

# Water Quality Assessment Units for the Columbia and Snake Rivers

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## Purpose

The Washington State Department of Ecology (Ecology) has adopted a modified form of the National Hydrography Dataset (NHD) polygon representations of the largest rivers in Washington (the Columbia and Snake Rivers) for representing the 305(b)/303(d) Integrated Report (Water Quality Assessment).

Prior to the 2012 Water Quality Assessment, Ecology represented impairments on the 303(d) List and other categories on the 305(b) integrated report (Listings) for these rivers by overlaying a 45 seconds latitude by 45 seconds longitude grid over the hydrographic features. Data collected within an individual grid was combined and assessed for the determination of a categorical listing, identical to how Listings are generated for marine waterbodies and large lakes. While systematic, this grid method was criticized for its lack of suitability for representing the directional flow characteristics of rivers.

With the adoption of the NHD as the state's standard hydrography, Ecology will now represent Listings for all freshwater locations with Assessment Units based on unique NHD reach code values for the mapped features: streams and rivers will be represented by the respective NHD Flowlines line network, while lakes and other waterbody features will be represented by the respective NHD Waterbody polygons. The existing latitude/longitude based grid system will still be applied for marine waters and lakes greater than 1,500 acres in area.

While capable of representing hydrologically based divisions of rivers and streams, the linear network of the NHD does a poor job representing large rivers.

- The waterbody's width in some cases may significantly exceed the length of the line segment for a unique NHD reach code
- Islands or dams within the channel may create multiple (or no) channel lines through or around these features, from which to generate Listings
- Portions of the same river may be represented by multiple types of NHD polygon features, which may not have unique NHD reach codes to generate Listings in a manner similar to the linear features

The new Columbia and Snake River Assessment Units have been created to divide these rivers into relatively equal, hydrologically based, polygon reach extents. These polygons were created primarily by divisions of the combined NHD Area and Waterbody features representing these rivers, by watershed basins represented by Level 12 Hydrologic Unit Code (HUC) sub-basin areas of the Watershed Boundary Dataset (WBD). Like the NHD, the WBD also is managed by the USGS and is actively being edited to become more closely aligned to the NHD hydrography it contains. The HUC 12 WBD boundaries were chosen to divide the Columbia and Snake Rivers due to their rule-based basin divisions of relatively equal areas (HUC 12 areas around the Columbia and Snake Rivers range in size from 6,076 to 67,613 acres), resulting in relatively short Assessment Unit extents (2.8-19.1 river miles). This approach was determined to be the most consistent across these rivers extents when compared to other watershed basin delineation systems such as Watershed Resource Inventory Areas (managed by Ecology) or Watershed Administrative Units (managed by the Washington State Department of Natural Resources). The HUC 12 boundaries also divide these

ivers at almost all of the dam locations along their extents (only the Little Goose Dam on the Snake River is not currently a HUC 12 division<sup>1</sup>).

It was determined that reservoirs along the Columbia and Snake Rivers that are known to have mean detention times greater than 15 days will not be assigned these new Assessment Units applied to them, according to the Chapter 173-201A-600 (1)(a)(ii) WAC designation of freshwater uses for these reservoirs, similar to lakes. As such, these features (currently only Franklin D. Roosevelt Reservoir) will be managed as other lake Assessment Unit features.

Additionally, the mouth of the Columbia River, represented by HUC 12 170800060500 (Baker Bay-Columbia River) will remain represented by Grid Cell Assessment Units due to the influence of marine waters within this estuarine reach and that the channel width and presence of numerous islands which would not allow for clear cross-channel divisions of the river.

### Assessment Unit Development and Management

The Columbia and Snake River Assessment Units were created for the visual representation of the 303(d) list using the NHD and WBD information available at the time of the current Water Quality Assessment (approx. 2012-2014). These layers consist of those maintained within Ecology's Geographic Information System (GIS) and the Pacific Northwest Hydrography Framework<sup>2</sup>. The WBD attempts to divide the nation into 4-6 different hydrologic unit levels of watersheds with relatively equal areas, typically creating 5-15 divisions of the next highest hydrologic unit. Depending on the channel network and topography of the area, there may be divisions of the basin made at standard, single outlet points at the downstream extent of a sub-basin, or large standard hydrologic units may be divided into lower, middle, upper segments to meet the size criteria for WBD level divisions, referred to as mid-basin divisions.

It is these mid-basin divisions that are primarily used in the creation of Assessment Units for the Columbia and Snake River basins (the Snake River confluence with the Columbia River represents the single outlet point of the larger Snake River basin, and single outlet boundaries for other tributary systems are occasionally used to delineate NHD Area features for the Columbia and Snake Rivers, from portions which may (inaccurately) extend into adjacent tributary river systems). When divided in this manner, there are still portions of the Columbia and Snake Rivers that do not represent the intended sub-division of the rivers, requiring additional division rules for the creation of these Assessment Units. See Columbia and Snake River Assessment Unit Division Rules below.

The Assessment Units are created in a GIS by selecting and merging together all NHD Area and NHD Waterbody polygon features that have an underlying NHD Flowline feature naming them as either a Columbia River or Snake River flow path. These features are then intersected with the HUC 12 boundaries to divide the polygon extents of these rivers at the HUC 12 mid-basin levels. From

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<sup>1</sup> The proposed division of the WBD at the Little Goose Dam was approved December 5, 2014 and should be reflected in the next update to the WBD.

<sup>2</sup> The Pacific Northwest Hydrography Framework (PNWHF) Partnership was formed in 2003. Original partnering organizations included the Bureau of Land Management (BLM), U.S. Forest Service (USFS), and the states of Oregon and Washington. Oregon Water Resources Department represents the Oregon agencies within the partnership. Washington Department of Ecology represents the Washington agencies. The Natural Resources Conservation Service (NRCS) for Oregon and Washington was added to the Partnership in a [2008 revision of the PNWHF Memorandum of Understanding](#). The PNWHF also has close working relationships with several other organizations including but not limited to StreamNet, the Oregon and Washington geospatial framework organizations, and the USGS geospatial liaisons for each state

this basic framework the additional Columbia and Snake River Assessment Unit Division Rules are then applied to the polygon features, creating the final Assessment Unit features.

### Assessment Unit Numbering:

Assessment Units are assigned a unique ID number, in the format: 000000000000\_00\_00. The first 12 digits are the 12-digit HUC value containing that Assessment Unit. The two digits following the first underscore are a sequential, 2-digit integer defining whether the Assessment Unit applies to one (01) or more (02, 03, 04,...) waterbody features within the corresponding HUC 12. Currently only values of "01" apply, as these Assessment Units are only for either the Columbia River or the Snake River, which are unique within HUC 12 divisions. The last two digits of the ID are another sequential, 2-digit integer, defining the downstream to upstream sequence of Assessment Units for that waterbody (specified by the preceding 2-digit code), within that HUC 12 (specified by the initial 12-digit code). These last two digits are of primary importance for distinguishing the downstream-to-upstream sequence of features that have been manually divided according to the Division Rules below.

### Columbia and Snake River Assessment Unit Division Rules:

- 1. Assessment Units will be divided at HUC 12 mid-basin divisions of NHD Area and NHD Waterbody polygon extents (watershed boundary bisects the waterbody polygons)**
- 2. When more than one HUC 12 boundaries are present with a mid-basin division, joining together within the NHD Area and NHD Waterbody polygon extents of the Columbia and Snake Rivers, Assessment Units will be divided at the upstream-most boundaries that bisect the combined NHD Area and NHD Waterbody polygon extents.**

Some single outlet delineated HUC 12 basins occur coincident with a mid-basin division within the polygon extent of the Columbia or Snake River. Often, the intersection of the HUC 12 boundaries occurs within the extent of the NHD Area or NHD Waterbody polygon representing the Columbia or Snake River, such that there is not a single boundary line to make the division of Assessment Units with. In these cases, the creation of the Assessment Unit is based on the HUC 12 mid-basin division boundary and the upstream-most boundary of HUC 12 for the tributary (or tributaries) that until a division of the NHD polygon is created.

- 3. When NHD Area or NHD Waterbody features are not currently divided at the confluence with another major river, and extend significantly upstream within these tributary features, the perimeters of Assessment Units will be delineated according to rules for identifying the boundary of the Columbia or Snake River. Refer to the Manual Division Process below.**

Some NHD Area and NHD Waterbody polygons are not currently divided into separate features at some major and minor tributaries (i.e. the 2014 version of the NHD does not divide the Columbia River from the Sandy River, Oregon or the Entiat River, Washington). If there is no logical break in the NHD features near the confluence, the Assessment Unit will be divided by one of the following methods, in the following order of occurrence, depending on whether the necessary features are present.

- HUC 12 boundary at the tributary confluence, unless boundary extends into Columbia or Snake River.
- Straight line division of the tributary channel from the intersection of the HUC 12 boundary on the tributary's right bank shoreline to the HUC 12 boundary on the tributary's left bank shoreline.

- c. Logical inundation area extent or constriction in the mapped feature (typically guided by NHD Plus 1:100,000 Catchment boundaries).

**4. Assessment Units will be divided at the bisecting political boundaries of the Washington State borders with Canada, Idaho, and Oregon.**

The Columbia and Snake Rivers both represents borders of Washington State with both Oregon and Idaho states, and extends beyond the borders of Washington State. The Assessment Units representing these features will be handled in the following manner:

- a. Columbia River Assessment Units along the Washington and Oregon border from river mile 0 to approximately river mile 309 will not be divided longitudinally along the state boundary, but will represent the extent of the river width, where water quality data will be evaluated within.
- b. The Columbia River Assessment Unit will be divided at the Oregon border (approximate river mile 309), based on the Washington Counties GIS layer
- c. The Columbia River Assessment Unit at the Canadian border (approximate river mile 745) will be divided at the Canadian border, based on the Washington Counties GIS layer.
- d. Snake River Assessment Units along the Washington and Oregon border from river mile 139 to approximately river mile 176 will not be divided longitudinally along the state boundary, but will represent the extent of the river width, where water quality data will be evaluated within. The HUC 12 boundary of the Clearwater River will be used to divide the Clearwater River from the Snake River, at the northernmost portion of the Snake River border.
- e. The Snake River Assessment Unit extending from the border of Washington, Oregon, and Idaho will be divided by an artificial line extending across the Snake River in line with the Washington and Oregon Border (approximate river mile 176), based on the Washington Counties GIS layer.

**5. Assessment Units will be divided at any dam along the Columbia or Snake River.**

Little Goose Dam (Snake River) is the only dam on both the Columbia and Snake River systems not currently representing a HUC 12 boundary. In order to represent Snake River water quality as distinct reaches upstream and downstream from this feature, a manual division of the Snake River will be applied at this dam feature, extending from the middle of the dam structure along the right bank to the middle of the dam structure on the left bank, at approximate river mile 70.3.

**6. HUC 12 areas for the lowermost portions of the Columbia River currently (as of 2015) represent the waterbody itself, not the basin contributing to that waterbody. As such, there are no mid-basin divisions of these HUC basins forming representative, topographic divisions. In these cases, manual divisions (referring to the fact that the division is not made from an existing GIS feature class) are then needed for these features. Refer to the Manual Division Process below.**

The lowermost portions of the Columbia River (from river mile 0-120.5) are currently represented by three HUC 12 sub-basins representing the waterbody itself (HUC 12 170800060500 (Baker Bay-Columbia River), 170800030900 (Cathlamet Channel-Columbia River), and 170800030200 (Hayden Island-Columbia River)). These HUC 12 areas were created in the WBD following USGS considerations in coastal areas for dividing bays, sounds, and estuaries. The HUC 12 area at the mouth of the Columbia River (170800060500, Baker Bay-Columbia River) was determined to represent the most saline

portion of the River's estuarine environment and cross-channel divisions of this feature could not be successfully made due to the width of the channel (extending over 9-miles in width in the widest portion) and presence of numerous islands. Refer to the Manual Division Process below.

### Manual Division Process

#### GIS Layer Inputs:

- HUC 12 WBD polygons: Obtained from the Pacific Northwest Hydrography Framework website (<http://www.pnwhf.org/water-bound-dataset.aspx>)
- NHD Waterbodies: latest statewide Ecology release
- NHD Areas: latest statewide Ecology release
- Washington Counties: Department of Natural Resources GIS layer
- NHD Catchment polygons: USGS GIS layer

In addition to the Columbia and Snake River Assessment Unit Division Rules described above, manual divisions to create Assessment Units must follow the following rules:

1. All manual divisions of the channel must be created as perpendicular as possible to the channel, and must connect points on either bank of the mapped river feature in the following hierarchical order and following the additional Process rules below:
  - a. From the intersection of a HUC 12 boundary intersection on one bank to the nearest HUC 12 boundary intersection on the opposite bank.
  - b. From the intersection of a HUC 12 boundary intersection on one bank to the nearest NHD Catchment boundary intersection on the opposite bank.
  - c. From the intersection of a HUC 12 boundary intersection on one bank to a logical point along the shoreline of the opposite bank, representing a likely division of the subbasin.
2. All Columbia and Snake River Assessment Units must be greater than one river mile in length along the general channel course of the river.
3. Manual divisions will be created at the upstream intersection point of every HUC 12 tributary basin entrance along a bank (HUC 12 divisions extend to the Columbia or Snake River on either bank of a tributary mouth). These divisions must include the input (upstream basin area extent) from the major tributary within the downstream Assessment Unit, to represent the influence that the confluent tributary has on the downstream unit.
  - Should the HUC 12 boundary for such a tributary basin not spatially intersect the NHD Waterbody or NHD Area representing the Columbia or Snake River (due to GIS artifacts of how these layers were developed), an artificial division line will be made close to the edge of the river polygon, dividing the upstream HUC 12 boundary (upstream from any mapped NHD Flowline features) from the edge of the tributary's HUC 12 boundary to the nearest NHD Catchment intersection with the river polygon boundary, when available, or a logical point along the shoreline at a vertex of the river feature edge.
  - If two or more HUC 12 boundaries intersect the river feature on the same bank, within one river mile of one another, the downstream-most HUC basin will be used to delineate the Assessment Unit boundary.

- If HUC 12 boundaries intersect the river on opposite banks, within one river mile of one another, the upstream edges of both intersecting HUC 12 boundaries will be used as the dividing line across the river feature.
  - If a HUC 12 boundary intersects the river on one bank, within one river mile of a dividing HUC 12 boundary across the river feature, the dividing HUC 12 boundary is always used to represent the Assessment Unit division; no manual division is made.
4. All manual divisions of the channel must be made in a manner that avoids bisecting or dividing embayments or sloughs.
  5. Where islands are present in the channel at or perpendicular to HUC 12 boundary intersections with the river features, manual divisions must be made at the downstream-most extent of these islands. If an island has an Assessment Unit boundary along the downstream end, then the next upstream manual division must be made at the next possible location upstream from the island, no matter how many single outlet HUC 12 boundaries may intersect the river along the longitudinal extent of the island feature.

The intent of this rule is to keep continuity with the river features on one side of the island, rather than having Assessment Units divided within the island feature, where there is no surficial hydraulic connection between the split channels.