

DIGITAL MAPPING TECHNIQUES 2023

The following was presented at DMT'23
May 21 - 24, 2023

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2023)

<http://ngmdb.usgs.gov/info/dmt/>

Boundary Challenges in Ensuring Gapless Data

Presented by Emily Bunse

ebunse@ku.edu

Kansas Geological Survey
Digital Mapping Techniques
(DMT) 2023, Anchorage, AK

Collaboration from
John Dunham (KGS),
Ken Nelson (KGS),
Dee Lund (ISGS).

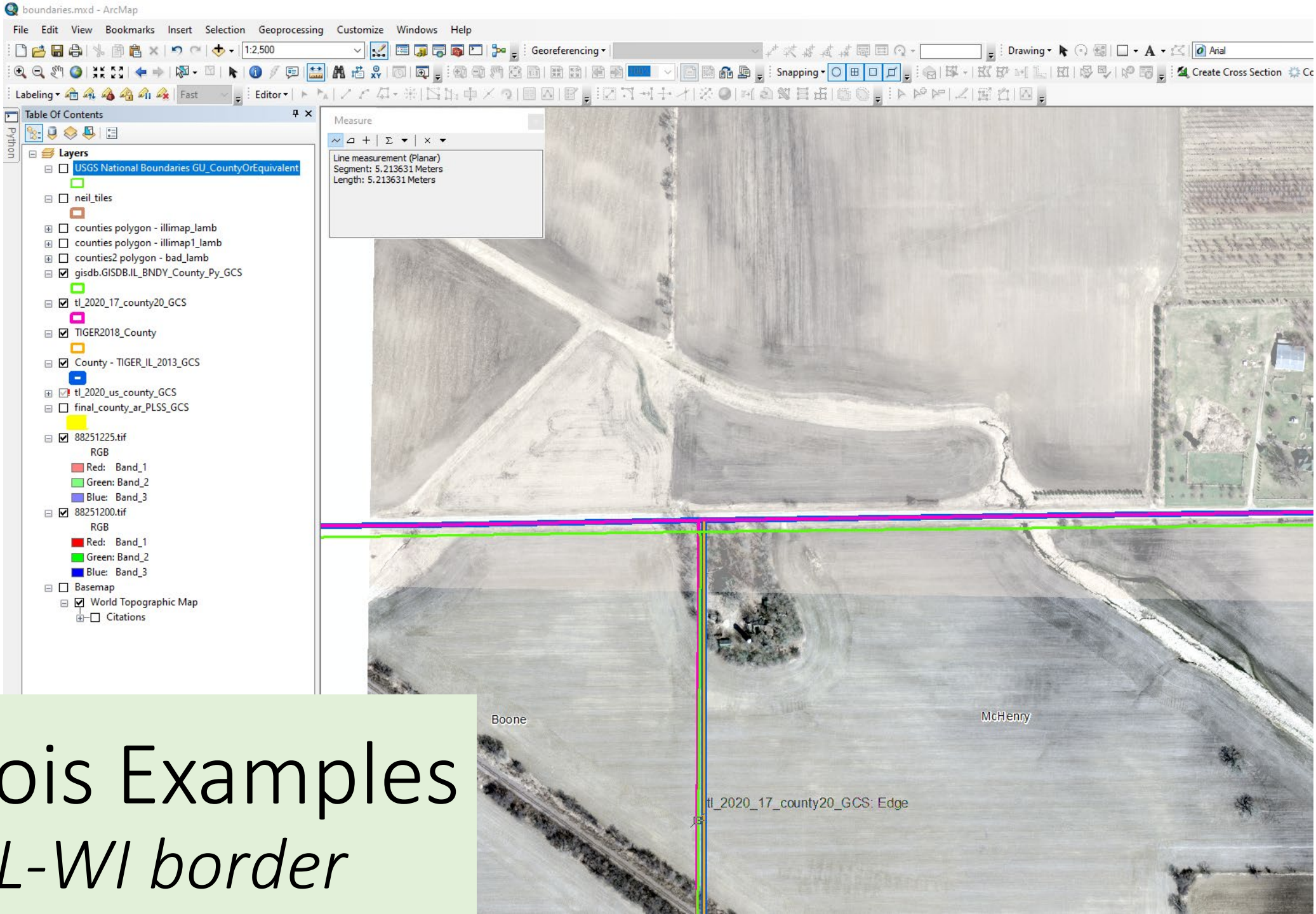
Boundary Effect

boundary effect

[Share URL](#) 

1. [data quality] A problem created during spatial analysis, caused by arbitrary or discrete boundaries being imposed on spatial data representing nondiscrete or unbounded spatial phenomena. Boundary problems include edge effects, in which patterns of interaction or interdependency across the borders of the bounded region are ignored or distorted, and shape effects, in which the shape imposed on the bounded area affects the perceived interactions between phenomena.

Fundamental problem of GIS (we are not alone!)



Illinois Examples
IL-WI border

Boone

McHenry

tl_2020_17_county20_GCS: Edge

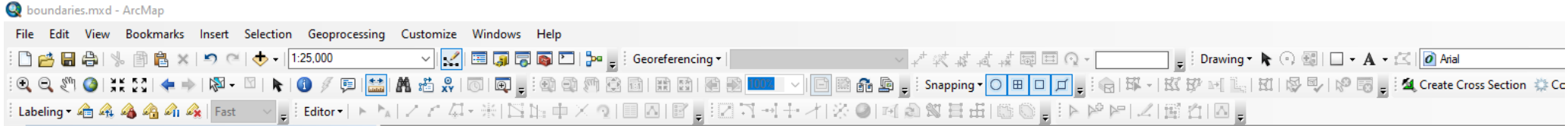
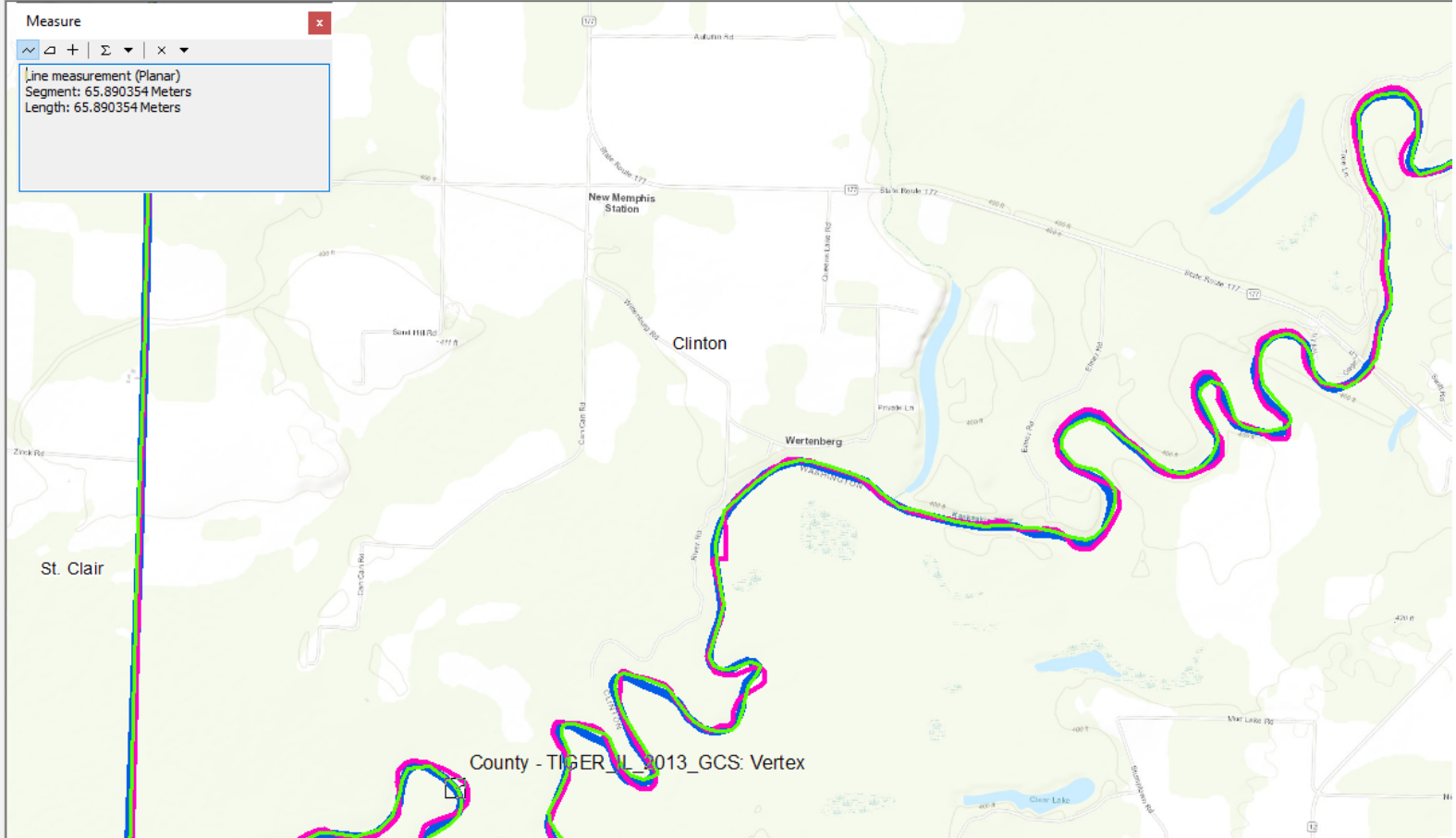
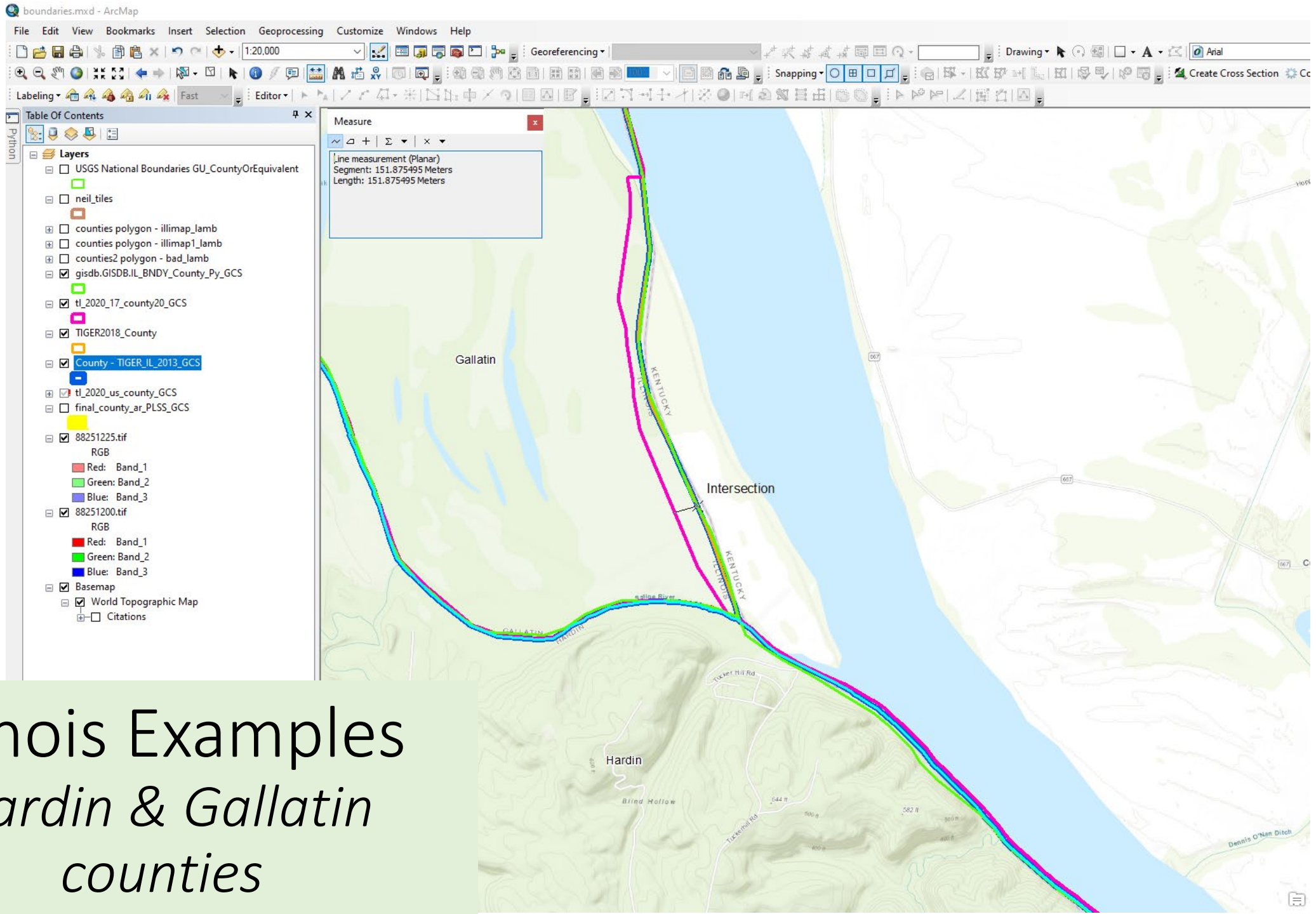


Table Of Contents

- Layers
 - USGS National Boundaries GU_CountyOrEquivalent
 - neil_tiles
 - counties polygon - illimap_lamb
 - counties polygon - illimap1_lamb
 - counties2 polygon - bad_lamb
 - gisdb.GISDB_IL_BNDY_County_Py_GCS
 - tl_2020_17_county20_GCS
 - TIGER2018_County
 - County - TIGER_IL_2013_GCS
 - tl_2020_us_county_GCS
 - final_county_ar_PLSS_GCS
 - 88251225.tif
 - RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
 - 88251200.tif
 - RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
 - Basemap
 - World Topographic Map
 - Citations

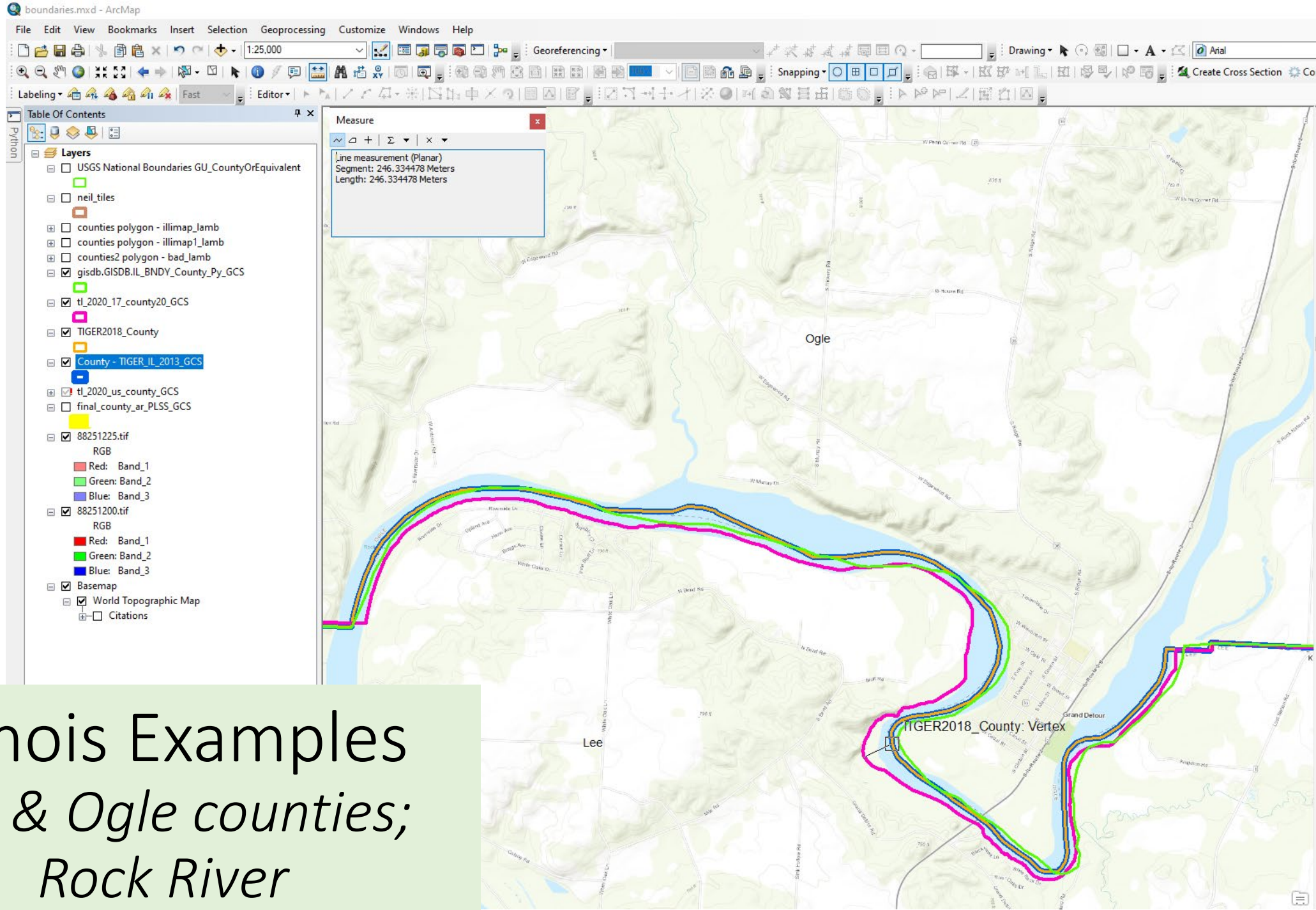


Illinois Examples
*Clinton & Washington
counties*



Illinois Examples

Hardin & Gallatin counties



Illinois Examples
*Lee & Ogle counties;
Rock River*

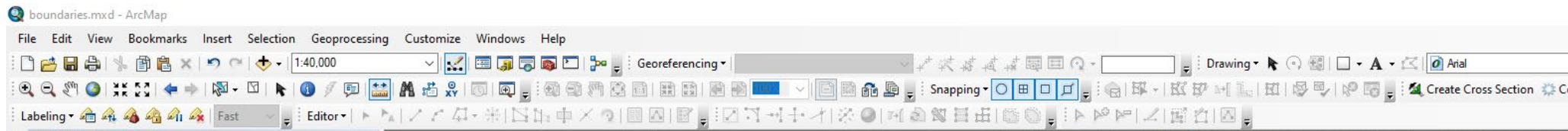
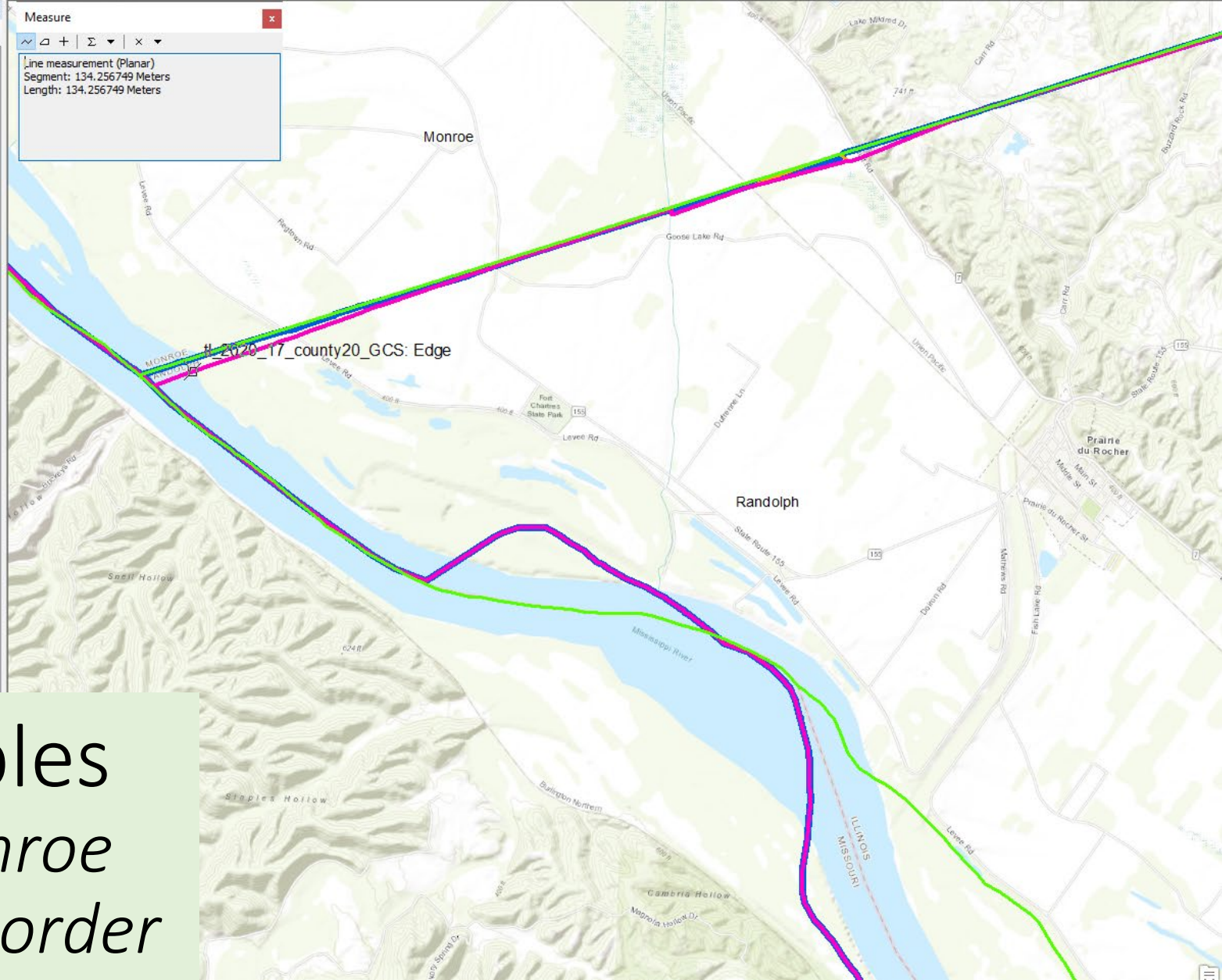


Table Of Contents

- Layers
 - USGS National Boundaries GU_CountyOrEquivalent
 - neil_tiles
 - counties polygon - illimap_lamb
 - counties polygon - illimap1_lamb
 - counties2 polygon - bad_lamb
 - gisdb.GISDB.IL_BNDY_County_Py_GCS
 - tl_2020_17_county20_GCS
 - TIGER2018_County
 - County - TIGER_IL_2013_GCS
 - tl_2020_us_county_GCS
 - final_county_ar_PLSS_GCS
 - 88251225.tif
 - RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
 - 88251200.tif
 - RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3
 - Basemap
 - World Topographic Map
 - Citations



Illinois Examples
*Randolph & Monroe
counties, IL; MO border*

County Boundaries

Measure Distance

Planar Metric

Result

Distance

Segment (m)	Path (m)	Sum (m)
223.26	223.26	223.26

Path Net Bearing: 185°
Path Net Distance: 223.26 m

223.26 m

Kenneth Heywood Park
University Park Golf Course

Garrison Recreation Area

Pottawatomie
Riley

Service Layer Credits

Riley County IT/GIS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, Esri, NASA, NGA, USGS, FEMA

1:50,000 | 96.6875428°W 39.3724049°N | Selected Features: 0

Kansas Examples
*Pottawatomie & Riley counties;
Tuttle Creek Lake*

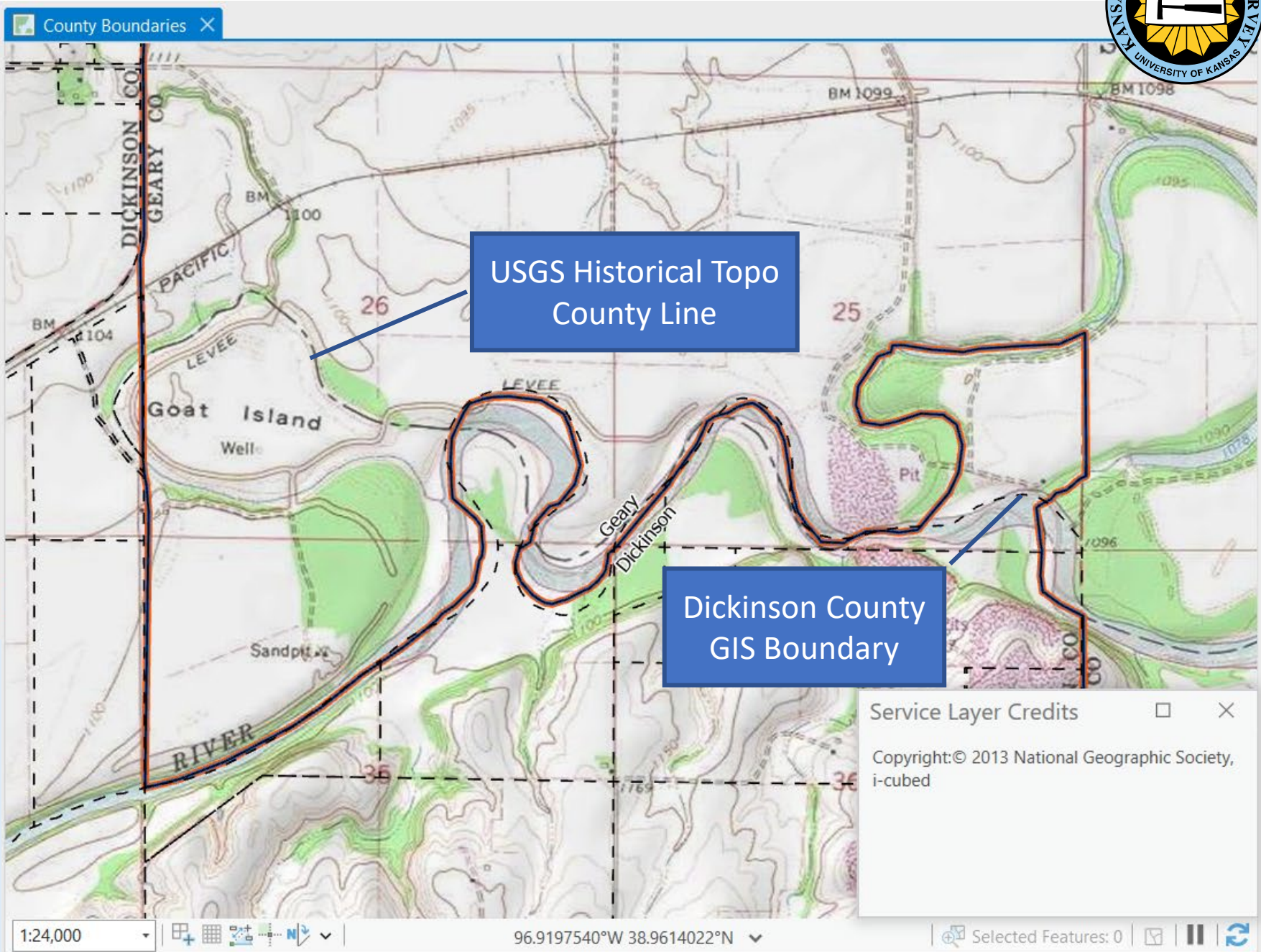
Contents

Search

Drawing Order

- County Boundaries
- TaxParcels2023 (Dickinson Co)
- Kansas County Boundaries View
- GU_CountyOrEquivalent
- tl_2013_us_county
- tl_2020_us_county
- USA_Topo_Maps

agree



Kansas Examples
*Dickinson & Geary
counties;
Smoky Hill River*

Similar to the Problem with Datums

Projecting from NAD27 to NAD83



Why are the NAD 83 position values so far from the NAD 27 values? Were the old coordinates wrong?

The old coordinates were not wrong, just different.

Positions obtained using the North American Datums of 1927 (NAD 27) and 1983 (NAD 83) are based on different earth shapes--or ellipsoids--and used the best technology available at the time. Mathematically, NAD 83 is a stronger datum because all previously existing horizontal stations and newer GPS surveyed stations were adjusted simultaneously. The positions within NAD 27 were adjusted in arcs, as the networks progressed across the country. Errors between stations adjusted in different arcs could have been substantial.

This issue is of declining importance and is seldom relevant to anything other than historical USGS maps (generally meaning maps published before 1990). All modern maps and GIS data are cast on NAD 83 or WGS 84, which are equivalent datums at map scales of 1:5,000 and smaller.

All federal agencies will replace NAD 83 and NAVD 88 (a vertical datum) with a [new datum](#) in 2022.

<https://www.usgs.gov/faqs/why-are-nad-83-position-values-so-far-nad-27-values-were-old-coordinates-wrong>



How large is the North American Datum of 1927 (NAD 27) to NAD 83 shift?

Within the conterminous 48 states, the North American Datum of 1927 (NAD 27) to the North American Datum of 1983 (NAD 83) shift of the latitude/longitude graticule (lines showing parallels of latitude and meridians of longitude for the earth) is in the range of **10-100 ground meters**. Changes to UTM values are generally larger, around 200 meters, and changes for other coordinate systems are different.

<https://www.usgs.gov/faqs/how-large-north-american-datum-1927-nad-27-nad-83-shift>

...let alone the numerous “realizations” of NAD83

- 2011
- NSRS 2007
- HARN

(see [NOAA National Geodetic Survey](#))

Suggestions from Datums Write Up

“Possible ways to deal with the gaps (and overlaps) include:

- (1) live with the gaps and overlaps;
- (2) establish, as agency or workgroup policy, that only one set of quad boundaries will be used (e.g., NAD27);
- (3) include with all quadrangle-map GIS data a buffer of circa 150 m additional data beyond the quad boundary.”

Illinois Examples
*Hardin County
& Ohio River*



What approach can we agree upon?

Common Boundary Data Source

- ▲ TaxParcels2023 (Dickinson Co)
- ▲ Kansas County Boundaries View
- ▲ GU_CountyOrEquivalent
- ▲ tl_2013_us_county
- ▲ tl_2020_us_county
- USA_Topo_Maps

When there is a county GIS department, are they the authoritative supplier of county boundaries for *geological* mapping purposes?

What role do statewide GIS organizations, such as the KS Data Access and Support Center (DASC), play in providing authoritative data for *geological* mapping?

Should we simply agree to use the most current version of the USGS National Map's National Boundary Dataset (NBD) for county *geological* mapping? *

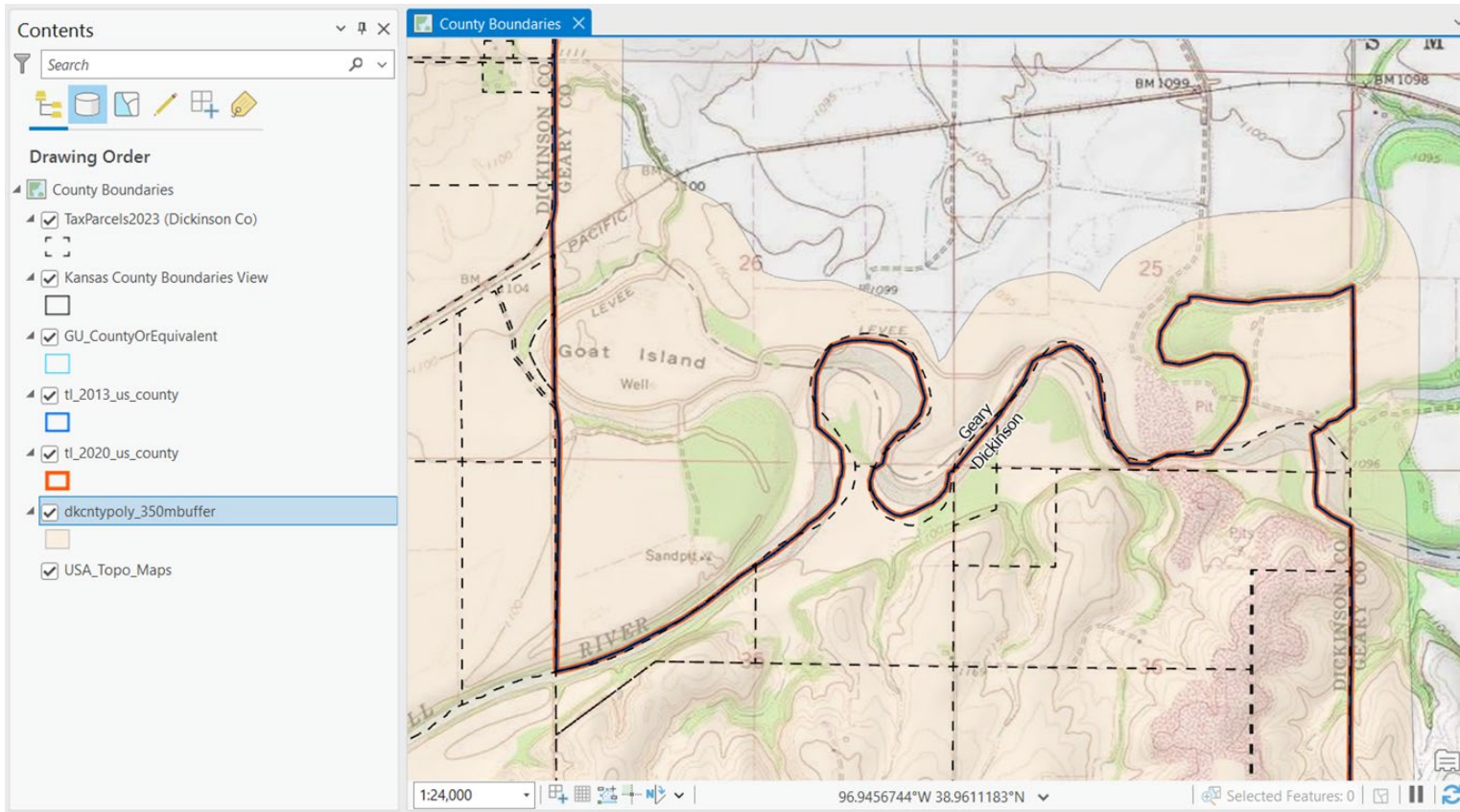
* The NBD uses TIGER data for counties. The metadata explicitly states that, "The USGS uses the TIGER data without editing or alteration."

If we agree to use the latest U.S. Census Bureau TIGER county boundaries, how do we reconcile mismatches over the years?

No matter the standards we use in mapping, there will always be matching issues with ESRI basemaps and other online mapping services. Do we mitigate or let it go?

What approach can we agree upon?

Common Standard(s?)/Approach(es?)

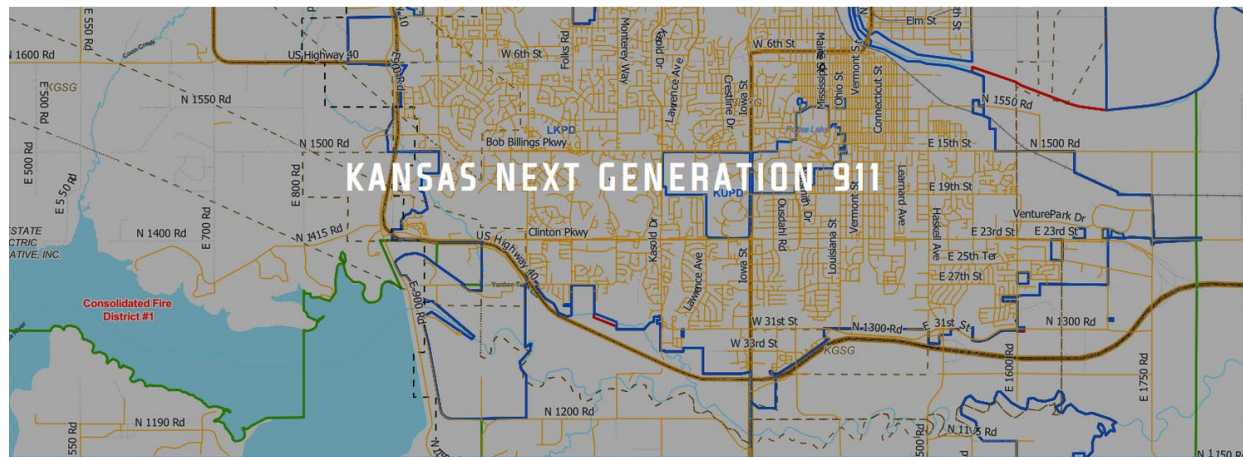


Buffering considerations

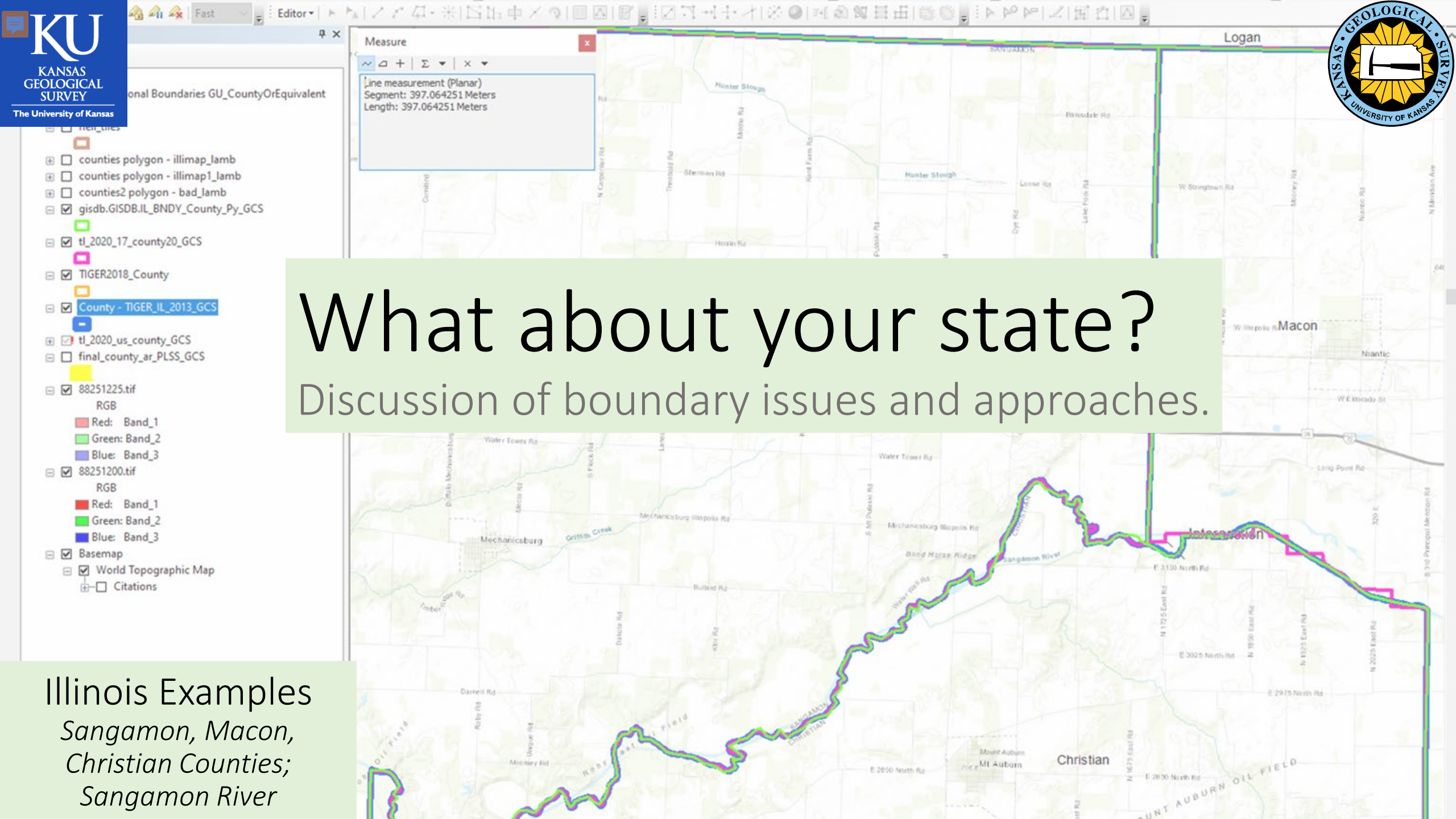
- How to handle overlapping data in compilations (better than gaps/slivers)?
- Clip the GeMS data or leave the buffer?
- Should the buffer distance be standardized?

What are other agencies using for boundaries?

- SSURGO – map using National Hydrography Dataset (NHD) Hydrologic Unit Code (HUC) subbasin boundaries
- Next Generation 911 – lessons in deciding on an authoritative, continuous (no gaps, overlaps) set of boundaries for the purpose
- DOT – it seems state DOTs use TIGER data for county highway maps.



Geographic Information System (GIS) technology, associated statewide geographic data layers, and location-based system components are the cornerstone of a Next Generation 911 (NG911) system.



What about your state?
Discussion of boundary issues and approaches.

Illinois Examples
Sangamon, Macon,
Christian Counties;
Sangamon River

Data, References, and Further Reading

- Dickinson County, Kansas, 2023, 2023 Parcels [shapefile format download]: <https://www.dkcoks.gov/155/Maps-and-Data> (accessed May 2023).
- ESRI, GIS Dictionary ["Boundary Effect"], <https://support.esri.com/en-us/gis-dictionary/boundary-effect> (accessed May 2023).
- Haugerud, Ralph, 2023, What datum(s) should be used for our geologic map GIS databases?: https://ngmdb.usgs.gov/Info/standards/GeMS/docs/Datums_for_geologic-map_GIS.pdf (accessed May 2023).
- National Geodetic Survey, 2018, Horizontal and Geometric Datums: National Oceanic and Atmospheric Administration (NOAA), <https://geodesy.noaa.gov/datums/horizontal/index.shtml> (accessed May 2023).
- Price, Mike, 2020, Mapping SSURGO Soils with ArcGIS Pro: ArcUser, Spring 2020, <https://www.esri.com/about/newsroom/arcuser/ssurgo/> (accessed May 2023).
- U.S. Census Bureau, TIGER Line Shapefiles (2010, 2013, 2018, 2020) accessed at <https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html> in May 2023.
- U.S. Geological Survey, Why are the NAD 83 position values so far from the NAD 27 values? Were the old coordinates wrong?: <https://www.usgs.gov/faqs/why-are-nad-83-position-values-so-far-nad-27-values-were-old-coordinates-wrong> (accessed May 2023).
- U.S. Geological Survey, How large is the North American Datum of 1927 (NAD 27) to NAD 83 shift?: <https://www.usgs.gov/faqs/how-large-north-american-datum-1927-nad-27-nad-83-shift> (accessed May 2023).