

## Lesson 11:

# Fine-Tuning Digital Orthophoto Quarter Quads

**Lesson Goal:** Reproject shapefile themes to align them with a DOQQ theme.

**What Will You Need:** A Pentium-class PC with 64 MB RAM, a minimum of 100 MB of free hard drive space, and ArcView GIS 3.2

**Data and Utilities:** The sample data set that accompanies this tutorial, available from the ArcUser Online Web site.



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A digital orthophoto quadrangle (DOQ) is an orthorectified, computer-generated image of an aerial photo in Universal Transverse Mercator (UTM) projection in North American Datum of 1983 (NAD83). A DOQ possesses the geometric properties of a map and meets the National Map Accuracy Standards. DOQQs provide an excellent cartographic base to overlay associated theme data and have applications in land management, habitat analysis, evacuation planning, and many other areas. This lesson describes how to use the ArcView Projection Utility in ArcView GIS 3.2 to unproject NAD27 data and then create new shapefiles in NAD83 that can be adjusted to align with 3.75-minute by 3.75-minute digital orthophoto quarter quadrangles (DOQQs).

The ArcView Projection Utility has greatly simplified the task of changing the projection of shapefiles. Prior to the release of this utility, ArcView GIS users who wanted to change shapefile projection used either the Projector!mod or Projector! extensions that are available from the ArcScripts section of the ESRI Web site.

In the United States, most users will be using the ArcView Projection Utility to transform themes based on the NAD27 to NAD83. NAD83 is an earth-centered datum (GRS 80 ellipsoid) unlike NAD27, which is based on an arbitrary starting point in Meades Ranch, Kansas. The positions of points or features based on these reference datums will differ considerably. Users who want to position digitized coverages originally derived from scanned hard copy, such as soils maps, tax parcel maps, or contour lines, onto DOQQs in NAD83 will need to use this utility. Though reprojected themes will line up reasonably well with features in DOQQs, a more precise alignment can be achieved by adjusting the false easting and northing values to “tweak” the theme. This lesson describes the steps necessary to achieve more precise alignment between DOQQs and feature themes.

### Getting the Sample Data

The files needed for this project are contained in a self-extracting zipped file that can be downloaded from the ArcUser Online Web site. DOQQs are digital raster images prepared by the USGS National Mapping Division in 3.75-minute by 3.75-minute quarter quadrangle format. Local offices of the United States Department

of Agriculture (USDA) Natural Resources Conservation Service receive this digital imagery for use in the National Cooperative Soil Survey Program and for other conservation projects and programs.

Locating and downloading the necessary files for this exercise is the first step.

1. Create a new folder named ALIGNWORK to hold downloaded data files.
2. Go to the ArcUser Online Web site and download the DOQQ data set.
3. Unzip all files using the WinZip decompression utility with the Classic option and place them in the ALIGNWORK folder.

Examine the unzipped files. The ALIGNWORK folder should contain all the files associated with the Homertaxnad27 and Homersoilnad27 shapefiles. Both shapefiles are in NAD27. When the Homersoilnad27.prj file is opened in Microsoft Notepad or another text editor, it displays the metadata that describes its projection. The remaining two files include Foster\_RDgpsUTM83, a small GPS-generated point shapefile, and Rt90fosterrd, a ~20 MB TIF image cut from Homer\_sw.bip, a ~131 MB DOQQ image file. For purposes of this article, the TIF image will serve as a proxy for the DOQQ. All USGS DOQQ files include a small header file (e.g., Homer\_sw.hdr) which provides information on the image's projection and datum. Homer\_sw.bip is cast on NAD83.

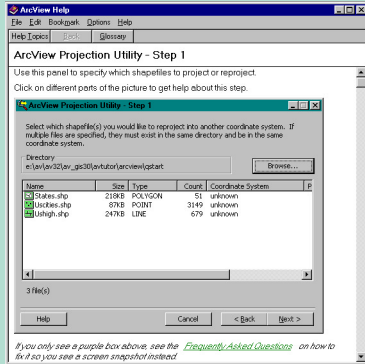
### Unprojecting NAD27 Feature Data

Since ArcView GIS cannot project image data such as DOQQ files, the shapefiles must be reprojected to properly align with the DOQQ.

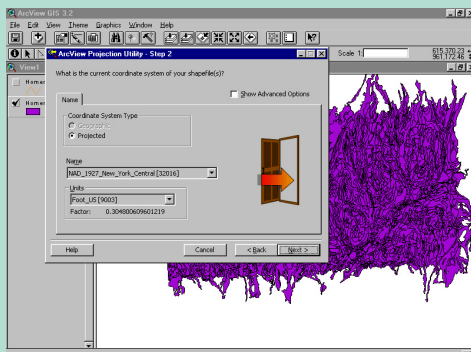
1. Start ArcView GIS and load the Projection Utility Wizard extension by choosing File > Extension and checking the box next to Projection Utility Wizard. Create a new project and open a new view (View1).
2. Add Homertaxnad27.shp and Homersoilnad27.shp to the view. Click on each theme's legend button to make it visible.
3. Change the Data Source Type from Feature Data Source to Image Data Source and add the TIF DOQQ image file Rt90fosterrd to this view. Turn on all themes and make them active. Click on the Zoom to Active Themes button. Note that the NAD27-based feature themes will not align with the NAD83 image. Delete the TIF image theme from the view.
4. Open a second view and add Rt90fosterrd.tif, the DOQQ image file, as a theme and make it visible. Save the project with the name ALIGN2783 by choosing File, then Save Project As.

### ArcView Projection Utility

The next steps require some familiarity with ArcView Projection Utility. Readers unfamiliar with this wizard-based tool can learn more about it by reading the dedicated help files that are available when the extension is loaded. This extension adds ArcView Projection Utility as a choice under the File menu in the View GUI. Choose File > ArcView Projection Utility to initialize the program. In the first dialog, ArcView Projection Utility—Step 1, click on the Help button on the lower-left side to invoke the help files for this utility. A quick-start tutorial, FAQs, coordinate system concepts, and many other related topics are included.



*In the first dialog of the ArcView Projection Utility, click on the Help button on the lower-left side to invoke the help files for this utility. A quick-start tutorial, FAQs, coordinate system concepts, and many other related topics are included.*



*The ArcView Projection Utility will be used to create decimal degree (unprojected) versions of the two feature themes.*

The ArcView Projection Utility will be used to create decimal degree (unprojected) versions of the two feature themes. The decimal degree feature data can be projected by choosing View > Properties and selecting a projection in the View Properties dialog box. Tweaking or adjusting the false easting and northing to align coverages will be accomplished by applying a custom projection using the View Properties dialog box.

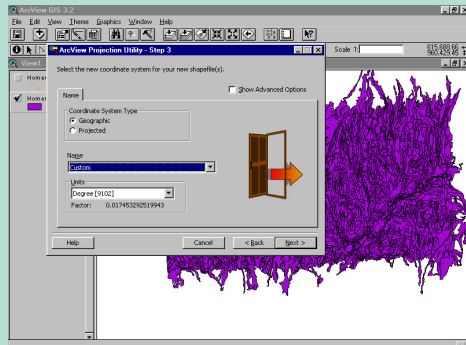
## Unprojecting and Reprojecting Feature Data

1. Create a new view (View3).
2. Return to View1 and make Homersoilnad27 the active theme. Open the projection utility. Since the theme to be reprojected has already been selected, the utility opens at Step 2 and indicates that the current coordinate system for the feature theme is NAD 1927 New York Central with units in feet.
3. Click on the Next button to advance to the Step 3 dialog box. Change the Coordinate System Type to Geographic, set Name to Custom, and leave Units set to Degree. Click on Next.
4. Choosing Custom for Name in the previous step triggers a dialog asking if you would like to specify a geographic transformation. Click on No.
5. When the Step 4 dialog box appears, click on the Browse button and navigate to the ALIGNWORK folder. Save the file as HomersoilDD. Click on the Next button.
6. Review input and output file settings displayed on the ArcView Projection Utility Summary page. Click on the Finish button. This creates a decimal degree (unprojected) version of Homersoilnad27. Be patient. A message will appear when file processing is finished. Click on OK to exit the dialog.
7. Add HomersoilDD to View 3. In View3, choose View > Properties and click on the Projection button. Set Category to UTM-1983 and Type to Zone 18. Click on OK in the Projection Properties and View Properties dialog boxes.
8. Make a permanent copy of this projected theme by choosing Theme > Convert to Shapefile. Navigate to the ALIGNWORK folder and save the new shapefile as HomersoilUTM83. Click on Yes to save this file in the projected units.
9. Add HomersoilUTM83 to View2.
10. Repeat Steps 2 through 9 for Homertaxnad27, but at Step 2 set Coordinate System Type to Projected, Name to NAD 1927 New York Central, and Units to Foot US. Name the decimal degree file HomertaxDD and the reprojected file HomertaxUTM83.
11. After both reprojected feature themes have been added to View2, make Rt90fosterrd.tif, the DOQQ-derived image, active and click on the Zoom to Active Theme button. Save the project.

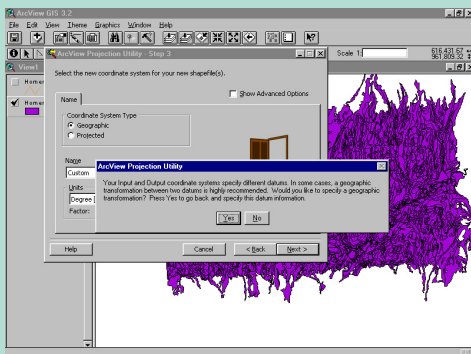
Examine View2. Both feature themes now appear more or less correctly positioned over the DOQQ image. Zooming in more closely to the roads shown in HomertaxUTM83 reveals that it doesn't align with the roads visible on the DOQQ. Modifications to the false Easting and Northing can move the features on these two themes closer together.

## Tweaking Features Themes

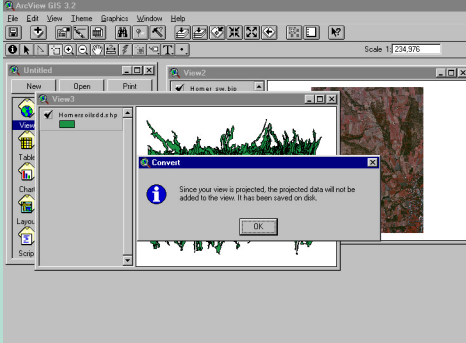
Examining View2 revealed that the tax parcel theme needed to



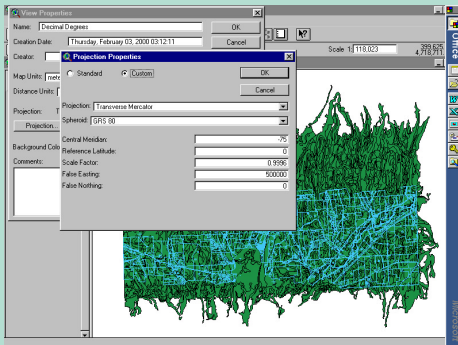
*In the Step 3 dialog box, change the Coordinate System Type to Geographic, set Name to Custom, and leave Units set to Degree.*



*Click on the Finish button to create a decimal degree (unprojected) version of Homersoilnad27. A message will appear when file processing is finished.*



One way to solve this problem without resorting to the ArcView Projection Utility is to simply reproject HomertaxDD.shp and save it as a new version.



Tweak the alignment of the shapefiles with the DOQQ by adjusting the False Easting and False Northing values when reprojecting the shapefiles.

shift slightly northeast. Since HomertaxUTM83 is not a decimal degree coverage, its projection cannot be customized using the Projection setting in the View Properties dialog. One way to solve this problem without resorting to the ArcView Projection Utility is to simply reproject HomertaxDD.shp and save it as a new version.

1. Make the HomertaxDD theme active in View3. Select View > Properties, click on the Projection button, and choose Custom from the Projection Properties dialog. Change the False Easting from 500000 to 500020 and the False Northing from 0 to 15. Press the Enter (Return) key to register these changes and click on OK in the View Properties dialog box.
2. Choose Theme > Convert to Shapefile. Navigate to the ALIGNWORK folder and save the new shapefile as HomertaxUTM83fe20n15. Since tweaking to achieve a best fit is a trial and error process, incorporating changes made to the projection in the file's name for later reference is a good practice.
3. Add HomertaxUTM83fe20n15 to View2. Also add the feature theme Foster\_RDGpsUTM83 from the ALIGNWORK folder and make it the active theme. Click on the Zoom to Active Theme button to reposition the view near some GPS points in an area where the shift of the theme can be better observed.

Now examine View2. The alignment of the tax parcel features with the DOQQ image is considerably improved. To further refine the alignment, return to View3, use the View Properties dialog to unproject HomertaxDD by clicking on the Projection button, selecting Standard rather than Custom, and verifying that the Map Units have reset to decimal degrees. Click on the OK button to finish the process, and the theme will be returned to an unprojected status. This step must be repeated each time a new tweaked version of the feature is created. Select View > Properties window, reset the projection to UTM 83 Zone 18, click on Custom, and set False Easting and False Northing to the new desired distances. Save the result as a new shapefile using a naming convention that includes the adjustments made to Easting and Northing values. When satisfied with the tax parcel alignment, delete the less satisfactory feature themes. Modify the HomersoilsDD feature theme in the same manner and add it to View2. Be sure to save the project.

## Summary

Attempting to align scanned or digitized images from different sources with different projection datums is a problem that has bedeviled many GIS users. The new projection utility that comes with ArcView GIS 3.2 has considerably simplified the process of using these types of data together. The steps presented in this article show how to reproject parcel and soil feature data in NAD27 for use with DOQQ image data in NAD83 and fine-tune feature theme alignment with the image base. Visit ArcUser Online for a sample data set and links to Web sites that provide additional information on the use of DOQQ data.

This lesson was based on an article by David Miller that originally appeared in the July—September 2000 issue of *ArcUser* magazine.