

Crossing the Keweenaw Waterway in an Emergency with a U.S Army Floating Bridge



Photo: John Kiefer

William Leder, Adjunct Professor (Ret.)
Department of Civil and Environmental Engineering

Contributions by Brent Cousino,
BSENVE, MSCE, are acknowledged



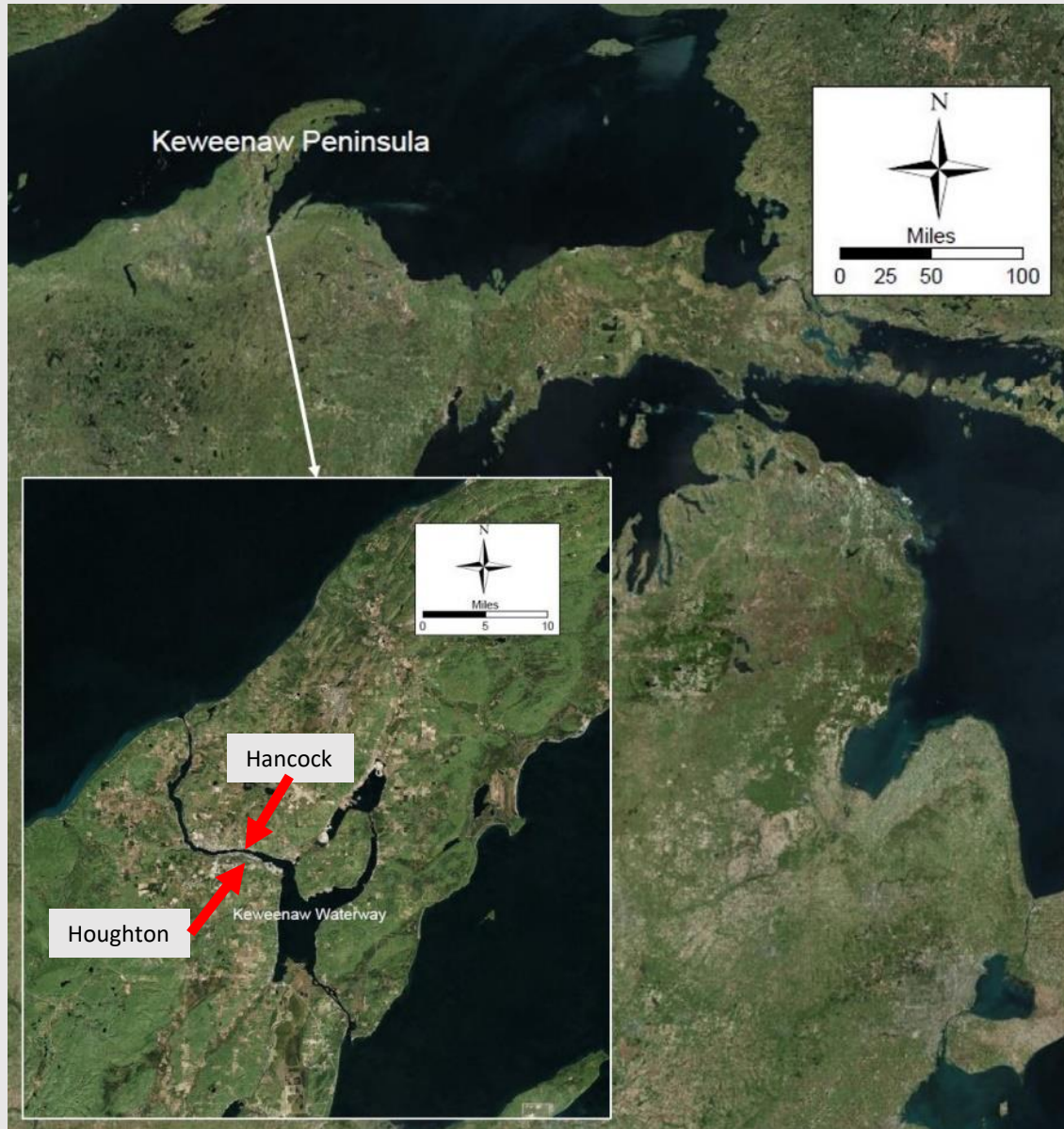
Michigan
Technological
University

Presentation Objectives

- Context – The Keweenaw Peninsula
- Explain the importance an emergency IRB** crossing
- How the preferred crossing location was selected
- Details of the proposed crossing infrastructure
- Traffic flow analysis
- Identify next steps leading to implementation

** Improved Ribbon Bridge

Keweenaw Waterway Location



March 3, 1865
Rivers and Harbors Act

Portage Lake Lift Bridge

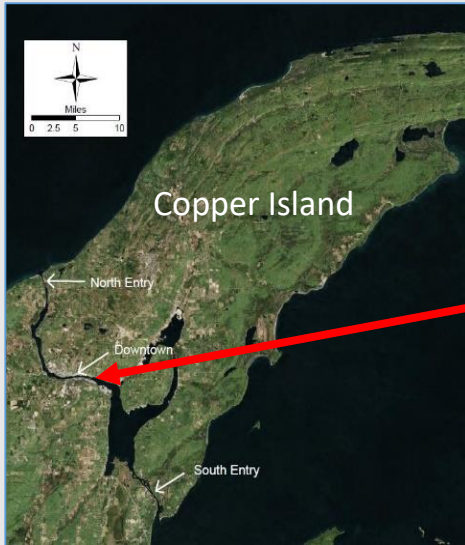


Photo: Adam Johnson

- Opened in 1959
- Only roadway link between “Copper Island” and the mainland
 - 21,000 people live north of the bridge
- 27,000 daily crossings; 2.5 times the traffic on the Mackinac Bridge
- Vital for emergency services, economy, institutions, and society

Why an Emergency Crossing is Vital

- Only vehicular link between Copper Island and the mainland
- Separation of key components of community
 - Both hospitals and only airport located north of the bridge
 - Food, fuel, medicine, and other essentials must flow north
 - Mix of employers and employees on both sides
 - Commerce and businesses on both sides
 - Michigan Tech on south side, Finlandia on north side

Vulnerabilities

What could happen?

- Electro-mechanical failure
 - Failure in August 2010 put bridge out of operation for 3 hours
- Struck by a vessel
- Major roadway transportation accident and ensuing fire

Assessing the Risk

Risk = Probability x Consequences

The probability of occurrence is low

But the consequences are very high

Therefore, the risk must be addressed

Bridge Collision – Ems River, Germany

December 2015



Photo: Jan-Timo Häckel

Oakland Maze Bridge Fire – California

April 2007



Photo: Contra Costa Times

Gasoline Tank Truck Accident - Chassell

February 2018



Photo: Daily Mining Gazette

4,500 gallon fuel spill



Improved Ribbon Bridge (IRB)



- U.S. Army modular floating bridge deployed by the Michigan National Guard
 - Ramp bays – 2 lanes by 22 feet long
 - Interior bays – 2 lanes by 22 feet long
 - 704 foot maximum length

Launch



Photo: Primeportal.net

Rafting



Full Enclosure



Photo: Primeportal.net

Objectives of Keweenaw Waterway Emergency Deployment

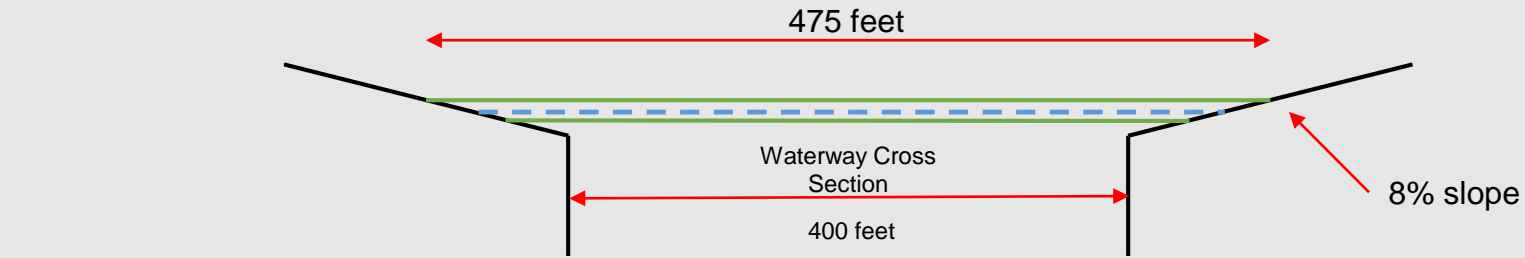
- Robust rafting between Houghton and Hancock
 - Operating like a ferry for vital movements (emergency vehicles, food, fuel, buses, and other high priority vehicles)
- Full enclosure at the preferred crossing location
 - Used for public conveyances
 - Two lane bridge for all types of highway vehicles

Lake Superior Water Levels

- 100 years of water level data
 - Low water = 599.48 feet (April 1926)
 - High water = 603.38 feet (October 1985)
 - Range = 3.90 feet
- The full enclosure length exceeds the shore-to-shore distance
 - Water will rise some distance up the on-shore access ramp

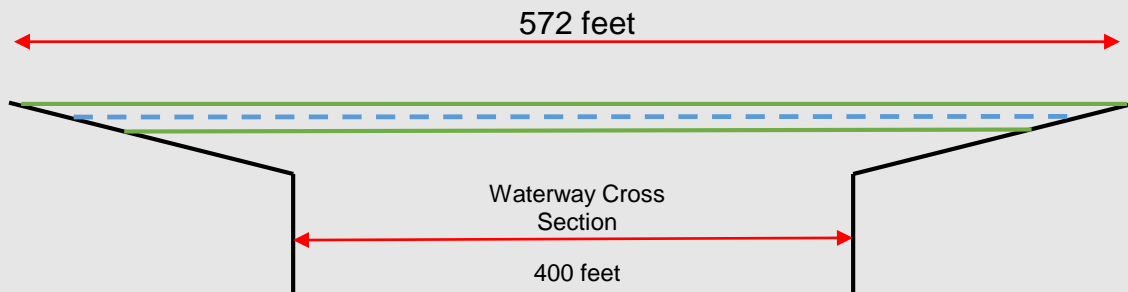
Lake Superior Water Levels

Cross Sections at Lily Pond



Low Water Level

IRB Floating on Water



High Water Level

Lake Superior Water Levels

Houghton County Marina



Three Potential Crossing Locations



South Entry

- Narrowest shore-shore span = 530 ft.
 - Few IRB bays for rafting
- 82 mile round trip
 - Energy use and emissions
- Existing roads not highly developed
- No publicly owned land on either side



Photo: USACE

Ruled Out

Downtown Houghton and Hancock

- Narrowest shore-shore span = 540 ft.
 - Few IRB bays for rafting
- Crossing would run through historic Quincy Smelting Works
- Full enclosure could impede rafting
- Problematic road geometry
- Potential traffic impacts in downtown areas



Ruled Out

North Entry

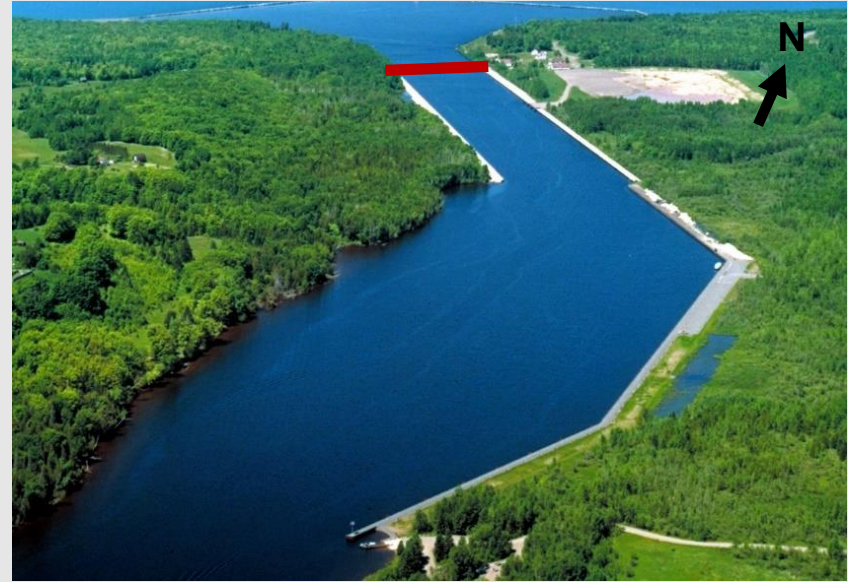
- Shortest shore-shore span of 400 feet
- Almost all of land is publicly owned
- Two potential crossing sites



Photo: USACE

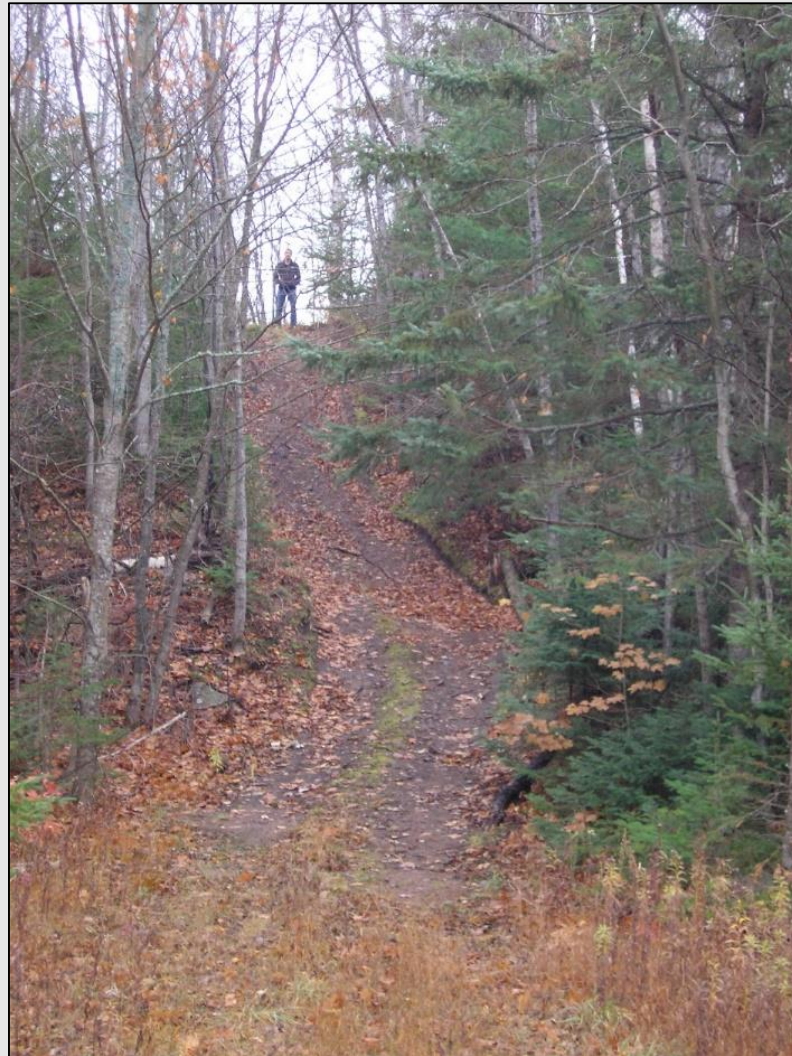
North Entry – Alternative 1

- 40 mile round trip
- Private property on west side
- Unacceptable access road grades on west side
- Concern about high waves
- Deep cuts for access roads
 - Makes snow removal challenging
 - High erosion potential
- No wetlands, but significant environmental impacts due to excavation

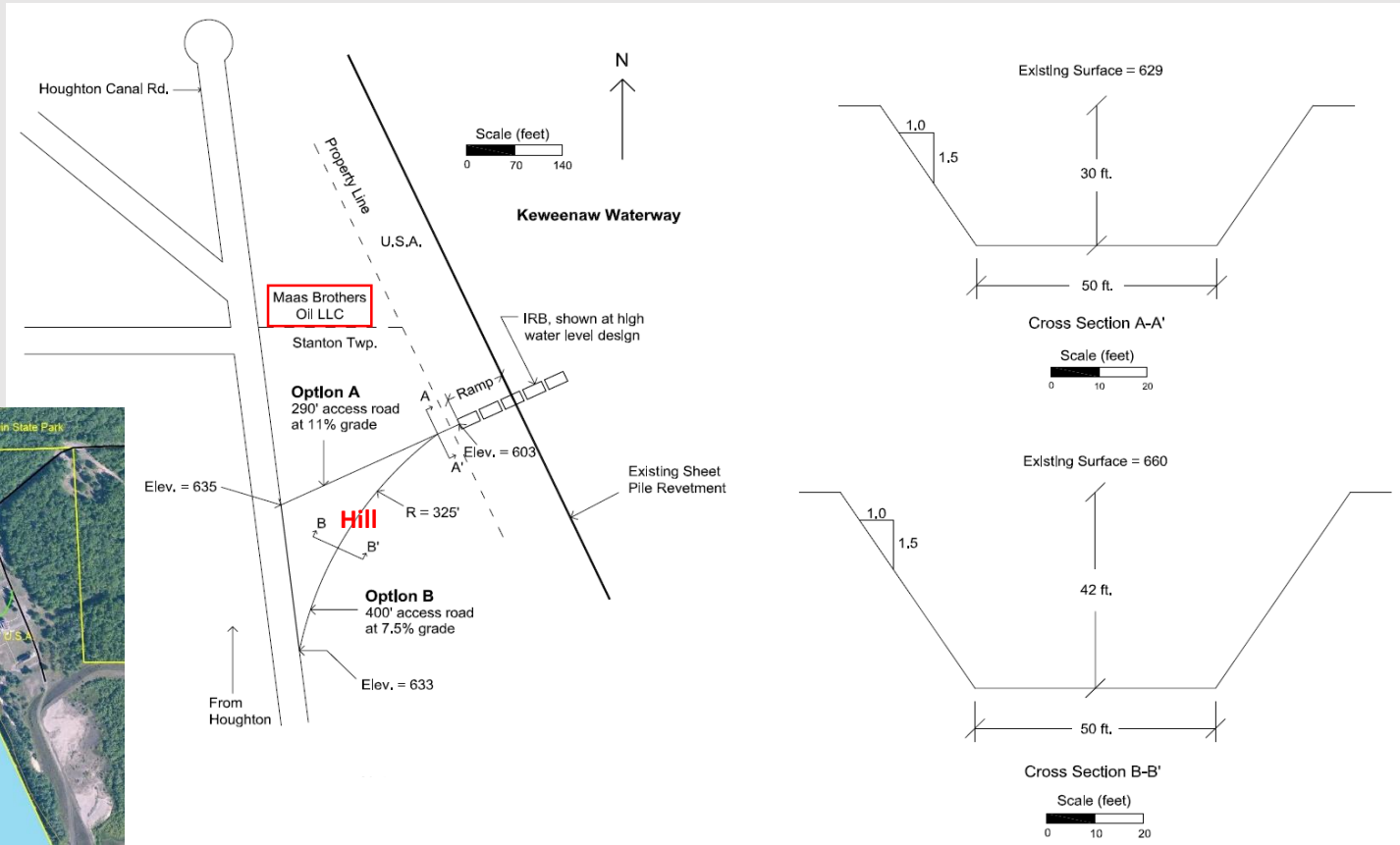


Ruled Out

Alternative 1 Hill



Alternative 1 Details



North Entry – Alternative 2

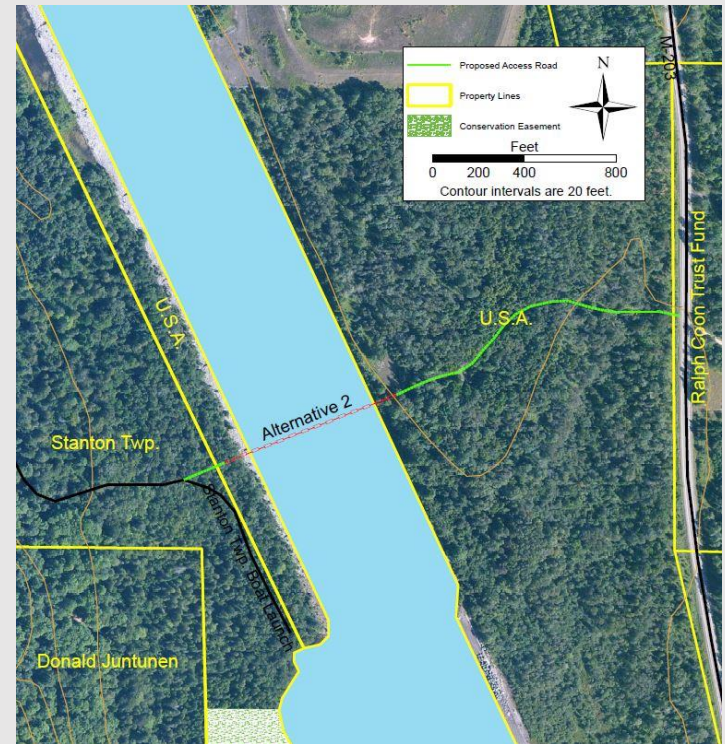
- 36 mile round trip
- Takes advantage of existing roads
 - West – Stanton Twp. Boat Launch
 - East – two track off of M-203
- Acceptable road profiles
- Reduced waves
- Minimal total wetland impacts



Preferred Site

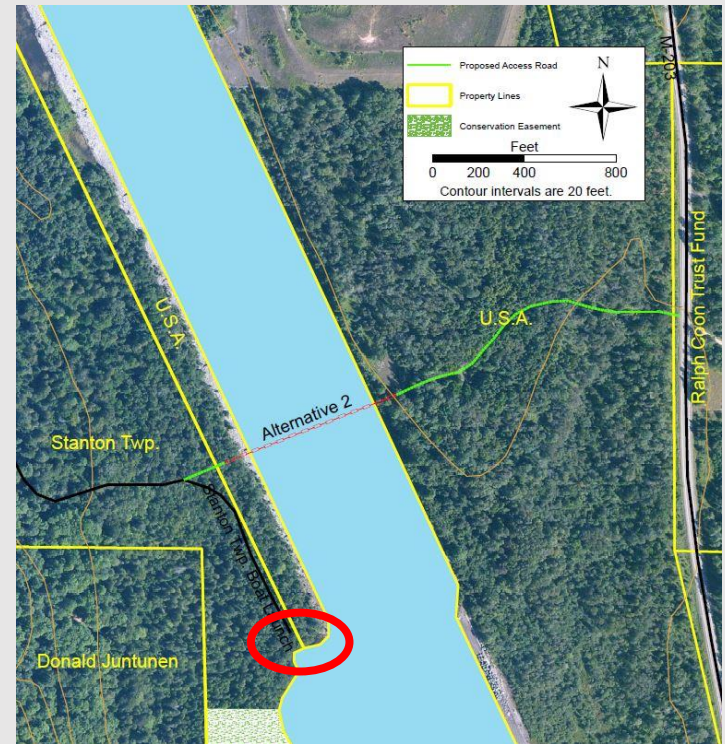
Preferred Alternative – West Side

- Uses existing Stanton Twp. Boat Launch Access Road
 - Land is owned by Stanton Twp. or U.S.A.
- 90 foot long by 50 foot wide concrete ramp at 8%
 - Modifications to steel sheet pile revetment required
- New 85 foot long access road
- Total wetland impact = 7,050 ft² (0.16 acres)



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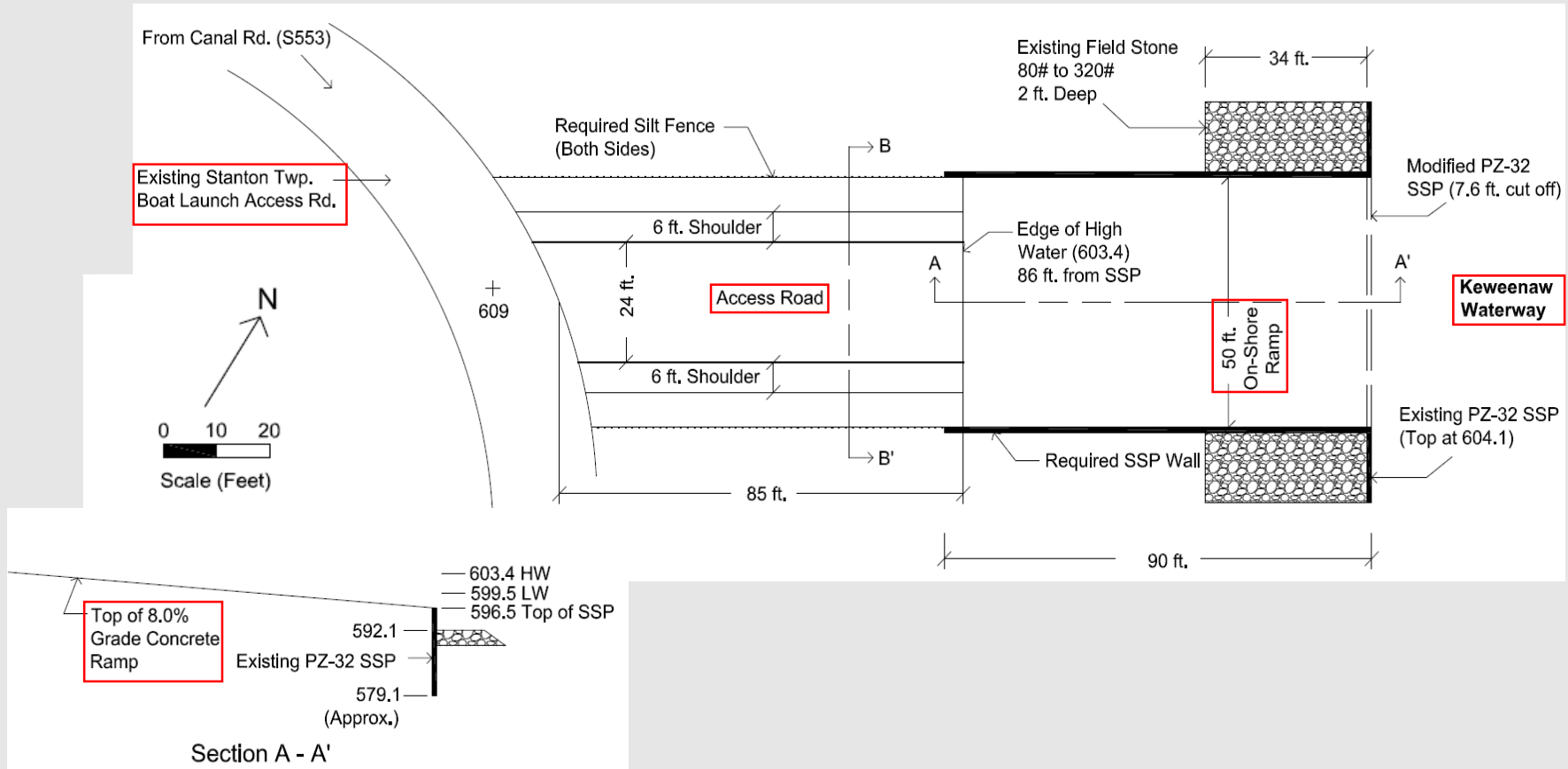
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Ramp Construction

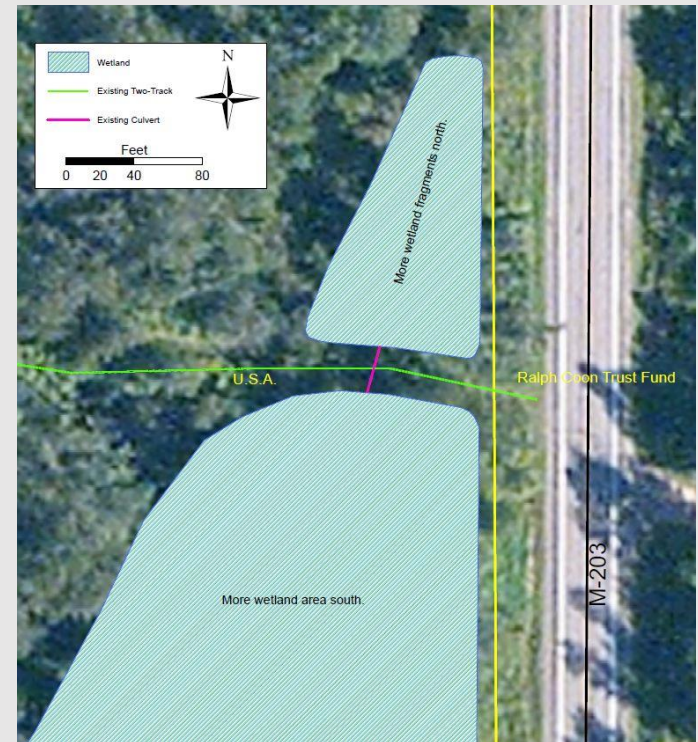
Water inflated rubber membrane cofferdam



Photos: Aqua Dam, Inc.

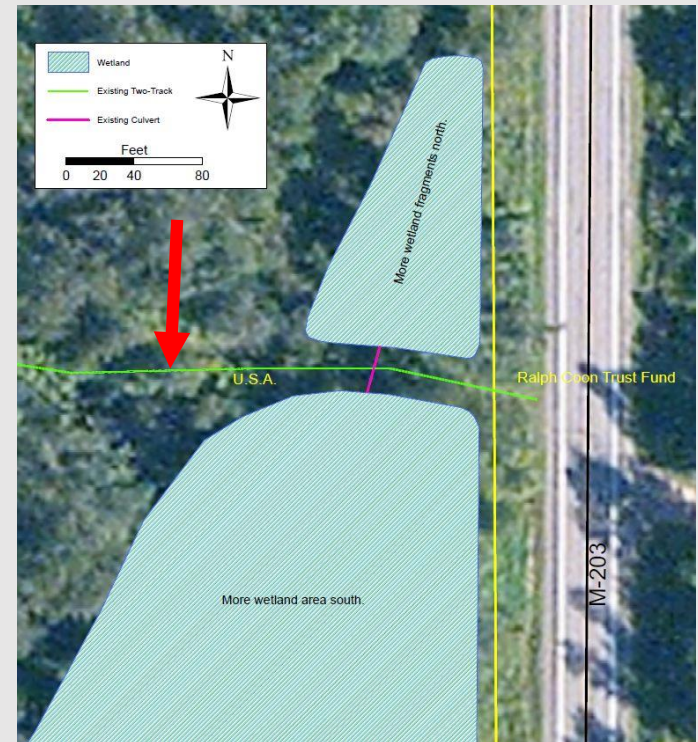
Preferred Alternative – East Side

- Uses existing two track off of M-203
 - Widen to accommodate two lanes
- Crosses small slice of private property
- Crosses small wetland areas
 - Two track is not considered wetland
 - Culvert connects the two fragments
 - Wetland impacts = 1,990 ft² (0.05 acres)
- Cleared grassy area that can be used for staging



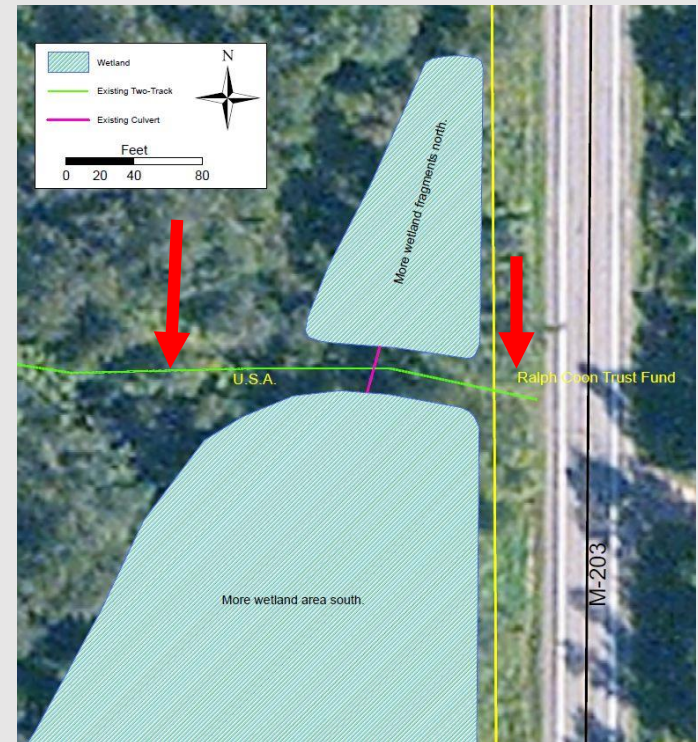
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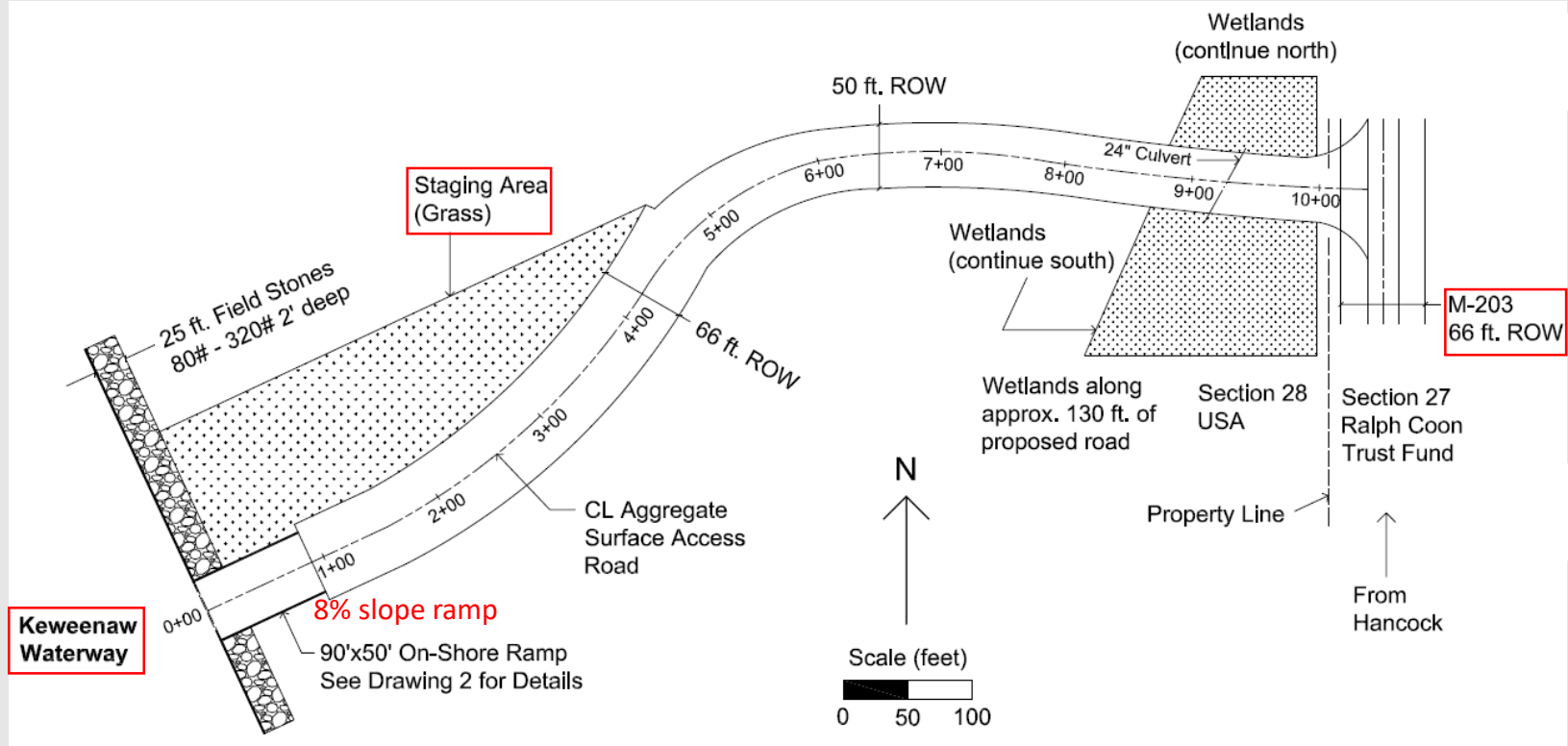
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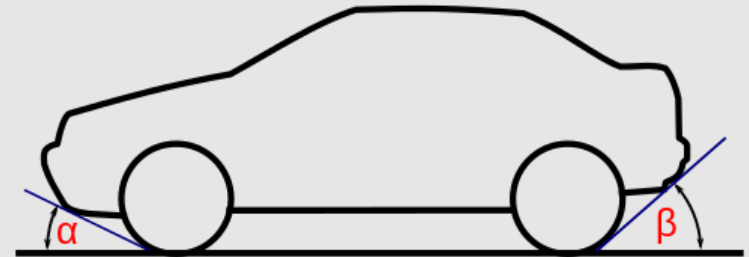


Timber Transition

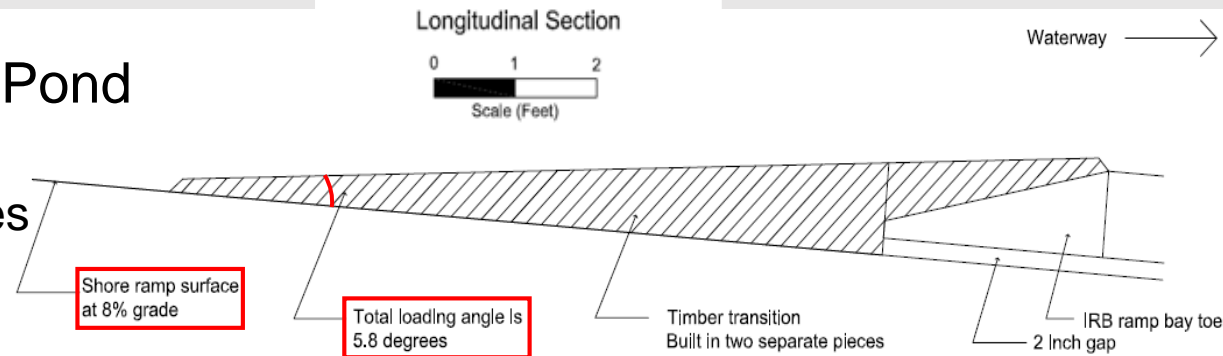


Timber Transition

- Must design for all angles of approach and departure
 - Angle of 5.8° will accommodate all vehicles
- Timber transition design spans full width of lanes
- Can be tested at Lily Pond Boat Launch
 - Both have 8% grades



Source: www.commonswikipedia.org



Theoretical IRB Traffic Flow

Condition *	Vehicle Spacing (feet)	Max Speed (MPH)	Capacity/Direction ** (autos per hour)	Lift Bridge Volume (northbound autos)
Normal – 25 mph	100	25	1,318 106%	1,238
Normal – 15 mph	100	15	791 64%	1,238
Caution – 5 mph	170	5	153 12%	1,238
Risk	580	3	31 3%	1,238

* Condition a function of wave height and weather as determined by 1437th field commander.

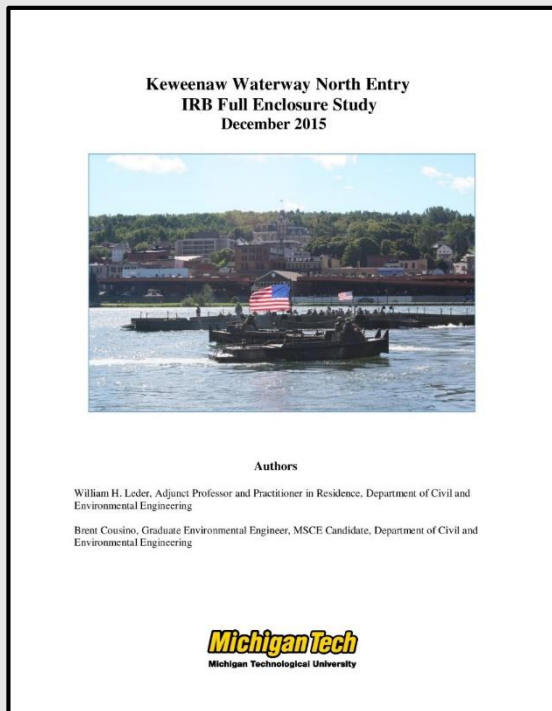
** Based on theoretical calculations. Actual rates will be less.

Measured Lift Bridge Traffic Volumes, 10/01/13, 4 to 5 pm

All vehicle types	Northbound	Southbound
All vehicle types	1,305	1,111
Autos only	1,238	1,054

Traffic volumes will be less during a lift bridge outage. How much?

First Step – Permit



Joint USACE/MDEQ Permit Application

All required information is in the report

Next Steps

- Joint USACE/MDEQ Application
- 1437th MNG exercise at Lily Pond
 - Same 8% slope
- Develop operational plans
- Civil Engineering Design
- USACE Section 408 Design Review
- Secure grant funding
- MOUs and property acquisition
- U.S. Coast Guard Bridge Permit Application



Lily Pond Boat Access Site

Thank You!

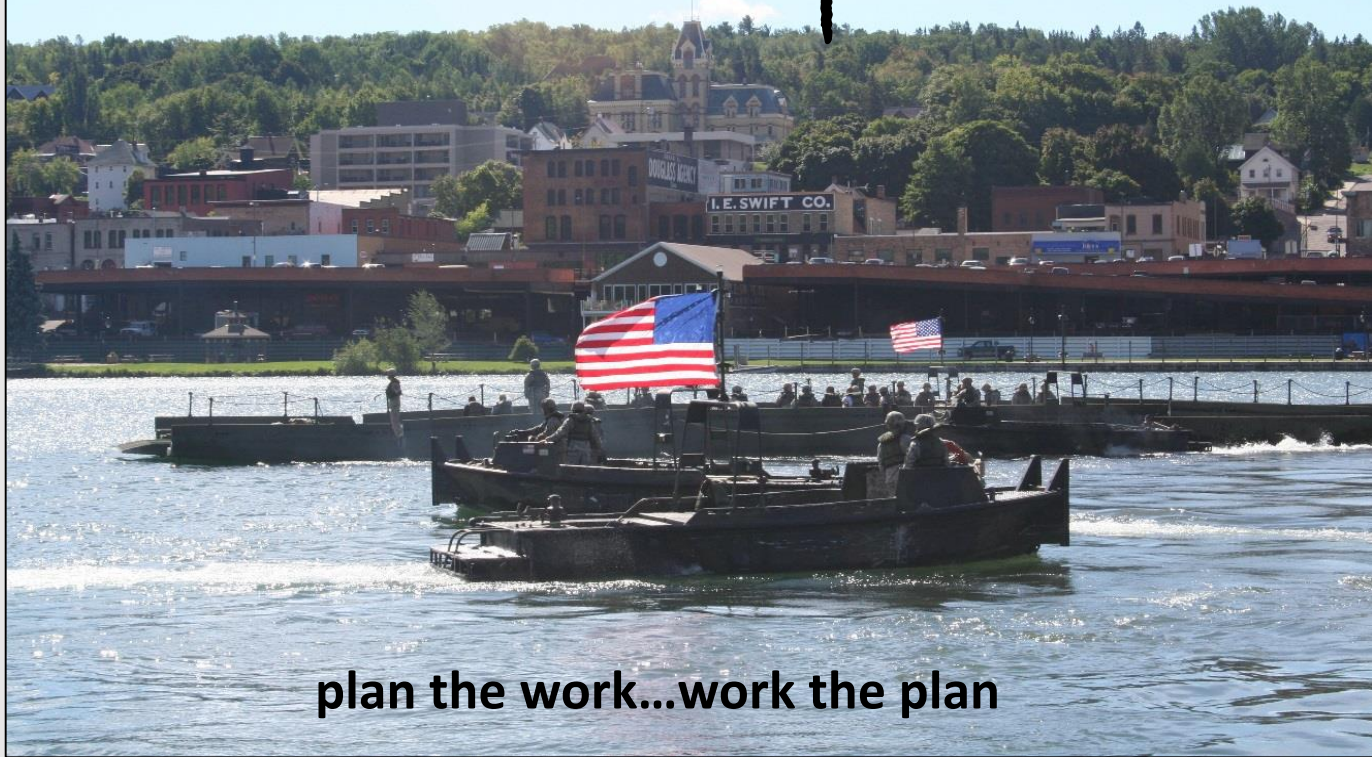


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Acknowledgements

- Jack Dueweke and Chris Van Arsdale, Houghton County Emergency Measures Directors
- Sergeant First Class Justin Proulx, 1437th MNG
- Senior Chief Ed Iverson, U.S. Coast Guard Station Portage
- John Paul Pietila, Traverse Engineering
- Jamey Markham, Stanton Township Supervisor
- Many others