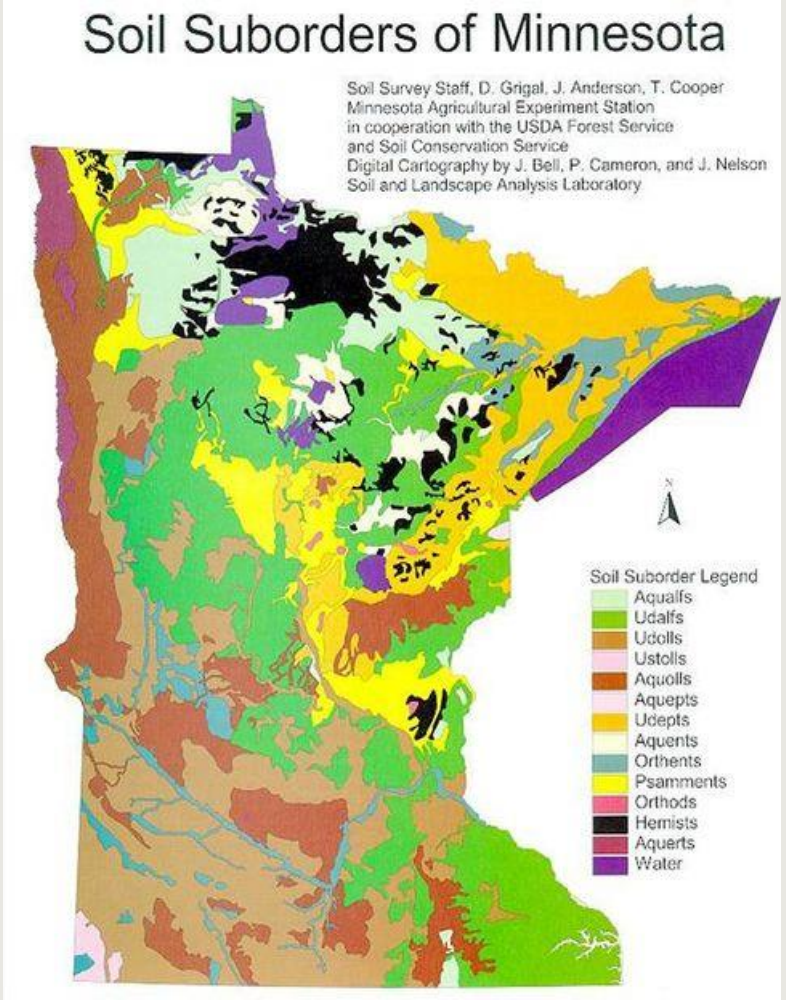
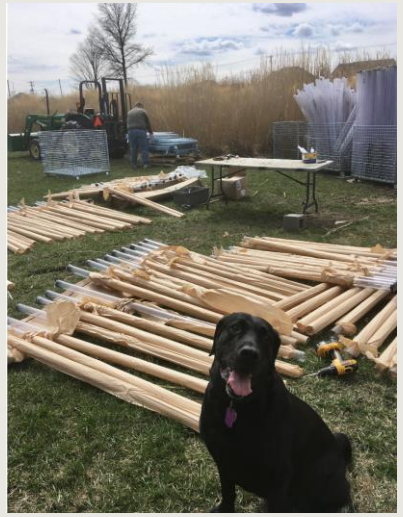
Creating Soil Maps Using the SSURGO Database & ArcGIS Pro

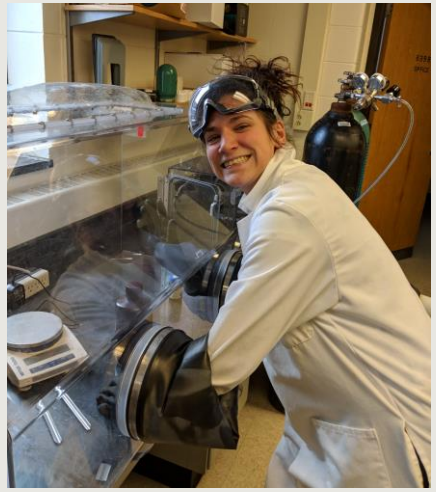
JESS MULCRONE • U-SPATIAL • UMN • 2024



Hi, I'm Jess

I work at USpatial with the University of Minnesota as a GIS Specialist. Before working here, I lived in Champaign IL working as a researcher for agriculture, ecology, and soil labs at the University of Illinois.





So, making soil maps is right up my ally!

The SSURGO Database

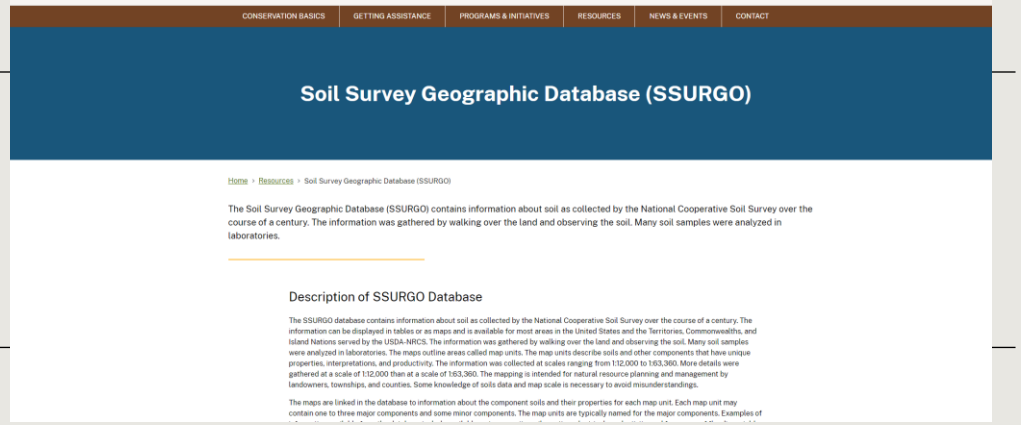
“The SSURGO database contains information about soil as collected by the National Cooperative Soil Survey over the course of a century. The information can be displayed in tables or as maps and is available for most areas in the United States and the Territories, Commonwealths, and Island Nations served by the USDA-NRCS. The information was gathered by walking over the land and observing the soil. Many soil samples were analyzed in laboratories. The maps outline areas called map units. The map units describe soils and other components…”

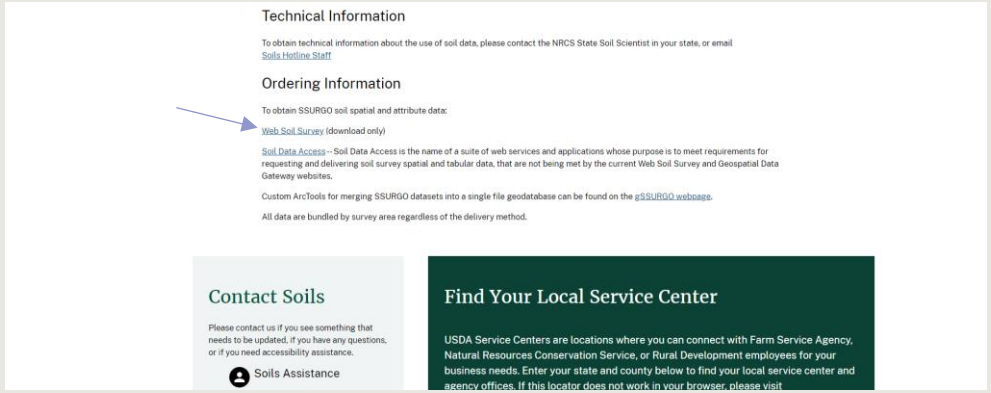
SSURGO Homepage

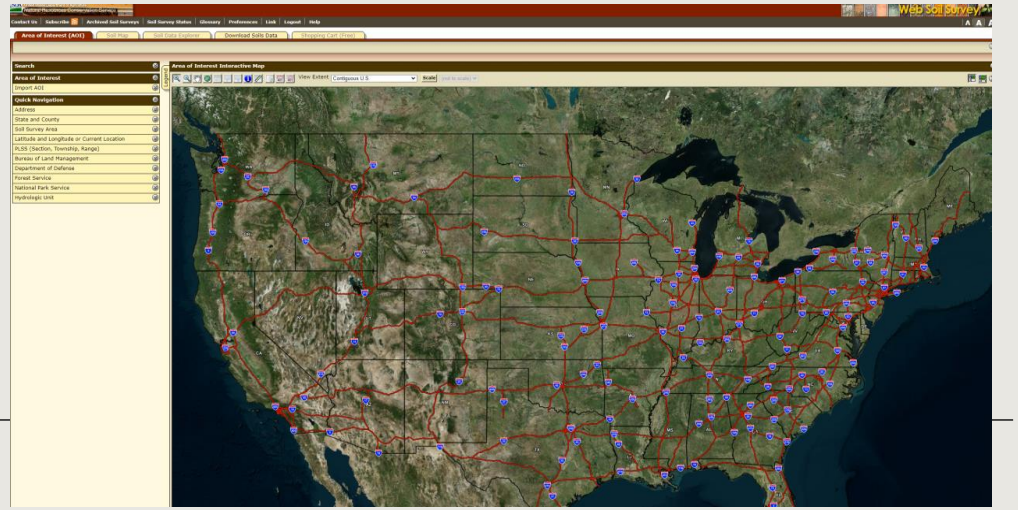
https://www.nrcs.usda.gov/resources/data-and-reports/soil-survey-geographic-database-ssurgo

Web Soil Survey

https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

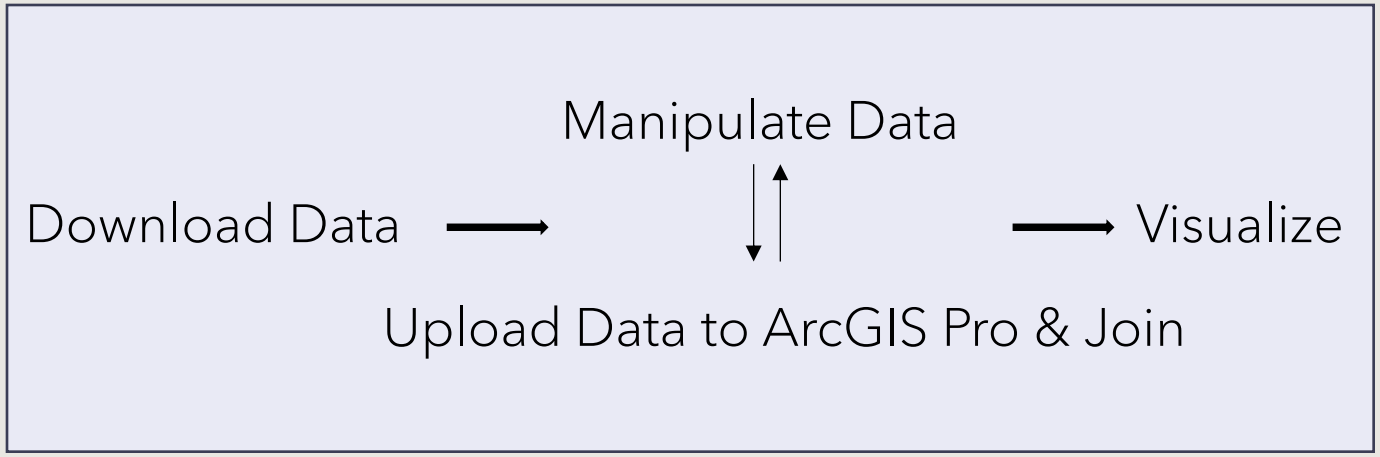






Steps to Create a Map from the SSURGO Database

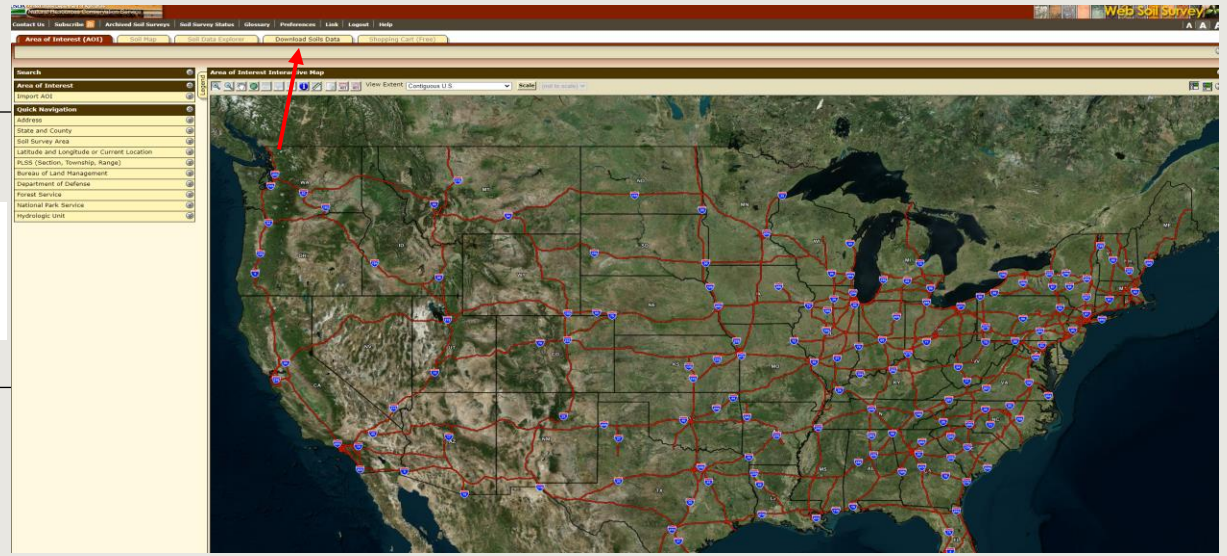
1) Get data spreadsheet from SSURGO via download.
2) Depending on your end goal, some mix of upload your data to ArcGIS Pro, join your spreadsheet data to other tables, and manipulate your data tables.
3) Visualize data by symbolizing map.



Soil Data Download

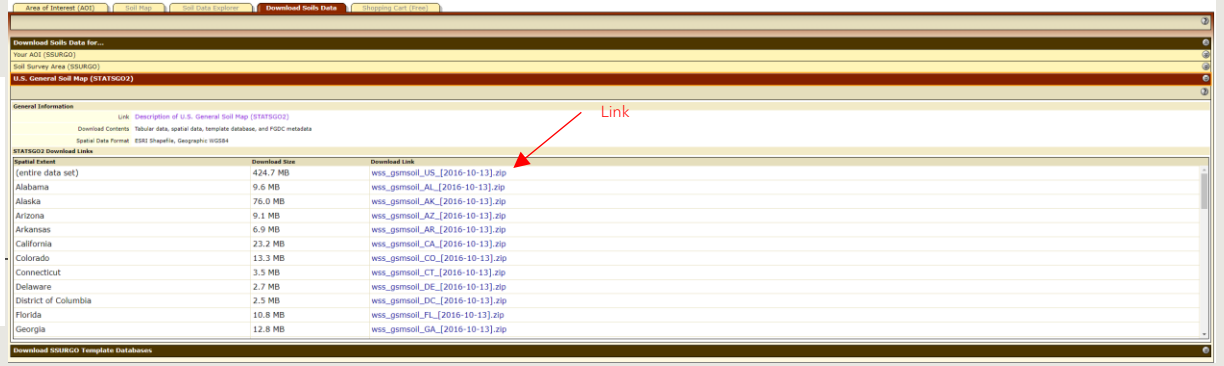
- From the SSURGO homepage select “Web Soil Survey” link towards bottom of the page, then the green “Start WSS” button. Next select the Download Soils Data tab (pictured right).
- There are 3 main ways to select an Area of Interest (AOI) for which to download data from. You can:
    1) Select spatially by uploading a shapefile or drawing the area.
    2) Select a county under the Soil Survey Area (SSURGO) section of the Download Soils Data Tab.
    3) Select the entire country or an entire state under the U.S. General Soil Map (STASGO20 section of the Download Soils Data tab).
- Generally, using 2 or 3 will be a better method than 1.
- Download by selecting the link in blue.

Spatial

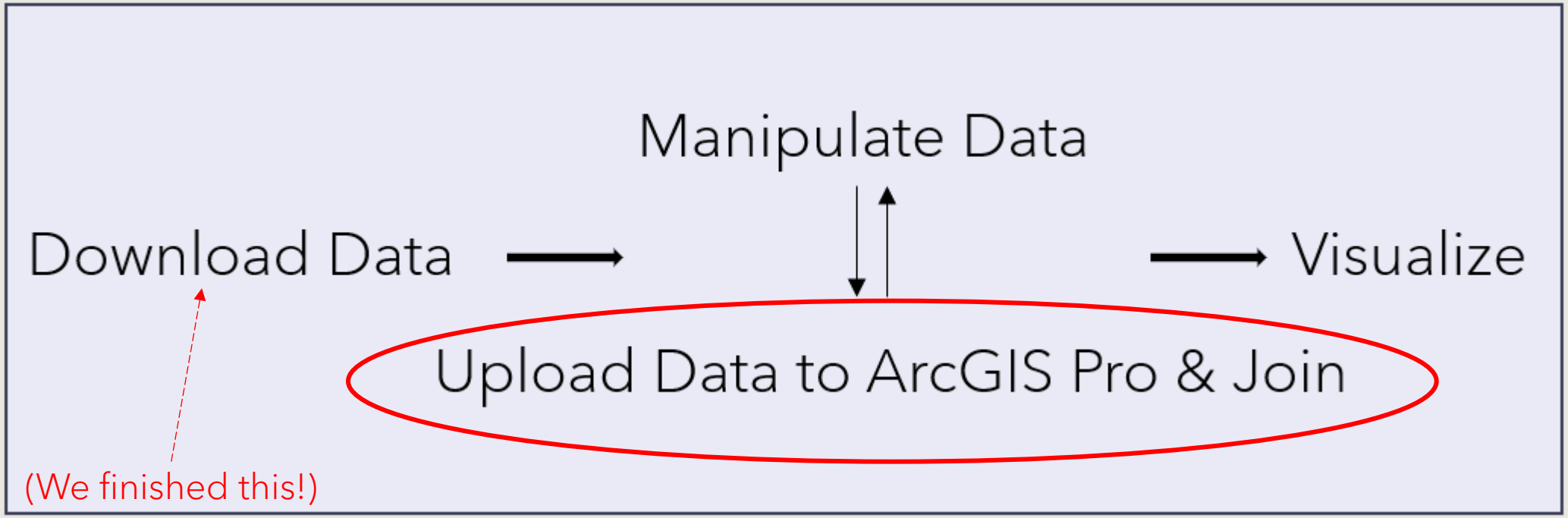


County

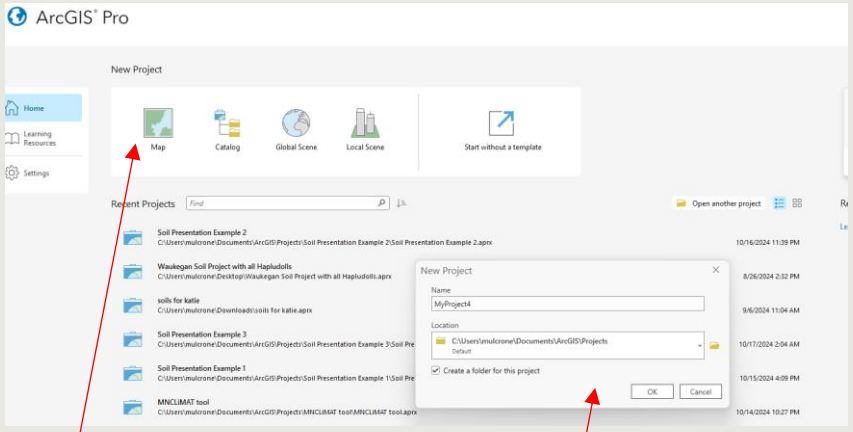
Entire US/ State



We're Here:


Manipulate Data
Download Data
Visualize
Upload Data to ArcGIS Pro & Join
(We finished this!)

Very Quick ArcGIS Pro Tour:



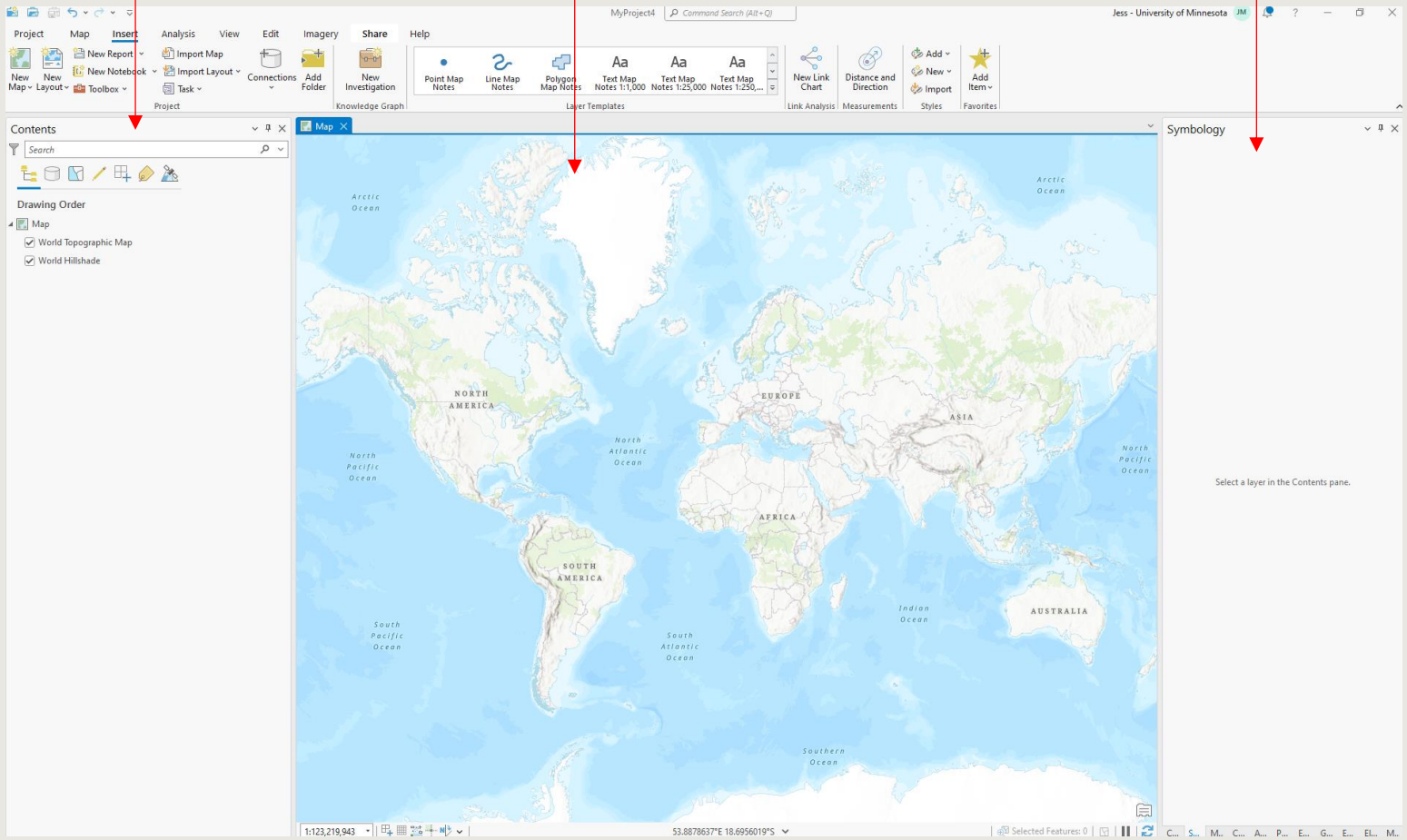
Click on the map to start a new project.

Name it and select OK.

Contents Pane

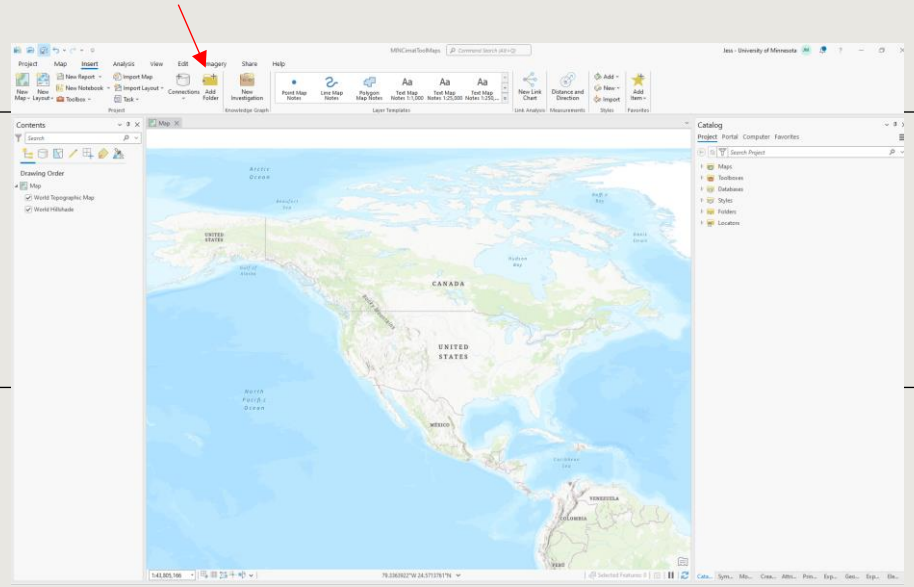
Map

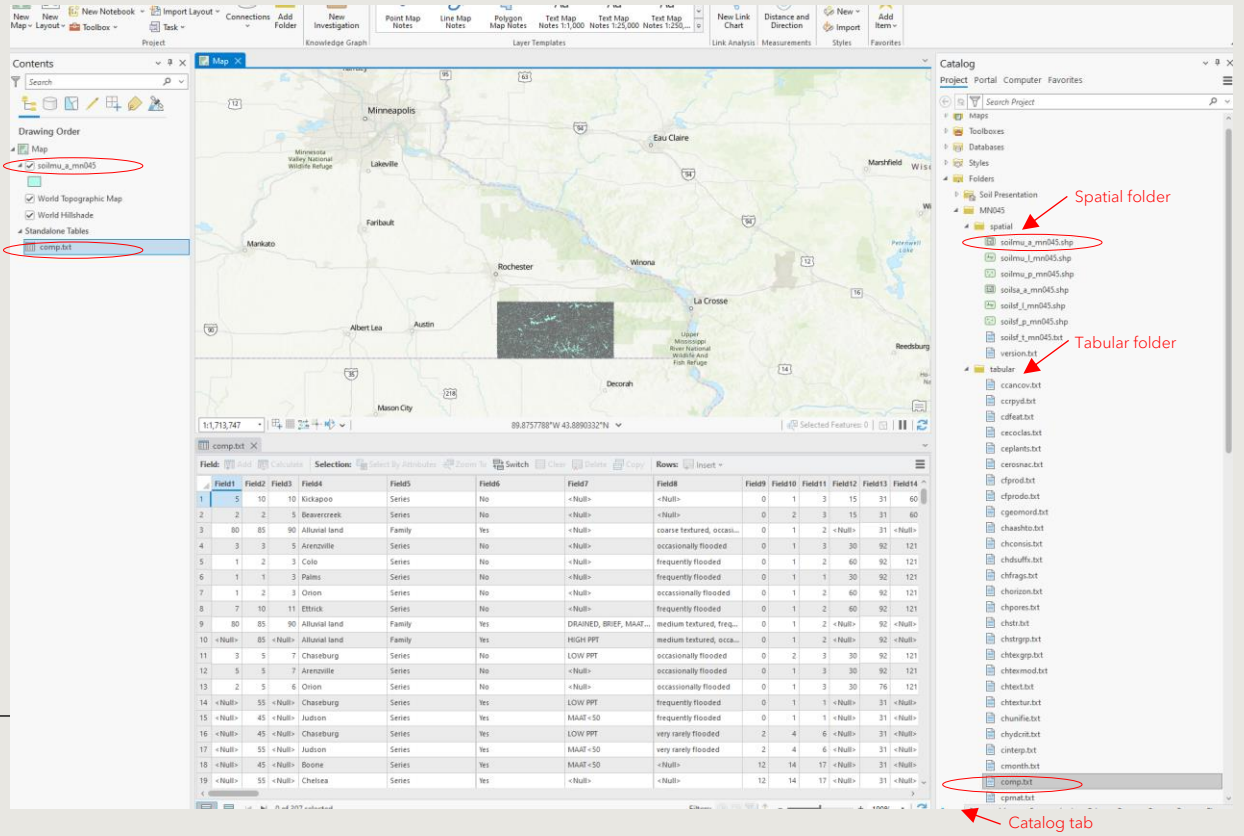
Right hand panel with tabs along the bottom for catalog, geoprocessing, symbolizing, and more.



Getting Data into ArcGIS Pro

- If you don't have ArcGIS Pro installed on your computer there are instructions here under the ArcGIS Pro section: https://rc.umn.edu/uspatial/software
- Once you open a new project select "Add Folder" under the "Insert" menu ribbon tab and navigate to the folder you just downloaded from SSURGO (you may need to unzip the folder first).
- Navigate to the "Catalog" tab at the bottom right-hand corner and expand the folder section. You should now see your SSURGO folder. There may be several maps under the spatial tab, but you are likely only interested in "soilmu_a_x" file. Drag and drop it into the map and it will appear both on the map and in the contents pane on the left.
- Below the spatial folder there will be a tabular folder. It contains many txt files but most of the time you only need the comp file. Drag and drop this file to the map as well, then right click and select Open in the window that appears to view.
- You now have your data in ArcGIS Pro!



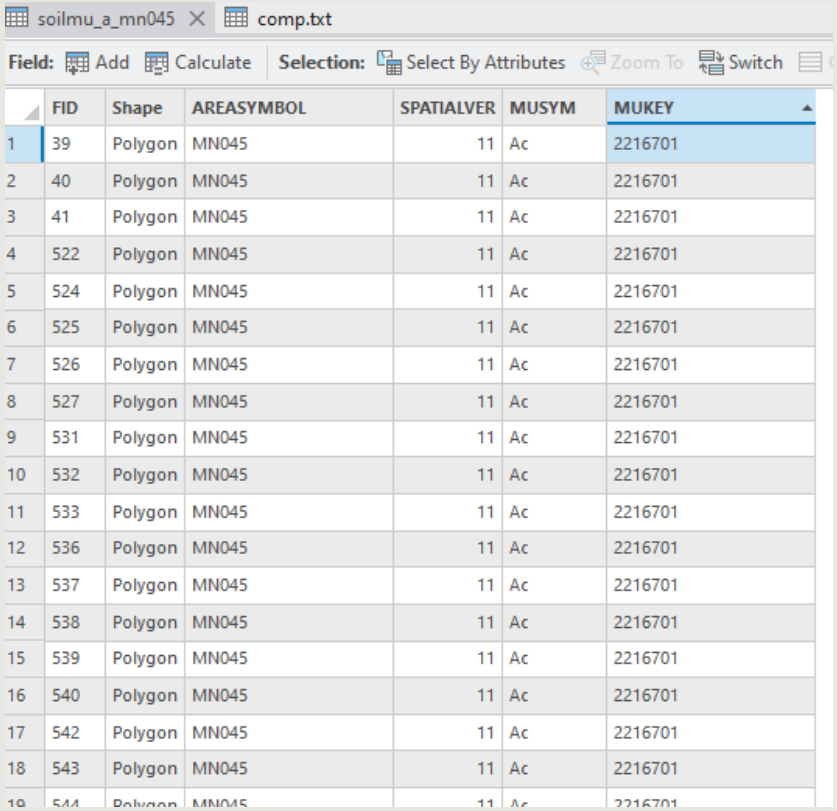


Using a Soil Data Comp Spreadsheet from SSURGO

- The comp data table has A LOT of columns (109 to be exact). You likely only need a handful. A few columns that will or might be useful are:
  - mukey (Mapunit key / Field108): A code representing a unique map unit. This is a very important field.
  - compname (Component Name / Field 4): The name of the soil series.
  - cokey (Component key / Field109): A code representing a unique component (soil series and characteristics).
  - comppct_r (Comp percent RV / Field2): The percentage of the component (soil series and characteristics) in the map unit.
  - majcompflag (Major component / Field6): Yes or No indicating whether the soil component is considered a major component of the map unit.
  - taxorder, taxsuborder, taxgrtgroup, taxsubgroup (Order / Field84, Suborder / field85, Great group / Field86, Group / Field87): The taxonomic groups.
- Unfortunately, the table can lose its column name headers and replace them with way less helpful field numbers. They've always been the same number and order when I've downloaded them but checking that they makes sense every time is smart. For more info on comp table columns see pages 35 – 42 here https://www.nrcs.usda.gov/sites/default/files/2022-08/SSURGO-Metadata-Table-Column-Descriptions-Report.pdf

Using a SSURGO Map Attribute Spreadsheet

- The map attribute table is much smaller than the comp table and only has 6 columns.
- The columns you will use are MUKEY, which represents a unique map unit like in the comp table, and the FID, which ties the MUKEY to a specific polygon. The attribute table has one row for each polygon on the map.
- MUKEY is the column used as the join field (or key) when performing joins because it is present in both tables.


soilmu_a_mn045 | comp.txt

Field: Add Calculate | Selection: Select By Attributes Zoom To Switch

	FID	Shape	AREASYMBOL	SPATIALVER	MUSYM	MUKEY
1	39	Polygon	MN045	11	Ac	2216701
2	40	Polygon	MN045	11	Ac	2216701
3	41	Polygon	MN045	11	Ac	2216701
4	522	Polygon	MN045	11	Ac	2216701
5	524	Polygon	MN045	11	Ac	2216701
6	525	Polygon	MN045	11	Ac	2216701
7	526	Polygon	MN045	11	Ac	2216701
8	527	Polygon	MN045	11	Ac	2216701
9	531	Polygon	MN045	11	Ac	2216701
10	532	Polygon	MN045	11	Ac	2216701
11	533	Polygon	MN045	11	Ac	2216701
12	536	Polygon	MN045	11	Ac	2216701
13	537	Polygon	MN045	11	Ac	2216701
14	538	Polygon	MN045	11	Ac	2216701
15	539	Polygon	MN045	11	Ac	2216701
16	540	Polygon	MN045	11	Ac	2216701
17	542	Polygon	MN045	11	Ac	2216701
18	543	Polygon	MN045	11	Ac	2216701
19	544	Polygon	MN045	11	Ac	2216701

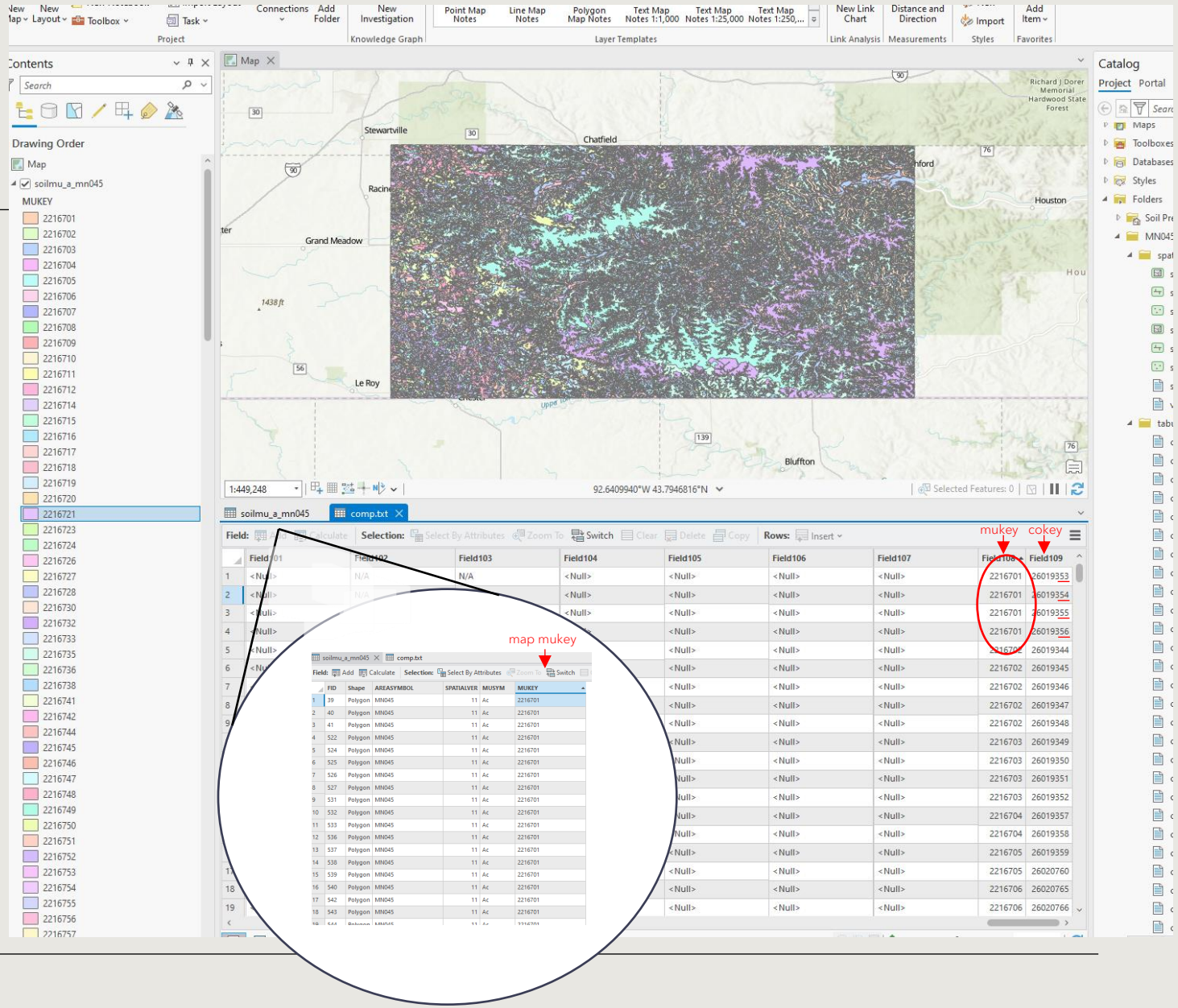
SSURGO Data Structure

To decide what to do next with our data, we need to think in terms of the SSURGO data structure.

In the screenshot to the right, the comp table is open, and the map attribute table shown in the magnifier.

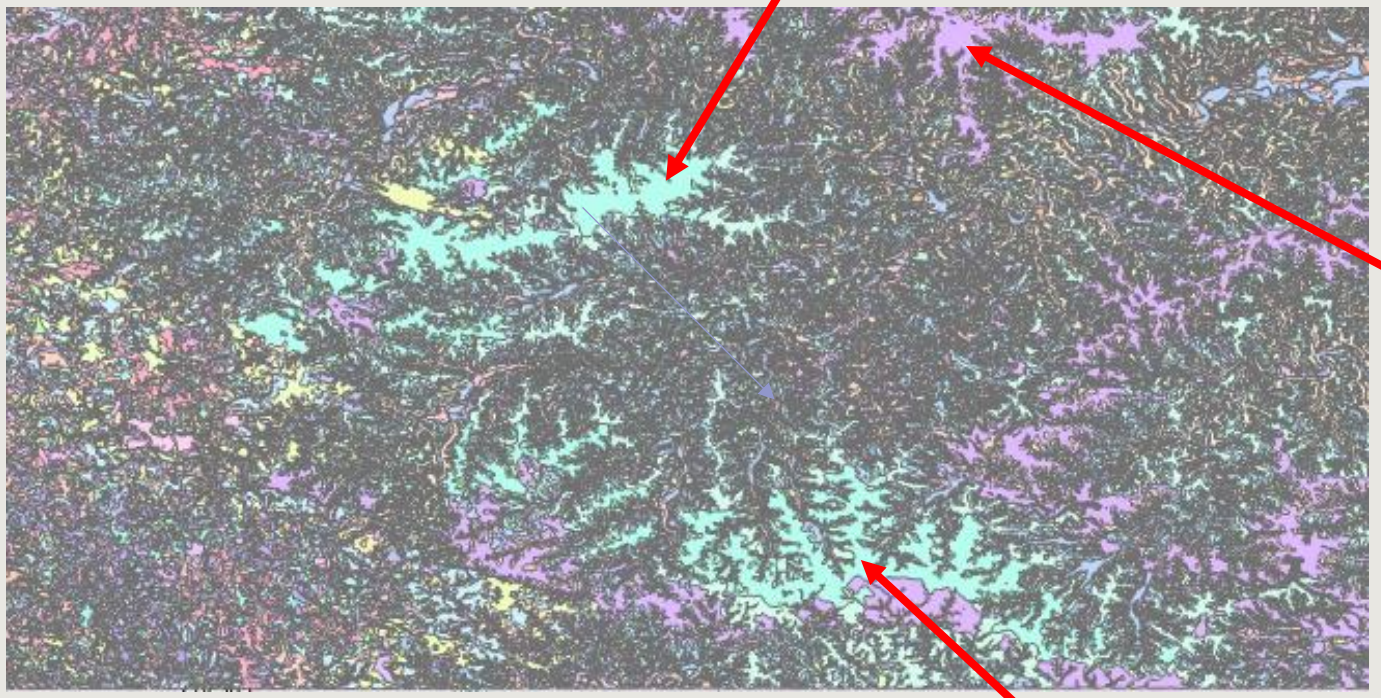
The map on the right is symbolized by mukey. These next points are a little confusing, but **important**:

- Each mukey represents a unique combination of soils, but that mukey often describes multiple polygons.
- Each cokey represents a unique soil component within a map unit. It's a code for a soil name – characteristics* - mukey combo. There can be multiple cokeys for one soil within a mukey due to different characteristics.
- The comp table has each cokey listed only once, but mukeys have a row in the comp table for each soil they contain.
- Meanwhile, the map attribute table will have a mukey listed as many times as there is a corresponding polygon on the map.
- SSURGO doesn't simply list the soils contained in each mukey because each row contains the information for one polygon with one object ID linking it to the map.



*I am not sure what the characteristics are or the threshold for difference.

Visual of mukey – soil relationship in case it helps!



MUKEY 1

contains

Soil A

Soil B

Soil C

MUKEY 2

contains

Soil B

Soil D

Soil E

Soil B with different characteristics

MUKEY 1

contains

Soil A

Soil B

Soil C

- The map has an attribute table with mukeys linked to spatial information.
- The information about which soils those mukeys contain comes from the comp table.

Example Questions:

- Which soil series or types are present in specific land parcels?
- Where are all the locations in a county that contain a soil series or type?
- What is the extent of a soil series or type over a region?

Example Question 1: Which soil series are present in these land parcels?

You have: A shapefile of polygons representing land parcels.

You want to know: Which soils are present in those land parcels.

Your product will be: A table.

Steps:

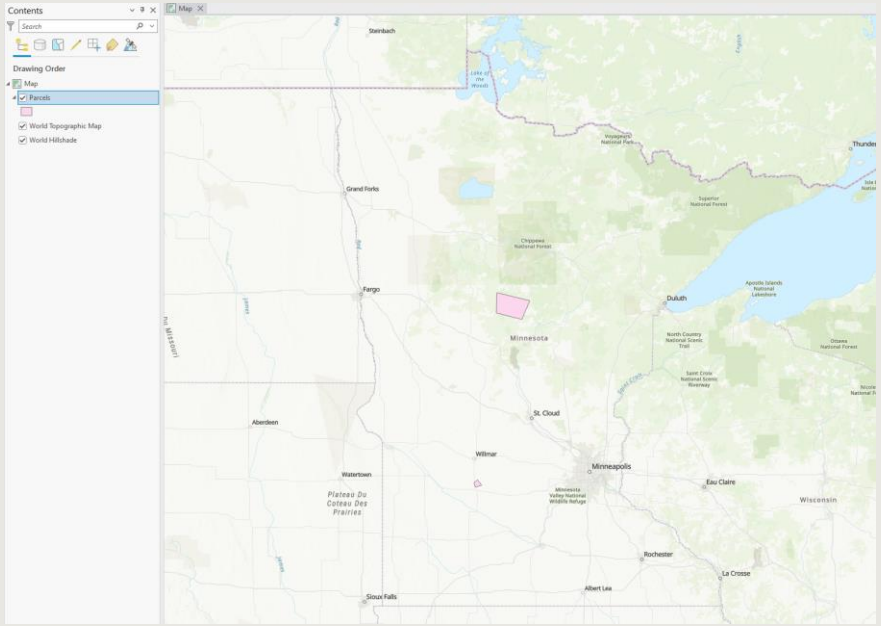
1) Download the soil data from SSURGO that covers all the land parcels.

2) Upload the SSURGO tabular and spatial data and your parcel shapefile into ArcGIS Pro.

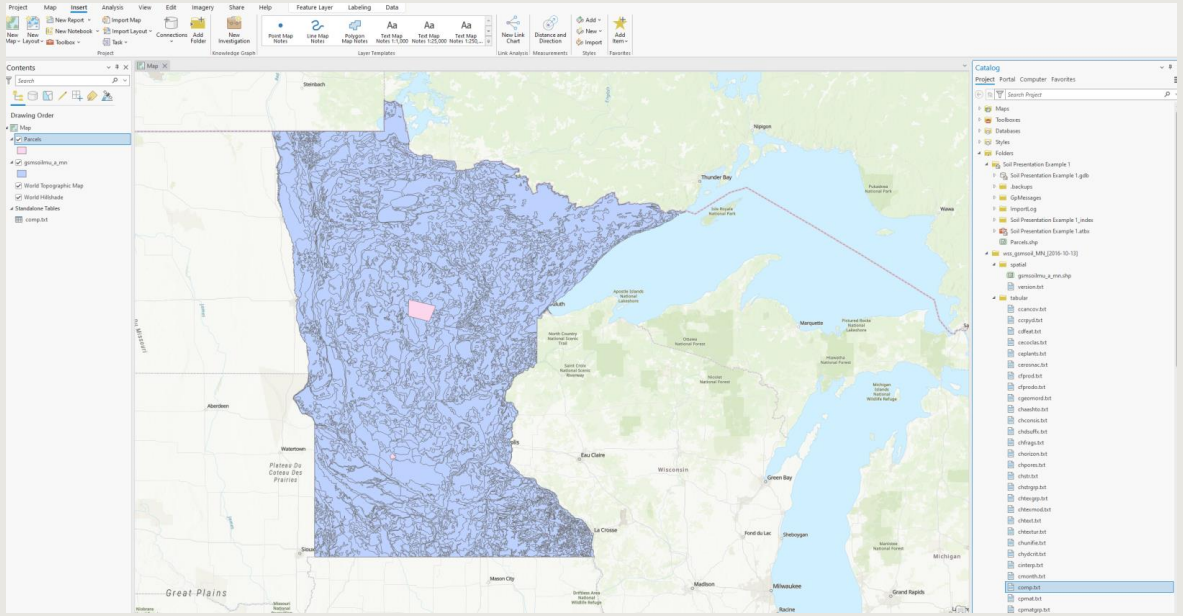
3) Perform a **spatial join** between the parcel layer and the SSURGO layer to get a table with a row for each mukey in each parcel.

3) Perform a **tabular join** between your new joined table and your comp table using mukey as the join field.

4) You can then sort your table by parcel name to see which soils are in which parcel.



So we have a parcel shapefile like this.



And we can get the SSURGO layer that looks like this. What we want is to know which mukeys correspond with the polygons under those two parcels, so we can link it to the comp table and know which soils are in those mukeys and therefore in the parcels.

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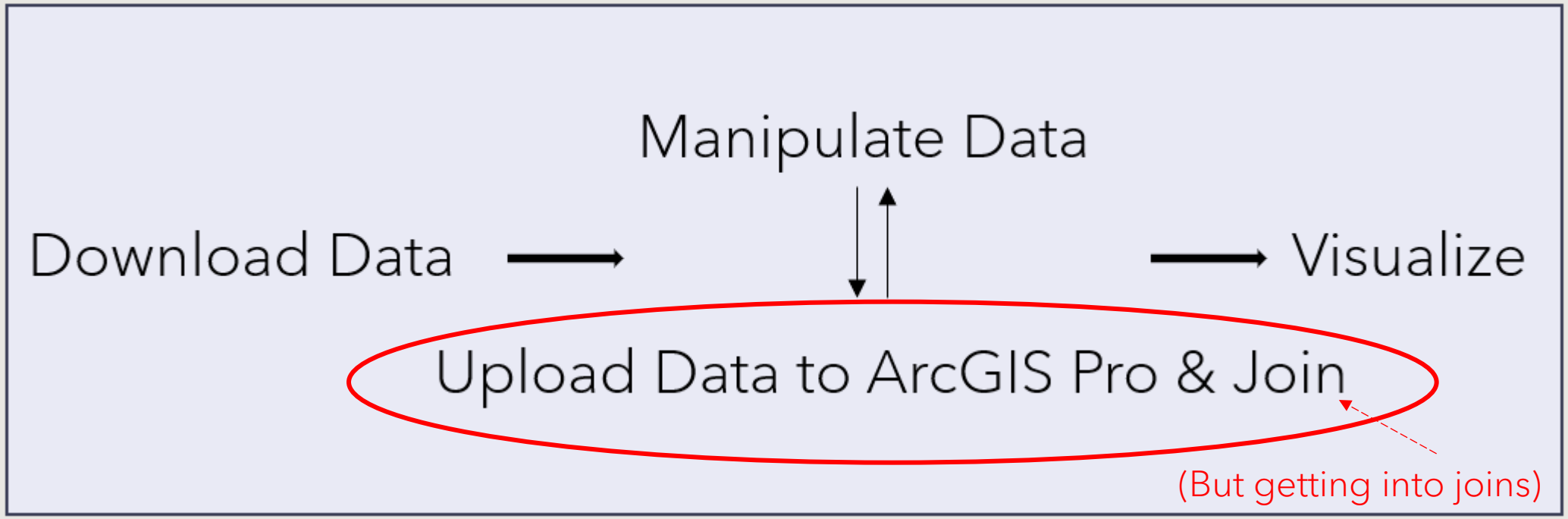
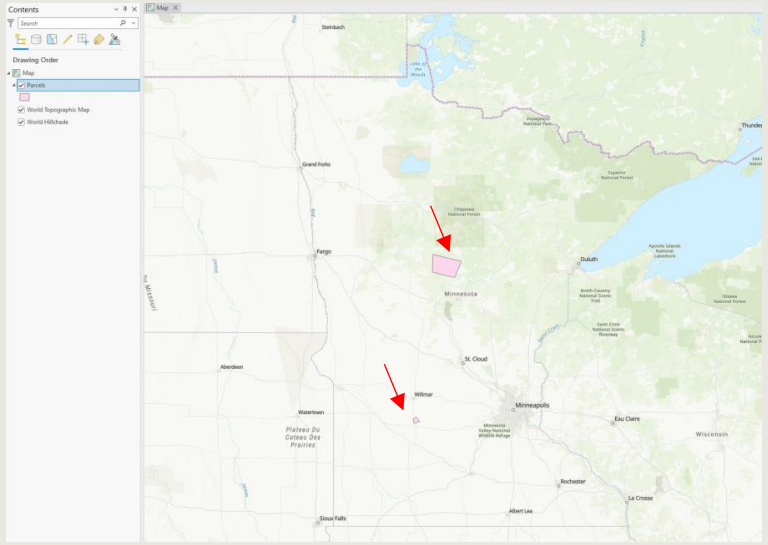
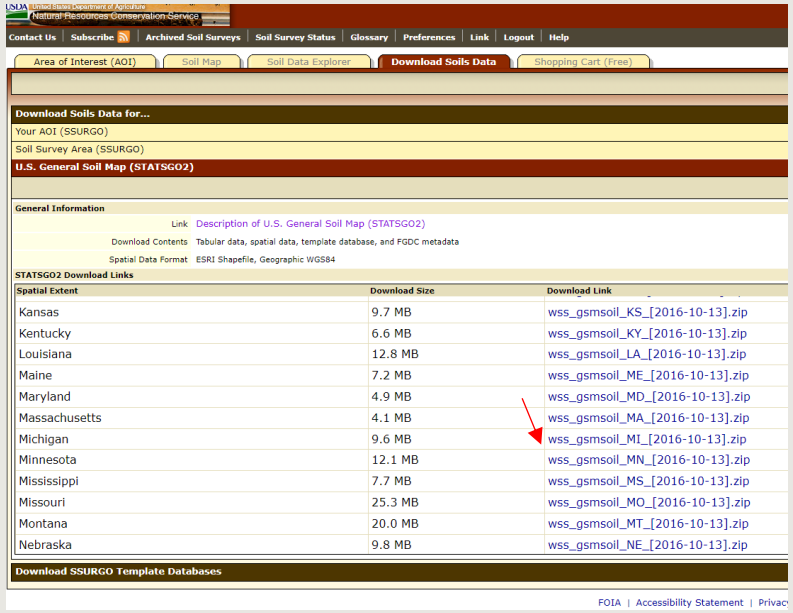
We're Still Here:



Parcel shapefile with 2 polygons:



1) Download SSURGO data that covers your parcel area.



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Area of Interest (AOI) | Soil Map | Soil Data Explorer | Download Soils Data | Shopping Cart (Free)

Download Soils Data for...

Your AOI (SSURGO)

Soil Survey Area (SSURGO)

U.S. General Soil Map (STATSGO2)

General Information

Link: Description of U.S. General Soil Map (STATSGO2)

Download Contents: Tabular data, spatial data, template database, and FGDC metadata

Spatial Data Format: ESRI Shapefile, Geographic WGS84

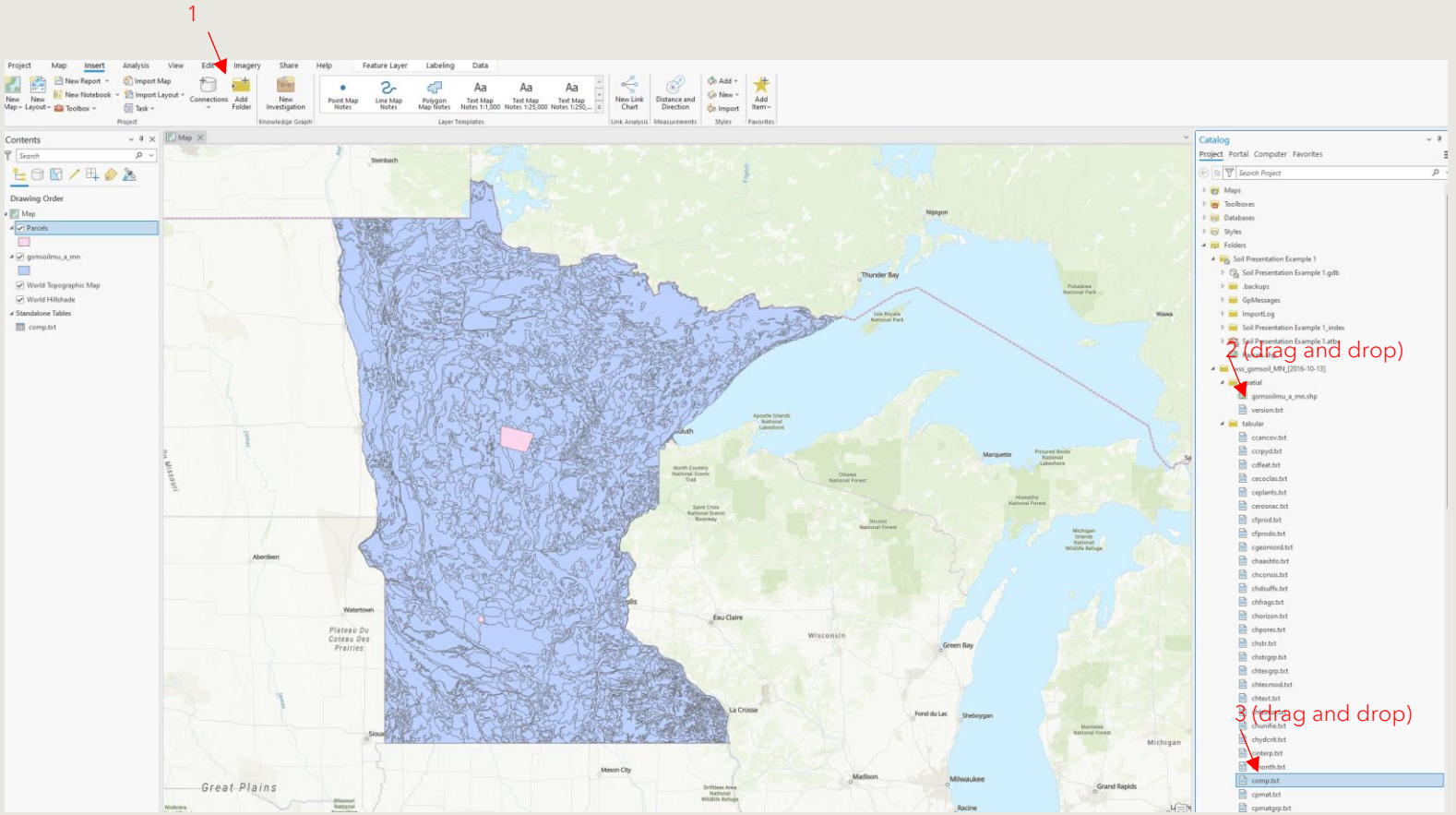
STATSGO2 Download Links

Spatial Extent	Download Size	Download Link
Kansas	9.7 MB	wss_gsmsoil_KS_[2016-10-13].zip
Kentucky	6.6 MB	wss_gsmsoil_KY_[2016-10-13].zip
Louisiana	12.8 MB	wss_gsmsoil_LA_[2016-10-13].zip
Maine	7.2 MB	wss_gsmsoil_ME_[2016-10-13].zip
Maryland	4.9 MB	wss_gsmsoil_MD_[2016-10-13].zip
Massachusetts	4.1 MB	wss_gsmsoil_MA_[2016-10-13].zip
Michigan	9.6 MB	wss_gsmsoil_MI_[2016-10-13].zip
Minnesota	12.1 MB	wss_gsmsoil_MN_[2016-10-13].zip
Mississippi	7.7 MB	wss_gsmsoil_MS_[2016-10-13].zip
Missouri	25.3 MB	wss_gsmsoil_MO_[2016-10-13].zip
Montana	20.0 MB	wss_gsmsoil_MT_[2016-10-13].zip
Nebraska	9.8 MB	wss_gsmsoil_NE_[2016-10-13].zip

Download SSURGO Template Databases

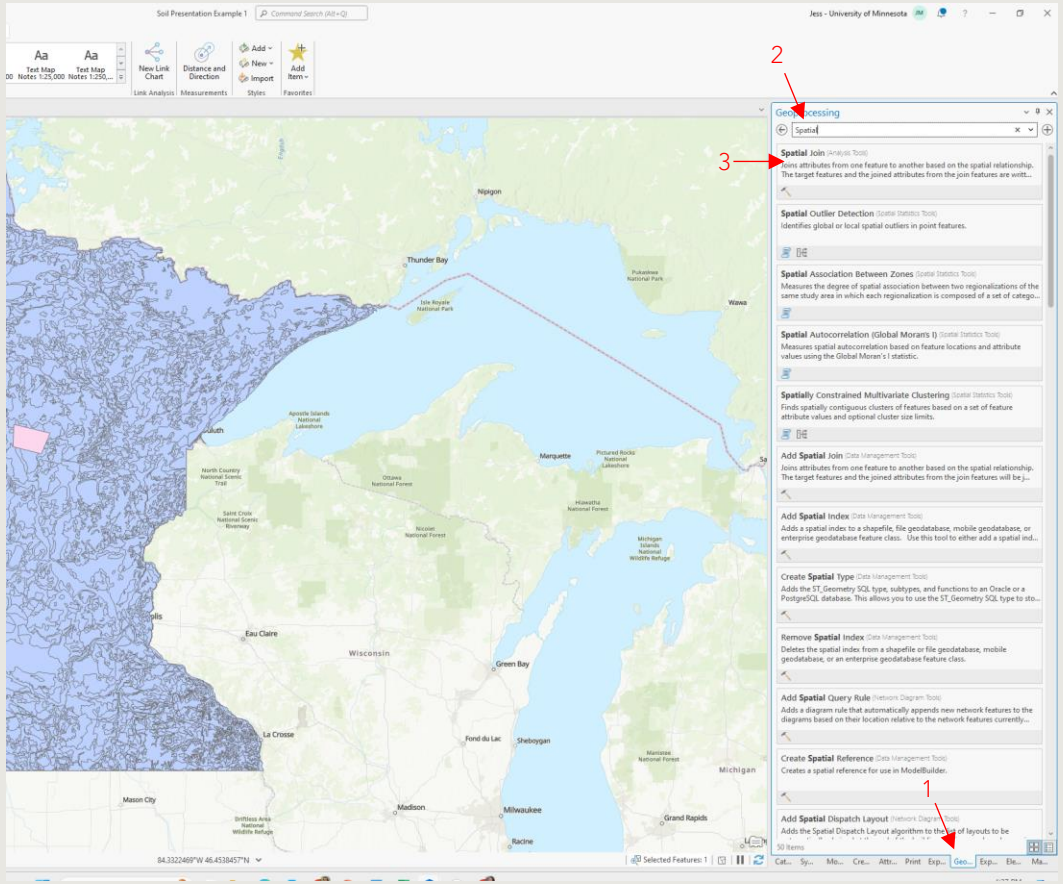
FOIA | Accessibility Statement | Privac

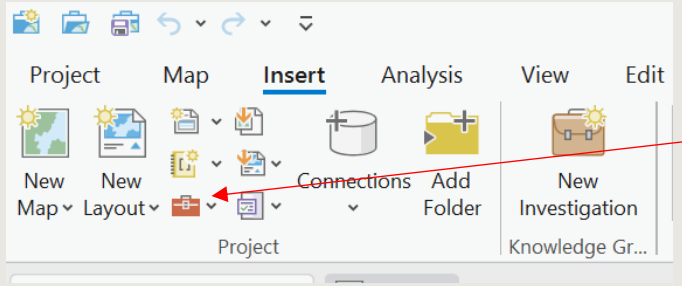
2) Upload SSURGO data and parcel data into ArcGIS Pro by selecting Add Folder and navigating to your data (might have to unzip). Then expand the Folders section of you Catalog tab (on the right pane, tabs along the bottom). Expand your downloaded folder and find the map under the spatial folder and comp table under the tabular folder. Drag and drop both.



*Note: Sometimes I have trouble finding the right folder to upload in my downloads folder. When this happens, I move or copy paste to a new location and find it there. I don't know why this happens.

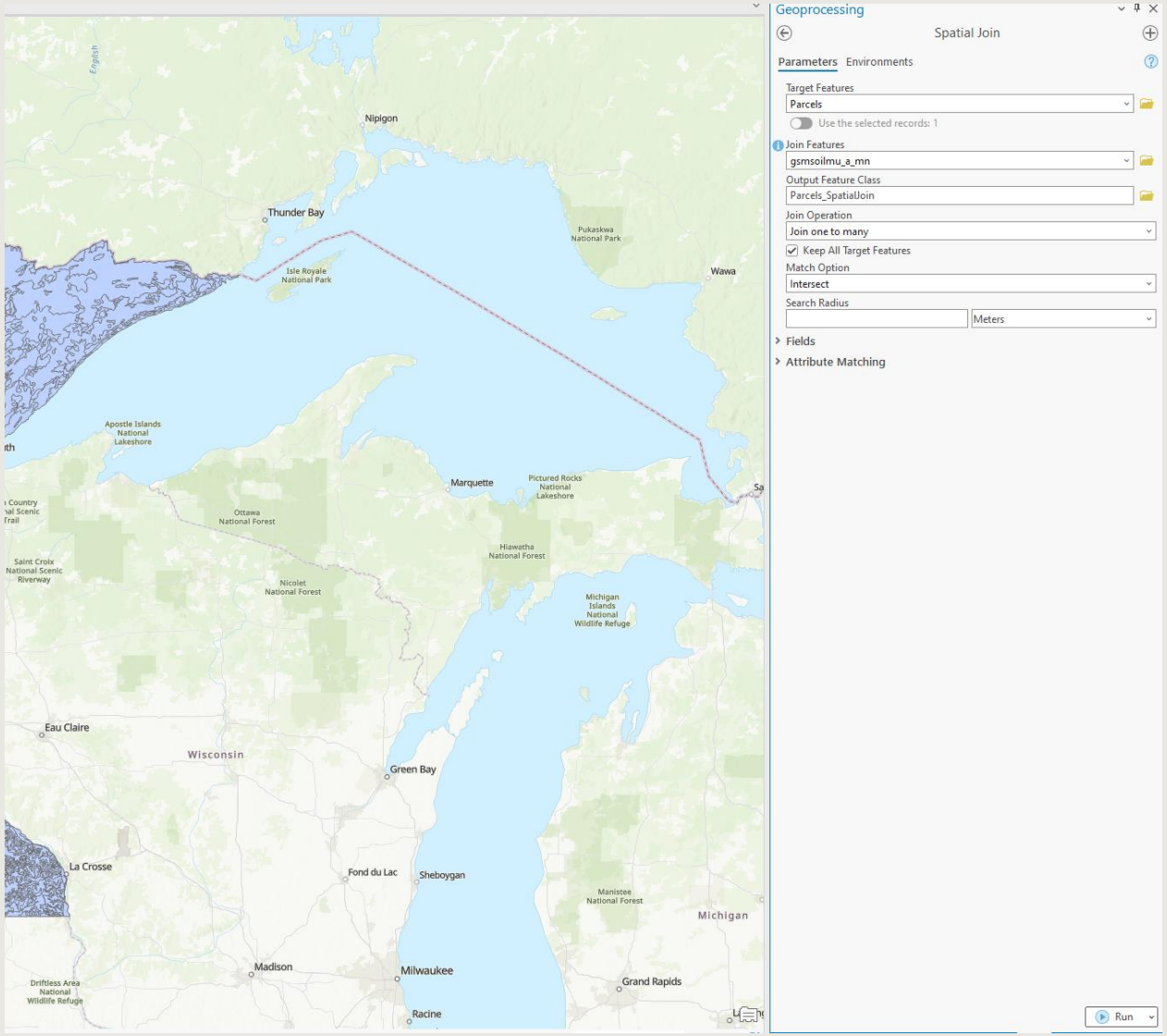
3) Perform a spatial join between the parcel layer and the SSURGO shapefile layer.





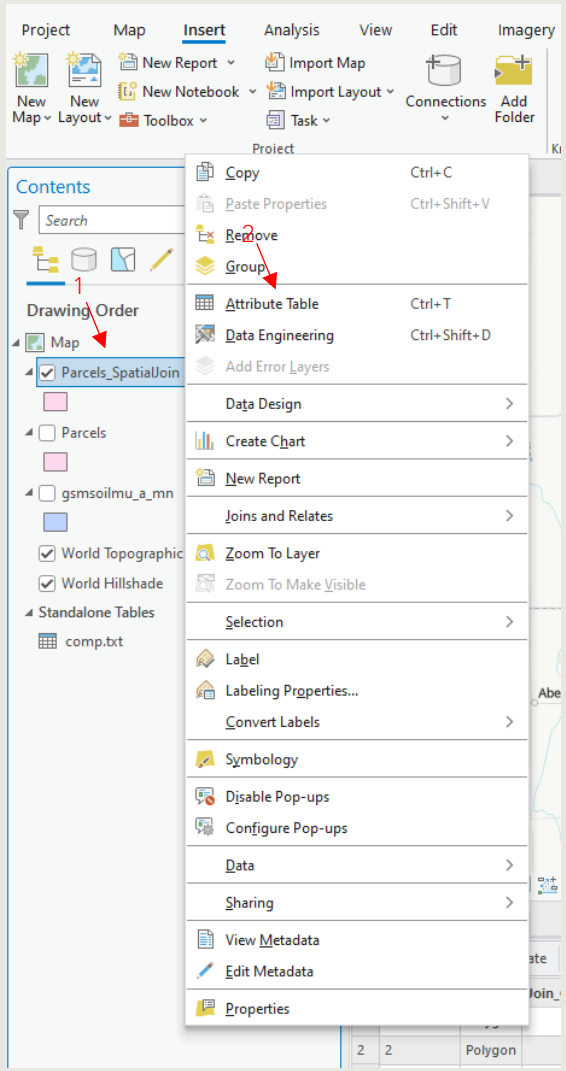
If the geoprocessing tab isn't there, navigate to insert on the top menu ribbon and select the toolbox icon.

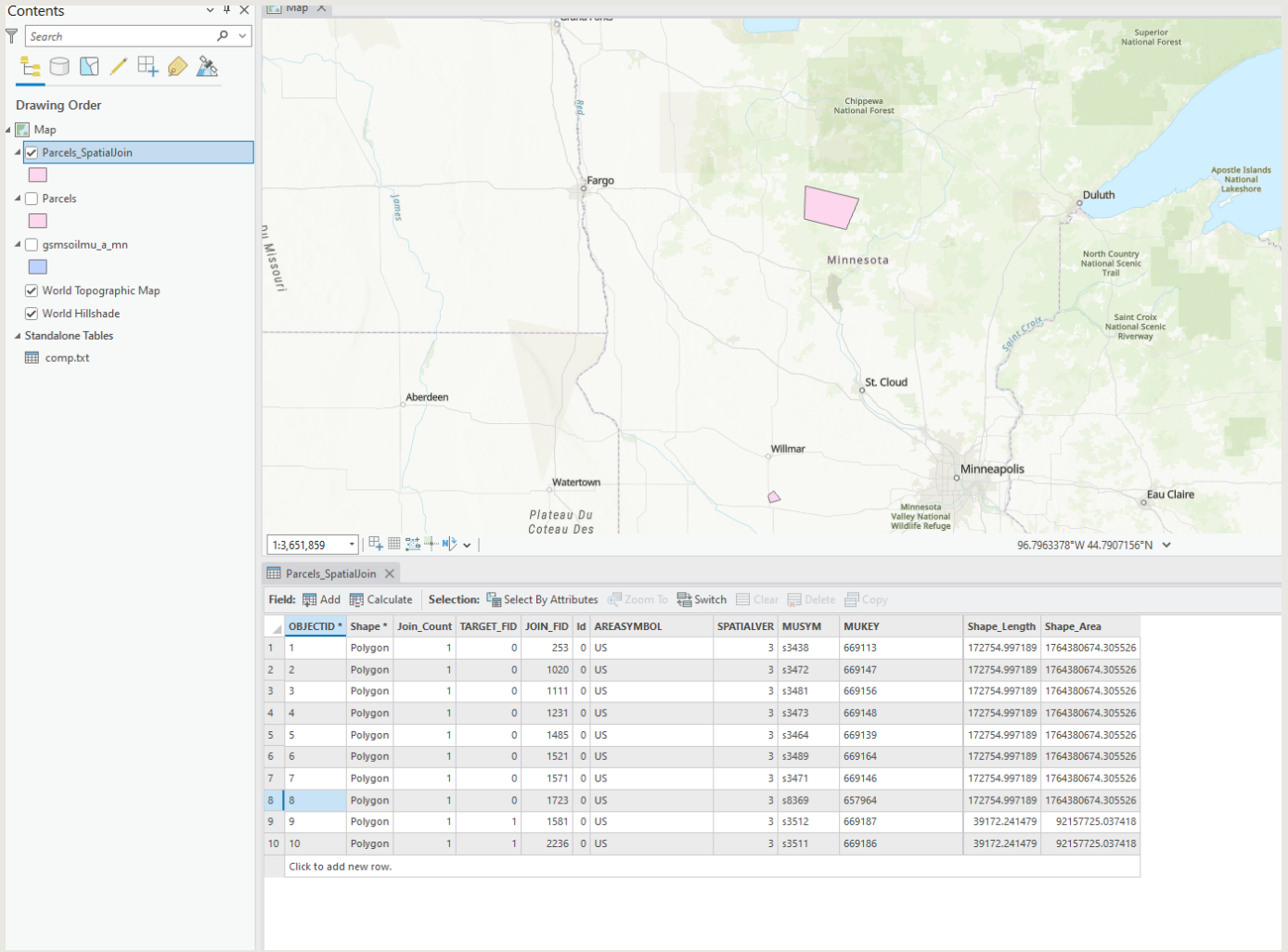
Your parcel shapefile will be your target feature and the SSURGO shapefile will be the join feature. Change Join to one-to-many (because there are multiple SSURGO polygons in each parcel) and leave match option as Intersect. Hit Run.



A new layer will appear on in your contents pane named what you wrote in the Output Feature Class field of your spatial join. The default is originalname_SpatialJoin, so in this case Parcels_SpatialJoin.

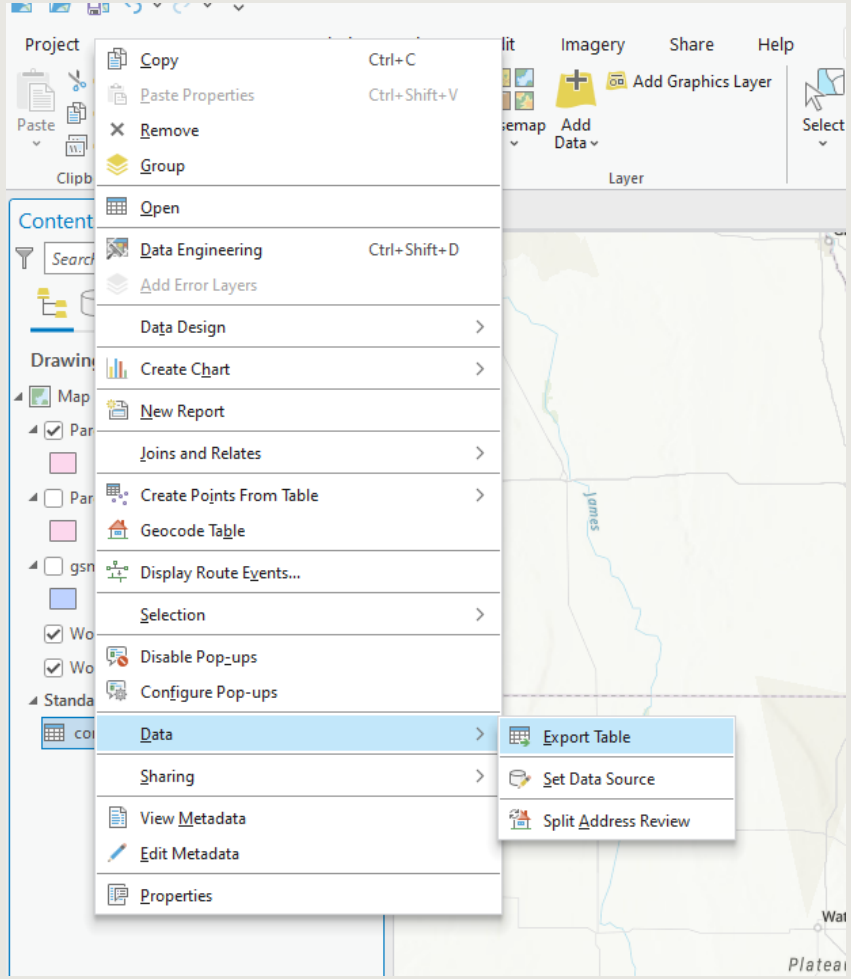
Right click on the new layer and select “Attribute Table” from the popup menu to view the table.



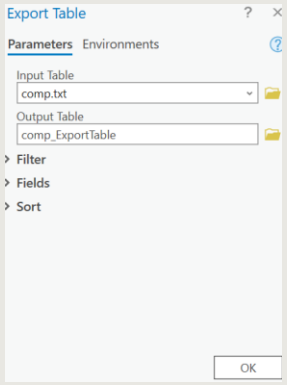


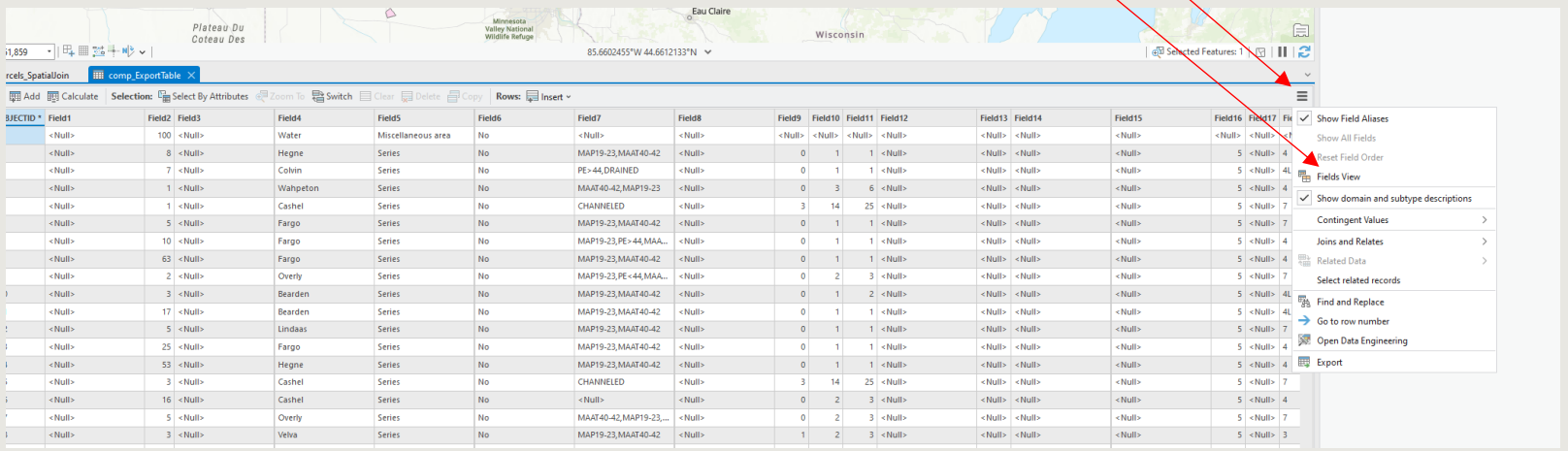
The next step is to perform a tabular join between your new joined layer and the comp table, but **you may need to change your comp table mukey column to text** instead of numerical. You will also likely need to "export" your comp table to make it editable (I don't know why ArcGIS Pro makes you do this). **This will probably feel like an annoying side quest; I'll try to go through it quickly.**

To "export" your comp table (essentially create a copy), right click on it under "Standalone Tables" in the contents pane, select data, and then select Export Table.

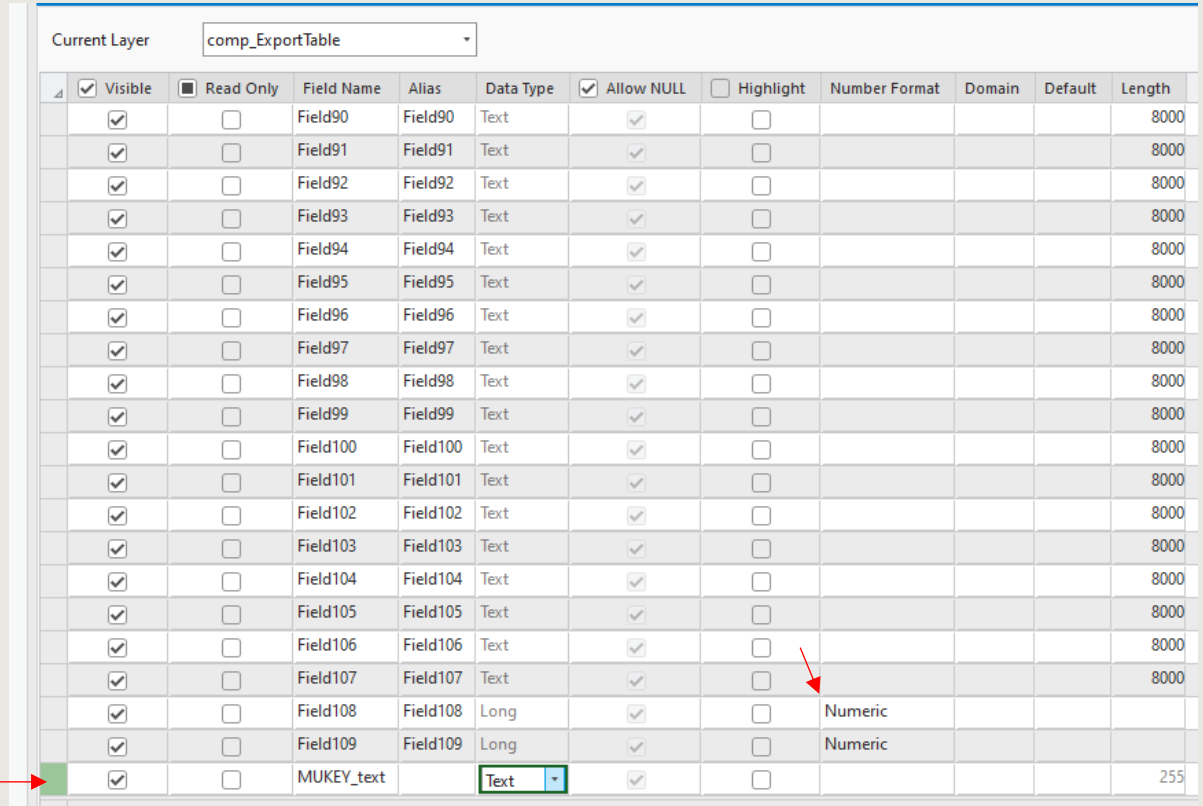


Leave the parameters in the pop up as the defaults and select Run. Your exported table will appear right below your original comp table in the contents pane. Open your exported table (right click > Open) and select the three stacked horizontal bars in the upper right-hand corner. Then select fields view.

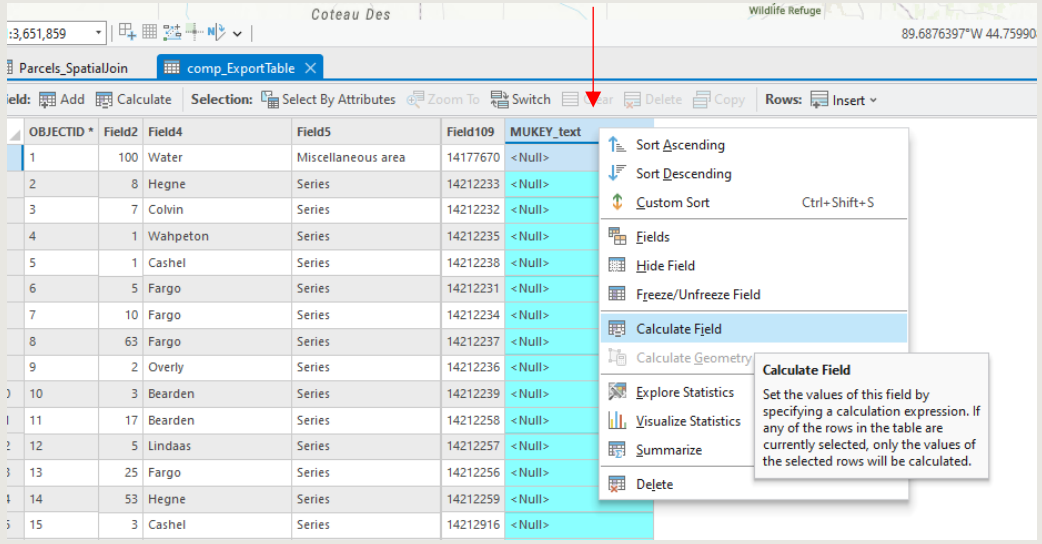




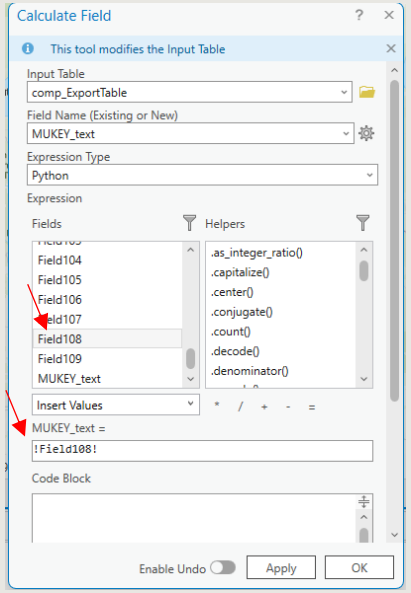
Our mukey field (Field108) is numeric, but we need it to be text to match the data type of the mukey field in the SSURGO shapefile attribute table so we can join them (a join would work if they were both numeric as well, they just need to be the same. I don't know why they aren't the same in the SSURGO database). There will be a row at the bottom of the fields view table that says "Click here to add a new field." Name the new field MUKEY_text and set the data type to text. You can either save changes with the save icon on the main ribbon or close out of the table and when asked if you would like to save changes, say yes.



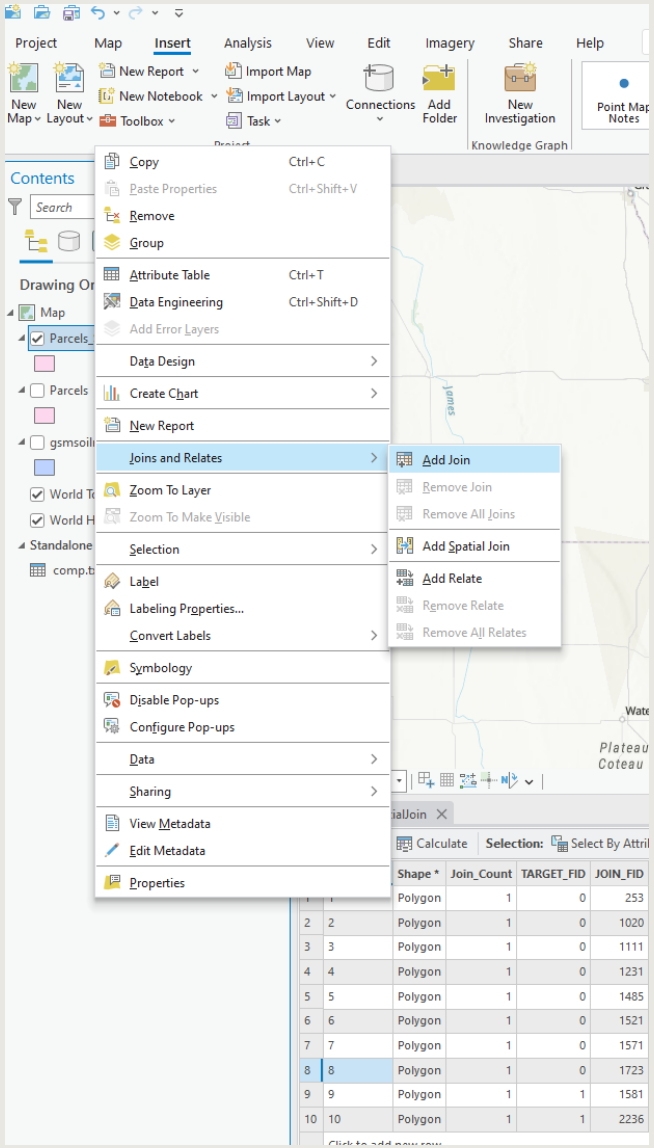
A new column will appear at the end of your table called MUKEY_text. Right click on the header and select calculate field.

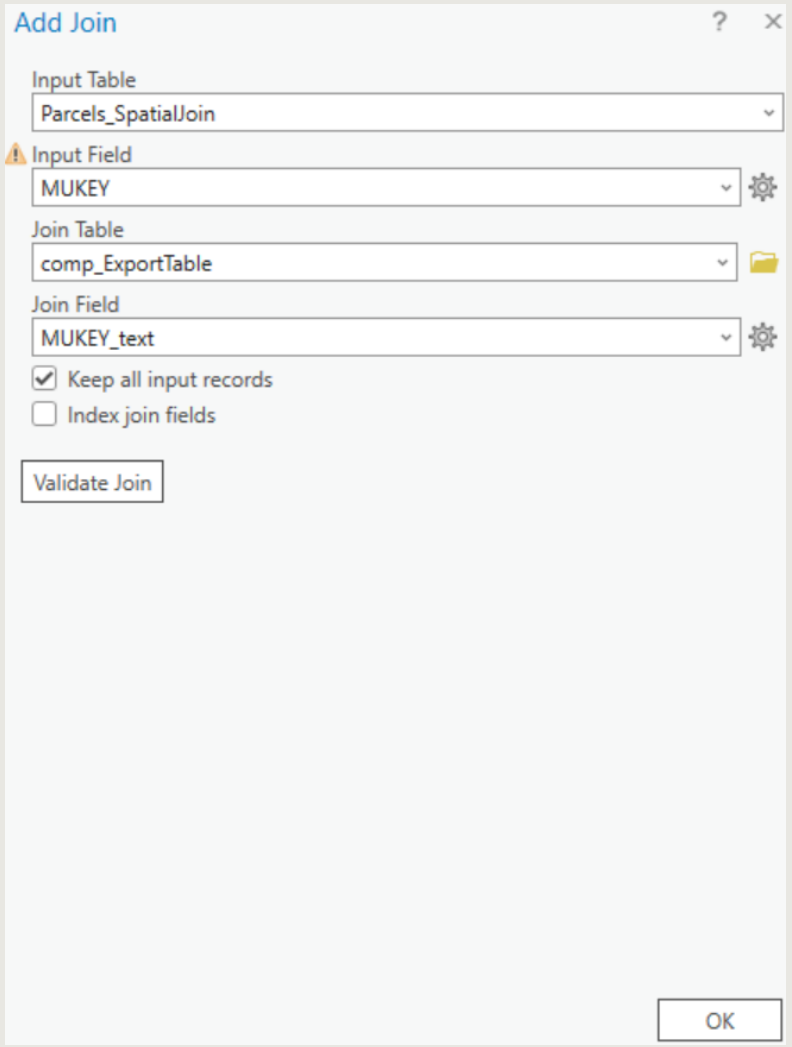


In the Calculate Field popup, click in the field that says MUKEY_text = and then select Field108 from the Fields window so that it populates the MUKEY_text field with the MUKEY data. Press OK.



4) Perform a tabular join between your new joined layer and the comp table (finally). Right click on your Parcel_SpatialJoin layer then select Joins and Relates, Add Join, and fill out the popup like below using the MUKEY columns as the join field. Select OK.





* In the spatial join we did a few slides ago we needed to select one-to-many, but in tabular joins in this window it will automatically do it for us.

*Also, we got to the spatial join tool a few slides ago using the Toolbox. This time, with the tabular join, we got there by right clicking on the map layer in the contents pane. This is a shortcut available for the tabular join but not the spatial join. We could also have gotten to the tabular join through the toolbox.

5) Now you can sort your table by parcel to see which soils are present in each polygon. The field here is TARGET_FID because the shapefile with the parcels was the target in the join and FID is the identifier of each polygon. Your two parcels have FIDs of 0 and 1.

OBJECTID *	Shape *	Join_Count	TARGET_FID	JOIN_FID	Id	AREASYMBOL	SPATIALVER	MUSYM	MUKEY	Shape_Length	Shape_Area	OBJECTID	Field2	Field4	Field5	Field109	MUKEY_text
6	Polygon	1	0	1521	0	US	3	s3489	669164	172754.997189	1764380674.305526	1180	2	Water	Miscellaneous area	14234595	669164
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	898	17	Chetek	Series	14234325	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	899	5	Warman	Series	14234339	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	900	1	Greenwood	Series	14234338	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	901	5	Menahga	Series	14234341	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	902	1	Isan	Series	14234324	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	903	2	Mahtomedi	Series	14234327	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	904	3	Mahtomedi	Series	14234330	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	905	10	Menahga	Series	14234326	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	906	3	Meehan	Series	14234329	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	907	1	Emmert	Series	14234332	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	908	8	Menahga	Series	14234335	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	909	1	Water	Miscellaneous area	14234328	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	910	4	Leola	Series	14234331	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	911	1	Mahtomedi	Series	14234334	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	912	1	Mahtomedi	Series	14234337	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	913	31	Chetek	Series	14234340	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	914	5	Menahga	Series	14234333	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	915	1	Seelyeville	Series	14234336	669146
8	Polygon	1	0	1723	0	US	3	s8369	657964	172754.997189	1764380674.305526	1	100	Water	Miscellaneous area	14177670	657964
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1455	4	Normania	Series	14234881	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1456	8	Ves	Series	14234883	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1457	25	Harps	Series	14234886	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1458	2	Mayer	Series	14234882	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1459	5	Doland	Series	14234891	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1460	13	Canisteo	Series	14234885	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1461	20	Seaforth	Series	14234888	669187

*Note: I've hidden some columns from view to see relevant columns. You can do this by unchecking rows on lefthand side of the fields view.

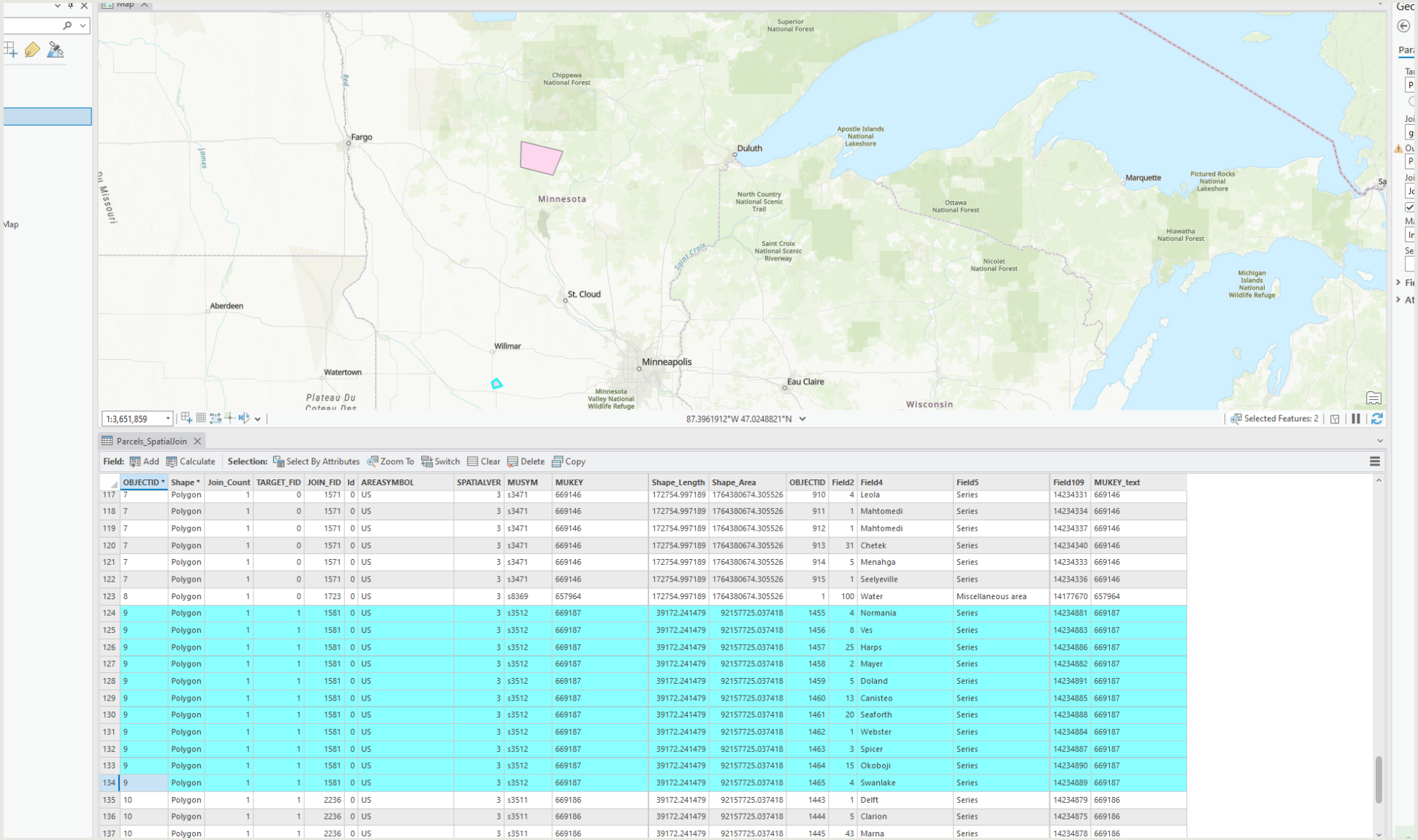
The Result:

This table is scrolled towards the bottom, but there are many more rows for the larger parcel (TARGET_FID 0) than the smaller parcel (TARGET_FID 1).

If you select one row, the corresponding parcel on the map will be highlighted, as well as other rows in the parcel with the same MUKEY.

Every soil contained in each parcel has a row in the table. So if you look at only TARGET_FID 0, the soils in Field4 are a list of all the soils in that parcel.

You can export this table to excel (we'll do that in the next example) or just get the info strait from this table.



	OBJECTID *	Shape *	Join_Count	TARGET_FID	JOIN_FID	Id	AREASYMBOL	SPATIALVER	MUSYM	MUKEY	Shape_Length	Shape_Area	OBJECTID	Field2	Field4	Field5	Field109	MUKEY_text
117	7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	910	4	Leola	Series	14234331	669146
118	7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	911	1	Mahtomedi	Series	14234334	669146
119	7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	912	1	Mahtomedi	Series	14234337	669146
120	7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	913	31	Chetek	Series	14234340	669146
121	7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	914	5	Menahga	Series	14234333	669146
122	7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	915	1	Seelyeville	Series	14234336	669146
123	8	Polygon	1	0	1723	0	US	3	s8369	657964	172754.997189	1764380674.305526	1	100	Water	Miscellaneous area	14177670	657964
124	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1455	4	Normania	Series	14234881	669187
125	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1456	8	Ves	Series	14234883	669187
126	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1457	25	Harps	Series	14234886	669187
127	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1458	2	Mayer	Series	14234882	669187
128	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1459	5	Doland	Series	14234891	669187
129	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1460	13	Canisteo	Series	14234885	669187
130	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1461	20	Seaforth	Series	14234888	669187
131	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1462	1	Webster	Series	14234884	669187
132	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1463	3	Spicer	Series	14234887	669187
133	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1464	15	Okoboji	Series	14234890	669187
134	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1465	4	Swanlake	Series	14234889	669187
135	10	Polygon	1	1	2236	0	US	3	s3511	669186	39172.241479	92157725.037418	1443	1	Delft	Series	14234879	669186
136	10	Polygon	1	1	2236	0	US	3	s3511	669186	39172.241479	92157725.037418	1444	5	Clarion	Series	14234875	669186
137	10	Polygon	1	1	2236	0	US	3	s3511	669186	39172.241479	92157725.037418	1445	43	Marna	Series	14234878	669186

* Note: The same soil might show multiple times for each parcel. You can delete them by sorting by soil type then right clicking on the number on the left side of the table and selecting delete row (make sure the soils are from different parcels before deleting!). You can do this in excel using the Table to Excel Tool. The soil can show up because it was in two separate MUKEY polygons within the parcel polygon, or because the soil shows up twice in the same MUKEY because of character differences.

We answered a question using SSURGO and ArcGIS Pro!

Now let’s do one where we make a map.

Example Question 2: Where are all the locations in Fillmore County that contain Dubuque or Fayette soil?

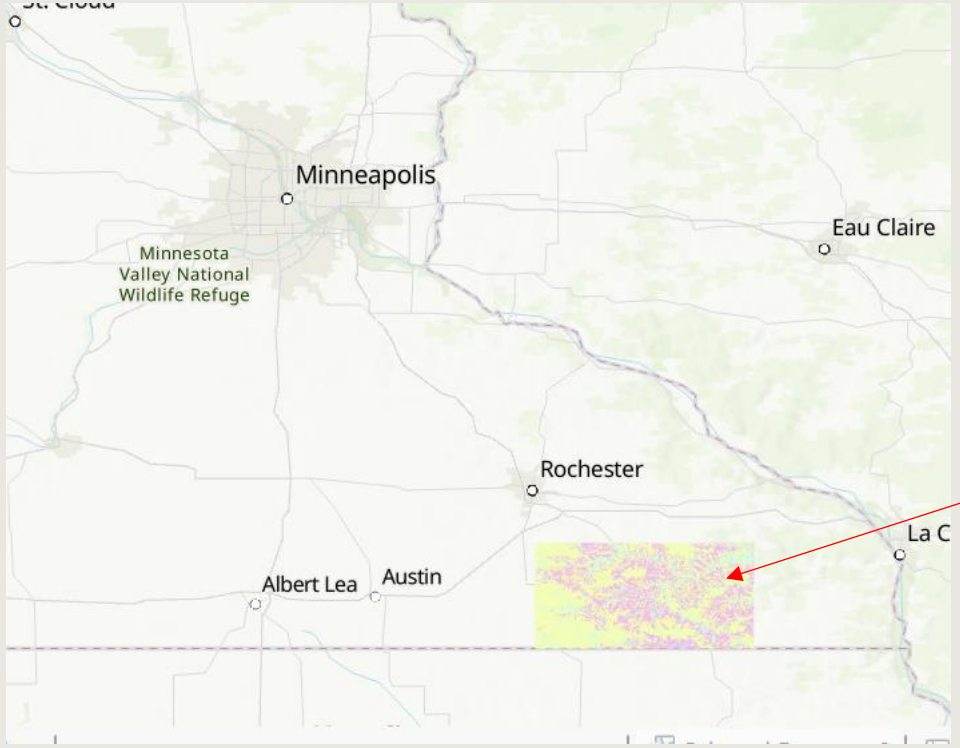
You have: The name of the county and soils type(s) you are interested in.

You want to know: The locations in the county where the soil type of interest is present.

Your product will be: A map.

Steps:

1) Download the data for Fillmore county from SSURGO.
2) Upload the SSURGO tabular and spatial data into ArcGIS Pro.
3) Export the SSURGO comp table and open in excel because we need to manipulate the data.
4) Sort the data by soil and delete all rows that are not Dubuque or Fayette.
5) If there a mukey has rows for both Dubuque and Fayette, change soil to Dubuque & Fayette in one row and delete the other as the repeat means both soils are present in the mukey.
6) Export the attribute table for the SSURGO Fillmore County Shapefile and open in Excel. Create a new column called “soil label.”
7) Delete duplicate mukeys and copy paste the soil label (Dubuque, Fayette, or Dubuque & Fayette) into your new soil label column for any mukey that was left in the comp table once you whittled it down to Dubuque and Fayette only. For all other rows fill in “other soils.”
8) Save and upload the attribute table with the soil label column back into ArcGIS Pro.
9) Join the newly uploaded attribute table to the SSURGO polygon layer.
10) Symbolize the map by soil label.



Fillmore County

We want to link the mukeys of the polygons in the county to the soils each contains so we can show them on the map. Since we're only interested in two soils, it might be easier to start with the comp table and find the mukeys that contain Dubuque or Fayette soils, link those to the attribute table. This avoids a more complicated one-to-many join because each polygon will have one label (Dubuque, Fayette, Dubuque & Fayette, or other soils) instead of many soils.

Example Question 2: Where are all the locations in Fillmore County that contain Dubuque or Fayette soil?

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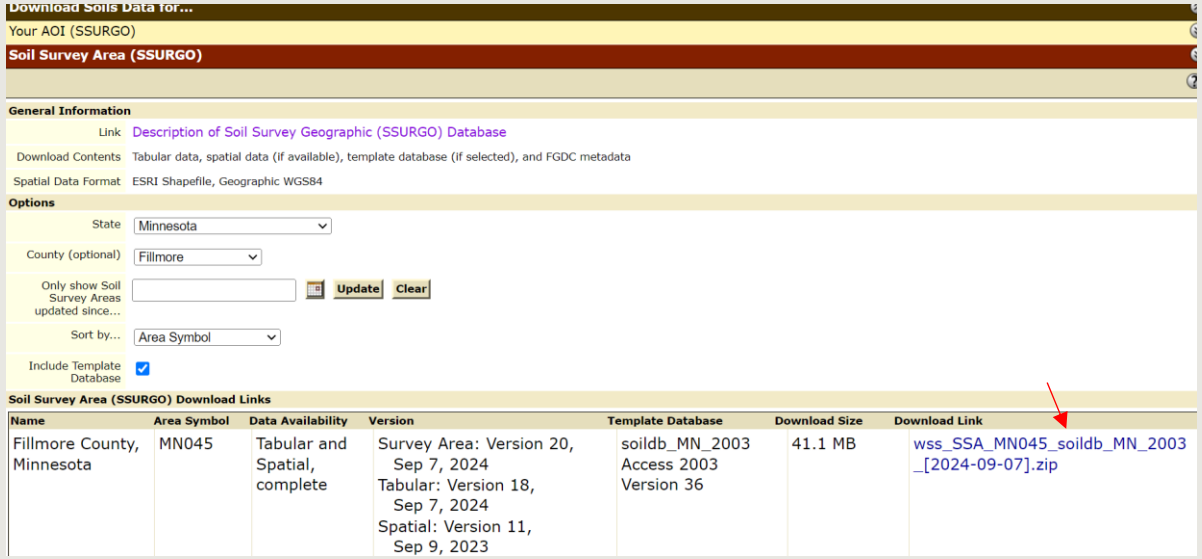
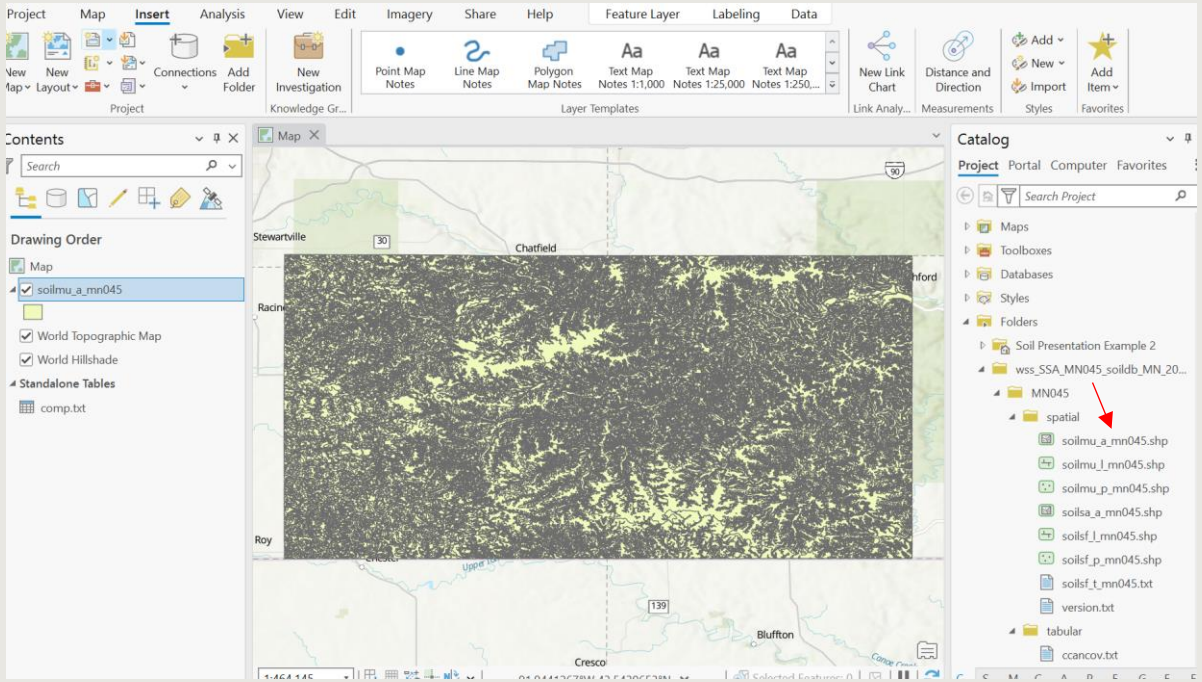
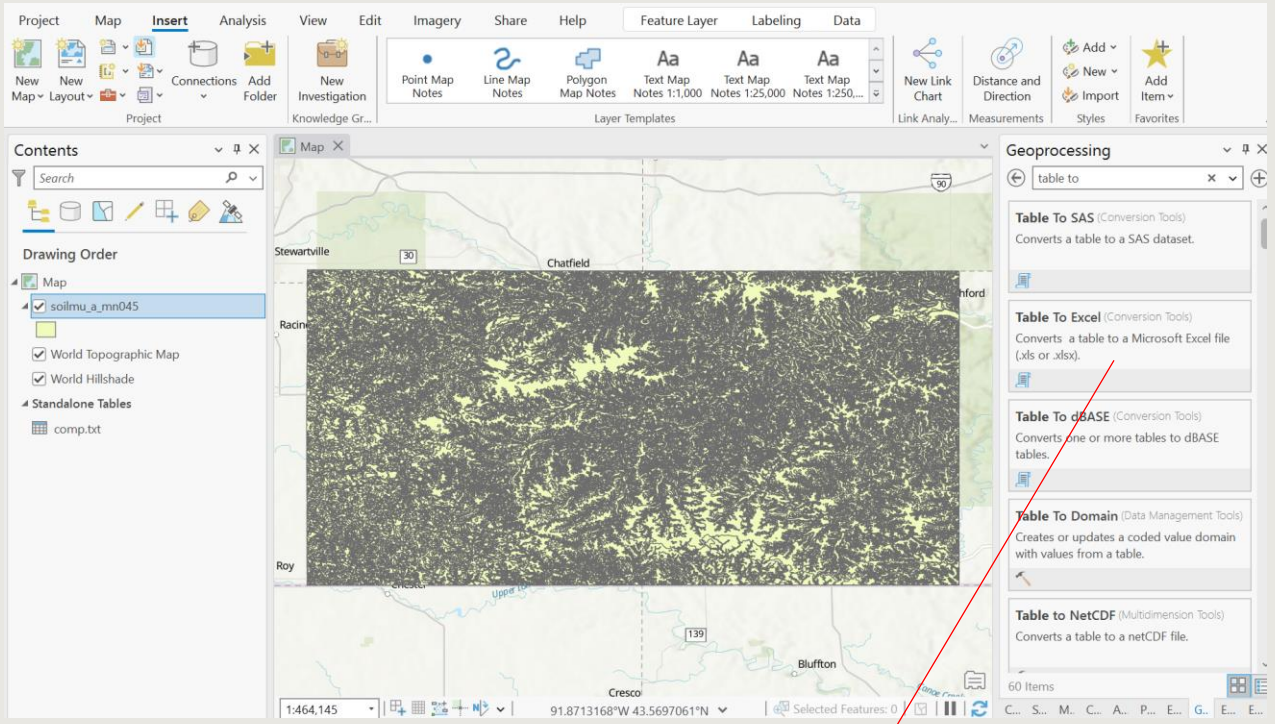
8) Save and upload the attribute table with the soil label column back into ArcGIS Pro.
9) Join the newly uploaded attribute table to the SSURGO polygon layer.
10) Symbolize the map by soil label.

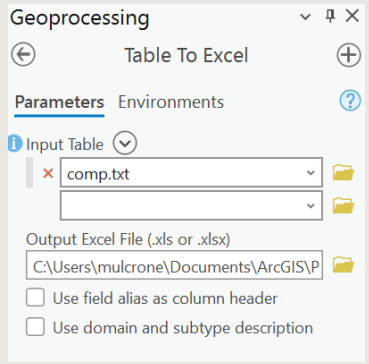
1 &2) Download data from SSURGO and upload in ArcGIS Pro. If there are multiple shapefiles use the one that starts with soil_mu_a.





3) Open the SSURGO comp table in pro and export to Excel using the "Table To Excel" tool under Geoprocessing .





4) Sort the Excel comp table by soil and delete all rows that are not Dubuque or Fayette

sort

	A	B	C	D	
1	Field1	Field2	Field3	Field4	
2	5	10	10	Kickapoo	Series
3	2	2	5	Beavercreek	Series
4	80	85	90	Alluvial land	Family
5	3	3	5	Arenzville	Series
6	1	2	3	Colo	Series
7	1	1	3	Palms	Series
8	1	2	3	Orion	Series
9	7	10	11	Ettrick	Series
10	80	85	90	Alluvial land	Family
11		85		Alluvial land	Family
12	3	5	7	Chaseburg	Series
13	5	5	7	Arenzville	Series
14	2	5	6	Orion	Series
15		55		Chaseburg	Series
16		45		Judson	Series
17		45		Chaseburg	Series
18		55		Judson	Series
19		45		Boone	Series
20		55		Chelsea	Series
21		45		Boone	Series
22		55		Chelsea	Series
23		55		Chelsea	Series
24		45		Boone	Series
25		45		Boone	Series

	A	B	C	D	
	Field1	Field2	Field3	Field4	
		55		Dubuque	Series
		55		Dubuque	Series
		55		Dubuque	Series
		55		Dubuque	Series
	0	5	10	Dubuque	Taxadjunct
	0	5	10	Dubuque	Taxadjunct
	0	5	10	Dubuque	Taxadjunct
	1	2	2	Dubuque	Series
0	0	1	2	Dubuque	Series
1	1	3	5	Dubuque	Series
2	1	3	3	Dubuque	Series
3	1	5	15	Dubuque	Series
4	15	20	30	Dubuque	Series
5	70	85	100	Fayette	Series
6	70	85	100	Fayette	Series
7	70	85	100	Fayette	Series
8	70	85	100	Fayette	Series
9	40	70	90	Fayette	Series
0	15	35	50	Fayette	Series
1					
2					

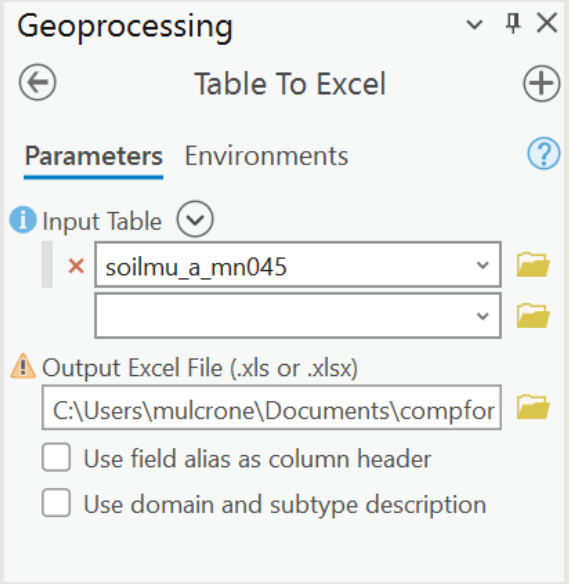
5) Trim the table down to only soil and mukey fields (Field4 and Field108). If there are repeat mukeys for Dubuque and Fayette, change the soil to "Dubuque and Fayette."

sort

Field4	Field108
Dubuque	2216727
Dubuque	2216728
Dubuque	2216730
Dubuque	2216732
Fayette	2216735
Dubuque	2216736
Fayette	2216736
Dubuque	2216738
Fayette	2216738
Dubuque	2216741
Fayette	2216741
Dubuque	2216770
Dubuque	2216780
Dubuque	2216781
Dubuque	2216782
Dubuque	2372355
Fayette	2372355
Dubuque	2372357
Fayette	2372357

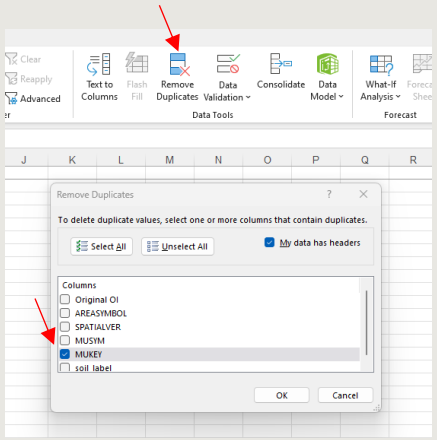
	A	B
1	Field4	Field108
2	Dubuque	2216727
3	Dubuque	2216728
4	Dubuque	2216730
5	Dubuque	2216732
6	Fayette	2216735
7	Dubuque & Fayette	2216736
8	Dubuque & Fayette	2216738
9	Dubuque & Fayette	2216741
10	Dubuque	2216770
11	Dubuque	2216780
12	Dubuque	2216781
13	Dubuque	2216782
14	Dubuque & Fayette	2372355
15	Dubuque & Fayette	2372357
16		

6) Export the attribute table for the SSURGO shapefile and open in Excel. Create a new column called “soil label.”



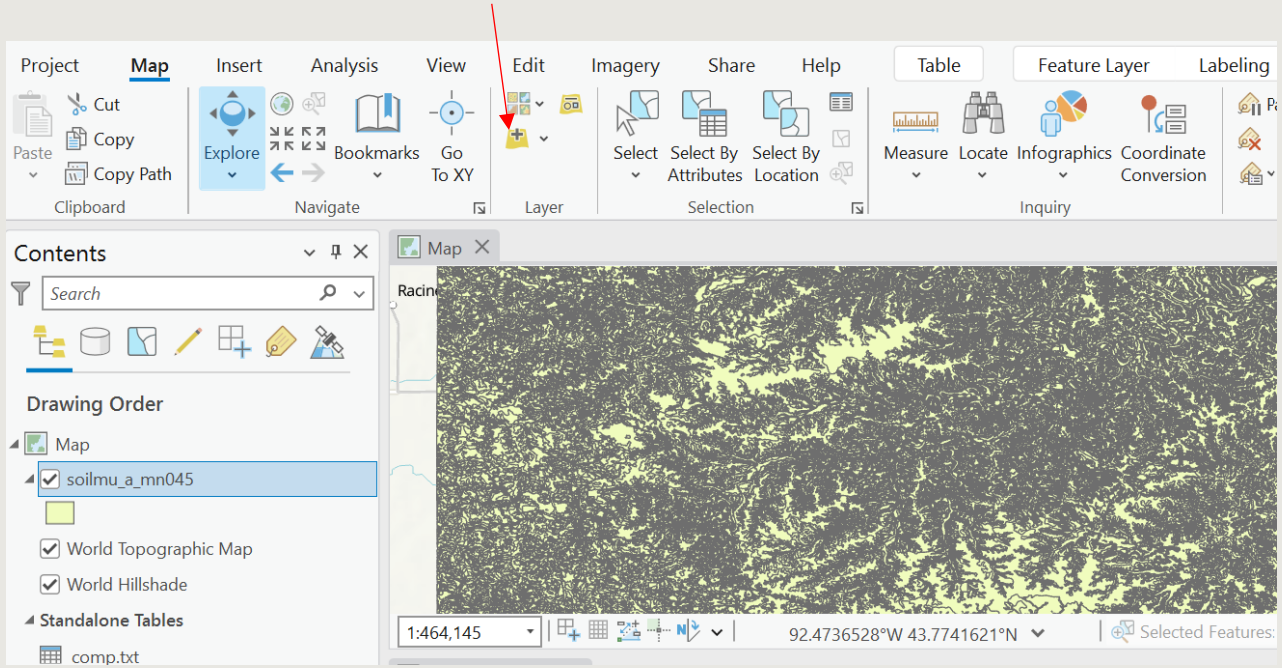
	A	B	C	D	E	F
	FID	AREASYMBOL	SPATIALVER	MUSYM	MUKEY	soil_label
1	0	MN045	11	Fh	2216741	
2	1	MN045	11	Fh	2216741	
3	2	MN045	11	Fh	2216741	
4	3	MN045	11	Fh	2216741	
5	4	MN045	11	Fh	2216741	
6	5	MN045	11	Fh	2216741	
7	6	MN045	11	Fh	2216741	
8	7	MN045	11	Fh	2216741	
9	8	MN045	11	Fh	2216741	
10	9	MN045	11	Kd	2216751	
11	10	MN045	11	Kd	2216751	
12	11	MN045	11	Kd	2216751	
13	12	MN045	11	Kd	2216751	
14	13	MN045	11	Kd	2216751	
15	14	MN045	11	Kd	2216751	
16	15	MN045	11	Kd	2216751	
17	16	MN045	11	Kd	2216751	
18	17	MN045	11	Kd	2216751	
19	18	MN045	11	Fd	2216738	
20	19	MN045	11	Fd	2216738	
21	20	MN045	11	Fd	2216738	

7) Delete duplicate mukeys by selecting the Remove Duplicates icon under the data tab in the top menu ribbon, checking only mukey, and then selecting OK. Sort by mukey and paste the soil label (Dubuque, Fayette, or Dubuque & Fayette) into the soil label column for any mukey that was left in the comp table (since those are the mukeys with Dubuque or Fayette soils). For all other rows fill in “other soils.” Save.

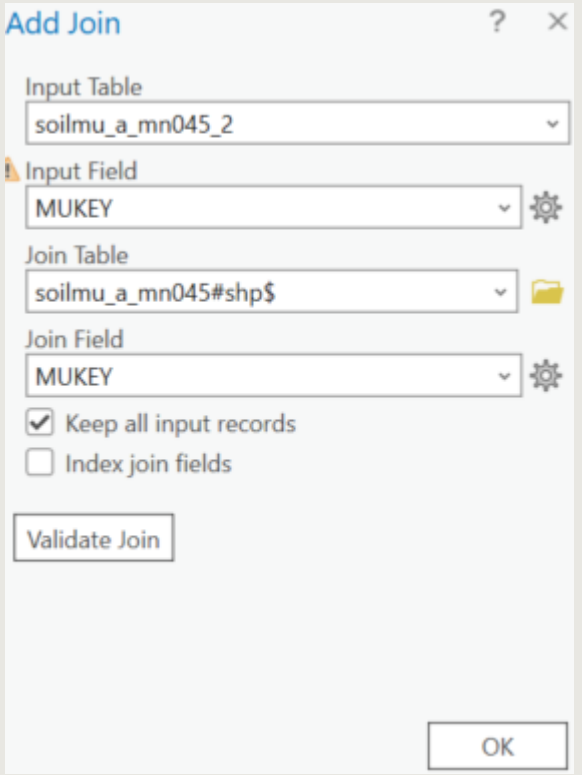


	A	B	C	D	E	F	G
1	Original OI	AREASYMBOL	SPATIALVER	MUSYM	MUKEY	soil_label	
2	39	MN045	11	Dx	2216727	Dubuque	
3	24936	MN045	11	Ds	2216728	Dubuque	
4	4434	MN045	11	Du	2216730	Dubuque	
5	13797	MN045	11	Dv	2216732	Dubuque	
6	23169	MN045	11	Rf	2216770	Dubuque	
7	23716	MN045	11	Sa	2216780	Dubuque	
8	25659	MN045	11	Sb	2216781	Dubuque	
9	10019	MN045	11	Sc	2216782	Dubuque	
10	11554	MN045	11	Ff	2216736	Dubuque & Fayette	
11	8365	MN045	11	Fd	2216738	Dubuque & Fayette	
12	16761	MN045	11	Fh	2216741	Dubuque & Fayette	
13	25134	MN045	11	N532C2	2372355	Dubuque & Fayette	
14	28287	MN045	11	N533D2	2372357	Dubuque & Fayette	
15	402	MN045	11	Fb	2216735	Fayette	
16	18214	MN045	11	Ac	2216701	Other Soils	
17	18860	MN045	11	Aa	2216702	Other Soils	

8 &9) Upload to ArcGIS Pro by selecting the + under the Map tab and navigating to your saved excel sheet. You may have to select the specific sheet instead of the whole file (this one is called soilmu_a_mn045#shp$).

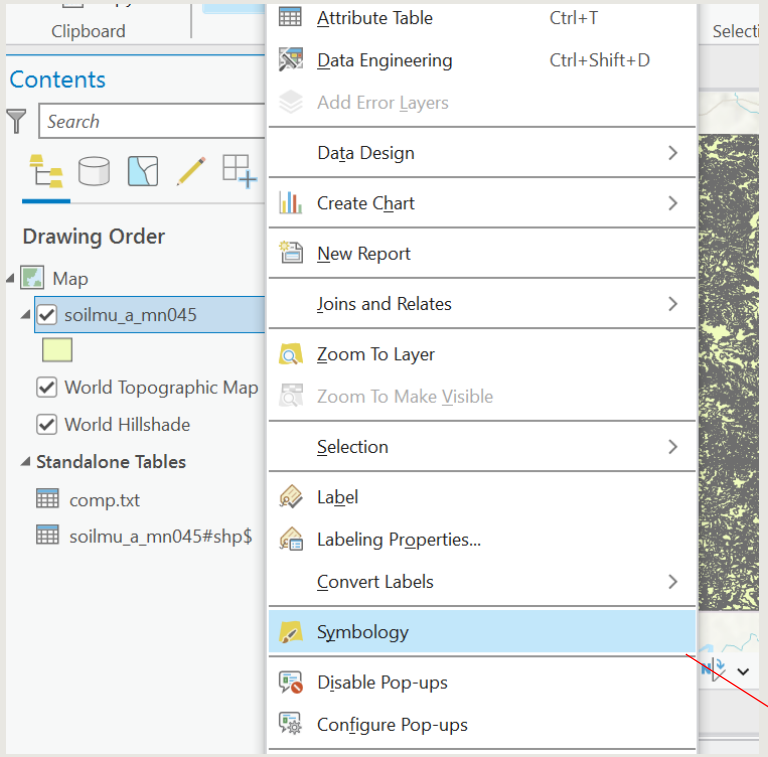


10) Join the new table to the SSURGO polygon layer using MUKEY.

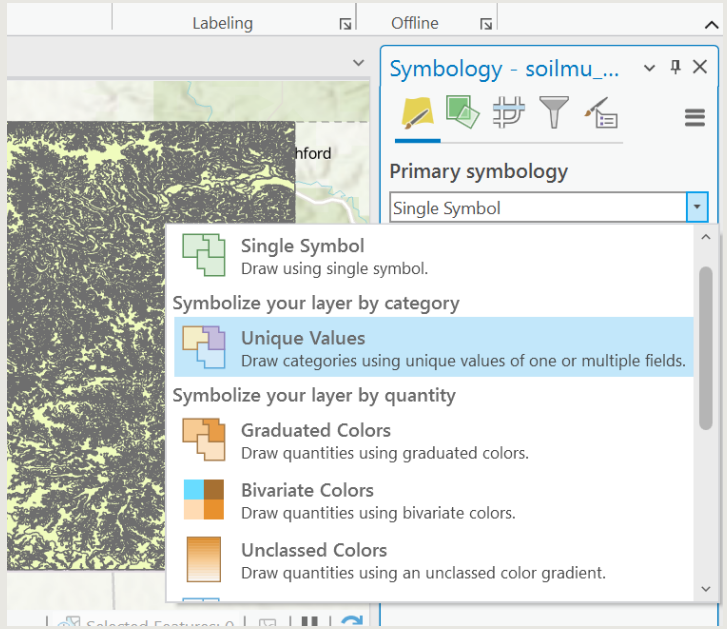


* We could have used object IDs to join instead and not deleted the duplicate MUKEYS; I've done it that way in the past. But this way is less prone to mistakes.

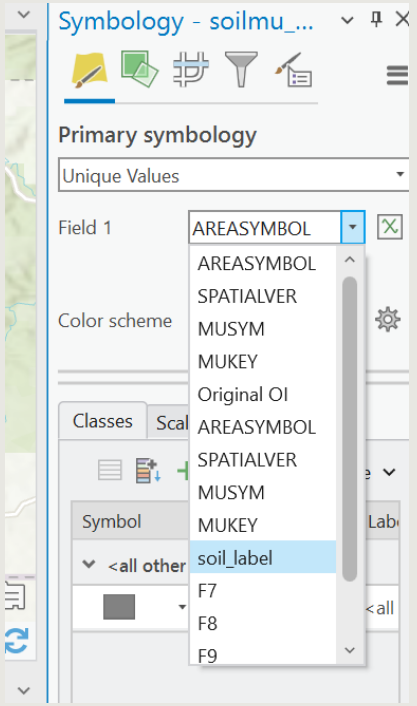
10) Symbolize the map. Right click on the joined SSURGO layer and select symbology.



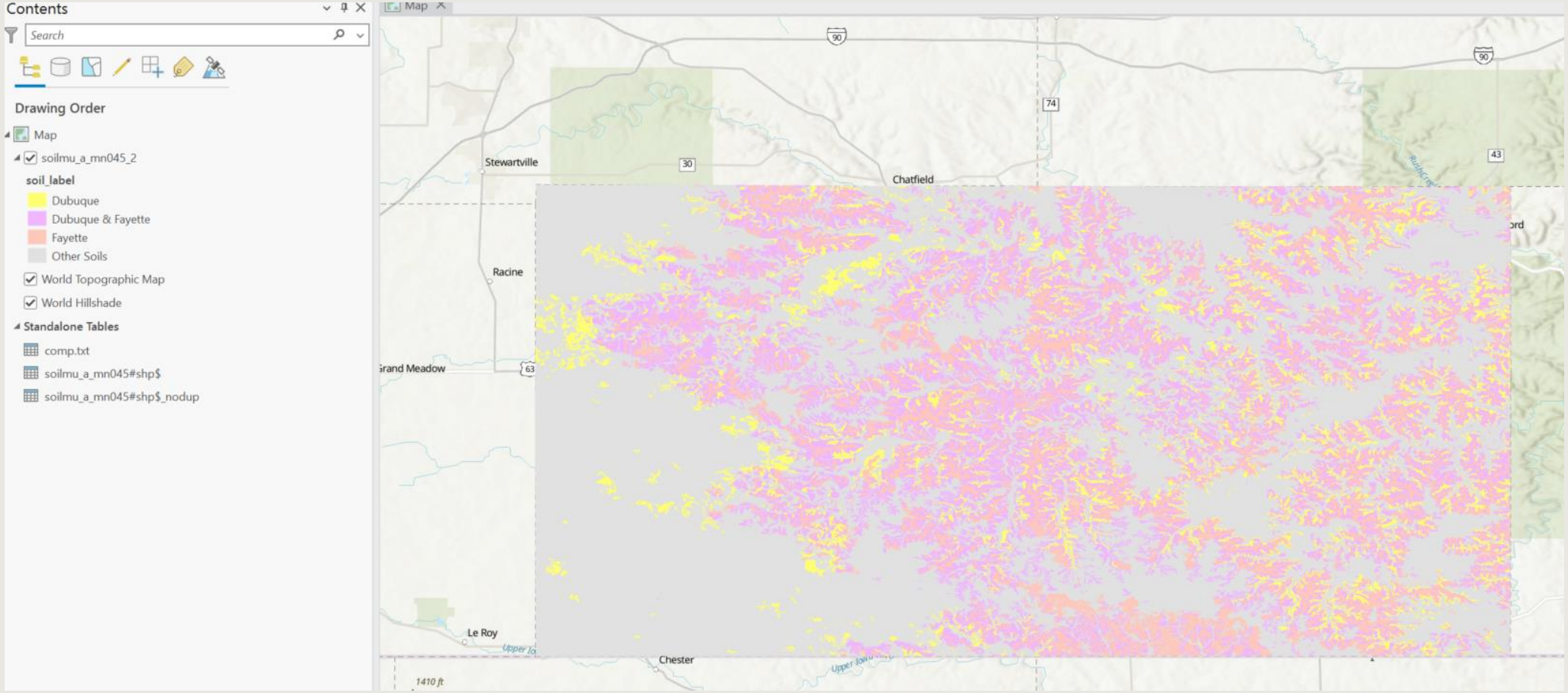
Open the Primary symbology dropdown and select Unique Values.



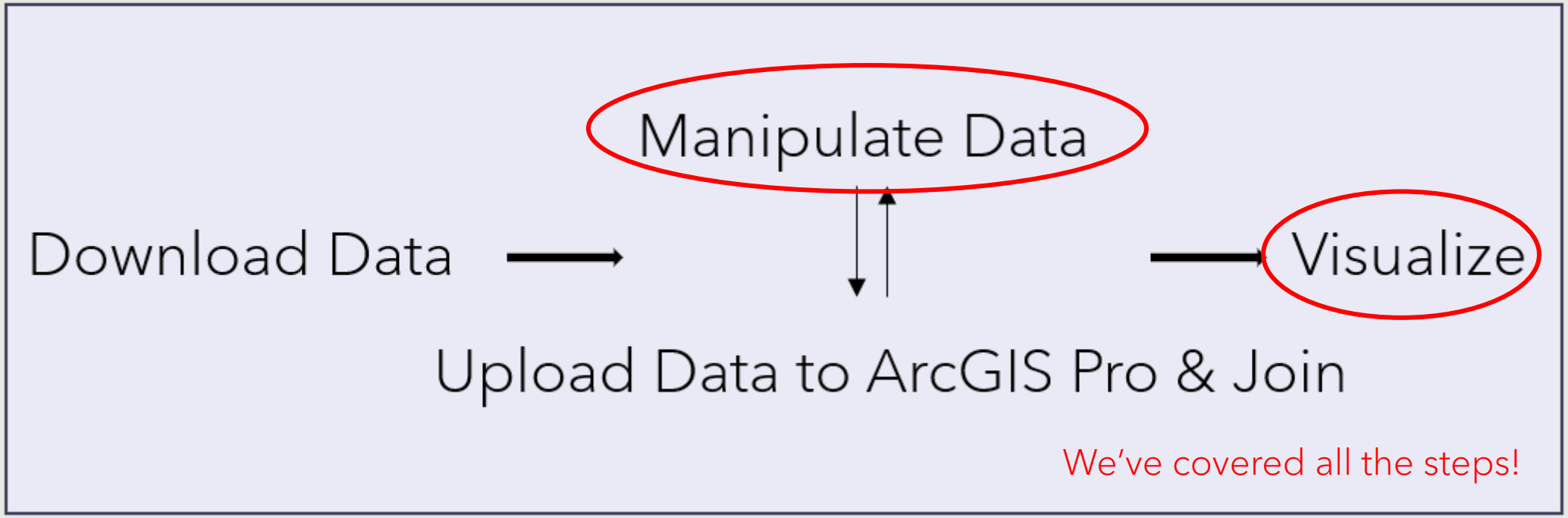
Open the Field 1 drop down and select “soil_label”



The Result:


Contents
Search
Drawing Order
Map
soilmu_a_mn045_2
soil_label
Dubuque
Dubuque & Fayette
Fayette
Other Soils
World Topographic Map
World Hillshade
Standalone Tables
comp.txt
soilmu_a_mn045#shp$
soilmu_a_mn045#shp$_nodup
Map
Stewartville
Chatfield
Racine
Grand Meadow
Le Roy
Chester
90
74
30
63
43
1410 ft

In The Last Example, We Also Covered:



Example Question 3 (Last One!): What is the Midwest extent of Waukegan soils compared to other Typic Hapludoll soils?

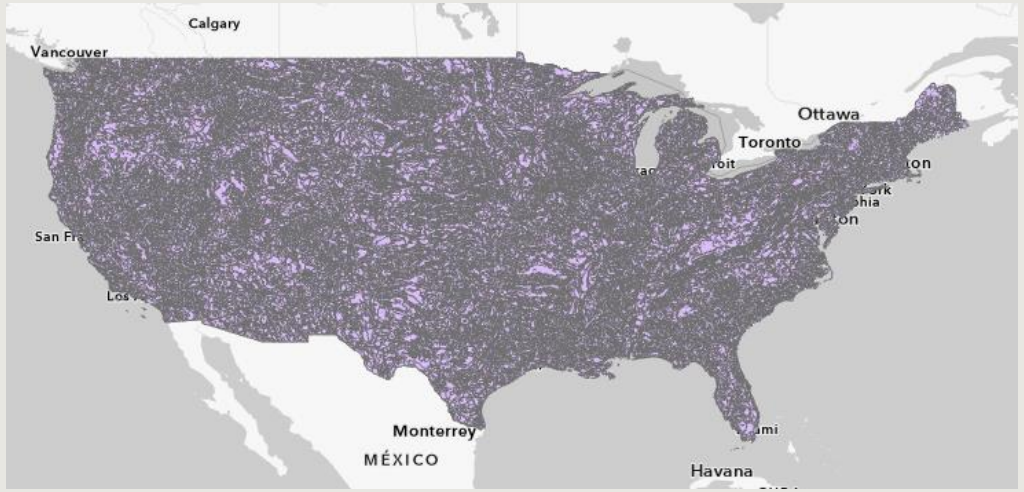
You have: The name of your region and soil type(s) of interest.

You want to know: The locations in the region where the soil types are present.

Your product will be: A map.

Steps:

1) Download SSURGO data for the Midwest.
2) Upload the SSURGO tabular and spatial data into ArcGIS Pro.
3) Export the comp table and open in Excel because we need to manipulate the data.
4) Sort by subtype.
5) Add new column called "soil code."
6) Fill in a 3 in the soil code column for every soil that isn't Typic Hapludoll, a 2 for any soil that is Typic Hapludoll but not Waukegan, and a 1 for each Waukegan soil.
7) Upload this new comp table to R then export the attribute table for the SSURGO shapefile from ArcGIS Pro and upload it to R as well.
8) Perform a left join in R.
9) Write code to keep only the row with the lowest number for each mukey because we want the overriding classification for each polygon.
10) Export the resulting table and upload back into ArcGIS Pro.
11) Join newly uploaded table to the SSURGO polygon layer.
12) Symbolize the map by soil code.



We have this SSURGO map of the US.

We want to use this area.

And classify each polygon in the Midwest as:

Waukegan =1
non-Waukegan Typic Hapludoll = 2
non-Typic Hapludoll = 3
non-Hapludoll = 4

With the most specific classification overriding the others.

We'll want to sort the comp table by these classifications to easily assign codes based on their classification, then join that table to the map attribute table and select the lowest code for each mukey as that one "wins." A mukey might have soils with each code because a mukey could have Waukegan soils as well as many others, but if it has Waukegan at all it should be classified as 1. If a mukey has no Waukegan soils and no non-Waukegan Typic Hapludoll soils, but does have non-Typic Hapludoll soils, it should be a 3. And so on.

Example Question 3 (Last One!): What is the Midwest extent of Waukegan soils compared to other Typic Hapludoll soils?

You have: The name of your region and soil type(s) of interest.

You want to know: The locations in the region where the soil types are present.

Your product will be: A map.

Steps:

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7) Upload this new comp table to R then export the attribute table for the SSURGO shapefile from ArcGIS Pro and upload it to R as well.
8) Perform a left join in R.
9) Write code to keep only the row with the lowest number for each mukey because we want the overriding classification for each polygon.
10) Export the resulting table and upload back into ArcGIS Pro.
11) Join newly uploaded table to the SSURGO polygon layer.
12) Symbolize the map by soil code.

1 &2) Download data from SSURGO and upload in ArcGIS Pro.

Area of Interest (AOI) | Soil Map | Soil Data Explorer | **Download Soils Data**

Download Soils Data for...

Your AOI (SSURGO)

Soil Survey Area (SSURGO)

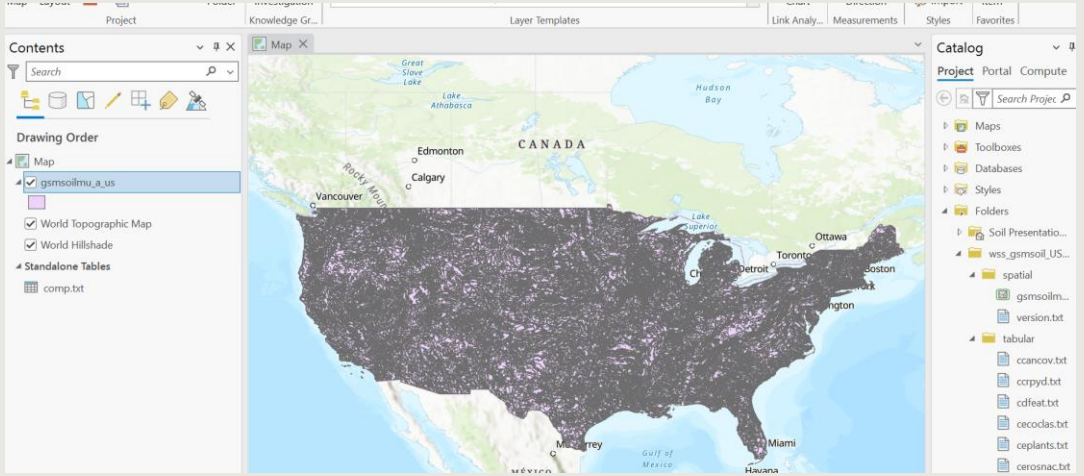
U.S. General Soil Map (STATSGO2)

General Information

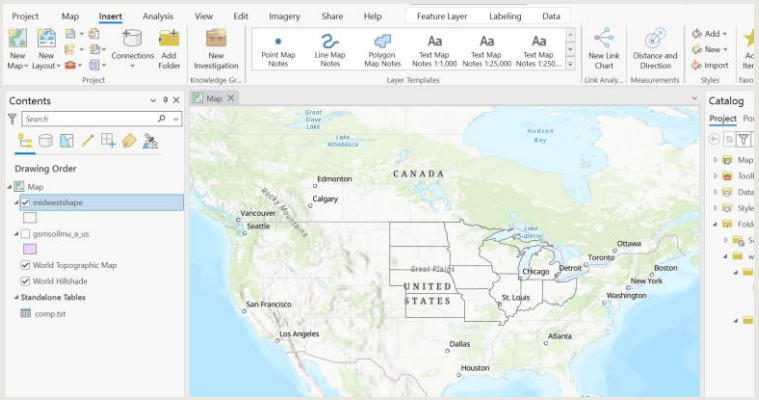
Link	Description of U.S. General Soil Map (STATSGO2)
Download Contents	Tabular data, spatial data, template database, and FGDC metadata
Spatial Data Format	ESRI Shapefile, Geographic WGS84

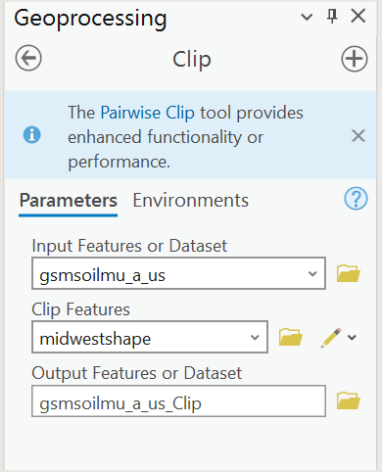
STATSGO2 Download Links

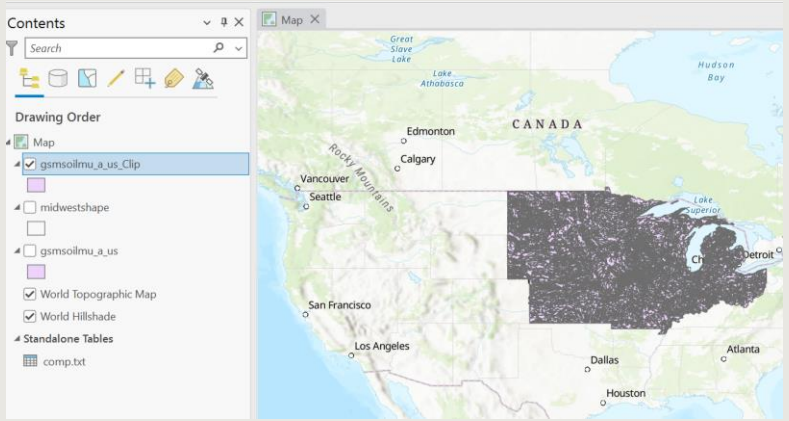
Spatial Extent	Download Size	Download Link
(entire data set)	424.7 MB	wss_gsmsoil_US_[2016-10-13].zip
Alabama	9.6 MB	wss_gsmsoil_AL_[2016-10-13].zip
Alaska	76.0 MB	wss_gsmsoil_AK_[2016-10-13].zip
Arizona	9.1 MB	wss_gsmsoil_AZ_[2016-10-13].zip
Arkansas	6.9 MB	wss_gsmsoil_AR_[2016-10-13].zip
California	23.2 MB	wss_gsmsoil_CA_[2016-10-13].zip
Colorado	13.3 MB	wss_gsmsoil_CO_[2016-10-13].zip



To get only the Midwest portion of the US map, I used the Clip tool under Geoprocessing (the tab is at the bottom of the pane, you can search Clip and it will come up). I clipped with a shapefile of the extent of the Midwest. You might be able to find shapefiles like this online but sometimes they need to be created. You can email me or USpatial if you ever need help making an extent map to clip from.

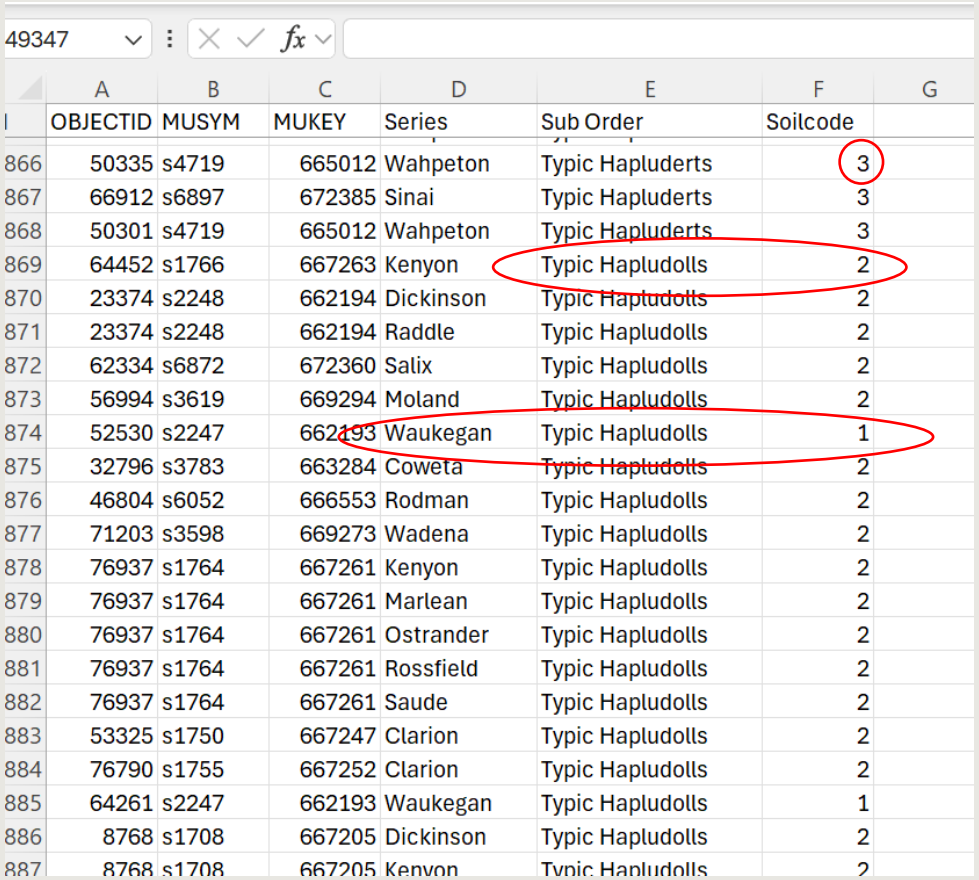






3) Export the comp table to Excel (use the Table to Excel tool).

4 &5) Sort the Excel comp table by Sub Order (Field84) and create a column called “soil type.”



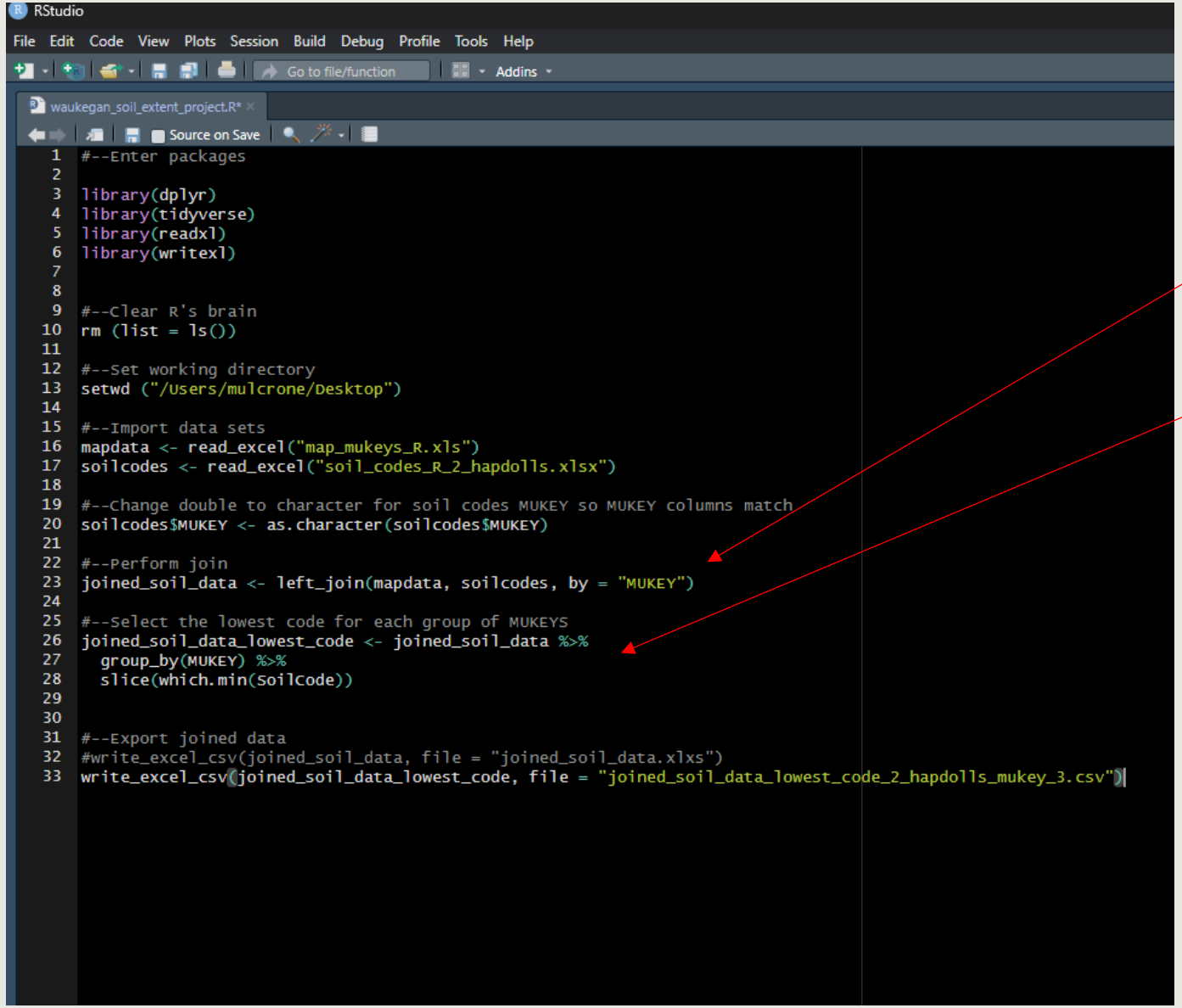
49347

	A	B	C	D	E	F	G
	OBJECTID	MUSYM	MUKEY	Series	Sub Order	Soilcode	
866	50335	s4719	665012	Wahpeton	Typic Hapluderts	3	
867	66912	s6897	672385	Sinai	Typic Hapluderts	3	
868	50301	s4719	665012	Wahpeton	Typic Hapluderts	3	
869	64452	s1766	667263	Kenyon	Typic Hapludolls	2	
870	23374	s2248	662194	Dickinson	Typic Hapludolls	2	
871	23374	s2248	662194	Raddle	Typic Hapludolls	2	
872	62334	s6872	672360	Salix	Typic Hapludolls	2	
873	56994	s3619	669294	Moland	Typic Hapludolls	2	
874	52530	s2247	662193	Waukegan	Typic Hapludolls	1	
875	32796	s3783	663284	Coweta	Typic Hapludolls	2	
876	46804	s6052	666553	Rodman	Typic Hapludolls	2	
877	71203	s3598	669273	Wadena	Typic Hapludolls	2	
878	76937	s1764	667261	Kenyon	Typic Hapludolls	2	
879	76937	s1764	667261	Marlean	Typic Hapludolls	2	
880	76937	s1764	667261	Ostrander	Typic Hapludolls	2	
881	76937	s1764	667261	Rossfield	Typic Hapludolls	2	
882	76937	s1764	667261	Saude	Typic Hapludolls	2	
883	53325	s1750	667247	Clarion	Typic Hapludolls	2	
884	76790	s1755	667252	Clarion	Typic Hapludolls	2	
885	64261	s2247	662193	Waukegan	Typic Hapludolls	1	
886	8768	s1708	667205	Dickinson	Typic Hapludolls	2	
887	8768	s1708	667205	Kenyon	Typic Hapludolls	2	

6) Put a 3 in the soil code column for any soil that isn’t Typic Hapludoll, a 2 for any soil that is Typic Hapludoll but not Waukegan, and a 1 for any soil that is Waukegan.

This example we aren’t deleting duplicate mukeys because we want all the mukey soil codes included in the next step when we select the lowest one.

7) Upload this file into R and export the SSURGO shapefile attribute table and upload to R as well.



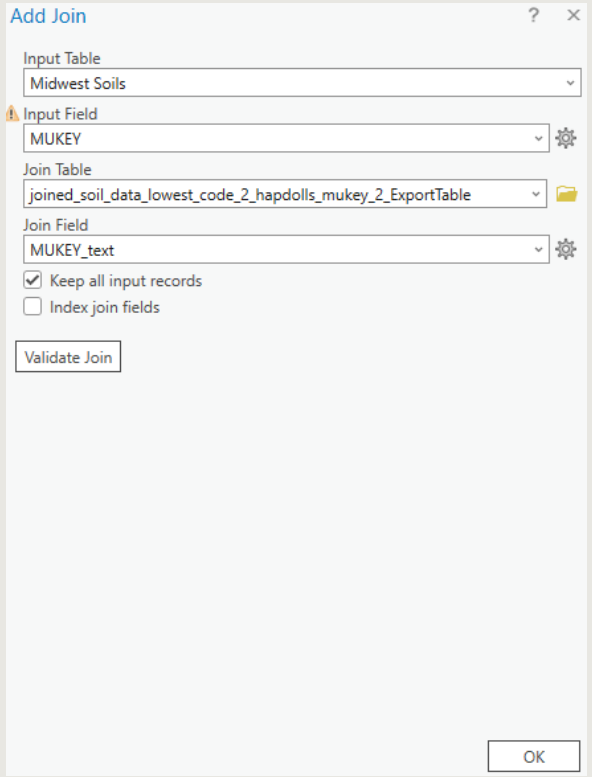
8) Perform a left join in R.

9) Keep only the lowest soil code for each MUKEY.

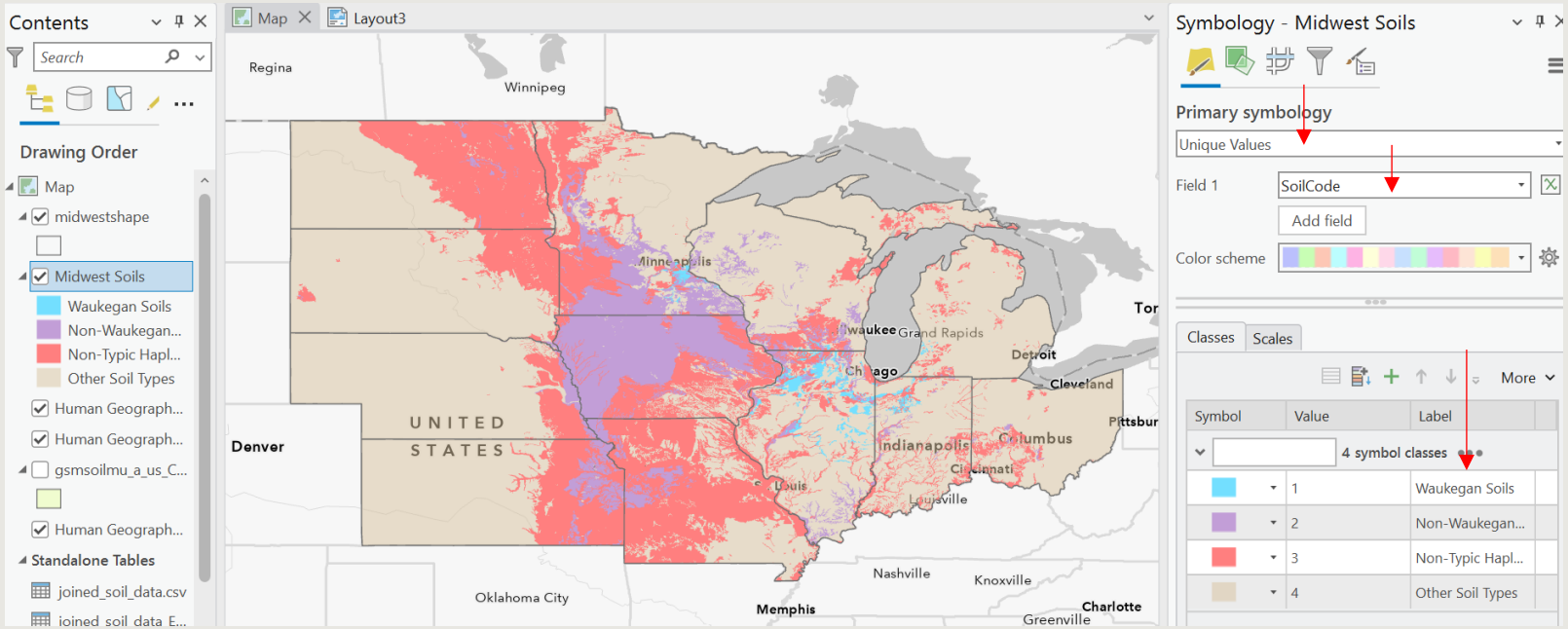
If you don't use R, this could all be done in Excel as well. If you don't use R and want to learn, I have tutorial on my GitHub that uses an easy soil moisture example that's for complete beginners. I'll link it in the resources slide.

* The other lines of code are importing, exporting, and doing the pesky conversion of MUKEYs to text from numeric for one of the datasets.

10 & 11) Export the resulting table, upload to ArcGIS Pro, and tabular join (right click > Joins and Relates > Add Join) to the SSURGO polygon shapefile using the MUKEY as the join fields. (The MUKEY in the table from R needed to be changed to text despite being set to text in the code. This just happens sometimes. I changed it using the same steps from the previous example).



12) Symbolize the map by selecting Unique Values and Soil Code. You can change the labels in the legend to display soil and soil type names instead of numbers.



Optional 13) Format the map

1) Select New Layout

2) Insert your map layout

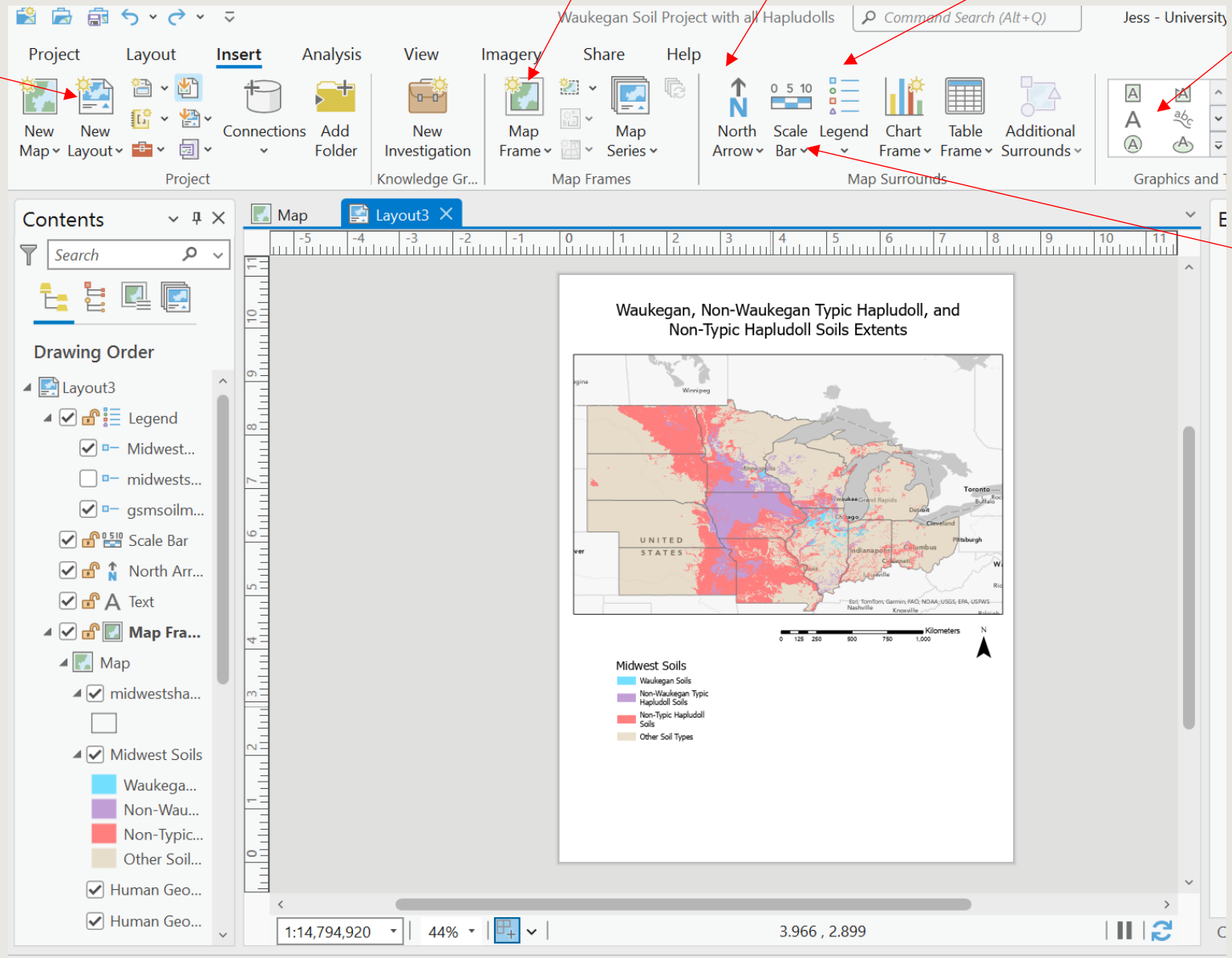
Add a North arrow

Add a legend

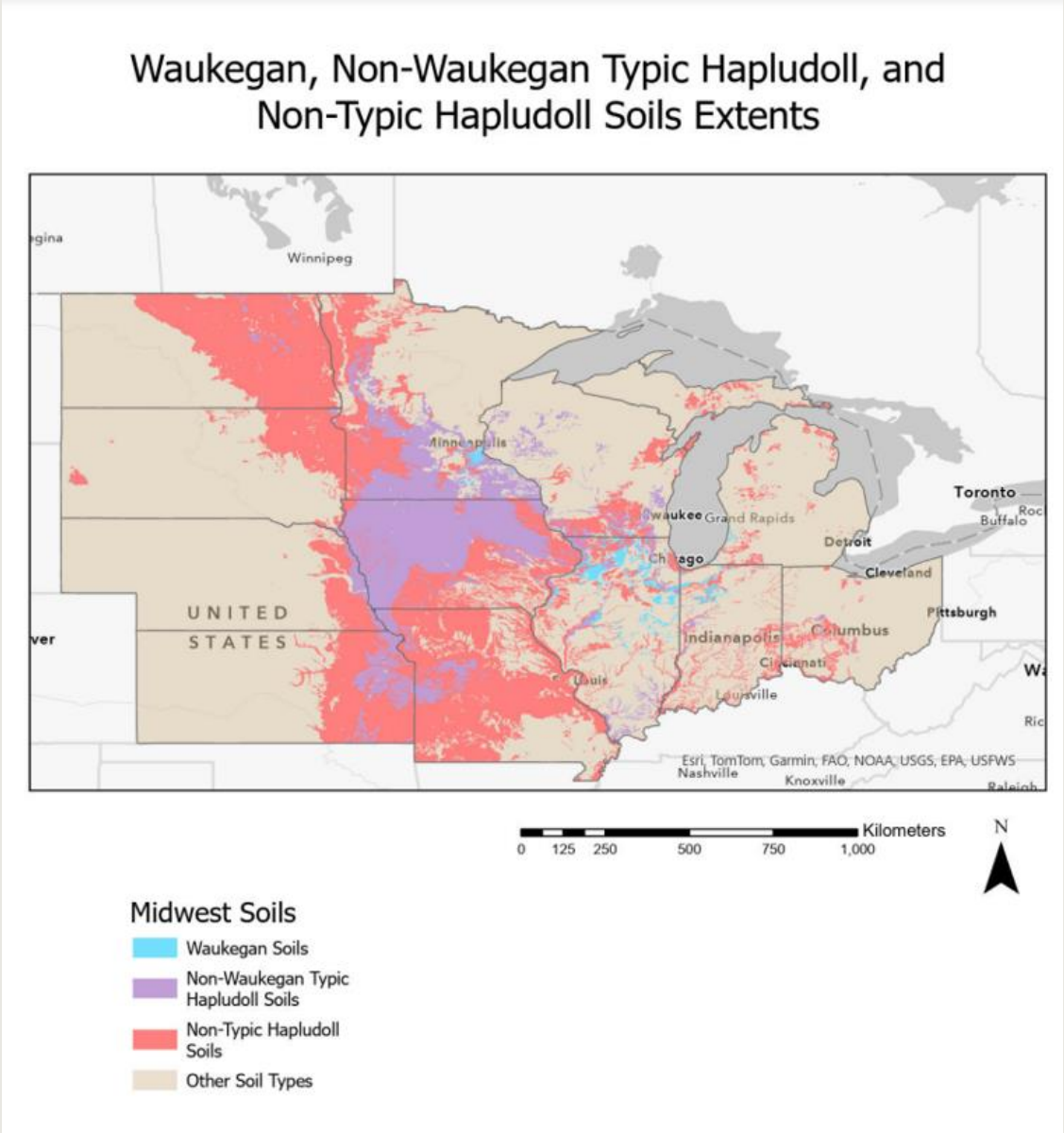
Add title

Add scalebar

There are more options and settings to format the layout that can take some figuring out, but this is the gist.

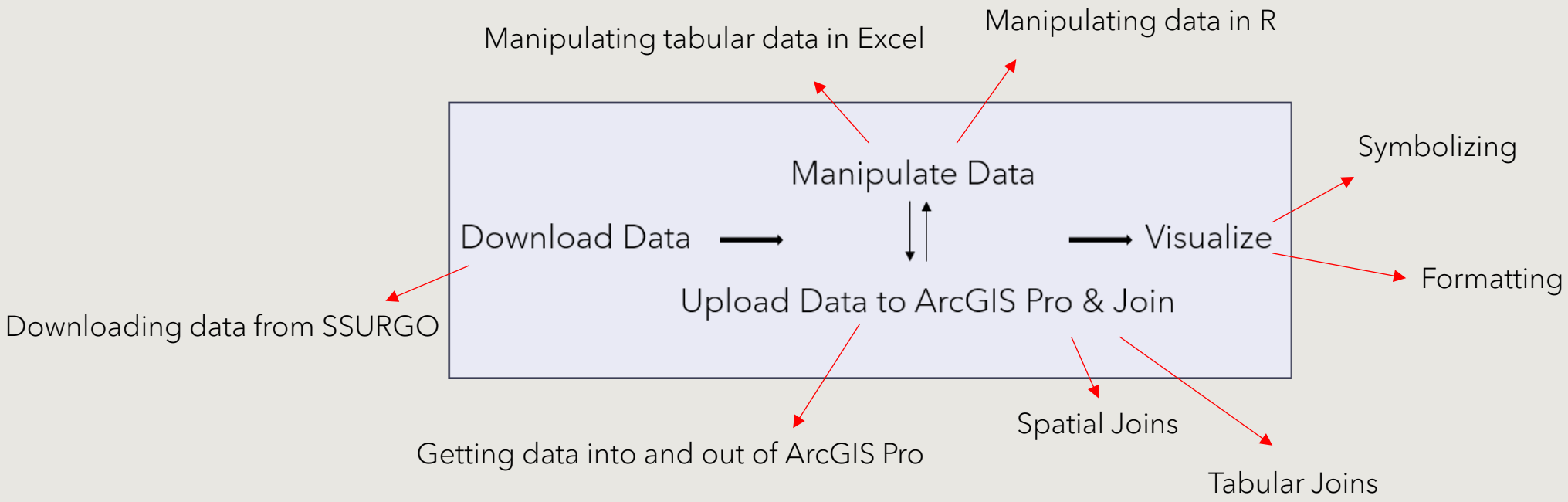


The Result:


Waukegan, Non-Waukegan Typic Hapludoll, and Non-Typic Hapludoll Soils Extents
Winnipeg
Minneapolis
Toronto
Buffalo
Grand Rapids
Detroit
Cleveland
Pittsburgh
Columbus
Indianapolis
Cincinnati
Louisville
Nashville
Knoxville
UNITED STATES
Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS
Kilometers
0 125 250 500 750 1,000
N
Midwest Soils
Waukegan Soils
Non-Waukegan Typic Hapludoll Soils
Non-Typic Hapludoll Soils
Other Soil Types

Done with Examples!

Quick Visual Summary of Steps



One Final Note: Figuring Out How to Manipulate the Data to Get at Your End Goal Can Be the Hardest Step in Soil Mapping

- (at least for me)
- The structure of the comp table and mukeys and how everything is linked takes getting used to. And manipulation needs to line up with join requirements and (if applicable) how the results need to be structured for symbolizing. It takes understanding the database and creativity.
- Point being if you're having trouble wrapping your head around how to answer a soil mapping questions with SSURGO don't feel bad. It can also be hard to find relevant SSURGO resources online. But it does get easier (and kind of fun) after the learning curve!

Also Remember:

These maps include the soils whether they are a major component or not. Datasets can be filtered to only include major components using the Yes/No magcompflag column (Field6). I don’t have a good grasp on how to make that decision.

Contact Info and Resources

- My email is mulcrone@umn.edu.
- The USpatial help desk email is uspatial@umn.edu.

(We prefer you email the help desk so we can keep track of metrics to prove to the University that they should fund us. Soil mapping questions will get routed to me).

- My favorite source for help with ArcGIS Pro is Esri help articles.
- I haven't found a great source for relevant SSURGO help. The metadata page on the SSURGO website can be helpful but takes getting used to.
- A beginners R tutorial using a soil moisture example is on my GitHub at https://github.com/Jemulcrone/resources. You can learn enough from that tutorial to write all the code used in this presentation.

Thanks for listening to my presentation! Good luck with any soil mapping you do and definitely feel free to reach out with any questions ☺