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Wetlands of the Great Artesian Basin Water Control District (Northern Territory)

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By Angus Duguid
Natural Resources Division
Department of Natural Resources, Environment, the Arts and Sport
PO Box 1120
Alice Springs NT 0871

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Front Page Image: interdune lakes in the Snake Creek section of the Finke River floodout (photo by Peter Latz, November 2001)

Executive Summary

This report describes wetlands of the portion of the Northern Territory (NT) that overlies the aquifers of the Great Artesian Basin. This area has been declared as the Great Artesian Basin Water Control District; and a water allocation plan is being prepared. The plan will focus on the groundwater resource but will also consider surface water, including ecological values of wetlands. The purpose of this report is to support the preparation of the water allocation plan.

The geography, climate and hydrology of the area are described here to assist in understanding the ecology of the wetlands. The Water Control District is very large and encompasses most of the NT portion of the Simpson Desert. The parallel sand-dunes of the Simpson Desert are dominant landscape features. The control district also has a few small hills and areas of flat or undulating stony plains; and these influence the location and nature of some of the significant wetlands. The area has very low rainfall, being part of the most arid region in Australia. However, major rivers flow into the Water Control District from higher rainfall areas with elevated rocky terrain such as the MacDonnell Ranges, Harts Range and Dulcie Range.

The variety of wetland types known from the Water Control District is described here, with comments on their abundance and ecological characteristics. There are no perennial waterholes or springs recorded in the area. Most of the temporary waterholes in rivers are believed to last only a few months after river flows. Following river flows, some waterholes may last for longer periods (in the order of one year) but there is very litte information on this. All the major rivers flood-out among sand-dunes of the Simpson Desert, and only the Finke River extends through the Water Control District, with one of its terminal floodouts being in South Australia. The floodouts are major landscape features of the Water Control District. All the floodouts contain areas where water persists for weeks or months in swamps or pans, however, these wetland areas are a small proportion of most of the floodouts. In contrast to the floodouts of the other rivers, the Finke River floodouts include an extensive group of large swamps and lakes between sand-dunes. These fill when episodic large flows occur (e.g. every 10-20 years) and some can hold water for more than a year.

There are also many wetlands that are not filled from river flow. These include scattered claypans in the swales between sand-dunes. However, the majority are adjacent to low rocky hills or stony clay plains known as gibber. These include some notable aggregations of pans, some of which include lakes in which salinity influences plant and animal life and which are loosely referred to as salt lakes. The degree of salinity is not documented for any of these 'salt lakes' and neither are hydrogeological processes. Many are likely to be semi-saline rather than saline under formal definitions.

Major wetland aggregations include those in the south-east corner (Poeppel Corner), the Lake Caroline area, two groups west of the Plenty River (the upper and lower Plenty Lakes), the central Andado area, and the southern New Crown area. Some shrubby swamps occur, dominated by species such as Northern Bluebush, Swamp Bluebush, and Swamp Canegass; and some of these swamps are moderately large, such as Indinda Swamp and Duffield Swamp.

A substantial diversity of wetland plants and animals are recorded from the Water Control District. One of these is listed as vulnerable to extinction; a small sedge called the Dwarf Desert Spike-rush. Across the Water Control District, survey records of the species that occur at individual wetlands are sparse, making it difficult to assess the conservation significance (or ecological importance) of particular wetlands. In this report, factors such as number and size of wetlands in an aggregation, the longevity of water and the distinctiveness of individual wetlands have been taken into account in order to assess significance. A collaborative project to systematically determine significant aquatic ecosystems (wetlands) in the Lake Eyre Basin was completed in 2010 and contributes to assessing wetland significance in the Water Control District. There are several documented 'Sites of Conservation Significance' (SOCS) in the Water Control District and wetlands and associated species are among the values that contribute to the significance of some of these SOCS.

This report includes descriptions of selected wetlands and wetland aggregations. The information is collated from various sources. However, this report should not be treated as a comprehensive wetland inventory of the area. Likewise, the report does not provide a rigorous treatement of the hydrological processes, even though hydrological observatins and inferences are provided to assist with understanding the wetlands.

This report highlights the diversity of wetlands that occur. It also highlights knowledge gaps that could be filled with further survey and mapping of wetlands. Currently many wetlands are not mapped and for those that are mapped, the type of wetland is not known. Systematic mapping combined with field survey of biological values would enable more reliable assessment of conservation significance.

Acknowledgments

Anne Pye, Jason Barnetson and Simon Fulton undertook aerial survey flights with the author. The pilots are thanked for their skillfull operation of the aircraft. Ringwood and New Crown Stations are thanked for the use of their airstrips and hospitality.

Anne Pye commissioned this report in order to assist with her preparation of the related Water Allocation Plan. Anne provided background information, commented on drafts of this report and provided encouragement, as well as taking some of the aerial survey photographs.

Jason Barnetson processed satellite imagery to detect surface water and synchronised photography and GPS data from aerial survey work, as well as taking many of the aerial survey photographs and advising on spatial data issues.

Peter Latz provided much information and valuable insights based on various biological survey expeditions. This included recent surveys to the Allitra tablelands area, the Northern Plenty Lakes and the Lake Caroline lakes, undertaken with Rachel Paltridge and Jayne Brim Box in 2010. Peter also kindly proof-read a draft of this report.

Simon Fulton provided information on hydrogeology and hydrology via personal communications and in his draft technical report on hydrogeology of the Wtaer Control District.

Graham Ride commented on a draft and provided advice on hydrological content.

Jane Duguid helped with proof-reading.

Various NT Government staff took photographs that have been used, particularly David Albrecht. Colleen Costelloe of Andado Station took one of the photographs of Old Andado Station.

Images from Google Earth were extracted using a licensed copy of the Google Earth Pro software.

The maps presented include data from Geoscience Australia.

Many people who have lived, worked and travelled in the area have contributed indirectly and directly to collective understanding of the ecosystems. Not all such knowledge is recorded in published written form and so it is likely that considerable knowledge exists that was not available for the preparation of this report. In particular, the traditional ecological knowledge of traditional Aboriginal owners is acknowledged.

Photograph of *Glinus orygioides* at a wetland near Lake Caroline; an example of post inundation growth (photo by D. Albrecht,).

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Cracking and peeling clay on claypan in the Skull Creek wetland group (photo by A. Duguid)

1. Introduction

1.1 Overview

This report summarises existing knowledge about wetlands in the area declared as the Great Artesian Basin Water Control District (GABWCD). It covers the entire area overlying the Great Artesian Basin (GAB) within the Northern Territory and is abbreviated here as "NT-GAB". This is a large area measuring more than 400 km from east to west and over 300 km from north to south (see figures 1 to 3 below).

This assessment of wetlands provides information for the Water Allocation Plan being prepared for the Water Control District. The main emphasis of the allocation plan will be sustainable management of the groundwater resource. However, water allocation plans in the Northern Territory also cover surface water resources and any interaction between groundwater and dependent ecosystems, and plans are required to consider the water requirements for the natural environment.

1.2 Aims and Scope

The principal aim is to provide information that will assist in developing a water allocation plan for the GABWCD.

By summarising existing knowledge about wetlands of the area and their conservation significance, this report also contributes to ongoing wetland inventory and management in the southern part of the Northern Territory. However, this report should not be regarded as a comprehensive inventory or detailed quantification of wetland values for the Water Control District, which are beyond the current scope.

The information presented is mostly from pre-existing sources. Aerial survey from a small aircraft was undertaken on two days in 2010, in preparation for this report and to take advantage of prevailing wet conditions. Subsequent investigation of specific sites has been limited to office activities, using a geographic information system (GIS) and satellite imagery, including examining imagery in Google Earth. Information on the plants and animals that occur at specific wetlands is all from the records of previous survey work.

This assessment includes:

- overview of the landscape and hydrological process;
- description of the main wetland types in the district;
- a summary of known biological characteristics, where various types occur and their relationship to the river systems;
- conservation significance of individual wetlands and groups of wetlands;
- descriptions of each major river and its floodout;
- information compiled for individual wetlands;
- recommended priorities for further work.

Some of the information presented is based on very limited data. These are supplemented by inferences and hypothesis made by the author. Observations and inferences by other people are also included and are referenced by name plus the abbreviation 'pers. comm.' in brackets, to indicate the information is from a personal communication or by the abbreviation '*in litt.*' for written correspondence. Where there is uncertainty about the validity of a statement this should be apparent from the wording but readers are advised to be alert for this in how they interpret parts of this document. The treatment of hydrology is sufficient to explain important aspects of wetland ecology in the NT-GAB but is not detailed and includes speculation due to the lack of scientific data and publications.

Although the emphasis of this report is on naturally occurring wetlands, human-created wetlands can be important for wetland dependent plants and animals. In the GABWCD there is one notable lake/swamp inundated by artesian bore water, which is described in this report.

1.3 Wetland definition

Wetlands are defined under the international wetlands treaty to which Australia is a signatory (Ramsar Treaty) and include natural and human-made surface waterbodies, areas of long-lasting water-logged soils and subterranean aquatic ecosystems. In some Australian states, rivers are excluded from the legislated definition of wetlands. In the Northern Territory there is no legislated or other formal definition for wetlands. In arid areas many watercourses flow intermittently and aspects of their ecological function are similar to non-riverine wetlands. Therefore, it makes sense to include rivers within the definition of wetlands.

The term 'aquatic ecosystem' has gained usage in Australia, to refer to wetlands including rivers. This term has been promoted to reduce confusion about the varying inclusion of rivers in wetland definitions. However, use of the term 'aquatic ecosystem' for wetlands in arid areas can also cause confusion and misunderstanding, because the majority of arid zone wetlands are dry most of the time.

In this document, the term 'wetland' is used in preference to 'aquatic ecosystem', and is defined below. The definition includes artificial wetlands, but the focus of this report is natural wetlands.

Formal definition of arid NT wetlands (Duguid *et al*. (2005)

Wetlands are areas of permanent or temporary surface water or waterlogged soil. They may be dry for decades but inundation or water logging must be reoccurring and of sufficient duration to be used by macroscopic plants and animals that require such conditions during their lifecycles. They may be natural or artificial, with still or running water which can be fresh or saline. In the inland they may be of any depth or size.

'Common language' definition of arid NT wetlands (Duguid *et al*. (2005)

Wetlands is a term that can mean different things to different people. Our definition is based on an international agreement and includes waterholes, rivers, swamps, clay pans, salt lakes and springs. It also includes artificial wetlands such as dams, sewage ponds and associated swamps.

Wetlands in the arid part of the Northern Territory range enormously in size from vast salt lakes to small spring fed pools. A few hold permanent water but most of the wetlands are dry most of the time. One of the distinguishing features is that following rain, wetlands continue to hold water after the surrounding landscape has dried out; either above the ground or in waterlogged soil.

To be considered a wetland, an area must at least occasionally be wet for long enough that it is used by plants and animals that require water logging or inundation during their lifecycles and are visible to the naked eye. Even if they are only filled once every few decades they may still be important for species conservation.

The application of the above wetland definition to particular features can be challenging and involve subjective judgments. This is usually due to a lack of knowledge about the persistence of surface water and water-logging and a lack of knowledge about the presence or wetland dependency of various species. This report includes a section describing wetland types of the Water Control District, which may help the identification of wetlands when they are dry.

In central Australia, nearly all the major river systems terminate in floodouts, which are places where river water spreads out and no longer flows in a defined channel. These floodouts often include wetland areas as well as areas that are marginal to the definition adopted for wetlands. In the NT-GAB, the floodouts of the major rivers are prominent landscape features that rely on surface water flows, and so information is provided in this report on each floodout system, not just those parts that are wetlands.

1.4 Geography & Surface Hydrology of the Water Control District

The geography and landscape of the Water Control District are summarised here to give context to the rest of the report. A technical report on the hydrogeology of the GABWCD is being produced (NRETAS 2011, draft by S. Fulton) and contains additional information on the surface geography including climate, hydrology and landscapes.

The Water Control District is located in the south-east corner of the Northern Territory (NT). The eastern and southern boundaries of the GABWCD are the borders of the NT with Queensland and South Australia respectively, as shown in figures 1 and 2. The rest of the boundary is based on the edge of the Great Artesian Basin (GAB) within the NT. The boundary line has been delineated to include the saturated portions of the geological strata that form the GAB aquifer but in places also includes unsaturated areas of the same strata (S. Fulton pers. comm.).

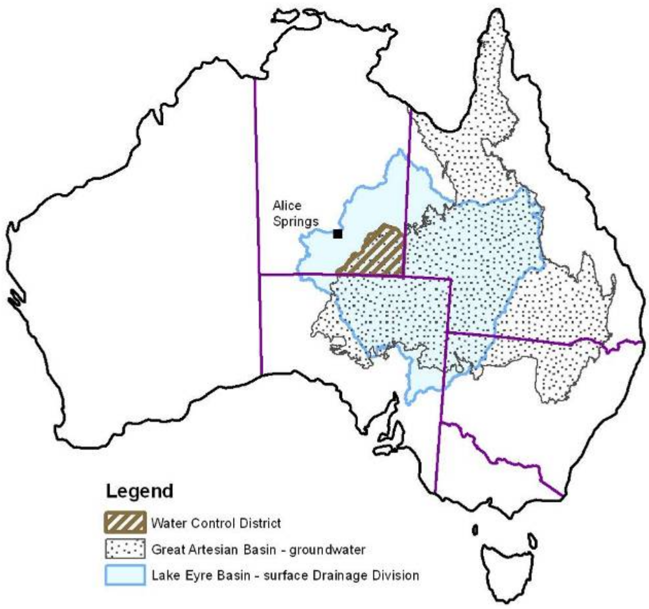


Figure 1. Map showing the location of the Great Artesian Basin and the Water Control District

The GABWCD is very large; similar in size to Tasmania. It roughly coincides with the NT portion of the Simpson Desert, which is one of the lowest rainfall regions in Australia. The GABWCD is entirely within the Lake Eyre Basin; one of the nationally defined Drainage Divisions.

The predominant landscape of the NT-GAB is the Simpson Desert with its striking longitudinal sanddunes. The north-east boundary of the Water Control District crosses the Finke River and cuts across the Simpson Desert dunefield, while the northern boundary roughly approximates the edge of the Simpson Desert dunefield.

Flat topped low hills (mesas) occur along the western and south-western edges of the control district. Low gravely rises and flat to undulating stony plains (gibber) also occur within the Simpson Desert and south of the Finke River and its floodout. Other very low hills occur within the Simpson Desert, most notably in the area extending south from the Allitra Tableland. The major rivers that flow into the NT-GAB have associated alluvial plains. In places these alluvial plains form quite distinct landscapes, whilst elsewhere they are hemmed tightly between longitudinal sand dunes or form a composite landscape of alluvial plain and scattered dunes. Several rivers flood-out into the dunefield, and the density of trees and shrubs in the inter-dune areas distinguishes the floodout from the surrounding dunefield. The Finke River is a far bigger river than any of the others and its floodout is a major landscape feature consisting of an extensive alluvial woodland, minor channels, and extensive swamps and lakes between the adjacent sanddunes. Scattered claypans are a feature of parts of the

Simpson Desert dunefield and also occur adjacent to many of the low hills and rocky rises. There are several distinct clusters of pans and swamps in the NT-GAB, including some quite large pans which are lakes when episodically filled from local rains. Some of these are regarded as salt lakes, in the broad sense, although there is little data to indicate the degree of salinity or connection to groundwater.

The NT-GAB contains parts of three nationally defined biogeographic regions (also called IBRA bioregions – see Thackway & Cresswell 1995). Most of the Water Control District is in the Simpson-Strzelecki Dunefields Bioregion (97%). The south-west of the Water Control District is in the Finke Bioregion (5% of WCD), and a small portion (2%) is in the Stony Plains Bioregion. All three bioregions extend substantially into South Australia. The Simpson-Strzelecki Dunefields bioregion extends into Queensland. The Finke Bioregion has a large part of its NT extent to the west and north-west of the NT-GAB. The extent of the bioregions in the Water Control District are shown in figure 6 in a subsequent section of this report.

River Systems

The GABWCD lies within a portion of the Lake Eyre Basin sometimes referred to as the Northern Rivers, with rivers running roughly from the north-east, towards Lake Eyre. These rivers are (from west to east):

- Finke River
- Todd River
- Hale River
- Illogwa Creek
- Plenty River
- Hay River

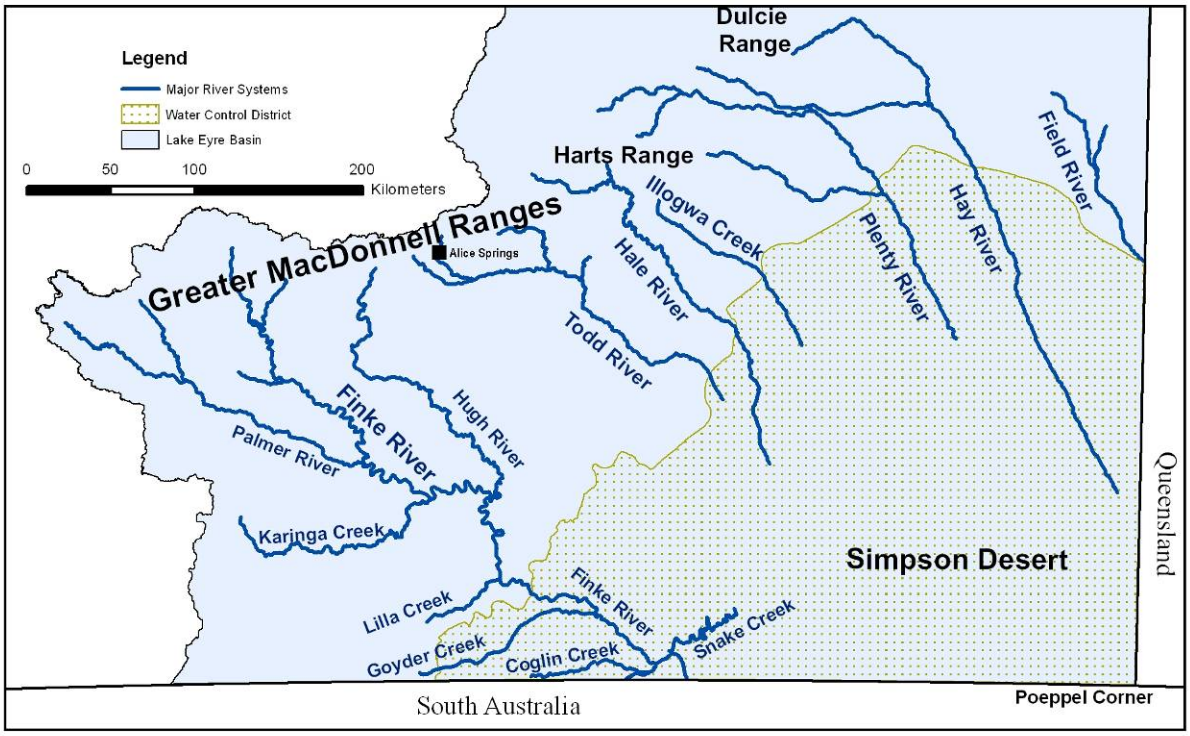


Figure 2. Map of major rivers and their catchment areas

The Field River is also in the NT portion of the LEB Northern Rivers zone but does not flow through the GABWCD.

All these rivers form in rocky hill country to the north and west of the Simpson Desert, and all of them dissipate in the Simpson Desert in a variety of types of floodout. Some parts of some floodouts are swamps that hold water for many months once filled. There is no record of surface water connection between any of these floodouts and the rivers that episodically flow into Lake Eyre from Queensland and South Australia. However, very large floods in the Finke River could conceivably connect through to the Macumba River in South Australia and on to Lake Eyre.

The Finke River forms to the north-west of the GABWCD and crosses into the Water Control District quite close to the border with South Australia (about 50 km north of the border). In contrast, all the other rivers that flow into the GABWCD do so from the north. Once they enter the Simpson Desert they flow approximately south-south-east between the longitudinal sand dunes. There are no major rivers that start in the Water Control District, but some of the small tributaries of the Finke River do rise in the district, as do a few small and isolated creeks running off isolated hills and stony plains.

Most of the creeks that are not connected to major rivers are only a few kilometres long. Four notable exceptions occur on Andado Station (see figure 3) and result largely from run-off from stony clay plains. Two rise west of Andado homestead and feed relatively large wetlands. The more southerly of these is Peebles Creek, which spans 32 km (straight line distance) from its origin to the terminus at Indemina Swamp. Similarly, the creek system to the north (unnamed on topographic maps) flows towards Indinda Swamp (distance 43 km). There are also mapped but un-named creeks in the vicinity of Hubbard Hill. One terminates at Intalpa Lake, covering a straight line distance of about 16 km. The largest creek in this area starts north-west of the conservation reserve to the north of Hubbard Hill (see figures 3 and 4). Channels of this creek may not be continuous but extend through Casuarina Swamp, with what appears to be an overflow channel heading south-south-east into the dunefields, with a total straight line span of 45 km.

The major rivers of the NT-GAB all flood-out in and adjacent to the dunefields of the Simpson Desert. This gives many sections of the floodouts a very linear pattern. The geography of the major river floodouts is described in more details in Section 5 of this report.

Overview of Surface Hydrology & History of Inundation Events

The district has no known permanent natural surface water and no long-lasting riverine waterholes. Likewise there are no recorded springs. 'Long-lasting' is used here as analogous to 'long-term' which was defined by Duguid *et al.*(2005) as 'inundated or saturated at least 80% of the time and typically for longer than 1 year at a time'.

River flows in the GABWCD are essentially episodic and can occur at any time of year. While most rivers in central Australia have some flow in most years, flows large enough to reach the GABWCD are less frequent. Large flow events are more likely in the warmer months of the year, when long-term average rainfall is higher and rain events tend to be more intense. The duration of flows is not well documented due to the sparcity of gauging stations. Flows often last for hours or days rather than weeks and months. Following periods of very high rainfall, groundwater discharge into river systems can keep sections of river flowing for months and very rarely for more than a year. However, such long-lasting flows are not documented for the lower reaches of the rivers where they flow into the NT-GAB. The technical report by Fulton (NRETAS draft 2011) summarises data on flow events in the Finke River at gauging stations well upstream of the NT-GAB.

At the outer/lower extent of some of the river floodouts, relatively dense tree and shrub cover occurs that is readily interpreted as the result of water from the river. However, it is likely that flowing surface water only rarely extends the full length of thickened vegetation. It is likely that saturation of the surface soils is short-lasting when it does occur, and it is possible that sub-surface movement of water down the floodout may account for woody thickening beyond the extent of surface flows.

The NT-GAB has very low average annual rainfall, less than 100 mm pa in parts, but the catchments of the major rivers have somewhat higher average rainfall of about 200-350 mm/year. Large flow events are associated with intense large rain events and these are sometimes associated with so called 'wet years', when rainfall more than doubles the average (e.g. see rainfall data presented by Fulton - NRETAS 2010). For example, two very large flow events occurred in the Finke River in 2000, filling wetlands in the Finke Floodout, including the inter-dune lagoons of Snake Creek. A very large flow event occurred in the Hay River in 2010, with considerable over-bank flows across the floodplain. Geomorphological evidence indicates that that these 'northern rivers' of the Lake Eyre Basin can change their course substantially with successive flow events and by as much as 50 km for the Todd River (M. Bourke seminar presentation). 'Mega-floods' have occurred in some of the NT-GAB rivers in the past few thousand years (Pickup *et al.* 1988; Pickup 1991; Paton *et al.* 1993; Bourke 1994, 1998 & 1999). This adds some weight to the speculation made here that the Finke River may occasionally connect to Lake Eyre via the Macumba River, within the current (Holocene) climate. A very rough 'guesstimate' of the flood magnitude/incidence required is proposed: 1 in 500-1,000 years.

Intense local rain events can cause widespread local inundation, even in average to low rainfall years and in years when many of the rivers do not have a major flow. Notable examples include very intense rainfall in the vicinity of Numery Station on 18 Jan 2007 (246 mm recorded at the homestead in 24 hours). A very large rainfall event occurred around Andado homestead in February 2011, caused by ex-cyclone Yasi (137 mm recorded in a single day). Both these events caused wetlands in the vicinity to be filled to very high levels by local run-off. Less spectacular rain events can also generate local run-off sufficient to inundate or partially fill some wetlands.

Groundwater and Wetlands in the GABWCD

There are no studies indicating that any natural surface wetlands of the Water Control District are sustained by discharging groundwater. There are no documented springs or permanent or near permanent waterholes. However, it is possible that some large episodically filled lakes and swamps may be connected to temporary watertables created by the same river flow and run-off events which inundate the wetland. If such aquifers do sometimes exist, then they are perched above the impermeable strata that confine the Great Artesian Basin aquifers. There is no direct evidence for this hypothesis as discussed below in the example of the Snake Creek lakes. However, research in lakes in arid South Australia, also in the Great Artesian Basin, indicates that such connections can occur, particularly in inter-dunal settings (Elizabeth Irvine pers. comm.). If such connections occur in the GABWCD they could be contributing salts into the surface waters and extending the period of inundation of wetlands.

In NT-GAB, the Snake Creek floodout lakes are episodically filled by large flows in the Finke River, such as in 2000. Bob Read and Peter Latz undertook a field survey in 2001 and recorded surface water conductivity for three of the lakes: "740, 1130, 3000 micro siemens per cm" (p.66, Duguid 2005). In general terms these measurements equate to 'fresh', 'semi-saline' and 'borderline saline' respectively. Duguid *et al.* (2005) provides a summary of various classifications of salinity used in Australian aquatic science. The differences in conductivity recored at in the Snake Creek lakes may be due to connection to a local watertable and variation in the conductivity of the groundwater at each lake. However, the water chemistry of each lake is probably strongly influenced by the soils and substrate. The Lake with the saltiest water had areas of gravelly limestone as well as the silt and sand that dominated at the other sites. Observations during ground survey indicated flood heights of nine to ten metres at some of the Snake Creek lakes (observations by Bob Read on the flanks of tall sand dunes), with lakes holding water for more than thirty months (Duguid *et al.* 2005). The height of the water when the flood waters ceased to flow is not known. Also, there is no data or modelling available for evaporation rates at these lakes following a large flood event. The general wetting of the landscape and the extent of lake waters must reduce pan evaporation below long-term averages. The longevity of the lakes is notable (in the order of two to three years following the 2000 inflow). However, it is only possible to speculate that they are sustained by a temporary perched watertable.

Elsewhere in the arid south of the NT there has been sufficient hydrogeological research to demonstrate that groundwater does discharge at many salt lakes, at or near the surface of the lake bed, leading to an accumulation of evaporites (salts) (e.g. see Jacobsen 1996; or Wischusen 1998). When such lakes are inundated by local runoff during rain events, or by flows down rivers and creeks, the resulting lake water is connected to the groundwater. In wetter climates of the geological past, continual discharge may have resulted in the accumulation of salts in the surface soils of the lakes. Presently we can only speculate about the hydrogeology of the saline/semi-saline lakes in NT-GAB. It is possible that these are episodically connected to perched watertables in years of very high rainfall, in the same manner speculated for the predominantly freshwater river-fed Snake Creek lakes.

Hills and Other Water-shedding Terrain

The nature and location of elevated rocky areas are important drivers of wetlands. They can be the sole source of surface water in wetlands or can add to water that falls as rain further away, and reaches a wetland via creek and river systems. The following descriptions include absolute elevations and the relative heights of uplands to the surrounding plains or dunefields (note that the abbreviation "c." is used for approximately and "m asl" for metres above sea level, which is used as equivalent to the Australian Height Datum). A selection of geographic reference points are shown on figure 3.

The highest point in the GABWCD is an unnamed spot height, 505 m asl, only 5 km from the most south-westerly extent of the control district. The lowest parts of the GABWCD are close to sea level (20-50 m asl) in the south-east corner adjacent to the borders with Queensland and South Australia (Poeppel Corner).

There is a substantial drop in elevation along the South Australian border; more than 450 metres from west to east. However, gradients across the landscape are shallow away from the few low hills. Only small areas are above 300 m asl. These are mostly in a narrow band extending from the south-west corner for about 180 km north-east along the margin of the GAB. An example of these highpoints is Mt Rumbalara (449 m asl) and c. 100 m above the surrounding plain). Others are Mt Gordon North (463 m asl) and Jenkins Bluff (472 m asl). The drainage lines associated with these uplands are all very short and are not associated with many swamps or pans.

The Finke River is already at a relatively low elevation where it crosses into the GABWCD (c. 270 m asl). The Todd, Hale, Plenty and Hay rivers cross in at similar elevations (230, 260, 270 and 220 m asl respectively). The far north-east is lower where the Field River crosses into the GAB at only 130 m asl, while Illogwa Creek crosses in the highest part of the northern boundary of the Simpson Desert dunefield at around 300 m asl.

The Beddome Range is the largest water shedding range in the control district and is near the south-west corner of the GABWCD. The Beddome Range forms a narrow plateau at around 400 m asl (highest point 429 m asl). Mount Grundy (398 m asl) is an outlier on the east end of the Beddome Range. The Beddome Range is not a tall feature in the landscape. It rises only 70-90 metres above the adjacent lowland on the north side (Goyder Creek) and 170-200 metres above the adjacent lowland on the south-east side (Coglin Creek). Goyder Creek crosses into the GABWCD near the very southeast corner of the control district at a similar elevation to the Beddome Range.

East of the Beddome Range is a very low stony tableland called Mt Wilyunpa. Situated just north of the South Australian border, this feature seemingly blocks the path of the Finke River, causing it to flood-out against the Simpson Desert dunefield, forming the Finke Floodout Forest and adjacent inter-dune wetlands. Other processes and features are no doubt also involved in the river flooding-out (e.g. changes in gradient and flow energy). Mt Wilyunpa (200-226 m asl) is only 20-40 m above the adjacent Finke Floodout Forest (c. 180 m asl). The dunefield to the north is at a similar elevation (around 200 m asl; an approximate height due to the complexity of determining average or predominant heights in dunefields).

In the same general area, there is a more substantial upland that includes Mt Daniel (379 m asl) near Crown Point and Mount McGowan (366 m asl), about 20 km south-west of New Crown homestead. These are around 100 – 120 m above the surrounding plains and form much of the catchment for Skull Creek.

There are two groups of small hills around 50 to 60 m high, adjacent to the South Australian border between Mt Wilyunpa and Poeppel Corner. The first group is marked on topographic maps as Walla Hills (198 m asl). The second includes Dakota Hill and Mount Etingimbra (171 m asl). Heights on the adjacent plain are around 120 – 130 m asl.

Towards the centre of the GABWCD there is an inconspicuous elevated area, called the Allitra Tableland, which is at most about 50 metres above the surrounding landscape (highest point 252 m asl). This upland is virtually surrounded by the Simpson Desert dunefield, apart from the adjacent floodplain and floodout of the Hale River. Despite the low relative elevation, it contributes run-off to the Hale River floodout as well as into various minor creeks, swamps and pans that are on or adjacent to the upland.

To the south of the Allitra Tableland is another low upland area that includes Poodinittera Hill, Crocker Hill (229 m asl), Marshall Bluff (224 m asl) and The Twins. Like the Allitra Tableland, this area is around 20 km long and sheds enough water to form small creeks and feed adjacent wetlands. Further to the south-south-west, about 25 km, a relatively isolated upland area around Hubbard Hill (215 m asl) also has an influence on adjacent wetlands. Although only around thirty metres high, small creeks run-off it and add to run-off from the gibber plains where Mac Clarke (*Acacia peuce*) Conservation Reserve is, with a substantial creek extending through Casuarina Swamp.

In the NT-GAB, stony clay plains (gibber landscapes) and low stony rises can provide substantial run-off and are often associated with swamps and pans. They are associated with three notable concentrations of wetlands:

- pans/lakes and swamps in the Lake Caroline area;
- pans/lakes and swamps known as the Plenty Lakes (west of the Plenty Floodout); and
- pans/lakes and swamps on Andado Station, including the Peebles Creek catchment, the area around Mac Clarke (*Acacia peuce*) Conservation Reserve and wetlands adjacent to the Crocker Hill upland area.

The area south-west of the Finke Floodout also has extensive plains with clay rich soils and gibber, which contribute run-off to local pans and to the Finke Floodout and its minor tributaries.

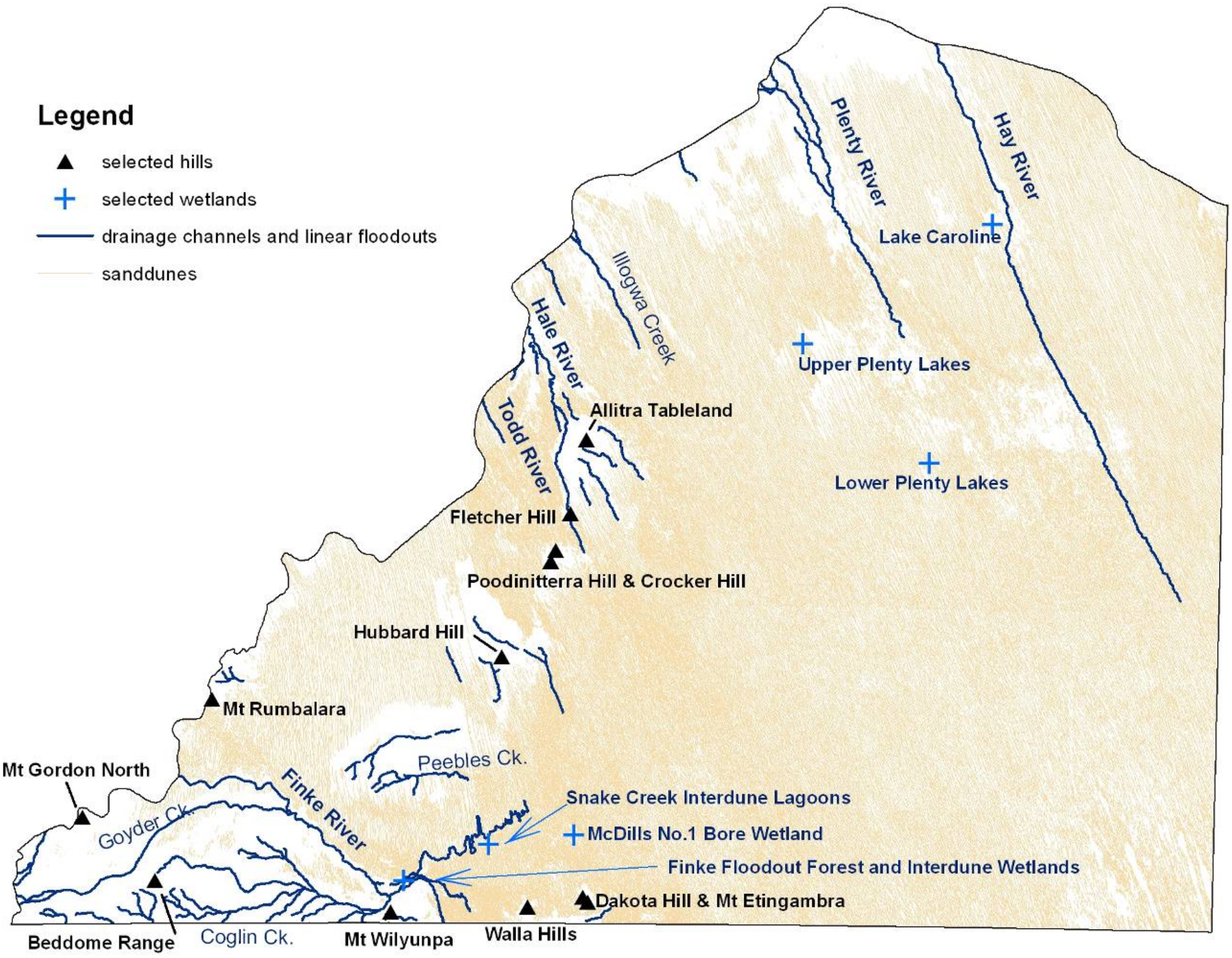
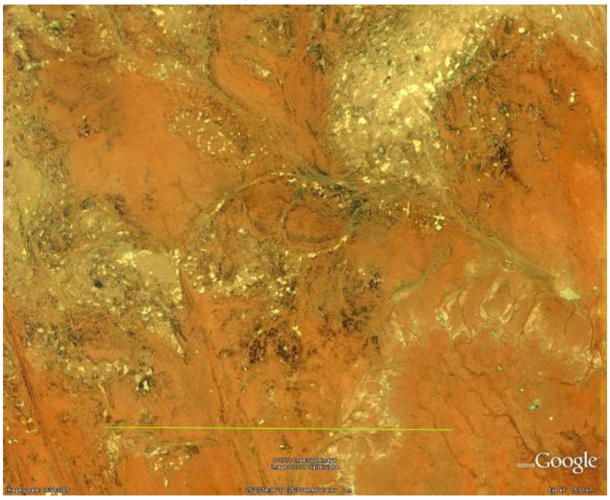


Figure 3. Map of topographic features of the Water Control District

Note: The shading is from line depictions of sanddunes and effectively maps the extent of the Simpson Desert Dunefield within the NT-GAB. White areas are a combination of alluvial flats, wetlands, gibber plains and rocky uplands.

Wetlands on stony plain bisected by dune
(photo: J. Barnetson 2010)



Google Ea rth image from October 2005 showing abundant turbid shallow wetlands on the gibber plains around Mac Clarke (*Acacia peuce*) Conservation Reserve.

Land Tenure and Land Use

The majority of the Water Control District is in the Simpson Desert with no current commercial land use. The remainder is mostly used for cattle grazing. There is a small Aboriginal township, a small conservation reserve and scattered Aboriginal living areas. Mineral exploration is currently active, including coal-seam gas investigations. Specific places and routes are also visited by tourists.

The pastoral leases (cattle station) are:

- Umbeara Station (overlaps the south-west corner of the GABWCD);
- Lilla Creek Station (a small part of the lease is in the GABWCD);
- Horseshoe Bend Station (a small part of the lease is in the GABWCD);
- New Crown Station (all within the GABWCD);
- Andado Station (mostly in the GABWCD);
- Numery (a small part of the lease is in the GABWCD);
- Tobermory (a small part of the lease is in the GABWCD).

The larger Aboriginal land areas are:

- Atnetye Aboriginal Land Trust (substantially in the GABWCD)
- Pmere Nyentee Aboriginal Land Trust (substantially in the GABWCD)
- Pmer Ulperre Ingwemirne Arletherre Aboriginal Land Trust (all within the GABWCD)

The only conservation reserve is:

- Mac Clark (*Acacia peuce*) Conservation Reserve.

There is also a large area of Vacant Crown Land occupying the south-east corner of the GABWCD. The major stations and land trusts and inhabited places are shown in figure 4.

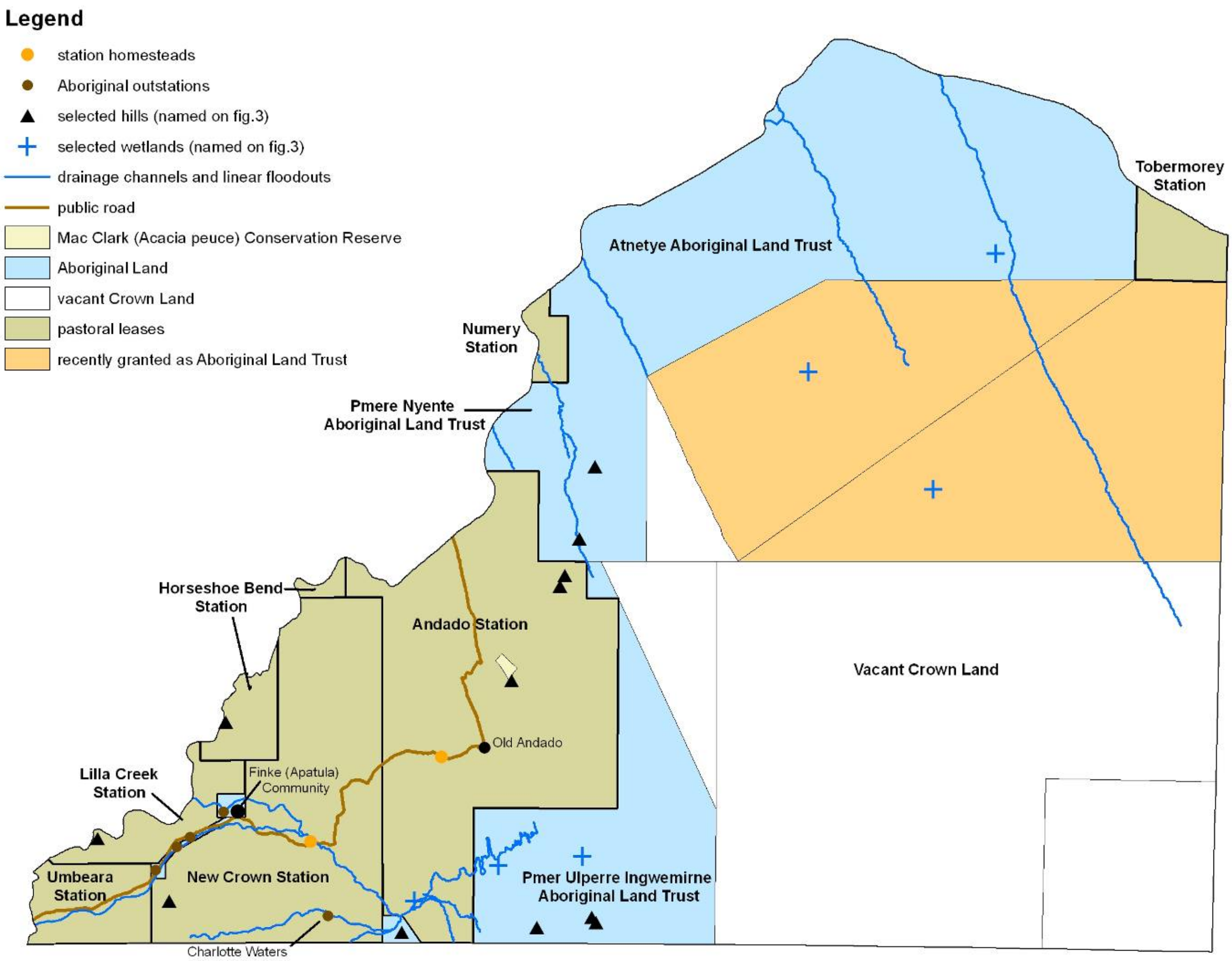


Figure 4. Land tenure and inhabited places

2. Information Sources

2.1 Information Sources

Information from various sources has been used to compile this report. Most of the information already existed. New information and understanding were obtained using remote sensing (satellite) data and from an aerial survey using light planes.

The main sources used were:

- aerial survey in May 2010;
- 1:250,000 scale topographic mapping – paper maps and digital (GIS) data (including Geodata 3 from Geoscience Australia);
- detection of surface water with Landsat TM imagery (see figures 5 and 6) (Duguid *et al*. 2005; Barnetson & Duguid 2008; Barnetson & Duguid 2010);
- inspection of individual wetlands using high resolution imagery in Google Earth;
- survey data and observations from field survey during the 2001 inventory of wetlands of the arid NT (Duguid *et al*. 2005; Duguid 2005);
- various other field observations by the author, notably from participation in a botanical survey in the Lake Caroline area (Duguid & Albrecht 2008);
- NT Herbarium specimen records using the Holtze database;
- land resource maps and reports (land unit mapping) for various stations (Andado, Lilla Creek, New Crown, Umbeara) (Jessop & King 1997, Kennedy & Bazzacco 2002; Kennedy & Sugars 2001a; Kennedy & Sugars 2001a);
- aerial survey of feral camels in 2001 (Edwards *et al.* 2004)(wetland data summarised in Duguid *et al.* 2005);
- biological survey reports (listed below);
- survey by Peter Latz, Jayne Brim Box and Rachel Paltridge, for feral camel research in 2010 (P. Latz pers. comm.); and
- personal communications – conversations with people who have worked in or visited the NT-GAB (e.g. Simon Fulton, Peter Latz, Jeff Cole, Robert (Bob) Read, Stephen Eldridge, Julian Reid, Robert Boomfield, Richard (Dick) Kimber), and Dennis Matthews.

Various biodiversity related reports contain useful information on wetlands and landscape processes in the NT-GAB. These include:

- *Wildlife Survey of the Hay River and Plenty River regions of the Simpson Desert* (Gibson & Cole 1985);
- *A Biological Survey of the Finke Floodout Region, Northern Territory* (Eldridge & Reid, 1998);
- *Botanical survey of the northern Simpson Desert July 2007: Hay River, Lake Caroline and Mount Tietkins areas* (Duguid & Albrecht 2008);
- *An inventory of sites of international and national significance for biodiversity values in the Northern Territory* (Harrison *et al*. 2009);
- *Plant species and sites of botanical significance in the southern bioregions of the Northern Territory. Volume 1: significant vascular plants* (White *et al.* 2000a) and *Volume 2: significant sites* (White *et al.* 2000b).

Aerial reconnaissance was conducted on two separate dates to visit some of the wetland features of the NT-GAB (see figure 5). Data collected are stored on NRETAS computer servers: flight paths, digital photographs, point locations of photographs, and a video for one of the flights (users of the photographic data should be aware that there were problems with the gps track-log for the second flight that prevented accurate time synchronisation with the digital cameras; so many photo point locations are inaccurate). These data are not yet combined with notes from the flights to create structured data for specific sites.

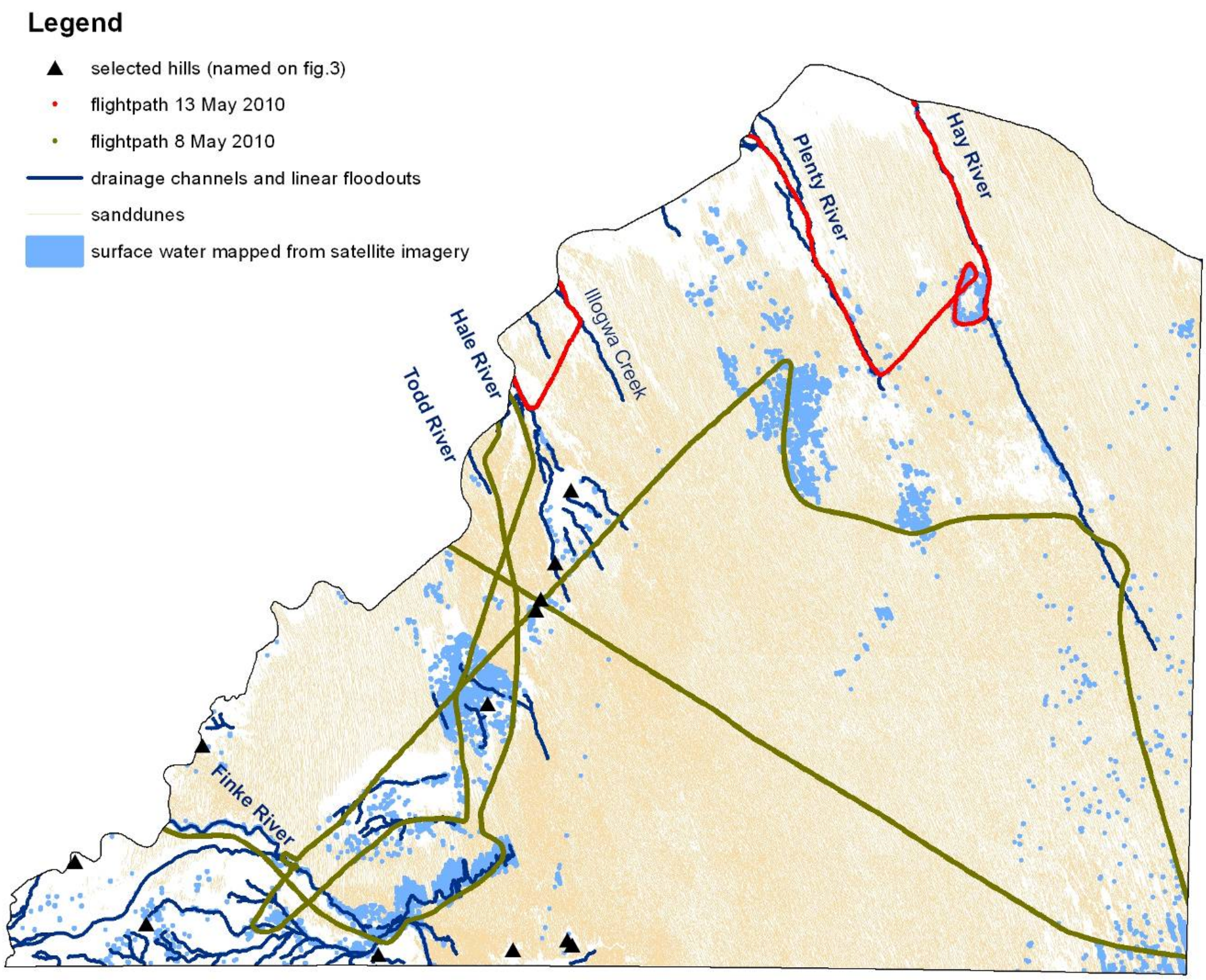


Figure 5. Aerial survey flight paths

2.2 Status of Wetland Mapping and Inventory

Wetland mapping of the Water Control District is at an interim stage. Wetlands have been identified using Landsat TM satellite images across the NT-GAB (see figure 6), and many of these are not depicted on 1:250,000 scale topographic maps. However, most of the wetlands mapped in either source are not attributed with a wetland type, and many of those identified from satellite images do not have meaningful wetland boundaries mapped. Also, various sources indicate that the remote sensing underestimates the number and extent of wetlands in some areas, based on observations following large rain events, for which satellite images have not yet been obtained and processed (e.g the central Andado area in late 2005 and autumn-winter 2011).

Information about wetland location and character was obtained from the various sources in preparing this report, but is not stored in a single integrated wetland database.

It is not yet possible to present meaningful numerical data about the number of wetlands of a particular type or their aggregate area. Additional wetland mapping was not possible in the preparation of this report.

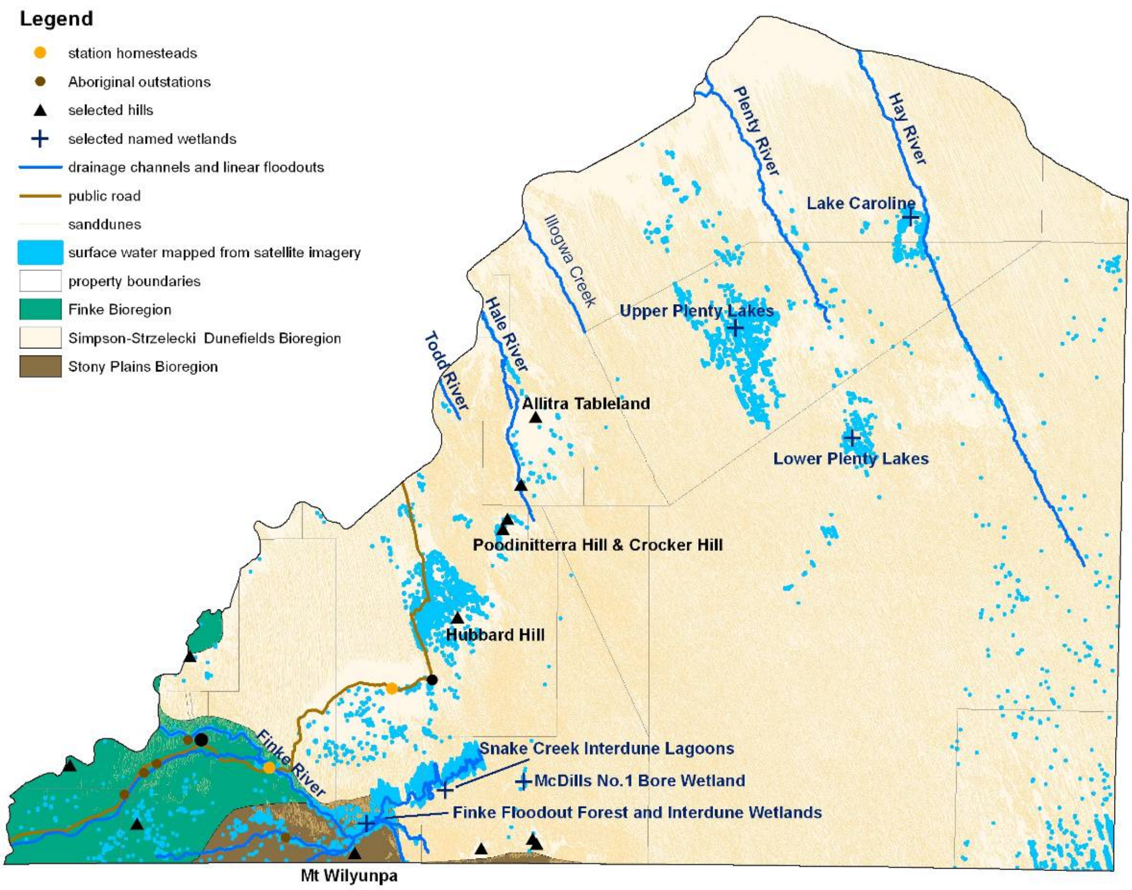


Figure 6. Bioregions and surface water mapped from satellite imagery

Note: the representation of surface water has been exaggerated to make some of the smaller waterbodies visible.

3. Description of the Main Wetland Types

In this section the main wetland types that occur in the NT-GAB are described. Examples of individual wetlands corresponding to some of these types are listed in Section 5.

3.1 Wetland Classifications, Wetland Types and Terminology

Relevant Classifications (Structured Division into Wetland Types)

A classification of arid NT wetlands was devised as part of an inventory in 2000-2001 (Duguid *et al.* 2005) and includes descriptions of the associated wetland types. The classification distinguishes types on various criteria including landform, salinity, vegetation and water permanency. Some of the types distinguished are more distinctive than others. Some are uncommon and may occur mainly as elements within a larger 'wetland complex' rather than being the dominant type at a wetland. Never-the-less, the types are a useful basis for indicating the diversity of wetlands and are used here.

The wetland types proposed by Duguid *et al.* (2005) can be equated to those in other classification systems. Duguid *et al*. (2005) provide a table for converting to Ramsar wetland types (see table 11 and appendix 7 in Duguid *et al.* 2005). A more recent classification has been developed for Australian wetlands, called the Australian National Aquatic Ecosystem (ANAE) Classification (draft), which provides a structure for grouping broad wetland types. Many of the arid NT wetland types used here are at a more detailed level of distinction than the ANAE types. In 2010, another classification was devised for identifying areas likely to be significant for conserving aquatic environments in the Lake Eyre Basin (Hale 2010). The purpose of that classification was to estimate wetland diversity from available spatial (GIS) data. Due to a lack of consistent wetland attribute data in existing spatial (GIS) databases, that classification was quite general and did not differentiate some ecologically distinct types based on attributes such as dominant vegetation, soil and landform.

Unfortunately, many of the wetlands identified from remote sensing, or shown on topographic maps, cannot be allocated to one of the types of Duguid *et al*. (2005) due to a lack of survey data or other information (e.g. vegetation type and salinity). Therefore it is not possible to quantify abundance or aerial extent of types. However, in this report a general estimate is given for the relative abundance of various wetland types (e.g. statements such as common or rare in table 1).

Terminology for Wetland Types and Characteristics

Wetland terminology can be confusing due to variations in usage and definitions. Some key terms are discussed here. More information on terminology for arid NT wetlands can be found in Duguid *et al.* (2005) and in Brim Box *et al.* (2008).

The term basin is used here for landforms that hold pooled water in a natural depression in the landscape. The term swamp is used for wetlands that have vegetation emergent from the water or growing when water has receded (post-inundation). Limnological studies from non-arid climatic zones refer to swamps as palustrine. Lakes, pools and claypans are basin landforms where 'open water' sits with no or minimal emergent vegetation. The limnological term for these is lacustrine. The term pan is used for shallow and typically flat bottomed basin landforms. Some pans may have emergent vegetation or post-inundation vegetation and therefore qualify as swamps in the arid NT classification. The term claypan encompasses a wide variety of wetlands with differences in shape, depth, size, soil and fringing vegetation. Here, claypan is used for basins with clay rich soil and which are predominantly bare (unvegetated) in the post-inundation stage. It is difficult to classify some wetlands as either swamps or claypans/lakes due to the presence of emergent vegetation in one part of the wetland and absence of it in other parts. Also, when emergent vegetation is very sparse or only present in clumps, the decision to classify a particular wetland as a swamp or claypan/lake can be somewhat arbitrary. In the NT, there are no agreed definitions defining swamps according to the extent, density, cover or life form of the vegetation.

In the NT-GAB, there are many areas where water from rainfall is concentrated in the landscape but which do not clearly correspond to the definition of a wetland. Areas that water 'runs-on' to during rain events are one example. The following discussion provides further clarification on areas that are intermediate between wetland and dryland and clarifies terminology for run-on areas, channels, floodways and floodouts.

Run-on areas are typically adjacent to higher 'run-off' areas. Run-on areas can occur at the base of distinct hill slopes but can also be low points in relatively flat landscapes. They can be small (e.g. less than a hectare) with a relatively small local run-off 'catchment'. They can also be substantially larger. Water pooling and soil saturation may be so brief that a run-on area is not regarded as a wetland. However, distinctive vegetation may occur due to a relative abundance of soil moisture. Some run-on areas have relatively dense perennial vegetation that contrasts to surrounding areas.

Water movement across the land surface from 'run-off' areas to 'run-on areas' is often called 'sheet-flow', as distinct from water flowing in a well defined channel. Channels are also referred to in this document as creeks and rivers. These two terms are used somewhat interchangeably, although 'river' typically indicates a relatively wide channel. In the arid NT there are also many places where water occasionally 'flows' in a distinct linear floodway that lacks any of the defining characteristics of a channel (incised elevation, distinct banks, often with a distinct substrate such as sand, gravel, or cobbles, and often with a relatively bare 'river-bed' contrasting with fringing riparian vegetation on and adjacent to the banks). In central Australia, it is common for river and creek channels to merge into floodways. Various landscape features occur where water spreads out from the point that a channel ends or dissipates and are called floodouts. They can occur with various sizes of drainage system, from small creeks to major rivers. Floodouts can occur both at the end of a drainage system (terminal floodout) or feed back into a major channel that continues downstream of the floodout (interim floodout). Floodouts include relatively linear floodways as well as broader features similar to floodplains and distinct depressions/basins where water forms a lake or swamp. Some large floodouts have minor and intermittent channels within them. The wetland types defined by Duguid *et al.* (2005) include some called 'flood-prone flats' for classifying run-on areas that are marginal to the definition of a wetland and can be applied to many sections of the NT-GAB river floodouts. However, the 'flood-prone flats' wetland types do not take into account the variations in hydrology and landform found in the NT-GAB.

3.2 Wetland Types of the Water Control District

Table 1 lists wetland types for the GABWCD, based on the arid NT wetland classification in Duguid *et al.* (2005). It is difficult to be certain that some types occur because survey data is so sparse and therefore the key attributes that distinguish some wetland types are unknown for most individual wetlands (e.g. salinity and type of shrub cover). Wetland types in Table 1 are described in more detail in Duguid *et al.* (2005). Comments specific to their occurrence in the GABWCD are given in the table. Further description is given for some wetland types in the subsequent section.

Table 1. Table of wetland types in the Water Control District

Arid NT Code	Arid NT Wetland Type / Broad Type	Occurrence + Comments ✓ indicates this type is known to occur ? indicates possibly occurring
Basins		
B1111	Highly Saline Lakes (salt lakes)	**?** degree of salinity and hydrogeology uncertain
B1121	Saline Lakes / Samphire Swamps	✓ includes relatively low salinities that are semi-saline or even slightly saline under some definitions; some very large lakes of this type occur as well as smaller ones, notably in the Poeppel Corner area, the Upper Plenty Lakes, the Lower Plenty Lakes and at least one of the larger lakes in the Lake Caroline area; there is some indication that gypsum may dominate some lakes rather than sodium chloride.
B1211	Large Freshwater Lakes and Pans	✓ large pans (> 8 ha) – notable examples include Casuarina Swamp, Old Andado Swamp, Lake Caroline, some of the Snake Creek Interdune Lagoons and some of the Plenty lakes.
B1221	Small Freshwater Lakes and Pans	✓ widespread and common both in inter-dune settings and on stony plains; includes variations in substrate (e.g. stony or not) and variations in fringing vegetation (presence or absence of Coolabah trees) and some with patchy occurrence of Canegrass (*Eragrostis australasica*) across the pan.
B2111	Samphire Saline Swamps	✓ possibly uncommon
B2112	Non-Samphire Chenopod Saline Swamps	**?** e.g. dominated by salt tolerant chenopods such as *Atriplex* species (e.g. Old Man Saltbush - *A. nummularia*; occurrence and salinity levels are uncertain – this may not be a useful 'wetland type' to distinguish in the NT-GAB.
B2211	Wooded Swamps (Non-linear)	✓ Coolabah swamps in basin-like depressions - with varying density of trees across the swamp, not just fringing. Trees are predominantly Coolabah (*Eucalyptus coolabah*). In NT-GAB wooded swamps mainly/only occur in basins that are channel-fed. Examples have been observed in the floodouts of most of the rivers but are uncommon, except in the Finke Floodout system where some large ones are known and where they may possibly be abundant.
B2212	Wooded Swamps (Linear/Riverine)	✓ associated with rivers (e.g. 'back-swamps'), and inter-dune floodouts; trees are predominantly Coolabah (*Eucalyptus coolabah*); although linear wooded floodout areas are widespread it is not clear whether these should be classified as linear wooded swamps or as flood-prone flats.
B2221	Bluebush Swamps	✓ dominated by Northern Bluebush (*Chenopodium auricomum*); and may be rare in NT-GAB; a substantial Bluebush swamp is known from New Crown station (Duffield Swamp) and one is recorded from the Plenty Floodout.
B2222	Lignum Swamps	✓ dominated by Lignum (*Muehlenbeckia florulenta*); widespread but mostly occurring as elements of larger wetland complexes.
B2223	Other Shrubby Freshwater Swamps	**?** *Maireana microcarya* dominates parts of some swamps in the south of New Crown Station, but may not dominate or characterise whole swamps – further survey work is required.
B2231	Grassy Freshwater Swamps	✓ not common in NT-GAB - one area of dense *Eriachne benthamii* is known from the Coglin Creek section of the Finke Floodout complex; some swamps are known to have areas of sparse to dense Canegrass (*Eragrostis australasica*); pans with Canegrass are common but it is often too sparse for them to be called swamps; pans with abundant Beetle Grass (*Leptochloa fusca*) are known in central Australia and may occur in the NT-GAB.
B2232	Herbaceous Swamps (non-grassy)	✓ this type includes pans and ponds dominated by Nardoo (*Marsilea* species) and areas where post-inundation herbs can dominate; these may only occur as sub-types in wetlands of some other predominant type.
Flats		
F0001	Bare Flood-prone Flat	**?** may occur; this type is not tightly defined and includes bare clay areas but could be broadened to include areas vegetated with grasses and forbs.
F0002	Wooded Flood-prone Flat	✓ as discussed earlier, extensive inter-dune floodouts conform to

		this type, but are marginal to the definition of 'wetland'; whilst some sections may hold water for long enough to be regarded as swamps.
F0003	Shrubby Flood-prone Flat	**?** may occur

Watercourses (including waterholes)		
WU1201	Temporary Upland Waterholes	**?** these probably occur in watercourses running off some of the minor hills; in NT-GAB waterholes of this type are expected to be small and not long-lasting.
WU2201	Generally Dry (Temporary) Upland Channels	✓ a small number are presumed to occur on the few hills.
WL1202	Temporary (Generally Dry) Lowland Waterholes	✓ these occur along the major rivers, minor creeks, and small channels within floodouts. There is little survey or other data regarding how long individual waterholes last.
WL2001	Major Wooded Watercourses	✓ major features of the GABWCD, most are sandy channels fringed by River Redgum (*Eucalyptus camaldulensis*). Some distinct channels may be fringed with Coolabah (*Eucalyptus coolabah*).
WL2002	Minor Lowland Wooded Watercourses	✓ it is presumed that some of the minor water courses have fringing eucalypt dominated riparian vegetation .
WL2005	Un-wooded Lowland Watercourses	✓ watercourses (sections of rivers and creeks) that are not fringed with tall trees are known to occur.
WL2006	Braided Channels	✓ parts of the lower Hay River and floodout (discussed further below).
WL2007	Highly Saline Channels	**?** no highly saline channels are known, but short channels with sufficient salinity to influence floristics are recorded in the Lake Caroline area; this wetland type has not been tightly defined with respect to the degree of salinity, but was originally intended for channels feeding into and between highly saline lakes.
Artificial *		
A1001	Dams Across Watercourses	**?** if present then not common in the NT-GAB due to the low number of small creeks that can be dammed
A1002	Excavated Dams/Tanks in Swamps and Pans	✓ common on some NT-GAB cattle stations for stock
A1003	Other excavations: quarries, borrow pits, mine pits	**?** probably occur
A2003	Minor Overflow from Bores	**?** probably occurs
A2004	Open Metal/Concrete Tanks filled from Bores	✓
A3001	Sewage Ponds	✓
A2005	Rogue Bores	✓ more than one of these existed in the past, but none is still free-flowing; McDills No. 1 Bore has been rehabilitated but a controlled flow has been continued to maintain part of the lake and swamp formed when it was rogue.

note that artificial wetlands are mostly outside the scope of this report, although the rogue artesian bore has relevance to groundwater management as well creating valued wetland habitat.

Since Duguid *et al.* (2005) determined their list of wetland types, further work has shown that it may be appropriate to adjust the classification and recognise some additional types. An example of this has been observed in the NT-GAB and elsewhere in central Australia, by inspecting high resolution satellite imagery on Google Earth. They are referred to here as 'reticulated swamps' and are characterized by a dense network of dark linear features against paler surrounds. The dark linear features appear to be well vegetated narrow channels, incised into clay plains which do not have shrubs or trees. Ground inspection is needed but it is possible that the linear features are dominated by lignum. Geomorphic processes that create these uncommon wetlands are not known but could include a 'gilgai' effect where differential swelling of wet clay causes soil movement. An example from the NT-GAB is discussed in Section 5, for a wetland given a preliminary name "Mt Wilyunpa Reticulated Swamp" since no existing name is known for this feature. As with many arid NT wetlands, it is expected that Aboriginal names exist, but are not known to the author. Where it is culturally appropriate to use Aboriginal names, these should be used for wetland inventory, along with names in common usage by non-aboriginal landholders, or published names such as on topographic maps.

3.3 Groupings of Wetland Types According to Water Source

The wetland types in table 1 are grouped primarily by landform (basins/flats/channels). Sub-groupings are based on salinity and vegetation type for basins. For channels and waterholes, the groups are based on upland vs lowland and frequency and duration of inundation. Reasons for these groupings are given in Duguid *et al.* (2005). The structure is mostly useful, but as with many aspects of wetland classification, some groups can be hard to define tightly. In the NT-GAB, the distinction between upland and lowland is easier to make than in some other parts of the arid NT.

As with any classification, other groupings are possible. For basin wetlands another common system distinguishes wetlands filled from major creeks and rivers (including those on floodplains) from those that are isolated from rivers. This is useful when water source or hydrological connections are important attributes. The box below shows broad wetland types of the NT-GAB grouped according to water source. The grouping is adapted from an assessment of wetlands of the Western Davenports Water Control District (Duguid 2009). A difficulty with this system is that some basin wetlands can be filled from either or both source.

Wetlands of Drainage Channels and Floodouts:

1. Waterholes in River and Creek Channels
2. River and Creek Channels (various geomorphic forms and vegetation types)
3. Floodout Swamps and Lakes (various geomorphic forms and vegetation types)

Other Wetlands (Isolated = not associated with a major river)**:**

4. Saline and Semi-saline Lakes / Swamps
5. Isolated Lakes / Claypans and Swamps (various geomorphic forms and vegetation types)
6. Possible Subterranean Ecosystems (stygofauna in aquifers)
7. Artificial Wetlands

Flood prone Areas Intermediate Between Wetland and Dryland:

8. Briefly Inundated Floodouts (Flood-prone Flats) and Floodplains (including floodways)

The following descriptions and interpretations of broad wetland types use the groups listed in the box above.

Wetlands of Drainage Channels and Floodouts

Waterholes in River and Creek Channels

Riverine waterholes in NT-GAB are varied in character, however, none have been described with regard to longevity of water, length, width, depth, substrate, position in landscape, turbidity, and vegetation. There are no permanent or near-permanent waterholes in the NT-GAB and even the longest lasting ones are estimated to dry out before one year without follow-up flows. In the GABWCD very few waterholes are marked on topographic maps. Survey records and remote sensing indicate where some waterholes occur. Observation from the aerial survey could be converted to approximate mapping coordinates for many shallow waterholes seen in May 2010.

Arid NT Wetland Types (see table 1): WU1201, WL1202.

Waterhole on Wall Hole Creek (photo: A. Duguid 2001)

Waterhole where Huckitta Creek and Atula Creek meet the Plenty River, near the edge of the NT-GAB (A. Duguid 2 010)

River and Creek Channels

The sections of creek and river channels between water holes can also be regarded as wetlands even though they only hold water briefly and only during flow events. In the district there is considerable variation in vegetation and soil type of both the river banks and river beds. Distinctive types include: wide bare channels lined by River Red Gums (with sandy, stony or earthy soils and with minimal gradient); narrow channels in hills (typically rocky and unvegetated or sparsely vegetated); minor lowland channels with minimal woody vegetation; and channels within floodout systems with Lignum (*Muehlenbeckia florulenta*). In some places the river consists of multiple channels rather than a single channel. These can be regarded as 'braided channels' although they may not conform to some definitions of that term. A notable instance of that in the NT-GAB is on the lower Hay River (to south of the Lake Caroline area).

Arid NT Wetland Types (see table 1): WU2201, WL2001, WL2002, WL2005; WL2006.

This section of the Hay River is an example of sandy river channels with fringing gum trees, sometimes with trees in the channels (photo: D. Albrecht 2007)

The Finke River just up stream of the floodout on New Crown Station, view to north-west (photo: J. Barnetson 2010)

Floodout Swamps and Lakes

Low lying areas within floodouts can hold water for weeks and months. Floodout swamps and lakes may be regarded as shallow lakes, or as swamps depending on the density of emergent Coolabah trees (*Eucalyptus coolabah* subsp. *arida*), Lignum (*Muehlenbeckia florulenta*) and other plants. Some can have predominantly bare clay beds and may be regarded as claypans, but typically with a fringing zone of wooded or shrubby vegetation (typically Coolabahs and/or Lignum).

Aerial survey and inspection of Google Earth are the main source of information on basin wetlands (swamps, pans, lakes) in NT-GAB floodouts. Most of the NT-GAB floodouts have only a few identified basin wetlands and there is minimal supporting ground survey data. In contrast, the Finke River floodout has numerous swamps and lakes after major episodic river flows. Some of these can last for more than a year.

In the arid NT, swamps and pans within floodouts typically have clay rich soils that at least partially prevent loss of water into the deeper soil profiles. However, some sites may have semi-permeable soils. It is possible that local watertables may be temporarily at the surface at such times. If such watertables exist in the GABWCD, they would be termed perched since they would not be connected to the underlying aquifers of the GAB.

Section 5 includes a summary for each river system and its floodout.

Arid NT Wetland Types (see table 1): B1211, B1221, B2211, B2212, B2222, B2231, ?B2232

Wooded Swamp in Finke Floodout complex, with dense post inundation herbaceous growth (photo: A. Duguid 2001)

Other Wetlands (Isolated = not associated with major rivers)

Saline and Semi-saline Lakes / Swamps

Some of the lakes seen during aerial survey (May 2010) had fringing white ground that appeared to be saline efflorescence; also some of the lakes appeared to have clear water (not turbid from suspended clay) which may be an indicator of salinity. Clear water and fringing white ground were notable at lakes in the Poeppel Corner area and some of the lakes in northern group of Plenty Lakes. One of the lakes in the Lake Caroline group had salt tolerant vegetation seen during botanical survey but no surface salt crusting on the main lake bed (Duguid and Albrecht 2008). Some of the Plenty Lakes were surveyed on the ground by Peter Latz in 2001 as part of the arid NT wetland inventory (Duguid *et al.* 2005). Some observations, including the presence of salt tolerant plants, indicated salinity, possibly gypsum dominated, but not sufficient to create a distinct salt crust (Peter Latz in.litt. and inventory data).

From the evidence above, it is assumed that salinity influences plant and animal life at some of the NT-GAB pans/lakes and they are loosely referred to as salt lakes. The degree of salinity is not documented for any of these 'salt lakes' and neither are hydrogeological processes. The origins and composition of the mineral salts is not known. Discharge from saline aquifers is a contemporary and continuous process at many Australian salt lakes, resulting in accumulating evaporates (e.g. see Jacobsen 1996; or Wischusen 1998). It is not known if any equivalent process occurs in the Simpson Desert, and if present, saline aquifer discharge is probably not continuous. Salts may have accumulated at some pans/lakes by this process in the past. In very wet years it is possible that perched aquifers occur (perched above the GAB aquifer) and bring salt from soils and/or rocks to the surface, however there is no data to support this hypothesis. It is also possible that the main source of salt is from surface run-off accumulating in the basins and that no groundwater processes are involved.

Arid NT Wetland Types (see table 1): ?B1111, B1121, B2112

Saline wetland in south-east of NT-GAB, Mirranponga Pongunna Lake area (photo: J. Barnetson 2010

(see pictures for Upper Plenty Lakes and the Lake Caroline area in section 6)

Isolated Lakes/claypans and Swamps

Isolated claypans are widespread across the NT-GAB. The term 'isolated' refers to their isolation from major river systems and other substantial drainage lines such as Peebles Creek. They occur in varying landscape settings, including sanddunes, and adjacent to low elevation rocky rises and hills. Some may occur on floodplains but rarely if ever receive water inflow from major rivers. Some claypans have Swamp Canegrass (*Eragrostis australasica*) growing on them, often on 'stony pans' in gibber landscapes. Mostly the Canegrass is in small patches or is generally sparse, such that the term claypan is more appropriate than swamp. However, parts of swamps in the Casuarina Swamp area have dense Swamp Canegrass. There are a few known swamps with dense Northern Bluebush (*Chenopodium auricomum*) (e.g. Duffield Swamp). A species of Maireana called Swamp Bluebush (*M. microcarpa*) is also recorded from the NT-GAB from New Crown and Andado stations, and dominates a substantial area of at least one wetland in the Skull Creek area (wetland inventory site data). Wooded swamps are a feature of rivers, floodplain and floodout systems. Some isolated claypans have some Coolabah trees on the edge, although most are tree-less.

Swamps and pans that are isolated from rivers and their floodouts and floodplains may typically be filled less often than those associated with rivers. This suggestion is made because they are usually filled from relatively local rain and runoff or sheet-flow. Heavy local rain is less likely to occur than heavy rain somewhere in the catchment of a major river. Nevertheless, these wetlands can hold water for weeks and months and this has been documented in the Andado area in 2010-2011. Some pans and swamps are within the vicinity of rivers and floodouts but are not obviously connected, such as most of the Lake Caroline group of lakes and swamps. Some clearly have inflow via minor creeks, while others seem to rely on sheet flow.

Most of these isolated basin wetlands are widely scattered (separated from each other). However, some distinct clusters of non-riverine swamps and pans are known. Major wetland aggregations include those in the south-east corner (Poeppel Corner), the Lake Caroline area, two groups west of the Plenty River (the Plenty Lakes), the central Andado area, and the southern New Crown area.

Arid NT Wetland Types (see table 1): B1211, B1221, B2221, B2222, B2223, B2231, B2232

The interdune lakes (or lagoons) in the Snake Creek floodout section of the Finke Floodout are an example of freshwater lakes (photo: P. Latz 2001)

Shallow stony claypan on Andado Station, with patches of Swamp Canegrass (*Eragrostis australasica*) (photo: A. Duguid 2001)

Small claypan between dunes in the Lake Caroline Group (photo: D. Albrecht 2007)

Wagon Claypan,with vegetated fringe common around some claypans, Andado Station (photo: A. Duguid 2001)


Isolated interdune swamp/herbaceous pan, east of lower Plenty River Floodout (photo: A. Duguid 2010)


Nardoo dominating a large part of one of the Skull Creek wetlands (photo: A. Duguid 2001)


Area of swamp dominated by Lignum and adjacent area dominated by post-inundation herbs (photo: D. Albrecht 2007)


Bluebush swamp (dominated by Northern Bluebush - Duffield Swamp on New Crown Station (photo: A. Duguid 2001)


One of the Skull Creek wetlands – a swamp with *Maireana microcarpa* (photo: A.Duguid 2001)

Unusual area of grassy swamp in the Coglin Creek Floodout, with dense swamp grass (*Eriachne benthamii*) (photo: A. Duguid 2001)

Herbaceous swamp in run-on area adjacent to Mt Wilunpa plateau (photo: A. Duguid 2001)

Possible Subterranean Ecosystems (Stygofauna)

Australian government policy and the international wetland treaty (Ramsar Treaty) both recognise that small aquatic animals can occur in wet caves and in some aquifers. Macroscopic (visible without magnification) aquatic stygofauna (underground animals) have been found in calcrete aquifers and in unconsolidated aquifers in the southern NT (Duguid *et al*. 2005; R. Read pers. comm.; W. Humphreys *in litt*.). Although stygofauna have not been recorded for the Water Control District, they may occur.

Artificial Wetlands

These are not dealt with in this report with the exception of McDills No.1 Bore Swamp (see section 5).

Briefly Inundated Floodouts (Floodprone Flats) and Floodplains

The floodouts of the major creeks can influence vegetation over large areas, as described in section 2.

4. Conservation Significance

Assessing the conservation significance of an individual wetland or group of wetlands involves comparing the characteristics of the individual with other wetlands in the surrounding region. A wetland that is very similar to many other wetlands in a region is typically considered to have less value than a wetland that has uncommon characteristics, such as rare species. However, it is important to consider that collectively, small seemingly ordinary wetlands may be important for the conservation of particular species (Whitehead & Chatto 1993; Duguid *et al* 2005). General issues relevant to assessing conservation significance of wetlands in the arid NT are presented in Duguid *et al.*, 2005, pp.227-228). In arid landscapes it may be more appropriate to focus on the conservation values of groups of wetlands rather than on individual wetlands, particularly when the characteristics of many of the individual wetlands are poorly known.

The following simple criteria were used to determine significance of wetlands in the Western Davenports Water Control District (Duguid 2009) and are relevant to the GABWCD:

1. relatively large areas of water and/or long lasting water with an associated benefit for wetland dependent plants and animals (including water birds);
2. presence of plant species that are rare (or appear to be rare) in central Australia;
3. presence of plant species that appear to be rare in the Water Control District and surrounding areas;
4. high diversity of wetland plant species.

For the NT-GAB the following additional criteria are meaningful:

5. high diversity of water birds;
6. unusual or rare wetland type.

Due to the sparsity of biological survey data criteria 4 & 5 cannot be applied with great confidence. However, there are wetlands in the NT-GAB with high recorded species diversity and with species that are apparently rare elsewhere in NT-GAB. The Lake Caroline group of wetlands has a high diversity of wetland plants, several of which are not recorded elsewhere in the NT-GAB. Criterion 5 is met only by the Snake Creek Floodout Lakes (inter-dune lagoons) which have by far the highest recorded diversity of waterbirds. However, caution is required in each of these assessments since so many other places have not had as much survey effort during or following inundation.

Currently insufficient data exist to use invertebrate assemblages to classify or assess the significance of wetlands in NT-GAB.

Some wetlands and river floodouts may be very important habitat for some bat species. Following the large flows in 2000, Dennis Matthews surveyed bats in the Finke Floodout and recorded the highest diversity and abundance of bats of anywhere he had surveyed in central Australia (D.Matthews pers. comm.).

The Ramsar international wetland treaty has detailed criteria and guidelines for identifying wetlands of international significance. There are no Ramsar listed wetlands in NT-GAB. It is possible that some sites could meet the Ramsar criteria. Current data for the Snake Creek Floodout could be interpreted as consistent with international significance (Duguid 2005, p.67).

The document called *A Directory of Important Wetlands in Australia* (Environment Australia 2001) is a national list of important wetlands, with descriptions of each. It was maintained by the Commonwealth Government between about 1993 and 2008. The criteria for including sites in the Directory are clearly stated but also allow for some subjective assessment of unquantified values, such as, being a good example of a wetland type in a bioregion. This and some of the other criteria give considerable flexibility in determining whether or not a wetland should be considered important. The full criteria can be found in the overview document for the third edition of the Directory (available online - see References). No wetlands in the NT-GAB are currently listed in the Directory of Important Wetlands in Australia. However, some were identified by Duguid *et al*. (2005) and Duguid

(2005) as meeting the criteria, and are listed in table 2. The level of significance given in table 2 is taken from Duguid *et al*. (2005). *A Directory of Important Wetlands in Australia* does not have categories of relative significance and more work is needed to establish criteria for what constitutes regional or national levels of significance. The geographic extent for assessing 'regional' significance of wetlands is not formally defined and could be a bioregion, a climatic group of bioregions, or a state or territory.

Criterion 6 suggested for NT-GAB (above) concerns wetlands with an unusual combination of biological and physical characteristics. These may be regarded as having some significance, even if no rare or threatened species are recorded. Such wetlands may conform to a particular wetland type in a classification. For example, areas of Bluebush swamp (*Chenopodium auricomum*) are uncommon in the Water Control District, even though they are common in other parts of central Australia. Other wetlands may not conform to a described wetland type. It may be appropriate to only rate wetlands of an unusual type as significant when other criteria are also met. For example, Duffield Swamp is a Bluebush Swamp, plus it is a moderately large wetland in the context of NT-GAB, and there is some evidence that inundation can sometimes be moderately long-lasting.

Table 2. Potential Directory of Significant Wetlands Sites for NT-GAB identified in Duguid *et al*. (2005)[1]

Level of Significance	Wetland Name	Main Values / Character
National/International	Snake Creek Interdune Floodout Lakes	waterbird diversity, large long-lasting waterbodies when filled
National	Casuarina Swamp	EPBC[2] listed plant species (*Eleocharis papillosa*)
National	Finke Floodout Forest [3] (and wetlands within and adjacent to it)	large unusual vegetation type with diverse wetland elements
Regional	Duffield Swamp	extensive Bluebush swamp with sometimes long-lasting inundation
Regional	Indemina Swamp	large swamp with diverse elements, moderate plant species diversity is recorded, suspected waterbird values
Regional	Indinda Swamp	a large swamp including areas of Bluebush, Lignum and wooded (Coolabah) swamp; moderate plant species diversity is recorded
Regional	Northern Simpson Desert Area Lakes[4] (Upper Plenty Lakes)	large collection of wetlands including some large lakes/pans, of which some are semi-saline; suspected value for waterbirds
Regional	Skull Creek Swamps	collection of small pans and swamps with diverse vegetation types

1. note that the sites listed in table 2 are those presented in Duguid *et al*. (2005) and that additional sites of significance are presented in this report, in table 3 below.
2. EPBC – the Commonwealth Environment and Biodiversity Conservation Act 1999.
3. note that assessment for this NT-GAB report involves grouping the floodout forest with the many adjacent inter-dune swamps. This was not clear in the 2005 report; also, in this table the Snake Creek section of the floodout is treated as distinct, although geographically and hydrologically they are continuous.
4. note that the Northern Simpson Desert Area Lakes are referred to elsewhere in this report as the 'Upper Plenty Lakes' due to their proximity to the Plenty River floodout, which is 20-30 km to the east. There are two other notable aggregations of lakes and pans in the northern Simpson Desert, one referred to in this report as the Lake Caroline Group, and one referred to as the Lower Plenty Lakes.

Existing information for the sites listed in table 2 was compiled in Volume 2 of the report on wetlands in the arid NT (Duguid 2005). For most sites, little additional biological information has been collected since. However, some sites are now regarded as 'significant' due to new information. The Lake Caroline Group of wetlands was surveyed in 2007 and was found to have a relatively high plant species diversity and diversity of wetland types (Duguid & Albrecht 2008). Additional sites that are now regarded as significant are listed in table 3, along with other wetlands that should be assessed further. For some of these, some information was collated in Duguid *et al.* (2005).

Table 3. Additional significant wetlands in the NT-GAB

Level of Significance	Wetland Name	Main Values / Character
National/Regional	Lake Caroline group of wetlands	Has a moderately high diversity of plants and wetland types and presence of plants that are not recorded elsewhere in the NT-GAB or appear to be rare in NT-GAB.
possible significance	"Mt Wilyunpa Reticulated Swamp"	An unusual geomorphic feature and wetland type; potentially distinctive vegetation.
possible significance	swamps and pans of Allitra Tableland	An aggregation of wetlands, with a variety of floristic assemblages (Peter Latz pers. comm.).
possible significance	Lower Plenty Lakes	An aggregation of wetlands – including claypans and semi-saline lakes.
possible significance	Central Andado Wetlands: aggregations of shallow stony pans in the central Andado Station area, including around Mac Clarke (*Acacia peuce*) Conservation Reserve, The Peebles Creek catchment, and areas in between	a very large collection of mostly small, shallow pans with mostly short lasting inundation; the number, density and extent of surface waterbodies is unusual in the arid NT and within NT-GAB; there is a group of pans/swamps at the edge of the stony plain and adjacent to the dunefield, 5.5 km NE of Rieks Dam that had a somewhat different appearance during aerial survey.
possible significance	Poeppel Corner Area Saline Lakes	A large group of saline or semi-saline lakes, most of which are over the borders in Qld and SA.
possible significance	Hay River Floodout swamps and channels	The floodout of the Hay River is notable for multiple (braided) channels and may have more swamps than the other large rivers in the north of NT-GAB (e.g. Hale and Plenty rivers).
possible significance	Plenty River Floodout	The floodout includes an area of notably dense inter-dune forest/woodland, spanning a series of parallel dunes; some swamp areas have been identified but these are not extensive. Arrunja Waterhole in the Plenty River floodout is not considered to be long-lasting but when dry may be a semi-permanent soakage where a perched watertable can be accessed by digging (based on information from P. Latz pers. comm.).
possible significance	Hale River Floodout complex	The Hale River Floodout covers a very wide and long area; it features various distinct distributary channels and areas of dense forest/woodland, including a particularly large area north of the Allitra Tableland; however, areas of longer-lasting swamps and waterholes, although present, are far less extensive than in the Finke Floodout. There is a soakage called Allua that may be semi-permanent (based on information from P. Latz pers. comm.) and is probably the same one referred to in the report of the scientific exploration by Madigan P. Latz pers. comm.).

The Australian Government is working with state and territory governments to create a new framework for identifying wetlands of particular significance. In the framework, wetlands are called *aquatic ecosystems* and include rivers and waterholes. The term High Conservation Value Aquatic Ecosystem (HCVAE) was used for several years but was superseded by High Ecological Value Aquatic Ecosystem (HEVAE) in 2010. It is still uncertain whether the Australian Government will establish a list of HEVAEs and store information about them. Likewise the ongoing role of *A Directory of Important Wetlands in Australia* (DIWA) is uncertain.

In 2009-2010 a project was undertaken for the Lake Eyre Basin (LEB), trialing the criteria for identifying HCVAE. The entire GABWCD is in the study area of the LEB HCVAE trial. The project report (Hale 2010) is available on request from the Australian Government. The project collated environmental data relevant to the HCVAE significance criteria. The LEB was divided into small sub-catchment areas. For each sub-catchment, scores were generated for each criterion. Catchments that had a 'very high' score for one or more criteria were identified as containing potential HCVAE. In addition, specific sites were nominated as potential HCVAE based on expert opinion. The Finke Floodout Forest and Snake Creek floodout were nominated as important sites in the LEB HCVAE project. No catchments of the NT-GAB were identified as likely to contain HCVAE/HEVAE by applying the criteria to available spatial data. A major outcome of that project was that for many parts of the LEB, biological survey data and wetland mapping are too sparse to systematically apply HCVAE criteria. It is also important to realise that the project aimed to identify the most important aquatic ecosystems from a national perspective. There is currently no official framework for identifying or listing significant wetlands at an NT or regional level. Also, the current HEVAE criteria do not include a process for ranking the relative importance of sites.

Rating the significance of wetlands/HEVAE can be quite subjective due to variation in quantity and quality of data. Critical knowledge gaps include:

- not knowing how often particular wetlands are inundated or how long the water lasts;
- not knowing which plant and animal species occur at individual wetlands;
- not knowing how an individual wetland contributes to sustaining regional or national populations of individual species;
- not knowing whether individual plant species use groundwater for transpiration and to what extent species and vegetation assemblages (communities) depend on groundwater.

Conservation significance can be assessed at various scales. For the southern part of the Northern Territory, two projects have identified broad sites of conservation significance. In 2001 a project on sites of botanical significance in the southern NT was completed (White *et al.*, 2001a & 2001b). In a later project covering the entire NT, sites of conservation significance were identified using both flora and fauna values (Harrison *et al.* 2009; Ward & Harrison 2009). The botanical sites of significance from 2001 are known as SOBS and the sites of conservation significance from 2009 are known as SOCS. In the GABWCD there are both SOCS and SOBS that include wetlands.

Sites of Botanical Significance in NT-GAB identified by White *et al*. (2000) were:

- **Allitra Tablelands** (Site 24-5-1) – includes some swamps and lakes/pans, but not the adjacent areas of the Hale Floodout; this site was rated as botanically significant at the national level due to a threatened Acacia (*A. pickardii*);
- **Andado** (Site 5-5-1) – includes the gibber plains and associated pans and swamps such as Casuarina Swamp, Indemina and Indinda, rated as botanically significant at the national level, due to presence of several threatened species including one at a wetland (*Eleocharis papillosa*);
- **Beddome Range** (Site 25-4-1) – defined by the upland area, rated as botanically significant at the national level due to a threatened Acacia (*A. latzii*).
- **Dakota** (Site25-5-PL1) - suspected significance;
- **Hay River Floodout** (Site 24-6-PL) – suspected significance (still not biologically surveyed);
- **Lake Caroline** (Site 23-6-PL1) – a group of wetlands of suspected (at that time) significance;
- **Lake Poeppel** (Site 25-6-1) - rated as botanically significant at the bioregional level although very few botanical records existed;
- **Old Todd River Floodout** (Site 24-5-3) – includes many wetlands but is mostly outside NT-GAB, rated as botanically significant at the bioregional level;
- **Prior Floodout of the Plenty River** (Site 24-6-1) – this is the area now referred to as the Upper Plenty Lakes and was rated as botanically significant at the bioregional level;
- **Rumbalara** (Site 25-4-2) – centred on the Rumbalara Range fringing the Simpson Desert;
- **Wilyunpa Tablelands** (Site 25-5-2) – includes the adjacent clay plains around Coglin Creek, and the Coglin Creek section of the Finke Floodout, rated as botanically significant at the national level;

Sites of Conservation Significance in NT-GAB identified by Harrison *et al*. (2009) and Ward and Harrison (2009) were:

- **Andado and Snake Creek Lakes** – based on the Andado site of botanical significance and extended to the south-east to include the Snake Creek interdune lakes section of the Finke Floodout and the Mayfield Swamp area;
- **Beddome Range and Wilyunpa Tablelands** – combines the two sites of botanical significance with the same names and includes the Finke Floodout Forest and some of the adjacent areas of interdune swamps/lakes.

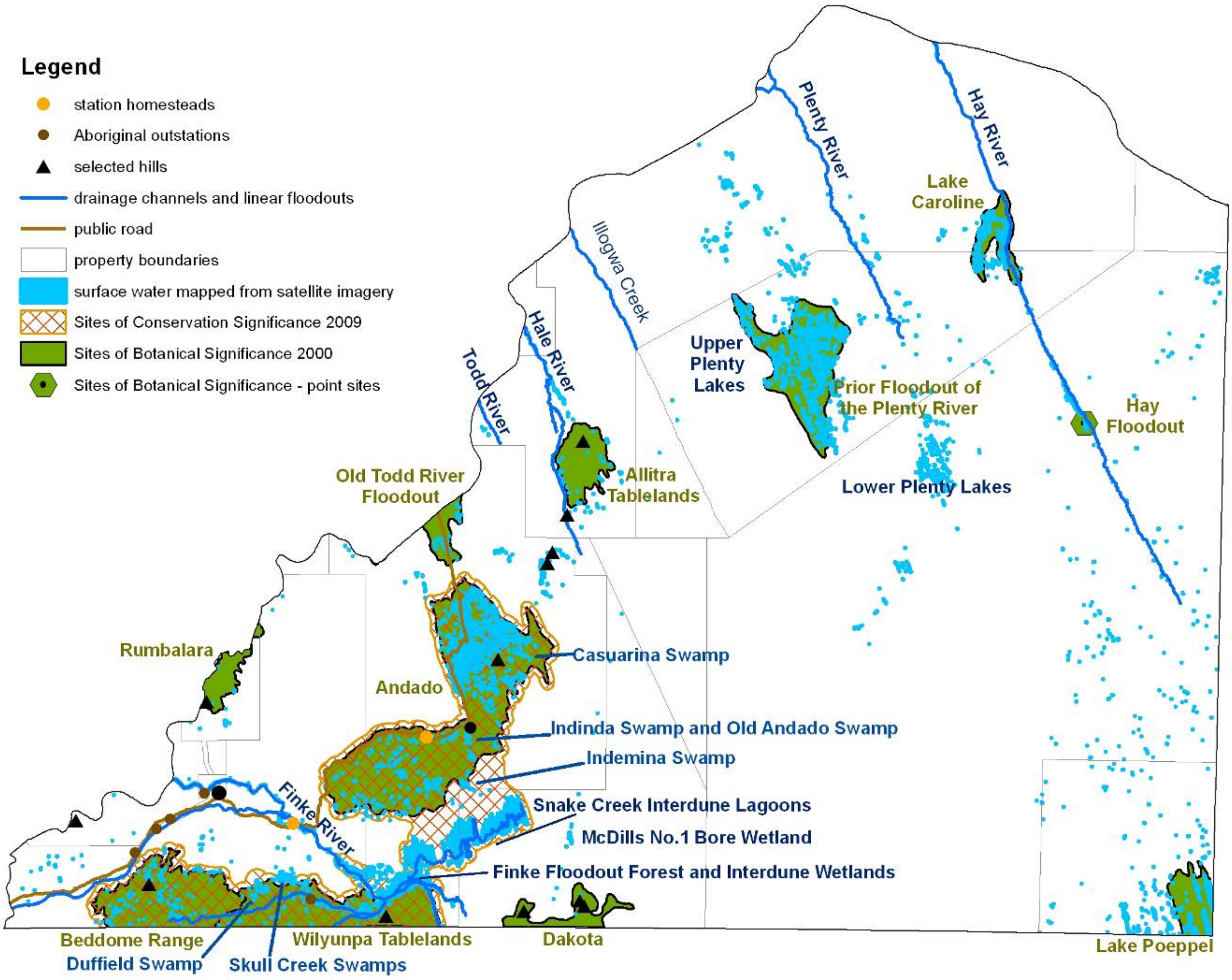


Figure 7. Sites of Botanical and Conservation Significance and Significant Wetlands
Note: labels in green text refer to sites of botanical significance, and blue labels to significant wetlands

5. Wetland Biota of the GABWCD

Only limited biological survey has been done in wetlands of the Water Control District. Therefore the information presented below should not be regarded as comprehensive. However, the information available is indicative of the diversity of wetland types and their importance for native species.

5.1 Fish

There are no long-term riverine waterholes in the GABWCD that provide drought refuge for fish. Several of the rivers have fish populations which rely on pools in the headwaters. When large flow events occur, fish can occur in waterholes and swamps at the lower end of these river systems within the GABWCD.

The Todd has a single species of fish recorded: Spangled Grunter (*Leiopotherapon unicolor*). There is no record of fishes in the Hale River. A distributary channel and floodway of the Hale River terminates very close to the lower Todd floodout (confirmed during the 2010 aerial survey). Therefore, fish migration between the two is conceivable in simultaneous extreme floods in both rivers. However, the Todd River has no known waterholes in the GABWCD, and those in the portion of the Hale River in the GABWCD are considered to be short-term. The floodouts of both rivers appear to have swamps but there is no data showing inundations lasting a substantial time (e.g. months).

Spangled Grunter have been recorded in the catchments of both the Plenty and the Hay Rivers. There are spring-fed refuge pools in the headwaters of both rivers, in the Dulcie Range. Also, these two rivers are connected by a distributary channel between the Marshall and Plenty rivers. There are no specimen or survey records of fish from the portion of the Hay River in the GABWCD but they are expected to occur there in temporary pools and swamps following river flows. There is a survey record from a waterhole in the Plenty River within the GABWCD (at Arrunja Waterhole in September 2001, Arid NT Wetland Inventory data).

The Finke River has nine species of native fish, as listed in table 4. Five of these species have been recorded within the GABWCD with specimens in Australian museums. Locations include: a riverine waterhole in the main Finke River channel (prior to the floodouts), tributaries in the Charlotte Waters area, pools within the first floodout complex, and an inter-dune lake of Snake Creek. It is likely that all nine species may sometimes occur in the GABWCD. One of the species not yet recorded is *Mogurnda larapintae*. A closely related species has been found in a floodout swamp of the Frew River (outside the GABWCD) which is indicative of how *M. larapintae* could be flushed down into the lower Finke River and floodout.

Three of the Finke fish species are considered endemic to the Finke under current taxonomy and are marked with (ε) in table 4. This is indicative of the isolation of the Finke River from rivers in South Australia that connect to Lake Eyre. Inspection of the lower floodout of the Finke in South Australia shows relatively thick woody vegetation extending south of the floodout swamp between dunes, to within around 10 km of the floodplain of the Dalhousie Springs system and Ambutchera and other creeks (seen from passenger jet and on Google Earth). Similarly, the influence of that floodout appears to extend south between dunes to the floodouts of other east running creeks (e.g. Arrabunda and Adnowgalara creeks). In that area on the edge of the Simpson Desert dunefield, floodways and channels can be seen connecting right through to the floodplain of the Macumba River which episodically connects to Lake Eyre. Therefore a surface water connection is feasible between the Finke River and other Lake Eyre rivers. It would require a very large flow or flows down the Finke River, combined with relatively local rain and flooding in the Macumba River catchment. For fish to travel upstream from the Macumba to the Finke and then up to the refuge pools in the upper and mid-Finke would require unusually long-lasting flows and/or a series of floods.

The three endemic Finke fish species are a mogurnda, a goby and a hardyhead, and all have related species of the same genus in other catchments of the Lake Eyre Basin (LEB). The Finke Mogurnda seems to be most genetically distinct relative to related LEB species (Mark Adams, South Australian Museum, pers. comm.).

Table 4. Fishes of the GABWCD

Scientific Name (ε = endemic to Finke River system)	**Common Name**	**Finke (*GABWCD)**	**Todd, Hay, Plenty**
Ambassis sp. (central Australia)	Glassfish	✓*	
Amniataba percoides	Banded Grunter	✓*	
Chlamydogobius japalpa ε	Finke Goby	✓	
Craterocephalus centralis ε	Finke Hardyhead	✓	
Leiopotherapon unicolor	Spangled Grunter	✓*	✓
Melanotaenia splendida subsp. *tatei*	Desert Rainbowfish	✓*	
Mogurnda larapintae ε	Finke River Gudgeon	✓	
Nematalosa erebi	Bony Bream	✓*	
Neosilurus hyrtlii	Hytrl's Catfish	✓	

5.2 Wetland Birds

The information presented here is mainly from data on water birds that were compiled in 2001. Sources included wetland inventory survey (Duguid *et al*. 2005), the NT Fauna Atlas and the Bird Atlas of Australia. Some more recent records have been incorporated but were not systematically searched for. A list of species is presented in table 5.

For water birds, the most species rich wetlands in the district appear to be the Snake Creek inter-dune lakes, based on a single trip in 2001. There are also anecdotal reports of water birds at swamps/lakes further north on Andado Station such as Indemina swamp on the Peebles Creek system (R. Bloomfield pers.comm.), at Indinda Swamp and at Old Andado Swamp (Jeff Cole, Jock Morse and Bob Read pers. comm.). Salt lakes and pans may be good water bird habitat when filled. *Ruppia tuberosa* is recorded from one of the Plenty lakes. *Ruppia* is a salt-tolerant submerged aquatic macrophyte (i.e. vascular plant, not algae) that is believed to be an important foundation species for food chains that support waterbirds (Peter Latz pers. comm.*)*. Wooded swamps in some of the river floodouts have varying densities of Coolabah trees across the swamp bed. It is speculated that wooded swamps may be important breeding sites for some bird species because of roosting sites surrounded by water, providing protection from some predators. Fish eating birds such as Pelicans are known to visit temporary waterholes on the lower Finke River at New Crown Station (M. Smith pers.comm.). The inter-dune lakes and swamps of the Finke floodouts can have fish populations that could potentially support fish eating birds. Fish have been recorded from the Snake Creek inter-dune lakes that are occasionally inundated by large floods in the Finke. There is no record of fish in swamps of the Plenty and Hay rivers but since fish (spangled grunter) occur in the catchments, they could episodically occur in the swamps of the floodout and provide food for fish eating birds, however, none of the NT-GAB wetlands is likely to have particular significance for fish-eating birds.

The only record of breeding in the data compiled in 2001 was of Gull-billed Terns, Red-capped Plovers and Darters at the Snake Creek Inter-dune Lakes (wetland inventory survey data recorded by Bob Read). Swans are reported as breeding in the Old Andado area in 2011 (J. Cole pers.comm. and R. Read *in. litt.*).

Rachel Paltridge recorded waterbirds at the Northern Plenty Lakes and at the Lake Caroline group of lakes in 2010 (P. Latz pers. comm.) but these data have not been incorporated here.

Table 5. Wetland birds recorded from the GABWCD (alphabetical order).

Species	Total Count
Australasian Grebe	22
Australian Pelican	141
Australian Pratincole	0
Australian White Ibis	1
Australian Wood Duck	266
Banded Lapwing	13
Banded Stilt	0
Black Swan	37
Black-fronted Dotterel	8
Black-tailed Native-hen	491
Black-winged Stilt	91
Caspian Tern	4
Clamorous Reed-Warbler	1
Common Greenshank	2
Common Sandpiper	0
Darter	88
egrets (unidentified)	4
Eurasian Coot	625
Freckled Duck	40
Glossy Ibis	1
Great Cormorant	9
Great crested Grebe	4
Great Egret	30
Grey Teal	1203
Gull-billed Tern	81
Hardhead	326
Heron (unidentified)	0
Hoary-headed Grebe	66
Intermediate Egret	2
Little Black Cormorant	54
Little Grassbird	0
Little Pied Cormorant	35
Masked Lapwing	16
Nankeen Night Heron	5
Oriental Plover	0
Pacific Black Duck	19
Pink-eared Duck	291
Plumed Whistling-Duck	0
Red-capped Plover	5
Red-kneed Dotterel	11
Red-necked Avocet	18
Royal Spoonbill	0
Sharp-Tailed Sandpiper	0
Silver Gull	2
Straw-necked Ibis	4
Swamp Harrier	0
tern (unidentified)	60
Whiskered Tern	30
White-faced Heron	5
White-necked Heron	15
Yellow-billed Spoonbill	6

Some inferences also can be drawn from wetlands in other parts of central Australia, to indicate other likely species. Table 6 lists waterbirds recorded at wooded swamps in the arid south of the NT, in 2001. That includes the GABWCD but most of the sites surveyed were further north.

Table 6. Wetland birds recorded from wooded swamps in the arid NT (alphabetical order).

Common Name	No. of Swamps Where Recorded	Total Nos. *
Australian Pelican	2	35
Australian Wood Duck	2	10
Banded Lapwing	1	2
Black Swan	1	1
Black-tailed Native-hen	1	2
Black-winged Stilt	2	8
Brolga	1	few
Cormorants (unidentified)	1	40
Darter	2	2
ducks (unidentified)	2	106
egrets (unidentified)	1	6
Eurasian Coot	1	8
Glossy Ibis	2	15
Great Cormorant	2	11
Great Egret	5	8
grebes (unidentified)	2	10
Grey Teal	5	344
Hardhead	4	76
Heron (unidentified)	1	2
Little Black Cormorant	3	120
Masked Lapwing	4	22
Pacific Black Duck	1	10
Pied Cormorant	5	59
Pink-eared Duck	5	190
Plumed Whistling-Duck	1	3
Red-kneed Dotterel	2	16
Royal Spoonbill	2	8
spoonbills (unidentified)	2	12
Straw-necked Ibis	3	25
Whiskered Tern	2	13
White-faced Heron	5	19
White-necked Heron	4	24
Yellow-billed Spoonbill	3	5

* Total Nos. is the total numbers recorded of that species, pooled from all the surveyed wooded swamps in the 2001 wetland inventory. Numbers are only indicative of abundance since waterbird survey was done opportunistically.

**note- not all these species are known from NT-GAB.

5.3 Invertebrates

Inland crabs (*Holthusiana transversa*) are known from a single site in the GABWCD: Wall Hole on Coglin Creek. It is likely that they occur elsewhere in the Finke floodout system. Inland crabs are common in the creeks and waterholes of the Dulcie Range and so may well occasionally occur in the Plenty and Hay Rivers and floodouts which have parts of their catchments in the Dulcie Range. However, they were not observed in the Australian Geographic survey to the Hay River in 2007, or by Gibson and Cole (1985).

The common yabby, *Cherax destructor*, is known from permanent and near-permanent waterholes in the upper Finke but has not been recorded in the GABWCD portion of the Finke system. It is possible that it occurs after large flows and may even persist in burrows between flows.

Few data exist for smaller aquatic macro-invertebrates in the GABWCD, although there was some opportunistic sampling during the 2001 wetland inventory survey (Duguid *et al.* 2001; Duguid 2005): Anisoptera, *Branchinella* sp., Choncostraca, Corixidae, *Lethocerus insulanus*, Trichoptera, and Zygoptera; all from claypans. Some invertebrate samples were collected by Dr. Jayne Brim Box in 2010 during field work to assess impacts of feral camels in the Simpson Desert (P. Latz pers. comm.).

Currently insufficient data exist to classify or assess the significance of wetlands such as claypans based on their invertebrate assemblage. Research by Brian Timms on the invertebrates of short-term wetlands of arid and semi-arid Australia indicates that there is much to learn (based on seminar at Australian Limnological Society Congress, 2009).

Freshwater mussels have not been recorded in the GABWCD but have been recorded in adjacent catchments of the Macumba River, less than 25 km away from the Finke system (at Eringa waterhole, Simon Abbott pers. comm., identified from photograph as *Velesunio* sp., confirmed by Keith Walker *in litt.*). There are anecdotal reports of small mussels at waterholes on the lower Finke River (R. Kimber pers.comm.).

5.4 Plants

Around 810 plant species (and sub-species and varieties) have been recorded from the control district. Most are native with only 17 being introduced. Around half the total number of species have been recorded from wetlands. Thus, wetlands appear to make a significant contribution to plant species diversity in the district, even though wetlands are a very small proportion of the landscape (note: in this document the term ‘species’ is used in a broad sense; some species have more than one formal sub-species or variety and each of these is treated as distinct for counting numbers of ‘species’).

Targeted survey data for plants at wetlands are available from the 2001 wetland inventory (Duguid *et al*. 2005; Duguid 2005) and from a botanical survey of the Lake Caroline area (Duguid & Albrecht 2008). All species recorded at those sites are listed in Appendix 1 along with additional wetland species collected as Herbarium specimens.

Not all wetland plants are aquatic (grow in water). Wetland Plants are defined here loosely, as those plants which have a definite preference for growing in wetlands. This definition is broad and potentially problematic and is discussed in more detail in Duguid *et al*. (2005). A revised list of wetland plants has been produced for the arid NT (Duguid, unpublished data, 2010) which includes ranking for fidelity to wetlands. For example, species with high fidelity to wetlands are rarely found in non-wetland habitats, whereas, those with slight fidelity are slightly more likely to occur in wetlands but are also often found in other habitats.

For the GABWCD, 93 plant species have high fidelity (H) to wetlands and 96 have moderate fidelity (M) (including those intermediate between M and H). A further 71 species have slight fidelity (S) (including those intermediate between S and M). More than 130 other species have been recorded at wetlands but are not regarded as having any preference for wetlands. These wetland preference numbers are presented in table 7.

Table 7. Wetland plants of the GABWCD by fidelity category.

Category	Number of Species
High Fidelity Wetland Plant Species	93
Moderate Fidelity Wetland Plant Species	96
Low Fidelity Wetland Plant Species	71
Other (no fidelity) Plant species Recorded at NT-GAB Wetlands	*139
Total Number Plant Species at Wetlands in NT-GAB	***399**

* note: figures are approximate due to uncertainty in the fidelity category for some species.

Aquatic and Semi-aquatic Plants

Only a small number of arid NT wetland plants grow in water for a substantial part of their life-cycle or tolerate extended inundation (e.g. more than a month). Such plants are often called aquatic, semi-aquatic, or aquatic macrophytes. Those that are recorded from wetlands in the NT-GAB are listed below.

Aquatic

- *Potamogeton tricarinatus* (Floating Pondweed) – one record from GABWCD, from a homestead
- *Ruppia tuberosa* – a submerged aquatic often found in inundated salt lakes; one record from the Plenty Lakes

Semi-Aquatic and/or Tolerating Prolonged Inundation

- *Chenopodium auricomum* (Northern Bluebush, often just referred to as Bluebush)
- *Crinum flaccidum* (Desert Lily) – can tolerate inundation but often grows in dryland run-on areas
- *Eleocharis pallens* (Pale Spike-rush)
- *Eragrostis australasica* (Swamp Canegrass)
- *Eriachne benthamii* (Swamp Wanderiee)
- *Eucalyptus coolabah* subsp. *arida* (Coolabah)
- *Leptochloa digitata* (Umbrella Canegrass) – typically at water edge, borderline for semi-aquatic
- *Leptochloa fusca* subsp. *muelleri* (Brown Beetle Grass)
- *Maireana microcarpa* (Swamp Bluebush; note, that the term Bluebush Swamp is used for *Chenopodium auricomum*)
- *Marsilea drummondii* (Common Nardoo, Clover Fern)
- *Marsilea exarata* (Swayback Nardoo)
- *Marsilea hirsuta* (Short-fruit Nardoo, Hairy Nardoo)
- *Muehlenbeckia florulenta* (Lignum)
- *Myriophyllum verrucosum* (Red Water-milfoil) – one record in the Finke Floodout
- *Peplidium aithocheilum*
- *Peplidium foecundum*
- *Schoenoplectus litoralis* (River Club-rush) - only recorded in GABWCD at McDills No1 Bore swamp
- *Typha domingensis* (Bullrush) – all records from artificial wetlands – often regarded as an "aquatic".

Two species that are common in GAB mound springs in South Australia are only known in the GABWCD from the wetland created by flow from the McDills No. 1 Bore: *Cyperus laevigatus* and *Schoenoplectus litoralis*. These and other wetland species appear to have colonized the bore wetland naturally. This is the only site in the NT where *C. laevigatus* has been recorded.

Rare and Threatened Species

Threatened Plant Species (Vulnerable or Endangered) at GABWCD Wetlands

There is one threatened wetland species known from the GABWCD: *Eleocharis papillosa* (Dwarf Desert Spike-rush). In the GABWCD it is known from a single swamp (Casuarina Swamp) where it has been collected twice. This is one of only 9 locations where this species is known to grow in the wild. It is classified as Vulnerable under both Northern Territory and Commonwealth legislation.

Another threatened species occurs in the vicinity of wetlands: *Acacia peuce* (Waddy-wood, Casuarina Wattle). Shallow stony pans occur among and adjacent to some stands of *Acacia peuce*. Also, Casuarina Swamp where *Eleocharis papillosa* has been collected is named for the stands of *Acacia peuce* a few kilometers away. However, *Acacia peuce* is not regarded as a wetland species.

Near Threatened Plant Species at GABWCD Wetlands

Several species (18) occur in the GABWCD that are classified as near threatened in the Northern Territory under Northern Territory legislation. This category applies to rare or uncommon species which are not known to be declining or exposed to a known threatening process. Most of these Near Threatened species have a high or moderate fidelity to wetlands but one has only slight fidelity (*Dysphania sphaerosperma*) and two have no particular fidelity but have been recorded at wetland sites in the GABWCD (*Atriplex eardleyae*, *Trianthema glossostigma*).

- *Acacia cyperophylla* var. *cyperophylla* (Mineritchie, Red Mulga, Minni Ritchi)
- *Atriplex eardleyae* (Small Saltbush, Eardleys Saltbush)
- *Atriplex lobativalvis*
- *Atriplex turbinata*
- *Centipeda cunninghamii* (Common Sneezeweed)
- *Cyperus alterniflorus*
- *Cyperus laevigatus*
- *Dentella pulvinata*
- *Dysphania sphaerosperma*
- *Gilesia biniflora* (Gilesia)
- *Glinus orygioides*
- *Lythrum wilsonii*
- *Maireana microcarpa* (Swamp Bluebush)
- *Mentha australis* (Native Mint, Australian Mint, River Mint)
- *Rumex crystallinus* (Shiny Dock, Glistening Dock)
- *Ruppia tuberosa*
- *Teucrium albicaule*
- *Trianthema glossostigma*

Data Deficient Species at GABWCD Wetlands

Seventeen species (17) are apparently rare but are poorly known. Because there is not enough data to determine whether they should be regarded as threatened or near threatened they are categorised as Data Deficient under the Territory Parks and Wildlife Act. The majority of these usually occur in wetlands (moderate or high fidelity) but 5 do not (*Crotalaria eremaea* subsp. *eremaea*, *Cullen discolor*, *Heliotropium sphaericum*, *Phyllanthus lacerosus, Zygophyllum aurantiacum* subsp. *simplicifolium*).

- *Atriplex angulata* (Fan Saltbush, Angular Saltbush)
- *Atriplex crassipes* var. *crassipes*
- *Atriplex morrisii*
- *Crotalaria eremaea* subsp. *eremaea* (Rattlepod, Desert Rattlepod)
- *Cullen discolor*
- *Heliotropium sphaericum*

- *Lawrencia viridi-grisea*
- *Lythrum paradoxum*
- *Osteocarpum acropterum* var. *acropterum* (Babbagia)
- *Paractaenum novae-hollandiae* subsp. *reversum* (Reverse Grass, Reflexed Panic)
- *Peplidium foecundum*
- *Peplidium* sp. Marla (W.R.Barker 3535)
- *Phyllanthus lacerosus*
- *Synaptantha tillaeacea* var. *hispidula* (Synaptantha)
- *Triglochin* sp. Newhaven (P.K.Latz 16797)
- *Verbena macrostachya* (Beach Vitex)
- *Zygophyllum aurantiacum* subsp. *simplicifolium* (Shrubby Twinleaf)

Weeds

A low proportion of plant species found at wetlands in the GABWCD are considered as definitely introduced (weeds) (17 out of 399). Most of these have a high or moderate fidelity to wetlands. Another four species are regarded as introduced to Australia by some authors, but for which there is evidence and opinion that they are native or have been naturalized in central Australia for a very long time. The Alice Springs Herbarium rates these as possibly introduced (Albrecht *et al.* 2007) but in many ways they are treated as native.

Introduced Plants (weeds)

- *Brassica tournefortii* (Wild Turnip, Turnip Weed, Mediterranean Turnip)
- *Cenchrus ciliaris* (Buffel Grass)
- *Chloris virgata s.lat.* (Feathertop Rhodes Grass, Furry Grass)
- *Citrullus colocynthis* (Colocynth, Bitter Paddy Melon, Colocynth Melon)
- *Citrullus lanatus* (Paddy Melon, Pie Melon, Wild Melon, Camel Melon)
- *Cynodon dactylon* var. *dactylon* (Couch Grass)
- *Lactuca serriola* forma *serriola* (Prickly Lettuce)
- *Malvastrum americanum* (Malvastrum, Spiked Malvastrum)
- *Nicotiana glauca* (Tree Tobacco)
- *Polygonum aviculare* (Wireweed, Knotweed, Prostrate Knotweed)
- *Polypogon monspeliensis* (Annual Beardgrass)
- *Ricinus communis* (Castor Oil Plant)
- *Sisymbrium erysimoides* (Smooth Mustard)
- *Solanum nigrum* (Black Nightshade, Black-berry Nightshade)
- *Sonchus oleraceus s.lat.* (Milk Thistle, Common Sow-thistle)
- *Spergularia marina* (Salt Sand-spurrey)
- *Tamarix aphylla* (Athel Pine)

Possibly Introduced (but regarded by some as native or long-term naturalised)

- *Cyperus hamulosus*
- *Datura leichhardtii* (Native Thornapple)
- *Salsola tragus* subsp. *tragus* (Buckbush, Rolypoly, Tumbleweed)
- *Vachellia farnesiana* var. *farnesiana* (Mimosa Bush, Sweet Acacia)

6. Descriptions of Major Rivers, Floodouts and Selected Wetland Features

6.1 Overview of River Systems

Descriptions of the major rivers and the geography of their floodouts are presented below. For some information the source of the observation or knowledge is given in brackets as follows:

GE = Google Earth;

AS = Aerial Survey;

GS = Ground Survey;

GD = Geodata (digital 1:250,000 scale topographic maps).

Finke River

The largest drainage system that enters the NT-GAB is the Finke River and its tributaries. Most of the catchment is in the greater MacDonnell Ranges, to the west and south-west of Alice Springs. The Finke forms a very wide, mostly single channel river from those uplands, down to the Water Control District and then dissipates into the first of its major floodouts, near the South Australian border. The Finke also has some minor tributaries forming outside the MacDonnell Ranges, including Karinga Creek, which joins the Finke upstream of the GABWCD. Several relatively minor tributaries of the Finke commence either fully or partly in the GABWCD. Lilla Creek, mostly forms outside the GABWCD and forms a sandy river channel that joins the Finke upstream of the GABWCD. A small part of the Lilla Creek catchment is in the GABWCD (Corella Creek). A group of relatively small tributaries of the Finke form around the Beddome Range, near the South Australian border and are either substantially or wholly within the GABWCD, including Goyder Creek, Duffield Creek and Coglin Creek (into which Duffield Creek flows). Coglin Creek is further fed by other minor creeks from South Australia.

Goyder Creek is a distinct sandy river channel and flows into the Finke well above the Finke Floodout. Duffield Creek has less well defined channels that are somewhat intermittent and dissipate in a series of swamps and pans at the junction with several minor creeks, including Skull Creek, and collectively these floodout towards Coglin Creek. Coglin Creek is relatively substantial, forming on the uplands on the south side of the Beddome Range, both in the NT and South Australia. Coglin Creek is joined by several smaller creeks in the general area of Charlotte Waters Telegraph Station (ruins), including minor creeks arising within the GABWCD and over the border in South Australia (e.g. Wall Creek, Racecourse Creek). Coglin Creek floods out near the ruined Charlotte Waters Telegraph Station, progressively dissipating into distributary channels and swamps, but also being joined by additional minor creeks from South Australia (e.g. Elathakinna Creek and the creek through Perry Ponds) before merging with the Finke Floodout.

The first floodout of the Finke River is colloquially known as ‘The Finke Floodout’ and consists of distributary channels, longitudinal swamps between dunes and areas of dense woodland that have been called ‘The Finke Floodout Forest’ (Duguid *et al*. 2005). Two major distributary channels form on the east and south sides of this floodout. One of these is called Snake Creek and heads east into the Simpson Desert dunefield, forming what can be considered a second floodout of inter-dune lakes and swamps, all within the GABWCD. The other main distributary channel retains the ‘Finke River’ name and flows south into South Australia where it follows the margin of the Simpson Desert dunefield and the rocky uplands east of Mount Dare Homestead, before flooding out on the edge of the dunefields. The initial Finke Floodout, including the Finke Floodout Forest, and the Snake Creek Inter-dune Lagoons (floodout) are significant wetland features of the GABWCD. Since there is no official naming of these various features, some care is needed to avoid ambiguity in referring to them.

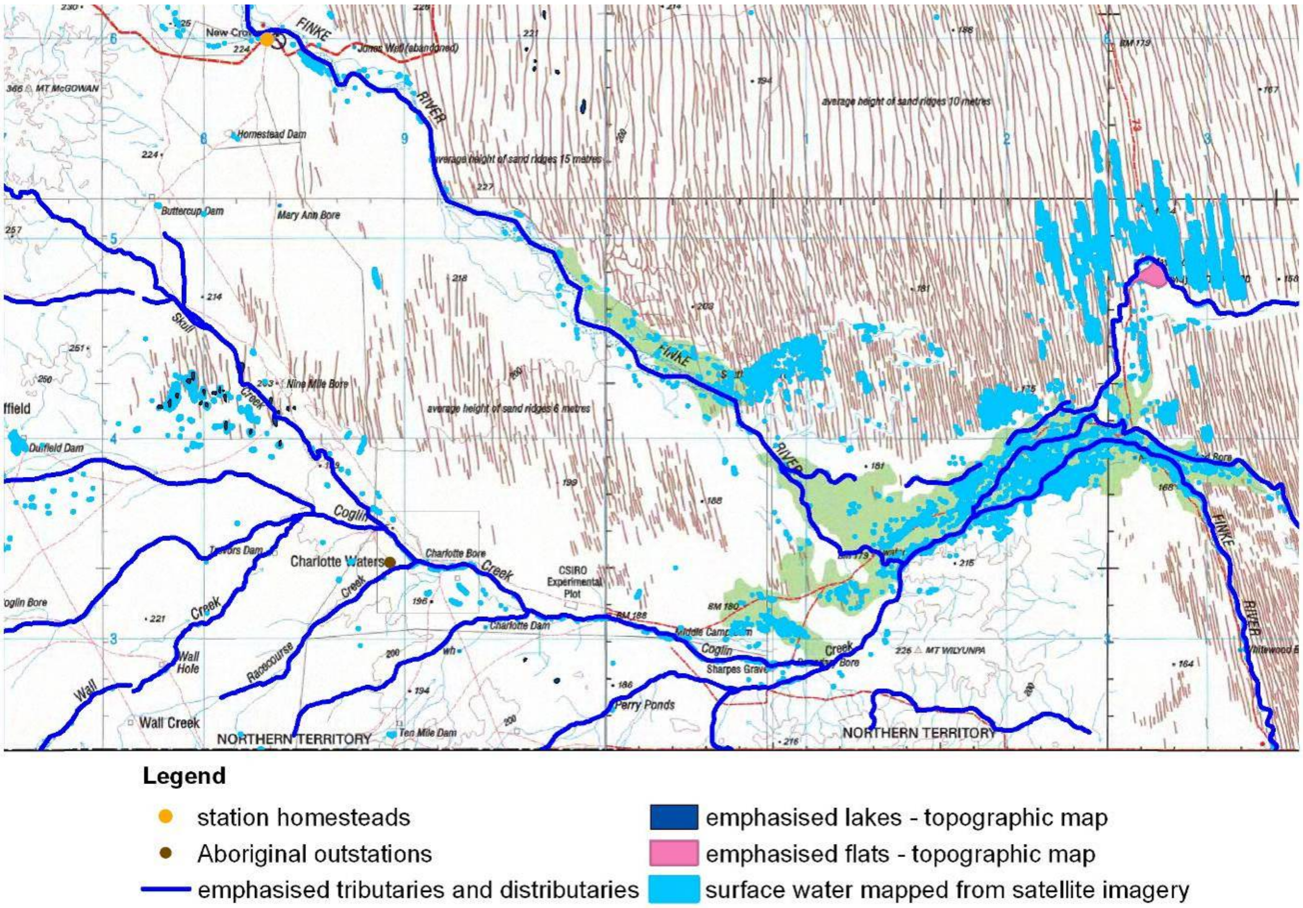


Figure 8. Topographic Map of lower Finke River and parts of the floodout

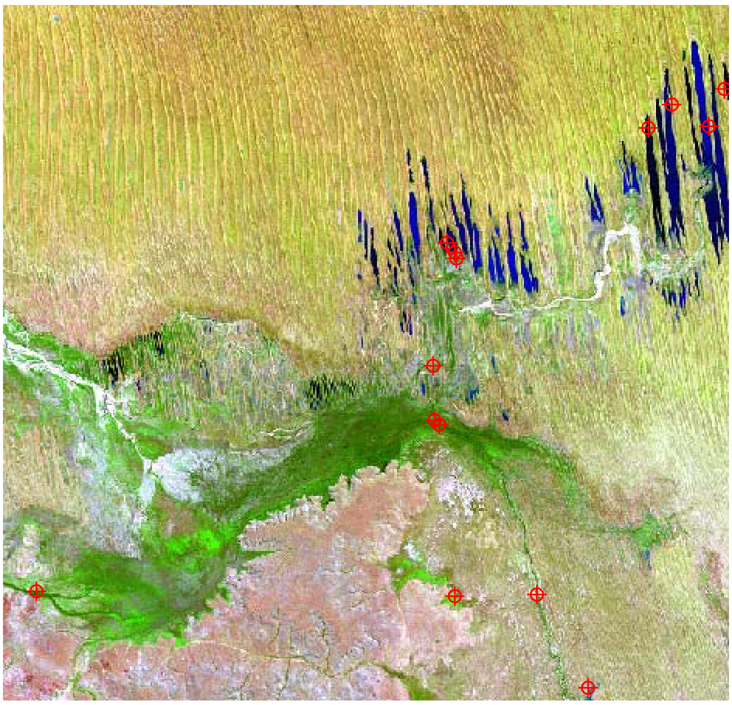


Figure 9. Finke floodout region - false colour Landsat image (RGB 741) from 7 June 2000, point symbols are 2001 wetlands survey sites (prepared by B. Clifford, published in Duguid *et al*. 2005)

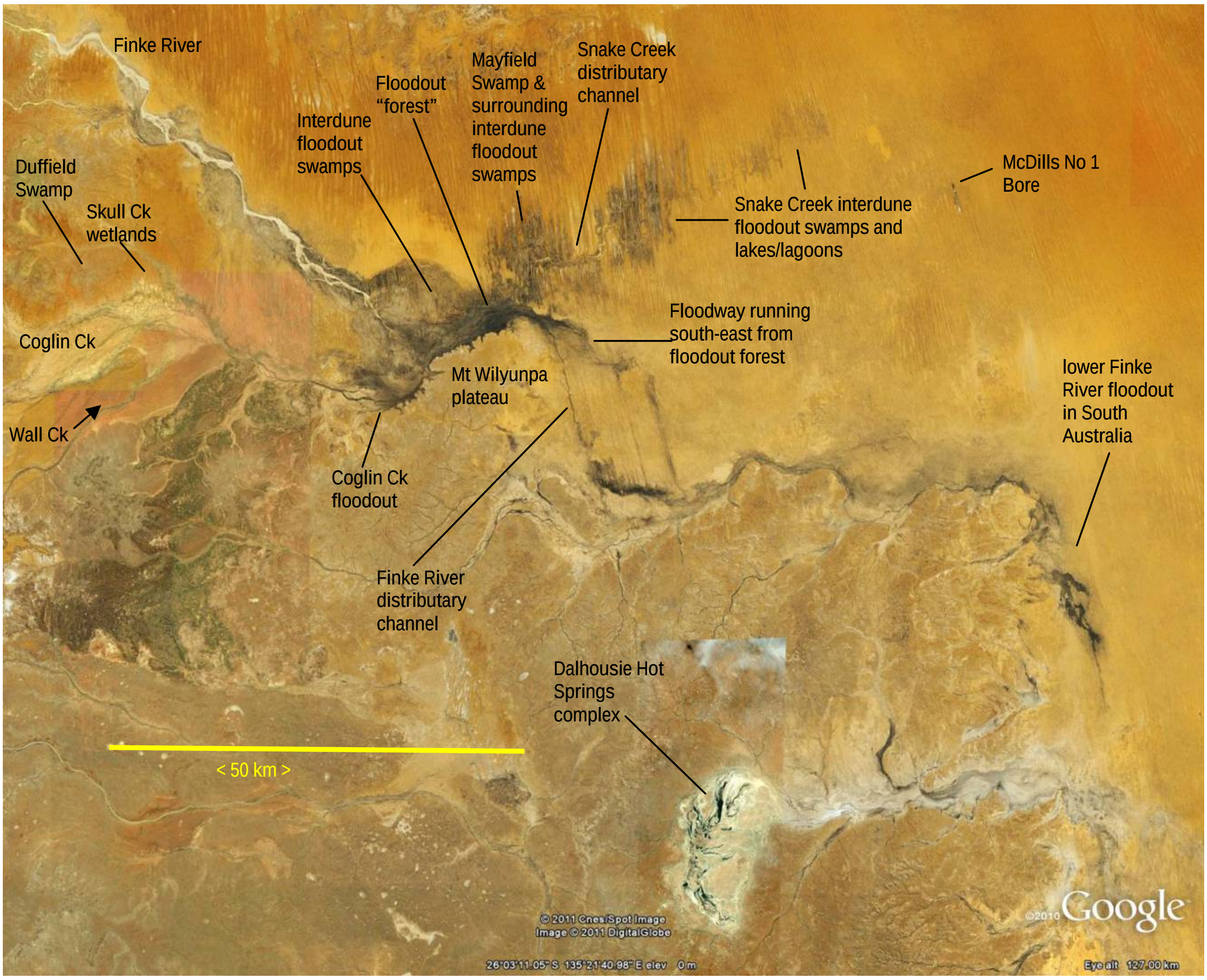
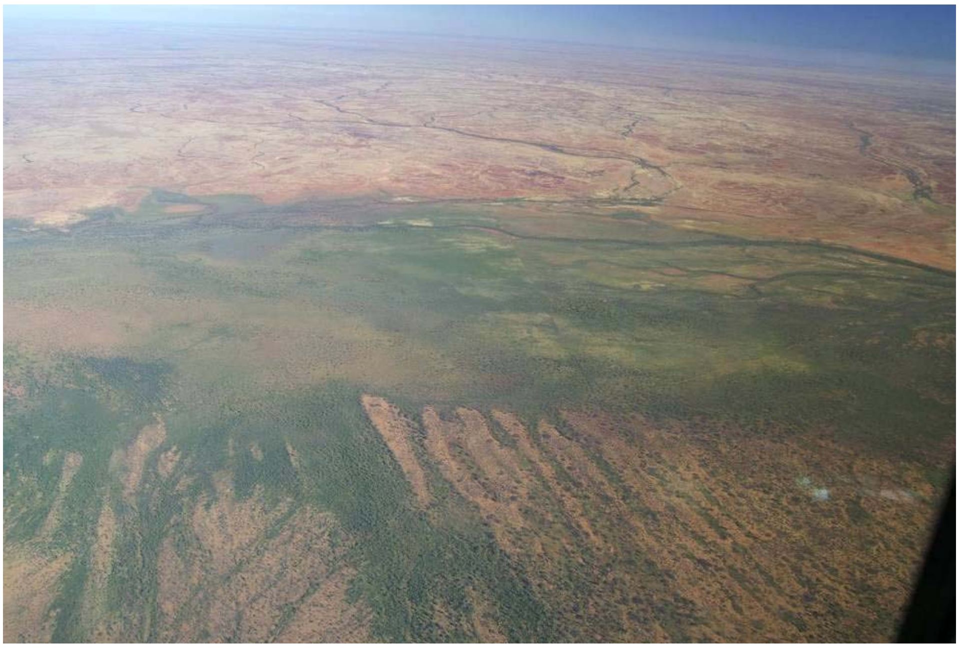


Figure 10. Google Earth image of the greater Finke floodout area, including the South Australian portion

Finke River with floodout of Finke and Coglin Creek in distance (view from north-west). The river is about 1 km wide in the foreground. (photo: A. Duguid 2010)

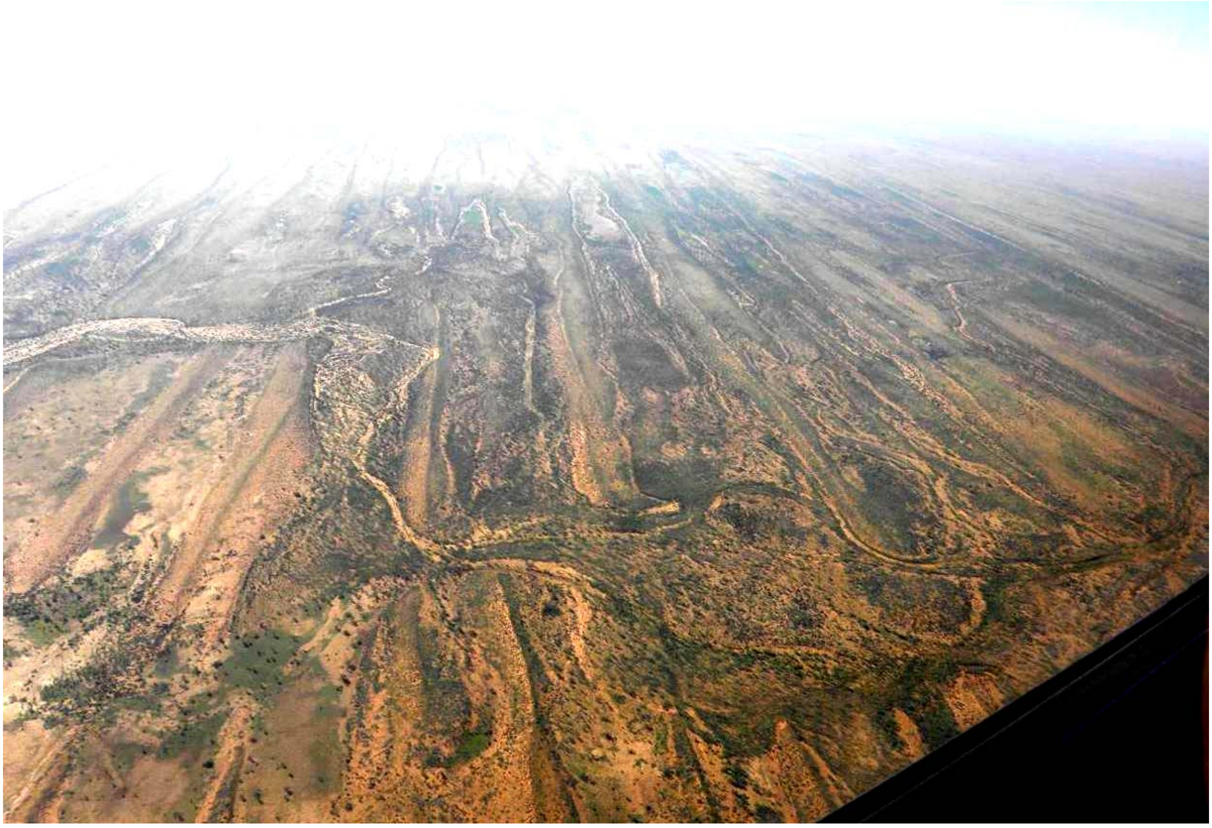


Coglin Creek floodout area, from north, channels visible from stony plains to south, This area connects to the Finke Floodout (left side of picture) (photo: J. Barnetson 2010)

Finke Floodout Forest from west with Mt Wilyunpa plateau on right (photo: A. Duguid 2010)

Finke Floodout from south with Mt Wilyunpa plateau in foreground, floodout forest with channels and residual water pools in mid-ground and adjacent inter-dune swamps in the top-right (photo: A. Duguid 2010)

Initial section of Snake Creek in the Mayfield Swamp area of the Finke Floodout interdune swamps (photo: A. Duguid 2010)



Section of Snake Creek and some of the larger interdune floodout areas (dry) (photo: A. Duguid 2010)

Interdune lake or lagoon in the Snake Creek floodout section of the Finke Floodout (photo: P. Latz 2001)

Southern distributary channel of Finke River, running south from Finke Floodout Forest and distributary floodway in foreground running south-east (from right to left), Mt Wilyunpa plateau in top-right of picture, photo from north-north-east (photo: J. Barnetson 2010)

Todd River

The Todd River has a relatively minor extent within the GABWCD. The river starts in the MacDonnell Ranges in the Alice Springs area and the East MacDonnell Ranges. River flows in the north-east part of the catchment are relatively frequent but often terminate at a floodout near the Alice Springs Airport or do not reach that far. Only relatively large events send substantial flows through this initial floodout to where the channel re-establishes to the east (possibly occurring in the order of once a decade, based on discussion with Richie Hayes of Undoolya Station). Substantial tributaries in the East MacDonnell Ranges may provide the greater part of water that episodically flows down the lower Todd towards the Simpson Desert (based on discussion with Kevin Kimlin of Ringwood Station).

The present day river has a second floodout to the north and north-east of Arookera Range at the margin of the Simpson Desert dunefield. It is believed that most of the water in river flows that reach this floodout is intercepted in the swamps, lakes and in the soils of flood-prone flats. This floodout system is around 22 km north of the GABWCD. A relatively minor floodway/channel continues into the dunefield and the GABWCD and is shown on 1:250,000 scale topographic maps as extending 17 km (straight line distance). Initially it is mostly confined to a single dune swale width or narrower. About 15 km into the GABWCD the floodout widens to about 4 swales with what appear to be inter-dune swamps (GE, AS) near where the floodway of a distributary channel of the Hale River dissipates (less than 3km between these)(see figure 11). To the south of these features the Simpson Desert portion of the Todd floodout rapidly become less distinct, appearing on Google Earth as a series of inter-dune pans across about 4 dunes swales, with decreasingly thickened woody vegetation (seen from aerial survey and clearly distinct from surrounding inter-dune vegetation). However, about 33km along the same series of swales there is an area of distinctly thickened woody vegetation (GE) which may be due to water from the Todd River. This area is also near the lower end of a major distributary path of the Hale River and may also be related to an influence of one or both rivers on soil moisture. It is hypothetically possible that temporary perched watertables may be created by large flow events and/or local rains; however, there is currently no data to assess this.

Geomorphological studies have demonstrated that the Todd River has followed various paths in the past, reaching the Simpson Desert up to 50 km west of the present day (Mary Burke pers. comm.).

Todd River Floodout (photo: J. Barnetson 2010)

Figure 11. Google Earth image of Hale River and Todd River floodouts
(the blue line is the edge of the GABWCD)

Hale River

The Hale River starts in the east and north-east of the greater MacDonnell Ranges including the southern side of the Harts Range. There are no interim floodouts and the river enters the Simpson Desert dunefield as a well-formed, large, sandy channel. At this point the edge of the GABWCD roughly coincides with the edge of the Simpson Desert.

A notable feature of the Hale is that several substantial distributary channels and floodways break away from the main flow path (see figure 12). Also, for much of its path into the Simpson Desert the channel and floodout areas are flanked by a landform resembling a floodplain (GE, GD, AS). In places the floodways extend/flow between low sanddunes but these lack the long continuous form that confines the Todd, Hay and Plenty rivers. The first distributary channel breaks off from the main channel about 4 km upstream of the GABWCD boundary and heads south-west towards the Todd River; skirting around and then cutting across the longitudinal dunefield. About 40 km into the GABWCD the major part of the Hale Floodout is split by a low rocky upland called the Allitra Tableland. The tableland sheds water via creeks running east and west from the tableland (20 - 50 m above plain). A small but distinct distributary channel of the Hale River runs down the east side of this upland (GE, GD, AS) before flooding out among longitudinal dunes. More substantial channels of the Hale River extend southwards along the west side of the Allitra Tableland and extend much further into the Simpson Desert.

Obvious channels can be seen in the general Hale floodout for around 81 km in from the edge of the GABWCD (straight line distance)(GE) and are mapped as continuous on 1:250,000 scale topographic maps for 81 km. The influence of Hale River water can be inferred from vegetation density and extends for more than 90 km from the edge of the GABWCD (straight line distance) (GE). At this southern extent the floodout patterns on remotely sensed imagery (GE) reach to another minor upland area with its own minor creeks (Poodinitterra Hill and Crocker Hill). The patterns include relatively dense vegetation and pale (apparently loamy) grey soils which contrast to the red of the dunefield. Although the image quality is moderately high, channels cannot be seen easily on Google Earth but are mapped on topographic maps (GD). To the south of this upland the distinctiveness of thicker woody vegetation decreases steadily and is not continuous along some swales.

To the north of Allitra Tableland, part of the Hale floodout forms an extensive area of very dense woodland or forest, which the author has observed from the air (AS) and on imagery (GE). The woodland is widest where it abuts the tableland, spanning about 5 km from east to west, with a continuous flat landform (not obviously bisected by dunes). It extends for about 17 km from north to south and for much of that length is much narrower and obviously set in dune swales. There is a discernable channel through much of this dense woodland (GE) which includes waterholes (AS). Parts of this Hale Floodout Woodland or ‘forest’ appear similar on imagery to the ‘Floodout Forest’ of the Finke River. Botanical survey is required for both places.

To the west of this large woodland or forest, the Hale has a more obvious and continuous distributary channel that does not have an associated inter-dune woodland/forest and continues to the west and south of the Allitra Tableland.

Observations by Peter Latz of large Coolabah trees dying in the floodout area west of the Allitra Tableland my indicate that this part of the floodout is recieveing less water now than for the past one to two centuries and that correspondingly that more water is now head following the distributary channel to the east of the tableland (based on information from P. Latz pers. comm.).

In 2010 Peter Latz visted a soak in the floodout on the west side of the Allitra Tableland, called Allua Soak. This may be the soak used by Cecil Madigan in his scientific exploration and crossing of the Simpson Desert in the early twentieth century. The location is 24° 36’ 00” south, 135° 44’ 13” east (P. Latz pers.comm.).

Allitra Tableland with densely wooded part of Hale River Floodout to north and distinct sandy distributary channel to east (from south-east) (photo: A. Duguid 2010)


Figure 12. Google Earth image of northern part of Hale River floodouts


Section of Hale River Floodout to south-east of Allitra tableland (from south-south-east) (photo: A. Duguid 2010)

Illogwa Creek

Illogwa Creek rises in the south of the Harts Range at the eastern extent of the MacDonnell Ranges bioregion. Both Illogwa Creek and its main tributary, Arema Creek, form in hills and run roughly south-east towards the northern Simpson Desert. Arema Creek joins Illogwa via a small floodout, about 10 km upstream of the GABWCD.

Despite a relatively small catchment the creek extends well into the dunefield. Defined channels are marked as extending 47 km from the edge of the GABWCD on topographic maps (GD). Floodways and very occasional pans/swamps are visible for nearly 80 km from the edge of the GABWCD on high resolution imagery (GE). For most of its length the floodout is confined to one or two swales but in parts occupies many swales. It mostly runs between and parallel with the longitudinal dunes, although less so where it first enters the GABWCD and where there is a landform that appears to be a floodplain (GE), similar to but much smaller than that around the Hale River.

One clearly discernable inter-dune swamp can be seen on Google Earth (GE) although other less distinct features may also be swamps.

Plenty River

The Plenty River rises on the north and east of the Harts Range and on the south-west of the Dulcie Range. The tributary from the Dulcie Range is the Marshal River which also flows to the Hay River to the east. The two are connected by a short but substantial channel about 5 km long. It is marked on topographic maps (GD) and clearly discernable on high resolution satellite imagery (GE).

The Plenty and Hay rivers follow parallel paths, once they have both entered and been somewhat confined by the Simpson Desert dunefield. Their paths into the desert are separated by about 50 km.

The Plenty river splits into an eastern and western branch for over 56 km, as it heads south-east across the sandplain and into the north of the Simpson Desert dunefield. The river enters the GABWCD divided into these two channels which are separated by about 7 km at their most distant. This is the approximate northern extent of the dunefield which is somewhat sparse. For a substantial distance (c.70 km) into the GABWCD the river passes through sand plains and is only intermittently flanked by dunes (GD, GE). This may be a remnant floodplain although soil colour on imagery (GE) is consistent with red sand rather than the alluvial soils around much of the Hale floodout. Shortly after entering the GABWCD the west branch of the Plenty is joined by two substantial tributaries from the west (Huckitta Creek and Atula Creek).

The Plenty has a long extent into the dunefield. Distinctive channels are marked on topographic maps (GD) and easily discerned on imagery (GE) for 65 kilometres (straight line) from the edge of the GABWCD. The topographic mapping shows channels continuing, with breaks and braided (multi-channel) sections for another 80 or so kilometres, however these appear on high resolution imagery to be mostly inter-dune floodways (i.e. not channels with banks and sandy beds) (GE). The extent of thickened vegetation or other indications of floodways visible on Google Earth is about 120-125 kilometres (straight line) from the edge of the GABWCD.

A notable feature of the Plenty floodout is a substantial area of inter-dune woodlands (AS, GE). This was observed during aerial survey. The extent of particularly dense vegetation covers a 5 km length of swales spread across 6 to 7 swales and spanning about 1.5 km (GE). Although this is much less than occurs for the Hale River, it is much larger than any equivalent features on the Hay River. The topographic map of the area shows coloured shading for this thick vegetation (GD) but over a much larger area, including less densely vegetated floodways.

Another notable feature of the Plenty River floodout is a Bluebush Swamp in the area of No. 9 Bore (wetlands survey site SD11) and the waterhole and soakage called Arrunja (located at 23° 49’ 02” east and 136° 42’ 47” south, GDA96 coordinates), both of which were surveyed by Peter Latz with Traditional owners during the 2001 wetland inventory.


Dense inter-dune woodland on the Plenty River floodout (A. Duguid 2010)

Hay River

The Hay River has a substantially longer detected extent within the GABWCD than the other rivers (210 km compared to about 125 km for the Plenty).

The main catchment for the Hay River is in the Burt Bioregion, to the south and south-east of the Dulcie Range. One of the main tributaries is the Marshall River which also feeds the Plenty River. The other main tributary is Arthur Creek. These two join to form the Hay River near the Tarlton Range. Several minor creeks run off the Tarlton Range and connect into Arthur Creek and the Hay. From there, the Hay River flows south-south-east about 44 km to the edge of the GABWCD which is at the edge of the Simpson Desert dunefield. It then continues in the same direction, trending parallel to the dunes.

The river has a broad sandy and mostly single channel for 81 km from the edge of the GABWCD, to just south of the Lake Caroline group of lakes. From here it divides into multiple channels and inter-dune floodways, which topographic mapping (GD) depicts as continuing for another 130 km, giving a total straight line extent in the GABWCD of around 210 km. This is almost to the Queensland border which is only another 30 km along the same trend line. Aerial survey towards the lower end of this mapped extent of the Hay showed distinct woody thickening along some floodways with occasional swamps. Other floodways appeared to be relatively unvegetated. Interestingly, these floodways at the lower end of the system are barely detectable on Google Earth imagery, and it seems likely that some of the features mapped on topographic maps as channels (GD) may be floodways.

The section of the Hay River between the Lake Caroline area and the part seen on aerial survey was inspected using Google Earth. There are several long areas with very dense vegetation along swales/floodways. Most sections have between 1 and three parallel floodways/swales. This contrasts to the Plenty floodout which had much broader areas of dense woodland occupying many swales but over a much shorter distance. However, fauna and flora may well be similar.

As discussed above, there are some swamps in the floodout section of the Hay River (i.e. south of the Lake Caroline group of lakes). Surface water has been detected on Landsat TM images at various sections although some may be part of a flood pulse down the system and not the location of riverine waterholes or swamps. Some swamp-like features are discernable on Google Earth and one was seen on aerial survey. In addition, there are inter-dune swamps adjacent to the sandy channel of the Hay in the Lake Caroline area. It is believed that these may receive water from over bank flow during large river flows, even though most of the Lake Caroline group of wetlands only get water from local runoff from low stony rises.


The start of the Hay River floodout, adjacent to southern end of Lake Caroline wetland group (photo: A. Pye 2010)


Swamp in southern section of the Hay River floodout (photo: A. Pye 2010)

Field River

The Field River runs into the Simpson Desert from the Toko Range and from low undulating terrain to the west. It reaches the margins of the Great Artesian Basin at the Queensland border and so does not flow through the GABWCD. In big flows its floodout may connect to the Mulligan River floodout via which there may be occasional surface water connections to Eyre Creek and Lake Eyre, including the Georgina and Diamantina rivers.

Comparison of the Major Northern Rivers

Some of the distinctive features discussed above for the northern rivers are summarised in table 8 below. The Finke is not included due to its different geomorphic setting. The Finke Floodout stands out as having by far the largest area of dense woodland/forest and wetlands.

Table 8. Comparison between the northern rivers.

River	Straight Line Extent of Continuous Channel/s into GABWCD GD = geodata (topographic 250K) GE = Google Earth	Approximate Straight Line Extent for Influence of River into GABWCD observed on Google Earth plus aerial survey observations	Comment on Drainage Channels and Extent of Influence	Summary of Floodout Woodland	Summary of Swamp and Pan Wetlands
Todd	12 km (GE) 17 km (GD)	55 km	thickened vegetation is indistinct in some parts; the initial section of obvious and dense floodout vegetation only extends 20 km into the GABWCD	minor occurrence between dunes	some/few
Hale	20-35 (GE)* 81 km (GD)	90 km (70 km of distinct channels and floodways visible on GE)	multiple distributary channels characterize the floodout, obvious floodout channels, floodways and vegetation are visible on Google Earth for 70 km; woody thickening visible to 90 km	very extensive and very dense in parts; substantial area not restricted to swales	various but mostly small and scattered through the very extensive floodout
Illogwa	21 km (GE) 47 km (GD)	80 km	the channel appears to become a floodway at around 21 km into the GABWCD but then reforms again	minor occurrence between dunes	some/few
Plenty	65 km (GE) 106 km (GD)	125 km (GE) (155 km of discontinuous channels mapped GD)	topographic mapping maps discontinuous channels to 155 km and maps some floodways as channels **	extensive area spanning multiple dunes/swales	some/few
Hay	120 km (GE) 210 (GD)	190 km (GE)	topographic mapping maps continuous channels, with many multiple channels sections SSE of Lake Caroline; a continuous distinct channel form is evident (GE) to about 120 km from the GABWCD boundary, some of the mapped channels (GD) are actually floodways	narrower extent and more elongated compared to the Plenty, extensive area of braided channels mapped	possibly more common than for Plenty.

* The extent of continuous channels of the Hale River could be interpreted as either 12 or 17 km based on Google Earth. Twelve km from the GABWCD boundary there is a section (1-2 km) of floodway/flood-prone flat separating distinct channels.

** The lower section of continuous channel mapped for the Plenty River on 1:250,000 topographic maps is through interdune floodout woodland and probably includes floodway landforms. Thus, while the mapped (GD) extent of continuous channels is 106 km into the GABWCD, the extent interpreted from imagery (GE) is much less (65 km). The topographic mapping of channels includes many further south-south-east (155 km from the edge of GAB), that are not continuous, and also include many which are believed to be floodways rather than distinct channels.

6.2 Descriptions of Individual Wetlands and Aggregations

Various sites are described below. The choice of sites is based on the availability of information, plus an intention to include examples of a variety of wetland types. Some sites are illustrated with photographs in section 3 on wetland types. The information presented for some sites is brief. Some of the information is from aerial survey and remote sensing and has not been published before. However, a lot of the information is already published elsewhere and is reproduced here for convenience. Not all existing and relevant information has been compiled and collated, due to time constraints. Some of the following text is reproduced from Duguid (2005) and Duguid *et al.* (2005) or modified from it. For expediency, headings from those sources are retained rather than developing a systematic presentation format for this document.

Table 9. List of wetland features described

Andado Swamp
Casuarina Swamp
Duffield Swamp
Finke Floodout/s
Indemina Swamp
Indinda Swamp
Lake Caroline Group of Wetlands
Lower Plenty Lakes
McDills No.1 Bore Lake/Swamp
Mt Wilyunpa Reticulated Swamp
Pans/swamps north-east of Rieks Dam
Skull Creek Pans and Swamps
Snake Creek Interdune Lagoons/Lakes
Upper Plenty Lakes

Andado Swamp

A large lake adjacent to Old Andado homestead. When observed from the air in 2010 emergent vegetation was sparse Coolabah trees and the wetland was a lake. If post inundation is prolific the term swamp maybe appropriate.

Birds observed by Bob Read June/July 2011:

Australasian Grebe, Black Kite, Black-fronted Dotterel, Fairy Martin, Grey Teal, Hardhead, Magpie-lark, Orange Chat, Pink-eared Duck, Red-kneed Dotterel, Welcome Swallow, Willie Wagtail

Birds observed by Jeff Cole 2010-2011:

Australasian Grebe, Black Swan and cygnets, Black-tailed Native Hen, Glossy Ibis, Grey Teal, Pink-eared Duck, White-faced Heron, White-necked Heron, Yellow-billed Spoonbill

Old Andado Homestead and adjacent wetland (photo: J. Barnetson 2010)

Lake/wooded swamp at Old Andado Homestead (photo: C. Costelloe 2011)

Casuarina Swamp

Location: -25.142S, 135.604E
General Description: A large lake/swamp. The name comes from the mis-application of 'Casuarina' for the *Acacia peuce* trees that grow in the general area. Further survey work is needed to determine the main wetland type. It is important due to its size, but mainly due to the presence of an endangered plant species, *Eleocharis papillosa* (Desert Dwarf Spike-rush), which has been collected from here in 1977 & 1990. The main area of this wetland was open water when seen during aerial survey, with no emergent vegetation. Areas of emergent vegetation occur at the edges and include Lignum and Coolabah. The lake/swamp bed may be vegetated when inundations dry up. Past observations have indicated that at times this wetland has been under intense grazing pressure from cattle and that this is likely to have had a long-term influence on floristic composition and erosion and deposition processes (P. Latz pers. comm.). Northern Bluebush (*Chenopodium auricomum*) is widely regarded as a species that can decrease or disappear from sites that experience prolonged intense grazing.

The catchment is adjacent gibber plains and includes a creek to the north-west that is mapped on the topographic map as intermittent (ie the channel is not continuous), with an overflow channel extending to the south of Casuarina Swamp.

Casuarina Swamp, nearby swamp and drainage lines from adjacent rocky upland (photo: A. Duguid 2010)

Preliminary Assessment Against Ramsar Site Criteria (Duguid 2005)**: "**This is a good example of a fresh water swamp in the Simpson-Strzelecki Dunefields bioregion (criterion 1), however it is one of many examples. The main claim for international importance is the presence of *Eleocharis papillosa* which is listed as vulnerable (under NT legislation) and is only known from seven* other sites. At one of the other sites there is evidence that it may already have been displaced by Couch Grass (*Cynodon dactylon*) and at another there is a rapidly expanding infestation of Couch Grass. Couch has not yet been recorded at Casuarina Swamp" (* now from 8 other sites).

Significance for Biodiversity Conservation: (National)

Directory of Important Wetlands in Australia (DIWA) Criteria:1, 4, 5

Duffield Swamp

General Description: A large Bluebush swamp (dominated by *Chenopodium auricomum*). The catchment is the adjacent gibber plains and low hills.

Significance for Biodiversity Conservation: (Regional) Good wetland bird habitat. Not thoroughly searched and may harbour populations of rare plants such as *Eleocharis papillosa*.

Directory of Important Wetlands in Australia (DIWA) Criteria:1

Duffield Swamp (and dam) from east (photo: J. Barnetson 2010)

Finke Floodout/s

Location: a large area at the bottom of New Crown and Andado stations, with a further floodout along Snake Creek that extends into Pmer Ulperre Ingwemirne Arletherre Aboriginal Land Trust.

General Description: This is a very large and diverse area where the Finke River floods-out from its main channel. It includes an alluvial plain of highly unusual dense wooded vegetation sometimes called the Finke Floodout Forest. All surface water is temporary but incorporates some longer-lasting waterholes, lakes and swamps, which are not well documented. Most of the area does not hold surface water for very long; probably in the order of weeks to one or two months. Some waterholes may last considerably longer and some lakes and swamp in the Snake Creek floodout have been recorded as lasting more than two years. Several individual survey sites were sampled for the wetland inventory in 2001. A fauna survey was conducted in the 1990s (Eldridge & Reid, 1998). Opportunisitic bat survey (c.2000/2001) indicated that the area may be very important for bats.

General Description: An extensive area of densely wooded/forested floodout of the Finke River

Significance for Biodiversity Conservation: (National)

Directory of Important Wetlands in Australia (DIWA) Criteria:1, Ramsar Criteria for International Significance: 1.

The initial part of the Finke Floodout is in Beddome Range Site of Conservation Significance while the Snake Creek section is in the Andado Site of Conservation Significance.

See the section above on the Finke River and also information listed separately for the Snake Creek Interdune Lagoons/Lakes.

Indemina Swamp

Location: -25.55 S, 135.41E Andado Station
General Description: Large swamp, mostly unwooded, but areas of open Coolabah woodland. The main water source is Peebles Creek. Various wetland plants recorded and anecdotal reports of large numbers of waterbirds (R. Bloomfield pers. comm.).

Significance for Biodiversity Conservation: (Regional) Various wetland plants recorded and reports of large numbers of waterbirds.

Directory of Important Wetlands in Australia (DIWA) Criteria:1

Indinda Swamp

Location: 25.375 S, 135.402E Andado Station

General Description: A very large swamp with catchment from adjacent gibber, and an un-named creek and very low rocky hills. Various vegetation zones including areas dominated by Northern Bluebush, areas dominated by

Lignum and areas with scattered Coolabah trees (wooded).

Significance for Biodiversity Conservation: (Regional) birds & plants

Directory of Important Wetlands in Australia (DIWA) Criteria:1

Bird survey data from Robert Read (in. litt.) from 26 June 2011:

Black Swan (breeding), Australian Wood Duck, Grey Teal, Pacific Black Duck, Hardhead, Crested Pigeon, Diamond Dove, Black-shouldered Kite, Letter-winged Kite, Whistling Kite, Black Kite, Nankeen Kestrel, Eurasian Coot, Black-winged Stilt, Red-necked Avocet, Banded Lapwing, Masked Lapwing, Little Corella, Orange Chat, Australian Magpie, Willie Wagtail, Torresian Crow, Brown Songlark, Zebra Finch, Emu, Flock Bronzewing

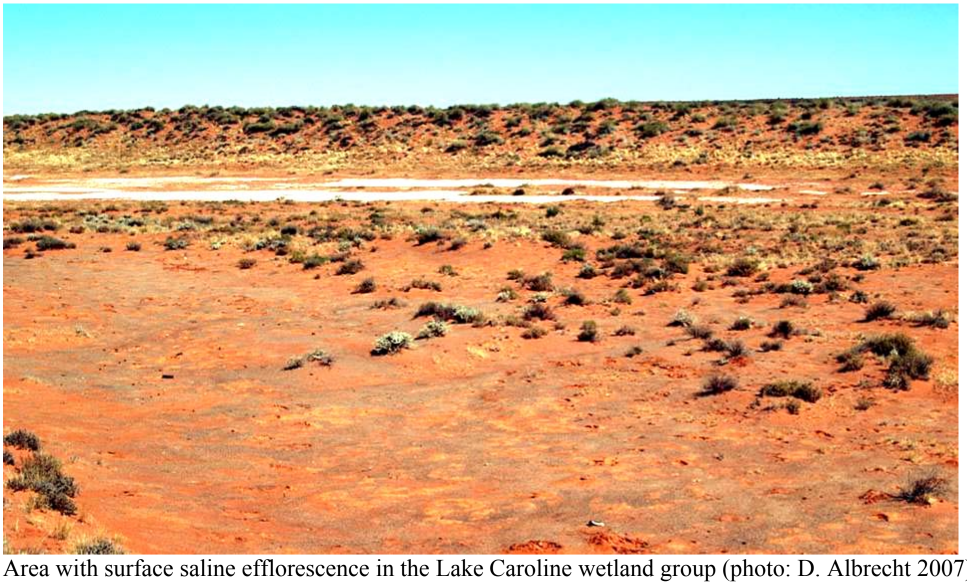
Indinda Swamp with Old Andado swamp/lake in bottom right (photo: J. Barneston 2010)

Lake Caroline Group of Wetlands

Location: Northern Simpson Desert – granted as an Aboriginal Land Trust in 2011.

Moderately large freshwater and semi-saline lakes plus an assortment of smaller claypans and swamps, some of which are in dune swales

Gibson and Cole (1985, p.10): "The Lake Caroline area was a series of three large dry claypans with many smaller claypans scattered throughout". However, they describe the soils at the north of Lake Caroline as powdery which is not typical of claypans: 'The surface of the claypan was so dry that the vehicles were sinking 15 cm into the powdery soil' (Gibson & Cole 1985, p.25).
Gibson & Cole (1985) refer to the roughly circular lake/pan south-west of Lake Caroline as Lake Deidre and the most south-westerly of the group of lakes as Lake Jeffry. Moderately steep stony ridges in the order of 2 -10 m high, some with cliffs, are a feature of the adjacent landscape to the lakes. A botanical survey was undertaken in 2007 (Duguid & Albrecht 2008), and some additional botanical and limnological sampling was done in 2011 by Peter Latz and Jayne Brim Box (P. Latz pers. comm.).



Area with surface saline efflorescence in the Lake Caroline wetland group (photo: D. Albrecht 2007)


Lake Caroline area: waterhole in Hay River in foreground, interdune wetlands and Lake Caroline in the distance (photo: A. Duguid 2010)


Interdune swamps at southern end of Lake Caroline Group (photo: A. Duguid 2010)


Lake Caroline wetland group (Lake Caroline in top right, and large lake to south in foreground); view from south (photo: A. Duguid 2010)


Low rock rises and gravely slopes providing catchment to the large lake south of Lake Caroline (photo: D. Albrecht 2007)


Islands near north-east edge of Lake Caroline looking from west (photo: A. Duguid 2010)


Floodplain of Hay River in Lake Caroline area (photo: D. Albrecht 2010)

Lower Plenty Lakes

This group of lakes was observed during the 2010 aerial survey but has never been surveyed botanically. The group is smaller than the Upper Plenty Lakes but appeared to have a somewhat similar landscape from the aerial survey. One pan was photographed with an unusually dense 'riparian' fringe of trees or shrubs.


Lower Plenty Lakes (photo: J. Barnetson 2010)


Lower Plenty Lakes (photo: J. Barnetson 2010)


One of the Lower Plenty Lakes with fringing trees and emergent shrubs which is unusual for this wetland group (photo: A. Duguid 2010)

McDills No. 1 Bore Lake/Swamp

McDills No. 1 Bore is a bore tapping water from the Great Artesian Basin (GAB). It is 29 km north of the South Australian border and about 100 km south-east of Andado homestead. The bore was in a rogue state for several decades creating a vast lake between the dunes. The lake boundary is shown on the 1:250,000 topographic map (mapping dating 1986); extending for 4.5 km. In the wet period of 2000 a TM satellite image from 26 March showed the lake as about 6 km long. There have been other rogue GAB bores in the NT but none that have produced such a vast wetland (G. Ride pers.comm.). Greg Leach and Bruce Thomson of the Alice Springs Herbarium collected the following wetland plants at the lake in 1987: *Cyperus gymnocaulos*, *Schoenus littoralis*, *Typha domingensis*, *Cyperus laevigatus*, *Heliotropium curassavicum and Zygophyllum simile*.

The bore has now been rehabilitated. Traditional Aboriginal owners of the area have specified that a reduced flow continue to sustain at least part of the lake for wildlife, however, the size of the area that is perennially inundated has been dramatically reduced. An internal NT Government report documents the rehabilitation process (Humphreys & Kunde draft). In 2011, NT Government surveyor, Roland Maddocks recorded coordinates at each end of the surface water, which was about 270 m long (MGA coordinate; north end 579 120 E, 7 153 520 N; south end 579 140 E, 7 153 250 N; on 23 August 2011; R. Maddocks *in litt*.).

In winter/spring 2011, Peter Latz undertook botanical survey in the area of the lake. He collected at nearby natural inter-dune swamps/pans and observed that there have been considerable impacts from introduced herbivores, including cattle, in the area of the lake (P. Latz pers.comm.).

Artificial lake/swamp at McDills No.1 Bore prior to rehabilitation (photo: unknown NT Government officer, December 2001)

Mt Wilyunpa Reticulated Swamp

Location: 25̊ 56’ 09” S, 135̊ 14’ 23” E (WGS84); Andado Station, north-east side of Mt Wilyunpa, adjacent to Finke Floodout.

This is an area of reticulated channels/depressions receiving run-on from the Mt Wilyunpa tableland. There is no on-ground information but the feature was seen during the aerial survey (J. Barnetson pers.comm.) and has been investigated using Google Earth.

Similar areas have been seen on imagery for other parts of the arid NT and have been called ‘reticulated swamps’ and are characterized by a dense network of dark linear features against paler surrounds. The dark linear features may be well vegetated narrow channels, incised into clay plains which do not have shrubs or trees. It is possible that linear features are lignum dominated. Geomorphic processes that create these uncommon wetlands are not known but could include a ‘gilgai’ effect where differential swelling of wet clay causes soil movement. The landform appears to be similar to larger swamps observed from the air and on imagery for other parts of the LEB.

This swamp is within the Beddome Range Site of Conservation Significance ((Harrison *et al*. 2009).

Oblique aerial photograph of Mt Wilyunpa Reticulated Swamp (photo: J. Barnetson)

Figure 13. Google Earth imagery for Mt Wilyunpa Reticulated Swamp

Pans/swamps NE of Rieks Dam

Location: 25° 00’ 20” S, 135° 31’ 27” E (WGS84); Andado Station, 5.5 km north-east side of Riek’s Dam.

A group of pans or unwooded swamps observed during aerial survey and appearing to be somewhat different to the many shallow pans on the gibber plain. The location is at the edge of the plain; adjacent to an area of extensive sanddunes. The areas of pooled water were surrounded by an extensive area of bright green vegetation which is assumed to be herbaceous. Similar extensive green swards around wetlands were seen to the east and north-east on the same aerial survey, adjacent to the Marshall Bluff upland.

Wetland group 5.5 km north-east of Rieks Dam (photo: A. Duguid 2010)

Poeppel Corner Saline Lakes

An extensive group of saline lakes occurs in the area of Peoppell Corner. The greater part of these is in Queensland and South Australia.

Small saline wetland in south-east of NT-GAB, near Mirranponga Pongunna Lake (photo: J. Barnetson 2010)

Extensive saline lakes in the Poeppel corner area (photo: J. Barnetson 2010)

Skull Creek Pans/Swamps

General Description: A series of small swamps and pans associated with Skull Creek. Some of the swamps are confined by low sand dunes. Vegetation structure varied, including bare claypan, Coolabah (wooded swamp), open Lignum, Swamp Bluebush (*Maireana microcarpa*), Nardoo, and other forbs and low sedges.

Significance for Biodiversity Conservation: (Regional) A good example of a group of small and diverse wetlands.

Directory of Important Wetlands in Australia (DIWA) Criteria:1

Ramsar Criteria for International Significance: not assessed

Skull Creek wetlands from south (photo: J. Barnetson 2010)

Snake Creek Inter-dune Lagoons/Lakes

The Snake Creek section of the Finke Floodout is notable for the many long and sometimes long-lasting interdune lakes. These have been termed lagoons, although some definitions for the term lagoon suggest it only applies to marine island settings. The lakes are part of a wetland complex that includes sections of channel and swamps.

General Description: An area of intermittently flooded freshwater lakes and swamps between tall sanddunes of the Simpson Desert. Some are exceptionally deep when full. Inundation is from the Finke River, along one of two main channels that exit the area referred to here as the Finke Floodout Forest. Although the system is believed to be predominantly freshwater, limited field survey has shown that at least one of the lakes is slightly saline.

Significance for Biodiversity Conservation: (National/International) A large area of very and relatively long-lasting temporary freshwater lakes, some of which are unusually deep, supporting significant populations of wetland birds.

Directory of Important Wetlands in Australia (DIWA) Criteria:1, ?3

Ramsar Criteria for International Significance: 1, 3, ?5

Bob Read compared 1971 photography with the June 2000 satellite image (in.litt. Nov 2001). On the 1971 photos the following is evident. The wetland SDS4 existed. The SDS5 wetland did not exist and it appears that this area had never flooded, although some of the wetlands further east did exist. The channel of Snake Creek was (and still is) blocked by a dune at 546300E, 7153800N. In 1971 it had not yet flowed along the alternative route to the north that it has now found. Some small wetlands further east were evident, but presumably had not filled since the channel blocked.

Table 10. Birds species of Snake Creek Interdune Lagoons, from 2001 survey by R. Read

Species	Number of Lakes (out of 4 surveyed)	Combined Count	Breeding
Australasian Grebe	2	22	
Australian Pelican	3	141	
Australian White Ibis	1	1	
Australian Wood Duck	4	162	
Black Swan	4	37	
Black-fronted Dotterel	3	6	
Black-tailed Native-hen	4	490	
Black-winged Stilt	4	82	
Caspian Tern	1	4	

Clamorous Reed-Warbler	1	1	
Darter	4	88	b
egrets (unidentified)	3	4	
Eurasian Coot	4	625	
Freckled Duck	2	40	
Glossy Ibis	1	1	
Great Cormorant	2	9	
Great crested Grebe	1	4	
Great Egret	4	30	
Grey Teal	4	1080	
Gull-billed Tern	4	77	b
Hardhead	4	111	
Hoary-headed Grebe	4	65	
Intermediate Egret	1	2	
Little Black Cormorant	2	21	
Little Pied Cormorant	4	15	
Masked Lapwing	4	16	
Nankeen Night Heron	2	5	
Pacific Black Duck	1	4	
Pink-eared Duck	4	105	
Red-capped Plover	1	1	b
Red-kneed Dotterel	2	9	
Red-necked Avocet	2	15	
Silver Gull	1	2	
Straw-necked Ibis	3	4	
tern (unidentified)	1	60	
Whiskered Tern	2	30	
White-faced Heron	3	4	
White-necked Heron	2	5	
Yellow-billed Spoonbill	3	6	

note: 9 of these species were not recorded at any other wetland in GABWCD in the dataset compiled in 2001.

The following is a draft description prepared for A Directory of Important Wetlands in Australia.

Reference Number: NT-potential-10

Location: 25 45 S, 135 20 E. An aggregation of lakes centered 16 km NE of Mayfield Swamp and about 270 km SSE of Alice Springs

Area: 0ha **Elevation:** 134 m ASL

Other Wetlands in same aggregation: Wetland type: B6 **Criteria for inclusion:** 1, ?3

Site description: A large area of intermittently flooded freshwater lakes and swamps between tall sand dunes of the Simpson Desert. Inundation is from the Finke River and some of the lakes are exceptionally deep and long-lasting for arid Australia.

Hydrological features: Inundation is from the Finke River, along one of two main channels that exit the area generally referred to as the Finke Floodout (or Finke Floodout Forest). The water is predominantly clear and fresh to semi-saline. Conductivity was measured in three lakes about 18 months after the inflow of flood waters and had surprising range of values: 740, 1130, 3000 micro siemens per cm. The water was neutral to alkaline with pH values from 7.4 to 9.3.

Water has persisted in some of the lakes for more than thirty months. Inspection of TM satellite imagery (ACRES quicklooks) indicated that the Finke River flowed into the Snake Creek floodout twice in 2000 (February and April) but not in 2001 or 2002. Inspection of a satellite image (eTM+) from 26 March 2000 showsed water in more than 50 inter-dune areas east from the Mayfield Swamp area. Bretan Clifford observed substantial areas of water persisting in September 2001 during an aerial survey of feral animals. Mary Bourke reported flying over areas of water in September/October 2002. Inspection of an image from 17 September 2002 indicated substantial water remaining in the northern end of two of the large inter-dune lakes and one smaller adjoining area. The length of water at 17/9/02 was apparently over 2.5 km in the longest of these three waterbodies. These residual waterbodies were all on Andado Station. The water depth remaining in the four long-lasting lakes surveyed in November 2001, was estimated as exceeding 1 metre. The fact that the lakes persisted in part for at least another 11 months (past September 2002) indicates that water depth was probably several metres in November 2001.

The following additional information on inundation history has been deduced mainly from satellite imagery and aerial photography. Kotwicki (1989, p.43) reports that the Finke flooded in 1967: "one of the most devastating floods in central Australia....the distributary stream ran north-east [from McDills Well] into the sand dunes filling inter-dune corridors to a depth of 6 m. Water remained in some corridors for nineteen months". Aerial photographs from September 1971 show some of the wetlands were well vegetated and must have had water in them a few months before, possibly having filled the previous summer. Others further to the east appear to have been quite dry. Although most of the swamps present on later images were present in 1971 at least one did not exist. Satellite imagery for February 1974 (Landsat MSS) shows the swamps full at that time. Satellite imagery for April 1993 shows substantial inundation, exceeding the area inundated during the November 2001 ground survey. Thus we can conclude that the swamps filled in 1967, 1971, 1974, 1993 and 2000. It is likely that they also filled in the big floods of 1983 and 1988, and quite possibly on other occasions in recent decades. They may receive some inundation relatively often, say once in 5 years, but a careful study of the hydrology would be needed to establish this. Major inundations are less frequent, in the order of once every ten to twenty years. The lack of large Coolabah trees indicates that in the past few centuries (until recent decades) water may have mainly bypassed the Snake Creek system. The alternate route for flood waters is along a substantial river channel running south from the Floodout Forest into South Australia (past Whitewood Bore).

Ecological features: The longer lasting waterbodies consist of large areas of predominantly open water which is relatively deep and long lasting in the context of arid Australia. Coolabah trees (Eucalyptus coolabah subsp. arida) are emergent in places but generally at insufficient density to classify the wetland as a wooded swamp. Wetland plants were surveyed at sites on three of the longest lasting lakes and also some of the much more temporary waterbodies near Mayfield Bore. These latter wetlands were typically more densely wooded and were classified as wooded swamps (non-linear). Some had dense coverage of tall annual post-inundation herbage; notably Cullen cinereum. Fish were observed in the longer lasting lakes but only one of the nine Finke River species was identified: Melanotaenia splendida subsp. tatei (Desert Rainbowfish). Other species are presumed to occur. A high diversity and relatively large number of waterbirds were recorded there. A surprisingly low diversity of plant species was recorded on the margins of the longer lasting lakes. This may be due to a relatively low frequency of flooding. Another possible cause is that this channel may have become more active in past decades after a period of unknown duration when possibly most floodwaters went south from the floodout Forest, towards Mount Dare.

Significance: A large area of very and relatively long-lasting temporary freshwater lakes, some of which are unusually deep, supporting significant populations of wetland birds.

Notable fauna: Over three thousand waterbirds (3384) were recorded in two days at four of the longer lasting lakes in November 2001, consisting of 36 species. This diversity of species is significantly high in the arid NT especially for a one-off survey. The longevity of the lakes means they provide habitat for waterbirds after most natural waterbodies in the region have dried out.

Land tenure: Pastoral Lease and Aboriginal Land Trust

Disturbances or threats: Current: Feral animals (camels) Potential: Domestic stock, four-wheel drive recreation, weeds.

Compiler and date: Angus Duguid and Bob Read, December 2002

Assessment against Ramsar criteria: A strong case can be made on several criteria. This is a highly distinctive aggregation of exceptionally deep and long lasting temporary lakes and clearly meets criterion 1. A high diversity of waterbirds, 36 species, was recorded in two days and the site is clearly important for regional biodiversity of waterbirds (criterion 3). A total count of 3,384 birds was made from 4 lakes in October 2001, a year and a half after the flood event that commenced the inundation. It is quite likely that in the intervening period, the aggregation of all the associated lakes supported more than 20,000 birds at some times (estimated satisfaction of criterion 5).

Site Description Preparation Status: requires checking against note from Bob Read

Landholder Consultation: preliminary discussion with Andado Lessee and CLC staff

Upper Plenty Lakes

(previously referred to as Northern Simpson Desert Area Lakes)

General Description: Moderately large and extensive group of wetlands in the northern Simpson Desert, west of the current floodout of the Plenty River. It includes freshwater claypans and semi-saline lakes that may be gypsum dominated. Some of the lakes are quite large.

Significance for Biodiversity Conservation: (Regional) An unusual wetland type in the SSD bioregion. Possible values for wetland birds.

Directory of Important Wetlands in Australia (DIWA) Criteria:1

Ramsar Criteria for International Significance: not assessed

Survey in 2001 was after the lakes had dried out having been inundated in 2000 and possibly in 2001. Plant remnants from a lake bed were of *Ruppia tuberosa* and it is possible that the lakes supported an abundance of waterbirds when inundated.
Gibson and Cole surveyed the essentially dry-land fauna of the area in 1985 (1985, p.11): 'The salt lake system near the Plenty River floodout consisted of several large dry salt pans and one large claypan' ..'Samphire *Halosarcia sp.*, fringed the flats to many salt pans'. Considerable additional information on soils and vegetation was added for survey sites conducted in the 2001 wetlands survey, however there are several useful photos from the 1985 survey complimenting those of 2001.

Peter Latz undertook botanical survey in 2001 and in 2010 and found no introduced plants on either occasion (p> Latz pers. comm.)which is highly unusual for any group of wetlands in central Australia.

Upper Plenty Lakes from south (photo: J. Barnetson 2010)

Upper Plenty Lakes (photo: J. Barnetson 2010)


Upper Plenty Lakes – apparent salty vs highly turbid contrast (photo: J. Barnetson 2010)


Gravely rise providing catchment to one of the Upper Plenty lakes (photo: P. Latz 2001)


Saline efflorescence at one of the Upper Plenty lakes (photo: P. Latz 2001)


One of the Plenty Lakes with saline eflorecence (photo: P. Latz 2001)


One of the ‘fresh’ (non-saline) Plenty Lakes from the adjacent sanddune (photo: P. Latz 2001)


One of the Plenty Lakes with areas of red gravel and areas of clay (photo: P. Latz 2001)

Upper Plenty Lakes – NW sections from south (photo: J. Barnetson 2010)

7. Discussions and Recommendations

This section includes some general recommendations for improving knowledge of wetlands in the NT-GAB and some discussion of wetland condition.

Mapping and Inventory

Remote sensing has identified the location of many wetlands. Further remote sensing work would be beneficial including images from the time of the aerial survey in May 2010 and from the very large inundations in the Andado area in February 2011.

The boundaries of individual wetlands need to be mapped on a case-by-case basis using field observations and remotely sensed imagery such as aerial photography and very high resolution satellite imagery (Google Earth imagery is often but not always adequate).

Judgments about the extent of a wetland can be difficult to make and satellite imagery from a range of inundation events can be helpful. It can also be difficult to allocate a wetland to a wetland type or group of types, without detailed imagery coupled with ground survey. Allocating wetland type is also difficult in many instances where different parts of a wetland correspond to different types. Using images from multiple dates may allow wetlands to be classified according to frequency and duration of inundation, which would further inform understanding of ecological function and conservation significance.

Further systematic collation of existing data and information for wetlands in the NT-GAB would assist in future assessments of conservation significance.

Hydrology

There are no long-term river gauging stations within the GABWCD so surface flows can only be estimated. New methodologies may eventually make collection of hydrological data more affordable. Improved hydrological data for rivers of the GABWCD would assist in understanding wetland ecology and associated conservation significance. Modelling surface elevations with digital elevation models may also improve understanding of surface water flows. Work by Craddock *et al.* (2010) has already demonstrated that generating a surface that excludes the undulations of sanddunes can provide useful insights. Repeating that work with additional elevation data inputs, such as from remote sensing, could be useful.

Condition

It can be estimated with confidence that only a small proportion of surface flows generated by rain are diverted into artificial storages or pumped from waterholes in the control district. Accordingly, it may be assumed that surface flows to natural wetlands are in a largely natural condition. Although many of the excavated tanks/dams in the control district are in swamps and pans, they only affect a small proportion of the many such wetlands. It is possible that there are local adverse effects on local hydrology and vegetation but there is no data showing this or showing an adverse affect on individual species. Much more survey work and targeted research would be required to assess this aspect of wetland condition.

Introduced plants (weeds) are a common feature of wetlands in central Australia including the NT-GAB. They currently constitute only a small proportion of the wetland flora, although in many wetlands some introduced species dominate the biomass. Some significant weeds include Athel Pine in the Finke River, which could have a long-term influence on the river and its floodout ecosystem. Grassy weeds are suspected to already have a significant effect on riverine and floodout ecosystems; notably Couch Grass and Buffel Grass. Impacts are hard to quantify but both species are abundant.

Various changes to soil structure and patterns of vegetation and leaf litter cover can potentially change run-off and infiltration rates compared to pre-European conditions across arid and semi-arid rangelands, however, there is little data to assess this in NT-GAB. Increased sedimentation rates due to roads, tracks and introduced herbivores may have resulted in increased sedimentation rates in river floodouts (P. Latz pers.comm.). This may be causing increased geomorphic dynamism in floodouts, causing current distributary channels to silt up sooner and new ones to scour down.

Inter-dune wetlands and adjacent plain, north of Finke floodout, plus dam excavated in wetland (photo: J. Barnetson 2010)

8. References

Albrecht, D. Duguid, A., Coulson, H., Harris, M. and Latz, P. (2007) Vascular Plant Checklist for the Southern Bioregions of the Northern Territory: Nomenclature, Distribution and Conservation Status, Second Edition, Northern Territory Government Department of Natural resources Environment and the Arts, Alice Springs.

Barnetson, J. and Duguid, A. (2008) NT-LEB Wetland Mapping: Revised Mapping of Wetland Extent in the Northern Territory Portion of the Lake Eyre Basin. Unpublished report. Northern Territory Department of Natural Resources, Environment, the Arts and Sport, Alice Springs.

Barnetson, J. and Duguid, A. (2010) Wetland mapping in mountainous terrain: a tough nut to crack. *Proceedings of the Australian Remote Sensing and Photogrametry Conference (ARSPC), Alice Springs, September 2010*. http://www.15.arspc.com/.

Bourke, M.C. (1994) *Cyclical construction and destruction of flood dominated flood plains in semiarid Australia,* Proceedings of the Symposium: Variability in Stream Erosion and Sediment Transport (Canberra, December 1994), IAHS Publ. No. 224, IAHS.

Bourke, M.C. (1998) Fluvial geomorphology and paleofloods in arid central Australia (PhD thesis abstract), *Quaternary Australasia,* 16 (1)**,** 31-32.

Bourke, M.C. (1999) *Floods in the Australian desert: The Hale River catchment,* A report submitted to the Parks and Wildlife Commission of the Northern Territory, Australia for permit numbers 6568 and 7401, Centre for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington DC.

Brim Box, J., Duguid, A. Read, R. Kimber, R.G., Knapton, A., Davis, J. and Bowland, A.E., 2008, Central Australian waterbodies: the importance of permanence in a desert landscape. *Journal of Arid Environments* 72, pp. 1395-1413.

Craddock, R. A., Hutchinson, M.F. and Stein, J.A. (2010) Topographic data reveal a buried fluvial landscape in the Simpson Desert, Australia. *Australian Journal of Earth Sciences*, 57: 1. 141 – 149.

Duguid, A. (2005). Wetlands in the Arid Northern Territory -Volume 2: Information Collated for Individual Wetlands. A report to the Australian Government Department of the Environment and Heritage on the inventory and significance of wetlands in the arid NT. Northern Territory Government Department of Natural Resources, Environment and the Arts. Alice Springs.

Duguid, A. (2009) *Wetlands of the Western Davenports Water Control District*. Unpublished internal report. Northern Territory Government Department of Natural Resources, Environment, the Arts and Sport. Alice Springs.

Duguid, A. and Albrecht, D. (2008). *Botanical survey of the northern Simpson Desert July 2007: Hay River, Lake Caroline and Mount Tietkins areas*. Unpublished report to the Australian Geographic Society and the traditional Aboriginal owners of the expedition area. Alice Springs Herbarium.

Duguid, A., Barnetson, J., Clifford, B., Pavey, C., Albrecht, D., Risler, J. and McNellie, M. (2005) *Wetlands in the arid Northern Territory*. A report to the Australian Government Department of the Environment and Heritage on the inventory and significance of wetlands in the arid NT. Northern Territory Government Department of Natural Resources, Environment and the Arts. Alice Springs. (http://www.nt.gov.au/nreta/wildlife/nature/aridwetlands.html)

Edwards, G., Saalfeld, K. and Clifford, B. (2004). 'Population trend of feral camels in the Northern Territory, Australia.' Wildlife Research 31.

Eldridge S. and Reid J. (1998). *A Biological Survey of the Finke Floodout Region, Northern Territory*. Arid Lands Environment Centre and the National Estate Grants Program.

NRETAS (2011). Draft report March 2011 by Simon Fulton. Great Artesian Basin Water Allocation Planning Process -Resource Assessment and Technical Review. Technical Report No. 01/2011D. Northern Territory Government Department of Natural resources Environment and the Arts, Palmerston.

Environment Australia (2001) *A Directory of Important Wetlands in Australia*, Third Edition, Environment Australia, Canberra. (http://www.environment.gov.au/water/publications/environmental/wetlands/directory.html)

Gibson, D.F. and Cole, J.R. (1985) *Wildlife Survey of the Hay River and Plenty River regions of the Simpson Desert,* Unpublished report, Conservation Commission of the Northern Territory, Alice Springs, NT.

Google Earth (internet site) http://earth.google.com

Hale, J. (Ed.), (2010) Lake Eyre Basin High Conservation Value Aquatic Ecosystem Pilot Project. Report to the Australian Government Department of Environment, Water, Heritage and the Arts, and the Aquatic Ecosystems Task Group.

Harrison, L., McGuire, L., Ward, S., Fisher, A., Pavey, C., Fegan, M. and Lynch, B. (2009). *An inventory of sites of international and national significance for biodiversity values in the Northern Territory*. Department of Natural Resources, Environment, The Arts and Sport, Darwin, NT.

Humphreys, B and Kunde, G (draft c. 2001) Rehabilitation of flowing bores in the Northern Territory portion of the Great Artesian Basin. Unpublished report. Northern Territory Government Department of Infrastructure Planning and Environment, Alice Springs.

Jacobson, G. (1996) The interrelationship of hydrogeology and landform in central Australia, In: *Exploring central Australia: society, the environment and the 1894 Horn Expedition,* (Eds., Morton, S.R. and Mulvaney, D.J.) Surrey Beatty & Sons, Chipping Norton, pp. 249-266.

Jessop, P. and King, D., 1997, *The Land Resources of New Crown Station,* Technical Memorandum 96/18, Northern Territory Government, Alice Springs

Kennedy, A. and Bazzacco, S., 2002, *The Land Resources of Umbeara Station,* Report Number 21/2002, Northern Territory Government, Alice Springs

Kennedy, A. and Sugars, M., 2001a, *The Land Resources of Andado Station,* Report Number 48/2001, Northern Territory Government, Alice Springs

Kennedy, A. and Sugars, M., 2001b, *The Land Resources of Lilla Creek Station,* Report Number 30/2001, Northern Territory Government, Alice Springs

Kotwicki, V. (1989) Floods in the western Lake Eyre Basin and their impact on Dalhousie Springs, In: Natural History of Dalhousie Springs, (Eds., Zeidler, W. and Ponder, W. F.) South Australian Museum, Adelaide.

Patton, P.C., Pickup, G. and Price, D.M. (1993) Holocene Palaeofloods of the Ross River, Central Australia, *Quaternary Research,* 40, 201-212.

Pickup, G., Allan, G. and Baker, V.R. (1988) History, Paleochannels and Palaeofloods of the Finke River, Central Australia, In: *Fluvial Geomorphology of Australia,* (Ed., Warner, R.F.) Academic Press, Sydney, pp. 177-200.

Pickup, G. (1991) Event Frequency and Landscape Stability on the Floodplain Systems of Arid Central Australia, *Quaternary Science Reviews,* 10, 463-473.

Thackway, R. and Cresswell, I.D. (eds.) (1995). *An Interim Biogeographic Regionalisation for Australia: a framework for establishing the national system of reserves, version 4.0.* Australian Nature Conservation Agency, Canberra.

Ward, S. and Harrison, L. (2009). Recognising sites of conservation significance for biodiversity values in the Northern Territory. Department of Natural Resources, Environment, The Arts and Sport, Darwin, NT.

White, M., Albrecht, A., Duguid, A., Latz, P. and Hamilton, M.. (2000a). *Plant species and sites of botanical significance in the southern bioregions of the Northern Territory; volume 1: significant vascular plants*. A report to the Australian Heritage Commission from the Arid Lands Environment Centre. Alice Springs, Northern Territory of Australia.

White, M., Albrecht, A., Duguid, A., Latz, P. and Hamilton, M. (2000b). *Plant species and sites of botanical significance in the southern bioregions of the Northern Territory; volume 2: significant sites*. A report to the Australian Heritage Commission from the Arid Lands Environment Centre. Alice Springs, Northern Territory of Australia.

Whitehead, P.J. and Chatto, R. (1996) Northern Territory (Overview), In: *A Directory of Important Wetlands in Australia,* Second Edition, (Ed., Australian Nature Conservation Agency) ANCA, Canberra, pp. 119-130.

Wischusen, J. (1998) *Hydrogeology of the Yuendumu - Papunya - Kintore Region Northern Territory (notes to accompany the Western Water Study 1:500000 Major Aquifer Systems Map),* Record 1998/31, Australian Geological Survey Organisation, Canberra.

Appendix 1: Plant Species Known from GABWCD Wetlands

Explanatory notes follow the list of species.

Part 1 – Botanical Names Ordered by Genus

Abutilon malvifolium MALVACEAE Gilgai Lantern-bush, Bastard Marshmallow Wtlndfid:nil Lfrm:?A/SLP~Fb H:8 WI:1

Abutilon otocarpum MALVACEAE Keeled Lantern-bush, Desert Chinese Lantern, Desert Lantern Wtlndfid:nil Lfrm:SLP/P~Fb/Ss H:4 WI:1

§ ***Acacia cyperophylla* var. *cyperophylla*** MIMOSACEAE Mineritchie, Red Mulga, Minni Ritchi Wtlndfid:M/H Lfrm:P~Tr/Sh H:2

Acacia georginae MIMOSACEAE Georgina Gidgee Wtlndfid:nil Lfrm:P~Tr/Sh H:17 WI:3

Acacia jennerae MIMOSACEAE Coonavittra Wattle Wtlndfid:?S Lfrm:P~Sh/Tr H:5

Acacia ligulata MIMOSACEAE Umbrella Bush, Dune Wattle, Small Cooba Wtlndfid:nil Lfrm:P~Sh H:25 WI:1 Lake_Caroline_Survey

§ ***Acacia peuce*** MIMOSACEAE Waddy-wood, Casuarina Wattle, Birdsville Wattle Wtlndfid:nil Lfrm:P~Tr H:14 WI:1

Acacia salicina MIMOSACEAE Cooba, Native Willow, Broughton Willow, Willow Wattle Wtlndfid:M/H Lfrm:P~Tr/Sh H:10 WI:7

Acacia tetragonophylla MIMOSACEAE Dead Finish, Kurara Wtlndfid:nil Lfrm:P~Sh H:11 WI:4

Acacia victoriae MIMOSACEAE Acacia Bush, Bramble Wattle, Victoria Wattle Wtlndfid:nil Lfrm:~ H:5 WI:3

Aeschynomene indica FABACEAE Budda Pea, Kath Sola Wtlndfid:H Lfrm:A/SLP~Fb/Ss H:2 WI:1

Alternanthera angustifolia AMARANTHACEAE Narrow-leaf Joyweed Wtlndfid:H Lfrm:A/SLP~Fb H:5 WI:8 Lake_Caroline_Survey

Alternanthera denticulata* var. *denticulata AMARANTHACEAE Lesser Joyweed Wtlndfid:H Lfrm:A/SLP~Fb H:1

Alternanthera nana AMARANTHACEAE Hairy Joyweed Wtlndfid:M Lfrm:A/SLP~Fb WI:1

Alternanthera nodiflora AMARANTHACEAE Common Joyweed Wtlndfid:H Lfrm:A/SLP~Fb H:7 WI:15 Lake_Caroline_Survey

Amaranthus cochleitepalus AMARANTHACEAE Wtlndfid:M Lfrm:A~Fb H:1

Ammannia multiflora LYTHRACEAE Jerry Jerry Wtlndfid:H Lfrm:A~Fb H:4 WI:1 Lake_Caroline_Survey

Aristida anthoxanthoides POACEAE Yellow Three-awn Wtlndfid:M/H Lfrm:A/SLP~MHb H:5 WI:1

Aristida contorta POACEAE Bunched Kerosene Grass, Mulga Grass Wtlndfid:nil Lfrm:A/SLP~MHb H:15 WI:5 Lake_Caroline_Survey

Aristida holathera* var. *holathera POACEAE Erect Kerosene Grass, White Grass, Arrow Grass Wtlndfid:nil Lfrm:A/SLP~MHb H:11 WI:9 Lake_Caroline_Survey

Astrebla elymoides POACEAE Hoop Mitchell Grass, Weeping Mitchell Grass, Slender Mitchell Grass Wtlndfid:S/M Lfrm:P~MHb H:3 Lake_Caroline_Survey

Astrebla pectinata POACEAE Barley Mitchell Grass Wtlndfid:S Lfrm:P~MHb H:33 WI:4 Lake_Caroline_Survey

Atalaya hemiglauca SAPINDACEAE Whitewood Wtlndfid:nil Lfrm:P~Tr H:6 WI:1

§ ***Atriplex angulata*** CHENOPODIACEAE Fan Saltbush, Angular Saltbush Wtlndfid:M/H Lfrm:A/SLP~Fb/Ss H:7

§ ***Atriplex crassipes* var. *crassipes*** CHENOPODIACEAE Wtlndfid:H Lfrm:?A/SLP~?Fb/Ss H:3 WI:1

§ ***Atriplex eardleyae*** CHENOPODIACEAE Small Saltbush, Eardleys Saltbush Wtlndfid:nil Lfrm:?A/SLP/P~?Fb/Ss H:3 WI:2 Lake_Caroline_Survey

Atriplex elachophylla CHENOPODIACEAE Annual Saltbush, Saltbush Wtlndfid:nil Lfrm:A/SLP/P~Fb/Ss H:9 WI:7

Atriplex holocarpa CHENOPODIACEAE Pop Saltbush Wtlndfid:S Lfrm:A/SLP~Fb H:15 WI:4

Atriplex limbata CHENOPODIACEAE Wtlndfid:nil Lfrm:?A/SLP~Fb/Ss H:12 WI:3 Lake_Caroline_Survey

Atriplex lindleyi* subsp. *conduplicata CHENOPODIACEAE Dwarf Saltbush Wtlndfid:?S Lfrm:A/SLP~Fb/Ss H:6

§ ***Atriplex lobativalvis*** CHENOPODIACEAE Wtlndfid:M/H Lfrm:A~Fb H:7 WI:1 Lake_Caroline_Survey

§ ***Atriplex morrisii*** CHENOPODIACEAE Wtlndfid:H Lfrm:A/SLP~Fb/Ss H:1

Atriplex spongiosa CHENOPODIACEAE Little Pop Saltbush Wtlndfid:S Lfrm:A/SLP~Fb H:14 WI:6 Lake_Caroline_Survey

§ ***Atriplex turbinata*** CHENOPODIACEAE Wtlndfid:M/H (?) Lfrm:A/SLP~?Fb H:3

Atriplex velutinella CHENOPODIACEAE Sandhill Saltbush Wtlndfid:S Lfrm:A/SLP~?Fb/Ss H:12 Lake_Caroline_Survey

Atriplex vesicaria CHENOPODIACEAE Bladder Saltbush Wtlndfid:nil Lfrm:~ H:18 WI:3 Lake_Caroline_Survey

§ ***Atriplex vesicaria* subsp. *macrocystidia*** CHENOPODIACEAE Bladder Saltbush Wtlndfid:nil Lfrm:P~Sh H:3 Lake_Caroline_Survey

Bergia ammannioides ELATINACEAE Water-fire Wtlndfid:H Lfrm:A~Fb H:2

Bergia henshallii ELATINACEAE Wtlndfid:H Lfrm:P~Fb/Ss H:4 WI:1

Bergia occultipetala ELATINACEAE Wtlndfid:H Lfrm:P/SLP/A~Fb H:4

Bergia pedicellaris ELATINACEAE Wtlndfid:H Lfrm:A~Fb H:1

Bergia trimera ELATINACEAE Small Water-fire Wtlndfid:H Lfrm:SLP/P~Fb H:3 WI:5 Lake_Caroline_Survey

Blennodia canescens BRASSICACEAE Wild Stock, Native Stock Wtlndfid:nil Lfrm:A~Fb H:10 WI:1

Boerhavia burbidgeana NYCTAGINACEAE Wtlndfid:nil Lfrm:P~Fb H:2 Lake_Caroline_Survey

Boerhavia coccinea NYCTAGINACEAE Tar Vine Wtlndfid:S Lfrm:P~Fb H:7 Lake_Caroline_Survey

Boerhavia dominii NYCTAGINACEAE Wtlndfid:M/H Lfrm:P~Fb WI:1

Boerhavia repleta NYCTAGINACEAE Wtlndfid:S Lfrm:P~Fb H:6 WI:1 Lake_Caroline_Survey

Boerhavia schomburgkiana NYCTAGINACEAE Yipa Wtlndfid:S Lfrm:P~Fb H:3 WI:3

Brachyscome ciliaris complex ASTERACEAE Variable Daisy Wtlndfid:?S Lfrm:A/SLP/P~Fb H:7

* ***Brassica tournefortii*** BRASSICACEAE Wild Turnip, Turnip Weed, Mediterranean Turnip Wtlndfid:nil Lfrm:A~Fb H:11 WI:13

Bulbine alata LILIACEAE Native Leek, Leek Lilly Wtlndfid:S Lfrm:A~MHb H:9 WI:1

Bulbostylis barbata CYPERACEAE Short-leaved Rush Wtlndfid:?S Lfrm:A~MHb H:3 Lake_Caroline_Survey

Calandrinia ptychosperma PORTULACACEAE Creeping Parakeelya Wtlndfid:M Lfrm:A~Fb H:9 WI:1 Lake_Caroline_Survey

Calandrinia pumila PORTULACACEAE Tiny Purslane, Tiny Parakeelya Wtlndfid:M Lfrm:?A/SLP~Fb H:7 Lake_Caroline_Survey

Calandrinia reticulata s.lat. PORTULACACEAE Wtlndfid:M Lfrm:?A/SLP~Fb H:3

Calandrinia stagnensis PORTULACACEAE Wtlndfid:S/M Lfrm:A~Fb H:2 Lake_Caroline_Survey

Calocephalus platycephalus ASTERACEAE Yellow Billybuttons Wtlndfid:nil Lfrm:A~Fb H:9 WI:6 Lake_Caroline_Survey

Calotis hispidula ASTERACEAE Bogan Flea, Bindyeye, Hairy Burr-daisy Wtlndfid:S Lfrm:A~Fb H:15 WI:8 Lake_Caroline_Survey

Calotis kempei ASTERACEAE Wtlndfid:?S Lfrm:A/SLP/P~Fb/Ss H:7 WI:1

Calotis latiuscula ASTERACEAE Leafy Burr-daisy, Yellow-flowered Burr-daisy Wtlndfid:?S Lfrm:A/SLP/P~Fb/Ss H:4

Calotis plumulifera ASTERACEAE Woolly-headed Burr-daisy Wtlndfid:M Lfrm:A~Fb H:12 WI:3 Lake_Caroline_Survey

Calotis porphyroglossa ASTERACEAE Channel Burr-daisy Wtlndfid:M Lfrm:A~Fb H:11 WI:2 Lake_Caroline_Survey

* ***Cenchrus ciliaris*** POACEAE Buffel Grass Wtlndfid:S Lfrm:P~MHb H:9 WI:4 Lake_Caroline_Survey

Centipeda crateriformis* subsp. *crateriformis ASTERACEAE Wtlndfid:H Lfrm:A~Fb H:12 WI:7 Lake_Caroline_Survey

§ ***Centipeda cunninghamii*** ASTERACEAE Common Sneezeweed Wtlndfid:H Lfrm:A/SLP~Fb H:2 WI:1 Lake_Caroline_Survey

Centipeda minima* subsp. *minima ASTERACEAE Wtlndfid:H Lfrm:?A/SLP~Fb H:2 WI:6

Centipeda pleiocephala ASTERACEAE Wtlndfid:H Lfrm:A~Fb H:1 WI:1 Lake_Caroline_Survey

Centipeda thespidioides ASTERACEAE Desert Sneezeweed, Gilgai Sneezeweed Wtlndfid:H Lfrm:?A/SLP~Fb H:4 WI:4 Lake_Caroline_Survey

Centrolepis eremica CENTROLEPIDACEAE Wiry Centrolepis Wtlndfid:M/H Lfrm:A~MHb H:3

Chenopodium auricomum CHENOPODIACEAE Northern Bluebush, Swamp Bluebush Wtlndfid:H Lfrm:P~Sh H:13 WI:12 Lake_Caroline_Survey

Chenopodium cristatum CHENOPODIACEAE Crested Goosefoot, Crested Crumbweed Wtlndfid:?S Lfrm:A~Fb H:3 WI:2 Lake_Caroline_Survey

Chenopodium truncatum CHENOPODIACEAE Wtlndfid:nil Lfrm:A~Fb Lake_Caroline_Survey

Chloris pectinata POACEAE Comb Chloris Wtlndfid:S Lfrm:A/SLP~MHb H:5 WI:3

* ***Chloris virgata*** s.lat. POACEAE Feathertop Rhodes Grass, Furry Grass, Feather Finger-grass Wtlndfid:S/M Lfrm:A/SLP~MHb H:3 WI:2

Chrysocephalum apiculatum ASTERACEAE Small Yellow Button, Common Everlasting, Yellow Buttons Wtlndfid:nil Lfrm:P~Fb/Ss H:4 Lake_Caroline_Survey

Chrysopogon fallax POACEAE Golden Beard Grass, Ribbon Grass, Weeping Grass, Spear Grass Wtlndfid:M Lfrm:P~MHb H:2 WI:1 Lake_Caroline_Survey

* ***Citrullus colocynthis*** CUCURBITACEAE Colocynth, Bitter Paddy Melon, Colocynth Melon Wtlndfid:S Lfrm:P~Fb/Cl H:6 WI:5 Lake_Caroline_Survey

* ***Citrullus lanatus*** CUCURBITACEAE Paddy Melon, Pie Melon, Wild Melon, Camel Melon Wtlndfid:S Lfrm:A~Fb/Cl H:5 Lake_Caroline_Survey

Cleome viscosa CAPPARACEAE Tickweed, Mustard Bush Wtlndfid:S Lfrm:A~Fb H:4 WI:1 Lake_Caroline_Survey

Clerodendrum floribundum VERBENACEAE Smooth Clerodendrum, Smooth Spiderbush, Lollybrush, Lolly Bush Wtlndfid:S Lfrm:~ H:3

Convolvulus clementii CONVOLVULACEAE Australian Bindweed Wtlndfid:S Lfrm:?A/SLP/P~Fb/Cl H:11 WI:6 Lake_Caroline_Survey

Convolvulus remotus CONVOLVULACEAE Wtlndfid:?S Lfrm:SLP/P~Fb/Cl H:2

Corchorus elderi TILIACEAE Wtlndfid:M/H Lfrm:P~Ss H:2 Lake_Caroline_Survey

Corchorus tridens TILIACEAE Wtlndfid:S/M Lfrm:?A/SLP~Fb H:1 Lake_Caroline_Survey

Cressa australis CONVOLVULACEAE Wtlndfid:H Lfrm:P~Fb H:2 Lake_Caroline_Survey

Crinum flaccidum LILIACEAE Sandover Lily, Desert Lily, Darling Lily, Murray Lily Wtlndfid:S/M Lfrm:P~MHb H:1 WI:1

§ ***Crotalaria eremaea* subsp. *eremaea*** FABACEAE Rattlepod, Desert Rattlepod Wtlndfid:nil Lfrm:SLP/P~Fb/Ss H:5 Lake_Caroline_Survey

Crotalaria novae-hollandiae* subsp. *lasiophylla FABACEAE New Holland Rattlepod Wtlndfid:nil Lfrm:SLP/P~Fb/Ss H:5 Lake_Caroline_Survey

Crotalaria smithiana FABACEAE Yellow Rattlepod Wtlndfid:S Lfrm:SLP/P~Fb/Ss H:8 WI:3 Lake_Caroline_Survey

Cucumis maderaspatanus CUCURBITACEAE Head-ache Vine Wtlndfid:nil Lfrm: P/SLP/A~Fb/Cl H:16 WI:1 Lake_Caroline_Survey

Cucumis melo CUCURBITACEAE Bush Cucumber, Wild Cucumber, Native Cucumber, Ulcardo Melon Wtlndfid:nil Lfrm:~ H:1 WI:4

Cucumis melo* subsp. *agrestis CUCURBITACEAE Bush Cucumber, Wild Cucumber, Native Cucumber, Ulcardo Melon Wtlndfid:nil Lfrm:A~Fb/Cl H:6 Lake_Caroline_Survey

Cullen australasicum FABACEAE Tall Verbine Wtlndfid:H Lfrm:?A/SLP/P~Fb/Ss H:10 WI:7 Lake_Caroline_Survey

Cullen cinereum FABACEAE Annual Verbine Wtlndfid:H Lfrm:?A/SLP~Fb H:8 WI:10 Lake_Caroline_Survey

§ ***Cullen discolor*** FABACEAE Wtlndfid:nil Lfrm:?A/SLP/P~Fb H:7 WI:1 Lake_Caroline_Survey

* ***Cynodon dactylon* var. *dactylon*** POACEAE Couch Grass Wtlndfid:H Lfrm:P~MHb H:3 WI:3

§ ***Cyperus alterniflorus*** CYPERACEAE Wtlndfid:H Lfrm:P~MHb H:1

Cyperus bifax CYPERACEAE Downs Nutgrass Wtlndfid:M/H Lfrm:P~MHb H:3 WI:5

Cyperus bulbosus CYPERACEAE Yalka, Nutgrass Wtlndfid:M Lfrm:P~MHb H:5 WI:2 Lake_Caroline_Survey

Cyperus carinatus CYPERACEAE Wtlndfid:H Lfrm:P~MHb H:1

Cyperus centralis CYPERACEAE Wtlndfid:H Lfrm:P~MHb H:1 WI:3

Cyperus difformis CYPERACEAE Variable-leaf Sedge, Variable Flat-sedge, Dirty Dora Wtlndfid:H Lfrm:A~MHb H:1

Cyperus gilesii CYPERACEAE Wtlndfid:M/H Lfrm:A/SLP~MHb H:2

Cyperus gymnocaulos CYPERACEAE Spiny Sedge, Spiny Flat-sedge Wtlndfid:H Lfrm:P~MHb H:2

?* ***Cyperus hamulosus*** CYPERACEAE Wtlndfid:H Lfrm:A~MHb H:2 Lake_Caroline_Survey

Cyperus iria CYPERACEAE Wtlndfid:M/H Lfrm:A~MHb H:3 WI:6

Cyperus ixiocarpus CYPERACEAE Ankar-ankar Wtlndfid:H Lfrm:P~MHb H:1

§ ***Cyperus laevigatus*** CYPERACEAE Wtlndfid:H Lfrm:P~MHb H:1

Cyperus nervulosus CYPERACEAE Wtlndfid:H Lfrm:A~MHb H:1

Cyperus pygmaeus CYPERACEAE Dwarf Sedge Wtlndfid:H Lfrm:A~MHb H:4 WI:1 Lake_Caroline_Survey

Cyperus rigidellus CYPERACEAE Wtlndfid:H Lfrm:A/SLP~MHb H:8 WI:2 Lake_Caroline_Survey

Cyperus squarrosus CYPERACEAE Bearded Flat-sedge Wtlndfid:M/H Lfrm:A~MHb H:5 WI:2 Lake_Caroline_Survey

Cyperus victoriensis CYPERACEAE Wtlndfid:H Lfrm:P~MHb H:7 Lake_Caroline_Survey

Dactyloctenium radulans POACEAE Button Grass, Finger Grass, Toothbrush Grass Wtlndfid:S Lfrm:A~MHb H:8 WI:13 Lake_Caroline_Survey

?* ***Datura leichhardtii*** SOLANACEAE Native Thornapple Wtlndfid:M/H Lfrm:A~Fb H:4 WI:6

Daucus glochidiatus APIACEAE Australian Carrot Wtlndfid:- Lfrm:~ WI:1

***Daucus glochidiatus* var. Clay edge** APIACEAE Australian Carrot Wtlndfid:M Lfrm:A~Fb H:5

§ ***Dentella pulvinata*** RUBIACEAE Wtlndfid:H Lfrm:P~Fb H:10 WI:3

Dichanthium sericeum POACEAE Silky Bluegrass, Queensland Bluegrass Wtlndfid:M/H Lfrm:~ H:1 WI:1

Dichanthium sericeum* subsp. *humilius POACEAE Dwarf Bluegrass Wtlndfid:M Lfrm:A~MHb H:7

Digitaria brownii POACEAE Cotton Panic Grass Wtlndfid:nil Lfrm:P/SLP~MHb H:4 WI:1

Diplatia grandibractea LORANTHACEAE Royal Mistletoe Wtlndfid:M Lfrm:P~Mt H:2

Drosera indica DROSERACEAE Narrow-leaved Sundew, Flycatcher, Indian Sundew Wtlndfid:H Lfrm:A~Fb H:2 WI:1 Lake_Caroline_Survey

Dysphania cristata CHENOPODIACEAE Crested Goosefoot, Crested Crumbweed Wtlndfid:?S Lfrm:A~Fb H:3 WI:2 Lake_Caroline_Survey

Dysphania glomulifera* subsp. *eremaea CHENOPODIACEAE Wtlndfid:M Lfrm:A~Fb H:1 WI:1

Dysphania plantaginella CHENOPODIACEAE Crumbweed Wtlndfid:M/H Lfrm:A~Fb H:4 Lake_Caroline_Survey

Dysphania platycarpa CHENOPODIACEAE Wtlndfid:H Lfrm:A~Fb H:11 WI:3 Lake_Caroline_Survey

Dysphania simulans CHENOPODIACEAE Salt-lake Rat-tail, Erect Crumbweed Wtlndfid:M Lfrm:A/SLP~Fb H:4 Lake_Caroline_Survey

§ ***Dysphania sphaerosperma*** CHENOPODIACEAE Wtlndfid:S Lfrm:A~Fb H:1

Einadia nutans CHENOPODIACEAE Wtlndfid:nil Lfrm:~ H:1 WI:2

Einadia nutans* subsp. *eremaea CHENOPODIACEAE Climbing Saltbush Wtlndfid:nil Lfrm:P~Ss/Sh H:6 Lake_Caroline_Survey

Elacholoma hornii SCROPHULARIACEAE Elacholoma Wtlndfid:M Lfrm:A~Fb H:2

Eleocharis pallens CYPERACEAE Pale Spike-rush Wtlndfid:H Lfrm:P~MHb H:1 WI:1

§ ***Eleocharis papillosa*** CYPERACEAE Dwarf Desert Spike-rush Wtlndfid:H Lfrm:P~MHb H:2

Elytrophorus spicatus POACEAE Spikegrass Wtlndfid:H Lfrm:A~MHb H:2

Enchylaena tomentosa CHENOPODIACEAE Ruby Saltbush, Sturts Saltbush, Plum Puddings, Berry Cottonbush Wtlndfid:nil Lfrm:~ H:13 WI:4

Enchylaena tomentosa* var. *tomentosa CHENOPODIACEAE Ruby Saltbush, Sturts Saltbush, Plum Puddings, Berry Cottonbush Wtlndfid:nil Lfrm:P~Sh/Ss Lake_Caroline_Survey

Enneapogon avenaceus POACEAE Native Oat-grass, Bottlewashers Wtlndfid:nil Lfrm:A/SLP~MHb H:9 WI:9 Lake_Caroline_Survey

Enneapogon polyphyllus POACEAE Woolly Oat-grass, Oat-grass, Leafy Nine-awn Wtlndfid:nil Lfrm:A/SLP~MHb H:8 WI:6 Lake_Caroline_Survey

Enteropogon acicularis s.lat. POACEAE Curly Windmill Grass, Umbrella Grass, Spider grass Wtlndfid:S/M Lfrm:P~MHb H:8 WI:1

Eragrostis australasica POACEAE Swamp Canegrass Wtlndfid:H Lfrm:P~MHb H:8 WI:3 Lake_Caroline_Survey

Eragrostis basedowii POACEAE Neat Lovegrass, Clustered Lovegrass Wtlndfid:S/M Lfrm:A~MHb H:7 WI:7 Lake_Caroline_Survey

Eragrostis confertiflora POACEAE Spike Lovegrass Wtlndfid:M Lfrm:A~MHb H:5 WI:1 Lake_Caroline_Survey

Eragrostis cumingii POACEAE Fairy Grass, Cumings Lovegrass Wtlndfid:M Lfrm:A~MHb H:1

Eragrostis dielsii POACEAE Mallee Lovegrass Wtlndfid:M Lfrm:A/SLP~MHb H:12 WI:19 Lake_Caroline_Survey

Eragrostis elongata POACEAE Clustered Lovegrass, Close-headed Lovegrass Wtlndfid:H Lfrm:P~MHb H:2

Eragrostis falcata POACEAE Sickle Lovegrass Wtlndfid:M Lfrm:P/SLP~MHb H:5 WI:8 Lake_Caroline_Survey

Eragrostis kennedyae POACEAE Small-flowered Lovegrass Wtlndfid:H Lfrm:?SLP/P~MHb H:3 WI:3

Eragrostis leptocarpa POACEAE Drooping Lovegrass Wtlndfid:H Lfrm:A/SLP~MHb H:9 WI:7

Eragrostis parviflora POACEAE Weeping Lovegrass Wtlndfid:H Lfrm:A/SLP~MHb H:1 WI:1

Eragrostis setifolia POACEAE Neverfail, Narrow-leaf Neverfail Wtlndfid:M Lfrm:P~MHb H:17 WI:15 Lake_Caroline_Survey

Eragrostis speciosa POACEAE Handsome Lovegrass Wtlndfid:M Lfrm:?SLP/P~MHb H:3 WI:1 Lake_Caroline_Survey

Eragrostis tenellula POACEAE Delicate Lovegrass Wtlndfid:M Lfrm:A~MHb H:4 WI:5 Lake_Caroline_Survey

Eragrostis xerophila POACEAE Knottybutt Neverfail Wtlndfid:?S Lfrm:P~MHb H:8 WI:2

Eremophea spinosa CHENOPODIACEAE Wtlndfid:- Lfrm:SLP/P~Ss H:1

Eremophila longifolia MYOPORACEAE Emu Bush, Weeping Emu Bush, Long-leaved Desert Fuchsia Wtlndfid:nil Lfrm:P~Sh/Tr H:21 WI:1

Eremophila macdonnellii MYOPORACEAE Splendid Fuchsia, MacDonnells Desert Fuchsia Wtlndfid:nil Lfrm:P~Ss/Sh H:44 WI:1 Lake_Caroline_Survey

Eremophila maculata MYOPORACEAE Spotted Fuchsia, Spotted Emu-bush Wtlndfid:?S Lfrm:~ WI:1

Eremophila maculata* subsp. *maculata MYOPORACEAE Spotted Fuchsia Wtlndfid:?S Lfrm:P~Sh H:14

Eriachne aristidea POACEAE Three-awn Wanderrie Wtlndfid:nil Lfrm:A/SLP~MHb H:11 WI:2 Lake_Caroline_Survey

Eriachne benthamii POACEAE Swamp Wanderrie Wtlndfid:H Lfrm:P~MHb H:10 WI:4

Eriochloa pseudoacrotricha POACEAE Perennial Cupgrass, Early Spring Grass Wtlndfid:M/H Lfrm:?A/SLP~MHb H:6 WI:7

Erodium carolinianum GERANIACEAE Wtlndfid:nil Lfrm:?A/SLP~Fb H:10 WI:4

Erodium crinitum GERANIACEAE Blue Herons-bill, Wild Geranium, Native Crowfoot Wtlndfid:nil Lfrm:A~Fb H:4 WI:1

Erodium cygnorum GERANIACEAE Storkbill, Wild Geranium, Blue Crowfoot Wtlndfid:nil Lfrm:A~Fb H:2 WI:1

Erythrina vespertilio FABACEAE Bean Tree, Batswing Coral Tree Wtlndfid:M Lfrm:P~Tr H:1

Eucalyptus camaldulensis* subsp. *obtusa MYRTACEAE River Red Gum Wtlndfid:H Lfrm: P~Tr H:5 WI:2 Lake_Caroline_Survey

Eucalyptus coolabah* subsp. *arida MYRTACEAE Coolabah Wtlndfid:M/H Lfrm:P~Tr H:16 WI:20 Lake_Caroline_Survey

Eulalia aurea POACEAE Silky Browntop, Sugar Grass Wtlndfid:M/H Lfrm:P~MHb H:2 WI:3 Lake_Caroline_Survey

Euphorbia biconvexa EUPHORBIACEAE Wtlndfid:S Lfrm:?A/SLP/P~Fb/Ss H:1 WI:1 Lake_Caroline_Survey

Euphorbia drummondii EUPHORBIACEAE Caustic Weed, Caustic Creeper, Mat Spurge Wtlndfid:?S Lfrm:A/SLP~Fb H:23 WI:7 Lake_Caroline_Survey

Euphorbia stevenii EUPHORBIACEAE Bottletree Caustic Wtlndfid:H Lfrm:?A/SLP~Fb H:3

Euphorbia tannensis EUPHORBIACEAE Caustic Bush, Desert Spurge Wtlndfid:nil Lfrm:~ Lake_Caroline_Survey

Euphorbia wheeleri EUPHORBIACEAE Wheelers Spurge Wtlndfid:nil Lfrm:A/SLP~Fb H:29 WI:1 Lake_Caroline_Survey

Fimbristylis dichotoma CYPERACEAE Eight Day Grass, Common Fringe-rush Wtlndfid:S Lfrm:P~MHb H:5 WI:4 Lake_Caroline_Survey

Frankenia serpyllifolia FRANKENIACEAE Bristly Sea-heath Wtlndfid:?S Lfrm:P~Ss/Sh H:32 WI:1 Lake_Caroline_Survey

§ ***Gilesia biniflora*** STERCULIACEAE Gilesia Wtlndfid:M/H Lfrm:A/SLP~Fb H:3

Glinus lotoides MOLLUGINACEAE Hairy Carpet Weed Wtlndfid:H Lfrm:A/SLP~Fb H:11 WI:9 Lake_Caroline_Survey

Glinus oppositifolius MOLLUGINACEAE Slender Carpet-weed Wtlndfid:H Lfrm:?A~Fb H:1 Lake_Caroline_Survey

§ ***Glinus orygioides*** MOLLUGINACEAE Wtlndfid:H Lfrm:?A/SLP/P~Fb/Ss H:5 WI:2 Lake_Caroline_Survey

Glossostigma diandrum SCROPHULARIACEAE Wtlndfid:H Lfrm:A~Fb H:2 WI:3

Glycine canescens FABACEAE Silky Glycine Wtlndfid:S Lfrm:P~Cl H:4 Lake_Caroline_Survey

Gnaphalium diamantinensis ASTERACEAE Wtlndfid:H Lfrm:A~Fb H:1 Lake_Caroline_Survey

Gnephosis arachnoidea ASTERACEAE Erect Yellow-heads, Golden Heads Wtlndfid:nil Lfrm:A~Fb H:14 WI:1

Gnephosis eriocarpa ASTERACEAE Low Billybuttons, Native Camomile Wtlndfid:S Lfrm:A~Fb H:18 WI:2

§ ***Gomphrena* sp. Martins Well** AMARANTHACEAE Wtlndfid:nil Lfrm:?A/SLP~Fb H:1 Lake_Caroline_Survey

Goodenia berardiana GOODENIACEAE Wtlndfid:nil Lfrm:A~Fb H:11 WI:1

Goodenia fascicularis GOODENIACEAE Silky Goodenia Wtlndfid:?S Lfrm:P~Fb H:1

Goodenia lunata GOODENIACEAE Heavy-soil Hand-flower Wtlndfid:S Lfrm:P~Fb H:11 WI:2

Goodenia modesta GOODENIACEAE Wtlndfid:M Lfrm:SLP/P~Fb H:3

Hakea leucoptera* subsp. *leucoptera PROTEACEAE Needlewood, Needle Bush, Needle Hakea Wtlndfid:nil Lfrm:P~Sh/Tr H:11 WI:1

Haloragis aspera HALORAGACEAE Rough Raspwort Wtlndfid:S/M Lfrm:P~Fb H:7 WI:11 Lake_Caroline_Survey

Helichrysum luteoalbum ASTERACEAE Jersey Cudweed Wtlndfid:H Lfrm: A~Fb H:6 WI:7 Lake_Caroline_Survey

Heliotropium ammophilum BORAGINACEAE Wtlndfid:S/M Lfrm:A/SLP~Fb H:5 WI:2 Lake_Caroline_Survey

Heliotropium curassavicum BORAGINACEAE Smooth Heliotrope Wtlndfid:M Lfrm:A~Fb H:5 WI:3

Heliotropium ovalifolium BORAGINACEAE Wtlndfid:M Lfrm:P~Fb/Ss H:2 Lake_Caroline_Survey

§ ***Heliotropium sphaericum*** BORAGINACEAE Wtlndfid:nil Lfrm:A/SLP~Fb WI:2

Hibiscus trionum* var. *vesicarius MALVACEAE Bladder Ketmia Wtlndfid:?S Lfrm:?A/SLP~?Fb/Ss H:1

Hypericum gramineum s.lat. CLUSIACEAE Small St Johns Wort Wtlndfid:H Lfrm:?A/SLP/P~Fb H:1 WI:1

Indigastrum parviflorum FABACEAE Small-flower Indigo Wtlndfid:?S Lfrm:A/SLP~Fb H:2

Indigofera colutea FABACEAE Sticky Indigo Wtlndfid:S/M Lfrm:A/SLP~Fb H:3

Indigofera linifolia FABACEAE Native Indigo Wtlndfid:S Lfrm:A/SLP~Fb H:2 Lake_Caroline_Survey

Indigofera linnaei FABACEAE Birdsville Indigo, Nine-leaved Indigo Wtlndfid:S Lfrm:?SLP/P~Fb H:2 WI:2

Ipomoea coptica CONVOLVULACEAE Wtlndfid:M Lfrm:A~Fb/Cl H:1

Ipomoea muelleri CONVOLVULACEAE Native Morning Glory Wtlndfid:S Lfrm:P~Fb H:10 WI:3 Lake_Caroline_Survey

Ipomoea polymorpha CONVOLVULACEAE Silky Cowvine Wtlndfid:M Lfrm:A~Fb H:5 WI:4 Lake_Caroline_Survey

Ipomoea racemigera CONVOLVULACEAE Wtlndfid:H Lfrm:?A/SLP~Fb/Cl H:1

Iseilema eremaeum POACEAE Wtlndfid:?S Lfrm:A~MHb H:9 WI:1

Iseilema membranaceum POACEAE Small Flinders Grass Wtlndfid:M Lfrm:A~MHb H:6 WI:1

Iseilema vaginiflorum POACEAE Red Flinders Grass Wtlndfid:M Lfrm:A~MHb H:7 Lake_Caroline_Survey

Ixiochlamys cuneifolia ASTERACEAE Silverton Daisy Wtlndfid:?S Lfrm:P~Fb/Ss H:4

* ***Lactuca serriola* forma *serriola*** ASTERACEAE Prickly Lettuce Wtlndfid:nil Lfrm:A/SLP~Fb H:1 WI:1

Lawrencia glomerata s.lat. MALVACEAE Clustered Lawrencia, Small Golden-spike Wtlndfid:M/H Lfrm:A/SLP~Fb/Ss H:5 WI:1

§ ***Lawrencia viridi-grisea*** MALVACEAE Wtlndfid:M/H Lfrm:P~Ss/Sh H:5 Lake_Caroline_Survey

Lechenaultia divaricata GOODENIACEAE Tangled Lechenaultia, Wirebush Wtlndfid:nil Lfrm:P~Ss H:9 WI:1 Lake_Caroline_Survey

Leiocarpa leptolepis ASTERACEAE Wtlndfid:M/H Lfrm:P~Fb/Ss H:9 WI:2

Lepidium muelleriferdinandi BRASSICACEAE Muellers Peppercress Wtlndfid:S/M Lfrm:A~Fb H:5 WI:4 Lake_Caroline_Survey

Lepidium phlebopetalum BRASSICACEAE Veined Peppercress Wtlndfid:nil Lfrm:A/SLP~Fb H:17 WI:3 Lake_Caroline_Survey

Leptochloa digitata POACEAE Umbrella Canegrass Wtlndfid:H Lfrm:P~MHb H:1 WI:6 Lake_Caroline_Survey

Leptochloa fusca* subsp. *muelleri POACEAE Brown Beetle Grass Wtlndfid:H Lfrm:SLP/P~MHb H:7 WI:2 Lake_Caroline_Survey

Lipocarpha microcephala CYPERACEAE Button Rush Wtlndfid:H Lfrm:A~MHb WI:1

Lotus cruentus s.lat. FABACEAE Red-flower Trefoil, Pink-flower Tefoil Wtlndfid:M Lfrm:A/SLP~Fb H:11 WI:7 Lake_Caroline_Survey

Lysiana exocarpi* subsp. *exocarpi LORANTHACEAE Harlequin Mistletoe Wtlndfid:nil Lfrm:P~Mt H:8 WI:1

Lysiana spathulata LORANTHACEAE Flat-leaved Mistletoe Wtlndfid:nil Lfrm:~ H:1 WI:1

§ ***Lythrum paradoxum*** LYTHRACEAE Wtlndfid:H Lfrm:?A/SLP~Fb WI:1

§ ***Lythrum wilsonii*** LYTHRACEAE Wtlndfid:H Lfrm:?A/SLP~Fb H:4 WI:1 Lake_Caroline_Survey

Maireana aphylla CHENOPODIACEAE Cottonbush, Leafless Bluebush Wtlndfid:?S Lfrm:P~Sh/Ss H:5 WI:1

Maireana campanulata CHENOPODIACEAE Wtlndfid:nil Lfrm:P~Sh/Ss H:1 WI:1

Maireana coronata CHENOPODIACEAE Crown Fissure Weed Wtlndfid:nil Lfrm:P~Fb/Ss H:9 WI:1

§ ***Maireana microcarpa*** CHENOPODIACEAE Swamp Bluebush Wtlndfid:M/H Lfrm:P~Ss/Sh H:5 WI:2

Maireana scleroptera CHENOPODIACEAE Wtlndfid:?S Lfrm:P~Fb/Ss H:9 WI:2

Malva preissiana MALVACEAE Australian Hollyhock, Native Hollyhock Wtlndfid:M/H Lfrm:A/SLP~Fb/Ss H:4

* ***Malvastrum americanum*** MALVACEAE Malvastrum, Spiked Malvastrum Wtlndfid:S/M Lfrm:SLP/P~Fb/Ss H:7 WI:7 Lake_Caroline_Survey

Marsilea drummondii MARSILEACEAE Common Nardoo, Clover Fern Wtlndfid:H Lfrm:P/SLP/A~Fn H:6 WI:6

Marsilea exarata MARSILEACEAE Swayback Nardoo, Little Nardoo Wtlndfid:H Lfrm:?P/SLP/A~Fn WI:8

Marsilea hirsuta MARSILEACEAE Short-fruit Nardoo, Hairy Nardoo Wtlndfid:H Lfrm:?P/SLP/A~Fn H:6 WI:1 Lake_Caroline_Survey

Melaleuca glomerata MYRTACEAE Inland Teatree Wtlndfid:M Lfrm:P~Sh/Tr H:4 Lake_Caroline_Survey

Melhania oblongifolia STERCULIACEAE Velvet Hibiscus Wtlndfid:nil Lfrm:P~Fb/Ss H:7 WI:2

§ ***Mentha australis*** LAMIACEAE Native Mint, Australian Mint, River Mint Wtlndfid:H Lfrm:P~Fb H:1

Minuria cunninghamii ASTERACEAE Bush Minuria Wtlndfid:?S Lfrm:P~Ss/Sh H:4 WI:1

Minuria denticulata ASTERACEAE Woolly Minuria Wtlndfid:M Lfrm:P~Fb/Ss H:23 WI:16

Minuria integerrima ASTERACEAE Smooth Minuria Wtlndfid:M Lfrm:SLP/P~Fb H:3

Mollugo cerviana MOLLUGINACEAE Fairy Lights, Fairy Bells Wtlndfid:M Lfrm:A~Fb H:2

Muehlenbeckia florulenta POLYGONACEAE Lignum, Tangled Lignum Wtlndfid:H Lfrm:P~Sh H:8 WI:11 Lake_Caroline_Survey

Mukia maderaspatana CUCURBITACEAE Head-ache Vine Wtlndfid:nil Lfrm:P/SLP/A~Fb/Cl H:16 WI:1 Lake_Caroline_Survey

Myriocephalus rudallii ASTERACEAE Small Poached Egg Daisy Wtlndfid:M Lfrm:A~Fb H:6 WI:2

Myriophyllum verrucosum HALORAGACEAE Red Water-milfoil Wtlndfid:H Lfrm:?A/SLP/P~Fb H:1 WI:3

Neptunia dimorphantha MIMOSACEAE Sensitive Plant, Nervous Plant Wtlndfid:M Lfrm:?A/SLP/P~Fb/Ss H:1

* ***Nicotiana glauca*** SOLANACEAE Tree Tobacco Wtlndfid:H Lfrm:P~Sh/Tr H:4 WI:1

Nicotiana megalosiphon* subsp. *sessilifolia SOLANACEAE Long-flowered Tobacco Wtlndfid:S Lfrm:A/SLP~Fb H:2

Nicotiana simulans SOLANACEAE Native Tobacco Wtlndfid:nil Lfrm:A/SLP~Fb H:9 WI:1

Nicotiana velutina SOLANACEAE Velvet Tobacco, Rubbish Pituri Wtlndfid:S/M (?) Lfrm:A/SLP~Fb H:20 WI:8 Lake_Caroline_Survey

§ ***Osteocarpum acropterum* var. *acropterum*** CHENOPODIACEAE Babbagia Wtlndfid:M/H Lfrm:?SLP/P~?Fb/Ss H:1

Osteocarpum dipterocarpum CHENOPODIACEAE Wtlndfid:nil Lfrm:?SLP/P~?Fb/Ss H:11 WI:1

Panicum decompositum* var. *decompositum POACEAE Native Millet, Native Panic, Australian Millet Wtlndfid:S Lfrm:P/SLP~MHb H:7 WI:4 Lake_Caroline_Survey

Panicum laevinode POACEAE Pepper Grass Wtlndfid:M Lfrm:A/SLP~MHb H:4

§ ***Paractaenum novae-hollandiae* subsp. *reversum*** POACEAE Reverse Grass, Reflexed Panic Wtlndfid:M Lfrm:A~MHb H:7 WI:2 Lake_Caroline_Survey

Paractaenum refractum POACEAE Bristle-brush Grass Wtlndfid:nil Lfrm:A/SLP~MHb H:11 WI:1 Lake_Caroline_Survey

Paspalidium jubiflorum POACEAE Warrego Summer Grass Wtlndfid:H Lfrm:P~MHb H:2 WI:3

§ ***Peplidium* sp. Marla** SCROPHULARIACEAE Wtlndfid:H (?M/H) Lfrm:?A/SLP/P~Fb H:3

Peplidium aithocheilum SCROPHULARIACEAE Wtlndfid:H Lfrm:A~Fb H:6 WI:4

§ ***Peplidium foecundum*** SCROPHULARIACEAE Wtlndfid:H (?M/H) Lfrm:A~Fb H:5 WI:3

Peplidium muelleri SCROPHULARIACEAE Wtlndfid:M Lfrm:?A/SLP~Fb H:1

Phyllanthus exilis EUPHORBIACEAE Wtlndfid:M/H Lfrm:?P/SLP~Ss/Sh WI:2

Phyllanthus fuernrohrii EUPHORBIACEAE Sand Spurge Wtlndfid:nil Lfrm:P~Ss H:11 Lake_Caroline_Survey

§ ***Phyllanthus lacerosus*** EUPHORBIACEAE Wtlndfid:nil Lfrm:?A/SLP~Fb/Ss WI:1

Pittosporum angustifolium PITTOSPORACEAE Native Apricot, Weeping Pittosporum, Native Willow Wtlndfid:nil Lfrm:P~Tr/Sh H:1 WI:1

Plantago drummondii PLANTAGINACEAE Dark Sago Weed, Dark Plantain Wtlndfid:S Lfrm:A~Fb H:11

Pluchea dentex ASTERACEAE Bowl Daisy Wtlndfid:M/H Lfrm:SLP/P~Fb/Ss H:1

Pluchea dunlopii ASTERACEAE Wtlndfid:S Lfrm:P~Ss/Sh H:7 WI:2 Lake_Caroline_Survey

Pluchea rubelliflora ASTERACEAE Wtlndfid:H Lfrm:P~Fb/Ss H:4 WI:4 Lake_Caroline_Survey

Polycalymma stuartii ASTERACEAE Poached Egg Daisy Wtlndfid:nil Lfrm:A~Fb H:15 Lake_Caroline_Survey

Polycarpaea breviflora CARYOPHYLLACEAE Wtlndfid:nil Lfrm:?A/SLP~Fb H:2 WI:1

* ***Polygonum aviculare*** POLYGONACEAE Wireweed, Knotweed, Prostrate Knotweed Wtlndfid:M Lfrm:A~Fb H:1

Polygonum plebeium POLYGONACEAE Small Knotweed Wtlndfid:H Lfrm:A~Fb H:7 WI:7 Lake_Caroline_Survey

* ***Polypogon monspeliensis*** POACEAE Annual Beardgrass Wtlndfid:H Lfrm:A~MHb H:1

Portulaca filifolia s.lat. PORTULACACEAE Slender Pigweed Wtlndfid:S Lfrm:?A/SLP~Fb H:3

Portulaca intraterranea PORTULACACEAE Buttercup Pigweed, Large Pigweed Wtlndfid:nil Lfrm:A~Fb H:12 WI:2

Portulaca oleracea PORTULACACEAE Pigweed, Common Purslane, Munyeroo Wtlndfid:nil Lfrm:~ H:2 WI:8

***Portulaca oleracea* var. Yuendumu** PORTULACACEAE Munyeroo Wtlndfid:nil Lfrm:A/SLP~Fb H:9 Lake_Caroline_Survey

Potamogeton tricarinatus POTAMOGETONACEAE Floating Pondweed Wtlndfid:H Lfrm:?A/SLP/P~MHb H:1

Pseudognaphalium luteoalbum ASTERACEAE Jersey Cudweed Wtlndfid:H Lfrm:A~Fb H:6 WI:7 Lake_Caroline_Survey

Pterocaulon sphacelatum ASTERACEAE Apple Bush, Bush Vicks Wtlndfid:?S Lfrm:A/SLP~Fb/Ss H:9 WI:13 Lake_Caroline_Survey

Ptilotus helipteroides AMARANTHACEAE Hairy Mulla Mulla Wtlndfid:nil Lfrm:~ H:6 WI:1

Ptilotus latifolius AMARANTHACEAE Tangled Mulla Mulla Wtlndfid:nil Lfrm:~ H:23 Lake_Caroline_Survey

Ptilotus obovatus AMARANTHACEAE Smoke Bush, Silver Bush, Silver Tails Wtlndfid:nil Lfrm:~ H:19 WI:2

Ptilotus polystachyus AMARANTHACEAE Long Pussy-tails Wtlndfid:nil Lfrm:~ H:25 WI:1

Ptilotus polystachyus* var. *polystachyus AMARANTHACEAE Long Pussy-tails Wtlndfid:nil Lfrm:A/SLP~Fb Lake_Caroline_Survey

Ptilotus sessilifolius AMARANTHACEAE Crimson Foxtail, Silver Tails Wtlndfid:nil Lfrm:~ H:11 Lake_Caroline_Survey

^ ***Radyera farragei*** MALVACEAE Bush Hibiscus Wtlndfid:?S Lfrm:P~?Ss/Sh H:1

Rhagodia eremaea CHENOPODIACEAE Tall Saltbush Wtlndfid:nil Lfrm:P~Sh H:2 WI:1

Rhagodia spinescens CHENOPODIACEAE Spiny Saltbush, Hedge Saltbush Wtlndfid:nil Lfrm:P~Sh H:19 WI:2

Lake_Caroline_Survey

Rhodanthe charsleyae ASTERACEAE Small Yellow Daisy, Charles Daisy Wtlndfid:nil Lfrm:A~Fb H:10 WI:2

Rhodanthe floribunda ASTERACEAE White Paper Daisy, Large White Sunray Wtlndfid:nil Lfrm:A~Fb H:14 Lake_Caroline_Survey

Rhodanthe moschata ASTERACEAE Musk Sunray, Musk Daisy Wtlndfid:nil Lfrm:A~Fb H:7 WI:1

Rhodanthe stricta ASTERACEAE Slender Sunray Wtlndfid:nil Lfrm:A~Fb H:10 WI:1 Lake_Caroline_Survey

Rhynchosia minima FABACEAE Native Pea, Rhynchosia Wtlndfid:S Lfrm:P~Fb/Cl H:4

* ***Ricinus communis*** EUPHORBIACEAE Castor Oil Plant Wtlndfid:H Lfrm:P~Sh H:5 WI:2

Rostellularia adscendens ACANTHACEAE Wtlndfid:S Lfrm:~ WI:1

§ ***Rumex crystallinus*** POLYGONACEAE Shiny Dock, Glistening Dock Wtlndfid:H Lfrm:A~Fb H:5 WI:3 Lake_Caroline_Survey

§ ***Ruppia tuberosa*** RUPPIACEAE Wtlndfid:H Lfrm:?A/SLP~MHb H:1 WI:1

Rutidosis helichrysoides* subsp. *helichrysoides ASTERACEAE Mulga Daisy, Grey Wrinklewort Wtlndfid:nil Lfrm:SLP/P~Fb/Ss H:7 Lake_Caroline_Survey

Salsola tragus CHENOPODIACEAE Buckbush, Rolypoly, Tumbleweed Wtlndfid:nil Lfrm:~ H:6 WI:8

?* ***Salsola tragus* subsp. *tragus*** CHENOPODIACEAE Buckbush, Rolypoly, Tumbleweed Wtlndfid:nil Lfrm:A/SLP~Fb H:8 Lake_Caroline_Survey

Santalum lanceolatum SANTALACEAE Plumbush, Wild Plum Wtlndfid:nil Lfrm:P~Sh/Tr H:12 WI:1 Lake_Caroline_Survey

Sauropus trachyspermus EUPHORBIACEAE Slender Spurge Wtlndfid:S Lfrm:P/SLP~Fb/Ss H:10 WI:6 Lake_Caroline_Survey

Scaevola collaris GOODENIACEAE Wtlndfid:M Lfrm:P~Ss/Sh H:6

Schenkia australis GENTIANACEAE Wtlndfid:H Lfrm:A~Fb H:5 WI:7 Lake_Caroline_Survey

Schoenoplectus dissachanthus CYPERACEAE Wtlndfid:H Lfrm:A~MHb H:3 WI:4 Lake_Caroline_Survey

Schoenoplectus litoralis CYPERACEAE River Club-rush Wtlndfid:H Lfrm:P~MHb H:1

Sclerolaena bicornis* var. *bicornis CHENOPODIACEAE Goathead Burr, Bassia Burr Wtlndfid:nil Lfrm:SLP/P~Fb/Ss H:7 WI:10 Lake_Caroline_Survey

Sclerolaena cuneata CHENOPODIACEAE Succulent Copper Burr Wtlndfid:?S Lfrm:SLP/P~Fb/Ss H:9 WI:3

Sclerolaena diacantha s.lat. CHENOPODIACEAE Grey Copper Burr, Horned Saltbush Wtlndfid:nil Lfrm:SLP/P~Fb/Ss H:13 WI:5 Lake_Caroline_Survey

Sclerolaena glabra CHENOPODIACEAE Wtlndfid:nil Lfrm:SLP/P~Fb/Ss H:6 Lake_Caroline_Survey

Sclerolaena intricata CHENOPODIACEAE Tangled Poverty Bush Wtlndfid:nil Lfrm:SLP/P~Fb/Ss H:13 WI:1 Lake_Caroline_Survey

Sclerolaena lanicuspis CHENOPODIACEAE Woolly Copper Burr Wtlndfid:nil Lfrm:SLP/P~Fb/Ss H:12 WI:2 Lake_Caroline_Survey

Sclerolaena urceolata CHENOPODIACEAE Squash Bush Wtlndfid:M Lfrm:SLP/P~Fb/Ss H:1

Senecio gregorii ASTERACEAE Annual Yellow Top, Fleshy Groundsel Wtlndfid:nil Lfrm:A~Fb H:14 WI:2 Lake_Caroline_Survey

Senna artemisioides* subsp. *alicia CAESALPINIACEAE Wtlndfid:nil Lfrm:P~Sh H:7 WI:1

Senna artemisioides* subsp. *filifolia CAESALPINIACEAE Desert Cassia, Broom Bush, Punty Bush Wtlndfid:nil Lfrm:P~Sh H:21 WI:3 Lake_Caroline_Survey

Senna artemisioides* nothosubsp. *sturtii CAESALPINIACEAE Dense Cassia Wtlndfid:nil Lfrm:P~Sh H:6 WI:1

Sesbania cannabina FABACEAE Yellow Pea-bush Wtlndfid:H (?M/H) Lfrm:~ H:2 WI:1 Lake_Caroline_Survey

Setaria dielsii POACEAE Diels Pigeon Grass Wtlndfid:M/H Lfrm:A~MHb H:3 WI:2

Setaria surgens POACEAE Brown Pigeon Grass Wtlndfid:nil Lfrm:A/SLP~MHb H:3 Lake_Caroline_Survey

Sida ammophila MALVACEAE Sand Sida Wtlndfid:nil Lfrm:P~Fb/Ss H:15 WI:4 Lake_Caroline_Survey

Sida argillacea MALVACEAE Wtlndfid:?S Lfrm:P~Fb/Ss H:2

Sida cunninghamii MALVACEAE Wtlndfid:nil Lfrm:P~Fb/Ss H:15 WI:1

Sida fibulifera MALVACEAE Silver Sida, Pin Sida Wtlndfid:S Lfrm:P~Fb/Ss H:12 WI:4 Lake_Caroline_Survey

Sida rohlenae* subsp. *rohlenae MALVACEAE Shrub Sida Wtlndfid:S Lfrm:P~Fb/Ss H:3 Lake_Caroline_Survey

Siemssenia capillaris ASTERACEAE Wiry Podolepis Wtlndfid:S/M Lfrm:A/SLP~Fb H:5

* ***Sisymbrium erysimoides*** BRASSICACEAE Smooth Mustard Wtlndfid:M Lfrm:A~Fb WI:2

Solanum ellipticum SOLANACEAE Native Tomato, Potato Bush, Potato Weed Wtlndfid:nil Lfrm:~ H:18 WI:3

Solanum esuriale SOLANACEAE Tomato Plant, Tomato Bush, Quena Wtlndfid:?S Lfrm:P~Fb/Ss H:4 WI:5

* ***Solanum nigrum*** SOLANACEAE Black Nightshade, Black-berry Nightshade Wtlndfid:M/H Lfrm:A/SLP~Fb H:3 WI:5

Solanum tumulicola SOLANACEAE Black-soil Wild Tomato Wtlndfid:S Lfrm:P~Fb/Ss H:2

* ***Sonchus oleraceus*** s.lat. ASTERACEAE Milk Thistle, Common Sow-thistle Wtlndfid:M Lfrm:A/SLP~Fb H:5 WI:2 Lake_Caroline_Survey

§ ***Spergularia brevifolia*** CARYOPHYLLACEAE Desert Sand-spurrey Wtlndfid:H Lfrm:?A~Fb H:3 WI:1 Lake_Caroline_Survey

§ ***Spergularia diandroides*** CARYOPHYLLACEAE Desert Sand-spurrey Wtlndfid:H Lfrm:A~Fb H:3 WI:1 Lake_Caroline_Survey

§ ***Spergularia diandroides*** CARYOPHYLLACEAE Desert Sand-spurrey Wtlndfid:H Lfrm:?A~Fb H:3 WI:1 Lake_Caroline_Survey

* ***Spergularia marina*** CARYOPHYLLACEAE Salt Sand-spurrey Wtlndfid:H Lfrm:?A/SLP/P~Fb H:3

Sphaeromorphaea australis ASTERACEAE Spreading Nut Heads Wtlndfid:H Lfrm:A/SLP~Fb H:4 WI:2 Lake_Caroline_Survey

Sporobolus actinocladus POACEAE Katoora Wtlndfid:S Lfrm:?SLP/P~MHb H:8 Lake_Caroline_Survey

Sporobolus australasicus POACEAE Australian Dropseed Wtlndfid:S Lfrm:A~MHb H:1

Sporobolus blakei POACEAE Wtlndfid:?S Lfrm:P~MHb H:2

Sporobolus caroli POACEAE Fairy Grass Wtlndfid:S Lfrm:?A/SLP~MHb H:1

Stackhousia intermedia STACKHOUSIACEAE Wiry Stackhousia Wtlndfid:S Lfrm:A~Fb H:1 Lake_Caroline_Survey

Stemodia florulenta SCROPHULARIACEAE Blue-rod Wtlndfid:M Lfrm:P~Fb/Ss H:3 WI:16 Lake_Caroline_Survey

Stemodia viscosa SCROPHULARIACEAE Sticky Blue-rod, Pinty-pinty Wtlndfid:M/H Lfrm:?A/SLP/P~Fb/Ss H:1

Streptoglossa adscendens ASTERACEAE Wtlndfid:S Lfrm:A/SLP~Fb H:11 WI:2 Lake_Caroline_Survey

Streptoglossa bubakii ASTERACEAE Wtlndfid:S Lfrm:A/SLP~Fb H:1

Streptoglossa cylindriceps ASTERACEAE Wtlndfid:M Lfrm:A/SLP~Fb H:2 WI:2

Stylidium desertorum STYLIDIACEAE Desert Triggerplant Wtlndfid:M Lfrm:A/SLP~Fb H:1

Swainsona oroboides FABACEAE Variable Swainsona Wtlndfid:?S Lfrm:A/SLP~Fb H:3 WI:2

Swainsona phacoides s.lat. FABACEAE Dwarf Swainsona, Woodland Swainsona Wtlndfid:nil Lfrm:A/SLP~Fb H:24 WI:1 Lake_Caroline_Survey

Synaptantha tillaeacea RUBIACEAE Synaptantha Wtlndfid:S/M Lfrm:~ H:3 WI:3

§ ***Synaptantha tillaeacea* var. *hispidula*** RUBIACEAE Synaptantha Wtlndfid:M Lfrm:A/SLP~Fb H:1 Lake_Caroline_Survey

Synaptantha tillaeacea* var. *tillaeacea RUBIACEAE Synaptantha Wtlndfid:S/M Lfrm:A/SLP~Fb H:5 Lake_Caroline_Survey

* ***Tamarix aphylla*** TAMARICACEAE Athel Tree, Athel Pine Wtlndfid:H Lfrm:P~Tr H:3 WI:1

Tecticornia halocnemoides* subsp. *longispicata CHENOPODIACEAE Wtlndfid:M/H Lfrm:P~Sh/Ss H:1

Tecticornia indica CHENOPODIACEAE Brown-head Glasswort, Samphire Wtlndfid:H Lfrm:~ H:1 WI:1

Tecticornia indica* subsp. *leiostachya CHENOPODIACEAE Wtlndfid:M/H Lfrm:P~Ss H:3

§ ***Tecticornia pergranulata* subsp. *divaricata*** CHENOPODIACEAE Blackseed Samphire Wtlndfid:H (?M/H) Lfrm:P~Sh/Ss H:2 Lake_Caroline_Survey

Tecticornia pergranulata* subsp. *elongata CHENOPODIACEAE Blackseed Samphire Wtlndfid:M/H Lfrm:P~Sh/Ss H:2 WI:1 Lake_Caroline_Survey

Tecticornia tenuis CHENOPODIACEAE Slender Glasswort Wtlndfid:S Lfrm:P~Sh/Ss H:13 WI:3 Lake_Caroline_Survey

Tephrosia brachyodon s.lat. FABACEAE Red Pea-bush Wtlndfid:M Lfrm:P~Ss H:8

Tephrosia sphaerospora FABACEAE Mulga Trefoil Wtlndfid:nil Lfrm:SLP/P~Fb/Ss H:8 WI:1 Lake_Caroline_Survey

Tetragonia eremaea AIZOACEAE Wtlndfid:S Lfrm:A~Fb H:7 WI:6

§ ***Teucrium albicaule*** LAMIACEAE Wtlndfid:M/H (?) Lfrm:P~Fb/Ss H:5

Teucrium racemosum LAMIACEAE Grey Germander Wtlndfid:M/H Lfrm:P~Ss/Sh H:9 WI:12 Lake_Caroline_Survey

Themeda avenacea POACEAE Tall Oat Grass, Oat Kangaroo Grass, Native Oat Grass, Swamp Kangaroo Grass Wtlndfid:S/M Lfrm:P~MHb H:1

Trachymene glaucifolia APIACEAE Wild Parsnip, Blue Parsnip Wtlndfid:nil Lfrm:A/SLP~Fb H:23 Lake_Caroline_Survey

Tragus australianus POACEAE Small Burr-grass, Sock Grass, Tickgrass Wtlndfid:nil Lfrm:A~MHb H:6 WI:2 Lake_Caroline_Survey

§ ***Trianthema glossostigma*** AIZOACEAE Wtlndfid:nil Lfrm:?A/SLP/P~Fb WI:1

Trianthema pilosa AIZOACEAE Wtlndfid:nil Lfrm:A/SLP~Fb H:5 Lake_Caroline_Survey

Trianthema triquetra AIZOACEAE Red Spinach Wtlndfid:S Lfrm:A/SLP~Fb H:5 WI:4 Lake_Caroline_Survey

Tribulus eichlerianus ZYGOPHYLLACEAE Bindieye Wtlndfid:nil Lfrm:A~Fb H:5 WI:1 Lake_Caroline_Survey

Tribulus hystrix ZYGOPHYLLACEAE Sandhill Puncture Vine Wtlndfid:nil Lfrm:A~Fb H:11 WI:2 Lake_Caroline_Survey

?* ***Tribulus terrestris*** s.lat. ZYGOPHYLLACEAE Cat-head, Caltrop, Bindieye Wtlndfid:nil Lfrm:A~Fb H:3 WI:3 Lake_Caroline_Survey

Trichodesma zeylanicum BORAGINACEAE Cattle Bush, Camel Bush Wtlndfid:nil Lfrm:~ H:11 WI:2

Trichodesma zeylanicum* var. *zeylanicum BORAGINACEAE Cattle Bush, Camel Bush Wtlndfid:nil Lfrm:A/SLP/P~Fb/Ss H:1 Lake_Caroline_Survey

§ ***Triglochin* sp. Newhaven** JUNCAGINACEAE Wtlndfid:M Lfrm:A~MHb H:1 Lake_Caroline_Survey

Triglochin nana JUNCAGINACEAE Dwarf Arrowgrass Wtlndfid:H Lfrm:A~MHb H:6

Trigonella suavissima FABACEAE Cooper Clover, Sweet Fenugreek Wtlndfid:M Lfrm:A/SLP~Fb H:11 WI:7 Lake_Caroline_Survey

Triodia basedowii POACEAE Hard Spinifex, Lobed Spinifex Wtlndfid:nil Lfrm:P~MHb H:11 Lake_Caroline_Survey

Triraphis mollis POACEAE Purple Plumegrass, Purple Heads, Needle Grass Wtlndfid:nil Lfrm:A/SLP~MHb H:11 WI:6 Lake_Caroline_Survey

Typha domingensis TYPHACEAE Bullrush, Cumbungi Wtlndfid:H Lfrm:P~MHb H:4

Uranthoecium truncatum POACEAE Flat-stem Grass Wtlndfid:S Lfrm:A/SLP~MHb H:4

Urochloa piligera POACEAE Hairy Armgrass, Hairy Summer Grass, Green Summer Grass Wtlndfid:S Lfrm:A~MHb H:4 WI:2 Lake_Caroline_Survey

Urochloa praetervisa POACEAE Large Armgrass, Large Summer Grass Wtlndfid:S Lfrm:A~MHb H:2 WI:7 Lake_Caroline_Survey

?* ***Vachellia farnesiana* var. *farnesiana*** MIMOSACEAE Mimosa Bush, Sweet Acacia, Sweet Wattle, Prickly Mimosa Wtlndfid:?* Lfrm:P~Sh H:3 Lake_Caroline_Survey

§ ***Verbena macrostachya*** VERBENACEAE Beach Vitex Wtlndfid:H Lfrm:?SLP~Fb H:5 WI:4

Vigna lanceolata FABACEAE Pencil Yam, Maloga Bean, Parsnip Bean Wtlndfid:M Lfrm:~ H:3 WI:3

Vigna lanceolata* var. *latifolia FABACEAE Pencil Yam, Maloga Bean, Parsnip Bean Wtlndfid:M Lfrm:P~Fb H:1 Lake_Caroline_Survey

Wahlenbergia queenslandica CAMPANULACEAE Bluebell Wtlndfid:S/M Lfrm:SLP/P~Fb H:7 WI:2 Lake_Caroline_Survey

Wahlenbergia tumidifructa CAMPANULACEAE Turgid-fruited Bluebell Wtlndfid:S Lfrm:A/SLP~Fb H:9 WI:6 Lake_Caroline_Survey

Waltheria indica STERCULIACEAE Wtlndfid:S Lfrm:P~Ss/Sh H:1

Zaleya galericulata* subsp. *galericulata AIZOACEAE Hogweed Wtlndfid:nil Lfrm:SLP/P~Fb H:2 WI:3

Zygochloa paradoxa POACEAE Sandhill Canegrass Wtlndfid:nil Lfrm:P~MHb H:23 WI:1 Lake_Caroline_Survey

Zygophyllum aurantiacum* subsp. *aurantiacum ZYGOPHYLLACEAE Shrubby Twinleaf Wtlndfid:?S Lfrm:P~Ss H:8

§ ***Zygophyllum aurantiacum* subsp. *simplicifolium*** ZYGOPHYLLACEAE Shrubby Twinleaf Wtlndfid:? Lfrm:P~Ss H:1

Zygophyllum compressum ZYGOPHYLLACEAE Rabbit-ears Twinleaf Wtlndfid:M Lfrm:A/SLP~Fb H:2

Zygophyllum eichleri ZYGOPHYLLACEAE Wtlndfid:nil Lfrm:A~Fb WI:2

Zygophyllum emarginatum ZYGOPHYLLACEAE Wtlndfid:nil Lfrm:A~Fb H:4 WI:1

Zygophyllum simile ZYGOPHYLLACEAE Wtlndfid:M Lfrm:A~Fb H:12 WI:3 Lake_Caroline_Survey

***** = not native, i.e. an introduced (weed) species

§ = indicates species of conservation significance and poorly known species that may be significant. None are currently listed as threatened in the Northern Territory.

Life Form Codes

Life form is given in a two part code with the prefix **"Lfrm:"**. The data and codes are based on the southern NT plant checklist[1]

A = annual; **SLP** = short lived perennial; **P** = Perennial

Cl = climber/twiner; **Fb** = Forb; **Fn** = fern; **HP**; herbaceous parasite; **Mt** = mistletoe; **Pm** = palmoid (palm/cycad)
Sh = shrub; **Ss** = subshrub (intermediate between forbs and shrubs with a semi-woody stem); **Tr** = tree

"**?**" indicates uncertainty.

Wetland Fidelity

Each species is assigned one of four categories concerning likelihood of finding it in a wetland or dryland situation:

high fidelity (H) = rarely occurs outside of wetlands (includes species of river channels and floodouts with occasional brief flooding);

moderate fidelity (M) = known to occur outside of wetlands but much more often in a wetland (includes species that also occur in non-wetland saline areas, or non-wetland run-on areas or black-soil plains);

slight fidelity (S) = often occurs outside of wetlands but slightly more often found in wetlands;

[1] Albrecht, D. Duguid, A., Coulson, H., Harris, M. and Latz, P. (2007) Vascular Plant Checklist for the Southern Bioregions of the Northern Territory: Nomenclature, Distribution and Conservation Status, Second Edition, Northern Territory Government Department of Natural resources Environment and the Arts, Alice Springs.

Part 2 – Common Names Used in the Text

Bluebush = an abbreviation for Northern Bluebush (*Chenopodium auricomum*) although this cane lead to confusion with Swamp Bluebush (*Maireana microcarpa*)

Brown Beetle Grass (*Leptochloa fusca*)

Canegrass = an abbreviation for Swamp Canegrass (*Eragrostis australasica*) although this can lead to confusion with Sandhill Canegrass (*Zygochloa paradoxa*)

Coolabah (*Eucalyptus coolabah* subsp. *arida)*

Dwarf Desert Spike-ruch (*Eleocharis papillosa*)

Lignum (*Muehlenbeckia florulenta*)

Nardoo (*Marsilea* spp.)

Northern Bluebush (*Chenopodium auricomum*)

River Redgum (*Eucalyptus camaldulensis* subsp. *obtusa*)

Sandhill Canegrass (*Zygochloa paradoxa*) – grows on loose sandy river banks and on some sanddunes

Swamp Bluebush (*Maireana microcarpa*)

Swamp Canegrass (*Eragrostis australasica*)