DEPARTMENT OF NATURAL RESOURCES

Division of Lands and Minerals

Mining Hydrology Program

Erika Herr| Mine Permitting and Coordination Supervisor

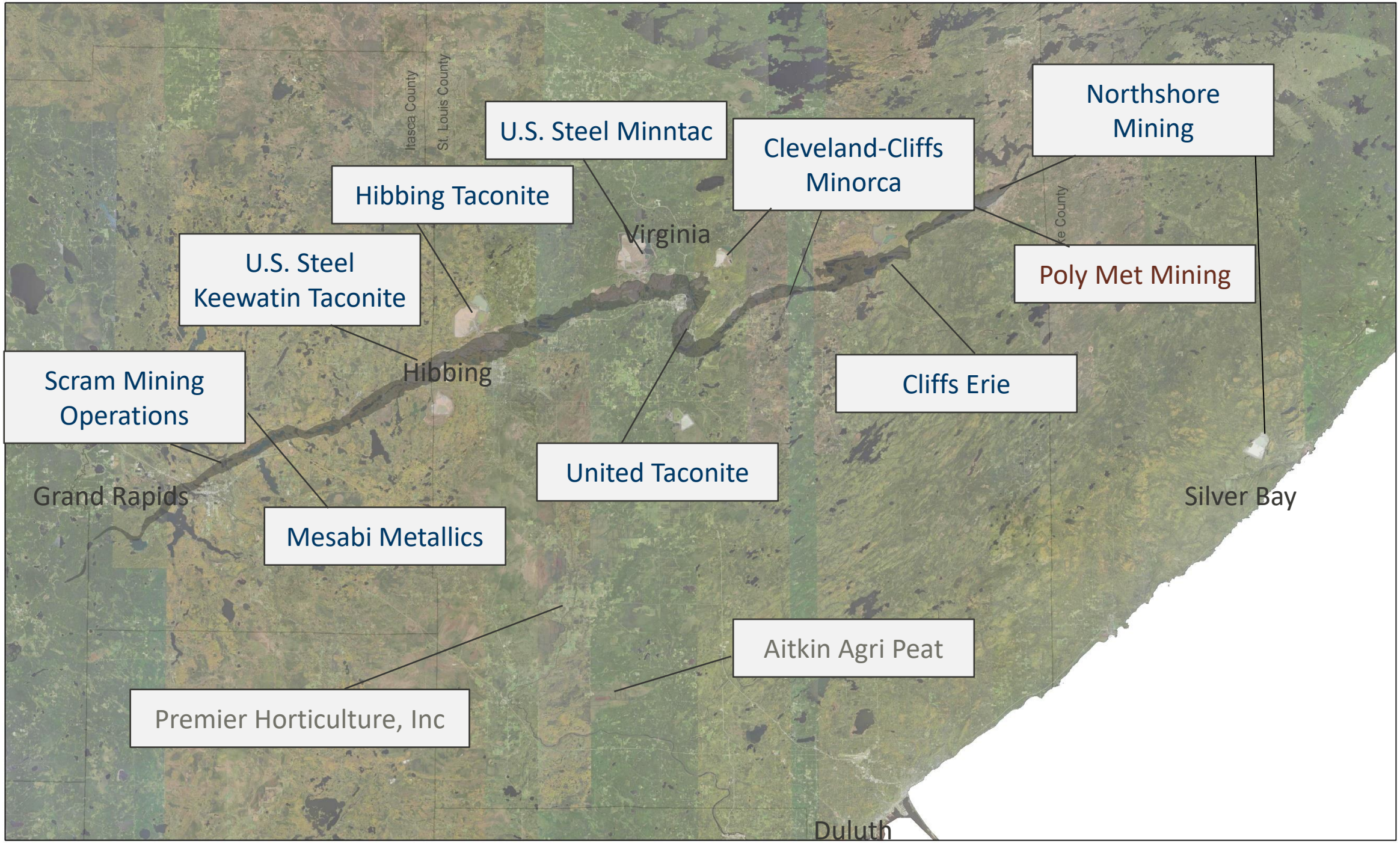
Division of Lands and Minerals

Mine Permitting and Coordination Section (staff in St Paul and Hibbing)

- Mining Hydrology/Waters – Regulatory and Technical work
- Reclamation – Permit to Mine
- Research – Research site and lab at Hibbing Lands and Minerals
- Planners
- Wetland Specialist – Wetland Conservation Act

Lands and Minerals Mining Hydrology Unit

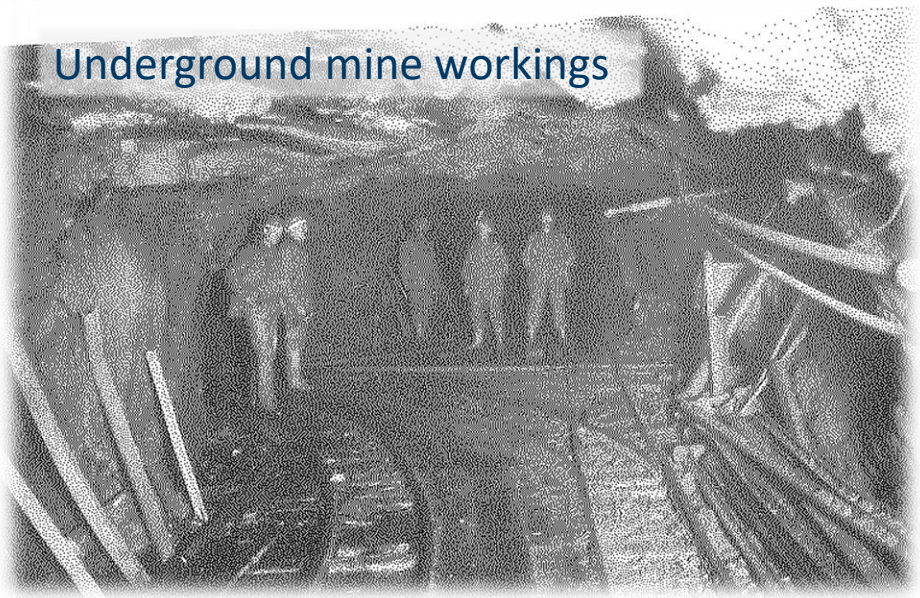
- Statewide program
- Projects that are worked on include ferrous, non-ferrous and peat mining; municipal water use
- Both regulatory and technical work
- Administers the Water Permitting Programs for mining-related projects (generally, those that require a Permit to Mine):
    - Public Waters Work Permits
    - Water Appropriation Permits
- Monitor surface and groundwater across the Mesabi Iron Range
- Participate in special studies and are technical experts for other programs (Permit to Mine, Environmental Review)


Itasca County
St. Louis County
U.S. Steel Minntac
Hibbing Taconite
Cleveland-Cliffs Minorca
Northshore Mining
Virginia
U.S. Steel Keewatin Taconite
Poly Met Mining
Hibbing
Scram Mining Operations
Cliffs Erie
United Taconite
Grand Rapids
Silver Bay
Mesabi Metallics
Aitkin Agri Peat
Premier Horticulture, Inc
Duluth

Mesabi Iron Range Mining

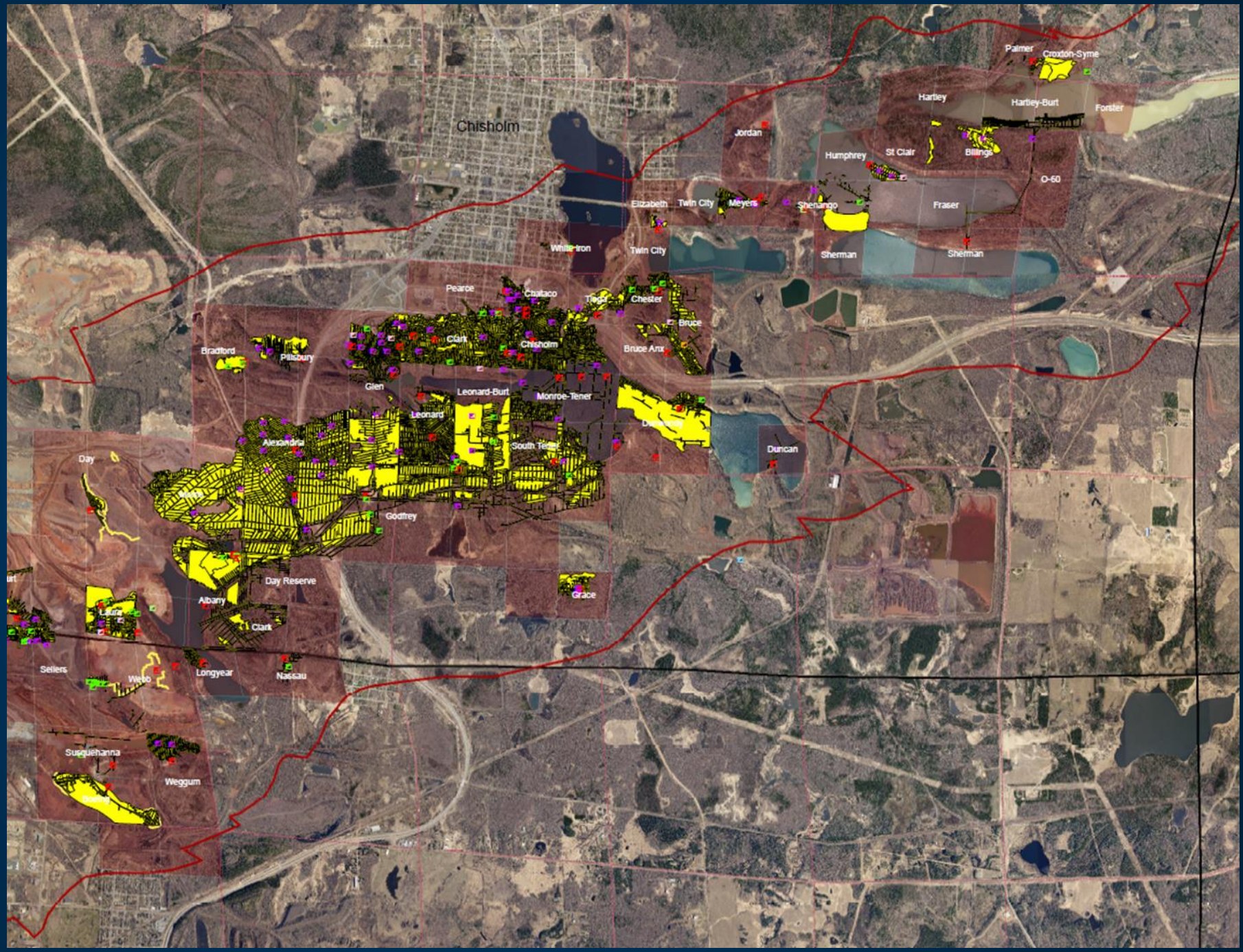
- Vast deposit of iron ore over 100 miles long called the Biwabik Iron Formation (BIF)
- The deposit dips to the southeast
- High-grade, oxidized iron ore (Fe_2O_3) began in the early 1890s
- Mining of taconite (low-grade, unoxidized iron ore (Fe_2O_4)) began in the 1950s
- Individual natural ore pits were typically small.
- Several pits in close proximity can create one larger pit lake once they fill with water.

Technology Progression Changed Landscapes

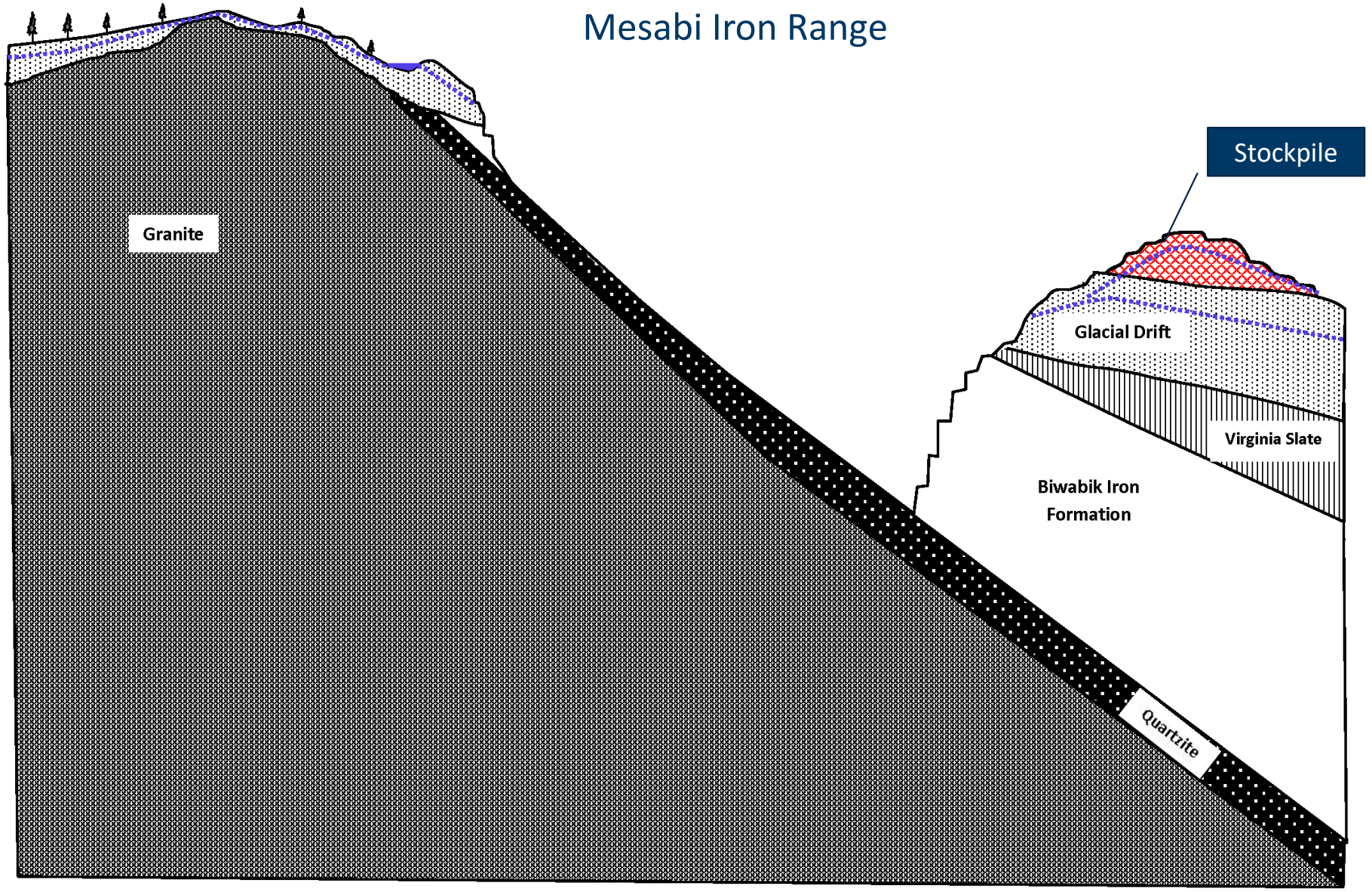


Technology Progression Changed Landscapes

DNR Underground Mine Mapping Project



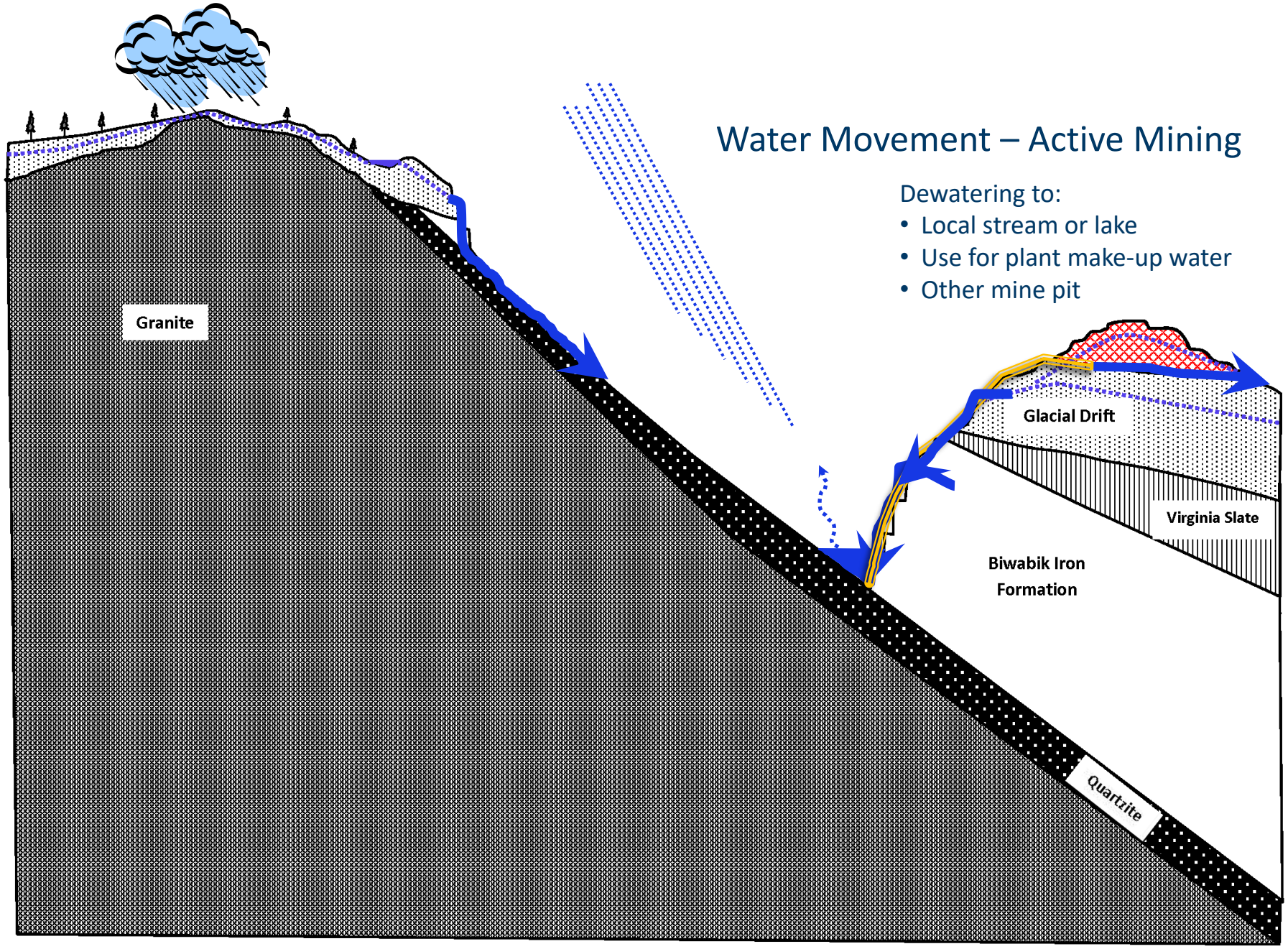
Pre-Mine Landscape Cross-section
Mesabi Iron Range



Water Movement – Active Mining

Dewatering to:

- Local stream or lake
- Use for plant make-up water
- Other mine pit



Regulatory - Water Appropriation Permits

- Guided by both Minnesota Statute (M.S. 103G) and Rule (M.R. 6115)
- Policy: conserve and utilize the water resources of the state
- Water Appropriation Permits required for an appropriation of over 10,000 gpd or 1 million gpy
- Waters of the state: surface water or groundwater

Water Appropriation Permitting – Taconite Mining

Rouchleau Pit Complex Water Appropriation Permitting – Taconite and Municipal

- Rouchleau Pit Complex
  - Missabe Mountain and Moose-Shaw Pits
- United Taconite needed to dewater the pit complex in order to mine
- Hwy 53 was re-routed to accommodate mining - bridge opened in 2017 (*tallest bridge in MN!)
- Many factors needed to be considered when amending permit
  - Other existing appropriators on the pit complex
  - Impacts of discharge

2019

June 2021


May 2022
Above the Range

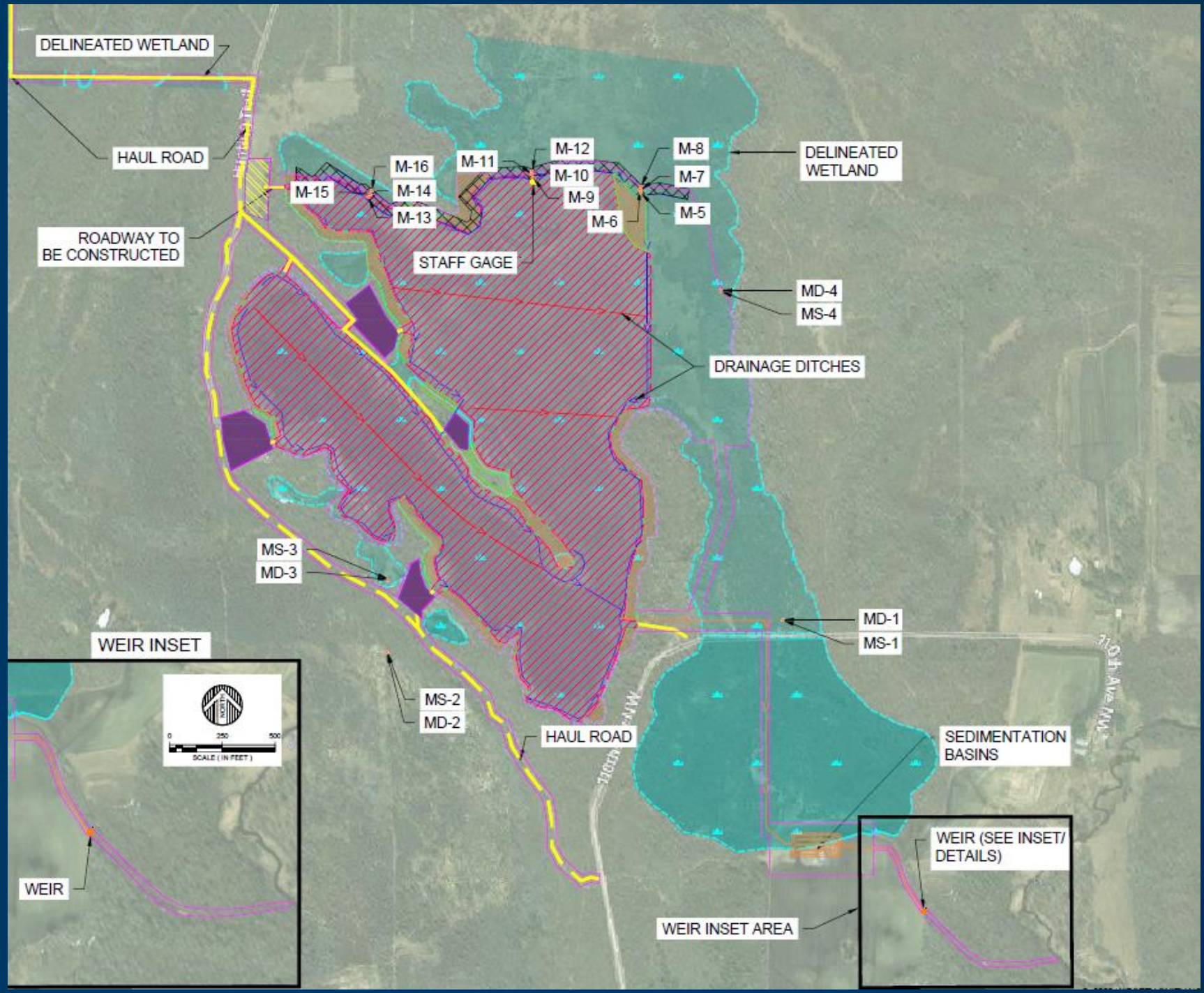
Peat Mining

- Peat fields are drained through a series of ditches
- Requires a Water Appropriation Permit

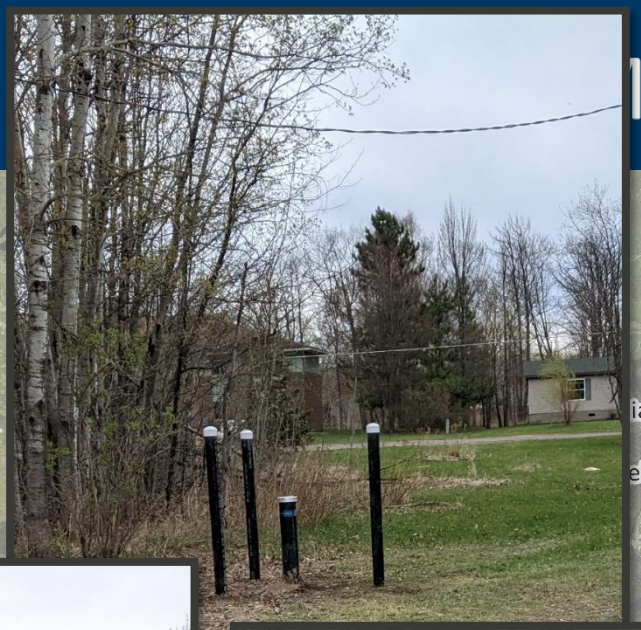
Water Appropriation Permitting – Peat Mining

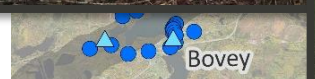
Hawkes Company - Mercil Site

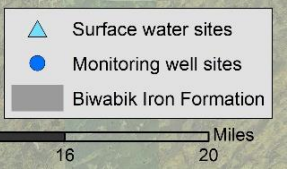
Hawkes Company Mercil Site - Surface and Shallow Groundwater Monitoring



Surface and

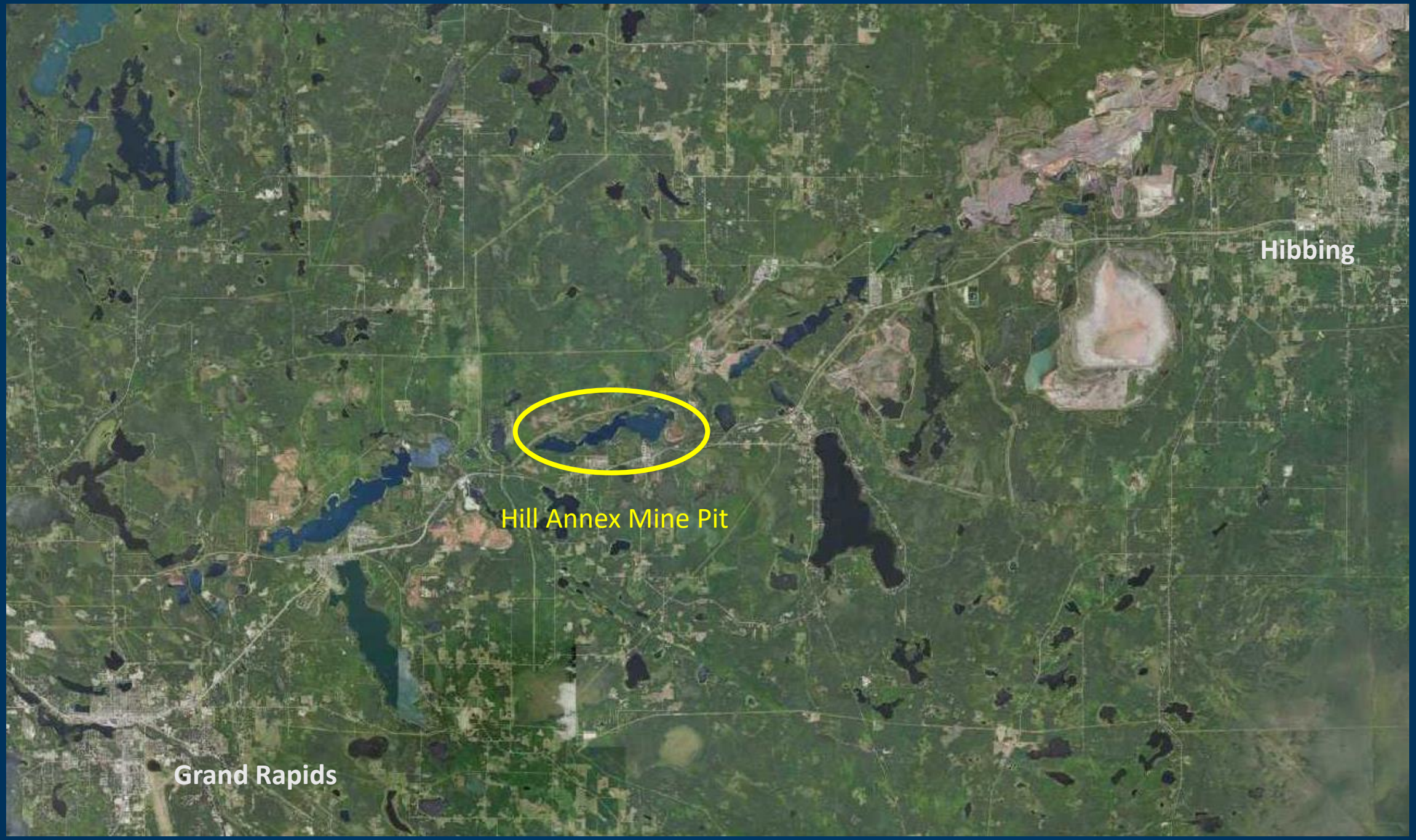


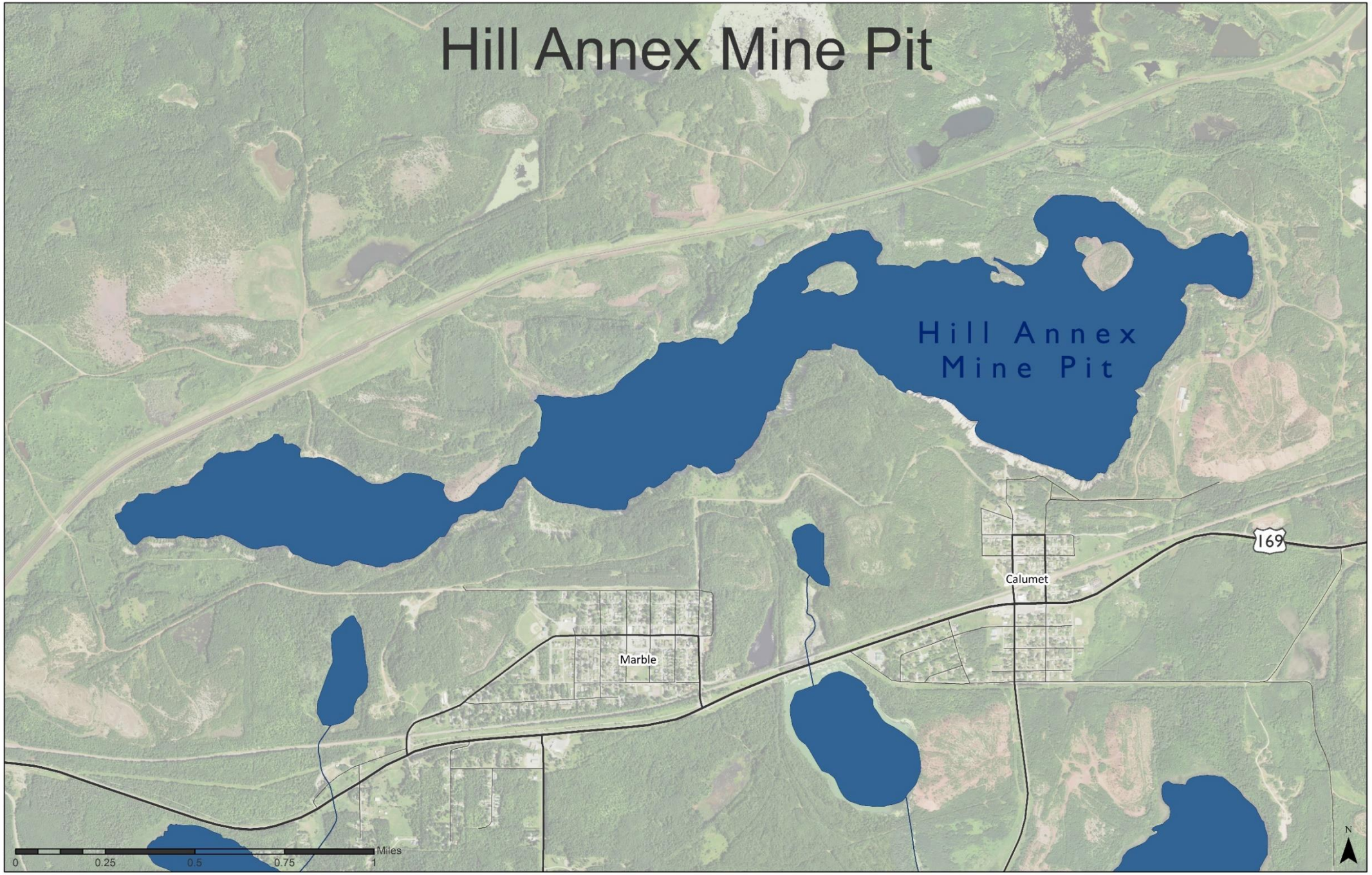

Bovey


Surface water sites
Monitoring well sites
Biwabik Iron Formation
Miles
0
2
4
8
12
16
20

DEPARTMENT OF NATURAL RESOURCES

Hill Annex Legacy Mine Pit


Hibbing
Hill Annex Mine Pit
Grand Rapids

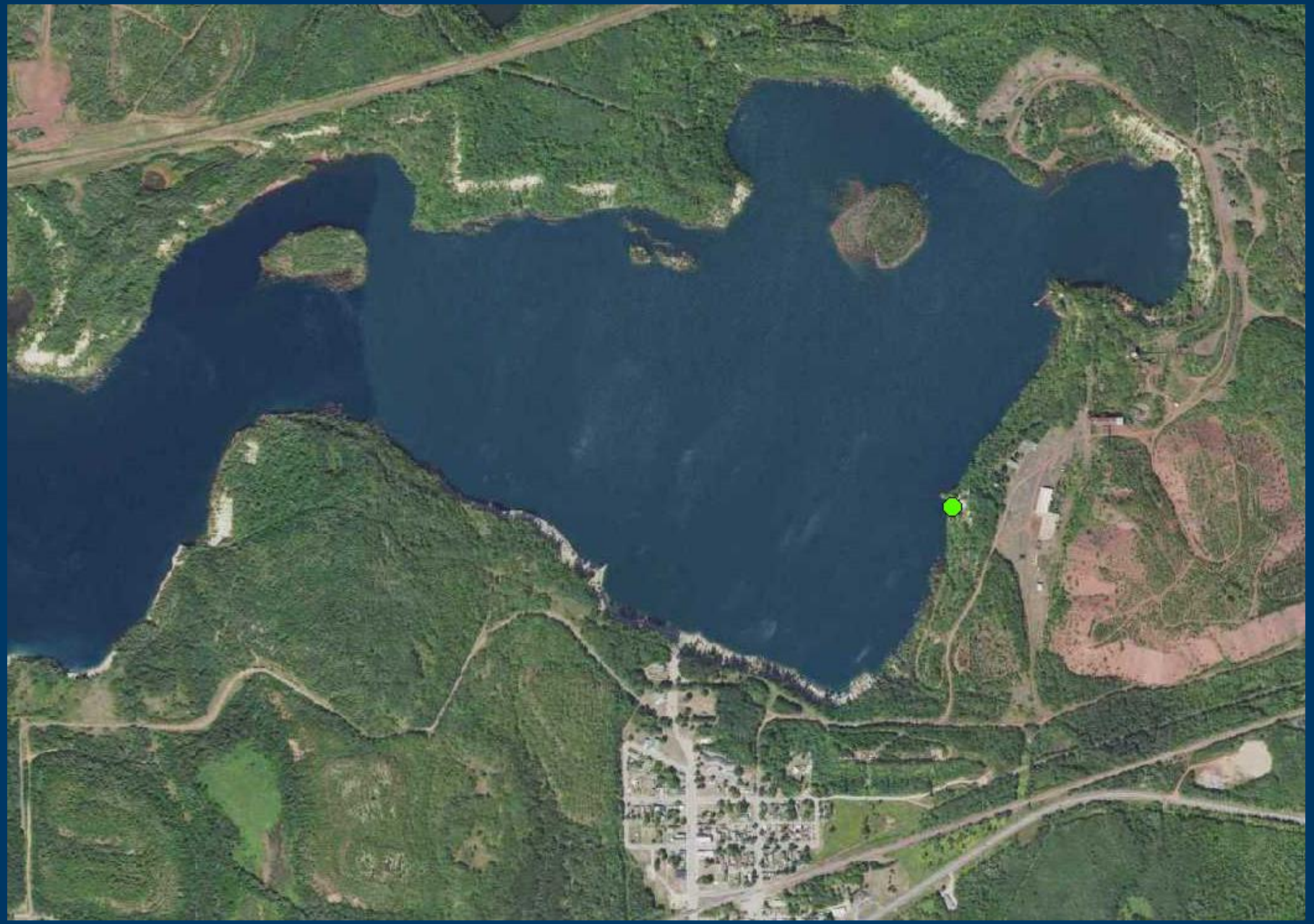

Hill Annex Mine Pit
Hill Annex
Mine Pit
Marble
Calumet
169
0
0.25
0.5
0.75
1
Miles
N

2021

Hill Annex Mine Pit

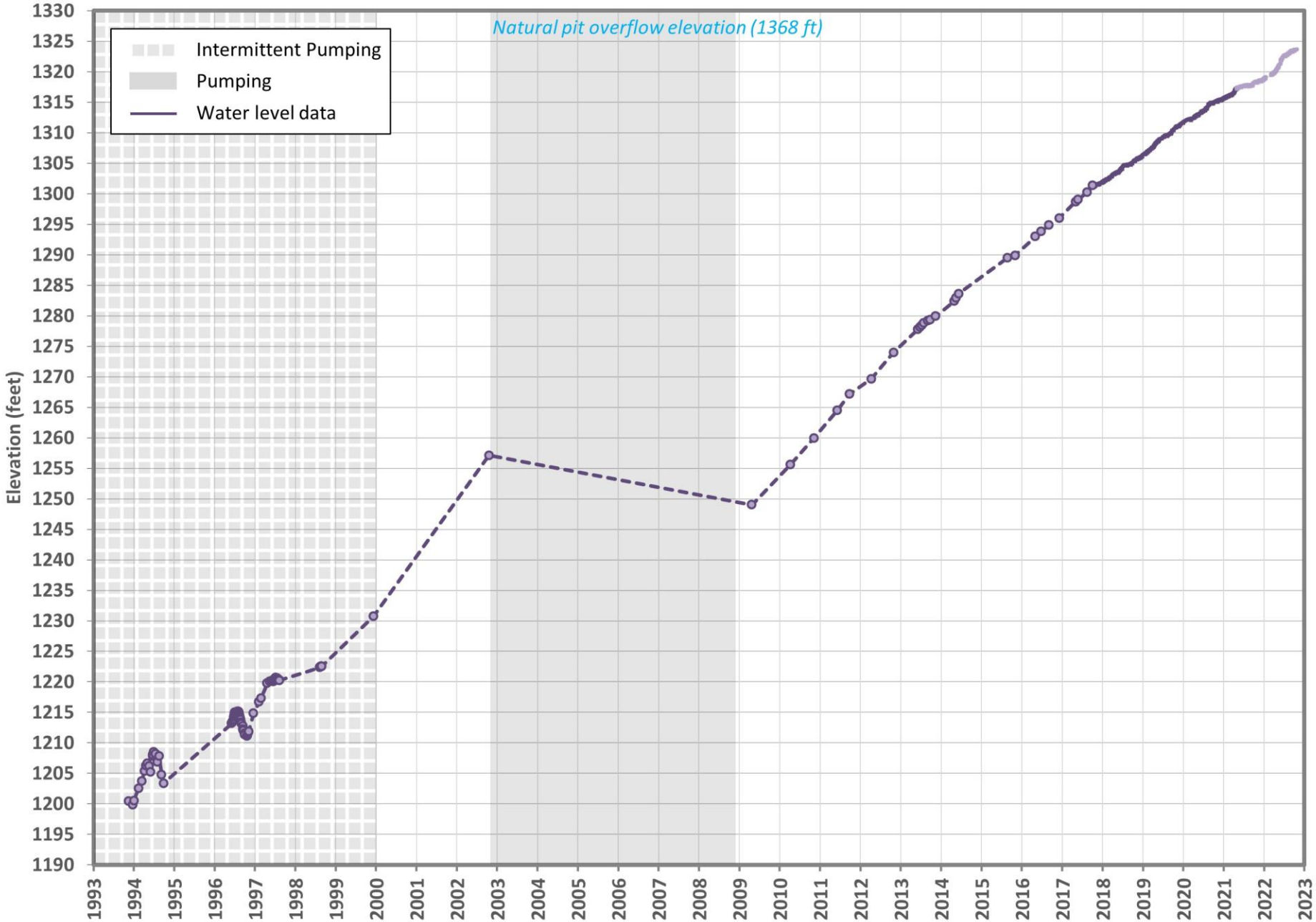
Phase 1 – Data Collection and Modeling

- Ongoing: Monitoring
  - -Pit surface water levels
  - -Groundwater: surficial and bedrock
- 2021: Additional surficial groundwater wells installed
- 2022: Additional bedrock groundwater wells installed
- 2022: Bathymetry data collected
- 2023: Additional groundwater well installation
- 2023: Modeling to predict if the pit will overflow and at what rate/volume

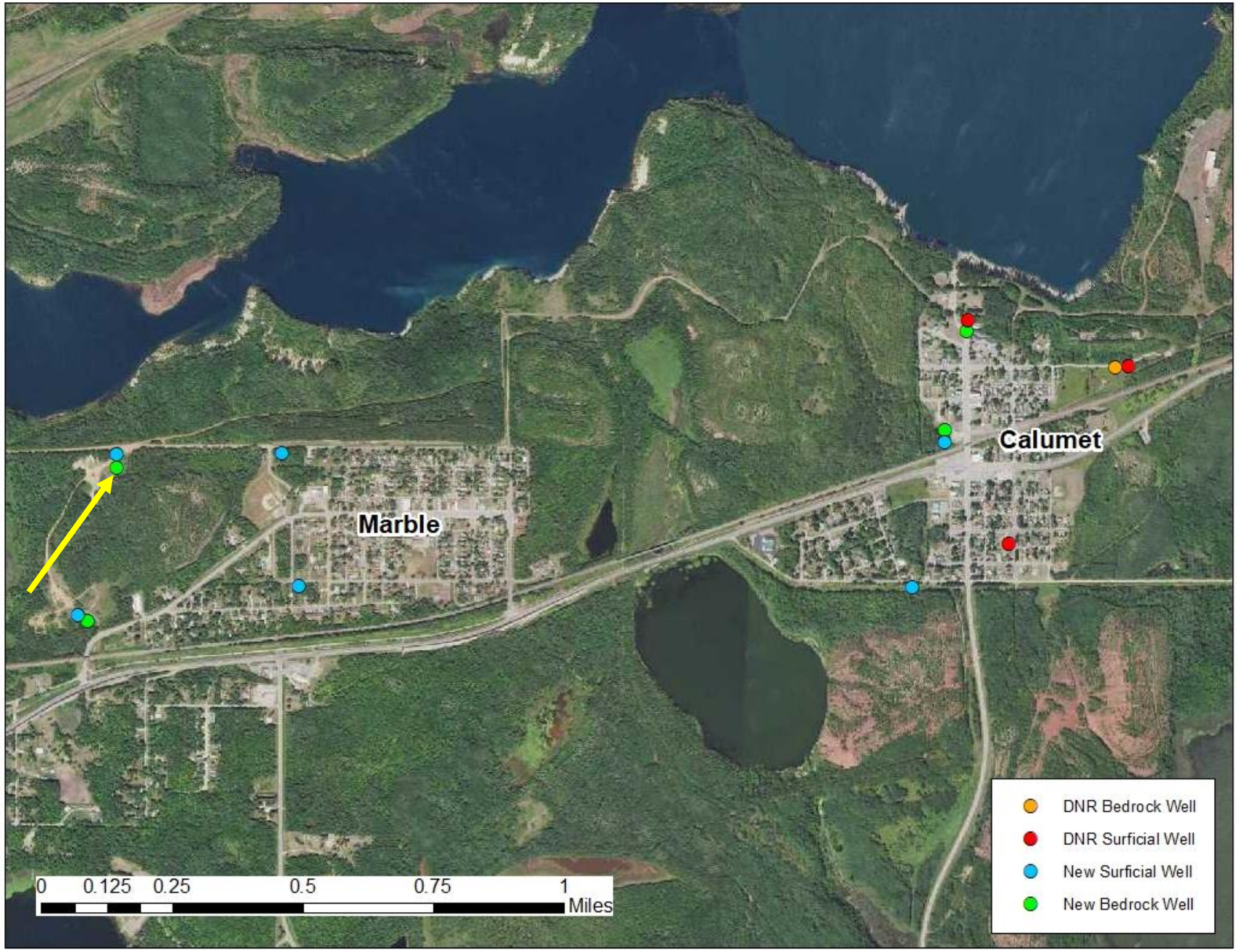


Hill Annex Mine Pit Surface Water Monitoring Site

Hill Annex Pit Water Levels

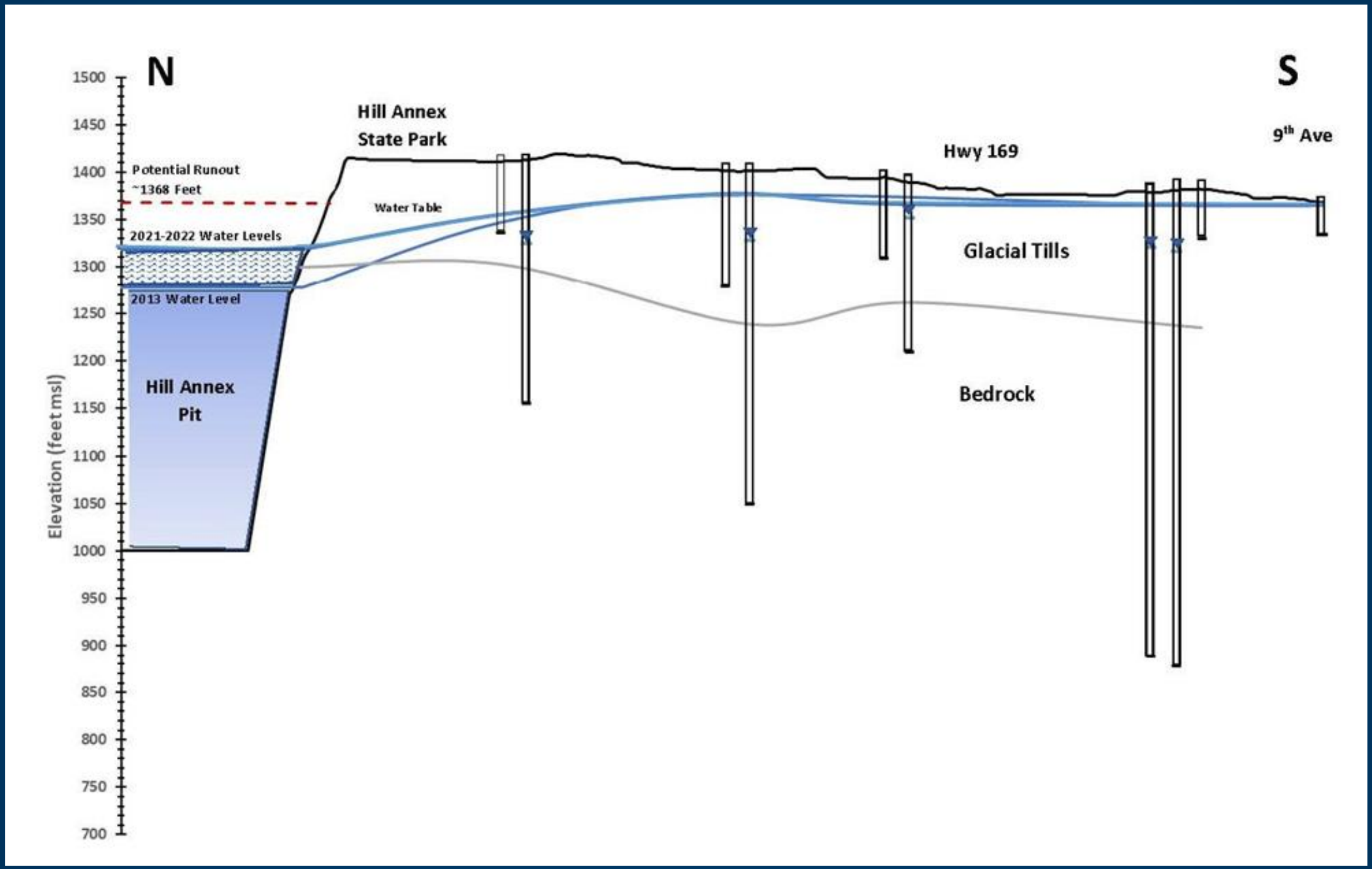


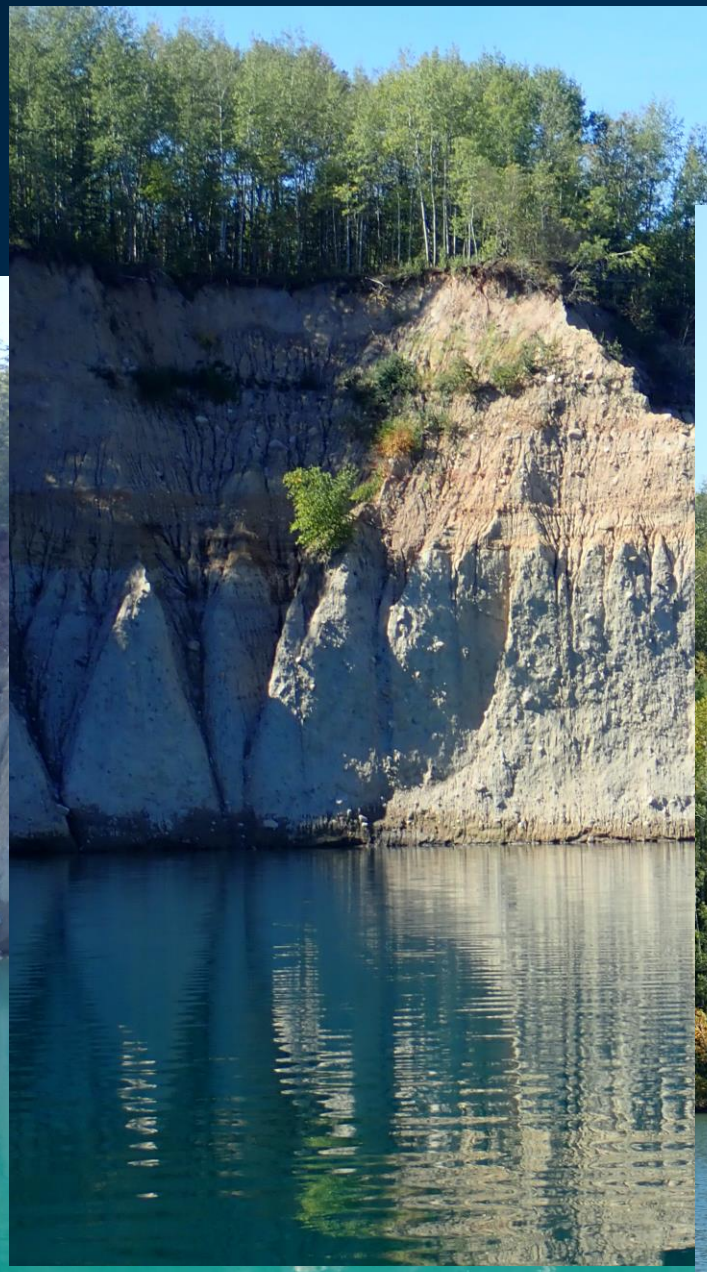
Hill Annex Mine Pit Groundwater Monitoring Well Locations



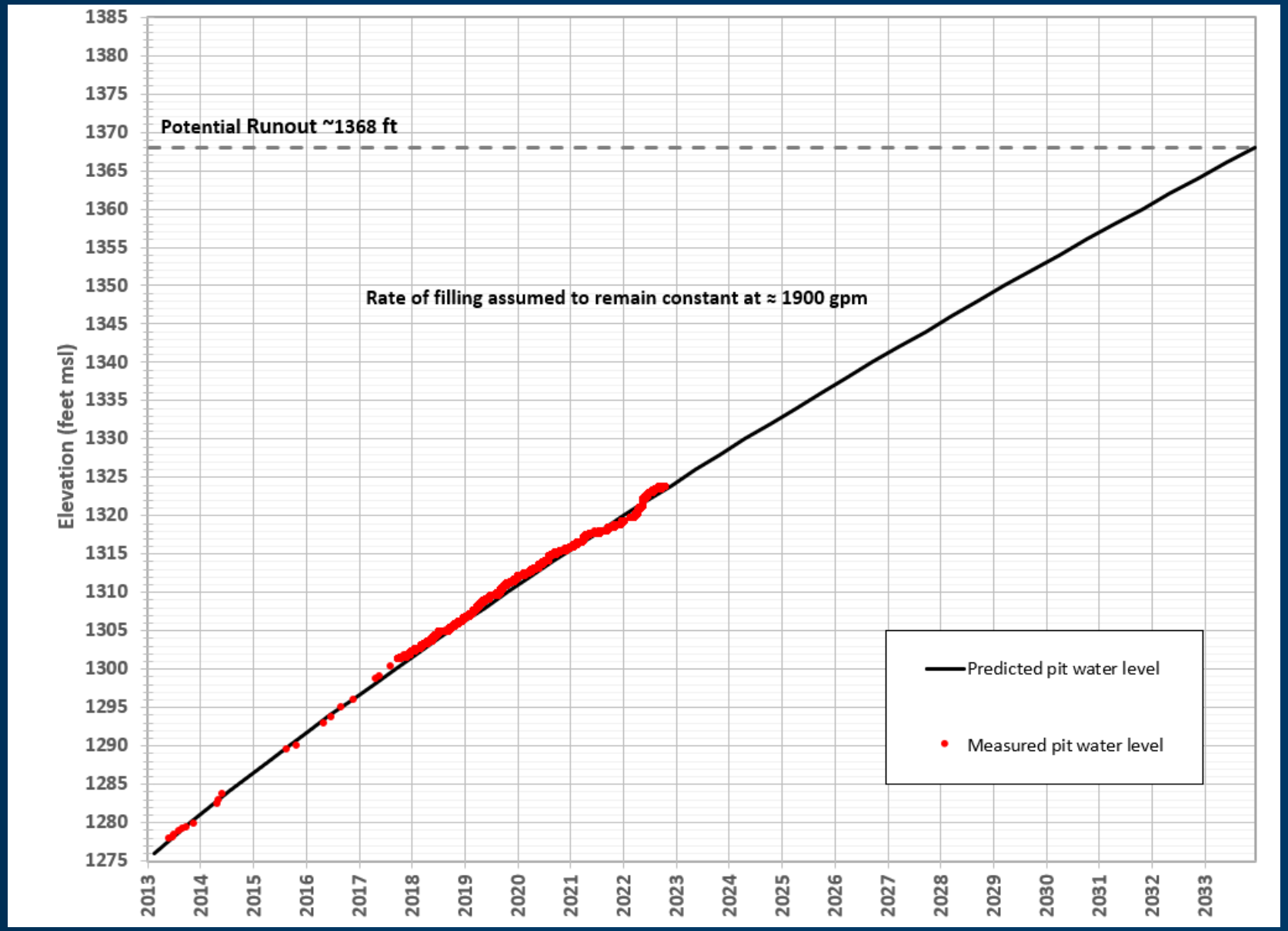

165


170
205
210


N
S
Hill Annex
State Park
9th Ave
Hwy 169
Potential Runout
~1368 Feet
Water Table
2021-2022 Water Levels
2013 Water Level
Glacial Tills
Bedrock
Hill Annex
Pit
Elevation (feet msl)
1500
1450
1400
1350
1300
1250
1200
1150
1100
1050
1000
950
900
850
800
750
700



Predicted* Time to Fill for the Hill Annex Mine Pit



Assumptions*:

-Climate

-Filling Rate (groundwater)

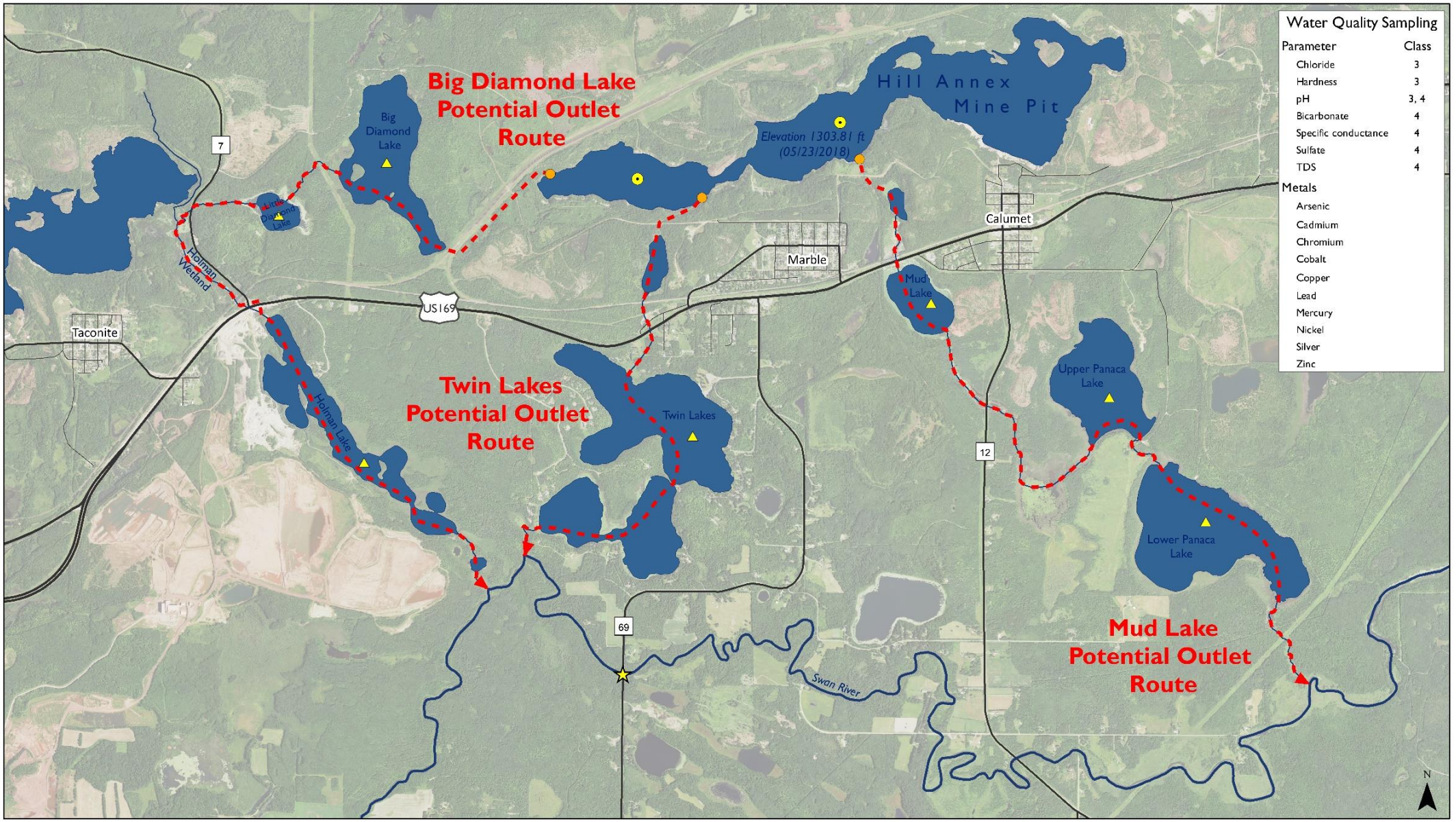
-Pit Volume

Hill Annex Mine Pit

Phase 2 - Outlet Design

Data collected and modeling conducted during Phase 1 will determine if an outlet route would be needed

- Engineering and designing of the outlet
- Pit wall stability study along discharge route
- An external contractor would be hired to work with state agencies to design an engineered outfall
- Route determined by DNR and MPCA technical staff and informed by collected monitoring data and modeling



DNR

Hill Annex Mine Pit Potential Outlet Routes

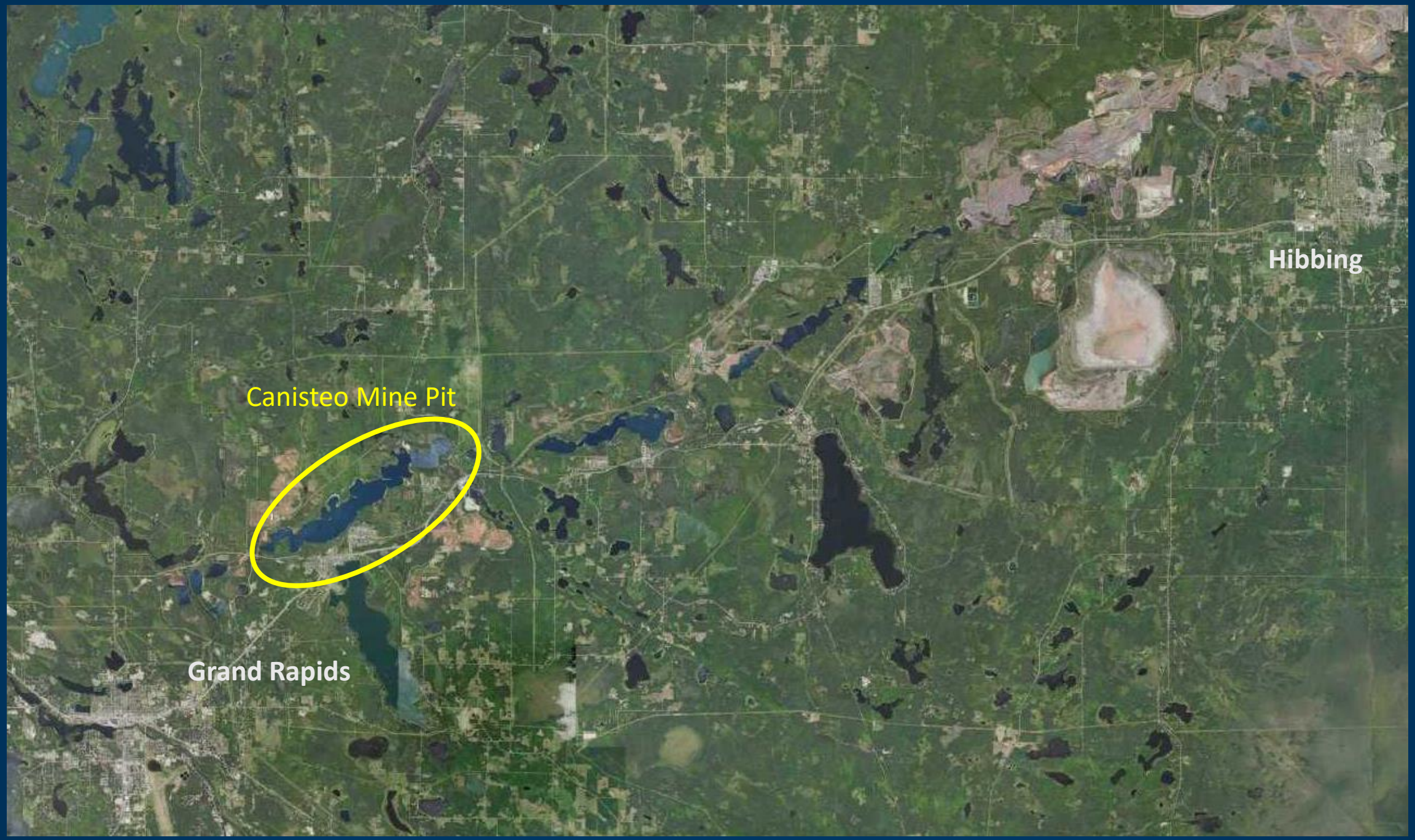
0 0.25 0.5 1 1.5 2 Miles

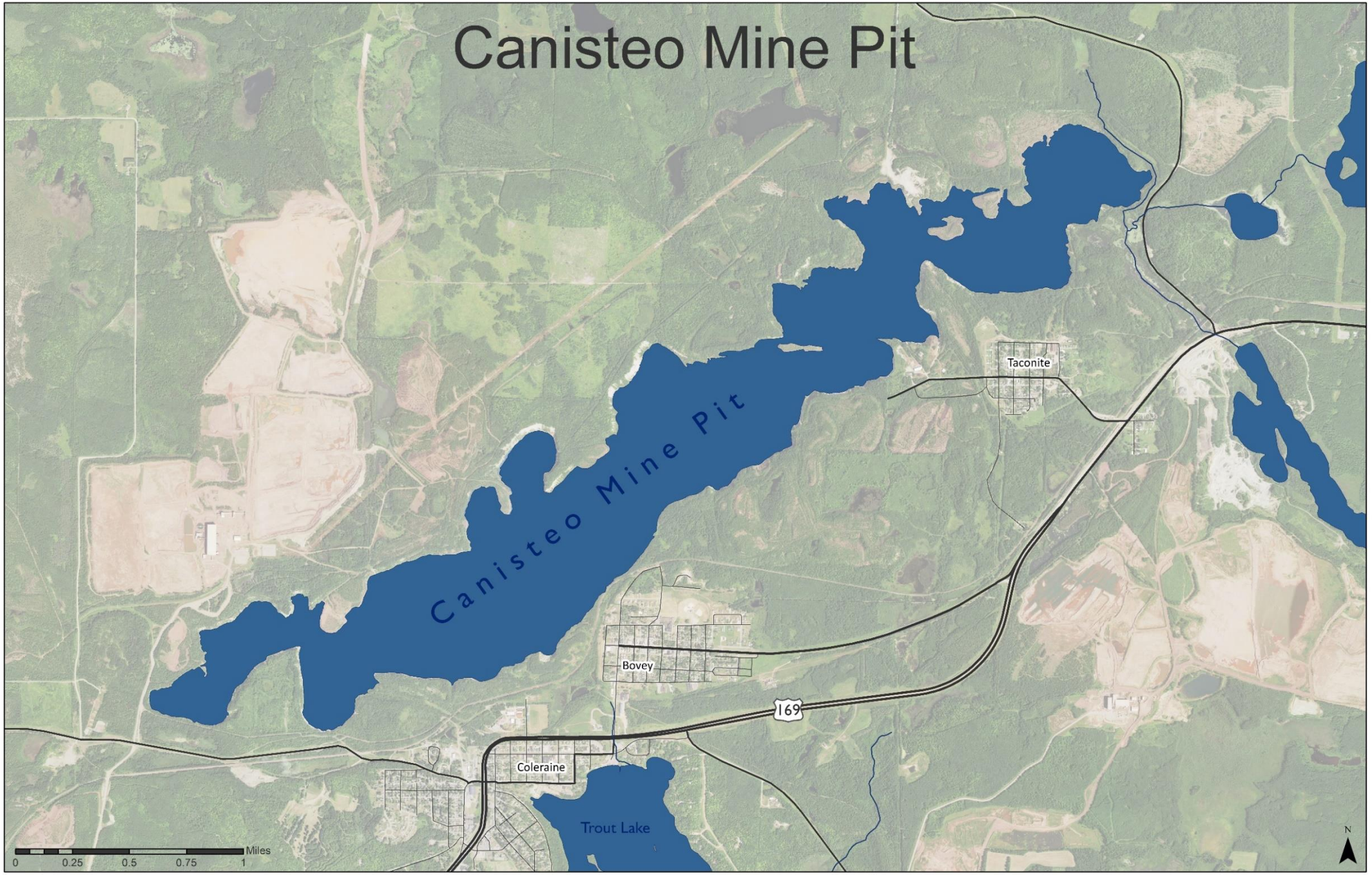
Natural Runout Elevation 1368 ft
Potential Outlet Routes
Lake, Pit Lake
Stream
River

Water Quality Sampling
Class 3, 4 (x3) and Metals (x1)
Class 3, 4 (x1)
Continuous Flow and Class 3, 4 (x3)

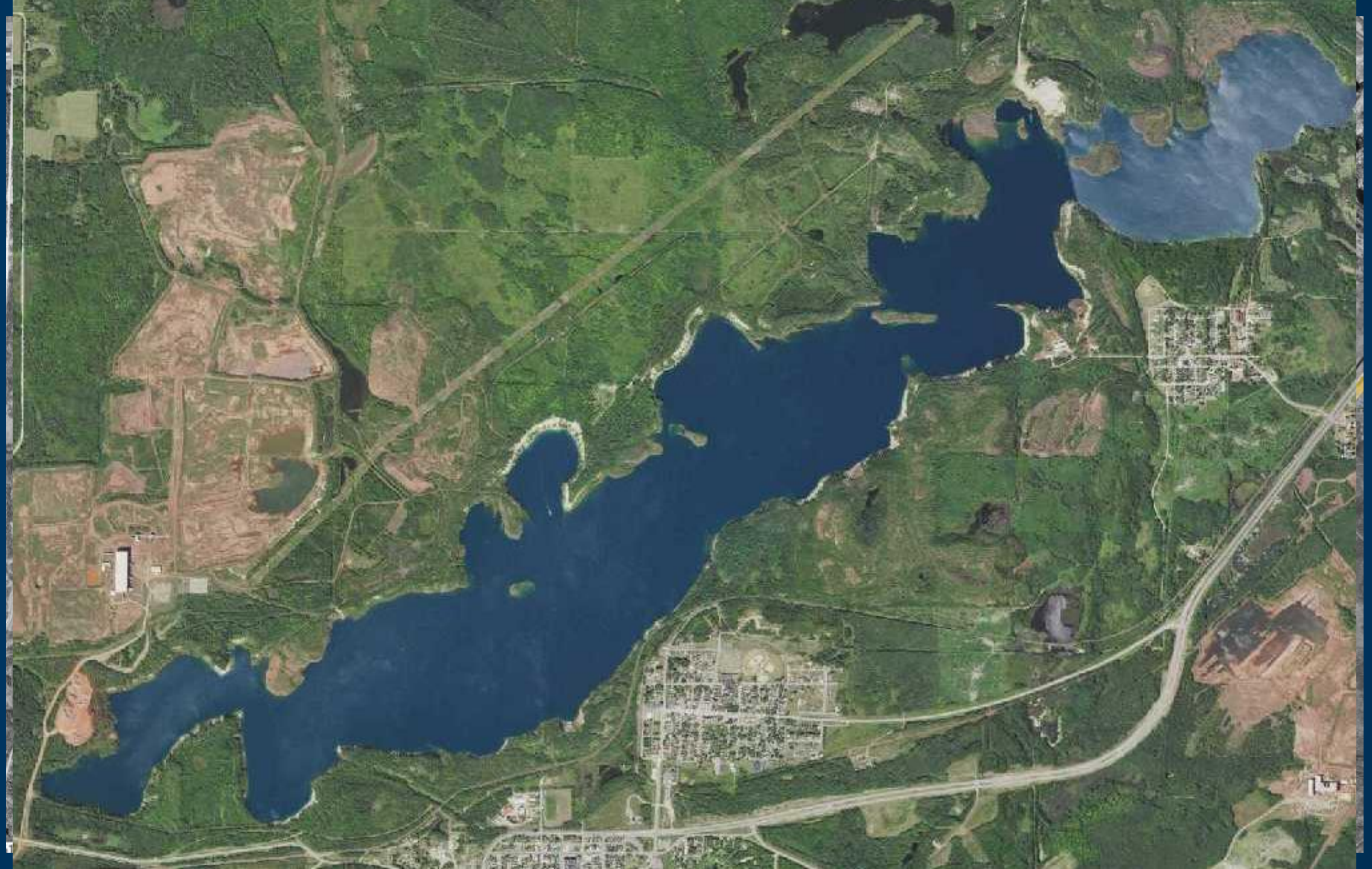
DEPARTMENT OF NATURAL RESOURCES

Canisteo Legacy Mine Pit


Canisteo Mine Pit
Hibbing
Grand Rapids


Canisteo Mine Pit
Canisteo Mine Pit
Taconite
Bovey
169
Coleraine
Trout Lake
0
0.25
0.5
0.75
1
Miles
N

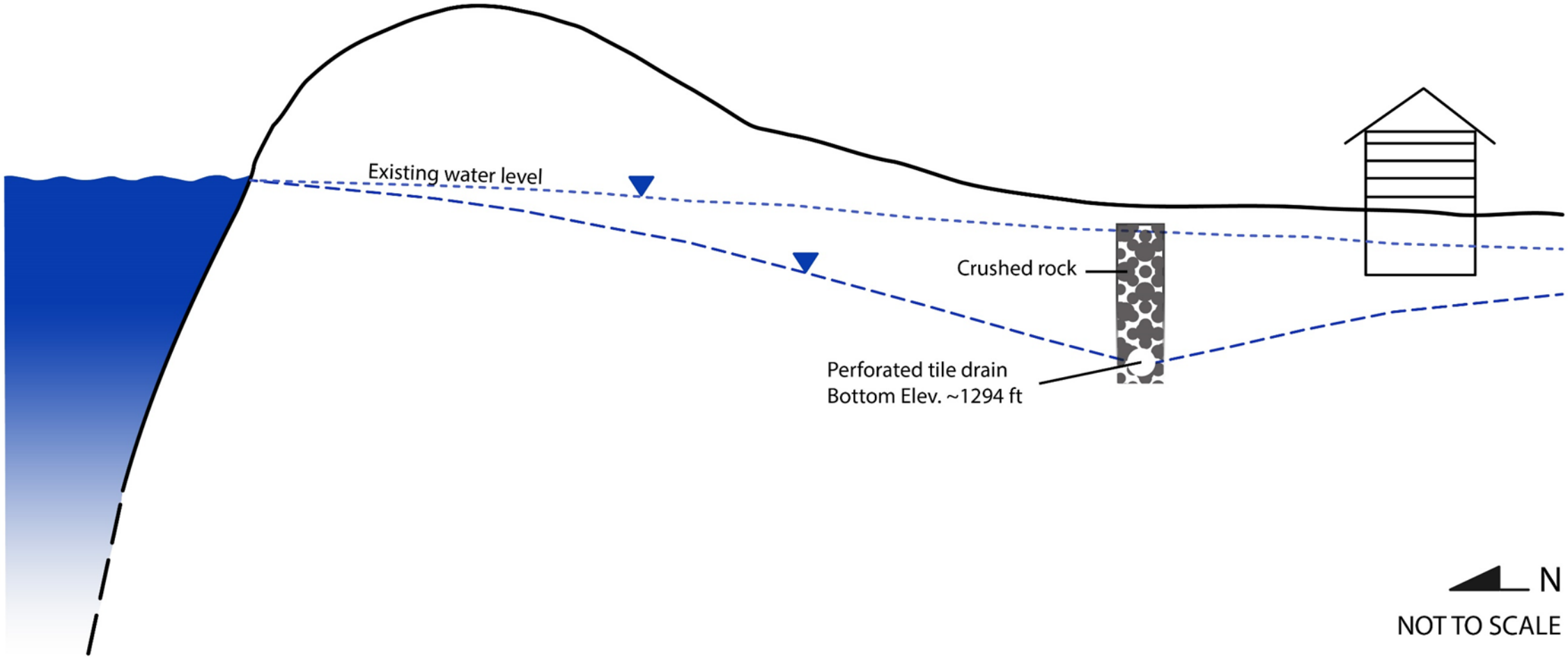
2021



Canisteo Mine Pit

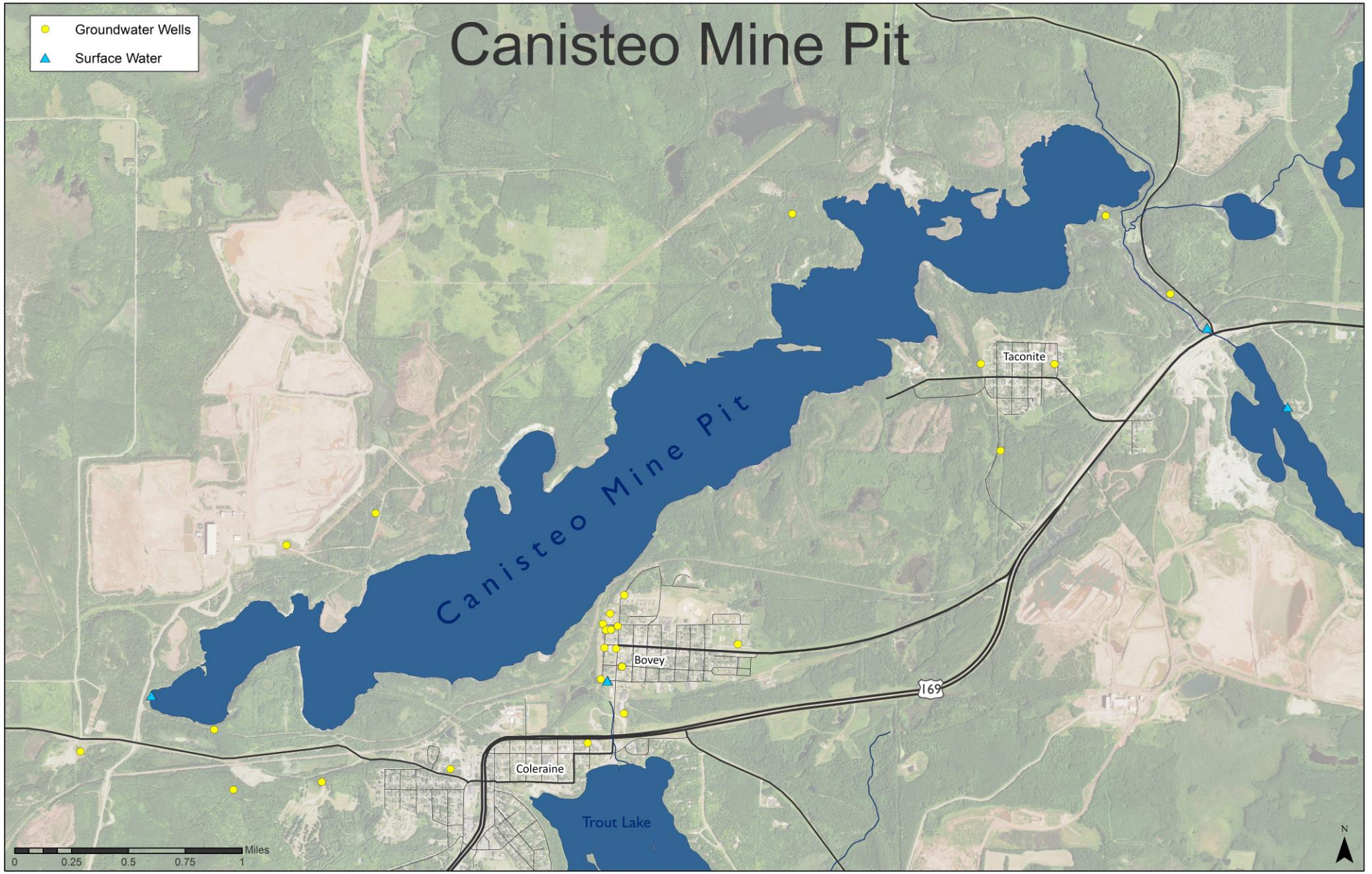
- 1999: Water level monitoring began (surface and groundwater)
- 2001: Canisteo Pit Water Balance Study
- 2008: Additional groundwater monitoring wells installed; pit stability study; outlet designed to discharge to the Prairie River
- 2008-2009: City of Bovey Wet Basement Survey was conducted
- 2011: Drain Tile System was installed


City of Bovey Drain Tile System
Canisteo
Mine Pit
Bovey
169
Coleraine
Trout Lake
N
Drain Tile System
Surface Flow Direction
Miles
0
0.25
2015 Aerial Imagery


Existing water level
Crushed rock
Perforated tile drain
Bottom Elev. ~1294 ft
N
NOT TO SCALE

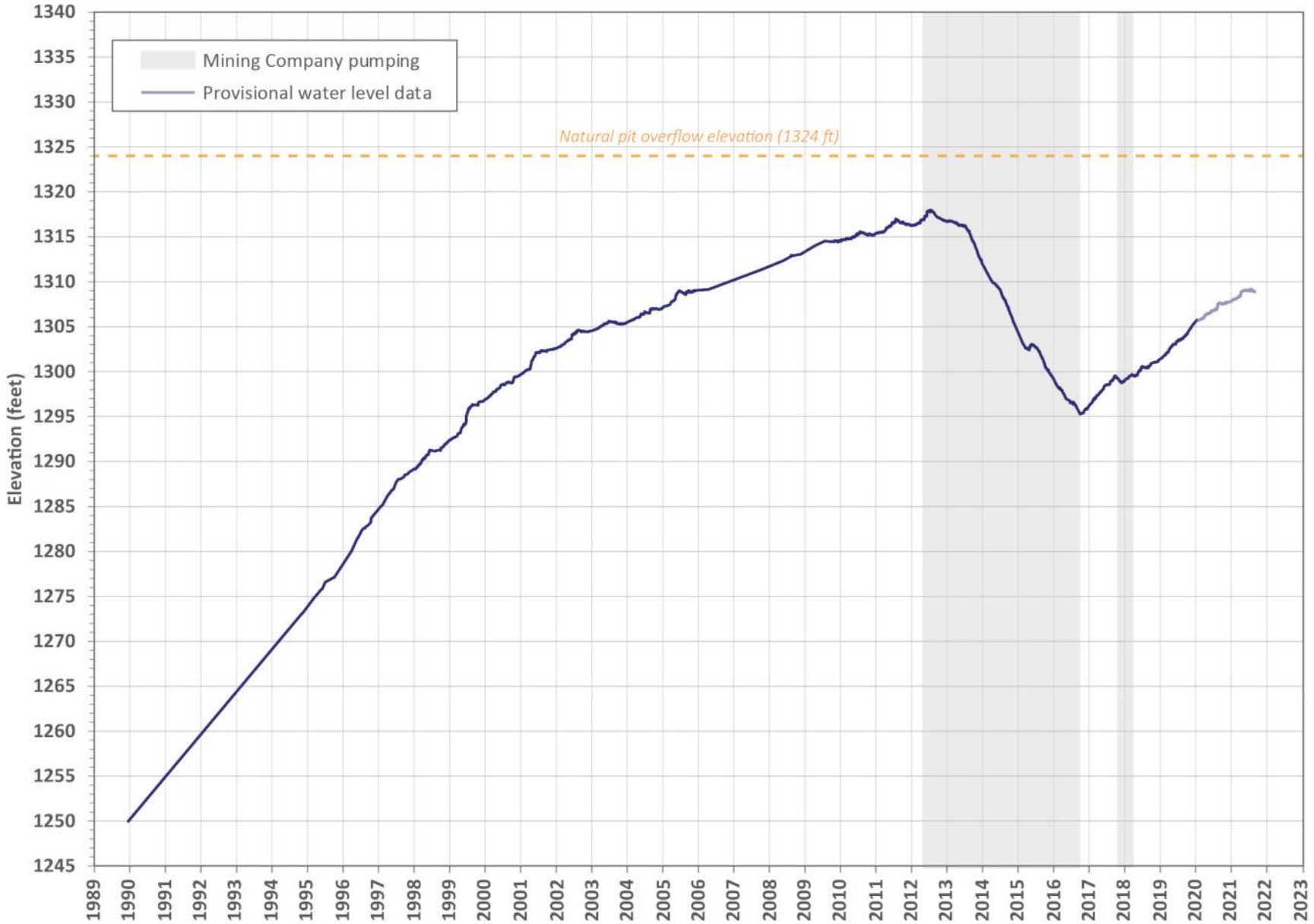
Canisteo Mine Pit

- 1999: Water level monitoring began (surface and groundwater)
- 2001: Canisteo Pit Water Balance Study
- 2008: Additional groundwater monitoring wells installed; pit stability study; outlet designed to discharge to the Prairie River
- 2008-2009: Wet Basement Survey was conducted
- 2011: Drain Tile System was installed
- 2012: Water Appropriation Permit was issued to scram mining operation
- 2012-2018: Pumping from Canisteo Mine Pit managed water levels

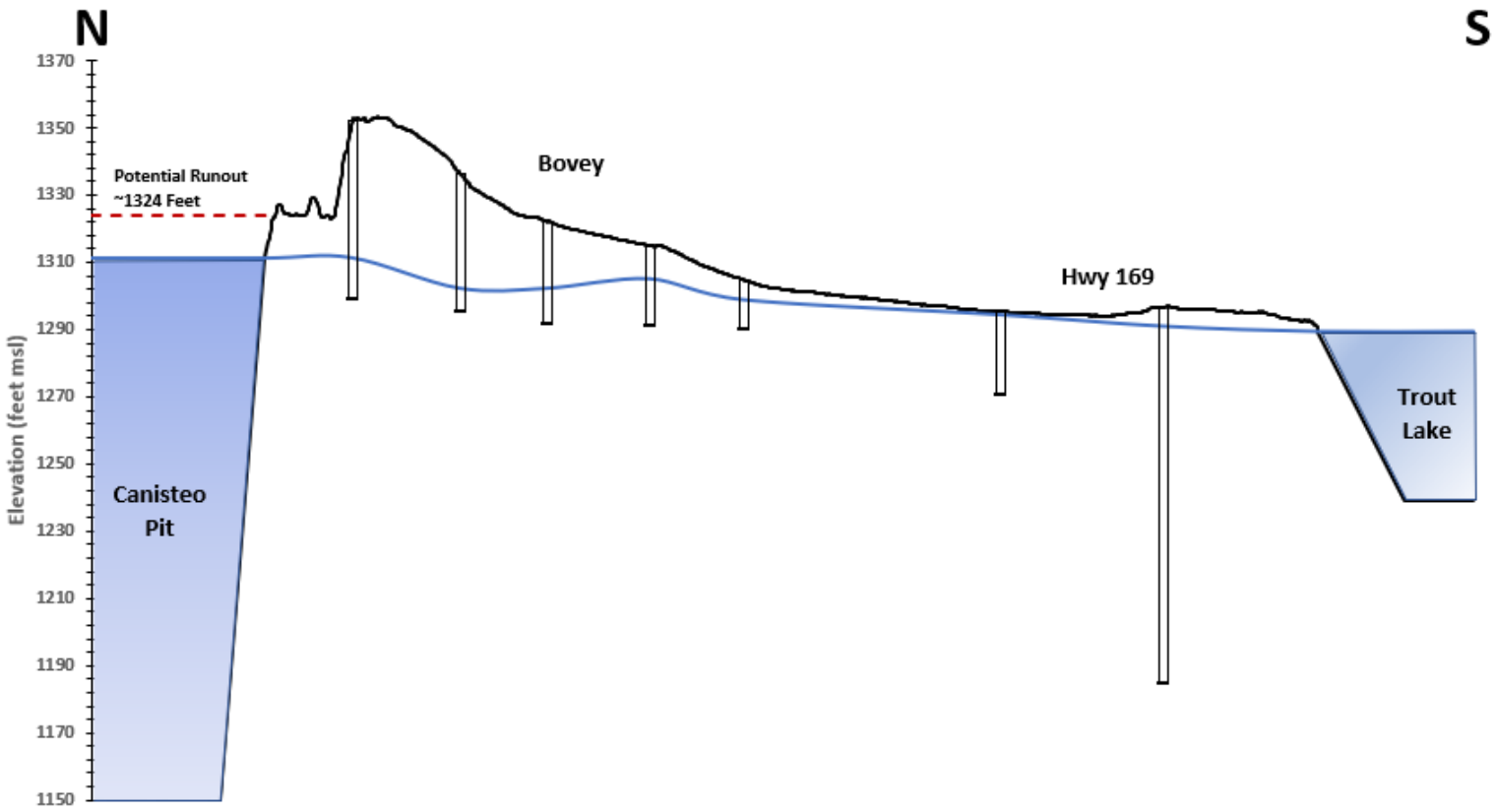


Monitoring Locations

Canisteo Mine Pit Water Levels



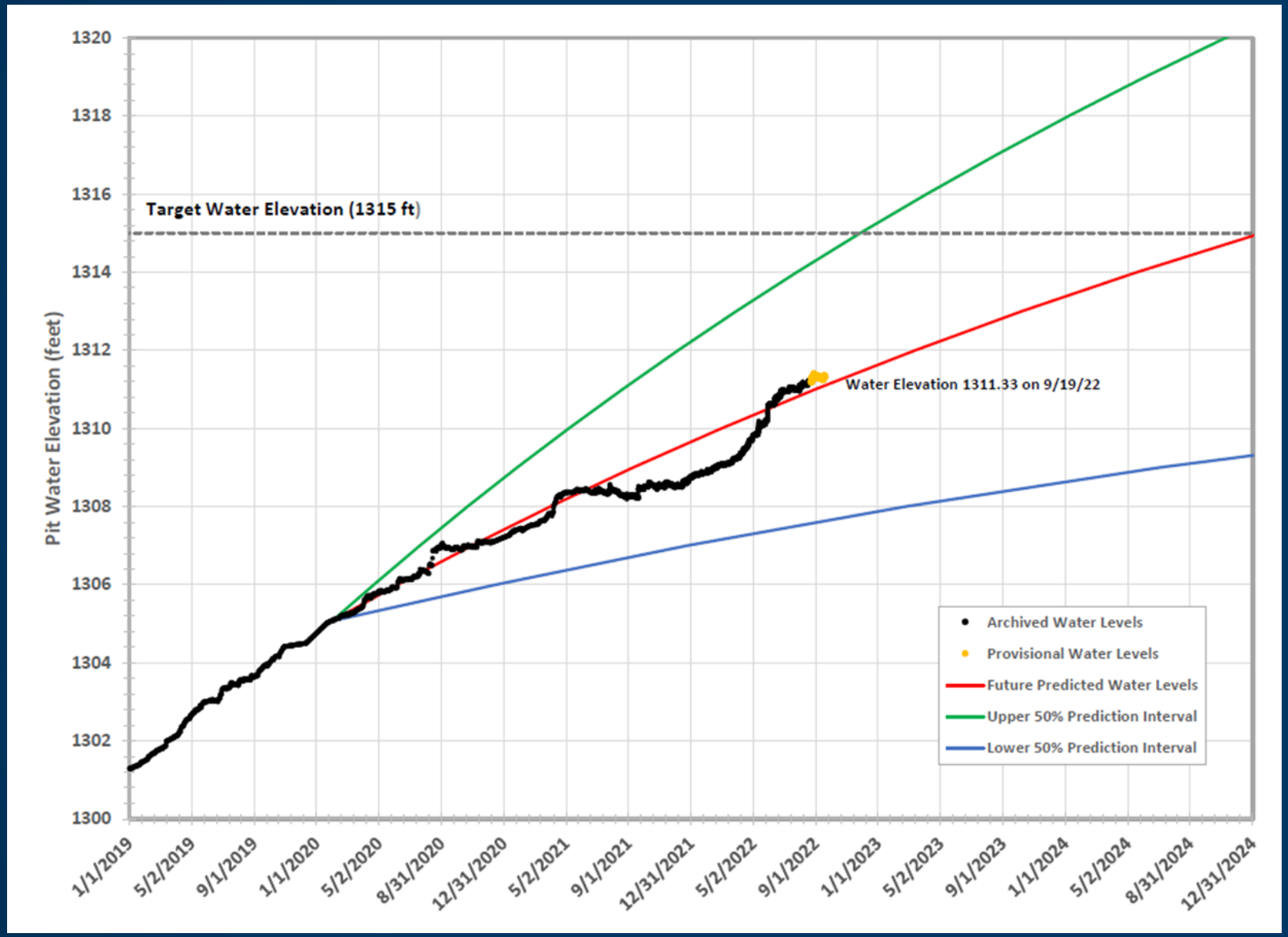
Groundwater well levels



Canisteo Mine Pit

- 2021: Contingency pumping planning
- 2022: Zebra mussels discovered
- 2022: Winter contingency pumping to start
- 2022-2023: Outlet planning continues; construction funding needed
- Ongoing: Data collection and model refinement

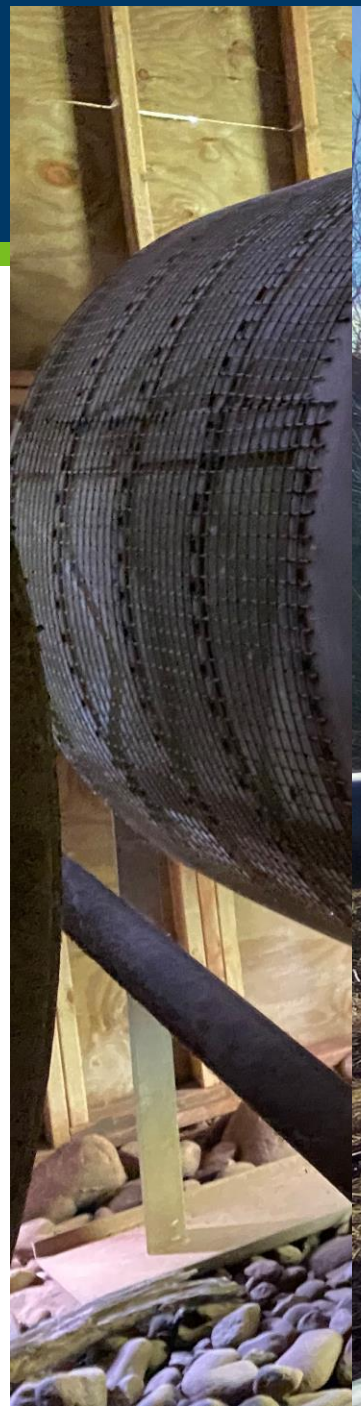
Predicted* Time to Fill for the Canisteo Pit



Assumptions*:

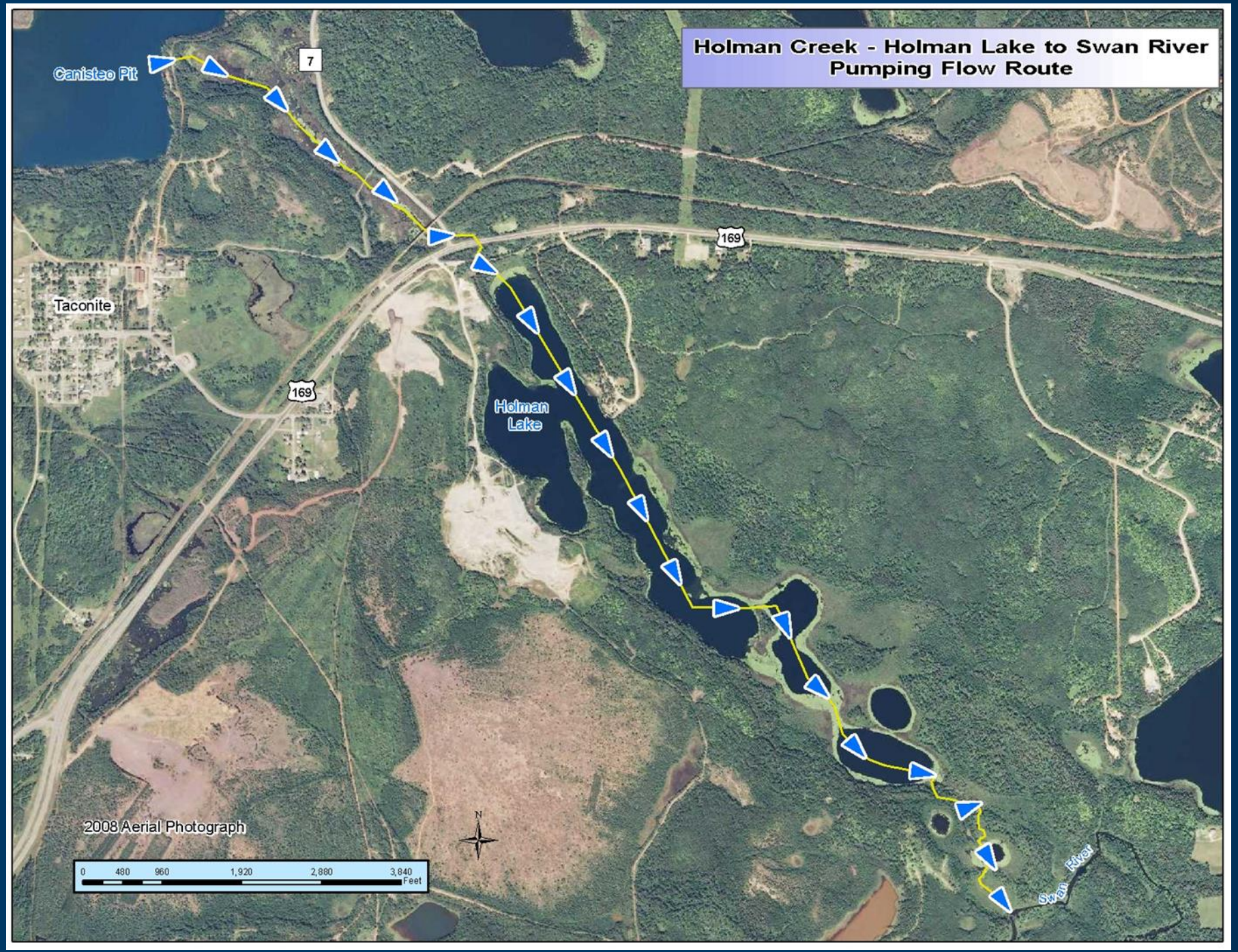
-Climate

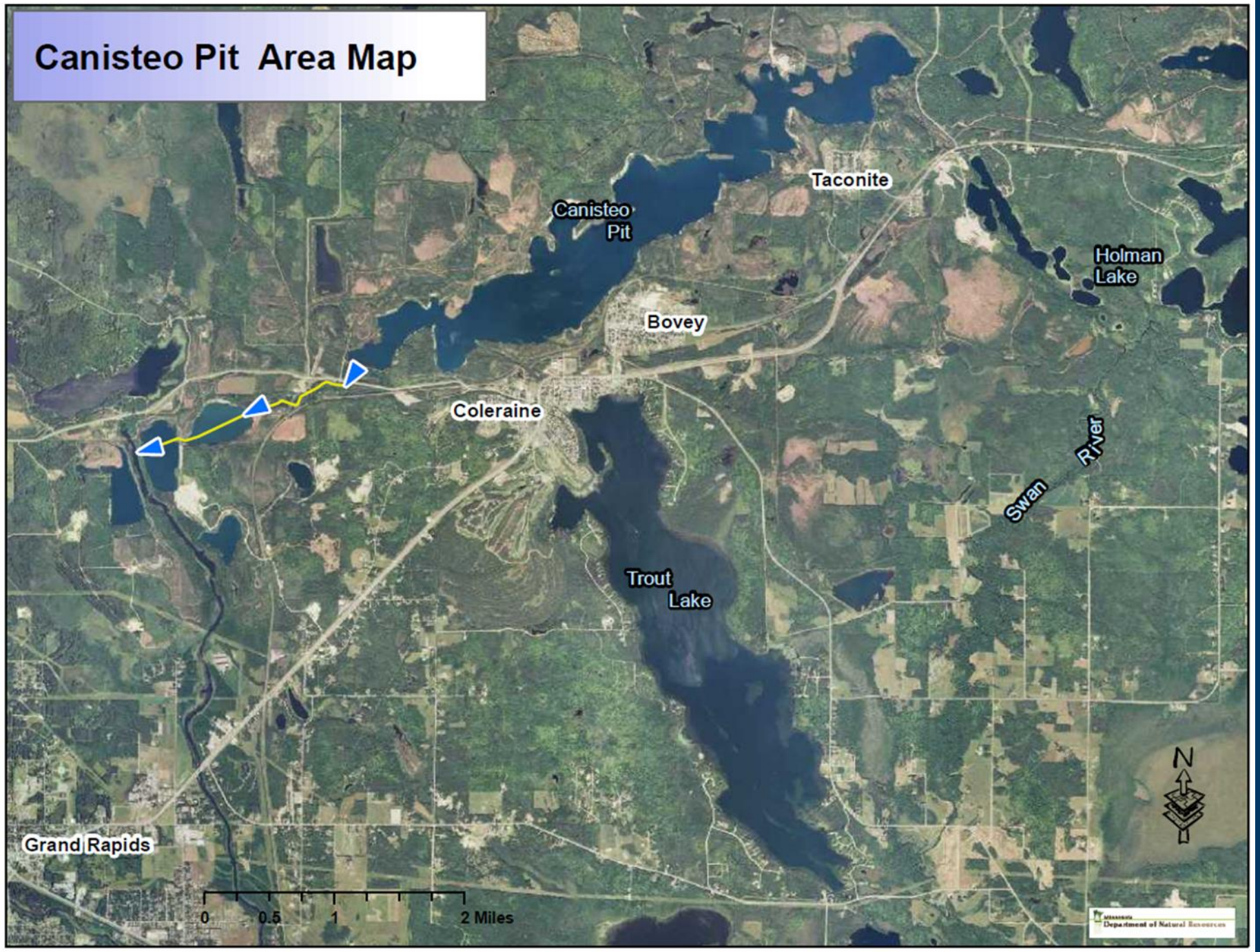
-Filling Rate (groundwater)



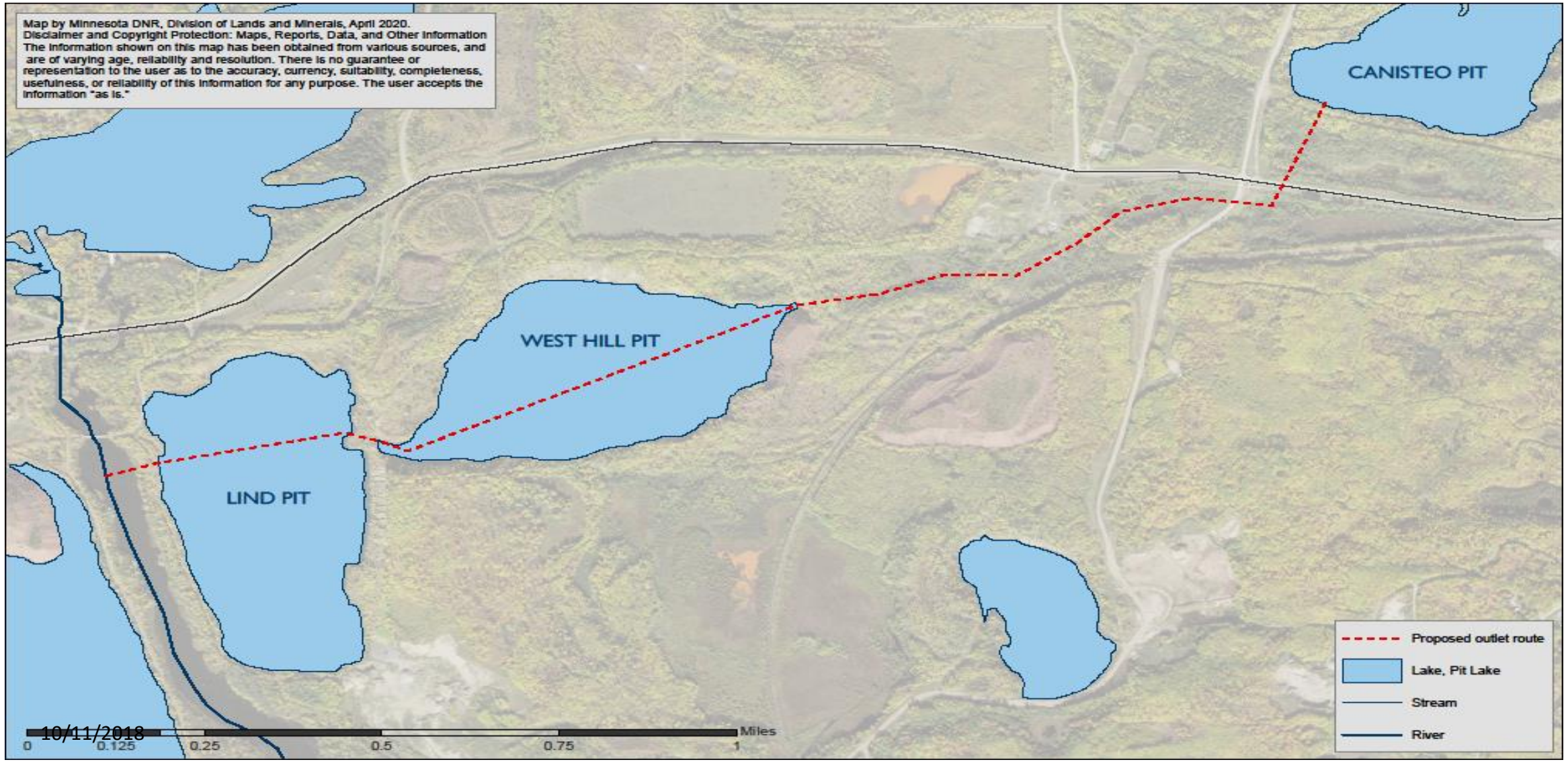

HECIMOVICH
MECHANICAL
HIBBING, MN
218-262-2969
United Rentals
VFD40736 VFD200
United Rentals
HECIMOVICH
MECHANICAL
218-262-2969
10461326
MECHANICAL
United Rentals
800-UR-RENTS

Contingency Pumping Outflow Route




Canisteo Pit Area Map
Taconite
Canisteo Pit
Holman Lake
Bovey
Coleraine
Swan River
Trout Lake
Grand Rapids
0
0.5
1
2 Miles
N

Canisteo Pit Proposed Permanent Outlet Route



Thank You!

Erika Herr

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218.231.8471