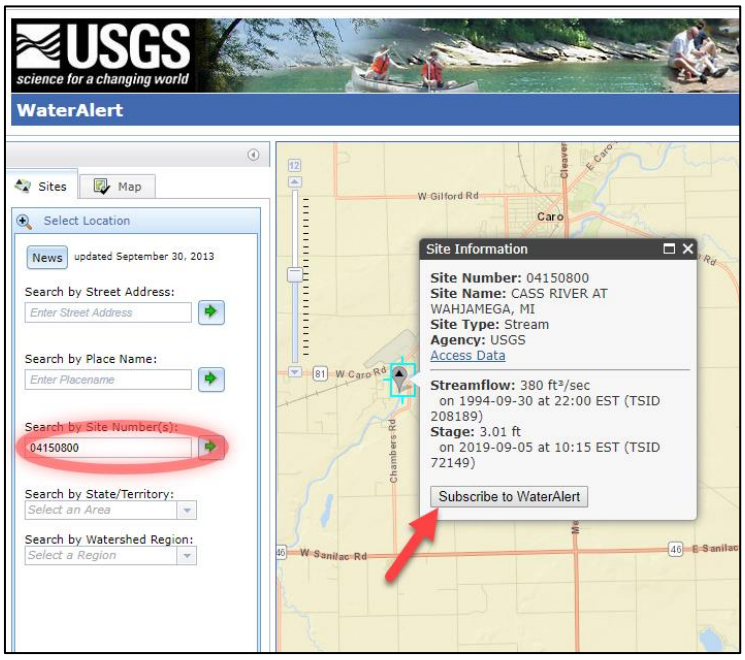




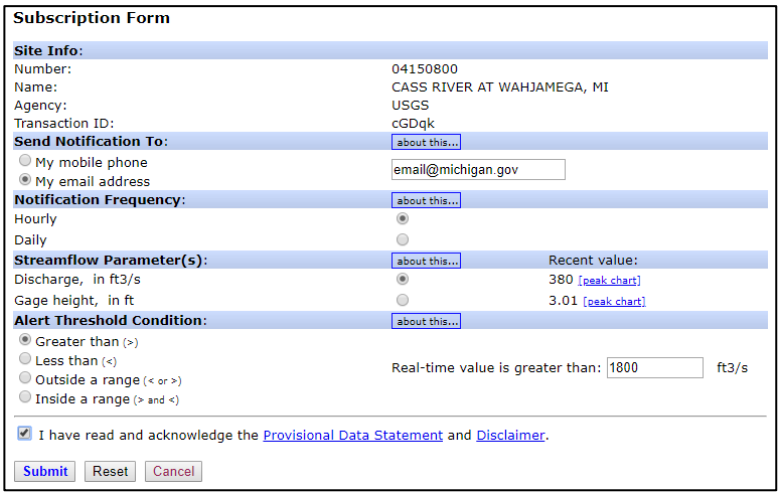
With the stream gauge number available, the link to USGS *WaterAlert* can be found under the ⓘ icon in the top right corner of the *Bridge High Flow Event Monitoring* site.

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.

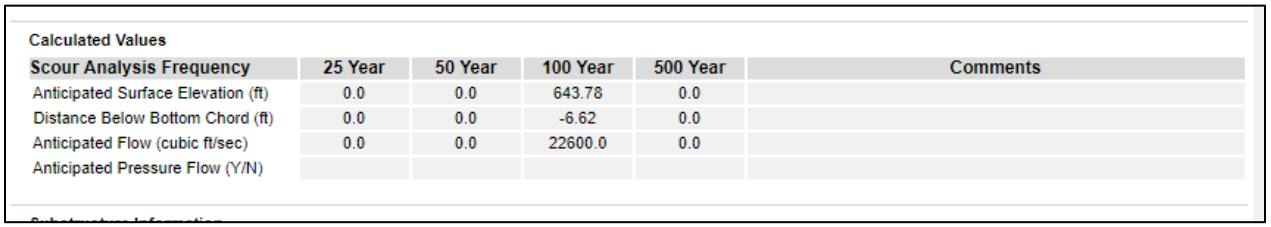


The *Subscription Form* allows users to be notified via mobile phone or email at different intervals based on discharge or gauge height.



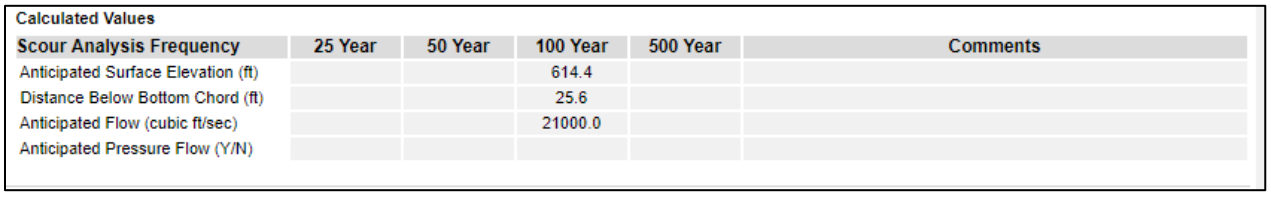
The *Streamflow Parameters* offer charts displaying the highest values of discharge and gauge heights recorded at the site.

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.



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.