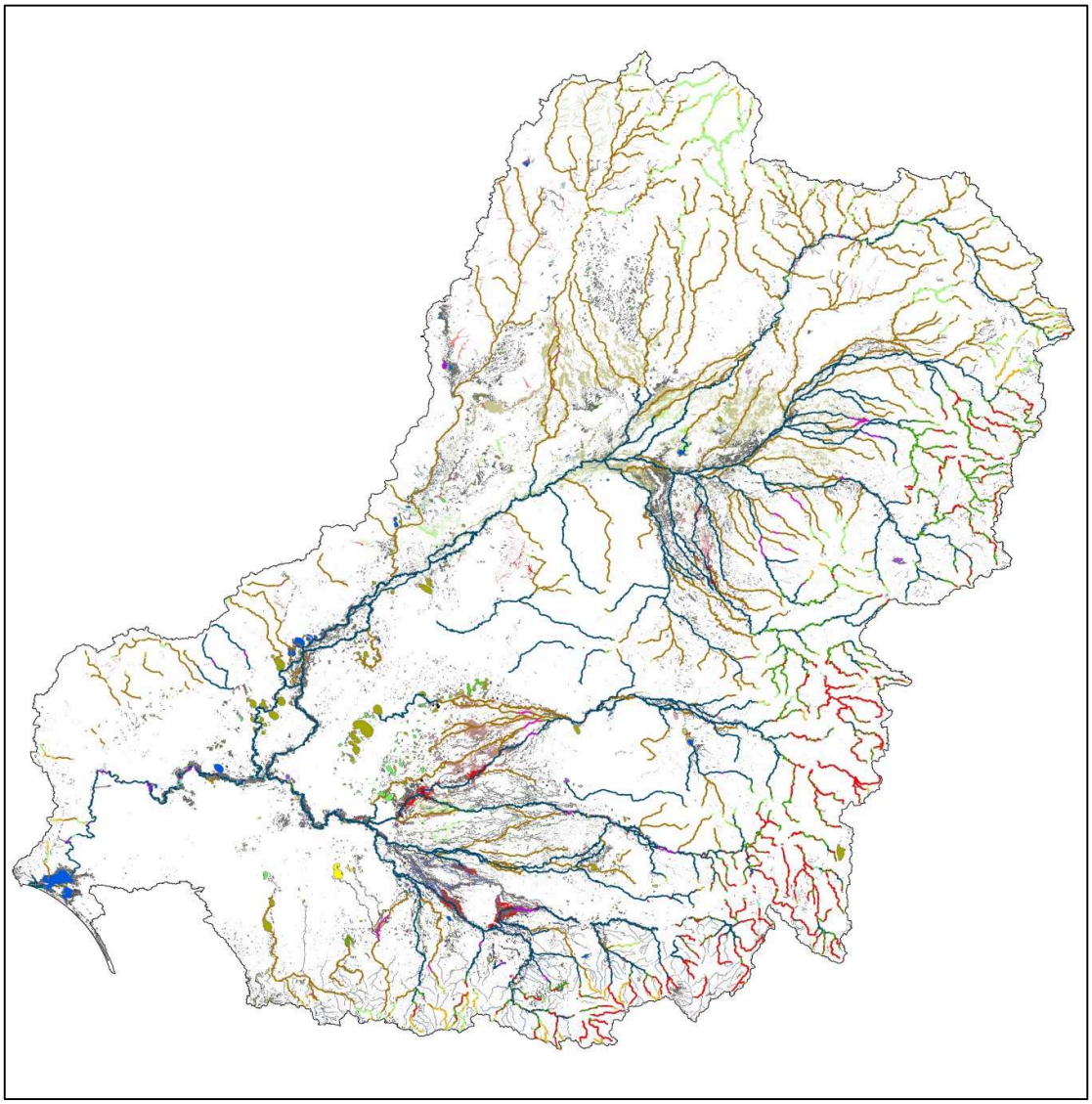
Australian National Aquatic Ecosystem (ANAE) Classification of the Murray-Darling Basin

Technical Report, Revision 3.0, March 2021



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Cover

ANAE mapping of the Murray-Darling Basin

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Abbreviations and acronyms

AETG	Aquatic Ecosystems Task Group
ANAE	Australian National Aquatic Ecosystem
AWRC	Australian Water Research Council (Catchment Boundaries)
CEWO	Commonwealth Environmental Water Office
DAWE	Department of Agriculture, Water and the Environment
DIWA	Directory of Important Wetlands
DoEE	Australian Government Department of the Environment and Energy (now DAWE)
DELWP	Department of Environment, Land, Water and Planning, Vic.
DEWNR	Department of Environment, Water and Natural Resources, S.A.
DPIE	Department of Planning, Industry and Environment, NSW
Geofabric	Australian Hydrological Geospatial Fabric
GIS	Geographic Information System
LiDAR	Light/Laser Detection and Ranging
LTIM	CEWO Long Term Intervention Monitoring Project
MDBA	Murray-Darling Basin Authority
MDB	Murray-Darling Basin
NCB	National Catchment Boundaries
NVIS	National Vegetation Information System
OEH	Office of Environment and Heritage, NSW. (now DPIE)
WOfS	Water Observations from Space (http://www.ga.gov.au/scientific-topics/hazards/flood/wofs)

Introduction

The Australian National Aquatic Ecosystem (ANAE) classification framework was proposed by the Australian Government Aquatic Ecosystems Task Group (AETG) to facilitate consistent cross-jurisdictional adaptive management of aquatic ecosystems (Aquatic Ecosystems Task Group 2012). The framework is published as Module 2 of the Aquatic Ecosystems Toolkit, a set of nationally agreed "good practice" tools for mapping, classifying and assessing the condition of aquatic ecosystems. It uses a rules-based approach to classify aquatic ecosystems using attributes of each system and the larger landscape and regional setting (Figure 1).

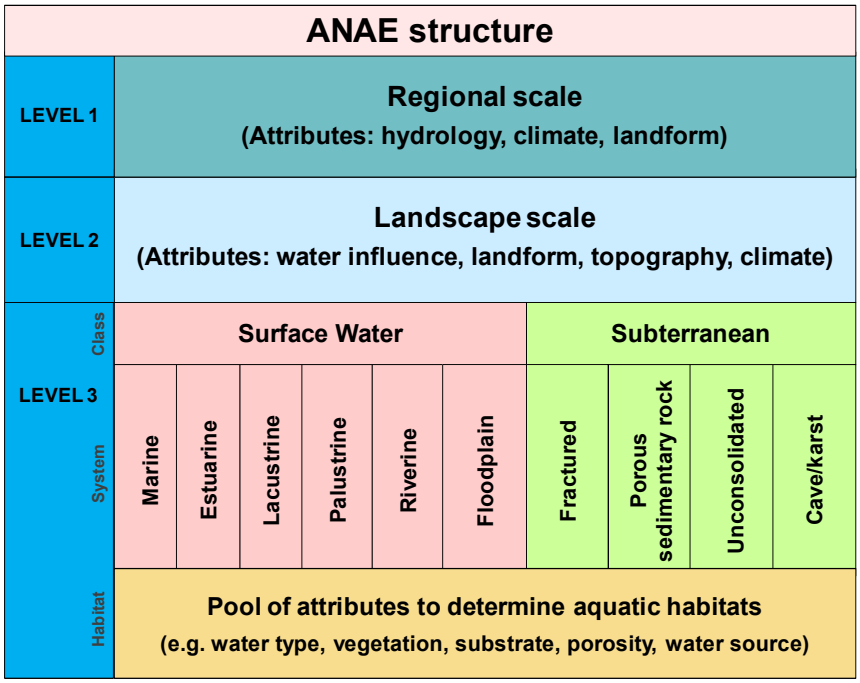

Figure 1: Structure and levels of the Australian National Aquatic Ecosystem Classification Framework (from AETG 2012).

The ANAE classification was applied to the Murray-Darling Basin to support adaptive management of surface water ecosystems with specific relevance to the management of Commonwealth environmental water (Cottingham et al. 2012; Brooks et al. 2014). The classification integrates the best available mapping for rivers, floodplains, wetlands and lakes from the Basin States, Murray Darling Wetlands Working Group, and Australian Government National mapping including the Australian Hydrological Geospatial Fabric (Geofabric, BOM 2020). Each mapped ecosystem is attributed with habitat characteristics relevant to the structure and function of those ecosystems which are used in combination by simple rules to classify the ecosystem type (e.g. Figure 2).

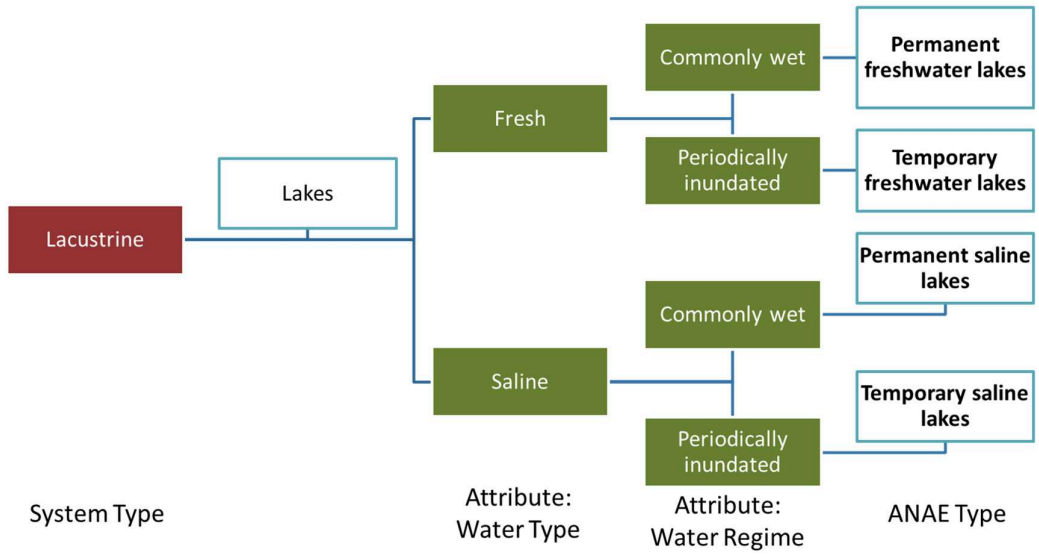

Figure 2. The ANAE classification framework is a simple rules based approach using attribute values to classify ecosystems into ANAE types.

There have been two previous releases of the Murray-Darling ANAE classification:

1. The Interim ANAE classification of the MDB report and GIS data set first brought together the state jurisdiction mapping and developed the classification typology publishing the classification data as version 1.6 (Cottingham et al. 2012; Brooks et al. 2014). It used the best available mapping and attribute data for aquatic ecosystems at the time with an expectation that the classification would be updated and refined as new data became available or if the ANAE framework was modified.
2. The classification was revised in 2017 to incorporate new vegetation mapping that had become available in NSW and to simplify the mapping of floodplain areas. This was a substantial revision designed to improve the accuracy and currency of the mapping and to integrate all ecosystem types into a single aquatic ecosystem map for the Basin (Brooks 2017). NSW state vegetation mapping for Western NSW was under development at the time of the 2017 ANAE update and it was not able to be included. This left a significant gap in the ANAE mapping that omitted the floodplains of the Darling River, parts of the Murray and lower reaches of the Paroo, Warrego and Condamine Rivers.

This report documents the 3rd update to the ANAE classification of the Murray-Darling Basin undertaken to:

1. Complete the ANAE classification of the Basin in NSW, filling the large gap in western NSW that was omitted from the 2017 update. New mapping for the Central Tablelands of NSW is also now available for inclusion.
2. Add water-dependent floodplain ecosystems in Queensland.
3. Incorporate the new nationally consistent high resolution river line mapping of the Australian Hydrological Geospatial Fabric v3.2 (Geofabric, BOM 2020).
4. Restore the v1.6 floodplain typology of the interim ANAE classification to separate floodplains from palustrine wetlands (reversing a change made in 2017).

Revision History

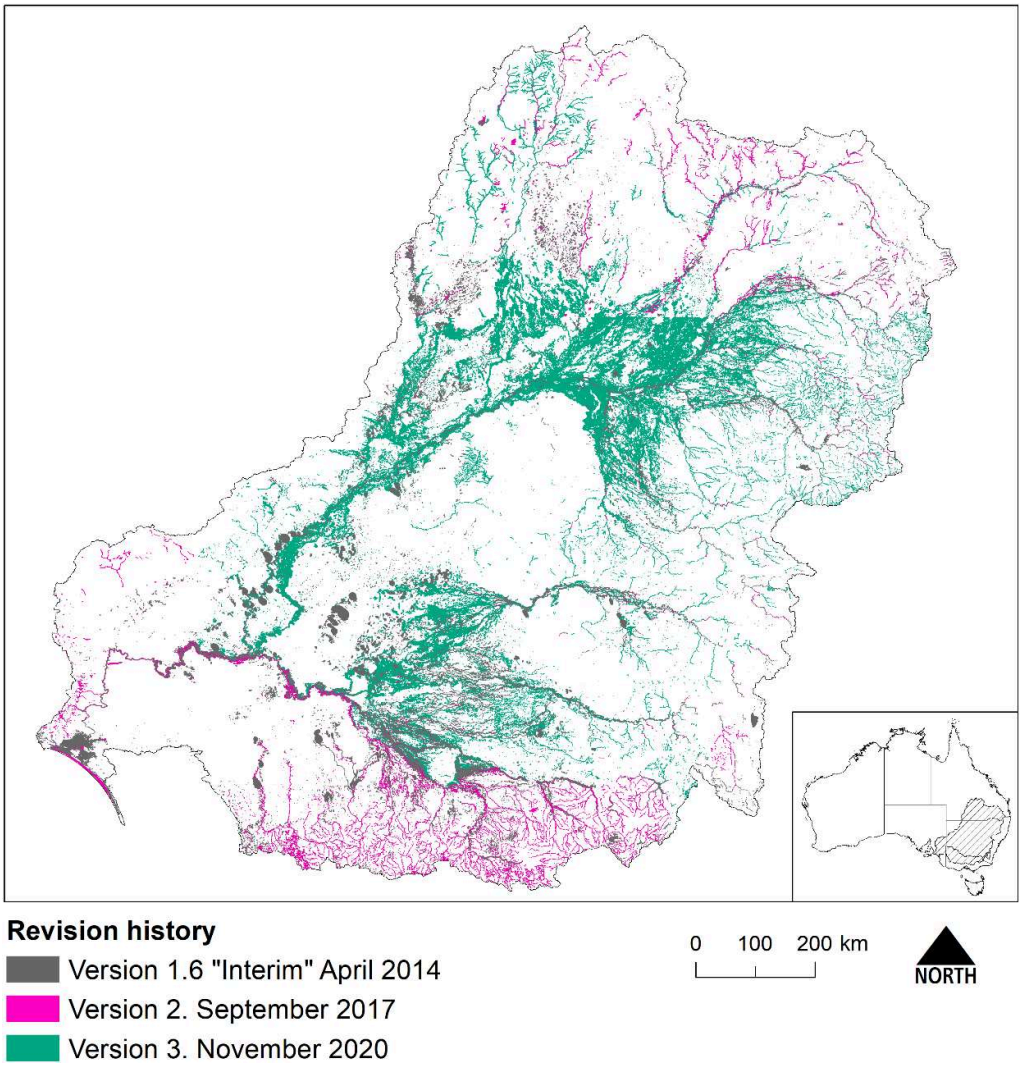

Figure 3. Revision history for the ANAE mapping in the Basin.

Revisions

1. NSW updates using the NSW state vegetation maps

The interim ANAE classification mapped wetlands in NSW to high resolution and accuracy in the Murray River valley and Murrumbidgee and Namoi catchments, however other parts of the state used low-resolution mapping sources that captured open water areas but greatly under-estimated the extent of wetland and floodplain vegetation. The 2017 update addressed this using NSW state vegetation mapping in the Murray and Riverina, Central West-Lachlan, and Border Rivers valleys (Figure 4). The vegetation maps identify plant community types and assign them to Vegetation Classes (Keith 2004) that include freshwater, saline and forested wetlands and various floodplain classes. Since 2017 these data sets have been updated, and new data sets mapping the Western Region and Central Tablelands have been released allowing the wetland mapping across most of NSW to now be updated (Figure 4).

The following NSW State Vegetation Type Maps were used.

- Riverina Region Version v1.2 - VIS_ID 4469 (OEH 2017)
- Central West / Lachlan Region Version 1.4. VIS_ID 4468 (OEH 2019a)
- Border Rivers Gwydir / Namoi Region Version 2.0. VIS_ID 4467 (OEH 2019b)
- Western Region v1.0. VIS_ID 4492 (OEH 2019c)
- Central Tablelands Region Version 1.0. VIS_ID 4778(OEH 2019d)

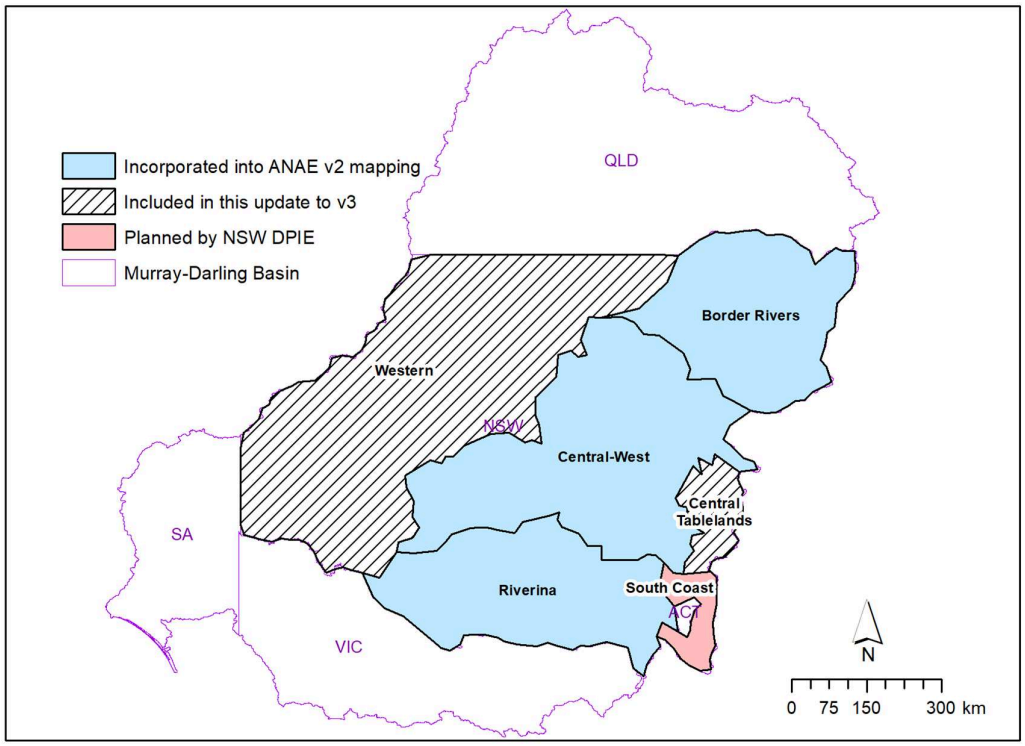

Figure 4: Extent and status of the new NSW state vegetation mapping. Published regions (blue) were used to update the ANAE classification in 2017 with new versions of these areas available in 2020. The Western region and Central Tablelands have now been published and were used to complete the ANAE classification.

Aquatic ecosystems were identified and mapped using plant community types (PCT) and associated Keith (2004) wetland classes as described by Brooks (2017). In GIS the polygons for PCT that mapped directly to ANAE wetland types were used. Arid zone PCT (PCTID 160, 166, 24) that showed low affinity to wetland areas were included only where there was evidence of inundation (>= 1Ha of total area (16 x 25m^2 pixels) with >=20 observations of inundation since 1987 in the Water Observation from Space data set (refer Brooks 2017).

The selected vegetation polygons were further processed in GIS to simplify the mapping by merging adjacent polygons of the same ecosystem type and eliminating isolated fragments(<0.5Ha).

Figure 5 shows the result of the updated mapping using the NSW state vegetation wetland and floodplain classes to map extensive floodplain areas dominated by river red gum and black box along the Darling River in western NSW.

The updated vegetation mapping also provided greater granularity to replace some very large wetland areas that were mapped as single polygons classified to one ANAE ecosystem type. An example is shown in the top of Figure 6 where the western floodplain of the Warrego River at Toorale (18,000 Ha as ANAE type Pt2.3.2: Freshwater meadow) and the Paroo flood-out area (120,000 Ha as ANAE type Pt1.6.2: Temporary woodland swamp) are highlighted. The new mapping allowed these large areas to be divided into a diverse array of ecosystem types that more accurately represent the aquatic ecosystem boundaries and the diversity of ANAE types in a manner that is consistent with how the ANAE classification maps floodplain ecosystems elsewhere in the Basin.

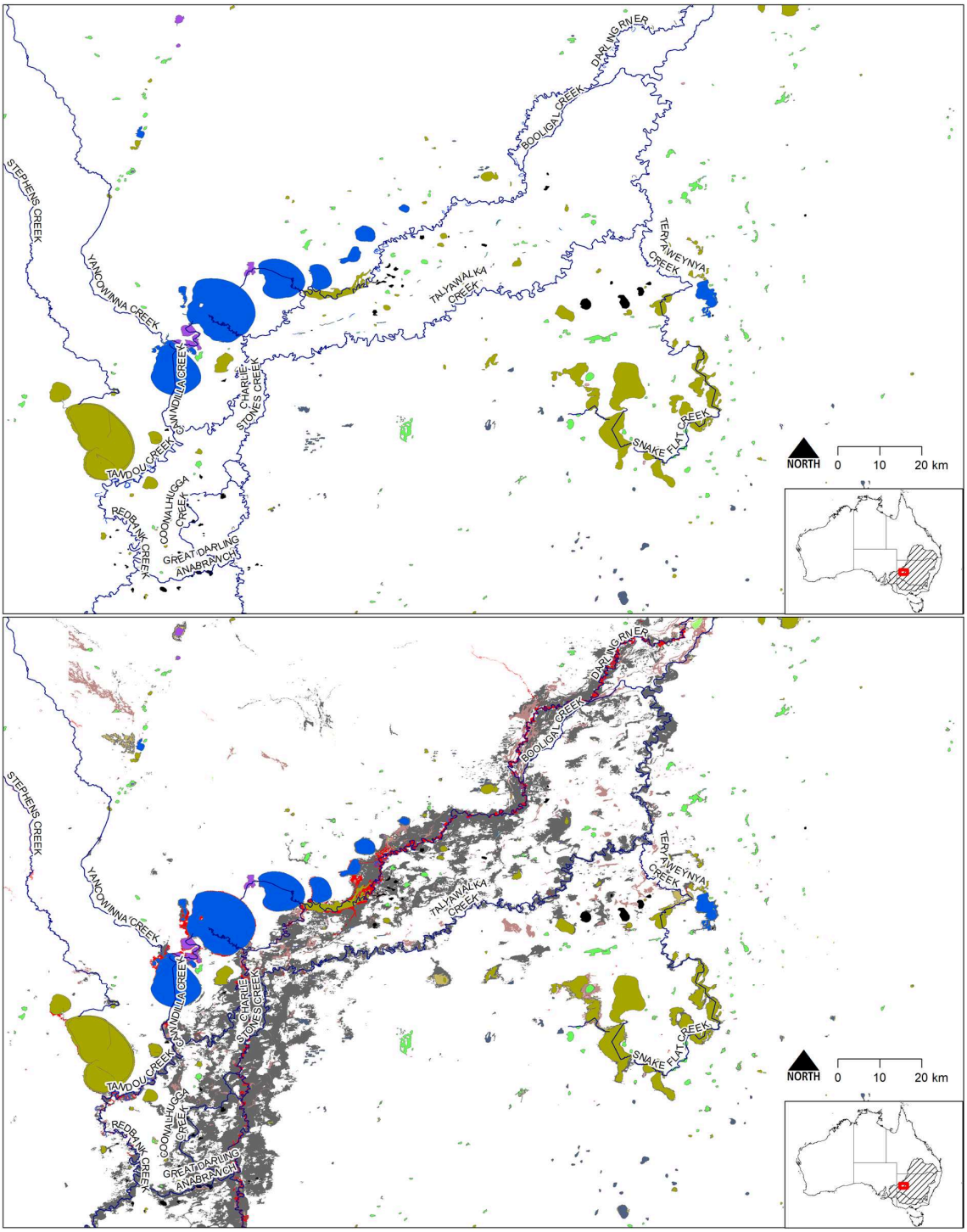

Figure 5: Comparison of ANAE classification mapping around the Darling River in the area of the Menindee Lakes before (top) and after (below) the update showing the addition of extensive areas of redgum (coloured red) and black box floodplain areas (coloured black).

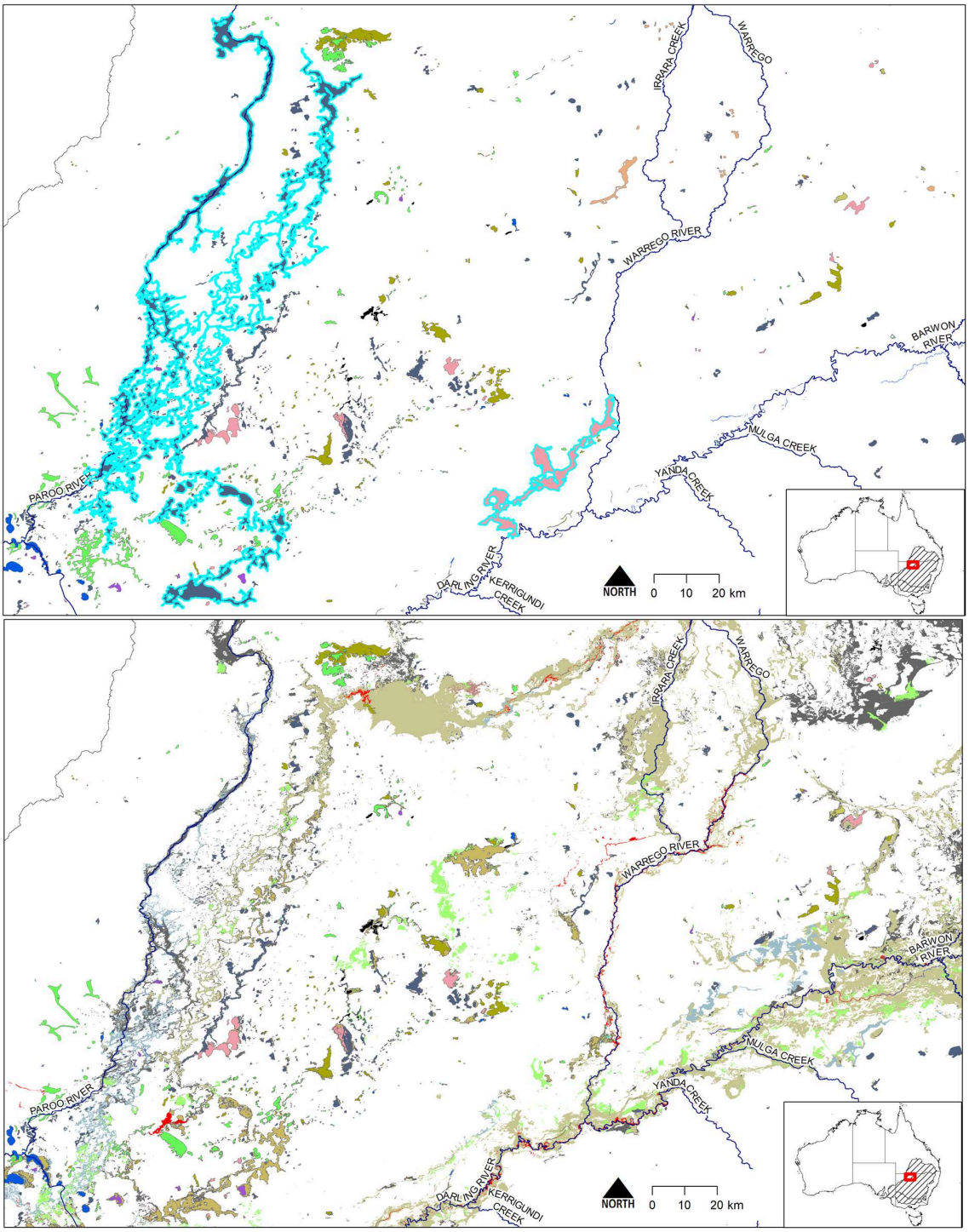

Figure 6: Comparison of ANAE classification mapping near the junction of the Warrego and Darling Rivers before (top) and after (below) the update showing the addition of extensive areas of coolibah floodplain (tan colour) and lignum (green). Two very large single polygons (top, outlined in blue) representing the western floodplain of the Warrego (18,000 Ha) and the Paroo floodout area (120,000 Ha) that were mapped as single ecosystem types have been replaced by more nuanced mapping showing the greater diversity of aquatic ecosystem types in these areas.

2. Inclusion of Queensland floodplain ecosystems

The 2017 update used water dependent vegetation to map floodplain and riparian systems in South Australia, Victoria and New South Wales but not in Queensland. Subsequent discussion with QLD Department of Environment and Science indicated that Queensland wetland mapping included additional floodplain areas mapped as "remnant regional ecosystems" with aquatic dependent vegetation that aligned with the ANAE classification typology (DES 2017). These areas were added to the ANAE mapping and classification in an unpublished ANAE data set in 2018 for use in the CEWO Long Term Intervention Monitoring (LTIM) Project evaluation and are now included formally as part of this update to ensure a consistent level of mapping effort for floodplains across all jurisdictions (Figure 7).

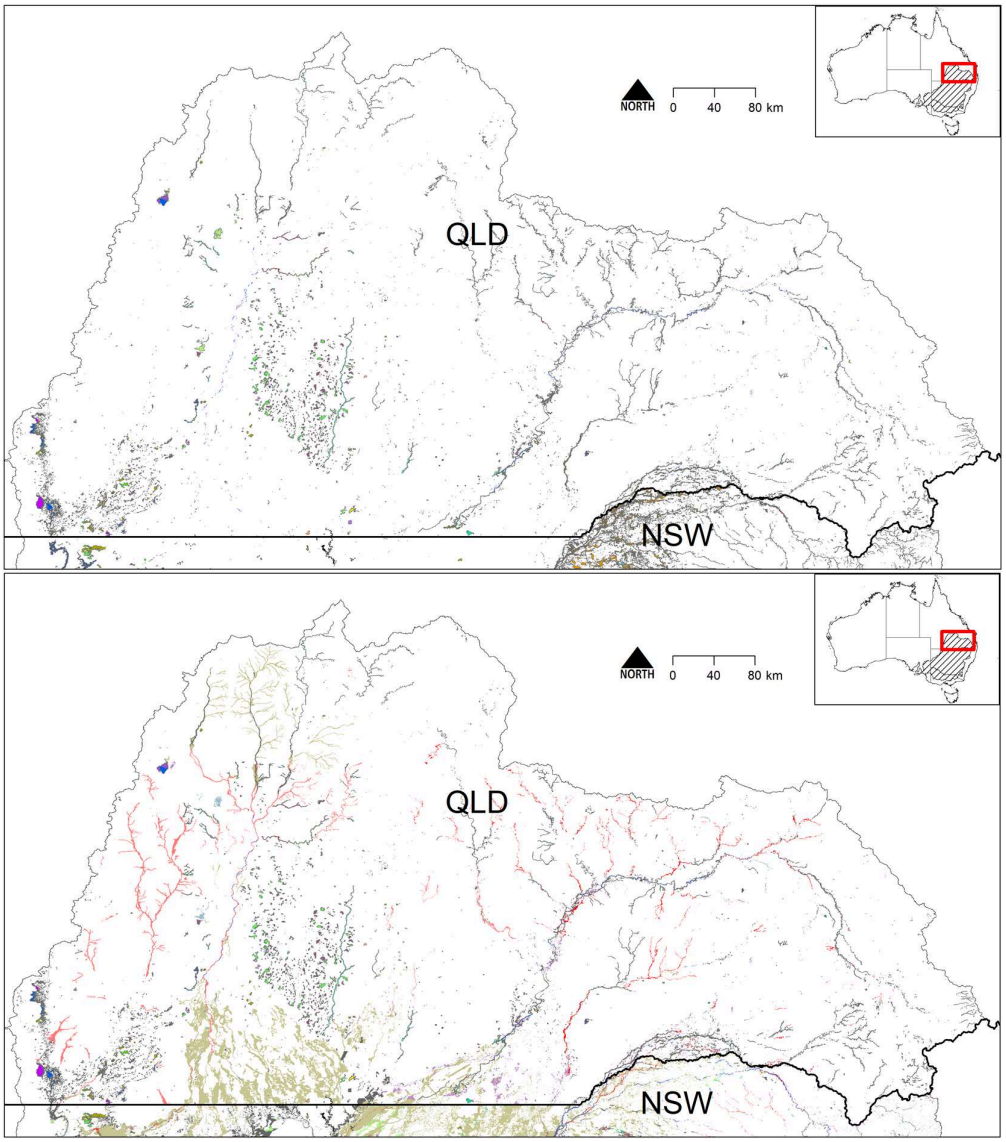

Figure 7: Comparison of ANAE classification mapping in QLD before (top) and after (below) the inclusion of floodplain "regional ecosystems" showing the addition of extensive areas of coolabah floodplain at the downstream end of the Warrego and Balonne Rivers (tan colour) and river redgum riparian zones (red) in the upper catchments

3. Improved river line mapping

The ANAE classification included two river line mapping layers.

1. MappedStreams_Geofabric is a classified copy of the Geofabric v2 mapped streams network that is consistently mapped but at a low resolution from a 9 arc-second digital elevation model (approximately accurate to 250m) (Figure 8). The river lines do not always align to riparian ecosystems and river lengths are under-estimated because the lines do not follow all river meanders.
2. ANAE_watercourses is a composite of higher resolution jurisdiction mapping that was included in the ANAE data set to improve alignment with riparian ecosystems. This mapping also includes many extraneous tributary fragments that are an artefact of how the layer was created (Figure 9). These fragments artificially inflate measurement of river lengths.

The Geofabric v3.2 mapped stream network released in 2020 provides a nationally consistent river network that is derived from a 1 arc-second digital elevation model (accurate to approximately 30m). The consistent resolution is important because river length measurement is highly dependent on the level of detail in the mapping with higher resolution mapping capturing more twists and turns in the river that increase the measured river length along the flow path between two points. The increased resolution greatly improves the alignment of the river mapping to riparian ecosystems (Figure 8) without the extraneous tributary fragments that are evident in the ANAE_watercourses layer (Figure 9). This update replaced the ANAE_watercourses layer with the Geofabric v3.2 geometry, re-applied the ANAE attributes and classified the river segment to their ANAE riverine ecosystem types (Figure 10).

Figure 8: ANAE_Geofabric v2 mapped streams (green) compared to the new higher resolution Geofabric v3 (yellow). The new mapping improves alignment with riparian ecosystems.

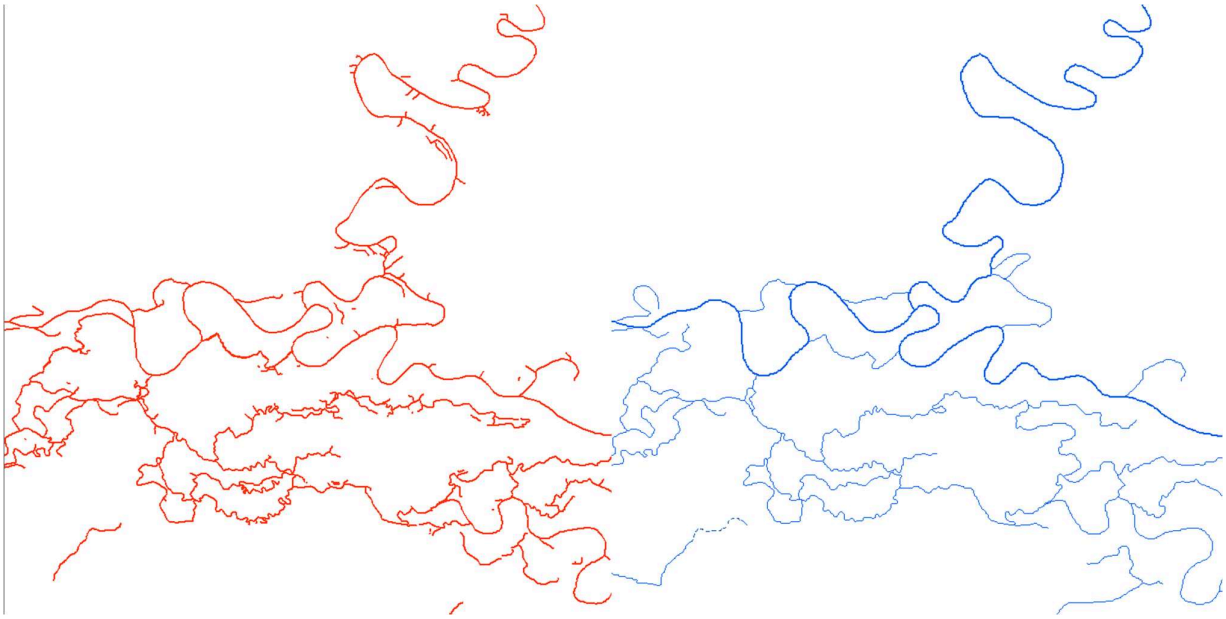

Figure 9: High resolution ANAE_Watercourses (red) compared to the new Geofabric v3 river lines (blue). The Geofabric v3 mapping removes fragments of minor tributaries ("whiskers") that artificially inflate evaluation of river distances influenced by Commonwealth environmental water.

A strength of the older Geofabric v2 mapping is that each river segment can be linked to the National Environmental Stream Attributes data set using the included "SegmentNo" that uniquely identifies the subcatchments of every line segments in the river network (Stein et al. 2012). The National Environmental Stream Attributes is an extremely useful data set that contains a vast array of metrics describing the topography, hydrology, land use, vegetation and climate for every sub catchment and waterway line segment. A similar data set has not yet been generated for the new higher resolution Geofabric v3.2. For this reasons the ANAE classification data set retains both versions as:

- MappedStreams_Geofabric2 (unchanged from v1.6)
- NetworkStreams_Geofabric3 (v3.0, this update)

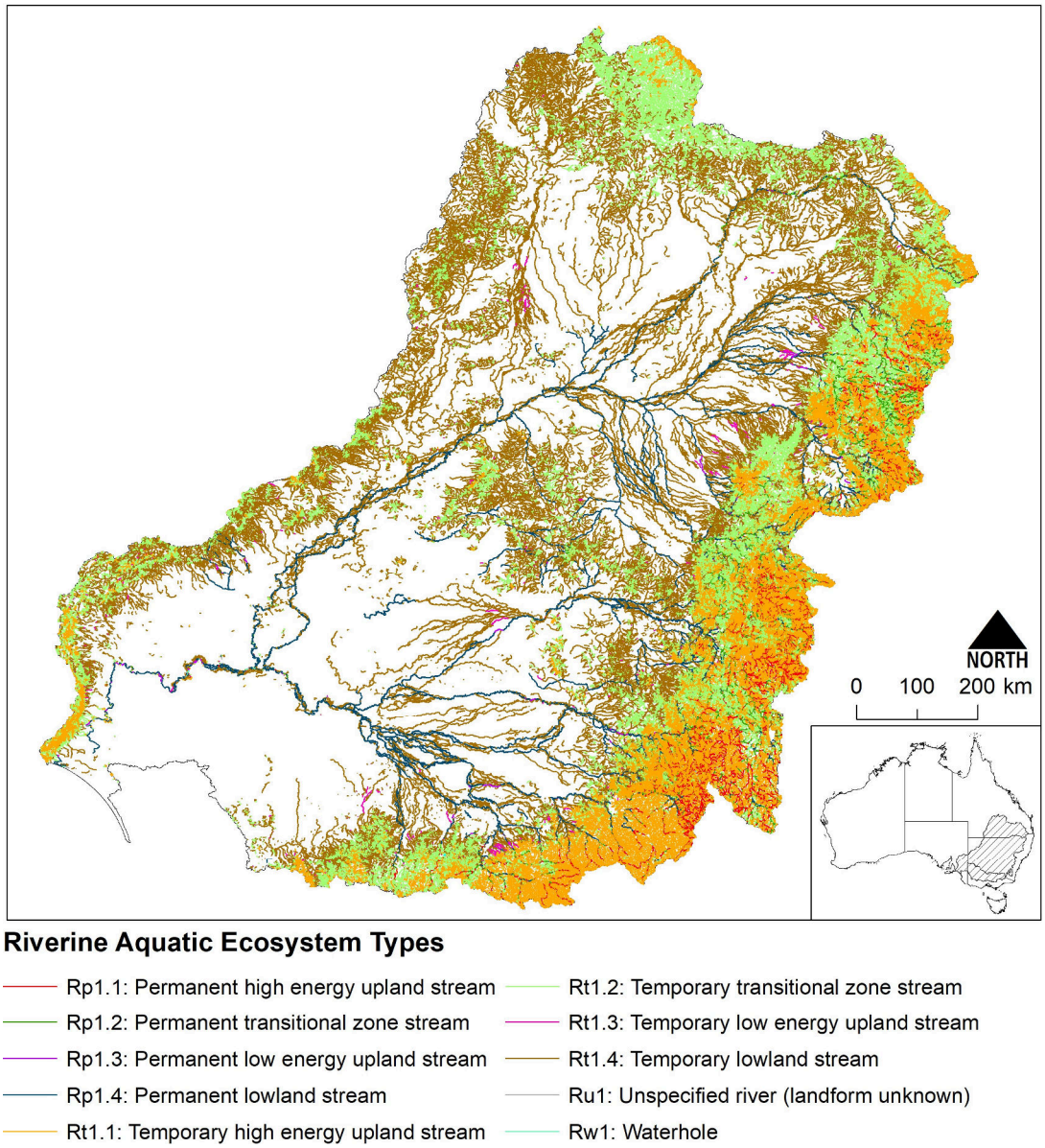

Figure 10. River line mapping in the ANAE classification of the Murray–Darling Basin (2020).

Landform was recharacterized using the slope and altitude

- Lowland: Slope < 0.5% and Altitude < 300m
- Upland Slope >=6% or (slope >0.5% and Altitude >500)
- Transitional Slope <6% Altitude <500m (and not lowland)
- Low Energy Upland Slope <0.5% and Altitude >500m

4. Restoring the floodplain system type

The 2017 ANAE update re-mapped floodplains as a subset of palustrine systems to align with NSW wetland mapping practices. This was a departure from the ANAE framework that identifies floodplains a separate ecosystem type (Level 3 Figure 1). In hindsight this change also made the classification more difficult to use. It was noted by MDBA (Ian Neeve pers comm. 2018) that the ANAE framework approach had the advantage of being able to more easily separate palustrine wetlands (that are often the target of environmental water) from the broad floodplain matrix that surrounds them in analysis and mapping. This is particularly relevant to environmental water management that is often constrained to in-channel flows and connected wetlands without inundating agricultural land on the floodplain (e.g. along the Goulburn River). The 2017 update retained the floodplain attribute to distinguish between depressional wetlands and floodplains but this required the end user of the classification to understand the significant of the attribute and then adjust the symbology used in mapping and analysis.

This update used the floodplain attribute to restore the floodplains to their own system type in alignment with the ANAE framework. This is a change in name only (attributes and mapping are unchanged). The extent of floodplains is shown in Figure 11 and Figure 12). All floodplains are attributed with the hydrological regime "periodic inundation" and the distinction between floodplain types is by the dominant water-dependent vegetation.

The floodplain ANAE classes are:

- F1.2: River red gum forest riparian zone or floodplain
- F1.4: River red gum woodland riparian zone or floodplain
- F1.6: Black box forest riparian zone or floodplain
- F1.8: Black box woodland riparian zone or floodplain
- F1.10: Coolibah woodland and forest riparian zone or floodplain
- F1.11: River cooba woodland riparian zone or floodplain
- F1.12: Woodland riparian zone or floodplain
- F1.13: Paperbark riparian zone or floodplain
- F2.2: Lignum shrubland riparian zone or floodplain
- F2.4: Shrubland riparian zone or floodplain
- F3.2: Sedge/forb/grassland riparian zone or floodplain
- F4: Unspecified riparian zone or floodplain

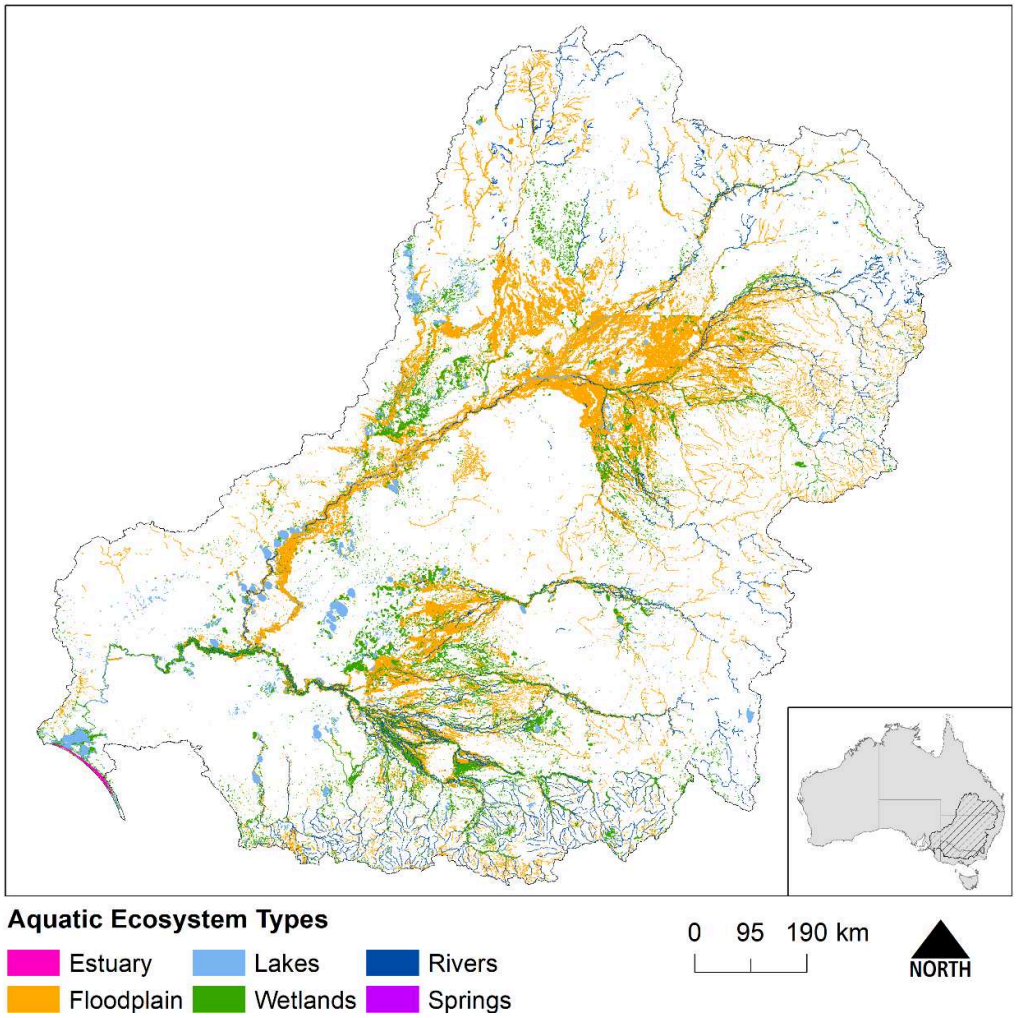

Figure 11. Aquatic ecosystem mapping in the ANAE classification of the Murray–Darling Basin (2020).

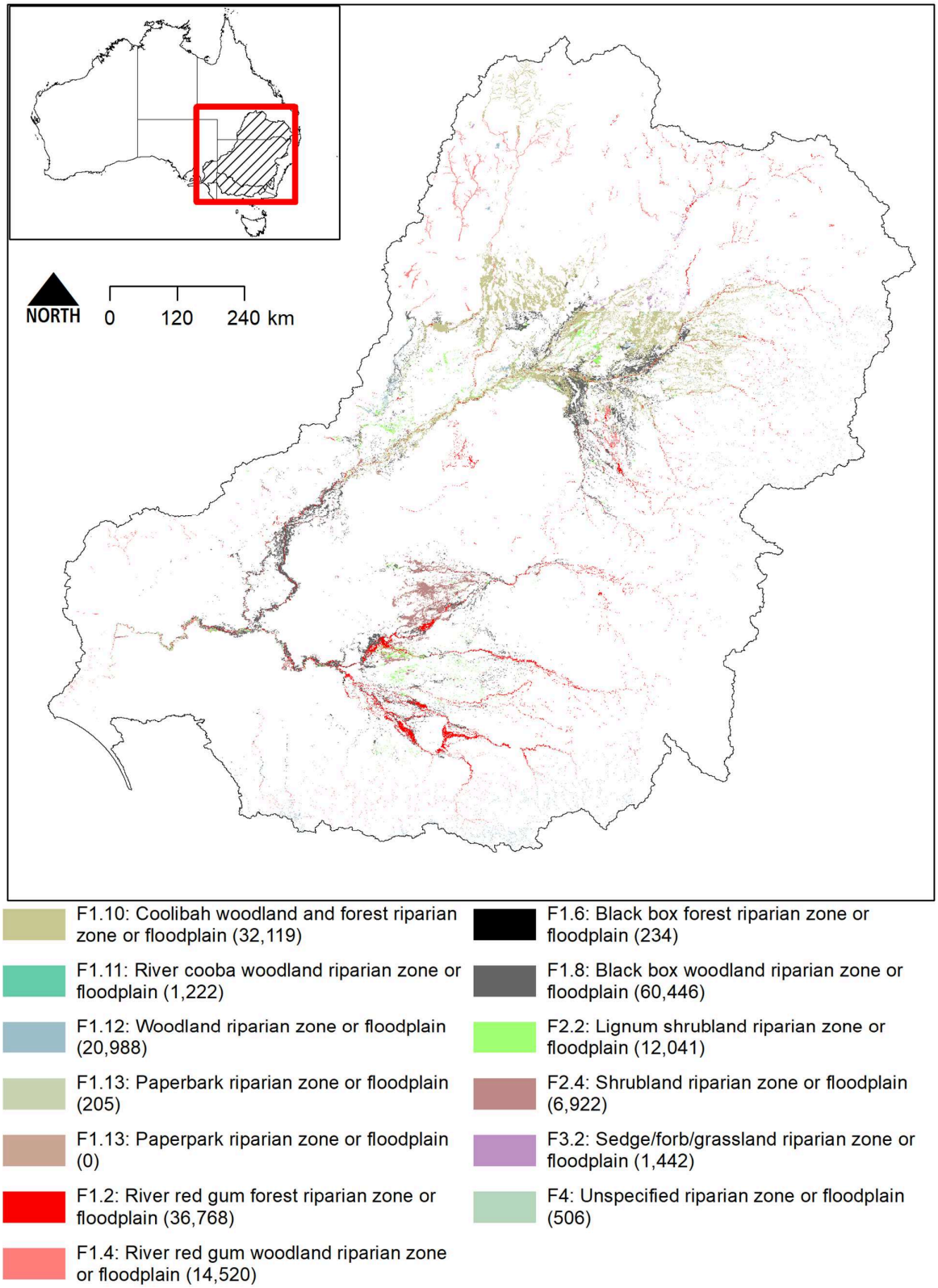

Figure 12. Distribution of floodplain ANAE types in the Basin with a count of the number of mapped floodplain polygons.

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