

USGS National Hydrography Dataset Newsletter
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by Jeff Simley, USGS

Keven Roth Retires

Keven Roth, known to many throughout the country for her tireless leadership of the NHD, is retiring from the U.S. Geological Survey at the end of December. Keven was involved in the inception of the NHD in 1992 when the Environmental Protection Agency and USGS decided to develop a single database that would support the needs of both agencies for mapping, geocoding, and geospatial modeling. In fact, the NHD began years before this with Keven's pioneering work with colleagues at the USGS in the development of an object-oriented, feature-based data model and related definitions of features, attributes, and values. This work was the forerunner of the NHD and in many respects the forerunner of the ESRI geodatabase model used by many today. With the USGS-EPA partnership for the NHD established, Keven led the effort to design the business model to support the NHD. Key to this design was the concept that the NHD would be a "living" model, continuously updated by the data users who knew the data best, leading to the idea for stewardship of the NHD. Keven's skill at partnership also came into play when it came time to actually build the NHD. This \$70-million program was far beyond the reach of any one agency, but by bringing together over 50 agencies to sponsor the NHD, Keven found a way to get the job done.

Today the NHD is widely accepted as the single source for hydrography nationwide with virtually all agencies across the country that use hydrography adopting the NHD as their standard. This has been no small feat but made possible through excellent database and program design by a consortium of partners brought together under Keven's leadership. As she retires, the medium-resolution coverage of the United States has been complete for four years now and the high-resolution coverage is well on its way to completion with 80% of the subbasins currently available.

Keven began her mapping career in the 1970's using "manual" GIS to find the best path analysis for powerline routing in North Dakota. Her career has exposed her to many facets of the geography and mapping business, giving her the ability to leave behind such an outstanding legacy as the NHD. Word has it that she will end up in Montana. Many in the GIS community doubt they have heard the last of Keven Roth. We wish her the best. Look out Montana!

Tennessee High Resolution NHD Complete

With the completion of the Lower Mississippi-Memphis subbasin, full coverage of High Resolution NHD for the entire State of Tennessee was achieved on October 31, 2005. The completion of NHD for Tennessee involved several partnerships between the USGS and outside agencies including the U.S. Forest Service (Land Between the Lakes NRA), the North Carolina Center for Geographic Information (CGIA), and the National Park Service (Natchez Trace Parkway). Work began on this statewide effort in 2001 as part of the DOI High Priority Digital Base Program which began to receive requirements for NHD in 2001. The agencies within the Department of Interior continued to lodge requests for high-resolution NHD in Tennessee through the DOI High Priority Program in subsequent years, and along with the NHD production effort in support of Homeland Security over major U.S. cities, combined to complete border-to-border NHD coverage over Tennessee. Tennessee will next need to develop an active data stewardship program that can maintain and update the high-resolution NHD coverage.

New Hampshire High Resolution NHD Complete

Full coverage of High Resolution NHD for the State of New Hampshire was completed on October 8, 2005 with the posting of the Piscataqua-Salmon Falls, ME-NH subbasin. The completion of New Hampshire involved several partnership/workshare agreements between the USGS and its partners including the University of New Hampshire (UNH-CSRS) and the Maine Office of Geographic

Information Systems (ME GIS). In addition, the Vermont Center of Geographic Information (VCGI) has provided local resolution NHD coverage of the western most CU's in the State of New Hampshire. The USGS Water Science Office for Vermont and New Hampshire also played an important role. Work began on this project in 2003. There is strong interest in the state for the stewardship of the data.

Value Added Attributes in the Vermont NHD

The National Hydrography Dataset for Vermont comes from the Vermont Hydrography Dataset (VHD), the only 1:5,000-scale local resolution NHD available in the country. The VHD has become the foundation for building powerful water resources management and modeling capabilities at the state, regional, local and private sector levels. To extend the utility of the VHD even further, the data has been enriched with "value added attributes" in order to improve a user's ability to analyze, navigate, display and select various hydrographic features. This additional attribution will increase the value of the data for both researchers and planners. The NHD Value Added Attributes (VAA's) are a set of 20 new attributes that are computed from the NHD flow table and assigned to each flowline in the stream network. The VAA's are designed to enhance the capabilities of NHD in three areas: 1) navigation; 2) analysis; and 3) display. The native NHD allows downstream/upstream navigation using a geometric network or a flow table of sequenced flowlines. The flow table allows more sophisticated navigation and this approach is employed with the VAA's. With the VAA's, three additional traversal methods are supported that allow even more powerful navigation that make NHD applications easier to implement and faster to process. These are: 1) SQL queries - a set of attributes that enable navigation both up and downstream with relatively simple SQL queries. The use of SQL queries to navigate the NHD makes large scale navigation feasible in interactive and web mapping applications. 2) From/To Nodes - A number of existing models, such as USGS/WRD's SPARROW model, use node navigation. The nationally unique from and to nodes in the VAA's support this; and 3) "Substance" routing - using the nationally unique hydrologic sequence number and several other related attributes, a very compact routine can be written to route up or down the stream network using the VAA's. This is useful in applications such as dilution modeling and impact assessment. These attributes can also be used to quickly determine whether two points on the network are on a flow path and which point is upstream. The analysis attributes are varied in their purpose. There is a unique identifier assigned to each stream from headwater to mouth which can assist in analyzing a complete stream or in relating older river mile index data to the NHD. Strahler stream order is assigned to each feature in the network providing this popular attribute for subsetting streams by size. There is a unique identifier assigned to each independent network and there is an attribute that provides the distance from the current feature to the network terminus. Finally, there is an attribute that provides the number of stream miles upstream of the current feature. For display applications, there is one attribute specifically designed to improve performance of large mapping applications particularly where internet connectivity band-width is concerned. This attribute is called Thinner and is used to display increasingly more dense stream networks as the application zooms in on the map. For more information, see http://www.vcgi.org/about_vcgi/?page=../projects/vaa/default_content.cfm.

Projecting the NHDinGEO

Projecting the NHDinGEO using a map projection has now been made incredibly easy thanks to the U. S. Department of Agriculture Forest Service. In the past, the NHDinGEO was somewhat hard to project because when using ESRI's ArcMap properties function for projection the NHD network would break. A suitable workaround was developed but this was somewhat labor intensive. Now the U.S. Forest Service NRIS folks in Corvallis, Oregon have made it possible to use the full suite of easy-to-use ArcGIS map projections and datum transformations. The process uses a custom toolbar that is added to ArcCatalog. The installation of the toolbar has also been made easy using an executable. To project the data, the user simply goes into ArcCatalog, highlights the NHD geodatabase they wish to reproject, then clicks on the Reproject button in the toolbar, then simply name an output geodatabase and click okay. Next drive through the familiar ArcGIS projection dialog windows and initiate the projection. A popup window lets you know when the projection is done. In testing this on a subregion size dataset of 50,000 flowlines and

30,000 waterbodies, the process took 18 minutes. However, a subbasin-sized dataset of 5,000 flowlines took three minutes. The procedure requires that the network be dropped in the course of the dialog windows. This means you need to rebuild the network using an available NHDinGEO network builder. The USFS Reprojection Tool will soon be available at <http://nhd.usgs.gov/applications.html> and the network builder at <http://nhd.usgs.gov/tools.html>. The USFS Reprojection tool can also be used to reproject any personal geodatabase as long as all of the feature classes share the same spatial coordinate system. The tool includes good documentation to help you with the process.

Answer to November Hydrography Quiz / December Quiz

Tom Denslinger from the Pennsylvania Department of Environmental Protection was the first to guess the location of last month's hydrography quiz as Boston Harbor on the coast of Massachusetts (see <ftp://nhdftp.usgs.gov/Quiz/Hydrography6.pdf>). About 25 people sent in the correct response, a big turnaround from the two that correctly guessed the previous month's Susitna River in Alaska. Tom is Chief of the Water Use Management Section in the Division of Water Use Planning. His work involves the water rights program for public water suppliers using surface water. Tom worked with Pennsylvania's DEP Stream File before incorporating the NHD. For those of you familiar with Boston Harbor, you may have recognized that the shape of the harbor in the quiz looks a bit odd. In fact it looks flattened vertically or stretched out horizontally. This is because the map was not projected. To see the projected view of the harbor see <ftp://nhdftp.usgs.gov/Quiz/Hydrography6P.pdf> (with a central U.S. prime meridian). Because Boston is at 42 degrees north latitude, the lines of longitude converge to about 75% of what they are at the equator (the cosine of 42 degrees). The map in the quiz looks stretched out because there was no convergence in this unprojected view. A map projection of the NHD, now made incredibly easy as noted in the article above, can provide a "nearly" correct view. You may also have noted the relative sparseness of hydrography over the Boston metropolitan area. This sparseness over urban areas is very common in the NHD because the source maps used to make the NHD did not show hydrography routed underground through culverts, a common practice in urban landscapes. Also, the large density of cultural features on the map caused the cartographers to keep the hydrography thinned to prevent clutter on the map. In the future, the USGS hopes to incorporate urban storm sewer databases into the NHD to provide a more complete urban flow system.

The December quiz is located at <ftp://nhdftp.usgs.gov/Quiz/Hydrography7.pdf>. Can you identify where this is? Again, it appears to be a harbor. The inland blue lines and polygons are streams, lakes, and double-line streams, while the green polygons are marshes and orange lines are canals. The lighter cyan-blue is sea-ocean. The tan shaded areas are foreshore (tidal zones), and the tucsan red lines are non-earth shoreline. The black lines are water pipelines. Send your guess to jdsimley@usgs.gov.

Upcoming NHD Workshops

Salem, Oregon – January 23 & 24, 2006. Contact Nancy Tubbs at ntubbs@usgs.gov.

Olympia, Washington – January 25, 26 & 27, 2006. Contact Sam Bardelson at stbardelson@usgs.gov.

Lafayette, Louisiana – February 15, 2006. Contact Pat O'Neil at pat_oneil@usgs.gov.

Phoenix, Arizona – March 1, 2006. Bureau of Land Management.

Arkansas, Missouri, Kansas, West Virginia, Pennsylvania, New Jersey, and Michigan workshops are planned for the future.

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The NHD Newsletter is published monthly. Get on the mailing list by contacting jdsimley@usgs.gov.

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Jeff Simley, USGS, assumes full responsibility for the content of this newsletter.