Department of
Environment and Conservation

Our environment, our future

Resource Condition Report for Significant Western Australian Wetland

Howick Swamp

2008

Figure 1 – A view across the water body at Howick Swamp.

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Contents

1. Introduction

The current report considers the ecological character and condition of Howick Swamp, a small near-permanent brackish claypan east of Esperance. Howick Swamp is situated in the Alexander River catchment and has a smaller, crescent-shaped swampy area to its south-east.

Howick Swamp was selected as a study site in the current project as it is a subregionally significant wetland (Comer *et al.* 2002). Long-term monitoring has occurred at Howick Swamp as part of the South Coast Wetland Monitoring Program conducted by the Department of Water (DoW).

1.1. Site Code

Inland Aquatic Integrity Resource Condition Monitoring Project (DEC): RCM038.

Waterfowl Counts in the South-West WA (DEC/RAOU): CALMWCSWWA_HOWI.

South Coast Wetland Monitoring Program (DoW): HOW.

1.2. Purpose of Resource Condition Report

This Resource Condition Report (RCR) was prepared by the Inland Aquatic Integrity Resource Condition Monitoring project (IAI RCM). The objective of the RCR is to provide a summary of information relevant to the ecology of Howick Swamp. This information is then used to describe the drivers of, and threats to, the wetland ecosystem. The resultant 'snapshot' of ecological character in 2008 will provide context for future monitoring of the lagoon and assist with assessing the effectiveness of management planning and actions at the site.

1.3. Relevant Legislation and Policy

This section provides a brief summary of the legislation and policy that may be relevant to the management of Howick Swamp.

International

Migratory bird bilateral agreements and conventions

Australia is party to a number of bilateral agreements, initiatives and conventions for the conservation of migratory birds. None of the waterbirds recorded thus far at Howick Swamp are listed under these agreements. However, waterbird data for Howick Swamp are limited and it is possible that listed waterbirds could be recorded at the swamp with further survey effort. Should this occur, the bilateral agreements that would be relevant to Howick Swamp are:

JAMBA - The Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment, 1974;

CAMBA - The Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment, 1986;

ROKAMBA - The Agreement between the Government of Australia and the Republic of Korea for the Protection of Migratory Birds and their Environment, 2006; and

The Bonn Convention on Migratory Species (CMS) - The Bonn Convention adopts a framework in which countries with jurisdiction over any part of the range of a particular species co-operate to prevent migratory species becoming endangered. For Australian purposes, many of the species are migratory birds.

National legislation

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places. These are defined in the Act as matters of national environmental significance.

There are seven matters of national environmental significance to which the EPBC Act applies. Currently, none apply to Howick Swamp. However, should further biological surveys be conducted at Howick Swamp, they may reveal the following two matters of environmental significance apply:

- nationally threatened species and ecological communities; and
- migratory species listed under international treaties JAMBA, CAMBA and CMS.

The EPBC Act regulates actions that will have or are likely to have a significant impact on any matter of national environmental significance. Such actions are subject to environmental assessment and approval under the EPBC Act. An 'action' includes a project, a development, an undertaking, or an activity or series of activities (http://www.environment.gov.au/epbc/index.html).

Western Australian state policy

Wildlife Conservation Act 1950

This Act provides for the protection of wildlife. All fauna (animals native to Australia) in Western Australia are protected under section 14 and all flora (plants native to Western Australia) are protected under section 23 of the *Wildlife Conservation Act 1950*. The Act establishes licensing frameworks for the taking and possession of protected fauna, and establishes offences and penalties for interactions with fauna.

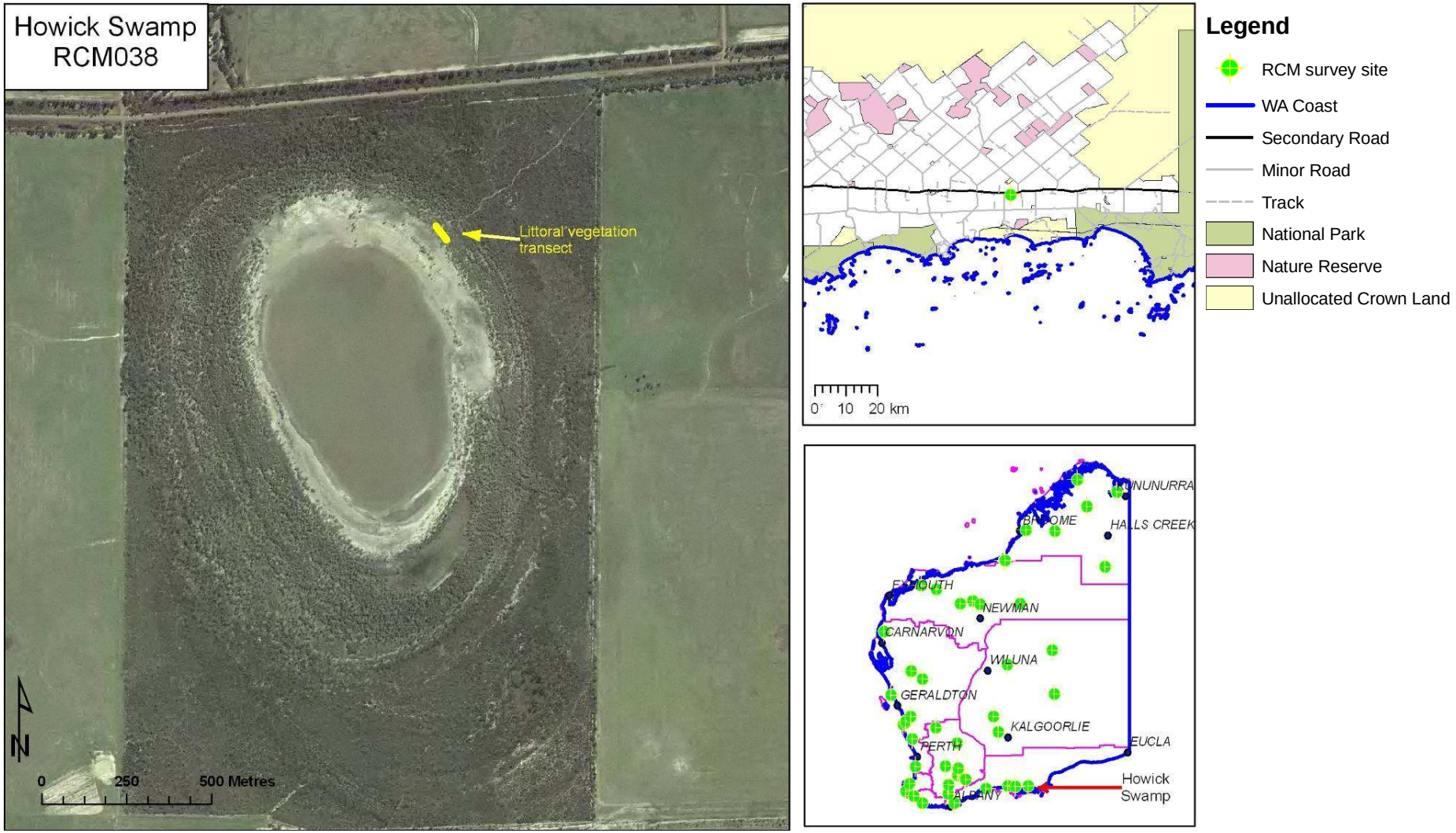


Figure 2 – Aerial photograph showing the location of the vegetation transect at Howick Swamp. Water quality and aquatic invertebrate samples were collected immediately adjacent to the vegetation sample site. The inserts on the right show the location of Howick Swamp in the state of Western Australia and in relation to the remaining IAI RCM survey sites.

2. Overview of Howick Swamp

2.1. Location and Cadastral Information

Howick Swamp lies approximately 82 km east of Esperance, south of Fisheries Road (Figure 2). The wetland is situated approximately 13 km from the south coast and lies at 70 m AHD (Australian Height Datum). The lake is located in the Shire of Esperance on Unallocated Crown Land, which is under the jurisdiction of the Department of Planning.

2.2. IBRA Region

Howick Swamp lies within the Recherche (ESP2) subregion of the Esperance Plains Interim Bioregionalisation of Australia (IBRA) region. The subregion has variable relief, comprising the Quaternary coastal sandplains and dunes overlying Proterozoic gneiss and granite as well as Eocene and more recent coastal limestone. It is characterised by proteaceous scrub and mallee heaths on sandplain overlying Eocene sediments and is rich in endemics. The vegetation of the Recherche subregion comprises heath, coastal dune scrub, mallee, mallee-heath and granite heath with diverse vegetation types (Comer et al. 2002).

2.3. Climate

The nearest Bureau of Meteorology weather station to Howick Swamp with comparable annual rainfall is at Esperance Airport (Bureau of Meteorology 2009). Records have been kept at Esperance Airport since 1950. Weather conditions at Howick Swamp would not differ appreciably from those at Esperance Airport.

Esperance Airport experiences a temperate Mediterranean climate. It receives a mean annual rainfall of 578.2 mm with about half falling between May and August (Figure 3). Annual evaporation at Esperance Airport is c. 1,700 mm.

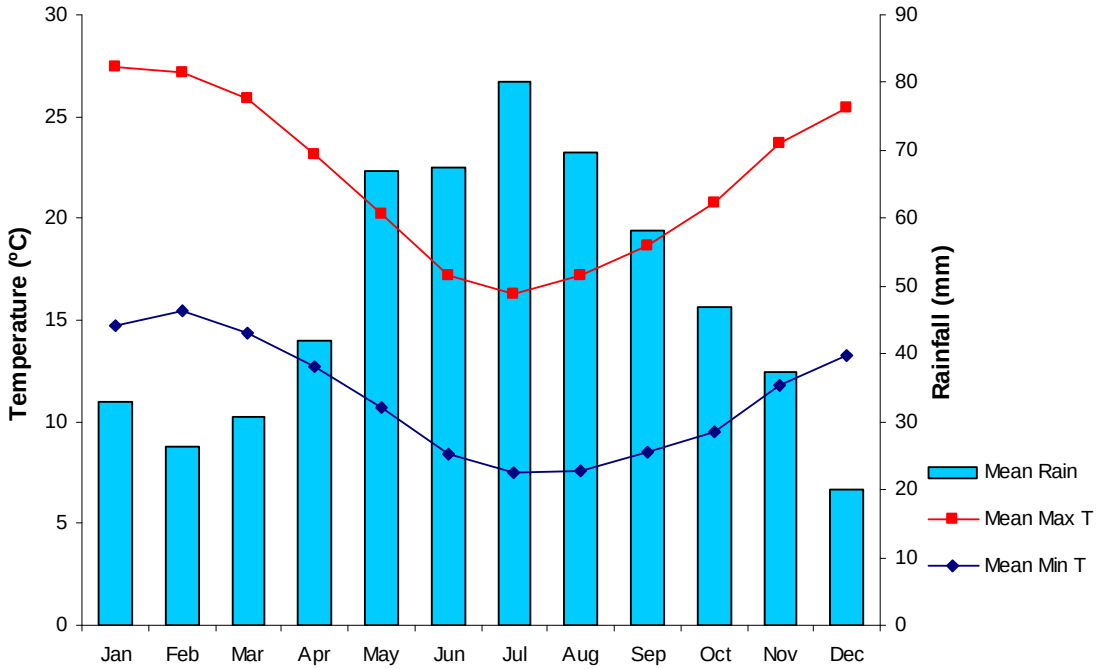


Figure 3 – Climatic averages for Esperance Airport, approximately 87 km west of Howick Swamp.

Howick Swamp was sampled on the 12th of November 2008. In the nine months preceding the IAI RCM survey (1 Feb 2008 – 12 Nov 2008), Esperance Airport received 465.2 mm of rain. The majority of this (272.2 mm) fell between July and September.

2.4. Wetland Type

According to the classification system employed by the Directory of Important Wetlands in Australia (Environment Australia 2001), Howick Swamp is a 'permanent saline/brackish marsh' (type B11).

Howick Swamp has also been evaluated by the Department of Water (DoW 2008), on the basis of guidelines developed by V & C Semeniuk Research Group (1997), as a mesoscale (1107 x 716), ovoid lake.

2.5. Values of Howick Swamp

Values are the internal principles that guide the behaviour of an individual or group. Value systems determine the importance people place on the natural environment and how they view their place within it. Divergent values may result in people pursuing different objectives in relation to nature conservation, having different reasons for desiring a commonly agreed outcome, or favouring different mechanisms to achieve that outcome. Because of this, it is important to be explicit about the values that are driving conservation activities at a wetland.

The Conceptual Framework for Managing Natural Biodiversity in the Western Australian Wheatbelt (Wallace 2003) identified eight reasons that humans value natural biodiversity:

a. Consumptive use

Consumptive use is gaining benefit from products derived from the natural environment, without these products going through a market place, for example, the collection and personal use of firewood or 'bushtucker'. While it is likely the local Aboriginal people used Howick Swamp historically, there are no known consumptive uses of the swamp today.

b. Productive use

Productive use values are derived from market transactions involving products derived from the natural environment. The same firewood that is collected for personal use may be exchanged for money or another commodity. While it is likely the local Aboriginal people used Howick Swamp historically, there are no known productive uses of the swamp today.

c. Opportunities for future use

Not all uses of the natural environment may be apparent at present. The potential for future benefit from the natural environment is maximised by maintaining the greatest possible biodiversity. Every lost taxa or ecosystem represents lost opportunities. Howick Swamp may support endemic or rare taxa. Such unique features would increase the potential for future opportunities to present.

d. Ecosystem services

There are many naturally occurring phenomena that bring enormous benefit to mankind. For instance, plants generate oxygen, insects pollinate food crops and wetlands mitigate floods by regulating water flows. The term 'ecosystem services', is used as a broad umbrella to cover the myriad of benefits delivered, directly or indirectly, to humankind by healthy ecosystems. Howick Swamp provides a drought refuge for domestic waterbirds. The wetland is part of the Howick Suite, which has been recognised as subregionally significant due to its importance for breeding, feeding, roosting, moulting or nursery areas, and refugia for animal taxa (Comer et al. 2002).

e. Amenity

Amenity describes features of the natural environment that make life more pleasant for people. For instance, pleasant views and shade or wind shelter from a stand of trees. It is difficult to quantify the amenity value of a site such as Howick Swamp, but it is certainly valued by the local community for the amenity it provides.

f. Scientific and educational uses

Parts of the natural environment that remain relatively unmodified by human activity represent great educational opportunities. Such sites allow us to learn about the changes that have occurred to the natural world. They may also be considered 'control' sites that allow us to benchmark other, altered habitats. Howick Swamp was included in the Waterfowl Counts in the South-West Western Australia (WCSWWA) project conducted by the Department of Conservation and Management (CALM, now DEC) and the Royal Australasian Ornithologists Union (RAOU, now Birds Australia) (Halse *et al.* 1990; Halse *et al.* 1992; Halse *et al.* 1994; Halse *et al.* 1995). Eight waterbird surveys were conducted at the lake between 1988 and 1992. Howick Swamp was also included in the South Coast Wetland Monitoring Program conducted by the Department of Water (DoW 2006, 2008). The Program involved monitoring 30 wetlands (later expanded to 71) between 1999 and 2008 for water quality and macroinvertebrates. Therefore, Howick Swamp is of significant scientific value.

g. Recreation

Many recreational activities rely on the natural environment (bird watching, canoeing, wildflower tourism, etc.) or are greatly enhanced by it (hiking, cycling, horse riding, photography, etc.). Recreation may deliver economic benefit derived from tourism and also delivers spiritual and physical health benefits to the recreator. Howick Swamp may be used by the local community as a passive recreation site.

h. Spiritual/philosophical values

People's spiritual and philosophical reasons for valuing the natural environment are numerous and diverse. One commonly cited is the 'sense of place' that people derive from elements of their environment. This is evident in many Aboriginal and rural Australians, who strongly identify themselves with their natural environment. Many people also believe that nature has inherent value or a right to exist that is independent of any benefit delivered to humans. A sense of spiritual well-being may be derived from the knowledge of healthy environments, even if the individual has no contact with them. No cultural significance has been specifically recorded for Howick Swamp. However, there are several sites of Aboriginal significance in the vicinity of the lake (Appendix 3).

The intent of nature conservation is usually to maintain the ecosystem service values, opportunity values and scientific and educational values at a given site. Doing so is likely to have positive effects on the amenity values, recreational values and spiritual/philosophical values to which the site's natural environment contributes. Consumptive and productive uses of the natural environment are not usually considered, as these are often incompatible with nature conservation.

3. Interactions between Ecological Components at Howick Swamp

An appreciation of the interactions between the elements of a wetland ecosystem is essential to understanding the condition of the system. Although components of a wetland are often monitored and managed as discrete entities, they exist as nodes in a complex ecological web. Documenting the full extent of the interactions that occur at a wetland would be impractical. However, it is essential to identify key interactions that define the system's ecological character.

Table 1 summarises the interactions between key components and processes at Howick Swamp. The table lists the components that are directly responsible for the provision of each service or benefit of the wetland and the biotic and abiotic factors that support or impact these components. Also listed are the key threats that may affect the components or processes. This information assists in the identification of the primary determinants of ecological character.

Table 1 – The relationship between the services and benefits delivered by Howick Swamp, and the key components and processes that support them.

Benefit or Service	Component	Factors Influencing Component		Threats and Threatening Activities
		Biotic	Abiotic	
Opportunity Value Potential future use of unique flora and fauna	Endemic flora Endemic fauna	Pollinators Food sources	Hydrological regime Water quality Fire regime Habitat extent and distribution	Alteration to hydrology due to climate change, groundwater extraction or catchment perturbation Salinisation Excessive nutrient input from surrounding farmland Grazing by stock and introduced pest animals Weeds Inappropriate fire regimes Predation by introduced fauna
Ecosystem Service Value It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail	Waterbirds that utilise the site as a drought refuge	Aquatic invertebrates (food source) Phytoplankton (food source) Wetland vegetation (habitat)	Hydrology Water quality Soils and sediments Habitat extent and distribution Fire regime	Alteration to hydrology due to climate change, groundwater extraction or catchment perturbation Salinisation Excessive nutrient input from surrounding farmland Grazing by stock and introduced pest animals Weeds Inappropriate fire regimes Predation by introduced fauna
Scientific/Educational Value Waterbird surveys Aquatic invertebrate surveys Water quality monitoring Vegetation surveys	Waterbirds Aquatic invertebrates Water quality Vegetation communities	Aquatic invertebrates Phytoplankton Wetland vegetation	Hydrology Water quality Soils and sediments Habitat extent and distribution Fire regime	Alteration to hydrology due to climate change, groundwater extraction or catchment perturbation Salinisation Excessive nutrient input from surrounding farmland Grazing by stock and introduced pest animals Weeds Inappropriate fire regimes Predation by introduced fauna

Benefit or Service	Component	Factors Influencing Component		Threats and Threatening Activities
		Biotic	Abiotic	
Recreational Value Bird watching Picnicking Bush walking Photography	Landscape amenity Waterbird populations Vegetation communities	Aquatic invertebrates (food source) Phytoplankton (food source) Wetland vegetation (habitat)	Hydrology Water quality Soils and sediments Habitat extent and distribution Fire regime	Alteration to hydrology due to climate change, groundwater extraction or catchment perturbation Salinisation Excessive nutrient input from surrounding farmland Grazing by stock and introduced pest animals Weeds Inappropriate fire regimes Predation by introduced fauna

4. Critical Components and Processes of the Ecology of Howick Swamp

The primary objective of the Howick Swamp RCR is to identify, describe and quantify the critical components and drivers of the wetland's natural environment. These components and processes determine the site's ecological character and are the variables that should be addressed in any ongoing monitoring.

Climate and geomorphology are the most important drivers of wetland ecosystems. Between them, these factors determine the position of a wetland in the landscape and the type and hydrological regime of that wetland. In turn, a wetland's position, type and hydrology exert a strong influence on its biota and biochemical properties and processes.

A summary of Howick Swamp's critical ecosystem components is presented in Table 2, followed by a detailed description of the results of the IAI RCM 2008 survey as well as of any previous studies conducted on the wetland.

Table 2 – Summary of critical ecosystem components at Howick Swamp.

Component	Summary description
Geomorphology	Mesoscale ovoid lake situated on the Esperance Sandplain on sandplain deposits
Hydrology	Influenced by groundwater and surface water; inflow via secondarily salinised creek from upper catchment; catchment has been extensively cleared
Water Quality	Mesosaline to hypersaline to brine, poikilohaline (146.2 mS/m); pH 8.57
Benthic Plants	None
Littoral Vegetation	Predominately *Eucalyptus occidentalis*, *Melaleuca cuticularis* woodland and saltbush, samphire shrubland; no weeds
Invertebrates	Four macroinvertebrate families identified
Fish	None
Waterbirds	At least 10 species recorded at the wetland.

4.1. Geology and Soils

Howick Swamp is located on sandplain deposits (Qpp_1). These are grey sand over pisolites over yellow clay, occupying a dissected sandplain (Esperance Sandplain) (Morgan 1967).

4.2. Hydrology

Howick Swamp is a non-perennial (probably near-permanent) lake with a crescent-shaped swamp located to its south-east. Howick Swamp, part of the Howick Suite, is situated in the Esperance Coast Basin within the Alexander River Catchment. Approximately 90% of the catchment area has been cleared for farming practices, including cattle farming (DoW 2008).

Howick Swamp is influenced by both groundwater and surface water. It receives inflow via a northern creek line from the upper catchment. The creek is affected by secondary salinisation (DoW 2008). The groundwater level in a monitoring bore situated to the north of Howick Swamp (EG36) was 13.6 m below ground surface at 69 m AHD in 2008, and the water level in monitoring bore (EG41) situated to the south of the swamp was 16.4 m below ground surface at 64 m AHD in 2008. In comparison, the swamp bed is at 66 m AHD, which indicates the water body is a window to the water table (DoW 2008).

4.3. Water Quality

Howick Swamp is a naturally saline, alkaline wetland (Table 3). The nitrogen concentrations may be of concern but can be naturally high in very saline wetlands.

Table 3 – Water quality parameters at Howick Swamp as sampled by the IAI RCM project in 2008.

pH	8.57
Alkalinity (mg/L)	230
TDS (g/L)	230
Turbidity (NTU)	0.25
Colour (TCU)	11
Total nitrogen (µg/L)	7,800
Total phosphorus (µg/L)	100
Total soluble nitrogen (µg/L)	6,800
Total soluble phosphorus (µg/L)	20
Chlorophyll (µg/L)	8.5
Na (mg/L)	44,300
Mg (mg/L)	3,250
Ca (mg/L)	838
K (mg/L)	1,060
Cl (mg/L)	64,300
SO_4 (mg/L)	10,500
HCO_3 (mg/L)	281
CO_3 (mg/L)	0.5

Results from the RCM survey were consistent with those of monitoring conducted by the Department of Water (DoW), commencing on the 15 February 2006.

Salinity over the DoW's sample period was brine, ranging between 84.7 and 1,020mS/cm. Howick Swamp is a large shallow basin and fluctuations in salinities relate to rainfall, evaporation and water level variations. Groundwater salinities of the nearby groundwater monitoring bores (EG36 and EG41), when monitored in February and August 2007, were highly saline at 23.85 mS/cm and 26.64 mS/cm respectively (DoW 2008). The extreme salinities within the lake are due to evaporation and salt accumulation.

Total nitrogen concentrations were high ranging from 2.6 to 14 mg/L (DoW 2008). Nitrogen concentrations on all of the sampling occasions exceeded the guidelines developed for ecosystem protection for southwest Australian wetlands for slightly disturbed systems of 1.5mg/L. The total nitrogen concentration of 7.8 mg/L, measured by the RCM project in 2008, was therefore within the normal range for Howick Swamp.

4.4. Benthic Plants

No benthic vegetation was recorded during the IAI RCM survey.

4.5. Littoral Vegetation

Howick Swamp is located on Unallocated Crown Land, which has not been cleared of native vegetation. The remnant vegetation buffer zone ranges from approximately 280 m to 830 m from the wetland's edge (DoW 2008). The vegetation surrounding Howick Swamp consists predominately of *Eucalyptus occidentalis*, *Melaleuca cuticularis* and an understorey consisting

mainly of saltbush, samphire and the sedge *Gahnia trifida*. There are a number of dead *M. cuticularis* on the fringes of the lake with some regeneration occurring (DoW 2008).

A single vegetation transect was established on the northern side of Howick Swamp (Table 4).

Table 4 – Site attributes of the Howick Swamp vegetation transect.

Datum		WGS84
Zone		51
Easting		478162
Northing		6264644
Length		50 m
Bearing		310
Wetland state		Full
Soil state (%)	Dry	0
	Waterlogged	100
	Inundated	0
Substrate (%)	Bare	65
	Rock	0
	Cryptogam	0
	Litter	1
	Trash	5
	Logs	0
Time since last fire		no evidence
Community condition		Natural
Upper Stratum	Cover (%)	21.0022
	Height (m)	<5
Mid Stratum	Cover (%)	27.6
	Height (m)	<0.4
Ground Cover	Cover (%)	<1
	Height (m)	0.1

Transect RCM038-R1

The transect was established approximately 75 m from the water's edge (Figure 4). The clayey soil was waterlogged at the time of survey. Vegetation was dominated by *Melaleuca cuticularis* low woodland (21% cover, <5 m tall) over *Tecticornia pergranulata* subsp. *pergranulata* low open samphire shrubland (27.6% cover, <0.4 m tall) over *Wilsonia humilis*, *W. backhousei* low isolated shrubs (<1% cover, 0.1 m tall). Table 5 provides a complete list of taxa recorded on the transect at Howick Swamp.

There were no species of weeds recorded on the transect. *Tecticornia pergranulata* subsp. *pergranulata* seedlings were abundant and occasional *Melaleuca cuticularis* saplings were scattered throughout the area (Figure 5). The overall community condition was considered 'natural' (Table 9 in Appendix 1).

Closer to the water's edge *Melaleuca cuticularis* was absent and *Tecticornia pergranulata* subsp. *pergranulata* open samphire shrubland formed the dominant vegetative stratum (Figure 6).

Figure 4 – Howick Swamp vegetation transect RCM038-R1.

Figure 5 – *Melaleuca cuticularis* sapling along vegetation transect RCM038-R1.

Figure 6 – Looking back from water's edge over *Tecticornia pergranulata* samphire shrubland, with *Melaleuca cuticularis* woodland in the background.

Table 5 – Plant taxa recorded along vegetation transect RCM038-R1 (in order of stratum then dominance).

Genus	Species	Height (m)	Stratum[1]	Form
Melaleuca	*cuticularis*	5	U1	Tree
Tecticornia	*pergranulata* subsp. *pergranulata*	0.4	M1	Chenopod
Wilsonia	*humilis*	0.1	G1	Shrub
Wilsonia	*backhousei*	0.1	G1	Shrub

1 In an NVIS description, 'U' denotes the upper storey, 'M' the mid storey and 'G' the under storey (ground cover). Numerals to denote substrata from tallest (ESCAVI 2003).

According to the National Vegetation Information System (NVIS), the vegetation community may be described as (ESCAVI 2003):

U1+ ^*Melaleuca cuticularis*\tree\6\i; M1 ^*Tecticornia pergranulata* subsp. *pergranulata*\samphire shrub\1\i; G1 ^*Wilsonia humilis*, *Wilsonia backhousei*\shrub\bc.

4.6. Aquatic Invertebrates

Four macroinvertebrate families were identified from Howick Swamp in 2008 (

Table 6). The low number of taxa present is about as expected for a wetland with this salinity (230 TDS g/L) and the four families are typical of saline wetlands. The three dipteran families probably contained just one or two species each. The *Manayunkia* polychaete is endemic to south-western Australia and is largely restricted to naturally saline lakes. After refilling, *Parartemia* brine shrimp would also be expected. Ostracods were present but not identified as identification of microinvertebrates was not included in the methodology. Species richness in this wetland would vary naturally as salinity changes through a hydrological cycle.

Table 6 – Aquatic macroinvertebrate families identified at Howick Swamp by the IAI RCM project in 2008.

Class	Order	Family	Lowest ID
Polychaeta	-	Fabriciinae	*Manayunkia* n. sp.
Insecta	Diptera	Dolichopodidae	Dolichopodidae
		Ceratopogonidae	Ceratopogonidae
		Chironomidae	Chironominae

Department of Water monitoiring of Howick Swamp recorded a total of eight groups of aquatic invertebrates (DoW 2008). The most abundant of these included Ostracoda (seed shrimp) and Copepoda (copepods). Other groups of less abundance included Chironomidae (non-biting midge larvae), Ceratopogonidae (biting midge larvae), Coleoptera (beetles), other Diptera (fly larvae), Culicidae (mosquitoe larvae), and Isopoda (slater like).

4.7. Fish

No fish were observed at Howick Swamp during the 2008 IAI RCM survey. Fish have not previously been recorded at the wetland.

4.8. Waterbirds

Howick Swamp has previously been surveyed for waterbirds by the Department of Conservation and Management (CALM, now DEC) and the Royal Australasian Ornithologists Union (RAOU, now Birds Australia) as part of the Waterfowl Counts in the South-West Western Australia (WCSWWA) project (Halse *et al.* 1990; Halse *et al.* 1992; Halse *et al.* 1994; Halse *et al.* 1995). At least nine species were recorded during eight surveys conducted between November 1988 and November 1992 (Table 7).

Two species were recorded at Howick Swamp during the 2008 IAI RCM survey: Red-capped Plover (*Charadrius ruficallipus*) and Australian Shelduck (*Tadorna tadornoides*) (Table 7). While Australian Shelduck had been sighted at the wetland previously, this was the first record of Red-capped Plover.

None of the waterbirds recorded at Howick Swamp thus far are listed under international migratory bird agreements.

Table 7 – Waterbirds observed at Howick Swamp (numbers in parentheses indicate maximum abundance).

Organisation/Project **Duration of project**		**DEC/RAOU** **WCSWWA** **1989 - 1992**	**DEC/RCM** **12/11/2008**
Common name	**Latin name**		
Australasian Shoveler	*Anas rhynchotis*	4	
Australian Shelduck	*Tadorna tadornoides*	45	55
Black Swan	*Cygnus atratus*	10	
Chestnut Teal	*Anas castanea*	8	
Eurasian Coot	*Fulica atra*	350	
Grey Teal	*Anas gracilis*	95	
Musk Duck	*Biziura lobata*	33	
Pacific Black Duck	*Anas superciliosa*	14	
Pink-eared Duck	*Malacorhynchus membranaceus*	300	
Red-capped Plover	*Charadrius ruficapillus*		24
Unidentified Duck		7	

4.9. Terrestrial Vertebrates

Emu (*Dromaius novaehollandiae*) tracks were observed at Howick Swamp during the 2008 IAI RCM survey. Two species of venomous snake have also been previously recorded (specimens lodged with the Western Australian Museum) within 5 km of the wetland: Dugite (*Pseudonaja affinis*) and Common Death Adder (*Acanthophis antarcticus*).

5. Threats to the Ecology of Howick Swamp

The ambition for management at Howick Swamp is to maintain those elements of the ecology that make it a subregionally significant wetland. The critical components of the ecology are the geomorphologic, hydrologic and water quality factors that make the lake a refuge site for domestic waterbirds. These factors are the primary determinants of the lake's ecological character. They are influenced by, and exert an influence on, the vegetation communities that surround the water body, the aquatic invertebrate and benthic vegetation communities that inhabit it and the threatening processes that face all of these. Also of importance are the elements of the system that contribute to its cultural and scientific value. These are the same as the above listed influences on the primary determinants of ecological character, with the addition of landscape amenity.

Threats to Howick Swamp must be considered in relation to their likelihood of causing failure of the above management goal for the lake. An assessment is made of the probability that goal failure will result due to the impacts of each threatening process identified at the site, or potentially acting there. The results of this assessment are presented in Table 8. In summary, failure to achieve the management goal for Howick Swamp is most likely to result due to the impacts of land clearing and associated changes to the wetland's hydrology, particularly salinisation. The impacts of excessive nutrient input to the wetland are also a significant factor. Weeds and climate change should also be considered as potential threats.

Howick Swamp has been described as being of good condition with recovery expected in the short-term with minimum intervention (Comer *et al.* 2002). The vegetation of Howick Swamp was described as 'natural' (Table 9 in Appendix 1) and few threats were observed during the IAI RCM survey.

Altered hydrology

Approximately 90% of the catchment Howick Swamp is located in has been cleared of native vegetation for agriculture, including cattle farming (DoW 2008). Vegetation has been cleared particularly in the vicinity of Howick Swamp, with little or no connectivity between areas of remnant vegetation. Increased run-off from this cleared land has caused waterlogging and extended the residence times of flooding at Howick Swamp. This, coupled with salinisation, has resulted in Howick Swamp exhibiting stress in the form of mortality of some of the fringing paperbark (*Melaleuca cuticularis*). Intensive rainfall events may also be contributing to the problem. Indeed, changed hydrology, namely altered flow regimes affecting riparian vegetation, has been recognised as the primary threat facing Howick Swamp (Comer *et al.* 2002).

As a wetland of the Wheatbelt, Howick Swamp faces secondary salinisation, a threatening process characteristic of the region. Extensive land clearing is affecting the region by raising water tables, bringing salt to the surface of the land. The hydrology of Howick Swamp is affected by both groundwater and surface water, including the northern creek line from the upper catchment, which has been secondarily salinised (DoW 2008). These inflows are undoubtedly contributing to the increasing salinity of Howick Swamp.

Eutrophication

The dominant land use surrounding the lake is for agriculture, notably wheat/cattle and cereal cropping. As the hydrology of Howick Swamp is reliant on surface drainage from surrounding areas, excess nutrient input poses a threat to the wetland's ecology. The two major nutrients leaching from agricultural lands are likely to be phosphorus and nitrogen. Imbalances of these nutrients may lead to algal blooms or favour introduced aquatic species (Frodsham 2007).

Previous sampling by the Department of Water revealed consistently high total nutrient levels (DoW 2008) and this was confirmed in 2008 by the RCM survey. Total nitrogen and total phosphorus levels exceeded the guidelines developed for ecosystem protection for southwest Australian wetlands for slightly disturbed systems (ANZECC/ARMCANZ 2000). It is likely that these excess nutrient inputs originate from surface run-off from surrounding farmland. Nutrients stored in the sediments may also enter Howick Swamp through surface and sub-surface flow from the surrounding land and via the creek line that drains surface salts from land to the north (DoW 2008).

Weeds

Weeds were not present at Howick Swamp and are therefore considered a negligible threat to the wetland's ecosystem. However, there is potential for weed invasion, particularly given the highly cleared surroundings of the wetland. Weeds were also observed on the access track leading to the swamp. The vegetation should therefore be monitored for weed incursions.

Climate Change

Climate change modelling conducted by the CSIRO predicts that rainfall received by the south-west of WA will decline by as much as 20% by 2030 and 60% by 2070, relative to 1990 figures (EPA 2007). Rainfall is expected to decline by approximately 5-10% in the Howick Swamp area. Average annual temperatures are also expected to rise across Western Australia (EPA 2007). The hydrology of Howick Swamp is reliant surface water inflow and groundwater. A reduction in rainfall in the catchment and an increase in evaporation caused by climate change could result in changes to the overall hydrology, water quality and ecology of the lake. However, the impact of such changes is considered negligible, particularly considering the current impacts of prolonged inundation.

Table 8 – Threat assessment for Howick Swamp.

An estimate is provided of the perceived likelihood of goal failure resulting from the impacts of each identified threat category.

Goal: to maintain the geomorphology and hydrology of Howick Swamp, thus ensuring it remains a suitable drought refuge for waterbirds and retains its scientific values.

Threat category	Management issue	Probability (%) that threat will cause goal failure with:		Assumptions underlying initial probability assessment and explanatory notes
		Existing management	Extra management	
Altered biogeochemical processes	Hydrological processes, particularly salinity	50	20	The catchment has been extensively cleared for agricultural use. As is characteristic of the Wheatbelt, the hydrology of Howick Swamp has been altered and the wetland is affected by salinisation. Considering the expected continuation of the surrounding land use, the threat of salinity will only worsen without management intervention. Altered hydrological regime and salinisation are the major threats facing Howick Swamp and are evident in the death of fringing paperbark.
	Carbon cycle and climate change	5	5	Rainfall is expected to decline by approximately 5-10% in the Howick Swamp area by 2070. Average annual temperatures are also expected to rise across WA. However, the impacts of climate change are expected to be negligible for Howick Swamp.
Impacts of introduced plants and animals	Environmental weeds	5	0	Weeds were not present at Howick Swamp. However, there is potential for weed invasion, particularly given the highly cleared surroundings of the wetland. Weeds were also observed on the access track leading to the swamp. The vegetation should therefore be monitored for weed incursions.
	Herbivory, wallowing and trampling by introduced species	5	0	No impacts were evident. However, rabbits are known to occur in the area and the surrounding land use includes cattle farming. There is potential for this to be a threat and impacts should be monitored.
Impacts of problem native species	Overgrazing by native species	0	0	No impacts evident.
Impacts of disease	Plant pathogens	0	0	No impacts evident.
Detrimental regimes of physical disturbance events	Fire regimes	10	5	There is no evidence of past fires at Howick Swamp. The fringing woodland is susceptible to fire. Too frequent fires could add to the effect of altered hydrology and salinisation by causing further tree death and limiting regeneration.
	Drought	0	0	The main threats to Howick Swamp involve increased waterlogging and prolonged residence times of flooding. Drought is unlikely to impact on Howick Swamp.

Threat category	Management issue	Probability (%) that threat will cause goal failure with:		Assumptions underlying initial probability assessment and explanatory notes
		Existing management	Extra management	
	Flood	10	5	The main threats to Howick Swamp involve increased waterlogging and prolonged residence times of flooding. This has contributed to paperbark death.
Impacts of pollution	Herbicide, pesticide or fertiliser use and direct impacts	20	5	The dominant surrounding land use for Howick Swamp is agriculture. The wetland's hydrology is affected by surface drainage. As such, Howick Swamp is susceptible to excessive nutrient input and pollution.
Impacts of competing land uses	Recreation management	1	0	Recreational usage of Howick Swamp is low impact and unlikely to have any deleterious impacts.
	Nutrient enrichment of water body	20	5	Nutrient enrichment may result from pollution from surrounding agricultural areas. Sampling has found elevated nitrogen and phosphorous levels.
	Urban and industrial development	0	0	The land surrounding Howick Swamp is already being extensively used for agriculture. Urban or industrial development is unlikely.
	Consumptive uses	0	0	There are currently no consumptive uses of Howick Swamp.
	Illegal activities	0	0	No evidence of any threat.
	Mines and quarries	0	0	No mineral potential.
Insufficient ecological resources to maintain viable populations	Habitat, genetic exchange	5	3	The catchment has been extensively cleared, particularly in the vicinity of Howick Swamp. There is little or no connectivity between areas of remnant vegetation. Off-site impacts on nomadic birds could potentially reduce their population size to unsustainable levels. Management would require a large-scale revegetation program to build vegetation corridors.

6. Knowledge Gaps and Recommendations for Future Monitoring

The most comprehensive data available for Howick Swamp involve waterbirds. Howick Swamp was included in the Waterfowl Counts in the South-West Western Australia (WCSWWA) project between 1988 and 1992. A total of eight waterbird surveys were conducted at the wetland. When surveyed by the IAI RCM project, Red-capped Plovers were observed for the first time. The record of a new species suggests that further species may still be recorded with additional survey effort. Howick Swamp is part of the Howick Suite, which has been recognised as subregionally significant for breeding, feeding, roosting, moulting or nursery areas, and refugia for animal taxa (Comer et al. 2002). Therefore, a complete knowledge of waterbird utilisation of the lake is highly desirable.

Howick Swamp has also been sampled for macroinvertebrates, water quality and vegetation by the DoW South Coast Wetland Monitoring Program. It was acknowledged that the monitoring period was relatively short and some effects of previous and current land use change and management may not yet have been evident (DoW 2008). Water quality sampling revealed consistently high nitrogen and phosphorus levels. Further monitoring may be required to determine any trends. Such monitoring could also serve as baseline data, which could measure the success or failure of any future management actions.

The IAI RCM project marked the first time Howick Swamp was sampled for macroinvertebrates for identification to species level. Previous sampling by DoW had limited identification to family level. Species level identification allows more detailed analysis of ecological condition and relationships to other wetland characteristics. Repeated aquatic invertebrate surveys are recommended to allow identification of the suite of species present at the wetland as well as of any trends in species richness.

The hydrology of the Howick Swamp and its catchment is not fully understood or monitored, particularly the interaction between groundwater and surface water (DoW 2008). A future monitoring program should be developed to address these issues.

Howick Swamp is not currently impacted by weeds. However, the wetland is located in a highly cleared area and weeds were observed on the access track leading to the wetland. Weed mapping may be beneficial to determine changes in the extent of weeds in Howick Swamp. Monitoring of the extent of weeds is useful in informing management decisions and could allow early detection of an issue.

References

ANZECC/ARMCANZ. (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand. October 2000.

Bureau of Meteorology. (2009) Climate Statistics for Australian Locations. Bureau of Meteorology. <http://www.bom.gov.au/climate/averages/> Accessed on 5 January 2009.

Comer, S., Gilfillan, S., Barrett, S., Grant, M., Tiedemann, K., and Anderson, L. (2002) Esperance 2 (ESP2 – Recherche subregion). In *A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002*. (McKenzie, N. L., May, J. E., and McKenna, S., eds). Department of Environment and Conservation, Perth, Australia.

DoW. (2006) *Sampling and Analysis Plan: Project: SC-B-REGWET South Coast Regional Wetland Monitoring Program*. TRIM File No: SC1516. South Coast Region, Department of Water. Dec 2006.

DoW. (2008) *South Coast Wetland Monitoring Project: Howick Swamp*. Department of Water, Esperance, Australia. June 2008.

Environment Australia. (2001) *A Directory of Important Wetlands in Australia, Third Edition*. Environment Australia, Canberra.

EPA. (2007) *State of Environment Report Western Australia 2007*. Environmental Protection Authority, Perth.

ESCAVI. (2003) *National Vegetation Information System: Australian Vegetation Attribute Manual*. Department of Environment and Heritage, Canberra, Australia. August 2003.

Frodsham, T. (2007) *Wetland Conservation in the Jerdacuttup-Ravensthorpe area, WA: Management of the Lake Shaster and Jerdacuttup Wetland Suites: Assessment and Recommendations*. Prepared by Green Skills for the South Coast Natural Resource Management Team, Denmark, Australia. July 2007.

Halse, S. A., Jaensch, R. P., Munro, D. R., and Pearson, G. B. (1990) *Annual waterfowl counts in south-western Australia - 1988/89*. Technical Report No. 25. Department of Conservation and Land Management, Perth, Australia. September 1990.

Halse, S. A., Vervest, R. M., Munro, D. C., Pearson, G. B., and Yung, F. H. (1992) *Annual waterfowl counts in south-west Western Australia - 1989/90. No. 2*. Department of Conservation and Land Management. July 1992.

Halse, S. A., Vervest, R. M., Pearson, G. B., Yung, F. H., and Fuller, P. J. (1994) Annual waterfowl counts in south-west Western Australia - 1990/91. *CALM Science* **1**: 107-129.

Halse, S. A., Pearson, G. B., Vervest, R. M., and Yung, F. H. (1995) Annual waterfowl counts in south-west Western Australia - 1991/92. *CALM Science* **2**: 1-24.

Morgan, K. H. (1967) *Esperance - Mondrain Island: Western Australian Geological Survey*. 1:250,000 Geological Series. Explanatory Notes. Bureau of Mineral Resources, Canberra, Australia.

Thackway, R., and Lesslie, R. (2005) *Vegetation Assets, States, and Transitions (VAST): accounting for vegetation condition in the Australian landscape*. Technical Report. Bureau of Rural Sciences, Canberra, Australia.

V & C Semeniuk Research Group. (1997) *Mapping and classification of wetlands from Augusta to Walpole in the south west of Western Australia'. Water and Rivers Commission*. Water and Rivers Commission and Department of Environmental Protection, Perth, Western Australia.

Wallace, K. J., B.C. Beecham., B.H. Bone. (2003) *Managing Natural Biodiversity in the Western Australian Wheatbelt: a conceptual framework*. Department of Conservation and Land Management, Perth, W.A.

Appendix 1 – Vegetation Condition

Table 9 – Overall Vegetation Community Condition Rating as adapted from Thackway and Lesslie (2005). Shading indicates the condition of Howick Swamp.

Overall Community Condition Rating					
	0	1	2	3	4
	RESIDUAL BARE	**NATURAL**	**IMPACTED**	**DEGRADED**	**REMOVED/REPLACED**
Community Condition Class	Areas where native vegetation does not naturally persist	Native vegetation community structure, composition and regenerative capacity intact - no significant perturbation from land management practices	Native vegetation community structure, composition and regenerative capacity intact but perturbed by land management practices	Native vegetation community structure, composition and regenerative capacity significantly altered by land management practices	Species present are alien to the locality and either spontaneous in occurrence or cultivated. Alternatively, vegetation may have been removed entirely
Regenerative Capacity	Natural regenerative capacity unmodified - ephemerals and lower plants	Regenerative capacity intact. All species expected to show regeneration are doing so	Natural regenerative capacity somewhat reduced, but endures under current/past land management practices	Natural regenerative capacity limited and at risk due to land management practices. Rehabilitation and restoration possible through removal of threats	Regenerative potential of native vegetation has been suppressed by ongoing disturbances. There is little potential for restoration
Vegetation Structure	Nil or minimal	Structural integrity of native vegetation is very high. All expected strata, growth forms and age classes are present	Structure is altered but persists, i.e. some elements of a stratum are missing	Structure of native vegetation is significantly altered, i.e. one or more strata are missing entirely	All structural elements of native vegetation are missing or highly degraded
Vegetation Composition	Nil or minimal	Compositional integrity of native vegetation is very high. All species expected at the site are present	Composition of native vegetation is altered. All major species are present, although proportions may have changed. Some minor species may be missing	Significant species are missing from the site and may have been replaced by opportunistic species. Loss of species affects structure of vegetation	Native vegetation removed entirely +/- replaced with introduced species

Appendix 2 – Herbarium Records

Plant specimens submitted to the Western Australian Herbarium
Wilsonia backhousei (RCM038-R1-03)

Herbarium Records
No records returned from a search of Western Australian Museum Herbarium records for the search coordinates:

- NW corner 33.7558°S, 122.7557°E
- SE corner 33.7708°S, 122.7695°E

Appendix 3 – Aboriginal Heritage

Government of **Western Australia**
Department of **Indigenous Affairs**

Aboriginal Heritage Inquiry System

Register of Aboriginal Sites

Search Criteria

4 sites in a search box. The box is formed by these diagonally opposed corner points:

MGA Zone 51	
Northing	Easting
6257078	470388
6272390	486097

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

Copyright in the information contained herein is and shall remain the property of the State of Western Australia. All rights reserved. This includes, but is not limited to, information from the Register of Aboriginal Sites established and maintained under the Aboriginal Heritage Act 1972 (AHA).

Legend

Restriction

- **N** No restriction
- **M** Male access only
- **F** Female access

Access

- **C** Closed
- **O** Open
- **V** Vulnerable

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

- **[Reliable]** The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
- **[Unreliable** The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

- **L** Lodged
- **I** Insufficient Information
- **P** Permanent register
- **S** Stored data
- **IR** Insufficient Information (as assessed by Site Assessment Group)
- **PR** Permanent register (as assessed by Site Assessment Group)
- **SR** Stored data (as assessed by Site Assessment Group)

Site Assessment Group (SAG)

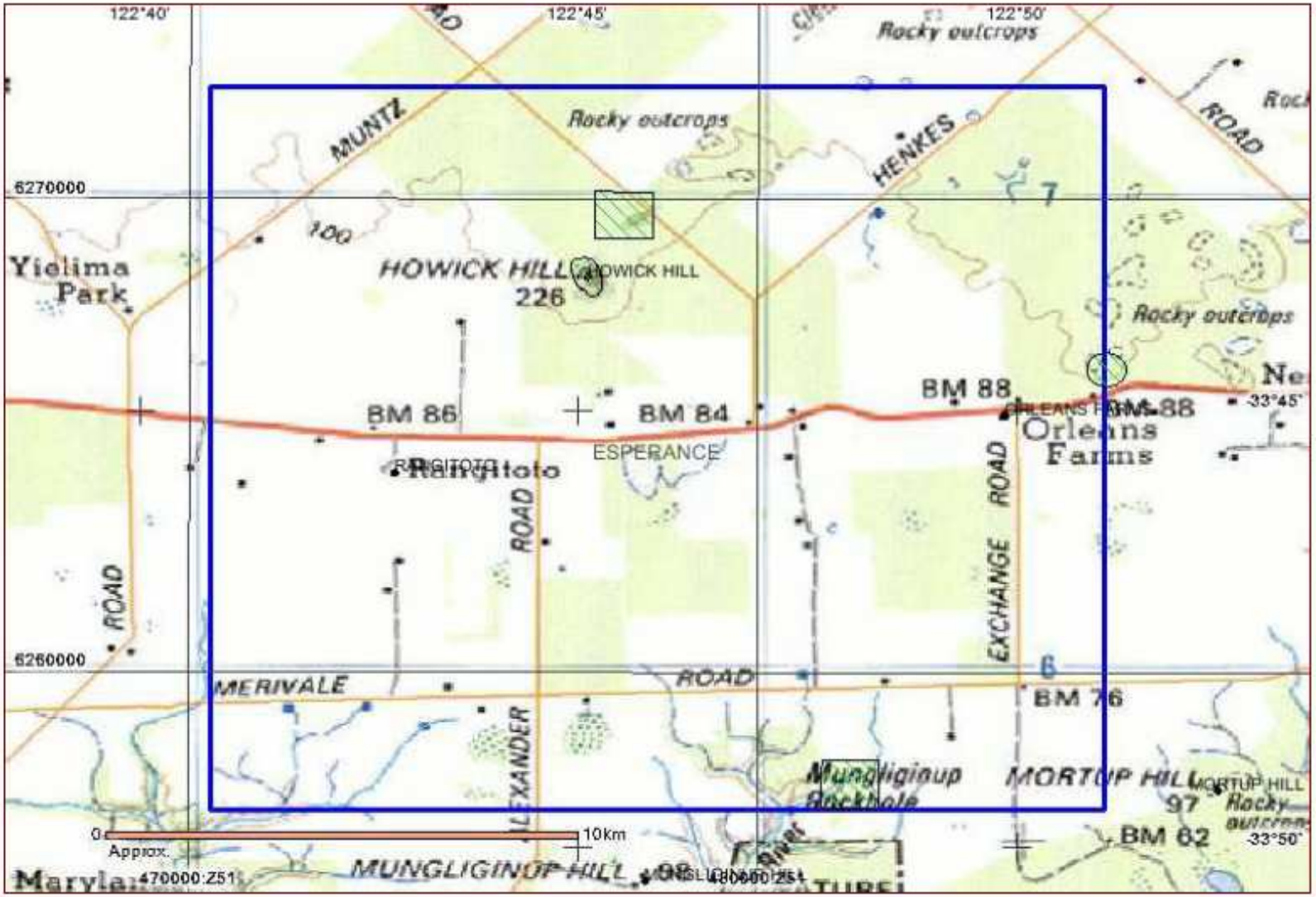
Sites lodged with the Department are assessed under the direction of the Registrar of Aboriginal Sites. These are not to be considered the final assessment.

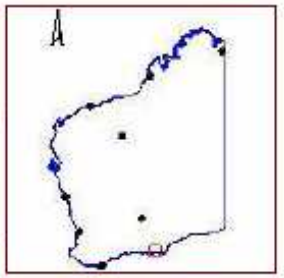
Final assessment will be determined by the Aboriginal Cultural Material Committee (ACMC).

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code "closed" or "vulnerable". Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
1677	P	O	N	Orleans Granite.	Artefacts / Scatter	Camp, Water Source, [Other: ?]		486137mE 6266406mN Zone 51 [Unreliable]	W01529
1936	I	O	N	Mungliginup Rockhole	Artefacts / Scatter	Water Source		481637mE 6257656mN Zone 51 [Unreliable]	W01237
1962	P	O	N	Howig Hill.	Artefacts / Scatter	Camp, Hunting Place, Rockshelter, Water Source, [Other: Lizard Trap & Isolated Artefacts]	*Registered Informant names available from DIA.	476977mE 6268350mN Zone 51 [Reliable]	W01209
1963	P	O	N	Howig North-East	Artefacts / Scatter			477637mE 6269656mN Zone 51 [Unreliable]	W01210





Legend

- Highlighted Area
- Town
- Map Area
- Search Area