National Catchment and Stream Environment Database version 1.1.4

J.L. Stein, M.F. Hutchinson and J.A. Stein
Fenner School of Environment and Society
Australian National University
Canberra, ACT 0200
Australia

The National Catchment Database is a linked set of spatial layers and associated attribute tables describing key elements of the surface water hydrology of the Australian continent at a map scale of about 1:250,000. It is built upon the representation of surface drainage patterns provided by the GEODATA national 9 second Digital Elevation Model (DEM) Version 3 (ANU Fenner School of Environment and Society and Geoscience Australia, 2008). The stream network and catchment boundaries contained within the database form foundation elements of the Bureau of Meteorology's Australian Hydrological Geofabric, the spatial framework that underpins the Australian Water Resources Information System (AWRIS) (http://www.bom.gov.au/water/geofabric/index.shtml). This database adds additional environmental attributes not available through the AHGF. It will be made generally available through Geoscience Australia but in the interim is supplied via this DVD.

The DVD contains three file geodatabases (ArcGIS version 9.3) :

1. National_Catchment_Boundariesv1.1.4.gdb – the National Catchment Boundaries (NCB) including separate feature classes delineating the topographically defined drainage basins and Level 1 and 2 of the NCBs and a lookup table, NCBPfafstetter, supplying the Pfafstetter coding and associated attribution for each of the lowest level NCB catchments.
2. DEMStreamsv1.1.3.gdb – a fully connected and directed stream network
3. stream_attributes.gdb – including a set of lookup tables supplying attributes describing the natural and anthropogenic characteristics of the stream and catchment environment. See the spreadsheet segment-envatts.xls for details of the attributes and their source data

A set of tables containing modelled monthly soil water surplus for each stream segment for each month for the years 1970 to 2008 is also available separately upon request.

The streams layer can be related to the catchment boundaries and environmental attribute lookup tables through a shared field (SEGMENTNO) that stores the unique identifier assigned to each stream segment . This field also supplies the values for the unique identifier stored in the field NCB_ID attributed to each of the NCB catchments that are the sub-catchments of the stream segments. The remaining catchments in the NCB with a SEGMENTNO field value of zero are the drainage basins that drain to an inland sink or a common section of coastline where there are no streams mapped in the AusHydro watercourse lines layer. The AusHydro watercourse lines are the directed streamlines used in the development of the national 9 second DEM (ANU Fenner School of Environment and Society and Geoscience Australia, 2008). They are available for download from the Geofabric website (http://www.bom.gov.au/water/geofabric/index.shtml). The DEM derived stream segments on this DVD may be related to the AusHydro watercourse line features through the common AusHydro_ID field.

Higher level aggregations of the NCB catchments may be derived by grouping the NCB catchments according to their NCB-code (e.g. by dissolving the catchment boundaries based on the first n digits of the NCB-code where n is the desired level of sub-division in the catchment hierarchy). Upstream or downstream tracing is facilitated by querying the Pfafstetter codes of individual levels. Further details are available in the metadata that accompanies each feature class and in the user guide (in prep.).

Version Changes

Version 1.1.4 (BoM version, October 2011)

DEM derived streams

Back track revisions made for version 1.1.3 for Fossey and Flinders Rivers – only change fom version 1.1.1 is removal of upstream section of segmentno 102865

NCB

Back tracks revisions to Fossey River. NCB vector and raster layers replaced with original segment and sub-catchment delineation as per version 1.1.1. Version 1.1.3 Pfafstetter coding retained. Pfafstetter coding for segment# 4448 attributed to returned Fossey River stream segments (#'s 4337,4338,4270,4364)

Version 1.1.3 (October 2011)

DEM derived streams

1. Corrected stream directions and/or underlying flow direction grid cell values in areas defined by the following geographic extents:
   i. 145.61875 -41.45625 145.64875 -41.43375 (Fossey River Tasmania stream segment grid cells)
   ii. 149.13 -26.365 149.205 -26.2925
   iii. Single grid cell @ 133.089,-23.611
   iv. 140.673569 -18.621471 140.696455 -18.615937 (Flinders River, NT stream segment grid cells)
2. Stream segment changes that resulted from these corrections:
   i. Stream segments numbered 4337,4338,4270,4364 combined with segment number 4448 (Fossey River, Tasmania). The combined segment is labelled as segment number 4448
   ii. Removed upstream section of stream (segmentno 102865) that erroneously crossed revised Level 1 drainage divisions
   iii. Flinders River segments reversed stream direction, consistent with the most recent AusHydro mapped stream directions

NCB

1. Revised after corrections to the flow directions noted above and the changes to Level 2 boundaries described below. All Pfafstetter codes recalculated.
2. Minor revision to the Level 1 Drainage Divisions reflecting corrections to the flow direction grid (as per i) and ii) above under DEM derived streams), consistent with the AusHydro mapped streams.
3. A minor revision to Level 2 boundaries consistent with changes to the Level 1 boundaries above.
4. A major revision to the Level 2 boundaries in the the Lake Eyre Drainage Division. Lake Eyre (north) is now included in a larger Lake Eyre Level 2 region while the Cooper Creek and Georgina-Diamantina Rivers Level 2 units now contain just the catchment of Cooper Creek and the Warburton River respectively and those internal basins that would drain to these rivers if they were to overflow via the lowest pour-point on the drainage divide.
5. The treatment of Lake Eyre is now consistent with other inland drainage basins i.e it is not treated as though a sea.
6. The discrimination of the tributary and mainstem for Pfafstetter coding now better reflects the principal flow pathways as defined by the D8 flow direction grid.
7. The BASINPFAF string field in the table NCBPfafstetter is reduced to 15 characters as fewer levels were required for the full sub-division of every basin to a level where no tributaries remain within a catchment unit following the changes in the Lake Eyre Drainage Division.
8. Additional layers SegNoLinkRaster and SegNoLinkVector added as requested by the BoM. These layers link every mainland NCB not draining directly to a DEM derived stream segment (i.e. catchments not containing a stream) with a DEM derived stream segment being either that to which

it would drain if it were to overflow via the lowest point on the drainage divide (for internally draining NCB) or that which is the closest stream outlet draining to the sea (for coastal draining NCB). This linked stream segment is also included in the SEGNOLINK field which has been added to the NCBPfafstetter table.

Stream attributes

No change – not yet updated to reflect flow direction edits noted above.

Version 1.1.2 (June, 2011)

1. Patched small areas of no data in about 20 segment sub-catchments draining to the coast and a small number draining into Lake Eyre. These "holes" arose when the sub-catchments were delineated using a flow direction grid with additional sinks placed where the original flow directions directed flow from the mainland to an immediately adjacent island grid cell

Version 1.1.1 (May, 2011)

1. Corrected incorrect bioclim parameter descriptions in segmentenvatts.xls for coldest and hottest month mean temperatures. These should have been coldest month minimum and hottest month maximum temperatures respectively

Version 1.1.1 (February, 2011)

NCB

1. The vector versions of the NCB layers are now derived with coordinates stored as double precision numbers to avoid the very slight (~0.5m) misalignment with the raster representation of earlier versions
2. The boundaries of a a small number of sub-catchments have been redefined using the alternative of the flow directions coded in an off-stream multiple flow direction grid cell where the previously selected D8 flow direction was: i) not consistent with the direction selected for the application of the Pfafstetter codes or ii) was directed to a stream grid cell below the confluence so forming a catchment "tail".
3. For completeness, the boundaries of the sub-catchments of the DEM connector segments that fall within Lake Eyre (north) are now included though as in previous versions they were not considered for the Pfafstetter sub-division of the Lake Eyre Basin. They are assigned a Pfafstetter code of "0000000000000"
4. A corrupted flow direction grid that prevented some small inland basins being sub-divided has been corrected and the Pfafstetter codes recalculated.
5. An additional field, PFAFNO, containing the numeric Pfastetter code for each NCB, has been added to the table NCBPfafstetter. This field is used by a new Pfafstetter tracing tool that is under development at the Bureau of Meteorology
6. The BASINPFAF string field is extended to 17 characters to allow for the full sub-division of every basin to a level where no tributaries remain within a catchment unit

Stream attributes

1. The fields UPSID1 and UPSID2 in the lookup table *identifiers.lut* were recalculated so that an upstream segment was identified for all stream segments downstream of a bifurcation not just mainstem stream segments
2. The fields CAT-A_KSAT, STR-A_KSAT and CAT-SOLPAWHC in the table *substrate.lut* have been recalculated after corrections to the source grid. Summary statistics for these attributes in earlier versions were erroneous in areas covered by soil landscapes with a Map Code identifier > 1235 that had been assigned incorrect values from the lookup table of Soil Hydrological Properties

Version 1.1 (September, 2010)

NCB

1. Pfafstetter codes have been substantially revised and are now stored in a separate lookup table. The starting basins for the Pfafstetter subdivision are now derived using the D8 flow direction grid thus recognising separate basins for each coastal outlet and every inland sink point even if they are connected upstream by a distributary (the "D8 Pfafstetter" basins). To enable mainstem-anabranch relationships to be included in network tracing queries new fields have been included to identify for each anabranch the SEGMENTNO of the main stem from which the anabranch offtakes, and to identify for each mainstem stream segment the SEGMENTNO of its anabranch.
2. The fields identifying the Pfafstetter codes are now numeric storing only the individual Pfafsttetter code for each level, making it easier to build the queries for network tracing. Only the NCB-CODE field contains the full multi-level composite string.
3. Inland basins where more than one stream drains to the sink grid cell are treated specially. The sink cell remains the basin seed for the contributing stream draining the greatest area but additional basins are seeded at the pour-point grid cells of smaller contributing streams. This enables Pfafstetter codes to be separately assigned to each stream.
4. Mainland and immediately adjacent island components of basins that were connected by the flow path defined by the flow direction grid were split unless within a stream segment sub-catchment (the latter to retain consistency with version 1.0).
5. All streams connecting to the mainstem channel are now considered to be tributaries for the assignment of Pfafstetter codes even where they are located entirely in grid cells identified as a valley bottom (and thus potentially a floodplain feature such as an oxbow).
6. The area of waterbodies is now included when calculating the area of tributary catchments (used to determine the largest four tributaries at each level of sub-division)
7. The representation of multiple-flow directions at confluences has been improved using Fortran bitwise procedures to ensure consideration of all tributary –mainstem linkages.
8. Stream segment sub-catchments, the lowest NCB catchment, have been re-calculated after removing flow direction “tails” (the grid cells upstream of a confluence directed to a grid cell downstream of a confluence). This has been done by changing the flow direction grid so that the most downstream of the grid cells forming a tail is directed to a neighbouring grid cell of a tributary upstream of the confluence.

DEM derived streams

3. The values for the attributes NAMETRACE,HIERACHYTR, PERENLTYTR have been revised to reflect updates to the D8 flow direction grid which determines the principal flow paths.

Stream attributes

1. Terrain attributes dependent on the DEM values, except aspect, have been re-calculated using the DEM v3.1. This version of the DEM includes 5 patches incorporating corrections to source data elevation errors that have been identified since the DEM version 3 release. These patches are rectangular windows defined by the following extents:

148.640	-34.998	148.823	-34.850
117.838	-34.748	117.983	-34.653
119.054	-21.214	119.139	-21.147
137.963	-35.905	138.051	-35.838
148.549	-20.796	148.629	-20.551

2. The confinement indicator and valley delineation derived using the mrVBF and mrRTF indices of Gallant and Dowling (2003) were calculated with an updated version of the program (mrvbf6g-a3, December, 2009)
3. All sub-catchment and catchment summary attributes (with the exception of those in RDI-geodata2.lut) were re-calculated using the revised flow direction grid with “tails” removed (see 8 above).
4. Attributes calculated based on the principal downstream flow path (downstream average and maximum slope, distance to outlet) were also re-calculated using a new D8 flow direction grid derived using an improved method for selecting the principal flow direction at multi-flow direction points that incorporates the downstream hierarchy.

Version 1 (February, 2010)

- beta release

Licence and use constraints

Access to, and use of the data should comply with the Creative Commons Attribution Australia Licence (see http://creativecommons.org/licenses/by/3.0/au/deed.en). It should include appropriate acknowledgement to the ANU Fenner School of Environment and Society.

While every effort has been made to ensure the accuracy of the data, the database is not warranted to be free of errors. Users should also consider the scale and limitations of the source data on which it is based. The database is suitable for application at regional to continental scale. Finer scale data should be obtained for local scale analyses and assessment. Please report any errors or other feedback to Janet Stein (Janet.Stein@anu.edu.au).

Citation

Please contact Janet Stein (Janet.Stein@anu.edu.au) for updated citation details

Acknowledgements

The development of the stream network and catchment boundaries was a collaborative project between the ANU Fenner School of Environment and Society, the Bureau of Meteorology, Geoscience Australia and CSIRO and was funded by the Bureau of Meteorology. The Department of Environment, Water, Heritage and the Arts contributed funding for the development of the stream attribute tables.

References

ANU Fenner School of Environment and Society and Geoscience Australia (2008) User Guide, GEODATA 9 Second DEM and D8 Digital Elevation Model Version 3 and Flow Direction Grid. https://www.ga.gov.au/image_cache/GA11644.pdf

Gallant J.C. and Dowling T.I. (2003) A multi-resolution index of valley bottom flatness for mapping depositional areas. Water Resources Research 39(1):1347.