

GENERATING A TERRAIN PROFILE USING MICRODEM

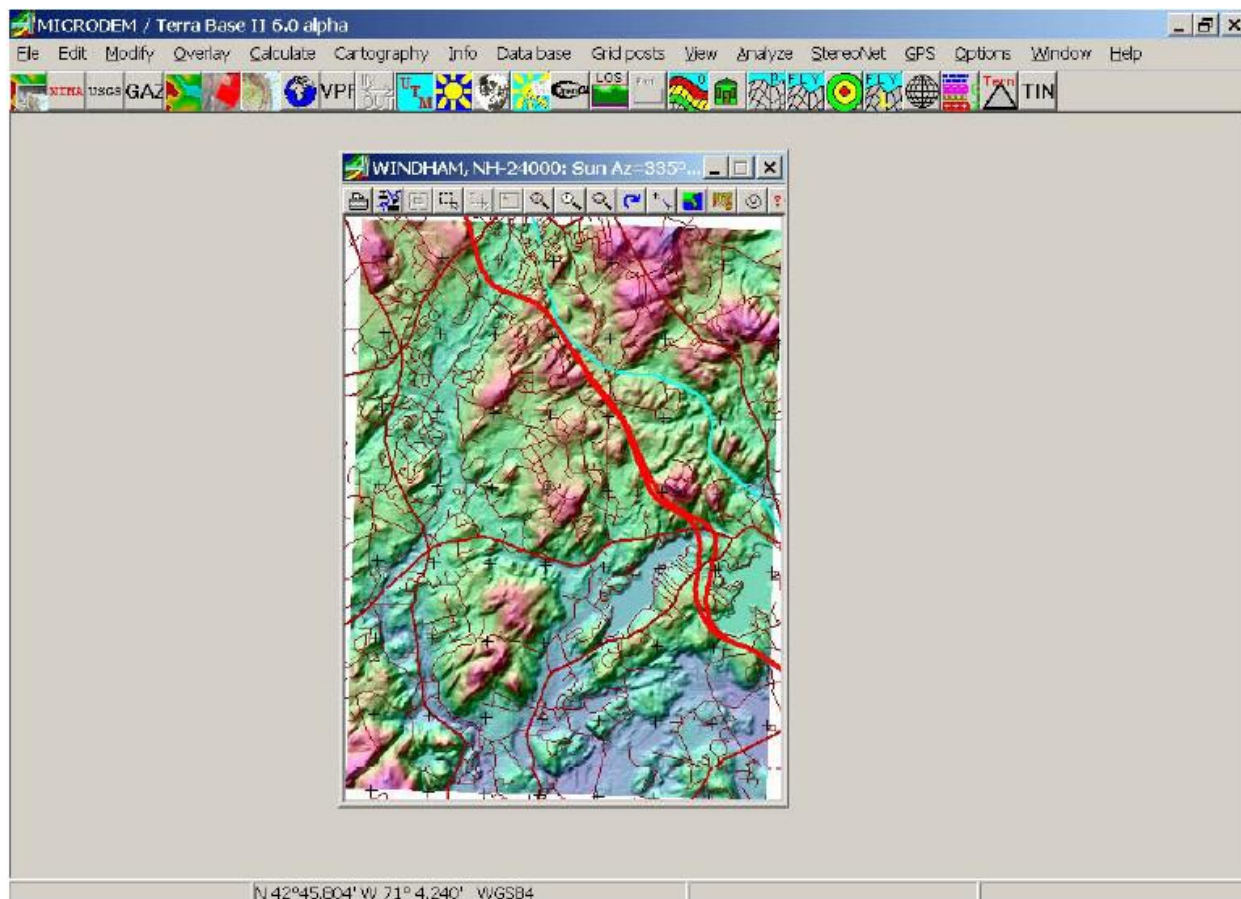


Fig 1—Screen shot from MicroDEM program, with topo of Windham, NH, region.

FIRST, GETTING THE MICRODEM PROGRAM

Use the version on the CD-ROM bundled with the ARRL Antenna Book. You can also download the latest version from: <http://www.nadn.navy.mil/Users/oceano/pguth/website/microdem.htm>. Be forewarned: This is a large download, some 30 MB in size. You will need to download the setup file and also the Microdem_debug.exe file, which is used to overwrite the original executable file installed by the setup file. Once you have installed MicroDEM, bring it up on-screen. **Fig 1** is a screen-shot of the program with the Windham, NH quad map displayed, together with Tiger US Census data showing roads, highways and streams.

Setting Options in MicroDEM

If this is the first time you've used the program, you need to set some options. Click on the **Options** menu listing at the top of the main window.

- Select the **Units** tab (you may have to use the horizontal scroll arrows at the top to see all the possibilities for options).
- You may want to respecify in the **Lat/Long** textbox the exact way to specify or show latitude and longitude. For example, let's say that your GPS shows your position at 42° 4' 30" N latitude and 82° 7' 35.1" W longitude. This is the so-called "degrees/minutes/seconds" method of showing latitude or longitude. You would select the "Decimal seconds" option. However, if your GPS showed the same position as 42.07500° N and 82.12641° W, this is expressed in "Decimal degrees."

- Click on the **Coordinates** tab. In the **Verify** box, click on the option **Keyboard entry**.

In the **Show roam on all maps** box click on the **Reasonable** option. Do this also for the **Verify Graphical Selections** box. The values for latitude/longitude determined by the mouse will now bring up a verification box in which you can type the exact coordinates.

- Now, click on the **Views** tab and then uncheck the box labeled **Missing values set to sea level**. Click the **Weapons Fans** button and then specify **Ray Spacing** of 5° and **Point Spacing** of 30 meters. Make sure you click on the **Radial lines** option in the upper right-hand corner. See **Fig 2**.
- You may next want to set a range ring to show the circle surrounding your tower location. I recommend later in this document that you use a radius of 4400 meters. Use **Options, Views, O Range circles** and then type 4400 for the first range ring, 0 for the others. Note that if you have selected “feet” for your units, this entry must still be 4400 meters, despite the label of feet that shows on-screen.
- Set the default subdirectories by clicking the **Directories** tab. MicroDEM creates a subdirectory system where map data will be stored, usually in x:\Mapdata, where the “x” denotes the disk drive you select during installation. The radial *.PRO files you will be creating later will be stored in the x:\Mapdata\MD-PROJ\Fans subdirectory.

Close the **Options** dialog and the MicroDEM program.

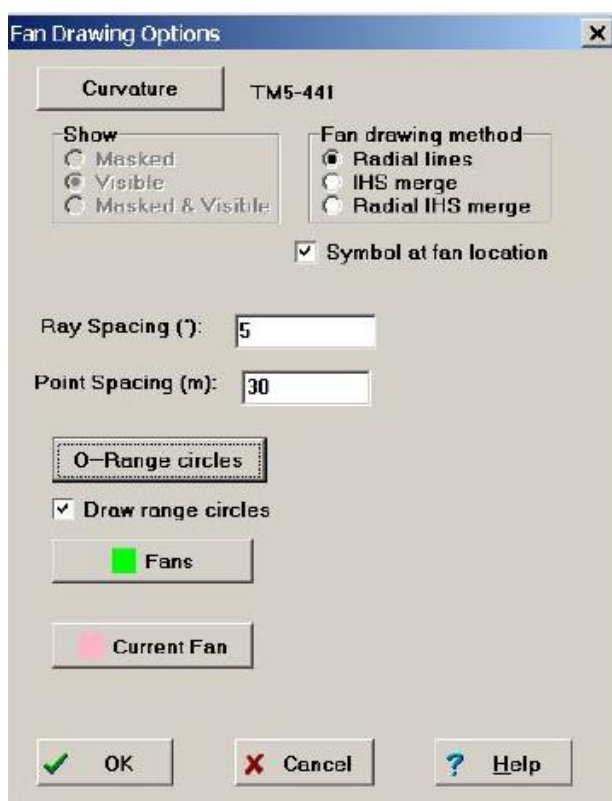


Fig 2—Setting the Options, View, Fan Drawing Options

GETTING THE MAP DATA

In the USA, the USGS (US Geologic Survey) maintains two types of public-domain terrain data sets available on the Internet. MicroDEM can use either of these data sets to create terrain profiles for HFTA. There are advantages and disadvantages to each method:

- DEMs (Digital Elevation Model) are essentially digital versions of the 7.5-minute paper topographic maps US hams are familiar with.
- NED (National Elevation Dataset), which are improved “seamless” versions of the paper topographic maps.

The DEM datasets are available from several commercial vendors. Some of these vendors charge no fees for limited Internet access to the data. The NED datasets are available directly from US Geological Survey, EROS Data Center, Sioux Falls, SD, on the Internet. I thank Pete Smith, N4ZR, for giving me some vital tips on how to download NED files.

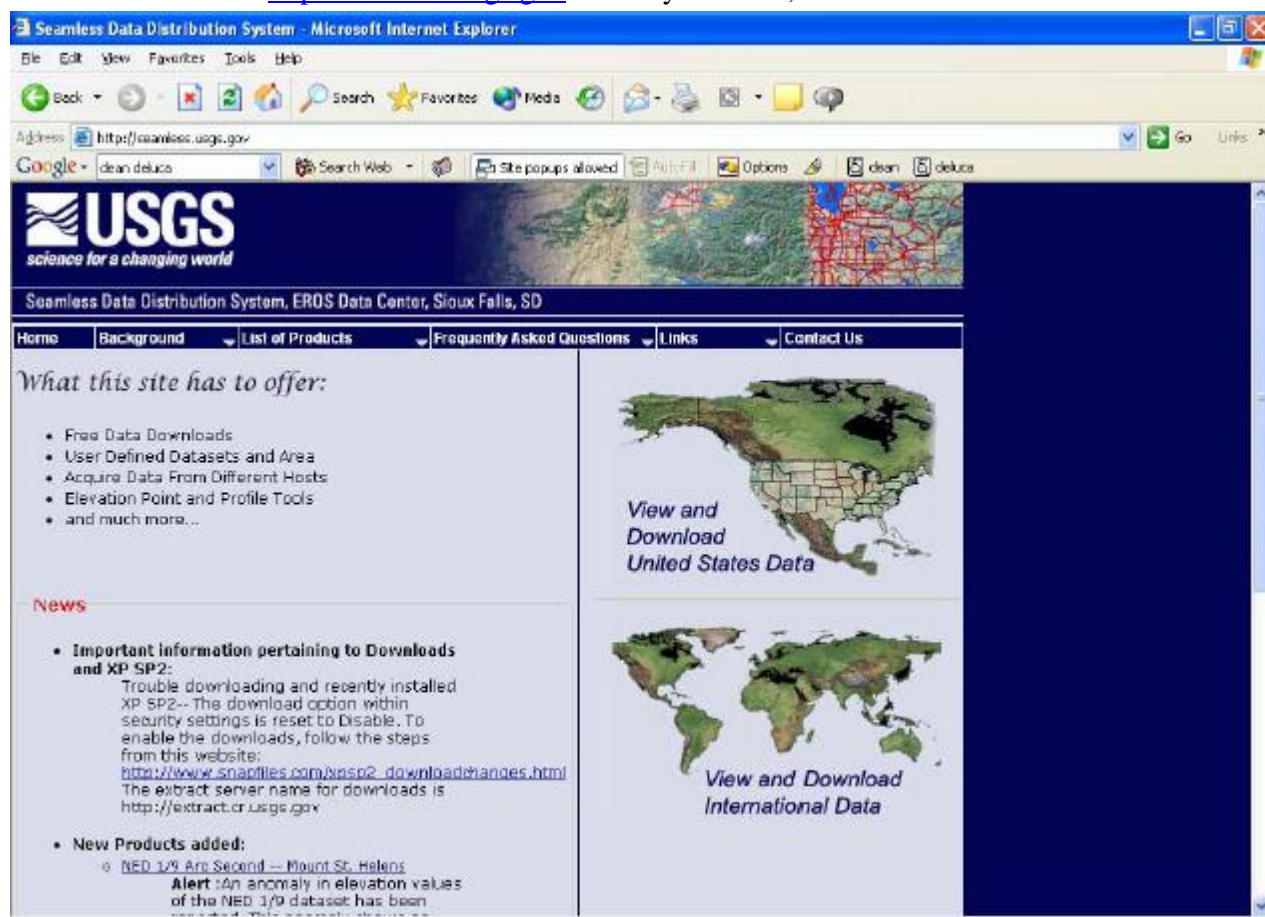
Downloading a specific DEM is usually faster than downloading a NED data file because the DEM is generally smaller in size, by a factor of about two. However, you may need to merge as many as four DEMs to cover an area large enough to create terrain profiles around a particular tower location. Furthermore, finding the specific DEM(s) for a particular tower location can involve quite a bit of hunting around at several Web sites. In general, I recommend downloading NED files, even though specifying the coordinates for a NED download requires a few simple math operations

DOWNLOADING A NED DATA FILE

MicroDEM can also use a NED file to create a custom-sized topographic map centered on the latitude/longitude you specify for the tower's base. The best way to obtain this is to place a hand-held GPS receiver out at the base of your tower. (The prices have come down to the \$100 range for GPS units that can also be used for amateur APRS applications.) Record the latitude/longitude in your notebook.

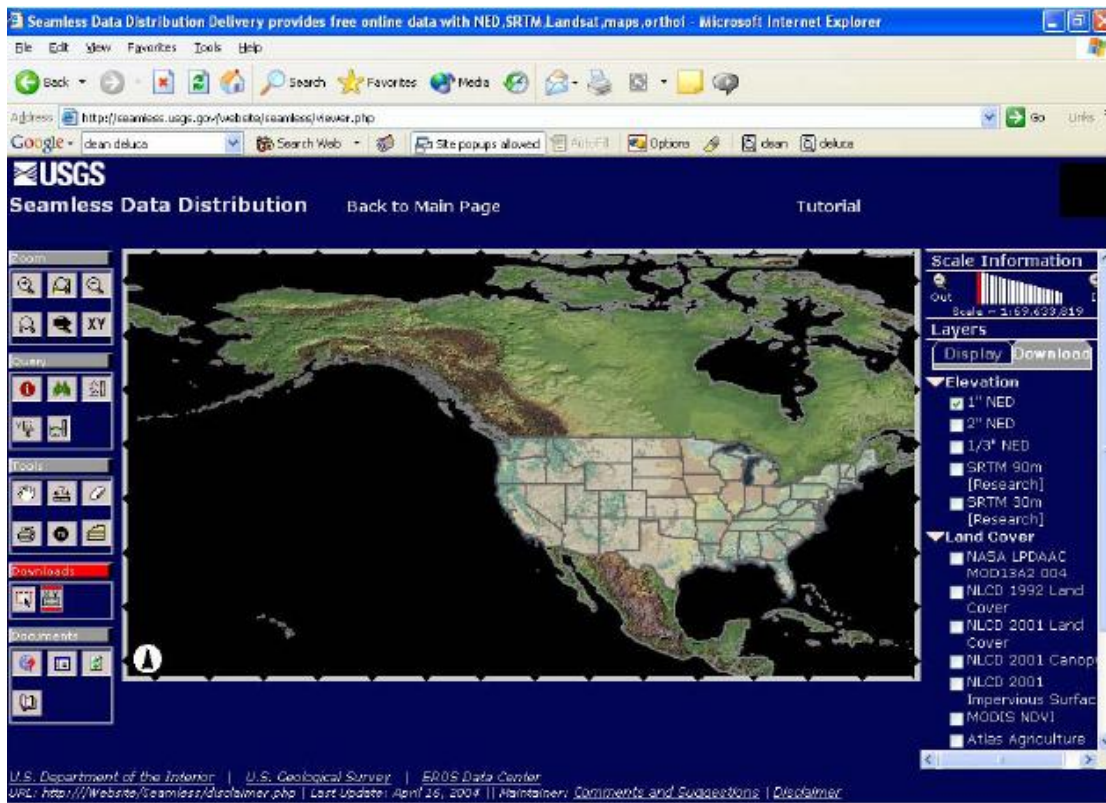
The idea is to create a rectangular box around the tower, by defining the latitude + 0.1° at the top, latitude - 0.1° at the bottom, longitude + 0.1° at the left and longitude - 0.1° at the right.

The URL is <http://seamless.usgs.gov>. When you arrive, the first screen looks like this:



Click on "View and Download United States Data". The Download button is the right-hand of the two buttons under "Downloads" in the lower left margin. Before you click on it, you need to determine which "layers" of data to

be downloaded. Click the Download tab in the right margin and when it appears, click on the triangle to the left of the word Elevation. That will drop down a list of the various elevation choices that are available:



You want to check the “1’ NED” box. You should also click on the “Land Cover” triangle and uncheck the default “NLCD 1992 Land Cover” box.

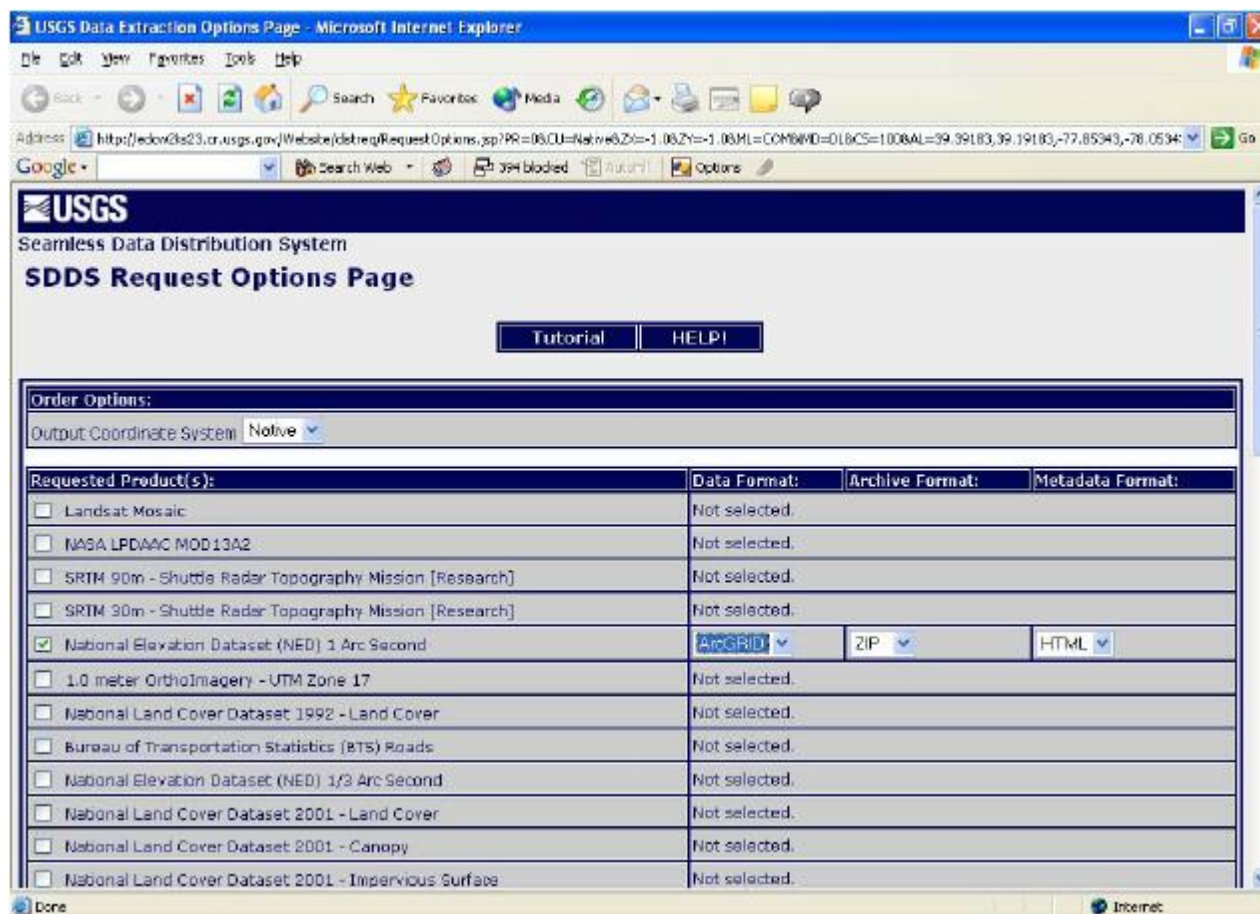
Now click on the download icon in the left margin. This will bring up a new browser window, where you have to define the limits of the area by the coordinates. It looks like this:



Now, add and subtract 0.1° to the tower's position to define the rectangle surrounding the tower base. For example, if the lat/long of the tower base is 42.841944° and 71.311222° (the digit to change is highlighted in red):

Top latitude = 42.941944° Bottom latitude = 42.741944°
Left longitude = 71.411222° Right longitude = 71.211222°.

When you are done, click on “Add Area” and you will go to the next screen. On the next screen, click the “Modify Data Request” button. When you do that, a completely new (and confusing) screen appears:



Make sure the NED 1 Arc Second box is checked. Go to the Data format drop-down in that line, and select GeoTIFF instead of ArcGRID. Scroll down to the bottom of the page and click on “Save Changes and Return to Summary.” Now you're back at the previous screen, but with the format of the download changed and updated. Make sure the dataset and output format are as shown. This is also a good time to check the coordinates one last time.

Next, click on **Download** at the bottom right of the next page. After the server busily processes the data, you will be presented with the standard Windows download dialog, with the .zip file name showing. It's a good idea to write down the name of the numerical zip file. Do not change the name (at this time) to a more human-friendly name! Save this file to somewhere you'll be able to find it later.

We're done with USGS, but the fun isn't quite over yet, because if you run MicroDEM at this point, pick “Open DEM” and try to open the zip file you just created, you will get an error. What you now need to do is to extract from the zip file (use WinZip or whatever you want) the file with the “tif” extension into the MapData\DEM subdirectory. When you open this *.tif file in MicroDEM, voila! You'll have your topo map open and ready to work on. You can then save it as a DEM with a descriptive name (like your call sign, for example), and open it directly once to be sure it's OK.

CREATING AZIMUTH TERRAIN FILES FOR HFTA IN MICRODEM

However, you've managed to do it, you now have digital terrain data available for MicroDEM. Again, you need your tower's exact latitude and longitude—which hopefully you've written down in your notebook. What we want to do is for MicroDEM to generate terrain profiles in 5° steps of azimuth, with a radius of 4400 meters around your tower base. This represents enough distance for HFTA to create accurate reflection and diffraction ray-tracings to compute the far-field elevation responses. (Note that MicroDEM asks you to specify the range in meters, even if you've set the Options to show distances in feet. Yes; it's confusing.)

Presuming that you have a map that covers the required area, now click on **Calculate, Intervisibility, Viewshed** menu. (You can also click on the **Weapons Fan** icon on the top of the map window for this.) Double-click anywhere on the map and a box will open, where you enter the exact latitude and longitude at your tower.

Once you have entered these numbers and have clicked **OK**, another form, **Viewshed Parameters** will open. See **Fig 3**. In the text box at the top, you may choose a name for MicroDEM to use for subsequent map operations, perhaps "N6BV-1" for the first tower location at a particular site, although this step is optional. Click the **Viewer Range (m)** text box and enter 4400 meters. Set the Right Boundary to 355 degrees. Make sure you have clicked the selection "Save radials" at the bottom. (Note: on certain display resolutions this may be difficult to see, since it is very near the bottom of the window.) Don't worry about setting the **Viewer AGL (m)** or **Viewed point AGL (m)** values. They're set at a default value of 2 m (the height of a soldier).

Click **OK** and a new **Input String** box will open asking you to specify a radials file name. This name isn't optional—Make sure that you specify a filename that HFTA will eventually use. Continuing our example, if you specify "N6BV-1", MicroDEM will quickly create 71 files labeled N6BV-0.00.PRO, N6BV-5.00.PRO, N6BV-10.00.PRO, ... up to N6BV-1-355.00.

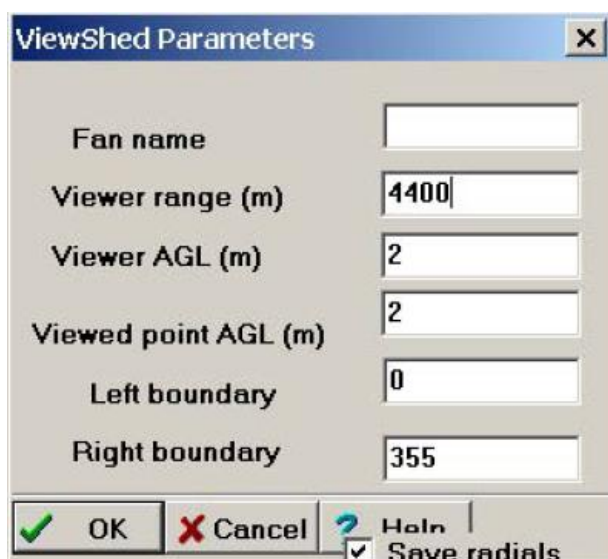


Fig 3—Setting the ViewShed Parameters. Note the “Save Radials” checkbox almost at the bottom of the form. Make sure it is checked. The “fan name” at top is optional.

This whole procedure takes about 5 seconds on a 1 GHz Pentium 3 computer running Windows 2000 Professional. Note that MicroDEM places the *.PRO files in the subdirectory: x:\Mapdata\MD-PROJ\FANS, where “x:” is the subdirectory you chose on the **Options, Directories** tab. You may want to move these files manually using Windows Explorer to another subdirectory of your choice after you finish working with MicroDEM. Use Windows Search to locate the files if they are not in this directory (search for .pro files). The .pro files are then loaded into HFTA as you need them.