2017–18 Basin-scale evaluation of Commonwealth environmental water – Ecosystem Diversity

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Report prepared for the Commonwealth Environmental Water Office by La Trobe University

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The La Trobe University offices are located on the land of the Latje Latje and Wiradjuri peoples. We undertake work throughout the Murray–Darling Basin and acknowledge the traditional owners of this land and water. We pay respect to Elders past, present and future.

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Abbreviations

ANAE	Australian National Aquatic Ecosystem (classification)
CEWO	Commonwealth Environmental Water Office
GIS	geographical information system
ha	hectare
LTIM	Long Term Intervention Monitoring
MDBA	Murray–Darling Basin Authority

1 Preface

This report uses the 2017 update of the Australian National Aquatic Ecosystem (ANAE) classification of the Basin to evaluate the contribution of Commonwealth environmental water to Ecosystem Diversity in the Basin. The 2017 update revised the ecosystem typology and substantially changed the number and extent of mapped aquatic ecosystems in areas that receive Commonwealth environmental water (Brooks 2017a). Results presented herein should not be compared to those in LTIM Ecosystem Diversity reports from the first two years of the project that used the obsolete "interim" ANAE classification (Brooks 2016, 2017b).

A cumulative comparison across the full duration of the LTIM project was achieved in 2018 by re-evaluating the contribution of Commonwealth environmental water delivered in each of the previous years against the revised ANAE classification (Brooks 2018). This current report extends that cumulative evaluation to include the 2017-18 water year.

Changes to the ANAE classification are expected as new and improved mapping and knowledge to classify ecosystem types becomes available. When this occurs, the cumulative evaluation of Ecosystem Diversity outcomes across years can be repeated against the revised classification to provide a consistent long-term LTIM Ecosystem Diversity data set.

Much of the introductory text and methods is repeated from previous LTIM Ecosystem Diversity evaluation reports to enable this report to stand alone for the convenience of the reader.

2 Introduction

Biological diversity describes the variety of living organisms and ecosystems on Earth. The concept of biodiversity is often understood in terms of numbers of species of microbes, plants and animals but increasingly the definition is expanded to include other forms of natural variation such as genetic diversity, ecosystem diversity and diversity of ecosystem function (Figure 1). Conservation biology is often focused on protecting and restoring ecosystems on the basis that this also preserves the communities and species within them in addition to critical ecosystem functions and services that ecosystems may provide to us (Cadotte *et al.* 2011; Pollock *et al.* 2017)

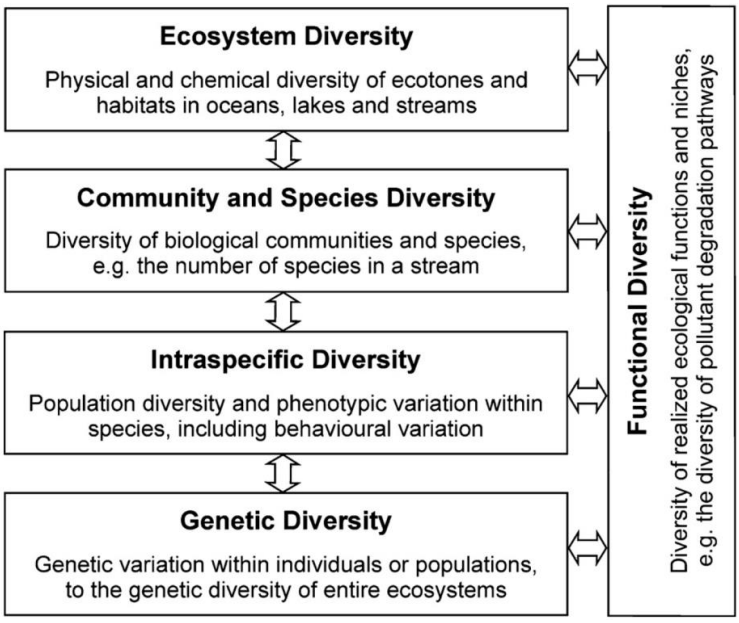

Figure 1. Hierarchical levels of biodiversity in aquatic ecosystems **(Geist 2011)**

There is increasing recognition globally that conserving biodiversity is critically important to maintain the functioning of natural ecosystems and for the sustainability of resources and ecosystem services on which human survival depends. Australia has joined 195 other countries as signatories to the United Nations Convention on Biological Diversity (1993, https://www.cbd.int) which provides guidance and impetus for conserving biodiversity and promoting sustainable development and sharing of genetic resources. The Basin Plan (Commonwealth of Australia 2012) is consistent with these objectives as it balances the need for sustainable water resource use with the environmental imperative to protect and restore biodiversity that is dependent on those same water resources.

Managed delivery of Commonwealth environmental water to aquatic ecosystems in the Basin supports water-dependent flora and fauna and provides the physical and chemical conditions that determine how those ecosystems function (Junk *et al.* 1989; Poff 1997; Thorp *et al.* 2006). Over decadal time scales, environmental water has potential to influence physical landscape diversity through geomorphological processes (Figure 2). In practice, however, the frequency and volumes of Commonwealth environmental water that are delivered are constrained by storage volumes, infrastructure, and land use to volumes that complement natural hydrological regimes and therefore large changes to the distribution and abundance of ecosystem types in the Basin are not expected within the duration of the LTIM project (5 years).

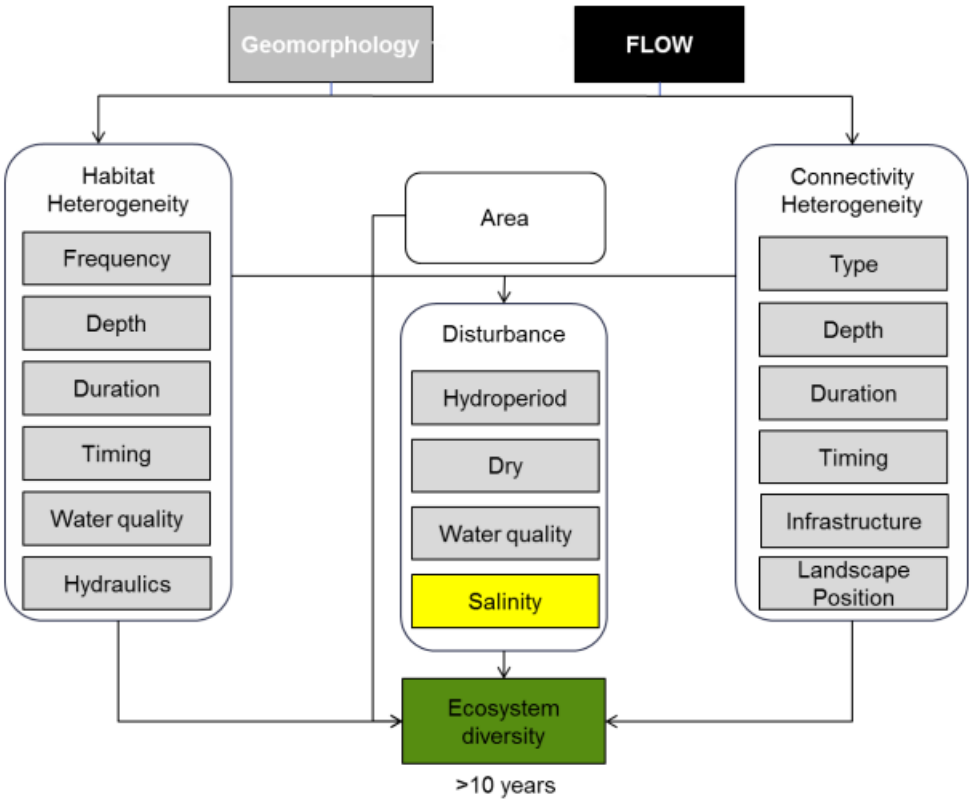

Figure 2. Cause-and-effect diagram depicting the influence of flow on landscape ecosystem diversity (MDFRC 2013).

This evaluation catalogues the different ecosystem types in the Basin that received Commonwealth environmental water during the 2017–18 water year. Evaluating the extent to which water-dependent ecosystem types have been supported by Commonwealth environmental water contributes to assessing the contribution of Commonwealth environmental water to Basin Plan biodiversity objectives as outlined in the Commonwealth Environmental Water Outcomes Framework (CEWH 2013).

3 Method

Ecosystem types in the Basin are defined using the interim ANAE Classification Framework (Aquatic Ecosystems Task Group 2012). The framework provides a consistent ecosystem type classification that can inform cross-jurisdictional adaptive management of aquatic ecosystems (

Figure 3).

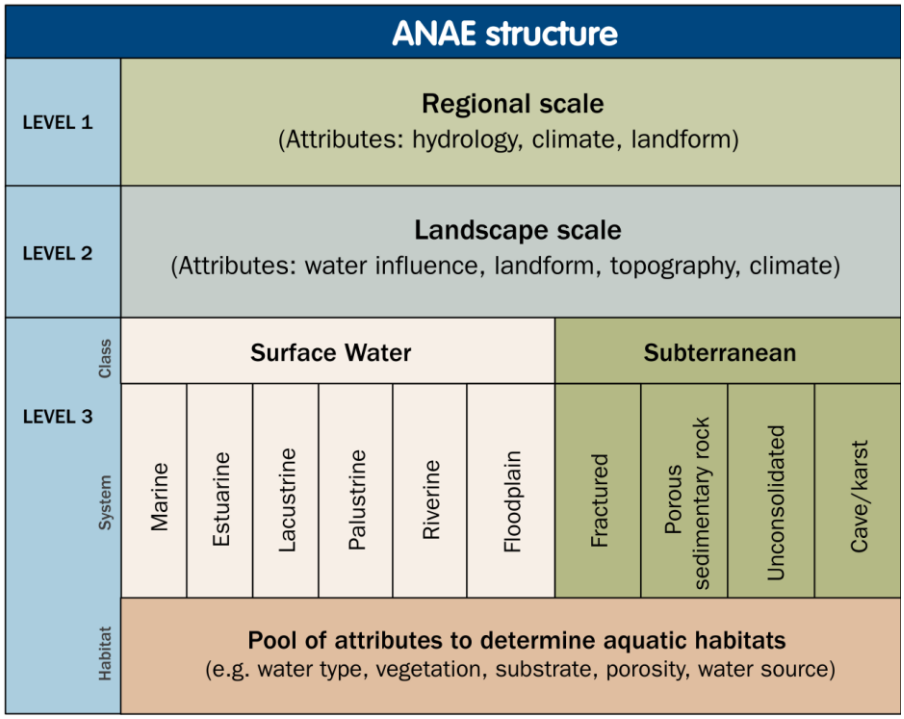

Figure 3. Structure and levels of the Interim Australian National Aquatic Ecosystem Classification Framework (Aquatic Ecosystems Task Group 2012).

The ANAE classification framework was applied to the best available jurisdictional mapping for Basin wetlands, floodplains and rivers by Brooks *et al.* (2014) to produce the interim Murray-Darling Basin Aquatic Ecosystem Classification data set. With subsequent updates (Brooks 2017a), this data set provides the LTIM project with relevant and contemporary ecosystem type definitions and mapping of their distribution throughout the Basin.

Overlaying the ANAE ecosystem map with the distribution of Commonwealth environmental water that was delivered in the Basin can then identify which ecosystem types received Commonwealth environmental water to answer the following short-term (1-year) and long-term (5-year) Basin-scale evaluation question:

1. *What did Commonwealth environmental water contribute to ecosystem diversity?*

3.1 Data

Data inputs to the evaluation of ecosystem diversity include:

The Murray-Darling Basin ANAE data set (Brooks *et al.* 2014; Brooks 2017a) (Figure 4). In 2017 the ANAE classification of the Basin underwent a substantial revision designed to improve the accuracy and currency of aquatic ecosystem mapping and to integrate all ecosystem types into a single aquatic ecosystem map for the Basin (Brooks 2017a). Additional changes were made in 2018 to further refine the classification of floodplains and to add new mapping for floodplains in QLD to

improve consistency of mapping across state borders (Figure 5).

As a result of all the changes to the ecosystem mapping, the Ecosystem Diversity evaluation results presented in this report are not comparable to those presented in the first two years of the LTIM project (Brooks 2016, 2017b). A cumulative comparison across the full duration of the LTIM project was made in 2018 using the revised classification and is extended to include the 2017-18 water year below (Section 4.3).

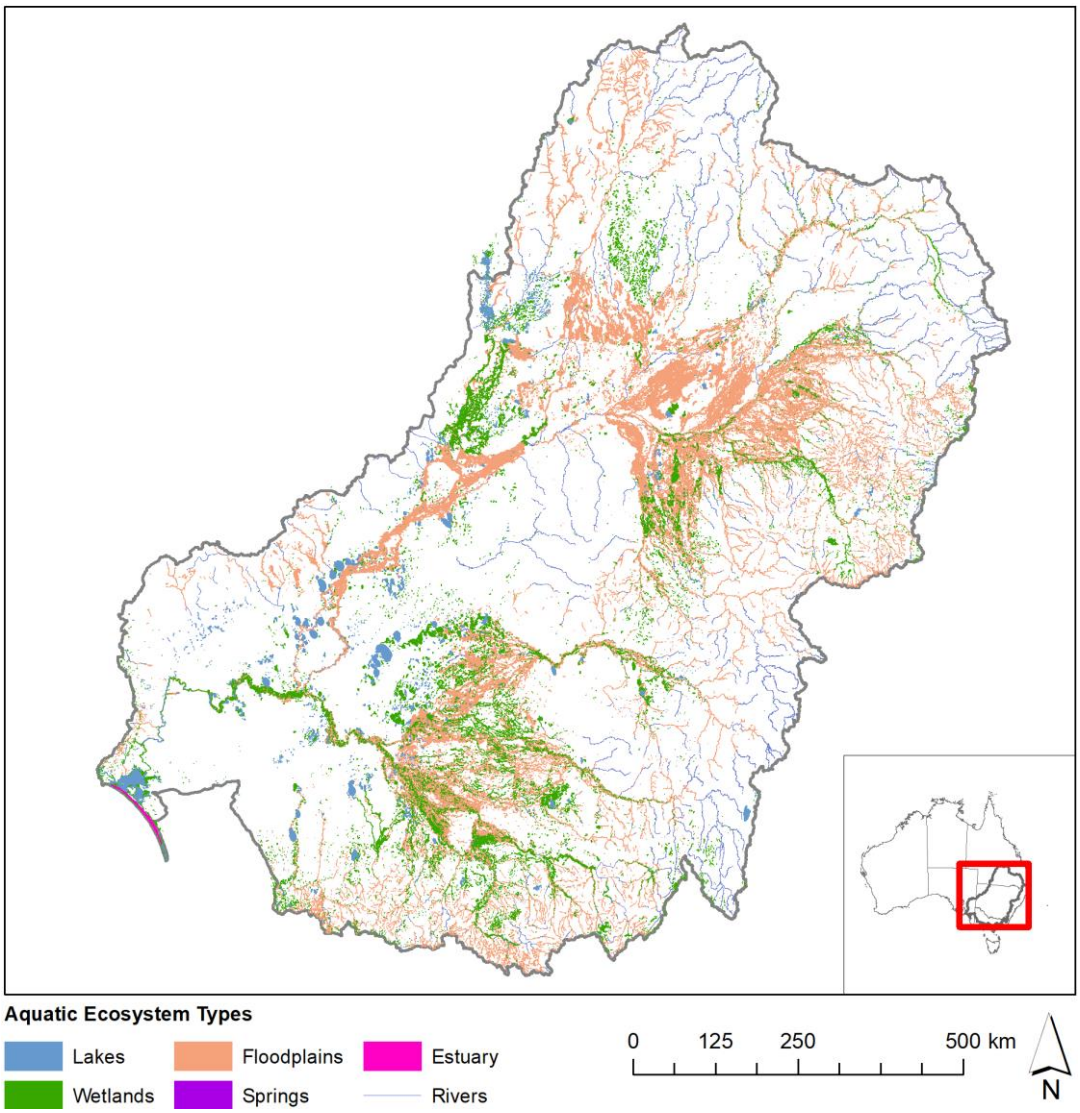

Figure 4. Aquatic ecosystems of the Murray-Darling Basin (ANAE 2018 mapping).

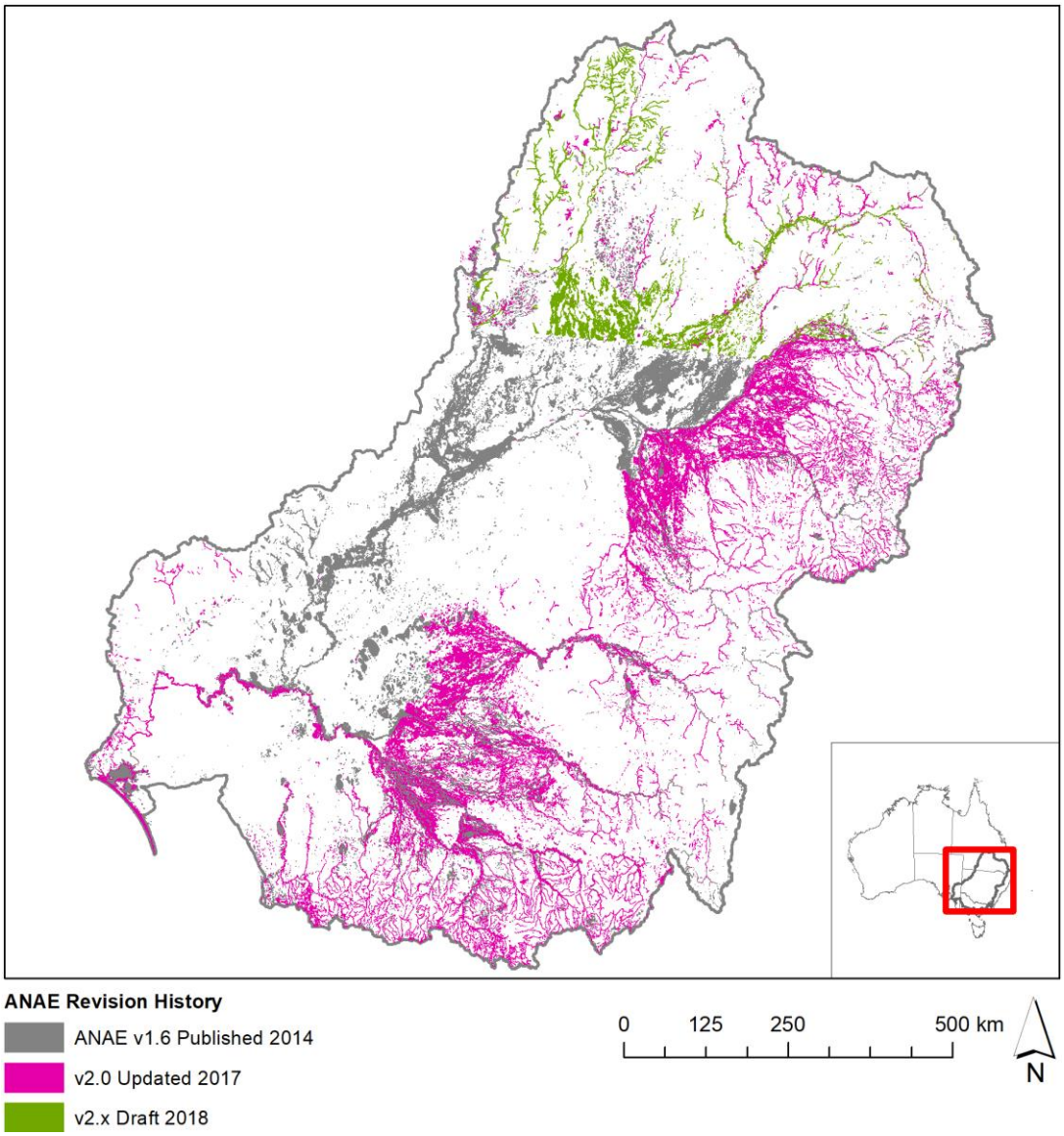

Figure 5. Revision history for the ANAE mapping in the Basin.

Commonwealth environmental water Inundation 2017–18 — a spatial representation of watering extent for Commonwealth environmental water delivered in the 2017–18 water year (Stewardson & Guarino 2019) (Figure 6). Commonwealth environmental water may include other environmental water (e.g. from State agencies) in a combined delivery and the extent mapped is the combined extent.

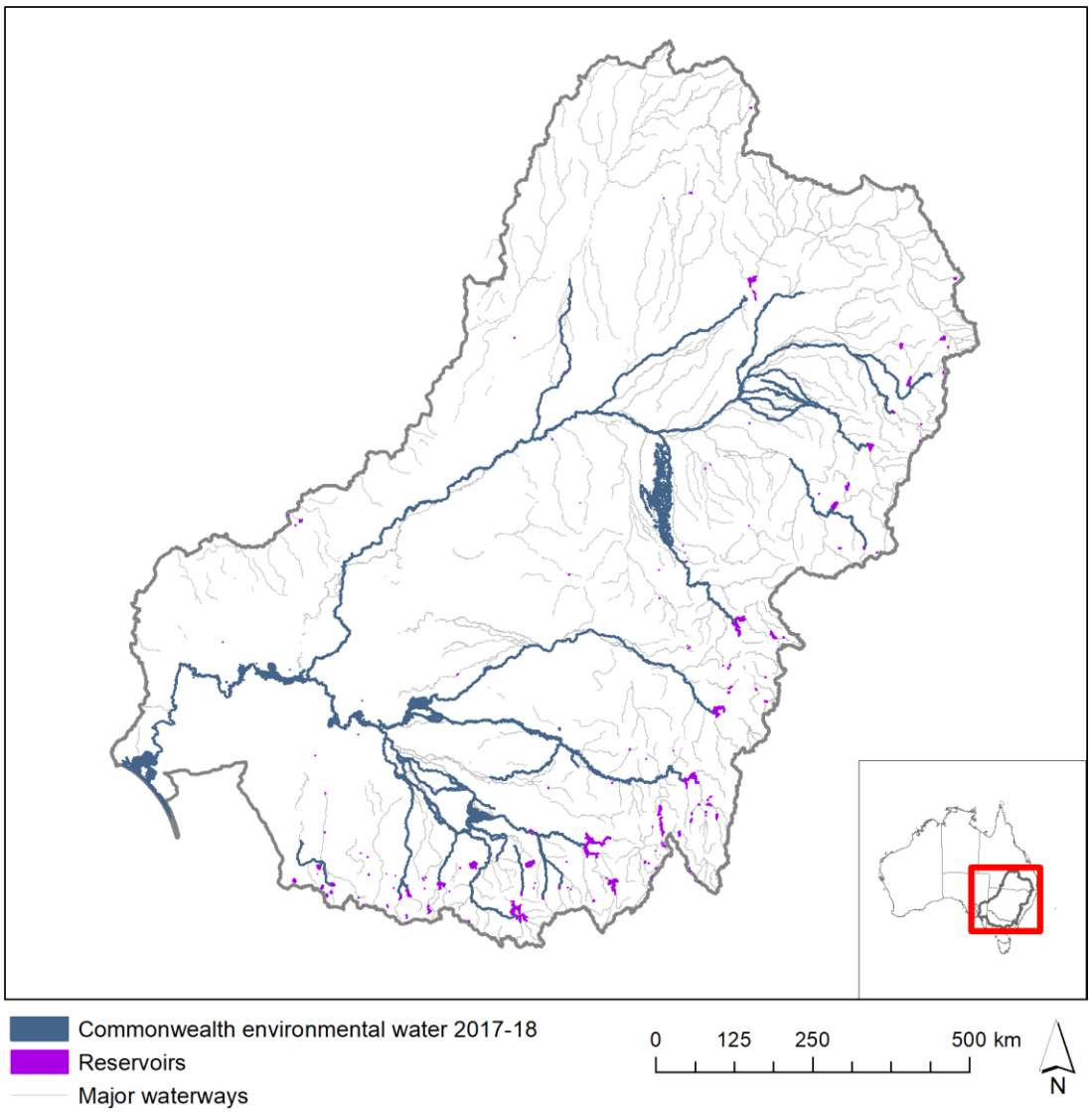

Figure 6. Commonwealth environmental water 2017–18.

LTIM valleys — a spatial layer developed for the LTIM project that subdivides the Basin into the major river valleys (Figure 7). These boundaries were derived from the Sustainable Rivers Audit (SRA) catchment boundaries with a modification to separate the Edward-Wakool Catchment from the Central Murray. The boundaries were adjusted slightly to improve the assignment of wetlands near valley boundaries to the watersheds in which managers and Commonwealth environmental water accounting allocate them. Mostly these changes affect the Central Murray area with a widening along the Murray River corridor to encompass fringing wetlands and the Gunbower and Barmah forests, and southern expansion of the Murrumbidgee valley to include Yanco Creek within the Murrumbidgee valley.

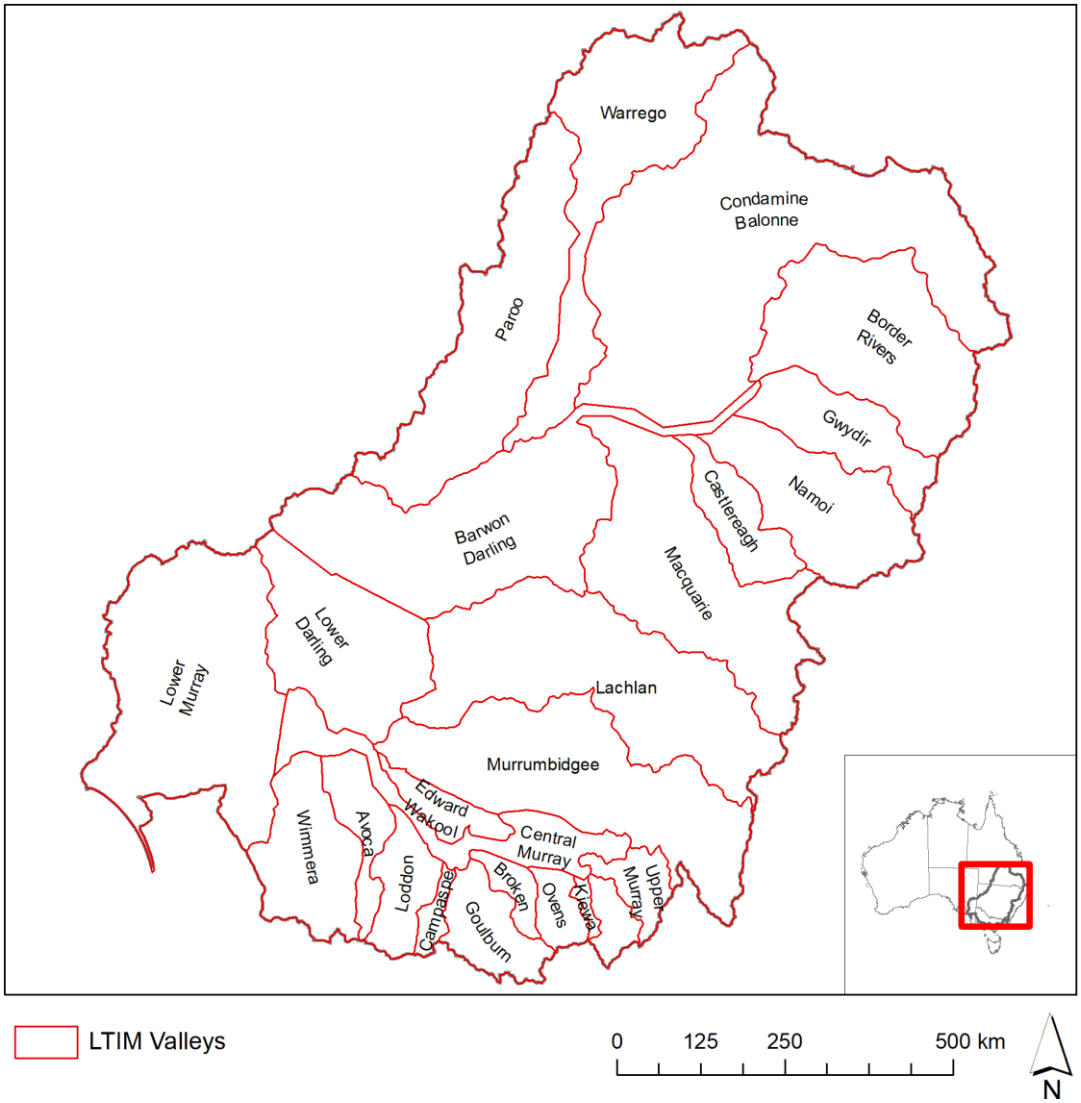

Figure 7. Valley boundaries within the Murray–Darling Basin used in this evaluation.

Geofabric v3 River Lines — new in this year's report is the mapping of river lines using the new Australian Geofabric v3 Network river lines (BOM 2019). This newly released beta product is still under development however the river line mapping is complete and provides more accurate and more consistent mapping for rivers than is available in the spatial maps compiled from jurisdiction data in the ANAE data set. The Basin ANAE waterway mapping compiles state data that varies in

resolution from 1:25 000 to 1:250 000 (equivalent to 25m to 250m accuracy) The Geofabric v2 Network Streams were generated from a 1 second DEM (30m) resolution consistently for the entire Basin. 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.

3.2 Approach

As in previous years, two different approaches were used to quantify the area of different ecosystem types that received Commonwealth environmental water:

1. Area inundated by Commonwealth environmental water = the sum of only the inundated areas of each wetland type, excluding the areas of wetlands that were not inundated.
2. Area influenced by Commonwealth environmental water = the sum of the all wetland areas that received water even if the inundation mapping showed that only a portion of the wetland was inundated.

The area *inundated* by Commonwealth environmental water is a 'literal' definition that represents the minimum contribution of Commonwealth environmental water in the landscape. The area *influenced* by Commonwealth environmental water acknowledges that aquatic ecosystems are complex interconnected systems and delivering water to part of a wetland contributes benefits to the entire wetland system. For example, filling a wetland depression may raise local water tables and benefit fringing vegetation, or provide feeding habitat for waterbirds that roost elsewhere in the wetland vegetation that was not inundated.

For lakes and palustrine wetlands, the total area *influenced* by Commonwealth environmental water is the appropriate measure of the contribution of Commonwealth environmental water to ecosystem diversity because water entering one part of a wetland depression is likely to raise water levels or the local water table across the extent.

For floodplains, the area *inundated* by Commonwealth environmental water is used to measure the contribution of Commonwealth environmental water to ecosystem diversity. This more conservative measure is used for floodplains because floodplains occur as broad continuous expanses and the ecosystem response is generally limited to the wetted area. Depressional wetlands and channels that hold or convey water through floodplains are considered as separate entities.

GIS methodologies for calculating these areas are provided attached in Annex A.

The spatial representation of watering extent for Commonwealth environmental water delivered in 2017–18 includes all watering actions that resulted in inundation beyond the river channel (Stewardson & Guarino 2019). River reaches that received in-channel pulses, freshes and passing flows are also identified (Figure 6); however, the river channel inundation mapping is not of sufficient resolution to identify inundation of river banks and fringing habitats along the channels.

Commonwealth environmental water reaching the end of the system contributes to the maintenance of the Coorong, Lake Alexandrina, Lake Albert and the Murray Mouth ecosystems. Reliable inundation models for this area do not exist at this time so the extent of inundation is estimated from the mapped extent of the Coorong, Lake Alexandrina, Lake Albert and the Murray Mouth. This estimate is considered reliable because the lakes are managed for a relatively constant water level of 0.5 to 0.8m AHD by regulating outflows through the barrages. Below the barrages, water levels in the Murray Mouth and Coorong are maintained near sea level.

4 Ecosystem Diversity Basin-scale evaluation

4.1 Highlights

In the 2017–18 water year:

- In 2017–18 there were approximately 104 500 ha of lakes and wetlands, nearly 40 000 ha of floodplains and 19 000 km of rivers in the Basin upstream of the Lower Lakes that was supported by Commonwealth environmental water.
- Commonwealth environmental water supported another 118 000 ha of Lake Alexandrina and Lake Albert and their fringing wetlands and 24 000 ha of estuarine habitat in the Coorong and Murray Mouth.
- All seven LTIM Selected Areas received Commonwealth environmental water with substantial areas also being inundated in the Macquarie, Murrumbidgee and Central Murray valleys (watering of Macquarie Marshes, Murrumbidgee river wetlands and Barmah-Millewa Forest).
- 70% of the different wetland ecosystem types and 83% of floodplain ecosystem types in the Basin were represented in the area inundated by Commonwealth environmental water.
- Of the wetland and floodplains receiving Commonwealth environmental water, 43% of the inundated area was dominated by temporary river red gum swamps and riparian floodplain (65 500 ha) along the Murrumbidgee River, the Barmah-MIllewa forest and then further downstream an the Murray-River floodplains in South Australia . This is 6% of the area of these ecosystem types in the Basin.
- Many permanent wetlands and lakes were also supported (38 000 ha excluding Lake Alexandrina and Albert or approximately 121 000 ha when the lower lakes are included) and 18% were meadows and marshes (27 000 ha) primarily in Gwydir and Macquarie valleys.
- Approximately 42% of the wetland areas that received Commonwealth environmental water were classed as temporary (intermittent) ecosystem types. These areas can be hot-spots for diversity if they support different suites of species in the dry and wet phases.
- As in previous years, Commonwealth environmental water contributed to all estuarine ecosystem types in the Basin during 2017–18 as environmental flows passed through to the Murray Mouth and Coorong.
- Thirteen of the rarest aquatic ecosystem types in the Basin, which include various types of paperback swamp, peat bogs and fens, lakes with aquatic macrophyte beds and saline marshes are mostly located in unmanaged catchments or above major storages. These ecosystem types may be outside the scope of Commonwealth environmental water releases from storages and can only be supported by Commonwealth environmental water where unregulated entitlements can be used to facilitate passing flows.

Comparing the four watering years 2014–15 to 2017–18:

- The broad pattern of watering across ecosystem types is similar across all the four years with 50% of ecosystem types supported to some extent by Commonwealth environmental water in all four years and 40% of ecosystem types not receiving any Commonwealth environmental water in any year over the same period. Gwydir wetlands, Macquarie Marshes, the Lowbidgee have received Commonwealth water in all years as has the Coorong, Lower Lakes and Murray mouth at the end of the system.
- 2017–18 was characterised by the large environmental flows down the Murrumbidgee River that inundated many permanent wetlands and lakes, temporary red gum swamps and marshes adjacent to the Murrumbidgee before then inundating river red gum floodplains along the Murray River into South Australia. Commonwealth water was also used to flood a greater extent of temporary red gum forest in the Barmah-Millewa forest this year than any

previous year. This is a similar distribution of supported ecosystem types to that of 2015–16 albeit with less inundation of lignum swamps along the Lachlan river system and more inundation of temporary red gum swamps along the Murrumbidgee.

- The 2014–15 and 2016–17 water years did not include inundation of red gum swamps of the Barmah Millewa forest however these areas were supported by environmental water from NSW and Victoria.

4.2 Basin-scale evaluation 2017–18

This evaluation does not consider the details of individual watering events and is ignorant of the specific timing and duration of Commonwealth environmental water in different areas of the landscape. The inundation map (Figure 6) collapses the maximum wetted extent of all watering actions during 2017–18 that included Commonwealth environmental water. The area inundated in each valley, and the length of river channels influenced by Commonwealth environmental water is presented in Table 1.

The contribution of Commonwealth environmental water to Ecosystem Diversity upstream of the Lower Lakes is presented under the broad system type categories: lakes and wetlands (Table 2), floodplains (Table 3), river channels (Table 4). The contribution of Commonwealth environmental water to Ecosystem Diversity in the Coorong and Lakes Alexandrina and Albert and the Murray Mouth are presented separately in (Table 5) for two reasons: the large areas of Lakes Alexandrina and Albert (82 500 ha) from masking finer scale patterns of inundation of lakes in the rest of the Lower Murray valley; and the constant managed water levels of the Lakes inundating the same ecosystems each year may hinder evaluation of more variable inter-annual differences in the use of Commonwealth environmental water in other areas of the Basin.

Commonwealth environmental watering actions contributed to the inundation of a wide range of ecosystem types within the Basin that included 51% of the different wetland types and 83% of the different floodplain types, and all (100%) of the river channel and estuarine ecosystem types.

A more detailed breakdown by valley is provided in Annex C (wetlands and estuarine ecosystems), Annex D (floodplains) and Annex E (river channels).

Table 1. Area of each LTIM catchment inundated by Commonwealth environmental water in 2017–18, including both floodplain and wetland ecosystem types.

Catchment name	LTIM Selected Area	Lakes and wetland area influenced (ha)	Floodplain area inundated (ha)	Length of waterways influenced (km)
Avoca		–	–	–
Barwon Darling		–	–	1899
Border Rivers		-	–	1349
Broken		181	–	347
Campaspe		–	–	114
Castlereagh		–	–	-
Central Murray		35 783	7716	2460
Condamine Balonne		–	–	505
Edward–Wakool	Edward–Wakool river system	104	23	976
Goulburn	Goulburn River	–	–	415
Gwydir	Gwydir river system	5303	2074	1149
Kiewa		–	–	-
Lachlan	Lachlan river system	5822	3437	1423
Loddon		–	–	374
Lower Darling		335	37	624
Lower Murray*	Lower Murray River*	31 223*	2135	1451
Lower Murray (Coorong Lakes Alexandrina and Albert and Murray Mouth)		Fresh: 100 614 Estuary: 23 123	9	
Macquarie		38 509	6130	2300
Mitta Mitta		–	–	-
Murrumbidgee	Murrumbidgee river system	18 416	15 390	2319
Namoi		–	–	537
Ovens		–	–	319
Paroo		–	–	-
Upper Murray		–	–	-
Warrego	Junction of the Warrego and Darling rivers	–	–	401
Wimmera		–	–	180
Total		**259 413**	**36 951**	**19 142**

* excludes the Coorong, Lakes Alexandrina and Albert and the Murray Mouth.

Table 2. Contribution of Commonwealth environmental water to ecosystem diversity of lakes and wetlands at the basin-scale. Ecosystem types are sorted by the area influenced by Commonwealth environmental water.

Australian National Aquatic Ecosystem (ANAE) wetland type	Total ex Coorong and Lower Lakes	Inundated*		Influenced*	
	area (ha)	Area (ha)	% of total	Area (ha)	% of total
Pt1.1.2: Temporary river red gum swamp	74 721	8035	10.8	34 910	46.7
Pp4.2: Permanent wetland	77 300	11 945	15.5	23 018	29.8
Pt2.2.2: Temporary sedge/grass/forb marsh	135 475	5198	3.8	15 776	11.6
Lp1.1: Permanent lake	127 660	14 518	11.4	15 292	12.0
Pt2.1.2: Temporary tall emergent marsh	68 622	2884	4.2	4154	6.1
Lt1.1: Temporary lake	459 347	717	0.2	3730	0.8
Pt2.3.2: Freshwater meadow	125 128	719	0.6	3620	2.9
Pp2.1.2: Permanent tall emergent marsh	7995	409	5.1	3451	43.2
Pt4.1: Floodplain or riparian wetland	10 494	389	3.7	2495	23.8
Pt1.8.2: Temporary shrub swamp	234 393	648	0.3	2218	0.9
Pt3.1.2: Clay pan	129 736	335	0.3	1654	1.3
Psp4: Permanent saline wetland	2114	495	23.4	629	29.8
Pt4.2: Temporary wetland	26 892	170	0.6	602	2.2
Pt1: Temporary swamp	3767	384	10.2	576	15.3
Pt1.6.2: Temporary woodland swamp	216 625	323	0.1	494	0.2
Pt1.7.2: Temporary lignum swamp	49 962	4	0.0	446	0.9
Lst1.1: Temporary saline lake	27 897	0	0.0	307	1.1
Pt1.2.2: Temporary black box swamp	60 272	106	0.2	239	0.4
Pu1: Unspecified wetland	1763	0	0.0	95	5.4
Pp2.3.2: Permanent grass marsh	1507	11	0.7	85	5.6
Pp2.4.2: Permanent forb marsh	738	1	0.1	22	3.0
Pp2.2.2: Permanent sedge/grass/forb marsh	3590	20	0.6	21	0.6
Pst2.2: Temporary salt marsh	40 294	3	0.0	4	0.0
Lsp1.1: Permanent saline lake	9229	0	0.0	0	0.0
Lt1.2: Temporary lake with aquatic bed	9052	0	0.0	0	0.0
Pst4: Temporary saline wetland	6118	0	0.0	0	0.0
Pst1.1: Temporary saline swamp	5728	0	0.0	0	0.0
Pp3: Peat bog or fen marsh	4425	0	0.0	0	0.0
Pst3.2: Salt pan or salt flat	3201	0	0.0	0	0.0
Lst1.2: Temporary saline lake with aquatic bed	2238	0	0.0	0	0.0
Lp1.2: Permanent lake with aquatic bed	2067	0	0.0	0	0.0
Pt1.5.2: Temporary paperbark swamp	412	0	0.0	0	0.0
Psp2.1: Permanent salt marsh	248	0	0.0	0	0.0
Lsp1.2: Permanent saline lake with aquatic bed	181	0	0.0	0	0.0
Psp1.1: Saline paperbark swamp	163	0	0.0	0	0.0
Pps5: Permanent spring	130	0	0.0	0	0.0
Pp1.1.2: Permanent paperbark swamp	1	0	0.0	0	0.0

* Area inundated/influenced by Commonwealth environmental water: see Section 3.2 for definitions.

Table 3. Contribution of Commonwealth environmental water to ecosystem diversity of floodplains at the Basin-scale, sorted by the area inundated.

Australian National Aquatic Ecosystem (ANAE) floodplain type	Total area (ha)	Inundated* area (ha)	% of total
F1.2: River red gum forest riparian zone or floodplain	639 022	25 708	4.0
F1.4: River red gum woodland riparian zone or floodplain	325 221	4887	1.5
F1.8: Black box woodland riparian zone or floodplain	779 639	1830	0.2
F2.2: Lignum shrubland riparian zone or floodplain	143 886	1474	1.0
F1.10: Coolabah woodland and forest riparian zone or floodplain	1 215 726	1335	0.1
F1.11: River cooba woodland riparian zone or floodplain	11 541	840	7.3
F2.4: Shrubland riparian zone or floodplain	408 614	473	0.1
F1.6: Black box forest riparian zone or floodplain	131 442	265	0.2
F1.12: Woodland riparian zone or floodplain	318 686	93	<0.1
F4: Unspecified riparian zone or floodplain	201 086	36	<0.1
F3.2: Sedge/forb/grassland riparian zone or floodplain	833 102	0	0.0
F1.13: Paperbark riparian zone or floodplain	17	0	0.0

* Area inundated/influenced by Commonwealth environmental water: see Section 3.2 for definitions.

Table 4. Contribution of Commonwealth environmental water to ecosystem diversity within river channels of the Basin sorted by the area influenced by Commonwealth environmental water.

Australian National Aquatic Ecosystem (ANAE) waterway type	Total	Inundated*	
	Length (km)	Length (km)	% of total
Rp1.4: Permanent lowland stream	40 783	11 533	28.3
Rt1.4: Temporary lowland stream	198 613	2109	1.1
Rp1.2: Permanent transitional zone stream	17 920	633	3.5
Rp1.1: Permanent high energy upland stream	59 080	587	1.0
Rp1.3: Permanent low energy upland stream	545	148	27.2
Rt1: Temporary stream	174	101	58.0
Rt1.1: Temporary high energy upland stream	167 220	89	0.1
Rp1: Permanent stream	293	69	23.5
Rt1.2: Temporary transitional zone stream	116 557	26	<0.1
Rt1.3: Temporary low energy upland stream	2795	24	0.9
Rw1: Permanent river (landform unknown)	308	3	1.0

* Area inundated/influenced by Commonwealth environmental water: see Section 3.2 for definitions.

Table 5. Ecosystem types in the Coorong, Lower Lakes and Murray Mouth that are influenced by Commonwealth environmental water. Ecosystem types are sorted by the area inundated by Commonwealth environmental water.

Australian National Aquatic Ecosystem (ANAE) wetland type	Total	Inundated*	
	area (ha)	Area (ha)	% of total
Lp1.1: Permanent lake	82 533	82 580	100
Ewd1.3.2: Coastal lagoon	18 912	18 832	100
Pt3.1.2: Clay pan	8990	7735	86
Pt2.1.2: Temporary tall emergent marsh	7717	5912	77
Pt2.2.2: Temporary sedge/grass/forb marsh	7042	2517	36
Etd1.3.3: Tide dominated estuary	2240	2230	100
Ewd1.2.4: Intertidal mudflat or sand bar	960	830	86
Pst1.1: Temporary saline swamp	2215	407	18
Ewd1.2.3: Intertidal saltmarsh	478	332	69
Etd1.2.1: Tide dominated saltmarsh	321	320	100
Ewd1.2.5: Intertidal rocky shoreline	284	284	100
Etd1.2.2: Tide dominated mudflats and sandbar	629	269	43
Pt4.1: Floodplain or riparian wetland	994	235	24
Pp4.2: Permanent wetland	107	149	139
Pt2.3.2: Freshwater meadow	64	59	92
Pst4: Temporary saline wetland	513	38	7
Pt1: Temporary swamp	0	24	-
Etd1.2.3: Tide dominated forest	19	19	100
Pt4.2: Temporary wetland	4295	15	<0.1
Pp2.1.2: Permanent tall emergent marsh	9	10	111
Pt1.8.2: Temporary shrub swamp	26	7	27
Etd1.1.1: Tide dominated rocky shoreline	7	7	100
Pt1.7.2: Temporary lignum swamp	3	3	100
Pp2.4.2: Permanent forb marsh	2	2	100
Lsp1.1: Permanent saline lake	2432	0	0
F2.4: Shrubland riparian zone or floodplain	632	0	0
Psp4: Permanent saline wetland	595	0	0
Pst2.2: Temporary salt marsh	412	0	0
Pst3.2: Salt pan or salt flat	169	0	0
F1.12: Woodland riparian zone or floodplain	57	0	0
F2.2: Lignum shrubland riparian zone or floodplain	33	0	0
Lt1.1: Temporary lake	28	0	0
F1.8: Black box woodland riparian zone or floodplain	3	0	0
Psp2.1: Permanent salt marsh	2	0	0

* Area inundated/influenced by Commonwealth environmental water: see Section 3.2 for definitions.

4.3 Cumulative Basin-scale evaluation (2014–18)

The cumulative evaluation compares the area of each floodplain ecosystem type that was inundated, and each wetland that was influenced by Commonwealth environmental water (i.e. the whole wetland area if part of the wetland was inundated) in each of the LTIM water years. The inter-annual comparisons presented in Table 6 and Table 7 should be viewed as indicative only as there are some differences in the way inundation extents were mapped in each year. The 2014–15 inundation likely over-estimates the extent of Commonwealth environmental water in the Macquarie Marshes, Gwydir wetlands and Lower Murrumbidgee (Lowbidgee) due to poor discrimination of Commonwealth environmental water from other water in satellite imagery. Improvements to the data assembly process increased the accuracy and confidence in the inundation mapping from 2015–16 onwards.

Commonwealth environmental water contributed to inundation of the Gwydir wetlands, Macquarie Marshes and Lowbidgee in all four years of LTIM 2014–18 whereas Commonwealth water was used to inundate the Barmah-Millewa forest only in 2015–16 and 2017–18. The broad pattern of ecosystem types supported by Commonwealth environmental water reflects the similarity in the distribution of watering actions among years with 50% of wetland, lake and floodplain ecosystem types in the Basin receiving Commonwealth environmental water in all four years and conversely 40% of ecosystem types have not received any Commonwealth environmental water during the same period (Table 6). Ecosystem types not supported by Commonwealth environmental water occupy only 2.4% of the wetland area in the Basin (51 000 ha) and are mostly located in unregulated valleys or in tributaries above water storages (Figure 8). Some of the ecosystem types that have not been supported by Commonwealth environmental water since 2014 may be included in areas targeted for watering by state-based delivery partners but it is currently beyond the scope of the of LTIM to evaluate all environmental water delivered by other jurisdictions.

Combining the inundation extents from the four years of LTIM to 2019, Commonwealth environmental water (outside of river channels) has supported 380 600 ha of lakes, wetlands and floodplains in the Basin. This is a small proportion (0.3%) of the total Basin area, but represents a larger proportion (5.2%) of the area maps as aquatic dependent ecosystems by the ANAE classification. Approximately 20% (74 200 ha) of the combined 380 600 ha of aquatic ecosystems supported by Commonwealth environmental water in the first four years of LTIM lies outside of the area currently mapped as managed floodplain by MDBA suggesting there is additional work required to confidently map the full extent of ecosystems that can be supported by Commonwealth environmental water.

The area and diversity of ecosystem types supported by Commonwealth environmental water in 2017–18 (year 4) was similar to the 2015–16 water year (LTIM year 2) albeit with less inundation of freshwater meadows and lignum and blackbox swamps along the Lachlan river system where smaller volumes were largely restricted to the channel. Both years included extensive inundation of temporary red gum swamps along the Murrumbidgee River and Murray River and of permanent tall emergent marsh in the Great Cumbung Swamp.

The 2014–15 and 2016–17 water years did not include inundation of red gum swamps of the Barmah Millewa forest however these areas were supported by environmental water from NSW and Victoria.

Over the duration of LTIM, Commonwealth environmental water has influenced more than 5% of the total Basin area of 14 different lake and wetland ecosystem types in at least one year (36% of these types present in the Basin). Another 10 lake and wetland ecosystem types have had only small areas (<5% of their area) supported by Commonwealth environmental water.

Inundation of floodplain ecosystems has been similar across all years (Table 7) with the total area of floodplain inundated by Commonwealth environmental water ranging from 110 000 ha in 2016–17 up to 196 000 ha in 2015–16. In 2017–18 the total area of floodplain inundated was 151 000 ha. As a proportion of floodplain in the Basin these extents are relatively small (often less than 1%). Inundation of floodplain ecosystems has been as high as 10% of total extent for "river cooba woodland riparian zone or floodplain" which is the second most restricted aquatic ecosystem type in the Basin occupying only 11 541 ha. By comparison, the most extensive floodplain type is coolabah woodland and forest riparian zone or floodplain with more than 1 million ha. The very restricted 17 ha of paperbark riparian zone or floodplain has not received Commonwealth environmental water during LTIM is mostly located on an unregulated tributary of the Namoi River in the Pilliga State Conservation Area that is out of scope for Commonwealth environmental water. Floodplain inundation is rarely an objective for Commonwealth environmental water because volumes are limited and delivery constraints imposed by infrastructure and built assets often restrict watering actions to volumes that are contained within river channels and wetlands. Extensive floodplain inundation is not expected unless Commonwealth environmental water is delivered to augment natural floods.

Table 6. Comparison of the contribution of Commonwealth environmental water to ecosystem diversity of lakes and palustrine wetlands from 2014-18 (sorted by the magnitude of watering in the 2017-18 water year). Ecosystem types with more than 5% of their total Basin area inundated in any one year are shaded pale blue. Ecosystem types that have not received Commonwealth environmental water during the period of LTIM are shaded red. Large differences (>10%) from previous years are highlighted in dark blue.

Australian National Aquatic Ecosystem (ANAE) wetland type	Total area (ha)	% receiving Cew				Differences		
		Y1 14-15	Y2 15–16	Y3 16–17	Y4 17-18	Y4-Y3	Y4-Y2	Y4-1
Pt1.1.2: Temporary river red gum swamp	74 721	13.3	56.1	10.1	46.7	36.7	-9.4	33.4
Pp2.1.2: Permanent tall emergent marsh	8005	43.1	51.9	0.0	43.1	43.1	-8.8	0.0
Pp4.2: Permanent wetland	77 406	26.1	28.1	26.0	29.7	3.8	1.6	3.6
Psp4: Permanent saline wetland	2709	8.5	37.9	6.3	23.2	16.9	-14.7	14.7
Pt4.1: Floodplain or riparian wetland	11 489	7.6	19.2	8.8	21.7	12.9	2.6	14.2
Pt1: Temporary swamp	3767	7.4	18.5	3.5	15.3	11.8	-3.2	7.9
Lp1.1: Permanent lake	127 660	1.1	3.9	5.4	12.0	6.6	8.1	10.9
Pt2.2.2: Temporary sedge/grass/forb marsh	142 517	11.5	14.3	11.9	11.1	-0.8	-3.3	-0.4
Pp2.3.2: Permanent grass marsh	1507	1.5	1.7	6.4	5.6	-0.7	4.0	4.1
Pt2.1.2: Temporary tall emergent marsh	76 339	4.1	5.7	4.1	5.4	1.4	-0.2	1.4
Pu1: Unspecified wetland	1763	0.0	0.0	0.0	5.4	5.4	5.4	5.4
Pp2.4.2: Permanent forb marsh	740	1.4	0.7	4.1	3.0	-1.1	2.3	1.6
Pt2.3.2: Freshwater meadow	125 192	15.1	16.8	16.4	2.9	-13.5	-13.9	-12.2
Pt4.2: Temporary wetland	22 916	<0.1	2.5	0.0	2.6	2.6	0.1	2.6
Pt3.1.2: Clay pan	138 725	2.3	2.7	1.2	1.2	0.0	-1.5	-1.1
Lst1.1: Temporary saline lake	27 897	0.0	0.5	0.0	1.1	1.1	0.6	1.1
Pt1.8.2: Temporary shrub swamp	234 419	0.7	3.2	0.9	0.9	0.0	-2.2	0.3
Pt1.7.2: Temporary lignum swamp	49 965	1.1	7.0	24.9	0.9	-24.0	-6.1	-0.2
Lt1.1: Temporary lake	459 375	0.6	1.7	0.5	0.8	0.3	-0.8	0.2
Pp2.2.2: Permanent sedge/grass/forb marsh	3590	0.4	0.5	0.4	0.6	0.2	0.1	0.2
Pt1.2.2: Temporary black box swamp	60 272	1.8	10.4	0.4	0.4	0.0	-10.0	-1.4
Pt1.6.2: Temporary woodland swamp	216 625	<0.1	0.3	<0.1	0.2	0.1	0.0	0.2
Pst2.2: Temporary salt marsh	40 706	<0.1	1.6	<0.1	<0.1	0.0	-1.6	-0.1
Pst1.1: Temporary saline swamp	7942	1.2	0.0	0.0	0.0	0.0	0.0	-1.2
Lsp1.1: Permanent saline lake	9229	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lt1.2: Temporary lake with aquatic bed	9052	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pt1.3.2: Temporary coolabah swamp	8271	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pst4: Temporary saline wetland	6631	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pp3: Peat bog or fen marsh	4425	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pst3.2: Salt pan or salt flat	3370	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lst1.2: Temporary saline lake with aquatic bed	2238	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lp1.2: Permanent lake with aquatic bed	2067	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pt1.5.2: Temporary paperbark swamp	412	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Psp2.1: Permanent salt marsh	249	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lsp1.2: Perm. saline lake with aquatic bed	181	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Psp1.1: Saline paperbark swamp	163	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pps5: Permanent spring	130	0.0	0.0	0.0	0.0	0.0	0.0	0.0

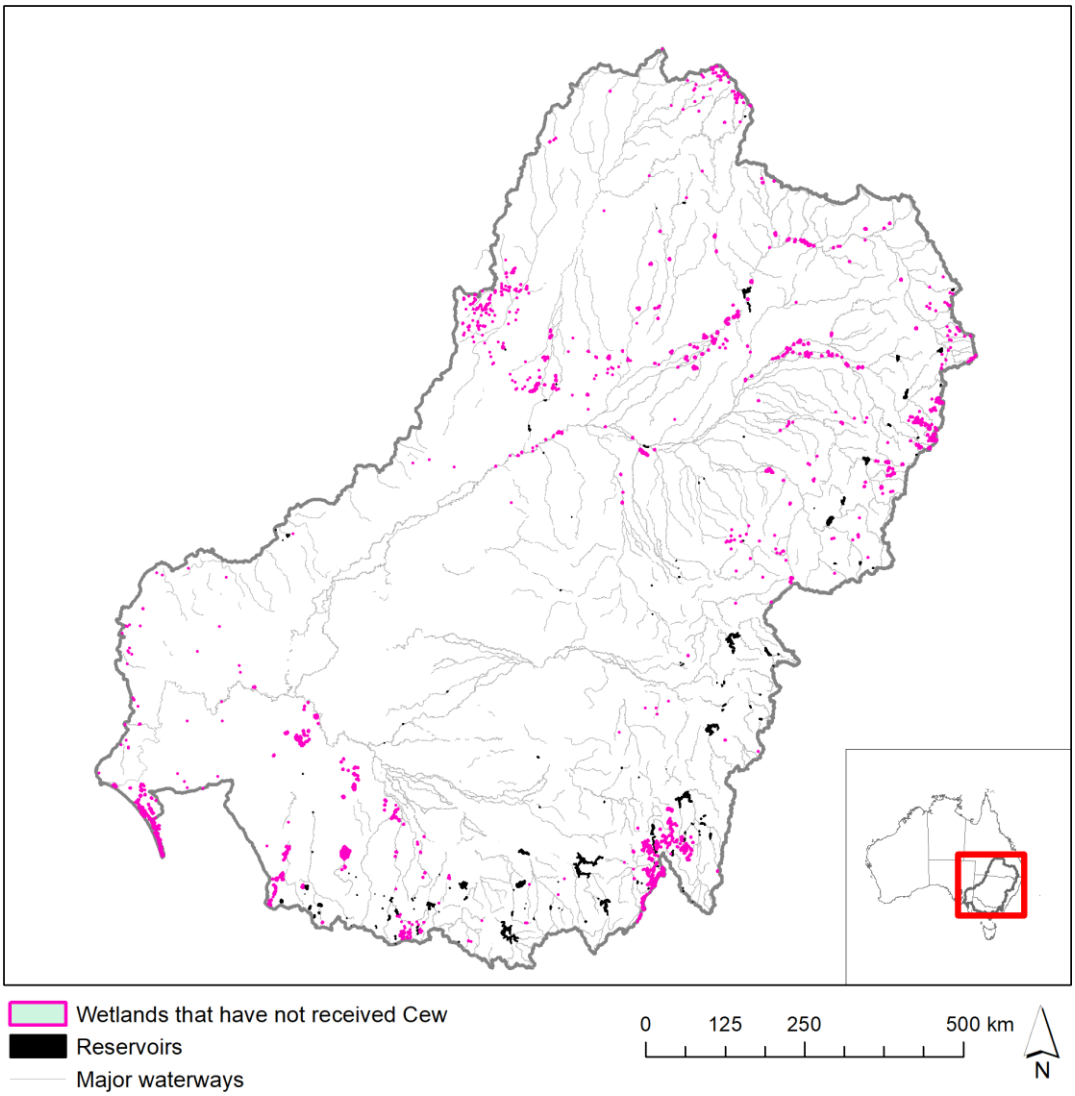

Figure 8. Wetland ecosystem types that have not been represented in Commonwealth environmental water inundation extents during the period of LTIM are predominantly located in unregulated valleys or higher in the catchments above water storages.

Table 7. Comparison of the contribution of Commonwealth environmental water to ecosystem diversity of floodplains from 2014-18 (sorted by the magnitude of watering in the 2017-18 water year). Ecosystem types with more than 5% of their total Basin area inundated in any one year are shaded pale blue. Ecosystem types that have not received Commonwealth environmental water during the period of LTIM are shaded red. Large differences (>10%) among years are highlighted in dark blue.

Australian National Aquatic Ecosystem (ANAE) wetland type	Total area (ha)	% receiving Cew				Differences		
		Y1 14-15	Y2 15–16	Y3 16–17	Y4 17–18	Y4-Y3	Y4-Y2	Y4-Y1
F1.11: River cooba woodland riparian zone or floodplain	11 541	9.8	2.0	6.7	7.3	0.5	5.2	-2.6
F1.2: River red gum forest riparian zone or floodplain	639 022	3.8	4.1	1.0	4.0	3.0	-0.1	0.2
F1.4: River red gum woodland riparian zone or floodplain	325 221	1.1	0.4	0.4	1.5	1.1	1.1	0.4
F2.2: Lignum shrubland riparian zone or floodplain	143 886	3.8	1.5	0.8	1.0	0.2	-0.5	-2.7
F1.8: Black box woodland riparian zone or floodplain	779 639	0.3	0.7	0.1	0.2	0.1	-0.4	-0.1
F1.6: Black box forest riparian zone or floodplain	131 442	0.4	1.0	<0.1	0.2	0.1	-0.8	-0.2
F2.4: Shrubland riparian zone or floodplain	408 614	0.3	1.5	0.6	0.1	-0.5	-1.3	-0.2
F1.10: Coolabah woodland and forest riparian zone or floodplain	1 215 726	0.3	<0.1	<0.1	0.1	0.0	0.1	-0.2
F1.12: Woodland riparian zone or floodplain	318 686	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0
F4: Unspecified riparian zone or floodplain	201 086	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0
F3.2: Sedge/forb/grassland riparian zone or floodplain	833 102	0.0	0.0	<0.1	0.0	0.0	0.0	0.0
F1.13: Paperbark riparian zone or floodplain	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0

4.4 Adaptive management

There are a number of avenues by which the Ecosystem Diversity evaluation can foster improvements in Commonwealth environmental water management and evaluation that have been identified in previous Ecosystem Diversity evaluation reports (Brooks 2016, 2017b, 2018). These recommendations are reproduced below. Progress on completing the update of the ANAE classification is expected during the latter half of 2019, and progress in developing expected outcomes for Ecosystem Diversity is planned for the CEWO Monitoring, Evaluation and Research (MER) project (2019-2022).

1) Improving confidence in the evaluation of the contribution of Commonwealth environmental water to Ecosystem Diversity. Completing the revision of the ANAE classification to include the new NSW state vegetation mapping for Western NSW and the Central Tablelands (Figure 9) will further improve the evaluation of the contribution of Commonwealth environmental water to Ecosystem Diversity in tributaries of the Darling River including the Junction of the Warrego and Darling rivers LTIM Selected Area.

2) Improving understanding of the landscape context at monitoring sites to inform extrapolation of observed outcomes to unmonitored sites. Understanding how biotic and functional responses vary among ecosystem types that are monitored within Selected Areas

may permit extrapolation of Selected Area and Basin matter outcomes to watering events in the same ecosystem types located in other areas of the Basin.

3) The CEWO currently does not have 1-year or 5-year expected outcomes for ecosystem diversity but it is hoped that this evaluation and other lessons learned from the LTIM project will seed thinking towards an appropriate approach for draft ecosystem objectives that can be trialed within the MER project. Understanding how key ecosystem types influence patterns of Basin biodiversity, resilience, ecosystem function and ecosystem services paves the way towards delivering Commonwealth environmental water for ecosystem objectives that move beyond counting ecosystem watering targets. For example, shaping flow regimes to preserve patterns of spatio-temporal variability along a river, or delivering water at critical times to maintain life forms or processes *because* they characterise ecosystem types that are to be preserved or improved. Managing to prevent or promote ecosystem turnover to new types may require long-term management frameworks with institutional memory and conviction to stay the course over decadal time scales and that allow some temporary systems to remain dry for sufficient duration to support the dry-phase ecosystem processes.

4) Developing watering objectives and expected outcomes for specific ecosystem types will require a collaborative approach with CEWO delivery managers to identify where and when management triggers are linked to particular ecosystem types. For example when priorities direct water to maintain permanent waterbodies as refugia in dry years, or where over-bank flows target freshwater meadows to protect vulnerable seasonal herbaceous wetlands.

5) Reducing the risks of implementing inappropriate watering regimes. Too much water, too frequently or consistently missing particular ecosystems types are all scenarios that are potentially deleterious to biodiversity in the Basin. Improving understanding of watering requirements at the aquatic ecosystem level should complement and enhance existing approaches that focus on the requirements of key species or communities. Through LTIM, we are assembling a library of Basin wide watering frequencies from Commonwealth environmental water. Ecosystems types (and locations) that are consistently not watered, or watered with too much regularity, can then be identified and an informed assessment of risks can then take place to determine if there is a need and capability to adjust management planning to ensure Basin Plan objectives are met.

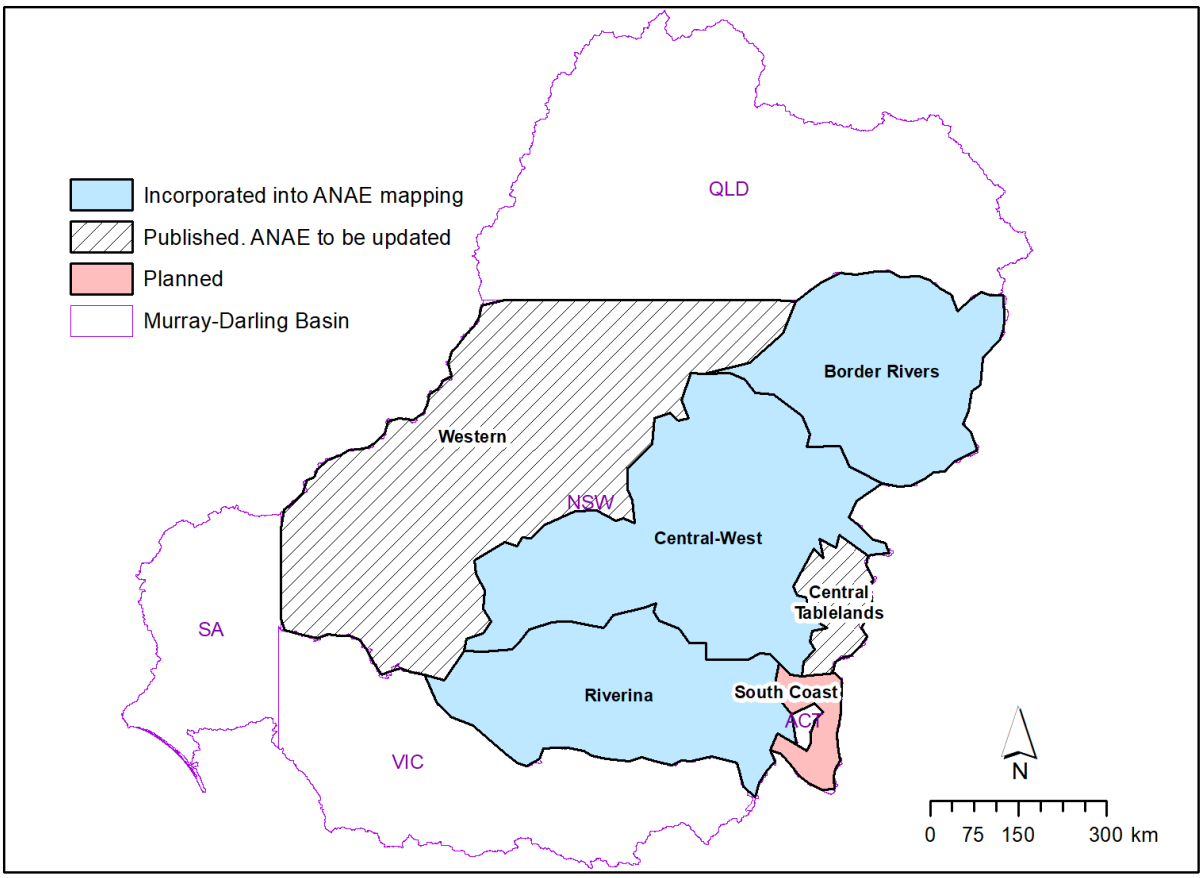

Figure 9: Extent and status of the new NSW state vegetation mapping. Published regions (blue) were used to update the ANAE classification in 2017. The Western region and Central Tablelands have been published and can be used to further improve the ANAE classification and LTIM Ecosystem Diversity evaluation.

5 Contribution to achievement of Basin Plan objectives

The Ecosystem Diversity component of the Basin evaluation contributes to the Basin Plan objective for Biodiversity under Section 8.05 of the Basin Plan and contributes indirectly to additional Basin Plan objectives by informing the evaluation of the Vegetation and Generic Diversity Basin Matters within the LTIM Project (Capon & Campbell 2016, 2017, 2019; Hale 2016, 2017, 2019).

The Commonwealth does not yet have 1-year or 5-year expected outcomes for ecosystem diversity (Table 8) and water is not currently delivered with direct understanding of the contribution of Commonwealth environmental watering to ecosystem diversity at the Basin-scale. However, this evaluation provides a foundation from which expected outcomes for ecosystem diversity may be developed in the future as the spatial and temporal patterns of watering to different ecosystem types under current management regimes is better understood.

Table 8. Commonwealth Environmental Outcomes framework for ecosystem diversity.

Basin Plan objectives	Basin outcomes	5–year expected outcomes	1–year expected outcomes	Measured and predicted 1-year outcomes 2017–18	Measured and predicted 1–4 year outcomes 2014–18
Biodiversity (Basin Plan S. 8.05)	Ecosystem diversity	None identified	None identified	Over 296 000 hectares of mapped wetland and floodplain inundated 71% of the different aquatic ecosystem types represented in areas influenced by Commonwealth environmental water	75% of the different aquatic ecosystem types inundated with Commonwealth environmental water.

References

Aquatic Ecosystems Task Group (2012) *Aquatic Ecosystems Toolkit. Module 2 Interim Australian National Aquatic Ecosystems (ANAE) Classification Framework*. Department of Sustainability, Environment, Water Population and Communities, Canberra, Australia.

BOM (2019) Australian Hydrological Geospatial Fabric (Geofabric) beta v3.0.5.

Brooks SS (2016) *Final Ecosystem Diversity Basin Matter Evaluation Report 2014-15* (No. MDFRC Publication 144/2017, May). Final Report prepared for the Commonwealth Environmental Water Office. Murray–Darling Freshwater Research Centre.

Brooks SS (2017a) *Classification of aquatic ecosystems in the Murray-Darling Basin: 2017 update*. Report to the Murray-Darling Basin Authority and Commonwealth Environmental Water Office, Canberra, Australia.

Brooks SS (2017b) *Final Ecosystem Diversity Basin Matter Evaluation Report 2015-16* (No. MDFRC Publication 144/2017, May). Final Report prepared for the Commonwealth Environmental Water Office. Murray–Darling Freshwater Research Centre.

Brooks SS (2018) *Final Ecosystem Diversity Basin Matter Evaluation Report 2016-17* (No. Publication 190/2018, September). Final Report prepared for the Commonwealth Environmental Water Office. La Trobe University Centre for Freshwater Ecosystems, Wodonga, Victoria.

Brooks SS, Cottingham P, Butcher R, Hale J (2014) *Murray-Darling Basin aquatic ecosystem classification: Stage 2 report*. Peter Cottingham & Associates report to the Commonwealth Environmental Water Office and Murray-Darling Basin Authority. Canberra, Australia.

Cadotte MW, Carscadden K, Mirotchnick N (2011) Beyond species: functional diversity and the maintenance of ecological processes and services: Functional diversity in ecology and conservation. *Journal of Applied Ecology* **48(5)**, 1079–1087.

Capon SJ, Campbell C (2016) *2014–15 Basin-scale evaluation of Commonwealth environmental water - Vegetation Diversity*. Final Report prepared for the Commonwealth Environmental Water Office by The Murray–Darling Freshwater Research Centre, MDFRC Publication 107/2016, September, 85pp.

Capon SJ, Campbell C (2017) *2015–16 Basin-scale evaluation of Commonwealth environmental water - Vegetation Diversity*. Final Report prepared for the Commonwealth Environmental Water Office by The Murray–Darling Freshwater Research Centre, MDFRC Publication 145/2017, May.

Capon SJ, Campbell C (2019) *2017–18 Basin-scale evaluation of Commonwealth environmental water - Vegetation Diversity*. Final Report prepared for the Commonwealth Environmental Water Office by The Murray–Darling Freshwater Research Centre, MDFRC Publication 2019, May.

CBD (1993) The Convention on Biological Diversity.

CEWH (2013) Commonwealth Environmental Water – The Environmental Water Outcomes Framework v1.1.

Commonwealth of Australia (2012) Water Act 2007 Basin Plan.

Geist J (2011) Integrative freshwater ecology and biodiversity conservation. *Ecological Indicators* **11(6)**, 1507–1516.

Hale J (2016) *2014–15 Basin-scale evaluation of Commonwealth environmental water – Generic Diversity.* Final report prepared for the Commonwealth Environmental Water Office by The Murray–Darling Freshwater Research Centre, MDFRC Publication 109/2016, October, 48pp.

Hale J (2017) *2015–16 Basin-scale evaluation of Commonwealth environmental water – Generic Diversity.* Final report prepared for the Commonwealth Environmental Water Office by The Murray–Darling Freshwater Research Centre, MDFRC Publication 147/2017.

Hale J (2019) *2017–18 Basin-scale evaluation of Commonwealth environmental water – Generic Diversity.* Final report prepared for the Commonwealth Environmental Water Office by The Murray–Darling Freshwater Research Centre, MDFRC Publication 2019.

Junk J, Bayley P, Sparks R (1989) The flood pulse concept in river floodplain systems. *Canadian Special Publications of Fisheries and Aquatic Sciences* **106**, 110–127.

MDFRC (2013) *Long-term Intervention Monitoring - Generic Cause and Effect Diagrams* (No. 01.5/2013). The Murray-Darling Freshwater Research Centre, Albury.

Miles M, Eckert G (2013) Murray-Darling Basin ANAE dataset – Manual edits to SA component.

Poff NL (1997) Landscape filters and species traits: towards mechanistic understanding and prediction in stream ecology. *Journal of the North American Benthological Society* **16(2)**, 391–409.

Pollock LJ, Thuiller W, Jetz W (2017) Large conservation gains possible for global biodiversity facets. *Nature* **546(7656)**, 141–144.

Stewardson MJ, Guarino F (2019) *2017–18 Basin-scale evaluation of Commonwealth environmental water — Hydrology* (Final Report prepared for the Commonwealth Environmental Water Office). Latrobe University Publication 2018. La Trobe University Centre for Freshwater Ecosystems, Wodonga, Victoria.

Thorp JH, Thoms MC, Delong MD (2006) The riverine ecosystem synthesis: biocomplexity in river networks across space and time. *River Research and Applications* **22(2)**, 123–147.

Annex A. GIS Workflow

All spatial layers use the 1994 Geocentric Datum of Australia (GDA94). Areas in this report are in hectares and have been calculated in the Australia Albers Equal Area Conic projection to report accurate area measurements across the Basin.

The area of ecosystems inundated by Commonwealth environmental water is the fraction of the wetland area that intersects the Commonwealth environmental water inundation extent.

GIS Workflow:

1. Intersect:
    a. The Basin ANAE classification mapping;
    b. Commonwealth environmental water Inundation; and
    c. LTIM Valleys
2. Calculate polygon area in hectares using equal area GDA94 Australian Albers projection.
3. Sum the area of each ANAE wetland type per valley.

The area of ecosystems influenced by Commonwealth environmental water is defined as the sum of the areas of mapped features that are partially or fully overlapped by Commonwealth environmental water inundation extent.

GIS Workflow:

1. Select by location all ANAE wetland polygons that intersect the Commonwealth environmental water Inundation.
2. Intersect the selected wetlands with the catchment boundaries.
3. Calculate polygon area in hectares using equal area GDA94 Australian Albers projection.
4. Sum the area of each ANAE wetland type per valley.

Length of waterways influenced by Commonwealth environmental water

GIS Workflow:

1. Intersect:
    a. The Basin ANAE Geofabric v3 Waterways
    b. Commonwealth environmental water Inundation
    c. LTIM Valleys
2. Calculate the channel length inundated for each riverine ecosystem type in kilometres using equal area GDA94 Australian Albers projection.
3. Calculate summary statistics to sum the length of each river ecosystem type per valley.

Annex B. Ongoing evolution of the Basin ANAE classification

Confidence in the accuracy of mapping and the Basin ANAE classification was examined in a previous LTIM ecosystem diversity evaluation (Brooks 2016a) and in the development of the ANAE classification (Brooks *et al.* 2014). In South Australia, ANAE types were manually ascribed to wetlands and riverine reaches along the full length of the Murray River to improve confidence and alignment of the classification to ecosystem types used by South Australian wetland managers. Some additional limitations of the ANAE classification in South Australia that influence the findings in this report are noted in Miles and Eckert (2013) and include: farm dams classified as natural wetland ecosystems, temporary wetlands to the south-east of the south lagoon of the Coorong being classified as permanent, and wetland boundaries adjacent to the Lake Alexandrina that encompass multiple ecosystem types. These errors are mainly associated with wetland types around Lake Alexandrina and the Coorong (M Miles, pers. comm., 2017) but similar examples can be found in all states in areas where fundamental hydrological data and vegetation mapping are limited. The recent update to the ANAE addressed some of these issues but a comprehensive evaluation against the issues raised by Miles and Eckert (2013) has not been conducted.

There was generally good agreement between the ecosystem types identified by the Basin ANAE classification when ground-truthed at Selected Area sampling sites (Brooks 2016). Most discrepancies were related to inaccuracies in the mapping of wetland boundaries rather than fundamental disagreement with the ANAE classification itself. The poorest representation of ecosystem types by the ANAE classification was in the Lachlan river system, Gwydir river system and Junction of the Warrego and Darling rivers Selected Areas (Brooks 2016). The Lachlan and Gwydir valleys were included in the 2017 major update to the ANAE classification which greatly improved the mapping for this and subsequent evaluations of the contribution of Commonwealth environmental water to Ecosystem Diversity in these Valleys (Brooks 2017a). Ecosystem mapping in the Central Murray Forests, the Macquarie Marshes, and Murrumbidgee were also improved in the revision.

A major component of the 2017 ANAE update relied on NSW State vegetation mapping that was incomplete at the time. Mapping for Western NSW and the Central Tablelands (Figure 9) has now been published by the NSW Office of Environment and Heritage (now Department of Planning, Industry and Environment). Integration of these updated maps into the ANAE classification of the Basin will greatly improve wetland and floodplain ecosystem mapping in the Junction of the Warrego and Darling rivers Selected Area and in southwestern NSW along the Darling and Murray River floodplains. These areas all regularly receive Commonwealth environmental water and updating the ANAE classification in these areas to improve the accuracy and consistency of aquatic ecosystem mapping is a high priority. The cumulative evaluation of Ecosystem Diversity can then be retrospectively brought up to date using the revised ANAE maps and inundation mapping collated by LTIM to date.

Annex C. ANAE wetland types influenced by Commonwealth environmental water by valley

Lake and wetland types influenced by Commonwealth environmental water are represented by the entire wetland when any portion of the wetland was recorded as having been inundated. The contribution of Commonwealth environmental water to supporting wetland ecosystem diversity within each valley is presented below in Table C1 excluding the Coorong, Lower Lakes and Murray Mouth which are presented in Table 5.

Table C1. Area of each lake and wetland ecosystem type and the contribution of Commonwealth environmental water to supporting wetland ecosystem diversity within each valley, sorted by the area influenced with inundation highlighted in blue (excludes in-channel flows presented in Annex E).

Valley name	Australian National Aquatic Ecosystem (ANAE) lake and wetland types	Total area (ha)	Cew Area (ha)	Percent
Avoca	Lst1.1: Temporary saline lake	19 829	0	0.0
Avoca	Pt3.1.2: Clay pan	18 824	0	0.0
Avoca	Lt1.1: Temporary lake	4400	0	0.0
Avoca	Pt1.2.2: Temporary black box swamp	4382	0	0.0
Avoca	Lst1.2: Temporary saline lake with aquatic bed	1820	0	0.0
Avoca	Pst1.1: Temporary saline swamp	1544	0	0.0
Avoca	Pst2.2: Temporary salt marsh	1174	0	0.0
Avoca	Pt1.6.2: Temporary woodland swamp	814	0	0.0
Avoca	Pt2.3.2: Freshwater meadow	798	0	0.0
Avoca	Pt1.7.2: Temporary lignum swamp	773	0	0.0
Avoca	Pst3.2: Salt pan or salt flat	309	0	0.0
Avoca	Psp2.1: Permanent salt marsh	209	0	0.0
Avoca	Pt4.2: Temporary wetland	208	0	0.0
Avoca	Pt1.1.2: Temporary river red gum swamp	145	0	0.0
Avoca	Lsp1.1: Permanent saline lake	137	0	0.0
Avoca	Lp1.1: Permanent lake	61	0	0.0
Avoca	Pt1.8.2: Temporary shrub swamp	51	0	0.0
Avoca	Pp4.2: Permanent wetland	50	0	0.0
Avoca	Pst4: Temporary saline wetland	50	0	0.0
Avoca	Pt4.1: Floodplain or riparian wetland	1	0	0.0
Barwon Darling	Lt1.1: Temporary lake	57 153	0	0.0
Barwon Darling	Lp1.1: Permanent lake	31 496	0	0.0
Barwon Darling	Pt1.6.2: Temporary woodland swamp	16 384	0	0.0
Barwon Darling	Pt1.8.2: Temporary shrub swamp	11 011	0	0.0
Barwon Darling	Pp4.2: Permanent wetland	3586	0	0.0
Barwon Darling	Pt1.2.2: Temporary black box swamp	2955	0	0.0
Barwon Darling	Pt2.2.2: Temporary sedge/grass/forb marsh	1893	0	0.0
Barwon Darling	Pt2.3.2: Freshwater meadow	895	0	0.0
Barwon Darling	Pt1.1.2: Temporary river red gum swamp	378	0	0.0
Barwon Darling	Pt3.1.2: Clay pan	179	0	0.0
Barwon Darling	Pt1.3.2: Temporary coolabah swamp	88	0	0.0
Border Rivers	Pt2.2.2: Temporary sedge/grass/forb marsh	8829	0	0.0
Border Rivers	Pt4.2: Temporary wetland	3009	0	0.0
Border Rivers	Pt1.6.2: Temporary woodland swamp	2487	0	0.0
Border Rivers	Pp2.2.2: Permanent sedge/grass/forb marsh	1455	0	0.0
Border Rivers	Pp4.2: Permanent wetland	1124	0	0.0
Border Rivers	Lp1.1: Permanent lake	944	0	0.0
Border Rivers	Pt1.1.2: Temporary river red gum swamp	718	0	0.0
Border Rivers	Lt1.1: Temporary lake	671	0	0.0
Border Rivers	Pp3: Peat bog or fen marsh	652	0	0.0
Border Rivers	Pt2.3.2: Freshwater meadow	592	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) lake and wetland types	Total area (ha)	Cew Area (ha)	Percent
Border Rivers	Pt1.3.2: Temporary coolabah swamp	493	0	0.0
Border Rivers	Pt3.1.2: Clay pan	268	0	0.0
Border Rivers	Lp1.2: Permanent lake with aquatic bed	227	0	0.0
Border Rivers	Pt2.1.2: Temporary tall emergent marsh	96	0	0.0
Border Rivers	Pp2.3.2: Permanent grass marsh	26	0	0.0
Border Rivers	Pt1.2.2: Temporary black box swamp	15	0	0.0
Border Rivers	Lt1.2: Temporary lake with aquatic bed	12	0	0.0
Border Rivers	Pt1.8.2: Temporary shrub swamp	11	0	0.0
Border Rivers	Pst1.1: Temporary saline swamp	2	0	0.0
Broken	Pt2.3.2: Freshwater meadow	268	181	67.5
Broken	Lp1.1: Permanent lake	3305	0	0.0
Broken	Pt3.1.2: Clay pan	3033	0	0.0
Broken	Pt1.1.2: Temporary river red gum swamp	1907	0	0.0
Broken	Pt1.6.2: Temporary woodland swamp	427	0	0.0
Broken	Pt1.7.2: Temporary lignum swamp	192	0	0.0
Broken	Lt1.1: Temporary lake	104	0	0.0
Broken	Pt2.1.2: Temporary tall emergent marsh	97	0	0.0
Broken	Pt1.2.2: Temporary black box swamp	79	0	0.0
Broken	Pt2.2.2: Temporary sedge/grass/forb marsh	77	0	0.0
Broken	Pt4.1: Floodplain or riparian wetland	66	0	0.0
Broken	Pp4.2: Permanent wetland	43	0	0.0
Campaspe	Pt3.1.2: Clay pan	1903	0	0.0
Campaspe	Pt1.1.2: Temporary river red gum swamp	280	0	0.0
Campaspe	Pt1.6.2: Temporary woodland swamp	232	0	0.0
Campaspe	Lt1.1: Temporary lake	49	0	0.0
Campaspe	Pt2.1.2: Temporary tall emergent marsh	24	0	0.0
Campaspe	Lp1.1: Permanent lake	12	0	0.0
Campaspe	Pt2.3.2: Freshwater meadow	10	0	0.0
Campaspe	Pp4.2: Permanent wetland	4	0	0.0
Campaspe	Pps5: Permanent spring	1	0	0.0
Castlereagh	Pt2.2.2: Temporary sedge/grass/forb marsh	10 598	0	0.0
Castlereagh	Lt1.1: Temporary lake	406	0	0.0
Castlereagh	Pt1.8.2: Temporary shrub swamp	49	0	0.0
Castlereagh	Pt1.6.2: Temporary woodland swamp	35	0	0.0
Castlereagh	Pt1.2.2: Temporary black box swamp	30	0	0.0
Castlereagh	Pt3.1.2: Clay pan	30	0	0.0
Castlereagh	Pp4.2: Permanent wetland	18	0	0.0
Castlereagh	Pt2.1.2: Temporary tall emergent marsh	16	0	0.0
Castlereagh	Pp2.2.2: Permanent sedge/grass/forb marsh	8	0	0.0
Castlereagh	Lp1.1: Permanent lake	6	0	0.0
Castlereagh	Pps5: Permanent spring	1	0	0.0
Castlereagh	Pt1.1.2: Temporary river red gum swamp	1	0	0.0
Castlereagh	Pt2.3.2: Freshwater meadow	1	0	0.0
Central Murray	Pt1.1.2: Temporary river red gum swamp	38 459	23602	61.4
Central Murray	Lp1.1: Permanent lake	4111	2231	54.3
Central Murray	Lt1.1: Temporary lake	12 925	1822	14.1
Central Murray	Pp4.2: Permanent wetland	9187	1149	12.5
Central Murray	Pt2.1.2: Temporary tall emergent marsh	1444	709	49.1
Central Murray	Pt2.2.2: Temporary sedge/grass/forb marsh	2802	672	24.0
Central Murray	Pt2.3.2: Freshwater meadow	5157	586	11.4
Central Murray	Pt4.2: Temporary wetland	606	586	96.7
Central Murray	Pt1.6.2: Temporary woodland swamp	1540	461	29.9
Central Murray	Pt1.2.2: Temporary black box swamp	4166	141	3.4
Central Murray	Pt3.1.2: Clay pan	17 404	114	0.7
Central Murray	Pt1.8.2: Temporary shrub swamp	584	73	12.5
Central Murray	Pt1.7.2: Temporary lignum swamp	1575	24	1.5
Central Murray	Pt4.1: Floodplain or riparian wetland	461	7	1.5

Valley name	Australian National Aquatic Ecosystem (ANAE) lake and wetland types	Total area (ha)	Cew Area (ha)	Percent
Central Murray	Pp2.4.2: Permanent forb marsh	133	4	3.0
Central Murray	Pp2.1.2: Permanent tall emergent marsh	1169	2	0.2
Central Murray	Pp2.3.2: Permanent grass marsh	80	2	2.5
Central Murray	Pp2.2.2: Permanent sedge/grass/forb marsh	45	2	4.4
Central Murray	Pst2.2: Temporary salt marsh	2122	0	0.0
Central Murray	Pst4: Temporary saline wetland	2114	0	0.0
Central Murray	Lst1.1: Temporary saline lake	1286	0	0.0
Central Murray	Pst3.2: Salt pan or salt flat	732	0	0.0
Central Murray	Psp4: Permanent saline wetland	642	0	0.0
Central Murray	Lsp1.1: Permanent saline lake	461	0	0.0
Central Murray	Pst1.1: Temporary saline swamp	23	0	0.0
Condamine Balonne	Pt2.1.2: Temporary tall emergent marsh	38 236	0	0.0
Condamine Balonne	Pt1.8.2: Temporary shrub swamp	29 291	0	0.0
Condamine Balonne	Pt1.6.2: Temporary woodland swamp	13 223	0	0.0
Condamine Balonne	Pt1.7.2: Temporary lignum swamp	11 804	0	0.0
Condamine Balonne	Lt1.1: Temporary lake	11 535	0	0.0
Condamine Balonne	Lp1.1: Permanent lake	6454	0	0.0
Condamine Balonne	Pt4.2: Temporary wetland	6392	0	0.0
Condamine Balonne	Pt1.2.2: Temporary black box swamp	4683	0	0.0
Condamine Balonne	Pt2.2.2: Temporary sedge/grass/forb marsh	4248	0	0.0
Condamine Balonne	Pt2.3.2: Freshwater meadow	4020	0	0.0
Condamine Balonne	Pp4.2: Permanent wetland	3750	0	0.0
Condamine Balonne	Pp2.1.2: Permanent tall emergent marsh	2522	0	0.0
Condamine Balonne	Pt1.3.2: Temporary coolabah swamp	2423	0	0.0
Condamine Balonne	Pt3.1.2: Clay pan	1821	0	0.0
Condamine Balonne	Lp1.2: Permanent lake with aquatic bed	1648	0	0.0
Condamine Balonne	Lst1.1: Temporary saline lake	1624	0	0.0
Condamine Balonne	Pt1.1.2: Temporary river red gum swamp	1116	0	0.0
Condamine Balonne	Lt1.2: Temporary lake with aquatic bed	684	0	0.0
Condamine Balonne	Pt1.5.2: Temporary paperbark swamp	95	0	0.0
Condamine Balonne	Pp2.3.2: Permanent grass marsh	23	0	0.0
Condamine Balonne	Pps5: Permanent spring	6	0	0.0
Condamine Balonne	Lsp1.1: Permanent saline lake	3	0	0.0
Condamine Balonne	Pst4: Temporary saline wetland	1	0	0.0
Edward Wakool	Pp4.2: Permanent wetland	819	3	0.4
Edward Wakool	Pt3.1.2: Clay pan	3643	0	0.0
Edward Wakool	Pt1.2.2: Temporary black box swamp	1585	0	0.0
Edward Wakool	Pt1.1.2: Temporary river red gum swamp	1321	0	0.0
Edward Wakool	Lt1.1: Temporary lake	985	0	0.0
Edward Wakool	Pt2.3.2: Freshwater meadow	621	0	0.0
Edward Wakool	Pt1.6.2: Temporary woodland swamp	421	0	0.0
Edward Wakool	Pt1.8.2: Temporary shrub swamp	280	0	0.0
Edward Wakool	Pt2.2.2: Temporary sedge/grass/forb marsh	211	0	0.0
Edward Wakool	Pt1.7.2: Temporary lignum swamp	168	0	0.0
Edward Wakool	Lp1.1: Permanent lake	131	0	0.0
Edward Wakool	Pt2.1.2: Temporary tall emergent marsh	59	0	0.0
Edward Wakool	Pp2.3.2: Permanent grass marsh	19	0	0.0
Edward Wakool	Pp2.1.2: Permanent tall emergent marsh	7	0	0.0
Edward Wakool	Psp4: Permanent saline wetland	6	0	0.0
Edward Wakool	Pst1.1: Temporary saline swamp	5	0	0.0
Edward Wakool	Pp2.2.2: Permanent sedge/grass/forb marsh	1	0	0.0
Goulburn	Pt3.1.2: Clay pan	10 948	0	0.0
Goulburn	Pt1.1.2: Temporary river red gum swamp	5180	0	0.0
Goulburn	Lt1.1: Temporary lake	1598	0	0.0
Goulburn	Lp1.1: Permanent lake	1086	0	0.0
Goulburn	Pp4.2: Permanent wetland	1060	0	0.0
Goulburn	Pt1.6.2: Temporary woodland swamp	869	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) lake and wetland types	Total area (ha)	Cew Area (ha)	Percent
Goulburn	Pt2.1.2: Temporary tall emergent marsh	861	0	0.0
Goulburn	Pt2.3.2: Freshwater meadow	815	0	0.0
Goulburn	Pt1.7.2: Temporary lignum swamp	631	0	0.0
Goulburn	Pp2.4.2: Permanent forb marsh	571	0	0.0
Goulburn	Lst1.2: Temporary saline lake with aquatic bed	238	0	0.0
Goulburn	Pt2.2.2: Temporary sedge/grass/forb marsh	189	0	0.0
Goulburn	Pt4.1: Floodplain or riparian wetland	184	0	0.0
Goulburn	Pt1.2.2: Temporary black box swamp	124	0	0.0
Goulburn	Lsp1.1: Permanent saline lake	46	0	0.0
Goulburn	Lst1.1: Temporary saline lake	25	0	0.0
Goulburn	Pt4.2: Temporary wetland	19	0	0.0
Goulburn	Pp2.1.2: Permanent tall emergent marsh	4	0	0.0
Goulburn	Pst4: Temporary saline wetland	2	0	0.0
Goulburn	Pt1.8.2: Temporary shrub swamp	2	0	0.0
Gwydir	Pt2.2.2: Temporary sedge/grass/forb marsh	9881	4643	47.0
Gwydir	Pt2.1.2: Temporary tall emergent marsh	373	373	100.0
Gwydir	Pt3.1.2: Clay pan	236	42	17.8
Gwydir	Lp1.1: Permanent lake	70	26	37.1
Gwydir	Lt1.1: Temporary lake	1199	15	1.3
Gwydir	Pp4.2: Permanent wetland	293	1	0.3
Gwydir	Pp2.2.2: Permanent sedge/grass/forb marsh	1549	0	0.0
Gwydir	Pt4.2: Temporary wetland	392	0	0.0
Gwydir	Pt1.6.2: Temporary woodland swamp	182	0	0.0
Gwydir	Pp3: Peat bog or fen marsh	181	0	0.0
Gwydir	Pt1.8.2: Temporary shrub swamp	89	0	0.0
Gwydir	Pt1.1.2: Temporary river red gum swamp	13	0	0.0
Gwydir	Pt1.3.2: Temporary coolabah swamp	9	0	0.0
Gwydir	Pt2.3.2: Freshwater meadow	6	0	0.0
Gwydir	Pt1.2.2: Temporary black box swamp	4	0	0.0
Gwydir	Pp1.1.2: Permanent paperbark swamp	1	0	0.0
Kiewa	Pp4.2: Permanent wetland	723	0	0.0
Kiewa	Pt3.1.2: Clay pan	321	0	0.0
Kiewa	Pt1.6.2: Temporary woodland swamp	39	0	0.0
Kiewa	Lp1.1: Permanent lake	37	0	0.0
Kiewa	Pt1.1.2: Temporary river red gum swamp	23	0	0.0
Kiewa	Pt2.2.2: Temporary sedge/grass/forb marsh	12	0	0.0
Kiewa	Pt2.1.2: Temporary tall emergent marsh	3	0	0.0
Lachlan	Pp2.1.2: Permanent tall emergent marsh	3450	3449	100.0
Lachlan	Pt2.1.2: Temporary tall emergent marsh	588	451	76.7
Lachlan	Pt1.1.2: Temporary river red gum swamp	2206	442	20.0
Lachlan	Lt1.1: Temporary lake	32 307	345	1.1
Lachlan	Pt2.3.2: Freshwater meadow	21 005	123	0.6
Lachlan	Pt2.2.2: Temporary sedge/grass/forb marsh	13 504	40	0.3
Lachlan	Pp4.2: Permanent wetland	2914	16	0.5
Lachlan	Lp1.1: Permanent lake	7405	7	0.1
Lachlan	Pst2.2: Temporary salt marsh	30 315	0	0.0
Lachlan	Pt1.7.2: Temporary lignum swamp	22 220	0	0.0
Lachlan	Pt1.8.2: Temporary shrub swamp	16 460	0	0.0
Lachlan	Pt1.2.2: Temporary black box swamp	15 298	0	0.0
Lachlan	Pt3.1.2: Clay pan	14 938	0	0.0
Lachlan	Pt1.6.2: Temporary woodland swamp	3305	0	0.0
Lachlan	Pt4.2: Temporary wetland	348	0	0.0
Lachlan	Pp2.2.2: Permanent sedge/grass/forb marsh	63	0	0.0
Lachlan	Pp2.3.2: Permanent grass marsh	44	0	0.0
Lachlan	Pps5: Permanent spring	7	0	0.0
Loddon	Pt3.1.2: Clay pan	12 075	0	0.0
Loddon	Lp1.1: Permanent lake	6382	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) lake and wetland types	Total area (ha)	Cew Area (ha)	Percent
Loddon	Pt1.2.2: Temporary black box swamp	5724	0	0.0
Loddon	Pt1.7.2: Temporary lignum swamp	3941	0	0.0
Loddon	Pt2.3.2: Freshwater meadow	3408	0	0.0
Loddon	Lst1.1: Temporary saline lake	1478	0	0.0
Loddon	Pt1.6.2: Temporary woodland swamp	1404	0	0.0
Loddon	Pst1.1: Temporary saline swamp	1375	0	0.0
Loddon	Pt1.1.2: Temporary river red gum swamp	1256	0	0.0
Loddon	Lsp1.1: Permanent saline lake	1252	0	0.0
Loddon	Lt1.1: Temporary lake	417	0	0.0
Loddon	Pp4.2: Permanent wetland	314	0	0.0
Loddon	Lsp1.2: Permanent saline lake with aquatic bed	181	0	0.0
Loddon	Pst3.2: Salt pan or salt flat	109	0	0.0
Loddon	Pt1.8.2: Temporary shrub swamp	109	0	0.0
Loddon	Lt1.2: Temporary lake with aquatic bed	55	0	0.0
Loddon	Pst4: Temporary saline wetland	55	0	0.0
Loddon	Pt2.1.2: Temporary tall emergent marsh	54	0	0.0
Loddon	Psp2.1: Permanent salt marsh	37	0	0.0
Loddon	Pst2.2: Temporary salt marsh	28	0	0.0
Loddon	Pps5: Permanent spring	4	0	0.0
Lower Darling	Pt1.1.2: Temporary river red gum swamp	879	31	3.5
Lower Darling	Pp4.2: Permanent wetland	317	30	9.5
Lower Darling	Pt1.8.2: Temporary shrub swamp	107 971	26	0.0
Lower Darling	Lt1.1: Temporary lake	187 316	0	0.0
Lower Darling	Lp1.1: Permanent lake	9677	0	0.0
Lower Darling	Pt2.3.2: Freshwater meadow	8109	0	0.0
Lower Darling	Pt1.6.2: Temporary woodland swamp	4340	0	0.0
Lower Darling	Pt1.2.2: Temporary black box swamp	1920	0	0.0
Lower Darling	Pt3.1.2: Clay pan	1344	0	0.0
Lower Darling	Lst1.1: Temporary saline lake	509	0	0.0
Lower Darling	Pt4.2: Temporary wetland	53	0	0.0
Lower Darling	Pp2.3.2: Permanent grass marsh	26	0	0.0
Lower Darling	Pst2.2: Temporary salt marsh	4	0	0.0
Lower Murray	Lp1.1: Permanent lake	104 190	12389	11.9
Lower Murray	Pt4.1: Floodplain or riparian wetland	10 641	2488	23.4
Lower Murray	Pt2.3.2: Freshwater meadow	9007	2432	27.0
Lower Murray	Pp4.2: Permanent wetland	4474	2282	51.0
Lower Murray	Lt1.1: Temporary lake	30 782	825	2.7
Lower Murray	Psp4: Permanent saline wetland	2045	629	30.8
Lower Murray	Pt1: Temporary swamp	3767	576	15.3
Lower Murray	Pt1.7.2: Temporary lignum swamp	2651	422	15.9
Lower Murray	Pt3.1.2: Clay pan	17 674	392	2.2
Lower Murray	Lst1.1: Temporary saline lake	1546	307	19.9
Lower Murray	Pt1.1.2: Temporary river red gum swamp	503	213	42.3
Lower Murray	Pt2.1.2: Temporary tall emergent marsh	11 504	188	1.6
Lower Murray	Pt1.8.2: Temporary shrub swamp	3013	179	5.9
Lower Murray	Pu1: Unspecified wetland	1763	95	5.4
Lower Murray	Pp2.3.2: Permanent grass marsh	109	82	75.2
Lower Murray	Pp2.4.2: Permanent forb marsh	36	18	50.0
Lower Murray	Pt1.2.2: Temporary black box swamp	418	16	3.8
Lower Murray	Pt2.2.2: Temporary sedge/grass/forb marsh	7082	13	0.2
Lower Murray	Pt4.2: Temporary wetland	4982	0	0.0
Lower Murray	Pst1.1: Temporary saline swamp	2759	0	0.0
Lower Murray	Lsp1.1: Permanent saline lake	2674	0	0.0
Lower Murray	Pt1.6.2: Temporary woodland swamp	863	0	0.0
Lower Murray	Pst4: Temporary saline wetland	803	0	0.0
Lower Murray	Pst3.2: Salt pan or salt flat	586	0	0.0
Lower Murray	Pst2.2: Temporary salt marsh	438	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) lake and wetland types	Total area (ha)	Cew Area (ha)	Percent
Lower Murray	Psp1.1: Saline paperbark swamp	132	0	0.0
Lower Murray	Pt1.5.2: Temporary paperbark swamp	132	0	0.0
Lower Murray	Pp2.1.2: Permanent tall emergent marsh	11	0	0.0
Lower Murray	Psp2.1: Permanent salt marsh	3	0	0.0
Lower Murray	Pps5: Permanent spring	2	0	0.0
Macquarie	Pp4.2: Permanent wetland	18 961	18017	95.0
Macquarie	Pt2.2.2: Temporary sedge/grass/forb marsh	41 274	9219	22.3
Macquarie	Pt1.1.2: Temporary river red gum swamp	5783	5136	88.8
Macquarie	Pt2.1.2: Temporary tall emergent marsh	3014	2397	79.5
Macquarie	Pt1.8.2: Temporary shrub swamp	1704	781	45.8
Macquarie	Lt1.1: Temporary lake	9214	249	2.7
Macquarie	Pt1.2.2: Temporary black box swamp	1915	55	2.9
Macquarie	Pt1.6.2: Temporary woodland swamp	2636	31	1.2
Macquarie	Pp2.2.2: Permanent sedge/grass/forb marsh	46	15	32.6
Macquarie	Pt3.1.2: Clay pan	1895	1	0.1
Macquarie	Pt2.3.2: Freshwater meadow	2348	0	0.0
Macquarie	Pt1.3.2: Temporary coolabah swamp	1414	0	0.0
Macquarie	Lp1.1: Permanent lake	814	0	0.0
Macquarie	Pps5: Permanent spring	15	0	0.0
Macquarie	Pp3: Peat bog or fen marsh	9	0	0.0
Mitta Mitta	Pp4.2: Permanent wetland	1012	0	0.0
Mitta Mitta	Pt2.3.2: Freshwater meadow	626	0	0.0
Mitta Mitta	Pt3.1.2: Clay pan	594	0	0.0
Mitta Mitta	Pt1.6.2: Temporary woodland swamp	562	0	0.0
Mitta Mitta	Pt1.8.2: Temporary shrub swamp	449	0	0.0
Mitta Mitta	Lp1.1: Permanent lake	86	0	0.0
Mitta Mitta	Pt4.2: Temporary wetland	57	0	0.0
Mitta Mitta	Pt1.1.2: Temporary river red gum swamp	3	0	0.0
Murrumbidgee	Pt1.1.2: Temporary river red gum swamp	7359	5486	74.5
Murrumbidgee	Pp4.2: Permanent wetland	8981	1520	16.9
Murrumbidgee	Pt2.2.2: Temporary sedge/grass/forb marsh	30 950	1188	3.8
Murrumbidgee	Pt1.8.2: Temporary shrub swamp	23 125	1159	5.0
Murrumbidgee	Pt3.1.2: Clay pan	17 314	1105	6.4
Murrumbidgee	Lp1.1: Permanent lake	1484	638	43.0
Murrumbidgee	Lt1.1: Temporary lake	30 457	474	1.6
Murrumbidgee	Pt2.3.2: Freshwater meadow	35 226	297	0.8
Murrumbidgee	Pt2.1.2: Temporary tall emergent marsh	855	35	4.1
Murrumbidgee	Pt1.2.2: Temporary black box swamp	4870	27	0.6
Murrumbidgee	Pt4.2: Temporary wetland	1502	16	1.1
Murrumbidgee	Pp2.2.2: Permanent sedge/grass/forb marsh	31	5	16.1
Murrumbidgee	Pst2.2: Temporary salt marsh	1735	4	0.2
Murrumbidgee	Pt1.6.2: Temporary woodland swamp	1619	1	0.1
Murrumbidgee	Pp3: Peat bog or fen marsh	1832	0	0.0
Murrumbidgee	Pt1.7.2: Temporary lignum swamp	1500	0	0.0
Murrumbidgee	Pp2.1.2: Permanent tall emergent marsh	186	0	0.0
Murrumbidgee	Pp2.3.2: Permanent grass marsh	36	0	0.0
Murrumbidgee	Pps5: Permanent spring	19	0	0.0
Namoi	Pp4.2: Permanent wetland	11 288	0	0.0
Namoi	Pt3.1.2: Clay pan	5300	0	0.0
Namoi	Pt2.2.2: Temporary sedge/grass/forb marsh	5158	0	0.0
Namoi	Lp1.1: Permanent lake	5123	0	0.0
Namoi	Pt1.6.2: Temporary woodland swamp	3393	0	0.0
Namoi	Pt4.2: Temporary wetland	2909	0	0.0
Namoi	Lt1.1: Temporary lake	2604	0	0.0
Namoi	Pt1.2.2: Temporary black box swamp	1771	0	0.0
Namoi	Pt1.1.2: Temporary river red gum swamp	1618	0	0.0
Namoi	Pt2.3.2: Freshwater meadow	622	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) lake and wetland types	Total area (ha)	Cew Area (ha)	Percent
Namoi	Pt1.3.2: Temporary coolabah swamp	609	0	0.0
Namoi	Pt1.8.2: Temporary shrub swamp	568	0	0.0
Namoi	Pp2.2.2: Permanent sedge/grass/forb marsh	391	0	0.0
Namoi	Pp3: Peat bog or fen marsh	17	0	0.0
Namoi	Pt1.7.2: Temporary lignum swamp	16	0	0.0
Namoi	Pps5: Permanent spring	1	0	0.0
Ovens	Pt3.1.2: Clay pan	2029	0	0.0
Ovens	Pt2.3.2: Freshwater meadow	925	0	0.0
Ovens	Pt1.6.2: Temporary woodland swamp	818	0	0.0
Ovens	Pt1.1.2: Temporary river red gum swamp	441	0	0.0
Ovens	Pp4.2: Permanent wetland	213	0	0.0
Ovens	Pt4.2: Temporary wetland	154	0	0.0
Ovens	Lp1.1: Permanent lake	80	0	0.0
Ovens	Pt2.1.2: Temporary tall emergent marsh	47	0	0.0
Ovens	Pt2.2.2: Temporary sedge/grass/forb marsh	45	0	0.0
Ovens	Pp2.1.2: Permanent tall emergent marsh	30	0	0.0
Ovens	Pt4.1: Floodplain or riparian wetland	24	0	0.0
Ovens	Lt1.1: Temporary lake	4	0	0.0
Paroo	Pt1.6.2: Temporary woodland swamp	152 703	0	0.0
Paroo	Lt1.1: Temporary lake	44 847	0	0.0
Paroo	Pt1.8.2: Temporary shrub swamp	29 703	0	0.0
Paroo	Lp1.1: Permanent lake	18 283	0	0.0
Paroo	Pt2.1.2: Temporary tall emergent marsh	12 490	0	0.0
Paroo	Pt1.2.2: Temporary black box swamp	8427	0	0.0
Paroo	Pt2.3.2: Freshwater meadow	7398	0	0.0
Paroo	Lsp1.1: Permanent saline lake	5868	0	0.0
Paroo	Pp4.2: Permanent wetland	4470	0	0.0
Paroo	Pt2.2.2: Temporary sedge/grass/forb marsh	4165	0	0.0
Paroo	Pt1.7.2: Temporary lignum swamp	3471	0	0.0
Paroo	Pt1.3.2: Temporary coolabah swamp	2399	0	0.0
Paroo	Pst2.2: Temporary salt marsh	1449	0	0.0
Paroo	Pp2.1.2: Permanent tall emergent marsh	586	0	0.0
Paroo	Lst1.1: Temporary saline lake	371	0	0.0
Paroo	Pt1.1.2: Temporary river red gum swamp	111	0	0.0
Paroo	Pst4: Temporary saline wetland	77	0	0.0
Paroo	Pt4.2: Temporary wetland	34	0	0.0
Paroo	Pt3.1.2: Clay pan	31	0	0.0
Paroo	Pps5: Permanent spring	9	0	0.0
Upper Murray	Pp3: Peat bog or fen marsh	1729	0	0.0
Upper Murray	Pt3.1.2: Clay pan	1457	0	0.0
Upper Murray	Pp2.3.2: Permanent grass marsh	1144	0	0.0
Upper Murray	Pt2.2.2: Temporary sedge/grass/forb marsh	725	0	0.0
Upper Murray	Pp4.2: Permanent wetland	419	0	0.0
Upper Murray	Pt1.1.2: Temporary river red gum swamp	290	0	0.0
Upper Murray	Pt1.6.2: Temporary woodland swamp	137	0	0.0
Upper Murray	Lp1.1: Permanent lake	94	0	0.0
Upper Murray	Pps5: Permanent spring	63	0	0.0
Upper Murray	Lt1.1: Temporary lake	50	0	0.0
Upper Murray	Pt4.2: Temporary wetland	50	0	0.0
Upper Murray	Pt2.3.2: Freshwater meadow	24	0	0.0
Upper Murray	Pp2.1.2: Permanent tall emergent marsh	16	0	0.0
Upper Murray	Pt2.1.2: Temporary tall emergent marsh	3	0	0.0
Upper Murray	Pp2.2.2: Permanent sedge/grass/forb marsh	1	0	0.0
Warrego	Pt2.3.2: Freshwater meadow	19 542	0	0.0
Warrego	Pt1.6.2: Temporary woodland swamp	4611	0	0.0
Warrego	Pt2.1.2: Temporary tall emergent marsh	4392	0	0.0
Warrego	Pt1.8.2: Temporary shrub swamp	3703	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) lake and wetland types	Total area (ha)	Cew Area (ha)	Percent
Warrego	Lp1.1: Permanent lake	3267	0	0.0
Warrego	Pp4.2: Permanent wetland	3223	0	0.0
Warrego	Lt1.1: Temporary lake	2234	0	0.0
Warrego	Pt2.2.2: Temporary sedge/grass/forb marsh	875	0	0.0
Warrego	Pt1.3.2: Temporary coolabah swamp	836	0	0.0
Warrego	Pt3.1.2: Clay pan	653	0	0.0
Warrego	Pt4.2: Temporary wetland	265	0	0.0
Warrego	Pp2.1.2: Permanent tall emergent marsh	23	0	0.0
Warrego	Pt1.1.2: Temporary river red gum swamp	12	0	0.0
Warrego	Pps5: Permanent spring	2	0	0.0
Warrego	Pst1.1: Temporary saline swamp	2	0	0.0
Wimmera	Lt1.1: Temporary lake	25 070	0	0.0
Wimmera	Lt1.2: Temporary lake with aquatic bed	8300	0	0.0
Wimmera	Pt1.8.2: Temporary shrub swamp	5885	0	0.0
Wimmera	Pt3.1.2: Clay pan	4811	0	0.0
Wimmera	Pt1.1.2: Temporary river red gum swamp	4715	0	0.0
Wimmera	Pt2.3.2: Freshwater meadow	3738	0	0.0
Wimmera	Pst4: Temporary saline wetland	3311	0	0.0
Wimmera	Pt1.6.2: Temporary woodland swamp	3267	0	0.0
Wimmera	Pst1.1: Temporary saline swamp	2232	0	0.0
Wimmera	Pt1.2.2: Temporary black box swamp	1906	0	0.0
Wimmera	Pst3.2: Salt pan or salt flat	1633	0	0.0
Wimmera	Lp1.1: Permanent lake	1541	0	0.0
Wimmera	Lst1.1: Temporary saline lake	1132	0	0.0
Wimmera	Pt4.2: Temporary wetland	724	0	0.0
Wimmera	Pst2.2: Temporary salt marsh	404	0	0.0
Wimmera	Lp1.2: Permanent lake with aquatic bed	192	0	0.0
Wimmera	Pt1.5.2: Temporary paperbark swamp	185	0	0.0
Wimmera	Lst1.2: Temporary saline lake with aquatic bed	180	0	0.0
Wimmera	Pt1.7.2: Temporary lignum swamp	174	0	0.0
Wimmera	Pp4.2: Permanent wetland	145	0	0.0
Wimmera	Pt2.1.2: Temporary tall emergent marsh	127	0	0.0
Wimmera	Pt4.1: Floodplain or riparian wetland	111	0	0.0
Wimmera	Psp1.1: Saline paperbark swamp	31	0	0.0
Wimmera	Lsp1.1: Permanent saline lake	24	0	0.0
Wimmera	Psp4: Permanent saline wetland	16	0	0.0

Annex D. ANAE floodplain types inundated by Commonwealth environmental water by valley

For floodplains, the area inundated by out-of-channel delivery of Commonwealth environmental water is presented in Table D1.

Table D1. Area of each floodplain ecosystem type and the contribution of Commonwealth environmental water to supporting floodplain ecosystem diversity within each valley, sorted by the area inundated with inundation highlighted in blue.

Valley name	Australian National Aquatic Ecosystem (ANAE) floodplain type	Total area (ha)	Cew Area (ha)	Percent
Avoca	F1.4: River red gum woodland riparian zone or floodplain	3126	0	0.0
Avoca	F1.8: Black box woodland riparian zone or floodplain	2988	0	0.0
Avoca	F1.6: Black box forest riparian zone or floodplain	977	0	0.0
Avoca	F1.12: Woodland riparian zone or floodplain	891	0	0.0
Avoca	F2.2: Lignum shrubland riparian zone or floodplain	80	0	0.0
Avoca	F2.4: Shrubland riparian zone or floodplain	4	0	0.0
Avoca	F1.2: River red gum forest riparian zone or floodplain	1	0	0.0
Barwon Darling	F1.8: Black box woodland riparian zone or floodplain	76 393	0	0.0
Barwon Darling	F1.10: Coolabah woodland and forest riparian zone or floodplain	61 778	0	0.0
Barwon Darling	F2.4: Shrubland riparian zone or floodplain	38 256	0	0.0
Barwon Darling	F1.6: Black box forest riparian zone or floodplain	24 713	0	0.0
Barwon Darling	F4: Unspecified riparian zone or floodplain	12 492	0	0.0
Barwon Darling	F3.2: Sedge/forb/grassland riparian zone or floodplain	7238	0	0.0
Barwon Darling	F1.2: River red gum forest riparian zone or floodplain	4985	0	0.0
Barwon Darling	F1.12: Woodland riparian zone or floodplain	4535	0	0.0
Barwon Darling	F2.2: Lignum shrubland riparian zone or floodplain	1152	0	0.0
Barwon Darling	F1.4: River red gum woodland riparian zone or floodplain	356	0	0.0
Barwon Darling	F1.11: River cooba woodland riparian zone or floodplain	17	0	0.0
Border Rivers	F1.10: Coolabah woodland and forest riparian zone or floodplain	72 864	0	0.0
Border Rivers	F1.2: River red gum forest riparian zone or floodplain	26 220	0	0.0
Border Rivers	F1.12: Woodland riparian zone or floodplain	24 909	0	0.0
Border Rivers	F3.2: Sedge/forb/grassland riparian zone or floodplain	14 320	0	0.0
Border Rivers	F4: Unspecified riparian zone or floodplain	2816	0	0.0
Border Rivers	F2.2: Lignum shrubland riparian zone or floodplain	2375	0	0.0
Border Rivers	F1.11: River cooba woodland riparian zone or floodplain	2322	0	0.0
Border Rivers	F1.8: Black box woodland riparian zone or floodplain	1887	0	0.0
Border Rivers	F1.6: Black box forest riparian zone or floodplain	1029	0	0.0
Border Rivers	F1.4: River red gum woodland riparian zone or floodplain	655	0	0.0
Border Rivers	F2.4: Shrubland riparian zone or floodplain	323	0	0.0
Broken	F1.4: River red gum woodland riparian zone or floodplain	4497	0	0.0
Broken	F1.12: Woodland riparian zone or floodplain	1335	0	0.0
Broken	F1.8: Black box woodland riparian zone or floodplain	61	0	0.0
Broken	F2.2: Lignum shrubland riparian zone or floodplain	6	0	0.0
Broken	F1.2: River red gum forest riparian zone or floodplain	1	0	0.0
Campaspe	F1.4: River red gum woodland riparian zone or floodplain	2970	0	0.0
Campaspe	F1.12: Woodland riparian zone or floodplain	2062	0	0.0
Campaspe	F1.2: River red gum forest riparian zone or floodplain	17	0	0.0
Campaspe	F2.2: Lignum shrubland riparian zone or floodplain	1	0	0.0
Castlereagh	F1.10: Coolabah woodland and forest riparian zone or floodplain	41 695	0	0.0
Castlereagh	F1.8: Black box woodland riparian zone or floodplain	32 351	0	0.0
Castlereagh	F1.2: River red gum forest riparian zone or floodplain	11 973	0	0.0
Castlereagh	F1.6: Black box forest riparian zone or floodplain	4601	0	0.0
Castlereagh	F1.12: Woodland riparian zone or floodplain	4165	0	0.0
Castlereagh	F2.4: Shrubland riparian zone or floodplain	1706	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) floodplain type	Total area (ha)	Cew Area (ha)	Percent
Castlereagh	F1.4: River red gum woodland riparian zone or floodplain	215	0	0.0
Castlereagh	F2.2: Lignum shrubland riparian zone or floodplain	102	0	0.0
Castlereagh	F1.11: River cooba woodland riparian zone or floodplain	61	0	0.0
Central Murray	F1.2: River red gum forest riparian zone or floodplain	161 261	3991	2.5
Central Murray	F1.4: River red gum woodland riparian zone or floodplain	23 758	2,550	10.7
Central Murray	F1.8: Black box woodland riparian zone or floodplain	48 626	1062	2.2
Central Murray	F1.12: Woodland riparian zone or floodplain	6802	89	1.3
Central Murray	F2.4: Shrubland riparian zone or floodplain	1244	11	0.9
Central Murray	F2.2: Lignum shrubland riparian zone or floodplain	7200	10	0.1
Central Murray	F4: Unspecified riparian zone or floodplain	668	2	0.3
Central Murray	F1.6: Black box forest riparian zone or floodplain	4422	0	0.0
Condamine Balonne	F1.10: Coolabah woodland and forest riparian zone or floodplain	319 222	0	0.0
Condamine Balonne	F3.2: Sedge/forb/grassland riparian zone or floodplain	293 190	0	0.0
Condamine Balonne	F4: Unspecified riparian zone or floodplain	181 014	0	0.0
Condamine Balonne	F1.12: Woodland riparian zone or floodplain	68 277	0	0.0
Condamine Balonne	F1.8: Black box woodland riparian zone or floodplain	30 994	0	0.0
Condamine Balonne	F1.2: River red gum forest riparian zone or floodplain	18 032	0	0.0
Condamine Balonne	F1.4: River red gum woodland riparian zone or floodplain	13 901	0	0.0
Condamine Balonne	F2.4: Shrubland riparian zone or floodplain	9419	0	0.0
Condamine Balonne	F2.2: Lignum shrubland riparian zone or floodplain	3474	0	0.0
Edward Wakool	F1.2: River red gum forest riparian zone or floodplain	58 502	13	<0.1
Edward Wakool	F1.4: River red gum woodland riparian zone or floodplain	7721	9	0.1
Edward Wakool	F1.8: Black box woodland riparian zone or floodplain	77 969	0	0.0
Edward Wakool	F1.6: Black box forest riparian zone or floodplain	4193	0	0.0
Edward Wakool	F2.4: Shrubland riparian zone or floodplain	2471	0	0.0
Edward Wakool	F2.2: Lignum shrubland riparian zone or floodplain	1857	0	0.0
Goulburn	F1.12: Woodland riparian zone or floodplain	26 261	0	0.0
Goulburn	F1.4: River red gum woodland riparian zone or floodplain	17 945	0	0.0
Goulburn	F1.2: River red gum forest riparian zone or floodplain	5721	0	0.0
Goulburn	F1.8: Black box woodland riparian zone or floodplain	130	0	0.0
Goulburn	F2.4: Shrubland riparian zone or floodplain	35	0	0.0
Goulburn	F2.2: Lignum shrubland riparian zone or floodplain	27	0	0.0
Gwydir	F1.2: River red gum forest riparian zone or floodplain	15 515	911	5.9
Gwydir	F1.11: River cooba woodland riparian zone or floodplain	4501	639	14.2
Gwydir	F1.10: Coolabah woodland and forest riparian zone or floodplain	161 353	524	0.3
Gwydir	F1.12: Woodland riparian zone or floodplain	15 193	0	0.0
Gwydir	F1.6: Black box forest riparian zone or floodplain	14 093	0	0.0
Gwydir	F1.8: Black box woodland riparian zone or floodplain	5112	0	0.0
Gwydir	F1.4: River red gum woodland riparian zone or floodplain	859	0	0.0
Gwydir	F2.2: Lignum shrubland riparian zone or floodplain	656	0	0.0
Gwydir	F2.4: Shrubland riparian zone or floodplain	87	0	0.0
Kiewa	F1.12: Woodland riparian zone or floodplain	2715	0	0.0
Kiewa	F1.4: River red gum woodland riparian zone or floodplain	1391	0	0.0
Lachlan	F1.2: River red gum forest riparian zone or floodplain	97 333	3252	3.3
Lachlan	F1.8: Black box woodland riparian zone or floodplain	100 750	83	0.1
Lachlan	F2.2: Lignum shrubland riparian zone or floodplain	9706	56	0.6
Lachlan	F1.6: Black box forest riparian zone or floodplain	22 919	35	0.2
Lachlan	F1.4: River red gum woodland riparian zone or floodplain	4123	8	0.2
Lachlan	F2.4: Shrubland riparian zone or floodplain	224 941	2	<0.1
Lachlan	F1.12: Woodland riparian zone or floodplain	2259	0	0.0
Lachlan	F1.11: River cooba woodland riparian zone or floodplain	3	0	0.0
Lachlan	F3.2: Sedge/forb/grassland riparian zone or floodplain	1	0	0.0
Loddon	F1.4: River red gum woodland riparian zone or floodplain	8027	0	0.0
Loddon	F1.8: Black box woodland riparian zone or floodplain	7842	0	0.0
Loddon	F2.2: Lignum shrubland riparian zone or floodplain	6611	0	0.0
Loddon	F1.12: Woodland riparian zone or floodplain	2546	0	0.0
Loddon	F2.4: Shrubland riparian zone or floodplain	104	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) floodplain type	Total area (ha)	Cew Area (ha)	Percent
Loddon	F1.2: River red gum forest riparian zone or floodplain	101	0	0.0
Loddon	F1.6: Black box forest riparian zone or floodplain	33	0	0.0
Lower Darling	F1.2: River red gum forest riparian zone or floodplain	12 688	27	0.2
Lower Darling	F2.4: Shrubland riparian zone or floodplain	10 646	6	0.1
Lower Darling	F1.6: Black box forest riparian zone or floodplain	20 532	4	<0.1
Lower Darling	F1.8: Black box woodland riparian zone or floodplain	71 385	0	0.0
Lower Darling	F1.12: Woodland riparian zone or floodplain	1272	0	0.0
Lower Darling	F4: Unspecified riparian zone or floodplain	281	0	0.0
Lower Darling	F3.2: Sedge/forb/grassland riparian zone or floodplain	106	0	0.0
Lower Darling	F2.2: Lignum shrubland riparian zone or floodplain	8	0	0.0
Lower Murray	F1.4: River red gum woodland riparian zone or floodplain	35 793	712	2.0
Lower Murray	F1.2: River red gum forest riparian zone or floodplain	11 835	589	5.0
Lower Murray	F1.8: Black box woodland riparian zone or floodplain	35 795	441	1.2
Lower Murray	F2.2: Lignum shrubland riparian zone or floodplain	20 415	201	1.0
Lower Murray	F2.4: Shrubland riparian zone or floodplain	27 813	153	0.6
Lower Murray	F4: Unspecified riparian zone or floodplain	567	27	4.8
Lower Murray	F1.6: Black box forest riparian zone or floodplain	109	5	4.6
Lower Murray	F1.11: River cooba woodland riparian zone or floodplain	348	4	1.1
Lower Murray	F1.12: Woodland riparian zone or floodplain	1586	2	0.1
Macquarie	F1.2: River red gum forest riparian zone or floodplain	73 188	3272	4.5
Macquarie	F1.4: River red gum woodland riparian zone or floodplain	14 799	1282	8.7
Macquarie	F1.10: Coolabah woodland and forest riparian zone or floodplain	157 431	811	0.5
Macquarie	F2.4: Shrubland riparian zone or floodplain	41 153	228	0.6
Macquarie	F1.11: River cooba woodland riparian zone or floodplain	2752	197	7.2
Macquarie	F1.8: Black box woodland riparian zone or floodplain	158 156	167	0.1
Macquarie	F2.2: Lignum shrubland riparian zone or floodplain	6048	97	1.6
Macquarie	F1.6: Black box forest riparian zone or floodplain	20 301	75	0.4
Macquarie	F1.12: Woodland riparian zone or floodplain	6898	0	0.0
Macquarie	F4: Unspecified riparian zone or floodplain	1061	0	0.0
Macquarie	F3.2: Sedge/forb/grassland riparian zone or floodplain	142	0	0.0
Mitta Mitta	F1.12: Woodland riparian zone or floodplain	7472	0	0.0
Mitta Mitta	F1.4: River red gum woodland riparian zone or floodplain	320	0	0.0
Mitta Mitta	F2.4: Shrubland riparian zone or floodplain	37	0	0.0
Murrumbidgee	F1.2: River red gum forest riparian zone or floodplain	126 459	13652	10.8
Murrumbidgee	F2.2: Lignum shrubland riparian zone or floodplain	70 408	1,110	1.6
Murrumbidgee	F1.4: River red gum woodland riparian zone or floodplain	5153	325	6.3
Murrumbidgee	F1.6: Black box forest riparian zone or floodplain	9094	145	1.6
Murrumbidgee	F1.8: Black box woodland riparian zone or floodplain	94 712	76	0.1
Murrumbidgee	F2.4: Shrubland riparian zone or floodplain	27 982	73	0.3
Murrumbidgee	F4: Unspecified riparian zone or floodplain	80	7	8.8
Murrumbidgee	F1.12: Woodland riparian zone or floodplain	51	2	3.9
Murrumbidgee	F1.11: River cooba woodland riparian zone or floodplain	24	0	0.0
Murrumbidgee	F1.10: Coolabah woodland and forest riparian zone or floodplain	23	0	0.0
Namoi	F1.10: Coolabah woodland and forest riparian zone or floodplain	88 097	0	0.0
Namoi	F1.12: Woodland riparian zone or floodplain	26 664	0	0.0
Namoi	F1.8: Black box woodland riparian zone or floodplain	12 405	0	0.0
Namoi	F1.2: River red gum forest riparian zone or floodplain	10 917	0	0.0
Namoi	F1.6: Black box forest riparian zone or floodplain	3053	0	0.0
Namoi	F2.2: Lignum shrubland riparian zone or floodplain	2624	0	0.0
Namoi	F1.11: River cooba woodland riparian zone or floodplain	1513	0	0.0
Namoi	F1.4: River red gum woodland riparian zone or floodplain	599	0	0.0
Namoi	F2.4: Shrubland riparian zone or floodplain	153	0	0.0
Namoi	F1.13: Paperbark riparian zone or floodplain	17	0	0.0
Ovens	F1.12: Woodland riparian zone or floodplain	11 380	0	0.0
Ovens	F1.4: River red gum woodland riparian zone or floodplain	6837	0	0.0
Ovens	F1.2: River red gum forest riparian zone or floodplain	1916	0	0.0
Paroo	F3.2: Sedge/forb/grassland riparian zone or floodplain	506 857	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) floodplain type	Total area (ha)	Cew Area (ha)	Percent
Paroo	F1.4: River red gum woodland riparian zone or floodplain	98 545	0	0.0
Paroo	F1.12: Woodland riparian zone or floodplain	62 642	0	0.0
Paroo	F1.10: Coolabah woodland and forest riparian zone or floodplain	31 982	0	0.0
Paroo	F2.4: Shrubland riparian zone or floodplain	20 115	0	0.0
Paroo	F1.8: Black box woodland riparian zone or floodplain	17 227	0	0.0
Paroo	F4: Unspecified riparian zone or floodplain	1210	0	0.0
Upper Murray	F1.12: Woodland riparian zone or floodplain	3847	0	0.0
Upper Murray	F1.2: River red gum forest riparian zone or floodplain	2261	0	0.0
Upper Murray	F1.4: River red gum woodland riparian zone or floodplain	1475	0	0.0
Upper Murray	F2.4: Shrubland riparian zone or floodplain	265	0	0.0
Upper Murray	F2.2: Lignum shrubland riparian zone or floodplain	10	0	0.0
Warrego	F1.10: Coolabah woodland and forest riparian zone or floodplain	281 281	0	0.0
Warrego	F1.4: River red gum woodland riparian zone or floodplain	60 118	0	0.0
Warrego	F1.12: Woodland riparian zone or floodplain	18 777	0	0.0
Warrego	F3.2: Sedge/forb/grassland riparian zone or floodplain	11 249	0	0.0
Warrego	F2.2: Lignum shrubland riparian zone or floodplain	10 980	0	0.0
Warrego	F2.4: Shrubland riparian zone or floodplain	1048	0	0.0
Warrego	F4: Unspecified riparian zone or floodplain	896	0	0.0
Warrego	F1.8: Black box woodland riparian zone or floodplain	441	0	0.0
Warrego	F1.2: River red gum forest riparian zone or floodplain	96	0	0.0
Wimmera	F1.12: Woodland riparian zone or floodplain	16 128	0	0.0
Wimmera	F1.4: River red gum woodland riparian zone or floodplain	12 038	0	0.0
Wimmera	F1.8: Black box woodland riparian zone or floodplain	4416	0	0.0
Wimmera	F1.6: Black box forest riparian zone or floodplain	1373	0	0.0
Wimmera	F2.4: Shrubland riparian zone or floodplain	811	0	0.0
Wimmera	F2.2: Lignum shrubland riparian zone or floodplain	146	0	0.0
Wimmera	F1.13: Paperbark riparian zone or floodplain	1	0	0.0

Annex E. ANAE river channel types influenced by Commonwealth environmental water by valley

The lengths of river and stream channels of differing ANAE type influenced by the delivery of Commonwealth environmental water are presented in Table E1 as an in indicator of the contribution of Commonwealth environmental water towards riverine ecosystem diversity within each valley. River length measurement is highly dependent on the resolution of 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 Geofabric v3 beta Network Streams were used which are based on a 1 arc-second DEM with an approximate resolution of 30m.

Commonwealth environmental water is typically delivered from storages into lowland rivers. In hilly landscapes and where rivers cut through gorges the ANAE classification often identifies individual river sections as high energy streams. These transition into low energy lowland rivers as the valleys widen and flatten further downstream. The different ANAE ecosystem types in Table E1 are mostly distributed along the same major river within each valley rather than separate watercourses (refer Figure 6).

Table E1. Length of river and stream ecosystem types influenced by the delivery of Commonwealth environmental water (shaded blue) as represented by the Basin ANAE waterways data set in each valley

Valley name	Australian National Aquatic Ecosystem (ANAE) waterway type	Total Length (km)	Cew Length (km)	Percent
Avoca	Rt1.4: Temporary lowland stream	1752	0	0.0
Avoca	Rt1.2: Temporary transitional zone stream	1086	0	0.0
Avoca	Rt1.1: Temporary high energy upland stream	511	0	0.0
Avoca	Rp1.4: Permanent lowland stream	66	0	0.0
Avoca	Rp1.2: Permanent transitional zone stream	23	0	0.0
Avoca	Rt1.3: Temporary low energy upland stream	21	0	0.0
Barwon Darling	Rp1.4: Permanent lowland stream	4575	1867	40.8
Barwon Darling	Rt1.4: Temporary lowland stream	20 412	29	0.1
Barwon Darling	Rp1.2: Permanent transitional zone stream	36	2	5.6
Barwon Darling	Rp1.1: Permanent high energy upland stream	3	1	33.3
Barwon Darling	Rp1.3: Permanent low energy upland stream	1	1	100.0
Barwon Darling	Rt1.2: Temporary transitional zone stream	4715	0	0.0
Barwon Darling	Rt1.1: Temporary high energy upland stream	874	0	0.0
Barwon Darling	Rt1.3: Temporary low energy upland stream	178	0	0.0
Barwon Darling	Ru1: Unspecified river (landform unknown)	32	0	0.0
Barwon Darling	Rw1: Permanent river (landform unknown)	1	0	0.0
Border Rivers	Rp1.4: Permanent lowland stream	2431	616	25.3
Border Rivers	Rt1.4: Temporary lowland stream	13 996	491	3.5
Border Rivers	Rp1.2: Permanent transitional zone stream	2349	120	5.1
Border Rivers	Rt1.1: Temporary high energy upland stream	7129	61	0.9
Border Rivers	Rp1.1: Permanent high energy upland stream	2844	48	1.7
Border Rivers	Rt1.2: Temporary transitional zone stream	8963	13	0.1
Border Rivers	Rt1.3: Temporary low energy upland stream	92	0	0.0
Border Rivers	Ru1: Unspecified river (landform unknown)	39	0	0.0
Border Rivers	Rw1: Permanent river (landform unknown)	9	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) waterway type	Total Length (km)	Cew Length (km)	Percent
Broken	Rt1.4: Temporary lowland stream	1342	270	20.1
Broken	Rp1.4: Permanent lowland stream	53	37	69.8
Broken	Rp1.1: Permanent high energy upland stream	61	9	14.8
Broken	Rp1.2: Permanent transitional zone stream	67	8	11.9
Broken	Rt1.1: Temporary high energy upland stream	906	4	0.4
Broken	Rt1.2: Temporary transitional zone stream	394	0	0.0
Broken	Rt1.3: Temporary low energy upland stream	67	0	0.0
Broken	Ru1: Unspecified river (landform unknown)	10	0	0.0
Broken	Rw1: Permanent river (landform unknown)	5	0	0.0
Campaspe	Rp1.4: Permanent lowland stream	66	52	78.8
Campaspe	Rp1.3: Permanent low energy upland stream	38	37	97.4
Campaspe	Rp1.2: Permanent transitional zone stream	61	14	23.0
Campaspe	Rp1.1: Permanent high energy upland stream	86	6	7.0
Campaspe	Rt1.4: Temporary lowland stream	610	4	0.7
Campaspe	Rt1.1: Temporary high energy upland stream	1042	1	0.1
Campaspe	Rt1.2: Temporary transitional zone stream	1410	0	0.0
Campaspe	Rt1.3: Temporary low energy upland stream	37	0	0.0
Campaspe	Rw1: Permanent river (landform unknown)	15	0	0.0
Campaspe	Ru1: Unspecified river (landform unknown)	2	0	0.0
Castlereagh	Rt1.4: Temporary lowland stream	4076	0	0.0
Castlereagh	Rt1.2: Temporary transitional zone stream	3078	0	0.0
Castlereagh	Rt1.1: Temporary high energy upland stream	1731	0	0.0
Castlereagh	Rp1.4: Permanent lowland stream	596	0	0.0
Castlereagh	Rp1.2: Permanent transitional zone stream	482	0	0.0
Castlereagh	Rp1.1: Permanent high energy upland stream	169	0	0.0
Castlereagh	Rt1.3: Temporary low energy upland stream	164	0	0.0
Castlereagh	Rp1.3: Permanent low energy upland stream	45	0	0.0
Central Murray	Rp1.4: Permanent lowland stream	3271	1790	54.7
Central Murray	Rt1.4: Temporary lowland stream	3470	529	15.2
Central Murray	Rp1.3: Permanent low energy upland stream	108	71	65.7
Central Murray	Rp1.2: Permanent transitional zone stream	143	24	16.8
Central Murray	Rp1.1: Permanent high energy upland stream	306	17	5.6
Central Murray	Rt1.3: Temporary low energy upland stream	93	17	18.3
Central Murray	Rt1.2: Temporary transitional zone stream	869	11	1.3
Central Murray	Ru1: Unspecified river (landform unknown)	5	1	20.0
Central Murray	Rt1.1: Temporary high energy upland stream	1467	0	0.0
Condamine Balonne	Rt1.4: Temporary lowland stream	33 874	332	1.0
Condamine Balonne	Rp1.4: Permanent lowland stream	1163	173	14.9
Condamine Balonne	Rt1.2: Temporary transitional zone stream	16 518	0	0.0
Condamine Balonne	Rt1.1: Temporary high energy upland stream	3421	0	0.0
Condamine Balonne	Rt1.3: Temporary low energy upland stream	111	0	0.0
Condamine Balonne	Rp1.2: Permanent transitional zone stream	48	0	0.0
Condamine Balonne	Ru1: Unspecified river (landform unknown)	37	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) waterway type	Total Length (km)	Cew Length (km)	Percent
Condamine Balonne	Rp1.1: Permanent high energy upland stream	27	0	0.0
Condamine Balonne	Rp1.3: Permanent low energy upland stream	2	0	0.0
Condamine Balonne	Rw1: Permanent river (landform unknown)	0	0	-
Edward Wakool	Rp1.4: Permanent lowland stream	2304	912	39.6
Edward Wakool	Rt1.4: Temporary lowland stream	904	64	7.1
Goulburn	Rp1.4: Permanent lowland stream	528	302	57.2
Goulburn	Rp1.1: Permanent high energy upland stream	965	63	6.5
Goulburn	Rp1.2: Permanent transitional zone stream	313	30	9.6
Goulburn	Rt1.4: Temporary lowland stream	2065	9	0.4
Goulburn	Rt1.1: Temporary high energy upland stream	7563	6	0.1
Goulburn	Rt1.2: Temporary transitional zone stream	2529	3	0.1
Goulburn	Rt1.3: Temporary low energy upland stream	230	2	0.9
Goulburn	Rp1.3: Permanent low energy upland stream	51	0	0.0
Goulburn	Ru1: Unspecified river (landform unknown)	24	0	0.0
Goulburn	Rw1: Permanent river (landform unknown)	22	0	0.0
Gwydir	Rp1.4: Permanent lowland stream	1753	673	38.4
Gwydir	Rt1.4: Temporary lowland stream	3288	233	7.1
Gwydir	Rp1.2: Permanent transitional zone stream	3049	134	4.4
Gwydir	Rp1.1: Permanent high energy upland stream	2508	55	2.2
Gwydir	Rp1.3: Permanent low energy upland stream	118	33	28.0
Gwydir	Rt1.3: Temporary low energy upland stream	131	20	15.3
Gwydir	Rt1.1: Temporary high energy upland stream	4098	0	0.0
Gwydir	Rt1.2: Temporary transitional zone stream	2616	0	0.0
Gwydir	Rw1: Permanent river (landform unknown)	23	0	0.0
Gwydir	Ru1: Unspecified river (landform unknown)	6	0	0.0
Kiewa	Rt1.1: Temporary high energy upland stream	1266	0	0.0
Kiewa	Rt1.2: Temporary transitional zone stream	135	0	0.0
Kiewa	Rp1.1: Permanent high energy upland stream	104	0	0.0
Kiewa	Rp1.4: Permanent lowland stream	96	0	0.0
Kiewa	Rt1.4: Temporary lowland stream	68	0	0.0
Kiewa	Rp1.2: Permanent transitional zone stream	5	0	0.0
Kiewa	Rt1.3: Temporary low energy upland stream	1	0	0.0
Kiewa	Rp1.3: Permanent low energy upland stream	0	0	-
Kiewa	Ru1: Unspecified river (landform unknown)	0	0	-
Lachlan	Rp1.4: Permanent lowland stream	4877	1246	25.5
Lachlan	Rp1.1: Permanent high energy upland stream	6095	75	1.2
Lachlan	Rt1.4: Temporary lowland stream	15 336	60	0.4
Lachlan	Rp1.2: Permanent transitional zone stream	2215	38	1.7
Lachlan	Rp1.3: Permanent low energy upland stream	40	4	10.0
Lachlan	Rt1.1: Temporary high energy upland stream	10 526	0	0.0
Lachlan	Rt1.2: Temporary transitional zone stream	7848	0	0.0
Lachlan	Rt1.3: Temporary low energy upland stream	172	0	0.0
Lachlan	Rw1: Permanent river (landform unknown)	27	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) waterway type	Total Length (km)	Cew Length (km)	Percent
Lachlan	Ru1: Unspecified river (landform unknown)	20	0	0.0
Loddon	Rp1.4: Permanent lowland stream	405	326	80.5
Loddon	Rt1.4: Temporary lowland stream	3931	27	0.7
Loddon	Rp1.2: Permanent transitional zone stream	39	11	28.2
Loddon	Rt1.2: Temporary transitional zone stream	2684	9	0.3
Loddon	Rp1.1: Permanent high energy upland stream	71	2	2.8
Loddon	Rt1.1: Temporary high energy upland stream	1156	0	0.0
Loddon	Rt1.3: Temporary low energy upland stream	87	0	0.0
Loddon	Ru1: Unspecified river (landform unknown)	4	0	0.0
Lower Darling	Rp1.4: Permanent lowland stream	1852	616	33.3
Lower Darling	Rt1.4: Temporary lowland stream	3158	8	0.3
Lower Darling	Rt1.2: Temporary transitional zone stream	285	0	0.0
Lower Darling	Rt1.3: Temporary low energy upland stream	68	0	0.0
Lower Darling	Rp1.2: Permanent transitional zone stream	35	0	0.0
Lower Darling	Rt1.1: Temporary high energy upland stream	19	0	0.0
Lower Murray	Rp1.4: Permanent lowland stream	1402	839	59.8
Lower Murray	Rt1.4: Temporary lowland stream	9129	282	3.1
Lower Murray	Rp1: Permanent stream	360	170	47.2
Lower Murray	Rt1: Temporary stream	156	90	57.7
Lower Murray	Rp1.3: Permanent low energy upland stream	63	21	33.3
Lower Murray	Rp1.1: Permanent high energy upland stream	17	16	94.1
Lower Murray	Rw1: Permanent river (landform unknown)	10	7	70.0
Lower Murray	Ru1: Unspecified river (landform unknown)	48	6	12.5
Lower Murray	Rt1.2: Temporary transitional zone stream	5123	5	0.1
Lower Murray	Pt1: Temporary swamp	12	5	41.7
Lower Murray	Rt1.1: Temporary high energy upland stream	4048	3	0.1
Lower Murray	Rp1.2: Permanent transitional zone stream	36	2	5.6
Lower Murray	Rt1.3: Temporary low energy upland stream	370	1	0.3
Lower Murray	Pp4.1: Permanent floodplain wetland	3	1	33.3
Lower Murray	Lp2: Permanent floodplain lake	2	1	50.0
Lower Murray	Pt2.1.2: Temporary tall emergent marsh	6	0	0.0
Lower Murray	Lp1: Permanent lake	3	0	0.0
Lower Murray	Psp4: Permanent saline wetland	2	0	0.0
Macquarie	Rp1.4: Permanent lowland stream	5458	1539	28.2
Macquarie	Rt1.4: Temporary lowland stream	12 345	627	5.1
Macquarie	Rp1.2: Permanent transitional zone stream	2962	96	3.2
Macquarie	Rp1.1: Permanent high energy upland stream	7953	38	0.5
Macquarie	Rt1.1: Temporary high energy upland stream	13 036	0	0.0
Macquarie	Rt1.2: Temporary transitional zone stream	8679	0	0.0
Macquarie	Rt1.3: Temporary low energy upland stream	113	0	0.0
Macquarie	Rw1: Permanent river (landform unknown)	40	0	0.0
Macquarie	Rp1.3: Permanent low energy upland stream	8	0	0.0
Macquarie	Ru1: Unspecified river (landform unknown)	5	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) waterway type	Total Length (km)	Cew Length (km)	Percent
Mitta Mitta	Rt1.1: Temporary high energy upland stream	4235	0	0.0
Mitta Mitta	Rp1.1: Permanent high energy upland stream	519	0	0.0
Mitta Mitta	Rt1.2: Temporary transitional zone stream	144	0	0.0
Mitta Mitta	Rp1.4: Permanent lowland stream	97	0	0.0
Mitta Mitta	Rp1.2: Permanent transitional zone stream	57	0	0.0
Mitta Mitta	Rt1.4: Temporary lowland stream	38	0	0.0
Mitta Mitta	Rw1: Permanent river (landform unknown)	18	0	0.0
Mitta Mitta	Ru1: Unspecified river (landform unknown)	17	0	0.0
Mitta Mitta	Rt1.3: Temporary low energy upland stream	3	0	0.0
Murrumbidgee	Rp1.4: Permanent lowland stream	4192	1547	36.9
Murrumbidgee	Rt1.4: Temporary lowland stream	8283	449	5.4
Murrumbidgee	Rp1.1: Permanent high energy upland stream	9992	146	1.5
Murrumbidgee	Rp1.2: Permanent transitional zone stream	1996	81	4.1
Murrumbidgee	Rp1.3: Permanent low energy upland stream	122	77	63.1
Murrumbidgee	Rt1.1: Temporary high energy upland stream	12 939	10	0.1
Murrumbidgee	Rt1.3: Temporary low energy upland stream	56	9	16.1
Murrumbidgee	Rt1.2: Temporary transitional zone stream	5841	0	0.0
Murrumbidgee	Rw1: Permanent river (landform unknown)	41	0	0.0
Namoi	Rp1.4: Permanent lowland stream	2324	306	13.2
Namoi	Rp1.1: Permanent high energy upland stream	3594	141	3.9
Namoi	Rp1.2: Permanent transitional zone stream	1552	87	5.6
Namoi	Rp1.3: Permanent low energy upland stream	25	3	12.0
Namoi	Rw1: Permanent river (landform unknown)	25	1	4.0
Namoi	Rt1.1: Temporary high energy upland stream	9412	0	0.0
Namoi	Rt1.4: Temporary lowland stream	7502	0	0.0
Namoi	Rt1.2: Temporary transitional zone stream	5744	0	0.0
Namoi	Rt1.3: Temporary low energy upland stream	251	0	0.0
Namoi	Ru1: Unspecified river (landform unknown)	3	0	0.0
Ovens	Rp1.4: Permanent lowland stream	388	174	44.8
Ovens	Rt1.4: Temporary lowland stream	1017	90	8.8
Ovens	Rp1.1: Permanent high energy upland stream	344	24	7.0
Ovens	Rp1.2: Permanent transitional zone stream	82	18	22.0
Ovens	Rt1.1: Temporary high energy upland stream	3885	11	0.3
Ovens	Rp1.3: Permanent low energy upland stream	2	2	100.0
Ovens	Rt1.2: Temporary transitional zone stream	579	0	0.0
Ovens	Rt1.3: Temporary low energy upland stream	50	0	0.0
Ovens	Rw1: Permanent river (landform unknown)	1	0	0.0
Paroo	Rt1.4: Temporary lowland stream	26 096	0	0.0
Paroo	Rt1.2: Temporary transitional zone stream	4115	0	0.0
Paroo	Rp1.4: Permanent lowland stream	1167	0	0.0
Paroo	Rt1.1: Temporary high energy upland stream	297	0	0.0
Paroo	Rt1.3: Temporary low energy upland stream	142	0	0.0
Paroo	Rp1.2: Permanent transitional zone stream	40	0	0.0

Valley name	Australian National Aquatic Ecosystem (ANAE) waterway type	Total Length (km)	Cew Length (km)	Percent
Paroo	Ru1: Unspecified river (landform unknown)	25	0	0.0
Paroo	Rw1: Permanent river (landform unknown)	3	0	0.0
Upper Murray	Rt1.1: Temporary high energy upland stream	4829	0	0.0
Upper Murray	Rp1.1: Permanent high energy upland stream	3674	0	0.0
Upper Murray	Rp1.4: Permanent lowland stream	423	0	0.0
Upper Murray	Rt1.2: Temporary transitional zone stream	406	0	0.0
Upper Murray	Rp1.2: Permanent transitional zone stream	324	0	0.0
Upper Murray	Rt1.4: Temporary lowland stream	233	0	0.0
Upper Murray	Rw1: Permanent river (landform unknown)	25	0	0.0
Upper Murray	Rt1.3: Temporary low energy upland stream	9	0	0.0
Upper Murray	Rp1.3: Permanent low energy upland stream	4	0	0.0
Upper Murray	Ru1: Unspecified river (landform unknown)	2	0	0.0
Warrego	Rp1.4: Permanent lowland stream	599	241	40.2
Warrego	Rt1.4: Temporary lowland stream	20 641	144	0.7
Warrego	Rw1: Permanent river (landform unknown)	7	7	100.0
Warrego	Rt1.3: Temporary low energy upland stream	268	6	2.2
Warrego	Rt1.2: Temporary transitional zone stream	5797	3	0.1
Warrego	Rt1.1: Temporary high energy upland stream	493	0	0.0
Warrego	Rp1.3: Permanent low energy upland stream	6	0	0.0
Warrego	Ru1: Unspecified river (landform unknown)	1	0	0.0
Wimmera	Rt1.4: Temporary lowland stream	3531	177	5.0
Wimmera	Rt1.2: Temporary transitional zone stream	1965	2	0.1
Wimmera	Rt1.1: Temporary high energy upland stream	1353	2	0.1
Wimmera	Rt1.3: Temporary low energy upland stream	68	0	0.0
Wimmera	Rp1.4: Permanent lowland stream	45	0	0.0
Wimmera	Rp1.2: Permanent transitional zone stream	43	0	0.0
Wimmera	Ru1: Unspecified river (landform unknown)	13	0	0.0