USGS National Hydrography Dataset Newsletter
Vol. 14, No. 4, February 2015
by Jeff Simley, USGS

NHD Standards Review

The NHD Advisory Team met on February 10, 2015 to review the NHD Standards and explore any aspects to those standards that need improvement. The NHD standards are implemented on-line in the form of the NHD Data Model found at http://nhd.usgs.gov/NHDv2.2_poster_062614.pdf, which lays out the data structure in a graphic form and the NHD Feature Catalog found at http://nhd.usgs.gov/userguide.html?url=NHD_User_Guide/Feature_Catalog/NHD_Feature_Catalog.htm. Embedded in the Feature Catalog are (1) the data structure, (2) field definitions, (3) feature definitions, and (4) the Feature Template composed of (i) delineation rules, (ii) capture conditions, (iii) attribute information, and (iv) source interpretation guidelines.

Several items were found to be in need of improvement:

(1) Access to the NHD Feature Catalog described above needs to be more visible and intuitive to make sure data users have access to and can utilize this information.
(2) Positional Accuracy – Positional accuracy is governed by the National Map Accuracy Standards (http://nationalmap.gov/standards/nmas.html), which is based on the concept of "well-defined" points. Hydrography, by nature, generally doesn't have well-defined points. However, if a large number of points are collected and the mean calculated, this can suffice for a well-defined point. Implementing this practice to provide a practical solution for positional accuracy needs to be developed.
(3) Stream Classification – At relatively small scales most streams tend to be perennial and are fairly well-defined by stream banks. As the scale of mapping becomes larger it includes more intermittent streams, and at even larger scales such as those we are seeing with lidar, it includes many more ephemeral streams. These streams are much harder to define with consistency. Good standards are needed to address this situation
(4) Metadata – Metadata and the NHD were made for each other. Often, hydrographic features need background descriptive information and the feature-level metadata of the NHD is perfectly suited to fill that need. Yet the implementation of metadata in the NHD may fall short of its potential. Good guidance on metadata can help.
(5) Feature-to-Feature Rules – The relationship of features to each other is an important part of the geographic organization of features representing the landscape. This is built into the update software and also needs to be accessible to users. Fortunately an answer is at hand at http://usgs-mrs.cr.usgs.gov/NHDHelp/FeatureRules/feature_rules.htm.
(6) Stream Density – As we develop the NHD in the "quilt" environment in which collections of data maintenance are pieced together, the concept of varying densities of stream content become very evident. At the root of the issue is the criteria used to collect the streams, which can vary based on the requirements of the data steward. The result of varying criteria is varying density. Good standards are needed to guide data stewards on the rationale for including streams.
(7) Multi-Scale Guidance – The Feature Template described above defines the dimensionality of hydrographic features based on the concept of scale. For example, when working with 1:24,000-scale data the minimum width of a polygonal stream is 50 ft. At 1:4,800-scale the minimum width becomes 10 ft. This works as long as scale is well-defined, but in the era of GIS, lidar, and digital imagery, the concept of scale is often lost. Good hydrography standards can help better guide users on feature dimensionality in light of an industry that is becoming more "scaleless".

Hydrography Seminar Series

The last NHD Newsletter described an upcoming hydrography seminar series. On the eve of launching these seminars it was decided to reformat the series. The original concept was to linearly address the development of the NHD and WBD into its form as it exists today. Instead, a revised approach will focus on applications of the NHD and WBD. The March NHD Newsletter will provide more details.

NHD Metadata returns to ArcCatalog by Keven Roth

The general NHD metadata disappeared a while back from the ArcCatalog "description" tab. It has magically reappeared. Many users are not aware of this metadata and how it relates to the NHDMetadata table that is part of the data model, so here is a refresher.

The NHD was originally created using USGS DLGs, USFS CFFs and other similar source data that were typically based on the USGS Topo Maps. The process to create the NHD was the same for the whole country. The characteristics of the original NHD were consistent, so one metadata file for the entire NHD was acceptable. This metadata is associated with the feature dataset "Hydrography". In ArcCatalog, select any Hydrography feature dataset and click on the "description" tab to view the general NHD metadata.

In addition, the NHD took a bold step by providing feature-based metadata. The NHD was not designed to be maintained as part of a "national" program. It was designed to be maintained by local data stewards. That meant there needed to be a way to create metadata for irregular and ad hoc groups of features. The NHD data model contains a table called NHDMetadata and it contains all the required metadata fields with the exception of the Identification Information, which is maintained in the general metadata. It doesn't "look" like the typical metadata, because these are just the data elements – the elements that actually have values and text. The section headers and compound elements have been stripped out. To complete the metadata for a particular dataset, these data elements may be added to the general metadata. But this metadata does not apply to the whole dataset – it only applies to the features that have been added, revised or modified. The only way to discover which of the features belong to which metadata record is to link the metadata records to the individual features. The NHD data model contains three pre-built relationship classes to make this easy.
The easiest way is to identify any individual feature and see what metadata applies. If you click on the + next to the feature in the identify window, you will see 1DFToMetadataToFeature. That is short for a 1 dimensional feature (flowline) to the metadata table to the feature. Just keep clicking on the + signs and you will get the various metadata process descriptions that exist for that feature. You can also select a group of features and use the pre-built relates to find the metadata records associated with that group, or you can select a particular metadata process description and use the relates to find all the features that are associated with that metadata record.

The NHDMetadata table must be completed when any changes are made to a dataset. It has been a little hit or miss up to now, but we hope to provide more complete guidance on what needs to be included.

Official release of new HEM tool for ArcGIS 10.2.2 by Mike Tinker

HEM 2.7.2.0 for ArcGIS 10.2.2 and NHD model 2.2 is officially released! For those who don't know yet, the Hydrography Event Management (HEM) Tool provides full functionality for adding, editing, and tracking events indexed to the NHD. Events are external scientific data linked to the NHD by the ReachCode and measure of the NHDFlowlines. The ability to link external scientific information to the NHD is central to the NHD model. HEM tool can index point and line events to NHD flowlines, and index polygonal area events to NHD waterbodies. HEM events utilize the NHD schema and follow the

NHD metadata model, so event history and edits can by tracked. The tool also provides network measuring capabilities to determine distances through the NHDFlowline network. This release of the HEM tool is for ArcGIS 10.2.2 and NHD model version 2.2. The tool can be downloaded from the NHD website at http://nhd.usgs.gov/tools.html or from the Hydrographic Data Community HEM Tools page at https://my.usgs.gov/confluence/display/hdc/HEM+Tool+Downloads. (You will need a MyUSGS.gov account to access the HDC pages.)

Announcing the release of the NHD GeoConflation tool 2.0 by David Anderson

The USGS is proud to announce a new release version of the GeoConflation tool. The tool is a re-implementation of the previous AML-version of the conflation tool with several major enhancements including:

- Complete removal of dependence upon ArcInfo Workstation and AML scripts
- A redesigned and more user friendly Queued Edit Reviewer
- Enhanced spatial matching tolerance specifications more acceptable to present conflation efforts (and adjustable by users)
- Simpler workflow steps to follow
- Support for NHD model 2.2 and ArcGIS 10.1 (with an ArcGIS 10.2.2 in the works)
- New documentation released as well

The next task is to begin training. The current plan is to hold three types of training: (1) A Pre-Conflation preparation course designed to work with users considering conflation will be held quarterly starting in March/April time frame, (2) A training session will deal with the GeoConflation tool itself and performing the necessary steps to complete that part of the process. (3) The last training session will deal with Post-Conflation processing (XML transaction). These training sessions will be announced through the GeoConflation Tool product blog and Hydro Community Events calendar on the MyUSGS Hydrographic Data Community (https://my.usgs.gov/confluence/display/hdc/Hydrographic+Data+Community).

Beyond this, there are several other ongoing research efforts, planning decisions, NHD model investigations, and simplified business rule investigations ongoing to determine the best method for moving forward with conflation. With the introduction of many states collecting lidar and ifsar elevation datasets and wanting to extract higher than 1:24,000-scale resolution hydrographic data, the will need to enhance the toolset to do even better matching and conflation of information across the board. As these items will affect users going forward, the USGS encourages everyone to participate in the NHD Advisory group, the Technical Exchange Meetings for the tools, and any other steward oriented activity.

Many people have been involved in this re-implementation and each has contributed a lot of good content to the current effort. The USGS development team has done a stellar job going from one-person effort to a team effort over the last year. They have transitioned to an Agile method of coding multiple projects, including GeoConflation. The user acceptance testers did a great job in tracking down specific issues with the tools.

Navigating in a Projected View

It is now possible to use Utility Network Analyst in ArcMap to navigate the NHD in a projected view. This was done using ArcGIS 10.2.1. Not sure when this first became available. In the past it was not possible to conduct geometric navigation when the NHD data was projected.

Nationwide QC Pass of all Point Events by Mike Tinker

Starting now, NHD plans to use the HEM tool to synchronize the existing point events in the NHD. During the normal course of editing the NHD, flowlines can be moved, deleted, or assigned new ReachCodes. This can sometimes orphan the point events that were attached to the flowline. The USGS plans a comprehensive sweep of all point events in the NHD this Fiscal year. The USGS will synchronize all existing USGS stream gage point events, and add new ones from the national Water Information System (NWIS). The USGS will also synchronize all existing dam events, and add HUC8 hydrologic unit outlets

Hydro Hierarchy in the Applications Prototype Lab

A blog in the Esri Applications Prototype Lab, see http://blogs.esri.com/esri/apl/2015/02/09/hierarchy/, provides a look at an amazing application using the NHD to instantly navigate the NHD for the nation. Go to the link and click on the "Click *here* to view the live application." If you are not absolutely amazed you can get a refund.

February 2015 Status Report for NHD Network Improvement Project by Cynthia Ritmiller

Highlights:

- Region 06 data was provided to the NHDPlus contractor in January. This data was required for testing of their system but also provided another quality control check before high resolution NHDPlus would be created. The data was reviewed and edits in subregions 0601 and 0604 were completed.
- Edits within region 10 are over three quarters of the way complete.
- The last remaining subbasin in region 14 edits was reviewed.
- Preparation of the NHD Geodatabase for the NHDPlus contract is still occurring in Region 01, 02 and 12. Region 02 will be reviewed next.

Details:

- Initial Phase Network Improvement
    - Remaining: Region 19 (Alaska) is being completed as part of the Hydrographic Image Update project using the 2012 Horizon Systems QA/QC check results.
    - Initial Network Improvement Regions Completed: 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, and 22.
- Double Check Phase Network Improvement- Status
    - Region 01- Working within the next few weeks to clean up as many subbasins QAQC checks have already been run. Most of the work are in sub-regions 0105 and 0108. Some of Sub-Region 0108 has about 1,500 lakes without reach codes and these Sub-Basins will need to wait for a new tool update before assigning.
    - Region 02- new pre-staged Sub-Regions were received. QA/QC checks will need to be run and subbasins will then be assigned.
    - Region 03- Sub-basin 03070205 was completed. Sub-regions 0308-0318 have been through QAQC but still need reviewing. Will complete these edits working with our partners schedules'.
    - Region 04- Ready for double checks, QAQC checks were run and POC's have been contacted. Will begin reviewing the region within the next few weeks.
    - Region 05- Reviewing sub-regions 0512 and 0514.
    - Region 06- Data was provided to the NHDPlus contactor in January. This data was required for testing of their system and a final QC before HR NHDPlus will be created. The data was reviewed, and edits were completed in subregion 0601 and 0604 were

completed. Once new pre-staged Sub-Regions are received the QA/QC checks will be ran and another copy of data will be sent to Horizon Systems for the creating of HR NHDPlus within this region.

- Region 07- completed double check phase in May
- Region 08- needs to go through the Double Check phase. Before starting the Region the POC in the area will be contacted.
- Region 09- completed double check phase in September
- Region 10- was run through QA/QC checks and now completing double checks.
- Region 11-Ready for double checks, QAQC checks were run and POC's have been contacted. Will begin reviewing the region within the next few weeks.
- Region 12-new pre-staged Sub-Regions were received, QA/QC checks were in January and subbasins are being reviewed.
- Region 13- completed double check phase in July
- Region 14- completed double check phase- One remaining subbasin was reviewed 14020002 within February.
- Region 15- completed double check phase in September
- Region 16 (Great Basin) is almost complete only 3 subbasins remain. Edits will be completed.
- Region 17 -needs to go through the Double Check phase. Before starting a Region the POC in the area will be contacted.
- Region 18 - completed double check phase in May
- Region 19 (Alaska)- Initial Phase Network Improvement in progress see above.
- Region 20 - Completed double check phase in August
- Region 21 - Completed double check phase in August
- Region 22 (Pacific Islands) Sub-regions were re ran through EPA QA/QC check based on the results. Sub-Basin 22010000 was reviewed and fixed.

Note: Regions will be edited as per the NHDPlus contract schedule. Before starting a Region the area POC will be contacted.

The Network Value Added Attribute of the Month

Do you know your VAA's? This NHD Newsletter article is the thirteenth in a series to describe each of the Network Value Added Attributes. The flow network embedded in the NHD is what gives the NHD its analytic power. The Network VAA's boost this power by pre-calculating a number of network characteristics to make network analysis richer and easier to exploit. This month will examine StreamLevel.

StreamLevel is a value that enhances navigation operations. The concept is simple and powerful. All NHD Flowlines draining into the ocean are coded as StreamLevel=1. All flowlines flowing into the Level 1 flowlines are coded as StreamLevel=2. So for example, all flowline segments making up the Mississippi River, from Lake Itaska in Minnesota to the Mississippi River delta, are set to StreamLevel=1. All flowline segments of the Missouri River are set to StreamLevel=2. Then the process continues so that all flowlines that flow into the Level 2 flowlines are coded as StreamLevel=3. So for example, the Platte River flowing in the Missouri, is a Level 3 river and the South Platte River is a Level 4 river. The North Fork of the South Platte River is a Level 5 river, etc. Streams flowing into sinks, such as the Great Salt Lake, begin their coding with StreamLevel=4.

On the Mississippi River when navigating upstream, a convergence will be encountered at the junction with the Missouri River. If you wish to follow the main path, that is the Mississippi River, the correct

choice is to take the next Level 1 flowline. Where streams have no names, the StreamLevel concept is particularly useful.

Within the Mississippi River, if the river splits around an island, with Artificial Path flowlines flowing on both sides of the island, one set of flowlines will carry the name Mississippi River and be coded as StreamLevel=1. The other set of flowines will be coded as StreamLevel=2. When navigating up the Mississippi River, a convergence is encountered at the island. For the purpose of the navigation a choice must be made of which path to take. If you are currently on a Level 1 flowline, the correct move is to choose the next Level 1 flowline. That will keep the navigation route on the main path.

The concept works very cleanly for classic dendritic drainage systems. Where the drainage becomes very complex, such as braided streams, with diversion canals mixed in, the StreamLevel/Divergence system creates order out of chaos. It may be something difficult to encode, but once done, it creates a highly logical stream routing system and makes messy situations adhere to dendritic logic.

NHD Photo of the Month

This month's photo can be found at https://www.flickr.com/photos/usgeologicalsurvey/15317740476/. This is Duckweed Pond at the Riverbend Wildlife Management Area in Georgia. Photo credit: Alan Cressler. Submit your photo for the NHD Photo of the Month by sending it to jdsimley@usgs.gov.

January Hydrography Quiz / New February Quiz

Jason Piwarski was the first to correctly guess the January NHD quiz as the area of the Mississippi River at the confluence with the Iowa River near New Boston, Illinois. See ftp://nhdftp.usgs.gov/Quiz/Hydrography114.jpg. Jason works for the Institute of Water Research at Michigan State University (MSU) as a GIS Specialist. A major component of his job deals with development of online decision support tools for the purpose of improving water quality in the Great Lakes basin. Jason is also performing hydrologic modeling in the southwestern part of Michigan, using the NHD to predict streamflow and water catchment yield under various climate scenarios. He is a recent graduate from the MSU Department of Geography.

Others with the correct answer (in order received) were: Gerry Daumiller, David Straub, Kitty Kolb, Linda Davis, Evan Hammer, Daniel Button, Amy Prues, Ron Wencl, John Griffin, Joanna Wood, Calvin Meyer, David Hockman-Wert, Matt Rehwald, Tom Denslinger, John Kosovich, Jennifer Lanning-Rush, Janet Kellam, and Roger Barlow.

This month's hydrography quiz can be found at ftp://nhdftp.usgs.gov/Quiz/Hydrography115.jpg. This is a major bend on a major river. Be careful you don't fall into any sinkholes. Send your guess to jdsimley@usgs.gov.

Thanks to Keven Roth, Mike Tinker, David Anderson, Esri, Cynthia Ritmiller, and Cindy McKay.
The NHD Newsletter is published monthly. Get on the mailing list by contacting jdsimley@usgs.gov.
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