# Combining Digital Elevation Model (DEM) Merge Utilities for Devil's Lake Area in North Dakota

## 1.0 Introduction

The Digital Elevation Models (DEMs) utilities described in this document are scripts and an ArcView extension developed for the WetScape project and can be used to create an elevation basemap to run WetScape. WetScape is a Unix based program that can be used to identify topographical features that would be suitable for building wetland sites. For more information see the ids website (www.ids.colostate.edu/projects/wetscape). The DEM Merge Utilities can be used to combine or merge DEMs to build elevation coverages for any use. The extension and script accounts for differences in scale between DEMs and use the grid features in ArcView to create polygon coverages with elevation or elevation contours.

## 2.0 Tools Needed

1. **ArcView with Spatial Analyst** - ArcView is used to run the scripts to combine the DEMs. Since the grid functions are needed from ArcView, the spatial analyst extension should be available.

2. **DEM Merge Utilities ArcView Extension** - This can be downloaded from the ids website (http://www.ids.colostate.edu/projects/wetscape/download).

3. **Python** - It is recommended that python be installed on a Unix machine to use the wildcard functions. A Unix command shell to run the python script will also work with a Windows machine. This is because DOS doesn't have wildcards for command line arguments (see www.python.org to download).

4. **Python Script** - This script is used to create a res.txt file with information about the DEMs to be combined. This script can be downloaded from the ids website (http://www.ids.colostate.edu/projects/wetscape/download).

5. **Grass 5.0 and 4.1** - These versions of Grass should be installed on a Unix machine. Grass 5.0 is used to import the ArcView grid using r.in.arc (note: grass4.1 does not have this function). WetScape is run with Grass 4.1. Both of these versions of Grass can be downloaded from the internet (see http://www.baylor.edu/~grass/download.html).

6. **Lots of disk space** - This is to store the DEM files and create the coverage and therefore should be available to the Windows machine where you run the utilities. For example, 10m combined grids run 1.3 gigs.

## 3.0 Install Software, Download Extension and Script

You may need to have access to both Unix and Windows based computers. In the Unix system you can run the python script, run Grass 5.0 and WetScape with Grass 4.1. Windows can be used to run the ArcView extension and build an ArcView coverage. This description will assume you do not have a Unix shell for your Windows system, if you do you can run the Unix programs from a Windows machine.

1. Create a directory in on the Unix machine you want to install Grass and Python for the DEM files and copy the DEM files into this directory.

2. Install Grass 5.0 (If you want the final version of the coverage to be in Grass) and python on a Unix based machine. Python and grass can be downloaded from the following sites:

   -- http://www.python.org

   -- http://www.baylor.edu/~grass/download.html

3. Download the dem_merge.avx ArcView extension and the parseDEM.py script from the WetScape download page.

   -- http://www.ids.colostate.edu/projects/wetscape/download

4. Copy the dem_merge.avx file into the extension directory where you are running ArcView. The typical path for this directory is C:\ESRI\AV_GIS30\ARCVIEW\EXT32, although individual systems may vary.

5. Copy the parseDEM.py script into the directory you created in step 1.

## 4.0  Load and Parse DEMs

1. Using a Unix shell or on a Unix machine, inside the directory you created in Section 3.0, run 'python parseDEM.py *.dem' to generate the file 'res.txt' that will be used to build an index shapfile of all the DEMs in the directory.

2. Move the entire directory to a Windows machine.

3. Start ArcView and load the **Spatial Analyst** and **DEM Merge Utilities** ArcView extensions.
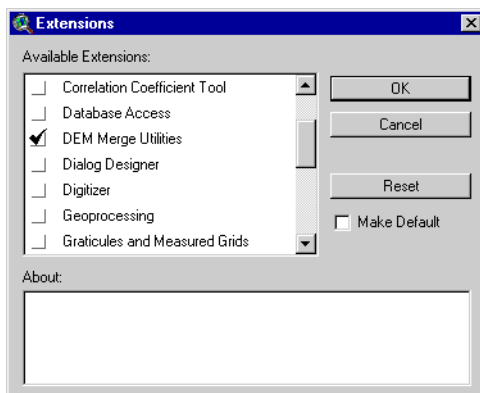


**Figure 1:** *Loading the DEM Merge Utilities Extension*

4. Open a view and select the bex icon in the button bar (the gold dog, i.e. ). You will be prompted for the res.txt file that you created in step 1. This will create a shapefile called demindex.* in your c:\windows\temp directory and will load the index file into the view.

5. Double click on the legend entry for the index file or select Theme > Edit Legend. Change the settings in the legend editor to display the names of the DEMs (see *Figure 2*). Check to make sure all the DEMs you wanted to load are loaded. For the example in *Figure 2* there are four quads in North Dakota made up of 13 DEM files with different resolutions. Only four of the files will be used, the extension looks for those with the best resolution.
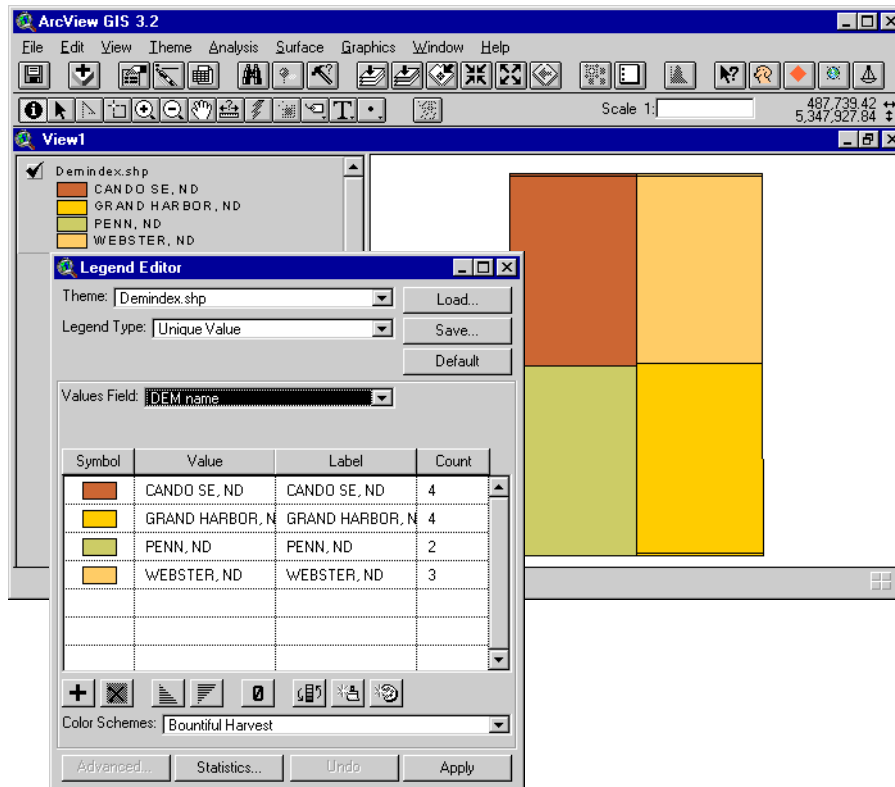
***Figure 2:*** *Index File Displayed in ArcView with the Legend Editor*

6.  Now run the DEM loader script using the orange diamond (i.e.  )on the view button bar. This will convert the DEMs with the best resolution in the directory where you picked the res.txt to grids and load them into the view (see *Figure 3*). This may take some time, depending on how many DEMs you are merging.
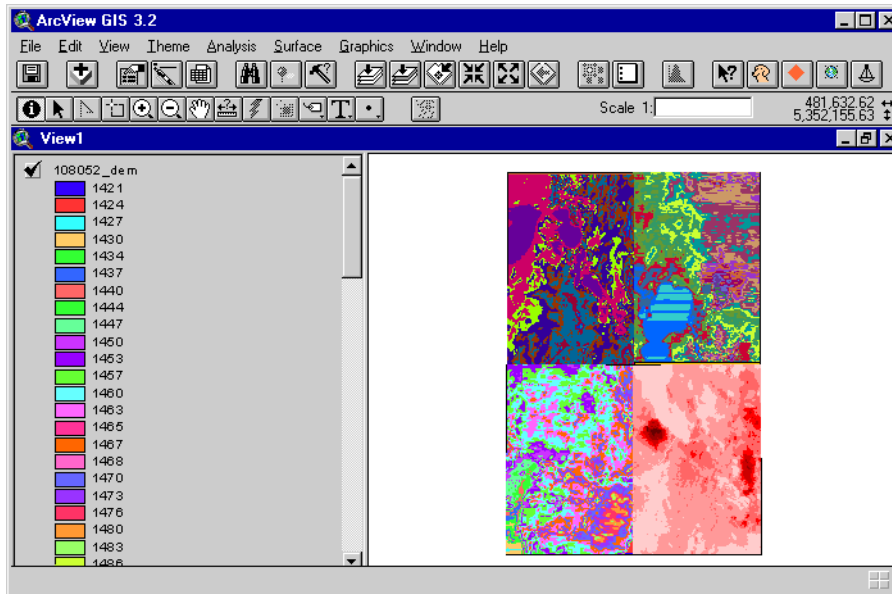
**Figure 3:** *Loaded DEMs*

7.  Run the script given by selecting the globe option (i.e. [globe icon]). This will generate a new set of DEMs that are in feet. This makes the assumption that any DEM with a max value < 1000 is in meters and will be multiplied by 3.280833333 so that all DEMs are in feet (see *Figure 4*).
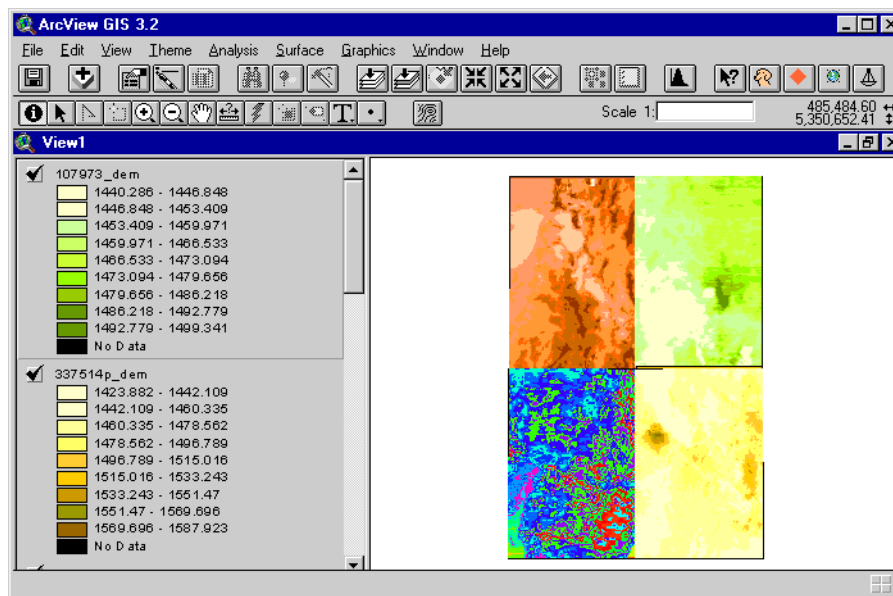


**Figure 4:** *DEMs Converted to Feet*

## 5.0  Merging DEMS

1.  Select the first DEM theme by clicking next to the name and run the DEM-combiner script given by the buoy button (i.e. [buoy icon]). You can see which theme is selected by the small rectangle surrounding the theme in the legend (see *Figure 4*, the 107973_dem theme is selected).
2.  When prompted select a location for the grid file (see *Figure 5*).
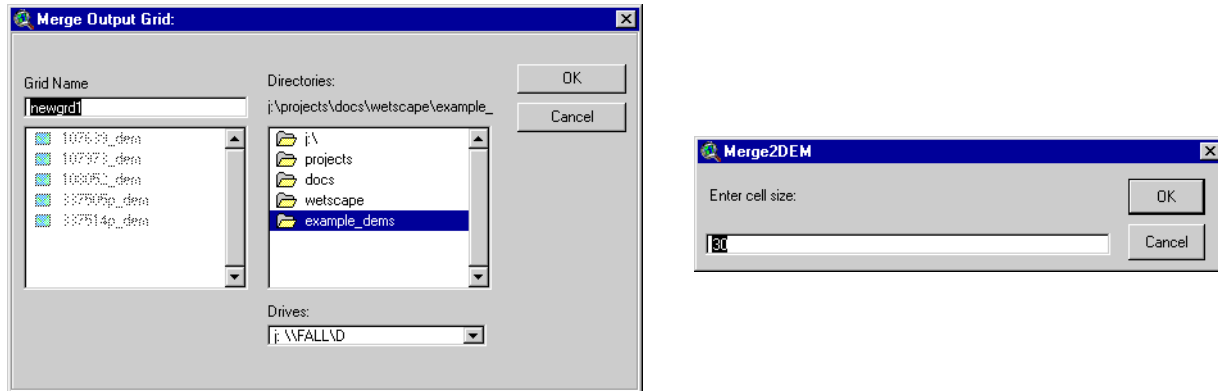
***Figure 5:*** *Saving the Grid File and Setting the Grid Size*

3.  Enter the cell size of the merged DEM (any grids that don't have the same cell size will be re-sampled).

4.  The first 12 DEM areas will be merged into the grid that you picked and will be de-activated.
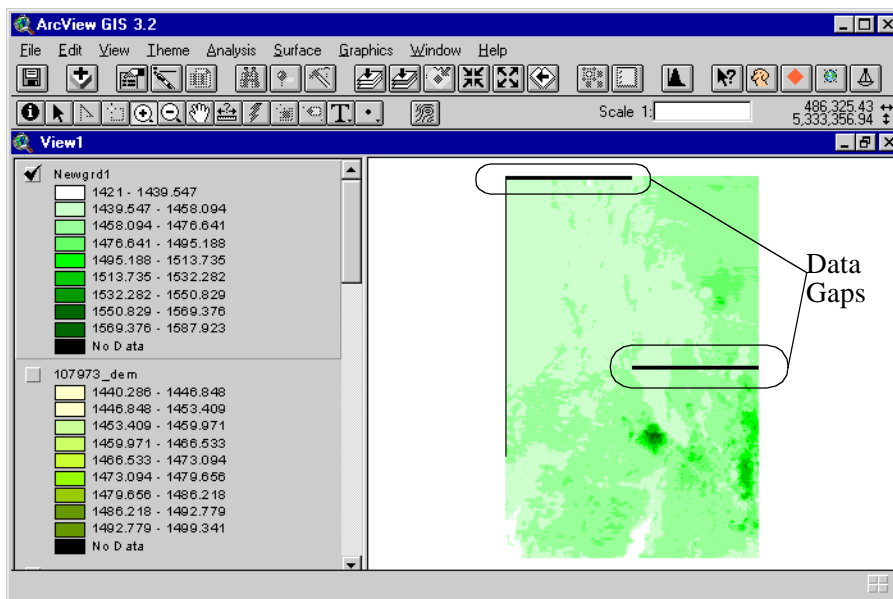


***Figure 6:*** *Merged DEMs*

5.  Select the newly generated grid and run the script again if there are more than 12 DEM areas. Repeat until all the DEMs have been de-activated.

6.  There will be gaps in the combined DEM grid. Fill these in using the 'Neighborhood Statistics' menu item from the Analysis pull-down menu (see *Figure 7*).
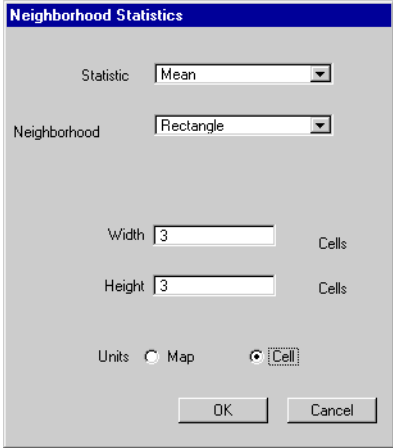
*Figure 7: Neighborhood Statistics Window*

7.  Start with the 3 cell neighborhood and re-rerun as needed using larger cell sizes until all gaps are filled (for the 10m combined map I needed over ten runs). Gaps show as black no data areas (see *Figure 6*).
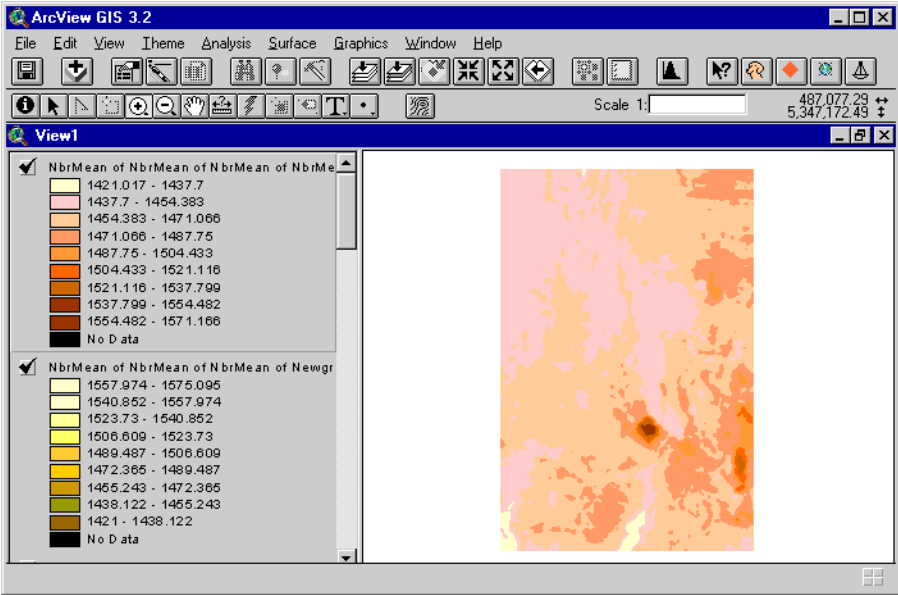


*Figure 8: DEM Map with Data Gaps Filled*

The newly created grid file can be saved and used for projects in ArcView, used to create contour lines using the **Surface > Create Contours** option, or used to make a Grass coverage for use with WetScape.

## 6.0  Creating a Grass Coverage for Use with WetScape

1.  Once the combined grid is ready, you will be ready to export it back into Grass. Use the 'Export Data Source' menu item from the File pull-down to generate an ascii export file of the grid.

*Note -*  *You will probably need to look at the theme properties to see where the grid file resides.*

2.  Feed this file into grass5 using r.in.arc on your Unix machine.

3.  Export the generated raster map using r.out.ascii (note that it may be possible to import the map directly into a grass4 dataset, but it has not been tested).

4.  In grass4, import the file from grass5 using r.in.ascii. Now you should be all set to go.

5.  For help with using Grass see the Grass website (http://www.baylor.edu/~grass/download.html).

6.  Load the created file into WetScape for use as an elevation base map.