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DIGITAL MAPPING TECHNIQUES 2025

The following was presented at DMT ‘25

May 18 - 21, 2025

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2025)
http://ngmdb.usgs.gov/info/dmt/

The USDA'S SSURGO datasets are a comprehensive source for America's knowledge on the distribution of soil types and dozens of other soil attributes. SSURGO's geographic database provides critical information regarding soil characteristics that are used by several sectors including agriculture, transportation, and construction. SSURGO data, for example, can be applied to discover the potential for different resources or to assist in surficial geologic mapping. This study presents a novel application for SSURGO datasets by using it to analyze the archaeological potential in buried soils. Metrics from SSURGO, such as, slope, parent material, geomorphic position, flooding potential, local phase, ecology, and soil horizons were used to calculate the potential for each soil unit in Kansas and Nebraska. This analysis targeted mapping units that consisted of mostly alluvium while units that were comprised of uplands, water, fills, and quarries were excluded because of their low potential for archaeological deposits. A case study analyzing documented archaeological sites in eastern Kansas was conducted using several validating techniques in ArcGIS Pro using location queries. The results for this analysis categorized 55% to 59% of the documented archaeological sites in the moderate to high potential category depending on which validation method was used. These analyses can provide a quick screening tool for several agencies including state transportation when planning new roadway construction. Maps can be generated illustrating where there is a significant amount of potential for buried archaeological deposits and can guide a DOT to avoid new construction at these locations, thus avoiding costly delays for an archaeological investigation.

A GIS-based approach assessing the potential for locating buried archaeological deposits using SSURGO data

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The University of Kansas

Digital Mapping Techniques (DMT) 2025, Norman, OK

What is SSURGO?, Significance

SSURGO

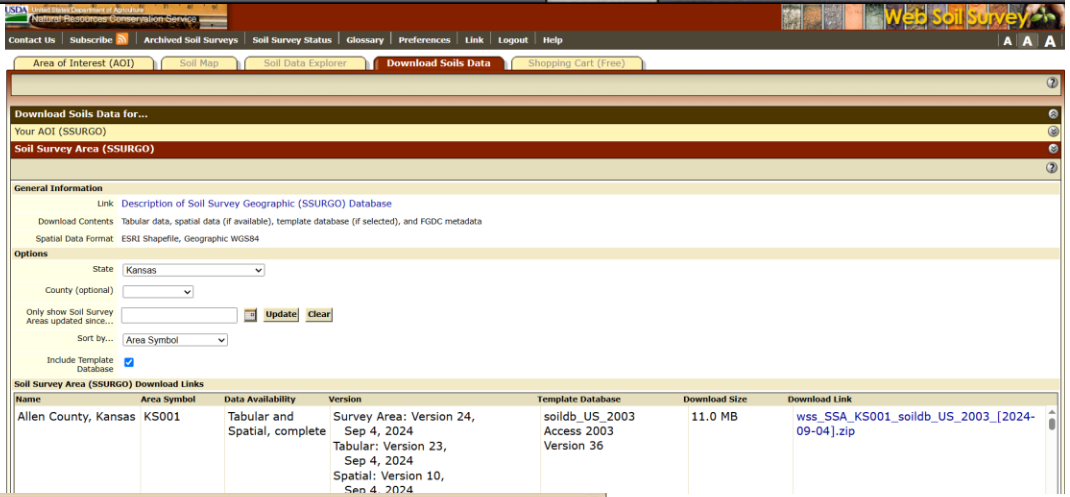
- Soil Survey Geographic Database
- Information about soil collected by the USDA NRCS over the past century

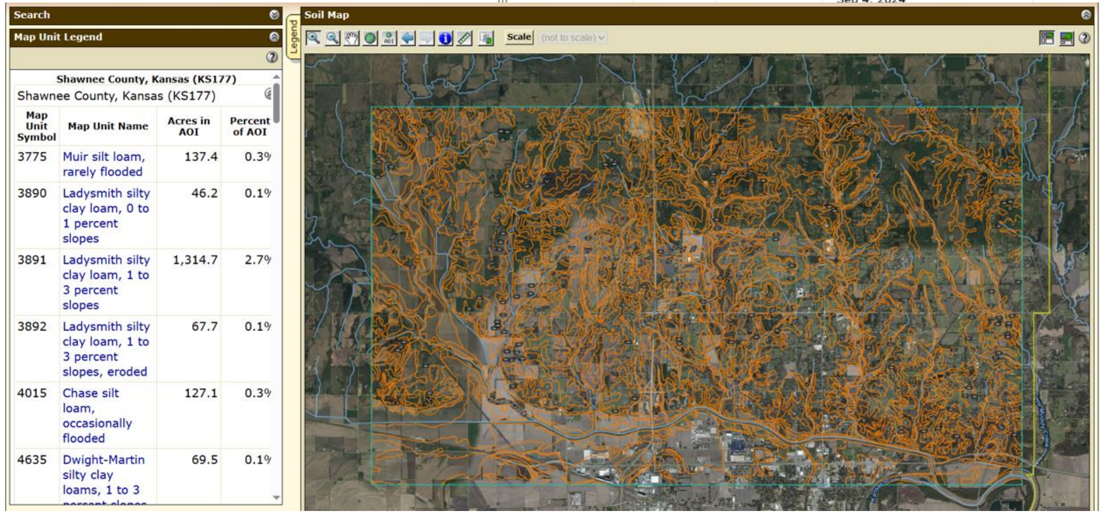
A plethora of info

- Database critical to agriculture, transportation, construction, and others
- Web interface and downloads

Database info

- Access database
- Mapping units by county
- Dozens of metrics
- Complicated one to many relationships





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Previous work/research

Previous work

- Layzell, A.L., Mandel, R.D., Ziska, C.L., and Bozell, J.R. 2018. Systematic Approach to Identifying Deeply Buried Archeological Deposits. Nebraska Department of Transportation Research Report SARP-P1(16) Mo48.
- Layzell, A.L. and Mandel, R.D. 2019. Using soil survey data as a predictive tool for locating deeply buried archaeological deposits in stream valleys of the Midwest, United States. Geoarchaeology.
- Layzell, A.L., Mandel, R.D., Ziska, C.L., and Bozell, J.R. 2021. A Statewide Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archeological Deposits in Nebraska: Phase II. Nebraska Department of Transportation Report SPR-P1(20) M100
- Layzell, A.L., Mandel, R.D., Swigart, J. and Williams, D.T., 2024. A Statewide Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archeological Deposits in Nebraska: Phase III-The Sandhills Region. Nebraska Department of Transportation Report SPR-FY23 (020)

Surficial geologic mapping

- Parent material
- Flooding frequency

GIS-base predictive model

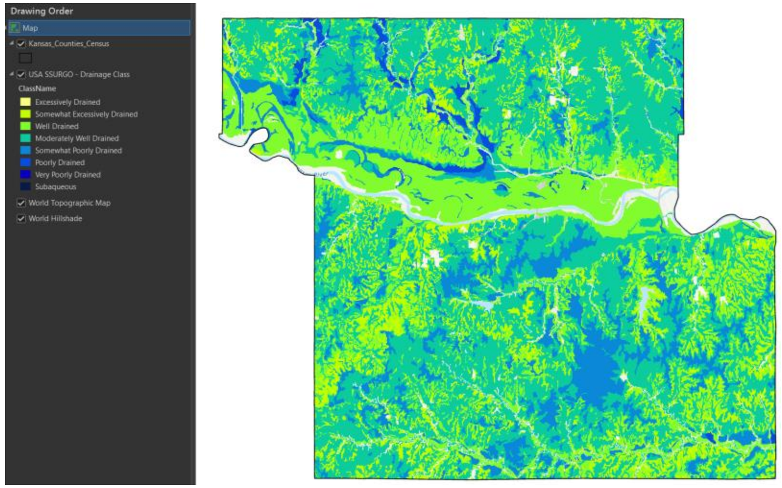
- Verify model with archaeological site data & geoarchaeological reports

Target soil data

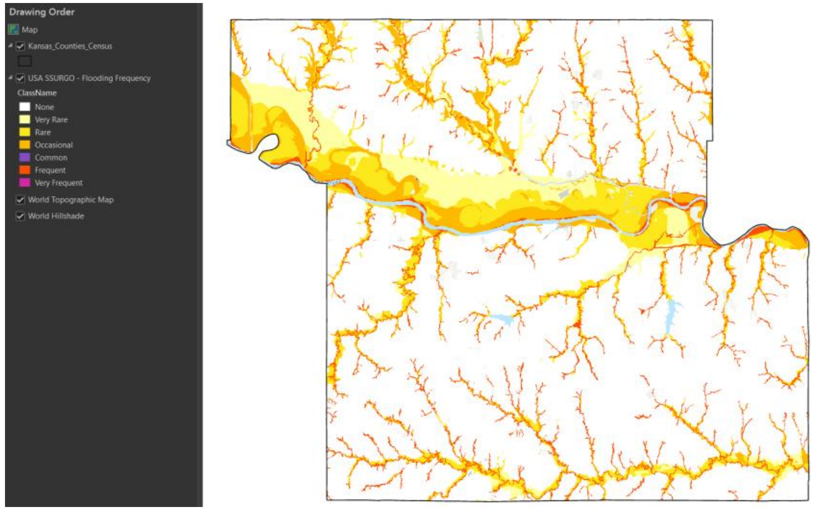
- Alluvial and colluvial soil series
- Not interested in uplands, till, water, quarries

Attributes used in model

- Elevation/slope
- Parent material
- Geomorphology/Ecology
- Local phase & flood frequency
- Soil horizonation
- Drainage



Shawnee County- Drainage Class



Shawnee County- Flooding Frequency

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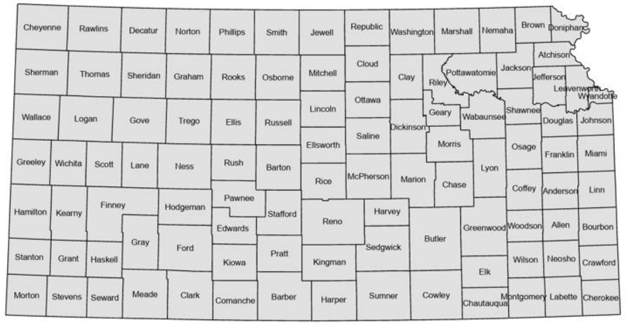
Workflow- data out of SSURGO

Extracting the data
- Time-intensive
- Multiple programs

Mapping
- Table joins
- 1 map layer, soil map units

Understanding SSURGO
- File extraction
- Field names
- Soil series complications
- Many joins

Entire project
- Workflow for each county
- 105 counties in Kansas, 93 in Nebraska
- Automation



SSURGO Online Download

↓

Microsoft Access and export tables

↓

Microsoft Excel, format and filter

↓

ArcGIS and add data, calculations

↓

Excel again, create sheets, format, score data

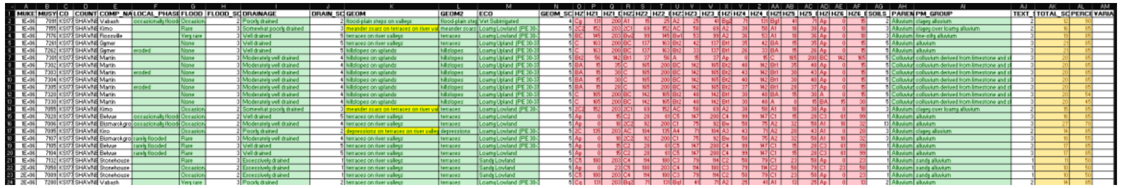
↓

ArcGIS once more, add new tables, create symbology and map

Analysis: scoring the potential

Scored based on attributes

Factor	Description	Score
Soils (horizonation)	Thin A horizons (<50 cm)	1
	Gleyed horizons (Bg)	2
	Overthickened A horizons (>50 cm) and Bw horizons	3
	Bk horizons	4
	Bt horizons	5
Landscape position (geomorphology)	Floodplain (depressions, channels, drainageways, swales, flats, wetlands)	1
	Floodplain (clayey, sandy, overflow)	2
	Floodplain (loamy, silty)	3
	Floodplain step	4
	Terrace/alluvial fan/footslope	5
Landscape position (flood frequency/local phase)	Frequent	1
	Occasional	2
	rare/none	3
	channeled	0
Depositional environment (parent material/texture)	Sand	1
	Clay	2
	Silt/loam	3
Drainage	Very poorly drained/excessively drained	1
	Poorly drained	2
	Somewhat poorly drained	3
	Moderately well drained	4
	Well drained	5



COUNTY	COMP_NAME	LOCAL_PHASE	FLOOD	FLOOD_SCORE	DRAINAGE	DRAIN_SCORE	GEOM	GEOM2	ECO	GEOM_SCORE
SHAWNEE	Wabash	occasionally flooded	Occasional	2	Poorly drained	2	flood-plain steps on valleys	flood-plain steps	Wet Subirrigated	4
SHAWNEE	Kimo		Rare	3	Somewhat poorly drained	3	meander scars on terraces on river valleys	meander scars	Loamy Lowland (PE 30-37)	5
SHAWNEE	Rossville		Very rare	3	Well drained	5	terraces on river valleys	terraces	Loamy Lowland (PE 30-37)	5
SHAWNEE	Gymer		None	3	Well drained	5	terraces on river valleys	terraces	Loamy Upland (PE 30-37)	5
SHAWNEE	Gymer	eroded	None	3	Well drained	5	hillslopes on uplands	hillslopes	Loamy Upland (PE 30-37)	5
SHAWNEE	Martin		None	3	Moderately well drained	4	hillslopes on uplands	hillslopes	Loamy Upland (PE 30-37)	5
SHAWNEE	Martin		None	3	Moderately well drained	4	hillslopes on uplands	hillslopes	Loamy Upland (PE 30-37)	5
SHAWNEE	Martin	eroded	None	3	Moderately well drained	4	hillslopes on uplands	hillslopes	Loamy Upland (PE 30-37)	5
SHAWNEE	Martin		None	3	Moderately well drained	4	hillslopes on uplands	hillslopes	Loamy Upland (PE 30-37)	5
SHAWNEE	Martin	eroded	None	3	Moderately well drained	4	hillslopes on uplands	hillslopes	Loamy Upland (PE 30-37)	5
SHAWNEE	Martin		None	3	Moderately well drained	4	hillslopes on uplands	hillslopes	Loamy Upland (PE 30-37)	5
SHAWNEE	Martin		None	3	Moderately well drained	4	hillslopes on uplands	hillslopes	Loamy Upland (PE 30-37)	5
SHAWNEE	Kimo		Occasional	2	Somewhat poorly drained	3	meander scars on terraces on river valleys	terraces	Loamy Lowland (PE 30-37)	5
SHAWNEE	Belvue	occasionally flooded	Occasional	2	Well drained	5	terraces on river valleys	terraces	Loamy Lowland	5
SHAWNEE	Bismarckgrove	occasionally flooded	Occasional	2	Moderately well drained	4	terraces on river valleys	terraces	Loamy Lowland	5
SHAWNEE	Kiro		Occasional	2	Poorly drained	2	depressions on terraces on river valleys	depressions	Loamy Lowland (PE 30-37)	5
SHAWNEE	Bismarckgrove	rarely flooded	Rare	3	Moderately well drained	4	terraces on river valleys	terraces	Loamy Lowland (PE 30-37)	5
SHAWNEE	Belvue	rarely flooded	Rare	3	Well drained	5	terraces on river valleys	terraces	Loamy Lowland (PE 30-37)	5
SHAWNEE	Belvue	rarely flooded	Rare	3	Well drained	5	terraces on river valleys	terraces	Loamy Lowland	5

HZ1	HZ1_D	HZ1_D2	HZ2	HZ2_D	HZ2_D2	HZ3	HZ3_D	HZ3_D2	HZ4	HZ4_D	HZ4_D2	HZ5	HZ5_D	HZ5_D2	HZ6	HZ6_D	HZ6_D2	SOILS_SC(	PARENT	PM_GROUP	TEXT_SCO	TOTAL_SCORE	PERCENT
Cg	131	200	A1	15	25	A2	25	41	Bg2	71	131	Bg1	41	71	Ap	0	15	2	Alluvium	clayey alluvium	2	12	90
2C2	152	203	2C1	69	152	AC	58	69	A2	38	58	A1	18	38	Ap	0	18	3	Alluvium	clayey over loamy alluvium	2	16	85
BC	145	203	Bw2	99	145	Bw1	53	99	A2	36	53	A1	18	36	Ap	0	18	3	Alluvium	fine-silty alluvium	3	19	85
C	163	200	BC	137	163	Bt2	42	137	Bt1	35	42	BA	15	35	Ap	0	15	5	Alluvium	alluvium	3	21	85
C	163	200	BC	137	163	Bt2	33	137	Bt1	26	33	BA	15	26	Ap	0	15	5	Alluvium	alluvium	3	21	85
Bt2	56	142	Bt1	37	56	A	15	37	Ap	0	15	C	165	200	BC	142	165	5	Colluvium	colluvium derived from limestone and shale	3	20	85
BA	15	35	C	165	200	BC	142	165	Bt2	48	142	Bt1	35	48	Ap	0	15	5	Colluvium	colluvium derived from limestone and shale	3	20	85
BA	15	30	C	165	200	BC	142	165	Bt2	43	142	Bt1	30	43	Ap	0	15	5	Colluvium	colluvium derived from limestone and shale	3	20	85
BA	15	30	C	165	200	BC	142	165	Bt2	40	142	Bt1	30	40	Ap	0	15	5	Colluvium	colluvium derived from limestone and shale	3	20	85
BA	15	28	C	165	200	BC	142	165	Bt2	37	142	Bt1	28	37	Ap	0	15	5	Colluvium	colluvium derived from limestone and shale	3	20	85
C	165	200	BC	142	165	Bt2	48	142	Bt1	30	48	BA	15	30	A	0	15	5	Colluvium	colluvium derived from limestone and shale	3	20	54
C	165	200	BC	142	165	Bt2	48	142	Bt1	30	48	A	0	15	BA	15	30	5	Colluvium	colluvium derived from limestone and shale	3	20	45
2C2	152	203	2C1	69	152	AC	58	69	A2	38	58	A1	18	38	Ap	0	18	3	Alluvium	clayey over loamy alluvium	2	15	85
Ap	0	15	C2	28	61	C5	147	200	C4	99	147	C1	15	28	C3	61	99	1	Alluvium	alluvium	3	16	85
Ap	0	18	2C2	92	200	C1	75	92	Bw	58	75	A2	32	58	A1	18	32	13	Alluvium	alluvium	3	27	70
2C	135	203	AC	104	135	A4	71	104	A3	43	71	A2	20	43	A1	0	20	3	Alluvium	clayey alluvium	2	14	85
Ap	0	18	2C2	92	200	C1	75	92	Bw	58	75	A2	32	58	A1	18	32	3	Alluvium	alluvium	3	18	55
Ap	0	15	C2	28	61	C5	147	200	C4	99	147	C1	15	28	C3	61	99	1	Alluvium	alluvium	3	17	85
Ap	0	15	C2	28	61	C5	147	200	C4	99	147	C1	15	28	C3	61	99	1	Alluvium	alluvium	3	17	85
C5	180	203	C4	114	180	C3	79	114	C2	58	79	C1	23	58	Ap	0	23	1	Alluvium	sandy alluvium	1	11	50
Ap	0	23	C5	180	203	C4	114	180	C3	79	114	C2	58	79	C1	23	58	1	Alluvium	sandy alluvium	1	10	50
C5	180	203	C4	114	180	C3	79	114	C2	58	79	C1	23	58	Ap	0	23	1	Alluvium	sandy alluvium	1	10	50

Total score from selected attributes

- 0–9 = low potential
- 10–12 = low-moderate potential
- 13–15 = moderate-high potential
- 16+ = high potential.

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Analysis completed for Nebraska and eastern Kansas

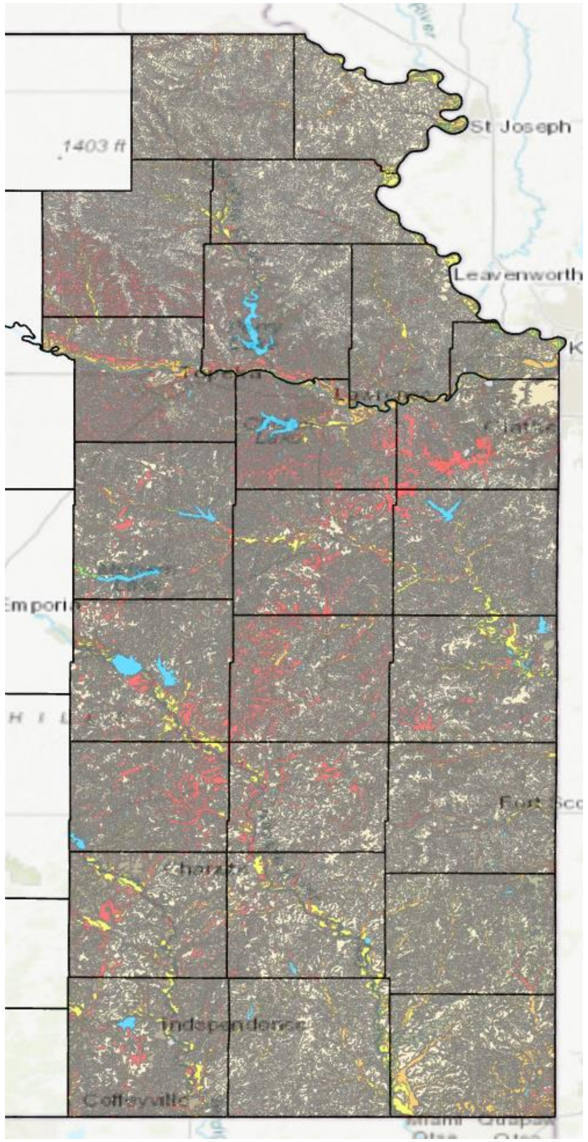
Study Area
- Kansas
- Nebraska

Potential
- High is red
- DOT perspective

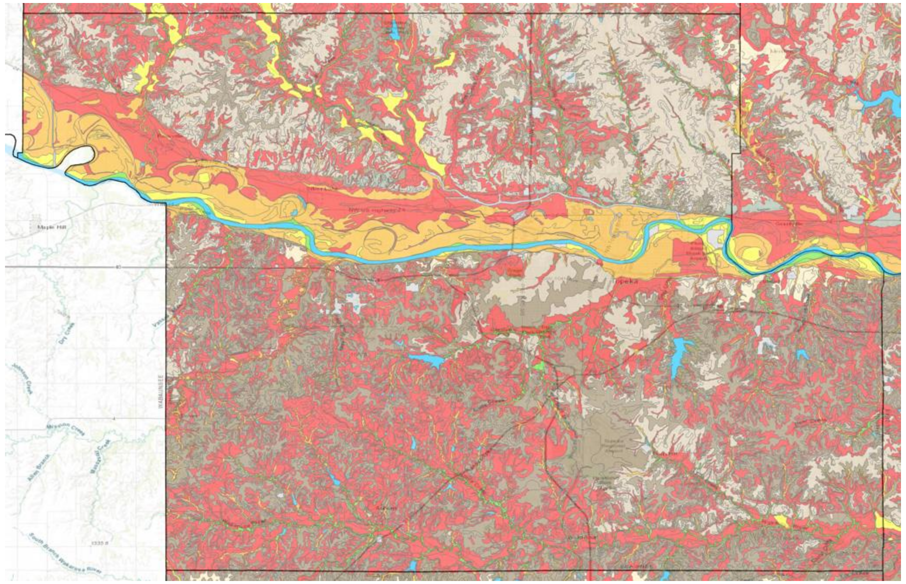
Predictive, screening tool
- DOTs, city planning
- Generalized data

Assess stream valleys of the Midwest

Relative elevation models (using LiDAR) developed for stream valleys in the Nebraska Sandhills



Eastern Kansas



Shawnee County, Kansas

Eastern Kansas results

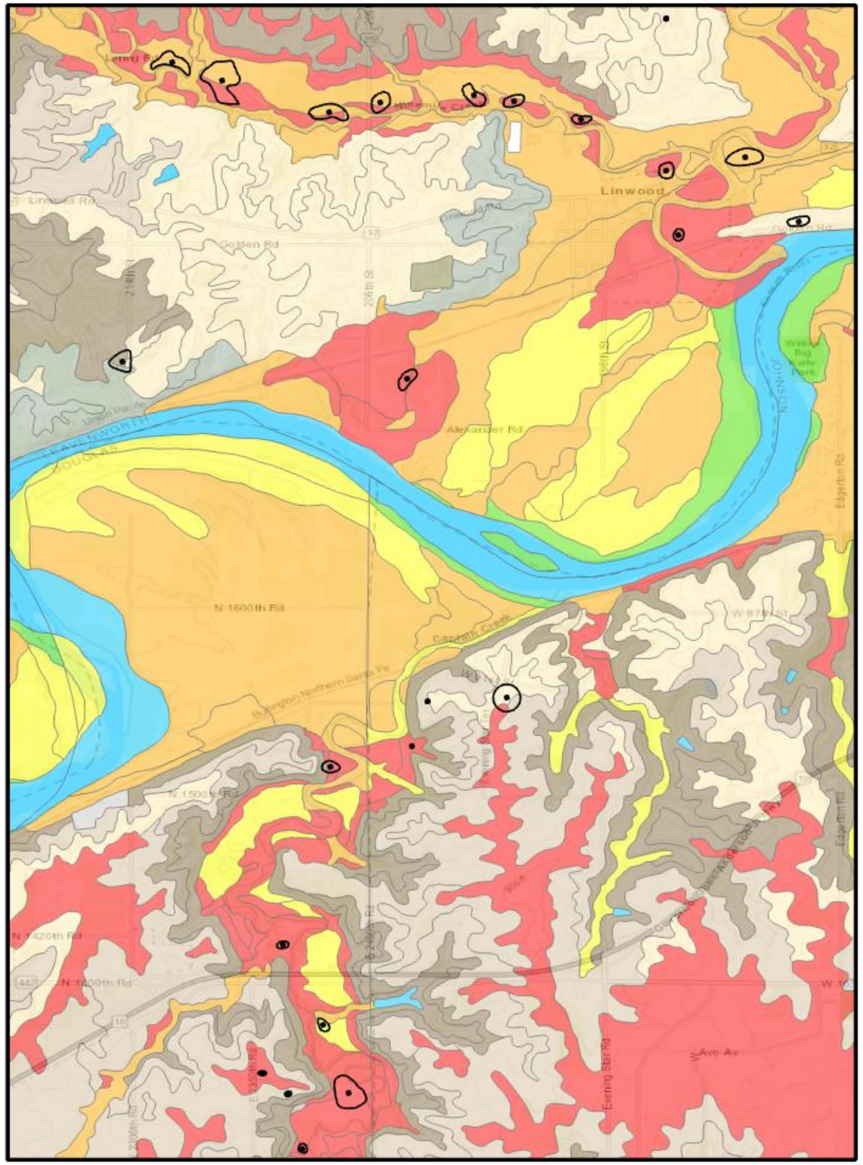
Tested results against known archaeo sites
- Eastern Kansas
- High density of known archaeo sites
- Database is confidential

Multiple methods
- Intersect, completely within, centroid

Revised sites
- Remove sites located in water

Eastern Kansas analysis compared to known Archaeo sites
- Approximately 60-72% of sites associated with high potential
- Another 21–29% of sites with moderate-high polygons

Important limitations
- Spatial scale of the soil survey data
- Uncertain nature of soil mapping



Selected area along Kansas river

Intersect (24)
- High (9)
- Loess (2)
- Low-Moderate (1)
- Moderate-High (10)
- Till (2)
- Uplands (1)

Completely within (8)
- High (4)
- Loess (2)
- Moderate-High (1)
- Till (1)

Centroid (24)
- High (11)
- Loess (3)
- Low-Moderate (1)
- Moderate-High (6)
- Till (2)
- Uplands (1)

HIGH
LOESS
LOW
LOW-MODERATE
MODERATE-HIGH
MODIFIED
OUTWASH
SPOIL/FILL
TILL
UPLANDS
WATER

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Thanks!

Future Work:

- Test model in Rocky Mountain Front Range
- Ground-truthing
- Complete analysis in western, central Kansas

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- Nebraska Department of Transportation
- State of Kansas Historical Society

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