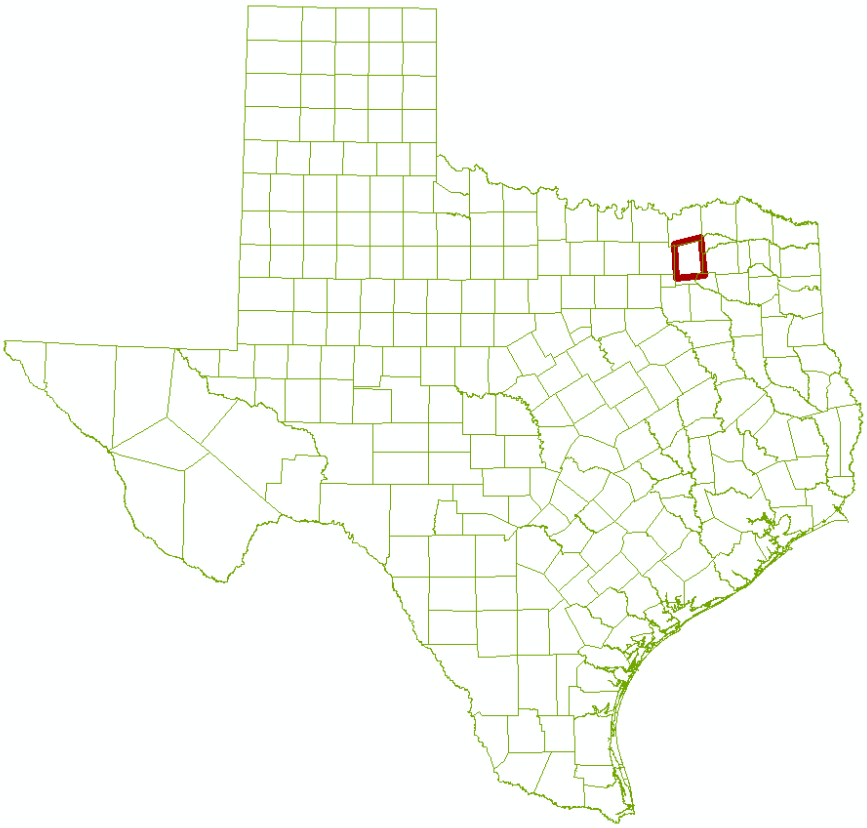
The University of Texas at Austin

A Study of the Oil and Gas Zones in Hunt County, Texas

Jackson School of Geology



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12/7/2009

I. Over View of Problem

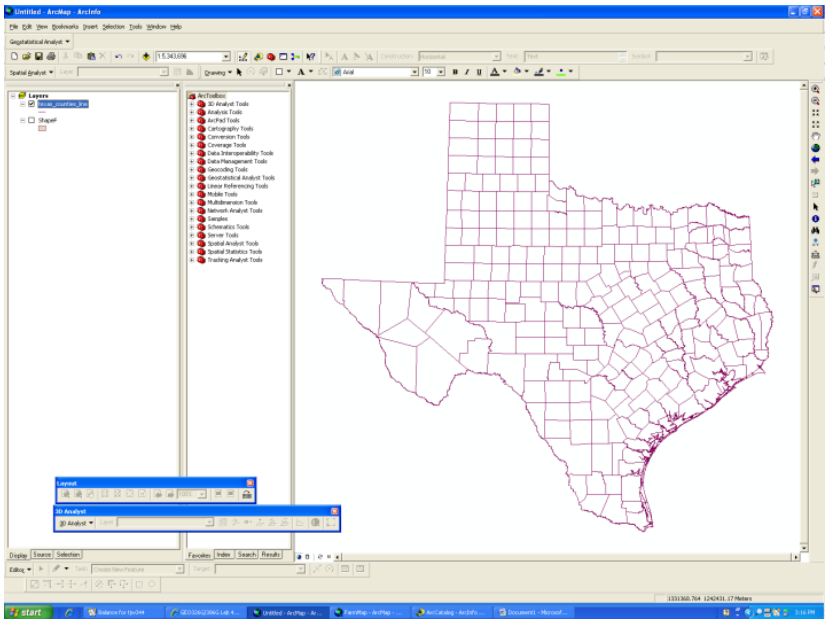
Fossils fuels are a huge source of energy that is used around the world. This make them valuable. Oil and Gas are the two fossil fuels that this paper attempts to locate in Hunt County, Texas. In order to have oil and gas you need a source rock, resevoir rock, and a trap rock. Once the source rock has reached the gas or oil window of temperature and pressure, it begins to produce oil and gas. These liquids then migrate towards the surface because they are less dense than the water in the rock. They will migrate until they have reached a non porous rock where they are trapped in the rock beneith it, known as the reservoir rock. Because gas is less dense than oil, the mixture will settle until the oil is benieth the gas. Two maps were produced. One map that shows a surface of the bottom of the trap rock, and another map shows the areas which which are likely to have either gas or oil based on the properties of petroleum systems. These areas will be compared with the location of Wickman Farms to dtermine if there is a possibility of drilling for oil under the property.

II. Data Provided

1) An excel file from Dr. Tim Meckel that contains thedecimal degree location of the 341 producing and non producing wells in Hunt County, Texas in the North American Datum 1983 coordinate system. Each well has a description of the status of the well in the form of an abbreviation that is described in a side table. If the well is producing, the perforation depths are given in feet with a perforation top and a perforation bottom.
2) A layer filefrom Lab 1 with county boundries of Texas in North American Albers coordinate system.
3) A layer file from Lab 1 contaning the surface geology with accompanying attributes of Texas in North American Albers coordinate system.
4) A survey of Wickman Farms containing the corordinates in degrees, minutes and seconds in the WGS 1984 coordinate system.

III. Construting a GIS

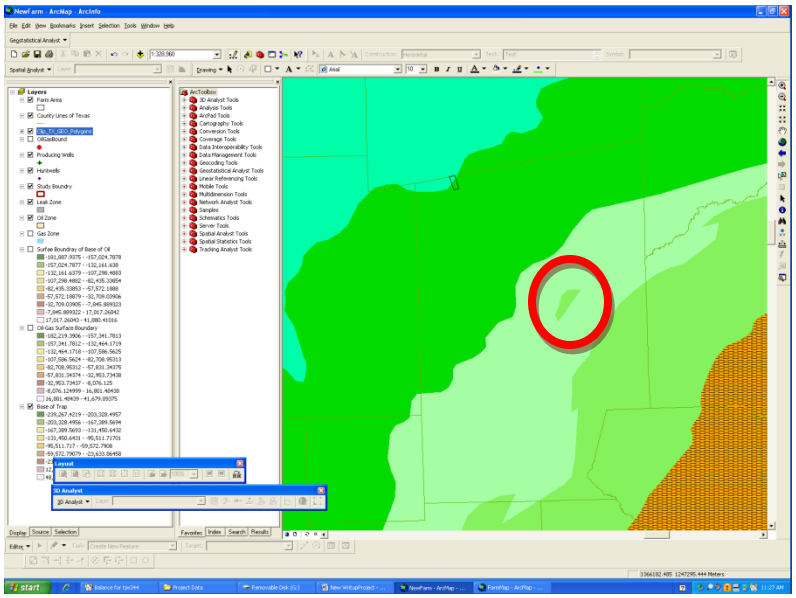
1) Starting with a blank ArcMap document, the the layer file with Texas county boundrys was added. Since the file was originally constructed in Albers coordinate system, the layer was then reprojected in North American Datum 1983 by clicking on the geodatabase and changing the projection. The end result show the Texas counties as shown in FIGURE 1.



[FIGURE 1]

2) To help understand the subsurface geology the layer file was added to the map. Once added to the map, no further work was created, as ArcMap automatically projected the layer into the North American Datum 1983 as shown in FIGURE 2.

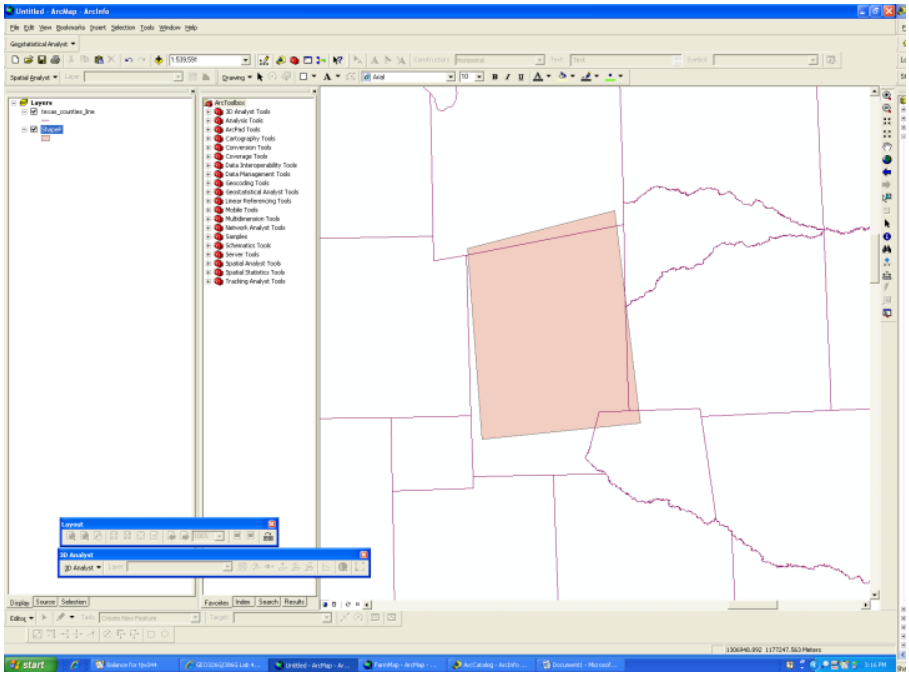
3)



[FIGURE 2]

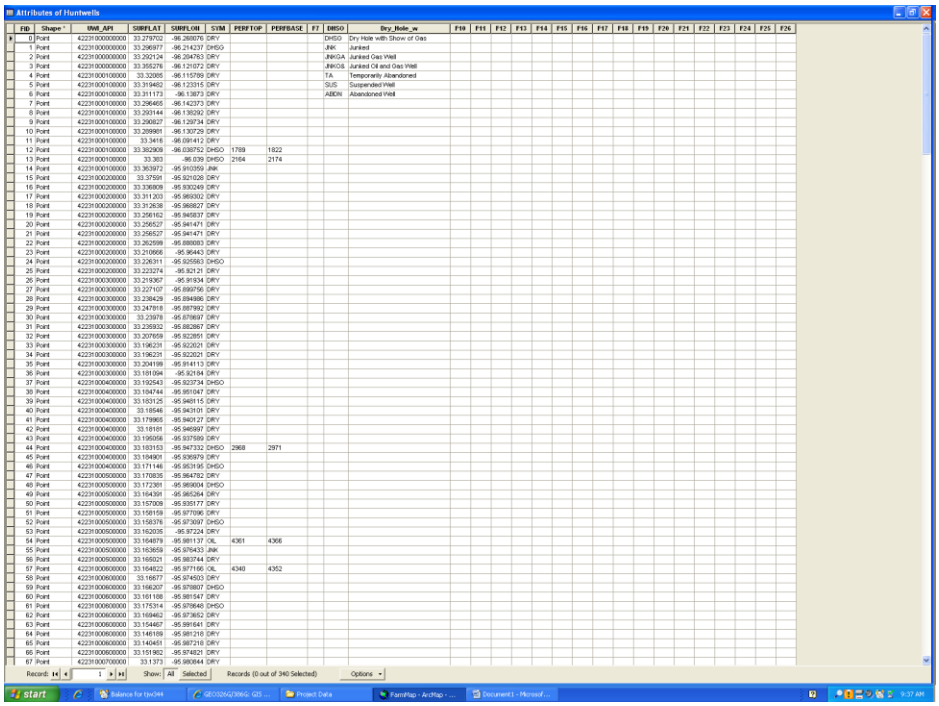
Looking at the geology in Hunt County it can be determined that there is an older unit of rock outcropping in the middle of a younger unit as circled in FIGURE 2. This indicates there there is a domal structure localized in that area.

4) In order to establish a study area of Hunt County, another layer file had to be created. In ArcCatalog, a new polygon file was created and labeled Study Area. Then, in ArcMap, the layer file was added to the geodatabase. Using the Editing tool, a polygon was constructed as shown in FIGURE 3.



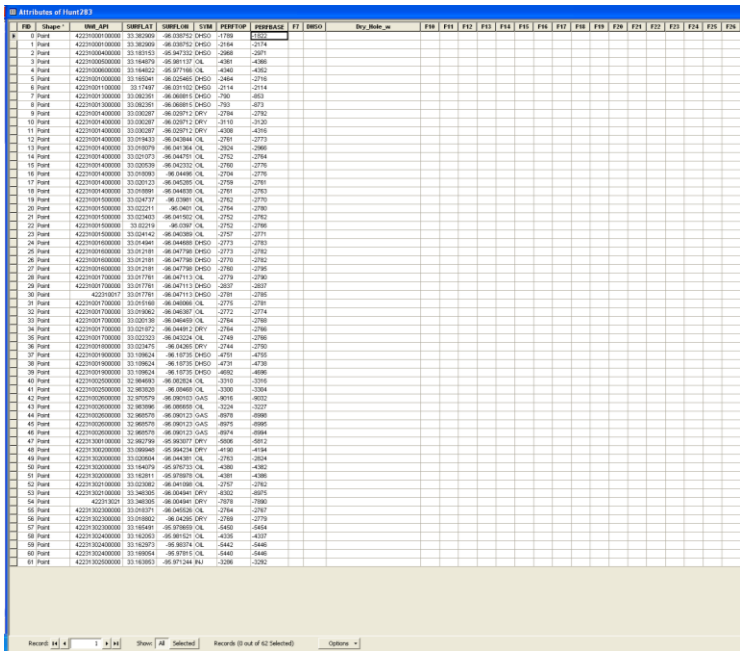
[FIGURE 3]

5) In order to add the wells to the document, the excell file must be converted to a point file. In ArcMap, the well locations and their attrinutes were added to the map by using the Add XY Data functin. In the wizard, the proper excell file was selected the x-coordinate column and the y-coordinate column. Because the excel file contained the decimal degree locations in NAD83, this coordinate system was selected in the wizard. The resulting file created in ArcMap was then saved as a layer file in order to access its attribute table which is shown if FIGURE 4.

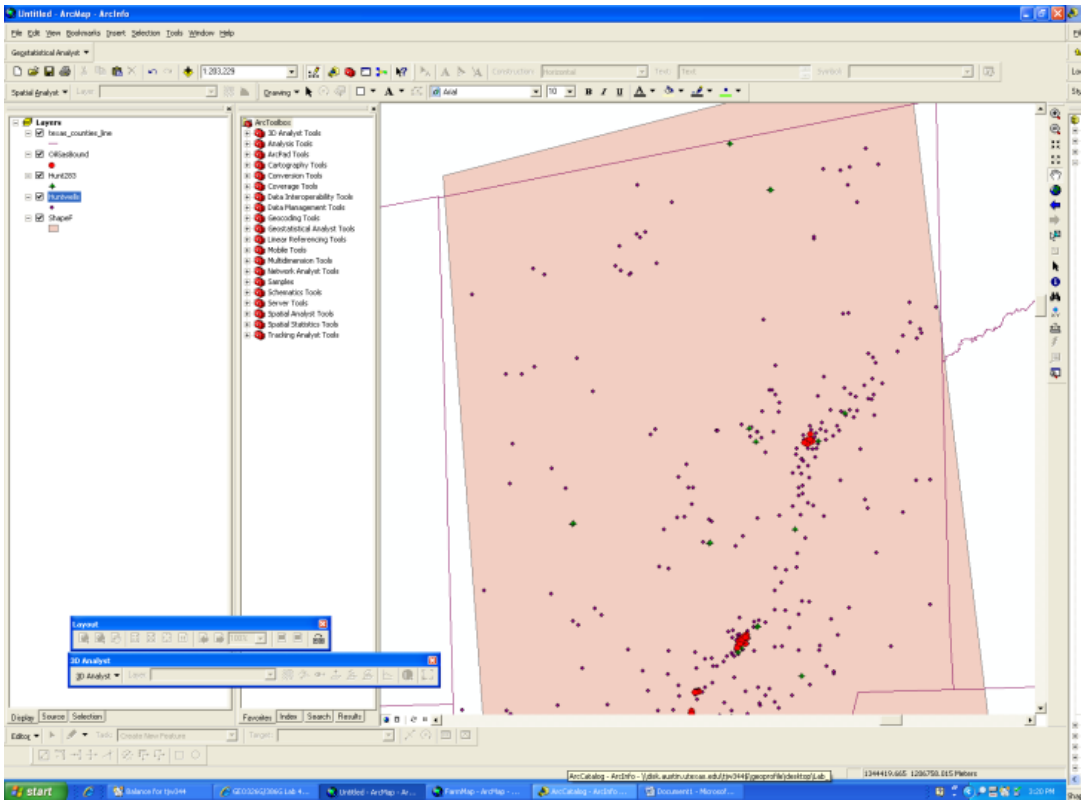


[FIGURE 4]

6) The majority of the wells are dry, and the data needed to be filtered to make a layer with only producing well data. Another layer file was created using the process described in step 3 and called Producing Wells. The attribute table was then viewed. In order to delete all of the dry wells in this layer, the selection query wizard was used, and all the points were selected that had [Perftop] = [Perfbase]. Once editor was turned on, these points were then deleted resulting in the attribute table shown in FIGURE 5. The two well point files were then symbolized to differentiate between them as resembling FIGURE 6.



[FIGURE 5]

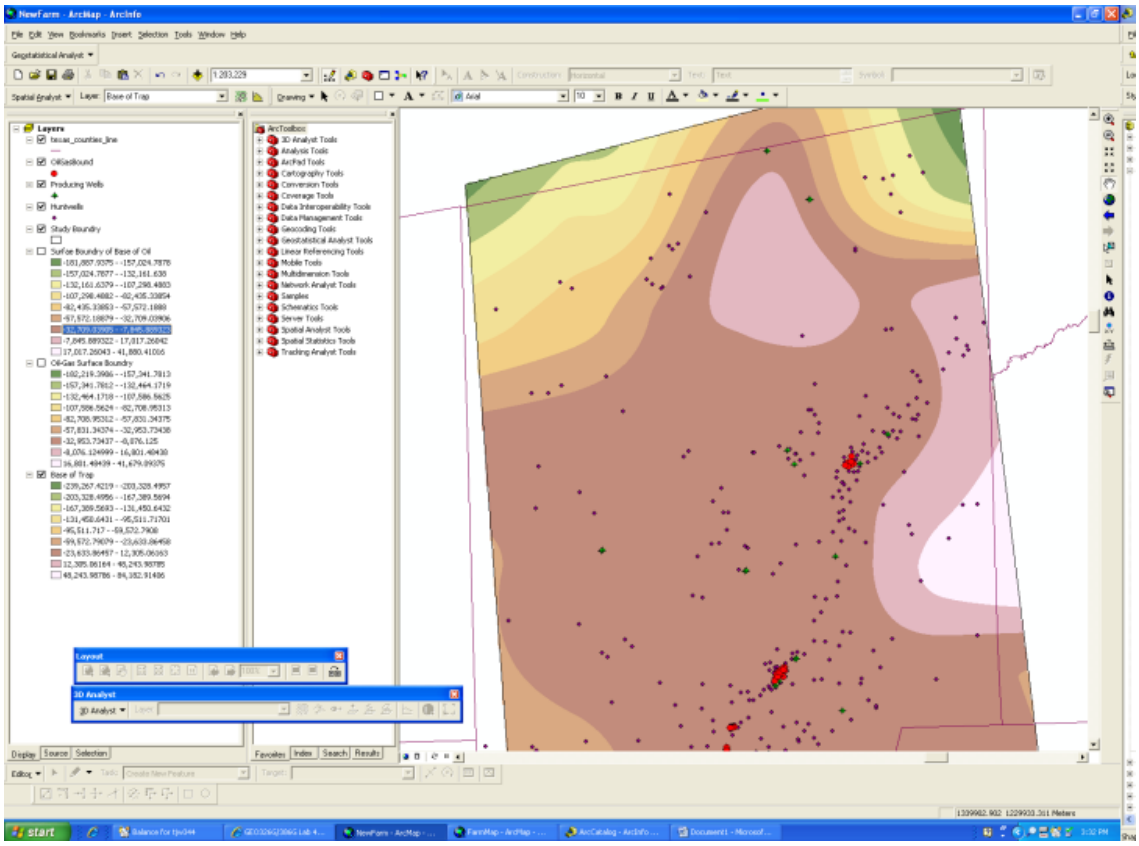


[FIGURE 6]

As wells are being drilled, casing placed down the hole to prevent many thing some of which include wall crumbling, and contamination of fluids into and from other rock layers that are not

of interest. Once the depth at which the layer containing the gas or oil has been exceeded, drilling is stopped and the casing is perforated at the target depth. The goal of the perforation is to allow oil or gas to flow from the reservoir rock into the well. Assumed in this project is that all perforations are in the reservoir, and that the perforations extend the entire length of the reservoir. Also assumed is that the gas perforations do not extend down into the oil, and that the oil perforations do not extend up into the gas. Because the reservoir rock lies just below the trap rock, the top of the perforations is assumed to be the bas of the trap rock.

7) Under these assumptions, a surface was created using the perforation tops of the producing wells using the Spatial Analyst Tool in ArcToolbox. The Interpolation Tool found in the Spatial Analyst Toolbar can only use data found in field that are set to numerical data.
First, two new well attribute fields needed to be created that are formatted for long integers, one for the perforation tops, and another for the perforation bases. Then using the Field Calculator, these columns were calculated to equal their given respective columns.
Also, all of the Spatial Analyst Tools create rasters only to the extent of the given data unless otherwise specified. So, in the Spatial Analyst Options wizard, under the Extent tab, the extent can be defined by another layer file. The Study Area layer file was selected.
It was then possible to use the Interpolation Tool in the Spatial Analyst Toolbar to create spline the data well data. In the Spline wizard, the producing well data file was selected, and the field just created, perforation tops, was set to as the data to create the surface raster. The Trap Rock surface raster result is shown in FIGURE 7.



[FIGURE 7]

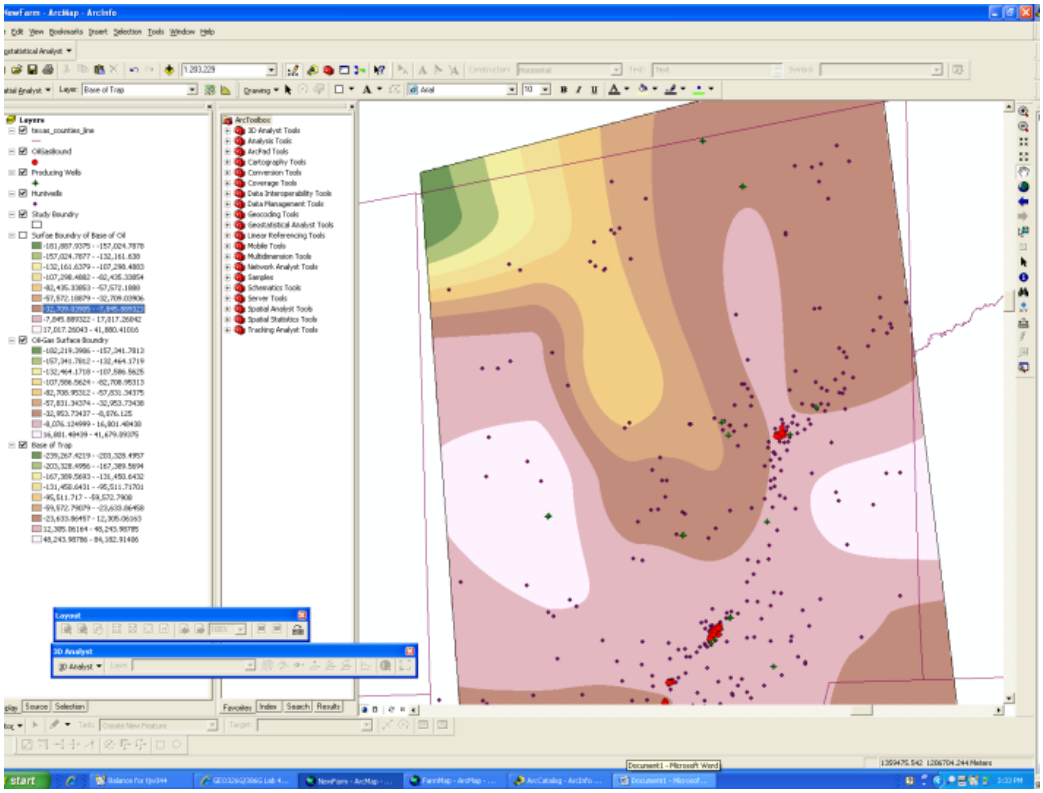
As stated earlier, and shown in FIGURE 2, the geology in the areas is in the shape of a dome. Despite the lack of a complete dome being shown, I believe the highpoints shown in white to the east of the map to be an anomaly formed in the splining process to form this raster due to a lack of producing well data in this area.

As stated in the Overview of the Problem, oil is denser then gas, and therefore will sink below it. This creates a surface between the oil and gas. This surface is known as the oil-gas boundary. Also, because water is denser than oil, and in the same way as above, a boundary between the water and oil can be found. I will call this the base of the oil boundary. When these boundaries are view from above, horizontal extents can be seen due to the limit of the source rock to produce oil and gas and the dome like structure of the trap rock.

8) In order to create these boundaries another field needed to be added to the Producing Wells layers file. The field contains the tops of the oil producing wells' perforations as well as the bottoms of the gas producing wells' perforations. This was done in a similar manner as in described in step 6.

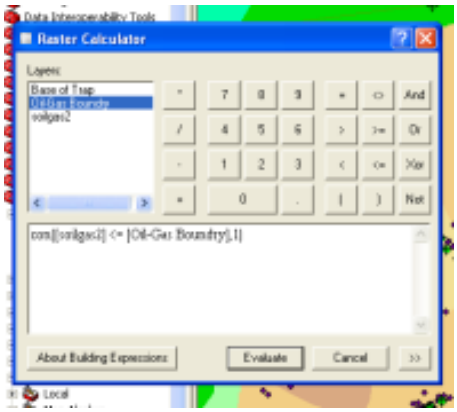
Once the proper field was created, it was then possible to create a surface by using the Interpolation wizard and its splining technique using the new field just created for the numerical data. The resulting surface of the oil-gas boundary is shown in FIGURE 8. Keep in mind that for

this step and all further steps, the Spatial Analyst extent was set to the extent of the Study Boundary polygon.

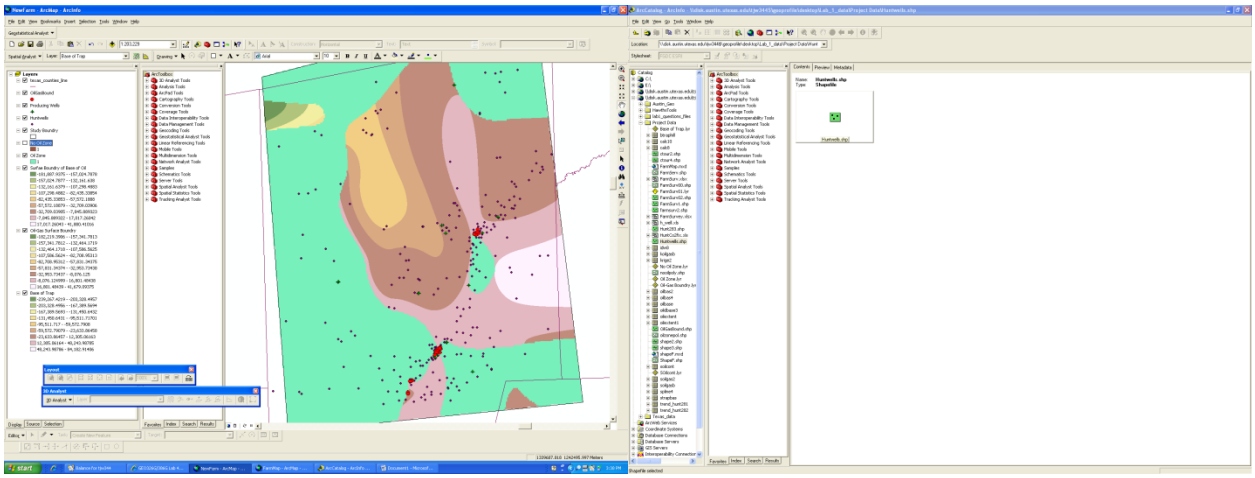


[FIGURE 8]

9) To create a polygon shape file of the area outside of the oil gas boundary a conditional statement was used to make all of the area outside equal to 1. The rater calculator wizard was used and the conditional statement “con([base of trap] < [oil-gas surface boundary],1)” was used. The raster calculator and the statement are shown in FIGURE 9. The raster created then needed to be exported as a shape file and then converted the shape file was then converted features to create polygons and saved as Oil Zone. The resulting shape file is shown in FIGURE 10.

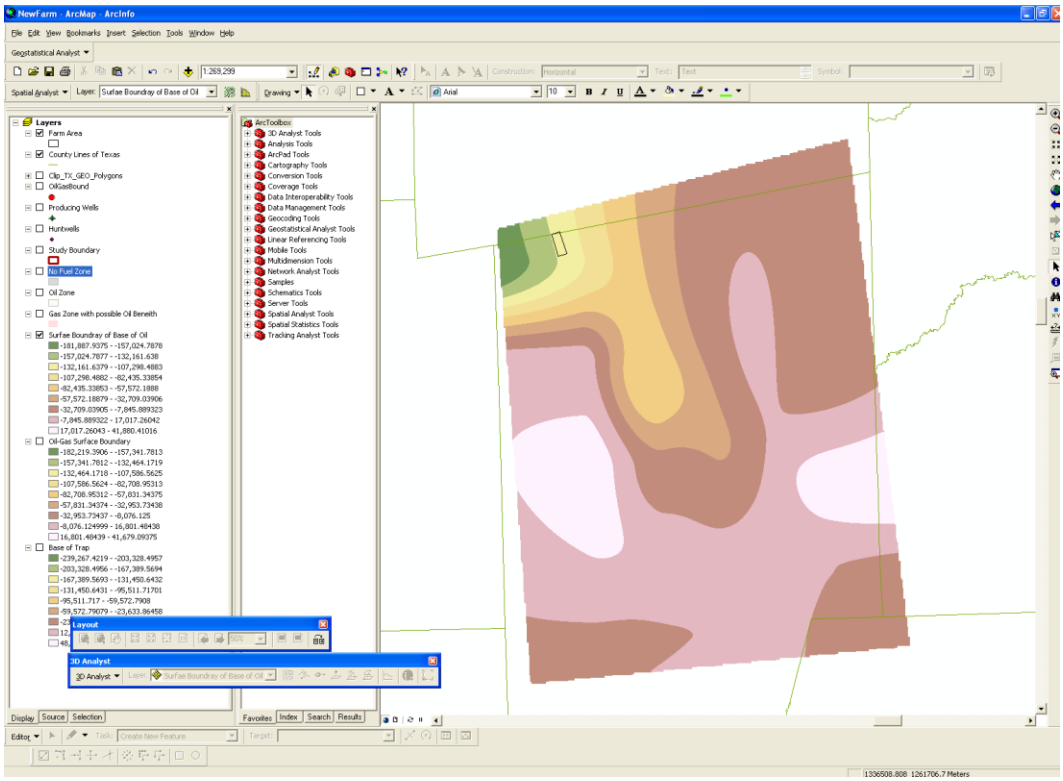


[FIGURE 9]

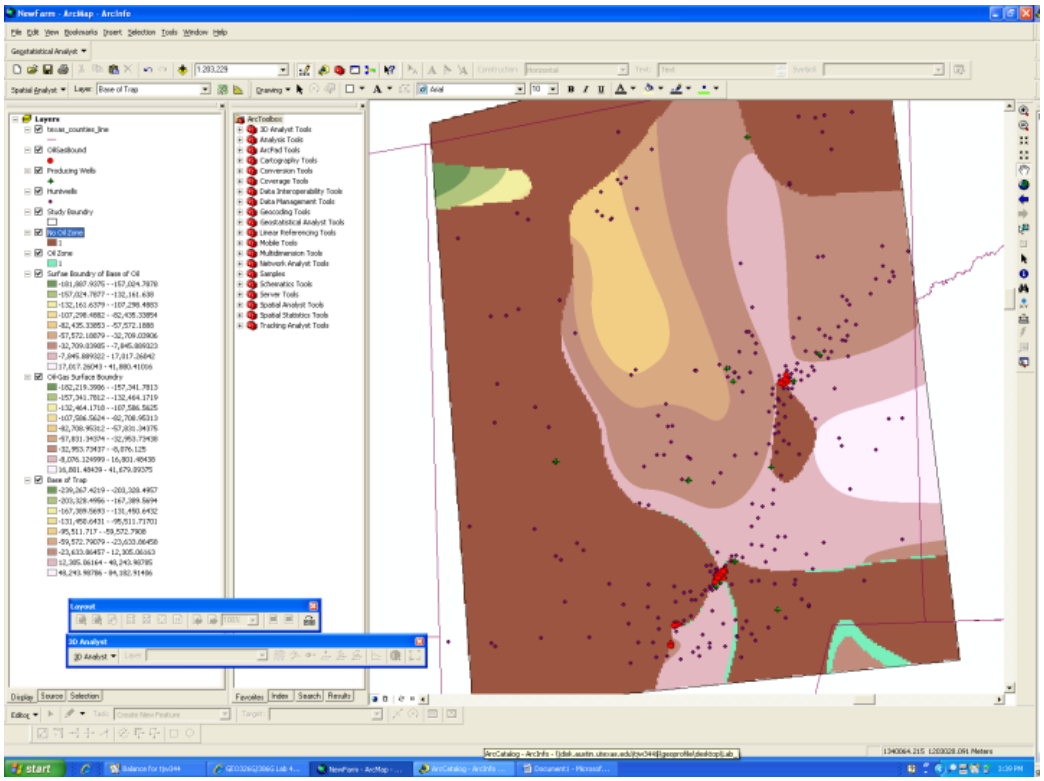


[FIGURE 10]

10) The next step was to create the outer extent of the oil based on the bases of the oil perforations. Done the same way as in step 9, a surface was created using the Interpolation wizard to spline the bases of the oil well perforations. The resulting raster surface shown in FIGURE 11 was then used in the raster calculator to change the area where the Base of the Trap is less than the Base of the Oil Surface Boundary to equal 1. That raster was then exported as a shape file and then the shape file was converted to features and saved as No Oil or Gas Zone. FIGURE 12 shows the newly created shape file on top of the previously created one.

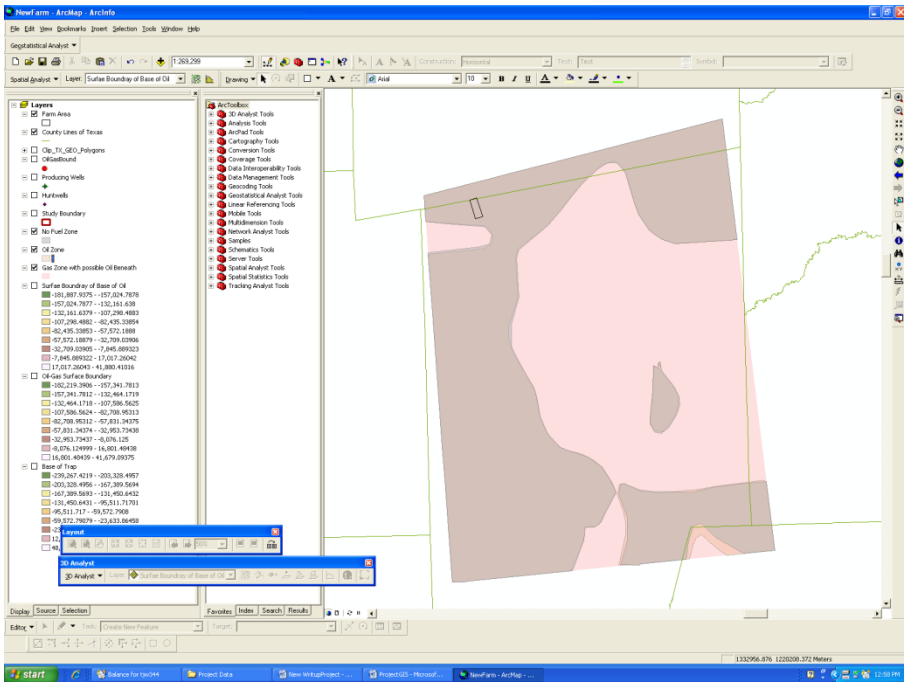


[FIGURE 11]



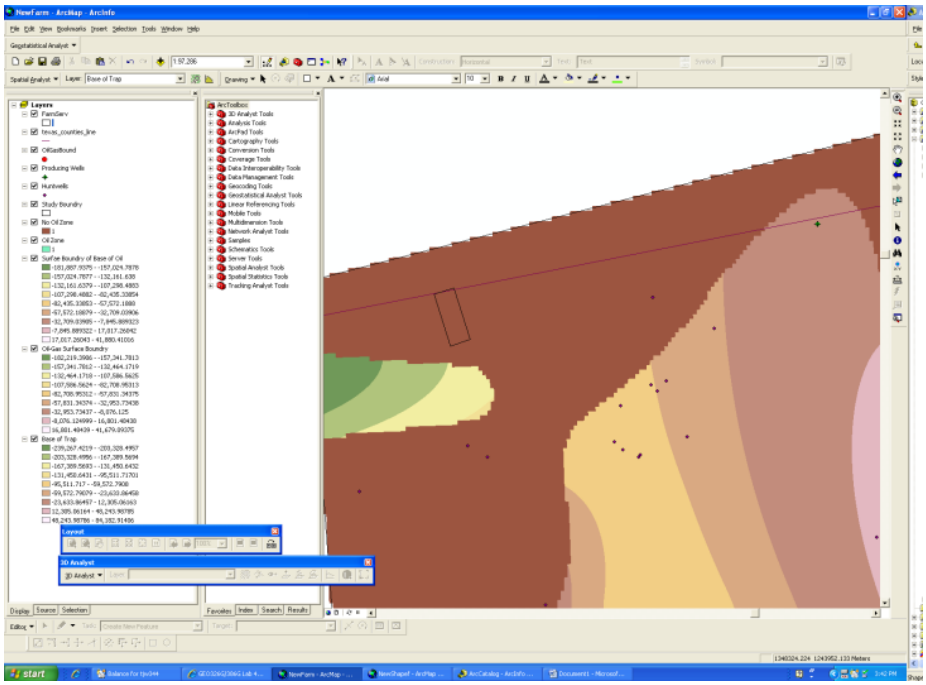
[FIGURE 12]

11) To be able to distinguish the gas zone with oil underneath it, the previously created study area shape file was added and placed beneath these layers, labeled as Oil/Gas Zone as shown in FIGURE 13.



[FIGURE 13]

12) The last step was to add the area of Wickman Farms to the map. The given survey points were in degrees, minutes and seconds, and these had to be converted to decimal degrees. An excel file was created and four points were chosen from the survey and added in decimal degrees to the excel file under their respective columns of latitude and longitude. A new polygon layer was created in ArcCatalog and named Farm Area. Then in a new ArcMap, the excel file, XY Data was added using the wizard. Using the editing toolbar, the points were then connected to form a polygon. The file was then saved and added to the database as shown in FIGURE 14. These jagged edges of in this picture are there because the screen capture was taken before the rasters were converted to polygon features.



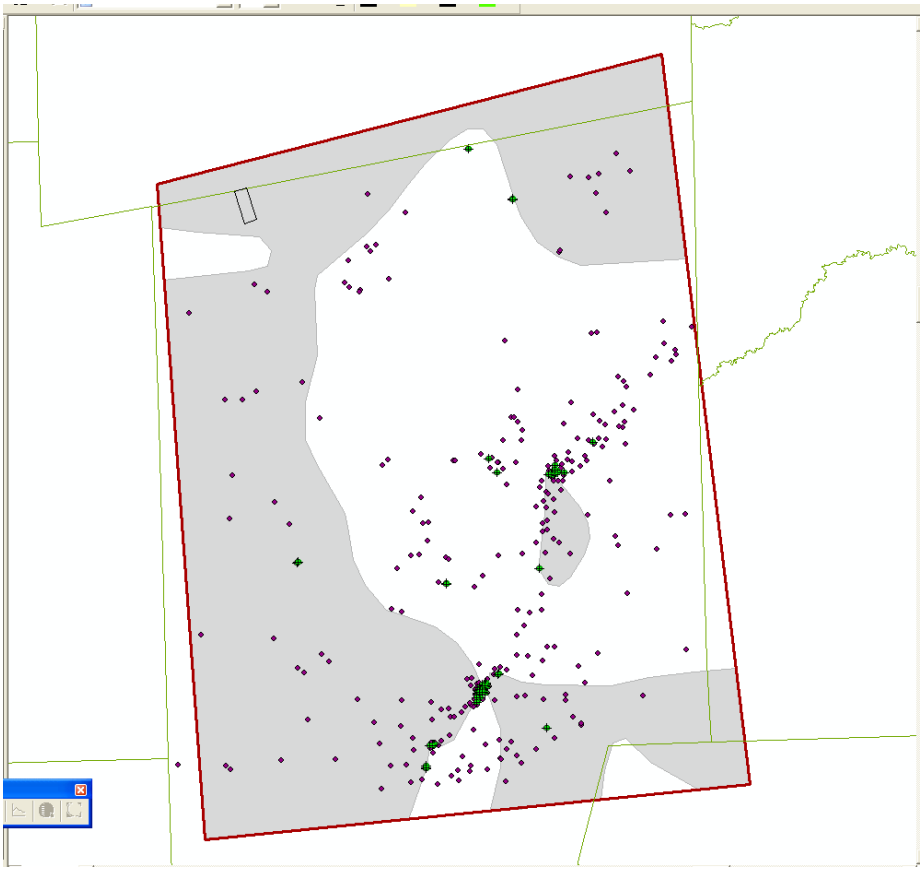
[FIGURE 14]

IV. Conclusion

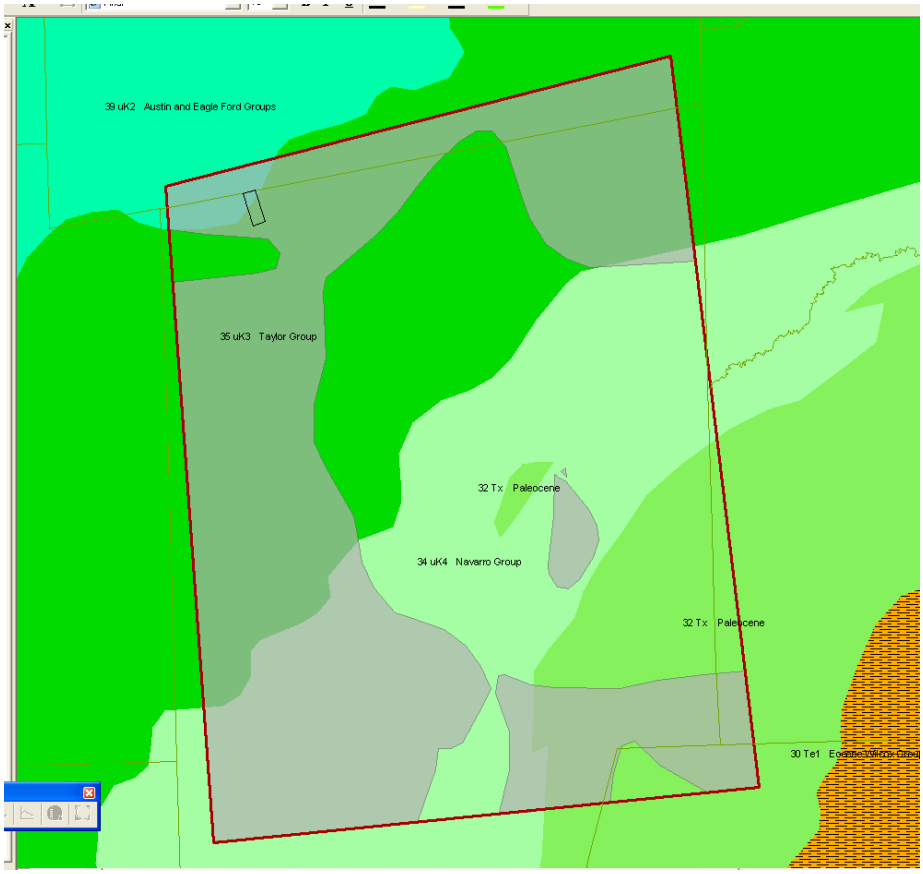
The finished map shows a good correlation with the given wells. The areas defined to have oil and/or gas are where actual producing wells are found. The “Possible Zones for Fossil Fuels in Hunt County, Texas” map that was created shows this. Because Wickman Farms lies in the No Oil or Gas Zone, it can be concluded that there is not likely any oil or gas under the property. Because my map shows such a large Oil/Gas Zone I can understand why there are so many wells drilled in the area, but this does not explain why so many of them are dry. This relationship is shown in FIGURE 15.

The other map created, “A Map of the Base of the Trap Rock in Hunt County, Texas”, shows the relationship between the base of the trap rock and the Oil and Gas Zones.

It is interesting to note that in the middle of the map there is a No Oil or Gas Zone. In the geology of the area shown in FIGURE 2 there is the cropping out of an older rock layer in the middle of a younger rock layer. Because the cropping out and the No Oil or Gas Zone are almost right on top of each other, I can postulate that the rock that is cropping out (Paleocene) is possibly the reservoir rock, and that the rock layer above it (Navarro Group) is the trap rock. This relationship is shown in FIUGRE 16.



[FIGURE 15]


39 uK2 Austin and Eagle Ford Groups
35 uK3 Taylor Group
32 Tx Paleocene
34 uK4 Navarro Group
32 Tx Paleocene
[FIGURE 16]

A Surface Map of the Base of the Trap Rock in Hunt County, Texas

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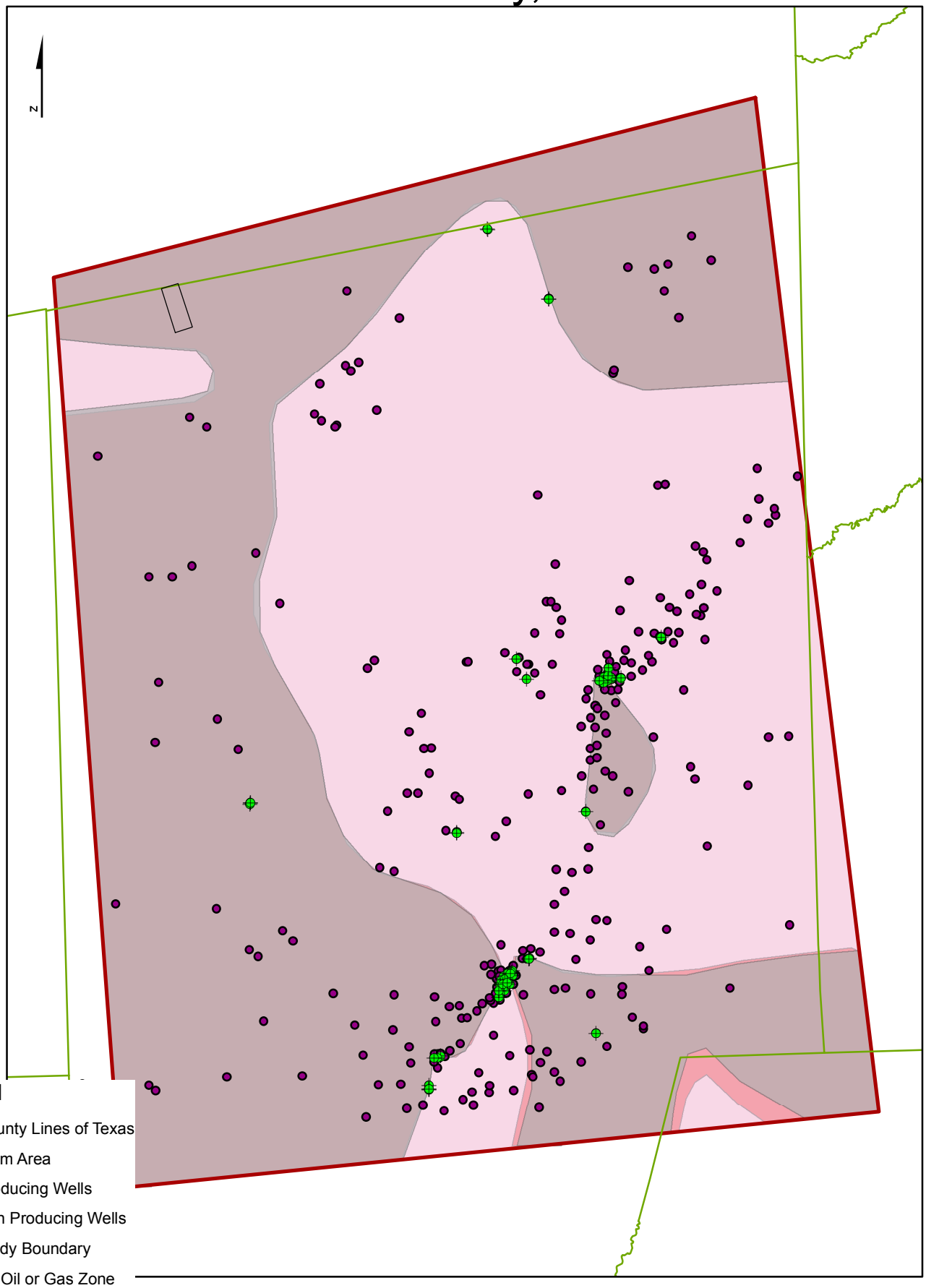
12/06/09

A Map of Possible Zones for Fossil Fuels in Hunt County, Texas



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