

# Basin and BCU Creation Documentation

## Transboundary Water Assessment Programme (TWAP) Basin and BCU Creation Documentation

October 2014 Prepared by Jim Eynard, Oregon State University.

This document describes the identification and creation of transboundary basin and basin-country units (BCUs), which is an update of previous basin and BCU layers within the Transboundary Freshwater Dispute Database (TFDD).

This update of these BCUs was done mainly by three people from October 2013 to August 2014:

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### Development of the Basin Shapefile

Basins were initially identified by David Allen using HydroBASINS data. HydroBASINS is a global river and lake catchment layer derived from HydroSHEDS and the global lakes and wetlands database (GLWD) (Lehner 2013). A 'MOST-DOWN' coding within the Level08 HydroBASINS was made to color-code large-scale drainages and make them visually obvious. Connected sub-basins with the same outflow were then selected (manually for small basins; automatically by 'MOST-DOWN' coding for larger basins) and given appropriate TFDD attribute codes. This initial output is a shapefile called "HydroBasins\_from\_David\_Allen\_20130830".

### Development of the Country Shapefile

The country shapefile is derived from the Global Administrative Unit Layers (GAUL) (FAO 2014) polygon shapefile that is developed, managed, and distributed by the Food and Agricultural Organization (FAO) of the United Nations. The "GAUL\_countries\_20131201" shapefile was created by dissolving the original FAO GAUL shapefile based on the "adm0\_name" attribute, so that the original shapefile of 27 761 records became a shapefile with a total of 276 multi-part features (i.e. one record in the database for each country or administrative unit in the world). The previous version of the TFDD had 242 distinct administrative features – this represents of an increase of 34 administrative features. Many of these new polygons represent disputed territories throughout the world, while a few others are actually "new" countries (e.g. South Sudan).

### Identification of Transboundary Basins

To identify which basins were transboundary, Doug Wood used the HydroBASINS output, the previous TFDD basin shapefiles, and the GAUL country shapefile. The identification of transboundary river

basins is a sub-selection of “HydroBasins\_from\_David\_Allen\_20130830” with modifications made where there were large discrepancies from the previous version. Other levels beyond level 8 of the HydroBASINS data were used as needed after manual inspection of the basin area. The result is the basin shapefile called “RiverBasins\_ver\_1\_20140215”. This shapefile includes all of the transboundary basins from previous versions of TFDD as well as an additional 10 basins that were not included in previous versions of the TFDD, for a new total of 286 transboundary basins.

### **Identification of Basin-Country Units**

To obtain basin-country units (BCUs), the transboundary basin shapefile was intersected with the country shapefile. The output of the intersection of “RiverBasins\_ver\_1\_20140215” and “GAUL\_countries\_20131201” shapefiles produced the “CountryBasinUnits\_EqualArea\_DTW\_20140503” shapefile. Apart from the modifications described below, this is the culmination of efforts to update OSU’s TFDD using the improved spatial precision and accuracy of the HydroBASINS and the most current administrative boundary data made available by the United Nations.

### **Additional Modifications to BCUs**

*Note that all previous filenames mentioned in this report do not have the modifications described below.*

**Removal of the Caspian Sea** - The country shapefile was further updated to remove the Caspian Sea from the GAUL country polygons. The GAUL shapefile typically includes seas as separate from countries, but there is some ambiguity regarding the Caspian on whether it is a lake or sea, which is likely why the GAUL shapefile includes the area of the Caspian as part of the 5 countries that border the “sea”. Due to inaccurate country area calculations for those 5 countries, the decision was made to erase the Caspian Sea from the GAUL shapefile. This reduced the area of the 5 countries bordering this sea to more accurately reflect the country area given in UN FAO statistics. Ultimately, this had no effect on the final BCUs as the Caspian is not considered a basin in the TFDD. The Caspian Sea polygon, which was used to erase, was obtained from Natural Earth Data (Physical Vectors – Lakes + Reservoirs, Version 3.0.0).

**Adding the Great Lakes** - The area of the Great Lakes was added to the GAUL shapefile to be included as part of the St. Lawrence Basin. This is the opposite problem to the Caspian Sea issue. Where the GUAL shapefile included the area of the Caspian as part of the surrounding countries, it did not include the Great Lakes, treating them as an ocean. However, the TFDD does consider the Great Lakes as part of the St. Lawrence basin and their area needs to be accounted for by the bordering countries (USA and Canada). This division of the Great Lakes was obtained from the country dataset from Natural Earth Data (1:10m Cultural Vectors - Admin 0 – Countries, Version 3.1.0). This area was then added to the BCUs of the St. Lawrence basin.

**Clip Basins to GAUL** –The basins shapefile was clipped to the “GAUL\_countries\_20131201” shapefile to eliminate discrepancies between the two shapefiles along the coastline. The basin shapefile, which was derived from the HydroBASINS shapefile, had a different, and seemingly lower resolution than the BCU shapefile, which was derived by the intersection of basins and the GAUL shapefile. The

discrepancy caused the sum of BCU areas not to exactly equal the area of its respective basin. Clipping the basin shapefile to the GAUL shapefile fixed this issue. However, due to the different resolutions of HydroBASINS and GAUL, there is still some fragmentation on the coastline that should be addressed in the future. In some areas, islands of a BCU seem to be separated from their main BCU polygon (e.g. see the coastal border of KGNK\_UKR and SRTA\_UKR).

### **Area Calculations**

To calculate the area of all polygons, the shapefiles were projected into World Cylindrical Equal Area projection. Using ArcGIS 10.2, the Calculate Geometry tool was used to determine the area in square kilometers.

### **Summary**

The final BCU shapefile made from the methods described in this report, including the modifications and area calculations, is called "BCU\_Master\_20140813". The basin shapefile can be derived from the BCU shapefile by dissolving by 'BCODE' in ArcGIS.

Future work and potential additional modifications to these BCUs will include: 1. the identification of slivers which may cause BCUs to lose their transboundary status, 2. adjustments to the areas of the delta of certain rivers to more accurately reflect the river basin area, 3. a look at the fragmentation issue due to the differing resolutions of GAUL and HydroBASINS, and 4. the use of new basin datasets to identify additional transboundary basins.

### **References**

FAO (2014). Food and Agriculture Organization of the United Nations. FAO GEONETWORK. Global Administrative Unit Layers (GAUL) (GeoLayer). (Version: GAUL\_countries\_20131201).

Lehner, B., Grill G. (2013): Global river hydrography and network routing: baseline data and new approaches to study the world's large river systems. *Hydrological Processes*, 27(15): 2171–2186. Data is available at [www.hydrosheds.org](http://www.hydrosheds.org).

[www.naturalearthdata.com](http://www.naturalearthdata.com)

