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GIS and Spatial Analysis GEOG 544
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Final Project

TerraSol Community Energy: Location Analysis Study

Introduction:

TerraSol Community Energy is a proposed community-solar-farm project. A solar farm is a photovoltaic power station which supplies energy to the grid. Community solar, on the other hand, is defined as a power station which can supply energy to a number of different households—this means that people can benefit from the peace of mind of powering their house with solar energy, without having to place solar arrays on their own roofs. The thing what will make TerraSol Community Energy different from other large solar farms in the area is that we will utilize sheep to keep the vegetation from growing over the photovoltaic arrays, instead of lawnmowers and other machinery. This will appeal to people who are looking at "green" solutions to their energy supply demands.

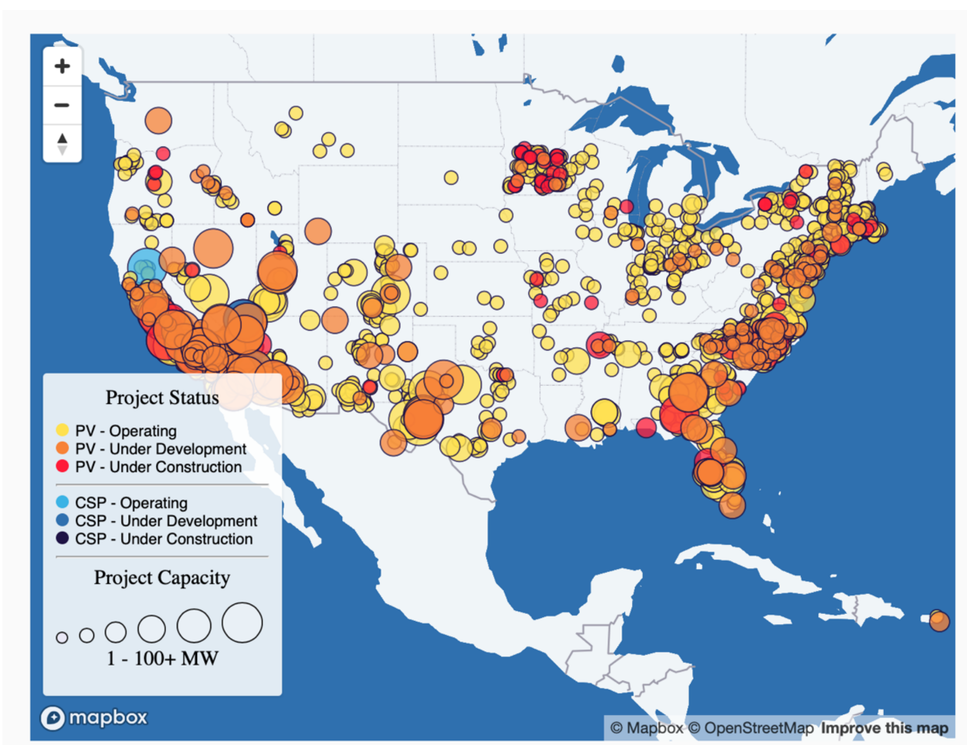


Figure 1: Map from Solar Energy Industries Association (SEIA) Showing current solar projects in the US.

This business will hire out a crew to build the solar array and will have sixteen employees to start. These employees will consists mainly of sales reps who will sell energy credits to customers who are interested in supporting this community solar project. The energy that the farm supplies will go straight to the local grid, but the customers who buy into our program will get a credit on their traditional energy bill.

Our target customers will be middle-aged, with higher educations, and disposable income. But since our customers can benefit from the community solar project from a distance away, the location of our customer base does not have to coincide exactly with the location of the solar farm. What does matter is how mush sun the area gets, how the area is zoned (because we are using the grounds as pasture for sheep, it must be zoned agricultural), and how large the area is. We are also looking for an area of about 100 acers, or just over 400,000 square meters so that we have room to grow.

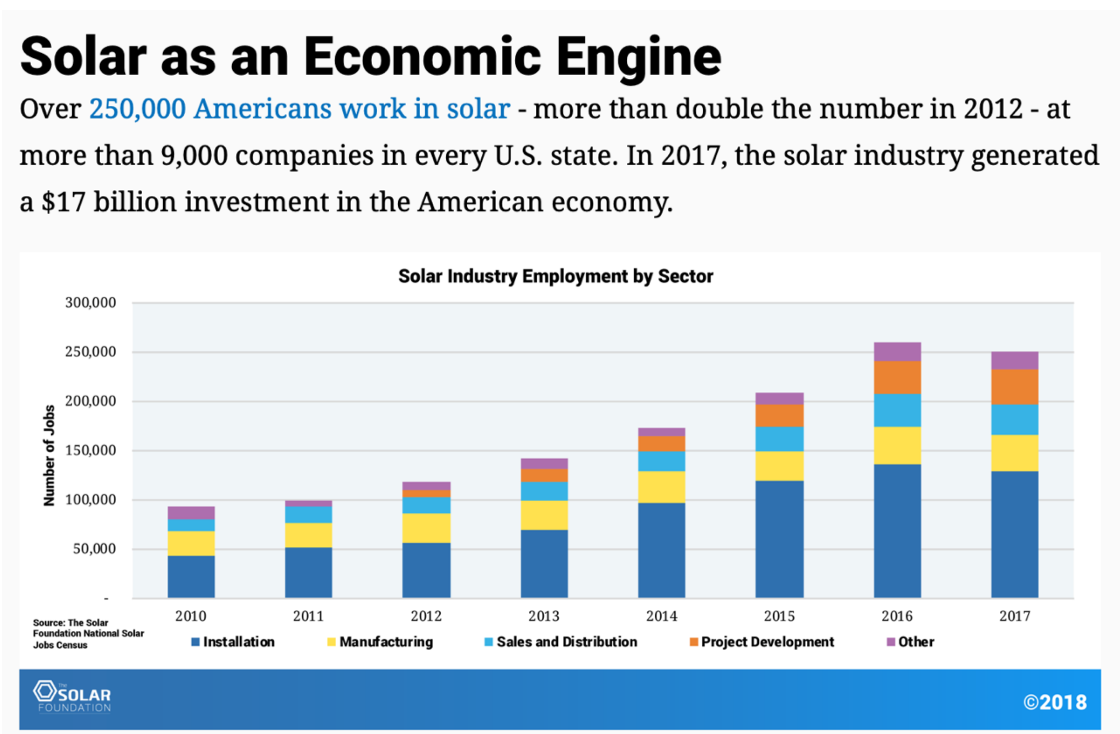


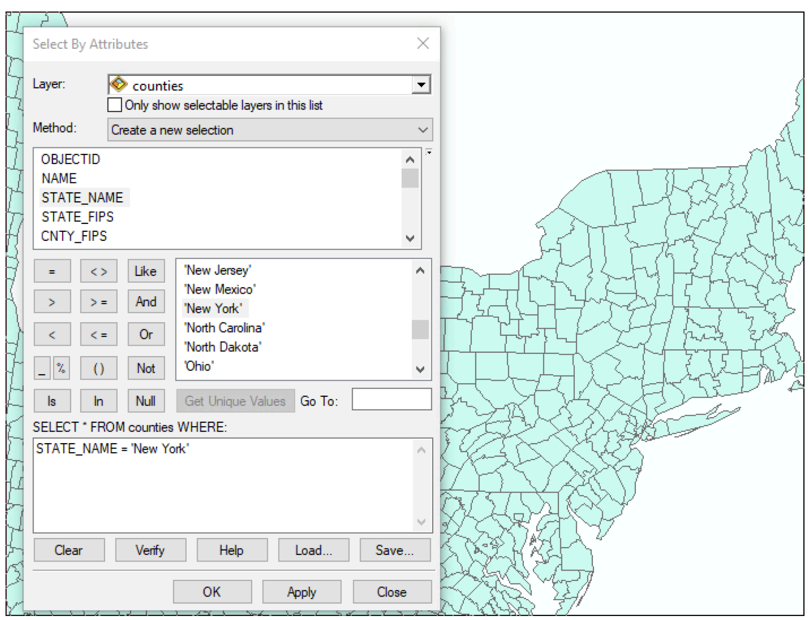
Figure 2: This graph, from the Solar Foundation National Solar Jobs Census, shows the growth of the solar industry and its impacts on jobs in the country.

Figures 1 & 2 show how solar energy is rising in popularity all over the country. Projects are in development on the east and west coasts, and this is having an impact on the economy by boosting jobs. States such as California, Texas, Florida, and North Carolina already have many large solar stations underdevelopment. New York has many smaller stations already operational, but not many large capacity solar stations. Because of this, and because of tax incentives available in NY for solar industries, we have decided to look for an area to build in NY.

Data Collected:

- Basic shapefiles of NY including counties, roads, hydrology from ESRI class data
- A map of solar radiation received on the ground in NY from the National Renewable energy Laboratory
- Text files of personal solar arrays in the state, compost facilities, and eclectic vehicle charging stations from data.NY.gov
- Shape files of average precipitation across the state and zoning districts from CUIGIR
- And finally a raster image of canopy cover also from CUIGIR

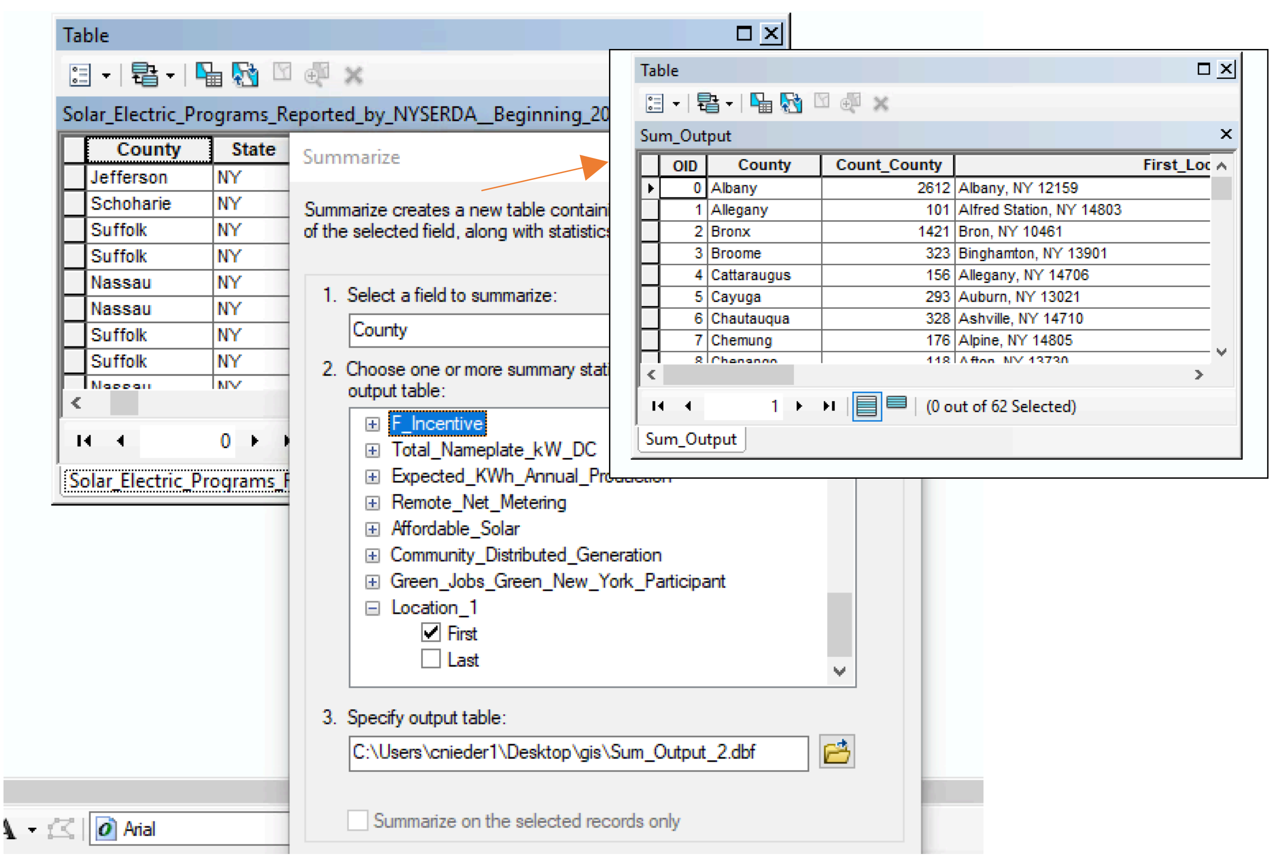
Basic NY Data Processing: To begin, I created a shapefile of NY counties from the world geodatabase in the ESRI class data. I then clipped roads and hydrology to the state.



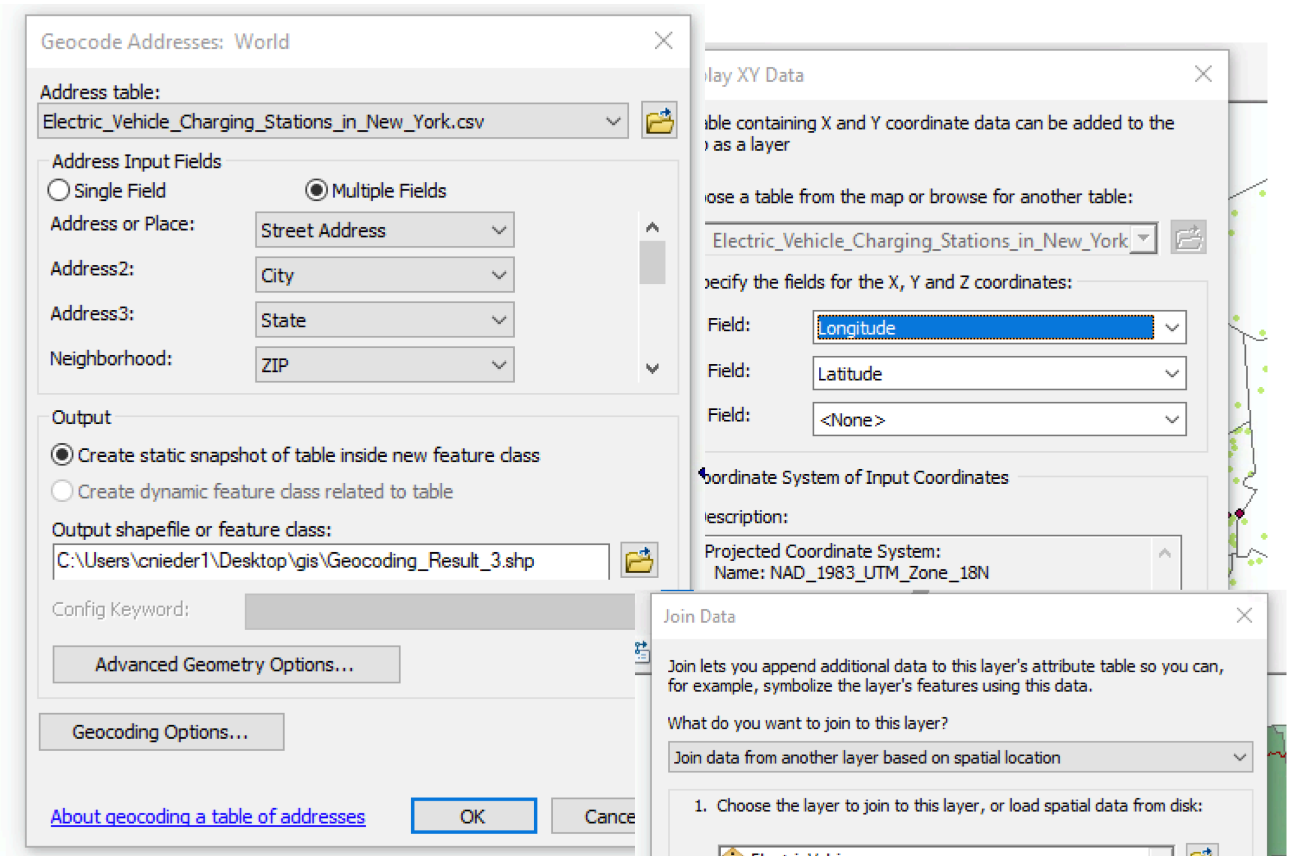
Understanding “Greenness” by County:

Although the census data is not that important for the location of this business, for it to be successful, it needs to be installed it in an area where people are already interested in the idea of green energy, ideas, and projects. To figure out good, “green” locations, I decided to look at existing personal solar arrays, areas where cities have put in large-scale composting facilities, and areas that have electric charging stations for vehicles. To create choropleth maps of these data, I needed to do some manipulations.

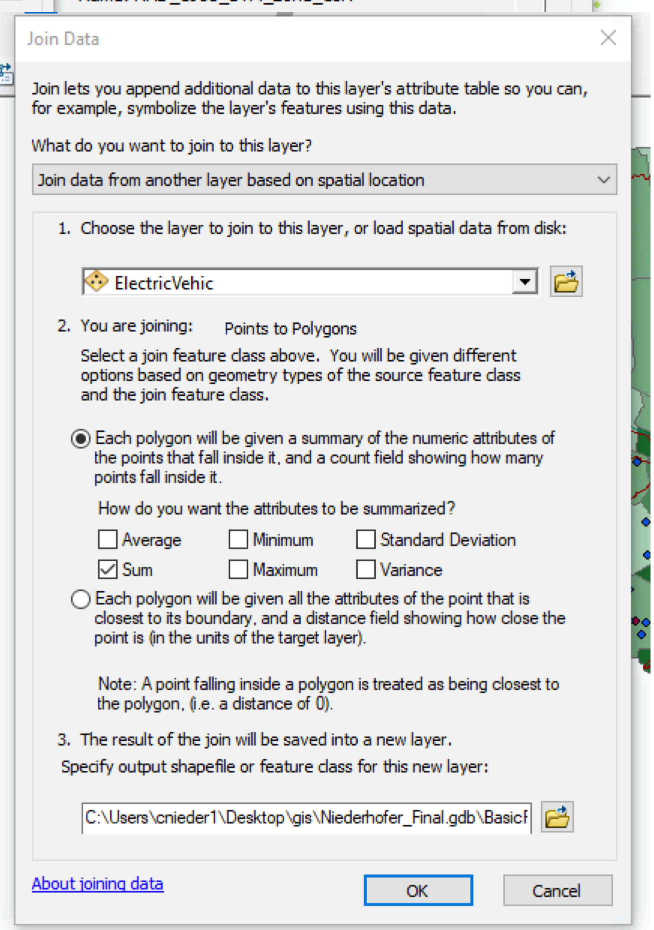
For the personal solar electric arrays, the list had a county field name, but because there were many solar arrays in each county (one to many), I could not use a simple join to join the table to my county shapefile. Instead, I first summarized the county field to get a count of solar arrays per county. This gave me a table of counties with field that summarized the solar data. This table, I could join to the county shapefile I had.

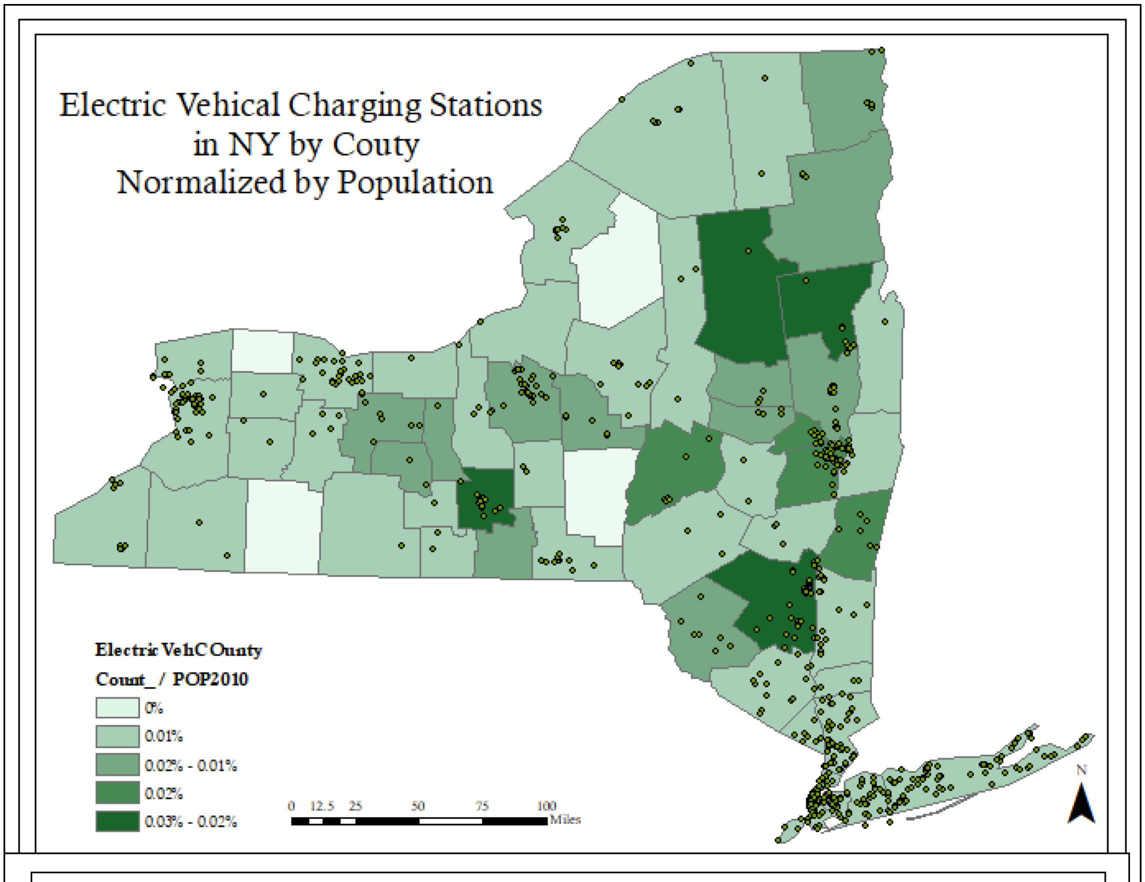


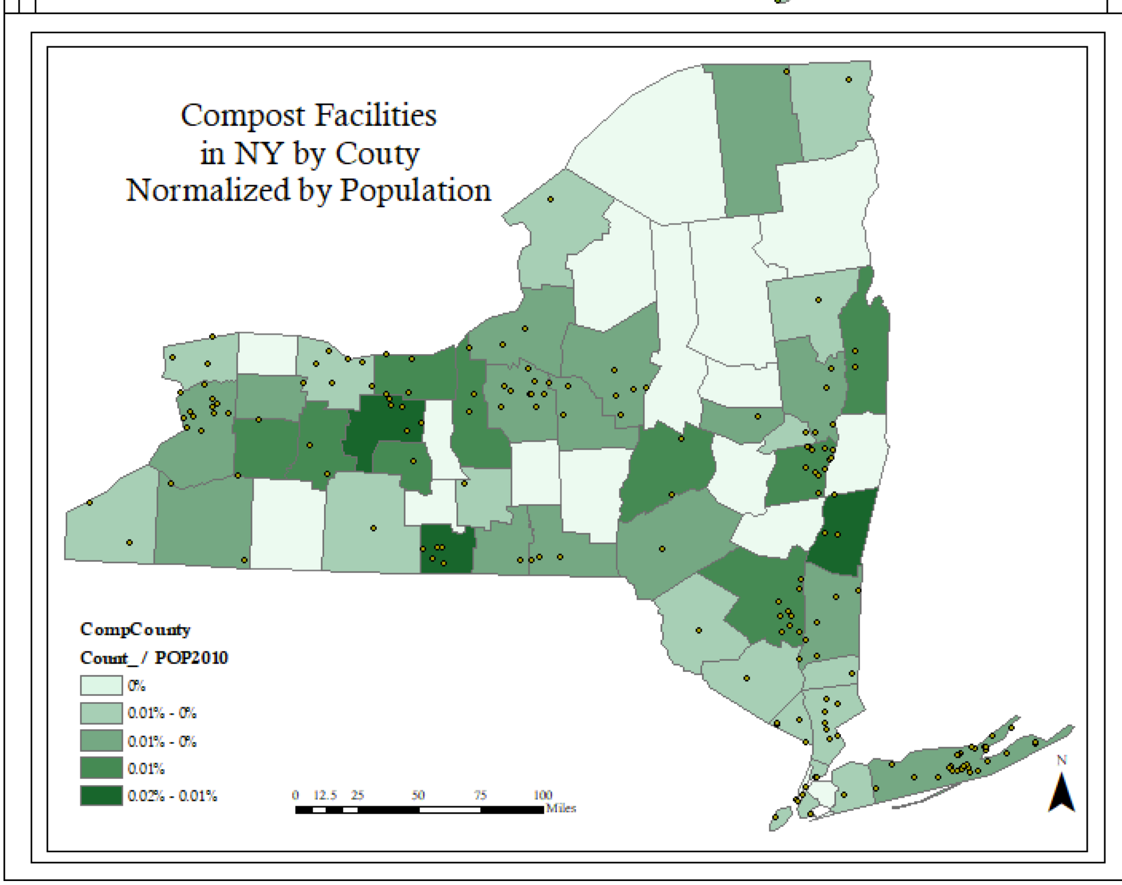
The table for the electrical vehicle charging stations included address fields, so it was easy to geocode using ArcGIS World geolocator. The Compost data table included latitude and longitude fields, so I used the XY data to create points.



Finally, I used spatial joins to give me a summary of the points in each county for both electric vehicle charging stations and for compost locations. I created choropleth maps for each variable, normalizing the numbers by 2010 census population numbers.




Electric Vehical Charging Stations
in NY by Couty
Normalized by Population
Electric VehC Ounty
Count_ / POP2010
0%
0.01%
0.02% - 0.01%
0.02%
0.03% - 0.02%
0 12.5 25 50 75 100
Miles
N


Compost Facilities
in NY by Couty
Normalized by Population
CompCounty
Count_ / POP2010
0%
0.01% - 0%
0.01% - 0%
0.01%
0.02% - 0.01%
0 12.5 25 50 75 100
Miles
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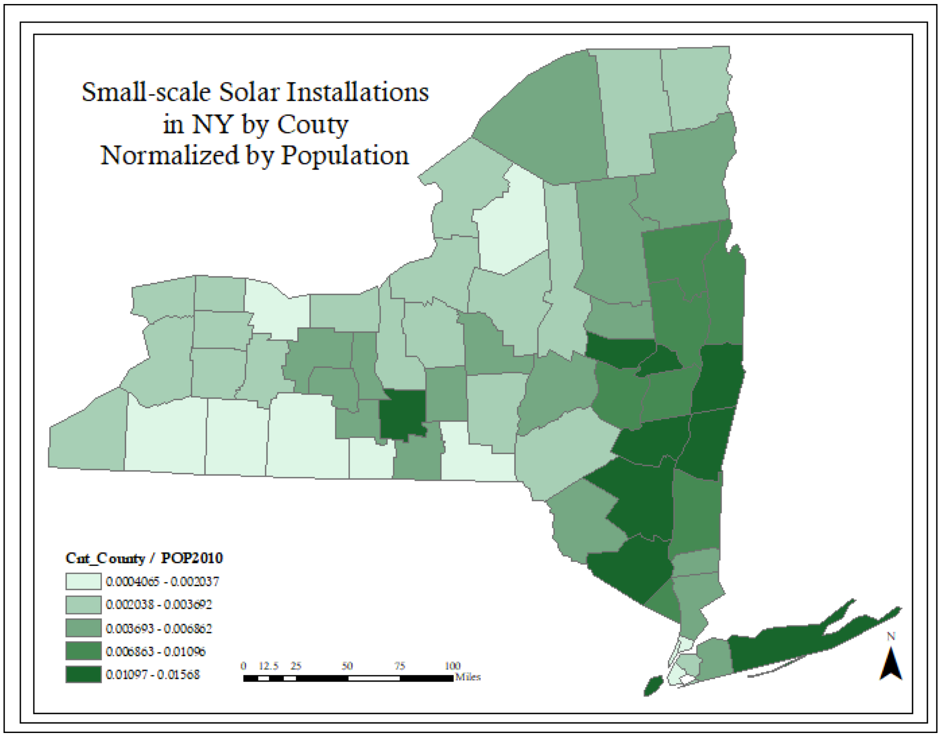
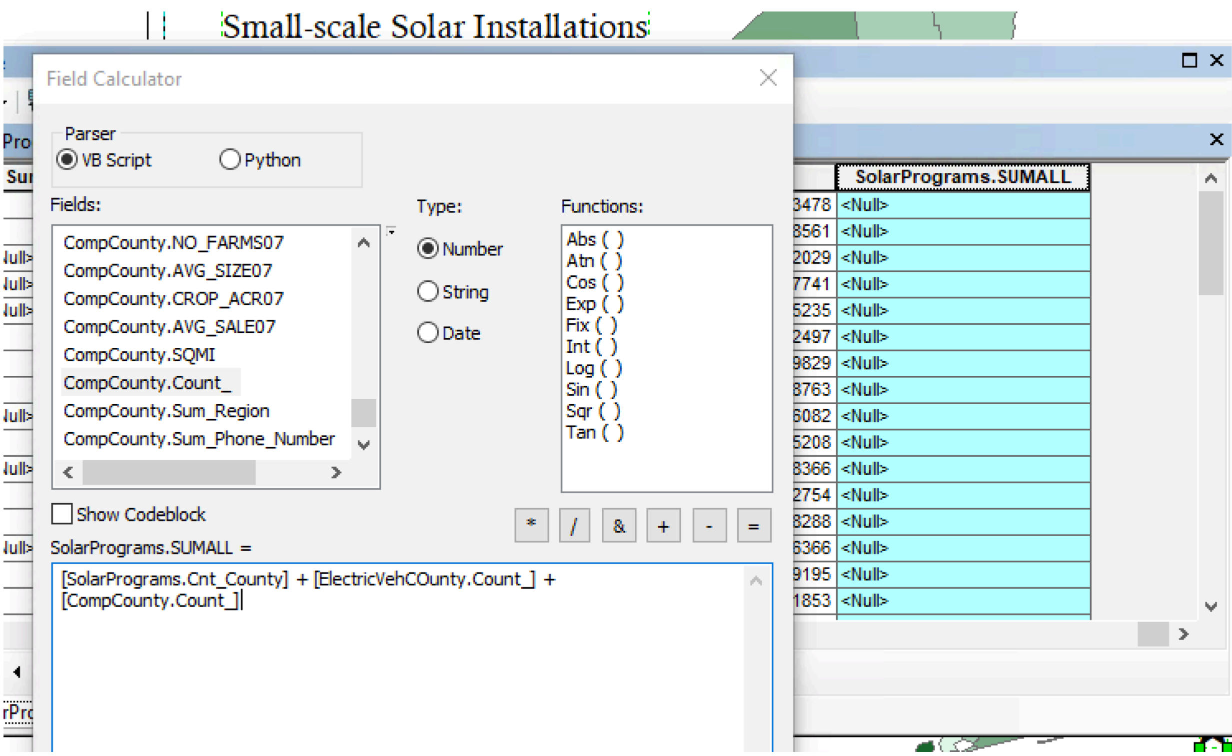
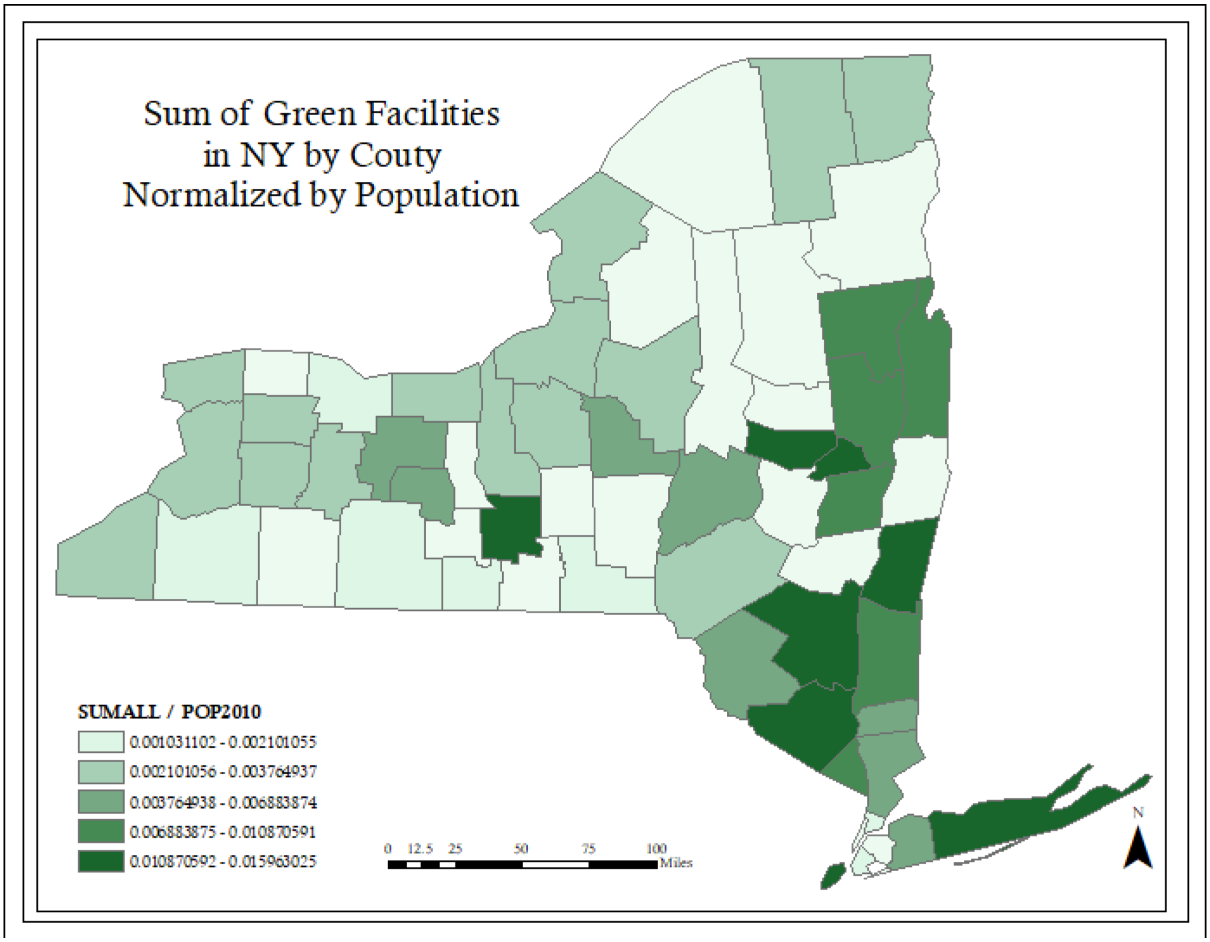
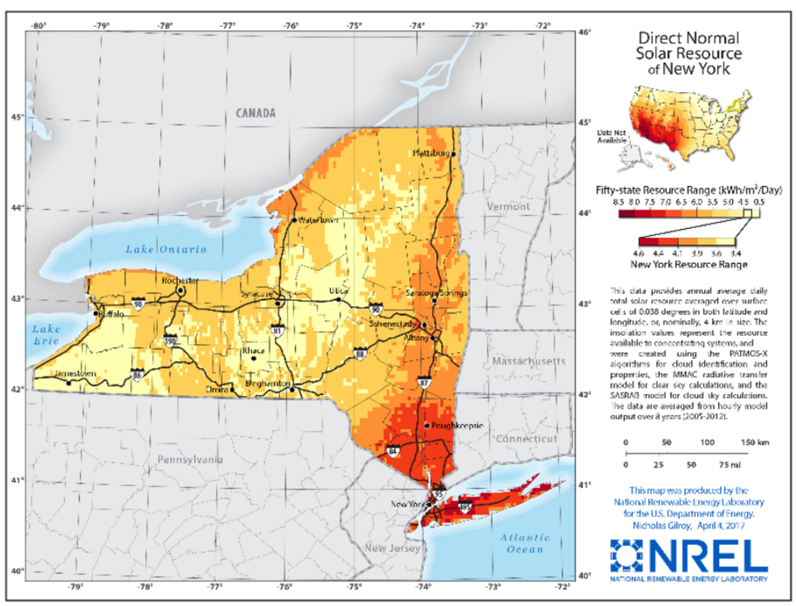


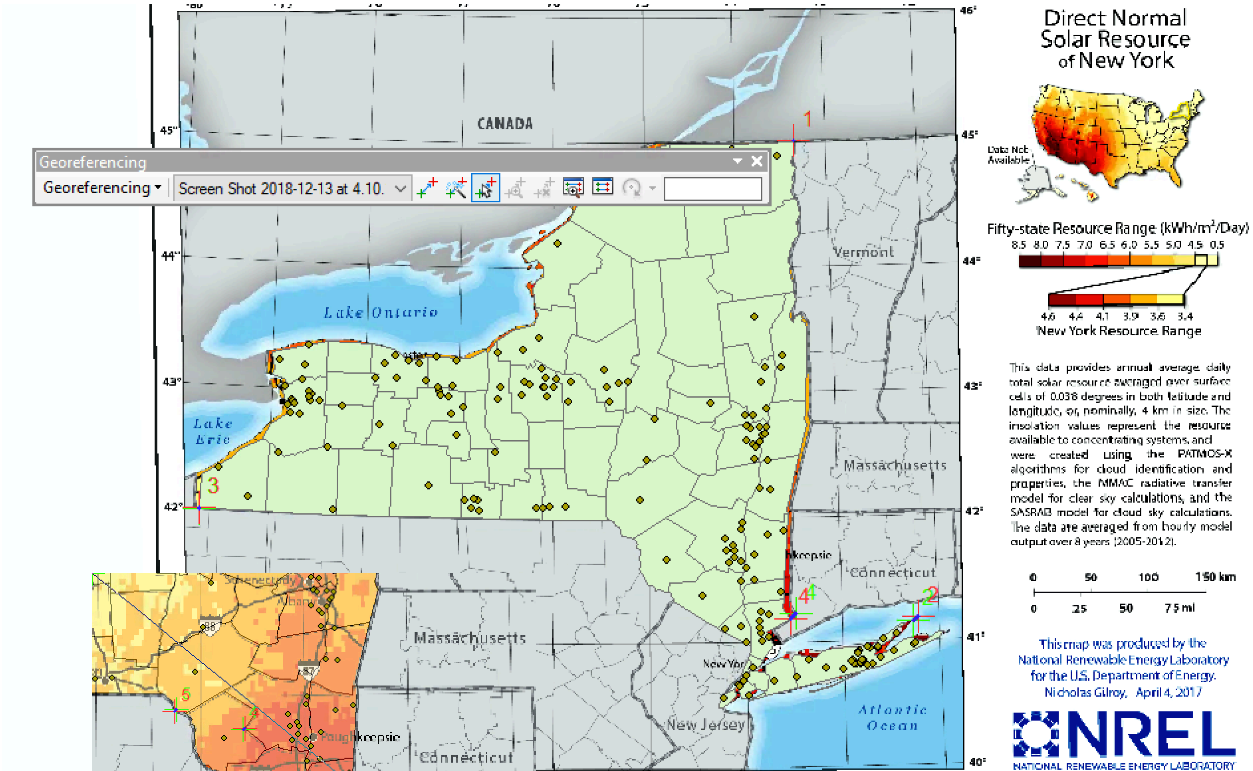
Next, I joined all three tables together and added a new field and used the field calculator to create a sum of the three types of data in each county. This gave me a look at the "greenness" of the county.



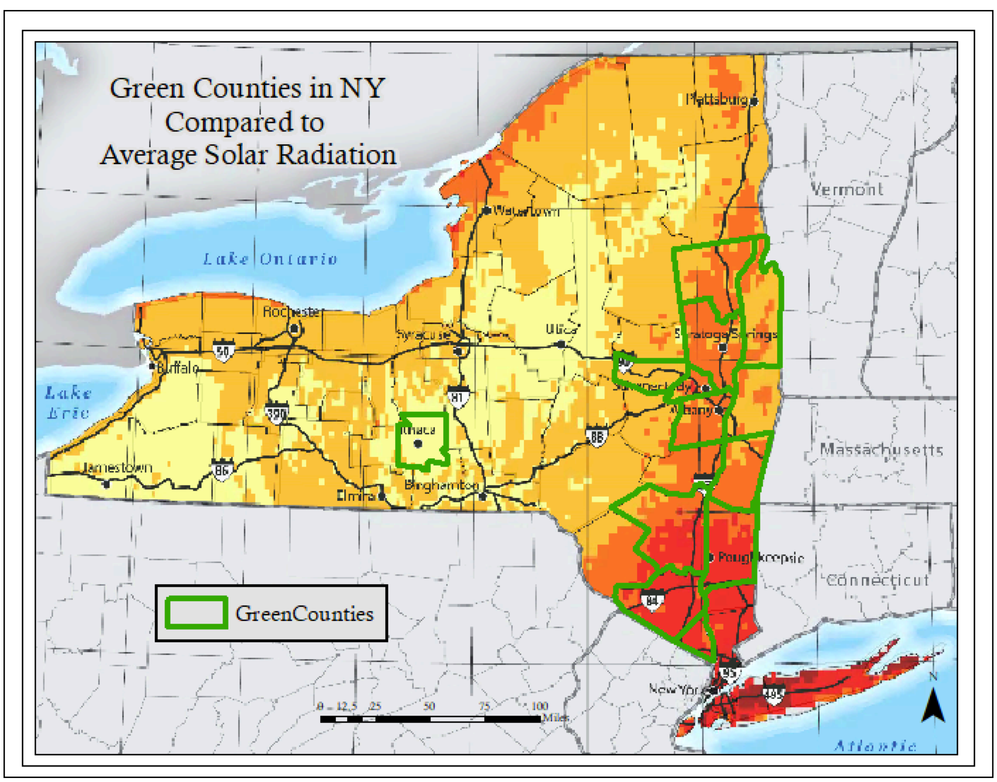


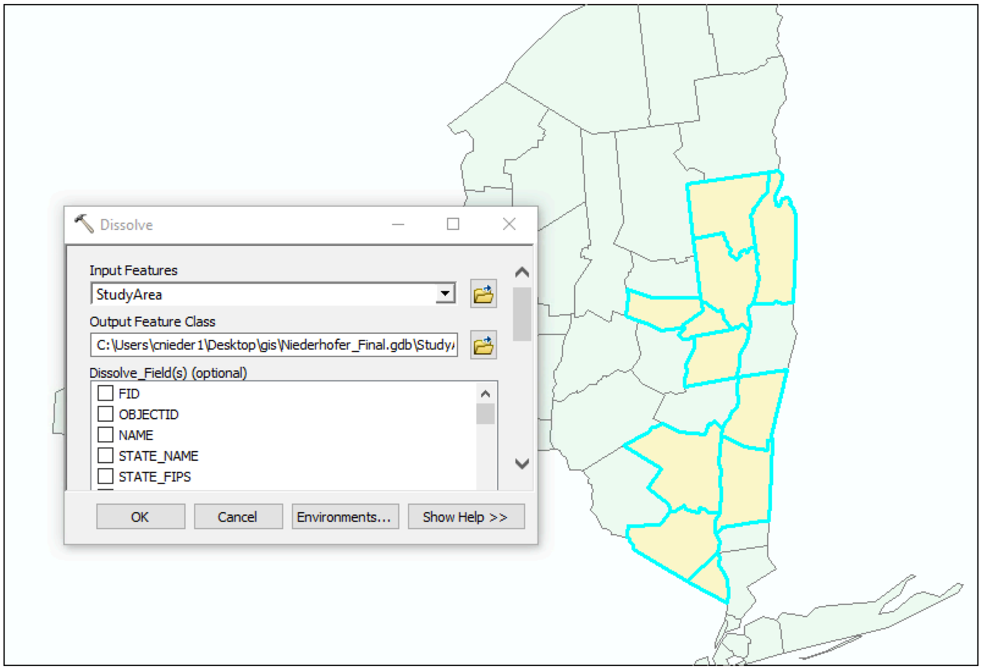
Next, I wanted to look at the solar radiation that each county receives annually. I could not find a data table showing this, but I did find a finished map from National Renewable Energy Laboratory (NREL) showing annual radiation levels for the state. I decided to use this and georeferenced it on top of the county map that I already had. This would not give me a usable attribute table, but I can use it for a visual reference.



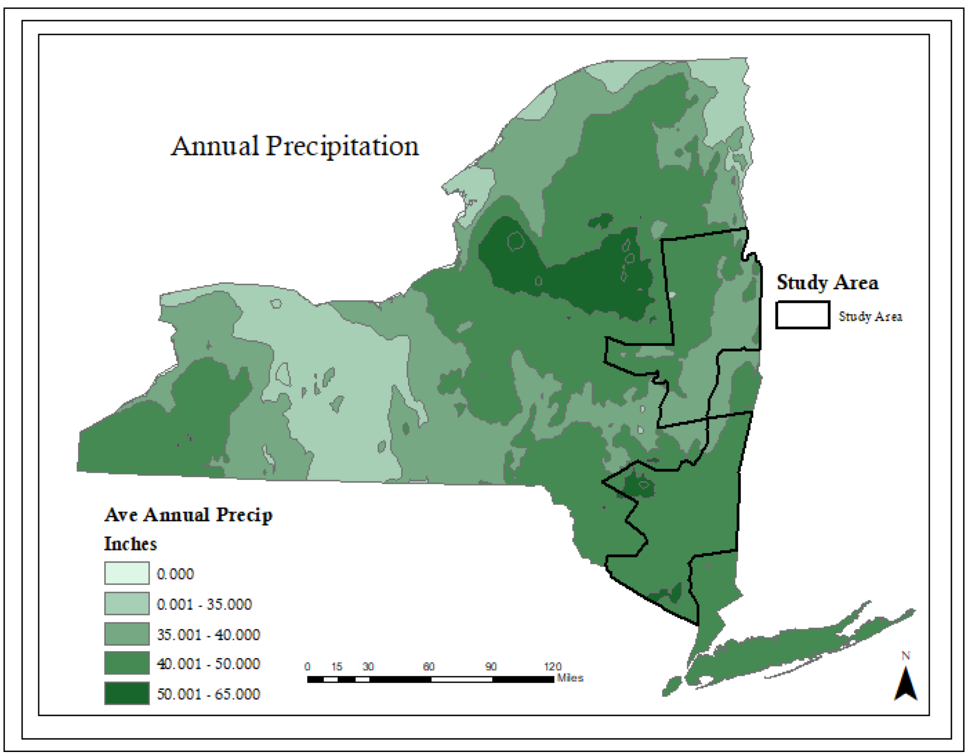


Next, I used select by attributes to select counties that had the most "green" attributes from my last choropleth map. I created a new shapefile of these "green" counties and overlaid them on top of the georeferenced radiation map.



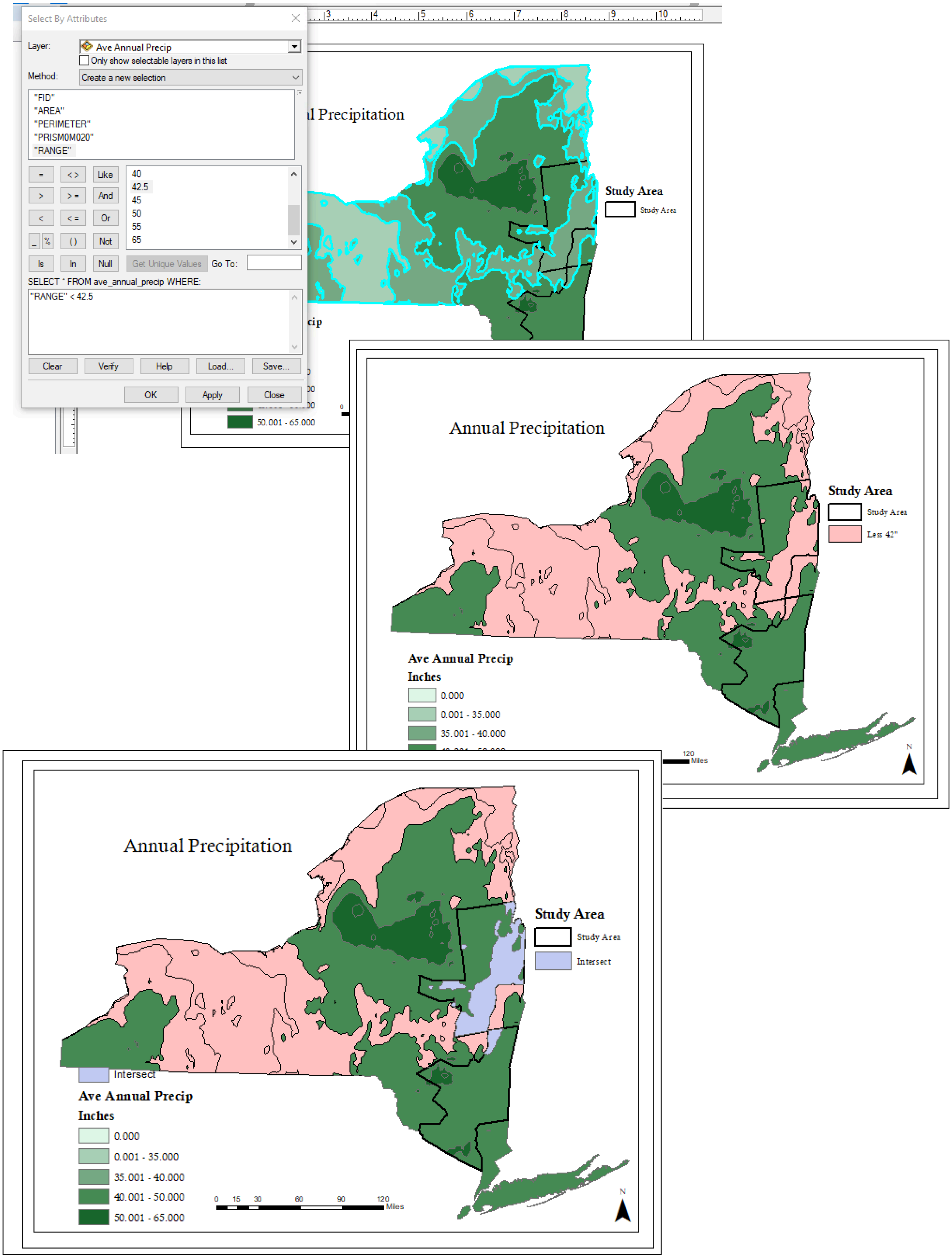


Most of the counties lined up with high radiation for the state. I used all but Tompkins county (the one in the center of the above map) as my first study area. I used the dissolve tool to get one continuous shapefile.



Next, I wanted to look at precipitation, with the thought that areas with less precipitation would have more blue skies, and less maintenance for the solar arrays.

I used select by attributes to select the areas with less than 42.5 inches of precipitation a year. I then created a new shapefile of the low-precipitation areas, and intersected that with my study area to get a new, more precise location. (See next page)


Select By Attributes
Layer:
Ave Annual Precip
Only show selectable layers in this list
Method:
Create a new selection
"FID"
"AREA"
"PERIMETER"
"PRISM0M020"
"RANGE"
=
< >
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45
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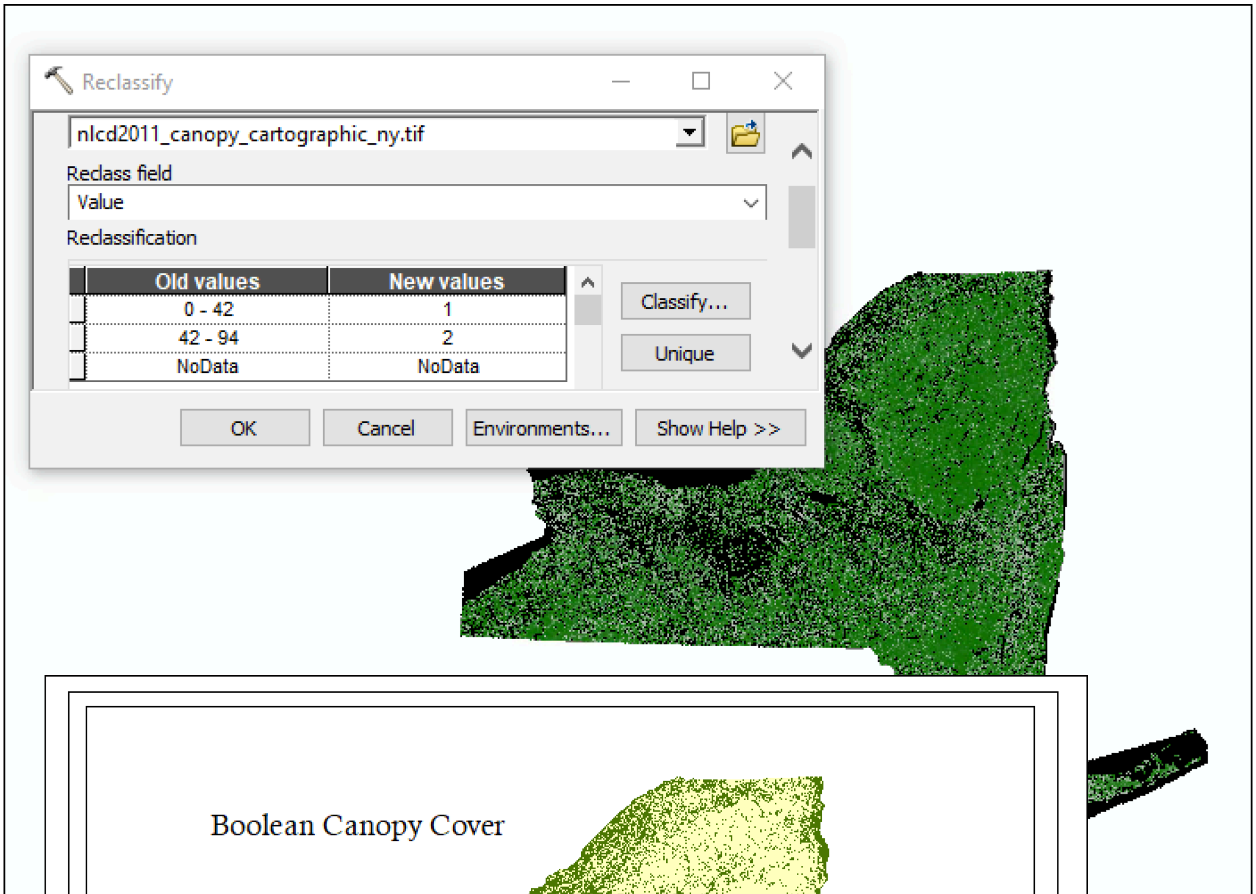
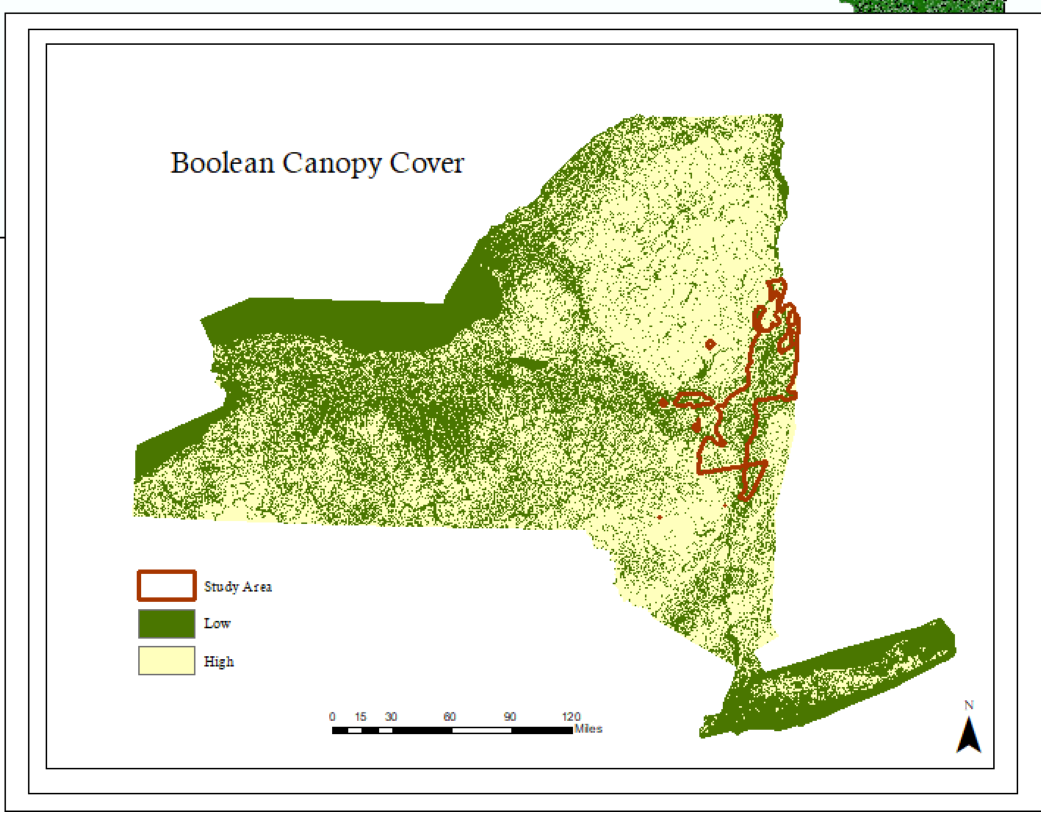
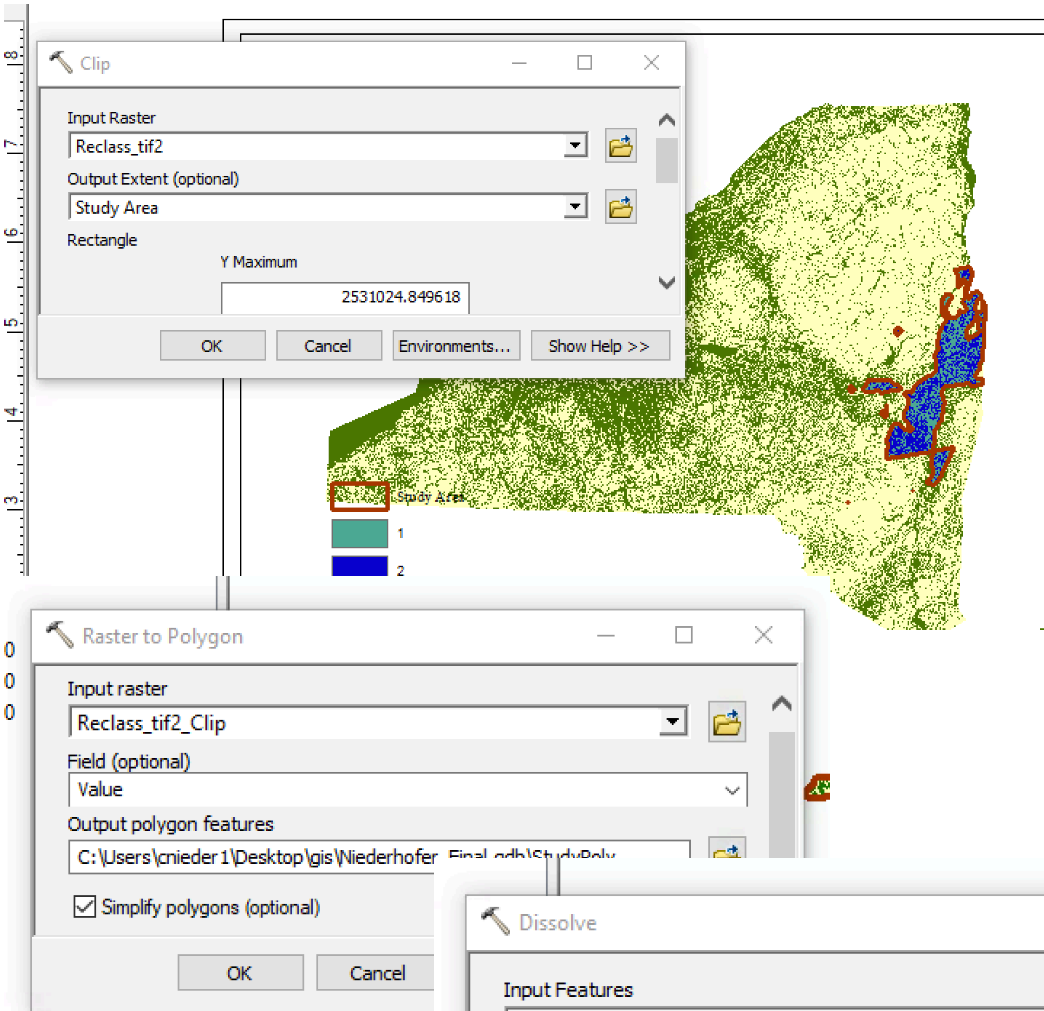
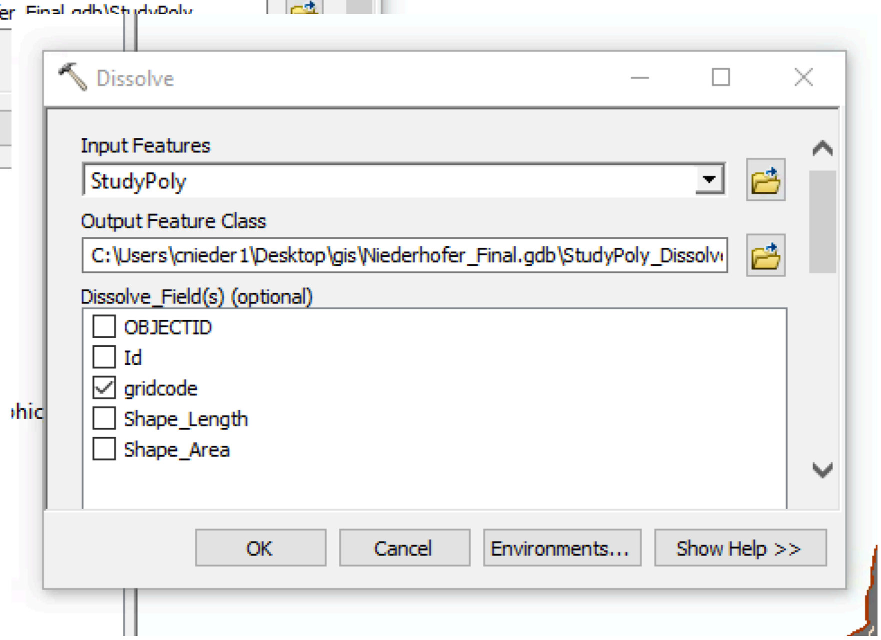
Get Unique Values
Go To:
SELECT * FROM ave_annual_precip WHERE:
"RANGE" < 42.5
Clear
Verify
Help
Load...
Save...
OK
Apply
Close
50.001 - 65.000
Annual Precipitation
Study Area
Study Area
Less 42"
Ave Annual Precip
Inches
0.000
0.001 - 35.000
35.001 - 40.000
Annual Precipitation
Study Area
Study Area
Intersect
Intersect
Ave Annual Precip
Inches
0.000
0.001 - 35.000
35.001 - 40.000
40.001 - 50.000
50.001 - 65.000
0 15 30 60 90 120
Miles
N

For the next step, I created a Boolean raster of canopy cover to show areas where I wouldn't have to cut down a lot of trees to install my solar arrays. I then clipped my raster to the latest study area, converted this raster to a polygon, and dissolved the edges of the polygon.



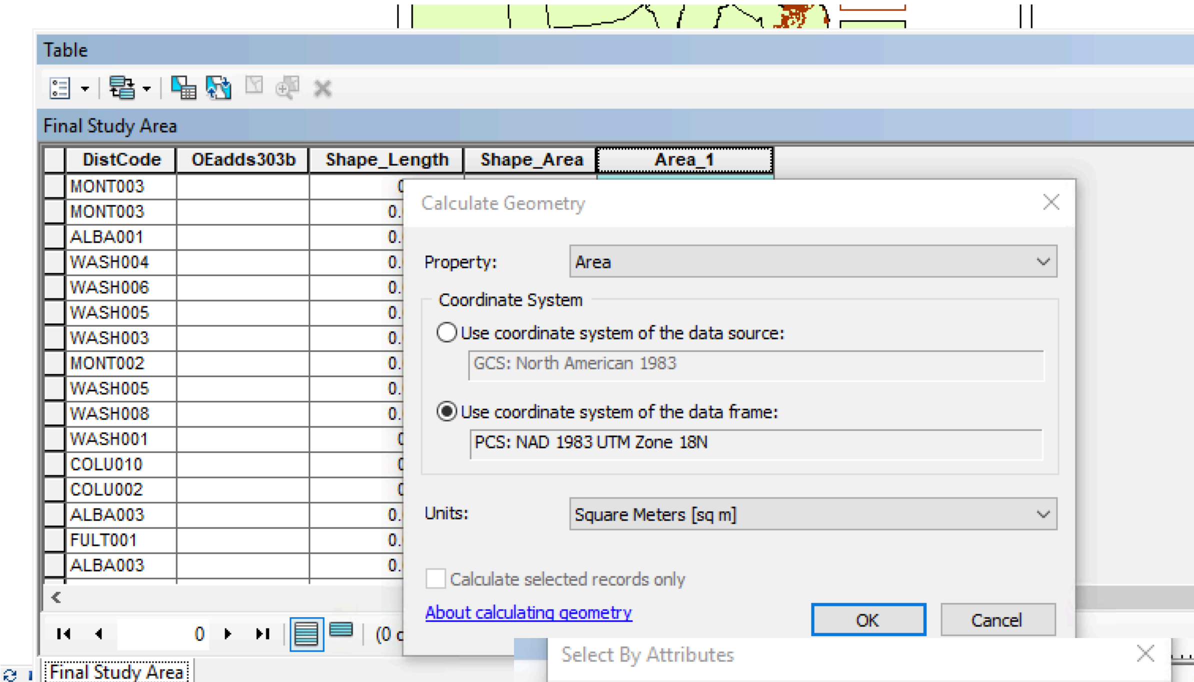




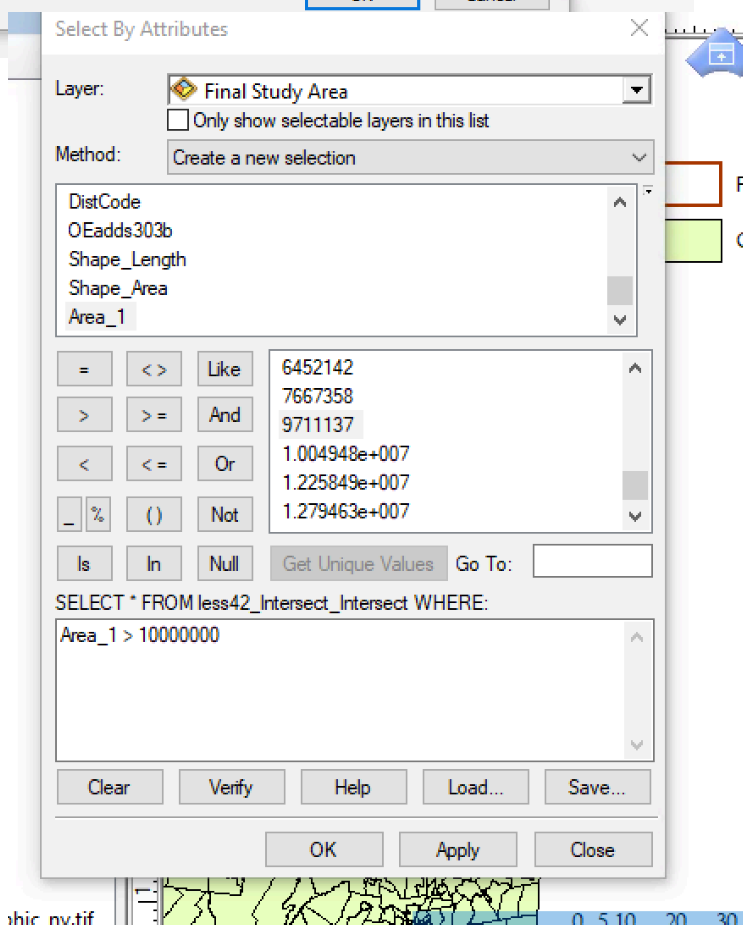


Next, I added a shapefile of agriculturally-zoned lands. To get my final study area, I wanted to select the correctly zoned areas which were large enough to make sure I would have enough room for my solar arrays.

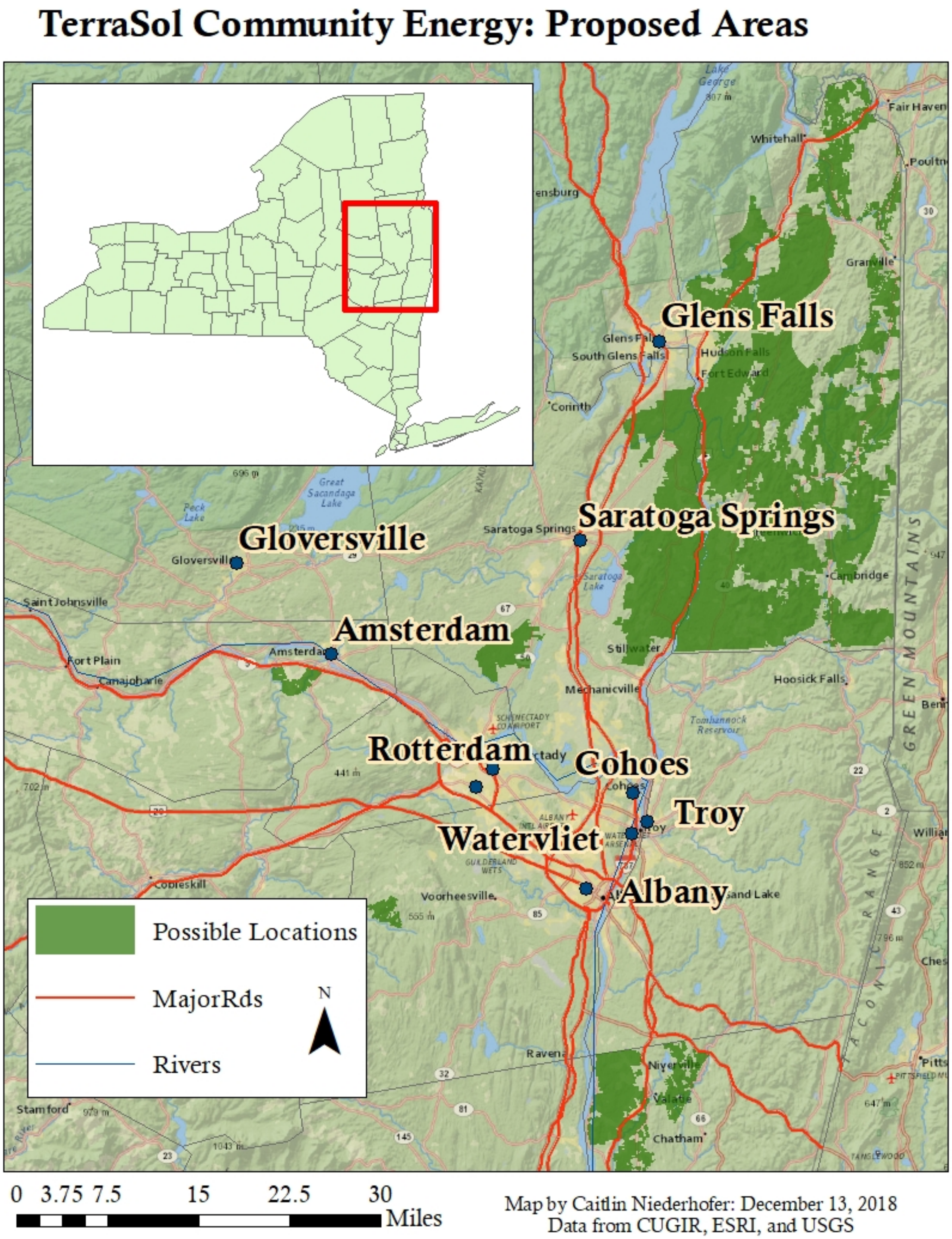
I created a new field and used the Calculate geometry tool to get an area for each agricultural area within my study area.



Finally, I selected just the areas of at least 100 acers.



Final Map:


TerraSol Community Energy: Proposed Areas
Glens Falls
Saratoga Springs
Gloversville
Amsterdam
Rotterdam
Cohoes
Troy
Watervliet
Albany
Possible Locations
MajorRds
Rivers
N
0 3.75 7.5 15 22.5 30
Miles
Map by Caitlin Niederhofer: December 13, 2018
Data from CUGIR, ESRI, and USGS

Final Proposed Area:

My final location is somewhere along the Hudson Valley North of Albany. This area has a "green minded" population, is zoned correctly, gets a high amount of solar radiation and little rain for the area, and I won't have to cut many trees. The next step is looking at land for sale in this area.

Photo from SolarPowerPortal.co.uk

Geodatabase I created for the project: