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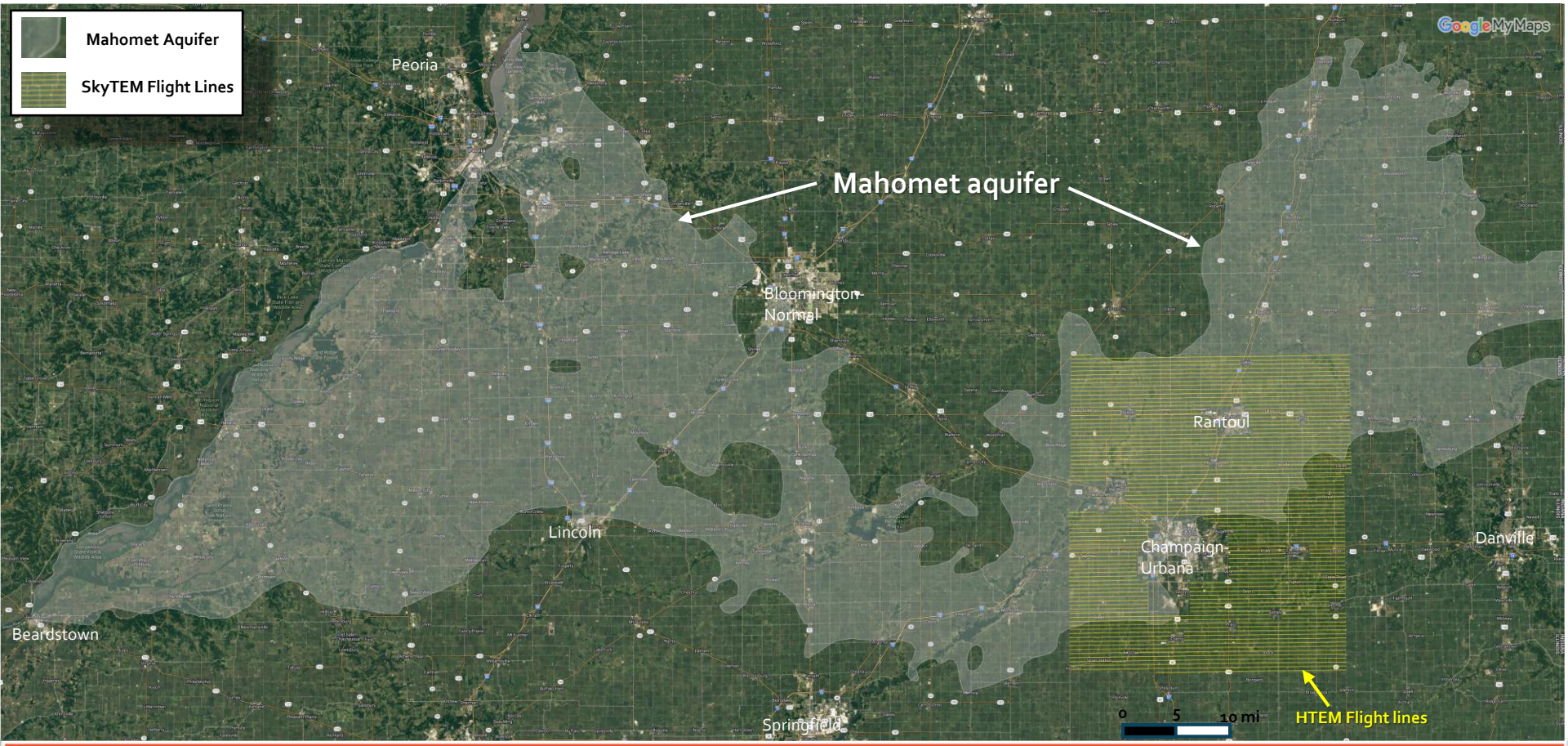
Geophysical Mapping of the Mahomet Aquifer using Airborne Electromagnetic Method



Kisa Mwakanyamale Gilkie, Ph.D.
kemwaks@illinois.edu
217-265-0528

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Donald A. Keefer, Jason F. Thomason, Steven Young, and Andrew J. Stumpf

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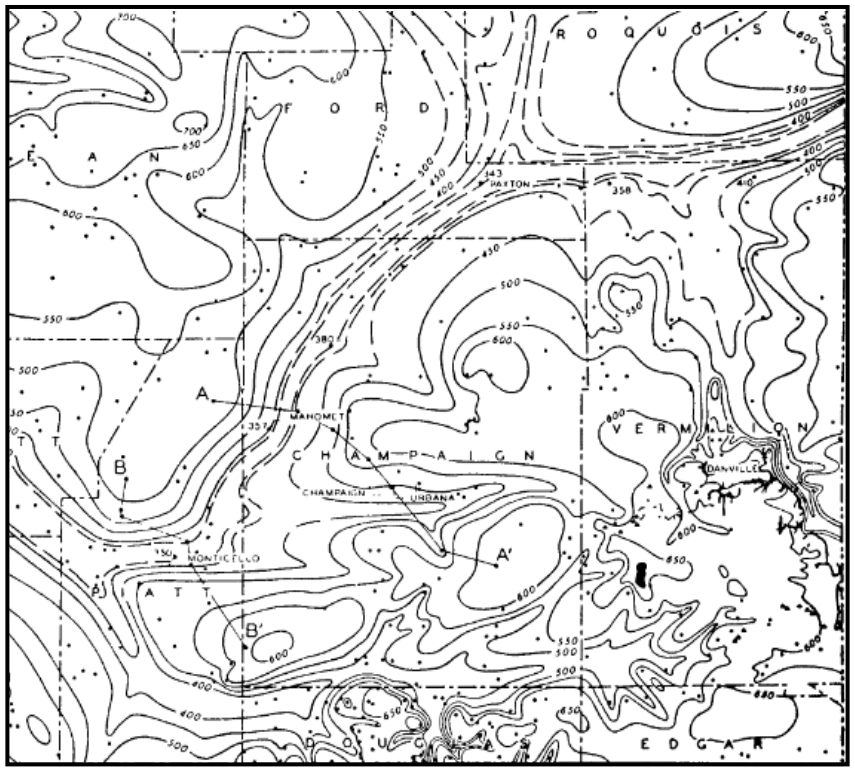
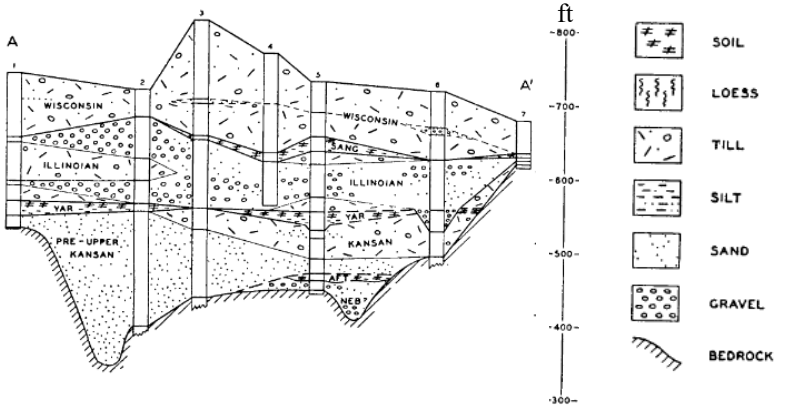
Acknowledgements

- Champaign County Board
- Champaign County 1st
- Local Leaders
- Local Advocacy groups
- State and Federal legislators
- Scientists across PRI
- Students! UIUC and ISU!
- Many motivated citizens

Mahomet Bedrock Valley (MBV)



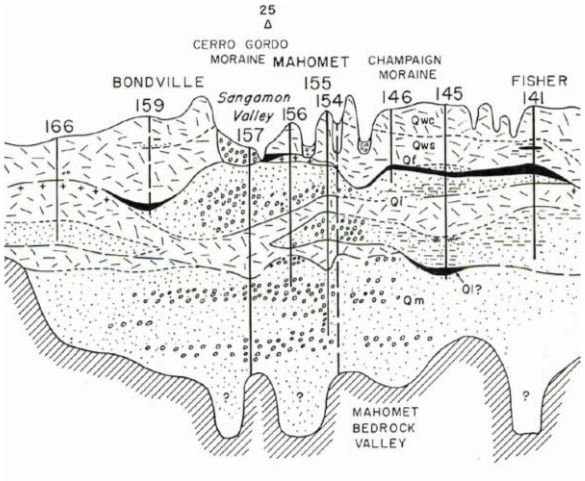


Map Legend

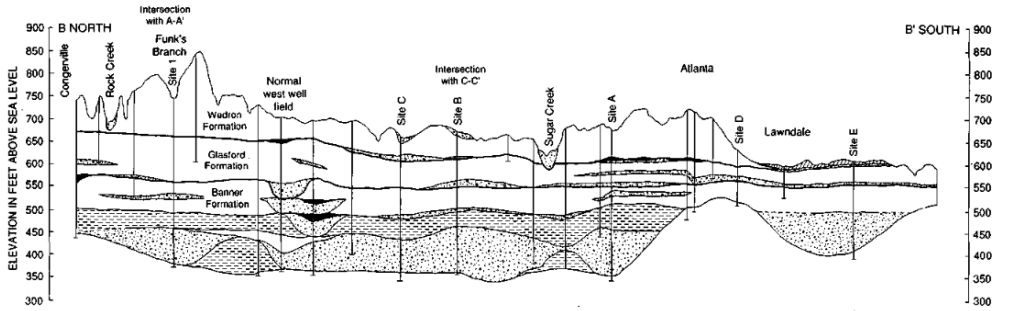
- 100 — Bedrock Elevation (50 ft interval)
- Margin of present Illinois Valley
- A — Á — Line of Cross-Section
- 288 — Well and Bedrock Elevation
- Bedrock Exposure

0 5 10 15 mi
0 8 16 24 km

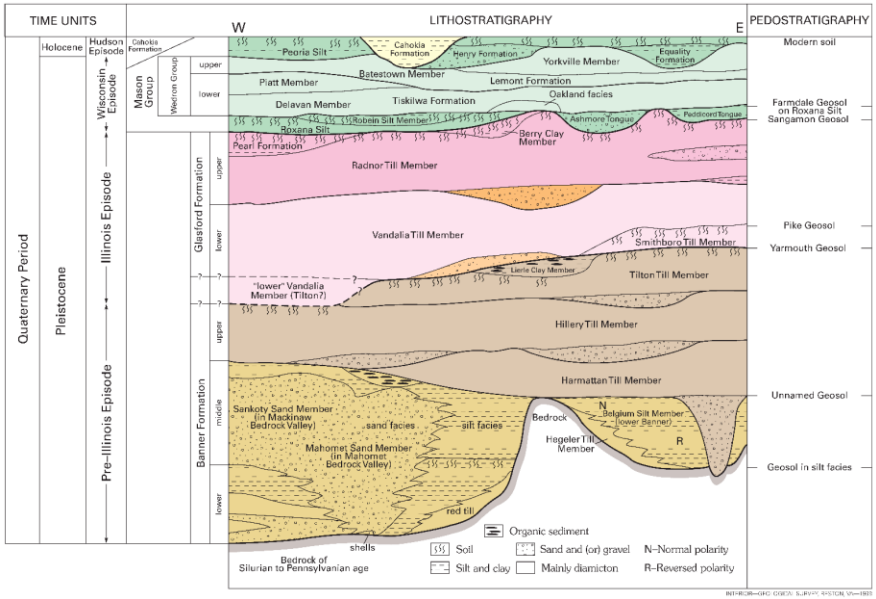
Geological Framework



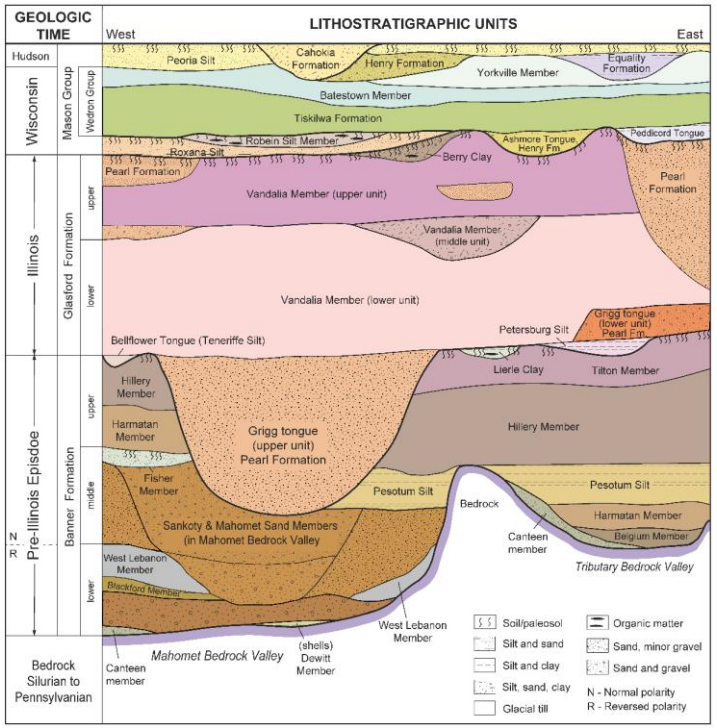
Mahomet Bedrock Valley (Horberg, 1953)



Sankoty-Mahomet (Wilson et al., 1994)

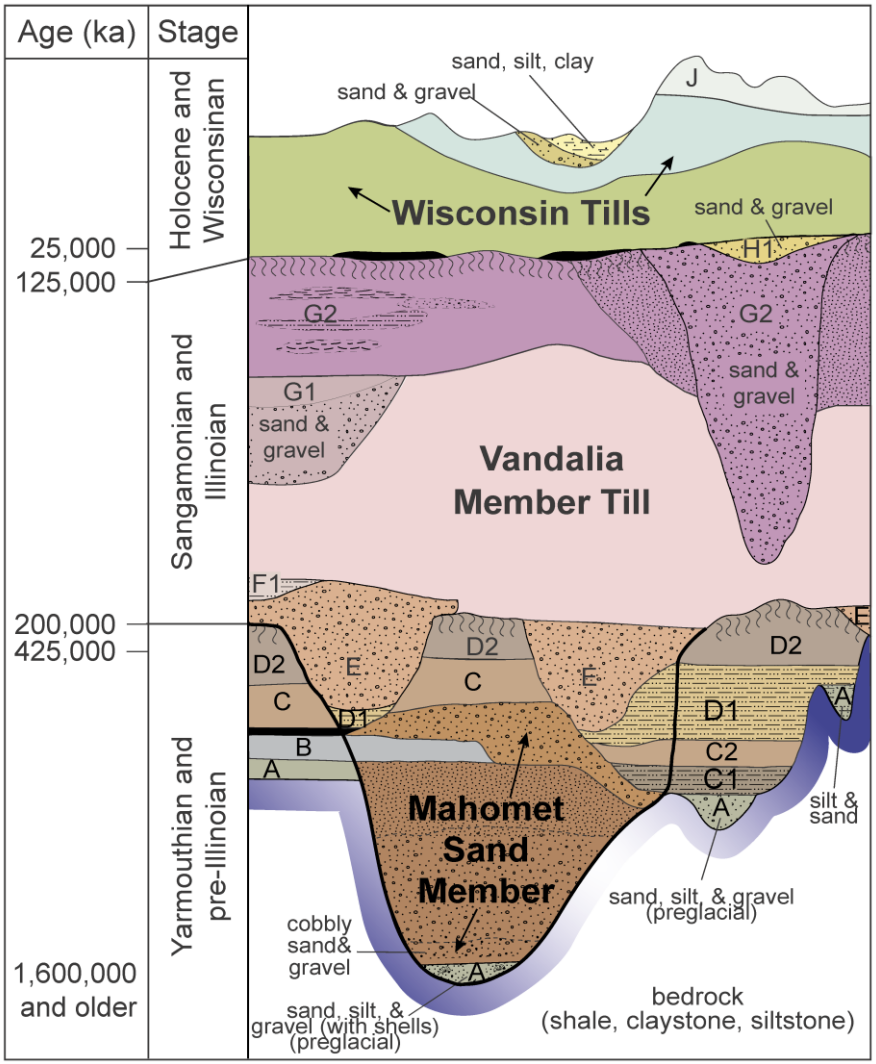


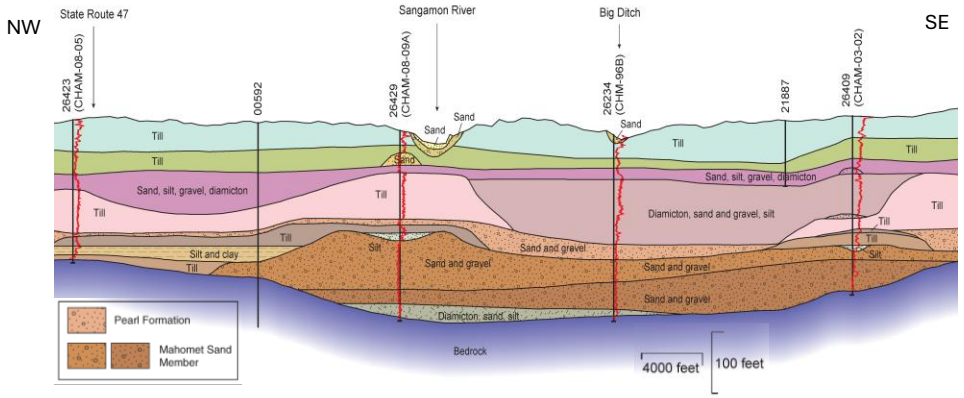
Mahomet Bedrock Valley (Soller et al., 1999); 5 boreholes

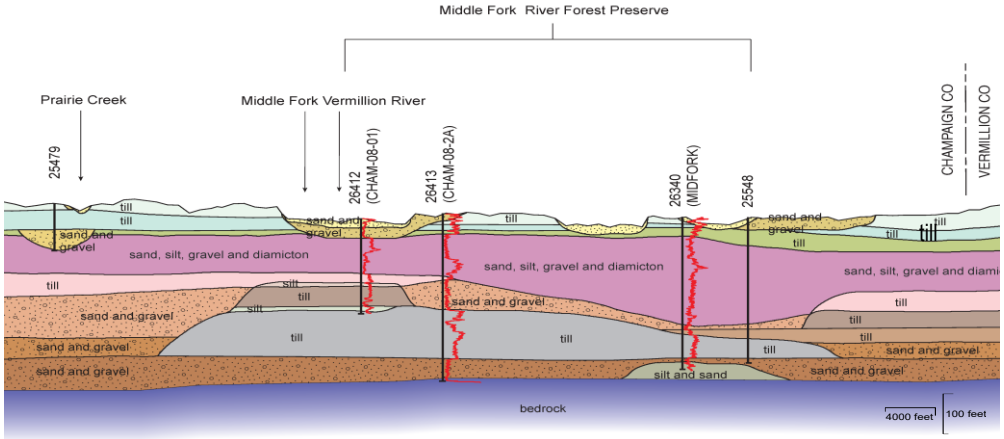


Champaign County and adjacent area (Stumpf et al., in review)
40 boreholes

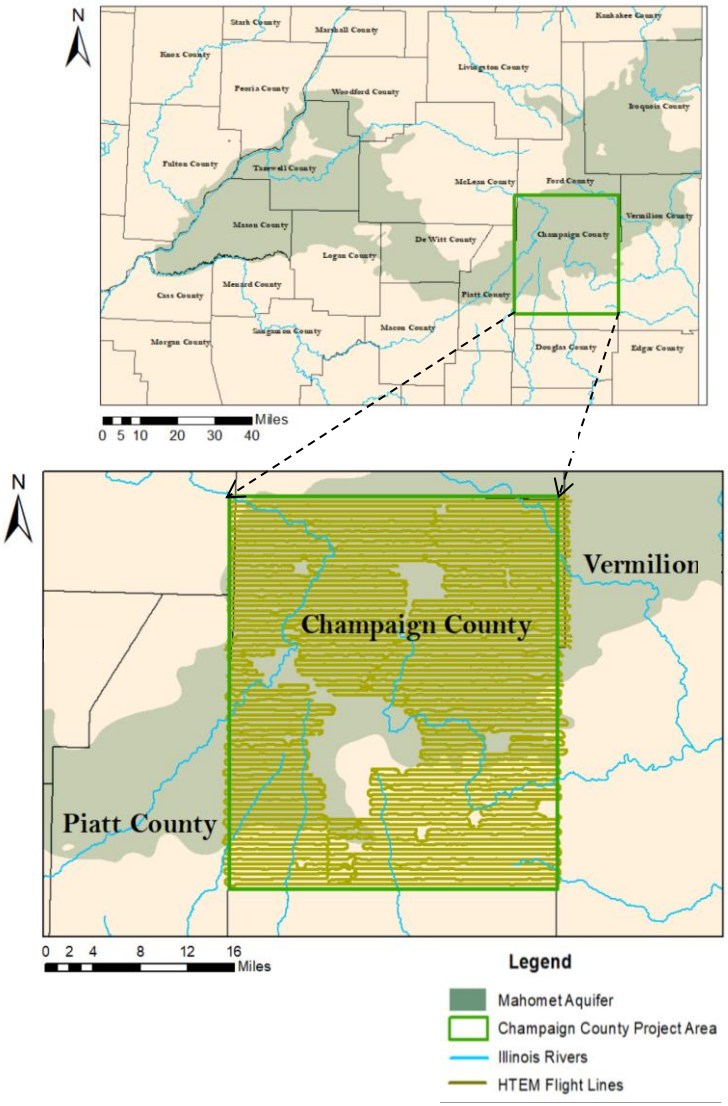
Problem


Age (ka)
Stage
Holocene and Wisconsinan
Sangamonian and Illinoian
Yarmouthian and pre-Illinoian
25,000
125,000
200,000
425,000
1,600,000 and older
sand, silt, clay
sand & gravel
J
Wisconsin Tills
sand & gravel
H1
G2
G2
sand & gravel
G1
sand & gravel
Vandalia Member Till
F1
D2
E
D2
C
E
D2
E
C
D1
D1
B
C2
A
C1
A
A
Mahomet Sand Member
silt & sand
sand, silt, & gravel (preglacial)
cobbly sand& gravel
A
sand, silt, & gravel (with shells) (preglacial)
bedrock (shale, claystone, siltstone)


NW
SE
State Route 47
Sangamon River
Big Ditch
26423 (CHAM-08-05)
00592
26429 (CHAM-08-09A)
26234 (CHM-96B)
21887
26409 (CHAM-03-02)
Till
Sand
Sand, silt, gravel, diamicton
Diamicton, sand and gravel, silt
Silt and clay
Silt
Sand and gravel
Diamicton, sand, silt
Bedrock
Pearl Formation
Mahomet Sand Member
4000 feet
100 feet


Middle Fork River Forest Preserve
Prairie Creek
Middle Fork Vermillion River
25479
26412 (CHAM-08-01)
26413 (CHAM-08-2A)
26340 (MIDFORK)
25548
CHAMPAIGN CO
VERMILLION CO
till
sand and gravel
sand, silt, gravel and diamicton
silt and sand
bedrock
4000 feet
100 feet

Project Goals



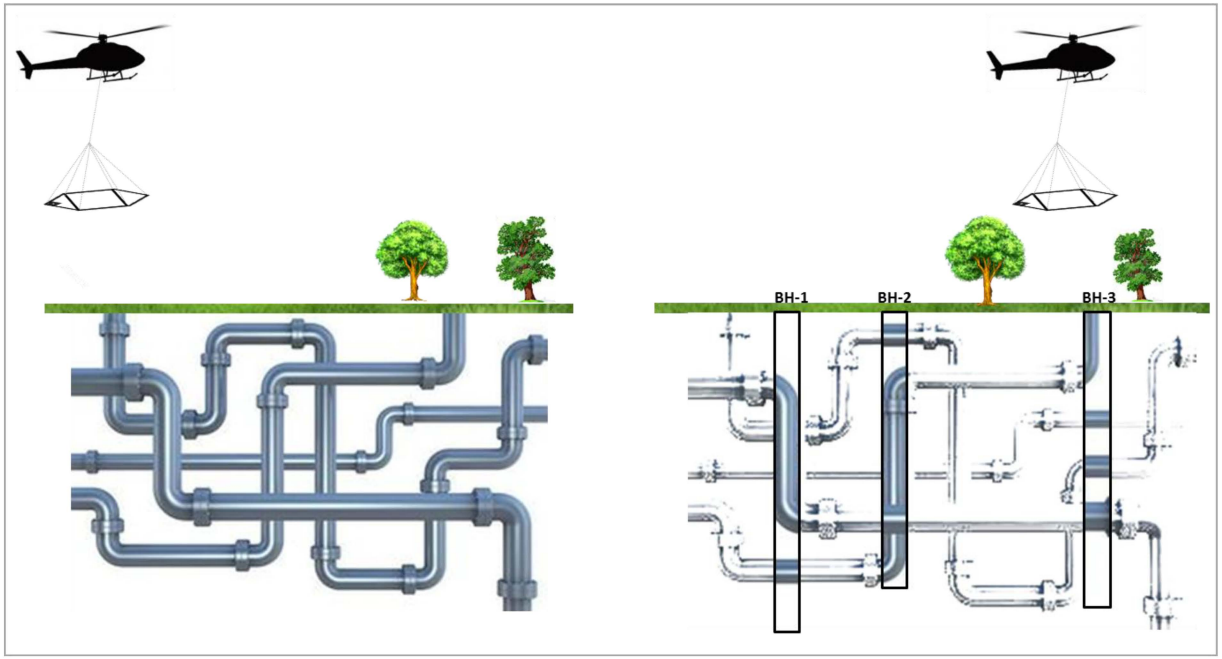
1. **Improve delineation of the Mahomet aquifer boundary**
   - Aquifer boundary
   - Aquifer characteristics

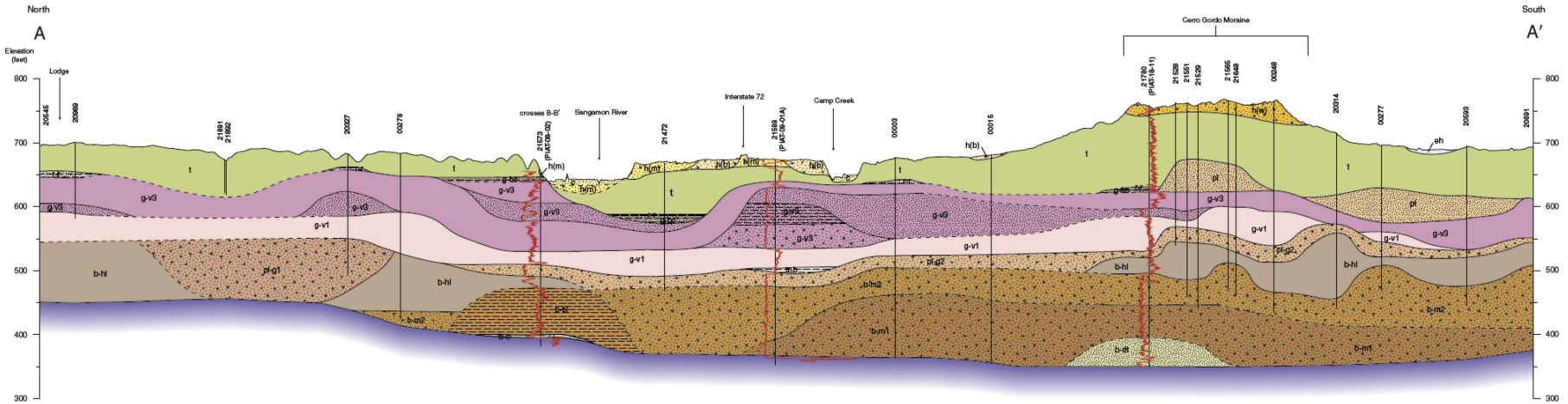
2. **Better define extent of aquifer and non-aquifer units**
   - Define characteristics of the aquifer and non- aquifer materials
   - Bedrock lithology (shale, carbonate, both?)
   - Bedrock structures (folds, faults, etc)
   - Bedrock surface topography

3. **Develop a 3-D geological model of the Champaign County and create an updated geological framework**

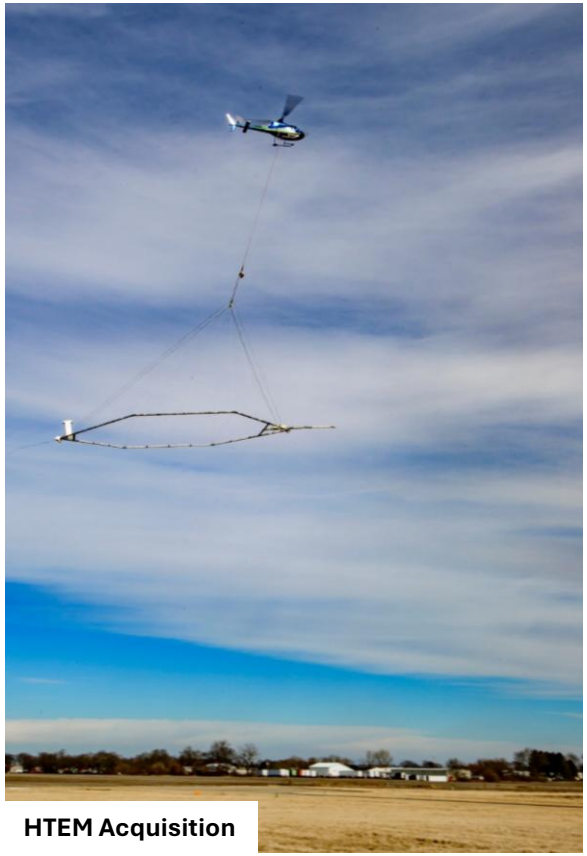
4. **Provide the Illinois State Water Survey with geologic information for use in developing a groundwater flow model.**

Methods - Integrated Approach



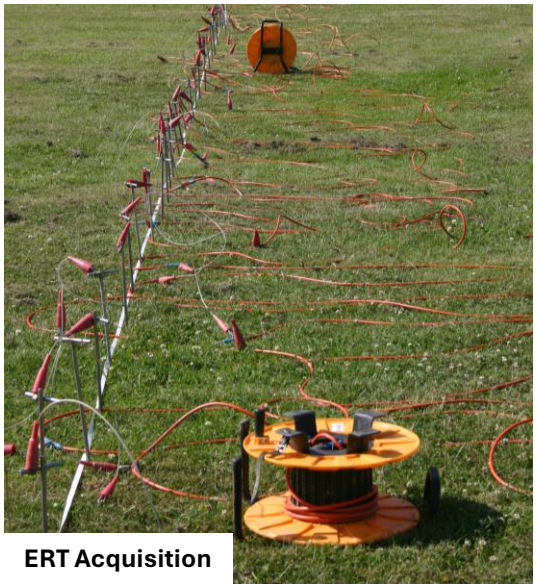


Integrated Approach - Methods



HTEM Acquisition

HVSR Acquisition



ERT Acquisition

Describing core

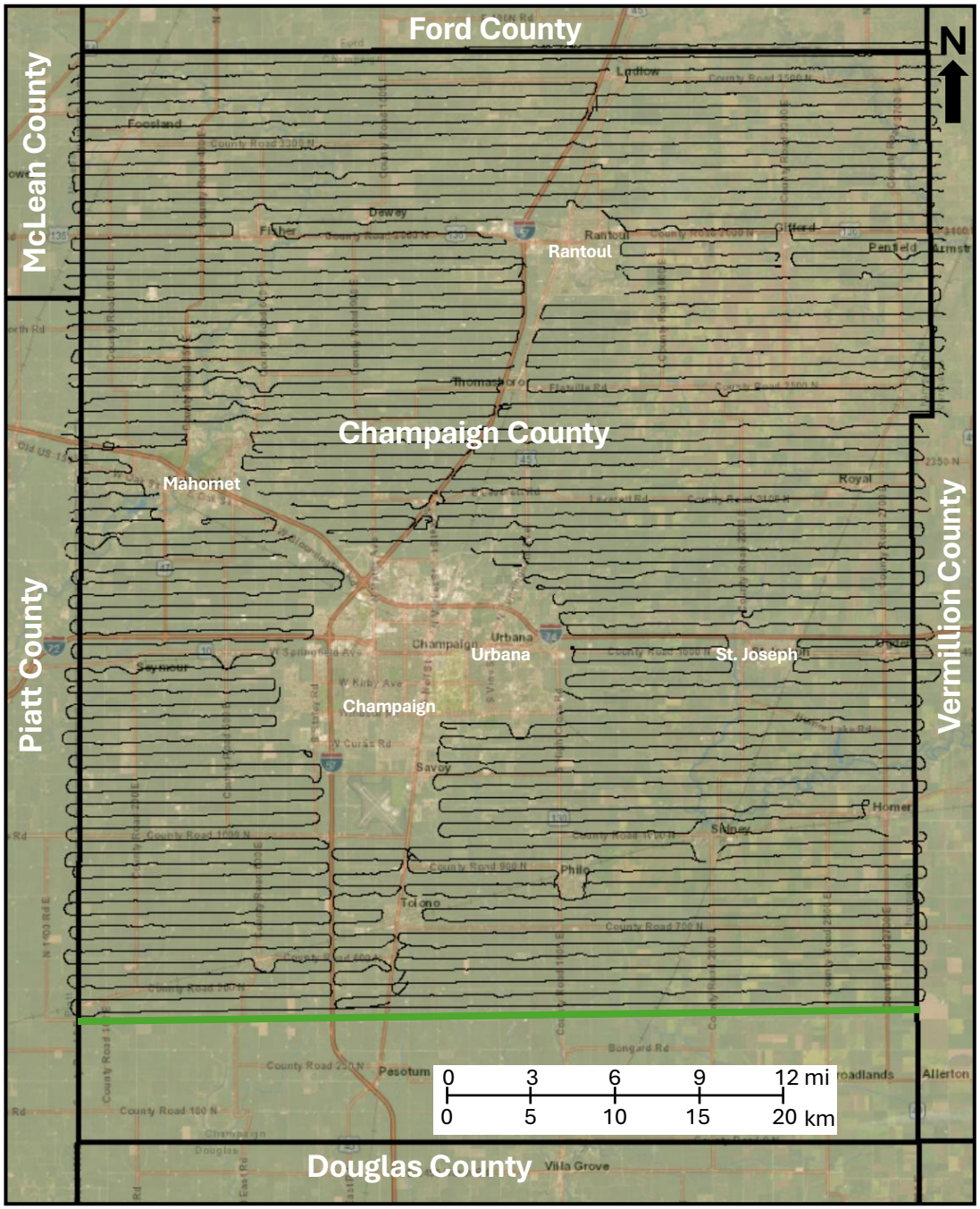
ISGS drilling rig system

Partial Core

Acquired HTEM Data

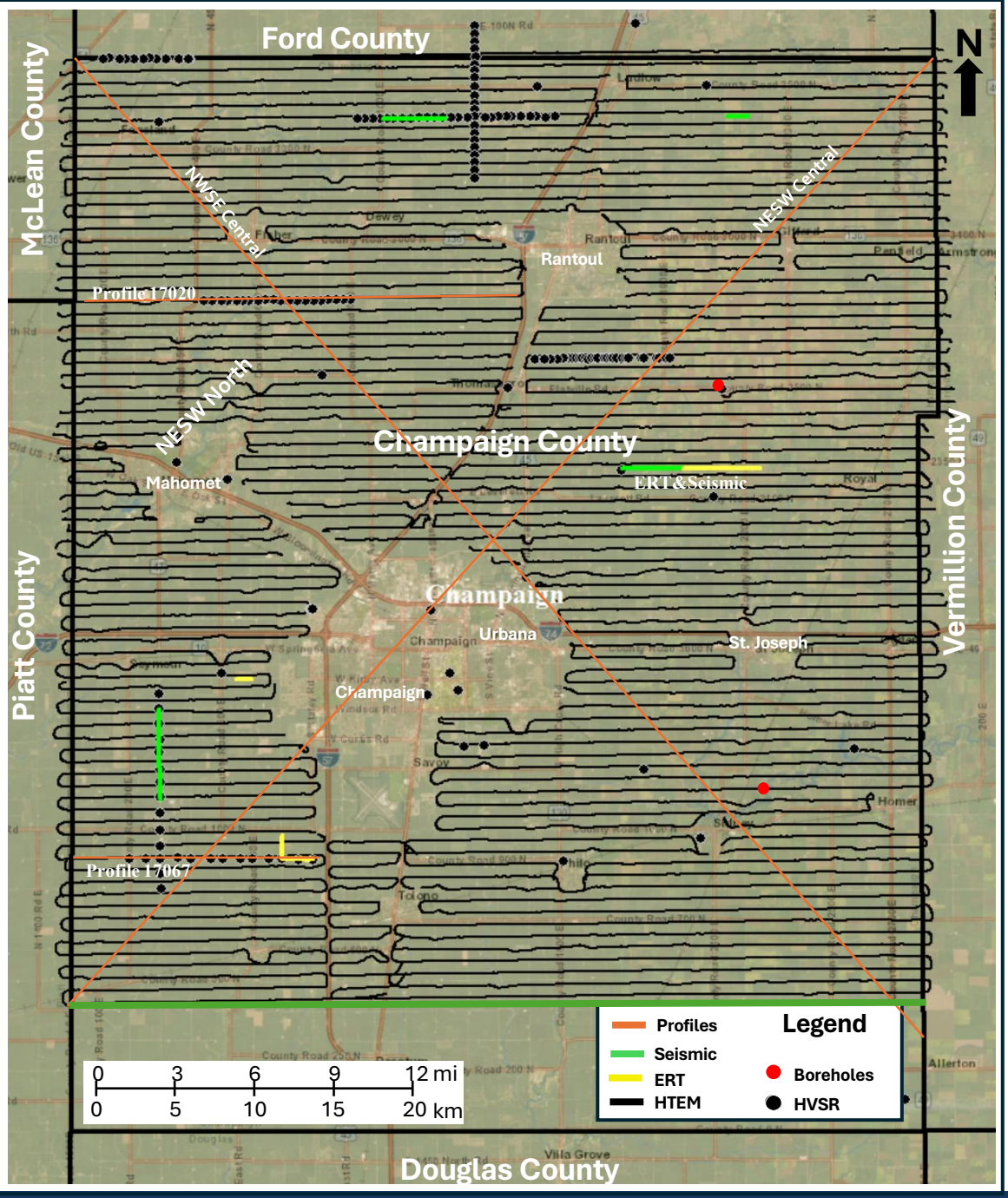
Acquired highest resolution HTEM data

- E-W transects
- ~ 3,145 km (1,954 miles) of HTEM
- 650 m (2132 ft) flight line spacing
- DOI ~300 meters (1000 feet)

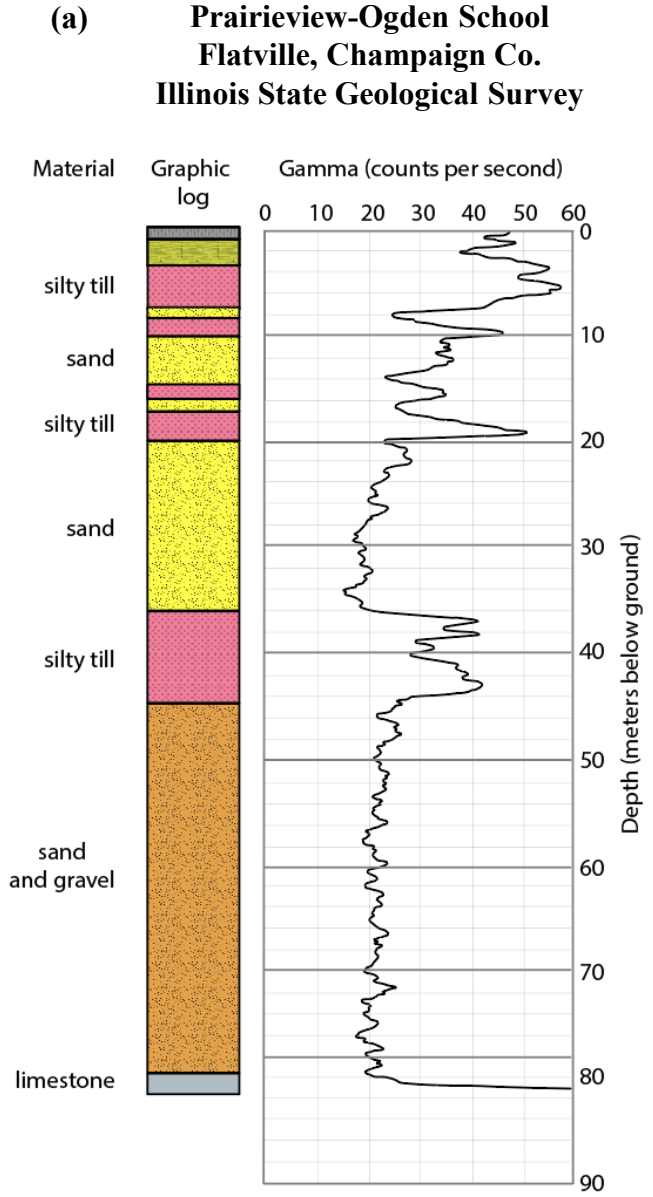


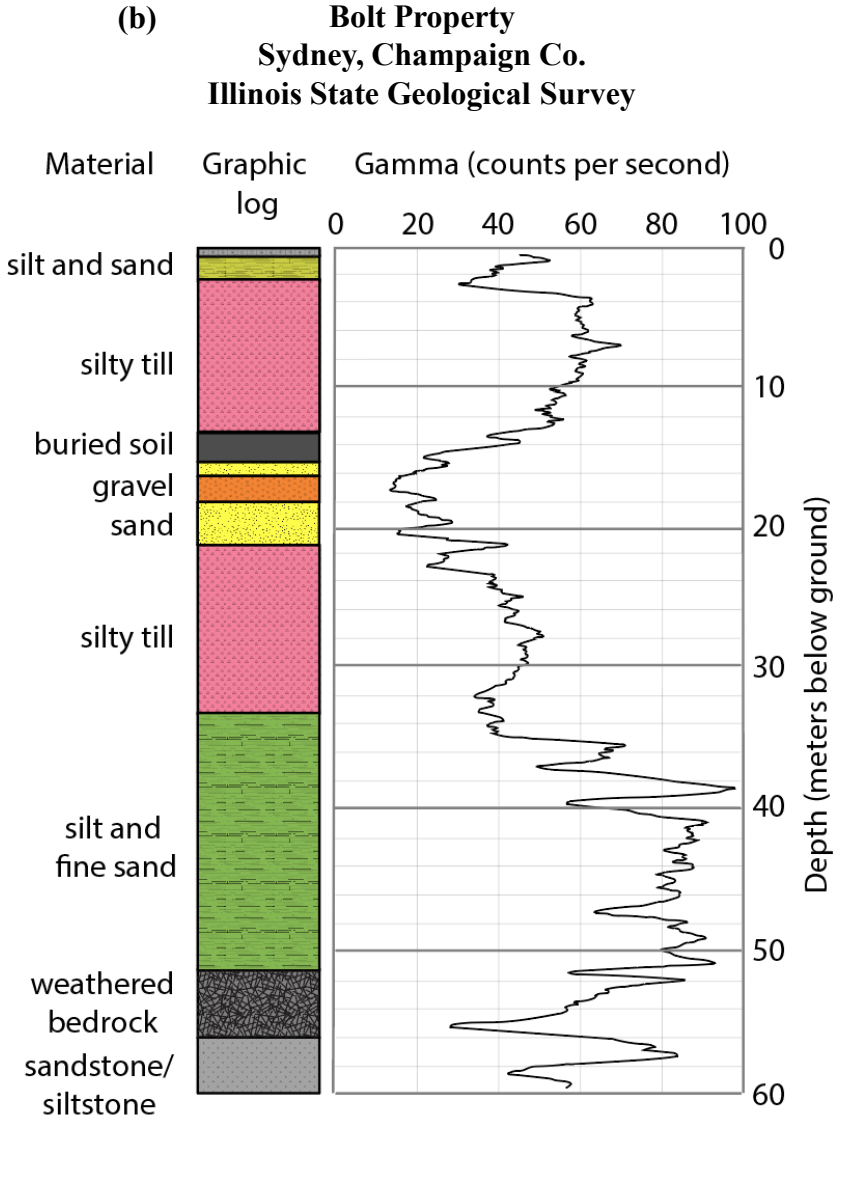
Other Acquired Data

1. **ERT Data**
   - 6.9 km (4.3 miles) of ERT data
2. **Seismic Data**
   - 15.66 km (9.72 miles) of seismic reflection data
3. **HVSR Data**
   - 180 HVSR points
4. **Boreholes**
   - 2 Boreholes

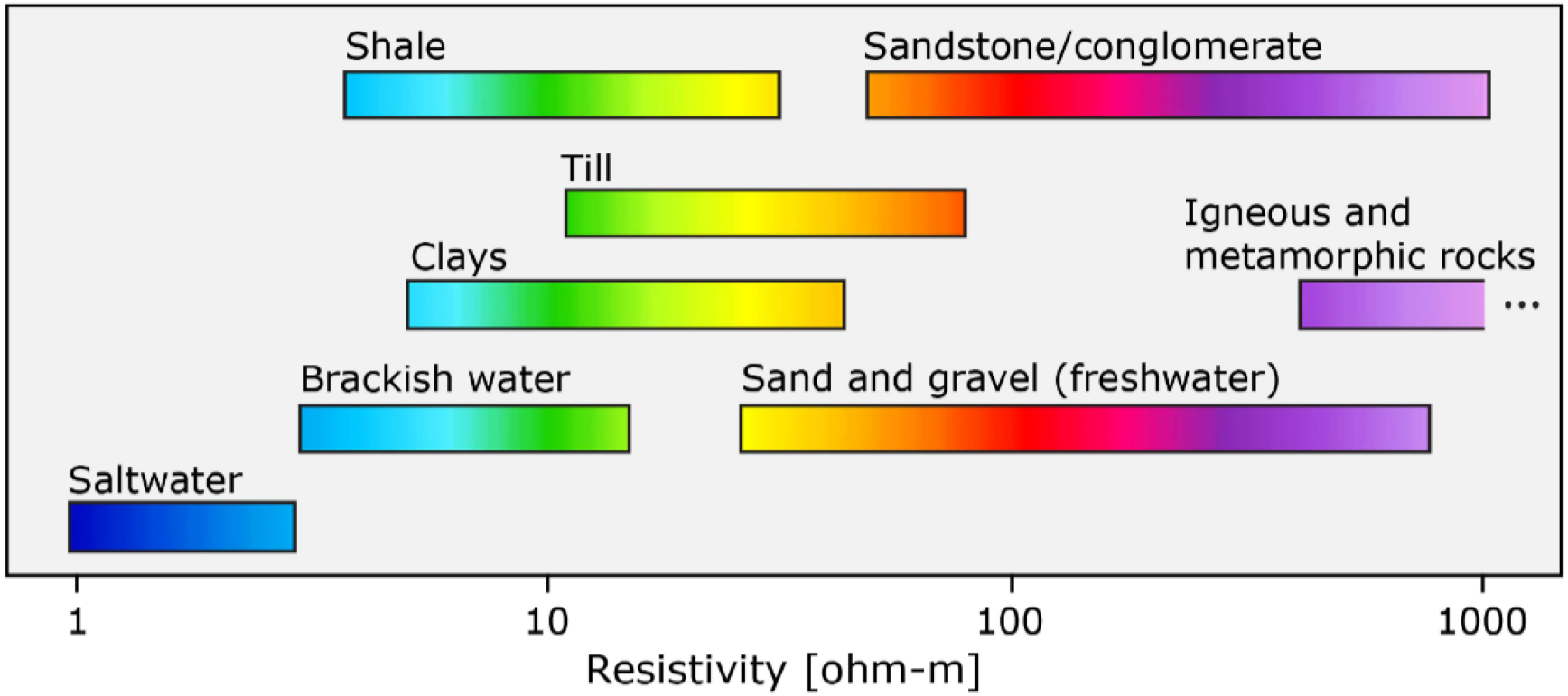


Drilling Results

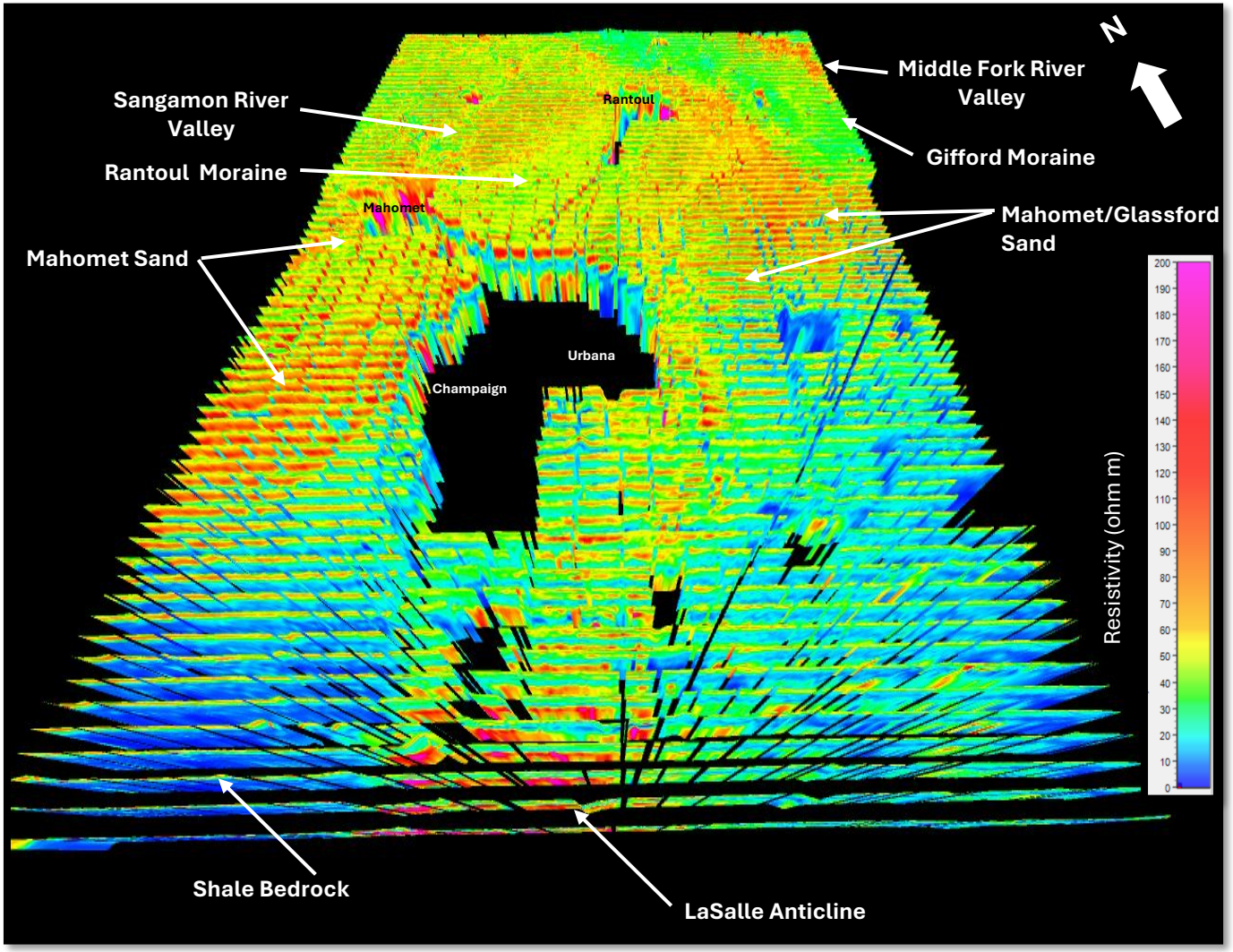




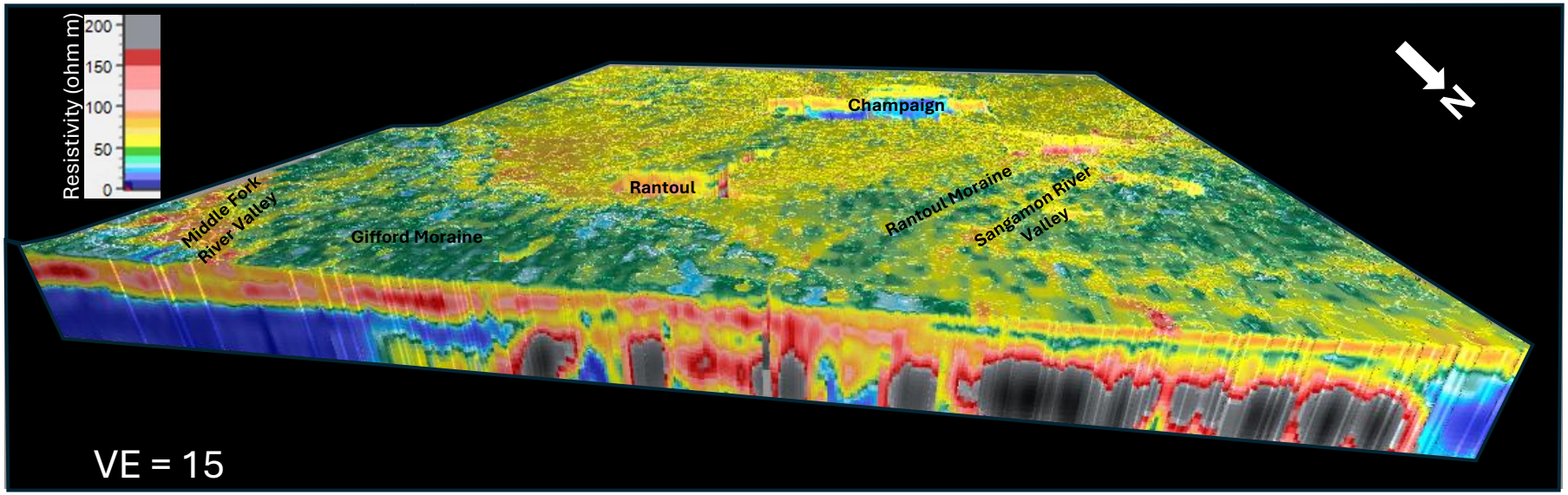
Resistivity of Geologic Materials



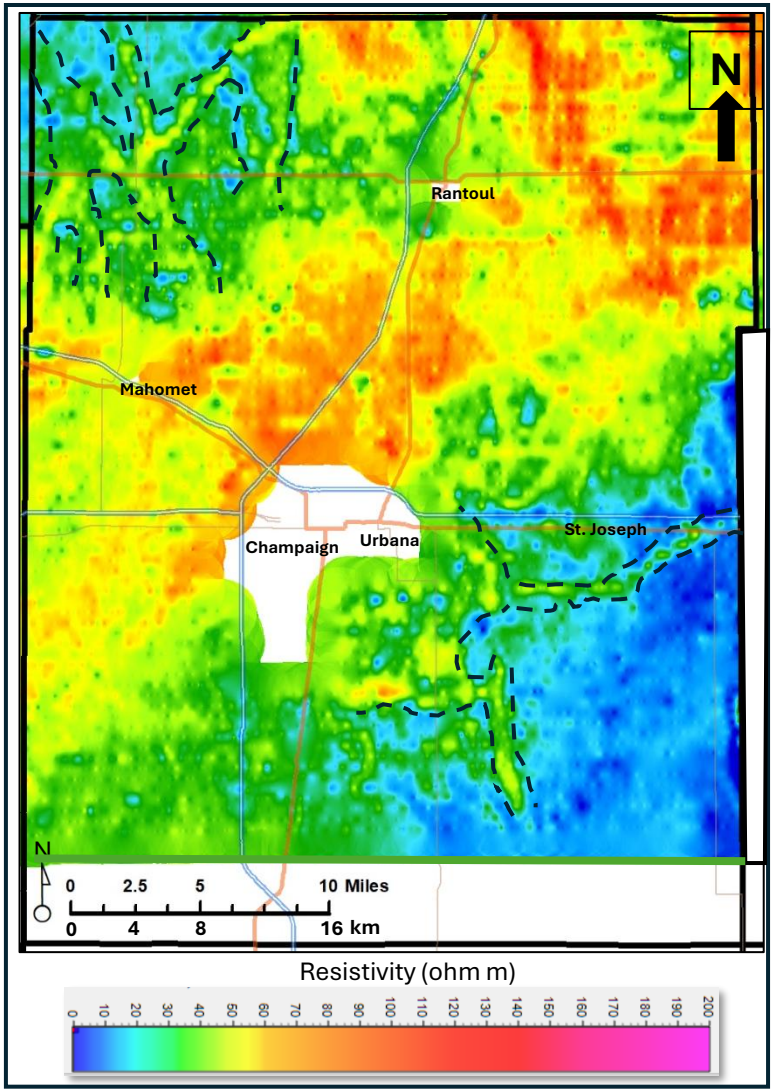
HTEM Results – Fence Diagram



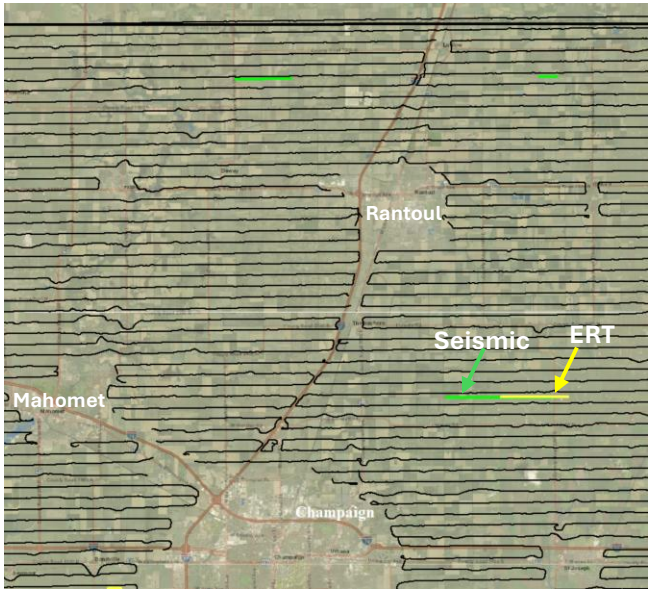
HTEM Results - 3-D Cube



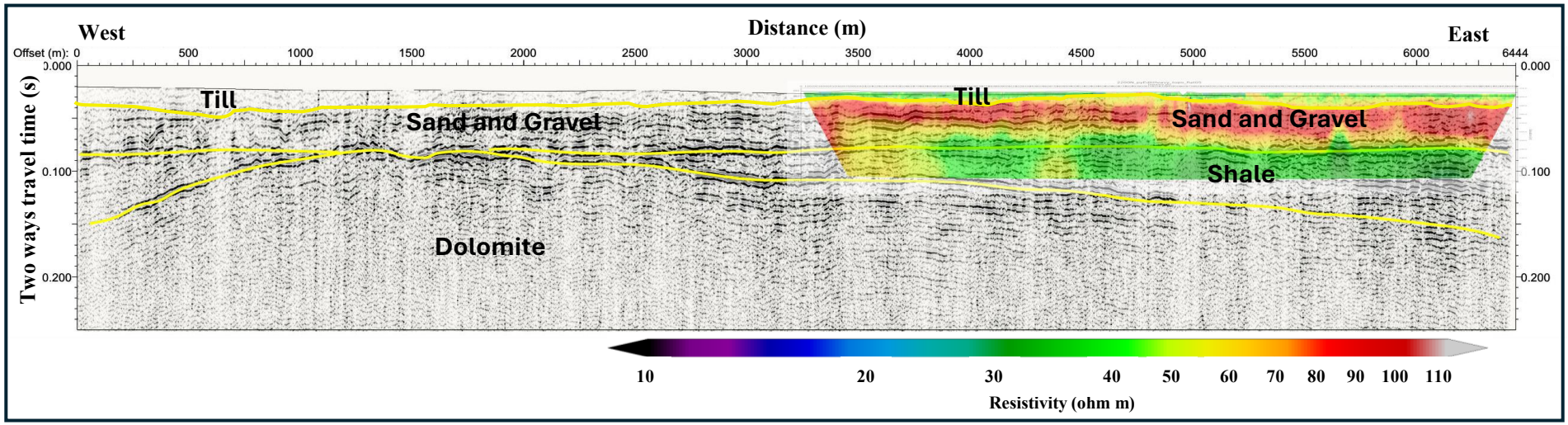
HTEM Results – Horizontal Slice



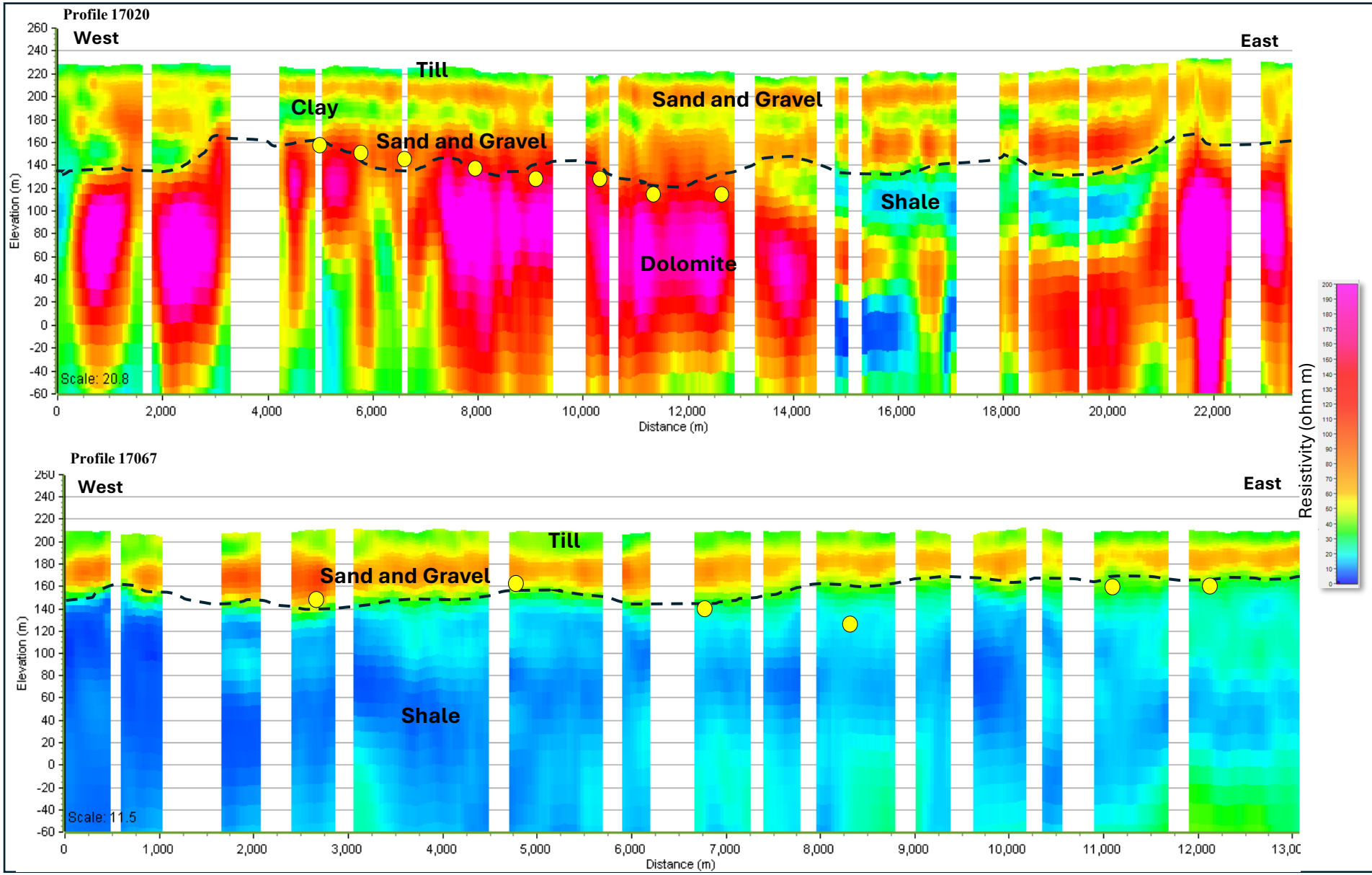
HTEM Results on Seismic Cross Section



- ERT is limited in the depth of investigation compared to Seismic surveys
- Imaged four seismic units and three ERT units
- Folded strata associated with the LaSalle Anticlinorium



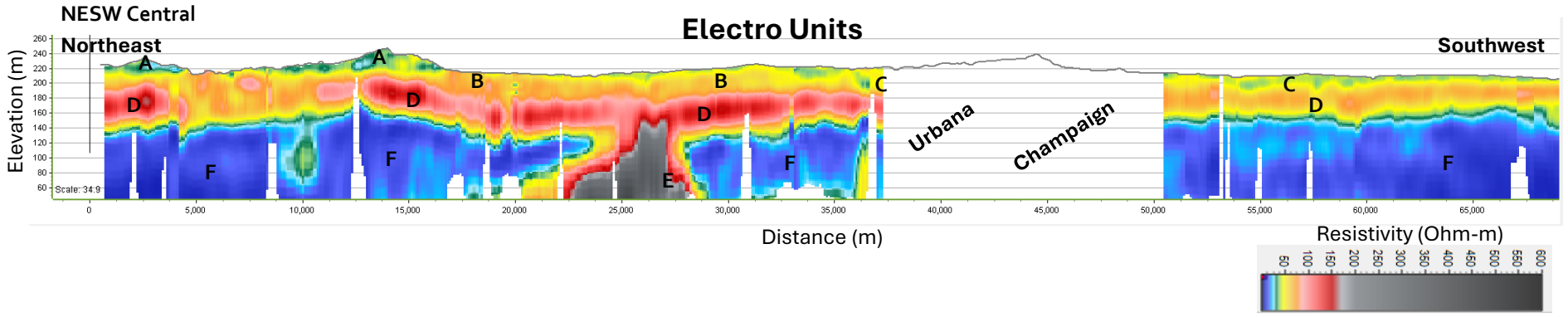
HTEM and HVSR Results

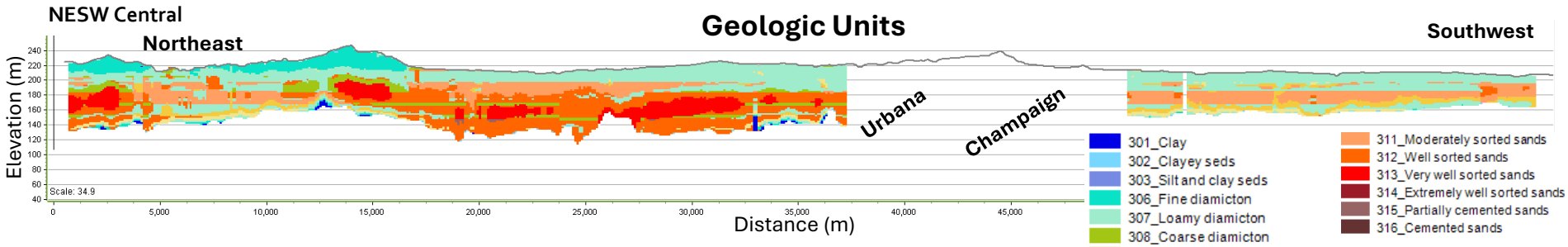


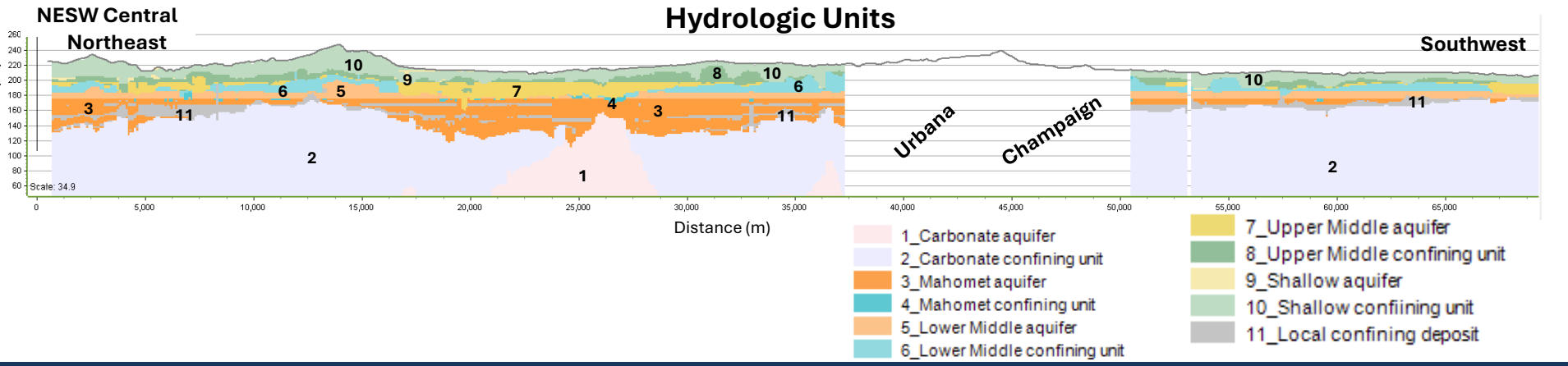
Electro Units to Material Type

Resistivity Range (ohm m)	Lithologic Material Type	Hydrologic Material Type
1 - 15	Shale	Shale Confining Unit
15 - 20	Clay; Shale; Weathered Shale	Clayey Confining Unit; Shale Confining Unit
20 - 35	Clay; Clayey Sediments; Silt and Clay Sediments; Fine Diamicton; Loamy Diamicton; Weathered Shale	Clayey Confining Unit; Shale Confining Unit
35 - 45	Silt and Clay Sediments; Fine Diamicton; Loamy Diamicton; Very Poorly Sorted Sands; Weathered Shale	Clayey Confining Unit; Leaky Clayey Confining Unit; Shale Confining Unit
45 - 55	Silty Sediments; Loamy Diamicton; Poorly Sorted Sands; Coarse Diamicton; Weathered Shale	Clayey Confining Unit; Leaky Clayey Confining Unit; Shale Confining Unit
55 - 120	Silty Sediments; Silt; Loamy Diamicton; Coarse Diamicton; Moderately Sorted Sands; Well Sorted Sands; Weathered Carbonate	Clayey Confining Unit; Leaky Clayey Confining Unit; Sandy Aquifer; Carbonate Aquifer
120 - 600	Silt; Very Well Sorted Sands; Extremely Well Sorted Sands; Partially Cemented Sands; Cemented Sands; Weathered Carbonate; Carbonate	Clayey Confining Unit; Sandy Aquifer; Carbonate Aquifer
>600	Cemented Sands; Carbonate	Carbonate Aquifer

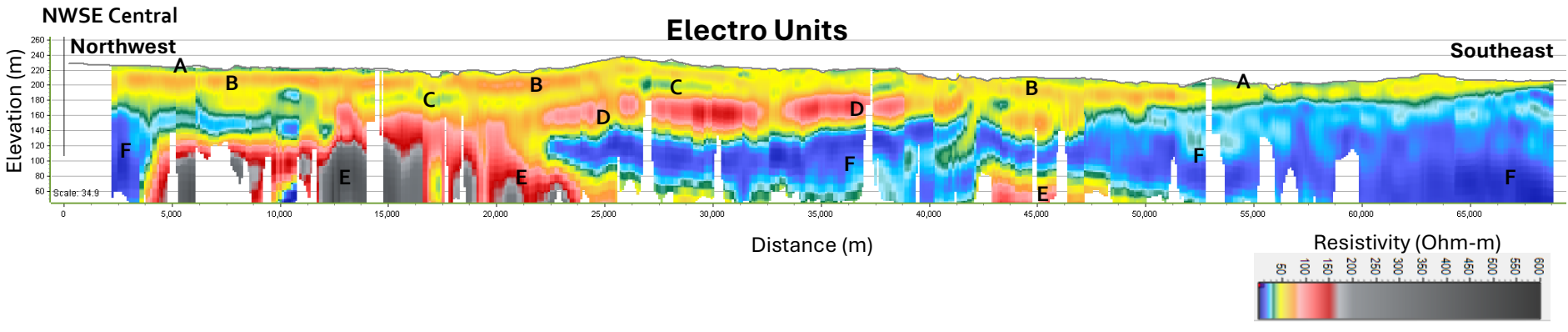
Material Type Conversion

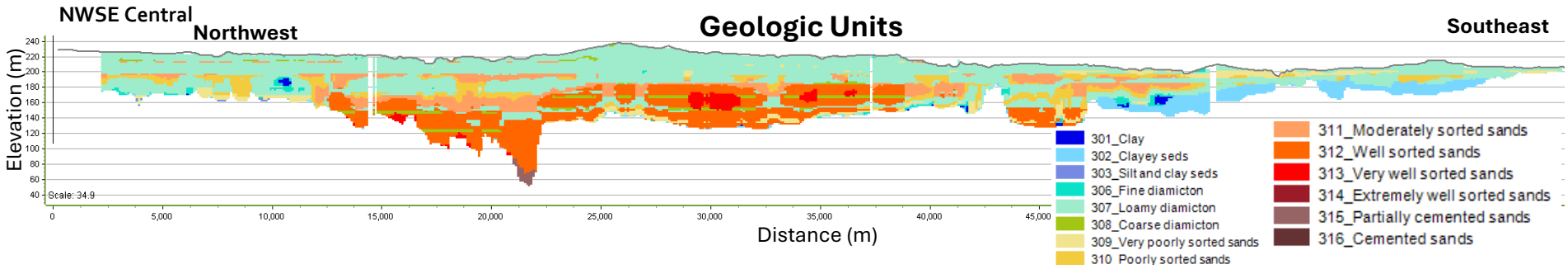


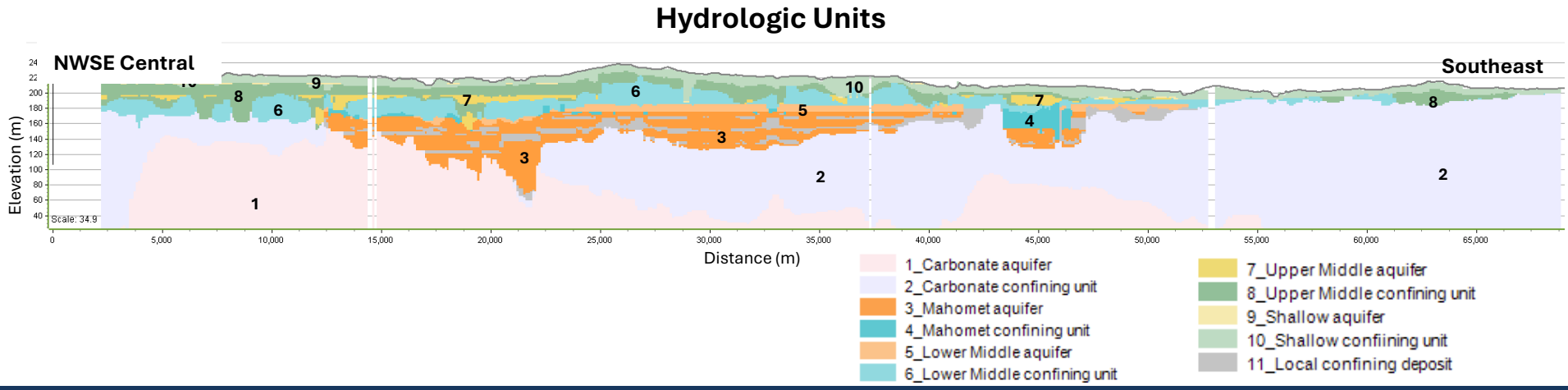




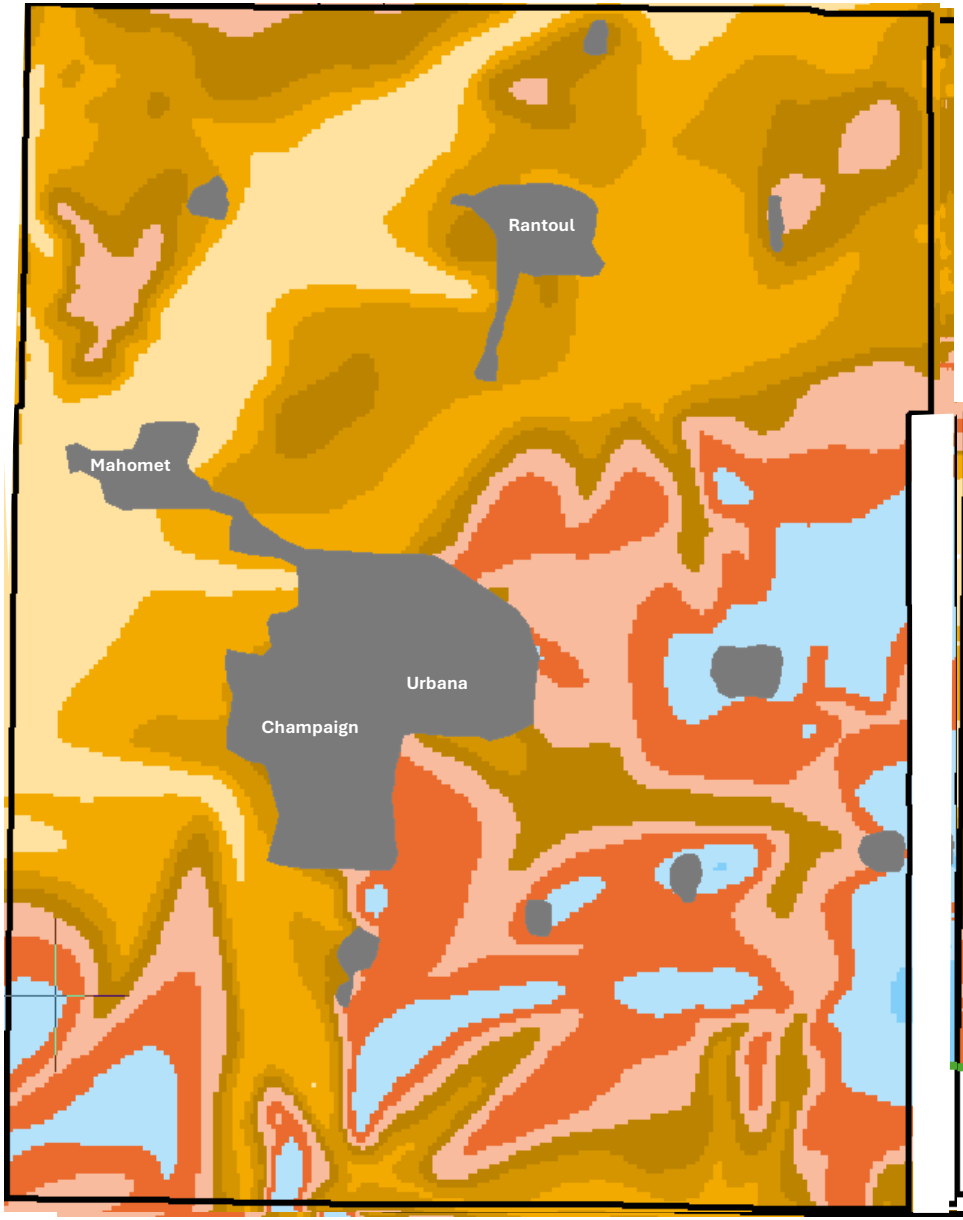
Material Type Conversion

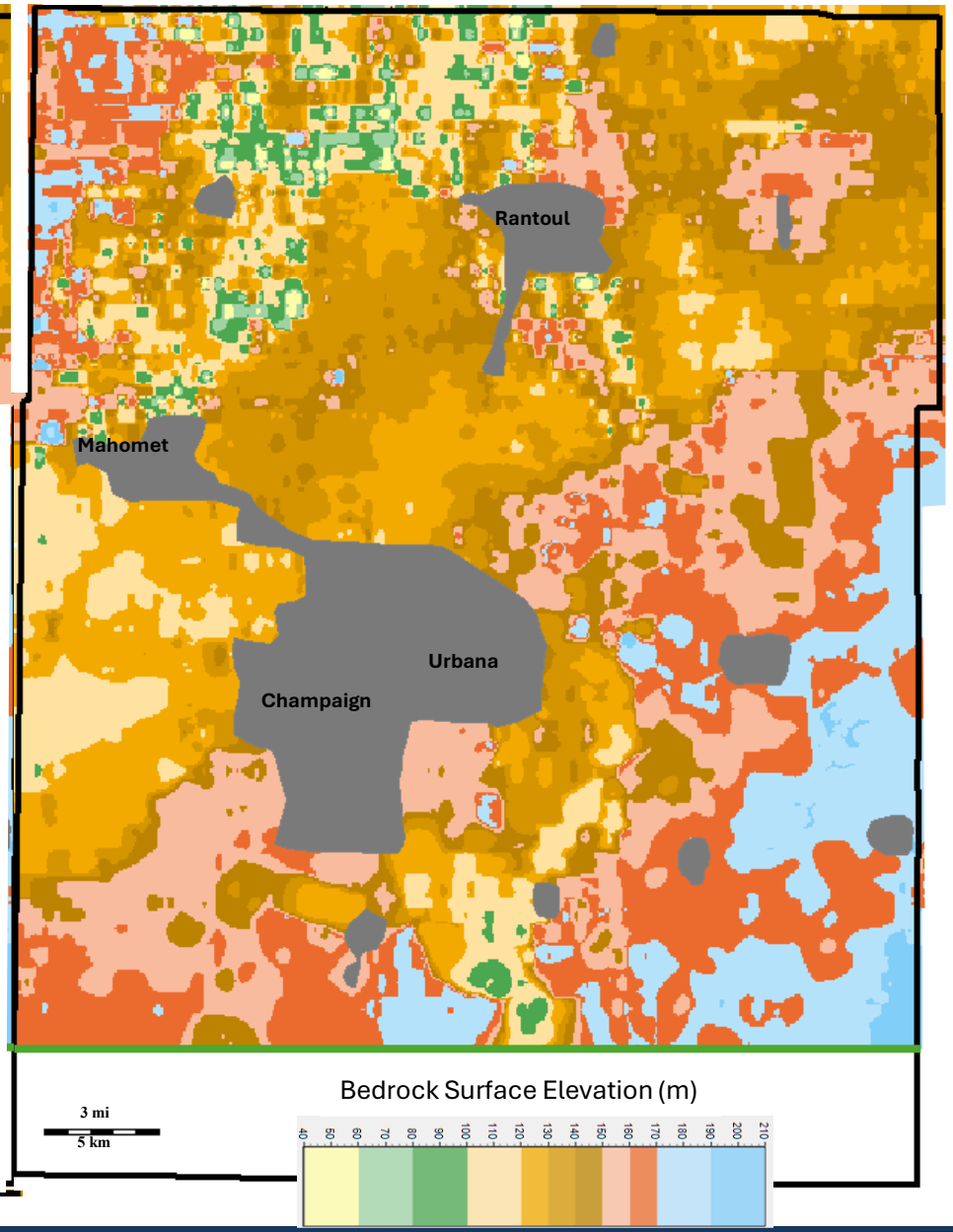




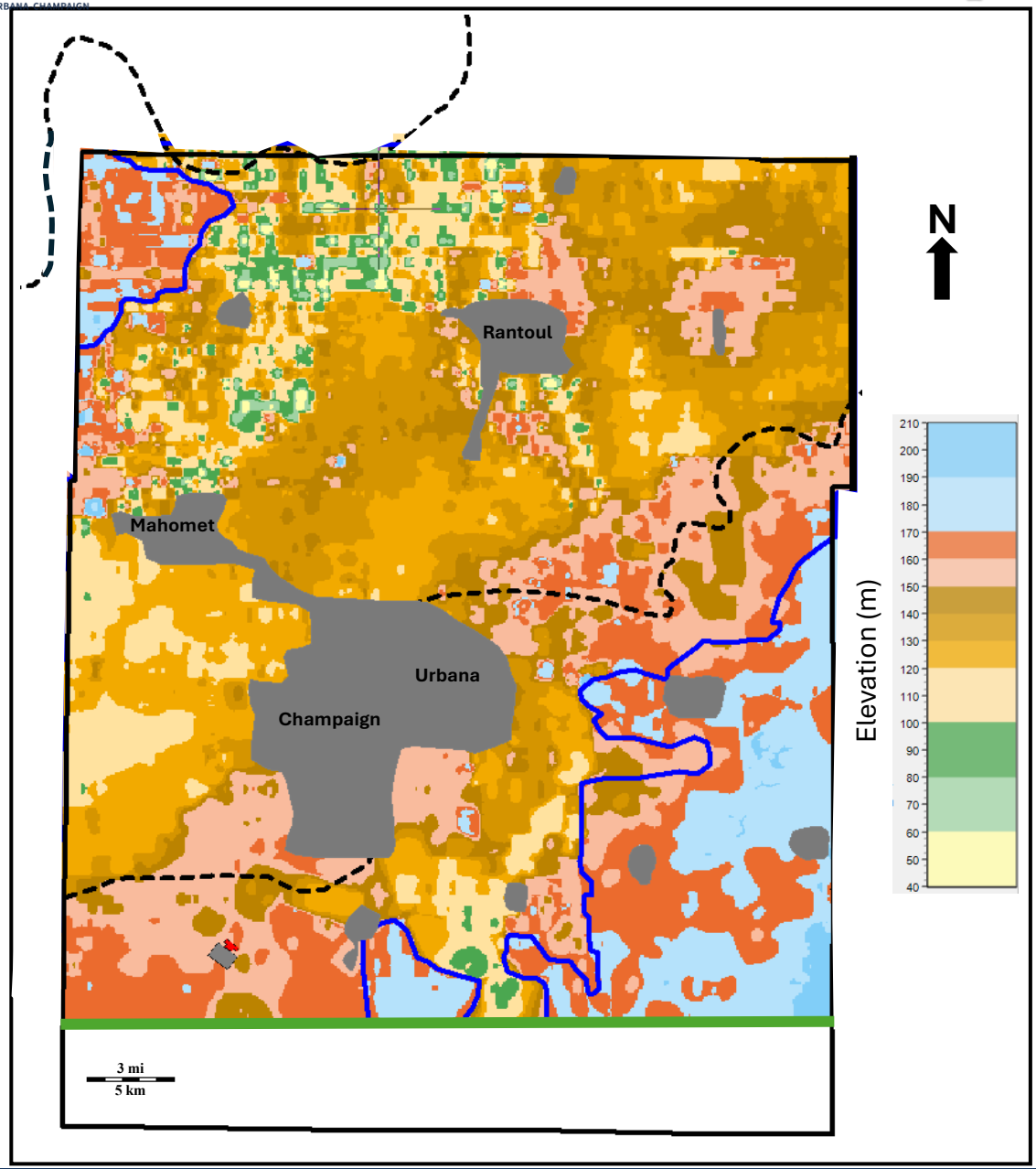


Bedrock Topography





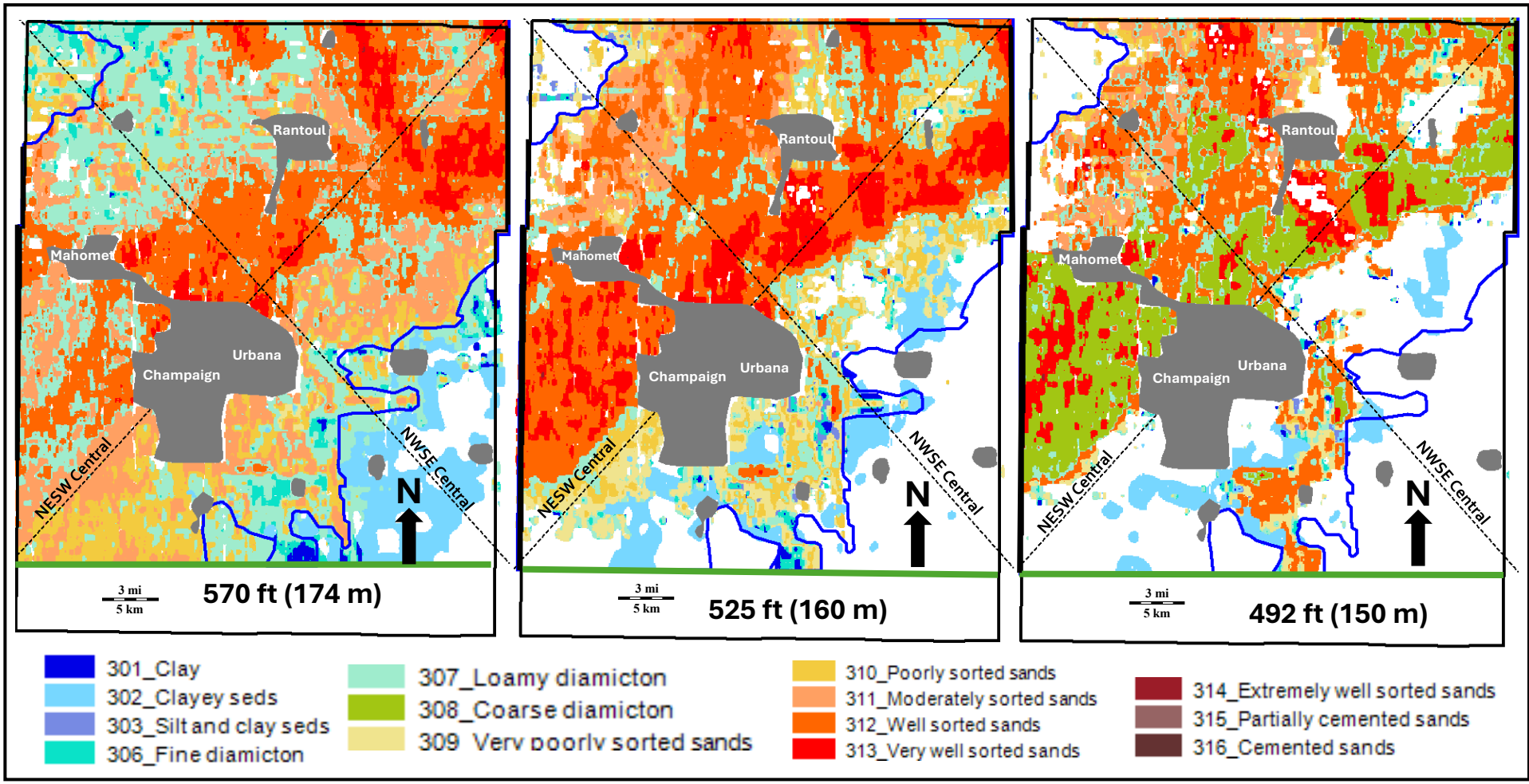
Extent of the Mahomet Aquifer



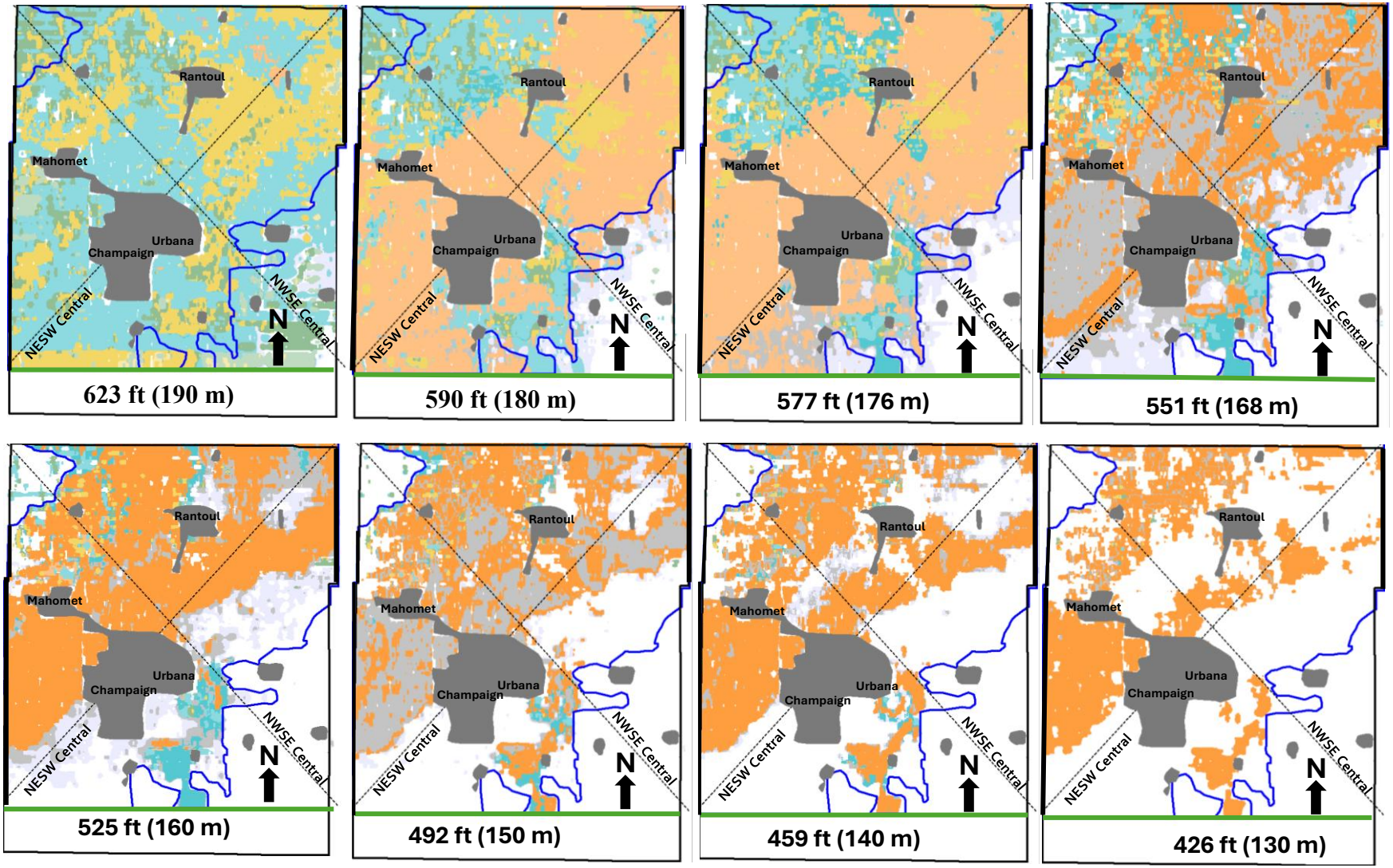
Roadcap, 2011 Boundary

HTEM Boundary

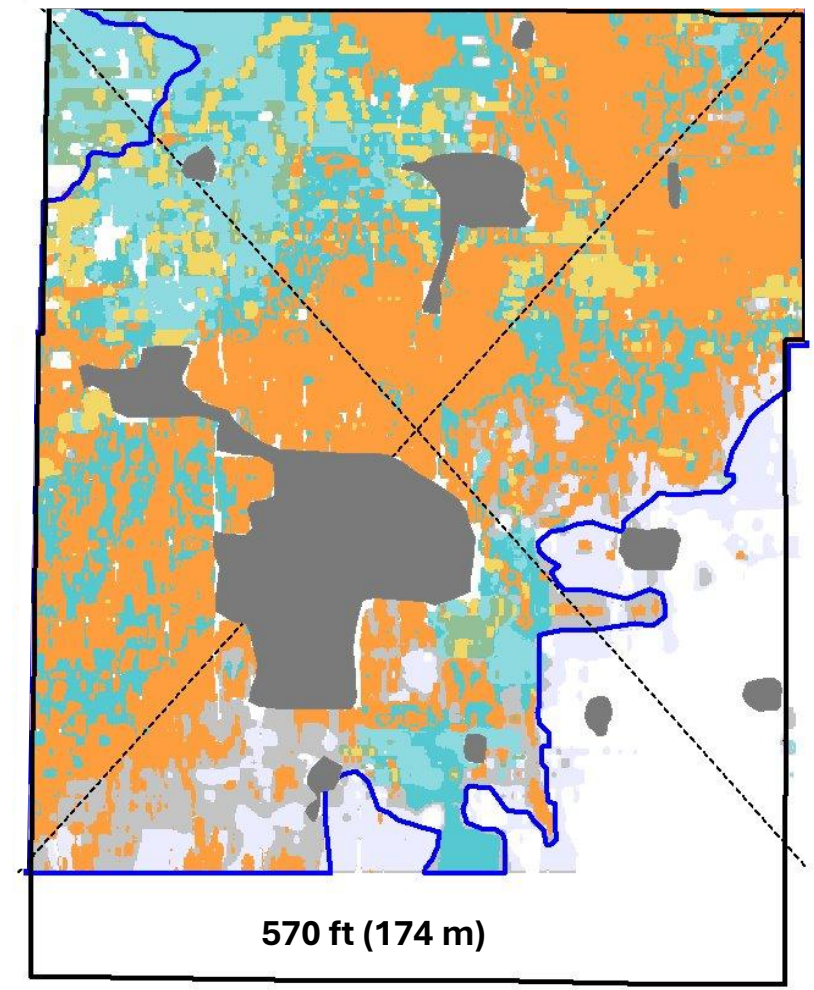
Distribution of Geologic Material

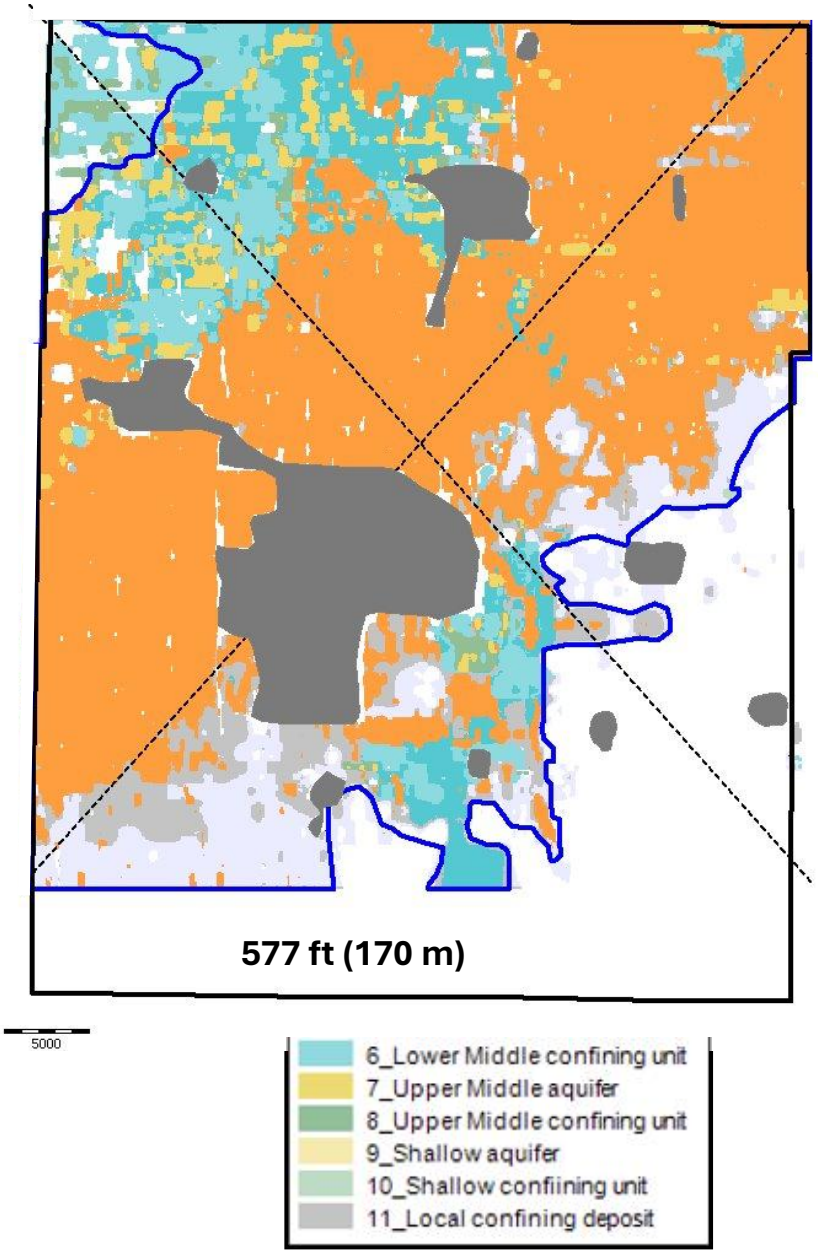


Distribution of Aquifer and Non-Aquifer Units

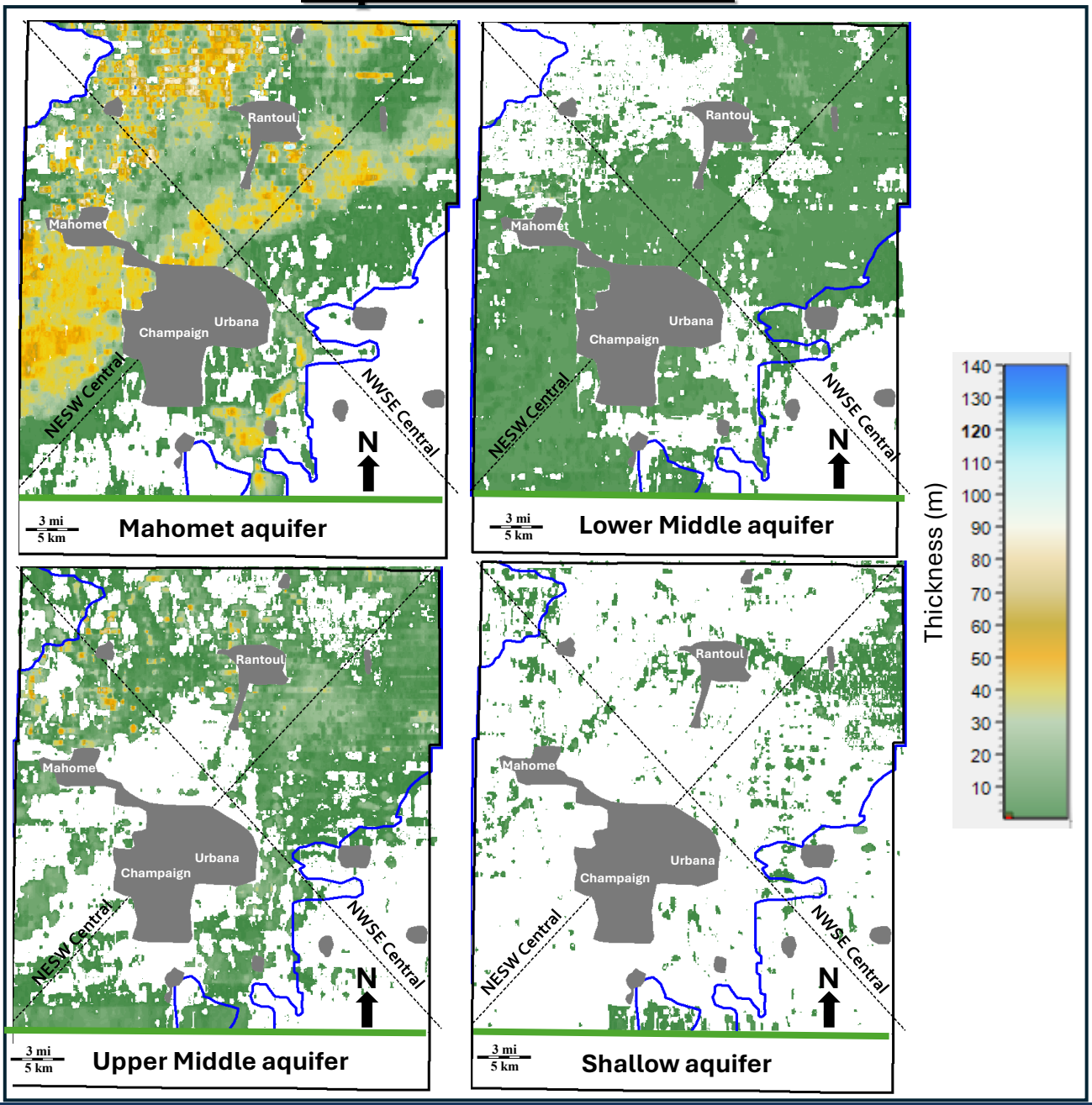


Distribution of Aquifer and Non-Aquifer Units

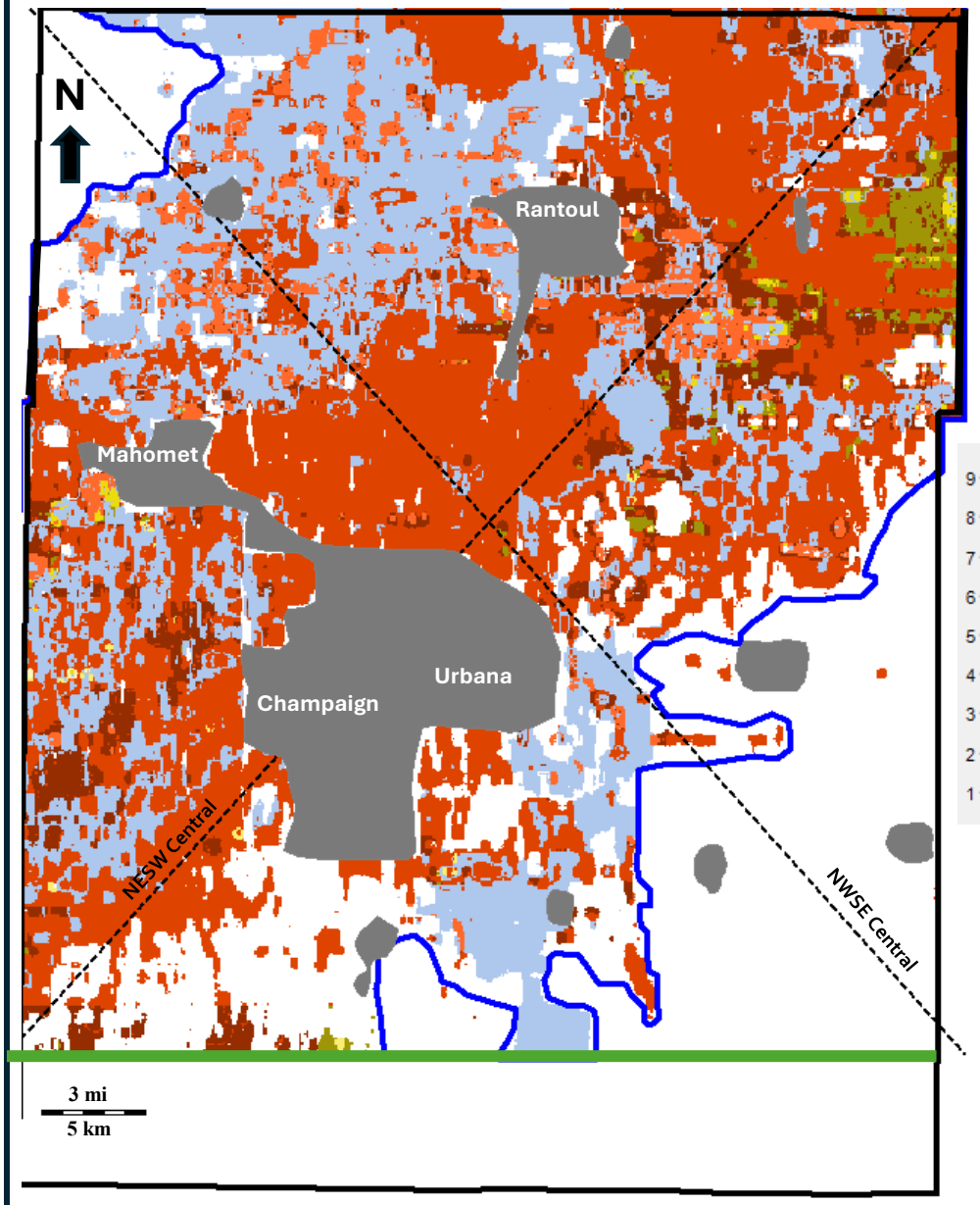




Aquifer Thickness

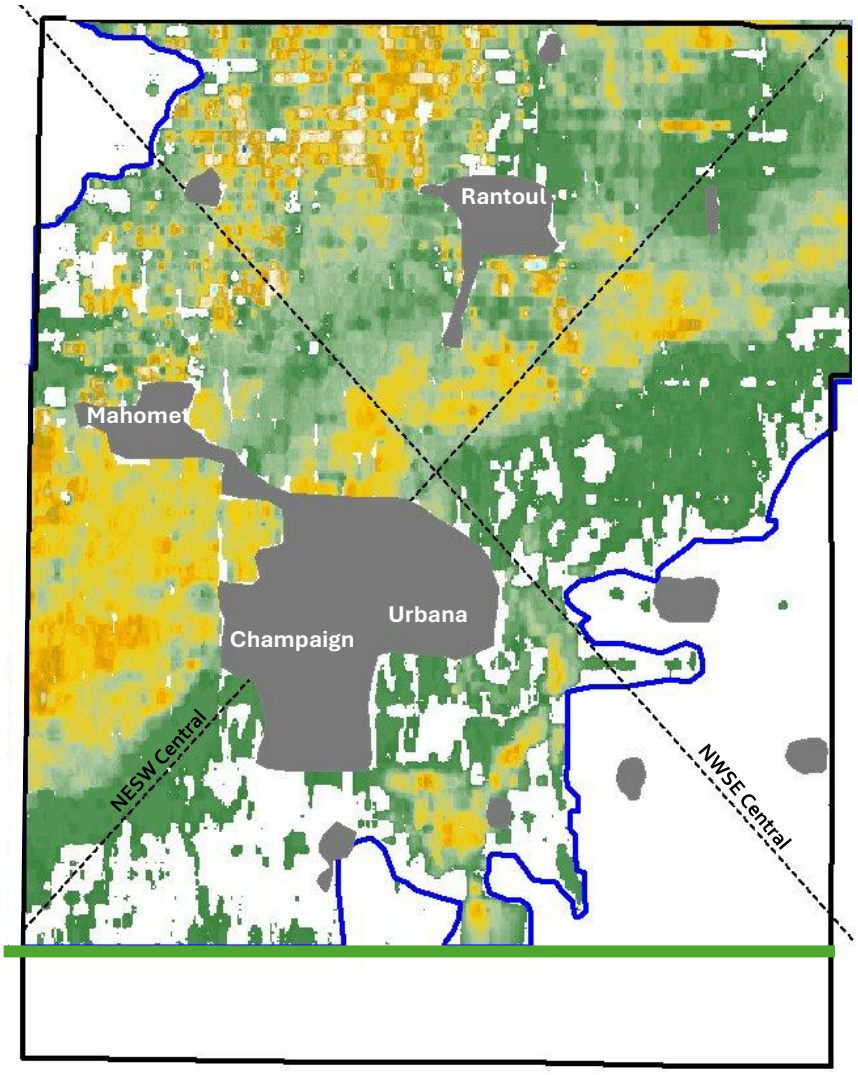


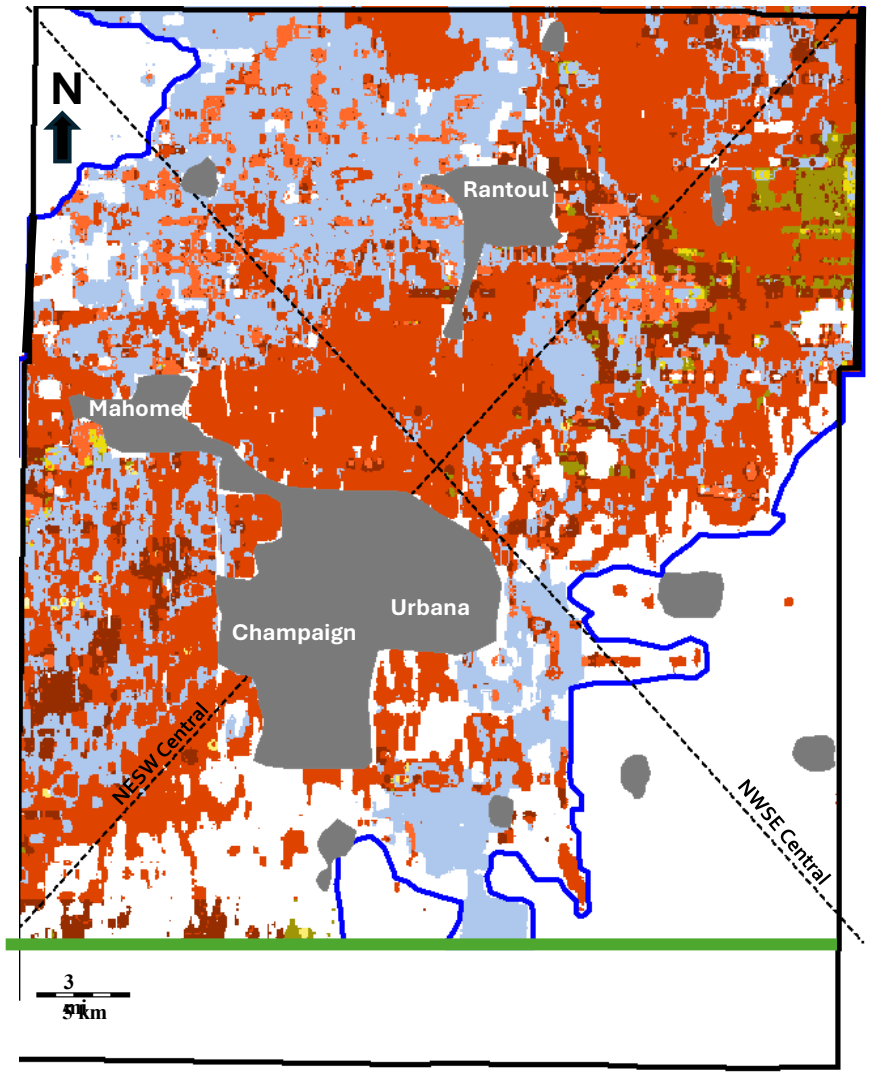
Aquifer Connectivity



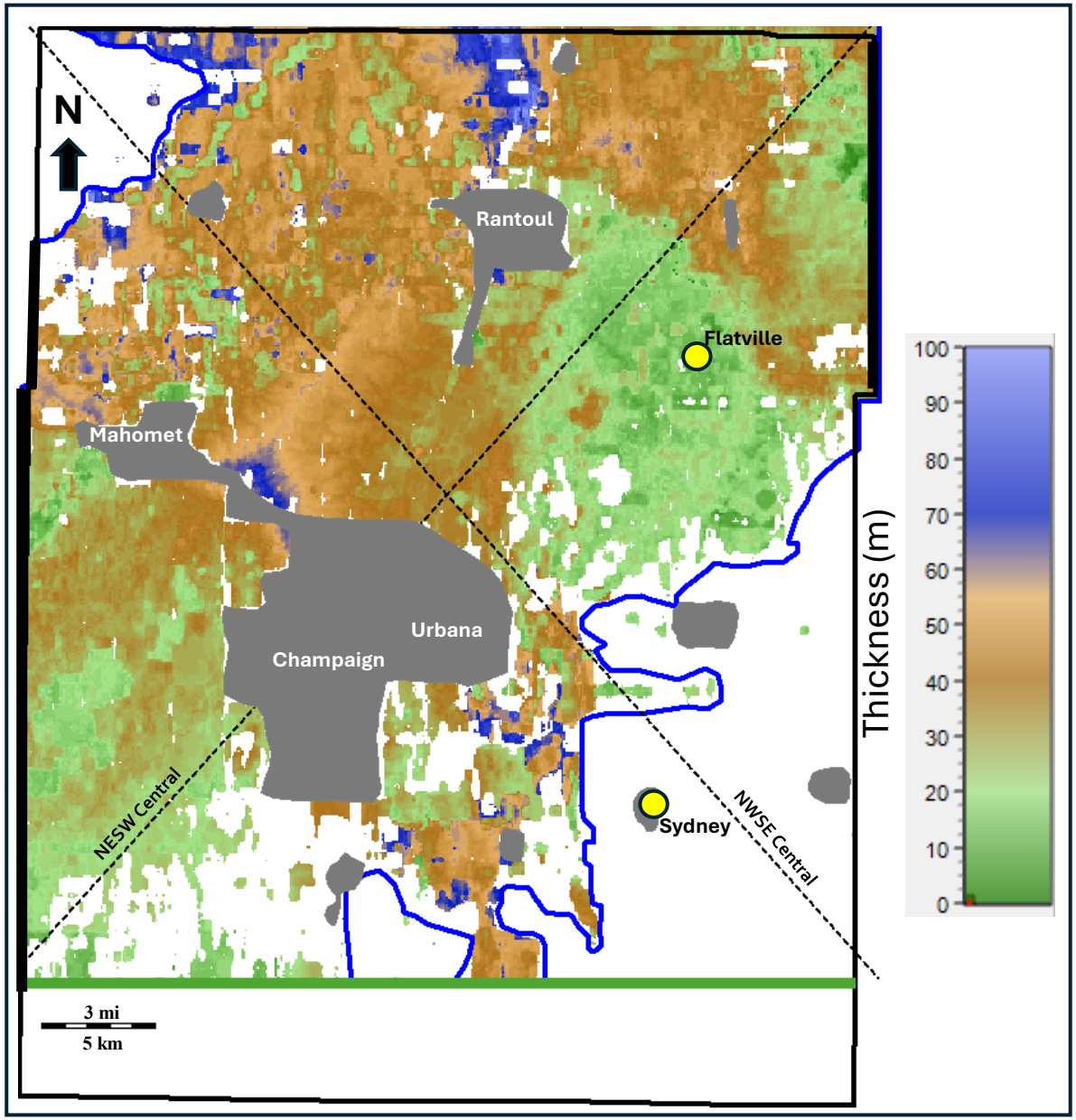
9 Mahomet, Lower, Upper Middle and Shallow aquifers in contact
8 Mahomet, Upper Middle and Shallow aquifers in contact
7 Mahomet, Lower Middle and Shallow aquifers in contact
6 Mahomet and Shallow aquifer in contact
5 Mahomet, Lower and Upper Middle aquifers in contact
4 Mahomet and Upper Middle aquifer in contact
3 Mahomet and Lower Middle aquifer in contact
2 Mahomet aquifer only
1

Mahomet Thickness and Connectivity

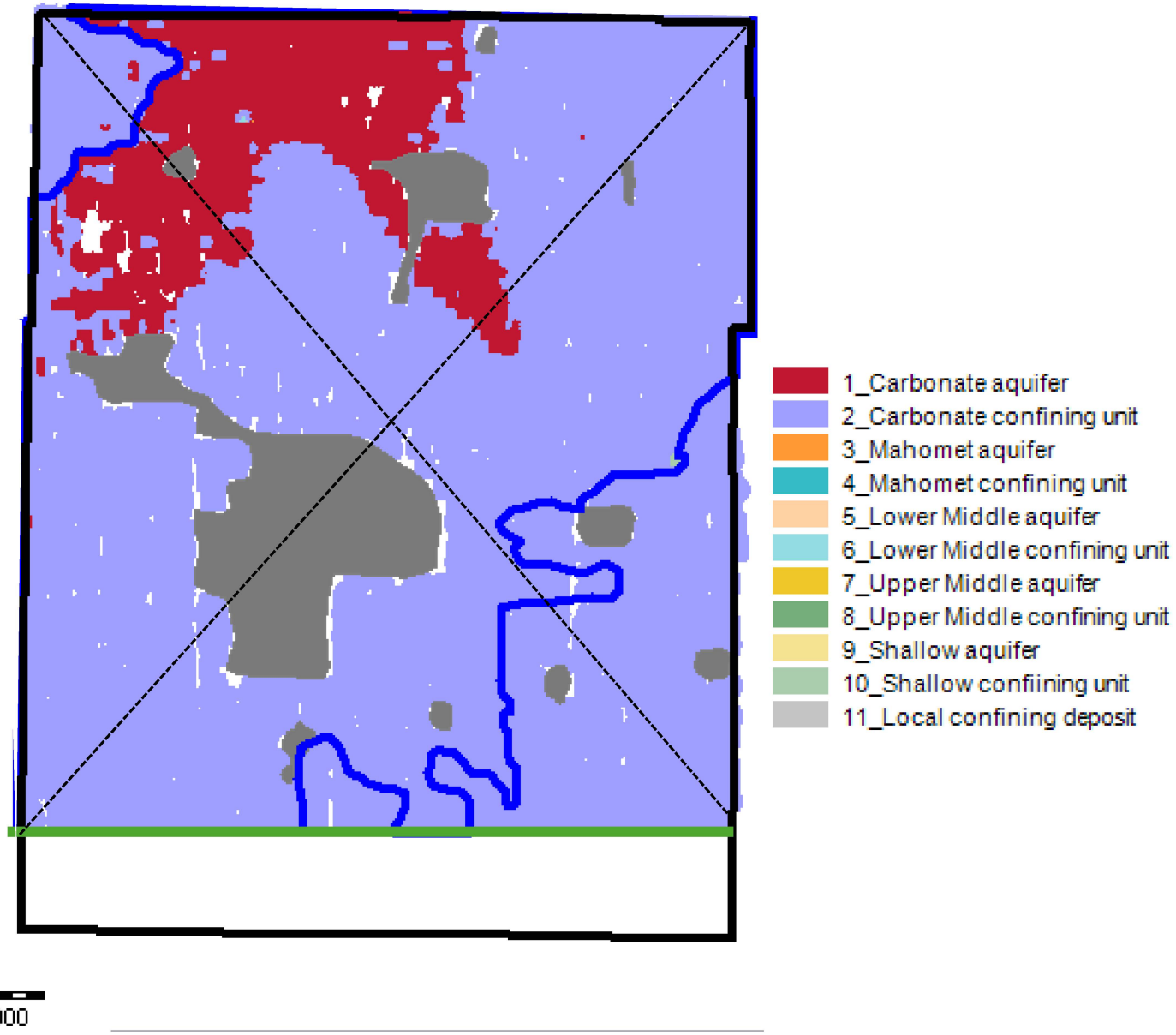




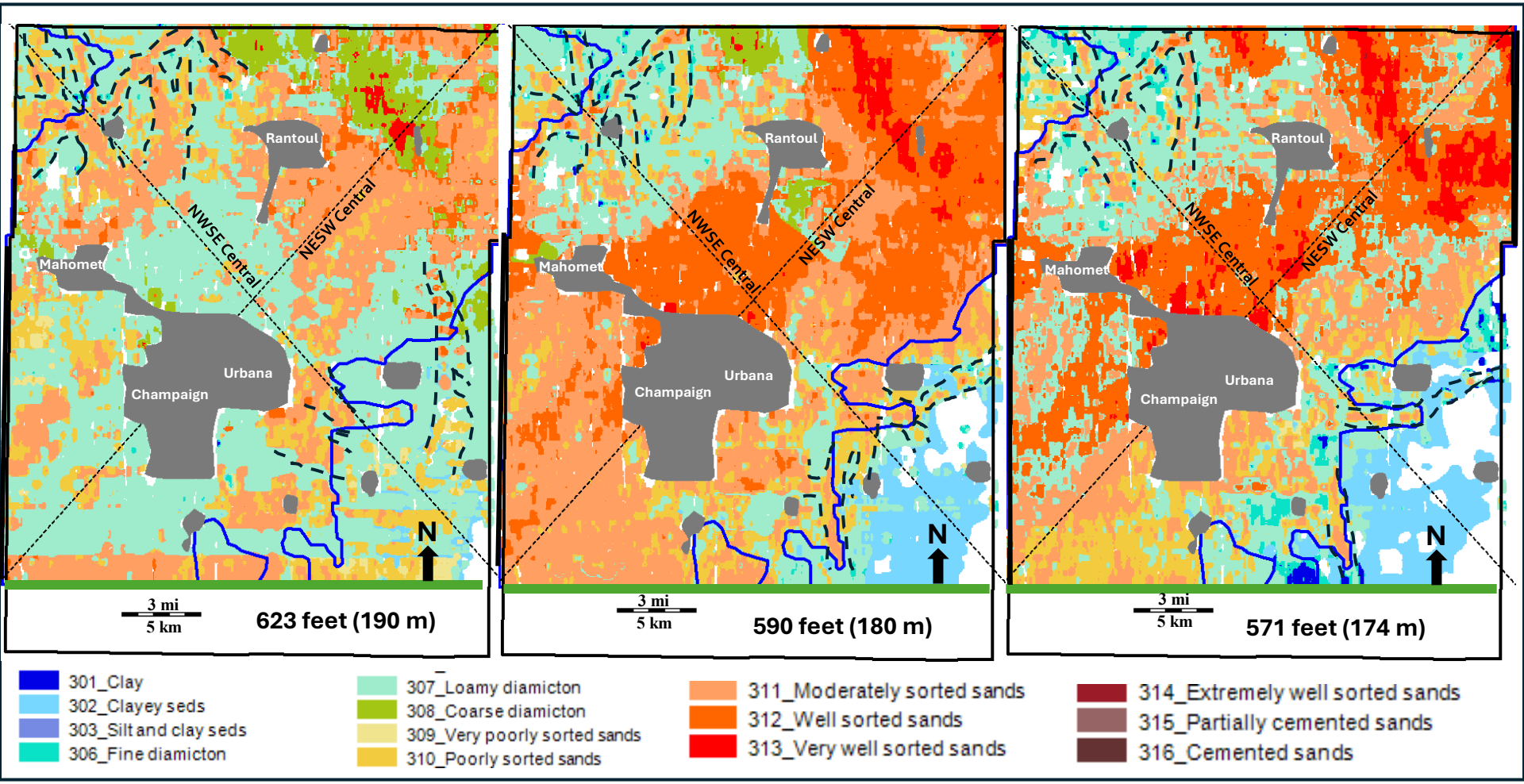
Thickness of Confining Unit



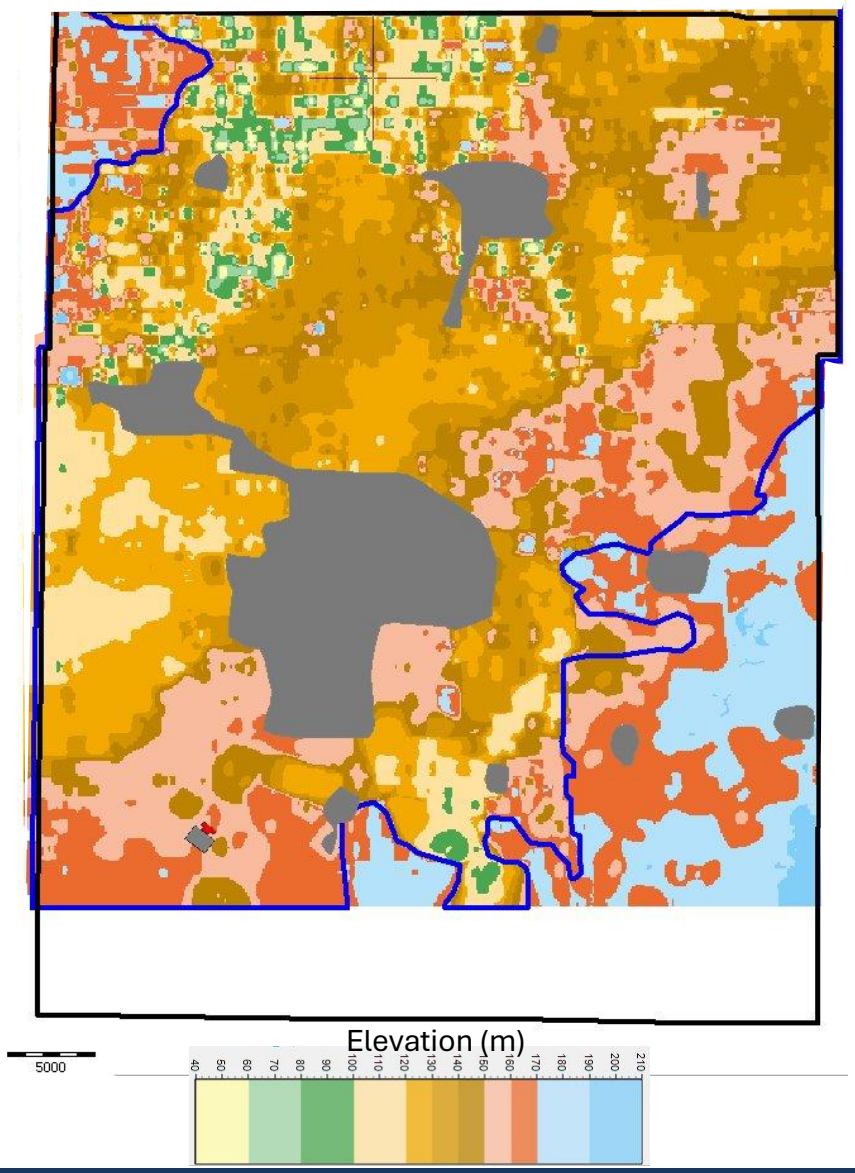
Distribution of Bedrock Units



Buried Channels



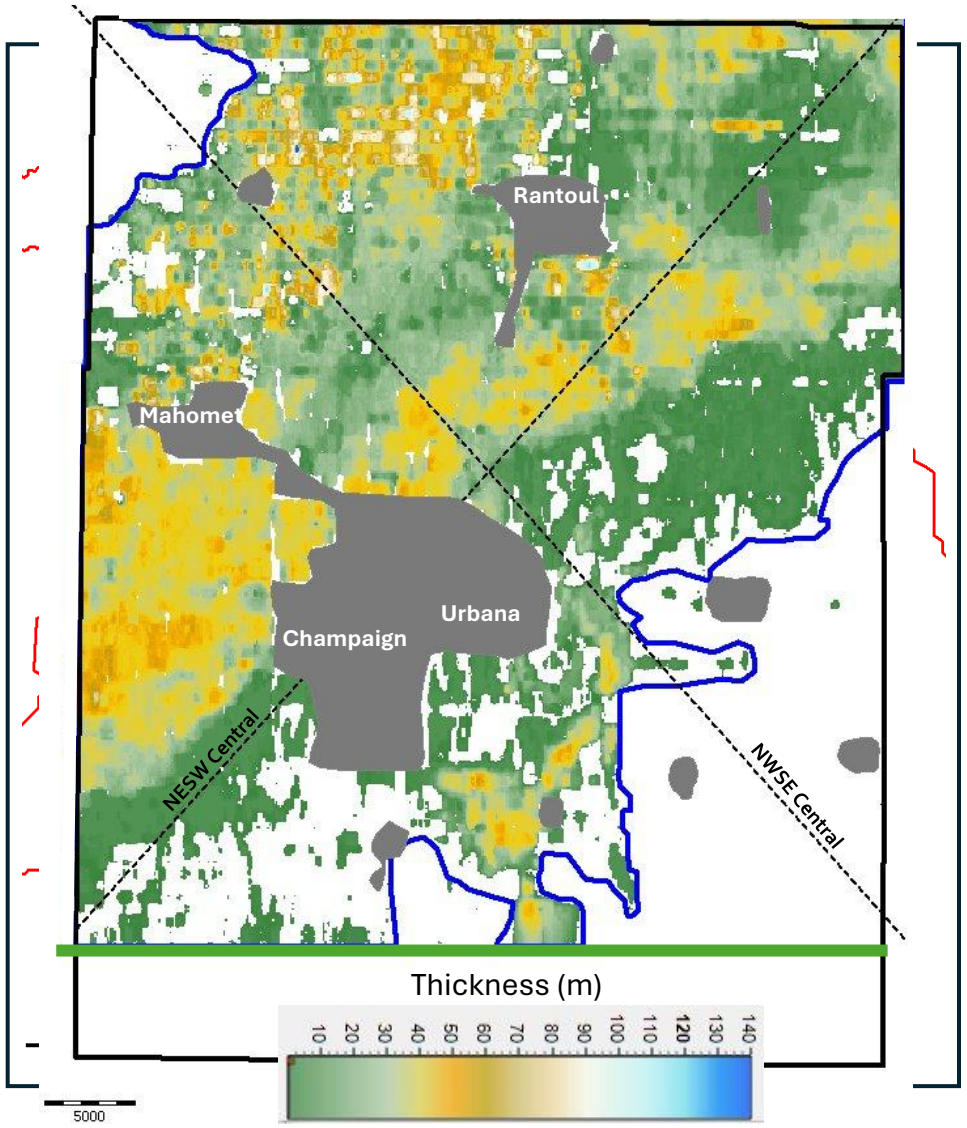
Conclusion



1. **First-ever high-resolution mapping of the distribution of;**
   - Aquifer/Non-Aquifer boundaries
   - Aquifer character/materials
   - Aquifer variability
2. **Identification of additional water resources**
   - Sand and gravel filled buried channels as possible additional water resources.
   - Hydrological connectivity of aquifers provide a significant source of groundwater for domestic and agricultural wells
   - Possible recharge zones through buried channels
3. **The high-resolution information from this project will contribute further to the sustainable management of groundwater resources in Champaign County**

Future Work

1. Redefining aquifer boundaries

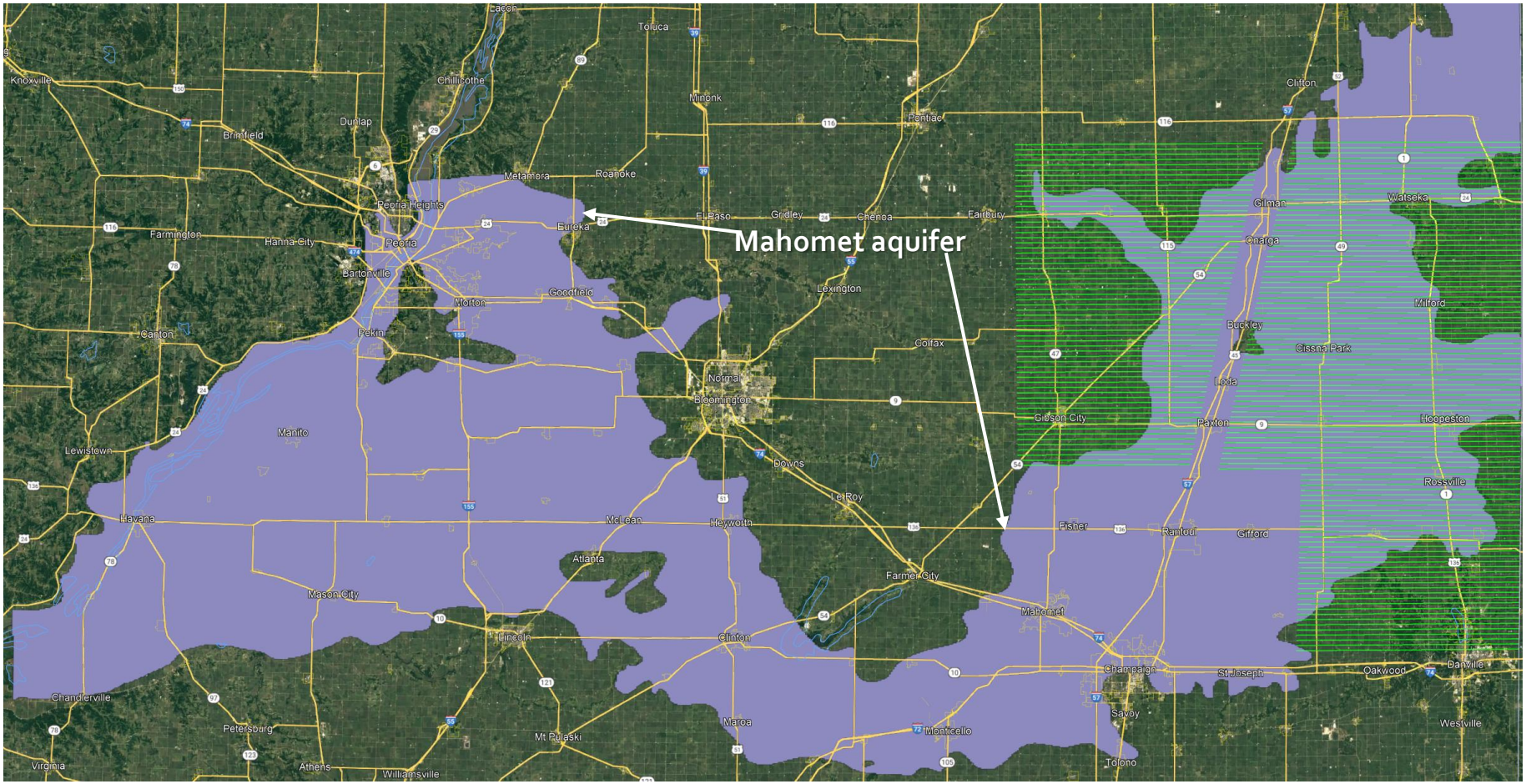


1. **USEPA (SSA) Boundary VS HTEM Boundary**
   - SSA boundary significantly underestimates the extent of the Mahomet aquifer
   - Potential changes to the estimates of saturated thickness of the Mahomet aquifer

2. **Integrate results from this project with groundwater flow models**
   - Improved predictions of long-term water quantity and quality
   - Improved understanding of economic development potential
   - Reduce uncertainty of model results

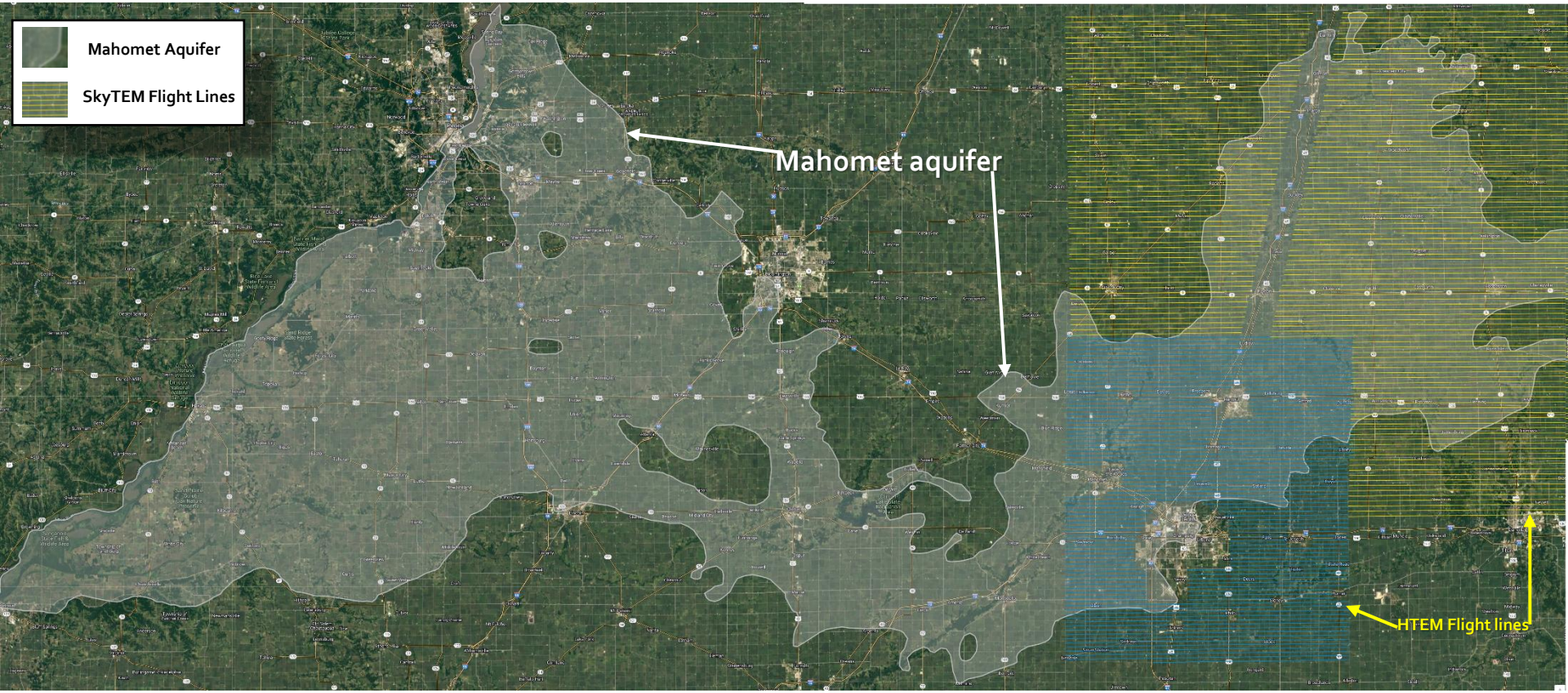
Future Work

2. Continue with HTEM characterization of the MBV north and east of Champaign County



Future Work

3. Continue to seek funds to complete the HTEM-based characterization and map the extent of the MBV in the entire east central Illinois.



Future Work

4. For more details;

1. Energizing Insight: New Maps for the Mahomet Aquifer (arcgis.com)

2. Mahomet Aquifer Airborne Mapping Program – HTEM Geologic Mapping Project (illinois.edu)

Thank you!!