

Vector Analysis: Farm Land Suitability Analysis in Groton, MA

Written by Adrienne Goldsberry, revised by Carolyn Talmadge 10/9/2018

Introduction

In this assignment, you will help to identify potentially suitable parcels for urban farming for the New Entry Sustainable Farming Project (“New Entry”). This project, supported by Tufts University, “assists people with limited resources who have an interest in small-scale commercial agriculture to begin farming in Massachusetts” (<http://www.nesfp.org/>). Much of the prime farmland in Middlesex County (where the town of Groton is located) has been developed, mostly for residential use. However, a growing population of beginning farmers has created a demand for agricultural uses on some of this land.

In this assignment, you will employ basic GIS **vector geoprocessing analysis tools** you have learned in class to identify potentially suitable farming parcels in Groton, MA. Please note that this exercise provides a very simplified version of New Entry’s GIS analysis – this is not the full process, but is intended to introduce students to overlay tools and analysis in a short tutorial.

New Entry’s Criteria for Suitable Farmland Areas:

- Minimum parcel lot size of 2 acres
- No wetlands
- Suitable land use for agricultural activities (aka Cropland, Nursery, Orchard, Pasture, Brushland/Successional or Very Low Density Residential)
- Prime Farm Land Soil which is good for farming.

Objectives

At the conclusion of this lab, you will have:

- Downloaded appropriate GIS datasets from MassGIS
- **Clipped** datasets at the state scale to a smaller town extent.
- Performed **Select by Attribute** queries to identify specific features of datasets, and **created new shapefiles** from these queries.
- **Joined** a table to a shapefile.
- Performed an **Intersect** to identify areas that meet the suitable farming criteria.
- **Calculated area** of polygons in a shapefile.

Data Sets and Sources

- For this analysis, download the following **Shapefiles** from [MassGIS Data Layers](#).

DataSet	Town	Specific Instructions
Standardized Level 3 Assessors' Parcels - Updated 9/13/2018	Groton	Click "Download Parcel Data: From a spreadsheet of links". Open the excel sheet and click on the link for Groton
Land Use (2005)	-	Click "Download this layer"
Community Boundaries (Cities and Towns)	-	Shapefile or Geodatabase is fine.
MassDEP Wetlands Original (1:12,000)	-	Download Statewide data
Soils Database		Open this link to download a Geodatabase of soils tables: It will automatically download. http://download.massgis.digital.mass.gov/shapefiles/soils/soi_middsx.zip

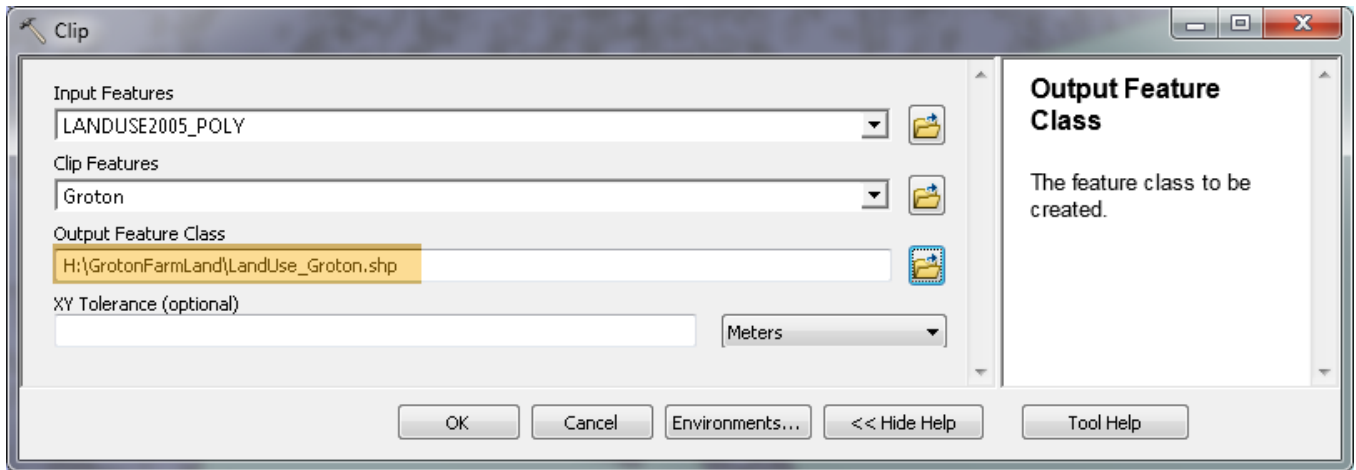
- In your H drive, create a folder named **GrotonFarmLand**. Move all the zipped files into this folder and extract each of the zipped files here. Remember, once the zip file downloads and you copy it into your H Drive folder, you need to right click and **Extract Here or use 7Zip to extract here**.
- Open a blank ArcMap, and add the following layers that you just downloaded to your map:
 - Towns_Poly.shp
 - M115TaxPar.shp
 - LANDUSE2005_POLY.shp
 - WETLANDSDEP_ORIG_POLY
 - GISDATA_SOILS_POLY_SV_MUNAME.shp
- Zoom to Groton. You can do this by using the find binoculars.

Clipping the Downloaded Data

For better data organization, you will **clip** your state wide datasets to Groton. This will speed up ArcMap because many of the datasets are very large and SLOW!

- Turn off all layers except Towns_Poly.
- In order to clip the data to Groton Boundary, you first need to create a shapefile of just Groton to use as the boundary.
- From the Towns_Poly layer, **select** the town of Groton. You can do this through **Select by Attributes**.
- Once Groton is selected, Data → Export Data into your H Drive. Name this new shapefile **Groton**.

5. **Clear your selection.** Turn back on the Land Use layer.
6. Use the **Clip** tool to clip the **LandUse2005** layer to Groton. In the top menu bar, select **Geoprocessing** → **Clip** and enter in the info. Make sure to save the **Output Feature Class** (the new shapefile) in your H Drive and call it **LandUse_Groton.shp**



7. Run the tool. Once it completes, **remove** the original Land Use layer- it is no longer necessary.
8. Use the **clip** tool to clip **GISDATA_SOILS_POLY_SV_MUNAME** (soil data) and **WETLANDSDEP_ORIG_POLY** (wetland data) as well. Save them both in your H drive folder with appropriate names. Once the data is clipped, **remove** the original Soil and Wetland data. They are LARGE and SLOW!
9. No need to Clip the Tax Parcels, since that layer is already just for Groton.
10. Take a few minutes to explore each dataset and associated attribute table and familiarize yourself with the information in each.
11. Arrange these layers in a logical manner, and symbolize them accordingly.

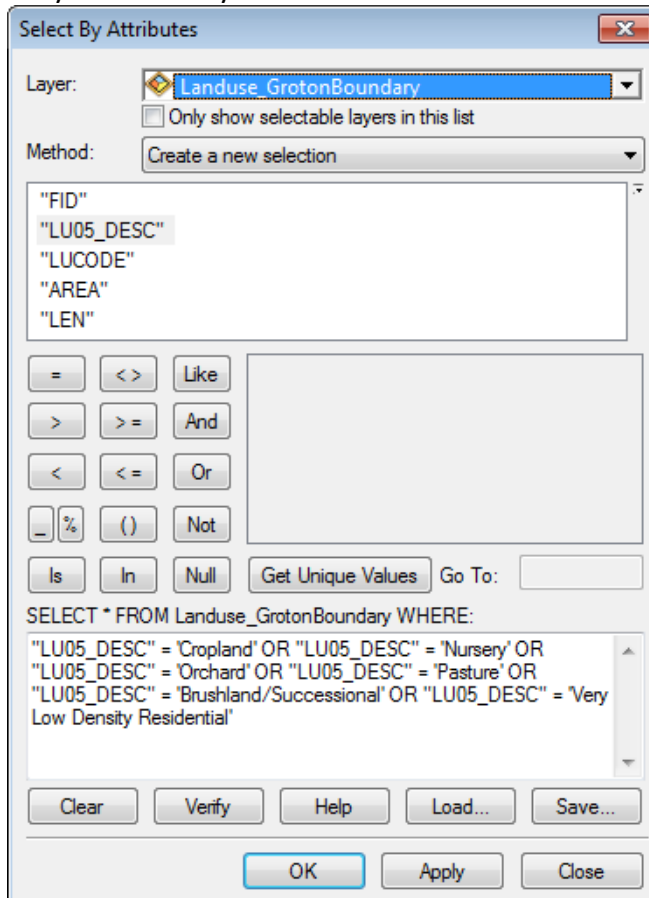
Finding Suitable Land Use Locations

First, we will select the appropriate **land uses** that are considered suitable for farm land. These are the land use categories that New Entry has determined appropriate for potential new farms out of all the land uses within the LANDUSE2005_Poly layer:

- Cropland
- Nursery
- Orchard
- Pasture
- Brushland/Successional
- Very Low Density Residential

1. Determine which field in the **Attribute Table** provides information on land use type. Then perform a **Select by Attributes** query on the LandUse_Groton layer to select the following:

- Cropland
- Nursery
- Orchard
- Pasture
- Brushland/Successional
- Very Low Density Residential



Note: You can select all the land uses together in one query using the **OR function**.

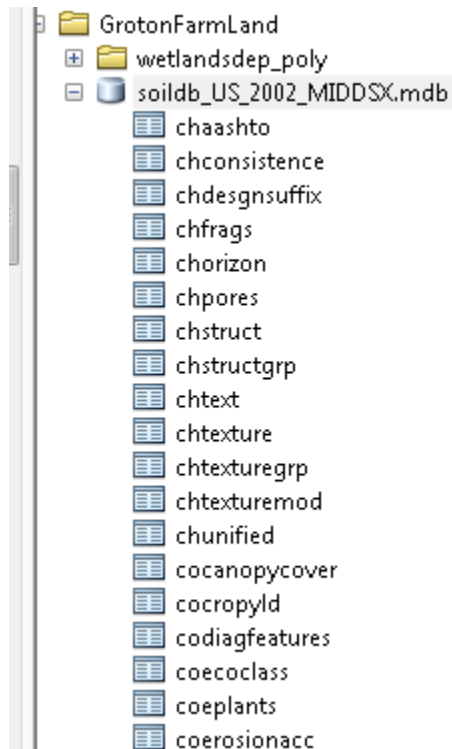
Hint: It is easier to perform a successful query by using the “buttons” and “get unique values”, rather than typing in the query directly into the text box.

2. Once selected, right click on LandUse_Groton and **export** the selected land uses (**Data → Export Data**) as a new shapefile to your **H Drive** and save as **SuitableLandUse_Groton**. Remember to name your exported shapefiles with logical names– this will save you much time later in the project!
3. Click “Yes” to add the new layer to your map.
4. Clear the selection from the *LandUse_Groton* layer after you have exported the new *SuitableLandUse_Groton* shapefile and turn off the old *LandUse_Groton* layer.
5. **Symbolize** your new layer with a **unique values color scheme** for each different land use **category**.

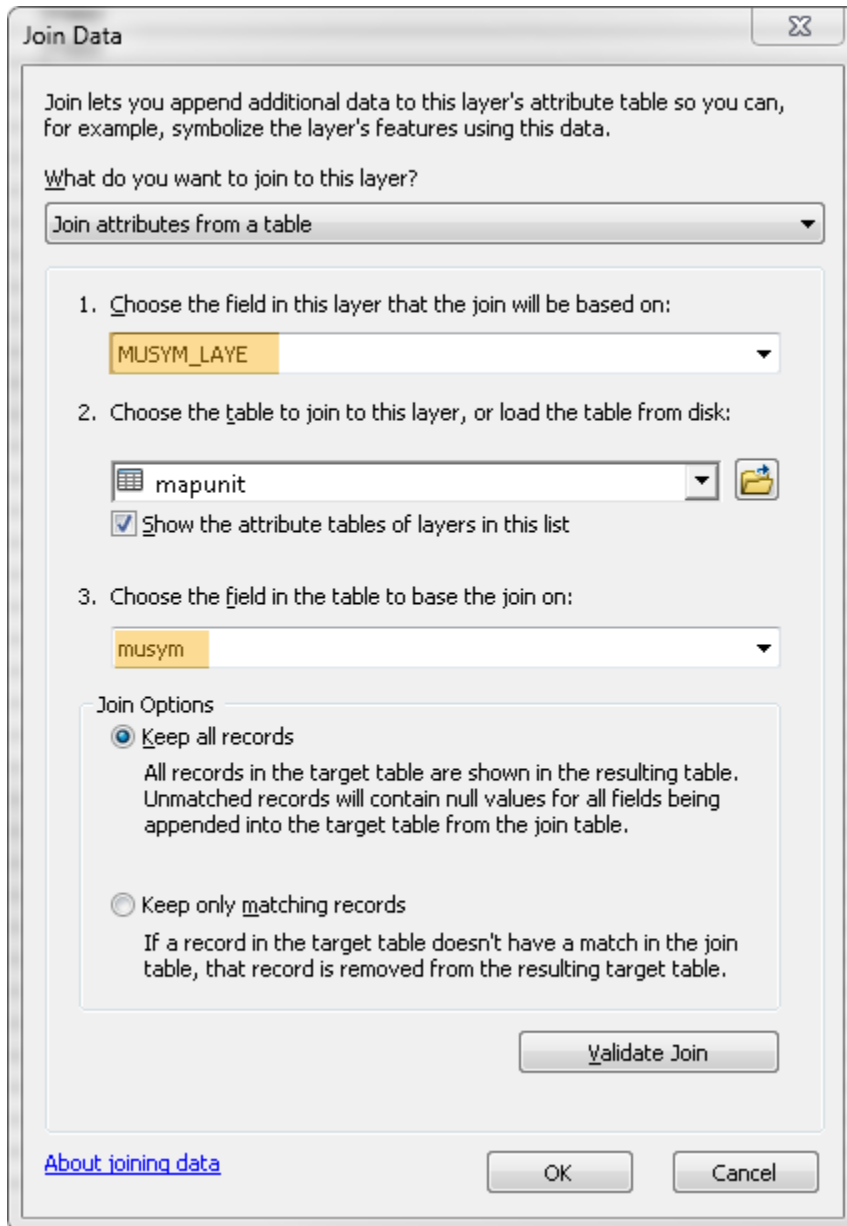
Joining Soil Information to the Soil Shapefile

Now, we need to take a closer look at the **Soil** data to know which soils are considered *prime farmland*. The soil also has a geodatabase with A LOT of tables. There are many different attributes collected about the soil including bedrock, moisture level, slope, ownership, and soo much more. These all come in different tables and are not already part of the attribute table because there are so many. Therefore, we need to **Join** the information about soil properties!

1. In Catalog, expand the Soil Geodatabase.



2. Find the table called **mapunit** and drag it in. Open this table to see the information. Scroll over to the field labeled **FarmIndcl**. This has information on whether the soil is appropriate for farming. Notice there are several rows that have “all areas are prime farmland”. Our end goal is to select those areas....but **FIRST**, we must **join** this table to the soil layer.
3. Open the attribute table for **Soil_Groton**. **Which field is the same in the shapefile and in the table?** We will use these fields to **join** the data. Remember what they are both called (they might not be the same name but could have matching contents).
4. Right click on the **clipped soil data** → **Joins and relates** → **Join...**
5. Make sure the tool is set to **Join attribute from a table**. Fill out the tool to join the mapunit table based on the MUSYM fields.

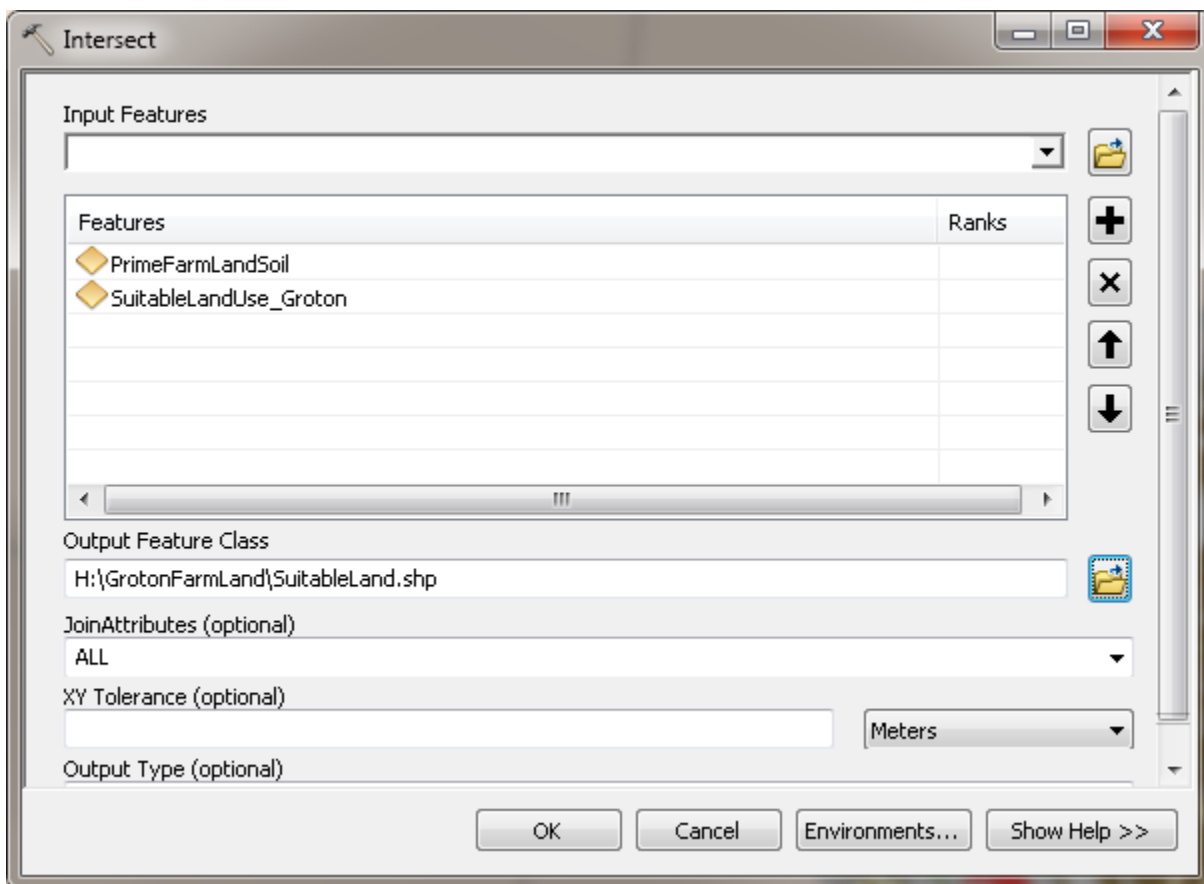


6. Press ok. Press yes if asked if you want to index the data.
7. Open up the **clipped Soil** Shapefile and make sure the join was successful – you should see the table joined to the end of the original attribute table. If it worked, **Data → Export Data** and save the new shapefile as **Soils_Joined**. This saves the join as the attribute table and no longer thinks of it as a “join”.
8. Turn off the clipped soil data, we will now be using this **joined soil data** moving forward. The whole purpose of this join was to have information on whether the soils are considered “prime farmland”. Now that it is part of the layer, we can use that information to select prime farm land!
9. Open the **attribute table** and find the field again that had data on “areas considered prime farmland”.
10. Perform a **Select by Attributes** to select “**all areas are prime farmland**”. Use **Data → Export data** to save this a new shapefile. Name it **PrimeFarmLandSoil**.
11. **Clear your selection** and turn off **Soils_Joined**. We are done with that layer.
12. Turn **PrimeFarmLandSoil** brown.

Intersecting Suitable Land Uses and Prime Farmland

In order to determine where New Entry farmers could potentially farm in Groton, we need to determine the locations where our criteria start to **Intersect** (or overlap). You should currently have the following shapefiles in your mxd:

- Areas of suitable land use - **SuitableLandUse_Groton**- selected from the original Land Use shapefile
 - **PrimeFarmlandSoil** in Groton – Selected from the Joined Soil Data.
 - Wetlands (we will discuss the wetlands layer in a moment)
13. **Intersect** (Geoprocessing → Intersect) **SuitableLandUse_Groton** and **PrimeFarmlandSoil** (but not wetlands). Give your new shapefile a logical name, such as **SuitableLand** and save it to the same location as the other shapefiles. Click OK.

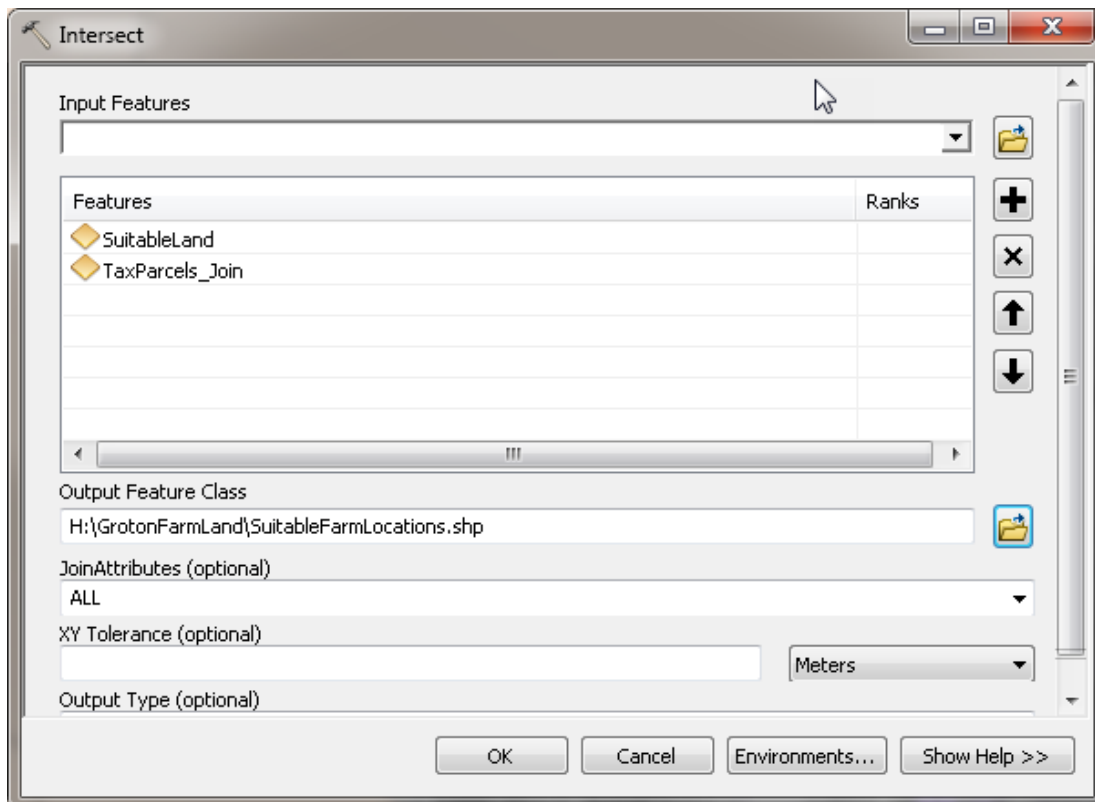


14. Turn off the old **PrimeFarmlandSoils** layer and the **SuitableLandUse_Groton** layer.
15. Review your new shapefile, **SuitableLand**. Does it seem logical? This layer now shows only areas where both “prime farm land” AND a suitable land use types overlap.
16. Next, spend some time reviewing this **SuitableLand** with the **Wetlands** layer. Do you visually see any areas that intersect with wetlands? If you look at your original land use layer, you will notice that **Wetlands** is listed as a separate land use category. Therefore, you will likely not have any suitable areas where wetlands are located since we did not select any land uses that were wetlands.

Determining Suitable Land based on Size of Tax Parcels

Next, we need to determine which **tax parcels** meet the minimum lot size criteria (**2 acres in this case**) for suitable farm lands. We will need to purchase the entire tax parcel, so it needs to be at least 2 acres!

1. Open the attribute table for M115TaxPar and review its contents. There is not much useful information there, is there? For example, there is nothing about the owners of the parcel, the addresses, or even the size of the parcels. **We need to join this shapefile with another table that has this information.**
2. From Catalog, add the *M115Assess.dbf* file to your map that was downloaded with the parcel data.
3. **Join** the *M115Assess.dbf* TO the *M115TaxPar* layer. To **join** the data, right click on **M115TaxPar** layer and go to **Joins and Relates** → **Join...**
4. Choose **LOC_ID** as the field on which to base the join – the attribute table and the .dbf each have this field so we will use it to join these two tables together. Make sure the correct **table** is being accessed.
5. Press yes when asked if you want to index the data.
6. When the join is complete, open the attribute table again for **M115TaxPar** – note that the information from *M115Assess.dbf* is now in that attribute table.
7. Scroll across the table to see the new information in the attribute table. This information (parcel owner, address, etc) will be important to identify the landowners of parcels that have potentially suitable land for New Entry farmers.
8. **Data** → **Export Data** to save this join. Name it **TaxParcels_Join**. Turn off the original **M115TaxPar** layer.
9. Now that we have included more information in the parcels layer, we can intersect **SuitableLand** and **TaxParcels_Join**. This will leave us with only Tax Parcels that are also suitable soils and land uses! Go to **Geoprocessing** → **intersect**. Save the shapefile in your H drive and call it **SuitableFarmLocations**.



16. Now, use **Select by Attributes** to select areas **Greater than OR EQUAL to (\geq) 2 Acres**.

17. **Export** (using Data → Export Data) the selection as a new shapefile to your map and save it **Final_SuitableFarmLocations_2Acres**.

Congrats! You have now identified those tax parcels/land greater than or equal to **2 acres in size**, which have the appropriate land uses for agricultural activities (**aka Cropland, Nursery, Orchard, Pasture, Brushland/Successional or Very Low Density Residential**) and that are considered **Prime Farmland Soils**. These are parcels that could be bought and used by New Entry farmers.

Deliverables

At the conclusion of this lab, you will submit:

- A map showing the Final Suitable Farm Locations that are greater than 2 Acres for the town of Groton.

The map should:

1. **Symbologize** the final results layer by the different **land use** types. Note: Do not symbologize the full land use layer!
2. Include information you find relevant to the map. However, do not overcrowd the map and try to show everything. You can also change the basemap, if you think that would be helpful (such as using an aerial imagery).
3. An inset map showing the location of Groton within Massachusetts.
 - a. No extent indicators, turn the town of Groton red and include all towns in MA. You now have a Groton layer in your H drive!
 - b. Don't have Mass be a floating island! Include surrounding states too.
 - c. Labels where necessary with character spacing and proper hierarchy.
4. Standard map elements
 - Title – Location, Date
 - Legend
 - North Arrow
 - Scale Bar
 - Data sources
 - Cartographer Information
5. Annotation listing the different factors/criteria required for the analysis.
6. Label the surrounding towns where appropriate with character spacing too.

Answers to the following questions in a word document:

1. What are the limitations of this analysis? What other information, or factors, might we want to consider when determining appropriate farm land?

2. How many of the land use category types remain in the final analysis?
3. How many acceptable sites are there in the final analysis? Show a screen shot of your attribute table.
4. Where you able to perform this analysis on the first try? We're there any tools you had trouble using?