Using GIS Training to Address Blood Pressure Medication Adherence Proximity Part I

*** Files needed for Part 1 of this exercise: *Twin_Cities_Tracts_2012_acs.shp, Twin_Cities_PWC_Tracts_acs.shp, Twin_Cities_FQHCs_30mile.shp,* and *Streets* (network dataset provided by StreetMap USA)

Part 1 Goals: The goal of this exercise is to compare the results proximity based analyses that evaluate geographic access to Federally Qualified Health Care Centers (FQHC) in the Twin Cities Area of MN. First you will calculate a half mile Euclidean distance from each FQHC using the buffer tool, next you will calculate half mile Network based distance service area for each FQHC. With this measures you will estimate geographic access to each US Census Tract level population aggregated to the geometric centroid AND its population weighted centroid.

Part 1 Skills: After completing this exercise, you should have a basic familiarity with both Euclidean and Network based proximity analyses and have an understanding of the implications of population aggregation.

Part 1 Problem: You are interested in finding the percentage of the Twin City's population below the poverty level within a half mile distance to any FQHC. To do this, you will create both a as the crow flies buffer, and a service area polygon representing a half mile drive distance through a network dataset (StreetMap USA) to any FQHC.

Add the data for you area of interest:

1. Open a new blank map in ArcMap.
2. Add the Twin Cities Tract shapefile: *Twin_Cities_Tracts_2012_acs.shp*. This shapefile represents the US Census Tract Boundaries for the study area joined to a set of social and demographic variables from the 2012 ACS. It will provide some useful geographical context for your analysis.
3. Next add the *Twin_Cities_PWC_Tracts_acs.shp. This shapefile represents the population weighted centroids* US Census Tract Boundaries joined to a set of social and demographic variables from the 2012 ACS.
4. Finally add FQHCs for the Twin Cities: *Twin_Cities_FQHCs_30mile.shp.* These data represent FQHCs within the Twin City Tracts and up to 30 miles beyond. You should note that 56 FQHCs in this shapefile.
5. All of the datasets you have added have been projected to the MN state standard projected coordinate system in any proximity based analysis your data must be projected correctly, confirm the projection of your datasets by examining their properties.
6. Make sure you points are on top of your polygons and symbolize your data so they are distinguishable.

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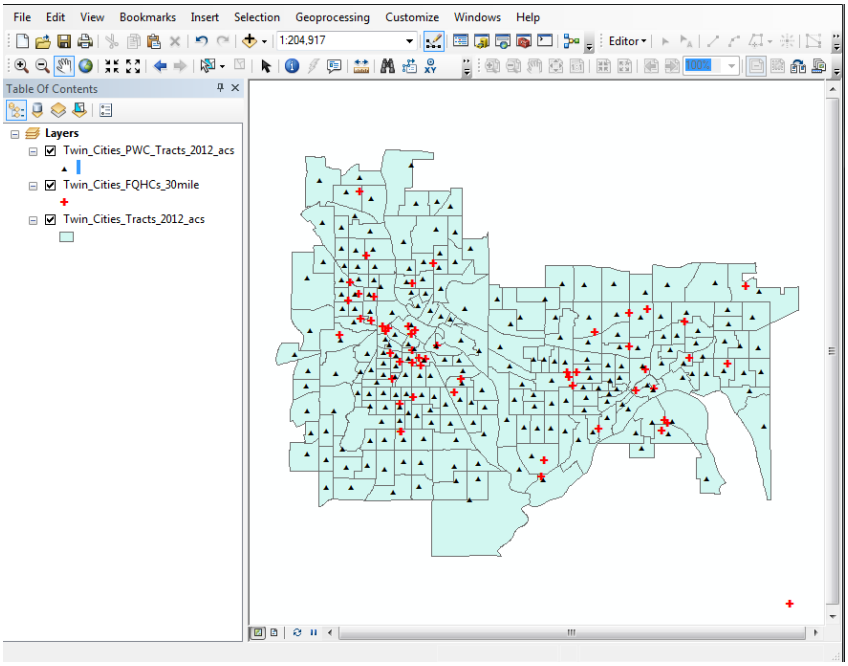
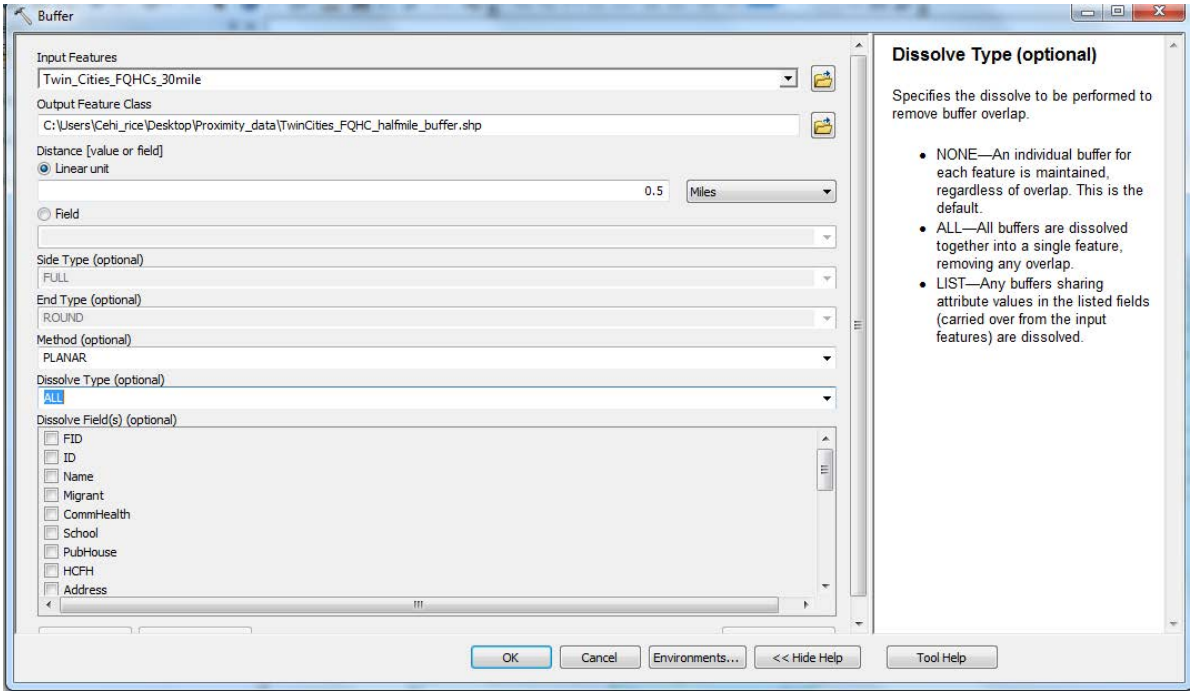
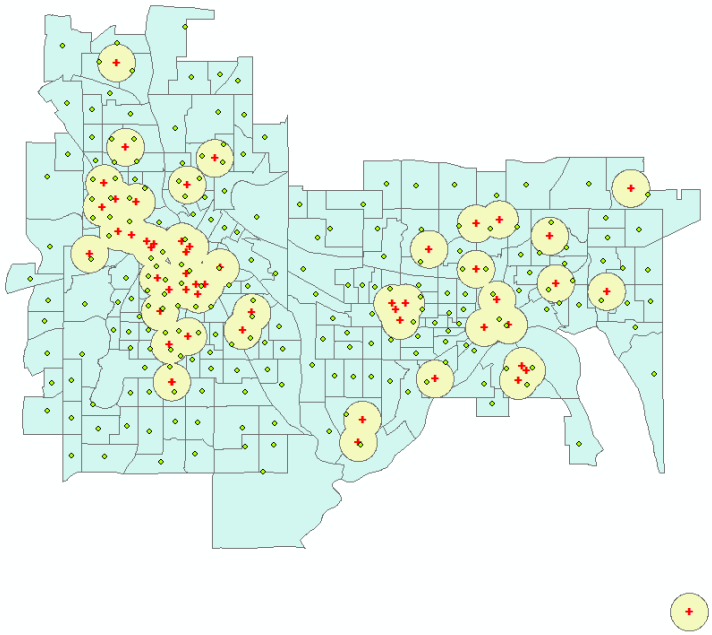


Perform a Buffer Analysis

1. Activate the Buffer tool- you can find this tool using the Search window, or under the Geoprocessing tab, or under the Proximity Analysis Toolset in ArcToolBox
2. Parameters for the tool:
    a. Your input features will be: *Twin_Cities_FQHCs_30mile.shp*
    b. Save you output feature class as: *Twin_Cities_FQHCs_halfmile_buffer.shp*
    c. Your buffer distance value will be a linear unit of 0.5 miles – this is an approximation of the distance that can be covered walking for 10 mins at a rate of 3 miles per hour.
    d. You will choose ALL for the dissolve type- do you know why?
    e. Stick with the defaults for the rest of the buffer options.

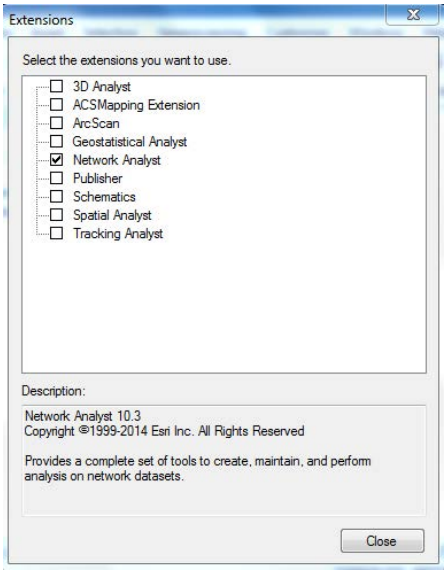


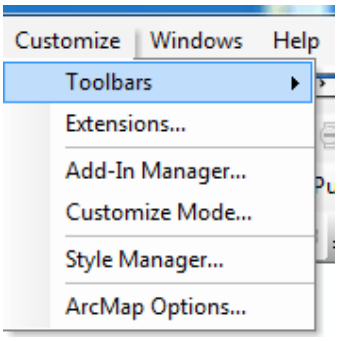
3. Take a look at your results**.**



Perform a Service Area analysis to calculate the a 1//2 mile network based distance to each of the FQHCs

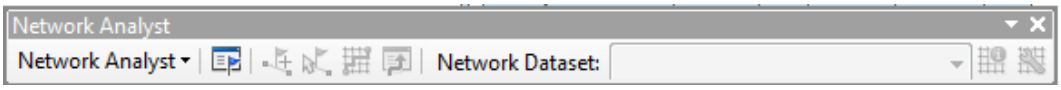
1. Activate the Network Analyst Extension by right clicking on Customize>Extenstions and checking the Network Analyst box.



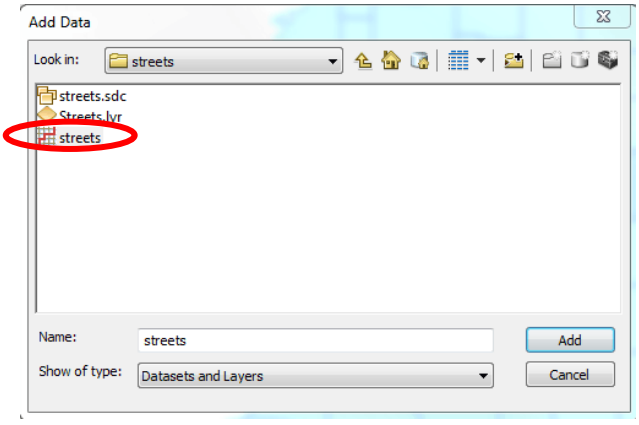


2. Activate your Network Analyst toolbar. Go to **Customize > Toolbars > Network Analyst.** ***Note that you need to make sure that you have activated the extension prior to adding the toolbar - the software will allow you to add the toolbar to a project even if the Network Analyst extension is not activated (it will not work though).***

   The toolbar looks like this:

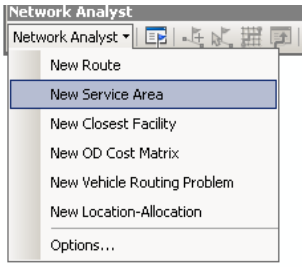


4. Add your Streetmap USA network dataset *streets.* It is located in the streets folder. Choose **Yes** to add all feature classes that participate in the network dataset. **Note:** This is a nationwide dataset included with Esri ArcGIS software disks. Be forewarned, it is large. The .sdc format is un-editable, but it means you will not need to create your own network dataset.

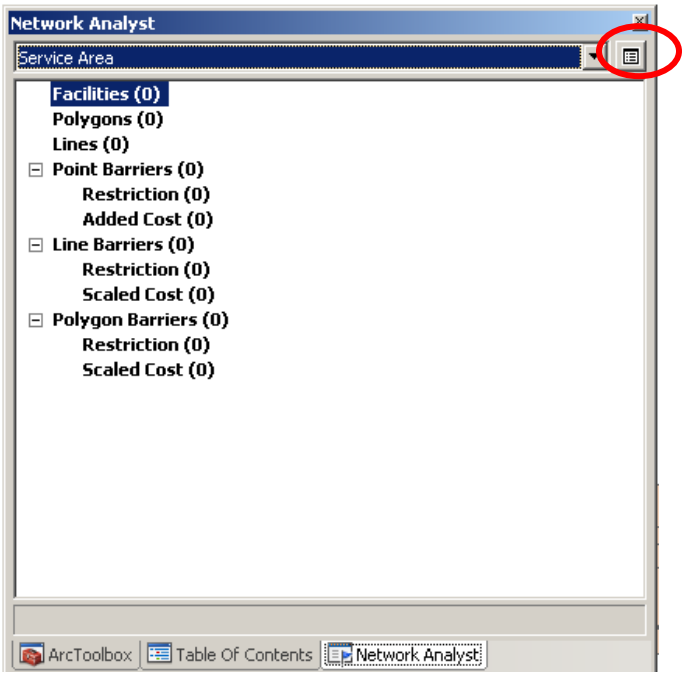


You should see a detailed road network begin to fill in. You can turn these off by un-checking them in the TOC to speed things up a bit.

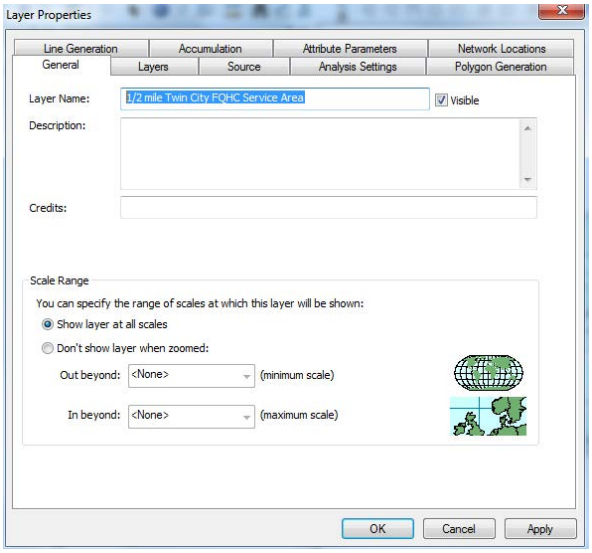
5. If your network analyst window is not visible, make it visible by left clicking on  in the toolbar.
6. In the Network Analyst toolbar, click **Network Analyst > New Service Area**.

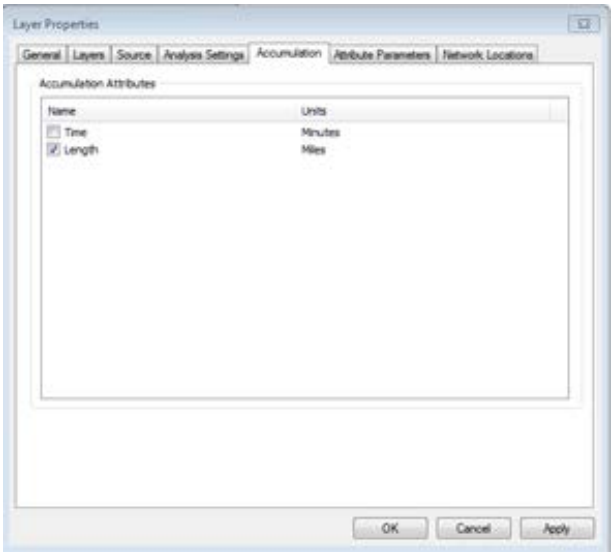


7. To adjust your service area properties and analysis settings, click on the **Service Area Properties** icon in the Network Analyst window (on the upper right-hand side).



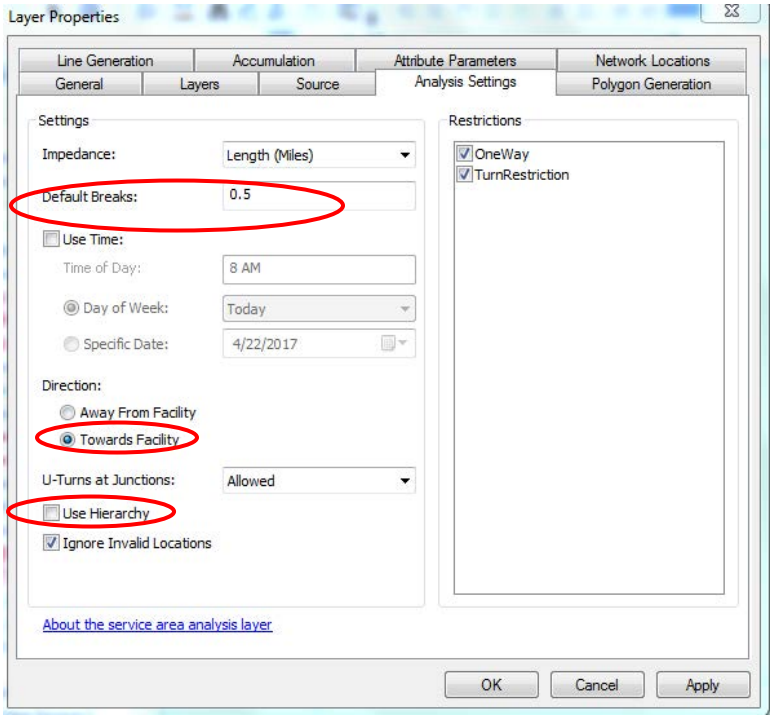
8. Under the **General** tab, name this service area layer: *1/2 mile Twin City FQHC service area Click* **Apply** rather than OK.



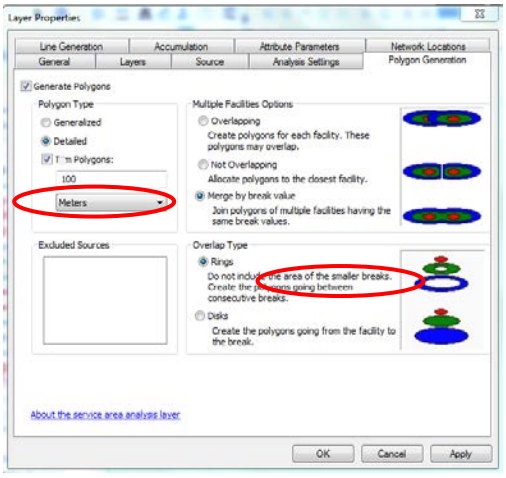


9. Under the **Accumulation** tab, check **Length**. This will length of moving through the network for your analysis. Click **Apply** rather than OK.

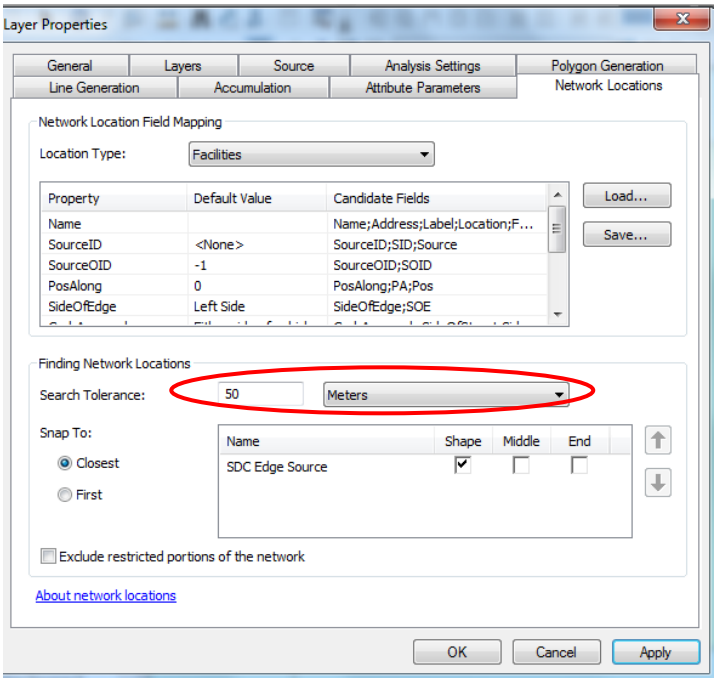
10. Under the **Analysis Settings** tab you should see that your impedance or cost will be measured in length (miles). Set your default break as **.5 miles**. Set your direction as **Towards Facility**. In this analysis you will Not **Use Hierarchy so make sure it is unchecked** and go with defaults for the remaining options on this tab. Click **Apply** rather than OK. (NOTE: **Hierarchical analysis** is a heuristic method for solving drive time by favoring travel on larger roads (e.g. highways) over small roads (e.g. local streets). Network Analyst can compute service areas more quickly when using a hierarchical analysis, but it is less exhaustive than a non-hierarchical analysis. The About network analysis with hierarchy help page has more information.)



11. Under the **Polygon Generation** tab, keep all the defaults with the exception of **Polygon Type** – select **Detailed** and **Multiple Facilities Options.** Select **Merge by break value** and click **Apply** rather than OK.



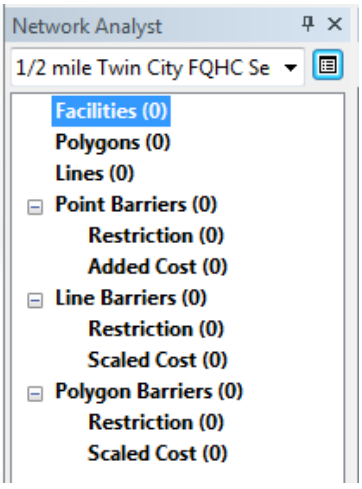
12. Under the **Network Locations** tab, set the tolerance for locating the FQHCs onto the network dataset. Set the **Search Tolerance** for finding the FQHCs on the network to **50 meters** (i.e. locations up to 50 meters from a road *will be located* on the network).



Note: You may need to adjust this since how well the locations load depends on the condition of the network dataset and the quality of your geocoded data. Stick with the defaults for the rest of the settings. Click **Apply,** then **OK.**

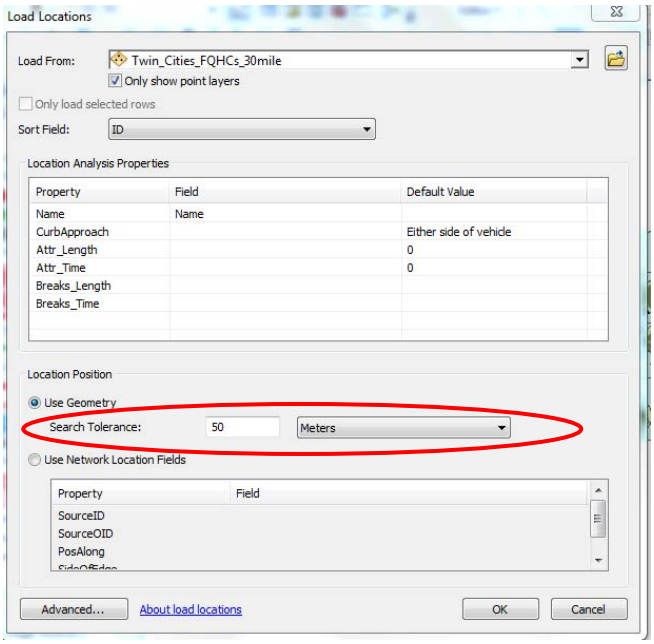
13. Right click on **Facilities** in the Network Analyst window and select **Load Locations**.

    The CVS pharmacies are the **Facilities** that you will be creating service areas for.

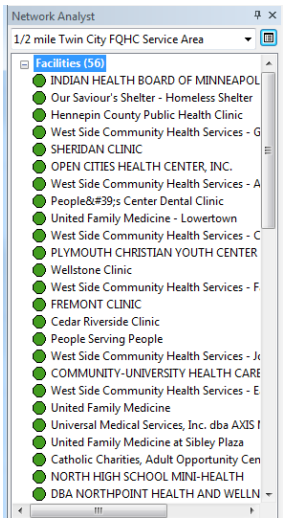


14. Make sure that your shapefile *Twin_Cities_FQHCs_30mile.shp* is the data to be loaded and select **ID** as your **Sort Field**. You can sort by any of the attributes in the table, but it is a good idea to use a unique

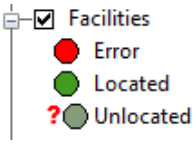
identifier. For the **Name** Property select **NAME** field; this will identify each facility by its name. The Search Tolerance you input in the **Network Locations** tab should be reflected here.



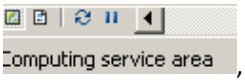
15. Click **OK**. You should see 56 facilities located in your Network Analyst window. All of your FQHCs have been loaded and located on the network dataset indicated by a green colored circle (yours will likely be a different color).

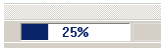


If any of your locations were not located or have errors you will see a red circle, or a circle with a question mark in your TOC.

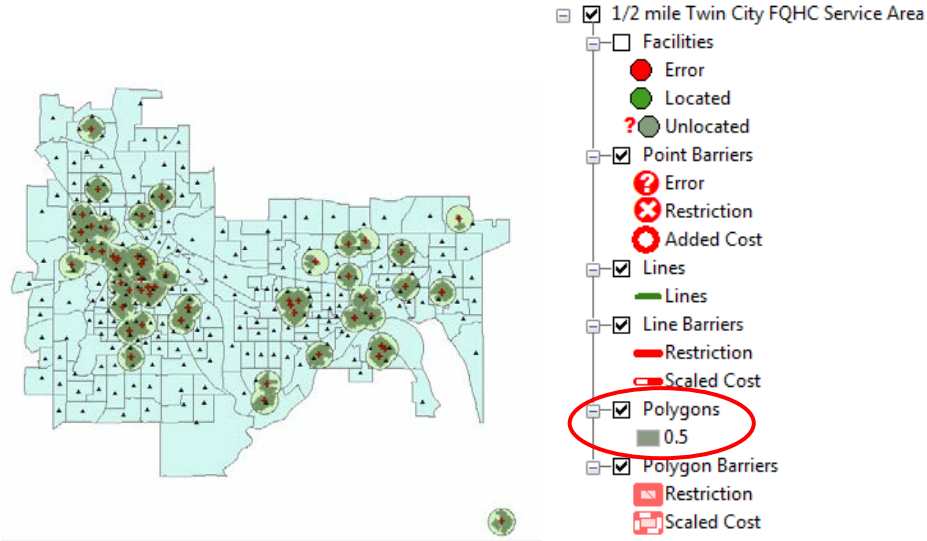


Solving the Service Area Problem

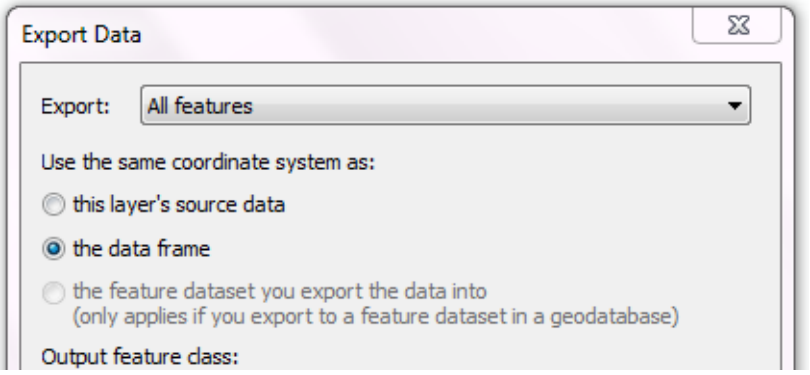
1. You have set up your analysis and loaded the facilities - now you can solve. Remember, you want to create a network-based area that represents a ½ mile drive time to any FQHC for your area of interest. Click on the Solve icon  to run the analysis. This may take a bit of time (remember that this is a very large network dataset).
2. While you wait, take a look around. Take a look at the lower left-hand side of your screen. If you see this: 

, it's a good sign. Some indication of progress on the lower right-hand side of your screen is also a good thing: 

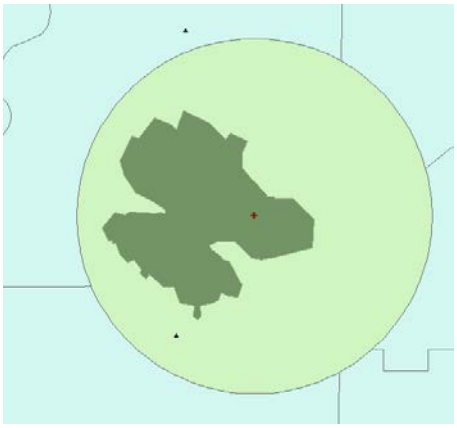
. Now is also a good time to stretch out, and ask any questions you may have.
3. When the solving is complete you should see something that looks like this:



4. In your table of contents you will see the results of your analysis. Export the polygon for your analysis to a new shapefile by right clicking on the layer in your TOC and choosing **Export Data**. Use the same coordinate system as **the data frame**. Name the file *TC_FQHC_halfmileSA.shp.*

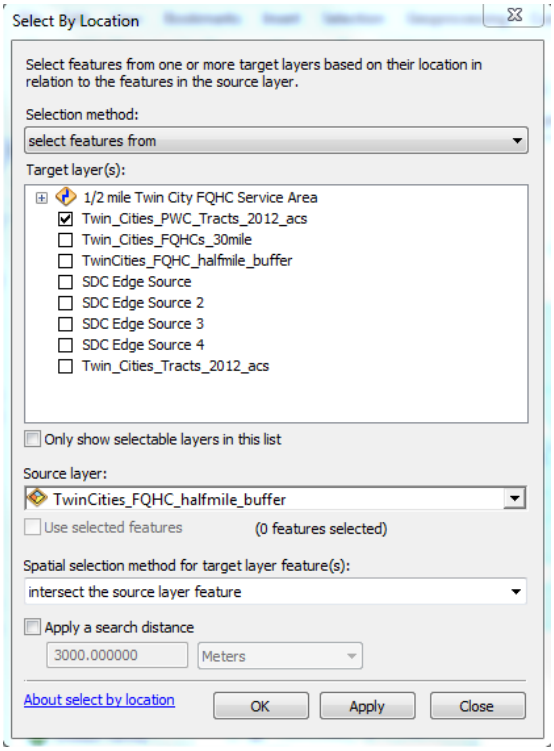


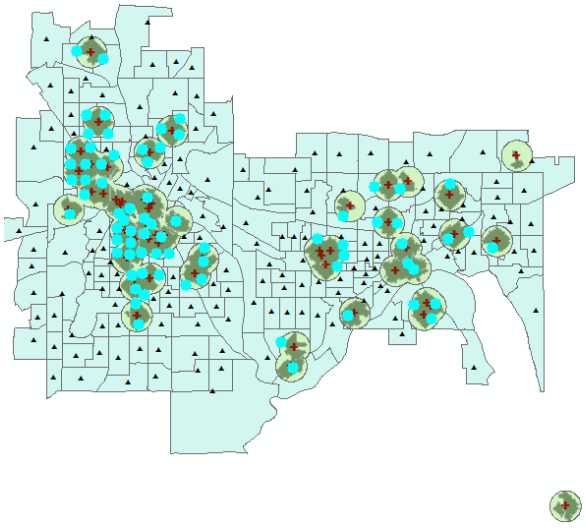
Add *TC_FQHC_halfmileSA.shp* to your data frame when prompted and aadjust the transparency of the service area so you can see all of the data beneath. Now that you have calculated both a Euclidean and Network based measure of Geographic accessibility to the FQHCs take a closer look at areas created by each method.



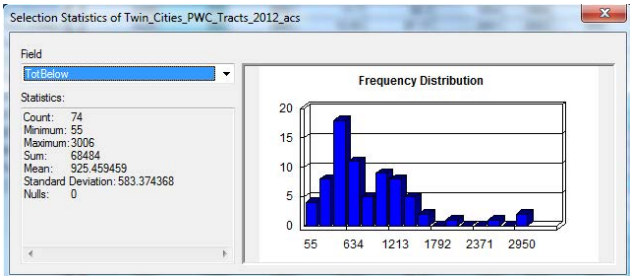
Determine the target population within both your buffer and service area polygons.

1. First evaluate population with ½ geographic accessibility using your Euclidean buffers:
2. Click **Selection > Select by Location**. Spatially select all *Twin_Cities_PWC_Tracts_2012_acs.shp* (**target layer**) that **intersect** *Twin_Cities_FQHCs_halfmile_buffer.shp* (**source layer**). You will assume that all of the population weighted centroids within the ½ mile buffer have populations that are within the ½ distance to a FQHC. Click **Apply**, then **OK**.





3. Open the table for *Twin_Cities_PWC_Tracts_2012_acs.shp*; you should see that 74 of the 228 tracts have been selected. Right click on the *TotBelow (Total population below poverty)* attribute field and select **Statistics** for these selected block groups**.** Take a look at the sum of the block group values for your selection. The 2012 ACS estimates 68,484 people below the poverty level in the study within a ½ mile Euclidean distance to any FQHC.



4. Now **Clear Selection** and take a look at the sum of the tract TotBelow values for all of the study area. The total estimate for this population is 157,145

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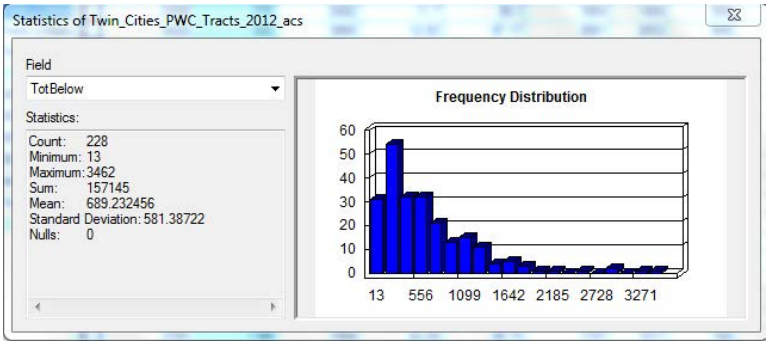
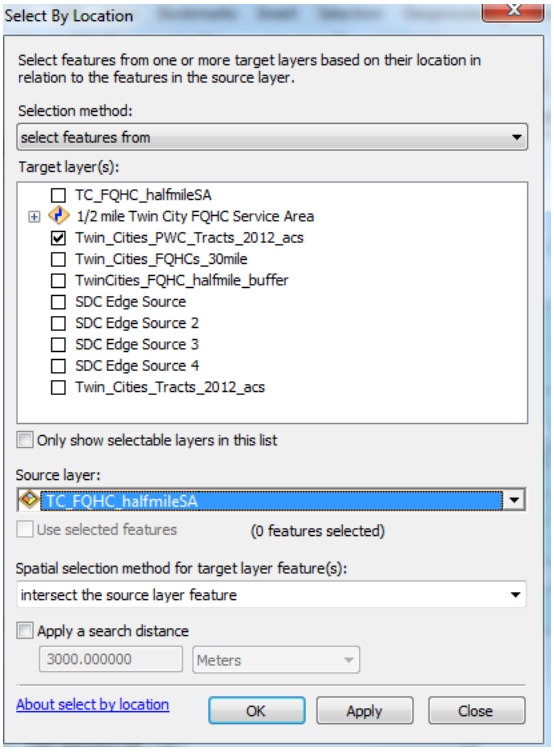
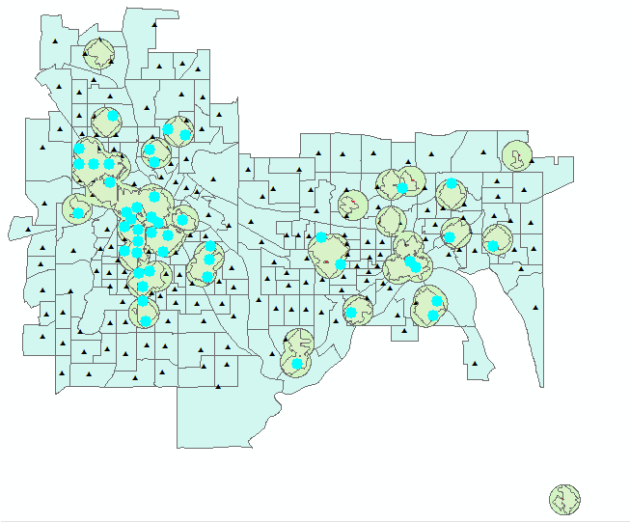


Solution

It looks like ~43% of population below poverty level for our study area are within a ½ mile Euclidean distance from any FQHC.

1. Now evaluate population with ½ mile geographic accessibility using the Network based service area
2. Click Selection > Select by Location. Spatially select all *Twin_Cities_PWC_Tracts_2012_acs.shp* (target layer) that intersect *TC_FQHC_halfmileSA.shp* (source layer). You will assume that all of the population weighted centroids within the ½ mile service area have populations that are within the ½ distance to a FQHC. Click Apply, then OK.





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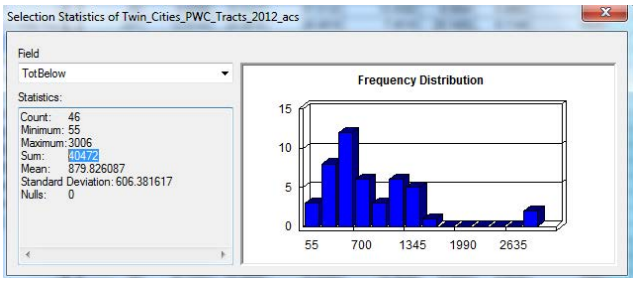
1. Open the table for *Twin_Cities_PWC_Tracts_2012_acs.shp*; you should see that 46 of the 228 tracts have been selected. Right click on the *TotBelow (Total population below poverty)* attribute field and select **Statistics** for these selected block groups**.** Take a look at the sum of the block group values for your selection. The 2012 ACS estimates 40,472 people below the poverty level in the study within a ½ mile network distance to any FQHC.



Solution

It looks like ~26% of population below poverty level for our study area are within a ½ mile Euclidean distance from any FQHC.

Discussion

1. What are some of important choices you made in this analysis?
2. There does seem to be a difference in the results of the two analyses – do you think this is important?
3. We aggregated population to a population weighted centroid in this analysis- how different would the results have been if we had aggregated population to the geometric centroid? The answers are below but if you would like to try this out the geometric centroids are also in the exercise data folder.

	geometric centroid		pop weighted centroid	
	count	%	count	%
Euclidean Distance Buffer	63,470	40.4%	68,484	43.6%
Network Distance Service Area	36,233	23.1%	40,472	25.8%

4. What are some likely assumptions/caveats to this type of analysis?