

Coal Mine Locations and Potential Watershed Interactions in Texas

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GEO 327G
Fall 2013

Problem

Strip mining for coal has a profound impact on the hydrology of a region. Active coal mines in Texas pose a threat to the health of our regional watersheds. Byproducts of mining, such as acid mine drainage, could potentially contaminate municipal water sources and be carried all the way to the Gulf of Mexico. Could a map be created that would show active coal mine locations in Texas and their possible interactions with nearby drainage areas?

Goal

The goal was to compile data on mine locations and watershed areas in Texas in order to create a map using GIS techniques. The map will show how close the active mine locations are to major rivers and drainage areas that run to the Gulf of Mexico.

Data

There is not currently an easily accessible map of coal mine locations in Texas. The exact mine addresses were also difficult to find, and in some instances I had to estimate the approximate locations.

I found a comprehensive list of Texas coal mines from the U.S. Department of Labor's Mine Safety and Health Administration (MSHA) database:

<http://www.msha.gov/drs/asp/extendedsearch/minesbystatecommodity.asp>

Oftentimes, the address listed in the MSHA website for the mines was the office location, and not the actual mining location. I used a combination of websites to determine the exact location of the mine. If the mine had a website, then sometimes the address could be found that way. The majority of the time I used the site mines.findthedata.org and used the "Mine Location" directions and the map. Since usually an exact address wasn't given, I compared the location on that map to a map on <http://www.gps-coordinates.net> to find the GPS coordinates of the mine location. I then input all of these GPS coordinates into Google Earth to create a comprehensive map of all the active mine locations I found. I did not include the abandoned mines listed on MSHA because the majority of those mines had been filled, and an exact mine location could not be found.

The shapefiles for Major River Basins, Major Rivers, Hydrologic Unit Code (HUC watersheds), and Texas Hillshade were downloaded from the Texas Water Development Board:

<http://www.twdb.state.tx.us/mapping/gisdata.asp>

Method

Once I had found all of the approximate mine locations, I mapped them all using Google Earth (Figure 1). I saved this map as a .kml file.



Figure 1. Mine locations mapped using Google Earth

I opened a blank document in ArcMap and I imported the Texas River Basins, Texas Major Rivers, HUC Watersheds, and Hillshade shapefiles that I had downloaded from the Texas Water Development Board. I checked that all files were projected in the same coordinate system as the Hillshade (North_American_1983_Lambert_Conformal_Conic). If not, I used the Batch Project (ArcToolbox>Data Management tools>Projections and Transformations>Feature>Batch Project) tool to change the coordinate system for all of the ones that were different. Once I turned the annotations off for the basins, made the basins_dd hollow, and turned off the display for Named_SubBasins_dd (it was a duplicate of the information found in the HUC Watersheds shapefile), my map looked like the one in Figure 2.

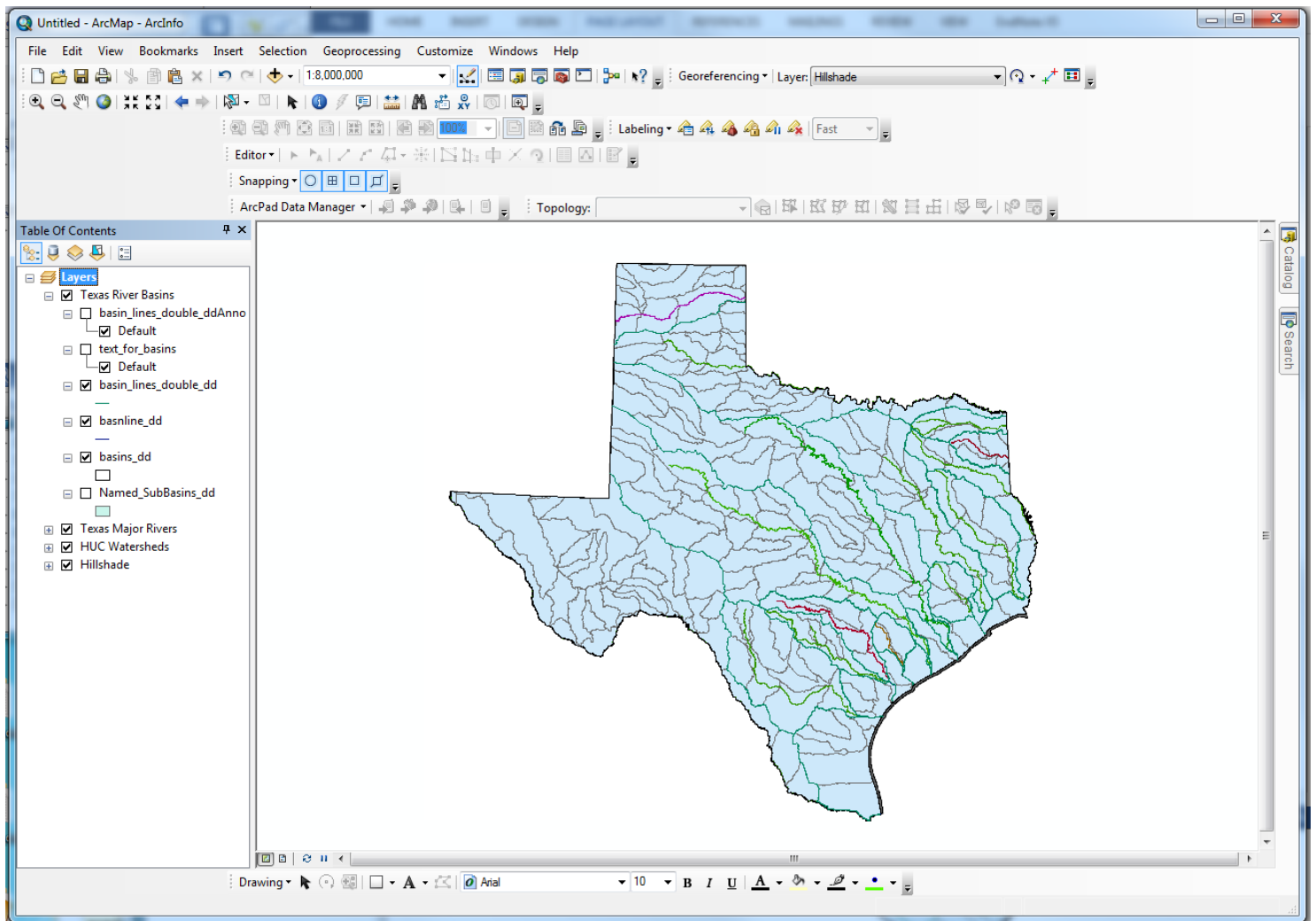


Figure 2. Initial map after uploading shapefiles

The Hillshade can't be seen on this map, so I changed the transparency of the HUC Watersheds to 50% (right click on HUC Watersheds in Table of Contents>Properties>Display>Transparency), and I changed the fill color to light gray. The rivers are all different colors in this map, so I changed them to a uniform symbol that is standard for water bodies. The basin_lines_double_dd layer in Texas River Basins represents the lines of drainage to the Gulf, I changed the symbol for this layer to be a blue that is darker than the Texas Major Rivers (Figure 3).

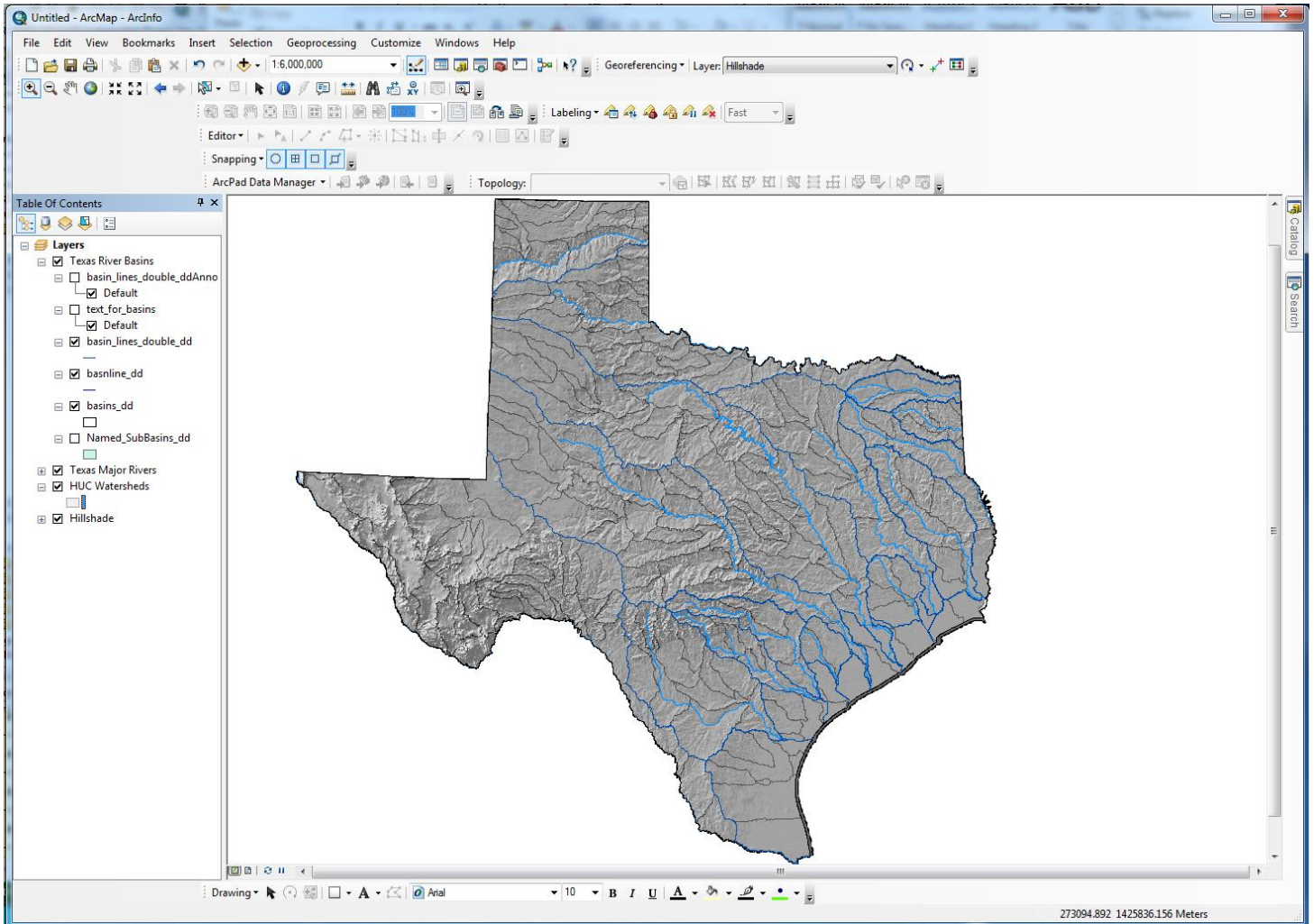


Figure 3. Map after changes to symbology

The next step is to import the mine locations from the Google Earth .kml file. To import the file I opened ArcToolbox, and chose Conversion Tools>From KML>KML To Layer. I chose the input file, output location, and name for the new layer (Figure 4). The 19 active mines are now displayed on the map, and the mine names can be found in the attribute table (Figure 5).

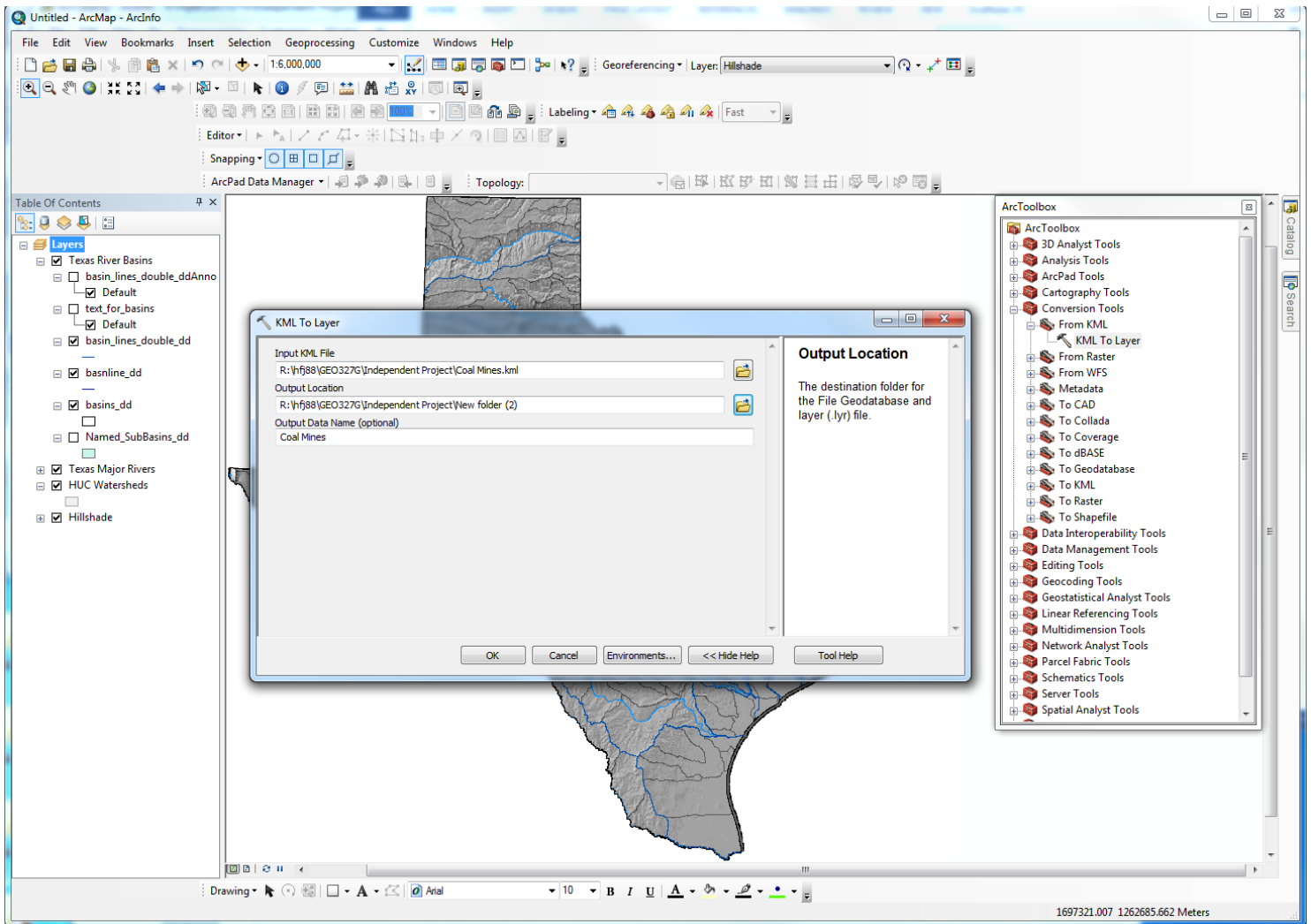


Figure 4. Using the “KML to Layer” tool to import mine locations

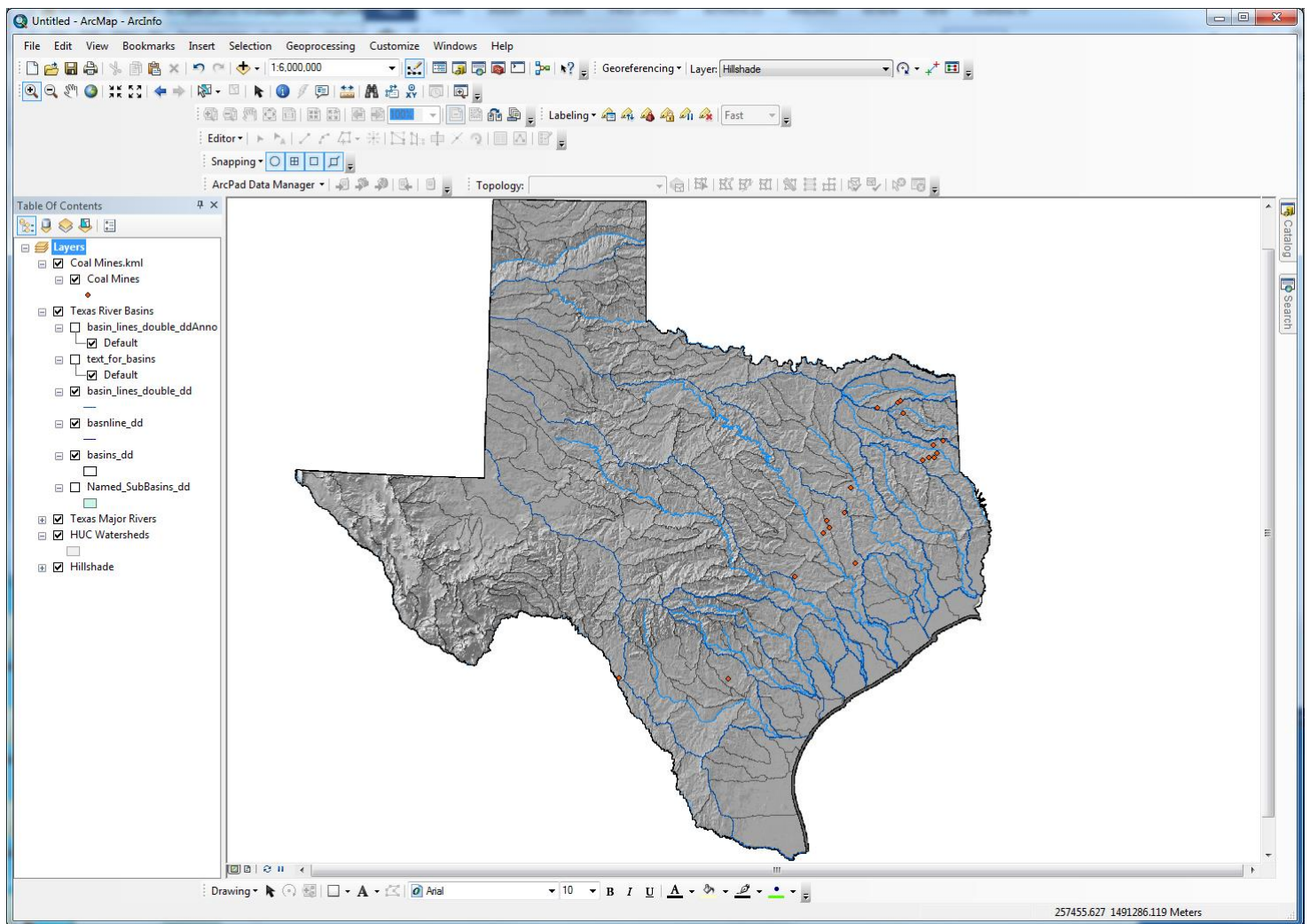


Figure 5. Coal mines added to the map

The coal mine locations need to be projected using the coordinate system used in the data frame (North_American_1983_Lambert_Conformal_Conic). To do this I used the Project tool (ArcToolbox>Data Management Tools>Projections and Transformations>Feature>Project). A new feature class (Coal Mines_Project) shows up in the Table of Contents.

I wanted to be able to easily identify which coal mines were the closest to the drainage basin lines that extend to the Gulf (basin_lines_double_dd). In order to find out how close the mines were to these drainage basins, I used the Select by Location window. I selected Coal Mines_Project as my target layer and basin_lines_double_dd as my source layer. For the spatial selection method I chose "target layer features are within a distance of the source layer feature." I then applied a search distance, and the mines that fell within that distance of the drainage basin lines would show up on the map highlighted blue (Figure 6). I then grouped those features together and created a symbol class under the Coal Mines_Project properties window, under the Symbology tab. I chose a color ramp that would show the mines within one mile of a drainage basin line to be red, and the mines farthest away from the drainage basin lines to be dark green.

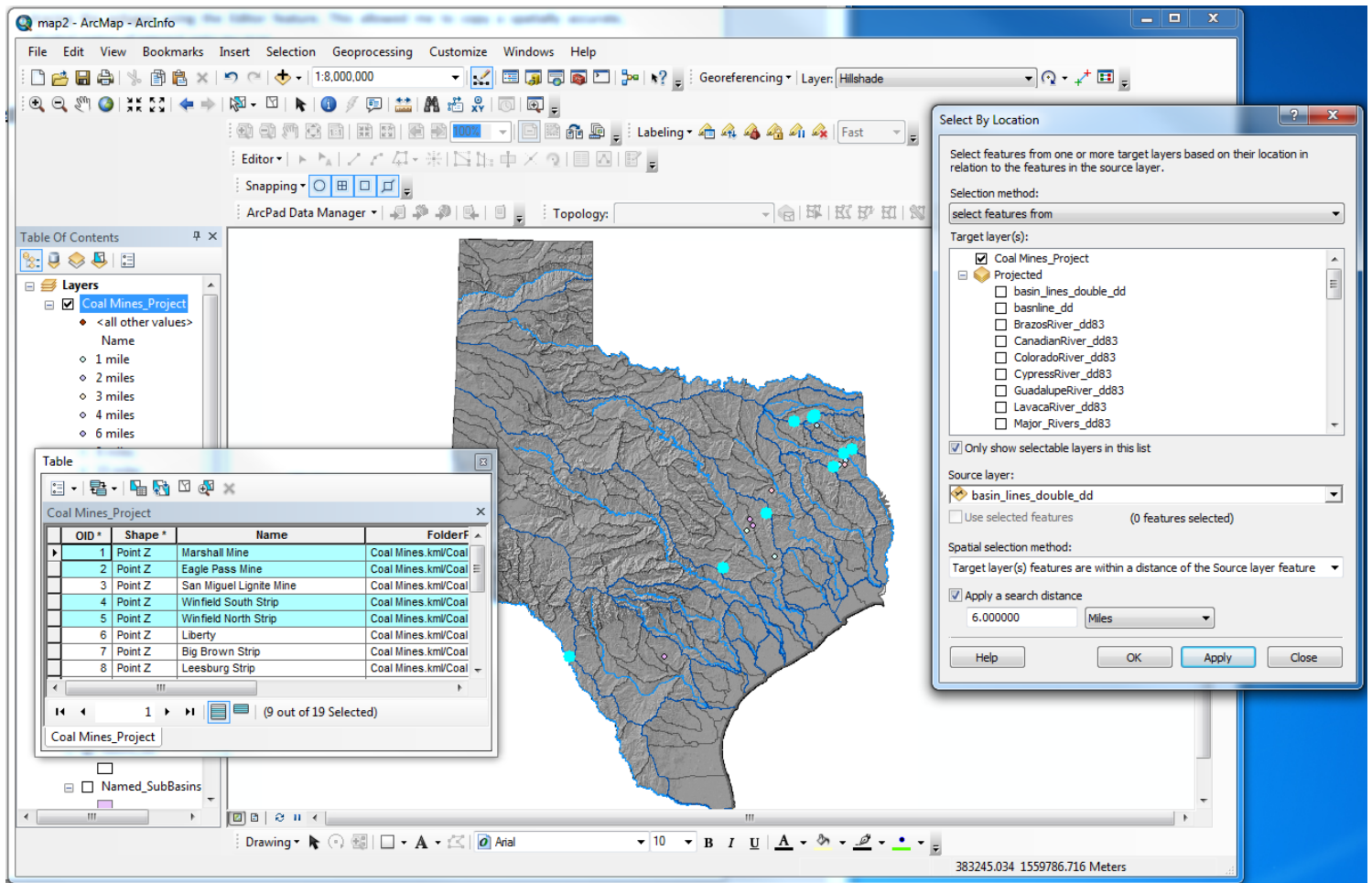


Figure 6. Highlighted mines found using Select by Location window

The map now shows all 19 of the active coal mine locations in Texas, and they are color coded according to their distance from a drainage basin line. I have added text to label the two mines that are within one mile of a drainage basin, as those are the most likely to contaminate the surface waters (see final map).

Conclusion

ArcMap allowed me to create a map that provides easy visualization of the distances of active coal mines in Texas to major drainage areas. The map showed that the majority of the mines are close to drainage areas, with only four of the mines being greater than 20 miles away from one. The runoff from precipitation events at the mine could easily carry contaminants produced by mining into the drainage basins and eventually into the Gulf, and this map provides an easy way to see which mines are at the greatest risk of producing surface water contamination.

Coal Mine Locations in Relation to Drainage Areas in Texas

Explanation

- Drainage Basin Line
- Major Rivers
- HUC Watersheds

Coal Mines

Distance from Drainage Basin

- 1 mile
- 2 miles
- 3 miles
- 4 miles
- 6 miles
- 8 miles
- 15 miles
- 20 miles
- 25 miles
- 35 miles

