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# Laboratory Exercise – Saratoga Springs Temple Site Locator

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# Laboratory Exercise – Saratoga Springs Temple Site Locator

## Background

On April 2, 2017, President Thomas S. Monson of The Church of Jesus Christ of Latter-Day Saints (LDS) announced that the LDS Church would build a temple in Saratoga Springs, Utah. The temple will be the eighteenth LDS temple built in Utah and the fifth in Utah County. It is anticipated that the temple will serve church members in Saratoga Springs, Eagle Mountain, Lehi, and other surrounding areas.

The LDS Church carefully chooses optimal sites for their temples. LDS temples tend to be viewable from the surrounding area, usual. Temples are also usually near major highways and in areas that already have several LDS meetinghouses. The Church owns many land parcels in the state of Utah, including large land parcels in Saratoga Springs. It would be beneficial for the Church to construct the temple on a site that is already owned by the Church.

## Problem Statement

The task of selecting a temple site falls on the leadership of the LDS Church. However, geographic information systems (GIS) technology could be very valuable in determining potential sites that would fit the Church's criteria. The task of this laboratory exercise is to find up to three locations that would be appropriate temple sites. This will be done in ArcGIS Pro using ModelBuilder. A model will be built with the goal of creating a heat map, showing the best locations in Saratoga Springs for the new temple. Though the actual criteria that the Church uses for temple sites is unknown, assumptions were made to define the spatial considerations of this project.

## Spatial Considerations

For the purposes of this laboratory exercise, you will use the following spatial criteria to consider in your GIS model:

- Proximity to major highways: The temple should be located within a half-mile of a major Utah highway.
- Proximity to LDS meetinghouses: The temple should be in an area that is dense with LDS meetinghouses.
- Visibility from much of Utah County: The temple should be visible from much of Utah County.

## Data

The following data are needed for this lab exercise. If these links are expired, all of these files can be located at <https://gis.utah.gov>.

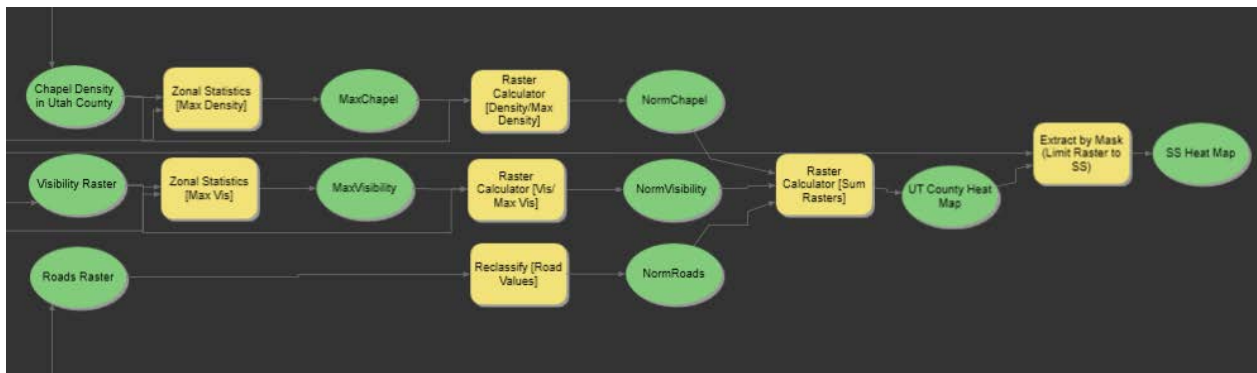
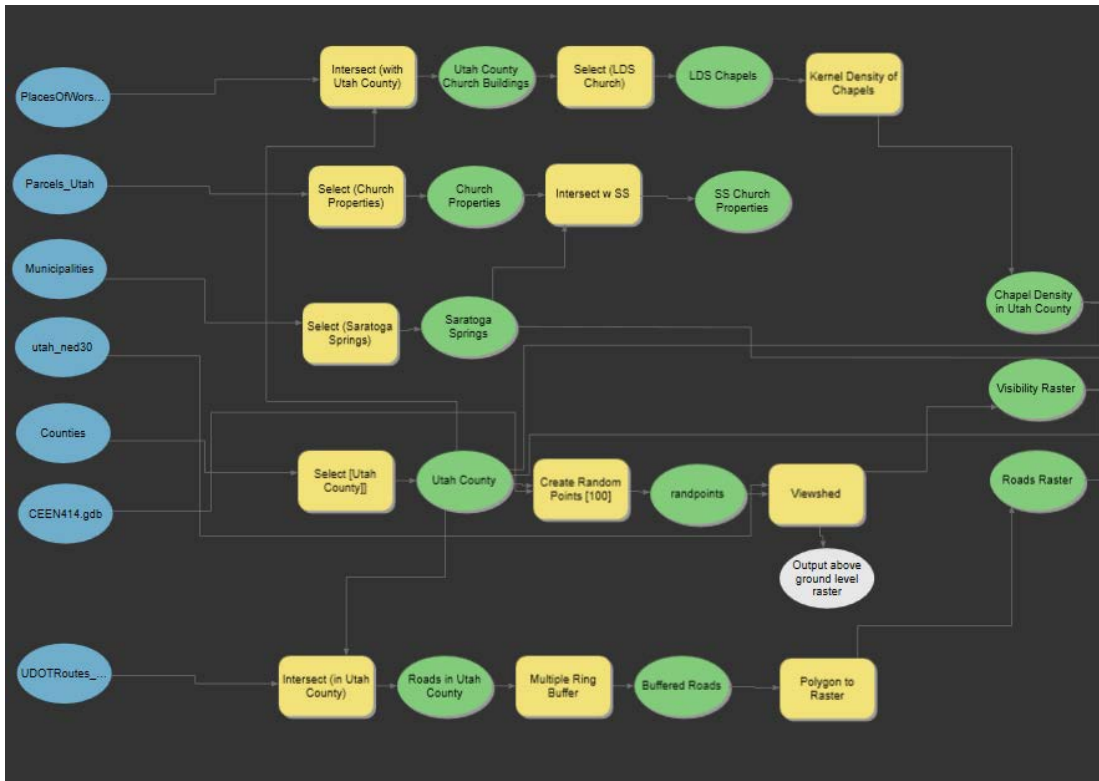
- <https://drive.google.com/drive/folders/0ByStJjVZ7c7mYmxjQWsdUhzTHc>  
Utah Counties and Cities: Counties\_shp and municipalities\_shape
- <https://drive.google.com/drive/folders/0ByStJjVZ7c7mWIV1M21QeW5Bd1k>  
Utah Parcels: Parcels\_utah\_shp
- <https://drive.google.com/drive/folders/0ByStJjVZ7c7mbzFMTkpBQzU5Z1E> Major Utah Highways:  
UDOTroutes\_LRS\_shp
- <http://raster.utah.gov/?cat=30%20Meter%20NED%20%7BDEM%7D>  
Utah County DEM: Utah\_ned30 - elevation data for viewshed tool.
- <https://drive.google.com/drive/folders/0ByStJjVZ7c7mS2V3WFB4RTFZS1U> Places of Worship: Placesofworship\_shp

### **ModelBuilder Tools**

This lab exercise will use many tools previously utilized on other lab assignments. These tools include: Select, Multiple Ring Buffer, Create Random Points, Polygon to Raster, Intersect, Kernel Density, Zonal Statistics, Reclassify, Raster Calculator, and Extract by Mask. For more information on these tools, see previous lab assignments, or consult the help tool within ArcGIS Pro or ArcMap 10.5. The following tool is new for this lab exercise:

- Viewshed determines the raster surface locations visible to a set of observer features. This tool will be used to find the most visible locations within Utah County. Inputs for this tool will include a random points file, and the Utah County DEM.

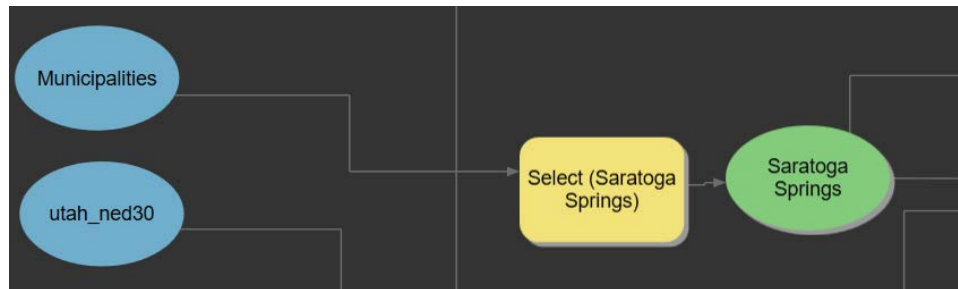
Example Model



## Step by Step Solution

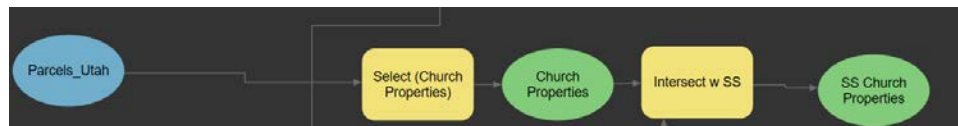
For an advanced GIS student, the information up to this point is sufficient to complete the assignment and create an output map from the results. Feel free to try conducting the analysis using only the information provided above. If you need specific steps, follow the instructions.

### Step 1



Many of the steps in this model use a Utah county, and a Saratoga Springs (SS) shapefile to limit the input data. Prepare these two shapefiles by using the select tool to select Utah County in the counties shape file and SS in the Municipalities shapefile.

### Step 2

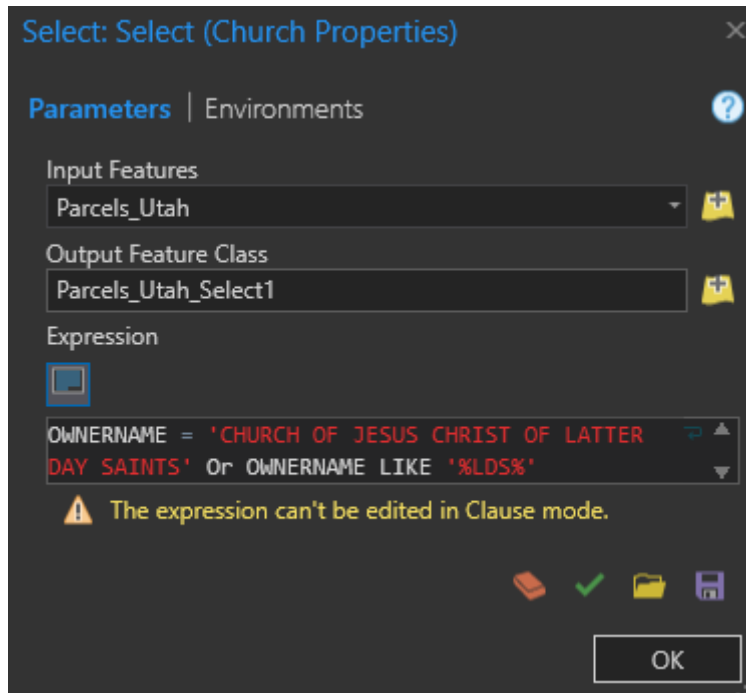


Using the parcel data obtained from the Utah GIS website use the select tool to identify just the parcels owned by the LDS church. In the select tool the expression should be similar to Name is Equal to THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS. This will give you church properties across Utah county. To isolate just Saratoga Springs properties, intersect a SS shapefile with the Utah County Church Properties.

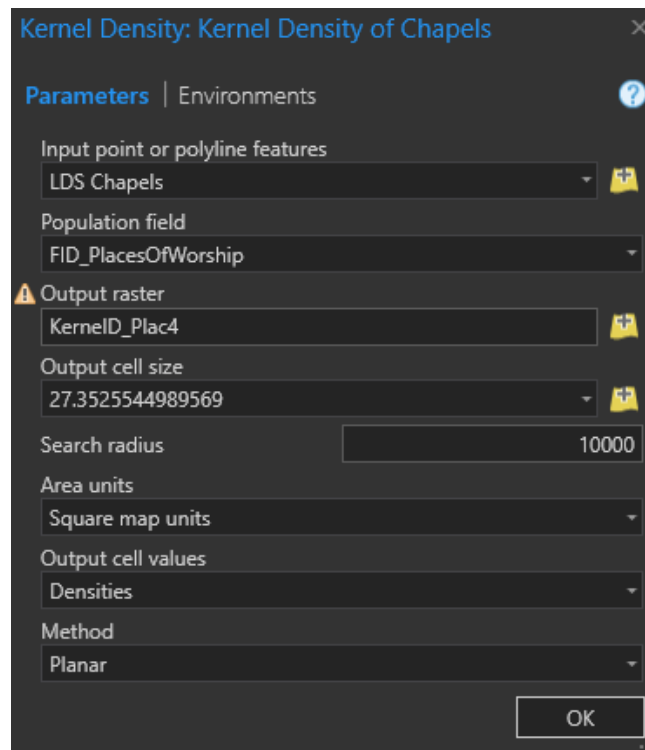
### Step 3



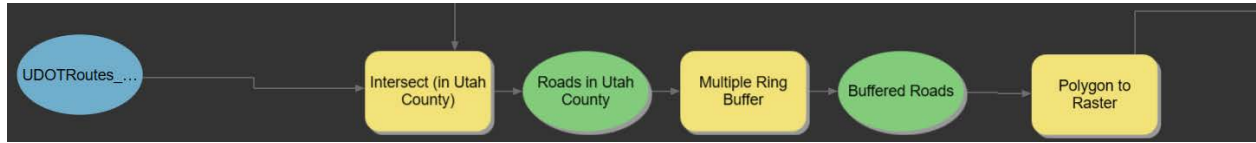
Using the places of worship data obtained from the Utah GIS website use the intersect tool to identify just places of worship in Utah County. Now using the select tool, you must select LDS Chapels. This can be done by using a phrase similar to OWNERNAME LIKE "%LDS%". Once you are satisfied with your selected Chapels, you are now ready to use the kernel density tool.



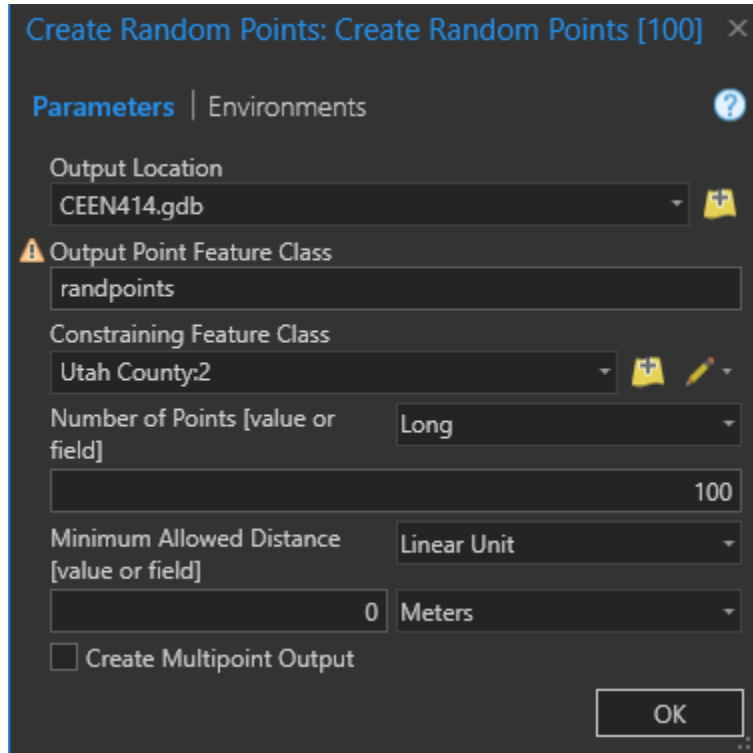
In the kernel density tool your input is the LDS Chapels shapefile. The output cell size should be set to the same cell size as your Utah County DEM Raster. The search radius is how far the tool will look for LDS chapels from a given point. A value of 10.000 M (or 10KM) is a good search size for this lab's purposes.



*Step 4*

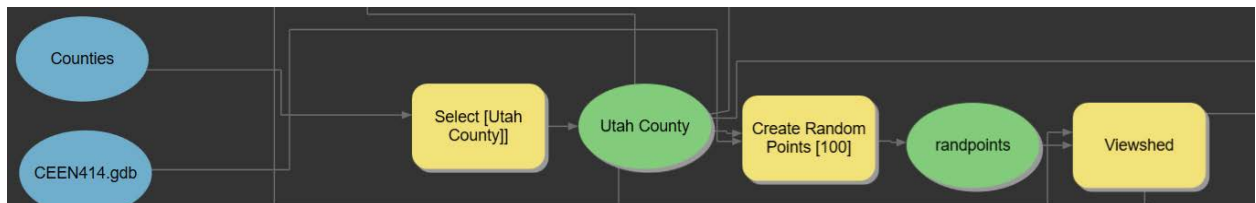


If you haven't yet, be sure to select Utah county from the counties shapefile. Create as many random points within Utah county as you would like using the Create Random Points tool.

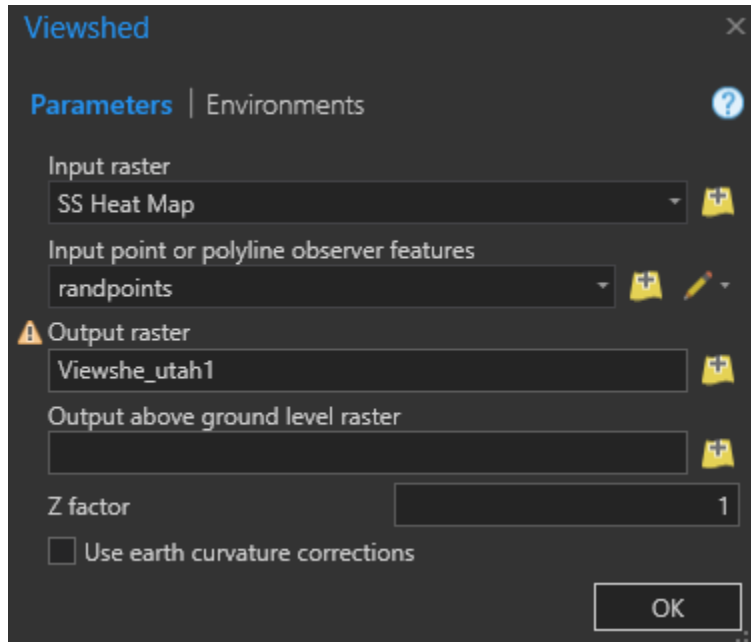


This tool requires a default output database. Assign your project database so it knows where to save the random points shapefile. The constraining feature class will be your Utah County shapefile. In the next step each random point you create will be processed by the viewshed tool. It takes the tool 5-15 seconds to determine the viewshed of one point, so the more points you create here the longer it will take your model to run the viewshed tool. 100 random points takes about 5 minutes to run.

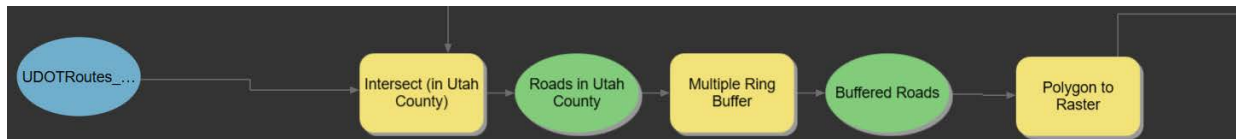
*Step 5*



Now it is time to run the Viewshed tool and calculate the visibility of areas within SS. The parameters of this tool are quite simple. It will require as an input your randompoints shapefile as well as the Utah County DEM raster file. The output for this tool will be a raster where each cell on the raster will have a value equal to the number of points that can see that cell. Your Viewshed parameters should look similar to the tool window shown below.

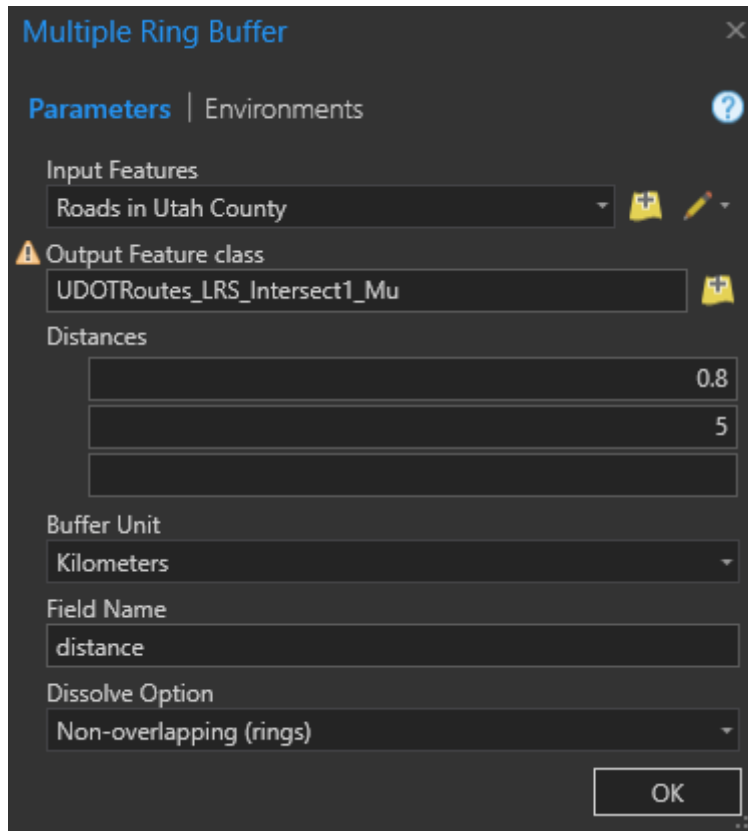


### Step 6

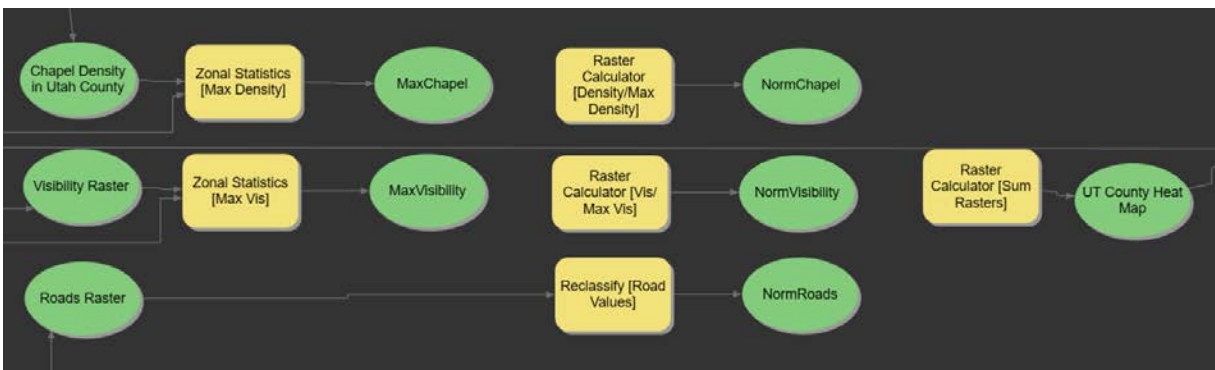


Use the intersect tool to identify roads within Utah County. On the roads in Utah county use the multi-ring buffer tool to create buffered areas that outline distance from major roadways. In this lab exercise just two rings were used. A buffer for areas within 0.5 miles and a buffer for areas within 3 miles of roadways. We assumed that areas more than 3 miles away from major roadways would not be of interest as a temple site. Your multi-ring buffer tool should look similar to the view window shown below. The buffered roads shapefile will then need to be converted into a raster using the Polygon to Raster tool.

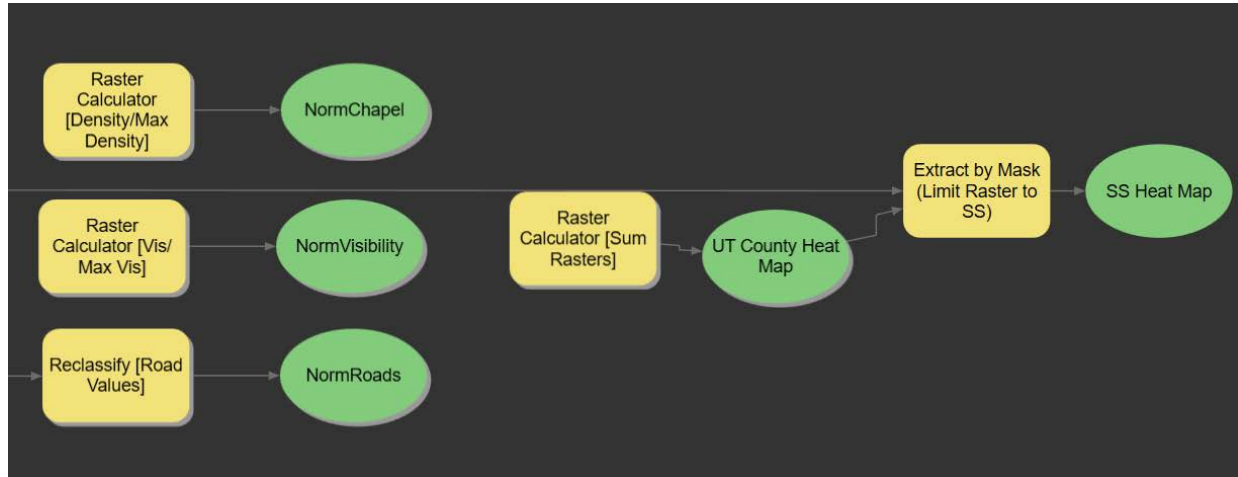




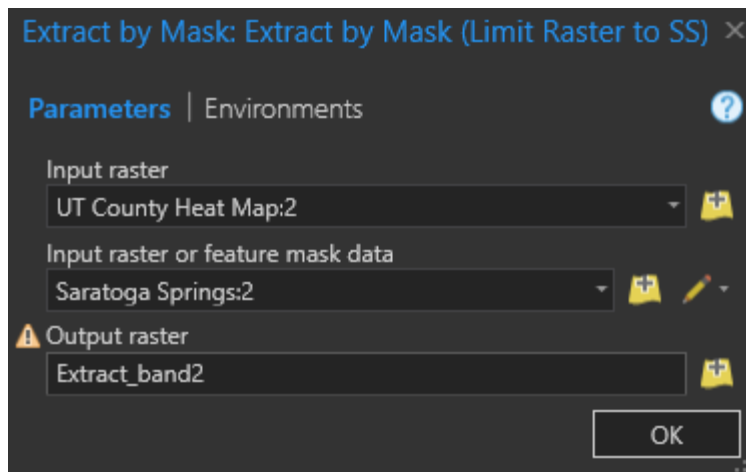
*Step 7*



By this step you should have a chapel density raster, a visibility raster, and a roads raster prepared. In this step you will normalize your data and combine it into one final raster that has high values for good site locations and lower values based on bad site locations. In this step the zonal statistics tool can be used to retrieve the maximum value from a raster. It is then possible, for example, to divide the chapel density raster by the max chapel to get a new chapel density raster with values from 0 – 1. The maximum value of your raster can determine the weight you want it to have on your final results. If you want each of your rasters to have equal weight you need to normalize them so that they all have the same max and min values. Then in the final raster calculator you can combine the normalized rasters by either summing, or multiplying their values together.

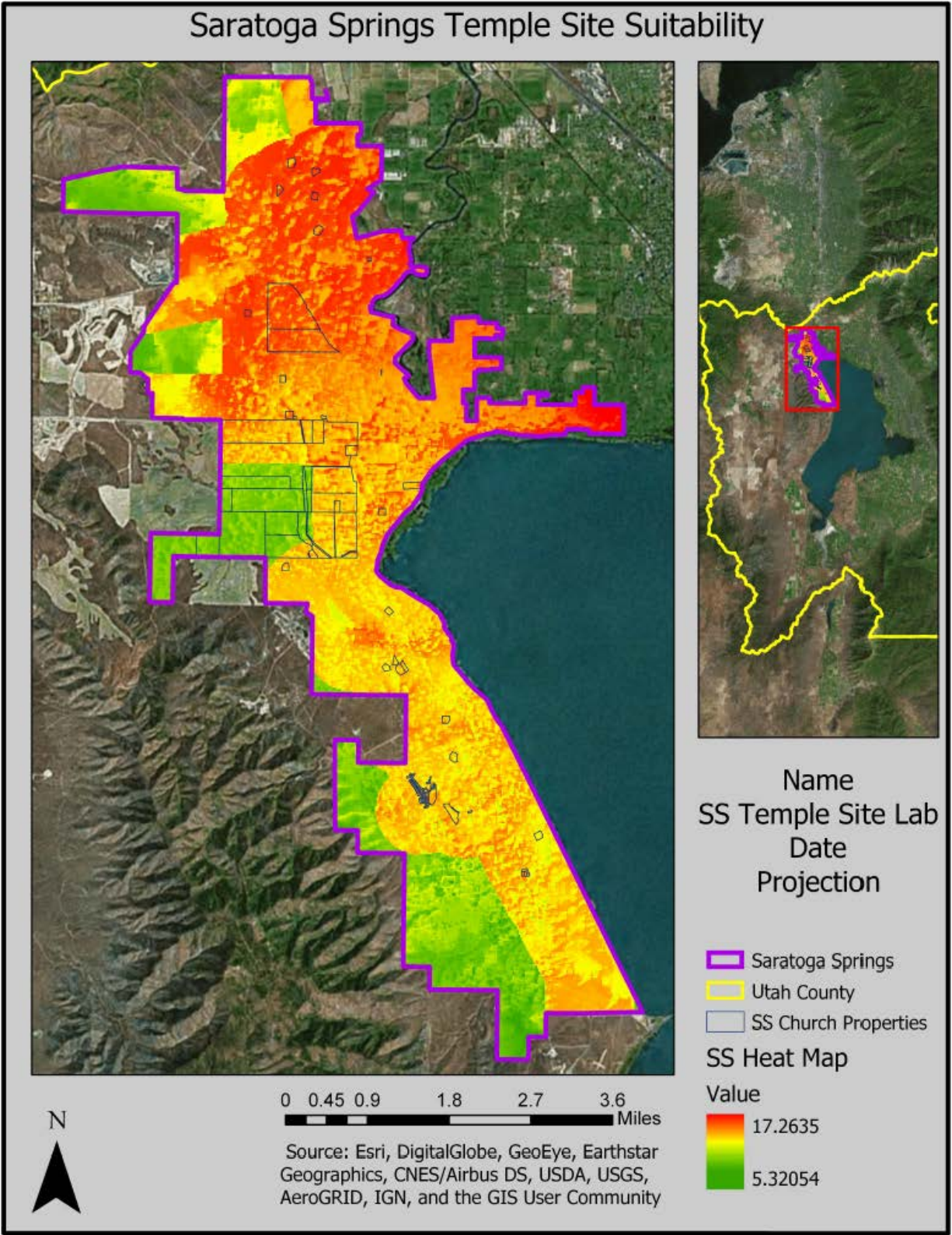
*Step 8*

The output of your final raster calculator will be a heat map of all of Utah County. Compared to the populations of Provo and Orem, SS will look very cold and like it is a poor location for a temple. Use the Extract by Mask tool to limit your raster to just SS. Now you will see a heat map of the best and worst locations in SS for a Temple to be Built. The settings in the extract by mask tool should look similar to the window below.

**Deliverables**

You have been asked to create a mask showing a heat map of good places to locate the new SS Temple. Your final map should include a colored heat map of SS where red indicates good locations and green indicated bad locations. You should also include on your map outlines of any parcels within SS that are already owned by the LDS church. For clarity also include an outline of SS city boundaries, an outline of Utah County, and a base map of your choice. You map should also include the other standard parts of a map like a north arrow, legend, scale, and other information that you believe would be useful.

**Example Map**



**Rubric for Saratoga Springs Temple Locator (ModelBuilder)**

Item	Points
Assignment Title, Author Name, Date, Course Name	/5
Describe your model <ul style="list-style-type: none"> <li>• List each of the tools used: (2 pts)</li> <li>• List tool settings applied for the analysis (could someone repeat the assignment using your lab report?): (2 pts)</li> <li>• List all input, intermediate, and output datasets: (2 pts)</li> <li>• Describe each input dataset including type (point, line, polygon, raster) and the source of the data: (2 pts)</li> <li>• Describe each output dataset (point, line, polygon, raster): (2 pts)</li> </ul>	/10
<ul style="list-style-type: none"> <li>• One full page (<b>8.5x11</b>) showing your model (5 pts)</li> <li>• All text is readable (<b>at least 10-point font</b>) (3 pts)</li> <li>• All tools and data sets are shown (2 pts)</li> </ul>	/10
<ul style="list-style-type: none"> <li>• Describe the recommended location(s) for the Saratoga Springs Temple. (3 pts)</li> <li>• Do you agree with the results, or were they different than expected? (2 pts)</li> </ul>	/5
Make a full page ( <b>8.5x11</b> ) map showing the results of your Saratoga Springs Temple locator heat map and the recommended locations. <ul style="list-style-type: none"> <li>• Map Title: (1 pt)</li> <li>• North Arrow: (1 pt)</li> <li>• Scale Bar: (1 pt)</li> <li>• Text box with author name, date, and map projection (1 pt)</li> <li>• Heat map of optimal temple locations clearly shown: (5 pts)</li> <li>• All datasets clearly symbolized: (1 pt)</li> <li>• Visible basemap: (1 pt)</li> <li>• Points showing recommended temple location(s): (1 pt)</li> <li>• Polygon layer of church-owned properties: (1 pt)</li> <li>• Zoomed to an appropriate scale for viewing analysis results: (1 pt)</li> <li>• All text is legible on printed map: (1 pt)</li> </ul>	/15
<b>Bonus Task:</b> Repeat the lab exercise with an additional set of data and parameter (i.e. use existing temple location point layer and give more points for raster cells that are farther from other temples). Include in your report what data you used, how you acquired it, what, if anything you changed to complete the exercise work. Also include an additional full page map showing your results.	Instructor's Discretion