

Information Sheet on Ramsar Wetlands (RIS) – 2009-2014 version

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Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX. 22 of the 9th Conference of the Contracting Parties (2005).

1. Name and address of the compiler of this form:

Western Australian Department of Conservation and Land Management (DCLM; now Department of Parks and Wildlife) in 1990. Updated by Roger Jaensch, Wetlands International – Oceania, on behalf of DCLM, in 1998, and by DCLM in 2000 and 2003. Updated by Wetland Research & Management on behalf of Department of Environment and Conservation (now Department of Parks and Wildlife) in August 2007. Updated by Department of Parks and Wildlife in 2014.

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Designation date

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Site Reference Number

All inquiries should be directed to:
Department of Parks and Wildlife
Principal Coordinator, Wetlands Section
17 Dick Perry Avenue
Kensington, WA, 6151
Australia
Tel: +61-8-9219 9000
Email: wetlands@dpaw.wa.gov.au

2. Date this sheet was completed/updated:

July 2014

3. Country:

Australia

4. Name of the Ramsar site:

The precise name of the designated site in one of the three official languages (English, French or Spanish) of the Convention. Alternative names, including in local language(s), should be given in parentheses after the precise name.

Vasse-Wonnerup System.

5. Designation of new Ramsar site or update of existing site:

The Vasse-Wonnerup System Ramsar site was designated on 7 June 1990. The previous RIS was dated 2007.

This RIS is for (tick one box only):

- a) Designation of a new Ramsar site ; or
b) Updated information on an existing Ramsar site

6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area

The Ramsar site boundary and site area are unchanged:

or

If the site boundary has changed:

- i) the boundary has been delineated more accurately ; or
- ii) the boundary has been extended ; or
- iii) the boundary has been restricted**

and/or

If the site area has changed:

- i) the area has been measured more accurately ; or
- ii) the area has been extended ; or
- iii) the area has been reduced**

** **Important note:** If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

The previous boundary was slightly incorrect in some areas and did not completely align with the cadastre (lot boundaries). The revised area of 1,109 hectares is a more accurate GIS re-calculation.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

The nomination RIS described the site as being wetland type F. After the site was extended in 2000, the classification was reviewed and the categories J, N, Ss and Xf were selected, as they more accurately describe the wetland types at site. The development of the 2007 ecological character description confirmed the wetland types.

Following a review of waterbird data by Lane et al. (2007), two additional waterbird species have been added as qualifying against Criterion 6, bringing the total number of species meeting this criterion to four (refer item 14).

7. Map of site:

Refer to Annex III of the *Explanatory Note and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:

- i) a hard copy (required for inclusion of site in the Ramsar List): ;
- ii) an electronic format (e.g. a JPEG or ArcView image) ;
- iii) a GIS file providing geo-referenced site boundary vectors and attribute tables .

b) Describe briefly the type of boundary delineation applied:

e.g. the boundary is the same as an existing protected area (nature reserve, national park, etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

The boundary of the Vasse-Wonnerup System Ramsar site includes part of Crown Reserve 31188 known as Sabina Nature Reserve, the majority of Nature Reserve 41568 and the part of Crown Reserve 40250 known as Tuart Forest National Park west of Tuart Drive Ludlow. Various parcels of Unallocated Crown Land are also included. All road reserves are excluded from the Ramsar site.

The complete details of lots included within the Vasse-Wonnerup System Ramsar site are listed below.

Lot details	Tenure
Lot 5595 on Plan 54431	Unallocated Crown Land
PIN 11906330	Unallocated Crown Land
Vasse Estuary (see table below)	None
PIN 528967	Unallocated Crown Land
PIN 528963	Unallocated Crown Land
PIN 528966	Unallocated Crown Land
PIN 526978	Unallocated Crown Land
PIN 1249529	Unallocated Crown Land
PIN 526992	Unallocated Crown Land
PIN 527032	Unallocated Crown Land
Lot 4646 on Plan 11567 Lot 4564 on Plan 9778	Crown Reserve 31188
Lot 4897 on Plan 17494	Crown Reserve 41568
Lot 4975 on Plan 92197 (west of Tuart Drive, Ludlow)	Crown Reserve 40250 (west of Tuart Drive, Ludlow)

Note: Unallocated Crown Land (UCL) refers to Crown land which is not subject to any interest (aside from native title interests) and which is not reserved or dedicated. A Parcel Identifier Number (PIN) is allocated to areas of UCL that do not have a defined cadastral identifier (e.g. lot number). Boundary descriptions including UCL will be revised as more information is available.

The Vasse Estuary has no defined cadastral identifier or PIN but can be identified by the lots that border the estuary as follows:

PIN 11621128	Lot 4805 on Plan 240253	Lot 94 on Plan 91775	PIN 11491730
Lot 57 on Plan 223220	PIN 528971	PIN 11495443	PIN 1249530
Lot 112 on Plan 220226	PIN 1375180	PIN 528953	Lot 96 on Diagram 30201
Lot 45 on Diagram 30201	PIN 528922	Lot 3002 on Plan 61580	Lot 5025 on Plan 14604
Lot 4897 on Plan 17494	Lot 204 on Plan 65900	Lot 7 on Plan 4065	Lot 500 on Plan 39441
Lot 9001 on Plan 25465	Lot 5205 on Plan 22210	Lot 4564 on Plan 9778	Lot 4646 on Plan 11567
Lot 126 on Plan 23470	Lot 56 on Plan 223219	Lot 55 on Plan 223219	Lot 16 on Plan 228827
PIN 527032	Lot 4975 on Plan 92197	PIN 526992	PIN 1249529
PIN 526978	Lot 40 on Plan 223219	Lot 41 on Plan 223219	Lot 42 on Plan 223219
PIN 526957	Lot 36 on Plan 223219	Lot 35 on Plan 223219	Lot 34 on Plan 223219
Lot 33 on Plan 223219	Lot 32 on Plan 223219	Lot 67 on Plan 223219	PIN 11492485
PIN 526937	Lot 29 on Plan 223219	Lot 28 on Plan 223219	Lot 27 on Plan 223219
PIN 11491731	Lot 95 on Plan 15642	Lot 94 on Plan 91775	

8. Geographical coordinates (latitude/longitude, in degrees and minutes):

Provide the coordinates of the approximate centre of the site and/or the limits of the site. If the site is composed of more than one separate area, provide coordinates for each of these areas.

Latitude: 33° 35' S to 33° 39' S: Longitude: 115° 22' E to 115° 28' E

9. General location:

Include in which part of the country and which large administrative region(s) the site lies and the location of the nearest large town.

The Vasse-Wonnerup System is in the City of Busselton (local government authority) in the state of Western Australia (population approximately 2.24 million in 2011) and is immediately east of the town of Busselton (local government area population of 30,300 in 2011) (Australian Bureau of Statistics, 2013). The Ramsar site as originally nominated in February 1990 consisted of non-freehold wetland (including the Vasse Estuary portion of Reserve 31188) within the boundaries of the Vasse and Wonnerup Estuaries and Wonnerup Inlet, and an adjoining area of non-freehold wetland (formerly part of Wonnerup Estuary) between Wonnerup Estuary and Forrest Beach Road. The Vasse, Sabina, Abba and Ludlow Rivers and The Deadwater were not included in the site. Dryland parts of Sabina Nature Reserve (Reserve 31188) and dryland parts of Unallocated Crown Lands that extended into the estuaries were also not included. In November 2000, the site was extended to include: an additional area of Reserve 31188, which includes a part of the Sabina River; those parts of Tuart Forest National Park (Reserve 40250) that are between the Vasse-Wonnerup System Ramsar site as originally nominated and Tuart Drive, Ludlow. This extension includes a length of the Abba River and the majority of Nature Reserve 41568 along the northern shore of the Vasse Estuary.

10. Elevation: (in metres: average and/or maximum & minimum)

Approximately 0-6 m above mean sea level (Australian Height Datum).

11. Area: (in hectares)

1,109 ha

12. General overview of the site:

Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

The Vasse-Wonnerup System Ramsar site is an extensive, shallow, nutrient-enriched, wetland system with widely varying salinities. Water levels in its two principal components, the Vasse and Wonnerup lagoons (former estuaries), are managed through the use of weirs (flood gates) with the aim of minimising flooding of adjoining lands and largely excluding seawater. The site supports tens of thousands of resident and migrant waterbirds of a wide variety of species including Black-winged Stilt (*Himantopus himantopus*), Red-necked Stint (*Calidris ruficollis*), Red-necked Avocet (*Recurvirostra novaehollandiae*), Australian Shelduck (*Tadorna tadornoides*), Australasian Shoveler (*Anas rhynchos*), and the largest regular breeding colony of Black Swan (*Cygnus atratus*) in south-west Western Australia (please see Appendix 1 for a list of waterbirds the site supports). The site's close proximity to residential, farming and tourism areas presents a range of management issues and opportunities.

13. Ramsar Criteria:

Tick the box under each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11). All Criteria which apply should be ticked.

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|--------------------------|---|--------------------------|---|--------------------------|---|--------------------------|---|-------------------------------------|---|-------------------------------------|---|--------------------------|---|--------------------------|---|--------------------------|
| 1 | • | 2 | • | 3 | • | 4 | • | 5 | • | 6 | • | 7 | • | 8 | • | 9 |
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14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.

The Ramsar site is considered to regularly support 20,000 or more waterbirds. The maximum record was 34,500 waterbirds in December 1998. More recently, on 7 March 2013, 25,000 Banded Stilt (*Cladorhynchus leucocephalus*) were recorded in the Ramsar site (eBird 2014).

Monitoring from 2007 to 2013 was restricted to an annual one day survey under the Birdlife Australia Shorebirds 2020 program, which is conducted across Australia on the same day. These surveys are undertaken at selected locations around the Ramsar site but are not designed to provide maximum bird numbers for the entire site for any one year. As the surveys are part of a national count, they may not occur during the ideal local conditions for waterbirds, and in particular may not coincide with the optimal water levels for peak numbers of waterbirds.

Large numbers of waterbirds have been recorded during these surveys (2/2/2008 - 13,138; 6/2/2010 - 13,146; 4/2/2012 – 15,556 Birdlife Australia Shorebirds 2020 unpublished data 2014). These data represent only a component of the site and it is considered that more intensive surveys covering the whole site during optimal conditions would exceed 20,000 waterbirds. Waterbird species that have been recorded in large numbers at selected locations (not the whole of the site) during the Shorebirds 2020 surveys are listed in the table below.

Common name	Scientific name	National listing (EPBC Act)	28/10/2007	13/1/2008	2/2/2008	6/2/2010	5/2/2011	4/2/2012	10/2/2013
Black Swan	<i>Cygnus atratus</i>		5,104						
Banded Stilt	<i>Cladorhynchus leucocephalus</i>				2,021	2,903			3,312
Australian Shelduck	<i>Tadorna tadornoides</i>							3,626	
Black-winged Stilt	<i>Himantopus himantopus</i>	Marine		1,468	1,785	1,922			1,721
Grey Teal	<i>Anas gracilis</i>			1,990	2,583	3,088		5,136	2,249
Pacific Black Duck	<i>Anas superciliosa</i>							2,756	
Red-necked Stint	<i>Calidris ruficollis</i>	Marine; Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)			1,365				
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>	Marine		1,203		1,010			1,049
Red-capped Plover	<i>Charadrius ruficapillus</i>	Marine					961		

Criterion 6: A wetland should be considered internationally important if it regularly supports one per cent of the individuals in a population of one species or subspecies of waterbird.

Surveys indicate that maximum counts for four species exceed the 1% population thresholds (Lane et al. 1997; Lane et al. 2007; Wetlands International 2012; Birdlife Australia Shorebirds 2020 unpublished data 2014).

Common name	Scientific name	Population	Maximum count	1% threshold
Black-winged Stilt	<i>Himantopus himantopus</i>	South East Asia-Australasia	5,000	1,000
Red-necked Avocet	<i>Recurvirostra</i>	Australia	4,000	1,100

	<i>novaehollandiae</i>			
Australian Shelduck	<i>Tadorna tadornoides</i>	South-west Australia	4,536	1,100
Australasian Shoveler	<i>Anas rhynchotis</i>	South-west Australia	716	250

15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation):

Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:

South West Coast drainage division

b) biogeographic regionalisation scheme (include reference citation):

Commonwealth of Australia (Bureau of Meteorology), 2011, Australian Hydrological Geospatial Fabric

16. Physical features of the site:

Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

The Wonnerup and Vasse Estuaries are no longer true estuaries because inflow of seawater is largely prevented by floodgates installed on their outlet channels. The estuaries now act as compensating basins for water discharging from the Ludlow, Sabina, Abba and Vasse Rivers. When the water level in the estuaries rises above sea level, hydrostatic pressure opens the floodgates and allows water to flow out to Wonnerup Inlet and the sea. When the level drops the gates close, thereby preventing ingress of seawater.

The Vasse-Wonnerup System is shallow; almost all the wetland area has a maximum water depth of less than 1 metre and large areas dry out in late summer. Water in the Vasse-Wonnerup System is fresh in winter and becomes saline in summer due to leakage past the floodgates and since 1988, some seawater being allowed to enter (principally the Vasse Estuary). Groundwater flow might also contribute. Salinity in the Estuaries is generally less than 5 parts per thousand from June to August (due to river inflow), increasing during spring to reach about 15 parts per thousand by December/January, and seawater (35 parts per thousand) by February. In March/April the water in the estuaries can become hypersaline (sometimes exceeding 40 parts per thousand) due to evaporation (Sinclair Knight Merz 2003).

The Vasse-Wonnerup System experiences periods of extremely poor water quality, particularly during summer and autumn, when large phytoplankton blooms (sometimes of toxic cyanophyta) necessitate the erection of public health warning signs (McAlpine et al. 1989, Sinclair Knight Merz 2003). The nutrient enriched conditions in the system fuel a cycle of phytoplankton blooms followed by bloom collapses which deplete dissolved oxygen during the decomposition process, often to critical levels for the aquatic biota. Periods of oxygen depletion exacerbate the water quality problems by increasing the release of further nutrients from the sediment (particularly phosphorous), contributing to further phytoplankton blooms. As the predominant phytoplankton in the system is often nitrogen fixing cyanobacteria, phosphorous is usually the limiting nutrient for phytoplankton growth. A coordinated approach is being undertaken to address the water quality problems in the catchment (see item 27).

The sea level changes during the Holocene resulted in the inundation of Australia's coastal wetlands. The peat sub-soil horizons in these waterbodies are naturally rich in organic material and iron oxides. They are also frequently low in oxygen, due to bacterial decomposition of the abundant organic material. When inundated, sulfate in the seawater mixed with wetland sediments produces large quantities of iron sulfides (e.g. pyrite) under anoxic conditions. Sulfate-reducing bacteria transform the sulfate from seawater into hydrogen sulfide gas (rotten egg gas). The sulfide in the gas then reacts with available iron to form pyrite. If subsequently exposed to air, by either natural or anthropogenic

disturbance, these sulfides oxidise to form sulfuric acid, resulting in acid sulfate soils (ASS) with pH < 4. Potential acid sulphate soils (PASS) are those which contain unoxidised sulfidic materials and generally have a pH > 6. Much of the low-lying coastal plains of the south-west have large areas of ASS or potential acid soils. Most of the Vasse-Wonnerup System Ramsar site is at high risk from ASS (Wetland Research and Management 2007).

The Vasse-Wonnerup System consists of broad expanses of open water (except when dry) with fringing samphire and rushes. In some areas, *Melaleuca* woodlands occur behind the samphire, and eucalypt woodlands are found on higher ground. However, all the area has been severely disturbed at various times in the past and much of it is currently cleared for agriculture.

The climate of the area is Mediterranean with cool, wet winters (June to August) and hot, dry summers (December to February) – weather is determined by eastward moving high and low pressure systems. During winter, rain-bearing cold fronts and strong westerly winds cross the coast and in summer, high pressure systems block the low pressure systems and the rain-bearing fronts are deflected south. Changing weather patterns associated with ‘greenhouse effects’ have led to a persistence of high pressure systems into winter, with a resultant increase in storm activity and intensity in the south-west, but reduced annual rainfall (Jones et al. 2005, Kay et al. 1994).

17. Physical features of the catchment area:

Describe the surface area, general geology and geomorphological features, general soil types, and climate (including climate type).

There are two major physiographic units of the Vasse-Wonnerup catchment; the Blackwood Plateau to the south, where tributary rivers arise, and the Swan Coastal Plain which contains the Ramsar site. On the Swan Coastal Plain, the rivers cross the Abba and Ludlow plains before entering the Vasse-Wonnerup wetlands. The coastal plain soil types are largely the product of sea-level changes over the past 4,000 to 20,000 years. Current sea-levels were reached some 6,000 years ago though there were minor fluctuations as recently as 4,000 years ago (Balla 1994). The soils are thus largely comprised of aeolian and marine deposits of unconsolidated quartz grain sand and calcareous material. These sandy soils are alkaline, have poor nutrient-binding and water-holding capacity but in many areas are prone to waterlogging (V & C Semeniuk Group 1998). They require drainage and the application of fertilisers to establish and maintain agricultural productivity. There are three basic soil-landscape units, all are Pleistocene in age. Much of the Ramsar site is contained within Vasse unit.

The Ramsar site is situated in the Perth Basin, on a narrow, flat plain of marine and alluvial sediments, and is separated from the ocean by a narrow system of low dunes. The urban area of Busselton, including a large residential canal estate, surrounds much of the Vasse Estuary, particularly on the northern side, while some land to the southern side of the site retains remnant Tuart (*Eucalyptus gomphocephalus*) forest vegetation. Within the catchment and less than one kilometre from the wetland there are multiple land uses including mineral sands mining, tree plantations, commercial horticultural activities, agriculture, peri-urban lifestyle lots, residential lots and light industry.

18. Hydrological values:

Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

The Vasse and Wonnerup Estuaries have an important role (artificial) in flood mitigation – protection of agricultural land and built assets.

The site is used as a compensating basin for discharge from four rivers; the Vasse, Abba, Sabina and Ludlow rivers (Environment Australia 2001). Floodgates on the exit channels of the Vasse and Wonnerup estuaries are used to manipulate water levels in the estuaries. Levels are lowered during winter to provide storage capacity for river floodwaters, when high sea levels would otherwise

prevent their discharge. Floodgates prevent storm surges¹ from causing saltwater inundation of low lying coastal lands adjacent to the estuaries and in Busselton township (Lane et al. 1997). This is likely to be of increasing importance given current predictions for increasing storm surges associated with climate change (IPCC 2007). Sea water has overtopped (+1.65 m AHD) the former (pre-2004) floodgate structures on some occasions, mostly associated with cyclones: June 1919 (severe winter storm); +1.94 m in Feb 1937 (unnamed cyclone); +1.79 in April 1978 (cyclone Alby); +1.70 in April 1991 (cyclone Fifi) (Lane et al. 1997).

Like most south-west Western Australian estuaries, geomorphology, long residence time and the high productivity of the Vasse-Wonnerup Estuary prevents nutrients, sediments, pesticides and other pollutants in wastewaters and agricultural run-off from being transported directly to Geographe Bay. The rate and extent of transport from the Vasse-Wonnerup Estuary to the Bay has not been studied.

19. Wetland Types

a) presence:

Circle or underline the applicable codes for the wetland types of the Ramsar "Classification System for Wetland Type" present in the Ramsar site. Descriptions of each wetland type code are provided in Annex I of the *Explanatory Notes & Guidelines*.

Marine/coastal: A • B • C • D • E • F • G • H • I • J • K • Zk(a)

Inland: L • M • N • O • P • Q • R • Sp • Ss • Tp • Ts • U • Va •
Vt • W • Xf • Xp • Y • Zg • Zk(b)

Human-made: 1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9 • Zk(c)

b) dominance:

List the wetland types identified in a) above in order of their dominance (by area) in the Ramsar site, starting with the wetland type with the largest area.

J, N, Ss, Xf

20. General ecological features:

Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

Remnant vegetation of the system is fairly uniform in arrangement (Tingay and Tingay 1980). The samphire belt is dominated by *Sarcocornia blackiana* and *Tecticornia pergranulata*. The rush and sedge zone is dominated by *Juncus kraussii* but *Lepidosperma* cf. *leptostachyum* and *Carex divisa* are also common. The tree zone behind the rushes comprises *Melaleuca raphiophylla*, *M. hamulosa* and *M. cuticularis* in either single-species or mixed stands. *Gahnia trifida* and *Juncus pallidus* occur in the understorey. *Melaleuca* woodlands often give way to open woodlands of *Eucalyptus rudis*. The vegetation of Tuart Forest National Park is dominated by open-forest of mature Tuart (*Eucalyptus gomphocephala*). Tall shrubs and small trees of Western Australian Peppermint (*Agonis flexuosa*) occur as understorey in the forest. There are also some very small areas (< 1ha) of seasonal freshwater *Melaleuca* swamp. *Eucalyptus rudis* trees and some sedges occur along the Sabina and Abba Rivers.

The Tuart Forest National Park and Nature Reserves that were added to the site in 2001 have contributed substantially to the conservation values of the site by providing protected buffer zones for wetlands and some seasonal feeding habitat for waterbirds. Tree hollows in these areas provide important breeding sites for Australian Wood Duck (*Chenonetta jubata*), Australian Shelduck (*Tadorna tadornoides*) and possibly other duck species. Adult ducks have been observed moving their broods from the forest to the wetlands.

¹ Large rises in sea level due to strong on-shore winds and low barometric pressures.

The Vasse-Wonnerup System provides an important coastal habitat for waterbirds (see Appendix 1), 37,446 were counted there in December 1998 (Lane et al. 2007). More than 80 species of waterbird have been recorded in the system (exceeded in Western Australia only at the Swan Canning and Peel Harvey Estuaries), including five darters and cormorants, 13 herons and allies, 11 ducks and allies, seven rails, 30 shorebirds and seven gulls and terns. In addition, four species exceed the 1% population threshold. See Appendix 2 for more details.

Twenty-one waterbird species are known to breed at the site, including the largest regular breeding colony of Black Swans in south-western Australia (see item 22). Waterbird count data are from Royal Australasian Ornithologists Union (now BirdLife Australia) and Western Australian Department of Conservation and Land Management (now Department of Parks and Wildlife) ground and aerial surveys 1981-91, Tingay et al. (1977), Jaensch (1986), Jaensch et al. (1988), Lane (1990, 1997a, 1997b, 2002), Jaensch and Lane (1993), Halse et al. (1990), Lane et al. (1997, 2007).

Comprehensive waterbird surveys of the Ramsar site are difficult as the site is large and many areas are hard to access. Recent monitoring from 2007 to 2013 has been conducted under the Birdlife Australia Shorebirds 2020 program, which comprises an annual one day survey at selected locations around the Ramsar site. These surveys are undertaken as part of a national count, which occurs across Australia at 150 key shorebird areas on the same day. The Shorebirds 2020 program aims to detect national population trends and the causes behind any local, regional and national change.

The surveys at the Vasse-Wonnerup System Ramsar site are conducted with staff from the Department of Parks and Wildlife and volunteers from Birdlife Australia. As the surveys are part of a national count, they may not occur during the ideal local conditions for waterbirds, and in particular may not coincide with the optimal water levels for peak numbers of waterbirds. While total numbers in these counts have not exceeded 20,000 since 2007, large numbers of waterbirds have been recorded (2/2/2008 - 13,138; 6/2/2010 - 13,146; 4/2/2012 - 15,556). These data represent only a component of the site and it is considered that more intensive surveys covering the whole site during optimal conditions would exceed 20,000 waterbirds.

21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14. Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

There are no nationally rare, threatened or endemic wetland plants known at the site. Problematic invasive plants including Bulrush *Typha orientalis* and Arum Lily *Zantedeschia aethiopica* are established in and around the Sabina and Abba Rivers.

22. Noteworthy fauna:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14. Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

The site supports the largest regular breeding colony of Black Swan (*Cygnus atratus*) in south-western Australia. More than 150 pairs of swans nest in most years and breeding is often successful. The system frequently supports >1% of the relevant Ramsar populations of Black-winged Stilt (*Himantopus himantopus*), Red-necked Avocet (*Recurvirostra novaehollandiae*), Australian Shelduck (*Tadorna tadornoides*) and Australasian Shoveler (*Anas rhynchotis*). Another five shorebirds have been recorded in numbers greater than 1% of the SE Asia-Australasia Flyway population in some years: Wood Sandpiper (*Tringa glareola*), Sharp-tailed Sandpiper (*Calidris acuminata*), Long-toed Stint (*C. subminuta*), Curlew Sandpiper (*C. ferruginea*) and Common Greenshank (*Tringa nebularia*) (see item 20). The site's migratory shorebirds are listed under the Japan–Australia Migratory Bird

Agreement (JAMBA), the China–Australia Migratory Bird Agreement (CAMBA), the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA), Convention on the Conservation of Migratory Species of Wild Animals (Bonn) and are specially protected by the Australian Government *Environment Protection and Biodiversity Conservation Act (1999)*.

The Australasian Bittern (*Botaurus poiciloptilus*) and the Australian Painted Snipe (*Rostratula australis*) have been recorded on occasion at the site. Both these species are listed as Rare or Likely to Become Extinct under the Western Australian *Wildlife Conservation Act 1950* and Endangered under the Australian Government *Environment Protection and Biodiversity Conservation Act (1999)*. The native Water Rat (*Hydromys chrysogaster*) has been recorded at the site, in several locations.

Recent surveys of fish fauna within the Ramsar site recorded high densities of relatively few native fish species (Tweedley et al. 2012). Two introduced freshwater fish species Eastern Mosquitofish (*Gambusia holbrooki*) and the Goldfish (*Carassius auratus*) were recorded within the Ramsar site (Tweedley et al. 2012) (see item 27).

Foxes (*Vulpes vulpes*) have been recorded preying on ducks moving their young from the Tuart forest to the wetlands. A management program is underway to reduce the impact (see item 27).

23. Social and cultural values:

a) Describe if the site has any general social and/or cultural values e.g., fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values:

The Ludlow Tuart Forest is of historical interest because it was among the first areas to be gazetted as State Forest in Western Australia, and was the site of the first formal training school for forest managers in the State. Several historic buildings are situated beside the wetland, notably Wonnerup House (National Trust). Timber floodgates were installed on the outlet channels of the Vasse and Wonnerup Estuaries in 1908 and were replaced in 1928. They were again replaced in 2004 with concrete structures. The heritage value of the 1928 structures is recognised, and their construction was documented and photographed prior to their demolition, and parts were saved for inclusion in a proposed interpretive centre (Sinclair Knight Merz 2003). Parts of the wetland are used for summer grazing by cattle.

There are 97 Aboriginal heritage sites listed by the Western Australian Department of Aboriginal Affairs as occurring within the local government region. Sixteen of these are located within or close to the Ramsar site, including the Wonnerup Scarred/Shield trees, Massacre site and Corroboree Ground (Centre for Cultural Research 1997, Western Australian Planning Commission 2005). The general location of the Aboriginal heritage sites can be viewed via the WA Atlas at:

<https://www2.landgate.wa.gov.au>

The Sabina and Abba Rivers in their entirety are listed as important mythological Aboriginal heritage sites associated with the Waugal and specially protected by the *Western Australian Aboriginal Heritage Act (1972)*. All the river systems feeding into the Ramsar site are registered as Aboriginal Sites of Significance by the Western Australian Department of Aboriginal Affairs. The sites include the rivers and their banks, as well as a few specific spot locations for other Aboriginal cultural values. These cultural values are linked to the maintenance of water quality and ecological connectivity of the Ramsar site to the wider regional environment.

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning?

If Yes, tick the box and describe this importance under one or more of the following categories:

- i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:
- ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:
- iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:
- iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

The Busselton-Wonnerup area is relatively rich in archaeological sites containing around 21% of all known artefact assemblages in the Busselton-Narrogin-Walpole Region². Of these, the most frequent locations are around estuaries, rivers, wetlands and coastal dunes. Prior to European contact, coastal lake chains including the Vasse-Wonnerup Estuary were an important source of food for Aboriginal people, particularly over the summer months. O'Connor et al. (1995) stated that the 'region's (Busselton-Narrogin-Walpole) waterways were the main focus of Aboriginal traditional life from the viewpoint of food and drink, living areas and highways along which seasonal migrations occurred'.

The Wardandi Noongar are the traditional custodians of lands bounded by Capel, Nannup and Cape Leeuwin, including the Busselton-Wonnerup area. The coastal wetlands and Geographe Bay are of great social, cultural and spiritual importance to the Wardandi (Wetland Research and Management 2007). Historically, the wetlands, estuary and bay were a major food source for local peoples. The Wardandi built fish traps (mungas) of stakes at the entrance to Wonnerup Inlet. Other food resources included waterfowl, eggs, long-necked turtles, frogs, crayfish and sedge roots. The foreshore and adjacent forest were sites of seasonal ceremonial and social gatherings as evidenced by the Coroboree Ground and semi-circular earthwork or 'religious grove' described by Péron during the 1801 Baudin expedition.

The Wardandi traditionally buried their dead in the coastal dunes between the Vasse-Wonnerup Estuary and Geographe Bay (Wetland Research and Management 2007). Skeletal remains have been discovered eroding from sand dunes or following disturbance by earthworks for housing and infrastructure. Ethnographic and archaeological information suggests two large burial grounds existed in the area, however to date, only isolated single internments have been discovered (Wetland Research and Management 2007).

The area is also infamous for the massacre of at least nine Wardandi people by European settlers at Wonnerup in February 1841. The massacre occurred to the north of the Ramsar site, on the north side of the Capel River. The Wonnerup area is the second site in Busselton where settlers met Noongar people. It is named after an Aboriginal term meaning '(Aboriginal) woman's digging stick' and was traditionally a place of women's gathering (Wetland Research and Management 2007).

24. Land tenure/ownership:

- a) within the Ramsar site:

² The Busselton-Narrogin-Walpole region covers an area of ca. 35,000 km² bounded by the towns of Capel, Busselton, Dunsborough, Augusta, Walpole, Kojonup, Katanning, Nyabing, Harrismith, Narrogin, Darkan, Boyup Brook, Balingup as described by O'Connor et al. 1995.

The site as originally nominated included (but was not limited to) the Vasse Estuary wetland portion of Sabina Nature Reserve (Res 31188); an area of Crown leasehold land at the north-eastern end of the site, and wetland portions of some Unallocated Crown Lands. Land added to the site in 2001 comprised Nature Reserve (an additional area of Sabina Nature Reserve 31188 and the majority of Nature Reserve 41568) and National Park (part of Tuart Forest National Park Reserve 40250). The Nature Reserves and National Park are vested in the Conservation Commission of Western Australia (appointed by the State Government). The purpose of Reserves 31188 and 41568 is 'Conservation of Flora and Fauna' and the purpose of Reserve 40250 is 'National Park'.

b) in the surrounding area:

Surrounding areas include freehold (privately owned) land, Unallocated Crown Land and Crown Reserves for purposes other than conservation.

25. Current land (including water) use:

a) within the Ramsar site:

The principal land use at the site is nature conservation and education (see item 28). The site also plays a vital role in flood protection for the town of Busselton.

b) in the surroundings/catchment:

The main settlement of the town of Busselton exists on the west boundary of the Ramsar site. A major residential canal estate is being developed on the northern side of Vasse Estuary and there are residential subdivisions on the southern side. The remainder of the Vasse Estuary and most of the Wonnerup Estuary is surrounded by farmland used principally for cattle grazing and potato cropping (Wonnerup Estuary). There is little recreational use of the wetlands. Information and maps on the land uses in the catchment can be found in *Vasse Wonnerup Wetlands and Geographe Bay water quality improvement plan* (Department of Water 2010, p. 10 www.water.wa.gov.au).

26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

a) within the Ramsar site:

Past management of water levels in the system has been largely satisfactory for waterbirds.

Excessive algal blooms in the lower estuary channels have at times resulted in sudden, mass fish deaths, mostly during the summer period. The principal cause of the deaths is thought to be temporary declines in dissolved oxygen concentrations due to night-time respiration of algal blooms (Lane et al. 1997). A coordinated approach is being undertaken to address this problem (see item 27).

The replacement timber floodgates which had been in operation since 1928, were themselves replaced in 2004. The new reinforced concrete floodgates were constructed within about 20 metres of previous positions. To ensure that construction did not impact on the site's ecological character, an environmental management plan was prepared (Sinclair Knight Merz 2003) and implemented.

b) in the surrounding area:

Urban development has continued to expand in the immediate vicinity of the site and there is continual pressure to allow land developments that may impact the site (Environmental Protection Authority 1999, 2000). New residential subdivisions have been approved near the north western boundary of the Wonnerup Estuary resulting in the ceding of approximately 70 hectares of fringing samphire and pasture grass communities to be added to the formal conservation estate and provide a buffer against the development.

A titanium mineral mine located approximately 1.8 km east of the northern end of Wonnerup Estuary in a section of State Forest adjoining Tuart Forest National Park has been finalised and rehabilitation has been completed. A new mine has commenced in former agricultural land approximately 1.2 km south of the southern boundary of the Vasse Estuary.

27. Conservation measures taken:

a) List national and/or international category and legal status of protected areas, including boundary relationships with the Ramsar site:

In particular, if the site is partly or wholly a World Heritage Site and/or a UNESCO Biosphere Reserve, please give the names of the site under these designations.

b) If appropriate, list the IUCN (1994) protected areas category/ies which apply to the site (tick the box or boxes as appropriate):

Ia ; Ib ; II ; III ; IV ; V ; VI

c) Does an officially approved management plan exist; and is it being implemented?:

No management plan or interim management guidelines currently exist for Reserves 41568 and 31188. A draft management plan for Tuart Forest National Park (see item 26) was released for public comment in 2011 and is awaiting finalisation (Department of Environment and Conservation 2011).

A conservation strategy has been prepared for the Busselton wetlands, which includes the Ramsar site (Western Australian Planning Commission 2005), the purpose of which is to guide sustainable land use and wise management of the biodiversity and environmental values of the Busselton wetlands and was a condition of approval for the canal development on the confluence of the Vasse and Wonnerup estuaries (Port Geographe). The Strategy was designed to guide the sustainable management of urban development in the areas surrounding the Ramsar site, while indicating other pressures on the wetlands system from agricultural land uses, it was not designed to meet the holistic management of the components, processes and ecosystem services of the Ramsar site.

A Geographe Catchment Management Strategy (Geographe Catchment Council 2008) was prepared as a broad guide to strategic natural resource management planning for community and local and State government stakeholders across the catchment to Geographe Bay.

d) Describe any other current management practices:

In 1997, community concern about sudden, mass fish deaths, death of fringing vegetation and loss of pasture production on adjoining land led to the formation of the Vasse Estuary Technical Working Group, which has reviewed the history of the management of the estuaries, and made a number of recommendations to reduce mass fish deaths in an environmentally acceptable manner (Lane et al. 1997). To reduce the incidence and severity of fish deaths, several measures have been used in the past: artificial openings of the Wonnerup Inlet sand bar each summer, increased harvesting of fish by professional netters, and partial openings of the flood gates to allow fish to escape and to raise the water level of Vasse Estuary. Since 1998, daily visual monitoring of fish behaviour and water quality in the lower reaches of the system has occurred during the spring and summer period to anticipate and prevent mass fish deaths (White 1999; Elscot 2000). The flood gates were upgraded in 2004 and are now remotely controlled by telemetry.

A monitoring program that aims to detect changes in the distribution and health of fringing vegetation of the Vasse Estuary, relative to the water regime and salinity (which is affected by floodgate openings), has been developed and permanent transect areas have been established (Froend 1999; Froend et al. 2000). Surveys of macrophytes, macroinvertebrates, nutrients, sediments and fish within

both estuaries have been undertaken by Murdoch University (e.g. Wilson et al. 2007, Tweedley et al. 2012).

Land Conservation District Committees and individual landowners are taking action to reduce nutrient discharge from farmland in the catchment. Action Plans have been prepared to guide landowners undertaking revegetation and rehabilitation along the tributary Vasse, Abba, Sabina and Ludlow rivers (GeoCatch 2000, 2002). Guidelines for the management of farmland adjacent to the wetlands have also been developed (Agriculture WA 2002).

The Department of Water have developed the *Vasse Wonnerup Wetlands and Geographe Bay water quality improvement plan* (Department of Water 2010), which provides nutrient targets based on water quality modelling. Management measures have been recommended in the plan in order to meet the nitrogen and phosphorus targets, and an implementation strategy has been detailed (Department of Water 2010). In February 2014, the Department of Water upgraded water monitoring equipment (data loggers) in the Ramsar site to improve water quality monitoring and provide earlier detection of the potential for algal blooms and fish deaths.

In January 2014 an independent review of water management within the Geographe Catchment was released for discussion (Water Science Pty Ltd 2014). The review focused on the management of the Ramsar site, water quality management within the catchment contributing to Geographe Bay, and water quality management of local waterways such as Lower Vasse River, Vasse Diversion Drain and Toby Inlet. Importantly, the review provides two future management options with an estimate of funding requirements.

Control of foxes (*Vulpes vulpes*) is undertaken regularly by monthly baiting in Tuart Forest National Park to reduce fox predation on ducks that nest in the Tuart forest and walk their young to the wetlands. A program has been established to control the spread of Arum Lily (*Zantedeschia aethiopica*). During 2012 and 2013, Murdoch University were funded by the Australian Government to undertake a project controlling introduced fish and crayfish in the Ramsar site and upstream waterways.

Restoration of degraded fringing vegetation occurring in the Tuart Forest National Park commenced in 2006 and has continued annually. To date, approximately 40 hectares have been prepared and planted with a mixture of sedges, understorey and overstorey elements. Another 6 hectares are scheduled for completion in the next two years. The aim is to increase the vegetative cover available to breeding waterbirds who walk their young from nest sites to the wetland waterbodies and restore crucial habitat elements such as fringing *Melaleuca* thickets and roosting trees such as along the Abba River. The project will expand to encompass the Sabina Nature Reserve in 2014.

28. Conservation measures proposed but not yet implemented:

e.g. management plan in preparation; official proposal as a legally protected area, etc.

A conservation strategy has been prepared for the Busselton wetlands, which includes the Ramsar site (Western Australian Planning Commission 2005). There are plans to reserve further areas adjacent to the site. A draft management plan for Tuart Forest National Park has been prepared (Department of Environment and Conservation 2011).

DairyCatch (i.e. Western Dairy, GeoCatch and the Western Australian Department of Agriculture and Food) provided funding support for dairy farmers to develop and implement best practice effluent plans in 2006. Effluent plans will assist landholders to significantly reduce the quantity of nutrients and bacteria that drain from their property into local waterways and receiving water bodies. Four 'Monitor Farms' have been developed to measure costs and benefits of best practice.

29. Current scientific research and facilities:

e.g., details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

The Department of Water is monitoring water quality in the lowest reaches of the estuaries. Water information is available from the Water Information Reporting database at www.water.wa.gov.au. There are no research facilities. See also item 27.

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:

e.g. visitors' centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

A bird hide at Malbup Creek has been upgraded and a self-guided walk-trail commencing from Layman Picnic Area runs parallel to Malbup Creek and partially along the lower reaches of the Abba River within the Tuart Forest National Park. Interpretive signage located at the Layman Picnic Area provides information on the extent and importance of the wetlands while interpretive signs describe the ecology of the rare Western Ringtail Possum *Pseudocheirus occidentalis*, which is present at the site. Pamphlets describing the birdlife of the estuaries have been prepared (Lane 1997a, 1997b).

A school-based education program, led by the Western Australian Department of Parks and Wildlife, exploring – among other things – the forest/wetland interface, has been in place since 1994. In the past, the Department has also conducted waterbird identification and 'Frog Watch' activities at the site. As part of an introduced fish control project undertaken by Murdoch University (2012-2013), an information leaflet was distributed to the community providing advice on the identification of introduced fish species and how to respond if introduced fish are found.

31. Current recreation and tourism:

State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

The site is used for low-impact, nature-based recreation activities, predominantly bird watching. Wonnerup Inlet is a popular recreational fishing location. See also item 30.

32. Jurisdiction:

Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept of Agriculture/Dept. of Environment, etc.

Territorial: The State Government of Western Australia.

Functional: The Conservation Commission (vesting) and the Western Australian Department of Parks and Wildlife (management on behalf of the Conservation Commission).

33. Management authority:

Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

The South West Region Office (Bunbury) supported by the Blackwood District (Busselton) of the Western Australian Department of Parks and Wildlife.

34. Bibliographical references:

Scientific/technical references only. If biogeographic regionalisation scheme applied (see 15 above), list full reference citation for the scheme.

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Appendix 1: Waterbirds supported by the Vasse-Wonnerup Ramsar site (adapted from Wetland Research and Management 2007).

Wetland types within Vasse-Wonnerup System Ramsar Site (adapted from Wetland Research and Management 2007):

i = Seasonal / brackish saline lagoons,

ii = Estuarine mud flats,

iii = Freshwater / brackish deltas (mouths of the Ludlow, Abba & Sabina rivers),

iv = Freshwater swamps and channels of tributary streams (lower reaches of the Abba & Sabina rivers).

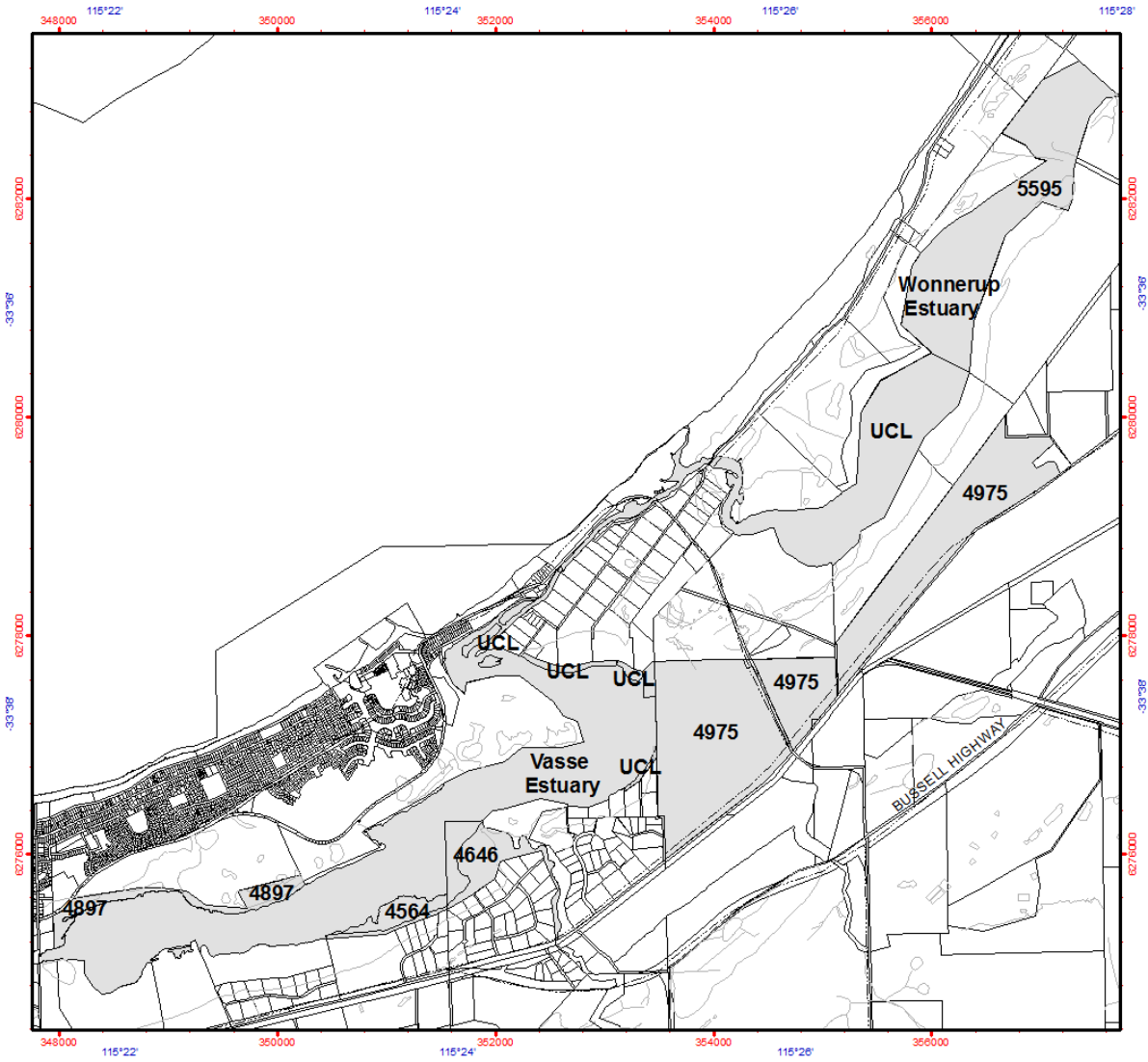
Common name	Scientific name	*Where found at site			
		i	ii	iii	iv
Blue-billed duck	<i>Oxyura australis</i>	✓			
Musk duck	<i>Biziura lobata</i>	✓			
Black swan	<i>Cygnus atratus</i>	✓		✓	
Australian shelduck	<i>Tadorna tadornoides</i>	✓	✓	✓	
Australasian wood duck	<i>Chenonetta jubata</i>				✓
Pacific black duck	<i>Anas superciliosa</i>	✓		✓	✓
Australasian shoveler	<i>Anas rhynchotis</i>	✓		✓	
Grey teal	<i>Anas gracilis</i>	✓		✓	✓
Chestnut teal	<i>Anas castanea</i>	✓		✓	
Pink-eared duck	<i>Malacorhynchus membranaceus</i>	✓		✓	
Hardhead	<i>Aythya australis</i>	✓		✓	
Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>	✓			
Darter	<i>Anhinga melanogaster</i>	✓		✓	✓
Little pied cormorant	<i>Phalacrocorax melanoleucos</i>	✓		✓	✓
Pied cormorant	<i>Phalacrocorax varius</i>	✓		✓	
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	✓		✓	✓
Great cormorant	<i>Phalacrocorax carbo</i>	✓		✓	✓
Australian pelican	<i>Pelecanus conspicillatus</i>	✓		✓	
White-faced heron	<i>Egretta novaehollandiae</i>	✓		✓	✓
Little egret	<i>Egretta garzetta</i>	✓		✓	✓
Eastern reef egret	<i>Egretta sacra</i>	✓			
White-necked heron	<i>Ardea pacifica</i>	✓		✓	✓
Great egret	<i>Casmerodius albus</i>	✓		✓	✓
Nankeen night heron	<i>Nycticorax caledonicus</i>	✓		✓	✓
Australasian bittern	<i>Botaurus poiciloptilus</i>	✓		✓	✓
Grey heron	<i>Ardea cinerea</i>				
Glossy ibis	<i>Plegadis falcinellus</i>	✓		✓	✓
Australian white ibis	<i>Threskiornis molucca</i>	✓		✓	✓
Straw-necked ibis	<i>Threskiornis spinicollis</i>	✓		✓	✓
Royal spoonbill	<i>Platalea regia</i>	✓		✓	✓
Yellow-billed spoonbill	<i>Platalea flavipes</i>	✓		✓	✓
Osprey	<i>Pandion haliaetus</i>	✓		✓	✓
Whistling kite	<i>Haliastur sphenurus</i>	✓	✓	✓	✓
White-bellied sea eagle	<i>Haliaeetus leucogaster</i>	✓		✓	✓
Swamp harrier	<i>Circus approximans</i>	✓		✓	✓
Buff-banded rail	<i>Gallirallus phillipensis</i>	✓		✓	✓
Australian spotted crake	<i>Porzana fluminea</i>	✓		✓	✓
Spotless crake	<i>Porzana tabuensis</i>	✓		✓	✓

Common name	Scientific name	*Where found at site			
		i	ii	iii	iv
Purple swamphen	<i>Porphyrio porphyrio</i>	✓		✓	✓
Dusky moorhen	<i>Gallinula tenebrosa</i>	✓		✓	✓
Black-tailed native hen	<i>Gallinula ventralis</i>	✓		✓	✓
Eurasian coot	<i>Fulica atra</i>	✓		✓	✓
Pin-tailed snipe	<i>Capella stenura</i>			✓	
Black-tailed godwit	<i>Limosa limosa</i>		✓		
Bar-tailed godwit	<i>Limosa lapponica</i>		✓		
Whimbrel	<i>Numenius phaeopus</i>		✓		
Marsh sandpiper	<i>Tringa stagnatilis</i>		✓		
Common greenshank	<i>Tringa nebularia</i>		✓		
Wood sandpiper	<i>Tringa glareola</i>		✓		
Terek sandpiper	<i>Xenus cinereus</i>		✓		
Common sandpiper	<i>Actitis hypoleucos</i>		✓		
Grey-tailed tattler	<i>Heteroscelis brevipes</i>		✓		
Great knot	<i>Calidris tenuirostris</i>		✓		
Red knot	<i>Calidris canutus</i>		✓		
Red-necked stint	<i>Calidris ruficollis</i>		✓		
Long-toed stint	<i>Calidris subminuta</i>		✓		
Pectoral sandpiper	<i>Calidris melanotos</i>		✓		
Sharp-tailed sandpiper	<i>Calidris acuminata</i>		✓		
Curlew sandpiper	<i>Calidris ferruginea</i>		✓		
Ruff	<i>Philomachus pugnax</i>		✓		
Painted snipe	<i>Rostratula benghalensis australis</i>			✓	
Pied oystercatcher	<i>Haematopus longirostris</i>		✓		
Black-winged stilt	<i>Himantopus himantopus</i>		✓		
Banded stilt	<i>Cladorhynchus leucocephalus</i>	✓	✓		
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>		✓		
Pacific golden plover	<i>Pluvialis fulva</i>		✓		
Grey plover	<i>Pluvialis squatarola</i>		✓		
Red-capped plover	<i>Charadrius ruficapillus</i>		✓		
Greater sand plover	<i>Charadrius leschenaultii</i>		✓		
Black-fronted dotterel	<i>Euseyornis melanops</i>		✓		
Red-kneed dotterel	<i>Erythrogonys cinctus</i>		✓		
Banded lapwing	<i>Vanellus tricolor</i>	✓			
Silver gull	<i>Larus novaehollandiae</i>	✓	✓	✓	✓
Caspian tern	<i>Hydropogone tschegrava</i>	✓		✓	
Crested tern	<i>Sterna bergii</i>	✓		✓	
Fairy tern	<i>Sterna nereis</i>	✓		✓	
Gull-billed tern	<i>Sterna nilotica</i>	✓		✓	
Whiskered tern	<i>Chlidonias hybridus</i>	✓		✓	
White-winged black tern	<i>Chlidonias leucopterus</i>	✓		✓	
White-fronted chat	<i>Ephthianura albifrons</i>	✓			
Welcome swallow	<i>Hirundo neoxena</i>	✓	✓	✓	
Tree martin	<i>Hirundo nigricans</i>	✓	✓	✓	
Clamorous reed-warbler	<i>Acrocephalus stentoreus</i>	✓			
Little grassbird	<i>Megalurus gramineus</i>	✓			

Appendix 2: Maximum bird counts at Vasse-Wonnerup System Ramsar site.

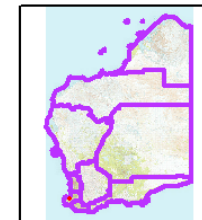
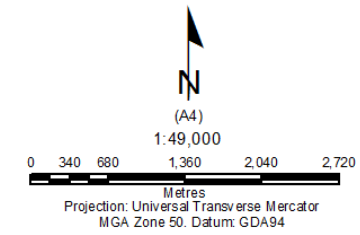
Common name	Scientific name	Maximum count	National listing
Banded Stilt	<i>Cladorhynchus leucocephalus</i>	25,000	
Grey Teal	<i>Anas gracilis</i>	14,000	
Pacific Black Duck	<i>Anas superciliosa</i>	4,200	
Black Swan	<i>Cygnus atratus</i>	5,104	
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	2,300	Marine, Bonn, CAMBA, JAMBA, ROKAMBA
Curlew Sandpiper	<i>Calidris ferruginea</i>	1,200	Marine, Bonn, CAMBA, JAMBA, ROKAMBA
Wood Sandpiper	<i>Tringa glareola</i>	72	Marine, Bonn, CAMBA, JAMBA, ROKAMBA
Long-toed Stint	<i>Calidris subminuta</i>	24	Marine, Bonn, CAMBA, JAMBA, ROKAMBA
Common Greenshank	<i>Tringa nebularia</i>	300	Marine, Bonn, CAMBA, JAMBA, ROKAMBA
Australian Pelican	<i>Pelecanus conspicillatus</i>	750	Marine
Great Egret	<i>Casmerodius alba</i>	237	
Yellow-billed Spoonbill	<i>Platalea flavipes</i>	151	
Eurasian Coot	<i>Fulica atra</i>	4,000	
White-faced Heron	<i>Egretta novaehollandiae</i>	379	
Whiskered Tern	<i>Chlidonias hybrida</i>	180	Marine
White-winged Tern	<i>Chlidonias leucoptera</i>	70	Marine, Bonn, CAMBA, JAMBA, ROKAMBA

Appendix 3: Map of the Vasse-Wonnerup System Ramsar site



Legend

- Road
- Hydrography
- Cadastre (Land Parcels)
- Ramsar site



Produced by the
Department of
Parks and Wildlife



Produced at 2:42pm, on April 28, 2014

Gridline shown at 2 minutes intervals
Grid shown at 2000 metre intervals

The Dept of Parks and Wildlife does not guarantee that this map is without fault of any kind and disclaims all liability for any errors, omissions or other consequences which may arise from relying on any information depicted.

Roads and tracks on land managed by DPW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.

If applicable this map is based on information provided by and with the permission of the Western Australian Land Information Authority (Landgate) (2013)