

HEALTHY WETLANDS: MAPPING, CLASSIFYING AND PRIORITISING THE WETLANDS OF THE SOUTHERN RIVERS

A Kelly¹, C Price¹, A Gosling¹

¹ WetlandCare Australia, Ballina, NSW 2478

Abstract

Wetlands are some of the most productive ecosystems in NSW, contributing to the state's water quality and biodiversity. Over the years information collection and mapping have been undertaken for NSW wetlands, however, information sources are scattered. It is important to bring this data into a format that allows all wetlands to be assessed and prioritised, and to direct limited resources into rehabilitation and protection where it will have the most benefit.

The *Healthy Wetlands for Healthy Catchments in the Southern Rivers Region* project aimed to map, classify and prioritise wetlands, using existing spatial data, within the Southern Rivers Catchment Management Authority (SRCMA) area. The project team collected and collated existing spatial data from a range of sources, including Federal, State and Local Government and various other natural resource organisations. Collated wetland polygons were classified in accordance with a classification system based on the latest Wetland Habitat Typologies, recently developed by the Queensland Wetland Program. The result is over 150,000 hectares of wetlands mapped and classified into 23 different classes (20 natural and 3 constructed) within the 32,000km² Southern Rivers catchment area.

Data relating to the wetland's value and potential threats was also collected from the sources mentioned above. This spatially available data was assigned to each wetland polygon to assist in the wetland prioritisation process, giving each wetland an overall Potential Threat Score and Potential Conservation Value Score. This data and scoring will guide wetland managers on target sites for wetland protection, conservation and condition improvement across the SRCMA.

The project recently culminated in an on-ground component involving wetland health assessments and corresponding site action plans for 15 important wetland complexes, selected using the data and decision support system developed from the mapping. These site action plans will be critical in directing further on-ground works to the wetlands that need them the most.

Introduction

Wetlands are one of the most critical natural environments for the provision of a number of ecosystem services that benefit the wider community. These services include water quality improvement, flood mitigation, nutrient cycling, carbon sequestration, water supply, food provision and recreational, cultural and aesthetic values.

Australia is reported to have lost between 75 to 90 percent of coastal wetlands over the past 200 years (Finlayson, 2000. Usback & James 1993). Not only have wetlands been decimated historically through land clearing for agriculture and urban development and drained or isolated from adjoining wetlands, they remain one of the most severely threatened ecosystems in eastern Australia through coastal development and land use

impacts.

Many eastern Australian wetland ecosystems and species are now listed as threatened under both the federal Environmental Protection and Biodiversity Conservation Act 1999 and the NSW Threatened Species Conservation Act 1995 as a result of their vulnerability to possible extinction in the rate of wetland loss continues.

In order to retain healthy, resilient wetlands in eastern Australia, action is needed at a local and regional level to better understand wetland areas and to minimise further damage or loss. Local and regional resources are often limited, both in capacity and funding to undertake essential wetland rehabilitation and protection activities. To ensure efficient allocation of resources, it is important to identify priorities for investment based on the conservation value and threats faced by wetland systems.

The recent ***Healthy Wetlands for Healthy Catchments in the Southern Rivers Region*** project mapped, classified and prioritised wetlands, using existing spatial data, within the SRCMA area. The project team utilised a proven methodology developed by WetlandCare Australia to map wetlands for other Catchment Management Authorities throughout NSW and collated existing spatial data relating to wetlands from a range of sources.

This data was then used with a suite of tools to guide wetland managers in prioritising target sites for wetland protection, conservation and condition improvement across the SRCMA.

This paper outlines the methodologies used to collate the mapping, assignment of the value and conservation attributes and scoring systems. It provides a summary and examples of the products of the project and highlights recommendations for improved mapping and methodologies.

Methodology

Mapping

Defining wetlands

The following wetland definition was used for this project to delineate wetlands from other vegetation communities.

“Wetlands are areas of permanent or periodic/intermittent inundation, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed 6 metres.”

Wetlands were initially separated into four broad categories for the purposes of this project; estuarine, riverine, lacustrine and palustrine as defined by the Queensland Wetland Program developed typologies.

Using these definitions from the Queensland Wetland Program did not result in any issues when classifying wetlands in southern New South Wales. The wetland definition and broad category wetlands types are applicable throughout Australia. Modifications to the typologies occurred at the final, detailed typology level to ensure the typologies suited the wetlands encountered in southern New South Wales. The typology system is depicted in the diagram below (Figure 1).

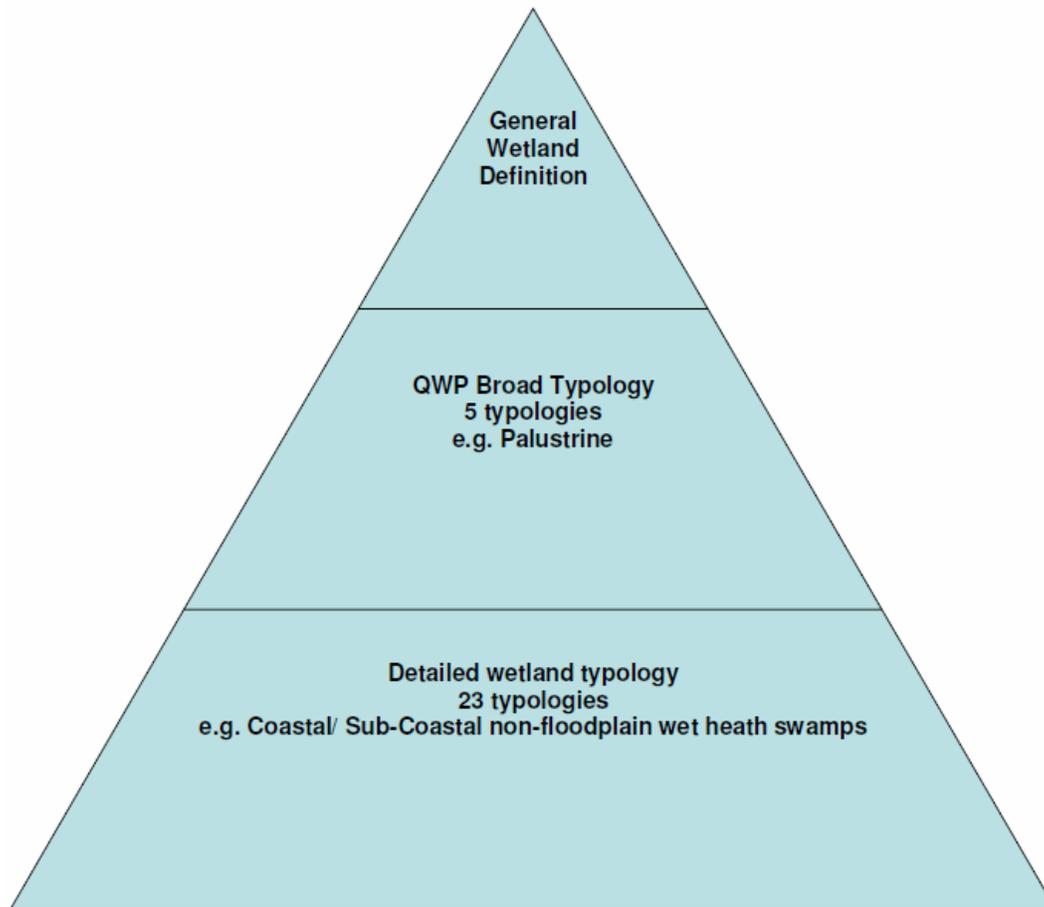


Figure 1. Typology system used with examples of both typology levels.

Project area

The project boundary was determined to be the Southern Rivers catchment area and was based on a layer provided by the SRCMA and formed the base layer for mapping (Figure 2). The premise was that the layer would give consistency for the varying datasets. The project area of the Southern Rivers catchment is described on the SRCMA website as reaching from:

"Stanwell Park in the north, to the Victorian border in the south, and includes the major river systems of the Shoalhaven, Snowy and Genoa"
(Southern Rivers Catchment Management Authority, 2010)

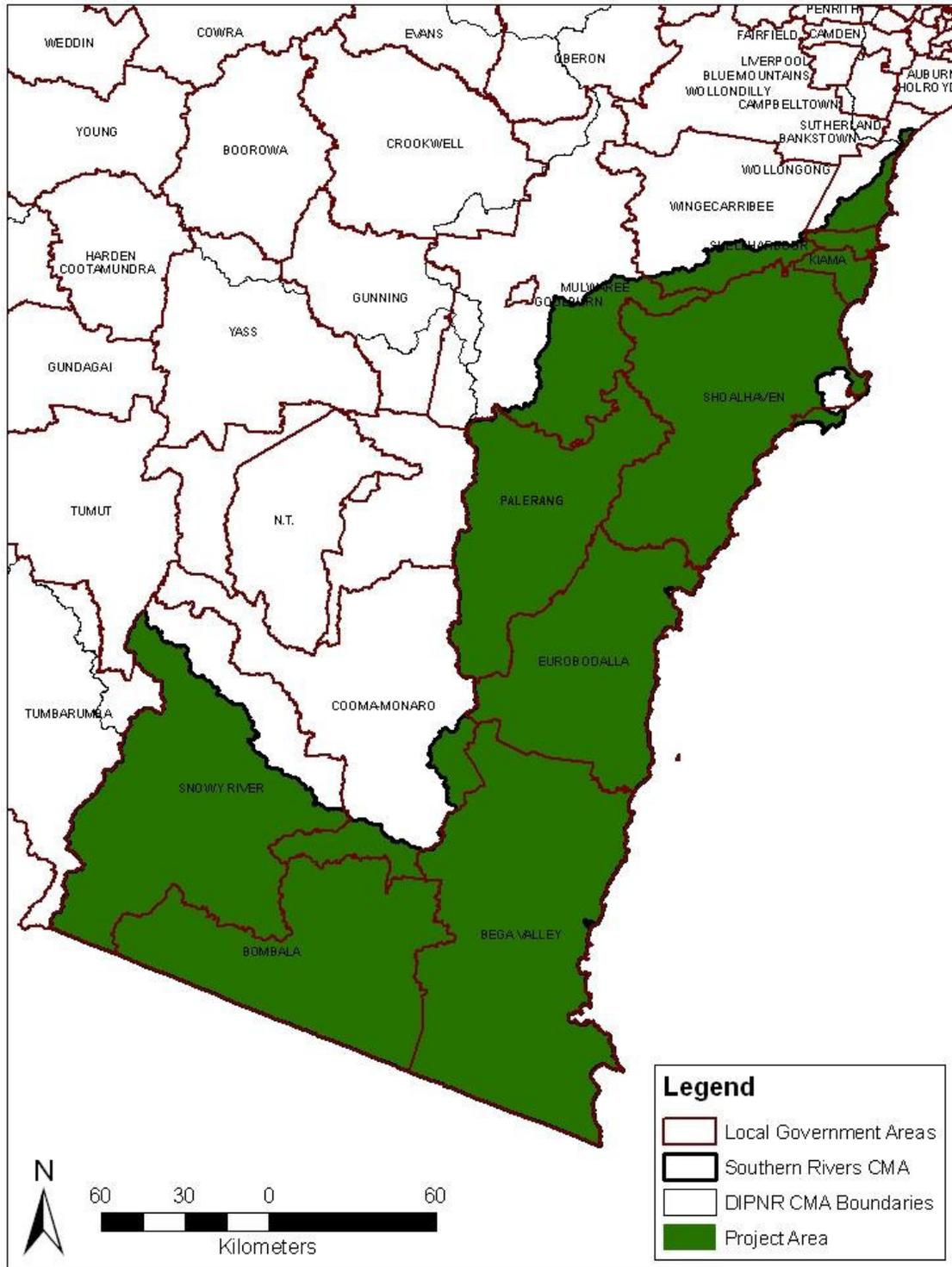


Figure 2. Project Area

Wetland map compilation

The final wetland map compilation layer consisted of 47 different data layers from varying sources. Their compilation was undertaken by;

1. Initial data checking – review of the layer for errors or anomalies
2. Wetland data extraction – data that was not relevant to wetlands inside each layer was excluded
3. Wetland element division – wetland data was separated into three elements; water, vegetation and geology
4. Quality assurance measures applied
5. Wetland complexes identified

Quality assurance measures

Where available, the data's age, scale and method of development was taken into account. A layer of 'higher' quality (newest, best scale, proven method of development) was 'overlain' over 'lesser' quality (older, poor scale, unknown or not proven method of development).

Where 'metadata' was not available to determine age, scale and method of development, the data was checked against 'known areas' for accuracy. (Data layers were not excluded because of a lack of accompanying information).

Data layers were projected to match the maps being produced and moved slightly, where necessary (Figure 4). Random checks of data layers against the Spot 5 imagery were conducted to ensure the correct assignment. Checks of known wetland areas (i.e. areas staff have ground truthed through workshop local knowledge) were completed to ensure the correct classes and attributes were being assigned.

Quality assurance checking procedures were 'run' on the final polygon dataset to ensure that there were no overlapping polygons, minimal slivers (without losing any wetland data), no 'null' value polygons and no void polygons. Where errors were identified they were corrected using various ArcGIS 9 functions and extensions.

Defining complexes

To assist with addressing on-ground management issues in entire wetland areas, rather than small pockets of wetlands (represented by individual wetland polygons of varying wetland types), wetland complexes were created to define groups of individual wetland polygons that could be managed together as a whole system. Wetland complexes have been named using local features such as waterways or towns. Wetland complex names are recommended to be reviewed to include local wetland names where possible (see Recommendations section).

Classification

Classification system

The compilation of many data layers resulted in each wetland polygon having different descriptions from different sources. To make the wetland descriptions more uniform a new classification system was created based on the Queensland Wetland Program's Wetland Habitat Typologies (a nationally recognized wetland classification system).

Initially all wetlands were grouped under the broader Wetland Habitat Typologies; estuarine, riverine, lacustrine and palustrine. A fifth class, marine, was employed by the Queensland Wetland Program but not utilised in this project. The marine typological class was not used for this project as it included areas that were both beyond the SRCMA area and includes waters greater than 6 meters below the lowest astronomical tide, which differs from the wetland definition accepted for the project.

It was necessary to further separate these broad typologies into more detailed typological classes. The detailed typological classes within the lacustrine and palustrine classes were taken directly from those developed under the Queensland Wetland Program, with a small number of alterations to suit the southern New South Wales wetland environment. The distinction between floodplain and non-floodplain detailed wetland types found within the lacustrine and palustrine typologies was facilitated by a spatial data layer. The detailed typologies for the estuarine and riverine broad typologies had not, at the time of classification, been developed by the Queensland Wetland Program. These detailed typologies (sub-classes within the broader estuarine and riverine typologies) were decided upon after consultation with the SRCMA. There is also an 'unclassified' class, this was assigned where there was a data layer showing the area as a wetland but the data lacked detail pertaining to the wetland type.

Table 1. Directory of Important Wetlands in Australia wetland classifications, including modifications.

<i>QWP Broad Typology</i>	<i>Detailed typology</i>
Lacustrine	<ol style="list-style-type: none">1. Coastal/ Sub-Coastal floodplain lakes2. Coastal/ Sub-Coastal floodplain lakes (Modified)3. Coastal/ Sub-Coastal non-floodplain lakes4. Coastal/ Sub-Coastal non-floodplain lakes (Modified)5. Upland lakes6. Upland lakes (Modified)7. Alpine lakes
Palustrine	<ol style="list-style-type: none">1. Coastal/ Sub-Coastal floodplain grass, sedge and herb swamps2. Coastal/ Sub-Coastal floodplain tree swamps3. Coastal/ Sub-Coastal floodplain wet heath swamps4. Coastal/ Sub-Coastal non-floodplain grass, sedge and herb swamps

	<ol style="list-style-type: none"> 5. Coastal/ Sub-Coastal non-floodplain tree swamps 6. Upland grass, sedge and herb swamps 7. Upland tree swamps 8. Upland wet heath swamps
Estuarine	<ol style="list-style-type: none"> 1. Estuary 2. Mangrove 3. Mud/ Sandflats 4. Saltmarsh 5. Seagrass
Riverine	<ol style="list-style-type: none"> 1. Riparian 2. River

Assigning classes

A typology was assigned to each wetland polygon. The class was determined by the descriptions included in the data layers used to compile the map and the spatial data layer used to distinguish floodplain wetlands from non-floodplain wetlands. Some descriptions can be found in both the floodplain and non-floodplain typologies as it was primarily the location of the wetland in relation to the floodplain spatial data layer that helped to determine the final typological grouping (e.g. Coastal/ Sub-Coastal non-floodplain tree swamps or Coastal/ Sub-Coastal floodplain tree swamps). If a wetland polygon did not include a detailed description it remained part of the mapping with an 'unclassified' classification.

These classes were further separated into upland (700m to 1800m), alpine (>1800m) or left as coastal/ sub coastal (<700m) by an elevation layer obtained from the Queensland Wetland Program. Additional to wetland polygon attribute information, the name of the spatial data layer and its metadata were used in considering whether the descriptor fell under the vegetation, water or geology groupings.

Prioritisation

The prioritisation process is made up of three components, attributes, indices and scores. Attributes relating to each wetland polygon were identified, these attributes group into indices that make up two final scores, the Potential Threat Score & the Potential Conservation Value Score. These two scores are used to determine wetlands that are a priority for protection, conservation and condition improvement (see section Attribute Scoring & Weightings for scoring).

Attribute relationship and Indices

Each of the two final scores, Potential Threat & Potential Conservation Value are made up of a series of attributes and indices.

Potential Threat Score: Includes Landuse Index, Development Index, Infrastructure Index, Environmental Impact Index & Climate Change Index

Potential Conservation Value Score: Includes Rehabilitation Index, Statutory Index, Landscape Index, Condition Index, Conservation Value Index

The relationship between attributes, indexes & scores is displayed in Figure 5.

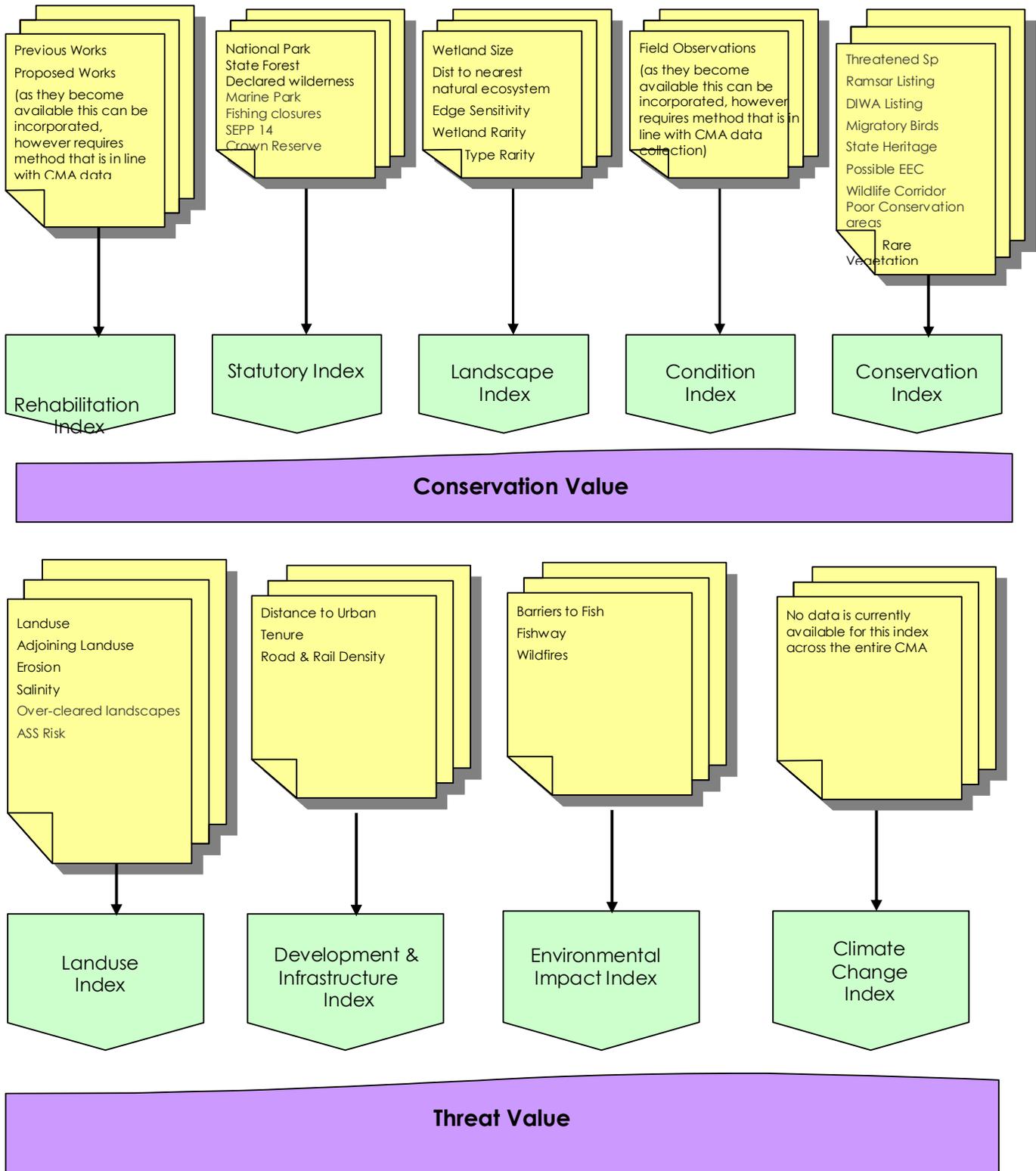


Figure 3. Summary of attribute relationships with Index and Scores used in prioritising wetlands.

Assigning attributes

Each wetland polygon was assigned a series of attributes, detailed below in three groups:

- General Attributes - these are used to identify the wetland and its location, and for refining the area of prioritisation (e.g. priority wetlands in the 'Eurobodalla catchment' only);
- Threat Attributes - these are used to compile the threat score used in the prioritisation process; and
- Conservation Attributes - these are used to compile the conservation score in the prioritisation process.

It was important for the prioritisation to be consistent across the project area, thus, only spatial data that was available for the majority of the project area and could viably be substituted in gap areas was able to be assigned to each wetland polygon. In some cases more detailed information relating to an attribute is available, but only for a small part of the project area. This data was not used in the prioritisation process to prevent 'bias' to areas with more detailed information. It is envisaged that this additional and more accurate data will be assigned to the relevant wetland polygons and used in prioritising wetlands on a smaller scale.

Attribute scoring and weightings

Each series of attributes that make up an index was assigned its own scoring system and attributes were also given two weightings.

- (a) Data Accuracy Weighting – an indication of the scale, age and method at which the data was produced.
- (b) Significance Weighting – an indication of the significance of the attribute in relation to the 'threat to' or 'conservation value of' the wetland.

This information was then combined in the following formula, to calculate the overall attribute contribution to the index score for each wetland polygon:

Index score = Total of (Attribute Score x Data Accuracy Weight x Significance Weight) for each attribute within the index

Complex prioritisation

Prioritisation of wetland complexes is an important procedure to determine which complexes are essential to focus on for on-ground management. Wetland complexes are made up of multiple wetland polygons, each polygon has all of the attributes, defined above, assigned to them and scored as described. Each wetland polygon has a total Threat Score and a Total Conservation Score. To determine a single score to prioritise Wetland Complexes for on-ground management the following formula was applied:

Average Conservation Score + Highest Conservation Score = Complex Prioritisation Score

This prioritisation score reflects the Catchment Management Authority's aims to protect high conservation value wetlands in their current planning. This formula can be changed to include threat values where prioritisation needs differ. This formula ensures that all of the scores from each polygon in the wetland complex is accurately represented. By including the highest conservation scored polygon in the complex this formula ensures that surrounding polygons do not mask the importance of a particular area within a wetland complex.

Project products

The products of this project include spatial data, pdf maps (Fig 8) and a decision support database. Spatial (or digital) data is available under licence from the SRCMA. The spatial data set includes the wetland polygons and all of the attributes used in the prioritisation process, plus their wetland id (relevant to the decision support database) complex number and complex name. A series of maps have been produced in pdf format. These are available on CD and on request from WetlandCare Australia and the SRCMA. The Decision Support database is geared to produce a range of reports to easily provide users with the information they require. The database is equipped with a user-friendly front-page that enables the user to access information easily for both wetland complexes and individual wetland polygons.

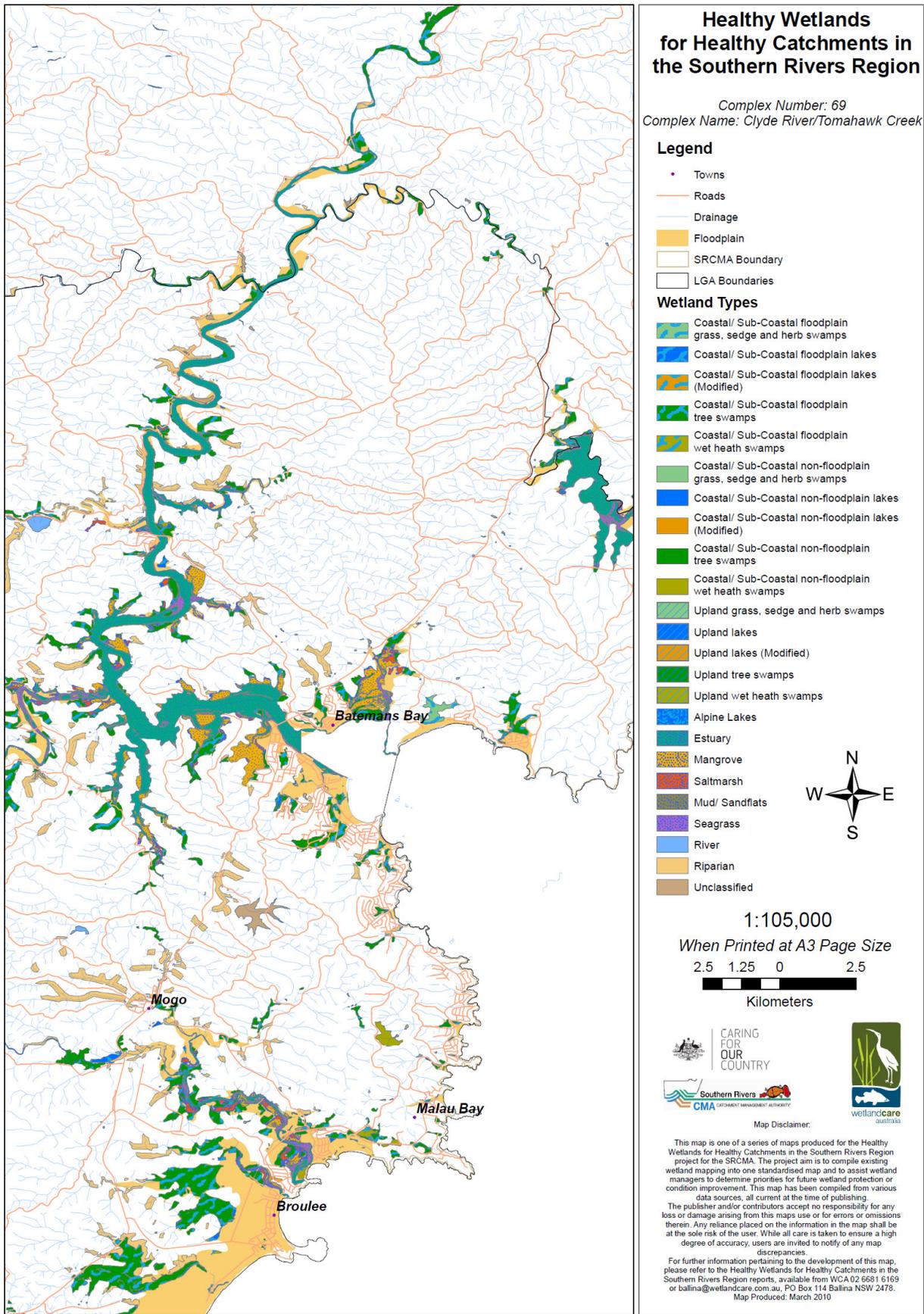


Figure 4. Pdf map of Clyde River/Tomahawk Creek wetland complex.

Decision Support Database

The Decision Support database is geared to produce a range of reports to easily provide users with the information they require. The database is equipped with a user-friendly front-page that enables the user to access information easily for both wetland complexes and individual wetland polygons. The diagram (Fig 9) below shows the information readily available to users via the front-page of the database:

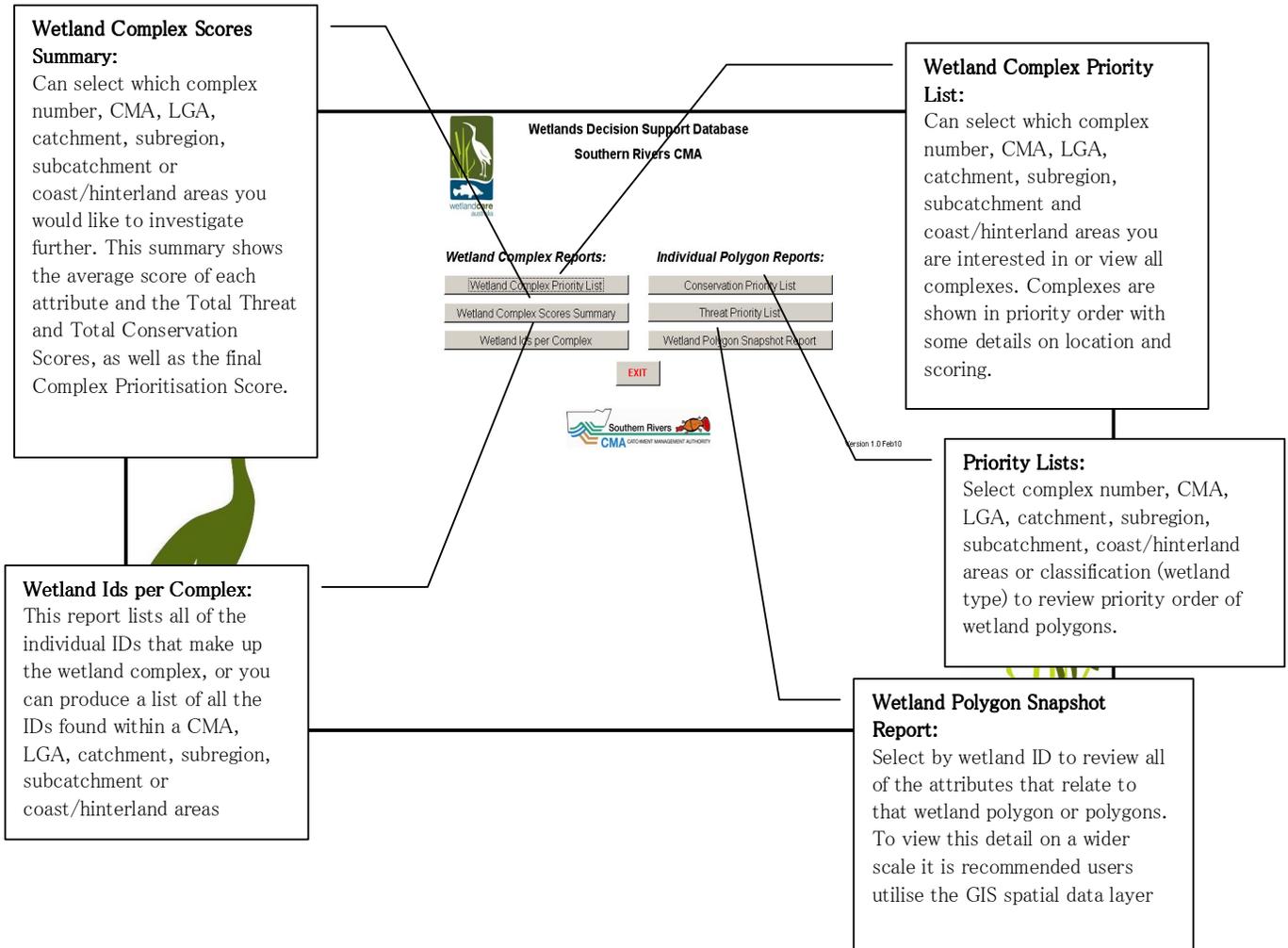


Figure 9. Database interface and details of reports produced.

Priority Lists – Complexes

Priority lists can be developed from the database in many different ways, as detailed in Figure 9, depending on the aims of different wetland managers.

Summary and Recommendations

This project successfully compiled a comprehensive wetland map and associated products for the Southern Rivers CMA area. It has since resulted in further assessment of fifteen priority wetlands in the region in preparation for on-ground works.

Key recommendations from this project include:

- encouraging all CMAs and NRMs in Australia to use or cross-reference one typological system when mapping wetlands;
- update attributes as additional and better quality data becomes available or inconsistencies are identified in the future;
- address the lack of wetland data available in the hinterland through an on-ground mapping project and incorporate these new polygons into the GIS layer and database;
- seek additional resources for the appropriate management in priority wetland complexes and polygons; and
- ground truthing of priority wetlands by LGA to fine-tune mapping.

References

1. Chafer, C.J., 1997, Biodiversity of Wetlands in the Illawarra: an inventory, Illawarra Catchment Management Committee, Wollongong.
2. de Jong, N. H., 2000, Wetland Plant Communities of the Lower Shoalhaven Region, AFFRC, Shoalhaven, NSW.
3. DECC, 2009, *Draft South Coast Regional Conservation Plan*, Department of Environment and Climate Change, Sydney.
4. Eco Logical Australia Pty Ltd , 2003, Wingecarribee Biodiversity Strategy – Phase 1, Wingecarribee, NSW
5. Environmental Protection Agency, 2005, Wetland Mapping and Classification Methodology – Overall Framework – A Method to Provide Baseline Mapping and Classification for Wetlands in Queensland, Version 1.2, Queensland Government, Brisbane. ISBN 0 9757 344 6 6.
6. EPA Queensland Wetland Program, 2009, DRAFT: Wetland Habitat Typology - Palustrine and Lacustrine Wetlands, Brisbane, NSW.
7. ESRI, 2002, Environmental Systems Research Institute Glossary (Help Manual), HCL Technologies Ltd., New Delhi.
8. Eurobodalla Shire Council, 2008, Matrix Criteria for Determining Wetland Rehabilitation Priorities, V2, Eurobodalla, NSW.
9. Jones, S., 2009, DRAFT: Explanatory Notes that go with Shoalhaven City Council Vegetation Mapping Project, Shoalhaven, NSW.
10. Knight, T and Evans, B., 2001, A Preliminary Archaeological Assessment of SEPP 14 Listed Wetlands in the Lower Shoalhaven Catchment Management Area, Shoalhaven City Council, Shoalhaven, NSW.

11. Mutendeudzi, M and Haeusler, T., 2008, Shoalhaven Illawarra Riparian Cover Mapping – Final Report. Southern Rivers Catchment Management Authority and Department of Water and Energy, Sydney.
12. nghenvironmental, 2007, Endangered Ecological Communities Survey and Mapping in Eurobodalla Shire, Bega, NSW.
13. Southern Rivers Catchment Management Authority, viewed 17 June 2010, http://www.southern.cma.nsw.gov.au/our_catchment-SRCMA_region.php.
14. Walter, K and Schelling, K., 2005, Remote sensing mapping of grassy ecosystems in the upper catchment of the Shoalhaven River (Southern tablelands section): Report to the NSW Department of Environment and Conservation, Queanbeyan.
15. Finlayson, C. M. (2000) Loss and Degradation of Australian Wetlands. Paper for LAW ASIA Conference: Environmental law issues in the Asia-Pacific region. Darwin, Australia.
16. Usback, S. & James, R. (compilers). 1993. A Directory of Important Wetlands in Australia. Australian Nature Conservation Agency, Canberra, Australia.