GIS I: Organizing Principles
Working With Spatial Data Exercise

*** Files needed for exercise: *MD_FQHCs.dbf, MD_Counties.shp, MD_Hospitals.dbf*

Goals: The goals of this exercise are to practice using projection tools from ArcToolbox and to work through common projection issues and solutions in ArcMap.

Skills: After completing this exercise, you will be able to display point level data from a table, define projections, project data, and adjust the data frame coordinate system.

Viewing Spatially Referenced Data in a Table

1. Open a **new blank map** in ArcMap.
2. Click the **Add Data** button , browse to the Working_with_Spatial_Data_Exercise_Data folder and add *MD_FQHCs.dbf*. Right click on the file in the **Table of Contents** and select **Open** to view the data. This is a table of federally qualified health center service locations in the state of Maryland.

Table

MD_FQHCs

FACILITY_N	CMS_PROV_5	CMS_PROV_6	CMS_PROV_7	
GOLDSBORO MEDICAL CENTER	316 Railroad Ave	Goldsboro	MD	2
DENTON MEDICAL CENTER	609 Daffin Ln	Denton	MD	2
FEDERALSBURG MEDICAL CENTER	215 Bloomingdale Ave	Federalsburg	MD	2
TOTAL HEALTH CARE, INC	1501 Division St	Baltimore	MD	2
PARK WEST MEDICAL CENTER, INC	319 W Belvedere Ave	Baltimore	MD	2
PARK WEST MEDICAL CENTER, INC	3319 W Belvedere Ave	Baltimore	MD	2
FAMILY HEALTH CENTERS OF BALTIMORE	631 Cherry Hill Rd	Baltimore	MD	2
TRI-STATE COMMUNITY HEALTH CENTER	130 W High St	Hancock	MD	2
HIGHLANDTOWN COMMUNITY HEALTH CENTER	3700 Fleet St Ste 200	Baltimore	MD	2
THREE LOWER COUNTIES COMM SERVICE INC	30413 Mount Vernon Rd	Princess Anne	MD	2
MATILDA KOVAL MEDICAL CENTER	2323 Orleans St	Baltimore	MD	2
BELAIR ROAD FAMILY HEALTH CENTER	3120 Erdman Ave	Baltimore	MD	2
GREATER BADEN HEALTH SERVICES	13605 Baden Westwood Rd	Brandywine	MD	2
NANJEMOY HEALTH SERVICES	4375 Port Tobacco Rd	Nanjemoy	MD	2

1 (0 out of 84 Selected)

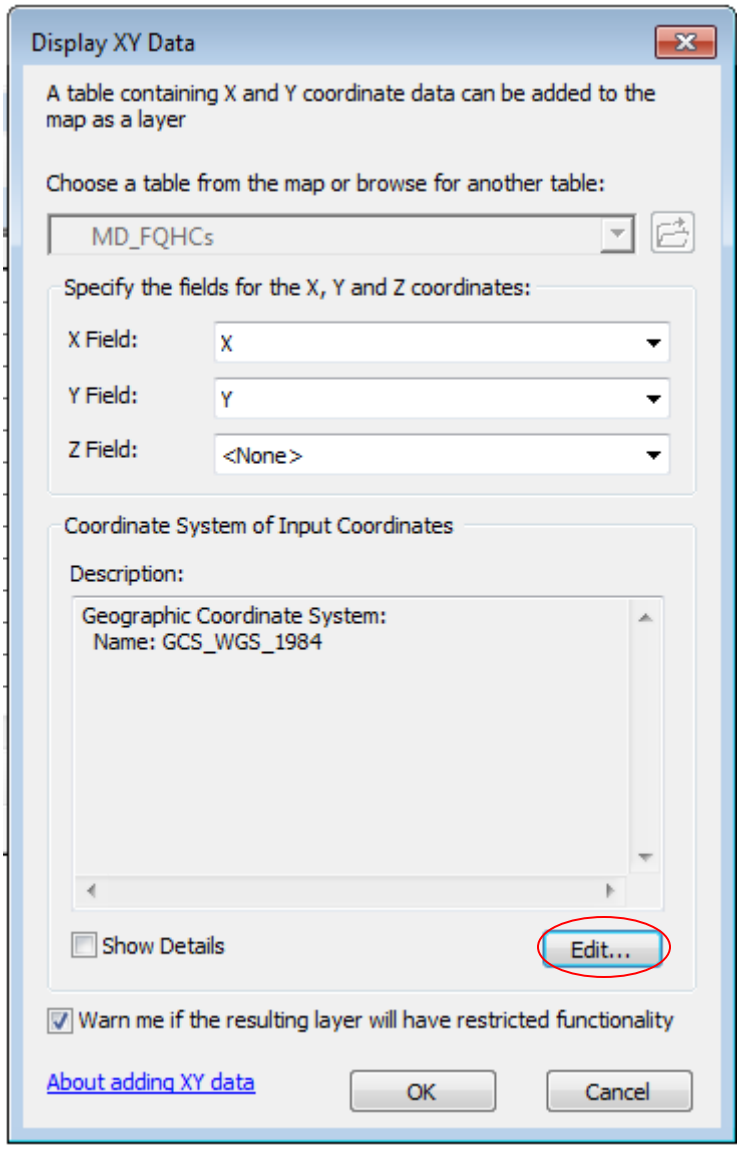
MD_FQHCs

3. Each record has spatial information attached; the address, city, state, zip, latitude and longitude are geographic references, meaning that these facilities can be located in space.

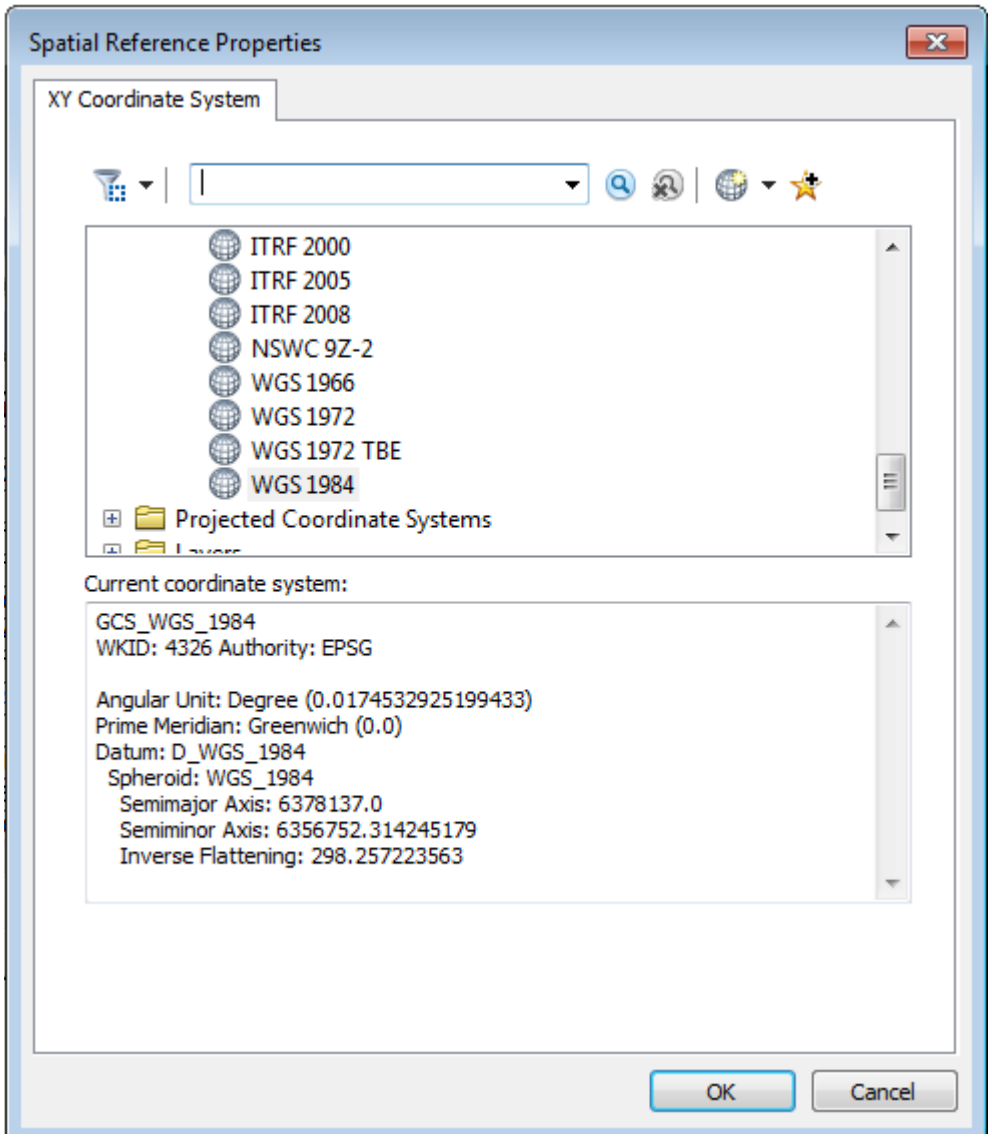
Displaying X/Y Data

1. You can turn this tabular data into a spatial dataset. There are many ways to do this, one way is to right-click on the *MD_FQHCs.dbf* table and choose **Display XY Data.** This will use the latitude and longitude coordinates in the table to locate the FQHCs in space.

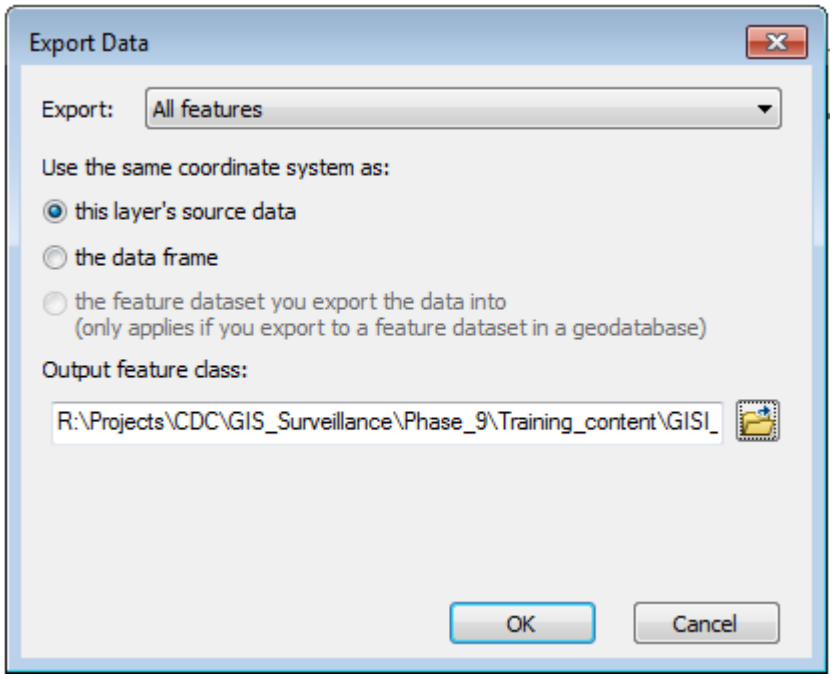
2. In the window that opens, ArcMap will have already selected **X** for the **X Field** and **Y** for the **Y Field**. It also says the coordinate system is unknown. You should know (from checking data documentation from the data source) that the coordinate system for the data is World Geodetic System (WGS) 1984, so let's tell ArcMap this. Click on the **Edit** button.



3. In the **Spatial Reference Properties** window, browse in the folder tree to **Geographic Coordinate Systems > World** and select **WGS 1984.** This should change the current coordinate system box to WGS 1984. Once you have verified this, click **OK**.



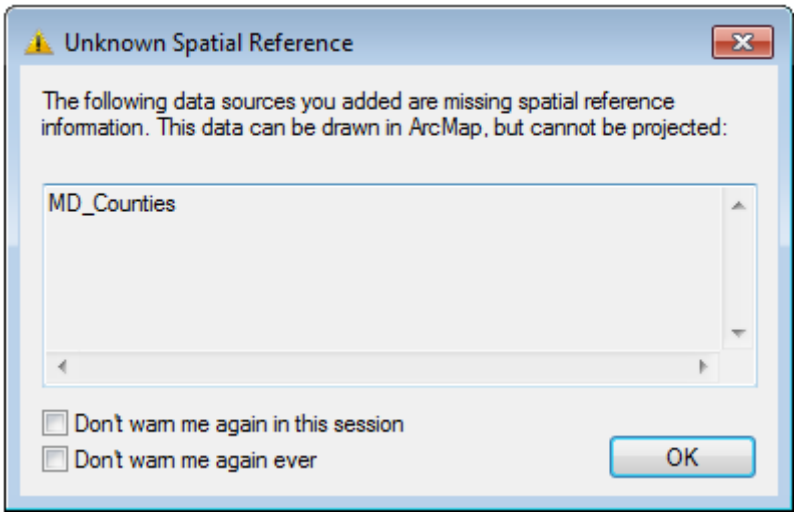
4. Back in the Display XY window, you should see that the coordinate system of input coordinates is now WGS 1984 instead of unknown. Click **OK**.
5. The data points should now be displayed on the map in a layer in your Table of Contents called *MD_FQHCs Events*. This is a temporary layer; you need to make it permanent.
6. Right click on the events layer and go to **Data > Export Data**. You should choose to **Export: All features**, with **this layer's source data**. Click the folder icon and save your shapefile with an appropriate name in your exercise data folder. Click OK. This will save the data as a file on your computer, instead of a temporary file saved only in the computer's memory.



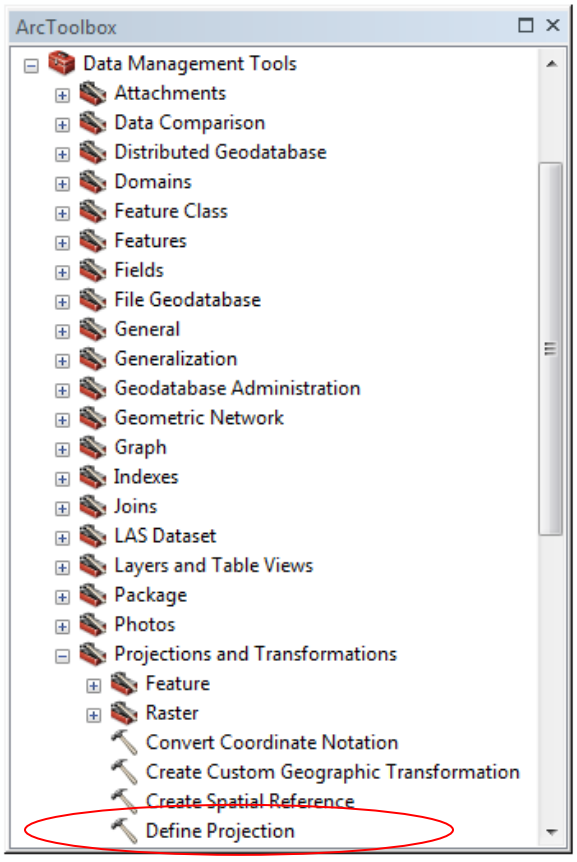
7. Choose **Yes** to add your new layer to the Table of Contents. At this point, you no longer need the original .dbf file, or the events layer you made previously. Right click on *MD_FQHCs.dbf* and *MD_FQHCs Events* and **Remove** them.

Defining Projections

1. Next, add the *MD_Counties* shapefile from the exercise data folder. You should get a pop up message saying the data has **unknown spatial reference information**. This may happen if the data did not have any coordinate system information originally or if the .prj file was lost or deleted. The data will display, but this should alert you that you need to ***define the projection*** for this piece of data before you use it for any analysis or mapmaking. Click **OK**.

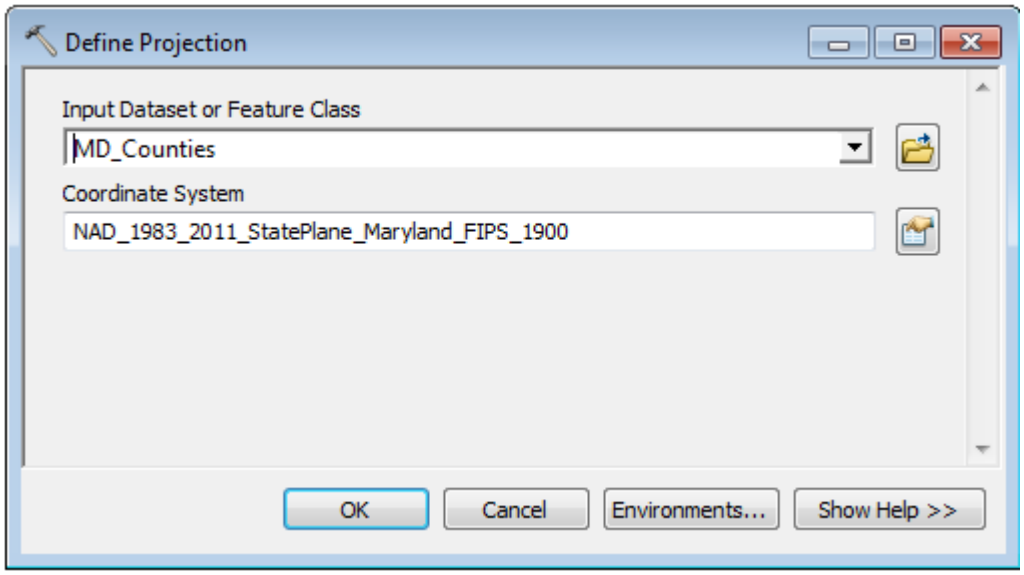


2. To define a projection, you will use **ArcToolbox**. If ArcToolbox is not visible on your ArcMap layout, you can open it by clicking the  button. ArcToolbox has hundreds of different tools. For now, let's look for the **Define Projection** tool. It is located under **Data Management Tools**, in the **Projections and Transformations** toolset.

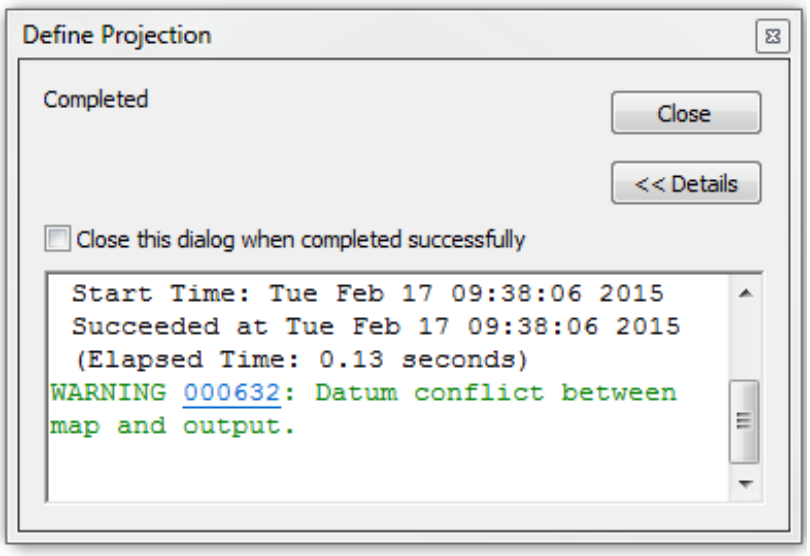


3. Double click on the tool. A tool dialog box will open. It will tell you what is required for the tool to do its job. In this case, only two fields are required. In the **Input Dataset or Feature Class** field, click the dropdown arrow and choose *MD_Counties*.

4. Click the  button next to the **Coordinate System** field to open the **Spatial Reference Properties**. This window should look familiar from earlier in this exercise. We contacted the file provider, so we know that the projected coordinate system should be North American Datum (NAD) 1983 (2011) (Meters). Browse to **Projected Coordinate Systems > State Plane > NAD 1983 (2011) (Meters) > NAD_1983_2011_StatePlane_Maryland_FIPS_1900**. Click **OK.** Check that your dialog looks like the image below.



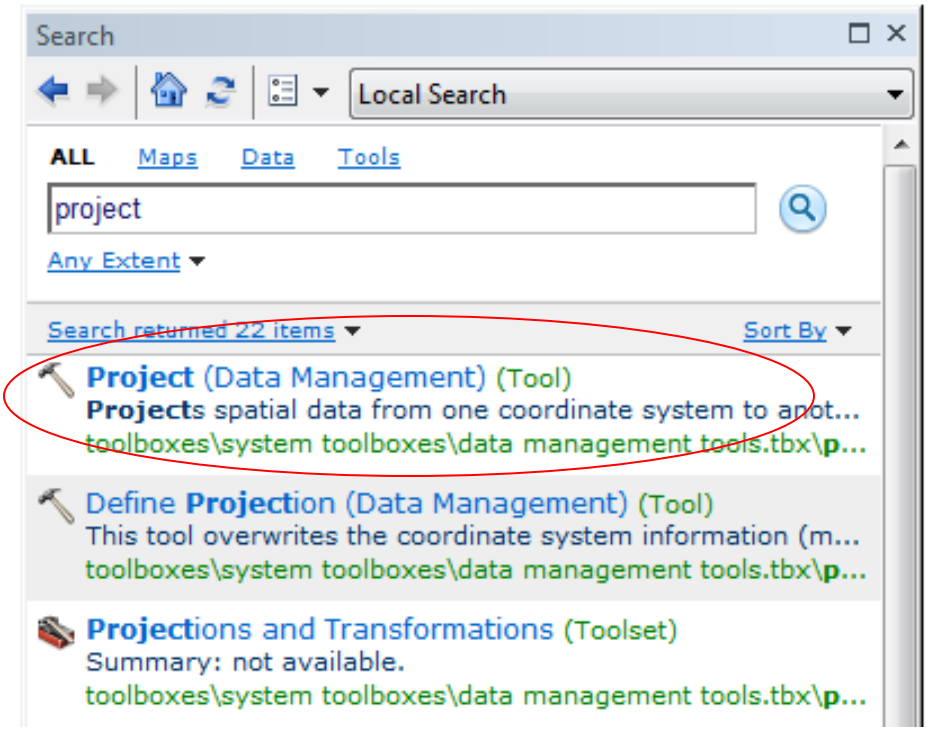
5. Click **OK** to run the tool. You may or may not get a warning message alerting you that this data and your map have different coordinate systems. Even if you don't get a warning, you should be aware that there may be an issue because you have added data with two different coordinate systems to the map. You can close the completion window.



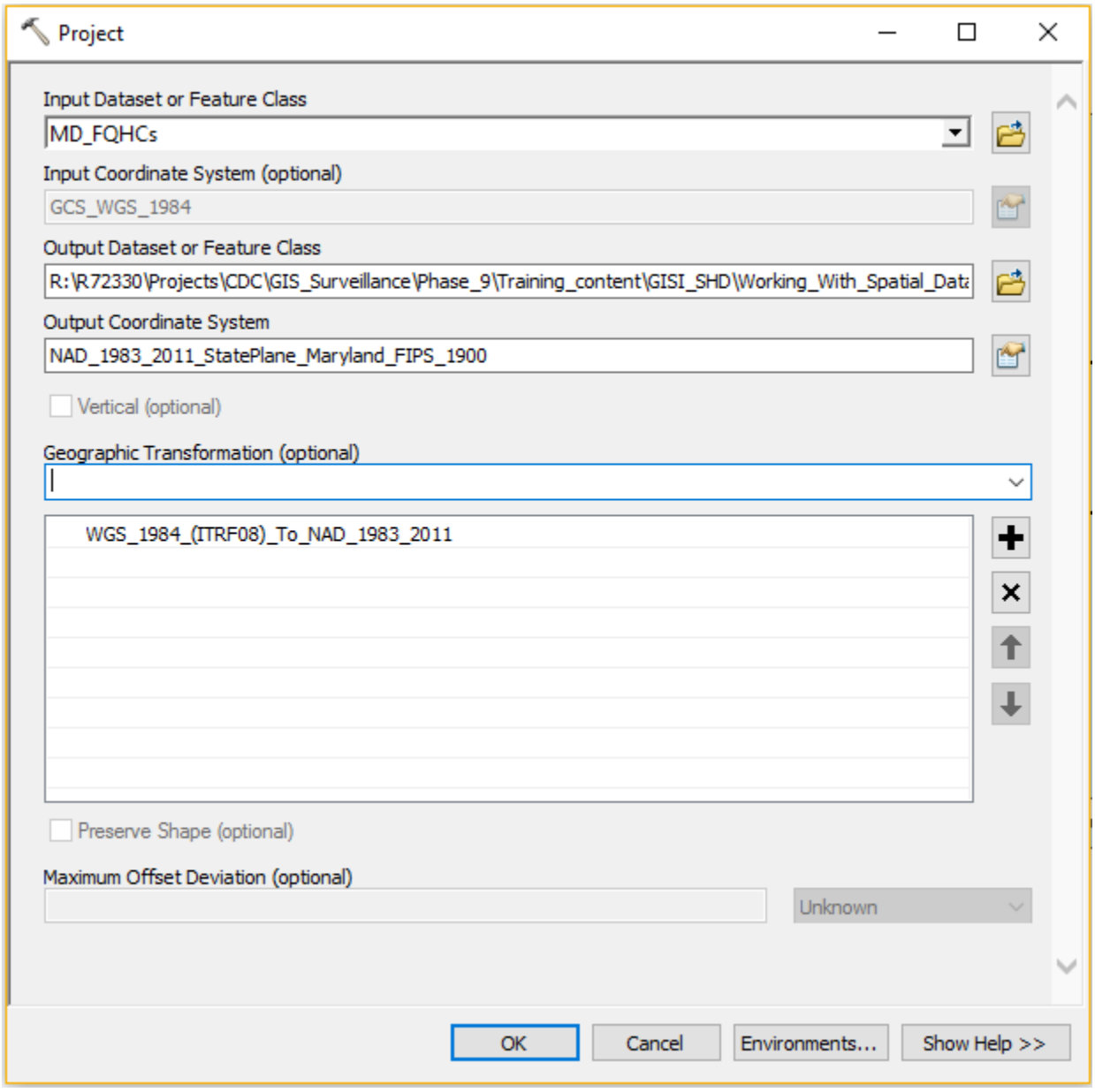
6. Take a look at your map. This is an example of data projecting on-the-fly. The counties were projected on-the-fly to match the display of the points that were already in the map. Even though the two layers appear to overlay perfectly, they have ***different*** underlying coordinate systems, which is a problem for running analyses. You can check to see that they have different coordinate systems by right clicking on each layer and going to **Properties > Source tab**. This is something you will fix next.

Changing Projections

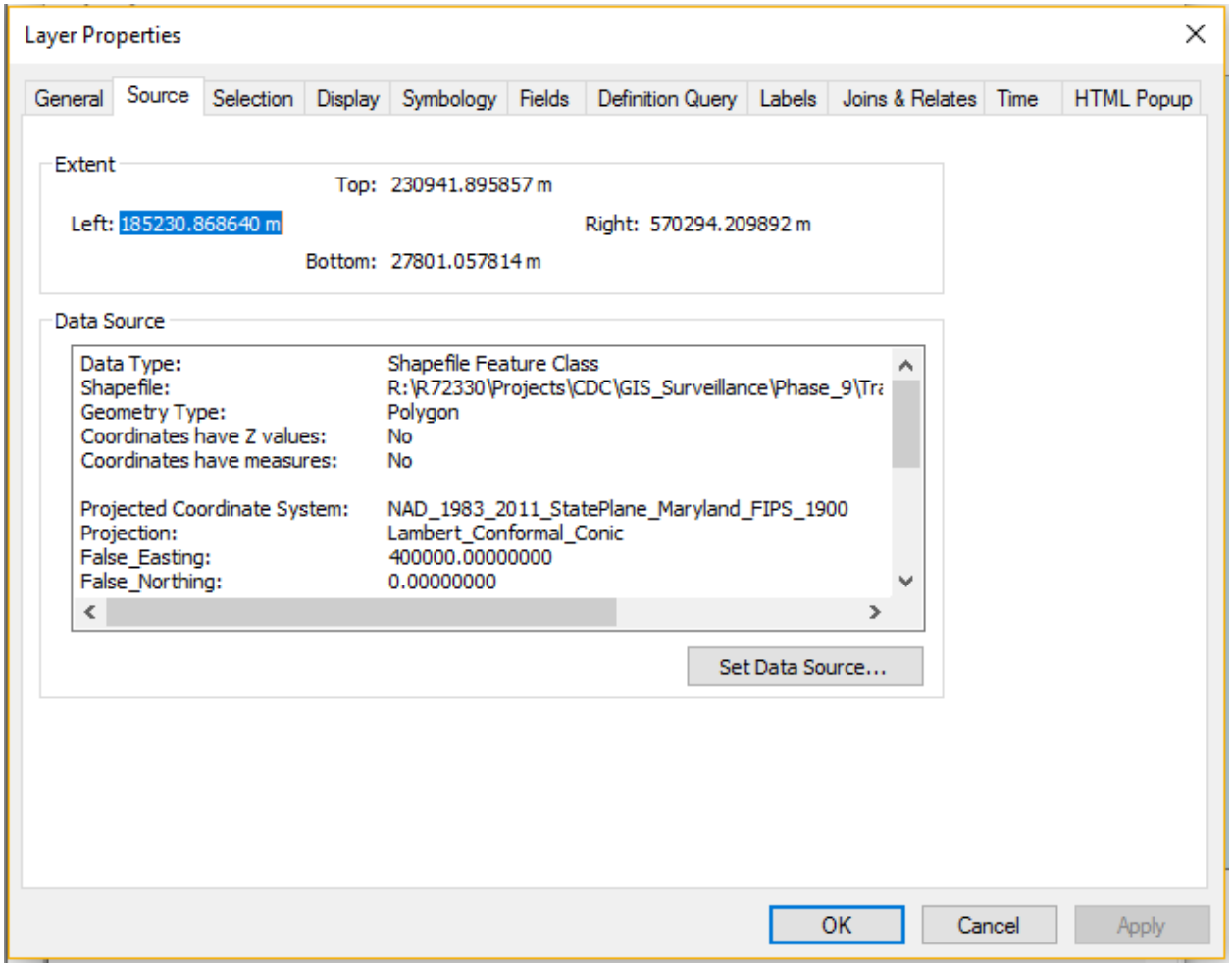
1. It would be best for both layers to have the same coordinate system, ideally a projected coordinate system that is well suited to Maryland. Both layers already have a defined coordinate system, so to ***project*** the coordinate system you will use the **Project** tool.
2. You could go looking for this tool in ArcToolbox, but let's try a different approach. Click the **Search** tab on the right side of the ArcMap window. You can search for keywords on this screen. Type in **Project**. You want the **Project (Data Management)** tool.



3. Click on the tool to open the tool dialog box.
4. For the **Input Dataset**, choose your point dataset of FQHCs. The **Output Dataset** will be a new shapefile. Save it in your exercise data folder and name it something logical.
5. For the **Output Coordinate System**, remember we defined a statewide system appropriate specifically for Maryland. We will use that to make sure they are consistent. Click the  button to open up the **Spatial Reference** dialog. Browse to **Layers > NAD_1983_2011_StatePlane_Maryland_FIPS_1900**. Click **OK**.
6. Check to make sure your dialog box looks like the image below and then click **OK** to run the tool and wait for it to finish.



7. This tool creates a new shapefile that is automatically added to your table of contents. You can check that it has the new coordinate system by going to **Properties > Source tab**.

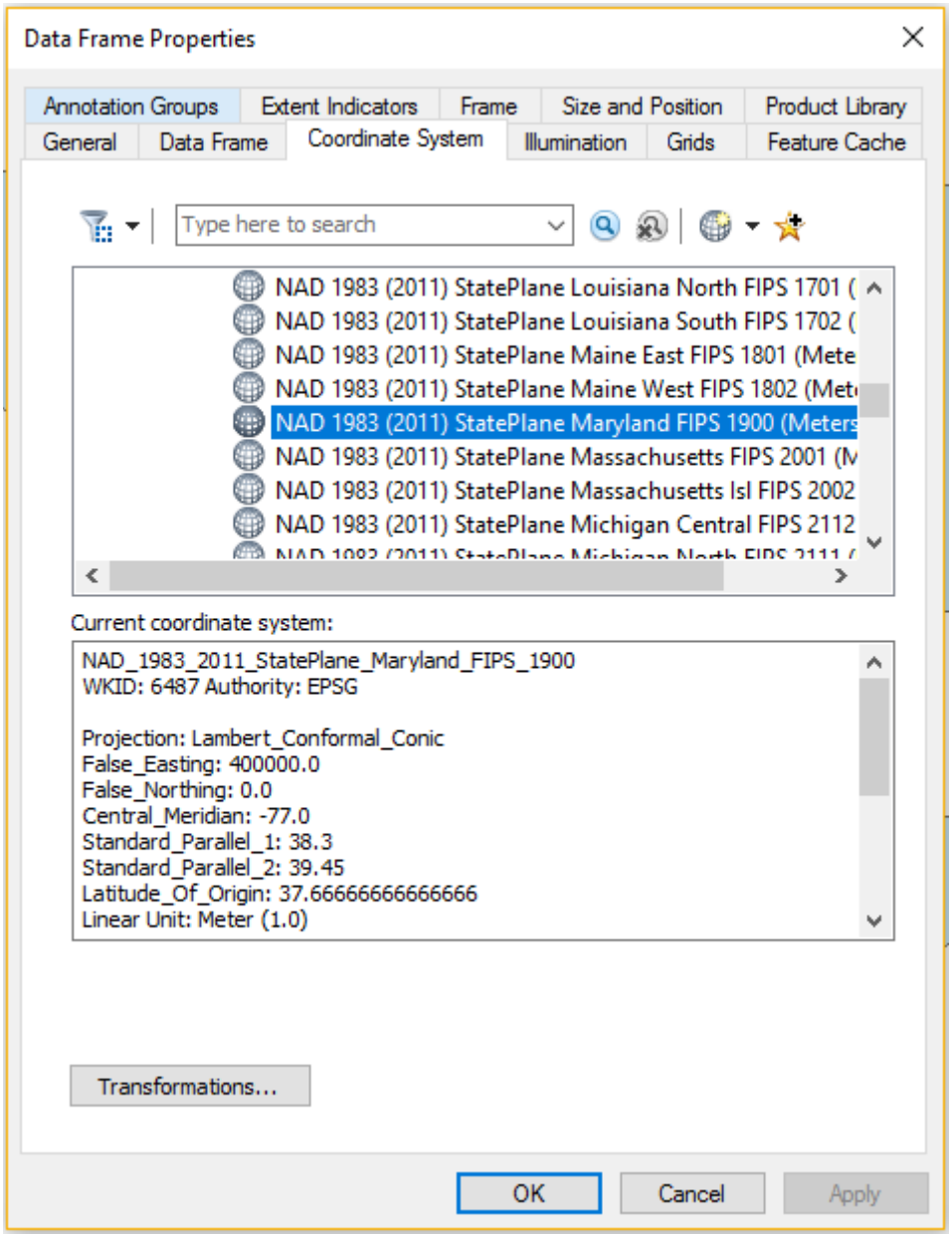


8. You can now remove your original FQHCs point layer.
9. What do you notice about the map after both layers have been projected into Maryland's state system? Did the map change?

Changing Data Frame Coordinate Systems

1. Remember that you always want the Data Frame to be in the same coordinate system as the data. Your data is now in Maryland's state system, but is the data frame? To see what coordinate system the data frame is in, right click in the white space on your map and go to **Data Frame Properties** > **Coordinate System tab.**
2. Currently, the data frame is in WGS 1984. This is because the very first piece of data you added to this project was in WGS 1984, and this set the data frame coordinate system. This will project all data we have in the workspace to WGS 1984 "on the fly".

3. Let's change the data frame coordinate system to be in Maryland's state system like the rest of the data. In the **Coordinate System tab**, browse in the folder tree to find Maryland's system in meters, select it, and click **OK**.



4. You should immediately notice the map display changes. Maryland is noticeably taller and looks less stretched. The data frame now has the same coordinate system as the data so everything is displaying as it should and you are ready to run analyses.

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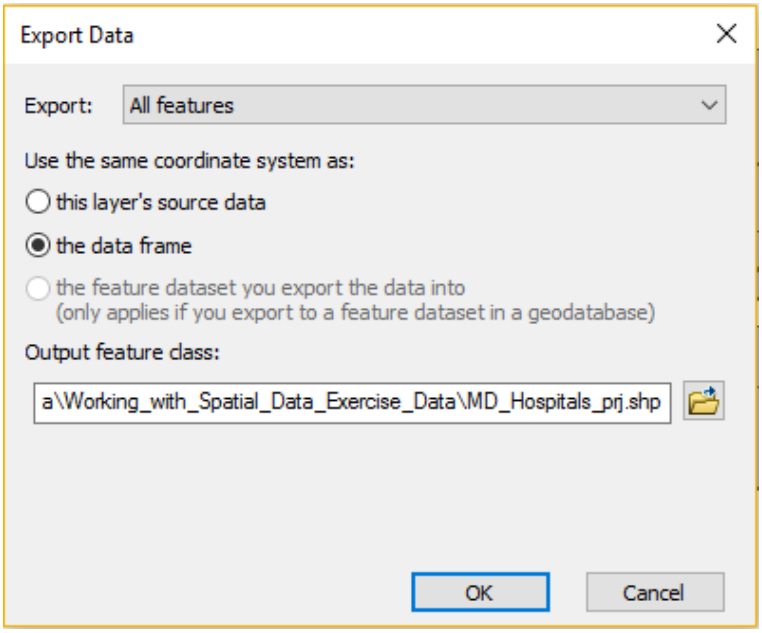
Projecting Data When Exporting

1. Add the last piece of data, *MD_Hospitals.dbf*. This file contains a list of hospitals in Maryland. Use the X and Y coordinates in the table to **Display XY Data**. The coordinates are in the Geographic Coordinate System GCS_WGS_1984. (You can refer back to **Displaying X/Y Data** section)
2. Remember that the new *Events* layer of hospitals is not permanent – it must be exported to a shapefile. Right click on the Events layer and select **Data > Export Data**.
3. ArcMap can project data for you in the export process. Consider your options carefully: do you want to export features using the same coordinate system as 1) this layer or 2) the data frame? In this case you could do either. You just set the data frame coordinate system to Maryland's standard state system, which is the system you want your data to be in, so you can select the **same coordinate system as the data frame**.



4. Save your shapefile with a logical name and click OK to export it. Be sure to add it to your map and remove the *Events* layer. This is a quick and easy way to project your data.