

Lesson 3:

Two-Dimensional Modeling

Lesson Goal: Load data converted from DLG-O to DXF format into ArcView GIS and display, edit, and thematically map it.

What You Will Need: A Pentium class PC with 32 MB of RAM (minimum) and 100 MB of free hard drive space, ArcView GIS 3.1 or higher and WinZip or an equivalent program, and an Internet connection.

Data and/or Utilities: The DXF Conversion Utility from the *ArcUser Online* Web site.



This lesson models data from a portion of the Grand Canyon.

This lesson expands on the techniques used in the previous lesson. Data from the Bright Angel Creek area in the Grand Canyon will be converted from digital line graph, optional format (DLG-O) data to Drawing Exchange Format (DXF) format data and loaded into ArcView GIS. This data, describing hypsography (or contours), hydrography, roads, railroads, public lands, and boundaries, will be classified and thematically displayed.

The data development and modeling procedures presented here will work with most 1:100,000 DLG-O USGS data for the continental United States once these data are converted to a DXF format.

A few words about hardware requirements would be in order before beginning to work on this model. A Pentium class PC with 32 MB of RAM and 100 MB of free hard drive space are the base system requirements to comfortably perform the operations described in this article. Though completed two-dimensional models take up between 20 MB and 50 MB, additional space is required to store the downloaded DLG-O files while these files are converted and the resultant DXF files are verified.

Locating and Preparing the Data

Go to the EROS Web site (edc.usgs.gov/), choose "FTP by Graphic" and click on the map within northern Arizona. Select the Grand Canyon quadrangle (GC4), then select Grand Canyon East. The North and South Bright Angel trails and Phantom Ranch are located in Tile 8 in the southeastern 15' division. It is helpful to refer to a paper copy of the Grand Canyon 1:100,000 quadrangle to familiarize yourself with the terrain to be modeled.

Within GC4 Tile 8, data are available in six categories. The recommended data sets are listed in Table 1 followed by the suggested shortened name to assign to each zipped type when downloading.

Before downloading, create a project directory called GC4FILES to receive the files, then download the six data sets, shortening names as indicated above. The hypsography set is rather large, so be patient. After downloading, use WinZip or another utility to extract each DLG-O file. Remember to append the DLG extension to each file as it is extracted.

Next, use DLGLX155.exe, a DOS freeware utility,

Table 1

Data Category	Data Description	Long GZ File Name	Short GZ File Name
Boundaries (bdf)	Political Boundaries	GC4.BDF08.opt.gz	GC4BDF08.gz
Hydrography (hyf)	Lakes, Rivers, Streams	GC4.HPF08.opt.gz	GC4HPF08.gz
Hypsography (hpf)	Contour Lines	GC4.HYF08.opt.gz	GC4HYF08.gz
Public_lands (plf)	Section Lines	GC4.PLF08.opt.gz	GC4PLF08.gz
Transportation (rdf)	Roads	GC4.RDF08.opt.gz	GC4RDF08.gz

to convert the unzipped DLG-O files to DXF files in version 12 format. This utility may be used interactively or in batch mode. Refer to the previous lesson for detailed information on using this utility. If using this utility in batch mode, the first line of a batch file to convert DLG-O files to DXF format should read

DLGLX155 /header=12 /no=lines /type=o GC4bdf08.dlgGC4bdf08.dxf0.

Copy this line five more times and edit file names to process each data set. Unzipped DLG-O files and converted DXF files are listed in Figure 2 with the size of each DXF file. Call up a directory of the files in your project directory to check the file sizes. Six DXF files identical or very close in size to the files shown in Figure 2 should have been created by this process. The new DXF files should reside in the same directory as the DLG and GZ files. Once the files are converted to DXF, they may be read directly into ArcView GIS with the CAD Reader extension. If disk space is short, you may delete GZ and DLG files after verifying that all DXF files were properly converted.

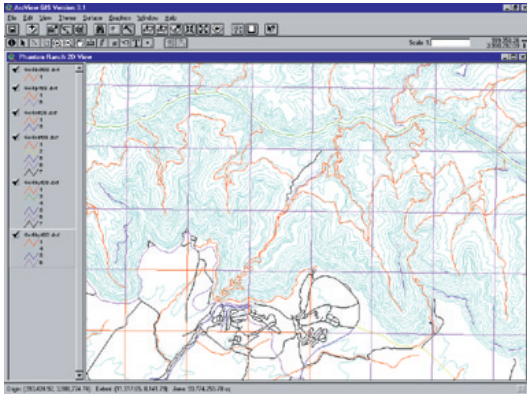
Table 2

Data Description	Suggested DLG File	Suggested DXF File	DXF File Size
Political Boundaries	GC4BDF08.DLG	GC4BDF08.DXF	10,197
Lakes, Rivers, Streams	GC4HPF08.DLG	GC4HPF08.DXF	462,427
Contour Lines	GC4HYF08.DLG	GC4HYF08.DXF	13,371,259
Section Lines	GC4PLF08.DLG	GC4PLF08.DXF	142,730
Roads	GC4RDF08.DLG	GC4RDF08.DXF	381,520
Railroads	GC4RRF08.DLG	GC4RRF08.DXF	15,740

Loading and Editing Two-Dimensional Data

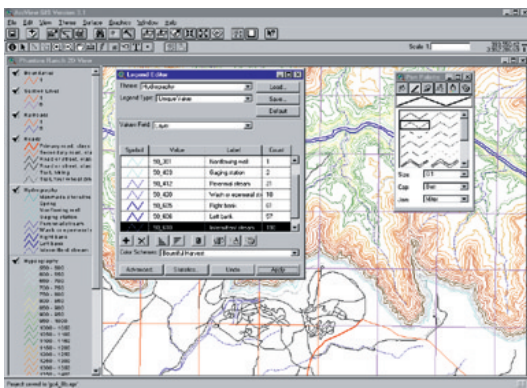
1. Begin an ArcView GIS session and set the working directory to the drive and directory where the Grand Canyon DXF files are stored. Be sure to load the CAD Reader extension by choosing File, then Extensions from the menu, and then checking the box for CAD Reader. Open a new view and select Properties from the View menu. In the dialog box that appears set Map Units to meters and Distance Units to miles or kilometers.
2. Click on the Add Themes button. With CAD Reader active, the six DXF files located in a file folder will be visible. Click on a folder to open it and note that there are four data types inside: lines, points, polygons, and annotation. The line data are the only data type needed for modeling. Double clicking on a DXF folder without opening it automatically loads the line set. Load all six data sets and arrange them in the legend window with boundaries on top, followed by public lands, railroads, roads, hydrology, and hypsography.
3. Turn each theme on, starting from the bottom, and watch the map draw. Notice that the layers are automatically displayed in the legend as solid lines and bright colors with a number value.

By default, CAD Reader applies the AutoCAD pen colors to the legend.



By default, CAD Reader applies the AutoCAD pen colors to the legend when DXF data is loaded.

4. Double click on each theme in the legend to open the Legend Editor. Under Legend Type choose Unique Value and in the drop-down box next to Values Field, select Layer. One or more brief alphanumeric codes will appear in the Value column of the grid. These codes can be joined to a lookup table to better explain the data types. Notice that there is a value at the bottom of the Value column that repeats the name of the original DXF file.
5. Apply a distinctive color scheme, such as Minerals, from the selections under Color Ramps. After modifying the legend for each theme, exit the Legend Editor. Turn each theme on beginning with hypsography at the bottom. Sit back and watch the map reappear. This is a good time to save your project for the first time.
6. Now turn off all the themes. Display one theme at a time. Using the Identify tool, notice that boundary lines surrounding the themes for hypsography, hydrography, railroads, and roads are associated with the file name listed at the bottom of the identify box. To hide these boundary lines, select Theme, and then Properties, from the menu. The file name layer contains features that ArcView GIS cannot identify as belonging to a named layer. Use a new Drawing option, located just below Definition in the Theme Properties dialog, to filter out these nonspecific features located in the file name layer. The Drawing option is available only when the CAD Reader extension is loaded in ArcView GIS. Select all layers except for the bottom one, which is the file name, and click OK.
7. Two data sets, public lands and boundaries, are coded inconsistently and require extensive editing to be useful for modeling. Do not use the Drawing option to filter these themes. While in Theme Properties, change the name for each theme to a friendlier alias. Click OK to close Theme Properties.



Thematically map the hydrology, roads, and railroad themes by assigning a Unique Value to each of these themes.

Display a table for each theme and observe the table structure. The primary data field for most themes is the Layer field. Notice that the hypsography data also include valuable information in the Elevation field. In the next exercise, information from the elevation field will be used to create a triangulated irregular network (TIN) with ArcView 3D Analyst.

Remember to carefully review and, when necessary, edit data that will be used to create models. Sort the data in hypsography table in ascending order and verify that there are no zero or excessively high values. As with any data, some DLG-O files contain incomplete or improperly coded data and editing may be necessary. Elevation values should range between 700 and 2,600 meters for the data from GC4 Tile 8.

While viewing tables for hypsography, hydrography, roads, and railroads, check the Layer field to verify that filtering the data using the Drawing option was successful and that the Value field does not contain the name of the DXF file used to create the theme. Remember that boundaries and public lands are exceptions and some boundaries and public lands records will contain the original DXF file name. Save the project again before continuing on to the next step

Thematic Mapping and Presentation of Two-Dimensional Data

Once all six data types are loaded and edited, we can use the thematic mapping capabilities of ArcView GIS to create a meaningful map in our view. Data attributes can be applied to customize our map. Hypsography is an interesting theme to begin with since the Elevation field will create a topographic color ramp based on the contour lines.

1. Double click on the hypsography theme in the legend to open the Legend Editor.
2. Select Graduated Color as a Legend Type.
3. Choose Elevation as the Classification Field.
4. Click the Classify button to bring up the Classification dialog.
5. Set the number of classes to five. Click OK.
6. Select Elevation #1 located near the end of list of choices under Color Ramps.
7. Type in elevation ranges in the Value column. Each range spans 500 meters, beginning with 500, 1,000 and ending with 2,500, 3,000.
8. Tell the Legend Editor to apply the color ramp and close the Legend Editor.
9. Make hypsography the only active theme and press the Zoom to Active Theme button.

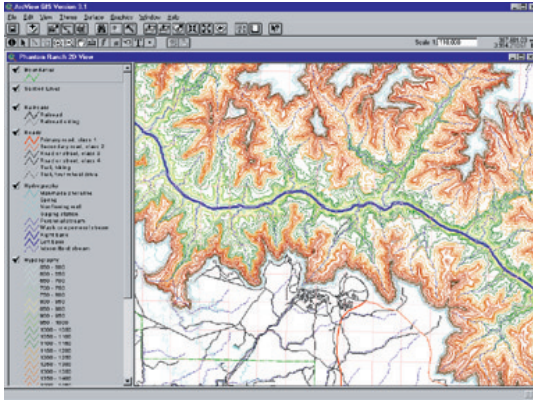
Now you can study the model. The low central area, colored light blue, represents topography at and near the Colorado River. The major southwest flowing drainage system in the northeast map quarter is the North Bright Angel Canyon, eroded along the Bright Angel Fault. Other North Rim canyons run parallel to Bright Angel Creek. Notice that South Rim canyons are shorter and steeper. Major hiking trails in the Canyon use the Bright Angel and other drainages to establish preferred routes. Save the project to preserve the new hypsography theme.

The hydrography, roads, and railroads themes are very interesting and usually map well. Build a legend for the hydrography, roads, and railroads themes by applying the alphanumeric code stored in the Layer field to distinguish between data types. Table 3 explains the meaning of each type.

Table 3

Data Theme	Layer Field Code	Feature Description
Roads	170_201	Primary road, class 1
Roads	170_205	Secondary road, class 2
Roads	170_209	Road or street, class 3
Roads	170_210	Road or street, class 4
Roads	170_211	Trail, hiking
Roads	170_212	Trail, four-wheel-drive
Railroads	180_201	Railroad
Railroads	180_208	Railroad siding
Hydrography	50_201	Manmade shoreline

To classify legends for the roads, railroads, and hydrology themes, open the Legend Editor for each theme. As before, select Unique Value for the Legend Type and choose Layer in the Values Field. After the legend builds, enter the correct feature description (e.g., Primary road, class 1, Trail, hiking) from the list in Figure 3 in the Label column, matching each data theme with the appropriate value. Select representative line colors and styles for each legend item. Make each theme visible and stack them in your favorite order. Boundaries and public lands will require extensive editing before mapping these themes. Future articles will show how these data can be edited so they are usable. The finished map could look similar to the illustration shown here. Save your project.



When the model is complete, each data set will be thematically mapped.

Now it's time to step back and admire your Bright Angel map. Observe relationships between hiking trails and canyons. Find the railroad spur leading up from Williams, Arizona. Calculate the elevation differences between the Colorado River and the Canyon Rims. You can determine the average slopes of your favorite hiking trail.

Summary

Using these steps you can load, analyze, edit, and present 1:100,000 scale USGS DLG-O data in ArcView GIS. After completing a Grand Canyon model, you can apply these techniques to USGS data for other areas to build your own models.

In the next lesson the Bright Angel model will be used to perform three-dimensional TIN modeling using the hypsography theme. Two-dimensional data will be placed on the TIN to create a very attractive three-dimensional model.

This lesson is based on an article written by Mike Price of ESRI that originally appeared in the October–December 1998 issue of *ArcUser* magazine.