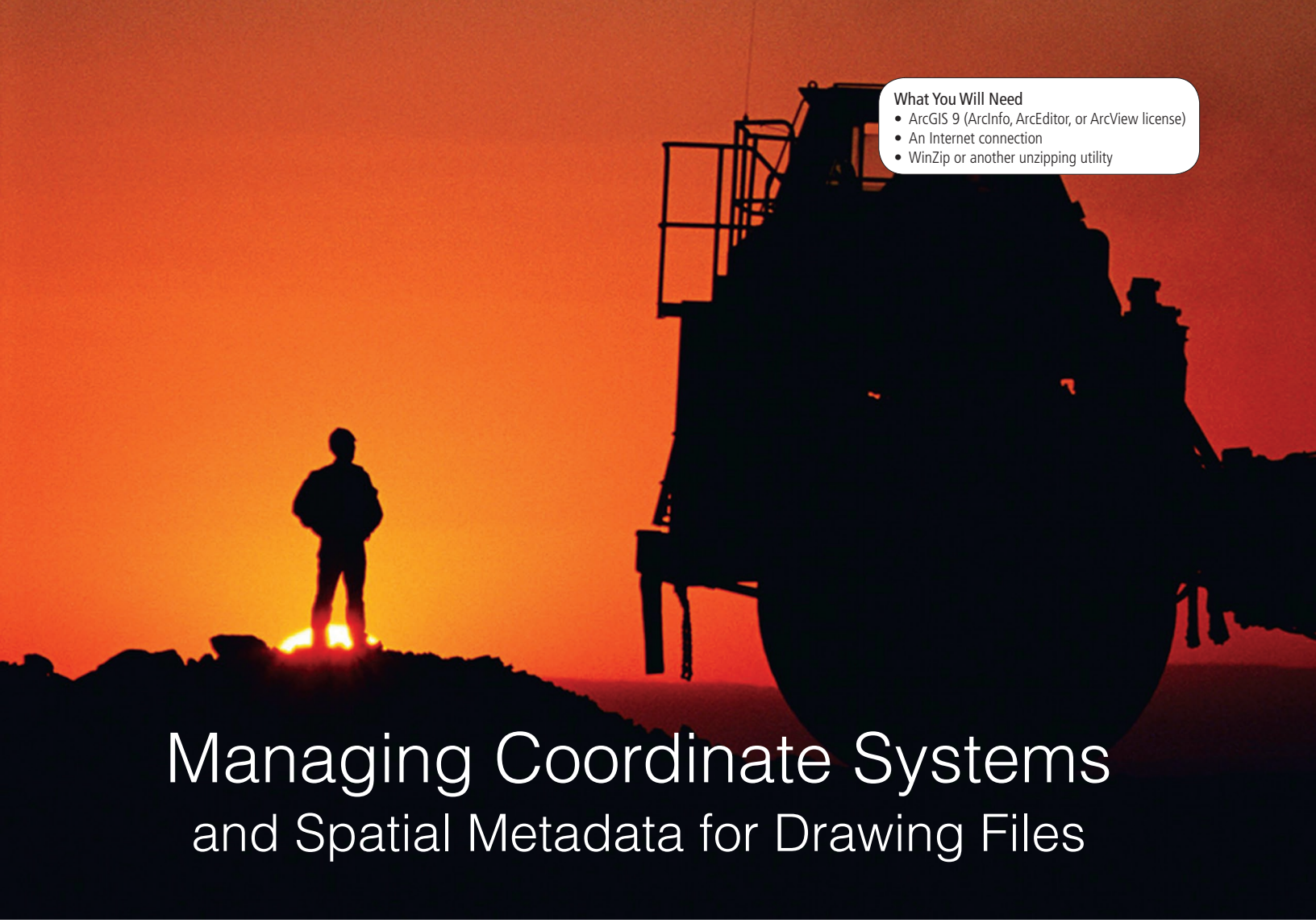


What You Will Need
- ArcGIS 9 (ArcInfo, ArcEditor, or ArcView license)
- An Internet connection
- WinZip or another unzipping utility

Managing Coordinate Systems
and Spatial Metadata for Drawing Files

By Mike Price, Entrada/San Juan, Inc.

To display CAD data on the fly correctly in ArcMap, appropriate projection data must be associated with a CAD file. This tutorial describes a quick procedure for associating projection data with CAD files that works with AutoCAD DWG and DXF files as well as Microstation DGN files. This method is easier than creating a World file. Basic familiarity with ArcGIS Desktop is assumed.

Getting Started

Visit the *ArcUser Online* Web site (www.esri.com/arcuser) to download the archived file containing the sample dataset for this exercise. Use WinZip or a similar utility to extract the files and allow the program to create subdirectories. The archive should create the directory structure shown in Figure 1. Storing projected data in dedicated, named folders is both helpful and important to an organized workflow.

Verify that DWGFiles\Unknown directory contains CoalMine.dwg and three ArcView 3 legend files (cad_x.avl, cad_l.avl, and cad_p.avl). The SHPFiles\MTSP83_M directory should contain Big Horn County Ownership - 22cad.lyr. A single projection (PRJ) file, MTSP27SF.prj, should be in the Utility folder. A PRJ is a simple text file that contains parameters for a coordinate system.

In this exercise, a CAD drawing of a Montana coal mine with an unknown coordinate system will be combined with other GIS data in a summary map in Montana State Plane North American Datum 1983 (NAD83) Single Zone Meters. The CAD drawing shows a large coal mine located approximately 25 miles east of the community of Hardin in Big Horn County, Montana. It was created in a recent version of AutoCAD. The projection, datum, and units are not specified but are probably standard.

Comparing the drawing with a large-scale cadastral reference in a known coordinate system will help determine the coordinate system for the coal mine drawing. This exercise will use reference data from the Montana Natural Resources Information System (NRIS).

NRIS (nris.state.mt.us/) hosts high-quality parcel-level data for all Montana counties. NRIS, in cooperation with the Cadastral Mapping Project and the Montana Department of Revenue, posts limited computer-assisted mass appraisal (CAMA) data in shapefile format for use by GIS professionals. This large-scale parcel data, in Montana State Plane NAD83 Single Zone Meters, is accurate and provides a great backdrop for registering Montana CAD drawings.

Obtaining Reference Data

Download the cadastral files for this exercise by going to nris.mt.gov/nsdi/cadastral/ and selecting Big Horn County (county 22). Save the zipped file to the SHPFiles\MTSP83_M directory. Unzip the archive and store the files in the same folder.

1. Start an ArcMap session and open a new map document.

2. Load Big Horn County Ownership - 22cad.lyr from \CoalMine\SHPFiles\MTSP83_M into the empty data frame.

3. If an exclamation point is displayed next to the Layer file in the Table of Contents, this means the file cannot locate its reference dataset (i.e., 22cad.shp). Right-click on the Layer frame in the Table of Contents and choose Data > Set Data Source and select 22cad.shp. Right-click on the Data Frame label and verify that the coordinate system is set to Montana State Plane NAD83 Single Zone Meters.

4. Save the project as CoalMine1 in the CoalMine folder.

5. Load the CoalMine drawing file from the DWGFiles\Unknown folder. Use the CAD drawing item (i.e., select the white icon) rather than the CAD feature dataset item. A warning box may indicate that this drawing has an unknown spatial reference. Click OK and allow the drawing to load. Click on the Zoom to Full Extent button. The CAD drawing displays as a small object far to the right of the Big Horn County CAMA data.

6. Right-click on the CAD layer and choose Zoom to Layer. Zoom in closely to one of the gravel roads and measure the road width and cadastral boundaries. Save the project again.

Determining the Correct Coordinate System

The roads are typically 40 to 70 units wide. Notice that this drawing is behaving as though it were constructed in U.S. Survey Feet rather than meters. This is an important observation. If measurements are being returned in feet, perhaps the drawing is already in State Plane.

1. Change the Data Frame units from Meters to US Feet by right-clicking on the Data Frame to open Data Frame Properties. Click on the Coordinate Systems tab.

2. Click the Modify button. Change Linear Units from Meters to Foot_US, but keep the coordinate system as NAD_1983_StatePlane_Montana_FIPS_2500. Click OK twice and zoom to full extent.

While Montana has only one NAD83 zone, it has three NAD27 zones—North, Central, and South. Big Horn County is just north of the Wyoming state line and is in NAD_1927_StatePlane_Montana_South_FIPS_2503.

3. Specify a new coordinate system by opening the Data Frame properties and clicking on the Coordinate System tab.

4. Choose Predefined > Projected Coordinate System > NAD_1927_StatePlane_Montana_South_FIPS_2503. Units should default to Feet. Click OK. The data for the northeast quarter of Big Horn County will be rendered, and the drawing file will now appear inside the county.

5. Zoom the display in and look at the alignment of the black fence lines and parcel boundaries. These features are near each other indicating that the drawing is now properly placed and that it was built in NAD_1927_StatePlane_Montana_South with US Survey Feet as the unit of measure.

6. Save the project and close ArcMap. In the DWGFiles directory, use Windows Explorer to rename the Unknown folder to MTSP27SF.

Creating and Managing CAD Projection Metadata

ArcCatalog can create metadata for a CAD file. Open an ArcCatalog session and preview the CAD and CAMA data but ***do not*** click on the Metadata tab. Verify that the Unknown folder in the DWGFiles directory has been renamed MTSP27SF.

Open the ArcCatalog Help and type the phrase "cad prj" on the Search tab. See the entry for Defining a Coordinate System for CAD Data. It lists several methods for defining and managing CAD projection information. The innovative method used in this exercise was developed to build metadata and projection information for CAD data in standard projections.

The secret is the shapefile PRJ file. As described in the help entry, the coordinate system parameters in a shapefile PRJ file can be associated with a CAD drawing if the PRJ file resides in the same folder as the CAD data file and has the same file prefix as the CAD file. By default, when a CAD file (or any file) is opened for the first time on the Metadata tab, ArcCatalog writes data properties in a metadata file that is saved as an XML file. While gathering properties about the data, ArcCatalog searches for a projection file with the same prefix. If it finds one, it associates the PRJ file with the drawing file.

When working with CAD data, always inspect and verify the CAD coordinate system metadata. If it is incorrect, edit it or rebuild the metadata by deleting the XML metadata file, associating the proper projection file, and opening the CAD drawing on the Metadata tab so a new metadata file will be generated.

1. Use the shapefile projection file provided in the sample data to register the CAD drawing. Copy MTSP27SF.prj from the Utility directory. Paste it into the DWGFiles\MTSP27SF directory, and rename the copy of the PRJ from MTSP27SF.prj to CoalMine.prj.

2. ***Now*** select the CoalMine Drawing View (white icon) from the ArcCatalog directory tree.

3. Open the Metadata tab for CoalMine.dwg and select the Spatial tab. Click Details to view the projection information. This should now read NAD_27_StatePlane_Montana_South_FIPS_2503.

4. Click on the Description tab and notice that some information must still be manually added. ArcCatalog reads some data properties and automatically adds and updates this information. Documentation such as keywords must be added by the user. Click on the Attributes tab and verify the field types and sizes for the fields of each entity type (i.e., point, polyline, and polygon).

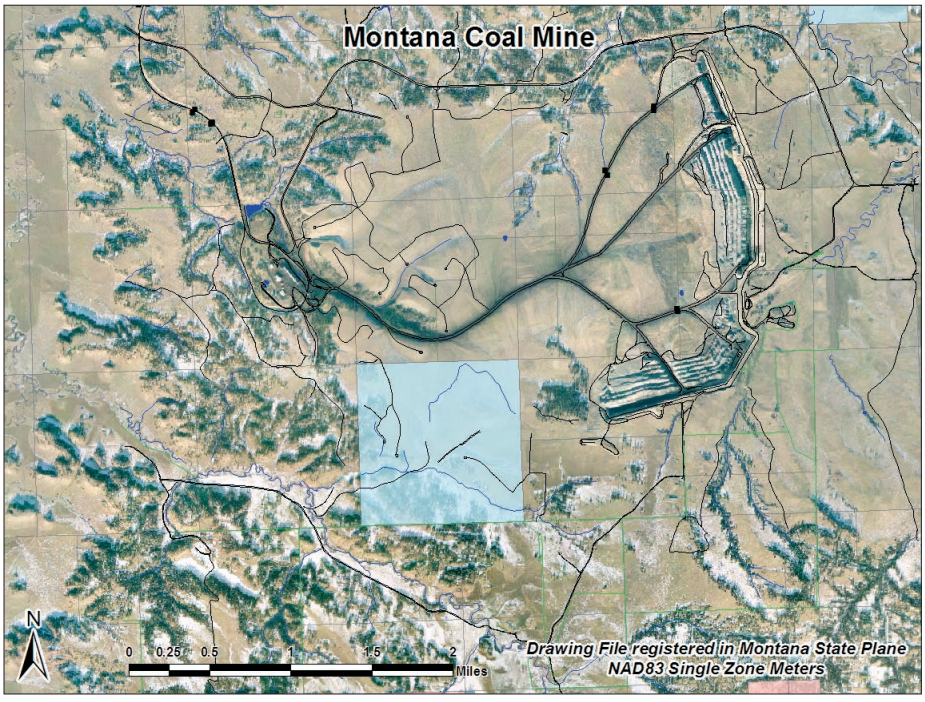
If the correct projection information is not displayed in the Metadata tab, close ArcCatalog, navigate to the DWGFiles\MTSP27SF folder using Windows Explorer, and delete the CoalMine.dwg.xml file. Verify that the MTSP27SF.prj file was copied to the DWGFiles\MTSP27SF directory and renamed CoalMine.prj. Close and reopen ArcCatalog and click on CoalMine.dwg and the Metadata tab to re-create the metadata.

Return to ArcMap

Now that the appropriate projection information has been associated with the CAD drawing, add it and the ownership data to a new map document.

1. Restart ArcMap and load Big Horn County Ownership - 22cad.lyr into a new map document. Verify that the Data Frame coordinate system is set to NAD_83_StatePlane_Montana_FIPS_2500.

2. Load the CAD drawing file by selecting the Data View (blue) icon and add each data type



This tutorial shows an easy procedure for associating projection data with CAD files that works with AutoCAD DWG and DXF files and Microstation DGN files.

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(points, polylines, polygons, annotation, and multipath). Ignore the warning that the CAD data has a different coordinate system than other map data. The CAD data will be managed by the projection file. It appears in the northeast portion of Big Horn County, the same place it displayed when the Data Frame coordinate system was set to NAD_27_StatePlane_Montana_South_FIPS_2503.

3. Right-click on one of the CAD layers and select Zoom to Layer.

4. Import ArcView 3 legends for the CAD layers. Right-click the CAD point layer in the ArcMap Table of Contents and choose Properties. In the Layer Properties dialog box, click on the Symbology tab and click the Import button.

5. In the Import Symbology dialog box, click the radio button next to the Import symbology definition from an ArcView 3 legend file (*.avl). Navigate to cad_x.avl and select it. Click OK. In the Import Symbology Matching dialog box, choose Layer for the Value Field.

6. Repeat the process for the CAD polyline layer, choosing cad_1.avl, and CAD polygon layer, choosing cad_p.avl.

7. Inspect all CAD entity types. Close study of the fences, shown as green lines, reveals that fence lines and parcel boundaries match closely.

8. Now, inspect the map. Notice that surface rights in the mine area are a mix of private and state ownership. Westmoreland Resources, Inc., one of the top coal producers in the United States, supplied the CAD drawing used in this exercise. Locate the property owned by Westmoreland by choosing Select > Select by Attributes. In the Select by Attributes dialog box, choose Big Horn County Ownership - 22cad as the Layer and create in the query "OWNR_NAM1" LIKE 'WESTMORELAND %'.

9. Finally, right-click on the Data Frame, choose Properties, and click on the General tab. Rename the Data Frame MT State Plane NAD83 Single Zone Meters and save the project as CoalMine1 to overwrite the previous map document.

Conclusion

This exercise shows how a shapefile projection file (PRJ file) can be used to define the coordinate system for a CAD drawing. Determining the coordinate system of a CAD drawing is often tricky. If possible, contact the data provider and request the necessary information. If registration information is not available, a bit of detective work is required to identify the correct coordinate system. Once this is known, create or borrow the proper projection file, copy it into the CAD directory, and rename the file with the same prefix as the CAD file using the short file naming convention (i.e., eight-character file name with a three-character file extension).

After the correct projection file is associated with the drawing file, it can be loaded into a Data Frame with a specified coordinate system.

Once a CAD drawing layer has been displayed in a new coordinate system, it can be exported with the Data Frame's coordinate system. This procedure works with AutoCAD DWG and DXF files, as well as Microstation DGN files. Using this technique to supply existing CAD files with correct metadata will allow drawing files to project on the fly. Unfortunately, this technique will not work with some drawings. For these drawings, the old fashioned CAD world file might still be the best way to go. Using these techniques, the CAD drawing shared with associates can include full CAD metadata and a projection file.

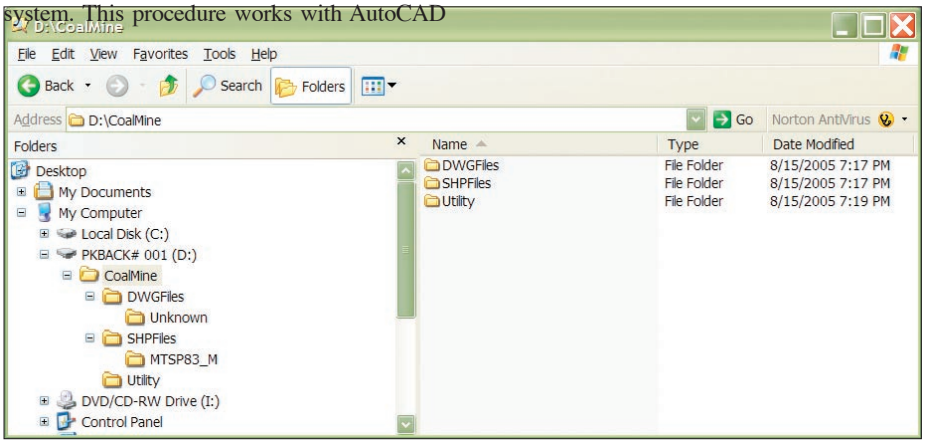
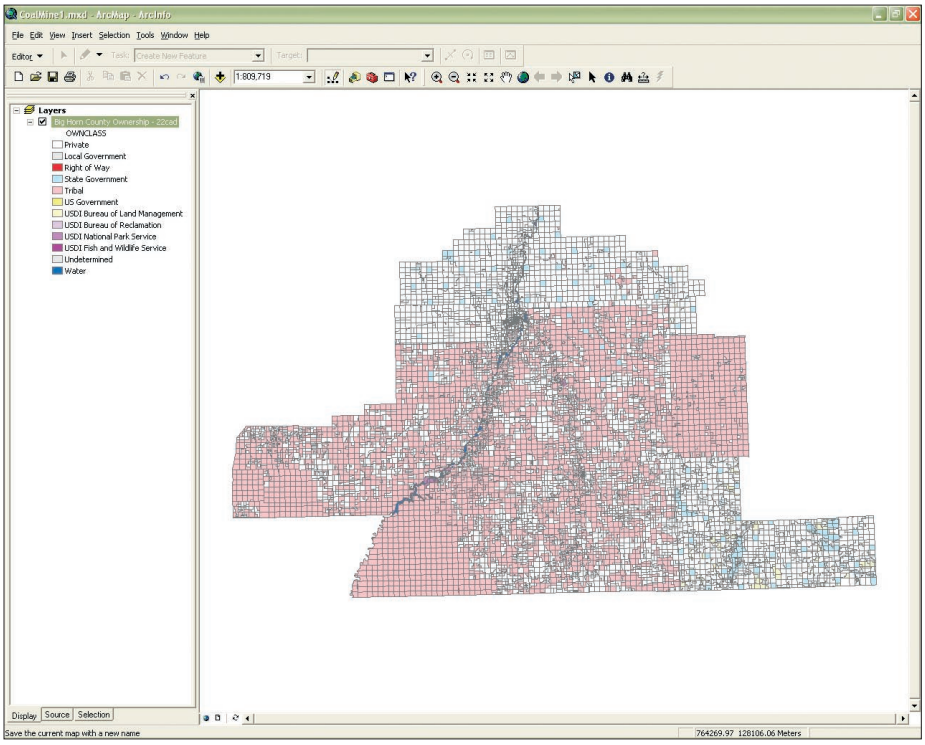
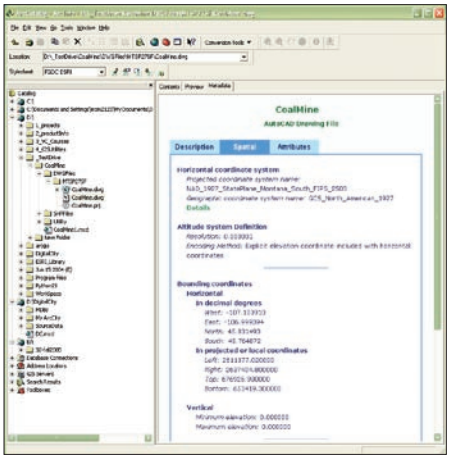


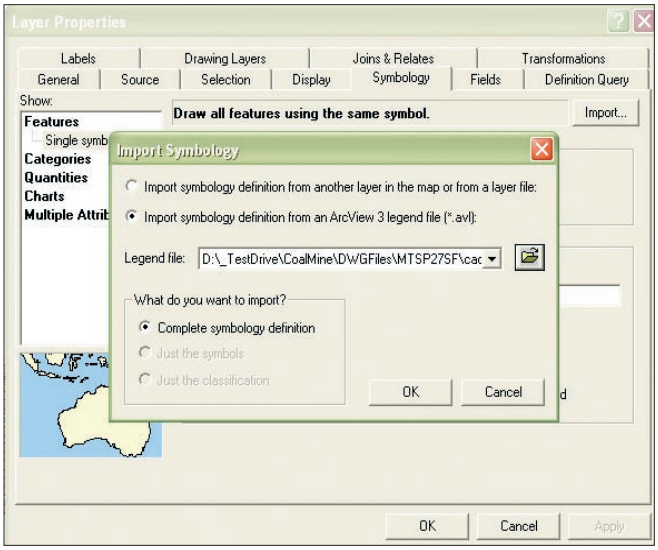
Figure 1: Storing projected data in dedicated, named folders is important to an organized workflow. The unzipped sample data archive should create this directory structure.



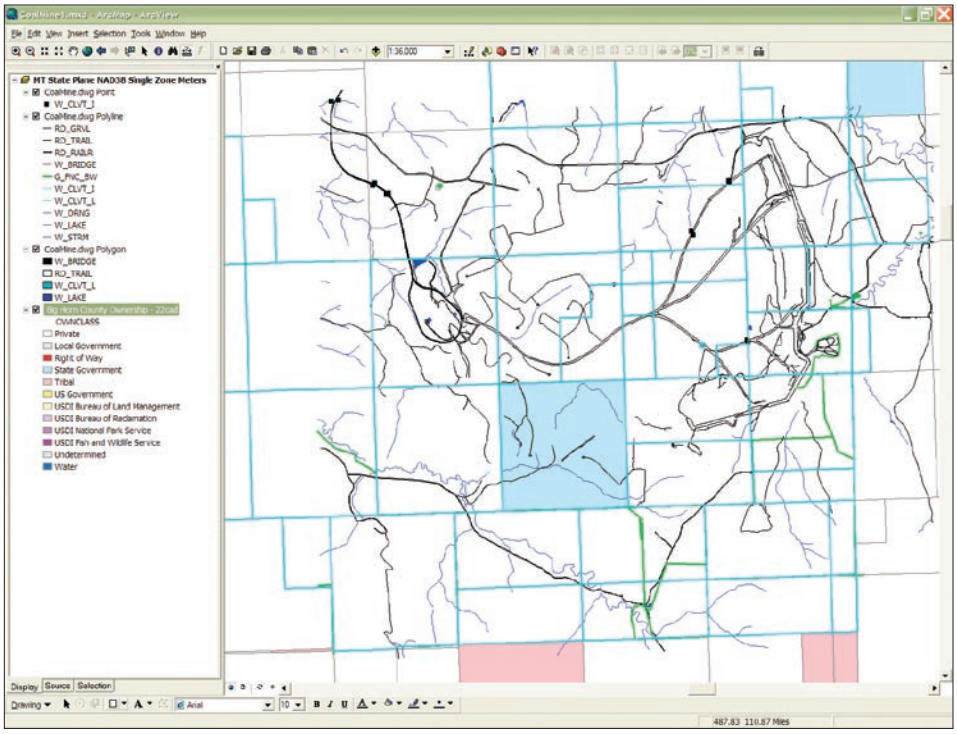
A large-scale cadastral reference in a known coordinate system, such as the CAMA data shown above, can help determine the coordinate system for CAD data in an unknown coordinate system.

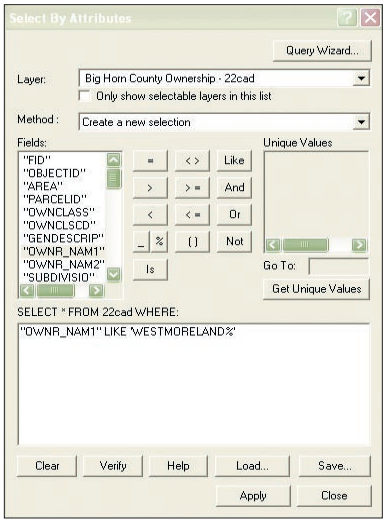


After copying the PRJ file and renaming it, open the Metadata tab for CoalMine.dwg and view the Spatial tab to verify that the projection information has been associated.



From the Layer Properties dialog box, import ArcView 3 legends to symbolize the CAD point, polyline, and polygon layers.





Choose Select by Attributes and query Big Horn County Ownership - 22cad.lyr for Westmoreland's landholdings.

Acknowledgments

The author thanks the Office of Surface Mining's Western Region Technical Team and the Montana Department of Environmental Quality's Coal Program for their continued efforts to implement and support the best management practices at surface coal mines in Montana and other western states. Thanks also go to Westmoreland Resources, Inc., and the staff at the Absaloka Coal Mine for allowing the use of a portion of a CAD drawing of a recent mine site that was derived from aerial photogrammetry.

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