

SECTION 2

Wetland inventory process

Wetland inventory is the process for determining and recording the location, number and specific characteristics of wetlands within a given area (Costa *et al.* 1996). The Fleurieu Peninsula wetland inventory consists of a spatial/relational database of wetland sites that contains information such as location and size, physical and biological features, human activities and impacts, and wetland function and values for the Fleurieu Peninsula region. The data collected provides baseline knowledge of the wetland resources within a region. This allows for informed and strategic decision making in regard to targeting future conservation, management, planning, and policy efforts.

The wetland inventory method generally follows Phases identified in Figure 0.1.

2.1 Inventory development

A survey protocol was developed specifically for the Fleurieu Peninsula wetland inventory allowing for the rapid collection of essential biological and physical quantitative and qualitative data for selected wetlands.

Numerous existing wetland inventory methods were researched and elements of all were adapted to suit the specific requirements of the Fleurieu Peninsula. The protocol is required to meet the criteria of several State and National inventory procedures and must also meet minimum dataset requirements for the collection of biological data in South Australia (DEH 2003).

Table 2.1 lists particular wetland inventories adapted for the Fleurieu Peninsula wetland inventory. A draft protocol was formulated and edited by several wetland experts before the final protocol was set.

Table 2.1. Existing wetland inventory methods used in the development of the Fleurieu Peninsula wetland inventory.

Title	Reference
Simplified method for wetland habitat assessment .	Cable <i>et al.</i> 1989
Techniques for survey, inventory and classification. In: <i>Manual of Wetlands Management</i> .	Beilharz 1996
Mediterranean Wetland Inventory (MedWet): Volumes 1 – 4.	Costa <i>et al.</i> 1996
Development and testing of a rapid appraisal wetland condition index.	Spencer <i>et al.</i> 1998
Wetland Inventory and Habitat Requirements – Wetlands Waterlink	Wilson 1999
A Manual for an Inventory of Asian Wetlands: Version 1.0.	Finlayson <i>et al.</i> 2002
A Ramsar framework for wetland inventory. In: <i>Wetlands: water, life, and culture</i> .	Ramsar Convention Bureau 2002b
Wetland Inventory for the Mount Lofty Ranges. Wetland Inventory for Kangaroo Island Wetland Inventory for Eyre Peninsula Wetland Inventory for Northern Agricultural Districts	Seaman 2002a Seaman 2002b Seaman 2002c Seaman 2002d
Coorong & Lower Lakes Ramsar Habitat Mapping	Seaman 2003
Wetland Inventory: Corangamite Region, Victoria.	Harding 2004
Framework for developing an Australian Wetland Inventory	Finlayson 1999 Finlayson 2004

Aims of the assessment methodology

Based on the analysis of wetland inventory and survey techniques listed in Table 2.1, the Fleurieu Peninsula wetland inventory aimed to develop a wetlands survey protocol that:

- Is consistent with existing State, Commonwealth and International assessment protocols;
- Provides a rapid assessment of wetlands values, character, condition and threats that is easily applied by both specialists and non-specialists;
- Maximises the value of data collected (where value is defined in terms of usefulness in guiding management activities, project implementation and funding decisions);
- Provides standardised field data collection sheets; and
- Is capable of regular revisions and updates of information providing for future long-term analysis.

Wetland rapid assessment methodology

The Fleurieu Peninsula wetland inventory protocol was designed to focus on defining and describing wetlands at both the 'wetland' and 'habitat' scale. Differing wetland habitats can occur in the same wetland complex, and have variable characteristics. For example, wetland habitats may not necessarily experience the same water regime, ecological characteristics or require/undergo the same form of management (Finlayson *et al.* 2002). Thus many of the larger wetland complexes were assessed in sectors where habitats and management related issues were variable.

For each wetland (or sector of a wetland) surveyed, the data attributes presented in Table 2.2 were collected. The wetland survey data sheets used for this inventory and the accompanying instruction manual are given in Appendix 3 and Appendix 4 respectively. Details of private property ownership were not collected due to privacy clauses and this information was not included in the resulting databases.

The protocol developed was designed to allow rapid field assessments of each wetland (or wetland sector) surveyed. The survey forms were designed to be completed within 1 – 1.5 hours at each wetland site. This allows for a standardised survey effort for each site, although survey effort was largely dependent on the size of the wetland being surveyed.

The wetland inventory field survey was based on representative cross-section transects of the wetlands walked by the surveyor. This provided a simplified method of recording dominant species within wetland inundation zones (refer to Appendix 4). Traditional quadrat-based vegetation survey techniques as described in Heard and Channon (1997) were considered unsuitable for wetland inventory purposes due to high variability in wetland vegetation associations as a result of varying inundation periods within the wetland. Quadrat-based survey would be too time consuming and beyond the scope of the wetland inventory.

Table 2.2. Data attributes collected during the field survey for each wetland (refer to Appendix 3 and 4).

Subject area	Attributes
Reference Data	<ul style="list-style-type: none"> ▪ Date and time ▪ Compiler details ▪ Organisation / project ▪ Location description ▪ Wetland ID (reference number) ▪ Wetland name ▪ GPS location ▪ List of site photos ▪ General Comments / Sketch map
Land tenure and Land use	<ul style="list-style-type: none"> ▪ Tenure – on-site and surrounding ▪ Land use – on-site and surrounding ▪ Management authority ▪ Social / Cultural values and Recreational facilities

	<ul style="list-style-type: none"> Fire History (year of fire)
General Hydrology & Landform	<ul style="list-style-type: none"> Wetland system Landform element Wetland origin Water regime Water source / name of feeding watercourses Water Depth (average and maximum) Presence of flow control structures
Wetland Classification	<ul style="list-style-type: none"> Category (Directory of Important Wetlands in Australia) Criteria for wetlands of National importance (Directory of Important Wetlands in Australia) Fleurieu Peninsula Swamp category
Threatening Processes	<ul style="list-style-type: none"> Disturbances / Management issues Current extent of disturbance Conservation measures taken (current and suggested)
Surface Water Chemistry	<ul style="list-style-type: none"> Conductivity pH Dissolved Oxygen Temperature Turbidity Water depth and flow at reading sites
Biological Characteristics	<ul style="list-style-type: none"> Vegetation zones present Vegetation layers present (plant growth forms) Width of buffer zone and percentage of wetland surrounded by buffer vegetation Cover of aquatic vegetation Amount of attached algae Vegetation height (understorey / overstorey) Flora diversity – including a list of species within each vegetation zone and cover abundance for each Fauna diversity and presence – including a list of species noted at the time of survey Weediness – including introduced species cover and richness
Subjective Assessment	<ul style="list-style-type: none"> Subjective assessment of aquatic and riparian vegetation condition Subjective assessment of entire wetland condition

2.2 Wetland mapping

Wetland mapping for the Fleurieu Peninsula region consisted of identifying, delineating and broadly classifying wetlands from remotely sensed images.

The development of wetland maps for the Fleurieu Peninsula region involved the use of 1:5 000 resolution rectified colour aerial photography and existing GIS coverages including:

- Inner Rural Series 2 (0.5m aerial photography);
- Digital elevation model (modelled from contours layer);
- Veg_SthMtLofty (Native Vegetation (floristic) – South Mount Lofty Ranges) subset of floristic types indicative of wetland environments;
- Wetlands – State-wide (incomplete);

- Emuswamp (swamps identified by Mt Lofty Ranges Southern Emu-wren Recovery Project);
- Topographic 1:50 000 waterbodies;
- Topographic 1:50 000 contours;
- Topographic 1:50 000 drainage;
- Sa_dir (Directory of Important Wetlands); and
- Catch_s (sub-catchment boundary).

Refer to Appendix 5 for descriptions of GIS layers.

Fleurieu Wetland GIS layer

A new GIS coverage was developed to store wetland boundaries and associated data for the Fleurieu Peninsula wetland inventory. An attribute table was created for the new layer that enabled data to be stored for each new polygon created. Refer to Appendix 6 for Fleurieu Wetland layer metadata.

Data from existing wetland boundaries were copied into the new layer and merged, adjusted or deleted where necessary to provide a single complete wetland spatial dataset for the region. This included the Emuswamp layer, topographic waterbodies and the floristic vegetation subset using only those vegetation communities indicative of wetland ecosystems (refer to Appendix 7). Previously unmapped wetlands were identified and digitised into the new layer from the aerial photography with the aid of ancillary data such as drainage, contours and digital elevation models. Refer to Figure 2.1 for illustration of wetland mapping methods.

The GIS program MapInfo Professional® 7.0 was used to perform all spatial data manipulation. All data was converted to MapInfo Tab file format, projection MGA54, datum GDA94.

The spatial data generated for the purposes of the Fleurieu Peninsula wetland inventory is to be included in the Wetlands – State-wide GIS coverage for South Australia at the conclusion of the inventory.

Wetland Numbering System

A Statewide numbering system was developed for identifying wetlands which follows the system established for the Murray River wetlands (Jensen *et al.* 1996) and used in the State-wide DEH wetland layer. The system numbers wetlands with the letter S (indicating South Australia) followed by a four-digit number where the first number indicates the region the wetlands occur within. For example, the Mount Lofty Ranges are assigned numbers S2000 to S2999.

A revision of the wetland numbering system in the DEH wetland map layers highlighted several incapacities of the original numbering system – namely the inability to store large numbers of wetlands per mapping region. A revised numbering system with greater capacity has been developed based on the original system and now consists of an eight-character field (e.g. S0200001). As this numbering system was implemented post-completion of the Fleurieu Peninsula wetland inventory, the original five-character identification codes are used throughout this report.

The Fleurieu Peninsula wetland inventory is included in the Mount Lofty Ranges region. Numbering for Fleurieu Peninsula wetlands follows existing wetland inventory work in the Mount Lofty Ranges region completed by Seaman (2002a). The wetlands mapped for the Fleurieu Peninsula wetland inventory are assigned numbers S2110 to S2968. These numbers were automatically assigned to polygons created during the mapping process and are used as the primary linking fields in the South Australian Wetland Inventory Database (SAWID) system.

Wetland Condition

During the digitising of polygons from aerial photography for the new wetlands layer for the Fleurieu Peninsula wetland inventory, a broad indication of the condition of the wetland is given (severely degraded; degraded; moderate; intact; pristine). This was determined by visually inspecting the aerial photography and was assessed using criteria such as surrounding vegetation condition, the presence of riparian vegetation, apparent density of vegetation and presence of overstorey species.

Existing wetland GIS layers including Mount Lofty Ranges Southern Emu-wren Recovery Program map data (Emuswamp) and native vegetation mapping (Veg_SthMtLofty) assisted this process.

Field survey data concerning condition of wetlands was incorporated into the condition values and updated where necessary. This wetland condition provides an indication only and cannot be considered entirely accurate (see Section 4.4).

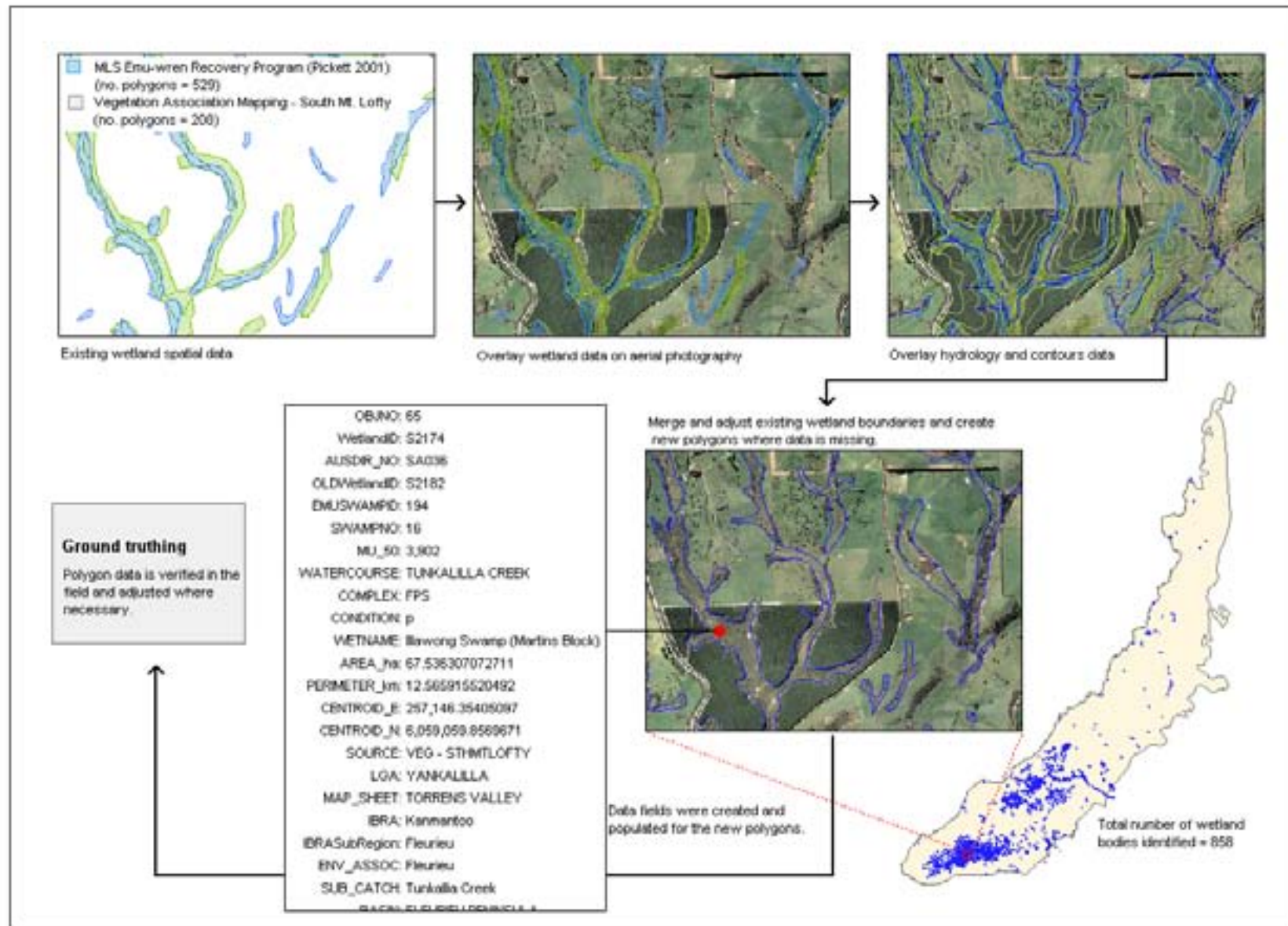


Figure 2.1. Wetland mapping method.

Accuracy assessment of spatial mapping

The accuracy of mapped waterbodies was assessed during field surveying of both wetlands included in formal field survey and wetlands visible from road-sides. Many adjustments, additions and deletions were performed after ground-truthing to complete the final mapping for the Fleurieu Peninsula.

The use of aerial photograph interpretation resulted in high accuracy of the final maps. Errors of commission were more commonly encountered during ground-truthing than errors of omission. Some irregularities and over-estimations of wetland area remain in the completed data.

2.3 Data management

South Australia Wetland Inventory Database

The South Australia Wetland Inventory Database (SAWID) was created in Microsoft Access 2000® format and contains all data collected through the inventory process. The database was created in the process of completing the wetland inventory for the Fleurieu Peninsula, and has since been expanded to handle data collected for other wetland inventories within South Australia. The database is to be used for current and future wetland inventory DEH initiatives in South Australia including Lower South East region (Taylor, due 2006); Channel Country region (Wainwright, due 2005); Great Artesian Basin Springs (Gotch, due 2006) and as the primary tool for a desk-top inventory of all wetlands and lakes within protected areas (Wainwright 2004). A basic description and user guide for SAWID is provided as Appendix 8.

The database contains all fields outlined in Appendix 4 and is designed for easy data entry from the standardised data sheets (Appendix 3). The structure of the database enables many surveys to be stored for each wetland body, thereby providing useful data for monitoring and evaluation in the future. SAWID is a computerised database engine with data/metadata entry and querying interfaces, and GIS display and querying capabilities. This database served as the primary data management / storage / retrieval component of the project.

SAWID was designed with a user-friendly interface and is formatted to potentially include all State-wide wetland inventory data and to be suitable for data-entry for future wetland inventory data. However, it is important that all biological survey data be stored in a permanent State-wide system. This exists in the form of an Oracle® based database and is held by Department for Environment and Heritage. It is expected that the SAWID will be included in the DEH Oracle® biological databases for South Australia by 2006 - 2007.

Data entry and manipulation

Several GIS analyses were performed on the wetlands spatial layer created for the Fleurieu Peninsula wetland inventory. Data that could be derived spatially for each wetland polygon included location information such as:

Major ecological boundaries:

- Interim Biogeographical Region of Australia (IBRA) & Sub-IBRA regions;
- Environmental Association;
- Catchments: Major Basin & Sub-catchment;
- Elevation;
- Rainfall band;
- Directory of Important Wetlands ID number; and
- Ramsar sites.

Spatial parameters:

- Area & Perimeter; and
- Geographic location: Centroid X & Y values, and MGA zone.

Jurisdictional boundaries:

- Local Government Authority;
- 1: 50 000 Map Sheet Number;
- Catchment Board;
- Tenure (Private/Public);
- Park (Conservation) Name;
- Heritage Agreement Number; and
- National Estate.

These data were linked using GIS to the specific Wetland ID given to each wetland polygon, and subsequently updated into SAWID tables. This process eliminated the need for manual entry of these basic data fields.

A number of sources of biological data could also be entered into SAWID with the use of GIS queries. These included data from Biological Databases of South Australia (BDBSA); frog census data (Frogwatch) and some water chemistry data (EPA).

Spatial GIS queries identified flora and fauna records that fall within the wetland polygons from the BDBSA (Survey, Opportune, Plant Population and Reserve databases) and frog census data. This data was manipulated to fit the format required by SAWID and pasted into relevant tables within the database.

Manual data entry was required only where data from existing studies had not been entered into BDBSA or other suitable electronic format (e.g. excel spreadsheet with position co-ordinates), or for the entry of new data generated through field survey for this project.

Through this process, data for a total of 858 wetlands within the Fleurieu Peninsula region were entered, including over 1000 individual surveys within these wetlands.

SECTION 3

Sampling procedure

Due to the large number of wetlands identified within the study area through mapping procedures discussed in Section 2.2, it was not practical within the scope of the project to survey each individual wetland. A sampling strategy was therefore necessary in order to strategically survey wetlands of greatest importance. The sampling strategy draws upon information and data generated through methods described in Sections 1 and 2 of this report.

Analysis of existing wetland data entered into SAWID highlighted several data deficiencies in current wetland knowledge for the Fleurieu Peninsula including:

- wetlands that have never been surveyed;
- a lack of dominant vegetation data for most wetlands;
- sub-catchments where wetlands have not previously been surveyed; and a
- lack of basic hydrological / chemical information for almost all wetlands.

These data deficiencies were taken into account to strategically select wetlands for further data collection as part of the inventory process. Wetlands where sufficient data existed were of less importance for sampling.

Wetlands within publicly owned land were given high priority for survey due to ease of access, and the likelihood that wetlands on reserves would be in intact condition and therefore more likely to meet criteria for important wetlands in Australia. Wetlands on private property that are known to be in good condition (either identified by aerial photograph interpretation, expert knowledge, or review of existing data) were also given high priority for further survey within the wetland inventory project. A project steering committee was formed to assist with the identification of important wetlands and priorities for survey work.

3.1 Priority sub-catchments

A number of sub-catchments were identified as areas of priority for further survey effort within the scope of the wetland inventory. Figure 3.1 illustrates survey effort on a sub-catchment scale within the study area.

Priority sub-catchments were determined from the analysis of survey effort in relation to known dominant vegetation presented in Figure 3.1. Sub-catchments with no wetland data (0% survey effort) and those with less than 10% of wetlands surveyed were considered priority sub-catchments for field survey. These included:

Priority 1 sub-catchments (0% surveyed)

- Marne River;
- Reedy Creek;
- Bremer-Barker;
- Angas River;
- Long Marsh;
- Tent Rock;
- Blowhole Creek; and
- Stockyard Creek.

Priority 2 sub-catchments (<10% surveyed)

- Finniss River;
- Currency Creek;
- Carickalinga Creek; and
- Yankalilla River.

The priority sub-catchments identified were taken into consideration in the ranking of priority wetlands for survey.

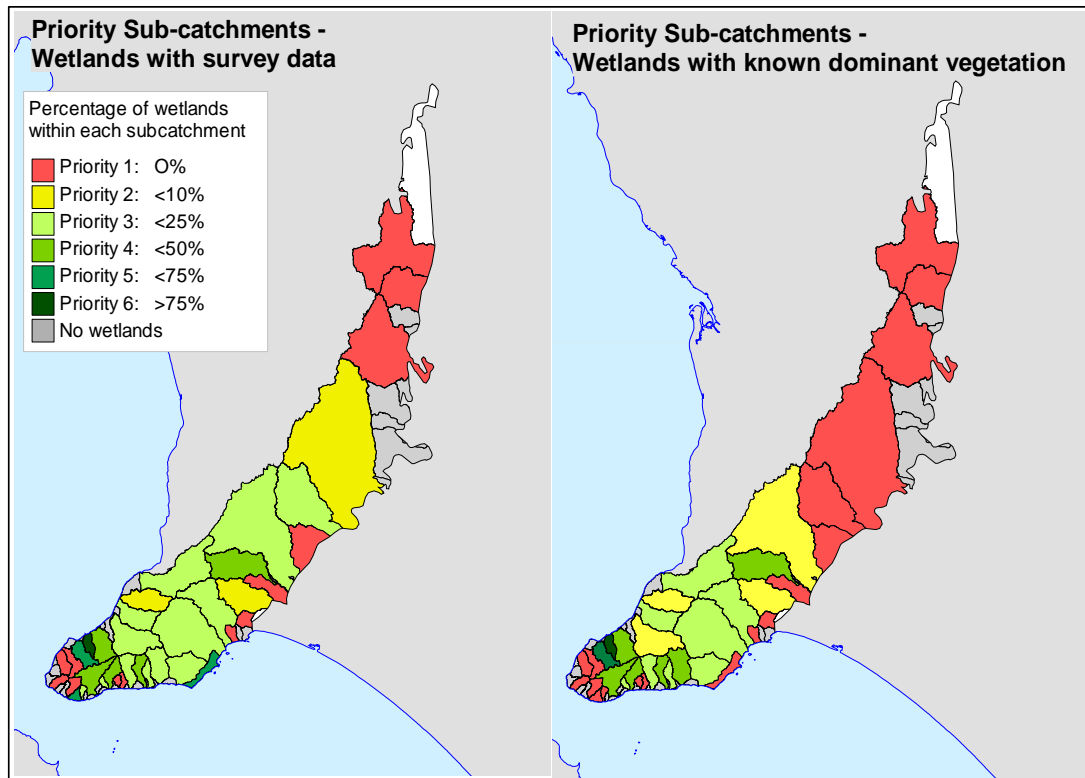


Figure 3.1. Priority sub-catchments for field survey identified through existing survey effort.

3.2 Priority wetlands for survey

A ranking system was developed that uses the data incorporated in SAWID to strategically identify wetlands that were high priorities for field survey. The ranking system was devised to reflect priorities relating to the major aims of the wetland inventory (ie, to identify wetlands of National importance) and to provide base-line data for a selection of wetlands identified in the study region.

A set of criteria were determined to assist in identifying priority wetlands for field survey using the data available:

- Number of surveys (sampling efforts) that have been completed within each wetland body;
- Presence of dominant floristic information including vegetation associations;
- Wetlands within priority sub-catchments;
- Wetlands within potential water stress areas (as defined by DWLBC catchment stress modelling);
- Condition of wetlands (determined from aerial photo interpretation);
- Known to contain habitats classified as Fleurieu Peninsula Swamp (see Appendix 1);
- Total area of the wetland body; and
- Tenure.

Additive ranking analysis

Each parameter to be scored was divided into data ranges. Scores were assigned to each of the range values within each parameter. These were subjectively assigned to each range relative to perceived field survey importance. For example, wetlands that have been well surveyed in the past were a lower priority than those where no ecological data exists. Table 3.1 shows the scores assigned

to each data range within each parameter. A negative score was assigned to wetlands that have had > 30 sampling efforts.

Scores for each parameter were added for each wetland to obtain a “Field Survey Priority Score” (maximum score = 10, where high scores indicate high priorities).

Table 3.1. Priority scores assigned to ranking parameters for identifying wetlands of high importance for field survey.

Parameter	Description	Score
Number of Surveys	< 5 surveys	2
	5 – 30 surveys	0
	> 30 surveys	-2
Known dominant vegetation	Yes	0
	No	1
Wetlands within priority sub-catchments	Priority 1 Sub-catchment	2
	Priority 2 Sub-catchment	1
	Priority 3-6 Sub-catchment	0
Wetlands within high water stress area	Extremely Stressed	1
	High Stress	0.5
	Moderate – Minimum Stress	0
Condition	Intact	1
	Good	0.5
	Degraded	0
Fleurieu Peninsula Swamps	Yes	1
	No	0
	Unknown	0.5
Total area of wetland	<10 ha	0
	>10 ha	1
Tenure	Private	0
	Public	1
Maximum Score		10

The Additive Ranking Analysis was performed for each wetland within the Fleurieu Peninsula region using SAWID. This was an automated process using several purpose built queries. The priority scores were exported into GIS format and updated into the wetland polygon layer. This enabled the mapping of priority wetlands.

A total of 16 wetlands were identified as high priorities (priority 1) for field survey, and 64 wetlands as priority 2 (Table 3.2). Wetlands identified as priority 1 and 2 through the analysis were targeted for field survey, followed by wetlands of lesser priority (Figure 3.3) identified as of high importance.

Table 3.2. Number of wetlands identified for each Priority range.

Field Survey Priority	Priority score range	No. of wetlands
Priority 1: Highest priority	> 6	16
Priority 2	5 - 6	64
Priority 3	4 - 5	175
Priority 4	3 - 4	385
Priority 5: Lowest priority	< 3	218

3.3 Field survey

Field survey of wetlands was conducted between February and October 2004, with the majority of surveys conducted in the spring months (September – October). A total of 138 wetlands were field surveyed within this time (see Plate 3.1). An additional 134 wetlands were ground-truthed from roadside vantage points and through collaborative work with MLRSEWRP Swamptrial project (M. Drew pers. com). Map 1 (back of this report) identifies the locations of wetlands surveyed for the Fleurieu Peninsula wetland inventory.



Plate 3.1. Field survey for Fleurieu Peninsula wetland inventory.

The majority of wetlands surveyed (72%) were within privately owned property (Figure 3.2). Access to privately owned wetlands was gained through the permission of the relevant landholder or manager, which were identified via digital cadastre data and Property Assist®¹. A total of 97 private properties were visited throughout the duration of field survey.

Some private properties containing high priority wetlands were not visited due to difficulties locating contact details or were not included in the survey at the landholders request (only one instance of denied access was encountered during field survey preparations).

Wetlands within publicly owned land including Conservation Parks and Reserves (Deep Creek CP, Stipiturus CP (Glenshera Swamp), Waitpinga CP, and Newland Head CP), and Forestry SA reserves were also surveyed. Figure 3.3 indicates the percentage of wetland surveys conducted for the Fleurieu Peninsula wetland inventory within each major land management tenure.

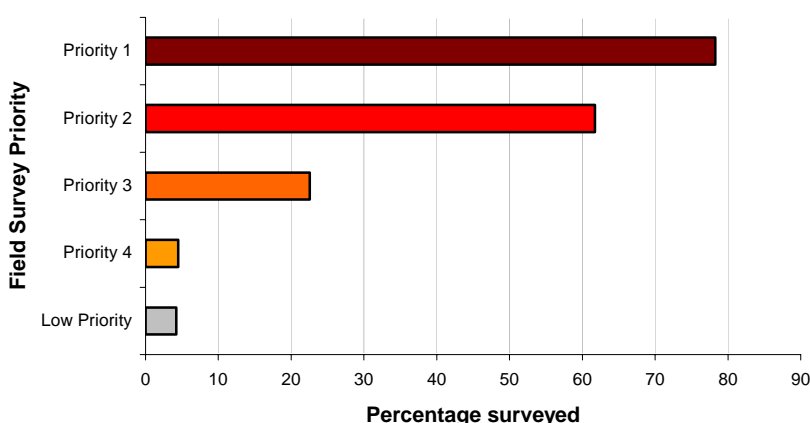


Figure 3.2. Percentage of priority wetlands surveyed.

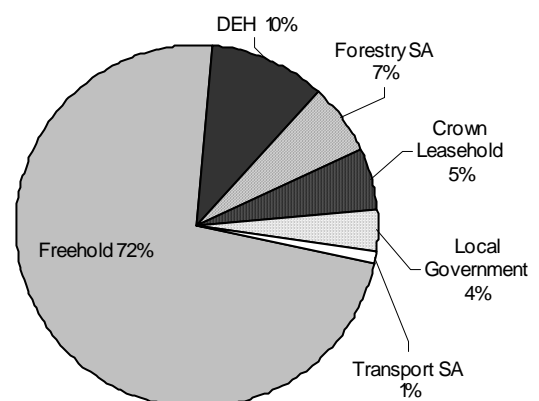


Figure 3.3. Percentage of wetlands surveyed across differing land tenures.

¹ Property Assist® is an online tool maintained by the Land Services Group of the South Australian Government that provides spatial land information and was used to identify land owners. See www.propertyassist.dais.sa.gov.au/pa/index.phtml