Simulation of Groundwater Flow and Groundwater/Surface-water Interactions in the Bad River Watershed, Wisconsin

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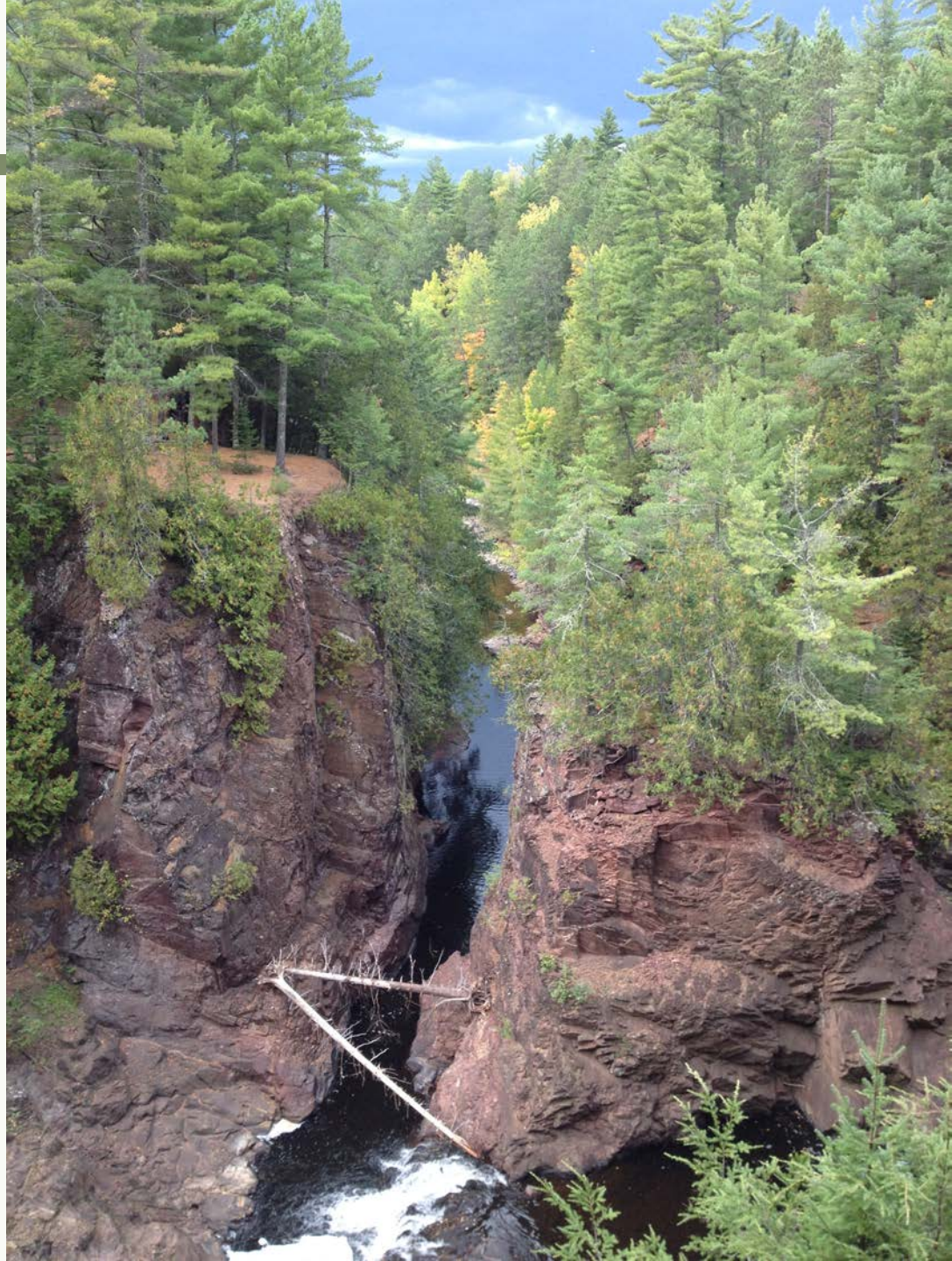
Overview

Background/Motivation

Analytic Element Screening Model

Evaluating new data worth

3-D MODFLOW model



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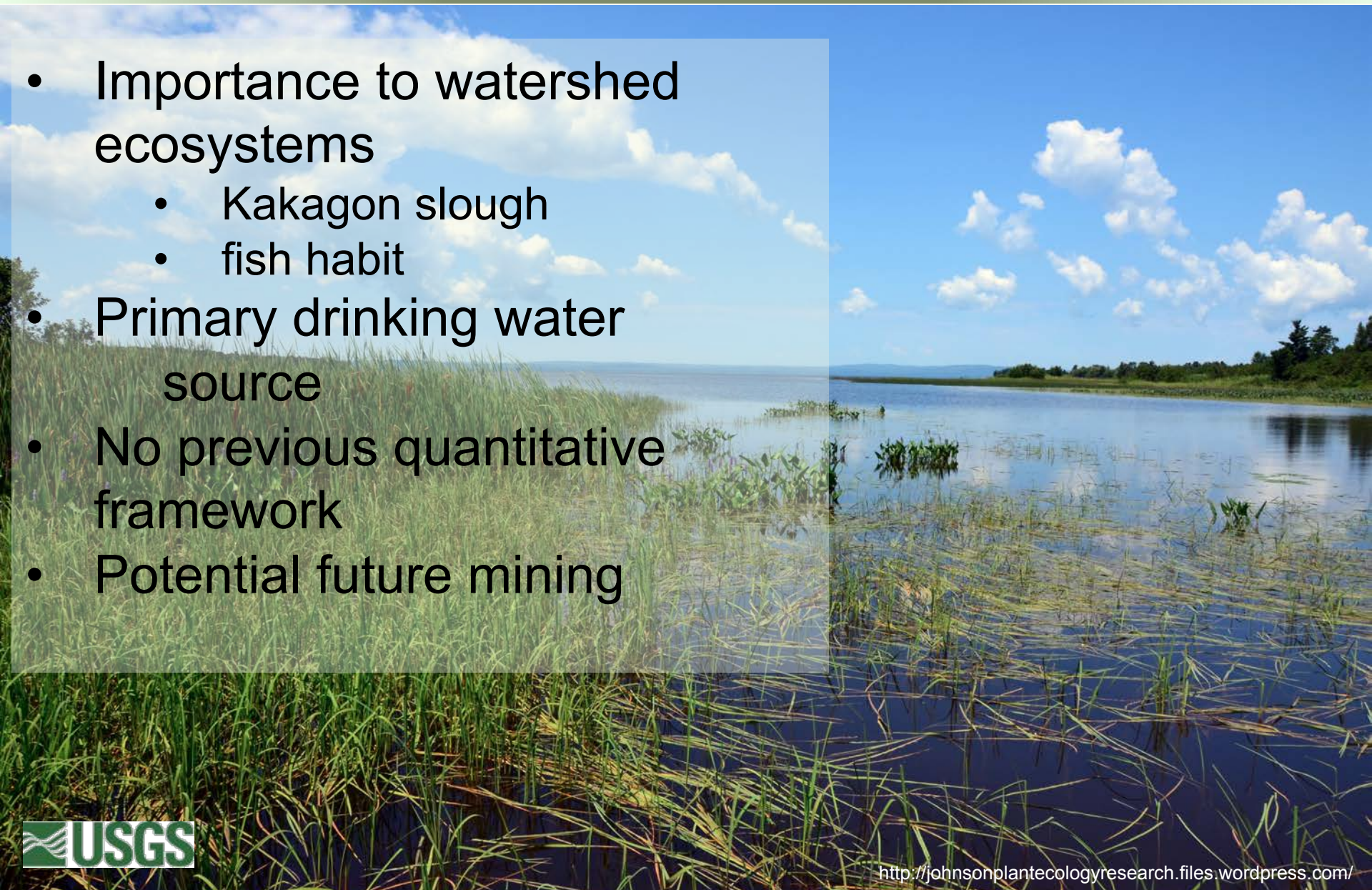
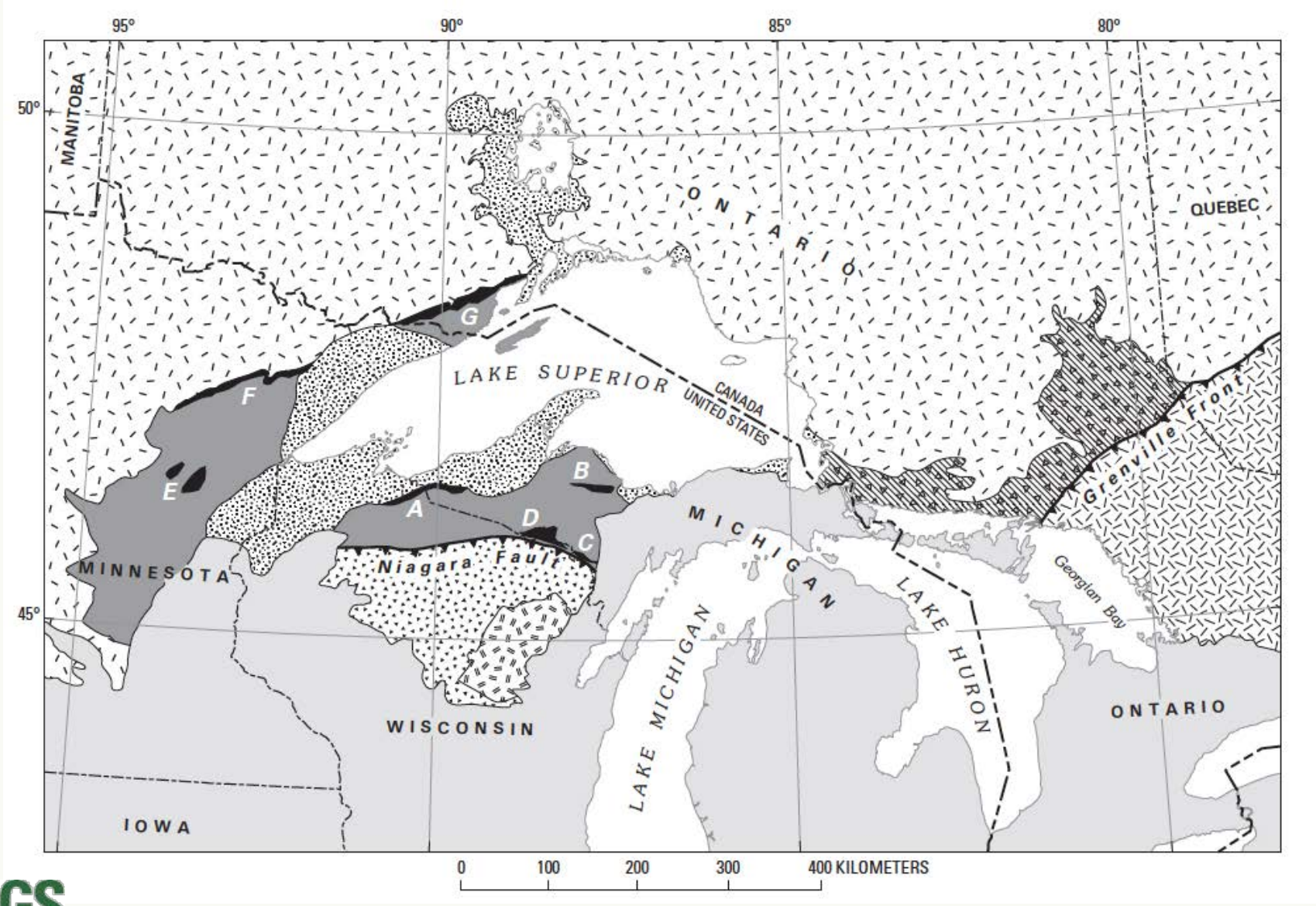
Motivation

- Importance to watershed ecosystems
  - Kakagon slough
  - fish habit
- Primary drinking water source
- No previous quantitative framework
- Potential future mining



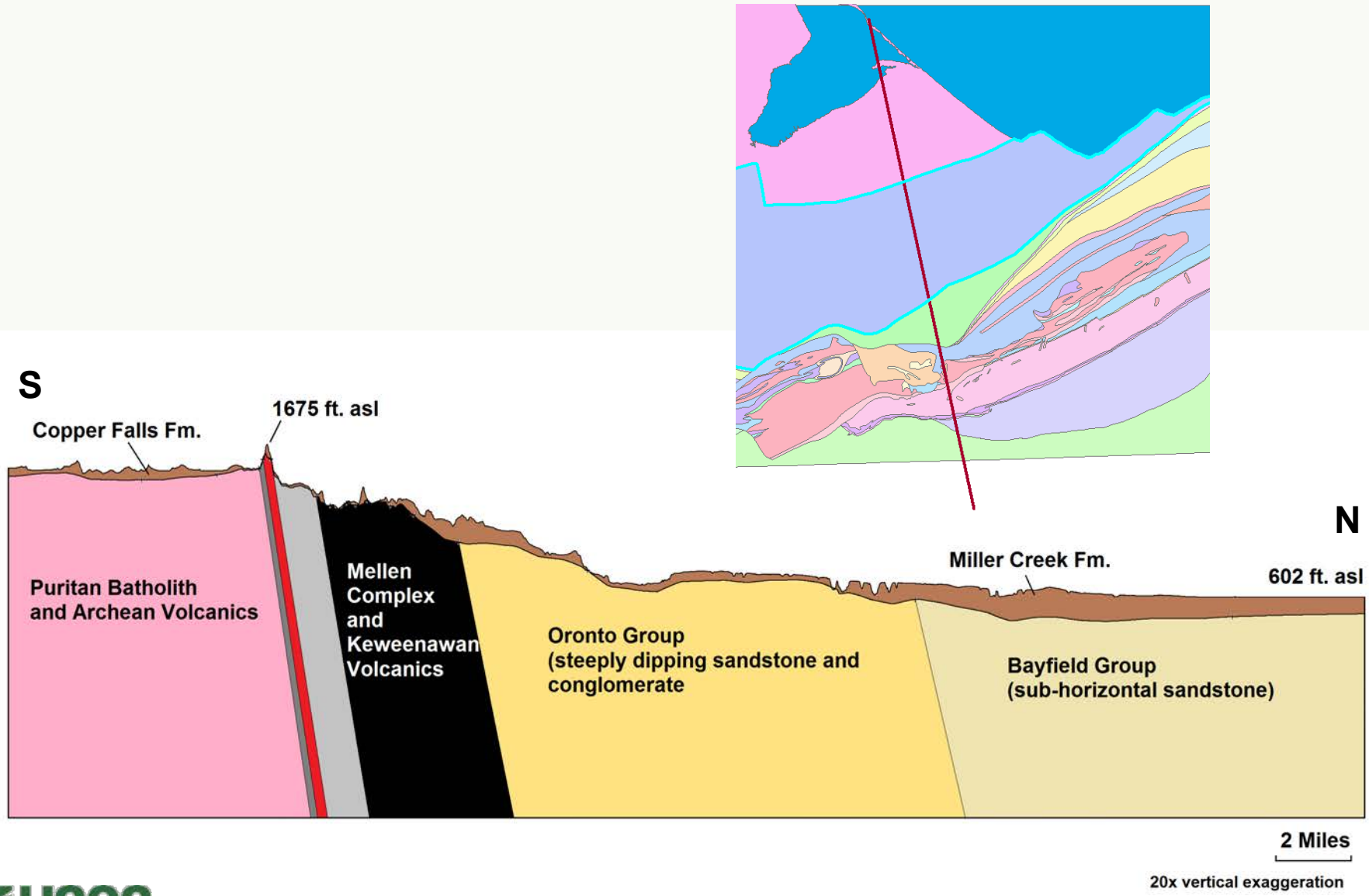
http://johnsonplantecologyresearch.files.wordpress.com/

Geologic Setting



from Cannon et al 2008

Geologic Setting



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Screening model overview

GFLOW

2-D (Dupuit Forchheimer)

Steady-State

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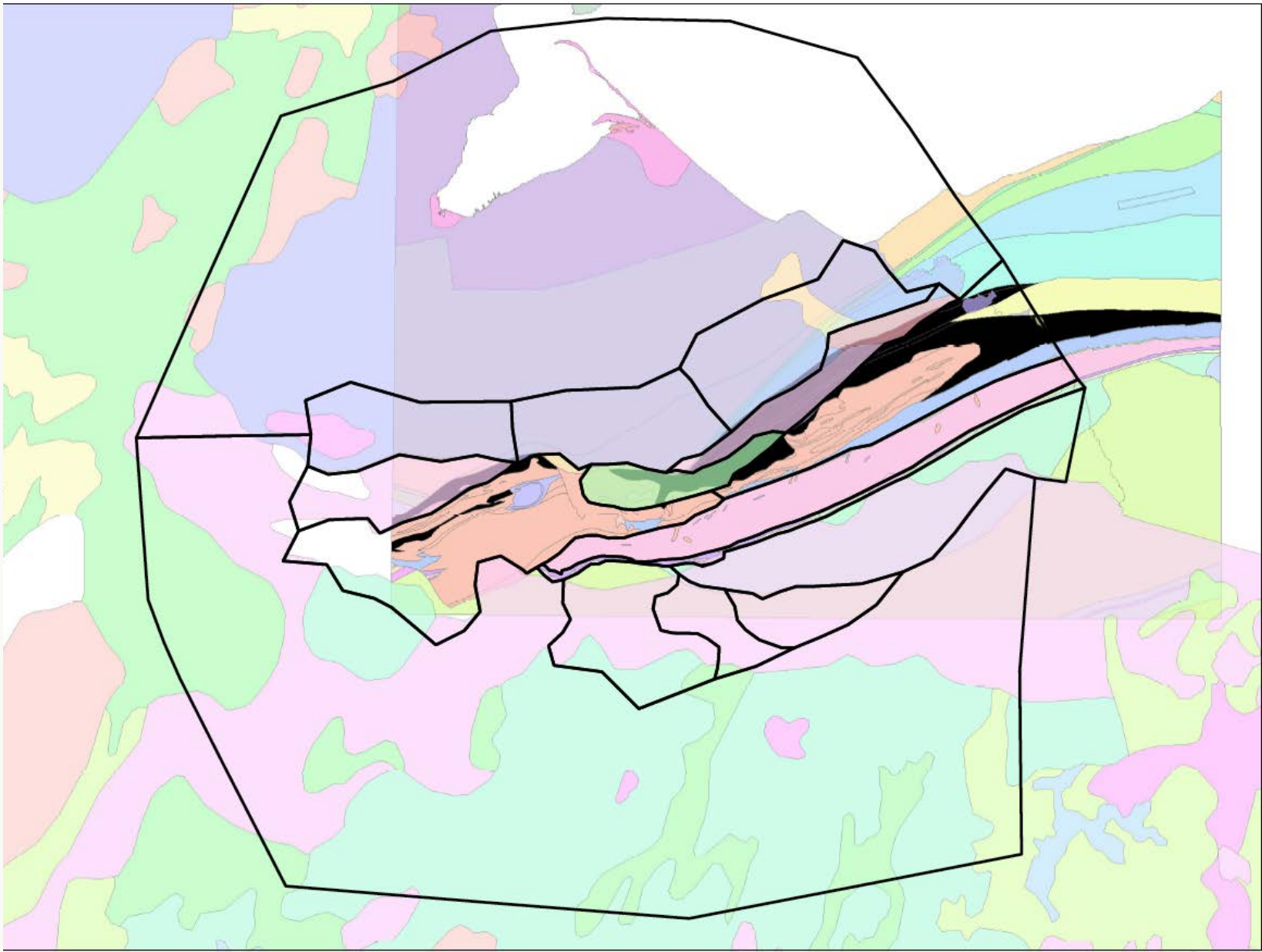
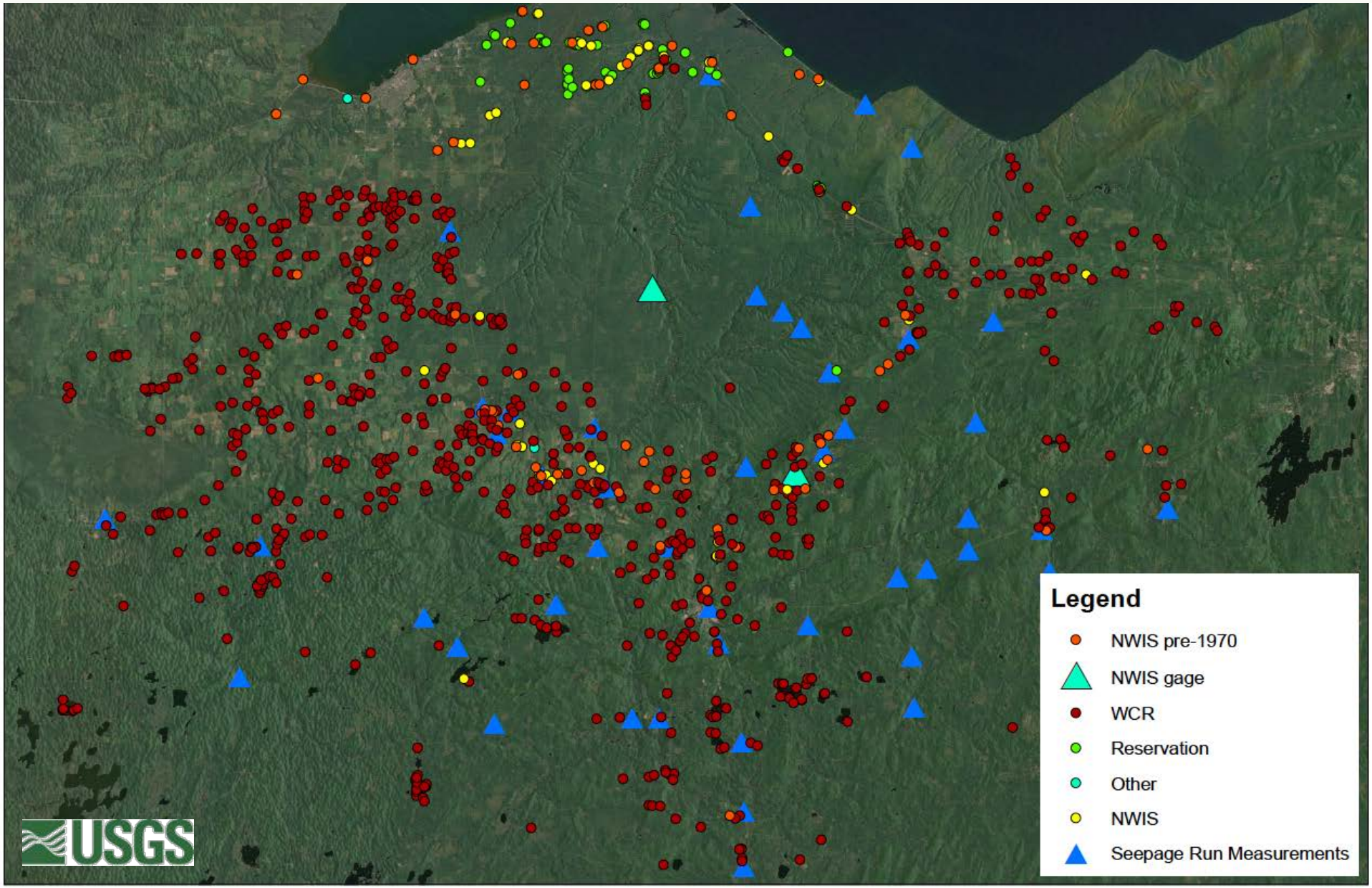
Screening model overview

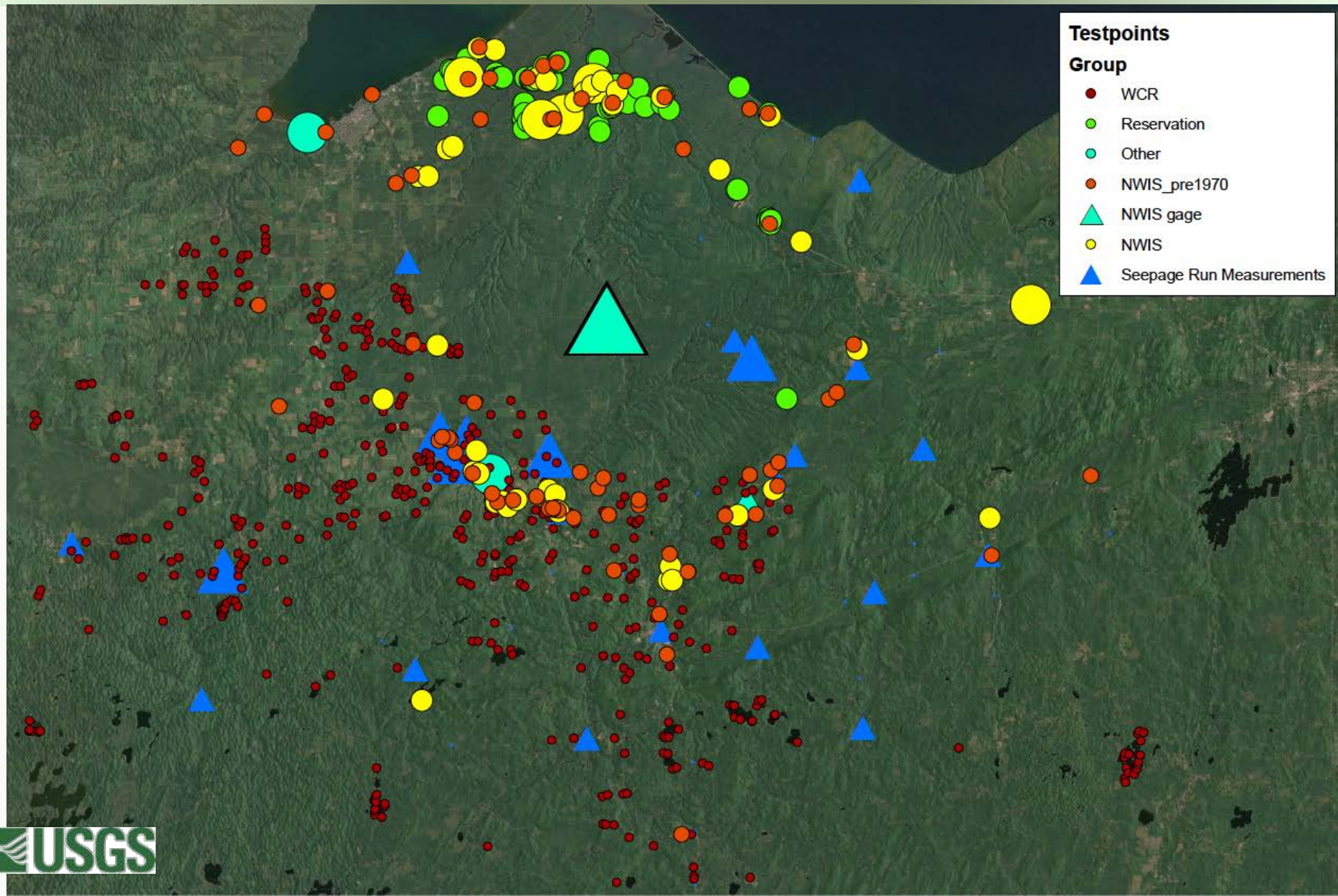


Screening model overview

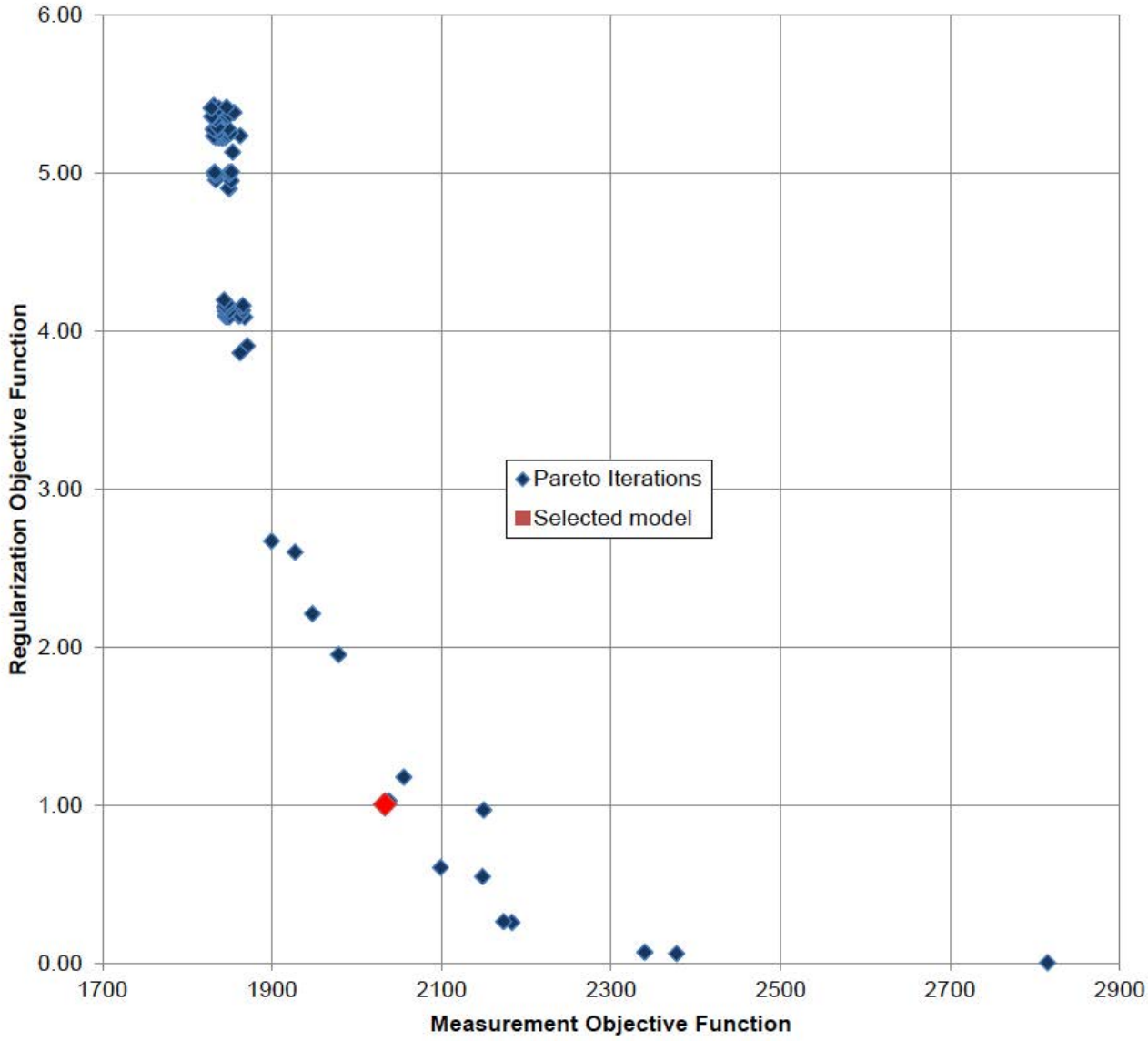
Calibration Data



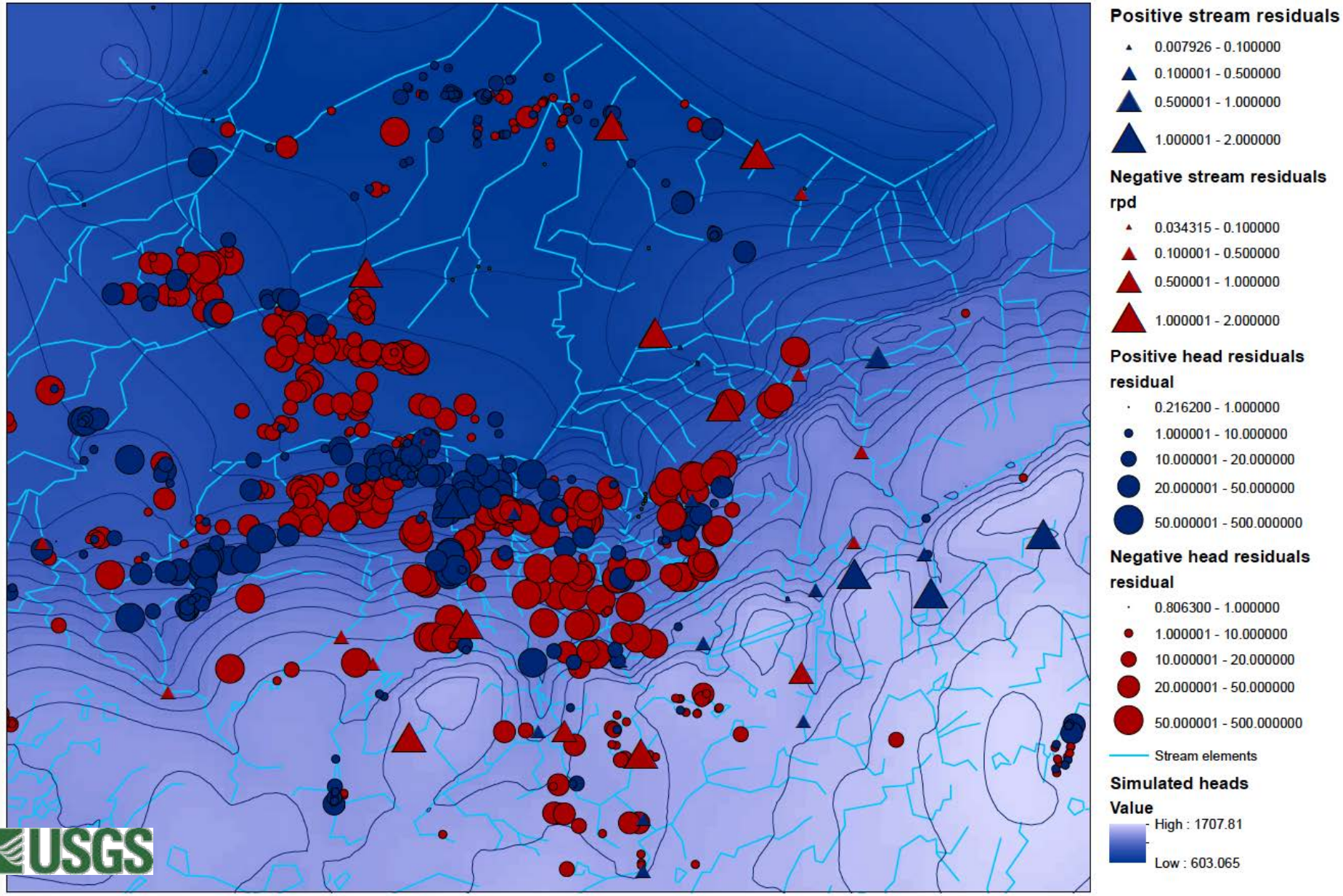
Calibration Data by weight



Pareto optimization

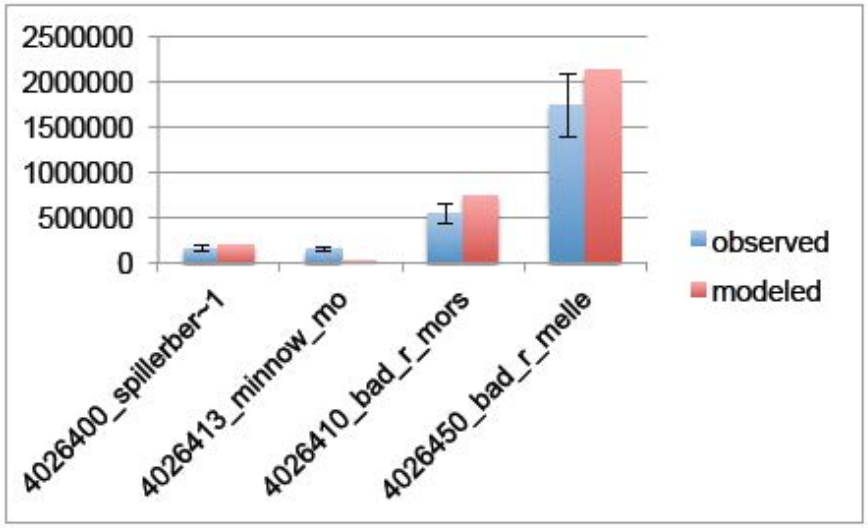


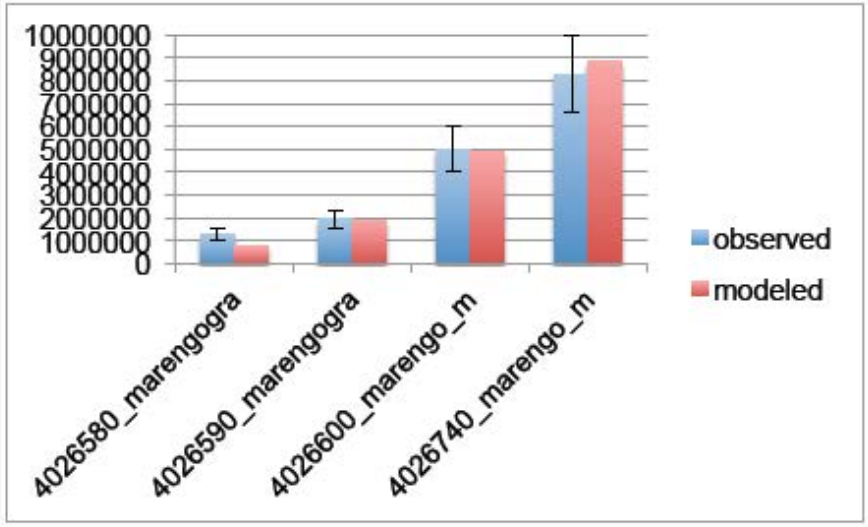
Final screening model calibration results

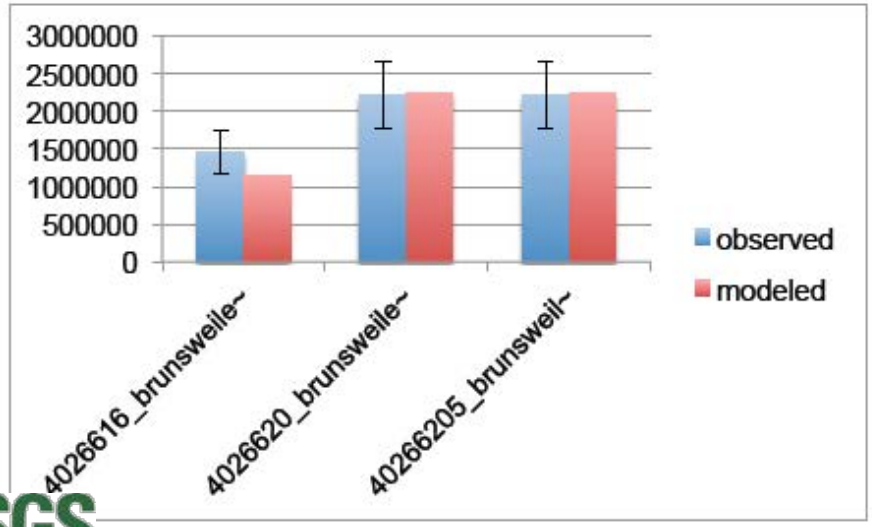


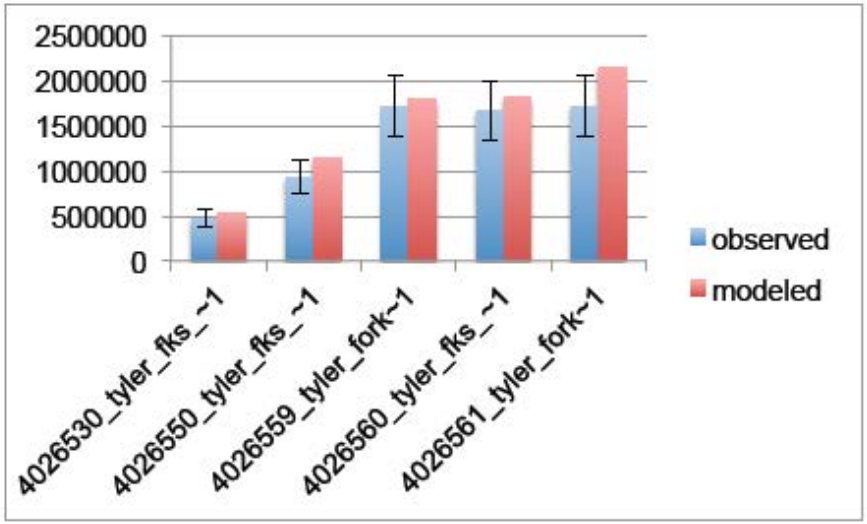
Final screening model calibration results

Simulated vs. Observed Streamflows (ft^3/d)









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Evaluating new data worth - uncertainty propagation

Observations
(heads, stream baseflows)

Groundwater Flow Model
(Parameters,
such as hydraulic conductivity,
recharge, etc.)

Prediction
(heads, stream baseflows)

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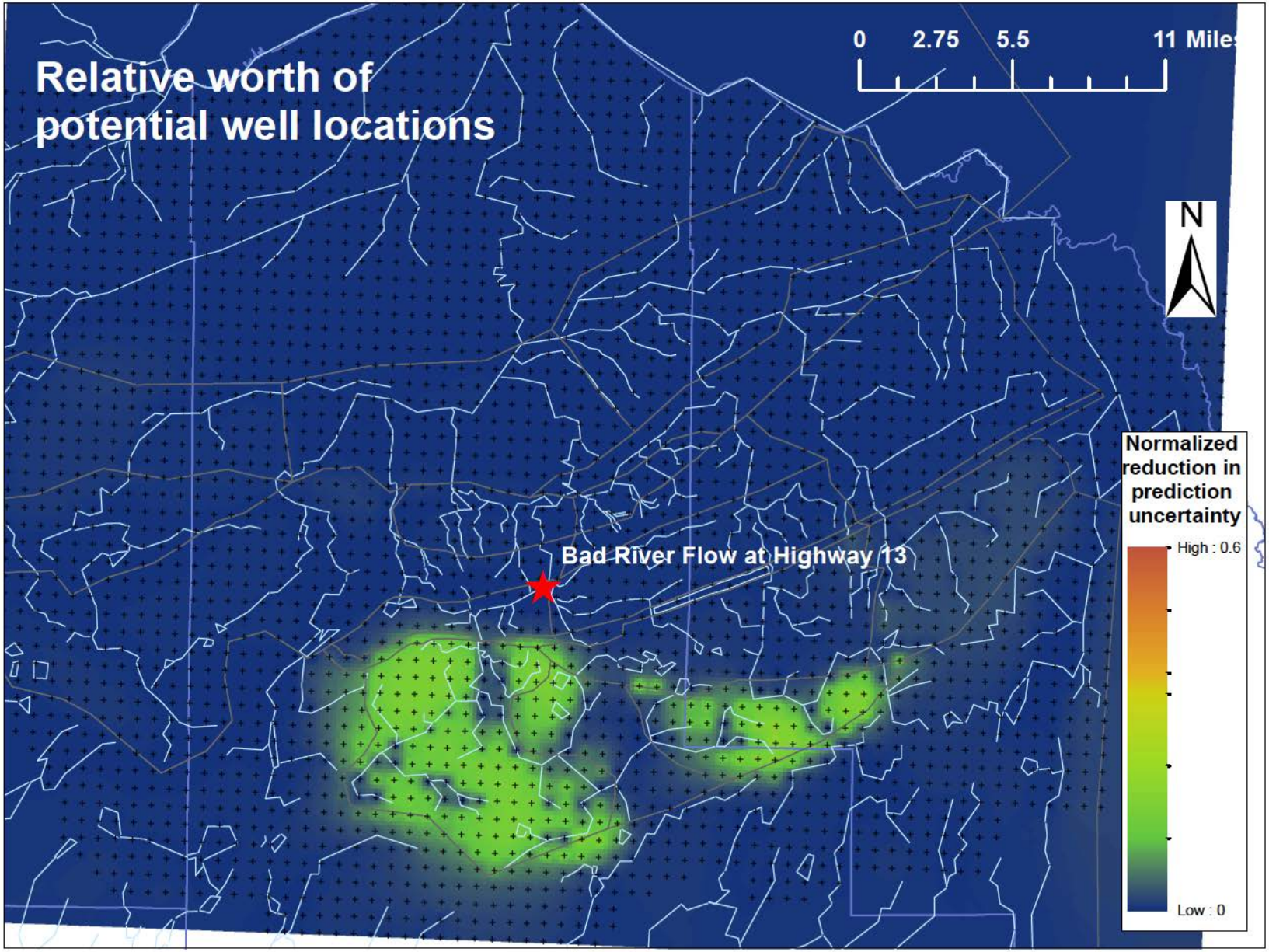
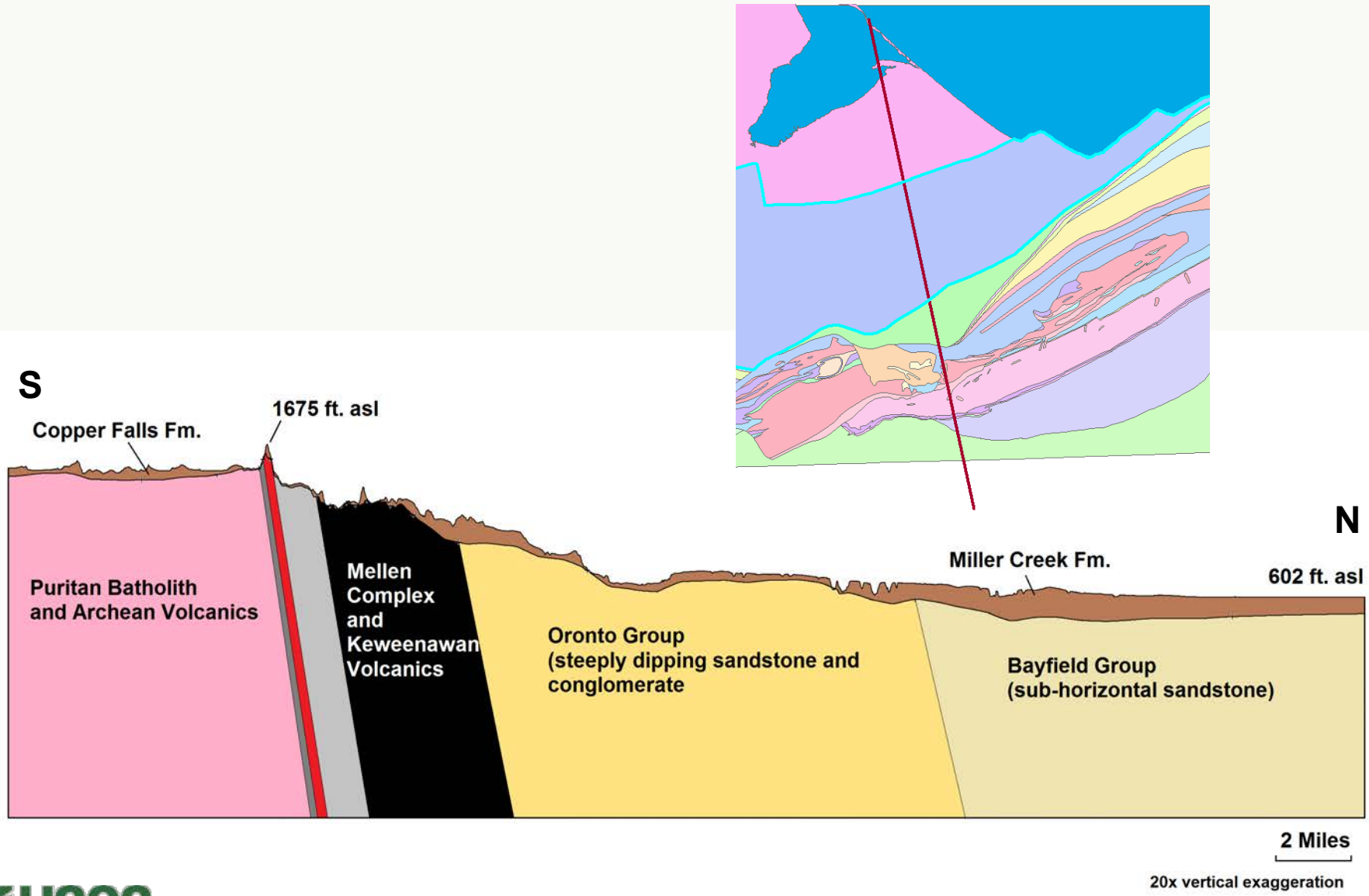
Evaluating new data worth



Geologic Setting



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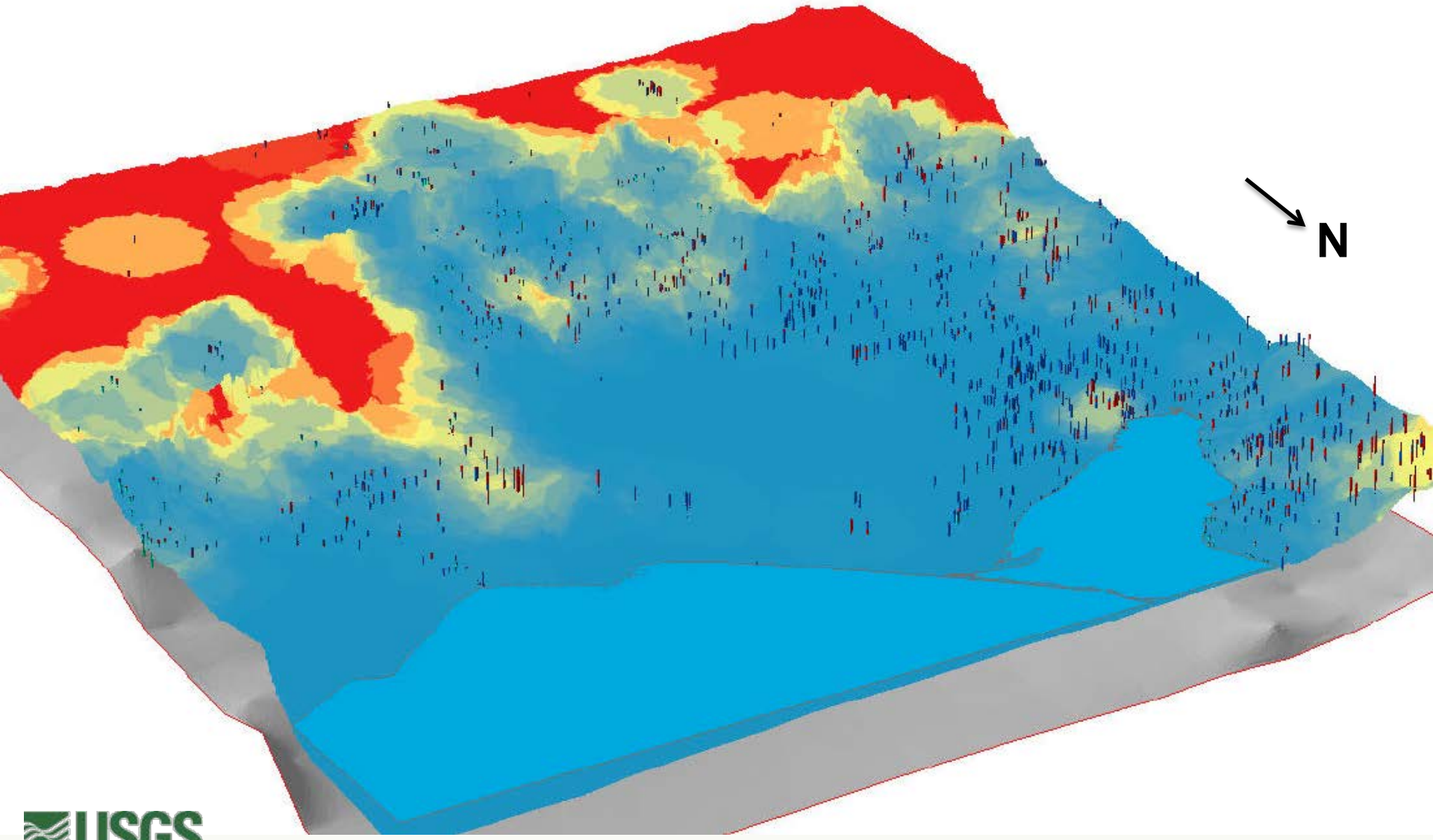
3D MODFLOW model – Layer 1 hydraulic conductivity



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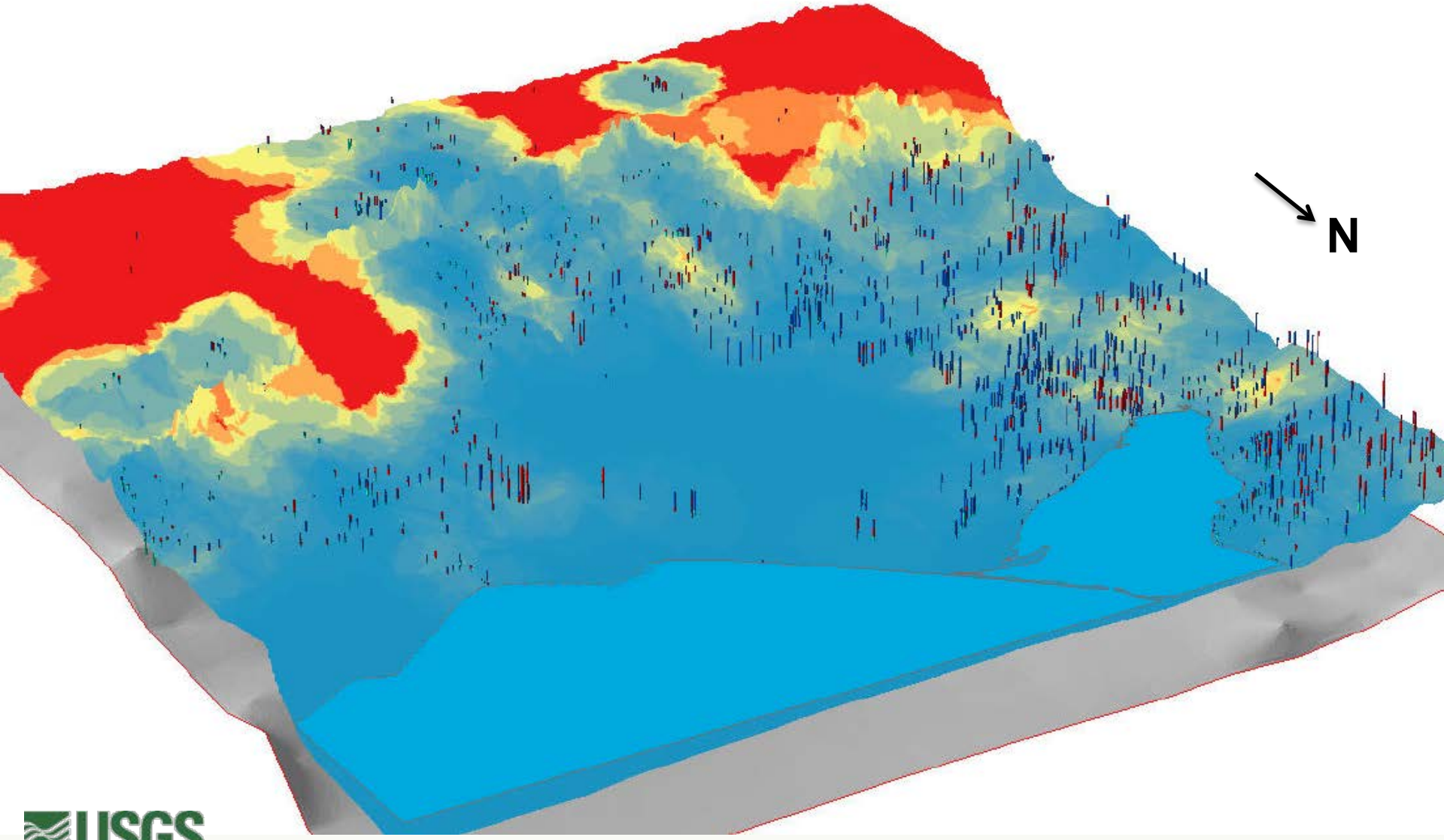
3D MODFLOW model – Layer 2 hydraulic conductivity



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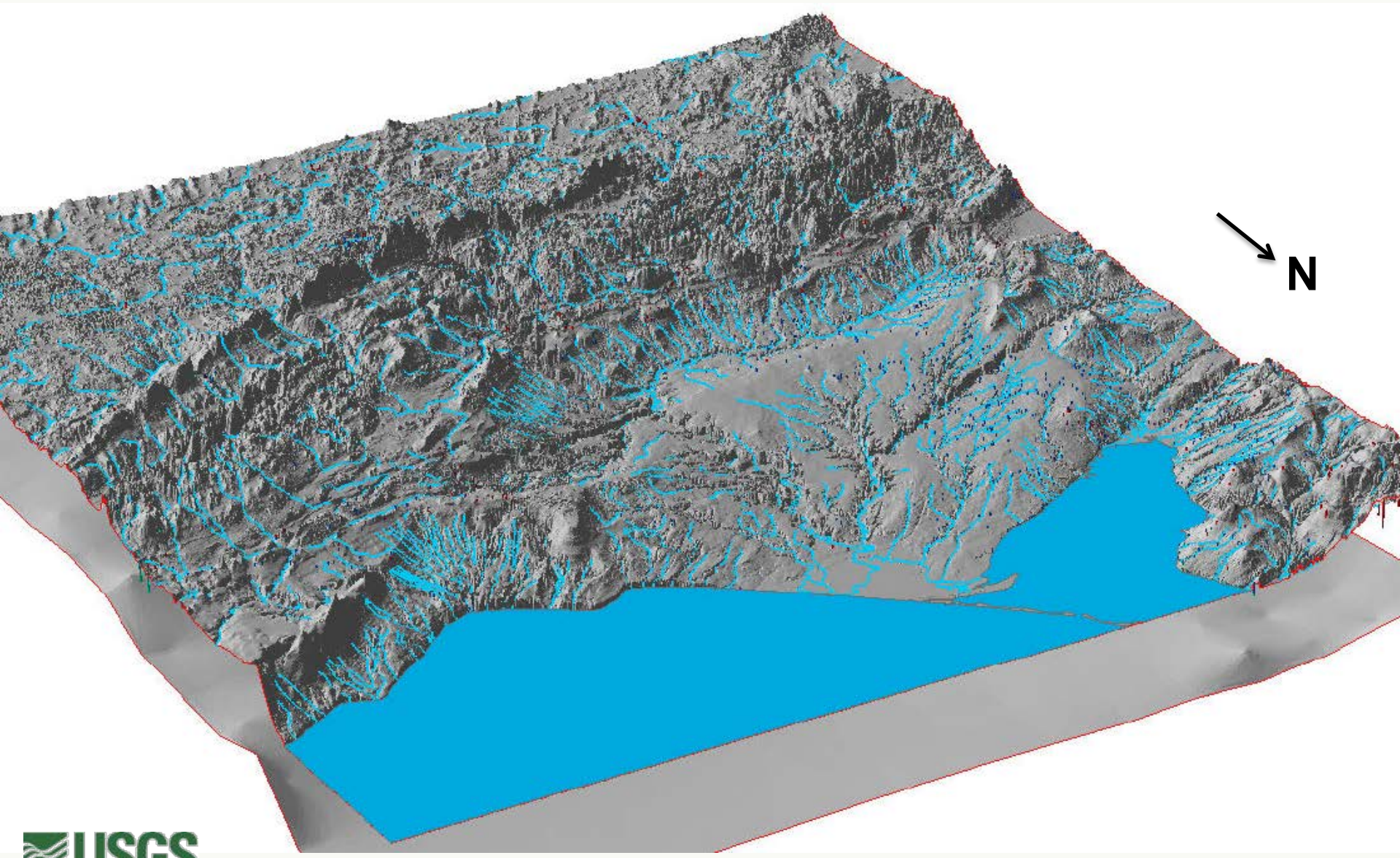
3D MODFLOW model – streamflow routing



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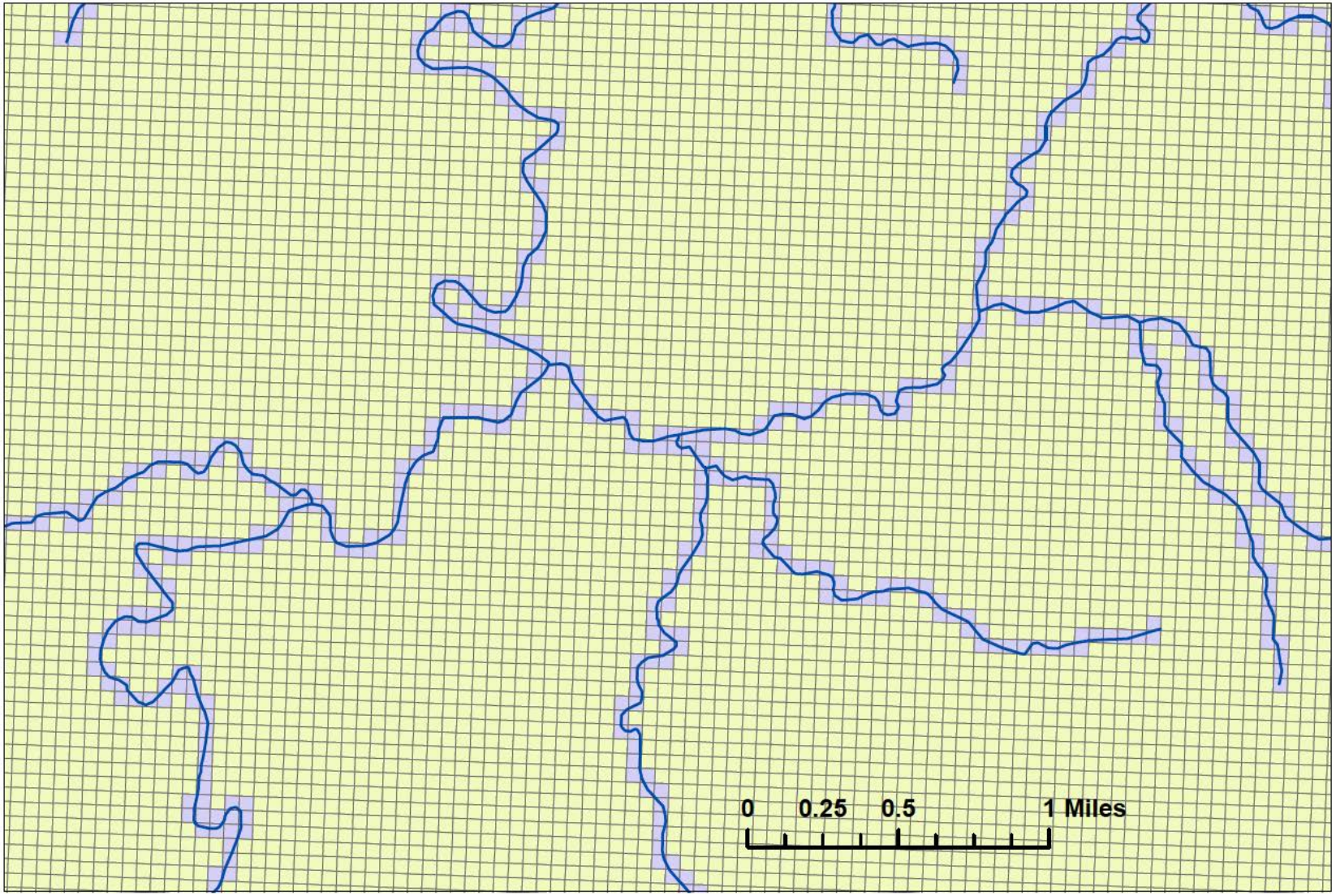
Streamflow Routing



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Fractures!

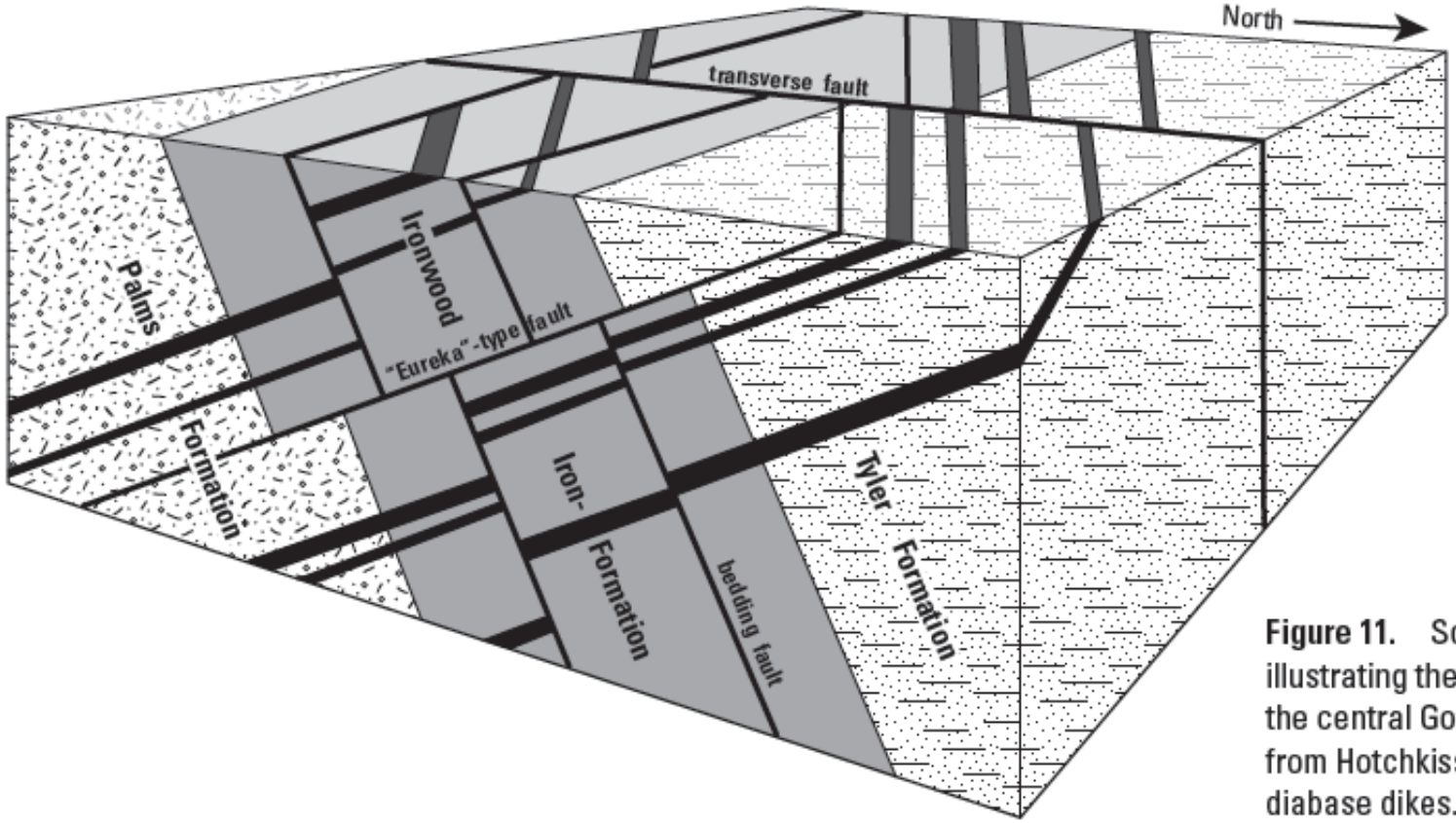

Figure 11. Schematic block diagram illustrating the geometry of fault sets in the central Gogebic iron range. Simplified from Hotchkiss (1919). Black units are diabase dikes.

From Cannon et al. 2008

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Upcoming work

Finish and calibrate MODFLOW model

Additional field data collection

- -baseflow measurements
- -water levels
- -additional wells?
- -DTS??

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Questions?

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References

Cannon, W.F., LaBerge, G.L., Klasner, J.S., and Schulz, K.J. 2007, The Gogebic iron range—a sample of the northern margin of the Penokean fold and thrust belt: U.S. Geological Survey Professional Paper 1730, 44 p.

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Data sources

Data type		Source:
Model input	Surficial Geology	GIS data from the USGS (Open File Report 99-546)
		GIS data from WGNHS (digitized from Quaternary Geologic Maps of the U.S.)
		Lake Superior bathymetry from NOAA (http://www.ngdc.noaa.gov/mgg/greatlakes/superior.html)
	Subsurface Geology	WGNHS Well Construction Reports
		GIS data from USGS (Misc. Field Studies Map 1174)
	Elevation	National Elevation Dataset 30m DEM
	Soil/Land surface hydrology	USDA and USGS GIS datasets
	Climate	NWS Temperature and Precip records from Mellen Airport
	Streams and Lakes	GIS data and tables from National Hydrologic Dataset (NHDPlus v2)
Calibration	Water Levels	National Water Information System (NWIS) database
		Reservation Wells
		WGNHS Well Construction Reports
		Field Observations
	Streamflow	NWIS
		Seepage Runs

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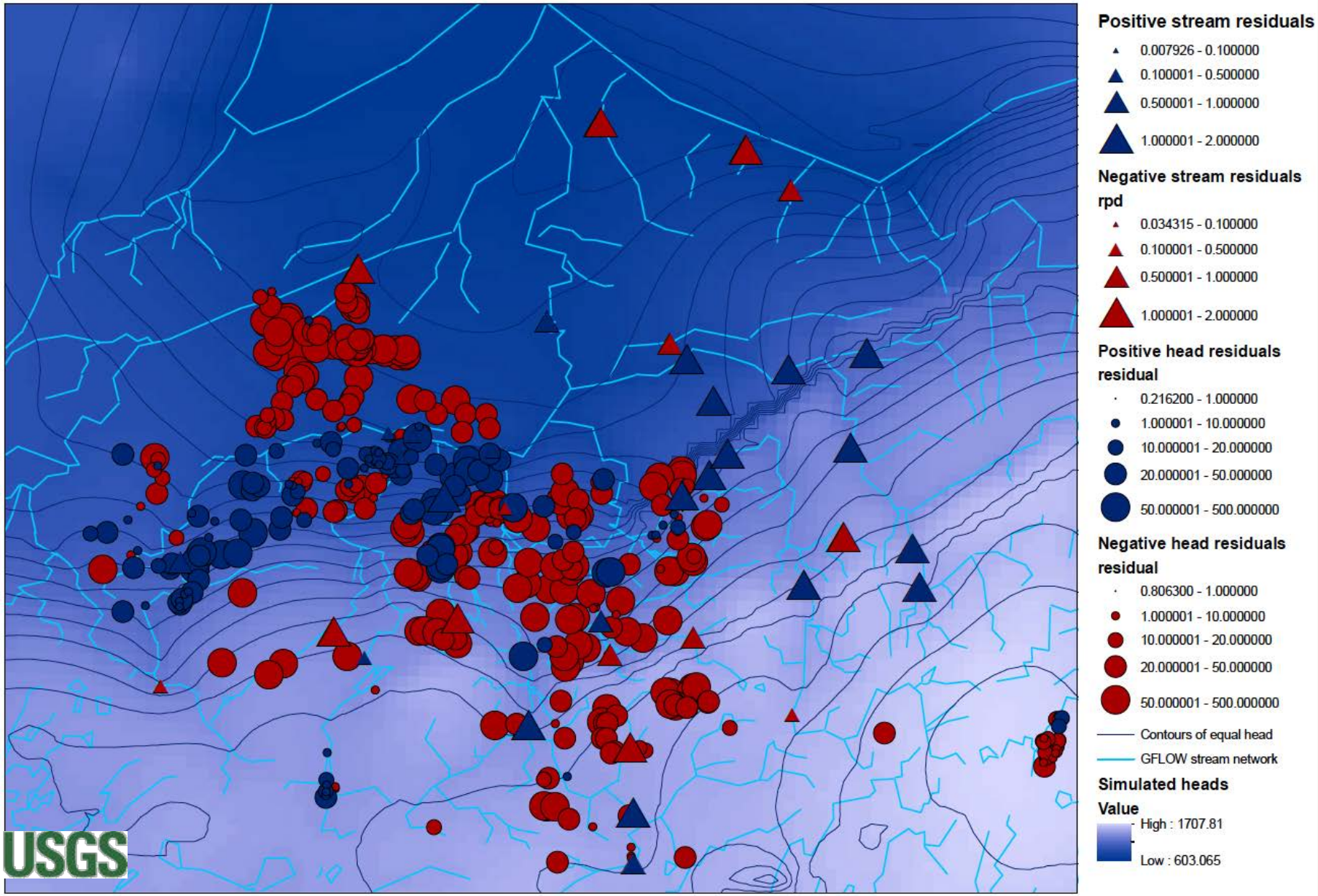
Early screening model calibration results



Streamflow Routing – NHDPlus data utilized

NHDSnapshot	NHDFlowline	GIS line features representing streams
NHDPlusAttributes	Elevslope	Min/Max elevations for each segment
	PlusFlowlineVAA (Value Added Attributes)	Value Added Attributes, including segment lenth, arbolate sum, stream order, hydrosequence numbering, and codes describing the feature type
	PlusFlow	Routing Information

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