Memorandum

U.S. Department
of Transportation
**Research and
Innovative
Technology
Administration**

Subject: TNM 3.0 Pooled Fund Update

Date: 19 August 08

From: Aaron Hastings

Reply to Attn. of: RTV-4F

To: Mark Ferroni

Review of Pooled Fund Task Items

The following five items have been cited by the pooled fund participants as being highly desirable updates for version 3.0 of the Federal Highway Administration's Traffic Noise Model (FHWA's TNM):

1) Barrier Reflections
2) Multi-lane Tools
3) Basic DXF Import
4) GIS Import / Export
5) Enhance Contour Capabilities

This update provides information about the direction that TNM 3.0 development is heading related to these five items. Because TNM 3.0 is still being developed all items discussed here should be considered tentative. Further, the graphic examples included are intended to indicate possible graphic abilities and do not necessarily represent the final graphics style for TNM 3.0.

Of the five items, ***Barrier Reflections*** is the only core acoustics item and is the most complicated update to implement. The data structure / framework for barrier reflections exist in TNM v2.5 code, however, the functionality needs to be completed and validated before it can be activated. Additionally, as with all core acoustics algorithms, *Barrier Reflections* will need to be re-implemented in C# for use in TNM v3.0.

Multi-lane Tools will be a set of Graphical User Interface (GUI) enhancements accessible through the plan view and the menu toolbar which will facilitate the creation of multiple lanes from a single lane. The level of automation will be dependent on available resources. Some automation issues include the determination of appropriate radius of curvature for multiple-lanes; the assignment of different ground types for medians, roads, and shoulders; and automatic distribution of traffic

among lanes. Automatic traffic distribution may include applying the same volumes to each lane or applying different percentages of heavy trucks to travel and passing lanes. Example dialogs for the multi-lane tools are shown in Figure 1 through Figure 3. To date, prototype dialogs inputs have been developed and multi-lane functionality has been generated, however, implementation is still experimental.

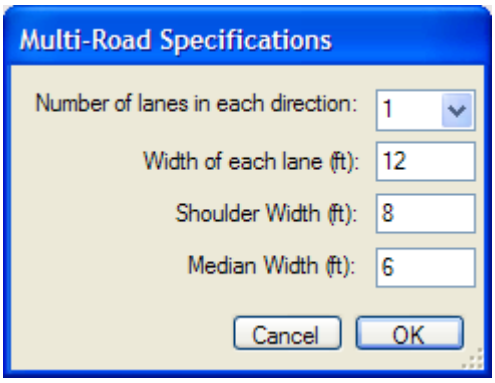

Figure 1: Simple dialog for creating multiple lanes

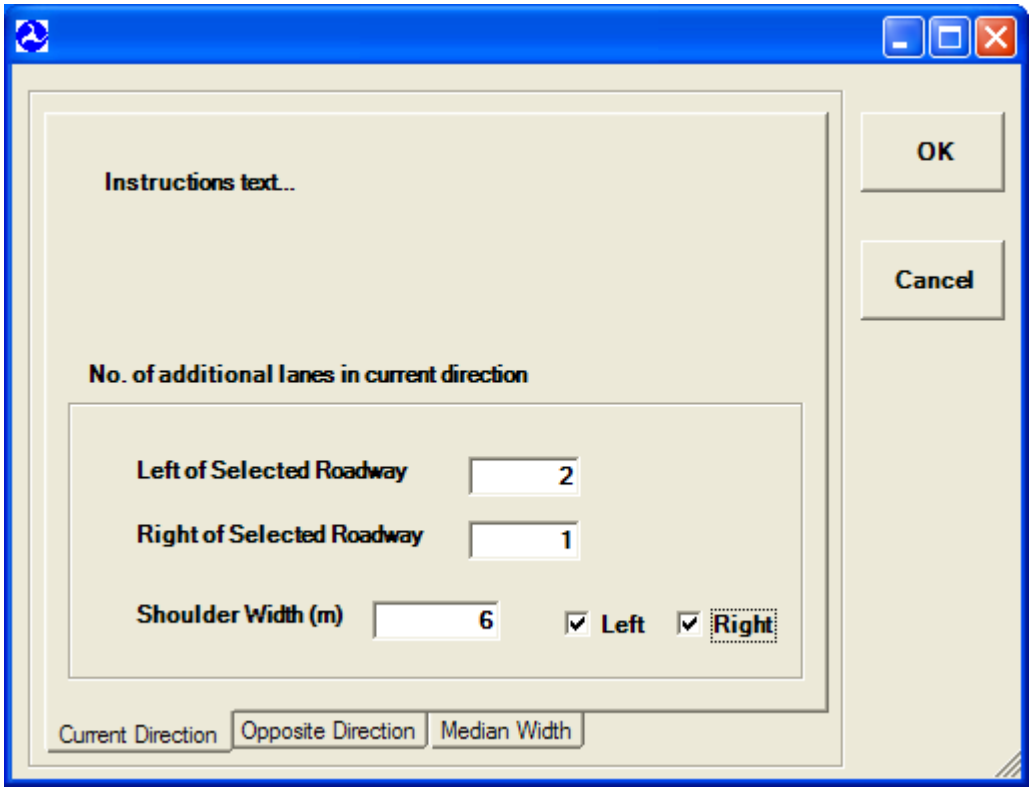

Figure 2: Advanced dialog for creating multiple lanes – Current Direction

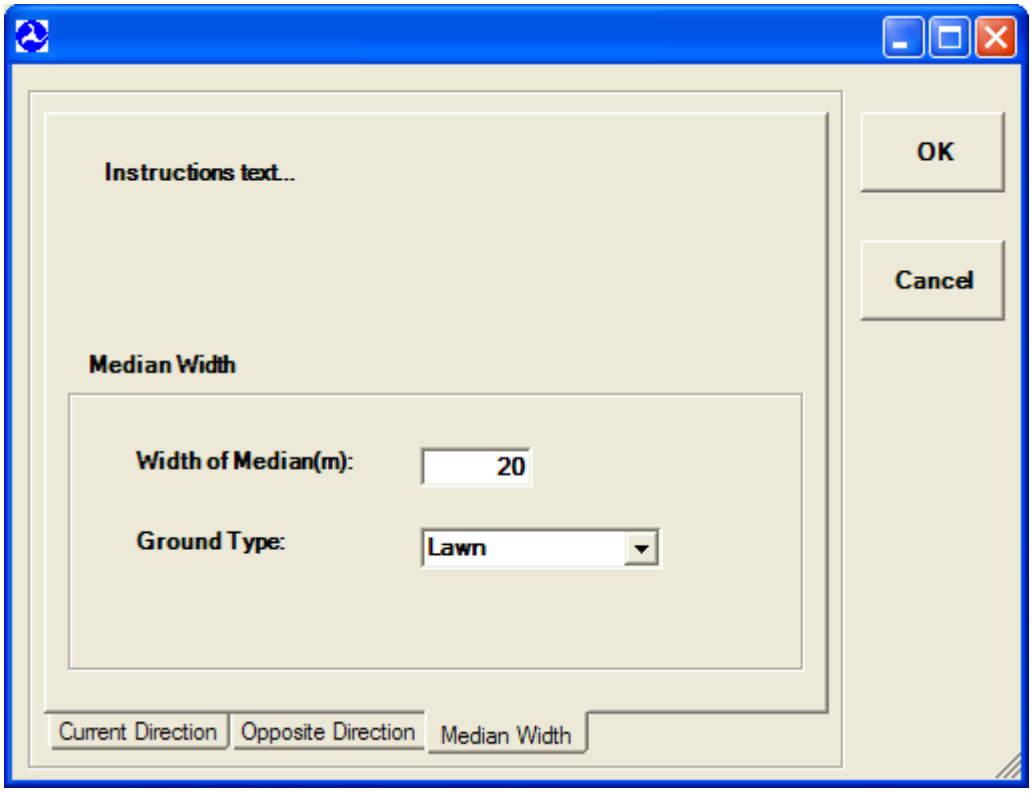

Figure 3: Advanced dialog for creating multiple lanes – Median Width

Both *Basic **DXF Import*** and ***GIS Import / Export*** will be implemented by use of a 3rd party application. The Manifold Geographical Information System (GIS) Application Programming Interface (API) is the primary tool under consideration for implementing this functionality. This API provides over 100 import filters and about 50 export filters. A sample list of filters that may be included in TNM v3.0 include[1,2]:

- USGS Digital Orthophoto Quadrangle, .doq, .coq, .jpg
- USGS Digital Raster graphics (scanned maps) in .tif format
- JPEG, .jpg, .jpeg
- Regular .tif, .tif with .tfw "world files", etc
- ESRI .adf format, also sometimes called ArcGrid format. Note that .adf files can contain either raster or vector data
- AutoCAD versions 13, 14, and 15
- Google Earth "Keyhole" KML and KMZ
- ESRI ArcView, including 3D and measured Shapefiles
- USGS Digital Elevation Module
- USGS DEM using Spatial Data Transfer Standard

[1] TNM v3.0 will focus on importing only the formats most useful to TNM users.
[2] Manifold's import capabilities do not support Microstation file formats natively. If an additional 3rd party application can be found to implement Microstation in a timely manner, then it may also be included in the import

For a more complete list of file formats that can be imported / exported using Manifold, please see http://www.manifold.net/info/formats.shtml.

Contour Capabilities will be improved in two ways: (1) by providing tools to export TNM models and results to GIS, and (2) by providing enhanced graphics within TNM itself. Graphics will be enhanced by utilizing a 3rd party API. Again the Manifold API is the primary tool under consideration. The Manifold API provides a rich set of graphical tools which will not only benefit contours but will also provide greater capabilities for rendering the plan, skew, and perspective views. A sample of some contouring capabilities in Manifold is shown in Figure 4. Additional discussion of Manifold's abilities and cost will be discussed below.

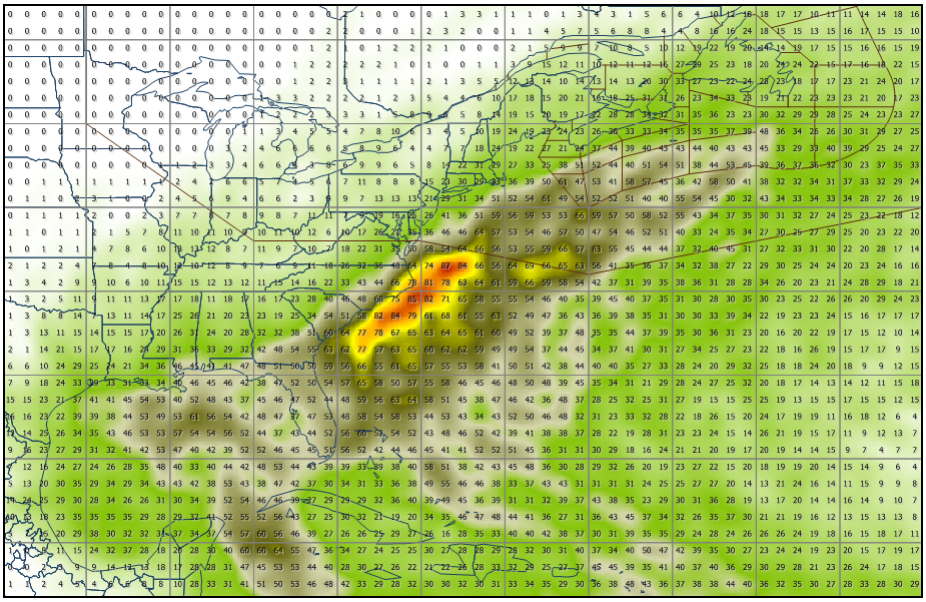

Figure 4: Sample contour graphics in Manifold (A frequency analysis of North Atlantic basin hurricanes for the period 1851 to 2005. More intense color shows more frequent hurricanes.)

Manifold Capabilities

Manifold is a Windows based GIS application that also provides API tools for developing standalone GIS features such as GIS related file import/export, GIS related graphical display, and GIS computations (e.g. shortest distance, equidistant, and Line-of-Sight (LOS) blockage computations). An abridged listing of some file import/export was given above. Graphic samples are given in Figure 4 to Figure 15. Some of these samples show graphics that are immediately desirable for TNM. For example, Figure 4 shows advanced contouring abilities and Figure 6 shows a method of generating very realistic looking perspective views for examining LOS blockage. Other samples show graphics which may prove to be useful in the future, either for analysis or for public presentations. For example, graphic features in Figure 11 may be useful for generating presentation graphics and the bar chart in Figure 15 may be useful for quickly indicating levels at various receiver locations. A complete listing of Manifold's functionality can be found at http://www.manifold.net/doc/manifold.htm. Initially, only the functionality that is useful for

implementing existing and proposed[3] TNM graphic functionality will be utilized. If it is feasible, additional functionality will be added later in the development cycle.

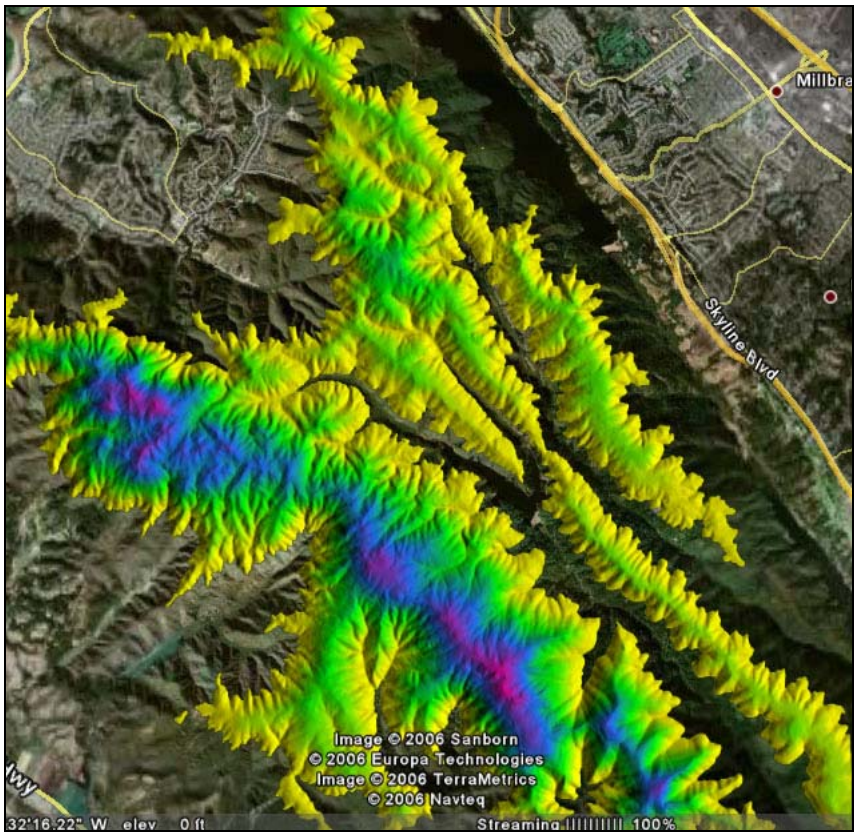

Figure 5: Elevation contour overlaid on imported orthophoto.

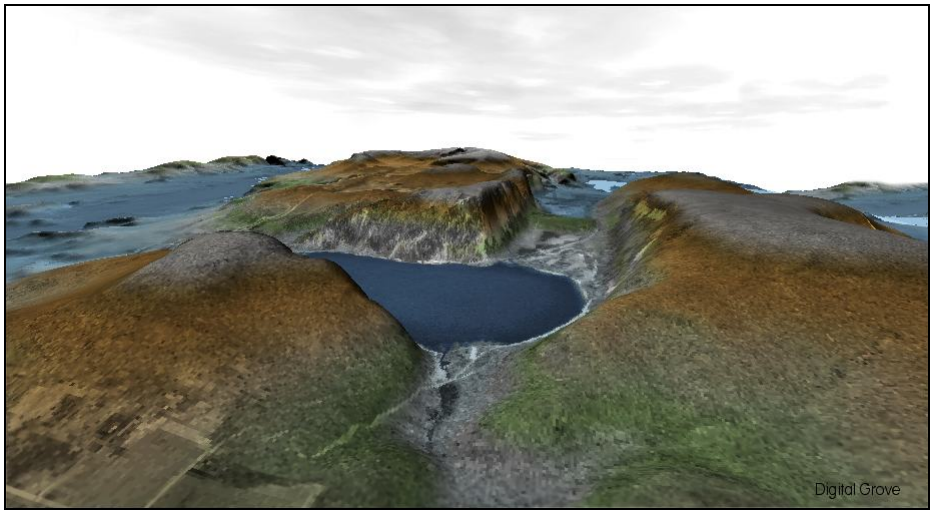

Figure 6: 3D terrain view. Includes a synthetic 3D terrain created by manifold from USGS DEM data and an overlaid orthophoto.

[3] See "TNM version 3.0 Potential GUI and Functional Updates.doc"

Figure 7: Landscape planning for a road surface.

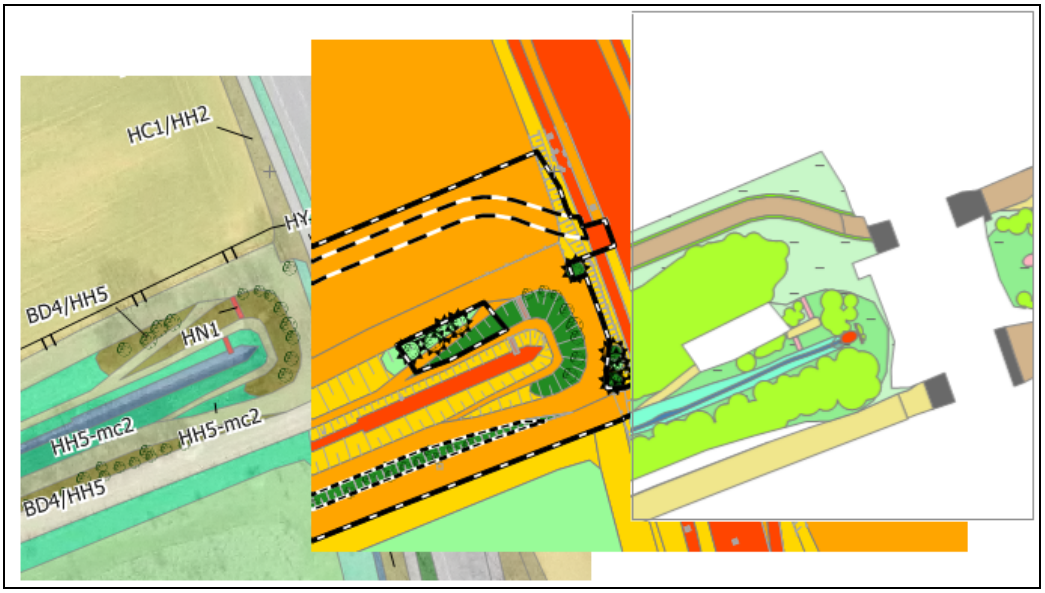

Figure 8: Landscape planning process shows the process of creating the previous figure.

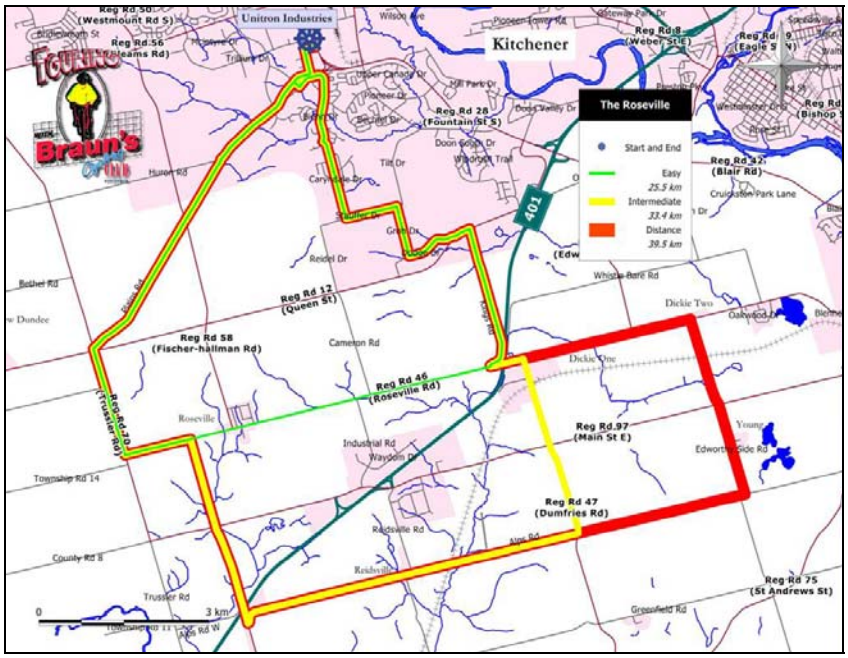

Figure 9: Simple route generated in Manifold with an underlying imported map image.

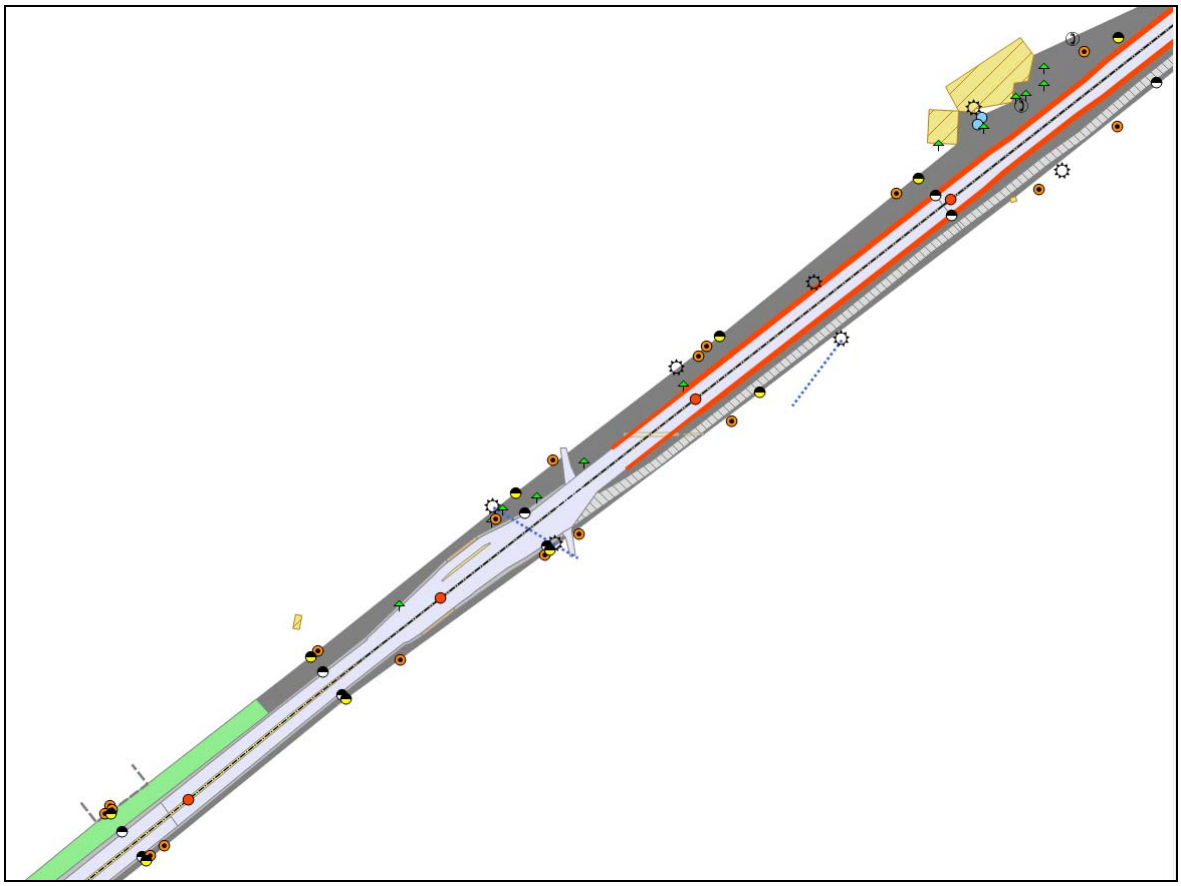

Figure 10: Road Asset Inventory. Note icons to indicate the various assets.

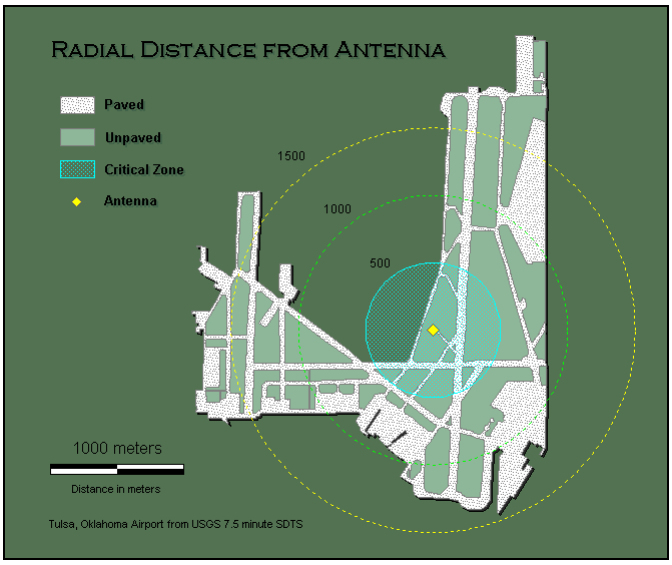

Figure 11: Graphic showing use of labels, legend and other simple features.

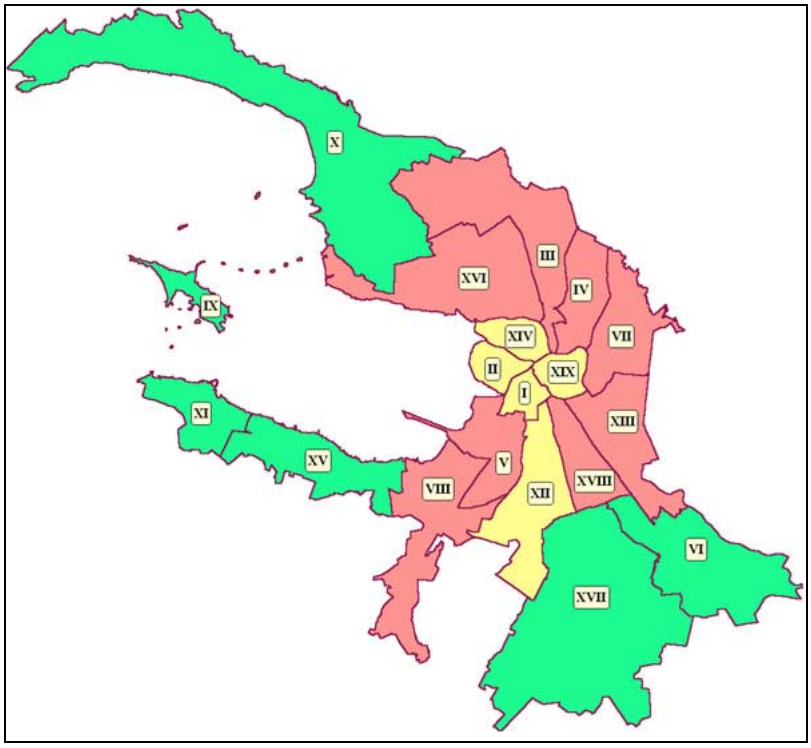

Figure 12: Sample map (A) of St. Petersburg.

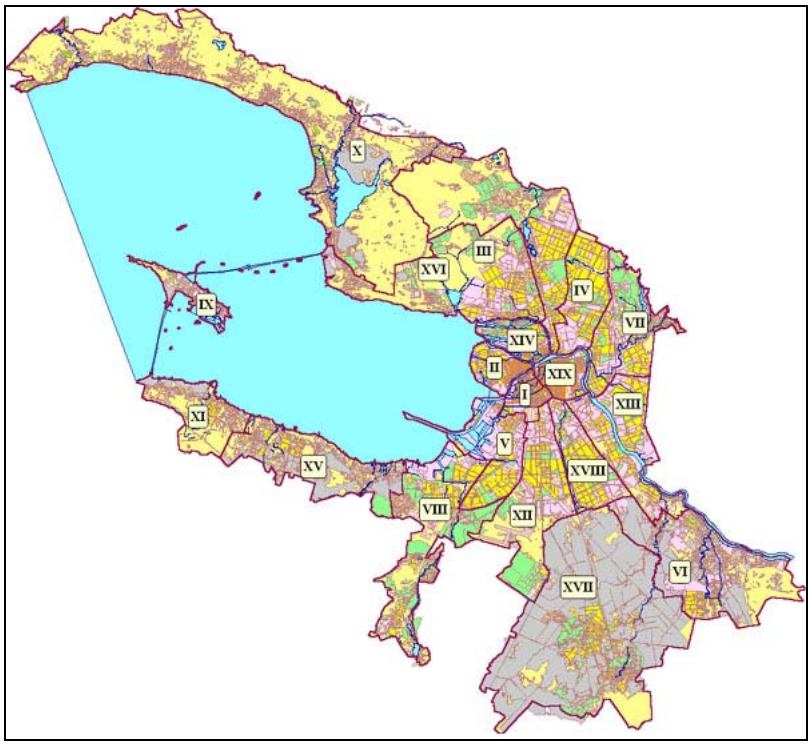

Figure 13: Sample map (B) of St. Petersburg.

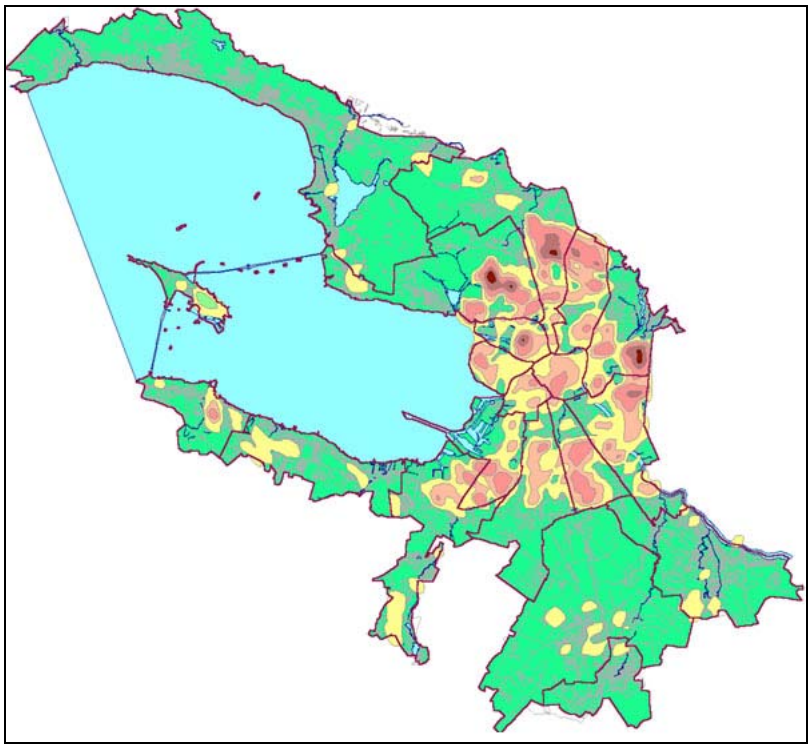

Figure 14: Sample map (C) of St. Petersburg.

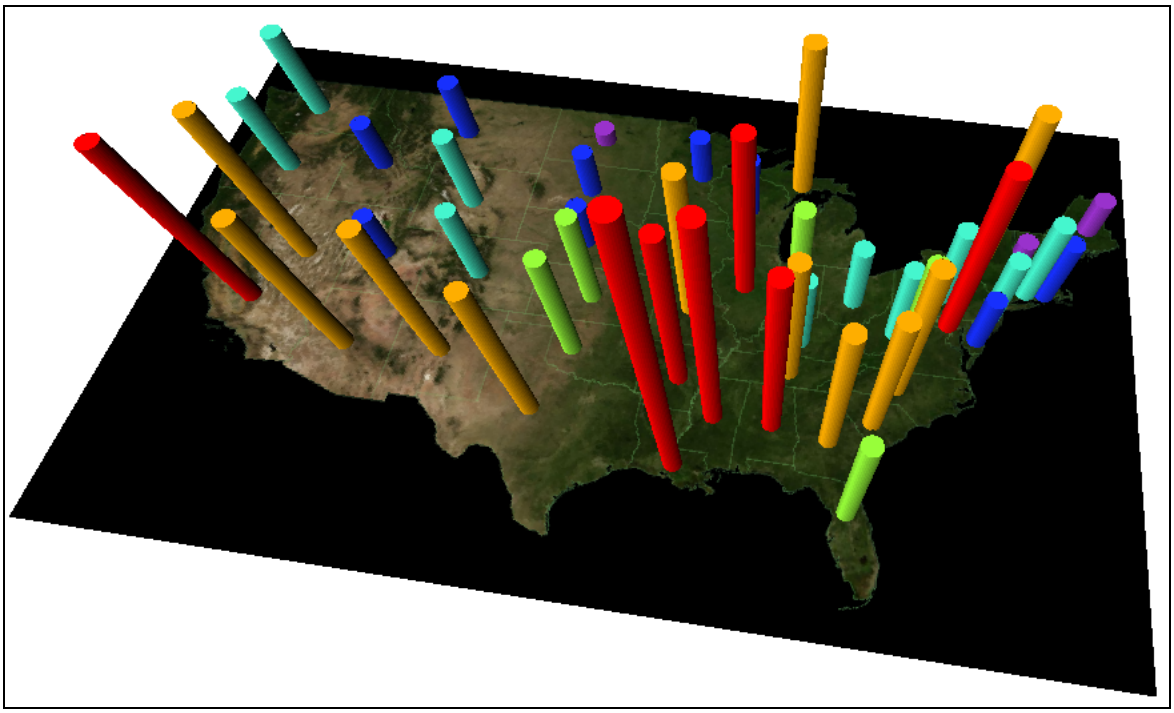

Figure 15: 3D bar chart overlaid with flattened terrain map.

Manifold Licensing

Historically, TNM has been provided as a site license, that is, anyone at a given site could use TNM provided that the site had at least one TNM license. The use of Manifold API will require a transition to a site-seat license hybrid due to Manifold's licensing policy, that is a single site license will be required for TNM, but then a separate seat license will be required for each computer that is capable of running TNM. For example, say a site had three users running TNM on their desktop computers, then the site would need to purchase one TNM site license and three Manifold seat licenses.

Licensing Caveats

Manifold allows the same license to be installed on a single computer up to 5 times, thereafter the license can no longer be used to install Manifold's .dll. It is not permitted to use the multiple installs of a single license to install the .dll on multiple machines for simultaneous use. For most desktop computers, 5 installations should be sufficient to maintain TNM for 5 to 10 years. Assuming that each training course uses new computers, each license could be used for a maximum of 5 courses before the license is used up.