



HIGH FLOW MONITORING

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Why Monitor?



Monitoring Required per Federal Regulations

§ 650.313 Inspection procedures.

(e) Identify bridges with FCMs, bridges requiring underwater inspection, and bridges that are scour critical.

(3) Bridges that are scour critical. Prepare a plan of action to monitor known and potential deficiencies and to address critical findings. Monitor bridges that are scour critical in accordance with the plan.



Metric #18: Inspection procedures – Scour Critical Bridges

rev 4/1/13

NBIS Reference: 23 CFR 650.313 (e) Bridges that are scour critical

Criteria

- Bridges over water have a documented evaluation of scour vulnerability.
- Bridges that are scour critical have a scour plan of action (POA) prepared to monitor known and potential deficiencies and to address scour critical findings.
- Bridges that are scour critical are monitored in accordance with the POA.

Review Scour POA for Monitoring Plan

MONITORING PROGRAM

Recommended Monitoring Requirements

Monitoring of this structures is mainly focused on the main channel near Piers 4 and 5. Flow rates can be obtained from the USGS monitor just down stream of the structure. These piers have been protected with rip rap along the shipping channel and depth measurements should be completed during and after the flood events to help verify the stability of the rip rap.

(Check all that are recommended)

Type	Frequency/ Amount	Comments
<input checked="" type="checkbox"/> Regular Inspection	24.0	Continue to wade and probe during routine inspections.
<input type="checkbox"/> Other Special Inspection		
<input checked="" type="checkbox"/> Underwater Inspection	60.0	
<input checked="" type="checkbox"/> Stream Bed Cross Sections	24.0	Update Stream Bed Cross Sections every 24 Months and after High Flow Events
<input type="checkbox"/> Monitoring Devices (Fixed, Sonar, etc.)		

Flood Monitoring - Initiate monitoring when any of the following occur

☐ NOAA Flood Warning (This includes both Flash Flood and Flood Warnings)

Flow Information

☐ Discharge (cfs)

☐ Rainfall (in/hr)

☒ WS Elevation (ft)

5.0

Measured from Top of Rail, Near Pier 3, North Side of Bridge

☐ Pressure Flow

☐ Debris Accumulation

Things to Look For

Items to Watch During Monitoring

The dolphins on Pier 3 show some settlement and loose chains and collision damage. Upstream dolphin at Pier 2 appears to have been struck and has 2 broken piles and 80% of total section remaining. Pier 3 footing is exposed up to ten feet at the upstream corner channel side. Pier 2 footing is exposed up to 6ft. (2005)

Foundation	Items to Watch
Abutment A	N/A
Abutment B	N/A
Pier 1	Water will reach the Pier at the 100yr event, Monitor for
Pier 2	Use depth finder along south side during flood event to verify channel depth (see notes in file)
Pier 3	This pier has rip rap along the north side.
Pier 4	Excessive Debris accumulate around this pier during a flood, Monitor for whirlpools
Pier 5	
Pier 6	



Chapter 6 of the MiSIM

MICHIGAN STRUCTURE INSPECTION MANUAL BRIDGE INSPECTION

CHAPTER 6

SCOUR

6.01 Purpose

The National Bridge Inspection Standards (NBIS) require each state to identify bridges that are scour critical, and to prepare a plan of action to monitor known and potential deficiencies in accordance with the plan. This process may be divided into two overall categories; the proper coding of Item 113, and managing bridges for scour vulnerability. Coding of Item 113 is determined through one or more analyses to determine whether the structure is susceptible to scour, and may be infrequently updated when conditions contrary to the assigned value are observed or scour countermeasures are installed. The managing of scour critical bridges is a recurrent effort that must be completed throughout the life of the structure. This chapter describes the minimum requirements and monitoring processes that must be adhered to for NBIS compliance. For additional information review Chapter 13 of the FHWA [*Bridge Inspector's Reference Manual*](#) (BIRM).

Chapter 6 of the MiSIM

6.06 Scour Critical Bridge – High Flow Event

It is often too dangerous to perform a scour inspection using probing or underwater diving techniques during or immediately following a storm event when the water elevation and flow levels are high. However, the site should still be safe to monitor from the deck surface if overtopping of the bridge has not occurred. The bridge owner or an inspection team leader should review the effects of the increased water velocities and look for signs that in adversely affect the structure. Repetitive site visitations should be scheduled as-needed until a scour inspection may be performed once levels return near normal.

Field reviews should be documented on the High Flow Event Report, which may be accessed within each bridge-specific POA. This is the only method to verify that that monitoring occurred. Fields within the High Flow Event Report include information for the storm duration, total rainfall, freeboard, and estimated flow rate. Additionally, the inspector may note observations including whirlpools, debris accumulation, and describe any actions that were taken. When settlement, pressure flow, or other conditions warrant closure of the structure the bridge owner shall be immediately notified and MDOT Bridge Field Services shall be contacted as described in [Chapter 10, Critical Findings](#).

Scour critical structures that have had active flooding will be evaluated annually to ensure that monitoring occurred through documentation of a High Flow Event Report (see Figure 6.06.01). This information is necessary to ensure compliance with NBIP Metric #18 is achieved.

MiBRIDGE High Flow Event Report

SCOUR ACTION HIGH FLOW EVENT

KATHRENS

Inspector Name	Agency / Company Name	Monitored Date	Monitored Time
Richard Kathrens	MDOT - Bridge Field Services	05/14/2013	12:00 AM

EVENT DETAILS

Storm Duration(hrs):	<input type="text" value="24"/>	Estimated Total Rainfall(in):	<input type="text" value="4"/>
High Water Distance From Chord(ft):	<input type="text" value="2"/>	Estimated USGS Flow Discharge(cu ft/sec):	<input type="text" value="15346"/>

EVENT NARRATIVE

Whirlpools Observed

Whirlpools were observed near the north side of pier 5

Debris Accumulation

Several logs and debris has collected near east side of pier 4

Action Taken / Closure

Detailed depth measurements to be completed. (See Scour Inspection for Details)

Comments

Rainfall total is estimated from Weather Underground for the days of April 10-April 21. The closest USGS active guage was USGS 04157000 SAGINAW RIVER AT SAGINAW, MI and the flow was recorded at 24,300 on 4/21/13

Chapter 6 of the MiSIM

6.07 Scour Critical Bridge – Scour Inspection

Once conditions are safe to access the waterway following a high flow event, a Scour Action Inspection should be performed to record any contraction or local scour that occurred during the flooding. At a minimum, this should include probing around all substructure units that were submerged to determine if changes in the streambed or footing exposure occurred. Where water depths exceed 10 feet and depth soundings indicate that scouring occurred it is highly recommended to enlist a qualified diving inspector or perform a detailed bathymetric survey to determine the extent of damage. When previously unrecorded footing exposure or undermining is identified the bridge owner should be notified immediately.

When unscheduled scour inspections are performed independent of the routine inspection data collected should be entered in MiB^{RIDGE} on the Scour Action Inspection form (see Figure 6.07.01)

MiBRIDGE Scour Event Report

SCOUR ACTION INSPECTION

COVEYJ2

Inspector Name

James Covey

Agency / Company Name

MDOT-Southwest Region

Inspection Date

04/15/2014

OBSERVED SCOUR

Comments

No scour found at the abutments.

Action(s) Taken

None.

RECOMMENDATIONS & ACTION ITEMS

Recommendation Type	Priority	Description
Other	H	Check abutments for scour during routine inspections.

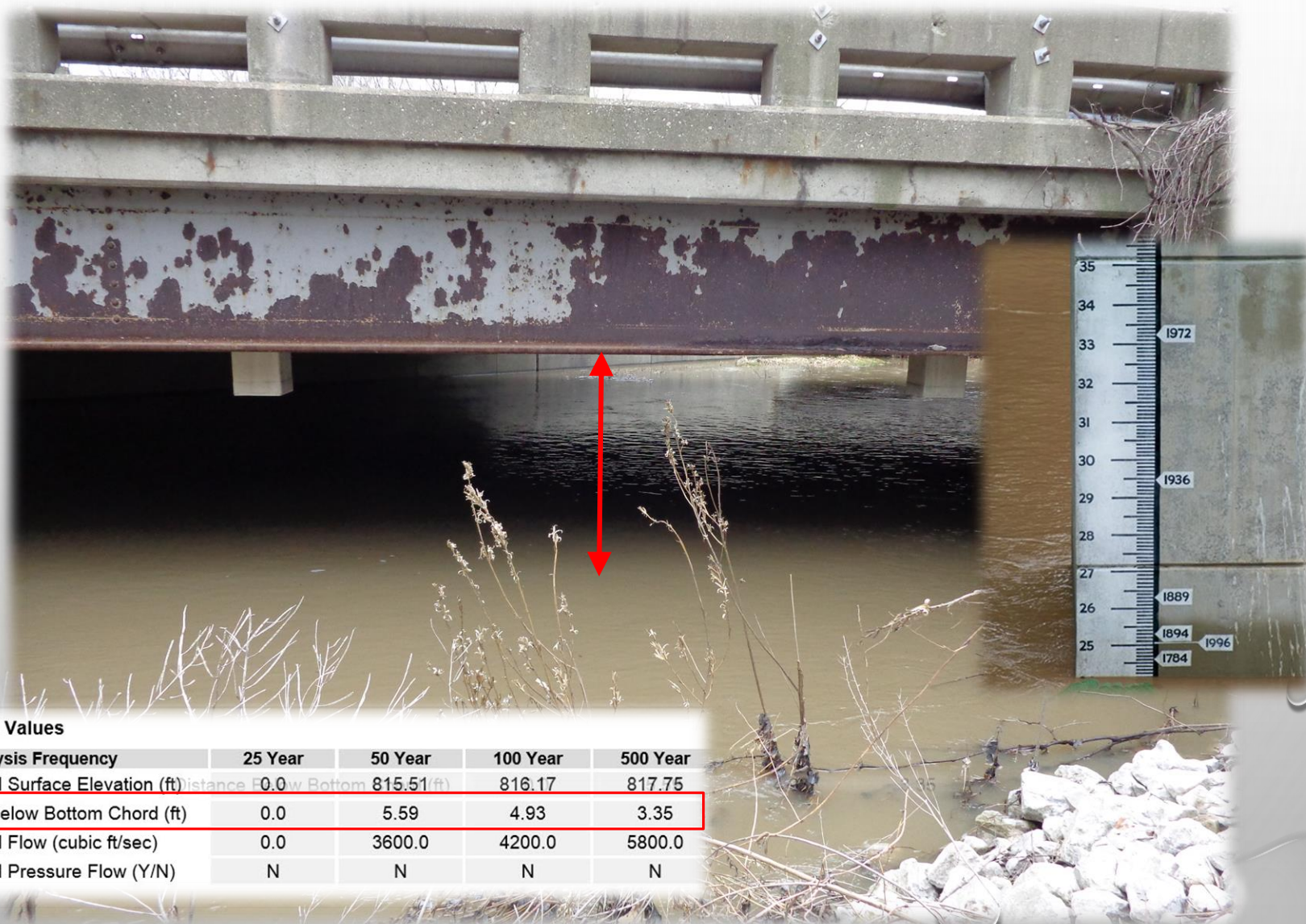
Safe Inspection Practices



Things to Look For



Things to Look For



Calculated Values

Scour Analysis Frequency	25 Year	50 Year	100 Year	500 Year
Anticipated Surface Elevation (ft)	0.0	815.51	816.17	817.75
Distance Below Bottom Chord (ft)	0.0	5.59	4.93	3.35
Anticipated Flow (cubic ft/sec)	0.0	3600.0	4200.0	5800.0
Anticipated Pressure Flow (Y/N)	N	N	N	N

Things to Look For



Things to Look For




Things to Look For





Guidelines for Monitoring

- Begin monitoring once a flood warning has been issued
 - Follow the POA
 - Visit bridge repeatedly as-necessary during an event until a post-event scour inspection can be performed
 - Update your POA as necessary after the event
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Tools for Monitoring

- Scour Action Plans (POA):
- Fish Finder
- ArcGIS High-Flow Monitoring Tool (Open using Google Chrome or Firefox)
 - <http://mdot.maps.arcgis.com/apps/webappviewer/index.html?id=6e46e8113340473f873c624ce3342518>
 - Username: MDOT_Viewer
 - Password: @g0V1ew3r
- Warnings and Watches - <http://alerts.weather.gov/cap/mi.php?x=1>

Underwater Technology



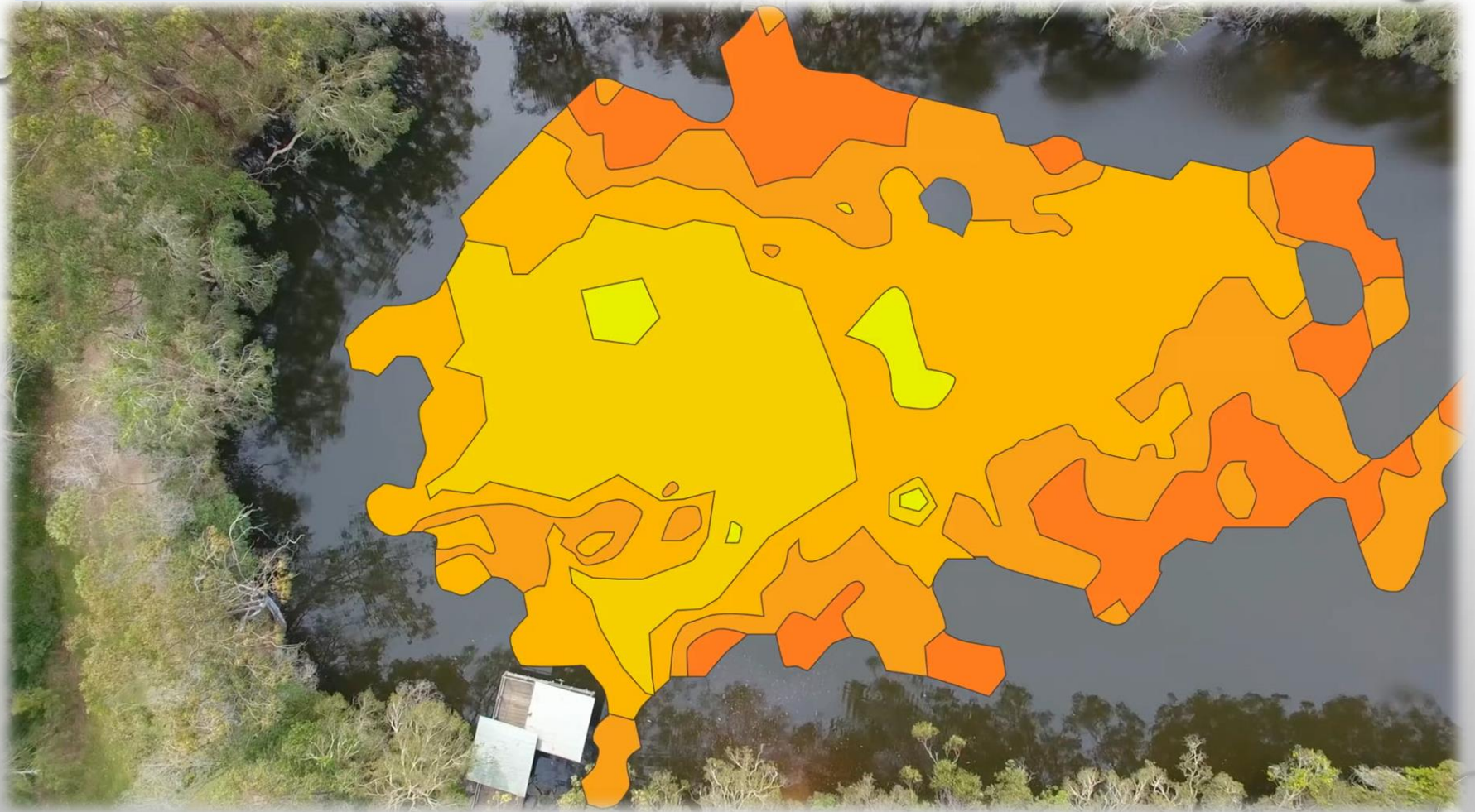
Deeper Smart Sonar
PRO+ Fish Finder



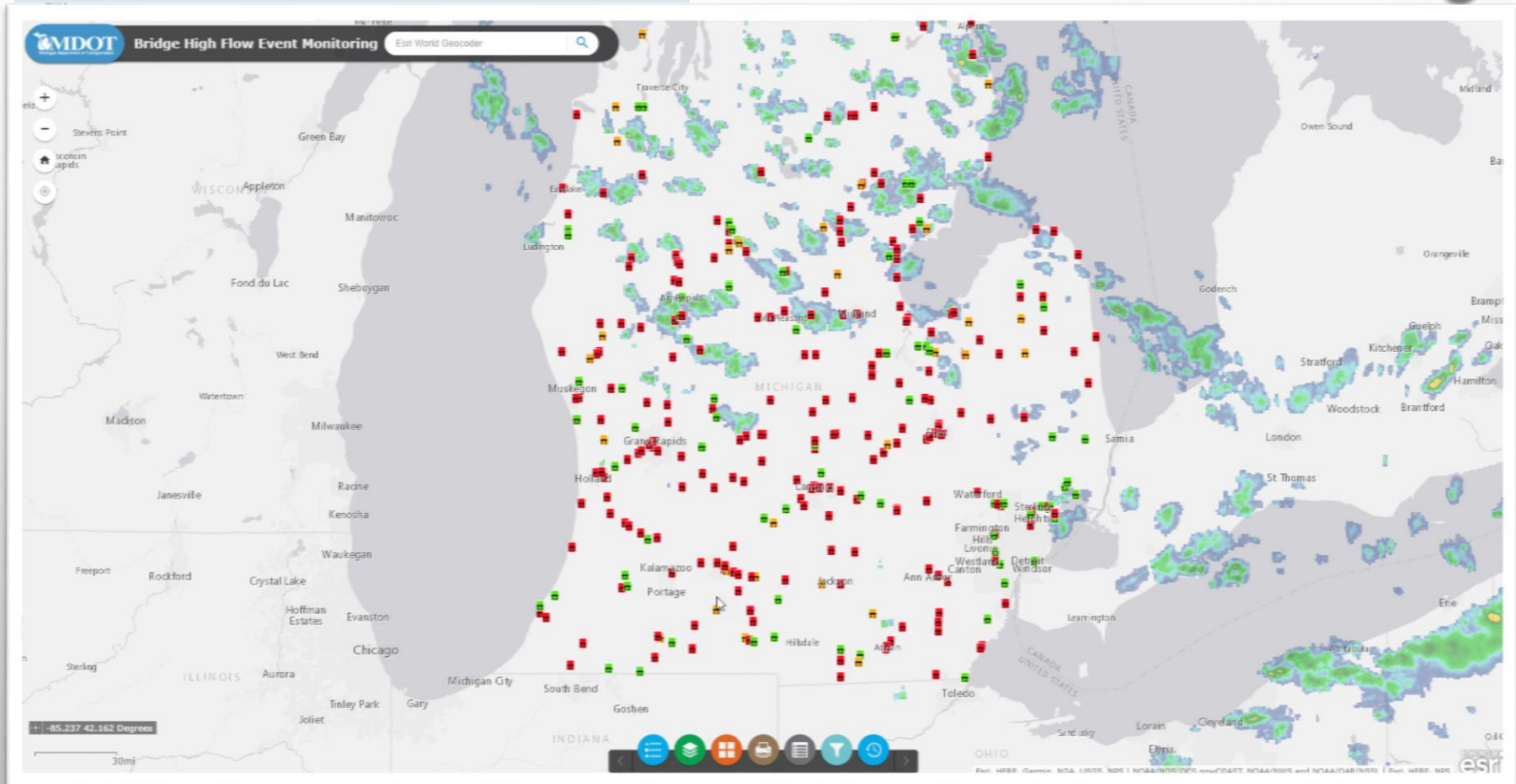
Underwater Technology



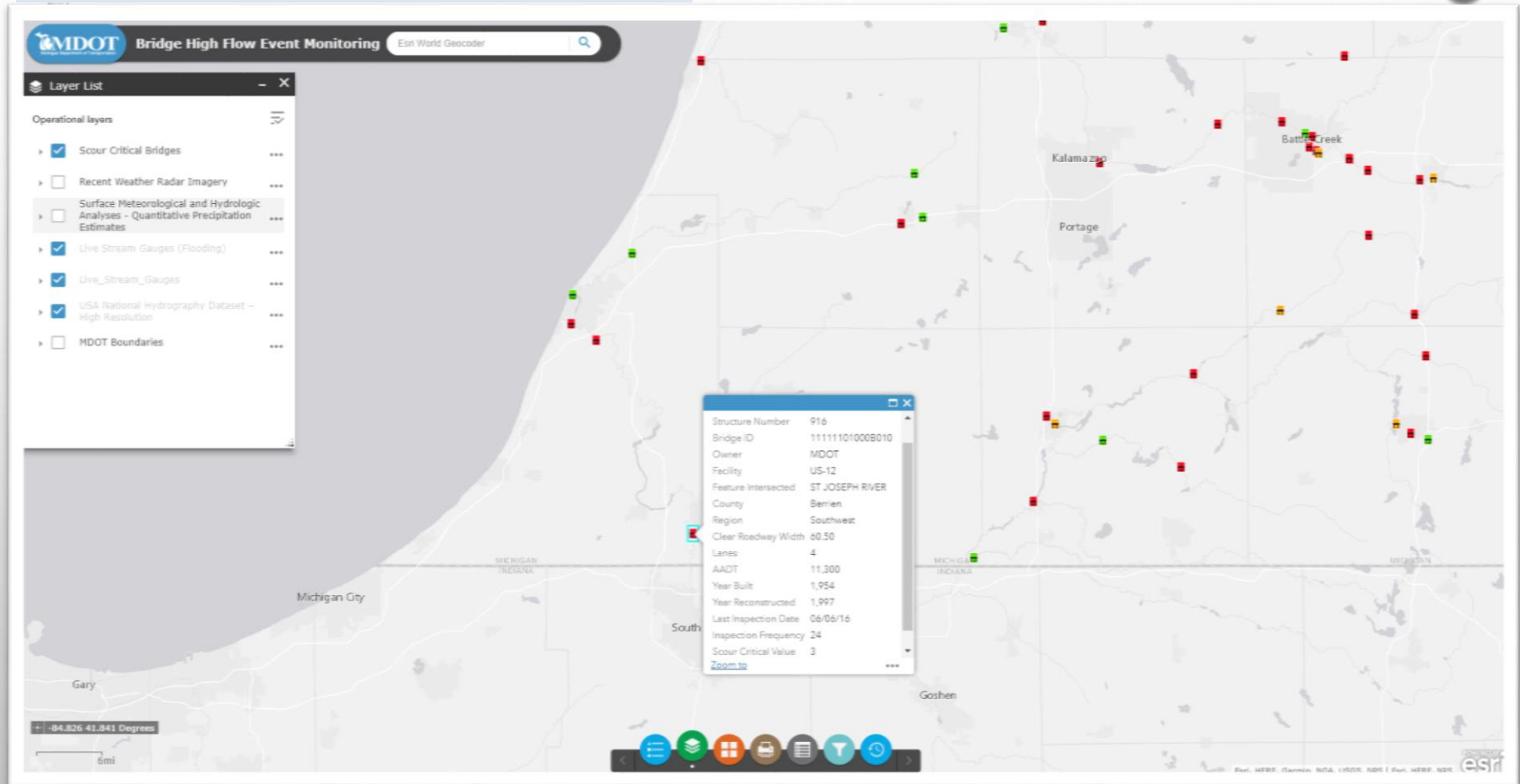
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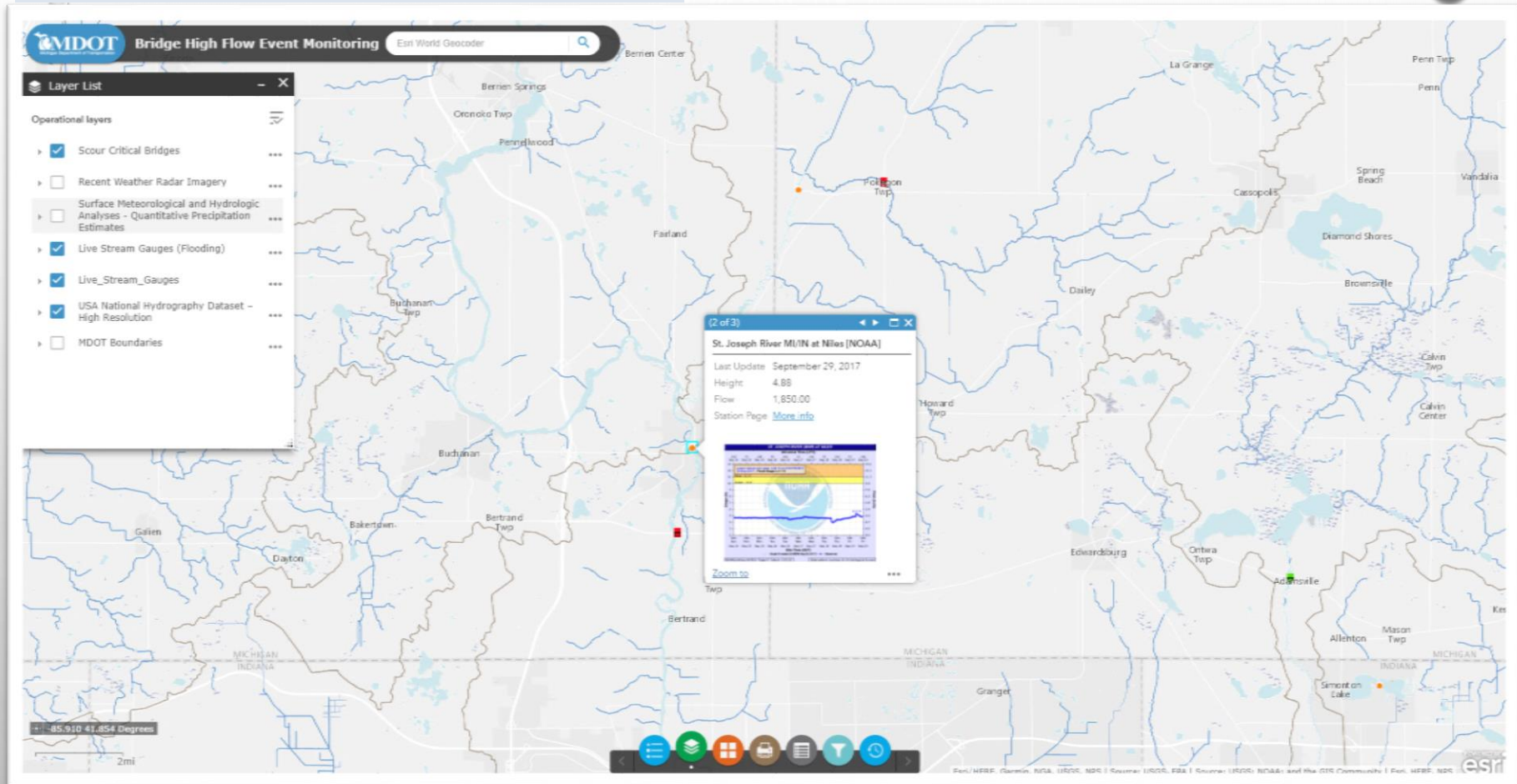
ArcGIS High-Flow Monitoring Tool



ArcGIS High-Flow Monitoring Tool



ArcGIS High-Flow Monitoring Tool



ArcGIS High-Flow Monitoring Tool

