West Virginia GIS Technical Center
West Virginia University
Department of Geology and Geography Eberly College of Arts and Sciences

October 2, 2018

TO: NHD Stakeholders of West Virginia

FROM: Maneesh Sharma, Project Leader, WV GIS Technical Center, WVU

SUBJECT: Final Progress Report for Updating National Hydrography Dataset (NHD) in West Virginia for areas affected by surface disturbance and hydrologic change. Project funded by EPA Grant OS83585101-0. Project Duration: 10/01/2015 to 09/30/2018

TIME PERIOD: October 2015 - September 2018

Dear NHD Stakeholders:

Here is the final progress report regarding updates to the National Hydrography Dataset (NHD) in West Virginia. Both the National Hydrography Dataset (NHD) and Watershed Boundary Dataset (WBD) are used to represent surface water on the National Map (http://nhd.usgs.gov/). The USGS is the primary steward for NHD, while the NRCS is the principal steward for WBD.

Highlights

- All watersheds checked for stream modification due to surface disturbance with emphasis on coal mining
    - 28,095 stream segments checked
        - 3,494 segments added/replaced
        - 2,509 stream segments modified
        - 1,602 stream segments deleted
- 29 watersheds checked for floodplain error
    - 36,816 segments checked
        - 1,819 segments modified
- USGS has incorporated NHD surface disturbance edits in the national database. Geodatabase for the entire state can be downloaded from the following website.

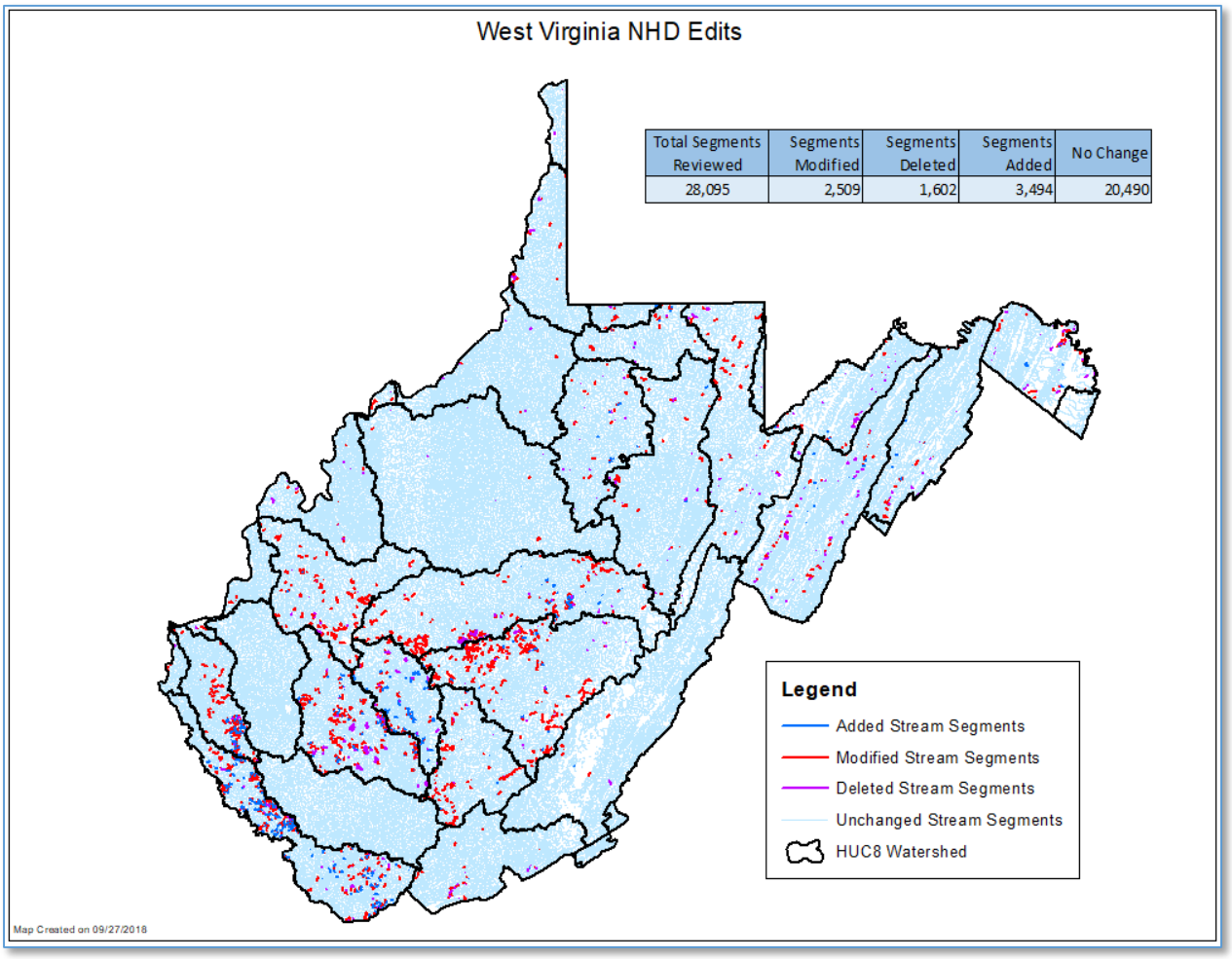
NHD Editing in State

1. Stream segment editing to reflect stream modification due to surface disturbance - Final editing of all watersheds has been completed and 28,095 stream segments have been verified. Water bodies and the stream segments area were revised and modified as needed. A total of 7,605 stream segments have either been digitized, modified or deleted. We have added/replaced 3494, modified 2509, and deleted 1602 stream segments. Table 1 shows the details of work done for each watershed. Figure 1 shows status of edits in each watershed. USGS has already incorporated edits in the national database. For more details about the NHD editing process and methodology see Appendix 1 at the end of the report.

Table 1: Details of NHD edits for reviewed watersheds for surface disturbance

Watershed	Feature Type	Checked Segments	Replaced/Added	Modified	Deleted
LOWER NEW	Stream	950	8	169	32
	Water Body		27	3	8
GAULEY	Stream	2305	126	421	58
	Water Body		520	3	50
UPPER KANAWHA	Stream	1022	73	250	21
	Water Body		75	3	4
LOWER KANAWHA	Stream	1244	2	110	16
	Water Body		0	0	0
MIDDLE NEW	Stream	193	2	42	27
	Water Body		39	1	33
ELK	Stream	1582	88	218	62
	Water Body		165	0	11
COAL	Stream	3132	109	251	179
	Water Body		126	0	0
TWELVEPOLE	Stream	473	235	163	13
	Water Body		192	0	9
RACCOON-SYMMES	Stream	229	0	8	4
	Water Body		0	0	0
BIG SANDY	Stream	23	0	3	3
	Water Body		0	0	0
GREENBRIER	Stream	224	1	9	1
	Water Body		38	1	4
TUG	Stream	1378	588	271	49
	Water Body		327	6	68
UPPER JAMES	Stream	47	0	0	11
	Water Body		1	0	0
WEST FORK	Stream	1139	26	30	22
	Water Body		276	2	231
UPPER OHIO	Stream	76	0	0	2
	Water Body		6	1	11
LOWER MONONGAHELA	Stream	361	11	12	2
	Water Body		57	2	19
UPPER MONONGAHELA	Stream	327	3	21	12
	Water Body		39	10	0
UPPER OHIO-SHADE	Stream	522	2	15	15
	Water Body		17	0	0
UPPER OHIO-WHEELING	Stream	502	0	10	42
	Water Body		7	0	0
LITTLE KANAWHA	Stream	972	2	16	37
	Water Body		1	0	0
LITTLE MUSKINGUM-MIDDLE ISLAND	Stream	667	0	6	24
	Water Body		3	0	0
TYGART VALLEY	Stream	1326	4	50	34
	Water Body		62	0	13
CHEAT	Stream	1088	2	49	104
	Water Body		24	2	2
NORTH BRANCH POTOMAC	Stream	862	4	12	55
	Water Body		27	1	28
SOUTH BRANCH POTOMAC	Stream	2760	16	50	110
	Water Body		9	0	16
YOUGHIOGHENY	Stream	91	2	0	2
	Water Body		7	1	4
CONOCOCHEAGUE-OPEQUON	Stream	883	6	45	71
	Water Body		53	5	22
CACAPON-TOWN	Stream	800	13	18	18
	Water Body		55	0	35

Figure 1: NHD edits (surface disturbance) map



2. <u>Stream segment editing for floodplain errors</u> – We have also worked on editing the stream segments that are outside of the floodplain areas. We used FEMA floodplain polygons to cross-check the stream segments. We checked 29 watersheds and modified stream segments that were outside of floodplain. We reviewed 36,816 stream segments and modified 1,819 segments. Table 2 shows details about editing of stream segments in floodplain.

Table 2: Details of edits for reviewed watersheds for floodplain error

Watershed	MODIFY	NO CHANGE	Total
Cacapon-Town	80	1602	1801
Conococheague-Opequon	25	1076	1127
Shenandoah	0	113	114
Upper Monongahela	106	410	563
Lower Monongahela	57	240	308
Upper Ohio-Wheeling	42	769	825
West Fork	144	1260	1492
Raccoon-Symmes	0	0	4
Lower Kanawha	205	829	1038
Upper Kanawha	230	623	861
Tygart Valley	72	2324	2520
Elk	66	1753	2168
Upper Ohio-Shade	54	1502	1577
Coal	80	1174	1438
Lower Guyandotte	99	1104	1299
Upper Guyandotte	43	690	825
Little Muskingum-Middle Island	15	1348	1427
Little Kanawha	106	3837	4418
Twelvepole	133	813	1042
Tug	127	428	673
Lower New	28	610	688
Big Sandy	16	79	120
Upper Ohio	0	6	7
Youghiogheny	8	77	108
Upper James	0	174	178
Gauley	44	2706	3455
Middle New	12	1094	1273
Greenbrier	17	2032	2454
Cheat	10	2875	3013

3. NHD Editing Feedback – We solicited feedback from stakeholders by using a web application and listserv

   a. Web application for feedback – We published the updated NHD data as a web application for feedback by stakeholders. The web app shows streams and waterbodies in all watersheds in West Virginia. In the web app, stakeholders can click on a segment and add comments about the modifications that needs to be done. Detailed instructions to add comment are also available in the web app. We received feedbacks from reviewers and incorporated the changes in the NHD dataset.

   b. Revisions from DEP – We received shapefiles of flagged NHD stream segments for review from DEP. The shapefiles included stream modifications for landfills, stream modifications for Total Maximum Daily Loads (TMDL), and stream modifications from Technical Applications and GIS unit (TAGIS). Table 3 shows details about the flagged segments received from DEP. We reviewed the total of 322 stream segments across the state. We have modified 219 NHD stream segments, added 18 new segments, and deleted 8 segments. Some other segments in the vicinity of flagged NHD segments were also modified or deleted accordingly. Figure 2a shows a stream segment that was not flagged but we modified as it was going through residential buildings. A pond next to this stream segment was also added. Figure 2b shows the updated stream segment and added pond.

Figure 2a: Non-flagged stream segment in a part of Little Mushkingum Middle Island

Figure 2b: Modified non-flagged stream segment and added pond in a part of Little Mushkingum Middle Island

Table 3: Details of edits received from DEP for all watersheds

Watershed	Shapefile	No. of Edits
Big Sandy	TMDL	3
Cacapon-Town	TAGIS	2
	Landfills	2
Cheat	Landfills	5
Coal	Landfills	2
Conococheague-Opequon	TAGIS	3
	Landfills	4
Elk	Landfills	2
Gauley	TAGIS	1
	Landfills	2
Greenbrier	TAGIS	7
	Landfills	2
Little Kanawha	Landfills	1
	TMDL	37
Little Muskingum-Middle Island	TAGIS	1
	Landfills	1
Lower Guyandotte	Landfills	8
Lower Kanawha	Landfills	6
Lower New	TAGIS	2
	Landfills	3
Middle New	TAGIS	3
	Landfills	2
North Branch Potomac	TMDL	2
Raccoon-Symmes	TAGIS	1
	TMDL	16
South Branch Potomac	Landfills	4
Tug	Landfills	4
Twelvepole	TMDL	26
	TMDL	75
Tygart Valley	TAGIS	2
	Landfills	4
Upper Guyandotte	TMDL	61
Upper Kanawha	TAGIS	2

	Landfills	4
Upper Monongahela	Landfills	5
Upper Ohio	Landfills	1
	TMDL	1
Upper Ohio-Shade	Landfills	2
Upper Ohio-Wheeling	TAGIS	1
	Landfills	3
West Fork	Landfills	5

Future Work

We will continue to update NHD with further edits should we receive further revisions from stakeholders. Please contact me or Kurt Donaldson (kdonalds@wvu.edu) if you have any questions.

Stakeholders

Following is a list of stakeholders in West Virginia

	Name	Email	Agency
1	Todd Fagan	tfagan@jeffersoncountywv.org	Jefferson County
2	Jessica Gormont	jgormont@jeffersoncountywv.org	Jefferson County
3	Jessica Perkins	jessica.d.perkins@wv.gov	WV DNR
4	Jared Beard	jared.beard@wv.usda.gov	USDA-NRCS
5	Wendy Noll	Wendy.Noll@wv.usda.gov	USDA-NRCS
6	Jason Bladow	Jason.Bladow@wv.usda.gov	USDA-NRCS
7	Yueming Wu	Yueming.Wu@wv.gov	WV DOH
8	Douglas Kirk	Douglas.W.Kirk@wv.gov	WV DOH
9	Mike Shank	michael.c.shank@wv.gov	WV DEP
10	Chris Daugherty	Chris.A.Daugherty@wv.gov	WV DEP
11	Elizabeth Byers	Elizabeth.A.Byers@wv.gov	WV DEP
12	John Wirts	John.C.Wirts@wv.gov	WV DEP
13	Patrick Campbell	Patrick.V.Campbell@wv.gov	WV DEP
14	Lisa King	Lisa.A.King@wv.gov	WV DHHR
15	Dustin Lowers	Dustin.E.Lowers@wv.gov	WV DHHR
16	Tony Simental	Tony.A.Simental@wv.gov	WV Office of GIS Coordinator
17	Jacquelyn Strager	JMStrager@mail.wvu.edu	NRAC
18	Katherine Paybins	Chris.A.Daugherty@wv.gov	USGS
19	Craig Neidig	cneidig@usgs.gov	USGS
20	Tatyana Dimascio	tdimascio@usgs.gov	USGS
21	William Smith	wjsmith@usgs.gov	USGS
22	J Sharpe	jbsharpe@usgs.gov	USGS
23	Sam Lammie	slammie@fs.fed.us	USFS
24	James Seay	James.Seay@ky.gov	Kentucky Division of Water
25	Randy Peck	crpeck@mix.wvu.edu	WVGISTC
26	Prgaya Srivastava	prsrivastava@mix.wvu.edu	WVGISTC
27	Kurt Donaldson	Kurt.Donaldson@mail.wvu.edu	WVGISTC
28	Maneesh Sharma	Maneesh.Sharma@mail.wvu.edu	WVGISTC

Sincerely,
Maneesh Sharma
GIS Project Lead
WV GIS Technical Center, WVU
Email: Maneesh.sharma@mail.wvu.edu

Appendix 1

NHD Editing Methodology

The NHD edits were done in two major steps. In the first step, we created a shapefile of flagged stream segments for West Virginia that needed to be reviewed. Streams for verification and modifications were identified using pre-existing reference data from FEMA, WVDEP, WVDOT, and the Natural Resources Analysis Center (NRAC) and WV GIS Technical Center (WVGISTC) located at West Virginia University. The flagged streams denote cases like streams going through highways, streams outside of floodplain, streams course change due to surface mining, braided streams, and streams that no longer exist. For instance, the streams going through highways, bridges, and roads were flagged by intersecting the stream layer with roads layer from WVDOT, the streams in surface mining areas were flagged by intersecting the stream layer with valley fill and permit boundary layers from WVDEP, and the streams outside of floodplains were flagged by intersecting stream layer with floodplain layer from FEMA. All flagged streams were reviewed for each watershed and edits were made accordingly. Review of all flagged stream segments and necessary edits were done using ArcGIS tools and local shapefiles. Specifically, we used the flow accumulation layer, local hydrolines, U.S. Census/WVDOT roads, floodplain layers, permit boundary and valley fill area layers, 3D elevation layer, and best available leaf-off aerial imagery for edits. The edits were categorized into five categories: MODIFY, REPLACE, DELETE, FP-ERROR (floodplain error), NO CHANGE. The segments categorized as MODIFY, REPLACE, DELETE, and FP-ERROR were exported as a separate shapefile to be used for the second step.

In the second step, we used the NHD Update Tool (version - 6.3.3.2) for ArcGIS 10.3.1 for the edits. The NHD production data for each watershed were downloaded from the NHD/WBD steward website (https://usgs-mrs.cr.usgs.gov/usgssteward/). Using NHD tools in ArcMap, the changes were made in the downloaded dataset with the help of an exported shapefile in the previous step. After making the edits and successfully executing a quality control check, the NHD data was submitted back to USGS for further review.

Below is a brief description about some of the modifications that were made in NHD flowlines of the NHD database.

Stream modification in Surface Mining Areas

Figure 1 shows an example of a surface modification due to surface mining. This surface modification has resulted in an altered stream flow pattern. Red lines show the existing stream segments in the NHD database. These stream segments do not represent the correct stream flow. We modified the streams to represent the current flow pattern. Blue lines show the current stream pattern.

Figure 1: Example of deleted and modified stream segments in a part of Gauley watershed

Other example of changes in surface mining affected areas can be seen in Figure 2. This figure represents a flagged stream, symbolized as red line, running in the middle of two side rip-raps in a coal mining area in Coal watershed. Due to the surface disturbance the original course of the stream was changed by creating rip-raps. New stream segments were added to represent the modified flow pattern. These are symbolized as blue lines.

Figure 2: Example of modified stream segments in a surface mining area in a part of Coal watershed

Stream Modification due to Urban Development

Urban development can also cause stream modifications to occur. Typically, these stream segments were either removed or water course completely changed due to the construction in urban or suburban areas. These kinds of stream segments were deleted and new stream segments were added. Figures 3 and figure 4 represent examples of such condition. The deleted stream segments are symbolized as red lines and added or modified stream segments are symbolized as blue lines.

Figure 3: Example of deleted and added stream segments in a part of Little Muskingum watershed

Figure 4. Example of a modified stream segment in a part of Lower Kanawha watershed

In many cases, new stream segments and connected waterbodies were added. These waterbodies include naturally occurring waterbodies as well as human-made waterbodies. Figure 5 shows a newly added stream segment and connected waterbody in a part of North Brach Potomac watershed. The newly added stream segment is represented as blue line. The red lines represent flagged streams for review.

Figure 5: Example of an added stream segment and connected waterbody in a part of North Brach Potomac watershed

Generally, USGS expects stream segment modification if a stream is more than 30 meters away from its actual location on the aerial imagery but, in some cases, the streams were going through the houses or other infrastructures. In such cases, the streams were modified even if they were less than 30 meters away from their actual location. Figures 6 and 7 represent examples of such conditions. The flagged streams are represented as red lines and modified streams are represented as blue line.

Figure 6: Example of modified stream cutting through a house in a section of Cheat watershed

Figure 7: Example of modified stream cutting through infrastructures in a part of Cheat watershed