River Murray Wetland Classification Project

Final
16/12/2009

Report to the Riverine Recovery Project
Department of Land, Water & Biodiversity Conservation

This publication may be cited as:

Jones, L. and Miles. M., 2009*, River Murray Wetland Classification Project (DEH)* report to the Riverine Recovery Project, Department of Water, Land & Biodiversity Conservation.

ISBN: 978-1-925964-28-8

TR 2009/33

Government of South Australia
Department for Environment and Heritage

Department for Environment and Heritage
GPO Box 1047, Adelaide, SA, 5001

Acronyms

AE Aquatic Ecosystem

ASSRAP Acid Sulfate Soils Risk Assessment Project

DEH Department for Environment and Heritage

DEM Digital Elevation Model

DIWA Directory of Important Wetlands

DWLBC Department of Water, Land and Biodiversity Conservation

FIM Flood Inundation Model

HCVAE High Conservation Value Aquatic Ecosystems

ML Megalitres

MDBA Murray Darling Basin Authority

RRP Riverine Recovery Project

SAAE South Australian Aquatic Ecosystems

SAMDBNRM South Australian Murray Darling Basin Natural Resource Management Board

SKM Sinclair Knight Mertz

SLU Soil Landscape Units

SQL Structured Query Language

WPP Wetland Prioritisation Project

Acknowledgements

This work builds on the contribution provided by many data collection and modelling projects over time as referred to in the text. The authors of this report would also like to acknowledge the valuable input, advice and review provided by Ben Fee, Tumi Bjornssen, Mike Harper, Dr Nick Souter, Rebecca Turner, Andrew Willson and Paul Wainwright.

Contents

1. Introduction

The goal of this project is to classify wetland types of the River Murray for two complementary projects;

a) the Wetlands Prioritisation project (WPP) funded by the South Australian Murray-Darling Basin Natural Resources Management Board (SA MDBNRM) and

b) the Riverine Recovery Project (RRP), managed by the Department of Water, Land and Biodiversity Conservation which is funded by the Commonwealth Government Murray Futures Program.

This characterisation of aquatic ecosystems is important in understanding the ecological assets of the system and to inform a prioritisation approach to the allocation of environmental water. These aspects are essential in improving the management of the River Murray in SA as well as informing further research and policy development in the Murray-Darling Basin and for investment decisions regarding national High Conservation Value Aquatic Ecosystems (HCVAE).

The WPP is currently in a validation stage with a number of changes being suggested by the steering committee. This project is in response to one of those changes and is also designed to feed into further investigations for the RRP. It should be noted that the timing of the final outputs from the WPP should be considered with any application of this projects outputs to RRP objectives. Section 2.8 provides more on the implications and connectivity between these projects.

1.1. Aim

The aim of the project is to define character types of aquatic ecosystems of the River Murray, according to the methodology developed by the South Australian Aquatic Ecosystems classification project (SAAE). This classification uses the geomorphological, hydrological and ecological characteristics of aquatic ecosystems to define different wetland types that exist in South Australia. It has been developed in consultation with representatives from Natural Resource Management Boards across the state. This is essentially the first application of the SAAE to a specific region. The results of the classification were incorporated into the Wetland Prioritisation project methodology to assign conservation-threat rankings to aquatic ecosystems, by geomorphic reach.

2. Method

2.1. Study area

The study area includes the aquatic ecosystems of the River Murray floodplain within the boundary of the 1956 flood, from the South Australian border to Wellington (Figure 1). This includes mapped wetlands and watercourses but the floodplain itself is excluded, i.e. those areas not bounded by polygons and where water would not remain upon recession of flood events.

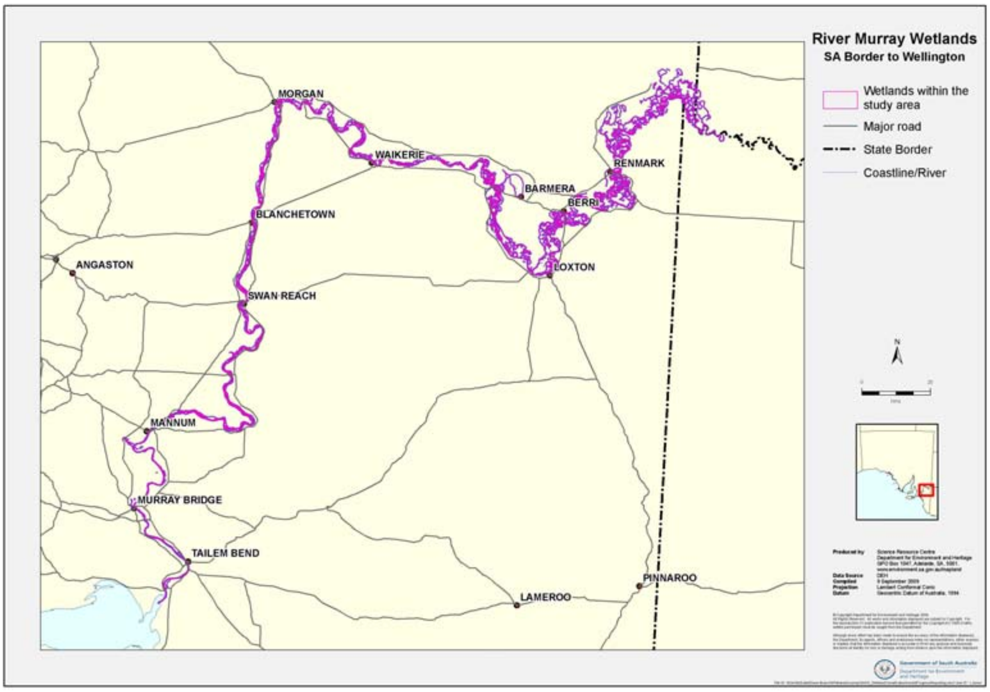


Figure 1 Location of the study area

2.2. Data sources

A summary of data sources used to aid interpretation of the aquatic ecosystem attributes, can be found in Appendix A.

2.2.1. Wetlands mapping

The wetlands mapping for the River Murray floodplain that forms the basis of the classification project was created as part of the Floodplain Prioritisation Project (2007), which took existing wetland mapping from various sources and combined and aligned it to 2005 ortho-photography (Frankewicz, 2008). Each wetland polygon has a unique wetland number (AUSWETNR). Both wetland and watercourse polygons are included in this dataset. The wetlands polygons that were located between the SA border and Wellington were selected for classification, which included a total of 1,428 polygons.

While the wetland polygons are an integration of all previous mapping efforts, it has been identified that it contains errors and omissions, Such "errors and omissions" are relative to what one thinks should be included. An agreed definition of what mapped polygons should represent (i.e. for wetlands and floodplains) has not been approached. However some gross changes have been applied to some polygons (e.g. old disposal basins that no longer hold the amount of water they used to). In addition, ongoing dialogue with floodplain managers may see an improved understanding and application of wetland mapping through development of improved information systems being developed by NRM Board and Murray Futures program. A further example of this is whether the balance of the 'floodplain' that exists outside of wetland polygons but within the 1956 flood level should be mapped as entities with unique identifiers. For completeness and in the context of South Australian aquatic ecosystem mapping – this makes sense. It would also allow a standard way of defining and naming floodplains as areas of potential or active management.

2.2.2. Vegetation mapping

The South Australian vegetation mapping data layer from the DEH corporate spatial database (SDE) contains extant native vegetation community mapping. It records the spatial extent, and describes the structural formation and composition of the vegetation communities across South Australia. The data has generally been captured by digitising on screen over aerial photography, with field studies providing floristic information. The imagery used for the mapping of the River Murray Floodplain was captured at 1:20,000 scale.

The vegetation mapping is used to attribute the presence of emergent, aquatic vegetation within an aquatic ecosystem and also to indicate likely salinity levels. The limitations of this data are that the mapping is based on the extrapolation of point based vegetation sampling (completed in 2003) and the interpretation of aerial photography, and not all mapping is verified in the field. Aquatic plant species and inundated vegetation are generally not mapped, so many aquatic ecosystems do not contain vegetation mapping. Due to the scale of the mapping, not all features visible in the latest imagery are represented in the vegetation mapping.

2.2.3. Flood Inundation Model (FIM)

The Flood Inundation Model (FIM) (Overton, 2006) predicts the extent of inundation of the River Murray floodplain under different flow conditions. The model is based on hydrological modelling and Landsat satellite imagery. The output from the model is a 30m raster grid. Each cell represents the amount of water in ML/day that is modelled commence to flow in that location. The FIM was used as an aid to attribute the hydrology and water regime fields, by showing aquatic ecosystems likely to be permanently connected to the River Murray. The limitations of this dataset are that it was produced at the floodplain scale (30m pixels), which is coarser than the scale of the aquatic ecosystems polygons. This means that very small or skinny watercourses and wetlands are not well represented in the data.

2.2.4. River Murray Digital Elevation Model (DEM)

The digital elevation model of the River Murray is a composite dataset produced by stitching together a series of 2m DEMS from over the floodplain (acquired through the Imagery Baseline Data Program, DWLBC, 2008). The DEM was used as an aid to attribute the Hydrology field and was used in a number of ways. It was used by draping a hillshade produced from the raw data over the top of imagery to create a 3D view of the landscape, by querying the raw data directly for the height of features, and in some cases by producing a profile graph across individual features to see the relative heights of channels and banks.

2.2.5. Soil Landscape Units

The Soil Landscape Units mapping (Soil and Land Program, 2009) contains information on soil types found in the agricultural regions of South Australia. The data is based on the interpretation of 1:40,000 stereo colour aerial photography and limited field inspections by soil scientists. Soil landscape boundaries were drawn onto 1:50,000 or 1:100,000 base maps and digitised or scanned into a spatial data layer in a GIS. The soil type information was used to interpret the Substrate field. Due to the scale of the mapping and the assumptions and interpretation used in the creation of the data, there was very little variation in soil type across the River Murray floodplain, and the majority of aquatic ecosystems were attributed with mineral - clay soil types.

2.2.6. Salinity Threat

Salinity threat raster data is an output from a project to model groundwater levels and salinity threat from land uses such as irrigated horticulture and native vegetation clearance (Floodplain Risk Methodology, Holland et al 2005). The data categorises the salinity threat into high, medium and low classes. This data was used to aid interpretation of the water source attribute, as an indication of unconfined groundwater being a possible water source for an Aquatic Ecosystem. The limitations of this data are that conditions may have changed since this data was captured.

2.2.7. Other data and information

Other sources of information were generally made available by SAMDB NRM Board, DWLBC and DEH staff.

- Various wetland Management Plans
- SAMDB NRM Wetlands Baseline Survey
- Permanent wetlands disconnected
- Wetlands with regulators
- Fish barriers (Leigh and Zampatti, 2005)
- DIWA classification of the River Murray wetlands
- Evaporation basins
- Watercourses
- Expert knowledge from wetland managers

2.3. Imagery sources

The primary imagery used in this project is the River Murray 2008, ortho-rectified infra-red imagery, it has 50cm pixels and the photography was taken in March 2008. Additional, ortho-rectified, colour and infrared aerial photography also with 50cm pixels, taken in 2005 was used to confirm some features.

2.4. SAAE Classification

The SAAE Classification is being developed by the Department of Water, Land and Biodiversity (DWLBC) in consultation with DEH, NRM board staff and others (Fee and Scholz 2009). This project is the first practical application of the classification. There have been some changes to the classification as a result of this project and it is possible that further refinements will occur in the future.

The classification system is split into three themes: wetlands, watercourses and estuaries. Only the wetland and watercourse themes are applicable to the study area. The themes have some shared, and some unique attributes. The attributes for each theme can be broadly grouped into landscape, hydrological and other.

Landscape attributes

Wetlands	Watercourses
Climate	Climate
Landscape setting	Landscape setting
Landform	Instream type
Size/scale	
Substrate	

Hydrological attributes

Wetlands	Watercourses
Hydrology	Hydrological connectivity
Water source	Water source
Water regime: Inflows	Water regime: Inflows
Water regime: Persistence	Water regime: Persistence
Salinity	Salinity

Other attributes

Wetlands	Watercourses
Vegetation presence	
Artificial	Regulated
Managed	

Twelve AE types have been identified for the River Murray corridor (Table 1). The classification for the types relevant to the River Murray (regional level) can be found in Appendix B, and Appendix C shows the full classification (at state level) of 28 SAAE wetland types as they stand in December 2009.

This application of the SAAE to a regional project (as distinct from a statewide approach) has highlighted that the identified state level types can be further broken down by whichever relevant attribute provides appropriate differentiation at the regional/local level. In this case, five state level types have been expanded to nine through inclusion of the hydrology attribute.

Table 1 Aquatic Ecosystem types identified in the River Murray corridor

Wetland Type	Code
Floodplain	FP
Permanent Lake – Terminal Branch	PLTB
Permanent Lake - Throughflow	PLTF
Permanent Swamp – Terminal Branch	PSTB
Permanent Swamp – Throughflow	PSTF
Saline Swamp	SSw
Temporary Wetland – Overbank Flow	TWOB
Temporary Wetland – Terminal Branch	TWTB
Temporary Wetland – Throughflow	TWTF
Watercourse Type	**Code**
Permanent Reach	PR
Seasonal Reach	SR
Ephemeral Reach	ER

2.5. Creation of the data entry tables

The classification of the aquatic ecosystems occurred in two separate, geodatabase data entry tables which are related to the wetlands polygons based on the AUSWETNR field. There are two data entry tables, one for wetlands and one for watercourses, due to the different attributes recorded for each theme. The data entry tables were set up in a binary fashion, with one column for each attribute, which was filled in with either a 0 or 1, depending on whether that attribute was applicable to the aquatic ecosystem. In the following example, (Table 2) the aquatic ecosystem has been classified as Macro in size.

Table 2 Example of the data entry tables

Mega	Macro	Meso	Micro	Lepto	Nano
0	1	0	0	0	0

2.6. Application of the SAAE Classification

Each aquatic ecosystem (polygon), was determined to be a 'wetland' or a 'watercourse' according to the following definition (sourced from Fee and Scholz, 2009).

> **Wetlands** are aquatic ecosystems that are not channelised flow through systems (i.e. watercourses) and do not occur at the interface between inland waters and marine waters (i.e. estuarine). An on-stream flow-through wetland is wider than the median width (+-10%) of the watercourse reaches at either end.
>
> **Watercourses** are channelised flow-through systems but do not occur at the interface between inland waters and marine waters (i.e. estuarine). Waterholes (<= +- 10% of watercourse reach median width) are deep pools or groundwater fed sections of watercourses where water persists beyond normal watercourses drying cycles.

Attributes were then entered into the data entry tables for each aquatic ecosystem (polygon). The following sections outline the intent of each attribute, how and what data was used and any apparent limitations.

2.6.1. Wetland attributes

Climate

Valid options: Desert, Grassland, Temperate.

Data Source: Koppen climate map (Jpeg).

Description: The climate attribute describes the Koppen climate class that the wetland falls within.

Method: By comparing the Koppen climate map with the location of the River Murray wetlands, it can be seen that all of the wetlands above Wellington fall in the category of Grassland.

Limitations: The Koppen climate mapping is very broad and provides no differentiation for the wetlands in the Murray corridor. This attribute is more relevant to state scale differentiation, however may play a role in classifying aquatic ecosystems of the Lower Lakes and Coorong region.

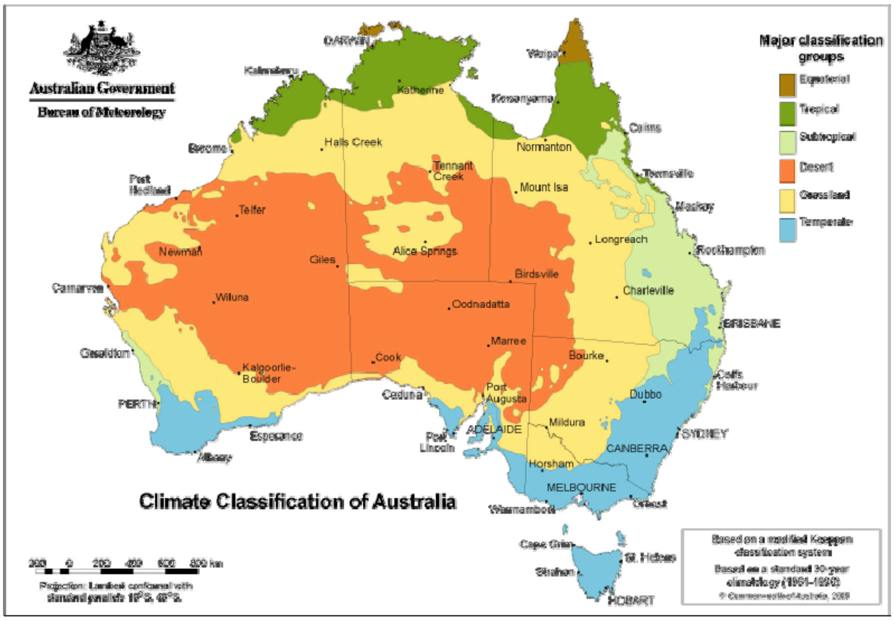


Figure 2 Koppen Climate Classification of Australia (Bureau of Meteorology, 2005)

Landscape setting

Valid options: Flat, Dune, Hills, Subterranean, Other.

Data Source: DEM.

Description: Landscape setting refers to the land surrounding the wetland, not the landform within the polygon extent.

Method: The whole of the floodplain is 'flat' and all polygons were attributed as such.

Limitations: This attribute is very broad, but appropriate for a landscape scale classification. It also provides no differentiation for the wetlands in the Murray corridor.

Example:

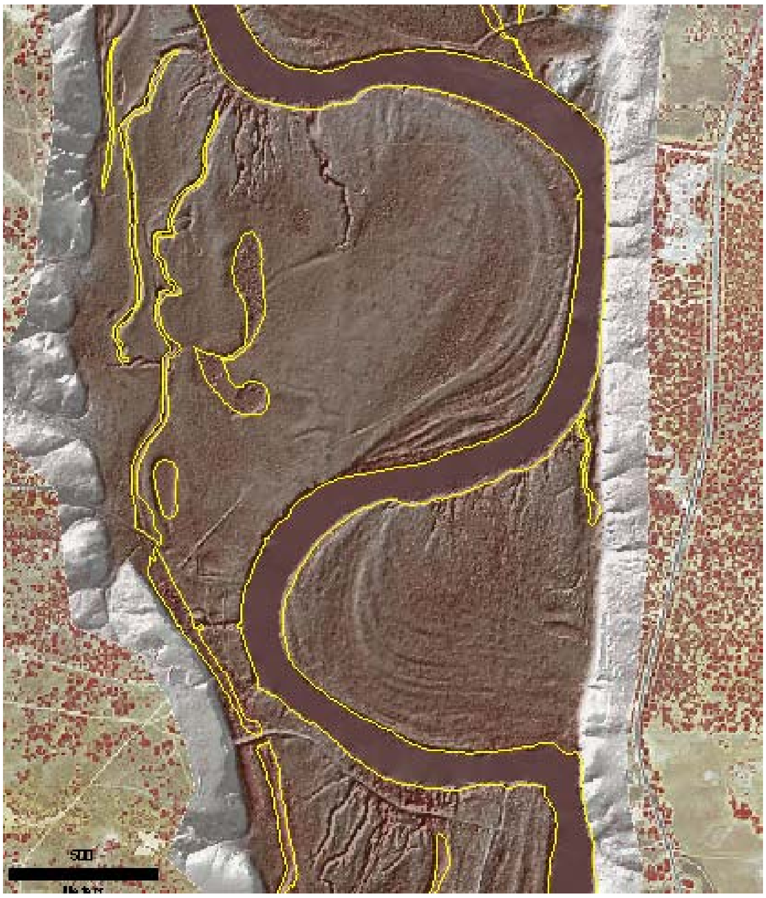


Figure 3 Example of a 'Flat' landscape setting outside polygons

Landform

Valid options: Basin, Flat, Subterranean, Mound, Other.

Description: The Landform attribute is used to describe the landform of the wetland itself (i.e. within the polygon extent).

Data Source: DEM.

Method: In general, the wetlands in the River Murray floodplain all form basins, except for the floodplain which is not mapped discretely. Some of the wetlands are very shallow, little more than a depression in the ground. 'Basin' was therefore assigned to every polygon as a default.

Limitations: The floodplain itself is not in the current wetlands mapping. This is an omission in the wetlands mapping.

Example:

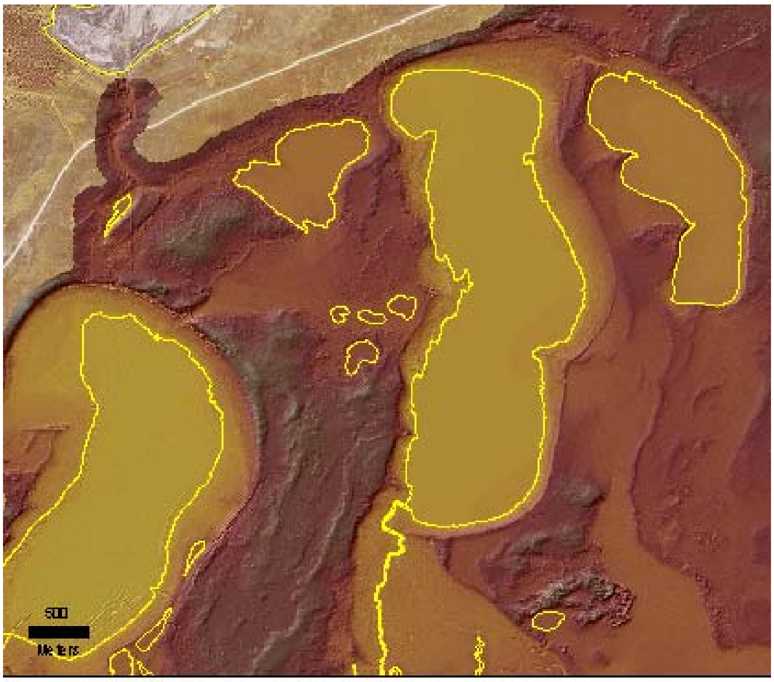


Figure 4 Example of the 'Basin' landform within polygons

Size and scale

Valid options: Mega, Macro, Meso, Micro, Lepto, Nano.

Description: The mapped extent (in hectares) of the wetland.

Data source: Wetland polygons.

Method: The size was calculated automatically using ArcMap tools.

Mega	=>10,000 ha
Macro	10,000 to 100 ha
Meso	100 to 25 ha
Micro	25 to 1 ha
Lepto	1 to 0.01 ha
Nano	=<0.01 ha

Limitations: The size of wetlands is a geomorphic driver of hydrological and ecological function along with water/basin depth, but while the size is easily calculated based on wetlands mapping, depth is difficult to measure remotely and there is not a comprehensive source of depth for wetlands in the River Murray floodplain.

Substrate

Valid options: Granite, Bedrock, Mineral Sand, Mineral Clay, Organic, Other.

Description: The substrate of the mapped extent of the wetland.

Data source: Soil Landscape Units mapping.

Method: Most of the wetlands within the floodplain are described in the Soil Landscape Units (SLU) mapping as overlying either 'Cracking clay soils', 'Wet soils' or 'Water' . A small number overlay 'Highly leached sands', 'Deep sands' or 'Calcareous soils'. The majority of polygons were attributed the value of Mineral Clay, with Mineral Sands added where appropriate.

Limitations: The scale of the mapping is very broad, but this does match the scale of the classification. Mapping only covers the agricultural regions, so excludes the Chowilla area. Extrapolation of the understanding gained in using the SLU mapping was applied to this area.

Example:

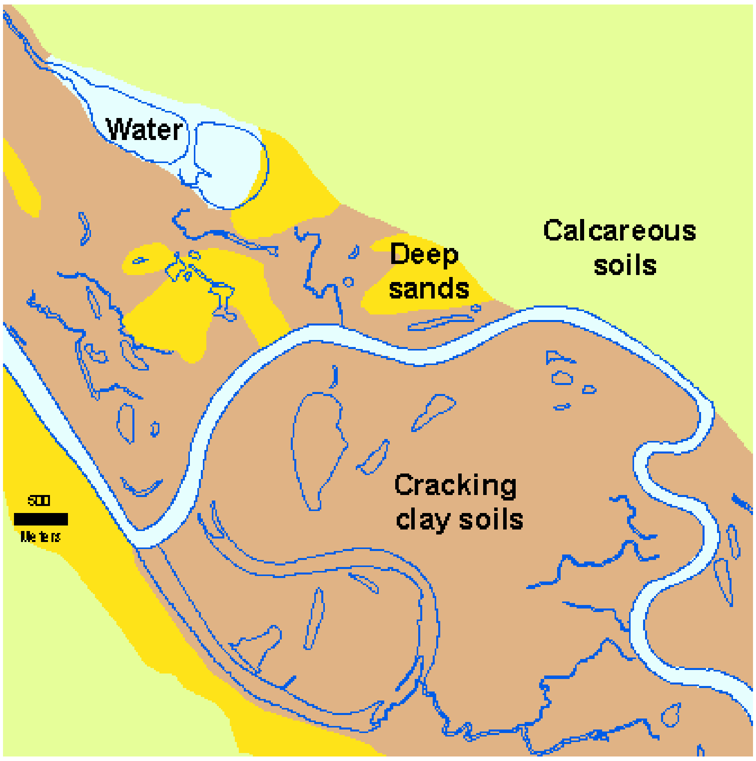


Figure 5 Example of the substrate (soil) mapping

Hydrology

Valid options: Throughflow, Overbank flow, Retained, Unconnected, Terminal Branch, End of System, Other.

Data Source: Aerial photography, Wetlands mapping, DEM, FIM.

Description: Hydrology refers to the hydrological connectedness of wetlands to other Aquatic Ecosystems.

Method: The shape of the wetland polygon, in addition to information from the DEM, is used to distinguish the hydrology.

Throughflow

Wetlands with more than one connection to watercourses from which water enters and exits.

For permanent wetlands, the permanent connections are counted and the non-permanent connections are ignored, and for seasonal or ephemeral wetlands all connections are counted. The presence in the imagery or DEM of a defined channel (or a watercourse in the watercourse data layer) is used to distinguish throughflow.

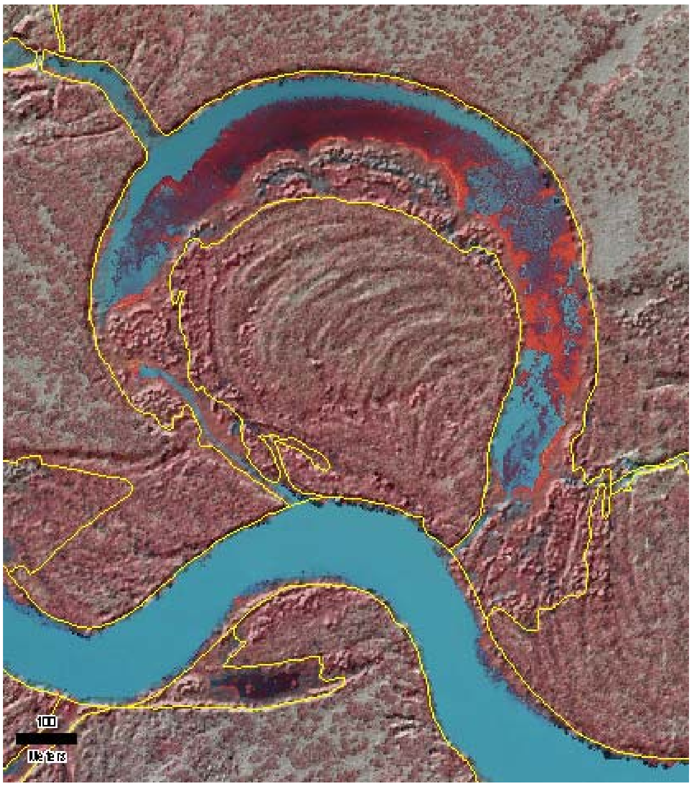


Figure 6 Example of throughflow

Overbank flow.

Primary water supply is from watercourse overbank flow. Water enters the wetland through spreading water over the banks during high flow levels. There is no defined channel, or the channel is poorly defined and requires a high commence to flow rate to fill.

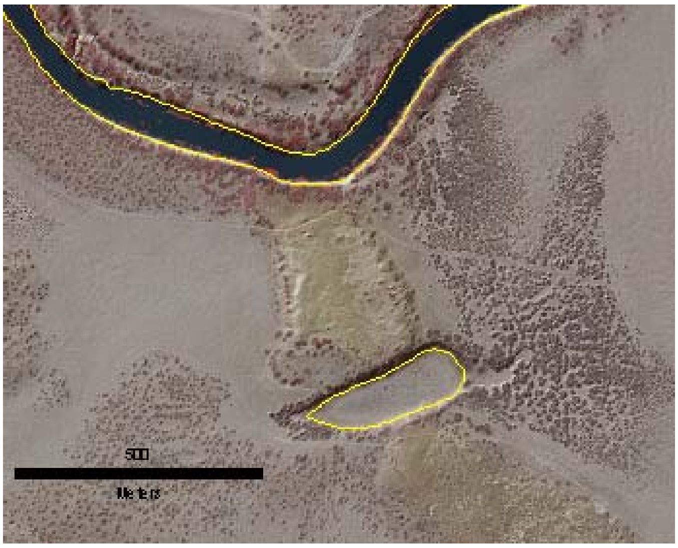


Figure 7 Example of overbank flow

Retained.

Either organic substrate or geomorphic properties (e.g. multiple branching of a watercourse) impedes flow so that residency time of water within the wetland exceeds that expected for unimpeded flow. Pooling of water alone is not considered retained. No examples.

Unconnected

There is no surface or subsurface hydrological connections to other Aquatic Ecosystems. No examples.

Terminal branch

Water enters from one point but does not exit at another point (i.e. one connection) but it is not the end of the system.

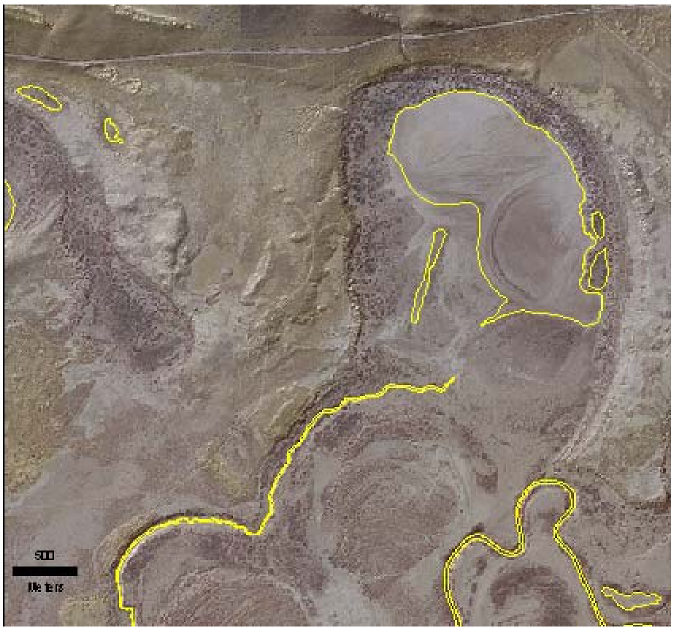


Figure 8 Example of a terminal branch

End of system

The final point in the path of a watercourse (E.g. Lake Eyre. Does not include dead-end side branches in the path of a watercourse that continues beyond the AE). No examples.

Limitations: The wetlands mapping is not complete, i.e. not all watercourses are mapped, so it is sometimes difficult to count connections. The polygon boundary may not fully represent the hydrology of the wetland, so multiple sources of information need to be viewed to get a clear idea of what is happening on the ground.

Water source

Valid options: Local runoff, Catchment fed, Unconfined groundwater, Artesian groundwater, Other.

Description: The origin of the primary water source for the Aquatic Ecosystem.

Data source: Salinity threat, Evaporation basins, Wetlands mapping, Watercourses.

Method:

Local runoff means that the wetland is predominantly filled from rainfall in the local area, (or when artificially modified it could be from salinity interception schemes). The watercourses data layer was used to define wetlands that received water from local runoff.

Surface water (or catchment fed) means that the wetland is filled from a river either at pool level or from flooding events. The wetlands mapping was used to define which wetlands received surface water. The majority of wetlands in the River Murray floodplain are catchment fed (SW).

Unconfined groundwater filled wetlands are significantly filled from groundwater that is close to the surface (and is not artesian or under pressure). The salinity threat layer was used to distinguish areas that have a high risk of groundwater located close to the surface. Wetlands with at least 50% of their area surrounded by a salinity threat rating of 1 or 2, had the water source recorded as GW (qroundwater) in addition to SW (catchment fed).

Artesian GW is groundwater from the artesian basin, and is only relevant to Artesian Springs.

Limitations: The definition of the water source attribute is the primary source of water for the aquatic ecosystem, but the method used describes all water sources, without showing the relative contribution of these water sources to the aquatic ecosystem.

Water Regime Inflows

Valid options: Permanent, Seasonal, Ephemeral.

Description: The frequency and constancy of water flowing into the Aquatic Ecosystem.

Permanent means that water constantly flows into the Aquatic Ecosystem (it is connected at pool level).

Seasonal means that water flows into the Aquatic Ecosystem at least, or more than, once a year.

Ephemeral means that water flows into the Aquatic Ecosystem less than once a year.

Data source: DIWA, Aerial photography.

Method:

- Imagery and the DIWA classification can be used to determine if inflows are permanent. If the imagery shows that the wetland has water in it, and is connected to the river at pool level, it is recorded as permanent. If the AE is being managed (with a structure such as a bank, stoplog or sluice gate) and is temporarily dry, but is otherwise able to be connected at pool level, it is still recorded as having permanent inflows. Managed wetlands are recorded in a separate field.
- Ephemeral wetlands are those that are dry on the imagery, or the DIWA classification records them as seasonal, episodic or temporary.

Limitations:

The 2008 imagery shows the landscape in an exceptionally dry period with weir pool levels below normal. Many large wetlands appear dry. The 2005 imagery shows many of the same wetlands 'wet' at pool level (and DIWA also records them this way). This particularly occurs between Lock 1 and Wellington. Given that the classification is about recording the normal or desirable situation, these wetlands are recorded as permanent if they are wet in the 2005 imagery and are identified by the term 'Pool level' in the comments field. This action has been taken because of the water level drop in this stretch of the River Murray due to continuing dry conditions and does not represent normal operating river levels.

Water Regime Persistence

Valid options: Permanent, Years, Annual.

Description: The persistence of water in the Aquatic Ecosystem after inundation.

Permanent means that water is always present in the Aquatic Ecosystem.

Years means that the water remains present in the AE for longer than one year but is not permanent.

Annual means that the water remains present in the AE for less than one year after inundation.

Data source: DIWA, Aerial photography.

Method: If the inflow is permanent, the persistence will be permanent too. It has been generalised that if the inflow is ephemeral it is unlikely to persist longer than one year.

Limitations: Attribution is based on generalisations.

Salinity

Valid options: Freshwater, Brackish, Saline.

Description: Salt concentration in the water of the Aquatic Ecosystem.

Freshwater	< 1,000 mg/L
Brackish	1,000 to 10,000 mg/L
Saline	> 10,000 mg/L

This item describes the broad salinity range of the wetland, and refers to the salinity of the wetland in the 'wet' phase, not after drawdown.

Data source: SA Vegetation, ASSRAP Report (Acid Sulfate Soils Risk Assessment Project Report (MDBA), Wetlands Baseline Survey (SKM).

Method:

- If the wetland is a permanent wetland, and surrounded by or supporting freshwater dependent vegetation (e.g. *Muehlenbeckia florulenta*, *Eucalyptus camaldulensis* forests, *Phragmites* or *Typha* grasslands) then the wetland is recorded as 'Fresh'.
- If there is halophytic vegetation present (e.g. *Sarcocornia* (Glasswort), *Dispyhma* (Pigface), *Tectocornia* (Samphire)) then the wetland is recorded as 'Brackish'.
- If the wetland has been used as an evaporation basin, or other data sources describe the salinity level in the wetland as >10,000mg/L, then it is recorded as 'Saline'.

Limitations: The salinity levels in wetlands in the River Murray system vary considerably over time. There is also not a lot of easily accessible water quality data to refer to for a desktop assessment, therefore the vegetation data was used as a surrogate. Sometimes the different sources of information gave conflicting results.

The ASSRAP data represented a sample at a single point-in-time which does not necessarily reflect the average salinity for the wetland over it's wet phase. Not all wetlands in the study area were sampled, and where the wetland was dry, water salinity was not able to be recorded. Where the wetland had shallow water, salinity readings were very high indicating that evapo-concentration had occurred. This data was therefore used with caution.

The baseline surveys also did not sample every wetland in the study area, but salinity recordings were taken across multiple dates, giving a better indication of the range of salinities that could occur at a wetland.

Vegetation Presence

Valid options: Vegetated, Unvegetated.

Description: Presence of native, amphibious (tolerates flooding and drying), emergent vegetation (i.e. Lignum, sedges, reeds).

Vegetated means than more than 10% of the inner, plan view extent of the wetland is covered by such vegetation.

Unvegetated means than less than 10% of the inner, plan view extent of the wetland is covered by such vegetation.

This item is used to distinguish between lakes with open, deep water and swamps with emergent, water dependant vegetation. It does not refer to fringing vegetation.

Data source: Aerial photography, Vegetation mapping.

Method: Visual interpretation from aerial photography and vegetation type information from vegetation mapping.

Limitations: The vegetation mapping may not define the vegetation adequately, e.g. the feature is too small to be present at the scale of the mapping.

Artificial modifiers

Valid options: Artificial

Description: The River Murray floodplain is a highly regulated and modified environment, but this item is specifically used to distinguish between natural, somewhat modified wetlands and significantly modified, artificial wetlands. Examples of artificial or artificially modified wetlands include marinas, Salt Interception Scheme evaporation basins and reservoirs.

Data source: Evaporation Basins, Aerial photography.

Method: The comments field is used to record the artificial modifier.

Managed Wetlands

Valid options: Managed

Description: A number of wetlands in the River Murray are hydrologically managed, through the use of banks and other structures. These structures can be used to temporarily disconnect permanently inundated wetlands for short or extended periods of time to allow them to dry out, or to initiate/extend periods of inundation for temporary wetlands.

Data source: Managed wetlands were identified by NRM board and DEH staff via lists of names. This was enhanced by indication of polygons associated with names directly within the mapping.

Method: Managed wetlands are identified and the comments field is used to provide more information. A list of managed wetlands is included in Appendix E.

2.6.2. Watercourse attributes

The Climate, Landscape setting, Water regime: inflows, Water regime: persistence and Salinity attributes are the same as the wetland attributes explained in section 2.6.1.

Instream type

Valid options: Watercourse, Waterhole, Spring, Anabranch.

Description: Channel type.

Data source: Aerial photography, DEM, Watercourse mapping.

Method: Watercourses as mapped by watercourse line mapping including the River Murray main channel, and DIWA types of B1- Permanent River Stream or B2 – Seasonal River Stream.

Waterholes occur where water persists beyond the average watercourse drying cycles, due to depth of pools or groundwater flow. Waterhole width is within the median width of the watercourse reaches at either end of the waterhole (+10%).

Springs (as they relate to watercourses) are either headwaters that immediately become channelised (i.e. no wetland formation) or feed waterholes.

An anabranch is a side branch of the main channel(s) of a watercourse. Anabranches may or may not reconnect to the main channel.

Example:

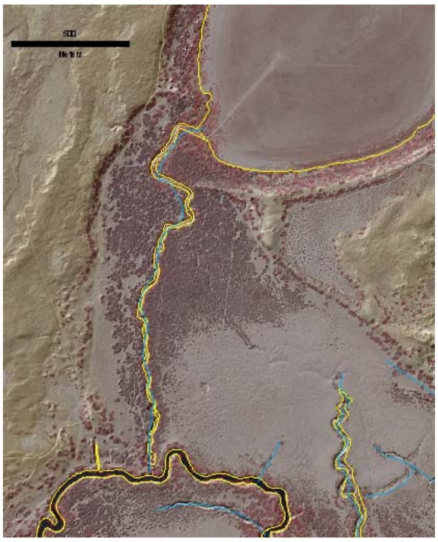


Figure 9 Example of a watercourse

Hydrological Connectivity

Valid options: Always connected, Sometimes connected.

Description: Refers to the hydrological connectedness to other AE's. Connectivity does not have to be with the same AE type, nor that all AE's of one type are connected. This relates to surfacewater and/or groundwater connectedness.

Always connected: There are always (>80% of the time) one or more surface or sub-surface hydrological connections to other AE's (not including marine connections for Estuarine AE's).

Sometimes connected: There are sometimes (<80% of the time) one or more surface or sub-surface hydrological connections to other AE's (not including marine connections for Estuarine AE's).

Data source: Aerial photography, DEM, Watercourse mapping

Method: Always connected watercourses are connected at pool level, so the polygons are physically very close and there is water in the aquatic ecosystem.

Limitations: Sometimes connected watercourses may not be mapped as physically close, and may require high flows before water enters the watercourse, or is mapped as being physically close but the watercourse is dry.

Water source

Valid options: Local runoff, Surface water and Groundwater

As for wetlands, except for Groundwater, which refers to any groundwater source.

Regulation

Valid options: Regulated, Unregulated.

Description: Regulation refers to watercourses where flow is managed through the use of structures such as weirs, stoplogs and sluice gates.

Data source: Fish Barriers, Wetlands with regulators, Permanent wetlands disconnected.

Method: Where a watercourse is managed through artificial structures, e.g. stoplogs, the watercourse is recorded as regulated, and the comments field is used to provide more information.

Limitations: Not all structures may be represented in the datasets used, and the spatial accuracy of the Fish Barriers dataset did not appear to be very high.

2.7. Classification of Wetland Type

An ArcMap model was created and used to assign the wetland type from the information recorded in the SAAE attributes, through a series of SQL statements. The SQL statements were drafted from the SAAE Classification and refined as gaps in the original classification were noted. The structure of the model allows the wetland types to be recalculated at any time, and any changes to the SAAE Classification can be incorporated into the SQL and used to update the wetland types. A summary of the SQL can be found in Appendix D. This matches the combinations outlined in the AE types of Appendix B

2.8. Impacts of incorporation of the SAAE classification into the Wetland Prioritisation project

The methodology for the Wetland Prioritisation project involved creating a data table of wetland records and populating the fields with relevant information from a range of sources. This was initially completed in 2008. An automated process was developed to calculate parameters from raw data scores and output frequency tables of AE type and conservation value. Alterations to account for rarity and representativeness of different AE types as outlined in 2.8.2 were performed manually, and then a second automated process used these values to calculate an initial set of priority classes.

This reclassification project has come along during the validation and review phase of the Wetlands Prioritisation (WP) project. The review identified three broad areas needing attention;

1) data/parameters
2) wetland type classification
3) removal of feasibility from method

This section outlines the impact this project has on that process and associated outputs.

2.8.1. Data/parameters

Some limitations of parameters in terms of both data collected and wording of criterion have been identified and are being scoped for revision in 2010 by the SAMDBNRM board. **These future changes will influence final outcomes of the WP project as a significant revisit of some data collection activity and/or modification to parameter definitions are on the table.** In the mean time, some of the more easily attainable data changes were implemented in order to provide improved outputs for the pressing needs of the Riverine Recovery project.

The WP outputs associated with this project include data/parameters as detailed in the WP documents (Butcher *et al,* 2007, Frankiewicz, 2008), plus:

1. Open water above Wellington was included as a structural layer. Wetlands classified as having permanent water (based on the DIWA class) and an EVC3 value of one or two (0-2 structural layers), had a structural layer added by amending the ECV3 value.
2. Where wetlands had a well vegetated littoral zone (TC5 = 1) and a single structural layer (EVC3 = 1) and the DIWA class was not one of the following; B4, B8, B10, B11 or B12), a structural layer was added by amending the EVC3 value. (i.e. allowing for habitat structure provided by littoral communities)
3. Wetlands classified as having permanent water (based on the DIWA class) were altered to ensure a habitat extent (ECV4) value of 3 (Wetlands with one or more structural layers covering >60% of the wetland area). This is to capture that open water as a habitat layer occupies the whole wetland.

Note: These interim data improvements may or may not be included in the 2010 work being scoped.

2.8.2. SAAE Classification

After the initial run of the WP method (Frankewicz, 2008), it was acknowledged that allocation of DIWA types needed revisiting and the arrival of this reclassification method was adopted as an appropriate review.

The SAAE is seen as an improvement over the DIWA typology as it focuses on differentiation of AE's by their ecological form and function (rather than some of the more arbitrary splits in DIWA such as greater or less than 8 hectares). The SAAE classes will therefore influence the WP outputs by redefining the list of 'types' and thus each type's rarity and representativeness. Section 3.1 details the new quantities of aquatic ecosystem types as allocated by this project.

Regarding rarity and representativeness, the original methodology defined these for DIWA classes in the whole study area. The revised methodology defines these by SAAE types for the geomorphic reaches. The methodology specifies that where there are less than 10% of wetland types (representativeness) within a geomorphic reach with an ecological value rank of 'high', then the best of lower ranked wetlands are promoted to 'high', based on ecological scores. Also, where there are less than ten examples of a wetland type (rarity) within a geomorphic reach, all of the wetlands are promoted to 'high' conservation value irrespective of ecological scores. There were forty instances of wetlands that were altered to increase their conservation value rank (detailed in Appendix G).

In a technical sense, this methodology was carried out by python scripts in ArcMap. The original script produced two frequency tables, one showing a frequency of DIWA classes for the study area, and the other categorising the DIWA classes by Conservation Rank for the study area. This script was altered to create the frequencies showing SAAE type by geomorphic reach, and SAAE type by Conservation Rank for each geomorphic reach. The results can be found in section 3.2.

2.8.3. Removal of feasibility from method

The original WP method considered three aspects of the AE in focus; ecological value, threatening processes and feasibility for remedial work. After discussion, it was decided by the steering committee that criterion captured for feasibility were not necessarily completely aligned with remedial potential of the threatening processes captured.

Feasibility was therefore suggested to be removed from the way the prioritisation was calculated. This means that the two main output products from the prioritisation method are now a conservation value (ecological value *plus* rarity and representativeness) and a threat value.

Now, instead of producing a protection rank and rehabilitation rank where the method attempted to inform the types of management any wetland may need, the WP method now uses the conservation value and threat ratings alone to assign a conservation-threat (CT) rank as the final priority. This in a sense removes the 'black-box' of combining ecological values, threats and feasibility via an automated approach based on parameters that may not necessarily have strong process linkages, and replaces it with two layers of information that can be applied together or separately to managing wetlands at site or regional scales.

Figure 10 shows how the CT ranks are arrived at when combining conservation value and threat ratings. **It should still be noted that keeping the two separate may be a better application when other parameters outside the WP method are to be considered in regional wetland management strategies.**

As there have been multiple changes to the methodology, any comparison of the original results from 2008 with the results of this project must be performed with due regard.

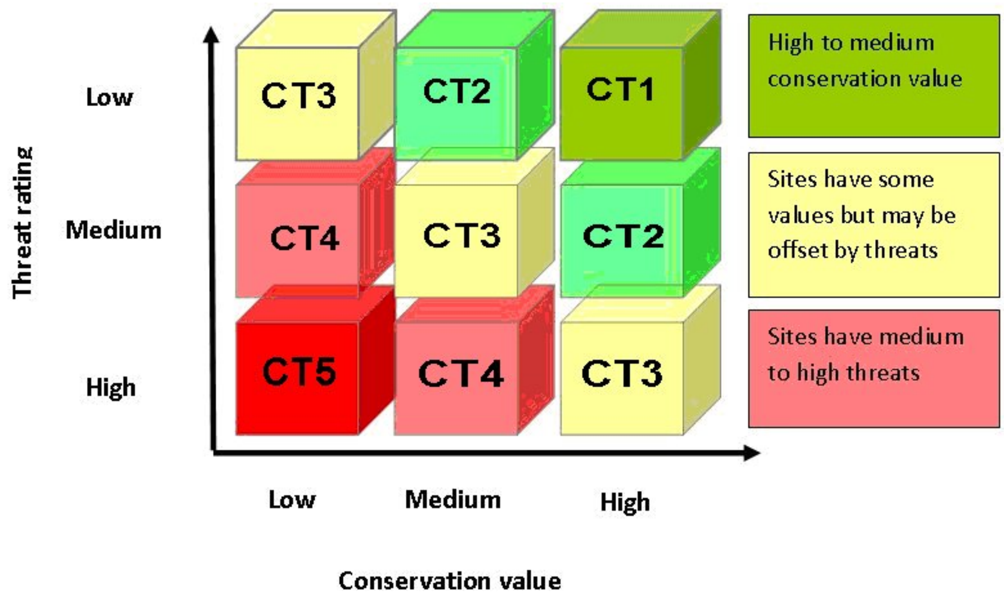


Figure 10 Conservation value versus threat rating matrix

3. Results

Outputs from this project come in three formats;

- A geodatabase of 1,428 aquatic ecosystem polygons with SAAE classification attached
- A table that relates to the 1,428 polygons using AUSWET_NR identifiers containing data, parameters, and CT rankings of WP project *as they currently stand subject to data limitations described in section 2.8*
- 3 series of maps (A3 size pdfs) showing wetlands coloured by SAAE types, conservation value and conservation threat ranks respectively

The following section provides some summary tables and statistics on the resulting SAAE types and priority rankings. The summary tables of SAAE types in fact describe a further breakdown using hydrology. The Permanent Lake and Permanent Swamp types have each been listed separately based on their hydrology (terminal banch and throughflow). The Temporary Wetlands have also been listed separately based on their hydrology (terminal branch, throughflow and overbank flow). This is further discussed in section 4.

3.1. Wetland type classification

1,428 aquatic ecosystem polygons were classified, including 294 watercourses and 1,134 wetlands. Table 3 summarises the wetland types by geomorphic reach. The geomorphic reaches have been used to divide the study area, with the view to ensuring that wetland types (representing the variety of ecosystem function) in sections of the River Murray that have different geomorphic characteristics have an equal chance of being considered in the prioritisation. There are three geomorphic reaches along the River Murray between the Border and Wellington: Border to Overland Corner, Overland

Corner to Mannum, and Mannum to Wellington. There are 63 artificial wetland polygons recorded, which included evaporation basins and marinas.

Table 3 Wetland types by geomorphic reach (including artificial wetlands in brackets)

Wetland Type	Border to Overland Corner	Overland Corner to Mannum	Mannum to Wellington	Total
Floodplain	1	1	0	2
Permanent Lake – Terminal Branch	27	43 (2)	6 (3)	76
Permanent Lake - Throughflow	22 (1)	56 (1)	4 (1)	82
Permanent Swamp – Terminal Branch	51	12	3	66
Permanent Swamp - Throughflow	29	19	13	61
Saline Swamp	33 (28)	4 (2)	4 (1)	41
Temporary Wetland – Overbank Flow	210 (7)	122	24 (1)	356
Temporary Wetland – Terminal Branch	118 (8)	78	11(5)	207
Temporary Wetland – Throughflow	111 (2)	127 (1)	5	243
Permanent Reach	92	40	1	133
Seasonal Reach	8	0	0	8
Ephemeral Reach	119	33	1	153
Total	821 (46)	535 (6)	72 (11)	**1,428 (63)**

Table 4 summarises the Directory of Important Wetlands (DIWA) types by geomorphic reach. It should be noted that there are a number of aquatic ecosystem polygons that have been assigned a wetland type that do not have a DIWA type. This is due to the edits to the polygon layer that occurred after the DIWA types were attributed, which resulted in the addition and deletion of a number of polygons from the wetlands dataset.

Table 4 DIWA types by geomorphic reach

DIWA Type	Border to Overland Corner	Overland Corner to Mannum	Mannum to Wellington	Total
B1 – Perm Riv Stream	85	37		122
B2 – Seas Riv Stream	112	33	1	147
B3 – Inland Delta			2	2
B4 – Floodplain, Riv Basins, Seas Flood Grassland, Savanna	40	29	1	70
B5 – Perm Freshwater Lake > 8ha	10	14		24
B6 – Seas Freshwater Lake > 8ha	8	13		21
B7 – Perm Saline/Brackish Lake	2			2
B8 – Seas – Intermittent/Saline Lake	17	2		19
B9 – Perm Freshwater Pond <8 ha, Marshes/Swamps with emergent Veg	118	105	21	244
B10 – Seas Freshwater ponds and Marshes, Sloughs, Potholes	197	171	22	390
B11 – Perm Saline/Brackish Marshes		5	3	8
B12 – Seasonal Saline Marshes	209	121	13	343
C1 – Water storage areas, Resv, Barrage, gen <8 ha			1	1
C2 – Farm ponds, Stock ponds, Small Tanks		2	3	5
C6 – Sewage Farms, Settling Ponds, Oxidation Basins	1			1
C7 – Irrigated land, Rice Fields, Canals, Ditches	1		1	2
(blank)	21	3	4	28
Total	**821**	**535**	**72**	**1,428**

*Note. Blank = new geometry not assigned to DIWA

3.2. Wetland Prioritisation

The wetland prioritisation scripts were run on the 26th November and the results are summarised in Tables 5 to 9. For the Border to Overland Corner reach, Table 5 summarises wetland types falling into high, medium and low conservation values. Table 6 and Table 7 summarise the data for the Overland Corner to Mannum and Mannum to Wellington reaches, respectively.

Table 5 Wetland type by Conservation Value - Border to Overland Corner

	CV RANK			
Wetland type	**High**	**Medium**	**Low**	**Total**
Floodplain	1			1
Permanent Lake – Terminal Branch	12	13		25
Permanent Lake – Throughflow	16	4	1	21
Permanent Swamp – Terminal Branch	22	29		51
Permanent Swamp – Throughflow	17	12		29
Saline Swamp	6	24	1	31
Temporary Wetland – Overbank Flow	25	153	30	208
Temporary wetland – Terminal Branch	16	86	12	114
Temporary Wetland – Throughflow	15	75	19	109
Ephemeral Reach	20	82	10	112
Seasonal Reach	8			8
Permanent Reach	58	31		89
n/a				23
Total	**216**	**509**	**73**	**821**

#n/a = data not collected in first pass of WPP (see section 2.8.1)

Table 6 Wetland type by Conservation Value - Overland Corner to Mannum

	CV RANK			
Wetland type	**High**	**Medium**	**Low**	**Total**
Floodplain	1			1
Permanent Lake – Terminal Branch	18	25		43
Permanent Lake – Throughflow	25	30	1	56
Permanent Swamp – Terminal Branch	2	9	1	12
Permanent Swamp – Throughflow	11	8		19
Saline Swamp	4			4
Temporary Wetland – Overbank Flow	13	100	7	120
Temporary wetland – Terminal Branch	9	59	10	78
Temporary Wetland – Throughflow	13	88	26	127
Ephemeral Reach	5	22	6	33
Permanent Reach	20	19		39
n/a				3
Total	**121**	**360**	**51**	**535**

#n/a = data not collected in first pass of WPP (see section 2.8.1)

Table 7 Wetland type by Conservation Value - Mannum to Wellington

	CV RANK			
Wetland type	**High**	**Medium**	**Low**	**Total**
Permanent Lake – Terminal Branch	6			6
Permanent Lake – Throughflow	3			3
Permanent Swamp – Terminal Branch	3			3
Permanent Swamp – Throughflow	2	10		12
Saline Swamp	4			4
Temporary Wetland – Overbank Flow	3	19	2	24
Temporary wetland – Terminal Branch	9			9
Temporary Wetland – Throughflow	5			5
Ephemeral Reach	1			1
Permanent Reach	1			1
n/a				4
Total	**37**	**29**	**2**	**72**

#n/a = data not collected in first pass of WPP (see section 2.8.1)

Table 8 summarises the conservation value of wetlands within each geomorphic reach, while Table 9 summarises conservation-threat rank by geomorphic reach.

Table 8 Conservation value by geomorphic reach (Managed wetlands in brackets)

Conservation value	Border to Overland Corner	Overland Corner to Mannum	Mannum to Wellington	Total wetlands	% of the total classified wetlands	Total Area (km^2)
High	216 (10)	121 (6)	37	374	26	1,004
Medium	509 (12)	360 (5)	29	898	63	773
Low	73	51 (2)	2	126	9	39
n/a	23	3	4	30	2	-
Total	**821**	**535**	**72**	**1,428**		**1,816**

#n/a = data not collected in first pass of WPP (see section 2.8.1)

Table 9 Conservation-threat Rank by geomorphic reach (Managed wetlands in brackets)

Conservation-threat Rank	Border to Overland Corner Reach	Overland Corner to Mannum Reach	Mannum to Wellington Reach	Total wetlands	% of the total classified wetlands	Total Area (km^2)
CT1	93	26 (1)	10 (3)	129	9	195
CT2	244	124 (4)	30 (8)	398	28	716
CT3	334	274 (6)	25 (11)	633	44	802
CT4	112	90 (2)	1	203	14	98
CT5	15	18	2	35	2	6
n/a	23	3	4	30	2	-
Total	**821**	**535**	**72**	**1,428**		**1,816**

#n/a = data not collected in first pass of WPP (see section 2.8.1)

The results show that 9% of aquatic ecosystems were in the CT1 rank, meaning that they have a high conservation value and low threat ranking, with 72% of these aquatic ecosystems occurring in the Border to Overland Corner Reach. Appendix F lists the aquatic ecosystems with a conservation-threat ranking of CT1. There are 129 aquatic ecosystems with a conservation-threat rank of CT1 and only 46 aquatic ecosystems ranked as high priority for protection (P1) in the original Wetlands Prioritisation project (8ewicz, 2009). All of the aquatic ecosystems ranked as P1 in the original list were also ranked CT1 in the current iteration.

The revised methodology has tripled the number of aquatic ecosystems categorised with a high conservation value and low threats in the Border to Wellington reaches. This is most likely to be due to the changes to the input data, described in section 2.8.1. These changes had the result of increasing the ecological values of a number of aquatic ecosystems used to calculate the final ecological score. There was an additional 83 aquatic ecosystems with a conservation value of 'high' and threat value of 'low' in the 2009 iteration of the WPP as compared to the 2008 version.

The changes to the dataset based on the rarity and representation of aquatic ecosystem types by geomorphic reach (as compared to DIWA types for the study area) did not affect the final outputs much. Only seventeen additional aquatic ecosystems had their conservation value increased to 'high' in the Border to Wellington reaches, as compared to the 2008 version.

While the changes to the matrix (Figure 10) generally altered the way that the final priorities were calculated and labelled, the conservation-threat rank CT1 was still calculated in the same way as the original high priority for protection (P1). The dropping of the feasibility component did not affect this particular value.

Table 10 compares the numbers of each DIWA class that was attributed with each SAAE type. This table shows that there is not a direct correlation between the two different classification systems. Some DIWA classes have a clear link to a specific wetland type such as B1- Permanent River Streams and Permanent Watercourse Reach, whereas other DIWA classes such as B9 - Permanent freshwater ponds (< 8 ha) is almost equally divided between Permanent Lake and Permanent Swamp. In most cases, even where there is a clear tendency for a DIWA class to match up with a wetland type, there are usually a few outliers that fall in a completely different type. This may be due either to the original DIWA classification being misattributed, the SAAE type being misattributed, or to the differences in the classification schemes.

Table 10 Comparison of DIWA and SAAE classes

DIWA	ER	FP	PL	PS	PR	SSw	SR	TW	TOTAL
B1	4				117	1			**122**
B2	127				8	1	7	3	**146**
B3			1					1	**2**
B4						2		68	**70**
B5	1		21	2					**24**
B6			5			3		13	**21**
B7						2			**2**
B8						3		15	**18**
B9			108	116	3	1		16	**244**
B10	4		10	8		7		360	**389**
B11			3			3		2	**8**
B12	10	2	1			15		315	**343**
C1						1			**1**
C2			5						**5**
C6								1	**1**
C7					1		1		**2**
(blank)	7		4	1	4	2		12	**30**
Total	**154**	**2**	**158**	**127**	**133**	**41**	**8**	**806**	**1,428**

B1. Permanent rivers and streams

96% of the AE's in this DIWA class were attributed with the SAAE class Permanent Reach.

B2. Seasonal and irregular rivers and streams

87% of the AE's in this DIWA class were attributed with the SAAE class Ephemeral Reach. 5% were attributed as Permanent Reaches and 5% as Seasonal Reaches.

B3. Inland deltas

Of the two aquatic ecosystems recorded with this DIWA type, one was attributed with the SAAE class Permanent Lake and the other as a Temporary Wetland.

B4. Riverine Floodplains; includes river flats, flooded river basins, seasonally flooded grassland, savanna and palm savanna

97% of the AE's in this DIWA class were attributed with the SAAE class Temporary Wetland.

B5. Permanent freshwater lakes (> 8 ha) includes large oxbow lakes

86% of the AE's in this DIWA class were attributed as SAAE class Permanent Lake.

B6. Seasonal/intermittent freshwater lakes (> 8 ha), floodplain lakes

62% of the AE's in this DIWA class were attributed as SAAE class Temporary Wetland, with 24% attributed as Permanent Lake and 14% as Saline Swamp.

B7. Permanent saline / brackish lake

Two records (100%) of this DIWA class were attributed with the SAAE class Saline Swamp.

B8. Seasonal / intermittent saline lake

83% of the AE's in this DIWA class were attributed with the SAAE class Temporary Wetland and 3 records (17%) were attributed as Saline swamp.

B9. Permanent freshwater ponds (< 8 ha)

44% of the AE's in this DIWA class were attributed with the SAAE class Permanent Lake, 48% as Permanent Swamp, 7% as Temporary Wetland. A small number of records were also attributed as Permanent Reach and Saline Swamp.

B10. Seasonal / intermittent freshwater ponds and marshes

93% of the AE's in this DIWA class were attributed with the SAAE class Temporary Wetland, 4% as Permanent Lake, 3% as Permanent Swamp and 3% as Saline Swamp.

B11. Permanent saline / brackish marshes

37.5% of the AE's in this DIWA class were attributed with the SAAE class Saline Swamp, 37.5% as Permanent Lake and 25% as Temporary Wetland.

B12. Seasonal saline marshes

92% of the AE's in this DIWA class were attributed with the SAAE class Temporary Wetland,

4% as Saline Swamp and 3% as Ephemeral Reach.

C1. Water storage areas, reservoirs, barrages, generally > 8 ha

There was one record in this DIWA class, and it was attributed as a Saline Swamp.

C2. Farm ponds, stock ponds and small tanks

There were 5 records in this DIWA class, all attributed as Permanent Lakes.

C6. Sewage farms, settling ponds, oxidation basins

There was one record in this DIWA class, and it was attributed as a Temporary Wetland.

C7. Irrigated Land, rice fields, canals, ditches

There were two records, one was attributed with Permanent Reach, the other as a Seasonal Reach.

4. Discussion

The following section discusses the main issues associated with limitations or results of the project – in no particular order:

The SAAE typology has been shown to be effective in this region of South Australia. In addition, this project has identified that further breakdowns of some types is relevant to distinguish finer variation at a more local scale. For example, with so many temporary wetlands, providing summaries that differentiate by hydrology provides greater detail on extant ecosystem function and habitat distribution.

The low number of Floodplain wetland types is due to the floodplain itself not being included in the wetland mapping. This definition is one being reviewed by this and other projects as mentioned in section 2.2.

The Permanent Swamp type was added to the SAAE classification to differentiate between permanent wetlands with emergent aquatic vegetation, and permanent wetlands without vegetation. This differentiation is more about the depth of the wetland, with deep permanent wetlands functioning differently to shallow permanent wetlands, but depth is not an easy attribute to apply in this area given the lack of bathymetry data available. Vegetation has therefore been used as a surrogate for depth, with deep wetlands assumed to be less likely to support emergent aquatic vegetation.

The Saline Swamp aquatic ecosystems generally reflect areas used as evaporation basins.

Salinity was difficult to attribute given the lack of consistently available data. This attribute could also benefit from a more explicit definition. It is defined as the salt concentration in the water of the aquatic ecosystem, and has been applied with the broad salinity ranges of the wetland in the 'wet' phase, not after drawdown. A comprehensive dataset of salinity was not available, and in any case, salinity varies over time as well as within some aquatic ecosystems. Point data of salinity readings were used with caution due to the spatial and point-in-time constraints of the data. Surrogates for salinity were found in the vegetation mapping, but this is less likely to be accurate for larger polygons. Changes to the classification saw the fresh and brackish salinity ranges grouped together with only the Saline Swamp type using a single salinity range as a defining feature.

The terms Artificial, Regulated and Managed wetlands may need to be revisited to see if their use is appropriate. Artificial wetlands have been recorded as those wetlands which have been significantly altered from their natural state in terms of their hydrology, morphology or water source and include marinas and evaporation basins. Managed wetlands have been recorded as those whose water regime has been manipulated through water control structures holding back water either from entering or exiting the wetland, in order to extend a period of inundation or temporarily dry out a permanently inundated wetland. Regulated watercourses have been recorded as those watercourses that contain a water control structure.

The DIWA and SAAE wetland types are not sufficiently similar to each other to be directly comparable.

Twenty-four aquatic ecosystems have been added to the original wetland mapping and attributed with a wetland type, but because they were not in the original dataset for the Wetlands Prioritisation project, and do not have ecological attributes collected for them, they have not received a conservation-threat rank. This will be addressed through the revised WP being scoped as mentioned in section 2.8.1

The Lower Lakes and Tributaries geomorphic reach is not included in the prioritisation process as the SAAE wetland type has not been assigned to these wetlands. This is a work in progress being negotiated by the SAMDB NRM Board and Coorong, Lower Lakes and Murray Mouth Murray Futures program. In the first instance, due to drastic changes in that ecosystems hydrology and its management, a revision of wetland geometry is required.

5. Recommendations

1) The wetlands mapping requires completing through inclusion of floodplain identifiers. This is a key data layer that is now quite well advanced but could be improved over time to ensure that it robustly supports management of the floodplain. For completeness and in the context of South Australian aquatic ecosystem mapping – this makes sense. It would also allow a standard way of defining and naming floodplains as areas of potential or active management. The development of the Management Action Database provides an ideal vehicle for defining and managing this key data layer into the future.

2) In terms of species observation and hydrologic monitoring records, comprehensive data management for long term storage and access should be high on the agenda for Murray Futures. This must consider existing SA Government data stores, complex requirements of data curation into the future such as taxonomy and statutory requirements for data sharing and supply to commonwealth agencies. In the first instance this should include provision of funds to collate existing data (such as baseline surveys) one time only, such that future applications and research draws on a consolidated database of consistent data standards.

3) A discussion of whether the wetland types identified represent the full range of wetland types in the River Murray corridor would validate the findings of this project. In addition, a task could be funded to verify the SAAE types with known biological and survey data.

4) Maintain a list of AUSWET_NR's of managed wetlands. This process highlighted that while a managed 'site' may be known by a certain name, the full complement of 'polygons' associated with environmental water delivery can be comprehensively described and mapped using AUSWET_NR identifiers.

5) The SAAE and WP methods should be pursued in the Lower Lakes and Tributaries geomorphic reach, as well as for floodplains when they have been adequately mapped. The WP method should still yield sensible results in these areas with respect to conservation values. Threat rankings may need further scrutiny to ensure appropriate processes for the AE types are considered.

6) For rareness and representativeness, the artificial wetlands should be excluded from the conservation threat outputs, as some have been assigned a conservation-threat ranking of CT1.

7) Use of this project's WP outputs should be propagated to other projects with care and in due consideration with the final implementation of data improvements discussed in section 2.8 (as well as data entry recommended in 2 above).

6. Conclusion

This project has demonstrated that the South Australian Aquatic Ecosystem Classification can be applied to aquatic ecosystems in the River Murray, and has resulted in twelve different wetland types being identified. This includes five (state level) wetland types which were further divided into nine sub-classes, and three watercourse types. The division into sub-classes demonstrates that the SAAE Classification can be augmented at the regional scale by including other relevant attributes of differentiation.

The revised methodology of the Wetlands Prioritisation project has increased (tripled) the number of aquatic ecosystems with a high conservation value and low threats This is most likely due to the changes to the input data resulting from the (interim) alterations to the methodology, as discussed in section 3.2. All of the aquatic ecosystems on the original list of wetlands ranked as high priority for protection also occur on the current list of aquatic ecosystems with a conservation-threat rank of CT1 (high conservation value and low threat).

While this review of AE classes has successfully recast understanding of ecosystem function throughout the floodplain from the DIWA view, it is issues of data collection and parameter definition that still require resolution for final outputs of the Wetland Prioritisation methodology to take hold. The WP project commenced with a slightly different focus on what it was informing – altered governance and funding models of river management have added new aspects to the use of its outcomes. Dropping the feasibility part has ensured the focus returns to the distinct outputs of conservation value and threats, while acknowledging usefulness of their combination as well.

Data management, of both recent historical baselines and current/future monitoring is critical to our ability to rerun this method and incrementally improve our understanding and prioritisation of aquatic ecosystem management through delivery of environmental water. Opportunities exist to draw on current developments of integrated information systems such as the Management Action database but smart money will need to be spent on properly collating data we already have to ensure this (and other) methods are fed by the best available source data, now and in the future.

7. References

Bureau of Meteorology, 2005, *Climate Classification of Australia*, Australian Government.

Butcher, R., Hale, J., and Cottingham, P. 2007. South Australian River Murray wetland prioritisation. Report prepared for SA MDB NRM Board.

Fee, B., and Scholz. G., 2009, *South Australian Aquatic Ecosystems Program: Stage 2 Report,* Incomplete DWLBC Report, Government of South Australia, through Department of Water, Land and Biodiversity Conservation, Adelaide

Frankiewicz, D., 2008 (Draft). Application of the South Australian River Murray Wetland Prioritisation Methodology. Department for Environment and Heritage, Adelaide.

Holland, K., Overton, I., Miles, M., Vears, L., Walker, G., 2005, *The Floodplain Risk Methodology (FRM)*. Report to the River Murray Catchment Water Management Board, CSIRO Land and Water Technical Report 27/05. December 2005.

Leigh, S., and Zampatti, B. (2005) A Preliminary prioritization of barriers to fish passage within anabranch and off-channel habitats along the River Murray SA. Report prepared for the Department of Water, Land and Biodiversity Conservation. South Australian Research and Development Institute (Aquatic Sciences), Adelaide.

Overton, I.C., McEwan, K., Gabrovsek, C. and Sherrah, J. (2006). *The River Murray Floodplain Inundation Model (RiM-FIM)*. CSIRO Water for a Healthy Country Technical Report, Adelaide. pp. 127

Soil and Land Program (2009). Landscapes and soils of southern South Australia – spatial data and land resource information. [DVD ROM]. Department of Water Land and Biodiversity Conservation, South Australia.

8. Appendices

8.1. Appendix A: Metadata

Spatial layer	scale / source	Capture Dates	Custodian
River Murray Wetlands	1:10,000	1992-2001	DEH – Information, Science and Technology
South Australian Vegetation Mapping	Variable	2000-2008	DEH – Information, Science and Technology
Salinity Threat	30m pixels from groundwater model outputs	2006	DEH – Information, Science and Technology
Flood Inundation Model (FIM)	30m	2006	CSIRO Land and Water
Permanent wetlands disconnected	n/a	2007	SA MDB Board
Wetlands with regulators	n/a	2007	SA MDB Board
Fish Barriers	n/a	1998 2005	Wetlands Care Australia SARDI (Leigh and Zampatti)
River Murray Digital Elevation Model	2 m	2003-2008	DWLBC
2008 Infra-red River Murray imagery	0.5 m	March 2008	DEH – Information, Science and Technology
River Murray Imagery	0.5 m	2005	DEH – Information, Science and Technology

8.2. Appendix B: SAMDB relevant Aquatic Ecosystems Classification Version 7

Riverine Recovery Project

		AE CLASSIFICATION ATTRIBUTES										
			Landscape setting				Hydrogeological setting					Other
Wetland type (INLAND & NOT instream)	**Abbreviation**	**Climate* (Koppen)**	**Landscape setting**	**Landform**	**Size / scale**	**Substrate**	**Hydrology**	**Water source**	**Water regime: Inflows**	**Water regime: Persistance**	**Salinity**	**Vegetation presence**
		D ≡ Desert; G ≡ Grassland; T ≡ Temperate	Fl ≡ Flat; Dun ≡ Dunal; Hill ≡ Hills; Sub ≡ Subterranean Other	B ≡ Basin; Fl ≡ Flat; Sub ≡ Subterranean M ≡ Mound Other	Mega ≡ >10,000 ha; Macro ≡ 100 ha - 10,000 ha; Meso ≡ 25 ha - 100 ha; Micro ≡ 1 ha - 25 ha; Lepto ≡ 0.01ha - 1 ha Nano ≡ < 0.01ha	Gr ≡ Granite; Bed ≡ Bedrock (not specifically granite) M-S ≡ Mineral-Sand; M-C ≡ Mineral Clay; Other	Thru ≡ Through flow; Over ≡ Overbank flow; Ret ≡ Retained; Unconn ≡ Unconnected Term ≡ Terminal branch EoS ≡ End of system Other	LR ≡ Local runoff SW ≡ Catchment fed; GW ≡ Unconfined groundwater; Art ≡ Artesian GW Other	P ≡ Permanent; S ≡ Seasonal (≥ 1:1); E ≡ Ephemeral (<1:1)	P ≡ Permanent; Y ≡ Years (> 1 yr / not perm) A ≡ Annual (≤ 1 yr)	Fresh ≡ Freshwater (< 1,000 mg/L); Brack ≡ Brackish (1,000 - 10,000 mg/L); Sal ≡ Saline - hypersaline (> 10,000 mg/L);	Veg ≡ Vegetated; Unveg ≡ Unvegetated
Permanent lake - Terminal Branch	**PLTB**	T / G	Hill / Fl	B	Macro / Meso / Micro / Lepto	[Bed/M-S/M-C]	Term	[LR/SW/GW]	P	P	Fresh / Brack	Unveg
Permanent lake - Throughflow	**PLTF**	T / G	Hill / Fl	B	Macro / Meso / Micro / Lepto	[Bed/M-S/M-C]	Thru	[LR/SW/GW]	P	P	Fresh / Brack	Unveg
Permanent swamp - Terminal Branch	**PSTB**	T / G	Hill / Fl	B	Macro / Meso / Micro / Lepto	[Bed/M-S/M-C]	Term	[LR/SW/GW]	P	P	Fresh / Brack	Veg
Permanent swamp - Throughflow	**PSTF**	T / G	Hill / Fl	B	Macro / Meso / Micro / Lepto	[Bed/M-S/M-C]	Thru	SW	P	P	Fresh / Brack	Veg
Floodplain	**FP**	D / G / T	Fl	Fl	Macro / Meso / Micro / Lepto	[M-S/M-C]	Over	SW	S / E	A	All	Unveg
Saline Swamp	**SSw**	G / T	Fl	Fl / B	Macro / Meso / Micro / Lepto	M-S / M-C	Ret / Term / Over / Thru	[LR/GW]	All	All	Saline / Hyper	Unveg
Temporary wetlands - Overbank Flow	**TWOB**	G / T	Fl	B	Mega / Macro / Meso / Micro / Lepto	[M-S/M-C]	Over	[LR/SW]	S / E	A	Fresh / Brack	Veg / Unveg
Temporary wetlands - Terminal Branch	**TWTB**	G / T	Fl	B	Mega / Macro / Meso / Micro / Lepto	[M-S/M-C]	Term	[LR/SW]	S / E	A	Fresh / Brack	Veg / Unveg
Temporary wetlands - Throughflow	**TWTF**	G / T	Fl	B	Mega / Macro / Meso / Micro / Lepto	[M-S/M-C]	Thru	[LR/SW]	S / E	A	Fresh / Brack	Veg / Unveg

Watercourse type (INSTREAM)	**Abbreviation**	**Climate* (Koppen)**	**Landscape setting**	**Instream type**	**Hydrological connectivity**	**Water source**	**Water regime: Inflows**	**Water regime: Persistance**	**Salinity**
		D ≡ Desert; G ≡ Grassland; T ≡ Temperate	Hill ≡ Hills; Sl ≡ Slope; Fl ≡ Flat	WC ≡ Watercourse; WH ≡ Waterhole; Sp ≡ Spring; Anab ≡ Anabranch	Conn ≡ Always connected; Semi ≡ Sometimes connected	LR ≡ Local runoff SW ≡ Catchment fed; GW ≡ Groundwater	P ≡ Permanent; I ≡ Intermittent (≥ 1:1); E ≡ Ephemeral (<1:1)	P ≡ Permanent; M ≡ Mid-term (> 1 yr / not perm); A ≡ Annual (≤ 1 yr)	Fresh ≡ Freshwater; Brack ≡ Brackish Saline ≡ Saline;
Permanent reach	**PR**	G / T	Sl / Fl	[WC/Anab/Sp]	Conn	[All]	P	P	Fresh / Brack
Seasonal reach	**SR**	G / T	All	[WC/Anab/Sp]	Semi	[All]	I	A	All
Ephemeral reach	**ER**	D / G	All	[WC/Anab]	Semi	SW	E	A	All

8.3. Appendix C: South Australian Aquatic Ecosystems Classification Version 7

Riverine Recovery Project

	Wetland type (INLAND & NOT instream)	Abbreviation	Climate* (Koppen)	Landscape setting	Landform	Size / scale	Substrate	Hydrology	Water source	Water regime: Inflows	Water regime: Persistance	Salinity	Vegetation presence
			AE CLASSIFICATION ATTRIBUTES: Landscape setting					Hydrogeological setting					Other
			D ≡ Desert; **G** ≡ Grassland; **T** ≡ Temperate	**Fl** ≡ Flat; **Dun** ≡ Dunal; **Hill** ≡ Hills; **Sub** ≡ Subt	**B** ≡ Basin; **Fl** ≡ Flat; **Sub** ≡ Subterranean **M** ≡ Mound	**Mega** ≡ >10,000 ha; **Macro** ≡ 100 ha - 10,000 ha; **Meso** ≡ 25 ha - 100 ha; **Micro** ≡ 1 ha - 25 ha; **epto** ≡ 0.01ha - 1 ha **Nano** ≡ < 0.01ha	**Gr** ≡ Granite; **Bed** ≡ Bedrock (not specifically granite) **M-S** ≡ Mineral-Sand; **M-C ≡ Mineral-Clay**	**Thru** ≡ Through flow; **Over** ≡ Overbank flow; **Ret** ≡ Retained; **Unconn** ≡ Unconnected **Term** ≡ Terminal Branch	**LR** ≡ Local runoff **SW** ≡ Catchment fed; **GW** ≡ Unconfined groundwater; **Art** ≡ Artesian GW **Other**	**P** ≡ Permanent; **S** ≡ Seasonal (≥ 1:1); **E** ≡ Ephemeral (<1:1)	**P** ≡ Permanent; **Y** ≡ Years (> 1 yr / not perm) **A** ≡ Annual (≤ 1 yr)	**Fresh** ≡ Freshwater (< 1,000 mg/L); **Brack** ≡ Brackish (1,000 - 10,000 mg/L); **Sal** ≡ Saline - hypersaline	**Veg** ≡ Vegetated; **Unveg** ≡ Unvegetated
Lac	Inland lakes	IL	D	Fl / Dun	B	Macro / Meso	[M-S/M-C]	Thru	[SW/GW]	P / E	P	Brack	Unveg
Lac	Dune lakes	DL	D / G / T	Dun	B	Macro / Meso	M-S	Thru	GW	All	All	Brack	Unveg
Lac	Salt lakes	SL	D / G / T	Fl / Dun	B	Mega / Macro	[M-S/M-C]	EoS	SW	E	Y / A	[Saline/Hyper]	Unveg
Lac	Terminal lakes	TL	D / G / T	Fl / Dun	B	Mega / Macro / Meso	[M-S/M-C]	EoS	SW	S / E	Y / A	Brack	Unveg
Lac	Permanent lake	PL	T / G	Hill / Fl	B	Macro / Meso / Micro / Lepto	[Bed/M-S/M-C]	Thru / Term	[LR/SW/GW]	P	P	Fresh / Brack	Unveg
Pal	Permanent swamp	PS	T / G	Hill / Fl	B	Macro / Meso / Micro / Lepto	[Bed/M-S/M-C]	Thru / Term	[LR/SW/GW]	P	P	Fresh / Brack	Veg
Pal	Artesian springs	AS	D	Fl / Dun	[Fl/Sub] / [M/Sub]	Lepto / Nano	[M-S/M-C/Org]	Thru	Art	P	P / Y	Brack	Veg
Pal	Inland swamps	IS	D	Fl / Dun	Fl	All except Nano	[M-S/M-C/Org]	Thru / [Over/Ret] / [Over/EoS]	SW	E	Y / A	Brack	Veg
Pal	Rockholes	RH	D / G	Fl	B	Nano	Gr	Unconn	LR	E	A	Brack	Unveg
Pal	Claypans	CP	D / G / T	Fl / Dun	B	Macro / Meso / Micro	M-C	Unconn	LR	S / E	A	Brack	Unveg
Pal	Floodplain	FP	D / G / T	Fl	Fl	Macro / Meso / Micro / Lepto	[M-S/M-C]	Over	SW	S / E	A	All	Unveg
Pal	Inland interdunal wetlands	IIW	D / G / T	Dun	Fl	Macro / Meso	[M-S/M-C]	Ret	[LR/SW]	S / E	Y / A	Brack	Veg
Pal	Soaks & springs	SkSp	D / G / T	Hill / Fl	Fl	Micro / Lepto	[M-S/M-C/Org]	Ret	GW	P / S	All	[Fresh/Brack] / [Brack/Salin	Veg
Pal	Grass sedge wetland	GSW	G / T	Hill / Fl	Fl	Meso / Micro / Lepto	[M-S/M-C/Org]	Ret	[LR/SW/GW]	S	All	[Fresh/Brack]	Veg
Pal	Saline Swamp	SSw	G / T	Fl	Fl / B	Macro / Meso / Micro / Lepto	M-S / M-C	Ret / Term / Over / Thru	[LR/GW]	All	All	Saline / Hyper	Unveg
Pal	Temporary wetlands	TW	G / T	Fl	B	Mega / Macro / Meso / Micro / Lepto	[M-S/M-C]	Thru / Over / Term	[LR/SW]	S / E	A	Fresh / Brack	Veg / Unveg
Pal	Freshwater meadows	FM	T	Hill / Fl	Fl	Meso / Micro / Lepto	[M-S/M-C]	Ret	LR	S / E	A	Fresh	Veg
Pal	Peat swamp	PS	T	Hill / Fl	Fl	Meso / Micro / Lepto	Org	Ret	[LR/SW/GW]	P	P	Fresh	Veg
Sub	Karst systems	Kst	G / T	Sub	Sub	Macro / Meso / Micro / Lepto	Bed / [Bed/M-S/M-C]	Thru	GW	P / S	P	Fresh / Brack / Saline	Unveg

	Watercourse type (INSTREAM)	Abbreviation	Climate* (Koppen)	Landscape setting	Instream type	Hydrological connectivity	Water source	Water regime: Inflows	Water regime: Persistance	Salinity
			D ≡ Desert; **G** ≡ Grassland; **T** ≡ Temperate	**Hill** ≡ Hills; **Sl** ≡ Slope; **Fl** ≡ Flat	**WC** ≡ Watercourse; **WH** ≡ Waterhole; **Sp** ≡ Spring; **Anab** ≡ Anabranch	**Conn** ≡ Always connected; **Semi** ≡ Sometimes connected	**LR** ≡ Local runoff **SW** ≡ Catchment fed; **GW** ≡ Groundwater	**P** ≡ Permanent; **I** ≡ Intermittent (≥ 1:1); **E** ≡ Ephemeral (<1:1)	**P** ≡ Permanent; **M** ≡ Mid-term (> 1 yr / not perm); **A** ≡ Annual (≤ 1 yr)	**Fresh** ≡ Freshwater; **Brack** ≡ Brackish; **Saline** ≡ Saline - hypersaline
Riv	Permanent reach	PWC	G / T	Sl / Fl	[WC/Anab/Sp]	Conn	[All]	P	P	Fresh / Brack
Riv	Seasonal reach	SWC	G / T	All	[WC/Anab/Sp]	Semi	[All]	I	A	All
Riv	Seasonal waterhole	SWH	G / T	Sl / Fl	[WH/Sp]	Semi	[All]	I	P	Brack
Riv	Ephemeral reach	EWC	D / G	All	[WC/Anab]	Semi	SW	E	A	All
Riv	Ephemeral waterhole	EWH	D / G	Sl / Fl	[WH/Sp]	Semi	[SW/GW]	E	P / M	All

	Estuary type (INSTREAM-MARINE interface)	Abbreviation	Climate* (Koppen)	Landscape setting	Landform	Substrate	Sediment trapping	Hydrological connectivity	Water source	Wave / tidal
			D ≡ Desert; **G** ≡ Grassland; **T** ≡ Temperate	**WC** ≡ Watercourse inflow; **Cst** ≡ Coast / Beach; **Emb** ≡ Marine embayment	**FanElg** ≡ Fan-shaped with elongate sandbars; **FanLat** ≡ Fan-shaped with lateral sandbars; **Fl** ≡ Flat; **FCh** ≡ Flat with channe	**R** ≡ Rock; **S** ≡ Sand; **Mar** ≡ Marine	**H** ≡ High efficiency; **M** ≡ Medium efficiency; **L** ≡ Low efficiency	**Conn** ≡ Always connected; **Semi** ≡ Sometimes connected; **Unconn** ≡ Unconnected	**LR** ≡ Local runoff; **SW** ≡ Catchment fed; **GW** ≡ Groundwater; **Sea** ≡ Seawater only	**W** ≡ Wave; **T** ≡ Tidal
Est	Wave dominated system	WDE	G / T	WC	FanLat	S	H	Conn / Semi	SW / GW	W
Est	Tide dominated system	TDE	G / T	WC	FanElg	S	M	Conn / Semi	SW / GW	T
Cst	Tidal flat and creeks	TFC	G / T	Cst	FlCh	S	L	Unconn	Sea	T
Cst	Embayments / lagoon	EBL	G / T	Emb	B	Mar	L	Unconn	Sea / [GW/Sea]	T

8.4. Appendix D: Attribution of the wetland type using SQL queries

Permanent Reach

"([CLI_G] =1 OR [CLI_T] =1) AND
([LS_SL] =1 OR [LS_FL] =1) AND
([IST_WC] =1 OR [IST_ANAB] =1 OR [IST_SP] =1) AND
([HYC_CONN] =1) AND
([WRI_P] =1) AND
([WRP_P] =1) AND
([SAL_FRESH] =1 OR [SAL_BRACK] =1) ")

Seasonal Reach

"([CLI_G] =1 OR [CLI_T] =1) AND
([IST_WC] =1 OR [IST_ANAB] =1 OR [IST_SP] =1) AND
([HYC_SEMI] =1) AND
([WRI_S] =1) AND
([WRP_A] =1) ")

Ephemeral Reach

"([CLI_D] =1 OR [CLI_G] =1) AND
([IST_WC] =1 OR [IST_ANAB] =1) AND
([HYC_SEMI] =1) AND
([WS_SW] =1) AND
([WRI_E] =1) AND
([WRP_A] =1) ")

Permanent Lake – Terminal Branch

"([CLI_T] =1 OR [CLI_G] =1) AND
([LS_HILL] =1 OR [LS_FL] =1) AND
([LF_B] =1) AND
([SCL_MACRO] =1 OR [SCL_MESO] =1 OR [SCL_MICRO] =1 OR [SCL_LEPTO] = 1) AND
([SUB_BED] =1 OR [SUB_MS] =1 OR [SUB_MC] =1) AND
([HYD_TERM] =1) AND
([WS_LR] =1 OR [WS_SW] =1 OR [WS_GW] =1) AND
([WRI_P] =1) AND
([WRP_P] =1) AND
([SAL_FRESH] =1) AND ([SAL_BRACK] =0 AND [SAL_SAL] =0) AND
([VEG_UNVEG]) =1")

Permanent Lake - Throughflow

"([CLI_T] =1 OR [CLI_G] =1) AND
([LS_HILL] =1 OR [LS_FL] =1) AND
([LF_B] =1) AND
([SCL_MACRO] =1 OR [SCL_MESO] =1 OR [SCL_MICRO] =1 OR [SCL_LEPTO] = 1) AND

([SUB_BED] =1 OR [SUB_MS] =1 OR [SUB_MC] =1) AND
([HYD_THRU] =1) AND
([WS_LR] =1 OR [WS_SW] =1 OR [WS_GW] =1) AND
([WRI_P] =1) AND
([WRP_P] =1) AND
([SAL_FRESH] =1) AND ([SAL_BRACK] =0 AND [SAL_SAL] =0) AND
([VEG_UNVEG]) =1")

Permanent Swamp – Terminal Branch
"([CLI_T] =1 OR [CLI_G] =1) AND
([LS_HILL]=1 OR [LS_FL] =1) AND
([LF_B] =1) AND
([SCL_MACRO]=1 OR [SCL_MESO] =1 OR [SCL_MICRO] =1 OR [SCL_LEPTO] = 1) AND
([SUB_BED] =1 OR [SUB_MS] =1 OR [SUB_MC] =1) AND
([HYD_TERM] =1) AND
([WS_LR] =1 OR [WS_SW] =1 OR [WS_GW] =1) AND
([WRI_P] =1) AND
([WRP_P] =1) AND
([SAL_FRESH] =1 AND [SAL_BRACK] =0 AND [SAL_SAL] = 0) AND
[VEG_VEG] =1")

Permanent Swamp – Throughflow
"([CLI_T] =1 OR [CLI_G] =1) AND
([LS_HILL]=1 OR [LS_FL] =1) AND
([LF_B] =1) AND
([SCL_MACRO]=1 OR [SCL_MESO] =1 OR [SCL_MICRO] =1 OR [SCL_LEPTO] = 1) AND
([SUB_BED] =1 OR [SUB_MS] =1 OR [SUB_MC] =1) AND
([HYD_THRU] =1) AND
([WS_LR] =1 OR [WS_SW] =1 OR [WS_GW] =1) AND
([WRI_P] =1) AND
([WRP_P] =1) AND
([SAL_FRESH] =1 AND [SAL_BRACK] =0 AND [SAL_SAL] = 0) AND
[VEG_VEG] =1")

Floodplain
"([LS_FL] =1) AND
([LF_FL] =1) AND
([SCL_MACRO] =1 OR [SCL_MESO] =1 OR [SCL_MICRO] =1 OR [SCL_LEPTO] =1) AND
([SUB_MS] = 1 OR [SUB_MC] = 1) AND
([HYD_OVER] =1) AND
([WS_SW] =1) AND
([WRI_P] =0) AND
([WRP_A] =1) AND

[VEG_UNVEG] =1")

Saline Swamp

"([CLI_G] =1 OR [CLI_T] =1) AND
([LS_FL] =1) AND
([LF_FL] =1 OR [LF_B] = 1) AND
([SCL_MACRO] = 1 OR [SCL_MESO] =1 OR [SCL_MICRO] =1 OR [SCL_LEPTO] =1) AND
([SUB_MS] =1 OR [SUB_MC] = 1) AND
([HYD_RET] =1 OR [HYD_TERM] = 1 OR [HYD_THRU] = 1 OR [HYD_OVER] =1) AND
([WS_LR] =1 OR [WS_GW] =1) AND
([SAL_SAL] =1) AND
([VEG_UNVEG] =1)")

Temporary Wetland – Overbank Flow

"([CLI_G] =1 OR [CLI_T] =1) AND
([LS_FL] =1) AND
([LF_B] =1) AND
([SCL_MACRO] = 1 OR [SCL_MESO] =1 OR [SCL_MICRO] =1 OR [SCL_LEPTO] = 1) AND
([SUB_MS] = 1 OR [SUB_MC] = 1) AND
([HYD_OVER] = 1) AND
([WS_LR] = 1 OR [WS_SW] = 1) AND
([WRI_P] = 0) AND
([WRP_A] = 1) AND
([SAL_FRESH] OR [SAL_BRACK] = 1) ")

Temporary Wetland – Terminal Branch

"([CLI_G] =1 OR [CLI_T] =1) AND
([LS_FL] =1) AND
([LF_B] =1) AND
([SCL_MACRO] = 1 OR [SCL_MESO] =1 OR [SCL_MICRO] =1 OR [SCL_LEPTO] = 1) AND
([SUB_MS] = 1 OR [SUB_MC] = 1) AND
([HYD_TERM] = 1) AND
([WS_LR] = 1 OR [WS_SW] = 1) AND
([WRI_P] = 0) AND
([WRP_A] = 1) AND
([SAL_FRESH] OR [SAL_BRACK] = 1) ")

Temporary Wetland - Throughflow

"([CLI_G] =1 OR [CLI_T] =1) AND
([LS_FL] =1) AND
([LF_B] =1) AND
([SCL_MACRO] = 1 OR [SCL_MESO] =1 OR [SCL_MICRO] =1 OR [SCL_LEPTO] = 1) AND
([SUB_MS] = 1 OR [SUB_MC] = 1) AND

```
( [HYD_THRU] = 1) AND
([WS_LR] = 1 OR [WS_SW] = 1) AND
 ([WRI_P] = 0) AND
([WRP_A] = 1) AND
( [SAL_FRESH] OR [SAL_BRACK] = 1) ")
```

8.5. Appendix E: Managed, Artificial and Regulated Aquatic Ecosystems

The following list has been generated from the mapped polygons and their managed status as captured through conversations with NRM and DEH staff.

Name	Complex	AUS_WETNR	Managed
BANROCK SWAMP	BANROCK COMPLEX	S0001660	Managed wetland
BELDORA WETLANDS	SPECTACLE LAKES COMPLEX	S0000926	Managed wetland
BELDORA WETLANDS	SPECTACLE LAKES COMPLEX	S0000928	Managed wetland
BRENDA PARK	BRENDA PARK AND MORPHETT FLAT	S0000547	Managed wetland
BRENDA PARK	BRENDA PARK AND MORPHETT FLAT	S0001759	Managed wetland
BRENDA PARK	BRENDA PARK AND MORPHETT FLAT	S0001760	Managed wetland
CAUSEWAY LAGOON	GURRA LAKES COMPLEX	S0000821	Managed wetland
HART LAGOON	SELF-CONTAINED HYDROLOGICAL UNIT	S0001672	Managed wetland
JAESCHKE LAGOON	ROSS AND JAESCHKE LAGOONS COMPLEX	S0001664	Managed wetland
LAKE BONNEY COMPLEX	LAKE BONNEY COMPLEX	S0001058	Managed wetland
LAKE LIMBRA	CHOWILLA COMPLEX	S0001621	Managed wetland
LAKE LITTRA	CHOWILLA COMPLEX	S0001626	Managed wetland
LAKE MERRETI	RAL RAL COMPLEX	S0000466	Managed wetland
LAKE WOOLPOLOOL	RAL RAL COMPLEX	S0001026	Managed wetland
LITTLE DUCK LAGOON	GURRA LAKES COMPLEX	S0002020	Managed wetland
LOCK 6 DEPRESSION	PILBY COMPLEX	S0001975	Managed wetland
MARTIN BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0000923	Managed wetland
MORGAN CONSERVATION PARK	MORGAN COMPLEX	S0000970	Managed wetland
MORGAN CONSERVATION PARK	MORGAN COMPLEX	S0001718	Managed wetland
MURBKO SOUTH	SELF-CONTAINED HYDROLOGICAL UNIT	S0001059	Managed wetland
MURBPOOK LAGOON COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0001060	Managed wetland
MUSSEL LAGOON	LOVEDAY COMPLEX	S0000938	Managed wetland
NELWART SWAMP	SELF-CONTAINED HYDROLOGICAL UNIT	S0001188	Managed wetland
NGAK INDAU	KATARAPKO GAME RESERVE COMPLEX	S0000002	Managed wetland
OLD LOXTON ROAD LAGOON	GURRA LAKES COMPLEX	S0000050	Managed wetland
PILBY CREEK	PILBY COMPLEX	S0001974	Managed wetland
PILBY LAGOON	PILBY COMPLEX	S0001973	Managed wetland
PIPECLAY BILLABONG	CHOWILLA COMPLEX	S0000366	Managed wetland
REEDY CREEK	SELF-CONTAINED HYDROLOGICAL UNIT	S0016023	Managed wetland
RIVERGLADES	SELF-CONTAINED HYDROLOGICAL UNIT	S0016022	Managed wetland
ROSS LAGOON	ROSS AND JAESCHKE LAGOONS COMPLEX	S0001682	Managed wetland
SCHILLERS LAGOON	NIGRA CREEK COMPLEX	S0001543	Managed wetland

SLANEY WEIR BILLABONG	CHOWILLA COMPLEX	S0000098	Managed wetland
WERTA WERT	CHOWILLA COMPLEX	S0001618	Managed wetland
WHIRLPOOL CORNER	SELF-CONTAINED HYDROLOGICAL UNIT	S0016024	Managed wetland
YARRAMUNDI NORTH	PORTEE COMPLEX	S0001558	Managed wetland
YATCO LAGOON	SELF-CONTAINED HYDROLOGICAL UNIT	S0000933	Managed wetland
BASEBY LEVEE	SELF-CONTAINED HYDROLOGICAL UNIT	S0000731	Artificial Wetland
BERRI DISPOSAL BASIN COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0000274	Artificial Wetland
BERRI DISPOSAL BASIN COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0001496	Artificial Wetland
BERRI DISPOSAL BASIN COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0001499	Artificial Wetland
BERRI DISPOSAL BASIN COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0001500	Artificial Wetland
BERRI DISPOSAL BASIN COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0001501	Artificial Wetland
BERRI DISPOSAL BASIN COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0001502	Artificial Wetland
BERRI DISPOSAL BASIN COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0000273	Artificial Wetland
BULYONG ISLAND BASIN	RAL RAL COMPLEX	S0000472	Artificial Wetland
BULYONG ISLAND BASIN	RAL RAL COMPLEX	S0000474	Artificial Wetland
BULYONG ISLAND BASIN	RAL RAL COMPLEX	S0000522	Artificial Wetland
BULYONG ISLAND BASIN	RAL RAL COMPLEX	S0000524	Artificial Wetland
BULYONG ISLAND BASIN	RAL RAL COMPLEX	S0000525	Artificial Wetland
BULYONG ISLAND BASIN	RAL RAL COMPLEX	S0001367	Artificial Wetland
BULYONG ISLAND BASIN	RAL RAL COMPLEX	S0000521	Artificial Wetland
BULYONG ISLAND BASIN	RAL RAL COMPLEX	S0000526	Artificial Wetland
CADELL BASIN	CADELL COMPLEX	S0000968	Artificial Wetland
COBDOGLA BASIN	ISOLATED BY BANKS AND CONTROL STRUCTURES FROM CHAMBERS CREEK	S0000267	Artificial Wetland
COBDOGLA BASIN	ISOLATED BY BANKS AND CONTROL STRUCTURES FROM CHAMBERS CREEK	S0001457	Artificial Wetland
DISHER CREEK	SELF-CONTAINED HYDROLOGICAL UNIT	S0000195	Artificial Wetland
DISHER CREEK	SELF-CONTAINED HYDROLOGICAL UNIT	S0000196	Artificial Wetland
DISHER CREEK	SELF-CONTAINED HYDROLOGICAL UNIT	S0001077	Artificial Wetland
DISHER CREEK	SELF-CONTAINED HYDROLOGICAL UNIT	S0001437	Artificial Wetland
EAST WELLINGTON	WELLINGTON COMPLEX	S0001465	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000334	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0001575	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0001577	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000331	Artificial Wetland

KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000332	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000333	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000335	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0001588	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000451	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000503	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000504	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000505	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000509	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0001030	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000508	Artificial Wetland
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0001576	Artificial Wetland
Kia Marina		S0002747	Artificial Wetland
LOVEDAY SWAMPS	LOVEDAY COMPLEX	S0000935	Artificial Wetland
LOVEDAY SWAMPS	LOVEDAY COMPLEX	S0000944	Artificial Wetland
LYRUP EAST	SELF-CONTAINED HYDROLOGICAL UNIT	S0000717	Artificial Wetland
LYRUP FOREST	GURRA LAKES COMPLEX	S0000152	Artificial Wetland
LYRUP_B10_728	GURRA LAKES COMPLEX	S0000728	Artificial Wetland
LYRUP_B8_1254	GURRA LAKES COMPLEX	S0001254	Artificial Wetland
MARTIN BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0000432	Artificial Wetland
MARTIN BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0000431	Artificial Wetland
MORGAN EAST	MORGAN COMPLEX	S0001111	Artificial Wetland
PAIWALLA WETLAND	PAIWALLA SWAMP COMPLEX	S0002460	Artificial Wetland
PAIWALLA WETLAND	PAIWALLA SWAMP COMPLEX	S0002461	Artificial Wetland
PELLARING FLAT	UPSTREAM END OF HYDROLOGICAL UNIT	S0000763	Artificial Wetland
RAMCO LAGOON	RAMCO LAGOON COMPLEX	S0001684	Artificial Wetland
ROCKY GULLY	MOBILONG SWAMP	S0001486	Artificial Wetland
TAILEM BEND	ISOLATED DOWNSTREAM END OF HYDROLOGICAL UNIT	S0001043	Artificial Wetland
WELLINGTON MARINA	WELLINGTON COMPLEX	S0001045	Artificial Wetland
unnamed		S0000765	Artificial Wetland
unnamed		S0001084	Artificial Wetland
unnamed		S0001487	Artificial Wetland
unnamed		S0001041	Artificial Wetland
unnamed		S0001396	Artificial Wetland
unnamed		S0001818	Artificial Wetland

KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000018	Regulated Watercourse
NGAK INDAU INLET	KATARAPKO GAME RESERVE COMPLEX	S0000033	Regulated Watercourse
NGAK INDAU INLET	KATARAPKO GAME RESERVE COMPLEX	S0000034	Regulated Watercourse
NGAK INDAU OUTLET	KATARAPKO GAME RESERVE COMPLEX	S0000037	Regulated Watercourse
NGAK INDAU OUTLET	KATARAPKO GAME RESERVE COMPLEX	S0000038	Regulated Watercourse
NGAK INDAU OUTLET	KATARAPKO GAME RESERVE COMPLEX	S0000039	Regulated Watercourse
NGAK INDAU OUTLET	KATARAPKO GAME RESERVE COMPLEX	S0000040	Regulated Watercourse
	MOBILONG SWAMP	S0000047	Regulated Watercourse
BANK 'E' CREEK	CHOWILLA COMPLEX	S0000099	Regulated Watercourse
PILBY CREEK	PILBY COMPLEX	S0000106	Regulated Watercourse
PILBY CREEK	PILBY COMPLEX	S0000107	Regulated Watercourse
ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX	S0000133	Regulated Watercourse
KATARAPKO BASIN	KATARAPKO GAME RESERVE COMPLEX	S0000144	Regulated Watercourse
KATARAPKO CREEK AND KATARAPKO ISLAND	KATARAPKO GAME RESERVE COMPLEX	S0000148	Regulated Watercourse
BERRI DISPOSAL BASIN COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT	S0000276	Regulated Watercourse
ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX	S0000289	Regulated Watercourse
SLANEY CREEK	CHOWILLA COMPLEX	S0000353	Regulated Watercourse
BULYONG ISLAND BASIN	RAL RAL COMPLEX	S0000473	Regulated Watercourse
ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX	S0000477	Regulated Watercourse
BOOKMARK CREEK	SELF-CONTAINED HYDROLOGICAL UNIT	S0000532	Regulated Watercourse
MUNDIC CREEK	PIKE/MUNDIC COMPLEX	S0000535	Regulated Watercourse
WINDING CREEK	GURRA LAKES COMPLEX	S0000822	Regulated Watercourse
BELDORA WETLANDS	SPECTACLE LAKES COMPLEX	S0000925	Regulated Watercourse
SCOTT CREEK	BRENDA PARK AND MORPHETT FLAT	S0001240	Regulated Watercourse
MCINTOSH CANAL	LAKE BONNEY COMPLEX	S0001275	Regulated Watercourse
unnamed		S0001337	Regulated Watercourse
unnamed		S0001341	Regulated Watercourse
BULYONG ISLAND BASIN	RAL RAL COMPLEX	S0001368	Regulated Watercourse
UPPER PIKE RIVER AND SNAKE CREEK	PIKE/MUNDIC COMPLEX	S0001511	Regulated Watercourse
YARRAMUNDI	PORTEE COMPLEX	S0001557	Regulated Watercourse
PILBY CREEK	PILBY COMPLEX	S0001617	Regulated Watercourse
HANCOCK CREEK	CHOWILLA COMPLEX	S0001620	Regulated Watercourse
LITTLE TOOLUNKA FLAT	TOOLUNKA FLAT COMPLEX	S0001698	Regulated Watercourse
NIGRA CREEK	NIGRA CREEK COMPLEX	S0001700	Regulated Watercourse
NIGRA CREEK	NIGRA CREEK COMPLEX	S0001701	Regulated Watercourse
SCHILLERS LAGOON	NIGRA CREEK COMPLEX	S0001710	Regulated Watercourse
PILBY CREEK	PILBY COMPLEX	S0001971	Regulated Watercourse

BLANCHETOWN FLAT	PORTEE COMPLEX	S0001995	Regulated Watercourse
BLANCHETOWN FLAT	PORTEE COMPLEX	S0001996	Regulated Watercourse
RIVER MURRAY		S0001997	Regulated Watercourse
MUNDIC CREEK	PIKE/MUNDIC COMPLEX	S0002005	Regulated Watercourse
unnamed	RAL RAL COMPLEX	S0016028	Regulated Watercourse
unnamed	RAL RAL COMPLEX	S0016029	Regulated Watercourse
TEMPLETON		S0016032	Regulated Watercourse
TEMPLETON		S0016033	Regulated Watercourse

8.6. Appendix F: Wetlands with a conservation-threat rank of CT1 per geomorphic reach

GEOMORPHIC REACH	AUS_WETNR	NAME	COMPLEX
Mannum to Wellington	S0001816	JURY SWAMP (JAENSCHS BEACH)	DOWNSTREAM END OF MYPOLONGA SWAMP
Mannum to Wellington	S0001479	POMPOOTA	ISOLATED BY LEVEE BANKS
Mannum to Wellington	S0001043	TAILEM BEND	ISOLATED DOWNSTREAM END OF HYDROLOGICAL UNIT
Mannum to Wellington	S0001045	WELLINGTON MARINA	WELLINGTON COMPLEX
Mannum to Wellington	S0000685	COWIRRA LANDING	
Mannum to Wellington	S0000596	Reedy Creek Swamp	
Mannum to Wellington	S0000680	unnamed	
Mannum to Wellington	S0000681	unnamed	
Mannum to Wellington	S0001041	unnamed	
Mannum to Wellington	S0001473	unnamed	
Overland Corner to Mannum	S0001669	BANROCK CREEK	BANROCK COMPLEX
Overland Corner to Mannum	S0001159	DEVON DOWNS SOUTH	BIG BEND
Overland Corner to Mannum	S0001160	DEVON DOWNS SOUTH	BIG BEND
Overland Corner to Mannum	S0001565	DEVON DOWNS SOUTH	BIG BEND
Overland Corner to Mannum	S0000825	BLANCHETOWN CARAVAN PARK	EDSONS FLAT COMPLEX
Overland Corner to Mannum	S0001741	MCBEAN POUND SOUTH	MCBEAN POUND COMPLEX
Overland Corner to Mannum	S0000970	MORGAN CONSERVATION PARK	MORGAN COMPLEX
Overland Corner to Mannum	S0001464	MORGAN CONSERVATION PARK	MORGAN COMPLEX
Overland Corner to Mannum	S0002021	MORGAN CONSERVATION PARK	MORGAN COMPLEX
Overland Corner to Mannum	S0001700	NIGRA CREEK	NIGRA CREEK COMPLEX
Overland Corner to Mannum	S0001707	NIGRA LAGOON	NIGRA CREEK COMPLEX
Overland Corner to Mannum	S0001110	BURRA CREEK	NORTH WEST BEND COMPLEX
Overland Corner to Mannum	S0001009	BLANCHETOWN FLAT	PORTEE COMPLEX
Overland Corner to Mannum	S0001133	SCRUBBY FLAT	SCRUBBY FLAT COMPLEX
Overland Corner to Mannum	S0001470	SCRUBBY FLAT	SCRUBBY FLAT COMPLEX
Overland Corner to Mannum	S0001131	SCRUBBY FLAT CREEK	SCRUBBY FLAT COMPLEX
Overland Corner to Mannum	S0001699	LITTLE TOOLUNKA FLAT	TOOLUNKA FLAT COMPLEX
Overland Corner to Mannum	S0000762	PELLARING FLAT	UPSTREAM END OF HYDROLOGICAL UNIT
Overland Corner to Mannum	S0000053	YOUNGHUSBAND	YOUNGHUSBAND COMPLEX
Overland Corner to Mannum	S0001798	YOUNGHUSBAND	YOUNGHUSBAND COMPLEX
Overland Corner to Mannum	S0001799	YOUNGHUSBAND	YOUNGHUSBAND COMPLEX
Overland Corner to Mannum	S0001804	YOUNGHUSBAND	YOUNGHUSBAND COMPLEX
Overland Corner to Mannum	S0000747	unnamed	
Overland Corner to Mannum	S0001237	unnamed	
Overland Corner to Mannum	S0001238	unnamed	
Overland Corner to Mannum	S0001562	unnamed	
Border to Overland Corner	S0000046	BANK 'E' CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0001076	BOAT CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0001095	BOAT CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0000093	CHOWILLA CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0001625	CHOWILLA ISLAND LOOP	CHOWILLA COMPLEX
Border to Overland Corner	S0000484	COOMBOOL SWAMP	CHOWILLA COMPLEX
Border to Overland Corner	S0000386	HYPURNA CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0000387	HYPURNA CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0000097	ISLE OF MAN HORSESHOE	CHOWILLA COMPLEX

GEOMORPHIC REACH	AUS_WETNR	NAME	COMPLEX
Border to Overland Corner	S0000344	NELWOOD	CHOWILLA COMPLEX
Border to Overland Corner	S0000298	PUNKAH CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0000299	PUNKAH CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0000354	SLANEY CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0000601	SLANEY CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0000343	SLANEY OXBOW	CHOWILLA COMPLEX
Border to Overland Corner	S0000326	WOOLSHED CREEK	CHOWILLA COMPLEX
Border to Overland Corner	S0000486	unnamed	CHOWILLA COMPLEX
Border to Overland Corner	S0002020	LITTLE DUCK LAGOON	GURRA LAKES COMPLEX
Border to Overland Corner	S0000152	LYRUP FOREST	GURRA LAKES COMPLEX
Border to Overland Corner	S0000049	OLD LOXTON ROAD LAGOON	GURRA LAKES COMPLEX
Border to Overland Corner	S0001194	SALT CREEK AND GURRA GURRA LAKES	GURRA LAKES COMPLEX
Border to Overland Corner	S0000133	ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000280	ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000282	ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000283	ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000289	ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000476	ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0001504	ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0001505	ECKERT CREEK AND THE SPLASH	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000147	KATARAPKO CREEK AND KATARAPKO ISLAND	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000148	KATARAPKO CREEK AND KATARAPKO ISLAND	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000150	KATARAPKO CREEK AND KATARAPKO ISLAND	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000435	KATARAPKO CREEK AND KATARAPKO ISLAND	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000498	KATARAPKO CREEK AND KATARAPKO ISLAND	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000781	KATARAPKO CREEK AND KATARAPKO ISLAND	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000033	NGAK INDAU INLET	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000036	NGAK INDAU INLET	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000039	NGAK INDAU OUTLET	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000040	NGAK INDAU OUTLET	KATARAPKO GAME RESERVE COMPLEX
Border to Overland Corner	S0000264	LOCH LUNA AND NOCKBURRA CREEK	LOCH LUNA
Border to Overland Corner	S0000711	LOCH LUNA AND NOCKBURRA CREEK	LOCH LUNA
Border to Overland Corner	S0001137	LOCH LUNA AND NOCKBURRA CREEK	LOCH LUNA
Border to Overland Corner	S0000501	LOVEDAY SWAMPS	LOVEDAY COMPLEX
Border to Overland Corner	S0000937	MUSSEL LAGOON	LOVEDAY COMPLEX
Border to Overland Corner	S0000796	MUNDIC CREEK	PIKE/MUNDIC COMPLEX
Border to Overland Corner	S0001185	MUNDIC CREEK	PIKE/MUNDIC COMPLEX
Border to Overland Corner	S0001186	MUNDIC CREEK	PIKE/MUNDIC COMPLEX

GEOMORPHIC REACH	AUS_WETNR	NAME	COMPLEX
Border to Overland Corner	S0001187	MUNDIC CREEK	PIKE/MUNDIC COMPLEX
Border to Overland Corner	S0016010	MUNDIC CREEK	PIKE/MUNDIC COMPLEX
Border to Overland Corner	S0000189	TANYACA CREEK	PIKE/MUNDIC COMPLEX
Border to Overland Corner	S0000190	TANYACA CREEK	PIKE/MUNDIC COMPLEX
Border to Overland Corner	S0001191	TANYACA CREEK	PIKE/MUNDIC COMPLEX
Border to Overland Corner	S0001512	UPPER PIKE RIVER AND SNAKE CREEK	PIKE/MUNDIC COMPLEX
Border to Overland Corner	S0001513	UPPER PIKE RIVER AND SNAKE CREEK	PIKE/MUNDIC COMPLEX
Border to Overland Corner	S0001980	UPPER PIKE RIVER AND SNAKE CREEK	PIKE/MUNDIC COMPLEX
Border to Overland Corner	S0001975	LOCK 6 DEPRESSION	PILBY COMPLEX
Border to Overland Corner	S0001399	PILBY CREEK	PILBY COMPLEX
Border to Overland Corner	S0001971	PILBY CREEK	PILBY COMPLEX
Border to Overland Corner	S0001972	PILBY CREEK	PILBY COMPLEX
Border to Overland Corner	S0001973	PILBY LAGOON	PILBY COMPLEX
Border to Overland Corner	S0001080	BIG HUNCHEE LITTLE HUNCHEE AND AMAZON CREEKS	RAL RAL COMPLEX
Border to Overland Corner	S0001081	BIG HUNCHEE LITTLE HUNCHEE AND AMAZON CREEKS	RAL RAL COMPLEX
Border to Overland Corner	S0001082	BIG HUNCHEE LITTLE HUNCHEE AND AMAZON CREEKS	RAL RAL COMPLEX
Border to Overland Corner	S0001106	BULYONG ISLAND BASIN	RAL RAL COMPLEX
Border to Overland Corner	S0001374	BULYONG ISLAND BASIN	RAL RAL COMPLEX
Border to Overland Corner	S0001296	HORSESHOE SWAMP	RAL RAL COMPLEX
Border to Overland Corner	S0000753	RAL RAL CREEK AND RAL RAL WIDEWATERS	RAL RAL COMPLEX
Border to Overland Corner	S0001101	RAL RAL CREEK AND RAL RAL WIDEWATERS	RAL RAL COMPLEX
Border to Overland Corner	S0001103	RAL RAL CREEK AND RAL RAL WIDEWATERS	RAL RAL COMPLEX
Border to Overland Corner	S0000277	BERRI DISPOSAL BASIN COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0000432	MARTIN BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0001166	MURTHO PARK COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0001173	MURTHO PARK COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0001178	MURTHO PARK COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0001295	MURTHO PARK COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0000083	NIL NIL	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0000751	NIL NIL	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0000752	NIL NIL	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0000312	PARINGA ISLAND	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0001388	PARINGA ISLAND	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0001440	PARINGA ISLAND	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0001441	PARINGA ISLAND	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0001442	PARINGA ISLAND	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0000467	WOOLENOOK BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL

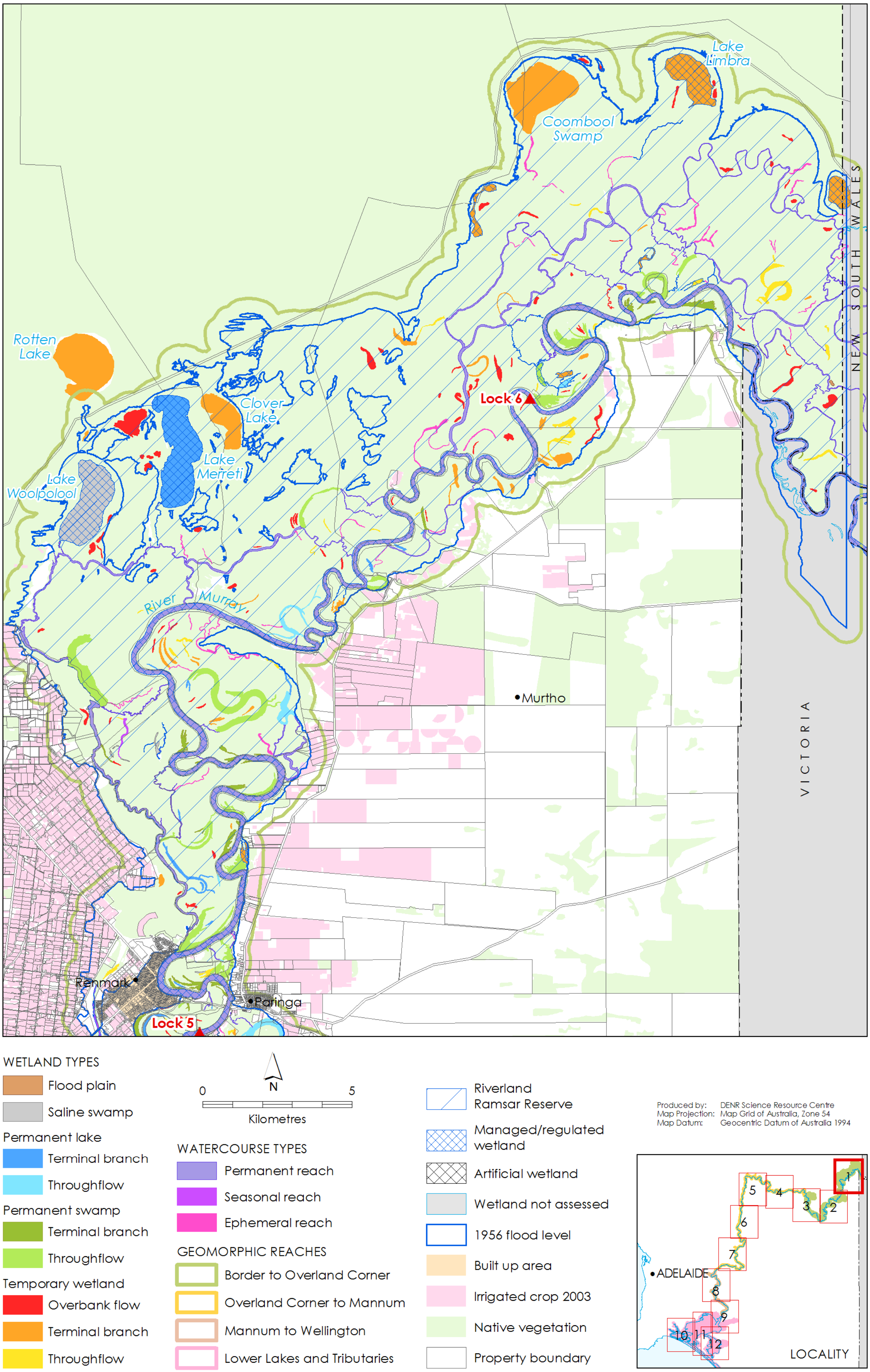
GEOMORPHIC REACH	AUS_WETNR	NAME	COMPLEX
			UNIT
Border to Overland Corner	S0000953	WOOLENOOK BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0000956	WOOLENOOK BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0000960	WOOLENOOK BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0001108	WOOLENOOK BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0001109	WOOLENOOK BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0002824	WOOLENOOK BEND COMPLEX	SELF-CONTAINED HYDROLOGICAL UNIT
Border to Overland Corner	S0000007	I BANK CREEK	
Border to Overland Corner	S0000496	unnamed	
Border to Overland Corner	S0000877	unnamed	

8.7. Appendix G: Records altered in the data entry table

GEOMORPHIC REACH	WETLAND TYPE	AUS_WETNR	Alteration of CV Rank
Mannum to Wellington	Ephemeral Reach	S0001474	medium to high
Mannum to Wellington	Permanent Lake – Terminal Branch	S0000685	medium to high
Mannum to Wellington	Permanent Lake – Terminal Branch	S0001043	medium to high
Mannum to Wellington	Permanent Lake – Terminal Branch	S0001084	low to high
Mannum to Wellington	Permanent Lake – Terminal Branch	S0001479	medium to high
Mannum to Wellington	Permanent Lake – Terminal Branch	S0001487	low to high
Mannum to Wellington	Permanent Lake – Terminal Branch	S0001815	medium to high
Mannum to Wellington	Permanent Lake – Throughflow	S0000609	medium to high
Mannum to Wellington	Permanent Lake – Throughflow	S0001045	medium to high
Mannum to Wellington	Permanent Lake – Throughflow	S0001477	medium to high
Mannum to Wellington	Permanent Swamp – Terminal Branch	S0001809	medium to high
Mannum to Wellington	Permanent Swamp – Terminal Branch	S0001810	medium to high
Mannum to Wellington	Permanent Swamp – Terminal Branch	S0001816	medium to high
Mannum to Wellington	Saline Swamp	S0001877	medium to high
Mannum to Wellington	Saline Swamp	S0002008	medium to high
Mannum to Wellington	Saline Swamp	S0002023	medium to high
Mannum to Wellington	Temporary Wetland – Terminal Branch	S0000610	medium to high
Mannum to Wellington	Temporary Wetland – Terminal Branch	S0000680	medium to high
Mannum to Wellington	Temporary Wetland – Terminal Branch	S0001041	medium to high
Mannum to Wellington	Temporary Wetland – Terminal Branch	S0001476	medium to high
Mannum to Wellington	Temporary Wetland – Terminal Branch	S0001805	medium to high
Mannum to Wellington	Temporary Wetland – Terminal Branch	S0001818	medium to high
Mannum to Wellington	Temporary Wetland – Terminal Branch	S0001819	medium to high
Mannum to Wellington	Temporary Wetland – Terminal Branch	S0002017	medium to high
Mannum to Wellington	Temporary Wetland – Throughflow	S0000681	medium to high
Mannum to Wellington	Temporary Wetland – Throughflow	S0001806	medium to high
Overland Corner to Mannum	Floodplain	S0001007	medium to high
Overland Corner to Mannum	Saline Swamp	S0000968	medium to high
Overland Corner to Mannum	Saline Swamp	S0001697	low to high
Overland Corner to Mannum	Saline Swamp	S0001699	medium to high
Overland Corner to Mannum	Temporary Wetland – Throughflow	S0000967	medium to high
Border to Overland Corner	Floodplain	S0000887	low to high
Border to Overland Corner	Seasonal Reach	S0000018	medium to high
Border to Overland Corner	Seasonal Reach	S0000144	medium to high
Border to Overland Corner	Seasonal Reach	S0000473	medium to high
Border to Overland Corner	Seasonal Reach	S0000523	low to high
Border to Overland Corner	Seasonal Reach	S0000532	medium to high
Border to Overland Corner	Seasonal Reach	S0001275	medium to high
Border to Overland Corner	Seasonal Reach	S0001366	medium to high
Border to Overland Corner	Seasonal Reach	S0001368	medium to high

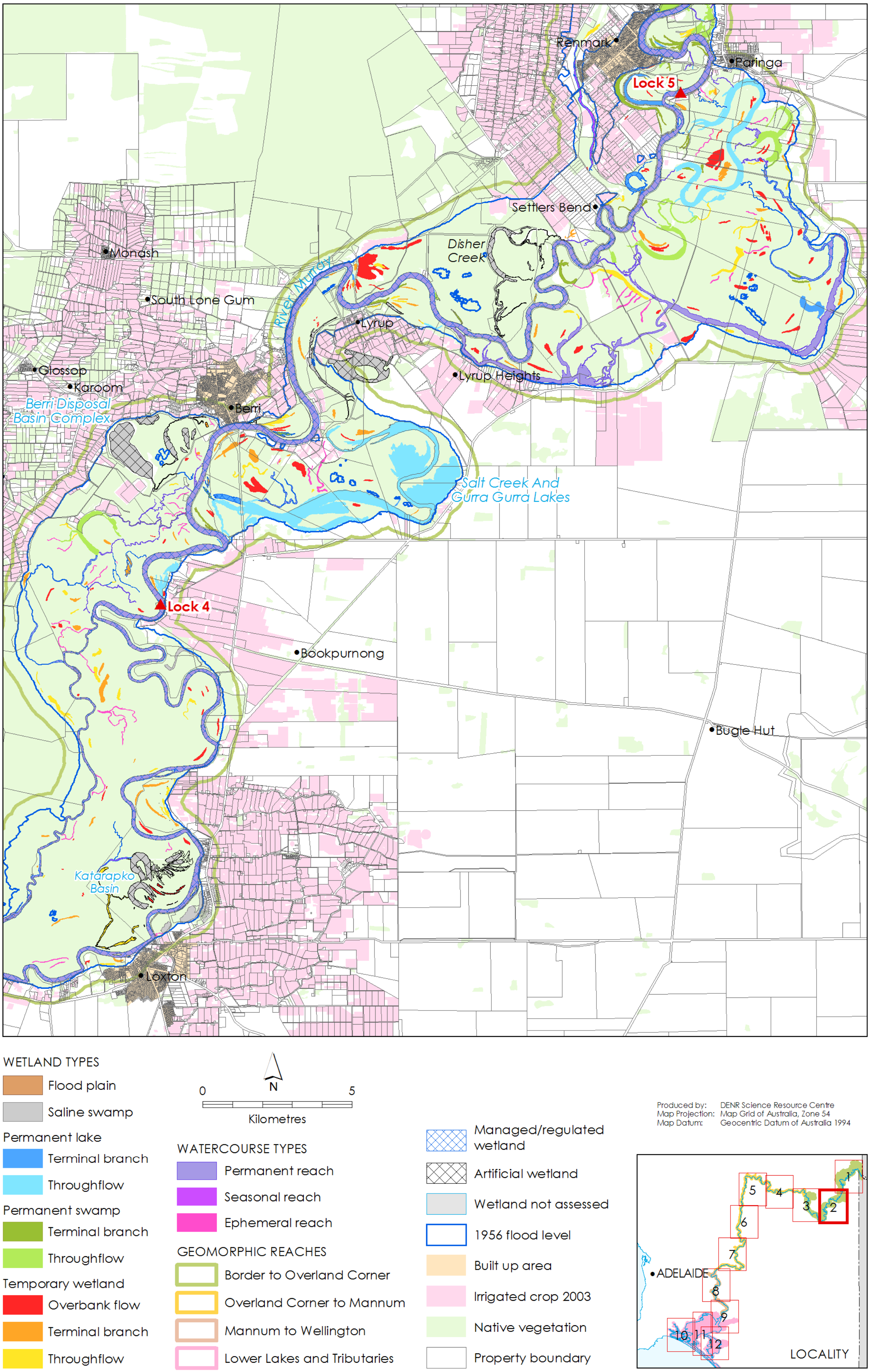
8.8. Appendix H: Maps of SA River Murray Aquatic Ecosystems

Map 1a: Riverland Ramsar - Aquatic Ecosystems



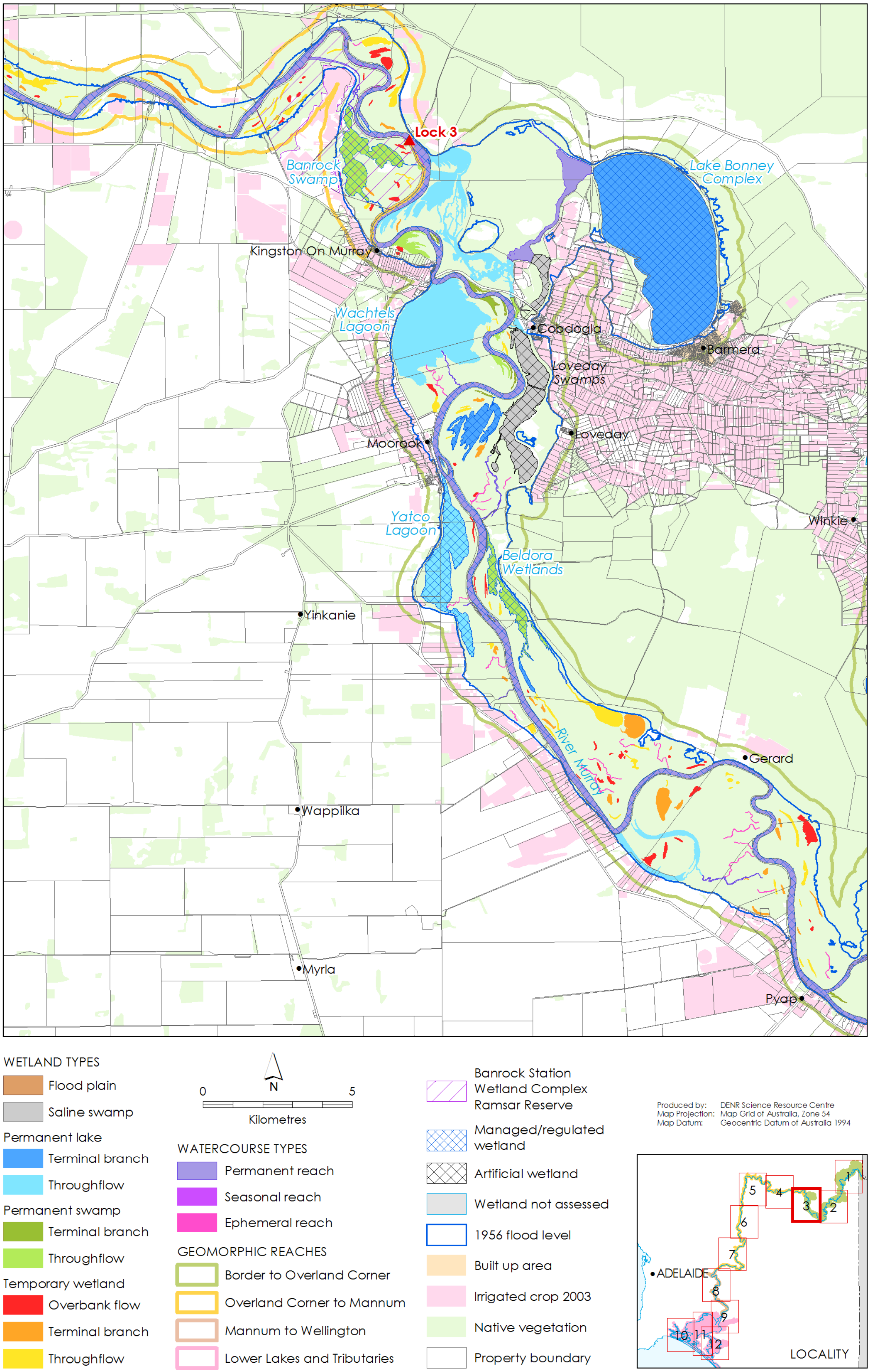
DEH MapID: 2011-5576

Map 2a: Loxton - Aquatic Ecosystems



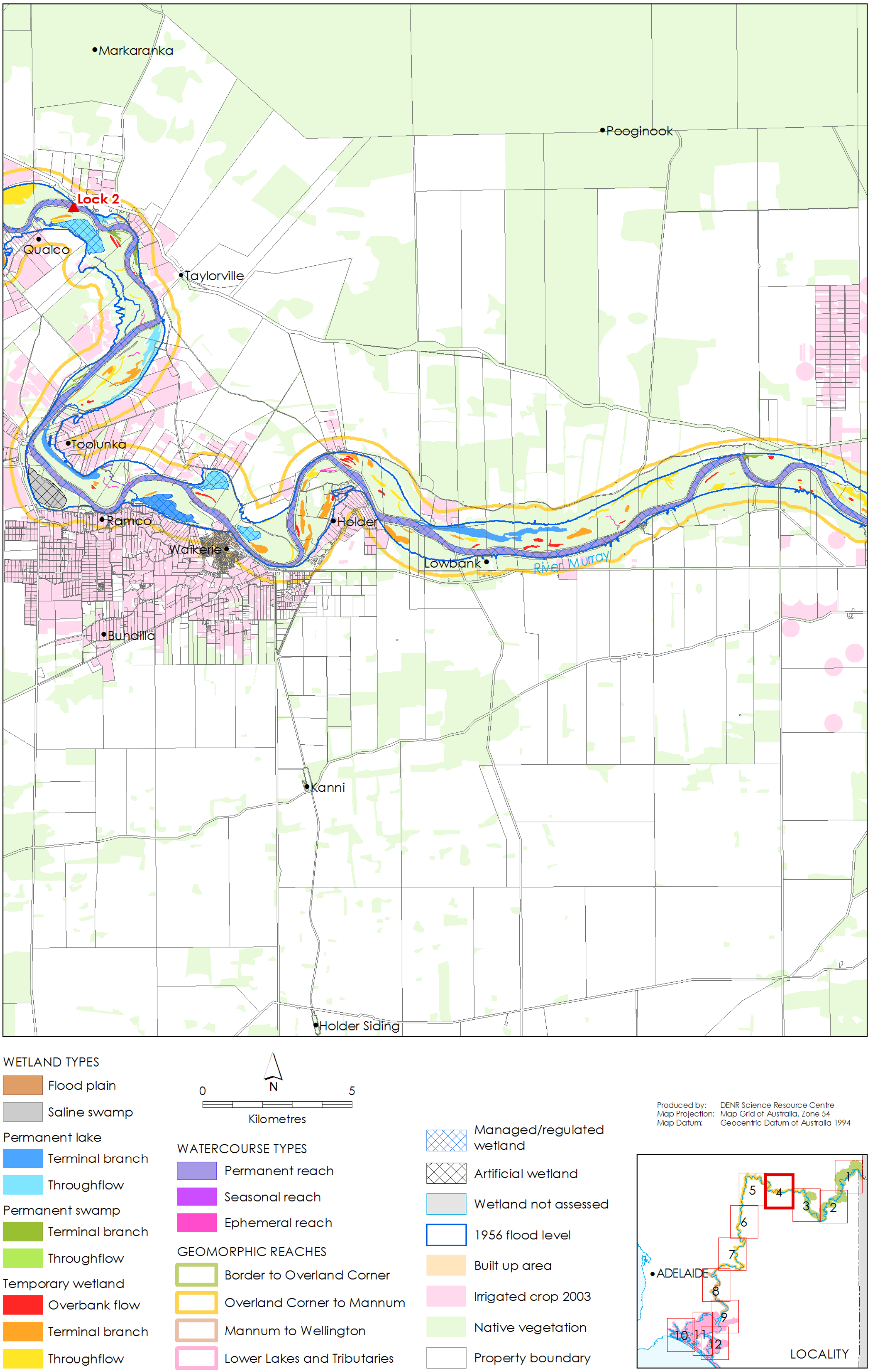
DEH MapID: 2011-5576

Map 3a: Barmera - Aquatic Ecosystems



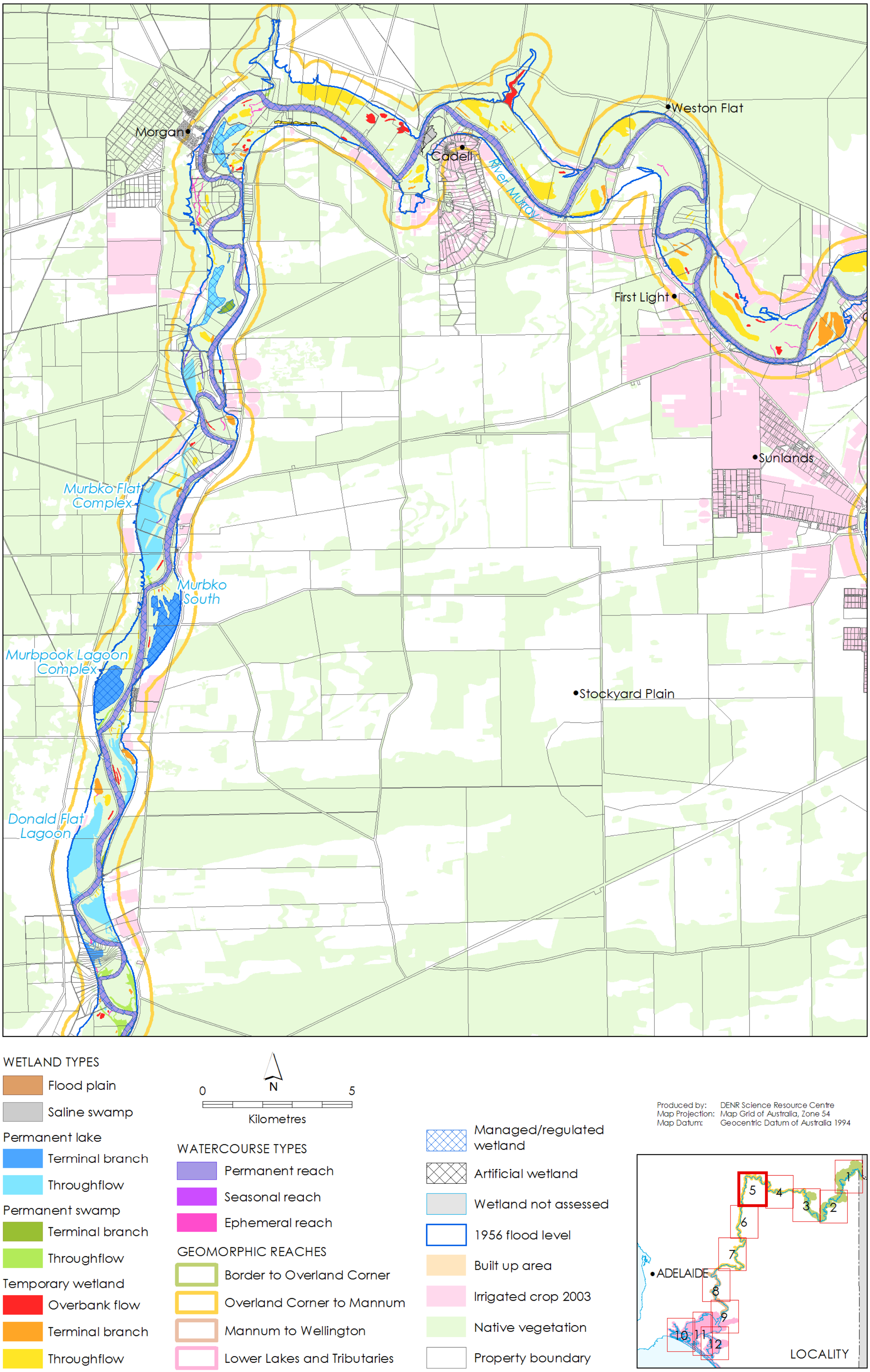
DEH MapID: 2011-5576

Map 4a: Waikerie - Aquatic Ecosystems



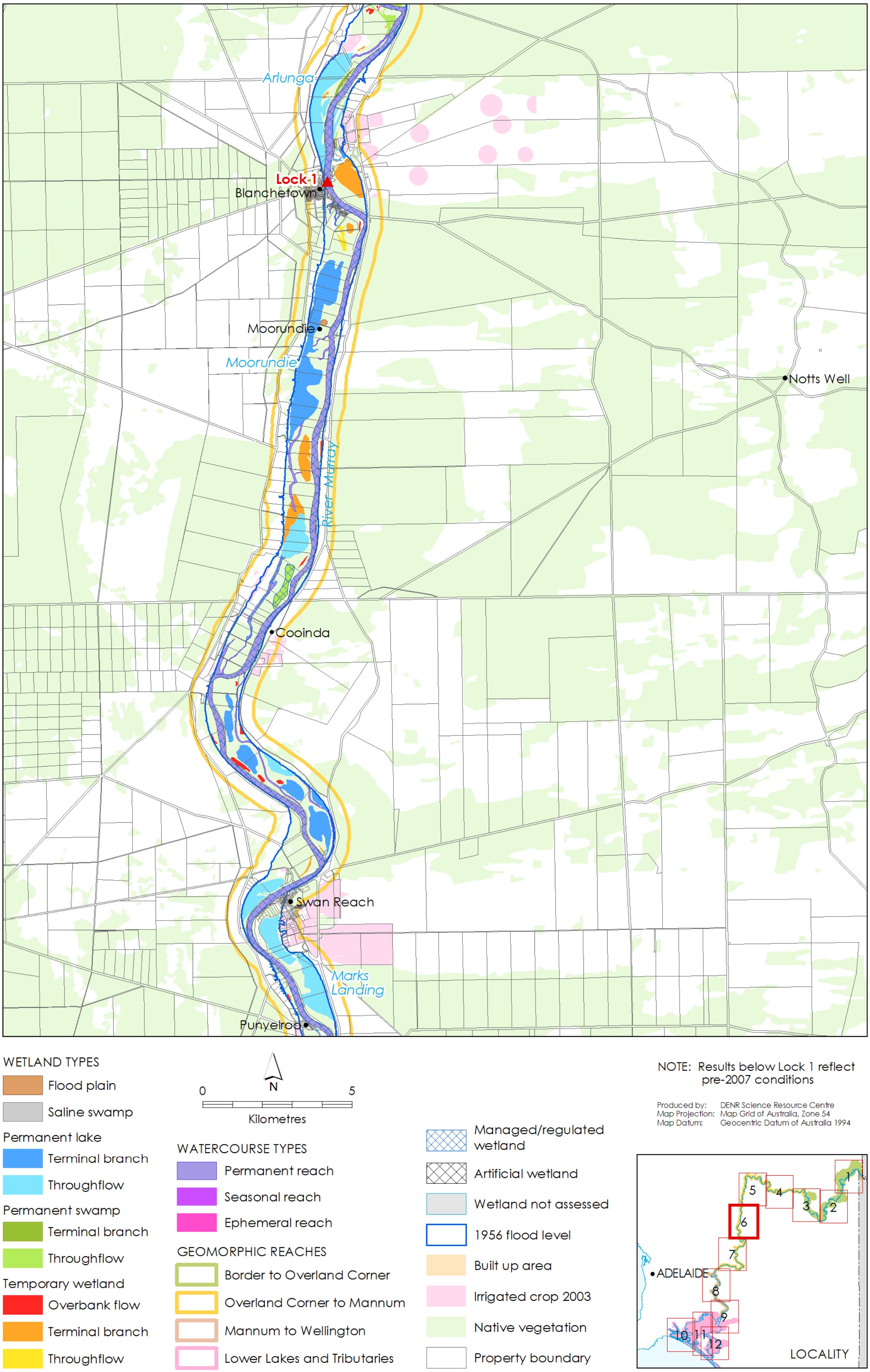
DEH MapID: 2011-5576

Map 5a: Morgan - Aquatic Ecosystems



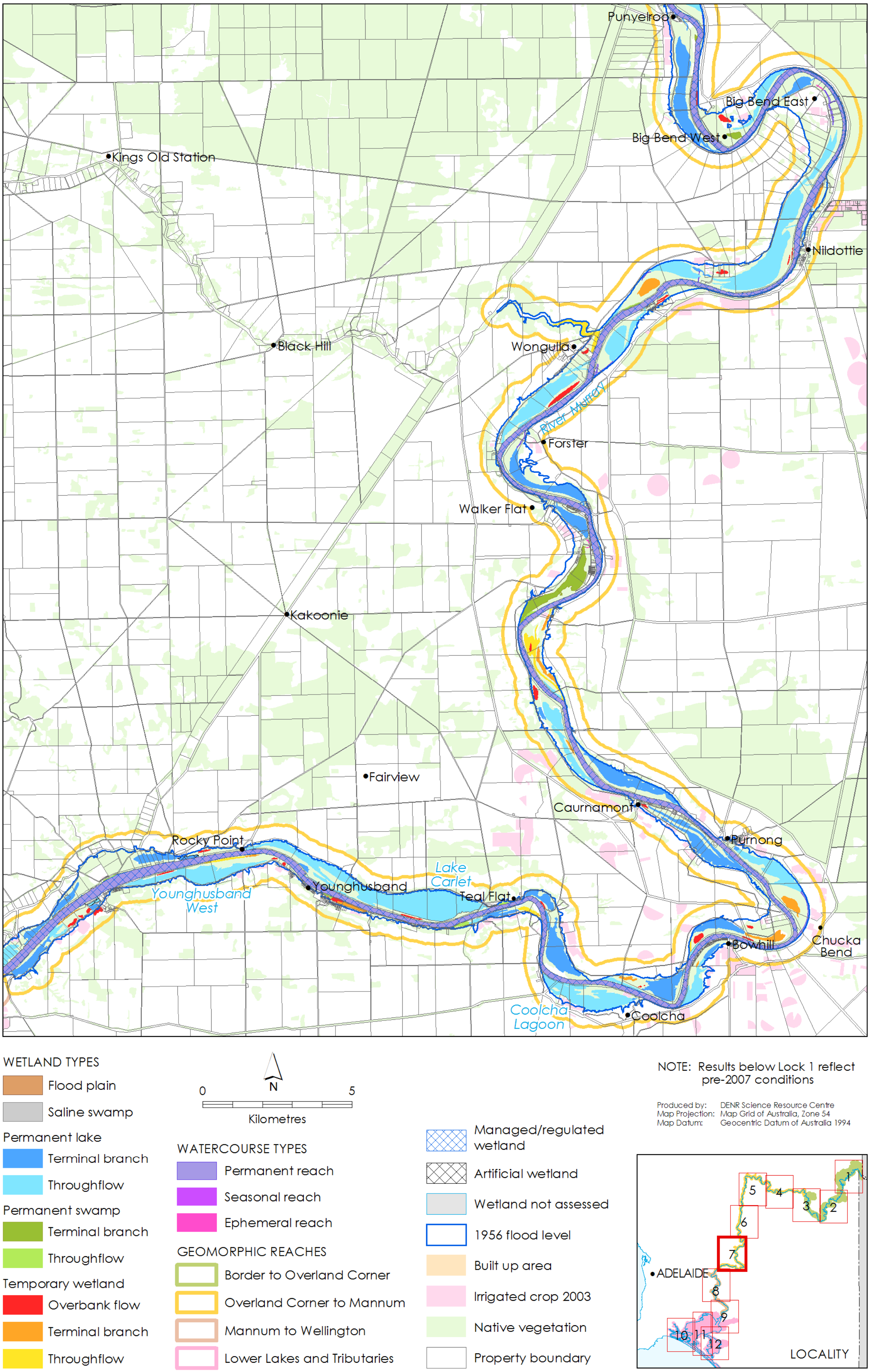
DEH MapID: 2011-5576

Map 6a: Swan Reach - Aquatic Ecosystems



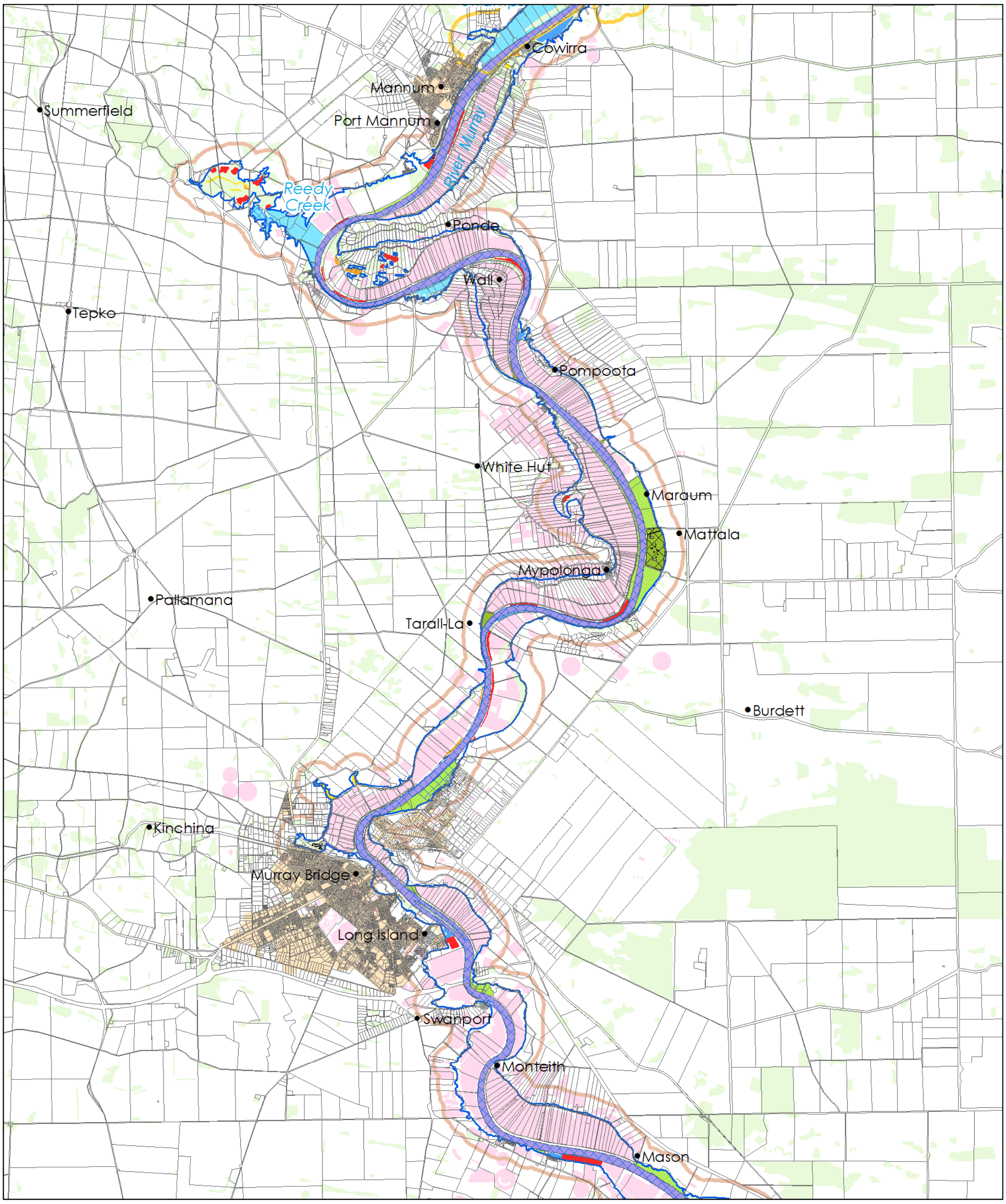
DEH MapID: 2011-5576

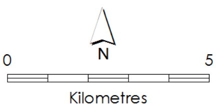
Map 7a: Walker Flat - Aquatic Ecosystems



DEH MapID: 2011-5576

Map 8a: Murray Bridge - Aquatic Ecosystems





WETLAND TYPES

- Flood plain
- Saline swamp

Permanent lake

- Terminal branch
- Throughflow

Permanent swamp

- Terminal branch
- Throughflow

Temporary wetland

- Overbank flow
- Terminal branch
- Throughflow

WATERCOURSE TYPES

- Permanent reach
- Seasonal reach
- Ephemeral reach

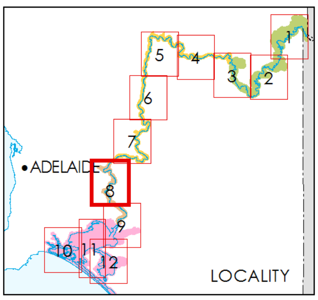
GEOMORPHIC REACHES

- Border to Overland Corner
- Overland Corner to Mannum
- Mannum to Wellington
- Lower Lakes and Tributaries

- Managed/regulated wetland
- Artificial wetland
- Wetland not assessed
- 1956 flood level
- Built up area
- Irrigated crop 2003
- Native vegetation
- Property boundary

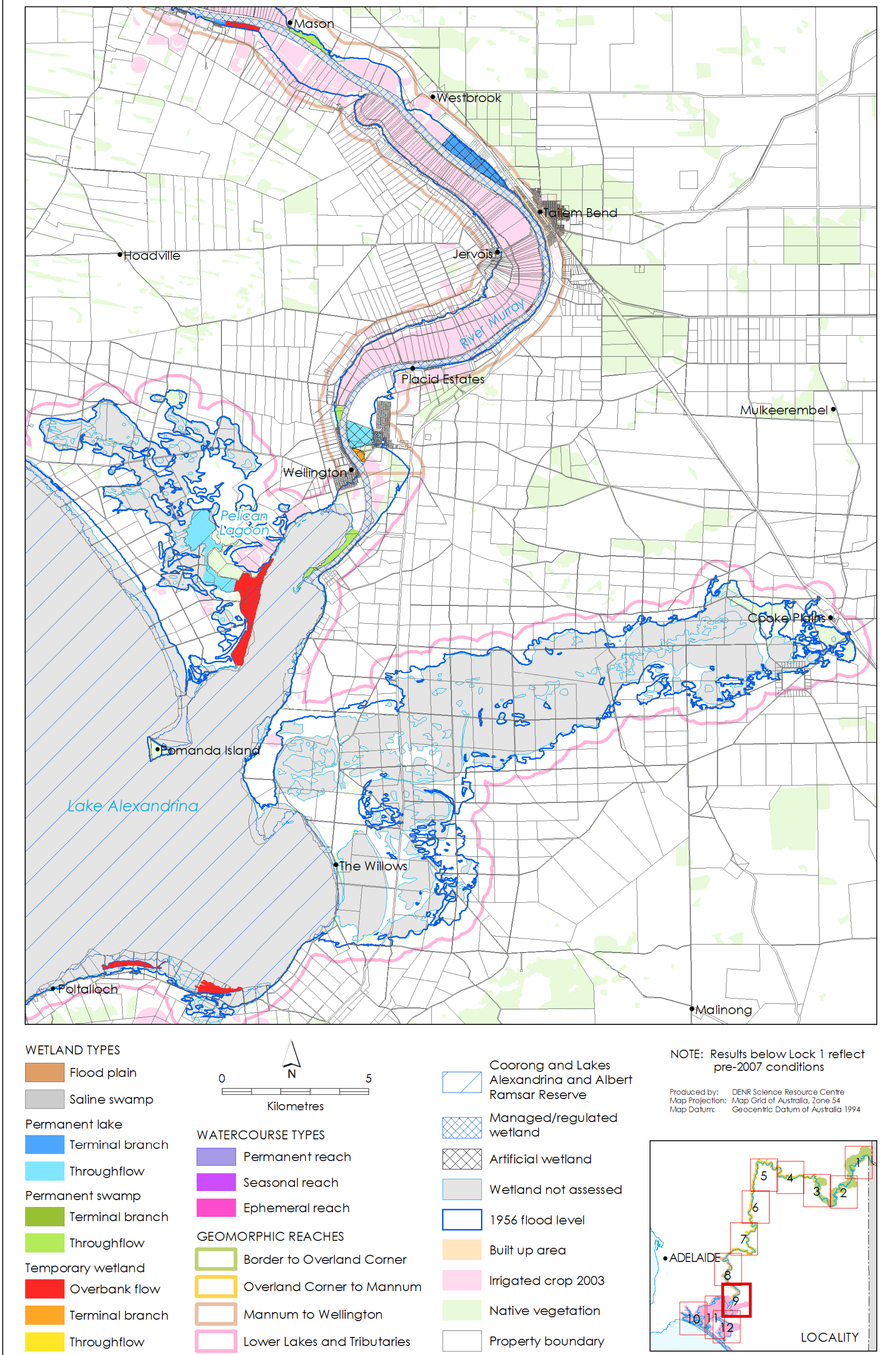
NOTE: Results below Lock 1 reflect pre-2007 conditions

Produced by: DENR Science Resource Centre
Map Projection: Map Grid of Australia, Zone 54
Map Datum: Geocentric Datum of Australia 1994



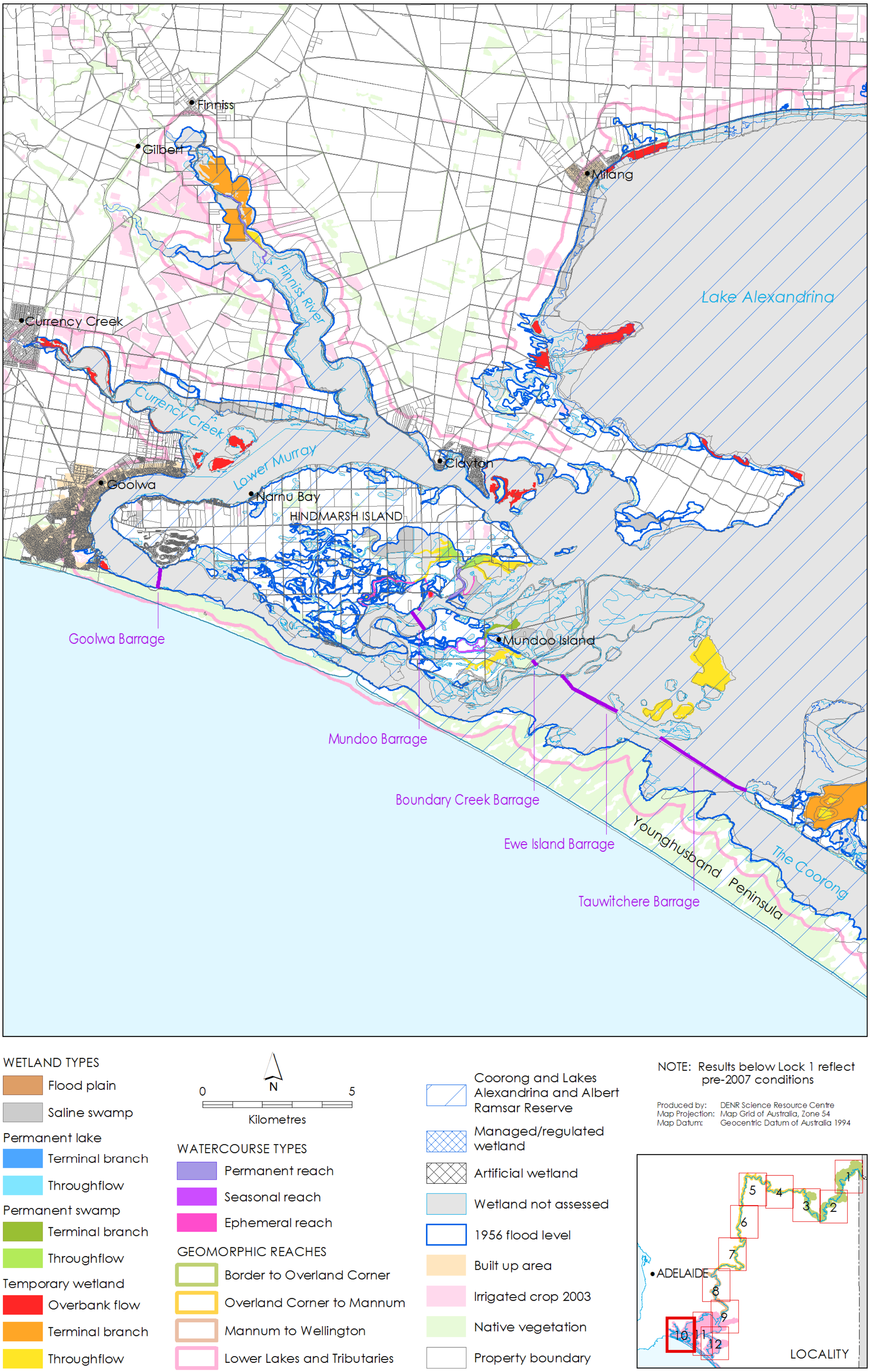
DEH MapID: 2011-5576

Map 9a: Wellington - Aquatic Ecosystems



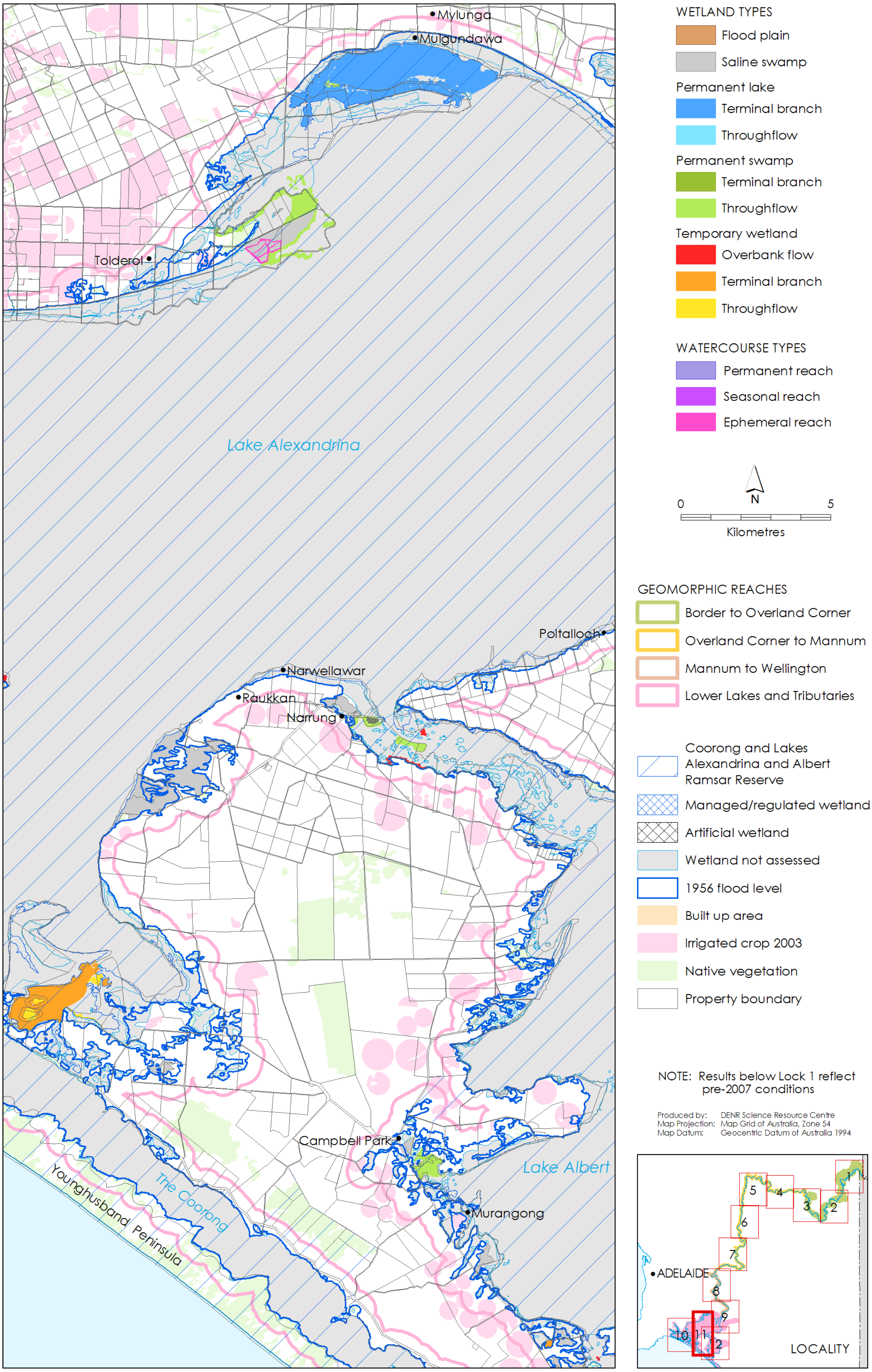
DEH MapID: 2011-5576

Map 10a: Goolwa - Aquatic Ecosystems



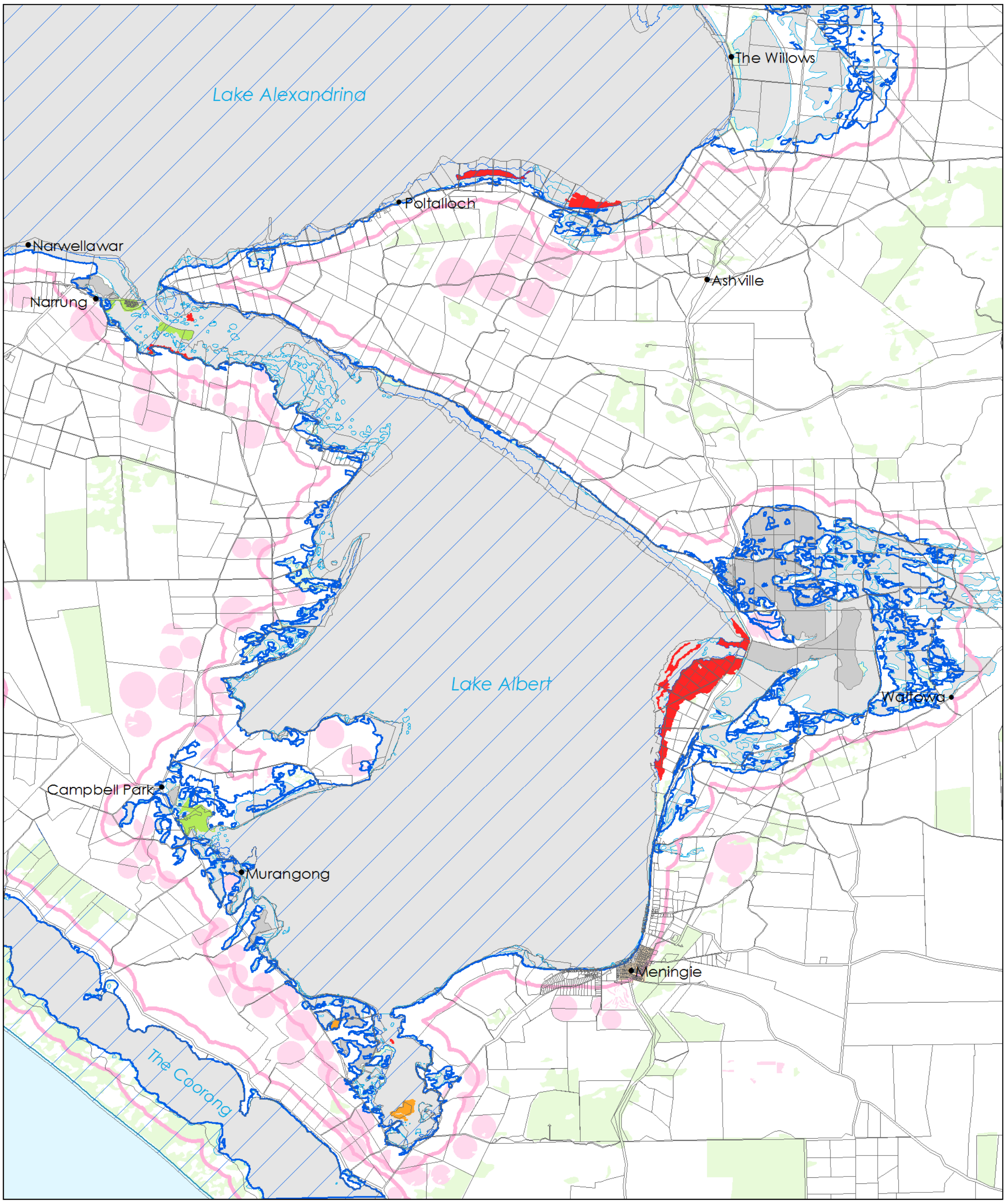
DEH MapID: 2011-5576

Map 11a: Narrung - Aquatic Ecosystems



DEH MapID: 2011-5577

Map 12a: Meningie - Aquatic Ecosystems



WETLAND TYPES
- Flood plain
- Saline swamp

Permanent lake
- Terminal branch
- Throughflow

Permanent swamp
- Terminal branch
- Throughflow

Temporary wetland
- Overbank flow
- Terminal branch
- Throughflow

N

0 5

Kilometres

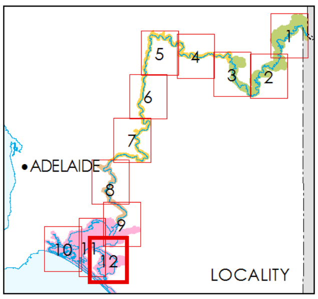
WATERCOURSE TYPES
- Permanent reach
- Seasonal reach
- Ephemeral reach

GEOMORPHIC REACHES
- Border to Overland Corner
- Overland Corner to Mannum
- Mannum to Wellington
- Lower Lakes and Tributaries

- Coorong and Lakes Alexandrina and Albert Ramsar Reserve
- Managed/regulated wetland
- Artificial wetland
- Wetland not assessed
- 1956 flood level
- Built up area
- Irrigated crop 2003
- Native vegetation
- Property boundary

NOTE: Results below Lock 1 reflect pre-2007 conditions

Produced by: DENR Science Resource Centre
Map Projection: Map Grid of Australia, Zone 54
Map Datum: Geocentric Datum of Australia 1994



DEH MapID: 2011-5576