

# NHDPlus

NHDPlus is an enhanced version of the 1:100,000 “medium” resolution National Hydrography Dataset. The NHDPlus is created and maintained by Horizon Systems Corporation with support from the EPA and USGS.

There are two versions of NHDPlus: NHDPlus Version 1 (which is still available, but archived) and NHDPlus version 2. Recommend using/downloading NHDPlus version 2. The unique feature IDs and catchment boundaries have changed between the two versions, so they are NOT compatible.

Website: <http://www.horizon-systems.com/nhdplus/>

Included in NHDPlus Version 2 (from website):

- Greatly improved 1:100K National Hydrography Dataset (NHD)
- Greatly improved 30 meter National Elevation Dataset (NED)
- **Nationally complete Watershed Boundary Dataset (WBD)**
- **A set of value added attributes to enhance stream network navigation, analysis and display**
- An elevation-based catchment for each flowline in the stream network
- **Catchment characteristics**
- **Headwater node areas**
- **Cumulative drainage area characteristics**
- Flow direction, flow accumulation and elevation grids
- Flowline min/max elevations and slopes
- **Flow volume & velocity estimates for each flowline in the stream network**
- Catchment attributes and network accumulated attributes
- Various grids from the hydro-enforcement process including the hydro-enforced DEM.

NHDPlus v2 data are distributed by 2-digit HUC (hydrologic regions). You download datasets for the entire region at once. For example, the entire Ohio river is a single region (05).

## **Notes on downloading:**

- **NOTE: When downloading data, it is best to follow instructions on pg 30/31 of the NHDPlus user guide so that datasets are placed in correct locations.**
- User Guide (here: [http://www.horizon-systems.com/NHDPlus/NHDPlusV2\\_home.php](http://www.horizon-systems.com/NHDPlus/NHDPlusV2_home.php) see link in middle of page). **See first few pages of User Guide for info on how NHDPlus has been recently improved from earlier version.**

### **Datasets to download (useful ones):**

See **NHDPlus v2 Users Guide** for a description of field names/contents in each dataset below.

- **NHD Snapshot** (this includes the NHD flowlines (streams), waterbodies, area features, etc. it is called a “snapshot” because it is not updated as the NHD is updated – it is from a single point in time when the NHDPlus v2 was created (not generally a problem)
- **NED Snapshot** (this includes the NED elevation data)
- **NHDPlus Catchment**: these are the catchment boundaries. They are generally related to the flowlines using FEATUREID (which is same as flowline COMID) and may be joined using those attributes. However, there is not always a 1:1 relationship between flowlines & catchments (not all flowlines will have catchments I think) but usually doesn’t cause an issue, unless you are using “homegrown” routines to navigate the flow network.
- **NHDPlus Attributes**: an attribute table (dbf) that can be joined to the catchments and/or flowlines. Includes lots of useful information, including stream order, whether segment is a divergence or not, cumulative area
- **Vogel Extension**: Includes flow estimates (mean annual flow) for each catchment/flowline
- **Precipitation and Temperature**: mean annual precipitation and mean annual temperature datasets by catchment (note values – see Users Guide). Data from PRISM.
- **NLCD data extension**: NLCD 2011 data have been summarized already by NHDPlus catchments. If this is needed, can be downloaded here: <http://www.horizon-systems.com/NHDPlus/V2NLCD2011.php>.
- **WBD Snapshot**: WBD is watershed boundary dataset (NRCS 12-digit watersheds).

NOTE: Many other datasets are also included with NHDPlus, including hydrologic derivative grids (FAC, FDR etc.) if needed. Note that you can also download the NED by hydro region through the NHDPlus website (this is probably the easiest way to download the NED for a large area, because otherwise you have to download individual tiles, then merge them together.)

MIKE NOTE: There are NHDPlus v2 exercises here: [http://www.horizon-systems.com/NHDPlus/NHDPlusV2\\_documentation.php](http://www.horizon-systems.com/NHDPlus/NHDPlusV2_documentation.php)

## NHDPlus Accumulation Tool

The NHDPlus accumulation tool has been updated to go along with NHDPlus v2 datasets. Download the tool here:

[http://www.horizon-systems.com/NHDPlus/NHDPlusV2\\_tools.php#NHDPlusV2 Catchment Attribute Allocation and Accumulation Tool \(CA3TV2\)](http://www.horizon-systems.com/NHDPlus/NHDPlusV2_tools.php#NHDPlusV2_Catchment_Attribute_Allocation_and_Accumulation_Tool_(CA3TV2))

### **Requirements to use this tool:**

To install the tool, you need a few other things on your computer FIRST. Must be installed in order.

- ArcGIS version 10.1. (The website says the tool has been “superficially tested” on a computer with ArcGIS version 10.2.2. I tested the tool on my computer with ArcGIS 10.2 and could only get the Accumulation portions to work (not the entire tool).)
- Microsoft .NET framework, current version (see download on NHDPlus v2 site)
- Microsoft SQL Server 2012 Express Local DB
- CA3TV2 tool itself.

To USE the tool, you also need to download and place some additional datasets on your computer first.

- NHDPlus v2.1 Accumulation Extension (additional datasets, download the hydro region you need only, place data in correct location with your other NHDPlus data)
- NHDPlus v2.1 Global Data

Once installed, the tool will be an independent program on your computer, accessed through the Start button (NOT through ArcGIS). See the “Help” menu choice in the program itself for more details (no manual on website).

### **Purpose of this tool (CA3TV2)**

The CA3TV2 tool performs attribute allocation and attribute accumulation. Allocation refers to the process to taking a raster dataset of landscape based data (such as land use, elevation etc.) and allocating values for that raster to individual catchments. For example, determining mean elevation in each catchment. This is preparing the data for accumulation.

I could not get the allocation tool to work properly w/ArcGIS 10.2. I believe there was some sort of limitation in installation. However, you can bypass the allocation tool by creating allocation output files yourself using ArcGIS and excel. I usually do this anyway (instead of using the Allocate tool) because I find it easier, and you don’t have to prepare the raster datasets. Also, it is easier to do for attributes that are not easily converted to rasters, such as counts of point features per catchment.

Accumulation refers to taking values for individual catchments (which can be areas in sq km, area weighted percent, sum, average, min, max) and accumulating same values for all upstream catchments. Accumulations are output in two formats: All upstream catchments, and all upstream catchments including divergences (see manual for explanation of divergence routing).

### **How to run the tool:**

This is how I run the tool in order to perform accumulations. I do NOT use the tool to run allocations.

First, prepare your input tabular data. Let’s say you would like to accumulate, by catchment:

- Total area of catchment
- Average percent impervious
- Total number of dams
- Total length of roads

Each will be summarized within individual catchments AND will then be accumulated for all upstream catchments.

### **Step 1. Summarize/allocate data to catchments:**

- Use appropriate tools in ArcGIS to summarize by catchment. For example, Spatial Analyst > Summarize by Zones can be used to summarize raster datasets (such as pct impervious). **BE VERY CAREFUL** that tiny catchments actually receive values when using Summarize Zones. Sometimes if a catchment is smaller than the cell size, the catchment values will be negative numbers (placeholders). Check all results first.
- For vector datasets the easiest tool to use is Tabulate Intersection (to summarize point, line, polygon features by catchment). **Make sure that if you're summarizing polygon datasets (like mine permit polygons, wetlands etc.) that you don't have any overlapping polygons before running Tabulate Intersection.** An easy way to do this is to convert to a polygon coverage.

**Step 2. Add required data to catchment attributes:**

Once you have results all in the attribute table for the catchments, JOIN the NHDPlus “Value Added Attributes” table to the catchment attribute table (use COMID & FEATUREID as the join fields). Every catchment should now have values for all fields in the VAA table. Sort to make sure.

**Step 3. Set up allocation table in Excel.**

a. Open exported catchment attribute table in Excel. Perform editing to create “allocation” results table for use by NHD CA3TV2 tool. This table needs to be in a very particular format (details are found in the Help file accessed through the CA3TV2 software).

b. The allocation table needs to be saved in CSV format, and needs to contain the following Columns (IN ORDER):

NOTE: These columns are for my example accumulation described above (area, pct impervious etc). The columns highlighted in blue here would change depending on what data you are accumulating.

FeatureID	MissDataA	AreaST	AreaS	ImpervVT	ImpervV	Hydroseq
-----------	-----------	--------	-------	----------	---------	----------

Here’s an example:

FEATUREID	MissDataA	AREAST	AREAS	ImpervVT	ImpervV	Hydroseq
2598583	0	S	213.39	V	33.20	200129176
2598611	0	S	172.8	V	45.0	200129175
2598629	0	S	780.84	V	12.20	200129174
2598633	0	S	260.64	V	10.0	200129173
2598635	0	S	532.62	V	0	200129172
2598641	0	S	267.84	V	0	200129171
2598657	0	S	263.25	V	0	200129170
2598665	0	S	332.46	V	99.0	200129169
2598669	0	S	430.02	V	0	200129168

The data included for each catchment for the fields listed above would then be:

FeatureID: The COMID for each catchment

- MissDataA: Make these all zero. This is the area within the catchment that is missing data (used if your catchments have incomplete data, for example, if half of your catchment is in Canada. Usually not an issue).
- AreaST: All cells should have the letter "S". This indicates that the next column (AreaS) contains a sum value.
- AreaS: all cells should have the value for area, in whatever units you want. Be aware that results are only reported with a few decimal places.
- ImpervVT: All cells in this column should have the letter "V". This indicates that the next column (ImpervV) contains an average value.
- ImpervV: All cells for this column have an average percent impervious value.
- Hydroseq: All cells in this column need to have the HYDROSEQ attribute value (from the NHDPlus VAA attribute table).

c. Sort the table in DESCENDING order by the Hydroseq field.

d. Save the table in CSV format.

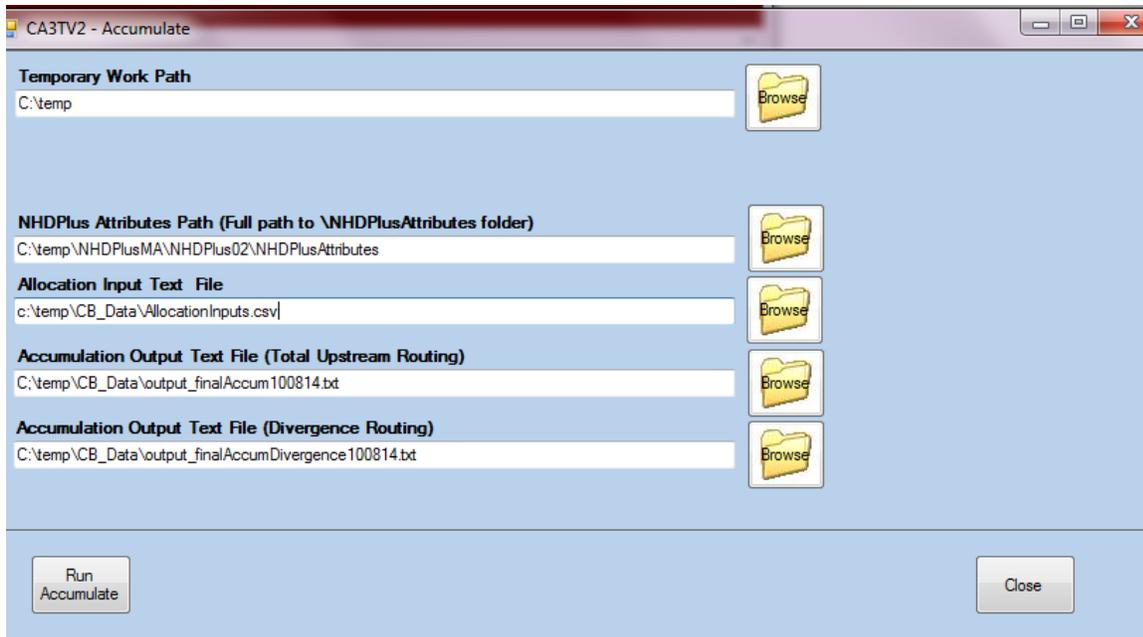
If you have other values to accumulate, see list below for letter codes for types of data that may be accumulated:

- A = value is an area in square kilometers
- P = value is an area-weighted percent
- X = value is a maximum
- N = value is a minimum
- V = value is an average
- S = value is a sum

See above for an example (few records) of properly set up file.

#### **Step 4. Run Accumulation using CA3TV2 tool.**

Press Accumulate in the tool. A dialog appears. Set up each setting in the dialog, including all input/output file names. Press Run Accumulate button.



**NOTES:**

- You can analyze catchments in a given portion of a drainage basin (you don't have to use all catchments in the entire HUC2 region). For example, I recently ran analysis for Region 02 (Mid Atlantic) but only used catchments in the Chesapeake Bay portion of the region. Worked fine.
- For n=80,000 records and about four variables being accumulated, the entire process took about an hour or so to run on my computer. It just runs in the background, and when it is done, you will see a window popup that says it is complete.
-