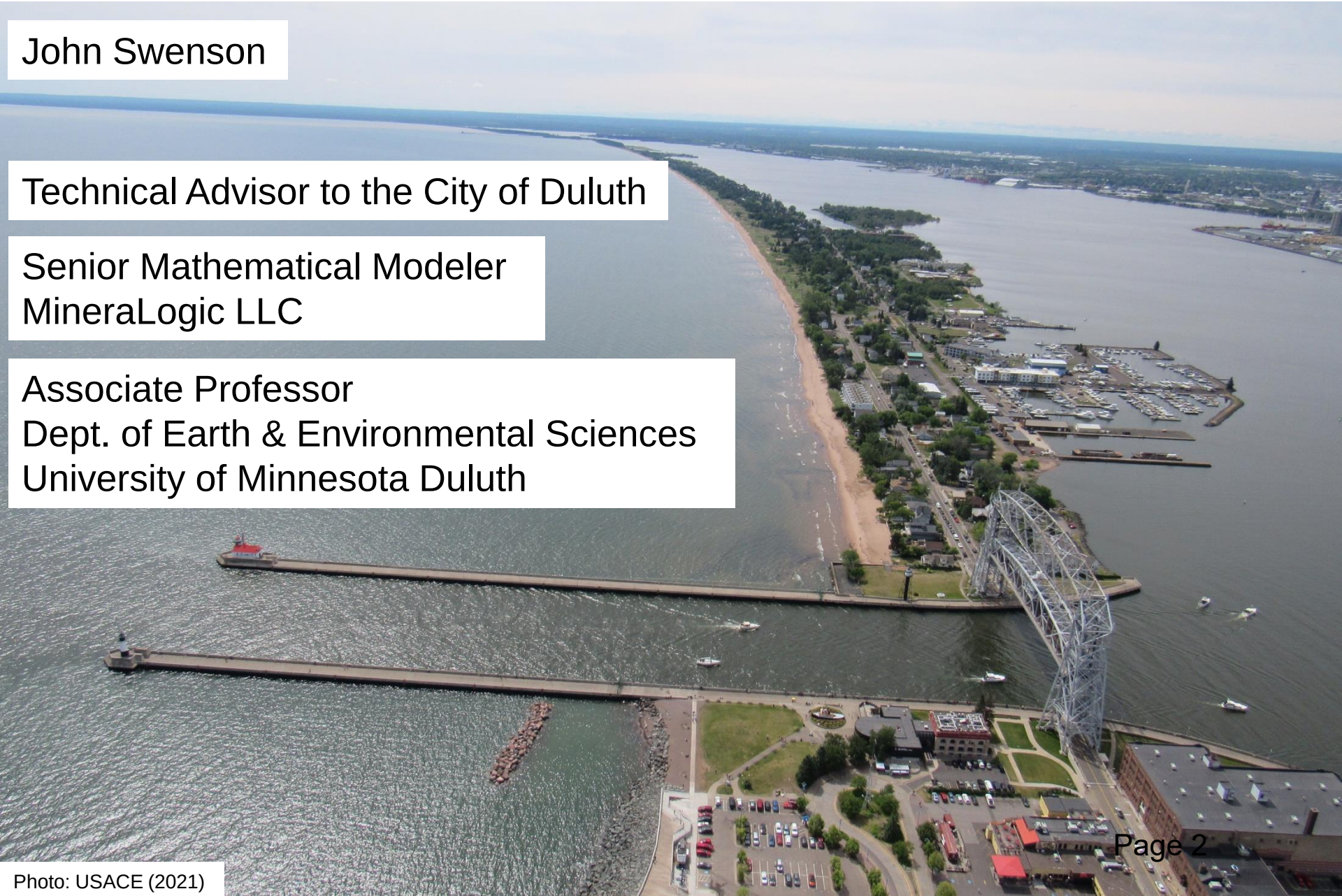
Section 111 Study - Minnesota Point
Public Information Meeting

Monday, June 3, 2024
1:00 - 3:00 pm

Compiled Presentations:

For additional information, or to submit questions, please reach out to the project team at the U.S. Army Corps of Engineers at LREPAO@USACE.ARMY.MIL

MN Point: What, why, and when?



John Swenson

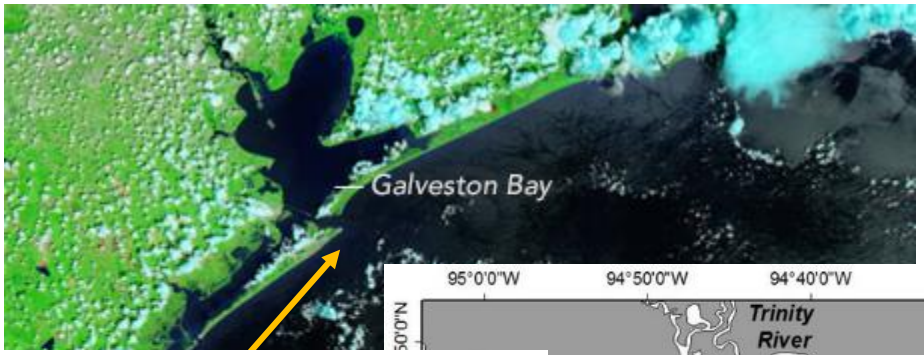
Technical Advisor to the City of Duluth

Senior Mathematical Modeler
MineraLogic LLC

Associate Professor
Dept. of Earth & Environmental Sciences
University of Minnesota Duluth

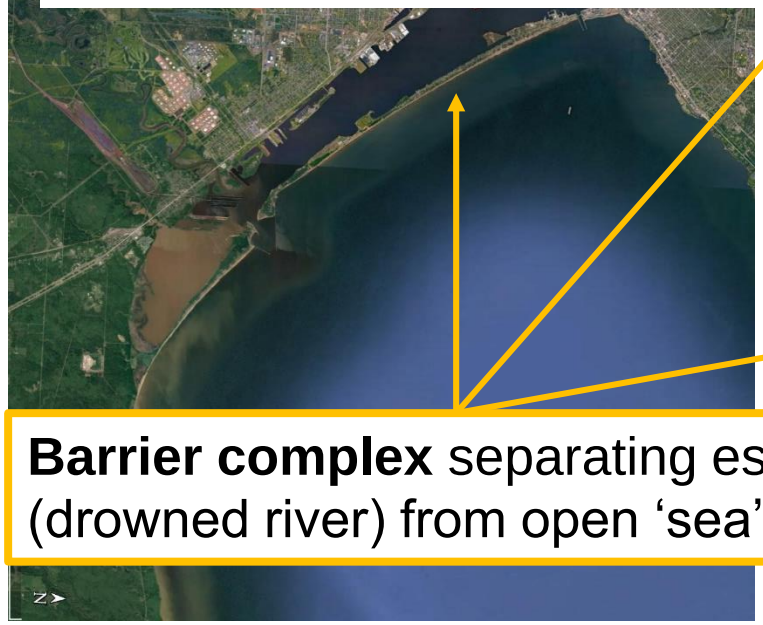
Photo: USACE (2021)

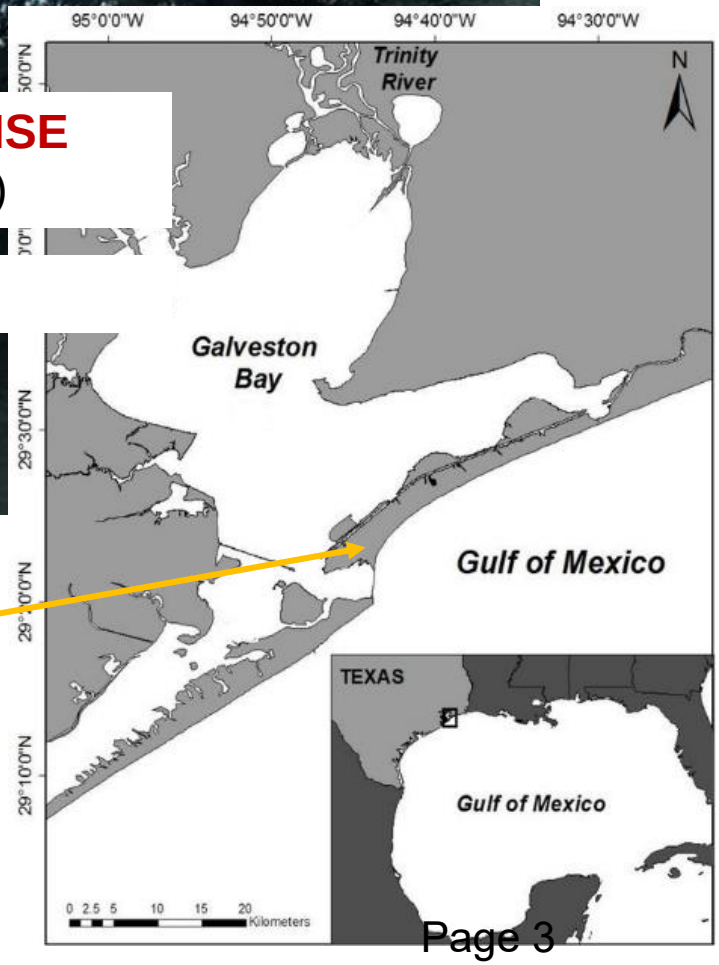
What is it? Just a big sand bar, right?



Key point 1: Barrier formation linked to **sea-level RISE**
(simple reason = must **drown river** to form estuary)

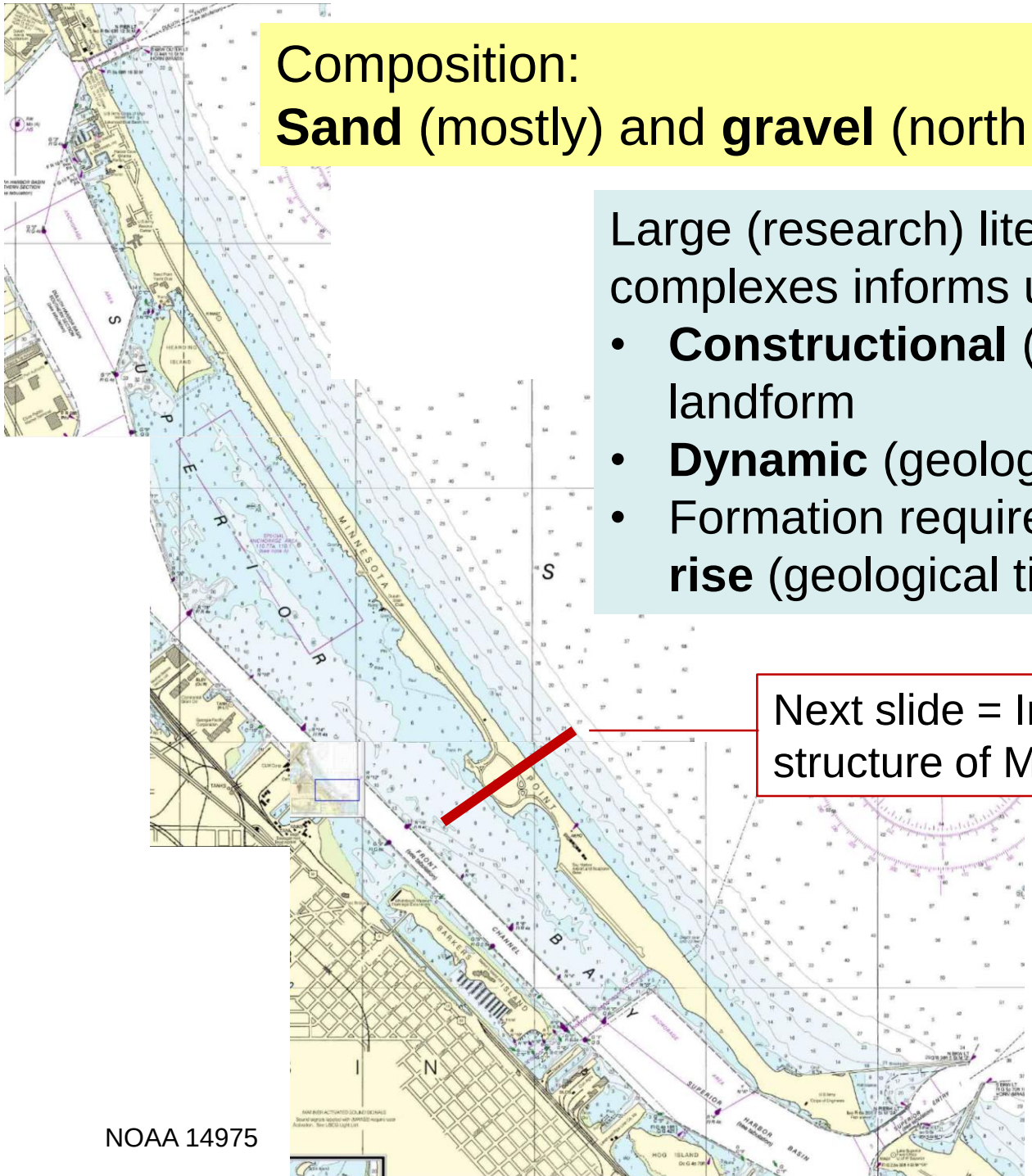
Key point 2: We need a supply of **sand**





Barrier complex separating estuary (drowned river) from open ‘sea’

Composition:
Sand (mostly) and **gravel** (north end); very little mud



Large (research) literature on barrier complexes informs us about MN Point:

- **Constructional** (net depositional) landform
- **Dynamic** (geologically)
- Formation requires rapid **lake-level rise** (geological timescales)

Next slide = Internal structure of MN Point

Note homogeneity in offshore structure (depth contours)

NOAA 14975

Ground-penetrating-radar (GPR) survey from **Harry Jol** (UW Eau Claire) and students

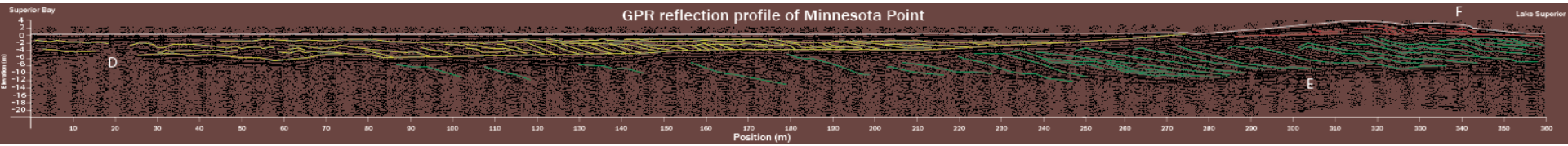
Harbor

Lake

Upper layer (yellow lines) = fill (dredge spoils) = old soccer fields = IGNORE

~25 m (thick)

Currently ‘exposed’ barrier



300 m

Focus on the **green** curves = surfaces of equal time / age

younger

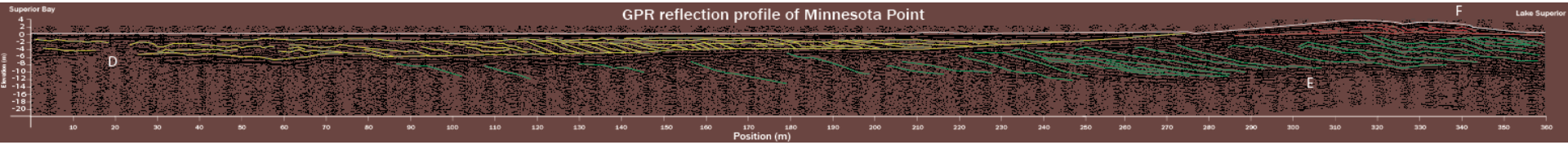
older

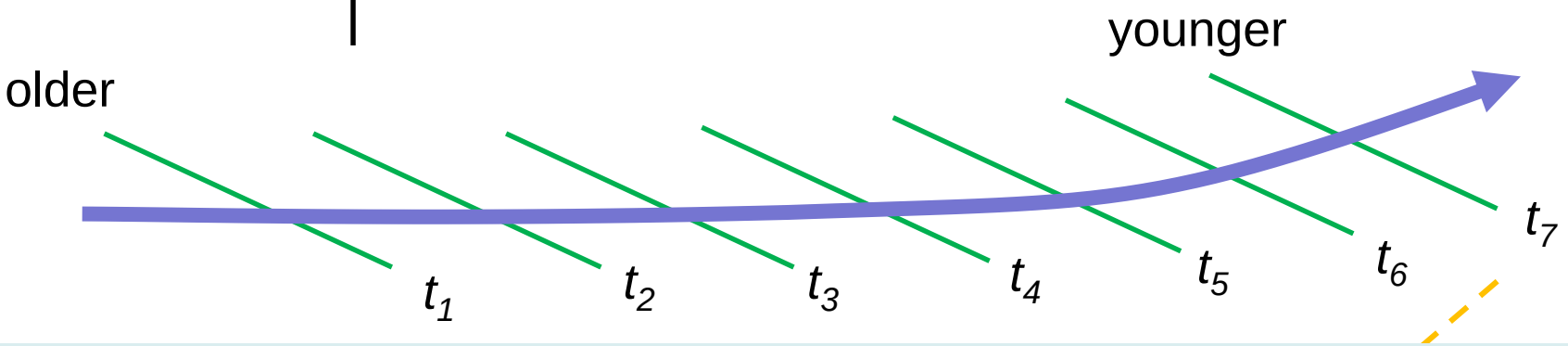
t_1 t_2 t_3 t_4 t_5 t_6 t_7

Harbor

~25 m (thick)

Currently ‘exposed’ barrier





Inferences from internal architecture :

- **Constructional** landform
- ~ 10-m thick package **building lakeward** through time atop older, genetically unrelated glacial sediments
- Timelines ‘climb’ in response to lake level rise (formation of barrier)
- Older timelines (beaches) **buried** beneath harbor

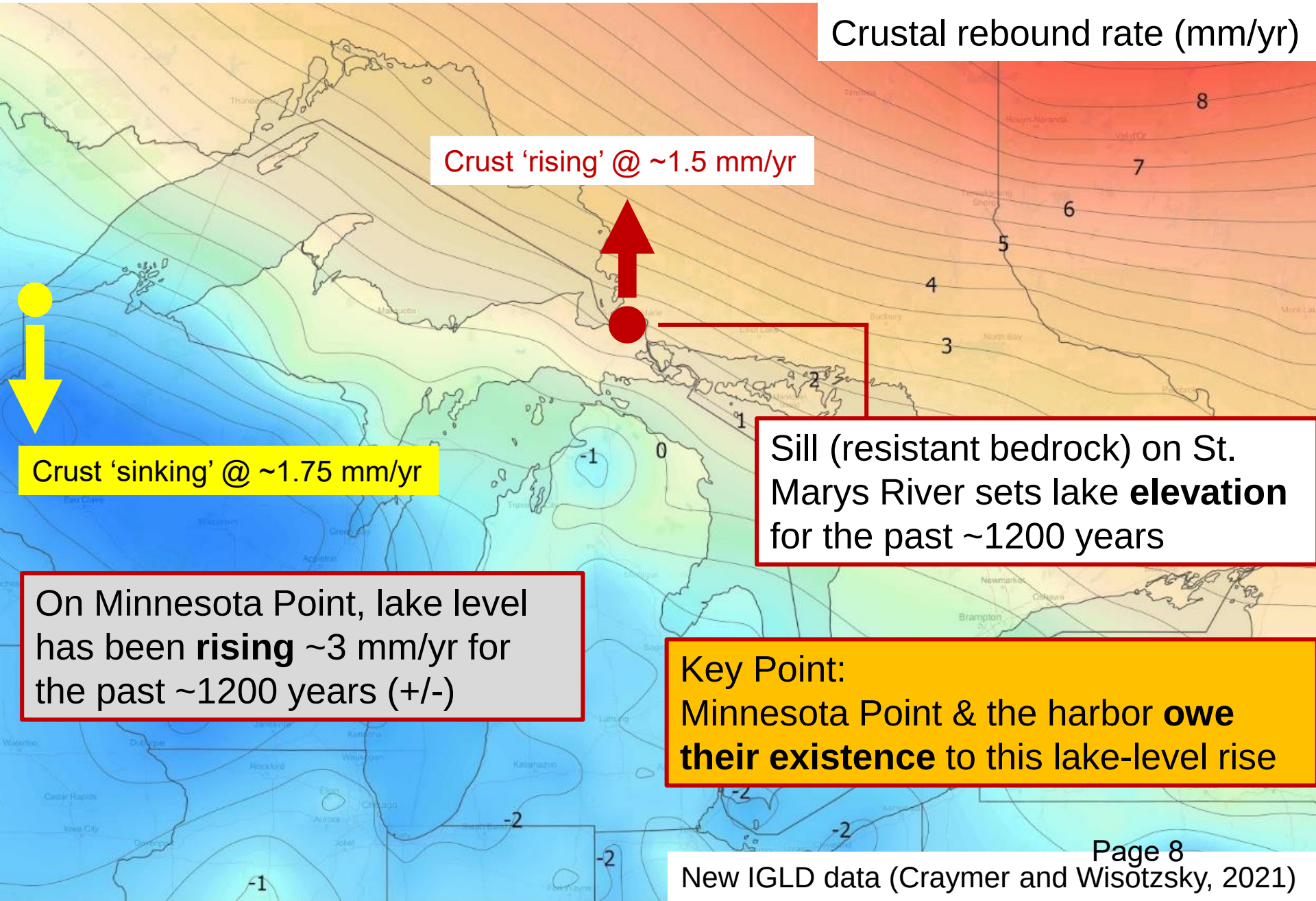
Why did it form?

Two basic ingredients:

1. Supply of sand and gravel
   - River input
   - Bluff erosion

2. Rapid (sustained) rise in lake level

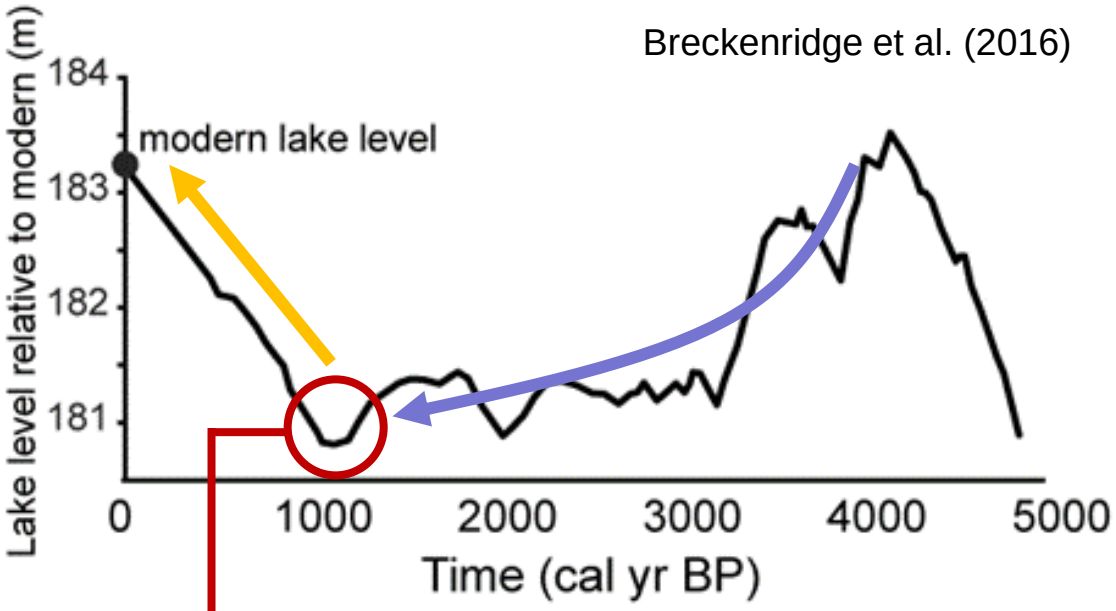
Lake level (millennial-scale change): 1200 yr BP - present



New IGLD data (Craymer and Wisotzsky, 2021)

When did Minnesota Point form?

Breckenridge et al. (2016)



1200 BP – present:

Rapid rise (~3.0 mm/yr)

4200 BP – 1200 BP:

Slowly falling to stable

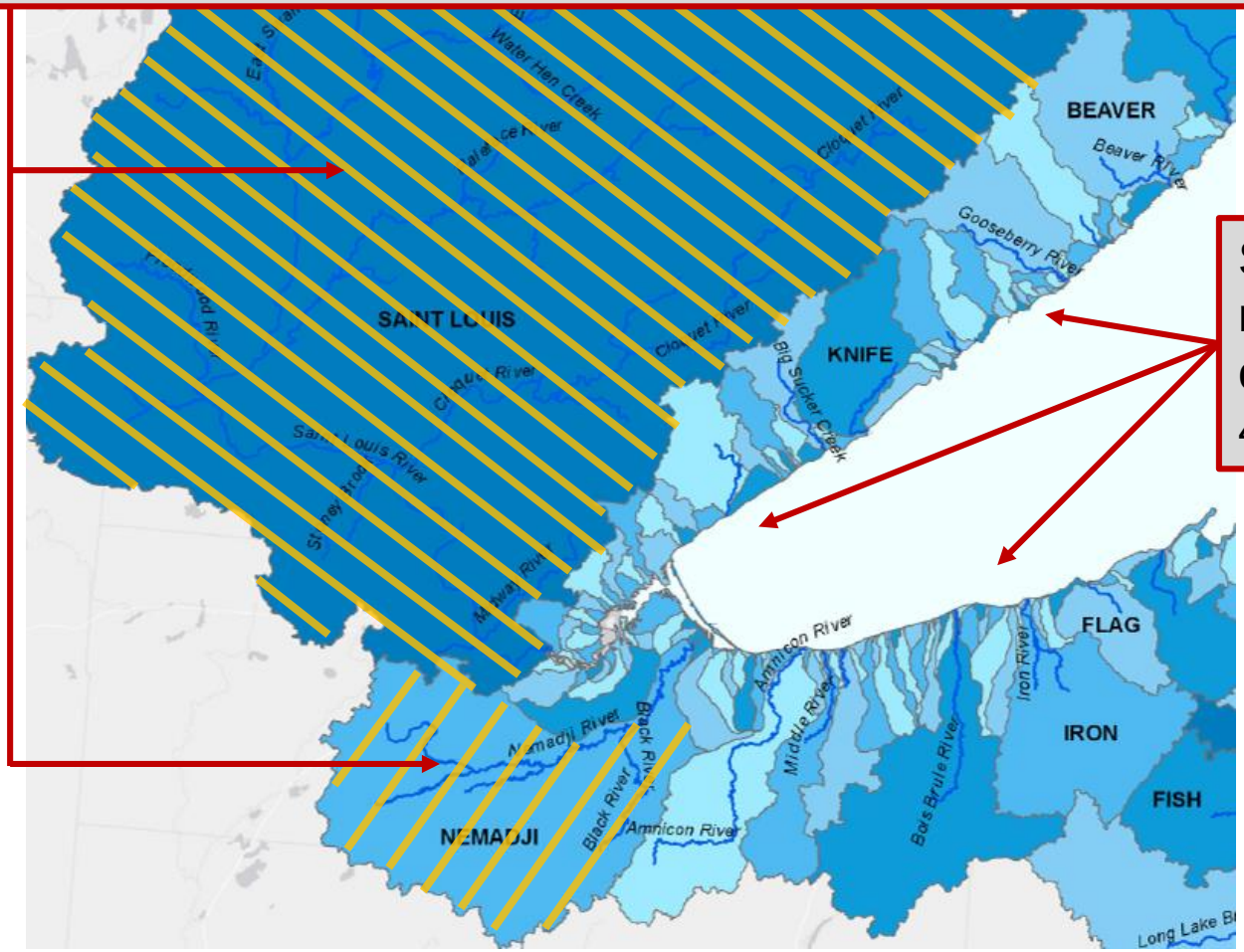
Some uncertainty in timing and magnitude; **trends certain**

- Barriers form in response to rising sea (lake) level
- Most likely time of MN Point formation

Sediment (sand & gravel) sources: **Riverine** input

- **St. Louis** and **Nemadji** basins contributed during stable / falling lake level (4200 – 1200 BP)
- Ditto the collection of small basins that feed the modern estuary and harbor
- **Neither St. Louis** nor **Nemadji** contributes **today** (flooded)

We are not concerned with **mud**

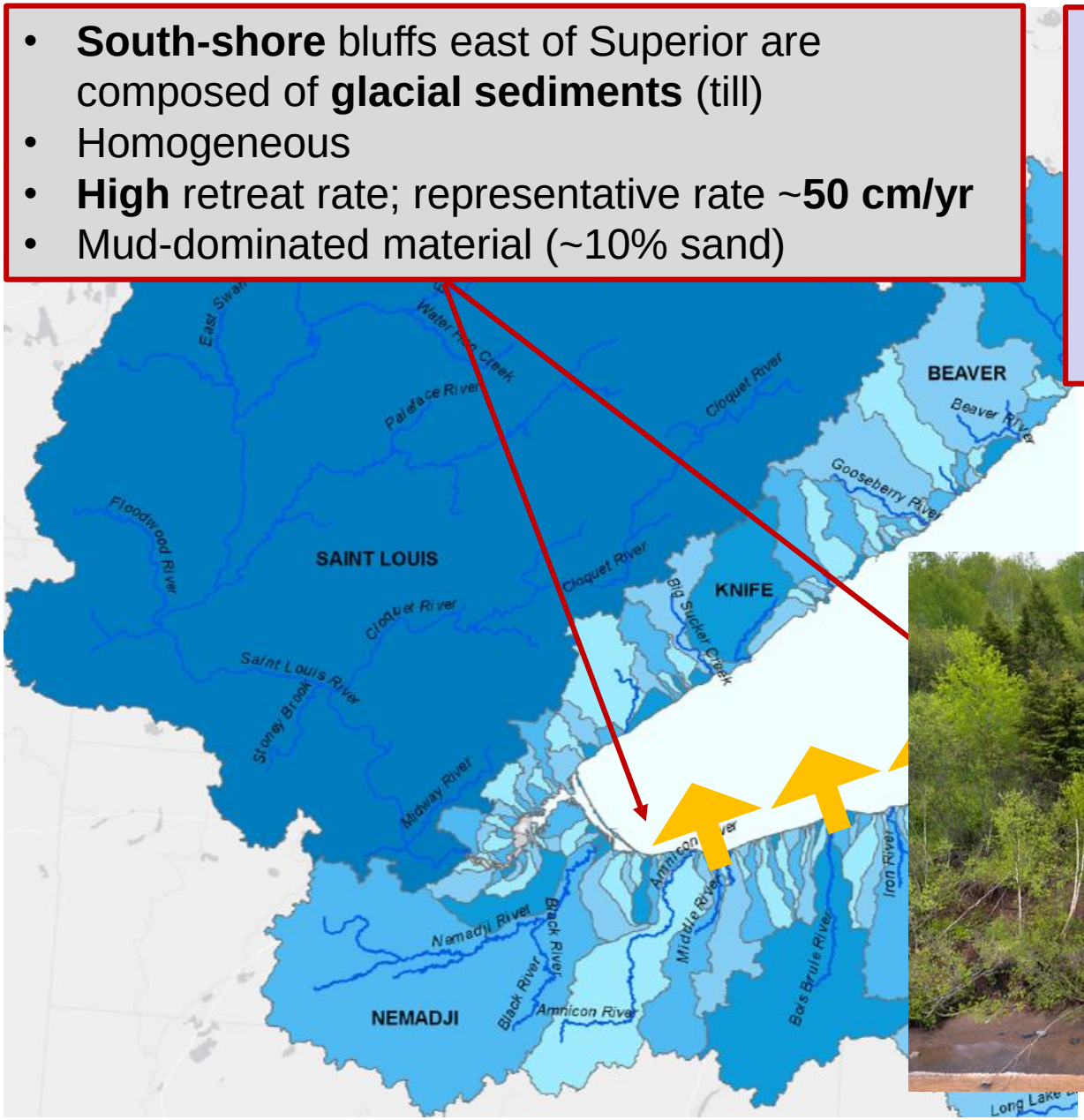


Smaller basins fed north / south shores continuously from 4200 BP – present

Sediment sources: Long-term lake-level rise and **bluff erosion**

- **South-shore** bluffs east of Superior are composed of **glacial sediments** (till)
- Homogeneous
- **High** retreat rate; representative rate ~**50 cm/yr**
- Mud-dominated material (~10% sand)

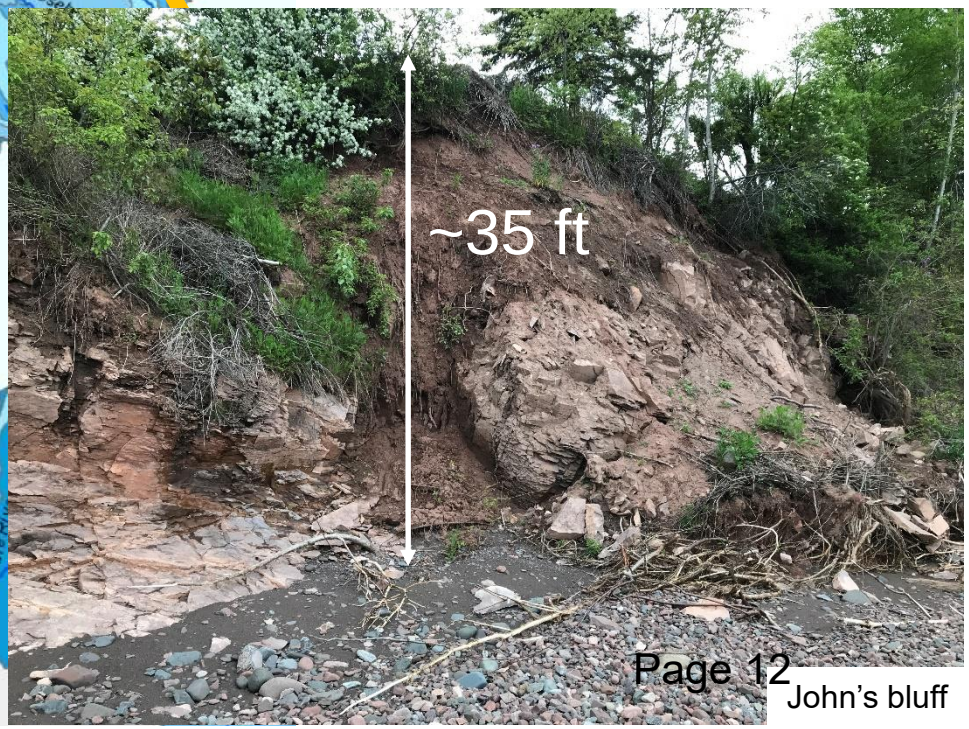
- Bluff erosion insignificant during stable / falling lake level (4200 – 1200 BP)
- Bluff erosion **ignited** when lake level began to rise rapidly (1200 BP – present)



Sediment sources: Long-term lake-level rise and **bluff erosion**

- North shore is **bedrock cored** w/ veneer of **glacial sediments** (till)
- Lower rates (limited by **bedrock weathering**)
- Representative retreat rate ~**5 cm/yr**

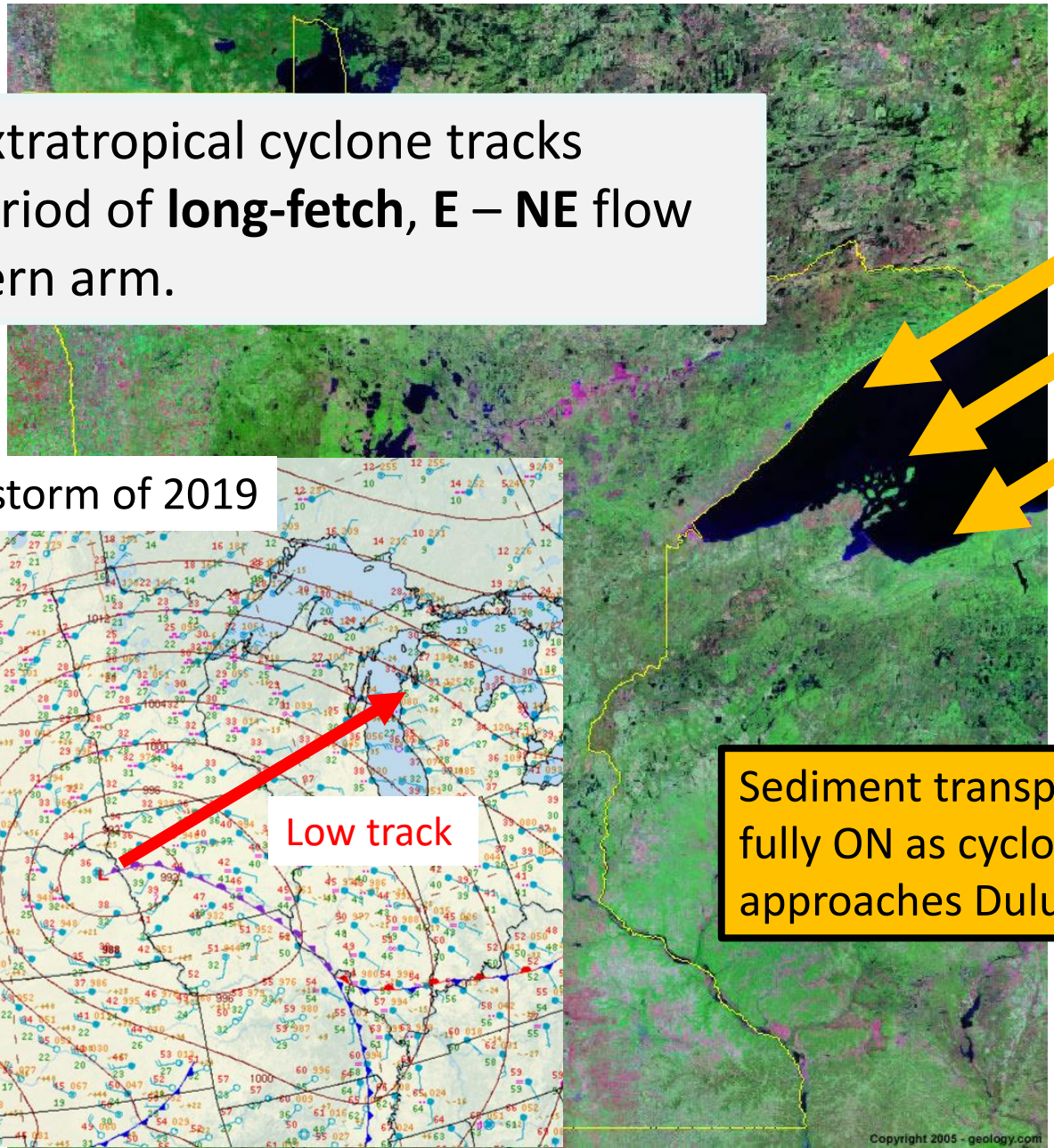
- Bluff erosion insignificant during stable / falling lake level (4200 – 1200 BP)
- Bluff erosion **ignited** when lake level began to rise rapidly (1200 BP – present)



John's bluff

Transport pathways: Sand and gravel transported during ‘storms’ (cyclones)

Nearly all extratropical cyclone tracks generate period of **long-fetch**, **E** – **NE** flow in the western arm.



Thanksgiving storm of 2019

Sediment transport ‘switch’ is fully ON as cyclone center approaches Duluth.

Lake circulation on the 'front end' of extratropical cyclones

Fig. 3. Conceptual diagram of the resulting flow. Surface wind stress from the northeast acts uniformly across the surface of the water and dominates flow in shallow areas. An opposing pressure gradient works throughout the water column and dominates flow in deeper areas, driving the plume offshore. [Color figure can be viewed at wileyonlinelibrary.com]

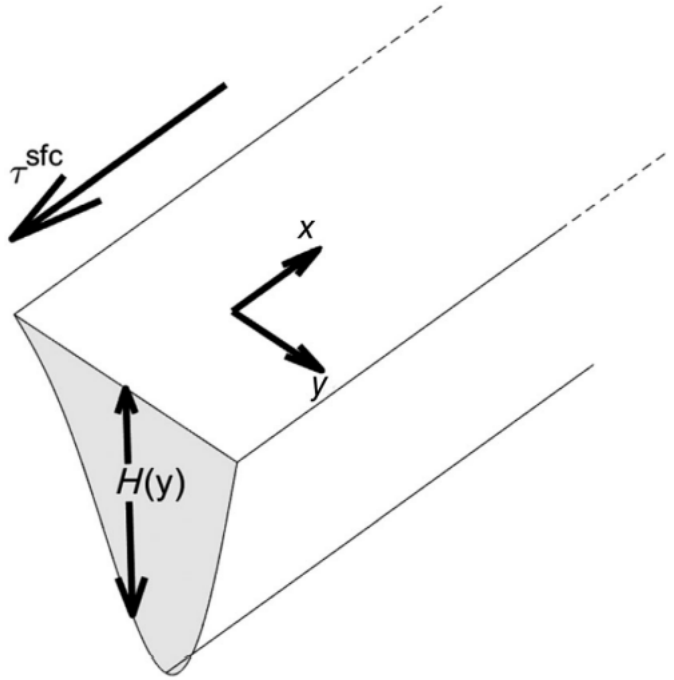


Fig. 2. Schematic figure of analytical model setting. The along-channel dimension is x, and the cross-channel dimension is y, with the sides of the channel at $y = \pm L$. Bottom bathymetry is designated $H(y)$. The wind stress τ is entirely in the along-channel direction.

LIMNOLOGY and OCEANOGRAPHY

ASLO

Limnol. Oceanogr. 64, 2019, 1309–1322

doi: 10.1002/lno.11117

The wind-driven formation of cross-shelf sediment plumes in a large lake

Paul McKinney,[1]* **Jay Austin**,[2] **Gills Fai**[3]

[1]National Research Council, U.S. Environmental Protection Agency, Office of Research and Development, Mid-Continent Ecology Division, Duluth, Minnesota

[2]Large Lakes Observatory and Department of Physics and Astronomy, University of Minnesota Duluth, Duluth, Minnesota

[3]Department of Physics and Astronomy, University of Minnesota Duluth, Duluth, Minnesota

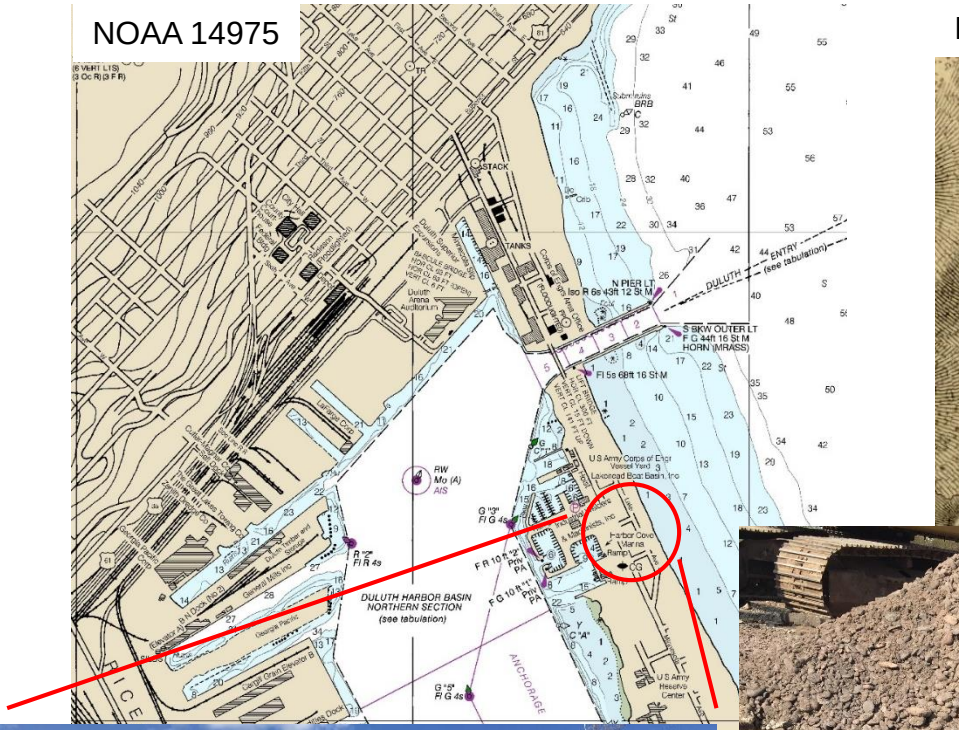
Sydor, M. 1979. Red clay turbidity and its transport in Lake Superior. Great Lakes National Program Office, US Environmental Protection Agency, Region V.

- **Offshore** circulation transports **mud** (plumes)
- Corresponding **nearshore** circulation drives littoral transport of **sand / gravel**

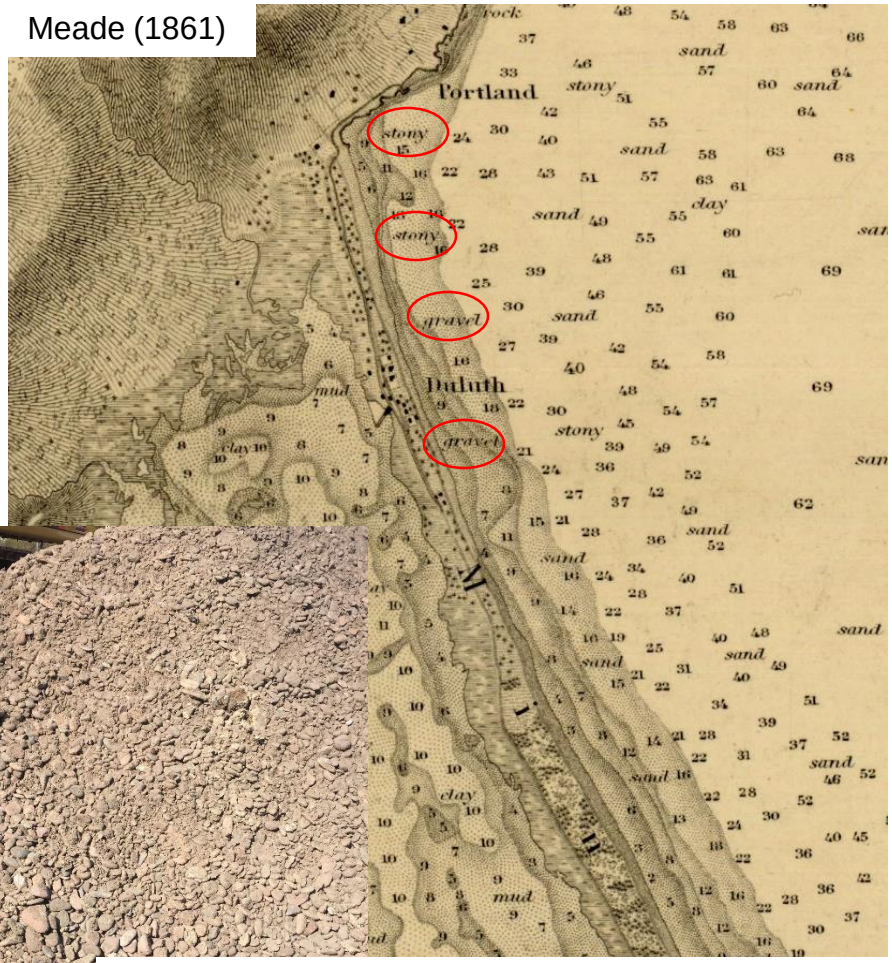
(Select) evidence for geomorphically significant sand / gravel supply from north shore sources:

North end of barrier composed of cobbles, gravel, and coarse sand derived from **north-shore** bedrock weathering & transport

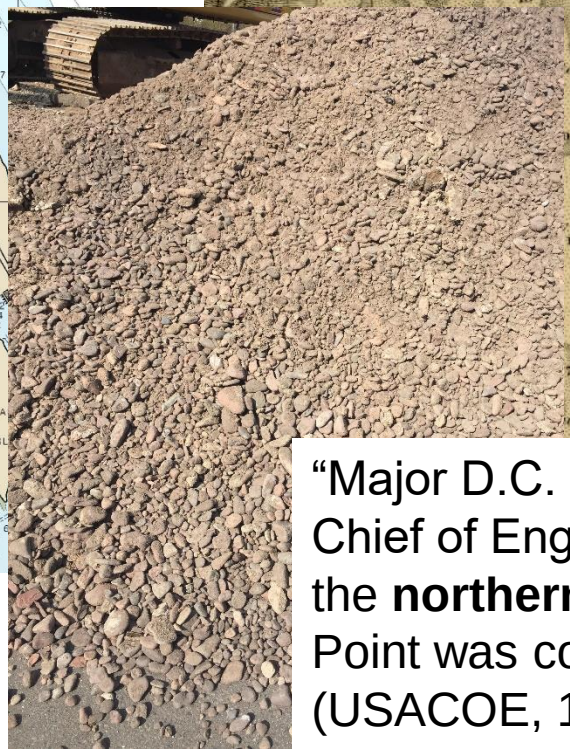
NOAA 14975



Meade (1861)



Photos: G. Glass



"Major D.C. Houston in his report to the Chief of Engineers in 1872, …, noted the **northern 2 miles** of Minnesota Point was covered in **gravel**."
(USACOE, 1974 Sec. 111 report)

Key Point:
North end is **gravel-cored**;
source = north shore

No stratigraphic logs

Minnesota Unique Well Number

544042

County St. Louis
Quad Duluth
Quad ID 244D

MINNESOTA DE
WELL AND
Minnesota S

Well Name	Township	Range	Dir Section	Subsection
INTER CITY OIL	50	14	W 27	DABCBA

Elevation 609 ft. **Elev. Method** LiDAR 1m DEM (MNDNR)

Address

Well 307 CANAL PARK DR DULUTH MN 55802
Contact 1923 SOUTH ST DULUTH MN 55812

Stratigraphy Information

Geological Material	From	To (ft.)	Color	Hardness
COARSE GRAVEL	0	20	BROWN	MEDIUM

Minnesota Unique Well Number

564343

County St. Louis
Quad Duluth
Quad ID 244D

MINNESOTA DE
WELL AND
Minnesota S

Well Name	Township	Range	Dir Section	Subsection
BUCKEYE INC.	50	14	W 27	DDCABB

Elevation 608 ft. **Elev. Method** LiDAR 1m DEM (MNDNR)

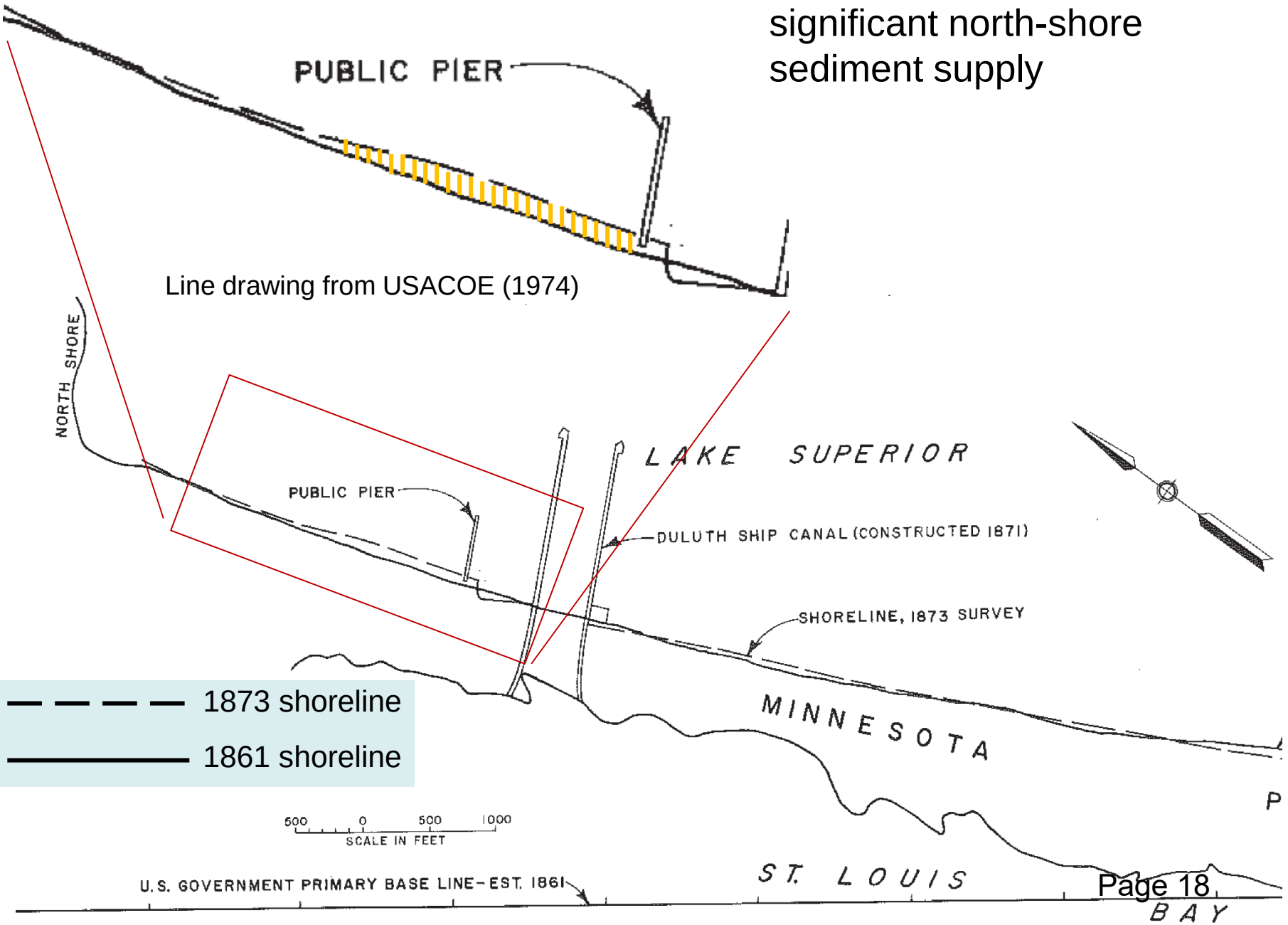
Address

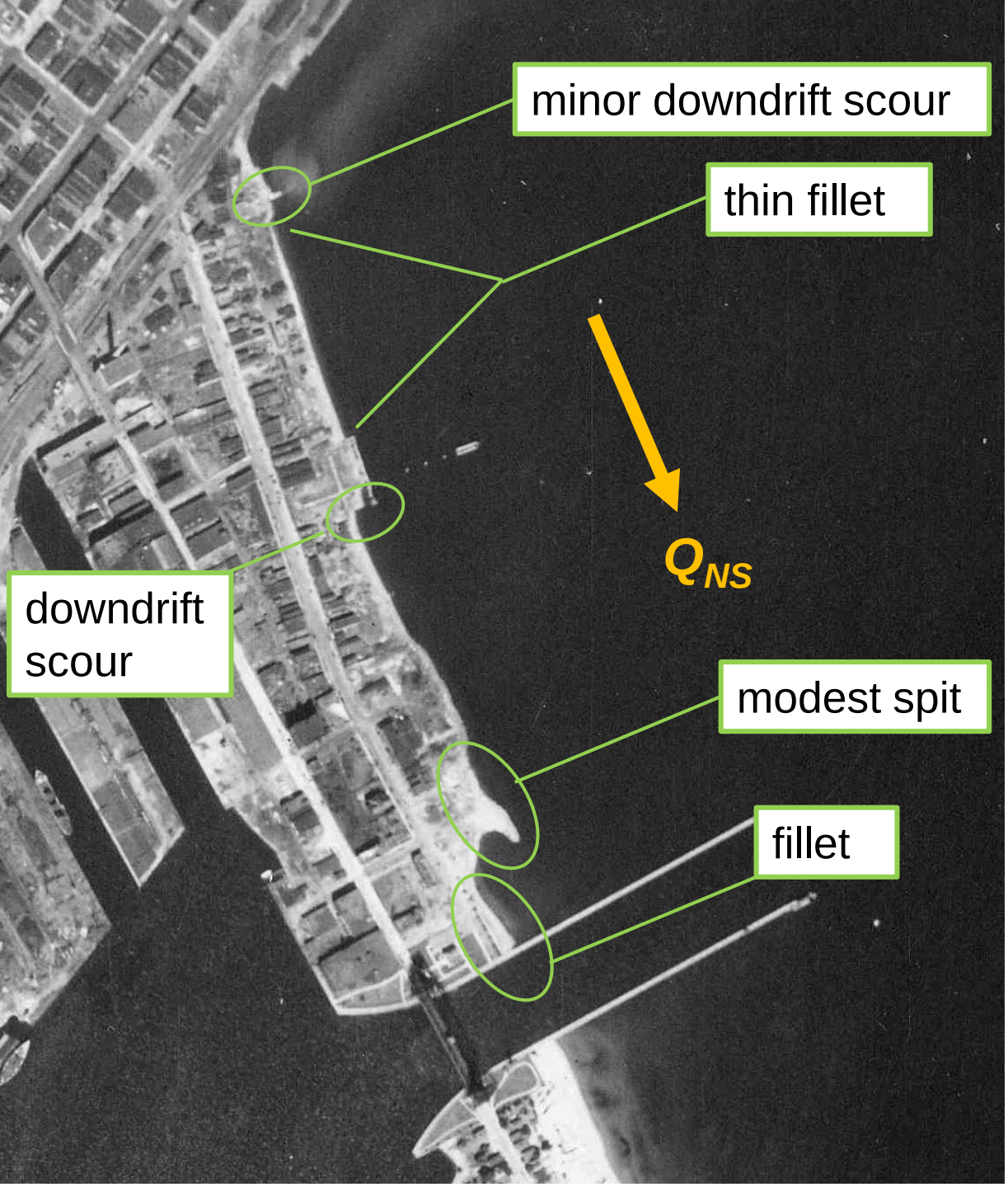
Well 501 LAKE AV S DULUTH MN 55802

Stratigraphy Information

Geological Material	From	To (ft.)	Color	Hardness
GRAVEL	0	25	BROWN	MEDIUM
SAND	25	46	BROWN	MEDIUM

The Public Pier: evidence of significant north-shore sediment supply





Morphologic features consistent with SSE littoral transport of north-shore sourced material.

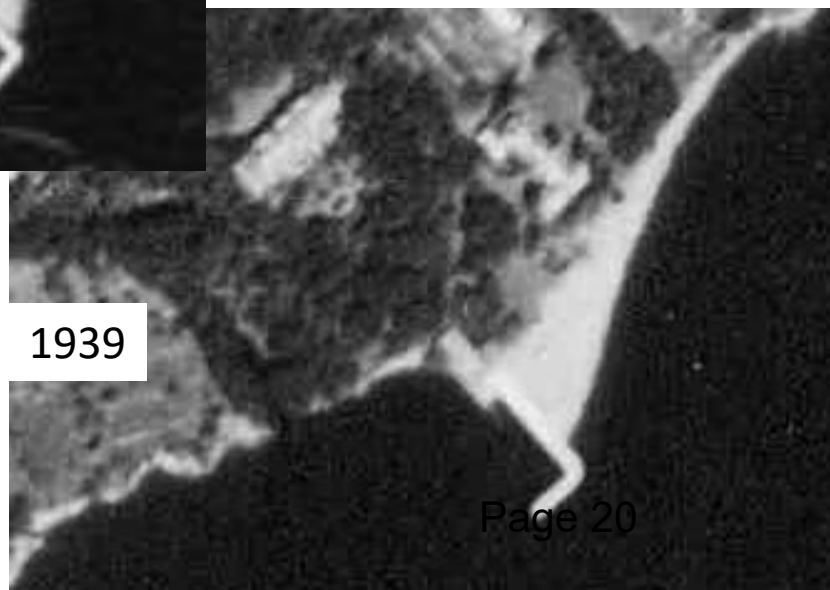
'Built' environment—complicates interpretation

1939 air photo (MHAPO)

Glensheen Mansion, east Duluth

Dock constructed *ca*. 1910

Well-developed fillet in east Duluth.



Multiple lines of evidence (historical air photos, etc.) support non-trivial north-shore supply of cobbles / gravel / sand

Lester River: Mouth bar reworking

Photo: Bob King

Lester River (more recent)

- 4” rain event on Sept 25, 2023
- Resultant mouth bar reworked completely over the next eight months
- Material is ‘headed southwest’

Oct 27, 2023

Looking southwest

Mar 14, 2024

May 26, 2024

U.S. ARMY CORPS OF ENGINEERS- MN POINT CAP 111

Captain Samuel Briscoe
Project Manager

June 3, 2024

Source: Google Earth

U.S. ARMY

US Army Corps of Engineers®

OUTLINE

- CAP 111 Authority Overview
- Scope
- Schedule
- Considered Alternatives

PURPOSE & BACKGROUND OF CAP 111 STUDY

The purpose of the Section 111 program is to determine the effect of Federal navigation structures on the shoreline, and develop plans for the mitigation of shore damages attributable to those structures. By monitoring the Great Lake shorelines over various time periods, the Detroit District can more efficiently manage dredged material from navigation channels for placement within the nearshore region and utilize knowledge gained through substantial analyses to address impacts by all structures. The section 111 program is critical to the Corps' desire to maintain a healthy and natural shoreline.

Section 111 of the 1968 River and Harbor Act provides authority for the Corps of Engineers to develop and construct projects for prevention or mitigation of damages caused by Federal navigation work. This applies to both publicly and privately owned shores located along the coastal shorelines of the United States.

The Corps can initiate an investigation of a prospective mitigation of damages project upon receipt of a request from a sponsoring agency empowered under state law to provide the required local cooperation.

PURPOSE & BACKGROUND OF CAP 111 STUDY

U.S. ARMY

This authority may not be used for the following purposes:

1.To construct works for prevention or mitigation of shore damage caused by riverbank erosion or vessel-generated wave wash.

2.To prevent or mitigate shore damage caused by non-Federal navigation projects.

A recommendation to construct a project to prevent or mitigate shore damage attributable to a Federal navigation project may be considered when both of the following conditions exist:

1.The navigation project has been determined to be the cause of the damage, and abandonment of the navigation project is not the most viable solution.

2.Analysis based on sound engineering and economic principles clearly demonstrates the feasibility of the proposed work.

Construction Requirements for Federal cost sharing are as follows:

1.If the work recommended is confined to mitigation work where erosion is totally attributable to the Federal navigation works, costs are shared in the same manner as the project causing the erosion or shoaling.

2.If the work recommended is a combination of mitigation and restoration of beaches eroded due to other causes, mitigation work will be shared in the same manner as the project causing the erosion or shoaling and the remaining work will be 100 percent local, unless it qualifies as a Federal beach erosion control project.

PROJECT LOCATION AND REMINDER OF PURPOSE AND NEED

Project Location - Minnesota Point, Minnesota is a long strip of land separating Duluth-Superior Harbor from Lake Superior. Minnesota Point is located on the south shore of Lake Superior at Duluth, Minnesota and is delineated by two navigation entrances to the harbor: Duluth Entry at western limit and Superior Entry at the eastern limit. Duluth Harbor is a deep draft commercial harbor that is about 360 miles from Detroit, Michigan.

Study Purpose & Need – The purpose(s) of the Minnesota Point Section 111 Feasibility study is to: 1) determine if the Federal navigation structures at Duluth and Superior Entries are contributing to the erosion damage on the shoreline of Minnesota Point; 2) to develop a feasible, economically-justified, and environmentally sustainable solution that will prevent or mitigate further shore damage cause by the Federal structures. The Minnesota Point provides a natural barrier for Duluth-Superior Harbor against the wave climate of Lake Superior. The erosion of the Minnesota Point shoreline has increased the threat of wave-induced flooding of residential properties and a historic pine forest, and threatens municipal infrastructure. Finally, a shoreline erosion solution is needed to protect this valuable regional resource.

U.S. ARMY

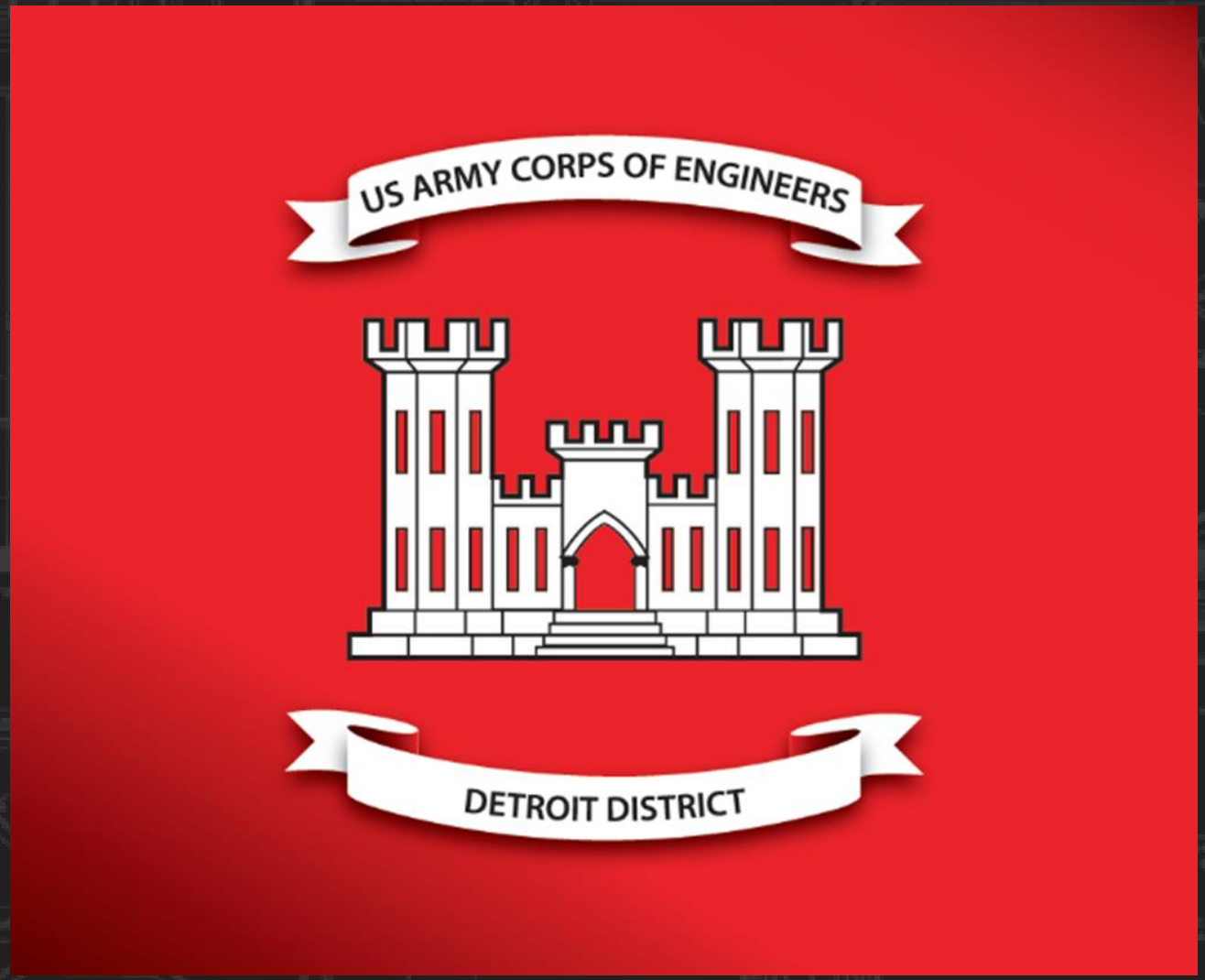
SCHEDULE MILESTONES

Milestone Name	Date Presented at last outreach meeting	Current Scheduled Date
Start Study / Receipt of Initial Funds		
Federal Interest Determination Approval	15 Mar 2022	15 Mar 2022 (A)
Feasibility Scoping Meeting	10 Mar 2023	10 Mar 2023 (A)
Feasibility Cost Share Agreement (FCSA)	N/A	N/A
Tentatively Selected Plan Meeting	24 Jul 2025	10 APR 2026
Approval of Final CAP Decision Document	23 Jun 2026	01 OCT 2026
Project Partnership Agreement Execution	31 Jul 2026	25 FEB 2027
Start Plans and Specs	TBD	TBD
Draft P&S Complete	TBD	TBD
Certified BCOES Review	TBD	TBD
Contract Award	TBD	TBD
Project Physical Completion	TBD	TBD
Project Fiscal Closeout	TBD	TBD
Notice of Project Completion	TBD	TBD

PRELIMINARY ALTERNATIVE PLANS

Measures	Bypassing Plant	Beach Nourishment	Constructed Dune System combined w Dune Grasses	Offshore Submerged Reef	Remove Federal Structures
Bypassing plant	**Bypassing Plant**				
Beach Nourishment	Bypassing Plant + Beach Nourishment	**Beach Nourishment**			
Constructed Dune System combined w Dune Grasses	Bypassing Plant + Constructed Dune System combined w Dune Grasses	Beach Nourishment + Constructed Dune System combined w Dune Grasses	**Constructed Dune System combined w Dune Grasses**		
Offshore Submerged Reef	Bypassing Plant + Offshore Submerged Reef	Beach Nourishment + Offshore Submerged Reef	Constructed Dune System combined w Dune Grasses + Offshore Submerged Reef	**Offshore Submerged Reef**	
Remove Federal Structures	Bypassing Plant + Remove Federal Structures	Beach Nourishment + Remove Federal Structures	Constructed Dune System combined w Dune Grasses + Remove Federal Structures	Offshore Submerged Reef + Remove Federal Structures	**Remove Federal Structures**

WE LOOK FORWARD TO CONTINUING TO PARTNER!



PLEASE EMAIL QUESTIONS TO:
LREPAO@USACE.ARMY.MIL

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Minnesota Point Hydrodynamic & Sediment Transport Modeling

Public Meeting #1

June 3, 2024 – Duluth, MN

Barr-Bergmann Joint Venture

Task Order: #W911K22D0003

BARR+BERGMANN JOINT VENTURE

Minnesota Point Modeling Overview

1. Modeling project team
2. Previous studies
3. Data gathering/literature review
4. Conceptual model
5. Boundary condition development
6. Model development
7. Scenario evaluation
8. Sediment budget development

BARR+BERGMANN JOINT VENTURE

Minnesota Point Modeling Team (Barr-Bergmann Joint Venture)

Project Team Org Chart

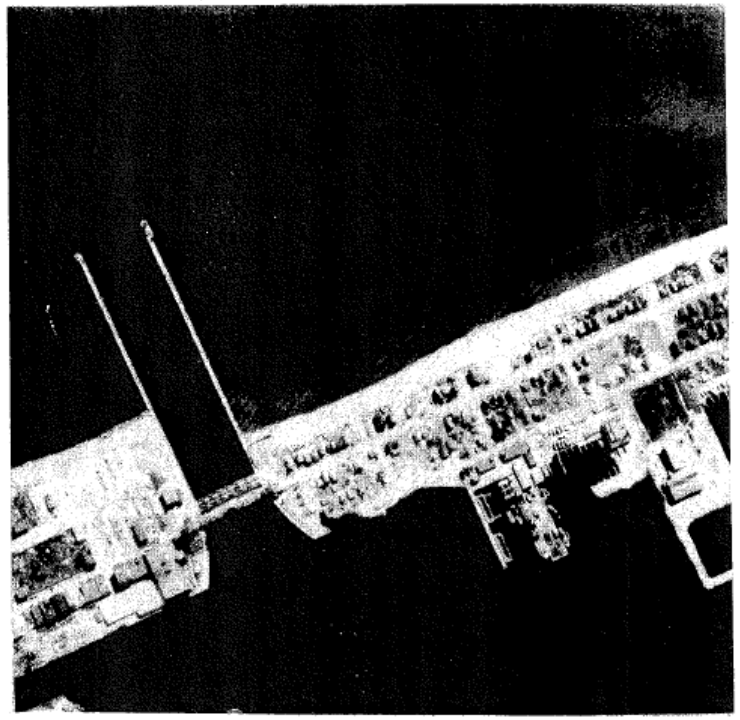
USACE Detroit District
Project Manager: Capt. Samuel Briscoe
Contracting Officer Rep: Thomas Resh
Technical Point of Contact: Dr. James Selegean
Coastal Engineer: Dr. Jesse McNinch

Barr-Bergmann JV
Model Development Team
Barr –Bergmann JV Officer: Bill Forsmark
Contract Manger: Dr. David Hibbs
Task Order Manager: Peter Hinck
Lead Coastal Modeler: Dr. Ben Sheets
Lead Hydraulic Engineer: Dr. Chris Frias
Lead GIS: Josh Vosejpka
Coastal Engineer: Nicole Peterson

Barr-Bergmann JV
QC Review Team
Quality Control Manager: Scott Kozak
QC Lead: Lisa Dolphin
Technical Reviewer: Dr. Hossein Kheirkhah Gildeh

Review of Previous Studies

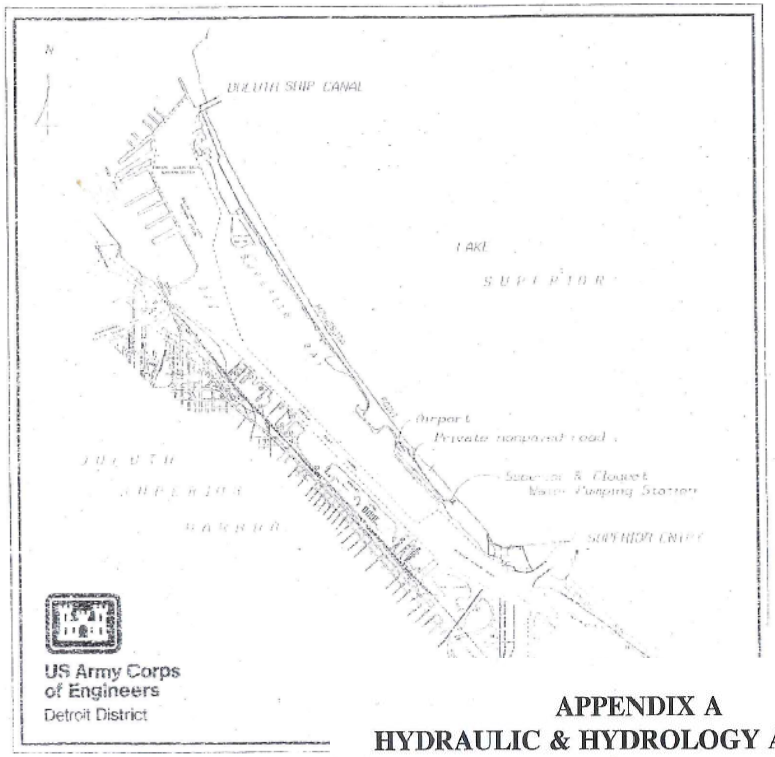
SECTION 111 DETAILED PROJECT REPORT
BEACH EROSION CONTROL ON
MINNESOTA POINT AT DULUTH, MINNESOTA



U.S. ARMY ENGINEER DISTRICT ST. PAUL
CORPS OF ENGINEERS
ST. PAUL MINNESOTA
NOVEMBER 1974

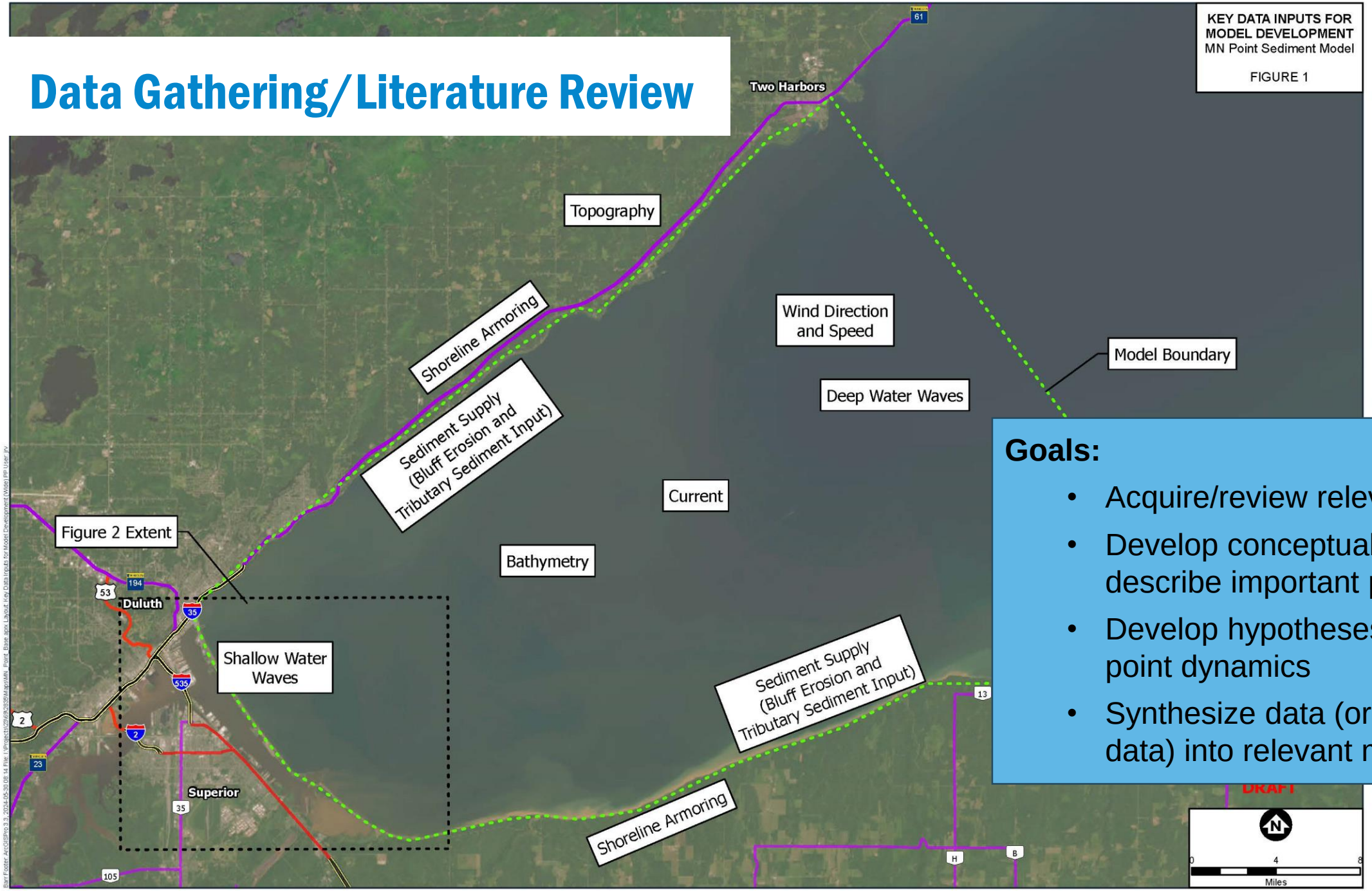
DETAILED PROJECT REPORT
SECTION 111 STUDY
MINNESOTA POINT, DULUTH, MINNESOTA

FEBRUARY 2001



APPENDIX A
HYDRAULIC & HYDROLOGY ANALYSIS
FOR
DETAILED PROJECT REPORT
SECTION 111 STUDY
MINNESOTA POINT, DULUTH, MINNESOTA

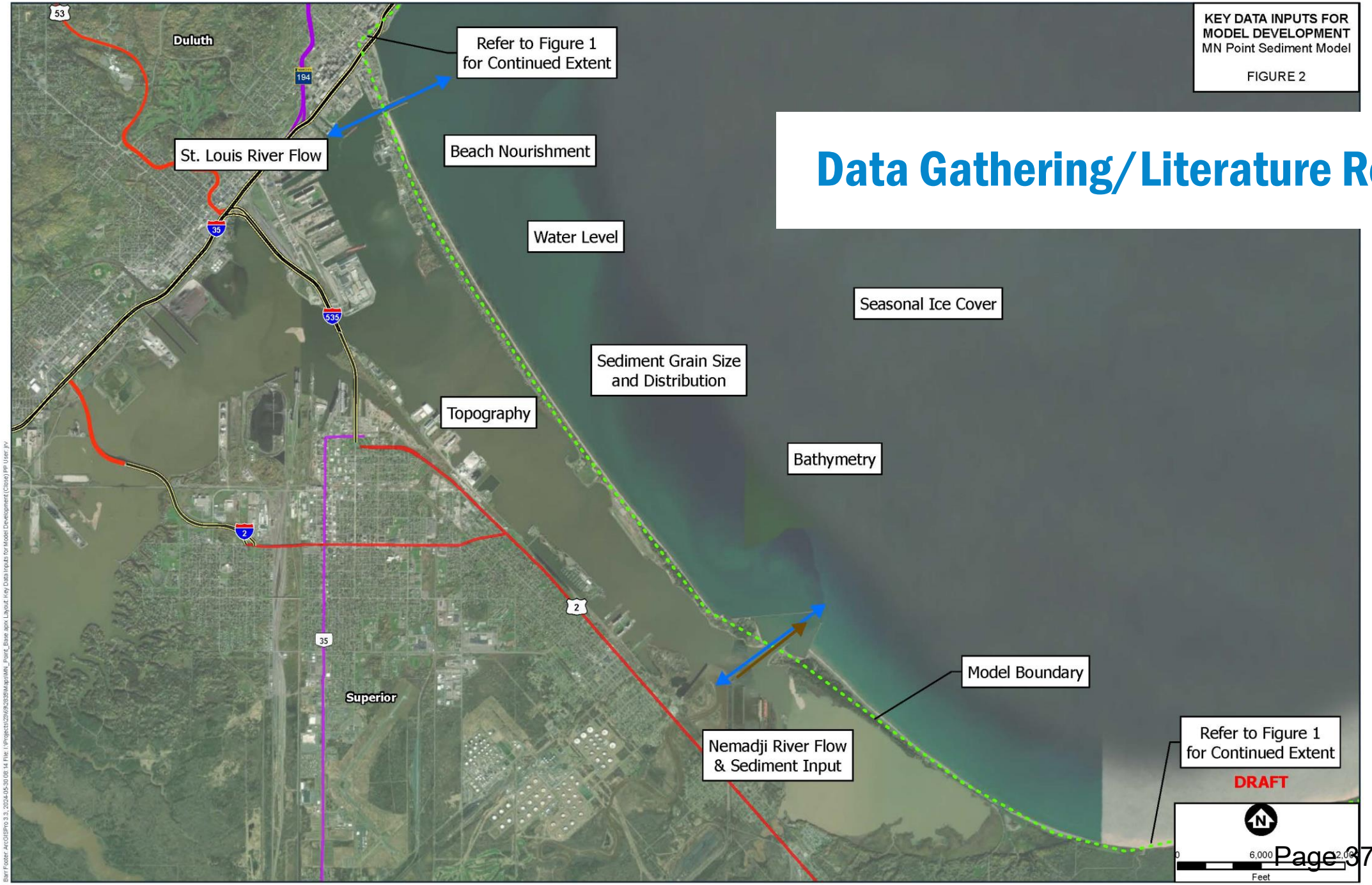
Data Gathering/Literature Review



Goals:

- Acquire/review relevant data types
- Develop conceptual site model to describe important processes
- Develop hypotheses regarding MN point dynamics
- Synthesize data (or subsets of data) into relevant model input

Data Gathering/Literature Review



Conceptual Model

Working hypotheses:

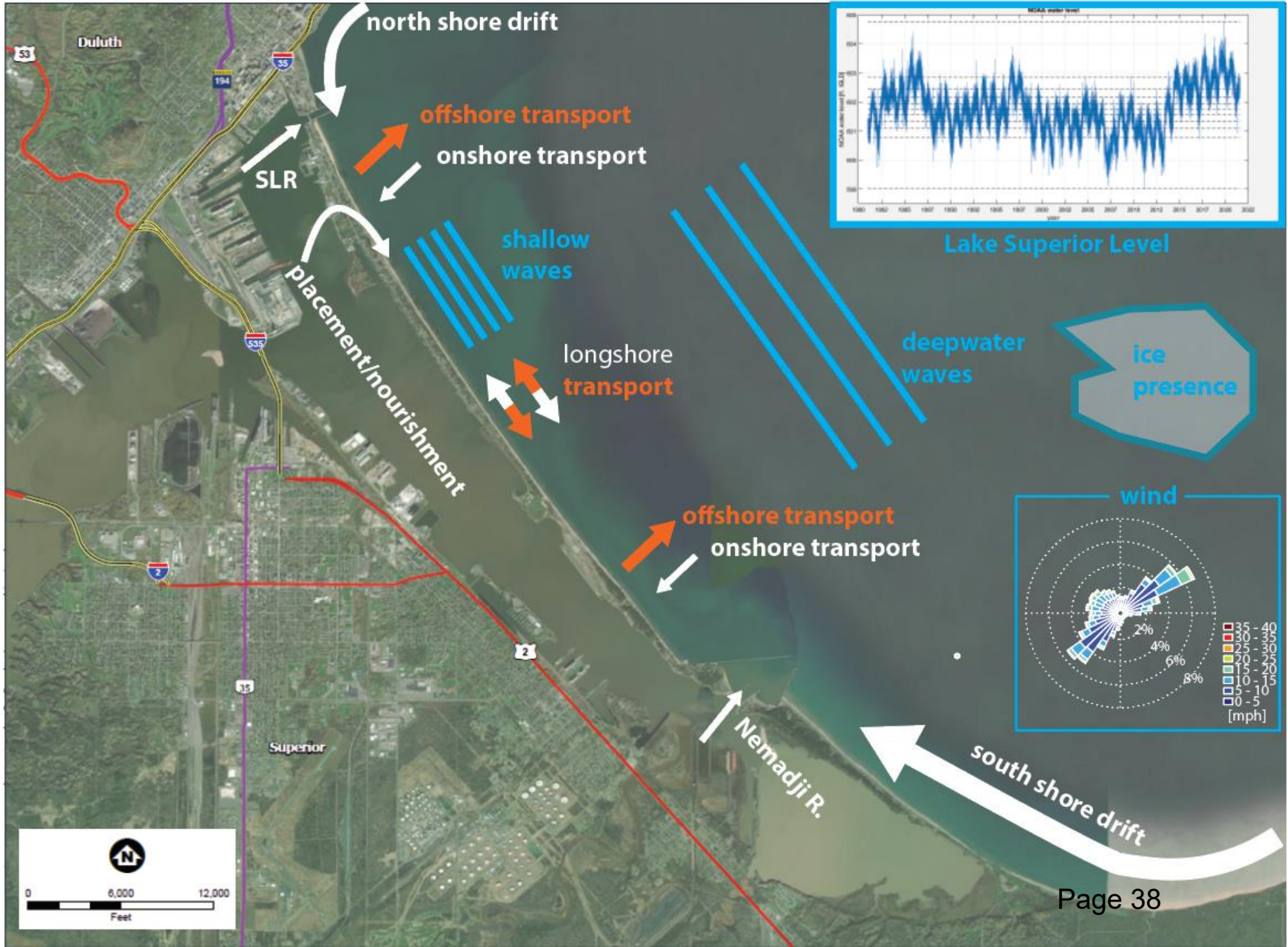
potential sediment source

potential sediment sink

important processes

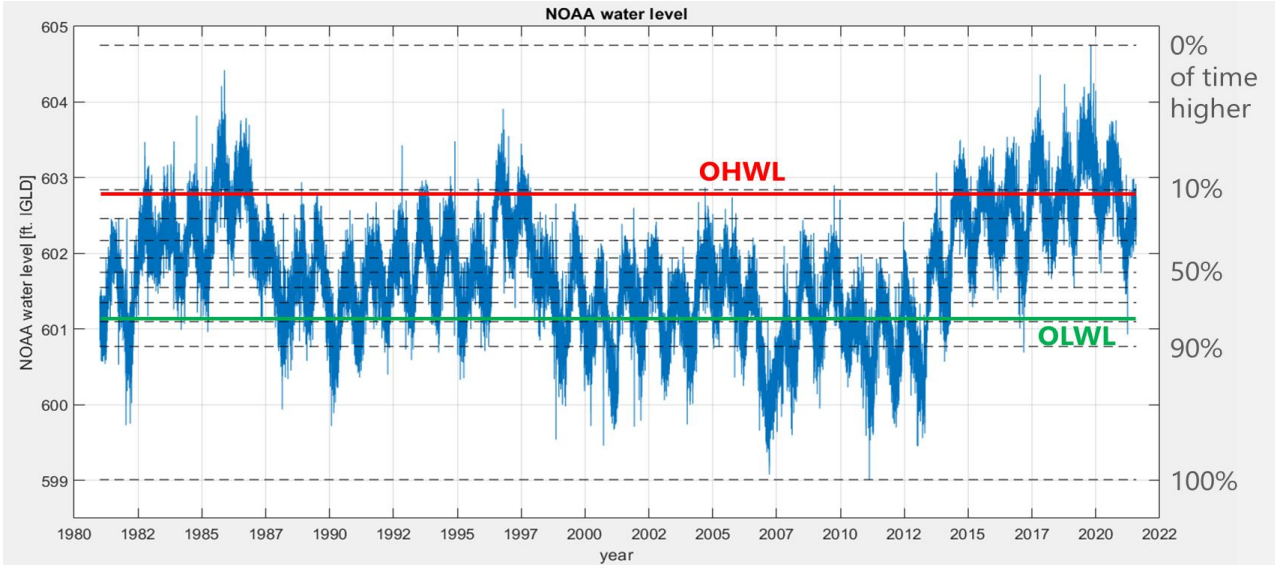
Intended to evolve:

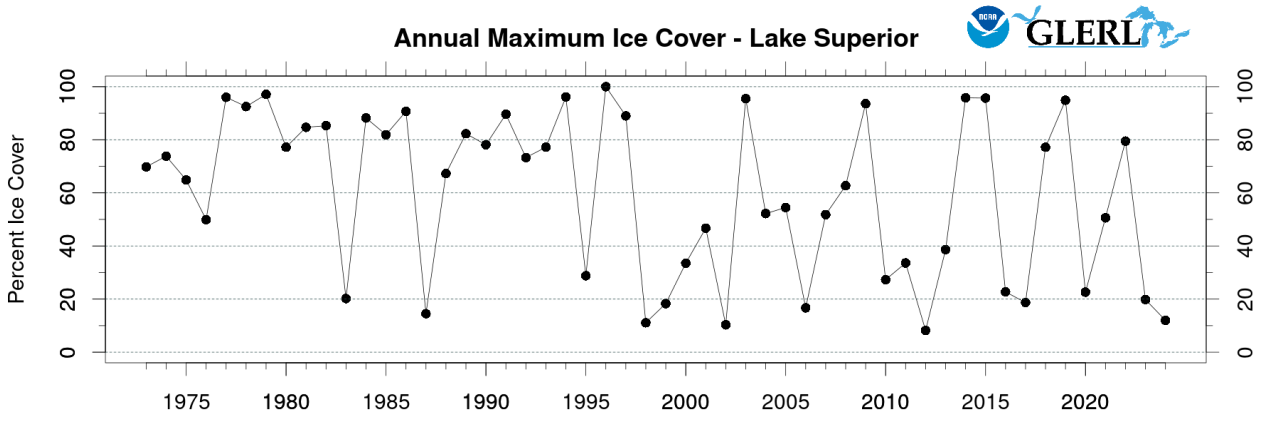
- as data is synthesized & modeling proceeds
- in consultation with City



Boundary Condition Development

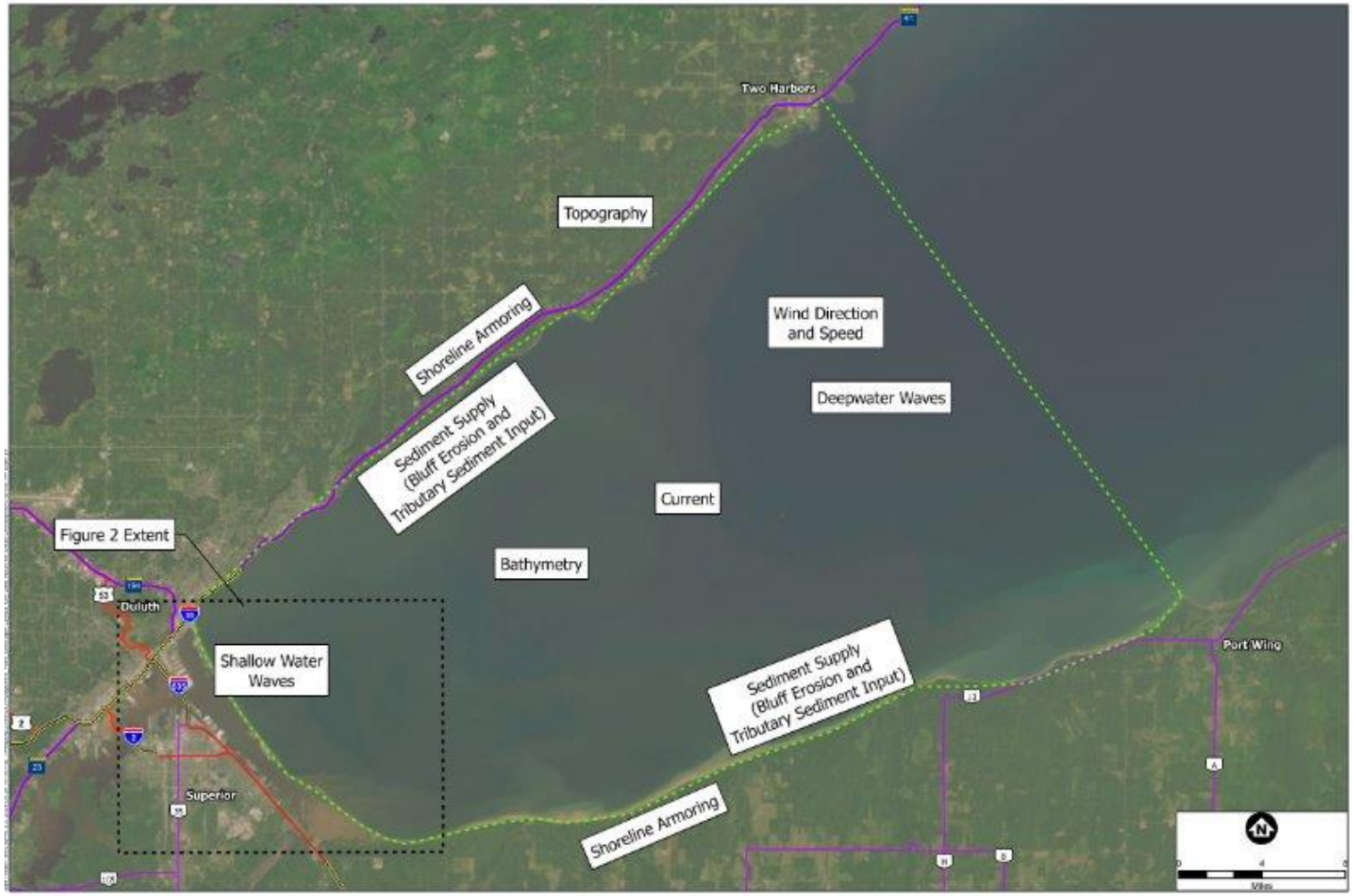
- **Topography and bathymetry:** combination of NOAA bathymetric data and land topographic data
- **Lake Superior water level:** seiche-related fluctuation, storm and wind related set-up and set-down, annual seasonal variation, decadal climatic fluctuations (NOAA)
- **Deep water wave forcing:** wave characteristics will be imposed on lakeward model boundary (WIS, NOAA)
- **Climate/Meteorological forcing:** wind speed and direction, temperature (ice)
- **Sediment sources:** erosion of beaches and bluffs along the north and south shores of the lake (literature)
- **Shoreline sediment type:** grain size and erodibility of the beach sediments (USACE)





Model Development

- **Model requirements:**
  - Wave generation
  - Longshore transport
  - On/off-shore transport
  - Beach evolution
  - Proven, open-source software
- **Planned approach:**
  - **Delft3D**
    - D3D-FLOW, D3D-MOR, D3D-WAVE
  - **XBeach**
    - Resolve 'swash' zone processes
  - successful global, Great Lakes, and Duluth area applications

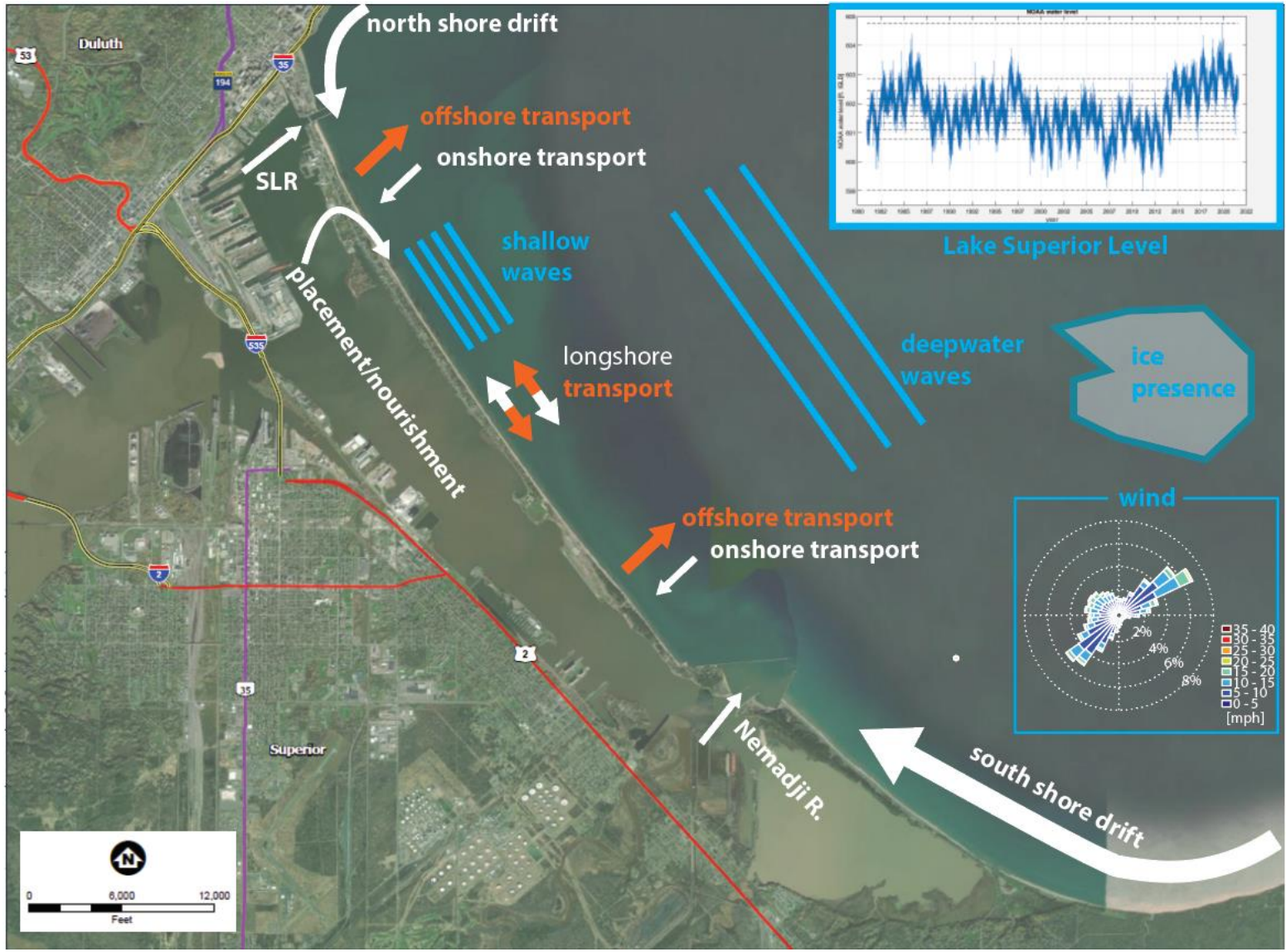


- **Model validation:**
  - Comparisons against historical data sets
  - e.g., historical sand placement & beach behavior, wave observations within model domain

Scenario Evaluation

Using developed modeling approach:

- Understand how sediment moves at MN point
  - Historical fairweather vs. storm conditions
  - Historical wind/wave attack angles
  - Historical low vs. high lake levels
- Scenarios to be selected by USACE in consultation with City



Sediment Budget Development

Use model predictions to evaluate hypotheses:

- Source magnitude
- Sink magnitude
- Interplay of environmental & anthropogenic factors

Goal:

- Where and how is MN point gaining or losing sediment?
- Under what conditions?