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ENVIRONMENTAL MANAGEMENT CONSULTANTS





ENVIRONMENTAL ASSESSMENT

Pleasant Grove Foreshore

WARD POINT



Ward Point
Pleasant
Grove
PEEL

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1.0 INTRODUCTION

1.1 Background

The study area in its entirety is described as Ward Point, Mandurah and covers an area of approximately 12.5 ha. Figure 1 depicts the location of the site.

Several development scenarios have been proposed for the area, the latest of which proposes the development of two residential areas comprising approximately 2.38 ha of land abutting the western site boundary.

This latest proposal is the subject of Amendment No. 17 to the City of Mandurah Town Planning Scheme No. 3, which was initiated by the City of Mandurah and referred to the Environmental Protection Authority under Section 48 of the Environmental Protection Act 1986. The EPA determined that formal assessment was not required and provided informal advice.

Under the terms of Section 3(1) (as amended) of the *Environmental Protection Act 1986*, the amendment is therefore deemed to be an assessed scheme. Development which accords with the scheme (i.e. residential development) may be approved by the planning authority without further reference to the EPA.

Amendment No. 17 has not yet been endorsed by the WA Planning Commission, which has previously advised of its intention to acquire the land for reservation in Regional Open Space as part of the Peel Regional Park, and through the publication of the draft Peel Region Scheme.

The land is now subject to a valuation for the purposes of determining the amount of compensation payable to the owner. To this end, it is necessary to establish a case for the highest and best use to which the land could practicably have been put had it not been acquired by the government.

1.2 Purpose of Report

This document addresses the environmental factors which influence the development potential of the site in terms of its highest and best use.

The document commences with a review of the sites physical and biological characteristics including a description of relevant hydrological characteristics of the Peel Inlet, which is directly adjacent to the site, on its eastern margin.

The document then addresses the effect on development potential of environmental constraints which may be identified by the application of preliminary guidelines for environment and planning published by the EPA.

This is followed by a more detailed analysis of individual elements of the sites environmental resources which emerge from the application of EPA guidelines leading to further conclusions regarding development potential.

Reference to previous EPA advice on development proposals for the Pleasant Grove project to the west of the present site, leads to the conclusion that the consideration of potential land uses within the site should be restricted to residential uses and associated services and including only ancillary uses which do not involve significant clearing of remnant indigenous vegetation or significant additional nutrient application.

1.3 Location

The study area measures approximately 12.5ha, with its eastern edges bounded by the Peel Inlet (Figure 1). It is located approximately 74km south of the Perth city centre, on the western side of the Peel Inlet north of the Dawesville Channel.

2.0 EXISTING ENVIRONMENT

2.1 Topography and Landforms

Topographic contours for the site are presented on Figure 1 as an overlay on an orthophoto at scale 1:2000.

The site is highest near its central western portion and falls in elevation from approximately 1.6 m AHD in the west, to 1.1mAHD in the middle, to 0.6mAHD towards the eastern boundaries, near the estuary margins.

Regional mapping of landform types at scale 1;250,000 published by Churchward and McArthur (1980) shows that the site consists of the Cottesloe landform-soil type, which is described as a low hilly landscape with shallow brown sand over limestone.

At a more detailed level, the sites landforms may be described as sand-plain in its interior merging towards the estuary with low sandy flats and low, gently undulating, shore-parallel beach ridges with intervening shallow swales

2.2 Soil Types and Land Capability

Land Capability mapping by the Department of Agriculture (Wells, 1989) describes the site as comprising soils types of the Spearwood Dune and Plain System and the Vasse Estuarine and Lagoonal System, as shown on Figure 2.

Figure 2 shows that Spearwood unit S4b and Vasse units V3and V4 occur within the site. These units are described as;

S4b – Flat to gently undulating sand plain with shallow to moderately deep siliceous yellow brown and grey brown sands with minor limestone outcrop.

V3 – Sand flats similar to V2 (Samphire covered sand and mud flats marginally higher than V1 and frequently inundated. Soils are deep alkaline alluvial sands and clayey sands) but marginally higher and commonly supporting stands of *Melaleuca* spp.

V4 – Low level storm beach ridges and terraces with shallow to moderately deep uniform alkaline black sandy loams to loams overlying unconsolidated shell beds or clayey marl. Minor limestone outcrop present.

The suitability of these land capability mapping units for land uses associated with urban development is described in Table 2.1.

Table 2.1
Land Capability

Land Unit	Capability for House and Road Construction	Capability for On-site Effluent Disposal
S4b	High	Fair (p)
V3	Very Low (f,i)	Very Low (o,f,i,s)
V4	Low (f)	Very Low (o)

Limiting Factors:

f	Flooding risk
i	Waterlogging or inundation risk
o	Water pollution risk by overland flow
p	Microbial purification ability
s	Water pollution risk – by subsurface drainage
y	Salinity risk

The land capability mapping data and land unit analysis presented in Wells (1989) lead to the conclusion that the Spearwood units have high capability for development whereas the Vasse units have low to very low capability due to flooding, waterlogging, salinity and water pollution risks.

2.3 Hydrology

2.3.1 Surface Water

The site is located directly adjacent to Peel Inlet which is a major estuarine system. Due to the low slopes and highly porous soils, there are no naturally occurring surface drainage lines within the site and no evidence of permanent surface water.

Under 25 year and 100 year recurrence interval flood conditions, high water levels in Peel Inlet can cause surface water entry to the site. Figure 3 shows the projected extent

of inundation predicted for 25 year and 100 year floods. Further discussion of Peel Inlet water level factors is given in sections 2.3.3 to 2.3.7.

As described in section 2.4.2, there are three low lying areas within the site where the topography and vegetation types suggest that shallow surface water may be present intermittently during the wettest months of the year, particularly following extended heavy rainfall periods.

2.3.2 Groundwater

There is an unconfined aquifer developed in the sediments of the Spearwood landform which is hydraulically connected to the Vasse landform and Peel inlet.

It is inferred from local knowledge and published literature that the superficial aquifer consists of a thin (3-5m) fresh water lens overlying brackish water of probable estuarine origin. The fresh water lens corresponds generally to the superficial sands while the brackish water occupies the underlying limestone.

Due to the site's location on a narrow isthmus between the Peel Inlet and the ocean, there is very little regional throughflow and the fresh groundwater is maintained largely by direct rainfall recharge.

The groundwater level is determined by rainfall, evapotranspiration, discharge to the estuary and tidal influence. The groundwater may be exposed at the surface in the three low lying areas noted in Section 2.3.1, during wet winter months.

No historic groundwater level information for the superficial aquifer is available. Soil auger investigations during October 2002 at 9 locations within the site showed that the water table is located between 0.7m to 1.4m below ground surface level.

The distribution and types of vegetation within the site indicate that maximum groundwater levels may reach higher levels than those measured in October 2002, during the highest rainfall months during winter, especially when higher tidal water levels in Peel Inlet occur. Minimum groundwater levels are likely to be slightly lower than those measured in October, with a January or February minimum inferred.

Appendix A presents details of groundwater levels and soil auger sites.

The site is located within the Falcon sub-area of the South West Coastal groundwater area (SWCGA). Groundwater abstraction in the area is controlled by the Water & Rivers Commission, with licences being required for all private and municipal bores.

2.3.3 Tidal Regimes

A review of previous published studies of water levels in the Peel-Harvey Estuary and calculations of wind wave generation and run-up has been conducted.

Table 2.2 summarises the average tidal levels after the construction of the Dawesville Channel. The data show that the Dawesville Channel has increased the average tidal range in Peel Inlet to 0.28m, which is approximately half of the ocean tidal range.

Table 2.2
Astronomical and Meteorological Tides

LOCATION	WATER LEVEL		
	MHHW (mAHD)	MLLW (mAHD)	Source
Ocean	+ 0.24m	- 0.26m	DMH Chart 307
Peel Inlet (Post – Dawesville Channel)	+ 0.135m	- 0.14m	DMH Report D10/92

Data collected by Lewis (1990) near Yunderup Canals indicate that meteorological conditions can change mean water levels in the inlet/Estuary by at least 0.5m over 5 – 7 days.

DMH Report No. D10/92 also presents estimated maximum and minimum water levels after construction of the Dawesville Channel. These levels are described in Table 2.3

Table 2.3
Estimated Water Level Post – Dawesville Channel

LOCATION	WATER LEVEL	
	Maximum (mAHD)	Minimum (mAHD)
Peel Inlet (Post-Dawesville Channel	+ 0.64m	- 0.48m

These maximum and minimum levels are consistent with the variations observed by Lewis (1990).

2.3.4 Flood Events

The impacts of flooding of the Serpentine, Murray and Harvey Rivers have been moderated by the Dawesville Channel.

DMH Report No D10/92 provides predicted water levels for the 1 in 25 year and 1 in 100 year flood events as described in Table 2.4.

The modelling work indicated that flood levels will now recede to tidal levels within five days, compared to 10-14 days pre-Dawesville Channel.

Table 2.4
Predicted Water Levels

LOCATION	WATER LEVEL (mAHD)	
	1 in 25 years	1 in 100 years
Peel Inlet (Post-Dawesville Channel)	+ 0.75m	+ 1.12m

Figure 3 interprets inundation areas for the site based on water level data for Peel Inlet and interpolated site contours.

2.3.5 Storm Surge Effects

The Dawesville Channel will allow oceanic storm surges to be more readily transmitted to the Estuary. DMH Report No D374/96 provides predicted combined tide and storm surge water levels in the Peel-Harvey Estuary of +1.15m on the basis of 1 in 100 year ocean water levels.

2.3.6 Greenhouse Effects

An allowance for sea level rise, one of the Greenhouse effects, is included in the design water level for the Ward Point Area. Guidelines for the design of coastal engineering projects with respect to Greenhouse effects recommend an allowance for mean sea level rise of +0.18m and +0.30m by the years 2030 and 2050 respectively (The Institution of

Engineers, Australia, 1991). These guidelines are currently incorporated into designs for coastal projects. However, more recent modelling by Wrigley and Raper (1992) provided revised best guess scenarios indicating a rise of +0.14m and +0.22m for the years 2030 and 2050 respectively.

2.3.7 Design Water Levels

The combination of the 1 in 100 year flood event with the strong and persistent wind conditions required to generate a set-up of +0.6m would produce an event of significantly greater return period than 1 in 100 years.

Selection of a 1 in 100 year design still water level involves consideration of the storm surge, flood and wind set-up events such that the combined probability of occurrence is 1 in 100 years.

Design water levels estimated for Peel Inlet (post-Dawesville Channel) by the Water Authority (1994) are shown in Table 2.5.

Table 2.5
Design Water Levels
(Water Authority, 1994)

LOCATION	100 YEAR STORM SURGES (S) (m)	WIND SET-UP (W) (m)	DESIGN WATER + W (mAHD)
Peel Inlet (Post-Dawesville Channel)	+1.15	+0.45	+1.6

2.3.8 On Site Effluent Disposal Capacity

Of the Land Capability Units recognised for the site, the Spearwood unit S4b shows fair capability for Effluent Disposal capacity (Figure 2).

A general 100 horizontal metre setback from the Peel Inlet is required by the City of Mandurah for conventional on-site effluent disposal systems (Figure 3).

At distances less than 100m from Peel Inlet, on-site effluent systems with nutrient removal capability must be utilised.

On site effluent disposal in locations less than 50m from Peel Inlet is not normally permitted under EPA or City of Mandurah guidelines for effluent disposal.

In order to meet both minimum ground levels for building and water table separation for effluent disposal systems, it is likely that areas proposed for development would need to be filled.

2.3.9 Sewerage

Existing sewer locations that may be utilised for connecting the site to reticulated sewerage are located both north and south-west of the site (Figure 4).

A sewer gravity main is located south-west of the site, in Signet Court, and provides an option for discharge to a pressure main in the short term.

Also, a vacuum sewer system exists to the north of Pleasant Grove, with a section of gravity sewer system, which 'feeds' into the vacuum system. This network drains to a pumping station located on the foreshore at the end of Olive Grove.

2.4 Biological Environment

2.4.1 Vegetation and Flora

Approximately one quarter of the site has been previously cleared and now consists of open parkland setting with isolated individual trees and stands of several trees.

The balance of the site supports remnant stands of native vegetation in varying condition. In these remnant stands there is evidence of grazing activities in previous years, in the form of loss of understorey vegetation and invasion of weeds.

The remnants of the original native vegetation are mapped at scale 1;250,000 as Cottesloe Complex – Central and South by Heddle *et al.* (1980). This is described as of a mosaic of *E. gomphocephala* woodland and *E. gomphocephala – E. marginata – C. calophylla* open forest on the deeper sands and a closed heath on the limestone outcrops.

Vegetation mapping of the Coast of the City of Mandurah undertaken by Trudgen (1991) shows much of the site as *Eucalyptus gomphocephala/Eucalyptus calophylla* Parkland Cleared, with the peripheries of the site described as Yoongarillup Plain – Peel Inlet Edge. The latter general community type is represented in Trudgen's mapping of Creery Island, an area recommended for reservation in the C50 area for System 6. For the purposes of a detailed evaluation of the development potential and environmental constraints presented by the site, the available published information is not sufficiently detailed to allow the evaluation to proceed.

Assessment of the remnant vegetation in terms of vegetation type, flora species present and possible floristic community types has been carried out by reference to both published technical literature and by direct botanical survey, by a specialist botanist.

The findings of these investigations are as follows.

2.4.1.1 Vegetation Types and Condition

The botanical survey of the site conducted for the purposes of this study was undertaken in September and October 2002. Vegetation units were distinguished on the basis of vegetation height, density and dominant species and mapped at scale 1:2,000 on a colour orthophotograph based on photography dated January 2002. Figure 5 presents the resultant vegetation map.

Eight vegetation communities have been identified for the site, two of which consist of transitions between other communities (E and FG), and one of which contains mosaics of an additional community (D contains pockets of C). The vegetation communities identified and mapped for the site are described as follows:

- Mr - Wetland Community -*Melaleuca rhaphiophylla* Low Open Forest with *Xanthorrhoea preissii* over *Juncus pallidus*, *Chorizandra enodis*, ?*Schoenus* sp, and introduced species *Ehrharta calycina*, *Trifolium campestre*, *Arctotheca calendula*, and *Lotus suaveolens*. Condition of this community is 4-5 (Good to Degraded), due to the level of grazing/clearing of understorey species; overstorey health alone would be 3-4 (Very Good to Good).

- D - *Eucalyptus gomphocephala* Parkland Cleared Low Open Woodland over *Juncus kraussii* with occasional patches of *Lepidosperma longitudinale* and introduced species, with mosaics of Mr (*Melaleuca rhaphiophylla*). Condition of

this community is 5 -6 (Degraded to Completely Degraded), due to the level of understorey clearing/grazing that has taken place.

- E - *Eucalyptus gomphocephala*, *Banksia attenuata* (Transitional community - D to F) with *Kunzea ericifolia* and *Melaleuca rhaphiophylla*. Condition of this community is 4 (Good).

- F - Tall Open Scrub with occasional *Banksia attenuata* over *Xanthorrhoea preissii*, *Regelia ciliata*, *Acacia saligna*, *Hardenbergia comptoniana*, *Patersonia occidentalis* and introduced species. Condition of this community is 4-5 (Good to Degraded).

- FG - *Kunzea ericifolia* and *Jacksonia sternbergiana* /Estuarine edge community of *Melaleuca rhaphiophylla* (Transitional community of F to G). Condition of this community is 4 (Good).

- G - Estuarine edge community of *Melaleuca rhaphiophylla* , with occasional *Casuarina obesa*, and very occasional *Banksia attenuata* and *Banksia littoralis* over *Melaleuca ?viminea*, over *Juncus kraussii*, *?Schoenus* sp., *Sarcocornia* sp., *Halosarcia indica* subsp. *bidens*, *Chorizandra enodis*, and *Gahnia trifida* with *Patersonia occidentalis* and *Conostylis aculeata* subsp. *aculeata*, and introduced species *Ehrharta calycina*, *Oxalis pes-caprae*, and *Briza maxima*. Condition of this community was 3-4 (Good to Very Good), and 4 (Good) in parts. Changes in species dominance was evident in this community, depending on the location either east or west of the track and adjacent fence through the community; vegetation was generally weedier to the east of the track, and contained more *Sarcocornia* sp. *and Halosarcia indica* subsp. *bidens*, and no *Banksia*'s. Some areas of this community contained the following species around track areas *Jacksonia sternbergiana*, *Acacia saligna*, *Viminaria juncea* and *Carpobrotus* sp., near tracks traversing community G. Condition of this community was 4 (Good).

- G1 - A variation of community G with *Casuarina obesa* and *Melaleuca cuticularis* dominating the overstorey, and increased *Sarcocornia* sp. and *Halosarcia indica* subsp. *bidens* in the understorey. Condition of this community was 4 (Good).

- H - Wetland community of *Juncus kraussii*, *Lepidosperma ?longitudinale*, *Schoenus* sp., *Astartea fascicularis*, emergent *Melaleuca rhaphiophylla*, occasional *Gahnia trifida*, *Sarcocornia* sp. and *Halosarcia indica* subsp. *bidens*, *Isolepis* sp.,

with introduced species including *Ehrharta calycina* and *Briza maxima*. Condition of this community is 4 (Good). Soils in this community were damp in parts at the time of the survey; surface water was not evident.

The condition of the mapped vegetation communities was ranked according to the Keighery (1994) scale used in Bush Forever (2000) (Appendix B), based on site observations.

The condition of the vegetation within the site has been affected in parts by grazing, human intrusion and weed invasion. Vegetation condition within the site, as described in accordance with Bush Forever (WA Govt, 2000), ranges from 3-4 (Very Good), 4 (Good), 4-5 (Good to Degraded) to 5 (Degraded) Figure 6 presents the findings of vegetation condition mapping.

2.4.1.2 Flora

Botanical survey also incorporated compilation of a detailed flora species list for use in determining whether there are any species of particular conservation significance within the site.

The CALM Declared Rare and Priority Flora Databases listed no Declared Rare Flora but seven Priority species as possibly occurring in the Point Ward area, including one Priority 2, four Priority 3 and two Priority 4 species (Appendix C). These and other possibly significant species were searched for within the site in September and October 2002.

No Declared Rare or Priority Species were located in the survey.

One species identified as *Chamaescilla corymbosa* was located within several locations in the survey area (Appendix A). The Priority 3 species *Chamaescilla gibsonii* was not located in the area, and although the two species are closely related, the specimens collected contained characteristics described by Keighery (2001) representative of the former.

Orchids were located within the site, but none were identified as Rare or Priority Flora.

2.4.1.3 Floristic Community Types

Preliminary examination of floristic community types was carried out by;

- comparison of species presence with the two way tables in Gibson *et al*,
- review of mapped locations for specific FCTs in Gibson *et al*.

Due to the lack of understorey vegetation in parts of the site, there are difficulties in reliably assigning Floristic Community Types to the vegetation mapping units identified by recent survey. The removal of understorey species has permanently eliminated the opportunity to collect floristic data on which this classification method critically relies upon.

Preliminary approximations of vegetation units with FCT's derived as described above may be summarise as follows.

The location of the property and the presence of Tuart suggests that Community D may have been Floristic Community Type 25 *Eucalyptus gomphocephala – Agonis flexuosa* Woodlands (Gibson et.al, 1994) in parts.

The lack of understorey species present in Community Mr, and the level of degradation in Community F does not allow for the assignment of a Floristic Community Type. Community H shows some affinities with Floristic Community 17, though further work is required to confirm this.

Community G and G1 show some affinities with Floristic Community Type 7, which is generally dominated by "*Melalecua viminea*, *M. uncinata*, *M. cuticularis* or *Casuarina obesa* or a mixture of these species" (Gibson et.al, 1994), though *Melaleuca rhaphiophylla* is known to occur in this community.

The combined presence of *Melaleuca rhaphiophylla* and *Casuarina obesa* in Community G may show affinities with Floristic Community Type 15, which is a Threatened Ecological Community, but further work would be required to confirm the presence of this Community.

The reservation and conservation status given by Gibson *et al.* (1994) for each of these Floristic Community Types are:

• Type 7	Well Reserved	Vulnerable
• Type 15	Well Reserved	Vulnerable
• Type 17	Well Reserved	Low Risk
• Type 25	Poorly Reserved	Susceptible

2.4.1.4 Threatened Ecological Communities

The preliminary FCT classifications noted above were checked against the list of Threatened Ecological Communities held within the CALM database (CALM, June 2002).

There are no apparent TEC's within the site, based on an absence of apparent correlations between vegetation types, preliminary FCT classes, and the communities described on the CALM database.

2.4.2 Wetlands

To investigate the location, extent and conservation classification of wetlands within the site reference was firstly made to the map series within the reference document entitled Geomorphic Wetland Mapping (WRC, 2002).

This reference updates mapping data first published in Wetlands of the Swan Coastal Plain, Wetland Mapping, Classification and Evaluation, Wetland Atlas, (Hill et al 1996). For this publication, aerial photography (1:25,000) was reviewed and in some wetland areas site assessment was undertaken to determine regional wetland mapping and classifications. For the Conservation Category wetlands (3Ec, 13Ec) within the study area, a site assessment using Bulletin 374 (now Bulletin 686[1]) was completed. The Resource Enhancement wetland (17Sr) within Lot 9 was not verified by a site assessment.

The WRC wetland maps have been overlain on an orthophoto map of the site to produce Figure 7.

[1] EPA Bulletin 686: A Guide to wetland management in the Perth and near Perth SCP area identifies wetland evaluation methods for wetland assessments, which include criteria covering natural and human use attributes for the wetland area.

Figure 7 shows that the WRC data indicates that several wetland areas occur within the site;

- the estuarine margin of the site, to a width of approximately 150 m from the Peel inlet shore is mapped as "conservation category estuarine peripheral wetland",
- an oval shaped area of around 5,000m2 near the centre of the site is mapped as "resource enhancement category sumpland".

(Our investigations which were carried out in detail at the site, provide a very accurate map which differs from the WRC map, and this is discussed in more detail later in this section). Not so, see Table 1

The estuarine peripheral wetlands are further identified in footnotes to the Wetland Atlas maps as Peel Inlet Ward Point (section north of the point) and Peel Inlet Peripheral (section south of the point).

Further descriptive data for these estuarine fringing wetlands is provided in the Wetland Atlas, as follows:

- Wetlands of national importance nominated for inclusion under the Ramsar Convention,
- Wetlands included in a *Directory of Important Wetlands in Australia* (ANCA, 1993),
- Regionally significant wetlands as identified in the Perth to Bunbury Study (WAWRC, 1991), and
- Outstanding wetland recognised in other regional wetland studies.

Verification of the WRC wetland mapping was carried out by direct site survey, using procedures established in Bulletin 686 including reference to topography, vegetation types and distribution. The results of this work are depicted on Figure 8 and may be summarised as follows;

- there is estuarine peripheral wetland at the margins of the site, comprising a low open forest *of Melaleuaca rhaphiophylla* and *Casuarina obesa*; = G/G1 Good
- the vegetation condition within the estuarine peripheral wetland was assessed (see section 2.2.2.1) and was found to vary between degraded, good and very good;
- there is a significant portion of land to the south of Ward Point which is mapped as estuarine peripheral wetland at Scale 1;25,000 by Hill et al 1996, but is found by survey to consist of two non–wetland vegetation types which are mapped as vegetation unit F described as Tall Open Scrub of *Kunzea ericifolia* and *Jacksonia sternbergiana*, and vegetation unit E – Tall Open Scrub to Low Open Woodland of *Eucalyptus gomphocephala, Banksia attenuata* and *Melaleuca rhaphiophylla;*
- for these two areas, the predominance of flora species typical of upland areas, the relatively elevated topography (1.0 to 1.4m AHD) and the absence of any evidence of seasonal surface water leads to the conclusion that they should not be mapped as wetland;
- There is an area mapped as vegetation unit H comprising a wetland community of *Melaleuca rhaphiophylla*, sedge species and *Astartea fascicularis*;
- The area mapped as vegetation unit Mr on Figure 5 may be mapped as a sumpland based on the vegetation type dominated by *Melaleuca rhaphiophylla*, and its topographic form which comprises a relatively low lying swale, which together suggest that there is intermittent or episodic surface water within this feature, during the wet winter months, particularly following extended heavy rainfall.

Application of the procedures described in EPA Bulletin 686 (Appendix D) in order to derive conservation categories was carried out with the following results;

- the fringing estuarine wetland mapped as vegetation units H, FG, G1 and G may be classified as C – conservation category;
- the swale shaped wetland mapped as vegetation unit Mr may be classified as Resource Enhancement; This veg is very good to good cover.
- the isolated area of vegetation unit Mr may be classified as Resource enhancement.

Basis non-wetland types? See table 1 presence of 'wetland' species

Is this so.?

The variation of the findings of detailed investigation of the site's wetlands in terms of conservation classification, with the results of regional survey data presented in Hill *et al* 1996, is consistent with expectations. This is because our survey dedicated a large amount of time on site to ensure that the assessment was completed to a high degree of accuracy, whereas, the WRC work was done as a part of a large scale program and it is unlikely that their programme of field work was able to apply as much time and effort to this one site.

2.4.3 Habitats and Fauna

Remnant vegetation and physical resources of the site present the following fauna habitats;

- parkland cleared vegetation with occasional mature tuart trees and paperbarks, provide shelter, roosting, nesting and feeding habitats for native birds, reptiles, and invertebrates;

- open sandplain provides a movement corridor and occasional feeding habitat for kangaroos and any other remnant native ground fauna;

- the remnant fringing estuarine vegetation and wetlands provide cover, shelter, roosting, nesting and feeding habitats for remanant ground dwelling fauna, native birds, reptiles, and invertebrates.

Reference to the data base compiled by the Department of Conservation and Land Management's (2002) database indicates that two Schedule 1 Fauna, 1 Schedule 4 and Three Priority Taxa are listed as potentially occurring in the area.

These species are described as follows;

Schedule 1 (Fauna that is Rare or likely to become Extinct)

Chuditch (*Dasyurus geoffroii*). This species is uncommon and patchily distributed on the coastal plain. It is highly mobile, occupies large home ranges and appears to utilise bush remnants and corridors. It has been recorded at Barragup and is likely to occur in many parts of Mandurah as occasional vagrants from the forest areas to the east.

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). This species frequents proteaceous scrubs and heaths and adjacent eucalypt woodlands. It is a seasonal visitor and breeding occurs in the wheatbelt and eastern forests.

Schedule 4 (Fauna which is Otherwise Specially Protected)

Peregrine Falcon (*Falco peregrinus*). This species is an occasional visitor to areas of open woodland and along margins with cleared land.

Priority Taxa

Quenda (*Isodon obesulus fusciventer*) P4 This species is moderately common in parts of the coastal plain where dense understorey vegetation occurs, particularly swamps and along riverine gullies. A population has been established in the Creery Wetland Sanctuary.

Hooded Plover (*Thinornis rubricolis rubricolis*) P4 This species has been recorded along the margins of shallows of lakes in the general area.

Eastern Curlew (*Numenius madagascariensis*) P4 This species is a migratory visitor and has been observed on flats and sandy beaches around Peel Inlet and along the coast. Notwithstanding this regional data regarding potential fauna species which could potentially utilise the sites habitats, there is no known evidence that any of these species have ever been sighted on the land or that they may occasionally use the site in a way which is important or critical to their life cycle.

If there are any fauna populations of special conservation significance residing within the site, it is considered most likely that this would be a limited population of Quenda (Southern Brown Bandicoot). Well vegetated seasonal wetlands such as those found within the site and mapped on Figure 9 provides suitable habitat for Quenda, and it is possible that a small population may have survived previous and current land uses and associated degrading processes. In the Perth Region and surrounds Quenda populations have been pressured and reduced by loss of habitat and by predation by foxes and cats.

Anecdotal advice from the landowner is that there are no Southern Brown Bandicoots in the site, consistent with technically based expectations.

3.0 EVALUATION OF DEVELOPMENT POTENTIAL BASED ON ENVIRONMENTAL CONSTRAINTS

This section of the report assesses the development potential of the site for residential and related land uses. Assessment has been undertaken by reference to and analysis of the identified environmental characteristics and features, which in turn have been determined by reference to published technical information and by direct site survey.

Development constraints have been derived from a general analysis of the site's physical environmental characteristics and also by application of environmental statutes, policies and guidelines established by State and local governments, and which are relevant to the site.

In carrying out this analysis of the statutory and policy factors, specific reference has been made to EPA Preliminary Policy No.33, Policies Guidelines and Criteria for Environmental Impact Assessment, Guidelines for Environment and Planning, August 1997.

Areas which are constrained for development are identified by the application of the policies, guidelines and criteria within Preliminary Policy No.33.

The areas within the site which would likely be approved for development by the EPA and any conditions of approval have been identified by this process.

3.1 Analysis of Relevant Physical Attributes of the Site

3.1.1 Land Capability

Analysis of land capability data for the site published by the Department of Agriculture (Wells, 1989) leads to the conclusion that those parts of the site which are mapped as Spearwood unit 4b can support residential development.

Development within areas mapped as Vasse land capability unit would require substantial engineering works to render the geotechnical conditions suitable for urban development, due to constraints imposed by soil types, groundwater levels, flooding risks and pollution potential.

Figure 2 depicts the location and extent of land mapped as Spearwood unit 4b which is considered suitable for urban development based on land capability analysis.

3.1.2 Water Table Clearance

Water table position data for the site shows that the water table was relatively close to the surface during October 2002.

Recognising that water table position typically reaches its seasonal maximum around October in this type of terrain, it is likely the measured water table position is relatively close to its maximum recorded level.

The 2002 winter rainfall season has been below average, as was the 2001 year, suggesting that slightly higher maximum water table levels than those recorded are possible. This possibility is mitigated by the location of the land immediately adjacent to Peel Inlet, where interconnection of the unconfined aquifer with Peel Inlet will tend to moderate the effect of variations in annual rainfall.

On this basis, recognising that a minimum ground level separation above water table of around 1.2m is normally required to meet civil engineering design criteria, between approximately 0.4m to 0.6m of clean free draining fill is likely to be required to lift the ground level in any area which was to be proposed for development.

A minimum natural winter level clearance of 0.5m is required for areas proposed for on-site effluent disposal. The area which has been parkland cleared and is mapped at Spearwood unit 4b generally meets this criteria.

3.1.3 Groundwater Quality

The land is not within a public water supply area or other policy area declared under state water legislation which has the objective of controlling land use as a means of protecting water quality for the purpose of potable water supply.

The land is located within the coastal plain catchment of the Peel Harvey Estuarine System and as such is required to comply with Statement of Planning Policy No.2.

The provisions of SPP No.2 as they relate to urban development require new development to manage nutrient export potential in accordance with criteria established

in the policy, so as to reduce the export of nutrients to the Peel Harvey Estuarine System as a means of controlling excessive algal growth in the estuarine environment.

In summary this requires that development of residential lots up to 4,000m2 are connected to a reticulated sewerage system, unless an on-site effluent treatment and disposal system satisfactory to the WAPC on advice from the Water Authority (now WRC), Health Department and EPA.

Rural residential lots over 4,000m2 may utilise on-site systems subject to acceptance by the EPA following demonstration by the proponent that nutrient export can be managed to within acceptable levels.

We are advised by Gilbert Rose Consulting Engineers that connection of new lots created within the site to a reticulated sewer system is possible, based on the existence of sewer mains in relatively close proximity. Figure 4 depicts the location of existing sewers.

For lot sizes between 500m2 and 4,000m2 based on soil types and water table levels, it is our conclusion on technical grounds alone and subject to detailed design that a proposal to service new residences with on-site effluent treatment and disposal systems which incorporate nutrient removal could be considered acceptable by the EPA.

3.1.4 Estuary Setbacks for On Site Effluent Disposal Systems

The City of Mandurah advises that the setback from the Peel Inlet for effluent disposal using conventional on-site systems is 100 metres (Figure 3). Small lots including anything under 500m² are considered unlikely to be approved for on-site effluent disposal; Lots of a minimum 2000m² are considered the minimum allowable size for on-site effluent disposal, in accordance with the Draft Country Sewerage Policy.

Areas with elevated groundwater levels are subject to special conditions of the Western Australian Planning Commission.

The Draft Country Sewerage Policy advises that site requirements for on-site wastewater are specified by the Health Department of Western Australia and require land to have a minimum depth to the seasonal or permanent water table from the natural ground surface of at least 0.5m, irrespective of the type of on-site waste water disposal system proposed.

EPA Guidelines for Environment and Planning No. 33 advise that the following environmental constraints should apply in environmentally sensitive areas (in this instance the capture zone, or areas 1km from the estuary):

- Septic tank systems should not be used on soils with low infiltration rates (high clay content),
- Septic tank systems are not appropriate on sandy soils with a high water table, generally land of 'low' and 'very low' land capability for effluent disposal,
- The base of the leach drain should be at least 2m above the highest known watertable or bedrock, and
- Septic tank systems should be setback at least 100m from the edge of any waterbody (highwater mark).

Setback distance for on-site effluent disposal using conventional septic tank/leach drain systems is therefore 100 metres from the inlet as shown on Figure 3. Minimum lot sizes of 2000m², and a minimum ground level of 0.5m above the maximum water table are required for lots to be serviced by on-site effluent disposal systems (City of Mandurah, (2002) and WAPC (1999)).

3.1.5 Peel Inlet High Water Level Factors

Data presented at section 2.3.7 shows that under extreme flood and storm events, water levels in Peel Inlet may rise as high as 1.15m AHD with a 0.45 wave set up factor, leading to a design level for minimum ground level to mitigate flooding risk of 1.6m.

Any development within the site will therefore need to be filled to meet a minimum ground level of 1.6m AHD.

Figure 3 plots areas within the site inferred to require filling to meet Peel Inlet water level criteria.

3.1.6 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring soils and sediments that contain sulfide minerals, predominately pyrite (an iron sulfide). In an undisturbed state below the

watertable, these soils are benign and non acidic. However, if the soils are drained, excavated or exposed by lowering of the water table, the sulfides will react with oxygen to form sulfuric acid.

Projects and developments in ASS risk areas that involve excavation, lowering the water table, compacting saturated soils or disturbing previously saturated sediments, may result in soil, groundwater and surface water acidity and the subsequent release of metals and precipitates (DoE, 2003 ASS Guideline Series). Appropriate management of ASS by landowners or developers is required under the *Environmental Protection Act 1986* to avoid environmental harm.

Lot 9 has been mapped by the WAPC (2003) as having a high risk of Actual Acid Sulphate Soil (AASS) and Potential Acid Sulphate Soil (PASS) <3m from the surface.

In accordance with DoE (2003) ASS Investigation guidelines, any unforeseen dewatering or soil disturbance, compaction or lateral displacement in the ASS risk area identified above would require a preliminary site assessment and investigation to determine whether or not ASS is present.

Depending on the results of the investigation, an ASS Management Plan (ASSMP) would probably be required in accordance with DoE (2003) guidelines. The ASSMP would identify management and/or treatment options for any disturbed ASS. If ASS impacts are identified, the following management options should be considered:

- Redesign of the layout of the excavations and/or re-flooding of potential ASS to limit oxidation of iron sulfides.

- Treatment strategies including neutralisation of ASS with aglime ($CaCO_3$), use of limestone barriers and the burial of potential ASS.

- Development of management strategies to control the watertable levels on- and off-site both during and post construction.

- Containment strategies to ensure that all contaminated stormwater and acidic leachate is prevented from entering the environment in the short- and long-terms.

It is our understanding that for development to proceed on site that it would need to be filled (with clean fill) to reach the minimum building levels in respect of Peel flood

levels. Filling will limit the need for excavation works and in turn contribute to minimising the risk of ASS issues emerging.

Excavation works at the site would be limited to those associated with underground servicing, for example, sewer main installation. These excavations may be satisfactorily managed using techniques noted above to acceptably prevent the emergence of issues associated with ASS.

3.2 Application of EPA Advice Regarding Conservation Values

Identification of the potential of the site to support urban development and related uses must take account of the effect of EPA policies and guidelines and its objectives for protection of the environment.

EPA Preliminary Policy 33 was developed and published so as to create a list of areas which the EPA considers environmentally significant, and therefore is the appropriate framework from which to evaluate the environmental constraints to development which would be recognised by the EPA.

This section of the report systematically works through Guideline No 33 and applies the EPA advice to the site in order to derive the potential development area.

Notwithstanding the review of the generic policy framework discussed subsequently, it is also noted that the City of Mandurah recently initiated Amendment 17 to TPS 3 in regard to his site. This amendment provides for the rezoning of two parcels of land currently within the Reserve 37706 from Conservation and Foreshore Protection. Specific comment on the environmental approval circumstances is also provided.

(i) Summary of Areas with Highest Conservation Value

Preliminary Policy No 33 provides a list of areas which the EPA has defined as environmentally significant, and advises that schemes or amendments which potentially impact any of the areas of highest conservation values listed in the policy are likely to attract formal assessment.

Formal assessment does not imply that EPA would necessarily refuse an application for development, but would require analysis of site specific and regional contextual issues and EPA's acceptance of a justification for development which demonstrates how the

EPA's objectives for conservation of environmental features could be met. This justification is normally provided by the proponent. Also approvals for assessed scheme amendments under Section 48 may be subject to legally binding conditions set by the Minister for the Environment.

In the section below EPA Advice is reproduced in italics, and an appropriate technical response or profile for the site, based on the findings presented in section 2, is then included in normal text.

1. Native Remnant Vegetation

Areas of highest conservation value area;

- *areas recommended for protection in the Systems "Red Book 'Report*

The site is not listed or noted in the System 6 Red Book Report. Figure 11 reproduces the System 6 map for the Peel Harvey Estuarine System.

- *land vested in the National Parks and Nature Conservation Authority for the purpose of Conservation for Flora and Fauna, National Park or Conservation Estate,*

The site is not within any of these land categories,

- *other areas recommended by the Department of Conservation and Land Management and endorsed by Government for inclusion in CALM estate:*

The site is not known to be recommended for inclusion in the CALM estate.

The Peel Inlet Management Plan (Waterways Commission, 1992) made a recommendation for Point Ward which proposed an area including the Point and extending up to approximately 500m inland for incorporation into Reserve 37706, and vesting in the City of Mandurah for recreation and foreshore protection.

An area of approximately 5ha extending to the high water mark of the estuary is noted as Reserved for proposed yacht club within the Peel Inlet Management Plan.

Figure 10 reproduces the map of recommendation areas from the management plan.

This recommendation suggests that the EPA would assess any development proposal within the land to determine whether the environmental values of the site within the context of its purpose for foreshore protection could be maintained by any development proposal put forward.

- *Land reserved as Parks and Recreation under the Metropolitan Region Scheme*

The land is proposed for Parks and Recreation by the Peel Region Scheme. This proposed reservation is the ultimate subject of investigations to which this report is directed for assistance in determining compensation value.

- *areas for multiple use where conservation is a defined use;*

Reserve 37706 in the City of Mandurah is reserved for the purpose of Conservation and Foreshore Reserve. This indicates that the EPA would likely choose to formally assess any proposal for development within the site.

- *areas with rare vegetation communities or assemblages considered by the EPA not adequately represented in secure conservation areas in the metropolitan area*

Vegetation survey and floristic analysis has concluded that there are no rare vegetation communities or assemblages within the site.

NO

Review of developed areas at the periphery of the Peel Harvey Estuarine system and reserves for conservation in the Peel region indicates that areas of fringing vegetation of the type found within the site are not extensively reserved.

- *land containing declared rare flora and fauna and the habitats of declared rare fauna,*

Flora survey data shows that the site does not support any declared rare flora species.

Whilst there are several species of native bird which are declared rare and are listed as possible visitors to the site, this investigation did not uncover any evidence that any of these species have ever been sighted on the land or that they may occasionally use the site in a way which is important or critical to their life cycle.

2. Wetlands

The wetlands of highest conservation value are;

- *lakes gazetted for protection in the Environmental Protection (Swan coastal Plain Lakes) Policy Gazetted in December 1992*

There are no lakes which meet this criterion within the site.

- *wetlands nominated for protection in the Draft Environmental Protection Policy for Lakes and Swamps of the South West Agricultural Zone;*

This classification does not apply to the site.

- *wetland areas recommended for protection in the Systems 'Red Book' reports:*

Figure 11 reproduced from the System 6 Red Book confirms that the site is not effected by any System 6 recommendations.

- *wetlands on land vested in the National Parks and Nature Conservation Authority for the purpose of Conservation of Flora and Fauna, National Park or Conservation Park, or areas recommended, and endorsed by Government, for inclusion in CALM estate for conservation purposes;*

The reserve was recommended for future management by the National Parks and Nature Conservation Authority as part of the Peel Regional Park. This recommendation indicates EPA would potentially ask to formally assess development proposal for the site.

- *wetlands in areas reserved as "Parks and Recreation" under the Metropolitan Region Scheme;*

The land is proposed for Parks and Recreation by the Peel Region Scheme. This proposed reservation is the ultimate subject of investigations to which this report is directed, for assistance in determining compensation value.

- *wetlands with rare vegetation communities considered by the EPA not adequately represented in secure conservation areas, or rare flora and fauna (and their habitats) especially east of the Swan Coastal Plain;*

This does not apply to the site.

- *wetlands identified by international agreement because of their importance primarily for waterbirds and their habitats.*

Whilst the site is located directly adjacent to the Peel Harvey Estuarine System, careful examination of the map of the listed wetland area provided in Preliminary Policy No.33, and reproduced here at Figure 12 leads to the conclusion that in this specific location, land areas beyond the high water mark are outside of the listed area.

Estuaries and Inlets

In general, all estuaries are of interest to the EPA, however, certain estuaries have specific management agencies which have statutory and advisory roles to play in their protection. These include the Peel Inlet – Harvey Estuary, Leschenault Inlet, Albany and Princess Royal Harbour, Wilson Inlet, and the Swan – Canning Estuary.

As noted earlier, the site is located adjacent to the Peel Harvey Estuarine System, but is not part of the area listed under the Ramsar Convention.

Notwithstanding this, the site is the subject of recommendations in the Peel Inlet Management Programme (Waterways Commission, 1992) and on this basis, the EPA may wish to formally assess any development proposal for land within the site.

Catchments with Special Requirements

The following catchment areas have special environmental requirement:

- *Lake Clifton;*
- *Swan Coastal Plain Catchment of the Peel-Harvey Estuary;*
- *Swan and Canning Rivers and Ellen Brook;*
- *Western Swamp Tortoise Habitat;*
- *Forrestdale Lakes;*
- *Wetlands and their environmental management areas, associated with Jandakot and Gnangara mounds*

The site is located within the coastal plain catchment of the Peel Harvey Estuary, and as such is subject to compliance with Statement of Planning Policy No.2.

Conclusions Regarding EPA Areas with Highest Conservation Values

In summary, analysis of the site and its environmental characteristics within the context of the EPA's published list of areas with highest conservation value indicates that, the EPA would potentially wish to formally assess a development proposal for the land on the basis of;

- its location adjacent to the Peel Harvey Estuary;
- to determine the degree of representative of the vegetation types present with the land within secure conservation reserves; and
- in respect of the purpose of the reserve which is listed as conservation and foreshore protection in City of Mandurah Town Planning Scheme No. 3.

3.3 Detailed Analysis of Relevant Factors Recognised by the EPA

Section 3.1 examined EPA advice which identifies areas with highest conservation value, and shows that environmental resources and characteristics defined for the site would likely trigger formal assessment by the EPA in the event that a development proposal for the site was submitted to government for approval.

This section of the report uses more detailed advice from Preliminary Policy No.33 in order to determine the effect of EPA conservation policy on the development capacity of the site with reference to relevant environmental factors and characteristics identified in the previous section.

3.3.1 Native Remnant Vegetation

Section 2.2.2 describes the ecological and biological attributes of remnant vegetation and flora.

Development within areas of the site which support remnant native vegetation would inevitably require some or all of the proposed development area to be cleared.

Characteristics of the sites remnant vegetation and flora which would influence or determine EPA's decision on a proposal to clear vegetation from the site are listed below, based on review of advice in part 1 of Preliminary Advice No.33, pages 5 to 8;

- There are no known gazetted or priority flora within the site, therefore the requirement to protect declared rare species would not influence an EPA decision on clearing,

- Direct loss of the conservation estate through clearing is identified as a "significant impact" which should be avoided,

- The EPA cites "management advice" that there should be no loss of vegetation in areas identified above,

- In terms of areal coverage, and vegetation condition, the site may be divided into the classes shown on Figure 6 (vegetation condition),

- Review of regional reserves indicates that vegetation types within the site may not be well reserved in secure conservation reserves.

Evaluation of this advice with reference to site conditions suggests that development potential within the site on the basis of remnant native vegetation may be summarised as shown on Figure 13, which indicates that the areas mapped as Condition Class 5-6, would likely be approved for clearing, based on its degraded to completely degraded condition.

Clearing in other areas of non wetland vegetation in poor condition may be approved if it is limited in area. In terms of Peel Harvey catchment management objectives, a development proposal which could deliver an increase in the area planted to deep rooted perennial vegetation could be supported by the EPA.

3.3.2 Wetlands

Development within areas of the site which supports wetlands would inevitably require some or all of the wetland area to be cleared and filled.

Characteristics of the sites wetlands which would influence or determine EPA's decision on a proposal to clear and fill part of all of wetlands within the site are

summarised below, based on review of advice in Part 1 of Preliminary Advice No.33, pages 10 to 40.

At this stage it is important to note that the Water and Rivers Commission wetland maps do not have any statutory force, they are published technical documents which are taken into account when the EPA or WAPC is making land use decisions under authorities established under the town planning and environmental legislation.

The only statutory document which the EPA has specifically created in respect of wetlands is the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*.

This EPP (which has been under review for some time in accordance with the 5 year term of currency which is specified for EPPs) applies to lakes (ie wetlands which are permanently inundated), and specifically classifies lakes which had more than 1000m2 of surface water on 1 December 1991, as EPP wetlands.

In respect of Point Ward, the wetlands which occur on the site and are mapped within the WRC wetlands atlas, are not EPP lakes. In fact they are sumplands (wetlands which are seasonally inundated) and damplands (wetlands which may never inundated but have waterlogged soils), and therefore by definition cannot be EPP lakes.

The classification of wetlands in terms of their "conservation category", which may be conservation, resource, or multiple use category, is carried out using the methods set out in Bulletin 686, and this technical information is taken into account in decision making be EPA/WAPC.

Broad Principles

- A wetlands attributes can be used to establish the value of that wetland as a natural system and for human purposes,
- Five management categories ranging from Multiple Use (M) to conservation (C) and high conservation (H), may be identified and different management objectives can be identified for each wetland class,
- The wetland and an appropriate dry land buffer should be protected from the direct impacts of development,

- Proposals which are likely to impact on H and C class wetlands are likely to be formally assessed by the EPA,

- Development involving some loss of wetlands in categories R and M could be recommended for approval by the EPA provided that either a wetland function is retained within the development or a wetland of a similar type is constructed or rehabilitated to fulfil equivalent functions,

Wetland Areas with High Conservation Value

- None of the sites wetlands meets the criteria listed on page 11.

Key Policy Advice

- The wetland should be identified and its boundaries defined,

- The extent of the wetland vegetation and dry land and catchment buffer should be defined,

- The conservation status of the wetland should be determined,

- Likely impacts should be identified and mitigation measures proposed, including on-going management measures,

Management Advice: Defining the extent of buffers for wetlands

- The concept of a buffer for wetlands is developed based on the assumption of persistent or permanent surface water within the wetland, and the use of the buffer to prevent adjacent land uses from causing a decline in water quality,
- As a guide, 50m or 1 metre AHD higher than the furthest extent of the wetland vegetation, whichever is the largest would be the minimum dryland buffer required by the EPA.

Application of this advice to the wetland areas within the site (as determined by this study rather than the regional mapping of Hill *et al*, 1996, which detailed analysis shows to be incorrect) leads to the conclusion that development within the area mapped by this investigation as conservation category wetland is unlikely to be approved by the EPA.

On the basis of their Resource Enhancement conservation class, development in other areas mapped as wetland within the site may be approved by the EPA subject to a mitigation strategy for the overall site which retained wetland function in defined parts of the site, and or improves the suite of wetland functions which are in operation.

It is noted that the EPA advice has the status of "Preliminary Policy", that the intent of using a wetland buffer as a means of protecting surface water quality, and that surface water expressions are limited in area and transient and short term in occurrence.

Therefore the acceptability of development of alternative land uses associated with residential functions, could only be determined within an assessment of an overall proposal for development within the entire site, with specific reference to the mitigation strategies discussed earlier in EPA advice and how they are proposed to be implemented by the development proposal.

Figure 14 depicts the effect of wetland factors on development potential.

3.3.3 Estuaries and Inlets

The site is located at the margins of Peel Inlet, an Estuary classified by government policy as having a catchment with special requirements.

As noted in section 3.1.4, special requirements for management of Peel Inlet are established in Statement of Planning Policy No.2. The requirements of development so as to meet the specifications of SPP No.2 have been discussed in terms of effluent management, as this relates to the setbacks to the Peel Inlet shoreline for various types of disposal systems.

The EPA's advice regarding Estuaries and Inlets is set out on Section 4 of Preliminary Policy No.33 and relevant elements of that advice are summarised below.

Broad Principles

- Estuaries should be kept ecologically sound, visibly healthy and their environmental values maintained,

- Catchment management objectives should be based on best management practices aimed at minimising nutrient export into estuaries,

- The public should have access to the foreshores and waters of estuaries in perpetuity.

Significant Impacts

- Removal of vegetation, regionally significant and important wetland habitats.

Key Policy Advice Areas

- The estuary, the fringing wetland vegetation, and some dry land buffer should be protected through enforceable management controls,

- Developments in the catchment should employ best management practices aimed at ecologically sustainable development and minimising the exports of nutrients, pollutants and sediments

- The identified values of the estuary should be maintained and enhanced – for Peel Inlet the relevant values include Recreational Water Quality and Aesthetics and Protection of Aquatic Ecosystems.

Interim Conclusion

Application of this preliminary advice to the site as it is defined in detail here leads to the interim conclusion that the EPA would seek formal assessment of any development proposal within the land, and in assessing the proposal would generally not support the removal of significant fringing vegetation or regionally important wetland habitats.

Further, in those areas which could be approved for development based on their freedom from fringing vegetation and regionally important wetland constraints, there would be a requirement to use best practice for land management to minimise the export of nutrients pollutants and sediments.

In respect of residential development, best practice for the achievement of these objectives would imply the following;

- residential development should be connected to a reticulated sewer system,
- any proposal for on-site effluent treatment and disposal should only propose the use of alternative treatment units with nutrient removal capability,
- stormwater should be treated on site using devices and design approaches which remove nutrients pollutants and sediments before release to Peel Inlet,
- applications of fertiliser to domestic lawns should be minimised and lawn areas minimised.

Any filling of the site should specifically use a type of soil with high nutrient (especially phosphorus) attenuation capacity, such as Spearwood Sand, or sand amended with a material such as red-mud, to increase nutrient attenuation capacity.
Further analysis of the EPA response to a development proposal with respect to protection of Peel Inlet, could only proceed by reference to a specific development proposal.

3.3.4 Catchments with Special Requirements

The Peel Harvey Estuarine system is identified as a catchment with special requirements and is discussed in section 7 0 and 7.3 in Preliminary Policy 33.

Review of these sections indicates that there is no additional preliminary policy advice within these sections beyond the policy positions noted earlier in relation to other factors.

3.4 Implications of Amendment 17 to City of Mandurah TPS No.3

Amendment 17 to TPS No.3 has been initiated by the City of Mandurah and referred to the EPA under Section 48 of the Environmental Protection Act. Appendix E reproduced the amendment text.

Amendment 17 proposed the rezoning of two land areas in the west of the site from Reserve for Conservation and Foreshore Protection, to Residential. Figure 15 depicts the effect of Amendment 17 on land within the site, presented as an overlay of the rezoning area on the orthophotograph at scale 1;2,000.

We are advised that Amendment 17 emerged as a mediated outcome from an Appeal against the refusal by the City of Mandurah of an application by the land owner to develop within an area of land within the site previously reserved for Conservation and Foreshore. Prior to this the site included a District Recreation Reserve, and a Special Zone - Recreation and Marine Commercial. Figure 10 identifies the relevant areas.

The EPA determined that the level of Assessment for Amendment 17 was Scheme Not Assessed – Advice Given.

The effect of this determination is that Amendment 17 is now deemed to be assessed by the EPA, and that information provided is advice only and is not legally binding on other decision making authorities.

In its advice on Amendment 17, the EPA identified remnant vegetation as the key environmental factor and re-iterated its advice published in Bulletin 562 which reported on the results of formal assessment if the special residential subdivision within Part Murray Locations 109 and 1339, Pleasant Grove. This area is located to the immediate west of the present site.

The Ministers Statement approving Special Residential Subdivision of this westerly area land is included here as Appendix F, including the attached appendix A which comprises a "Planning Statement" which lists permitted land uses and management objectives for development of the land.

Management objectives incorporated in the Planning Statement may be summarised as follows;

- only residential purposes are allowed, including generally one residence per lot,
- clearing of land other than for building envelopes, fences firebreaks access and servicing would not be permitted,
- significant additional nutrient application is not acceptable, as determined by guidelines agreed between the City of Mandurah and the EPA,
- perennial indigenous vegetation shall be established and maintained on areas previously cleared, and not required to be cleared for building envelopes, firebreaks, access and servicing, as determined by guidelines agreed between the City of Mandurah and the EPA,
- lots of 4,000m2 or less shall be connected to reticulated sewer,
- lots must be no smaller than 2000m2 and shall contain an appropriate sized building envelope,
- a stormwater disposal system shall be designed and constructed in accordance with guidelines to be provided by the City of Mandurah and the EPA.
- Public open space shall be subject to on-site management of stormwater and minimised fertiliser application.

Analysis of the location of rezoned land in relation to relevant environmental features mapped by this investigation enables the following observations to be made:

- the northern moiety comprises mainly areas mapped as vegetation in degraded to completely degraded condition, however a portion intrudes into vegetation in good condition, which is also classified as conservation category wetland both in Hill et al 1996, and by this present study,
- the southern moiety rezones a portion of land mapped as resource enhancement wetland and permits the construction of residences in very close proximity to an area mapped as resource enhancement category wetland,

- The EPA has not strictly applied guidelines and objectives for conservation category wetlands and wetland buffers published in preliminary policy No.33.

These observations lead to the conclusion, that the EPA's decision to not formally assess the project, has likely derived from an analysis which determined that the mediation process which led to the initiation of amendment 17 produced an outcome more consistent with its regional scale objectives, and that limited inconsistency with other criteria is therefore acceptable in the context of the land use option allowed by previous reservations for the site in TPS No.3.

It is also concluded that advice published in Preliminary Policy No.33 may be treated by the EPA as only a guideline, and developments which do not strictly comply with detailed criteria, may be acceptable to the EPA under conditions where the broader regional policy and management objectives of EPA policy may be met.

For the present site, these observations may be reasonably extended to the conclusion that relevant objectives for the EPA including,

- effluent stormwater and nutrient management to protect Peel Inlet water quality,
- retention of a permanent cover of perennial indigenous vegetation over those areas not required to be used for houses, gardens, roads and services, and
- the siting of development further away from, rather than nearer to the estuary edge with an apparent 50m guideline minimum separation distance.

are the key regional environmental protection objectives which must be met, and may be given greater weight in assessment of land development proposals for this site than other more detailed or specific criteria.

4.0 BRIDGEWATER SOUTH ESTATE-CASE STUDY

4.1 Background to Development

In 2002, a proponent proposed to subdivide Part Lot 1011 Old Coast Road, Erskine for residential development (approximately 3km north of Ward Point). The site consists of a conservation category wetland and is located adjacent to the Peel Inlet. The development consisted of residential lots at a density of 20 lots per hectare, primary school, large lot for a park home site, sewerage pump station, POS and drainage reserves and an area of Regional Open Space encompassing a central wetland area and part buffer.

Bridgewater South was the final stage of the overall Halls Head development. Previous stages to the north-east were approved and developed progressively over recent years.

Due to the site's environmental significance including a conservation category wetland (which is similar to the wetland (sumpland) found at Ward Point) an environmental assessment was prepared to provide the EPA on the environmental issues involved and their proposed management.

In October 2002, the EPA "*resolved to informally assess the proposal on the basis that the likely environmental impacts are not so severe as to warrant formal environmental assessment*". The level of assessment was not assessed-public advice given.

4.2 Relevance to Ward Point

Lot 1011 has similar environmental attributes to Ward Point/Pleasant Grove. For example, the wetland within Lot 1011 is one of only two sumplands of this group in the region that have a latiform (continuous uniform canopy) vegetation structure. The other wetland is located at Ward Point (Pleasant Grove), however, the wetland at Pleasant Grove is heavily degraded compared to the wetland in Lot 1011 and retains only 20% of its original canopy cover with no understory (BBG, 2002). Both sites are also located adjacent to the Peel Inlet and consist of Cottesloe landform soil types..

In summary this proposal and the outcomes is relevant to the current site and the matters we have been asked to address in that the land has a strong degree of similarity to the

Ward Point land in terms of the nature of the site's environmental characteristics and the development outcome which the EPA found envornmentally acceptable.

5.0 CONCLUSIONS

Application of each relevant land capability and environmental constraint factors can be used to derive a land use guide for the site, which can then be used as the basis for town planning.

Figure 16 presents an annotated land use guide for the site which results from application of the outcomes of site definition and analysis and EPA policy research and application, set out earlier in this report.

Figure 16 must be interpreted with the recognition that EPA preliminary environmental planning guidelines require interpretation in respect of particular environmental factors. The circumstances and outcomes of the assessment of Amendment 17 confirms that the EPA can incorporate is flexibility in application of detailed criteria when it can also be satisfied that higher order regional management objectives can be met.

Figure 16 depicts the following core areas, which are described and explained as follows,

- there are two areas verified by this investigation as conservation category wetlands: these are considered to have no development potential as preliminary policy as well as general conservation considerations indicate full conservation is the expected outcome for the long term management of these areas,

- in the west of the site the area of parkland cleared grassland and remnant trees is considered to have the physical capability to support residential development, and is free of any significant constraint in relation to vegetation, flora, habitat or fauna factors,

- There is a presumption of a guideline 50m buffer between the wetland edge and development: recognising that the principal intent of the buffer is for water quality protection, and that the conservation wetland has limited and transient surface water only, it is concluded that a buffer of less than 50m would be acceptable to the EPA provided other physical measures to protect the wetland values were also implemented.

- there is an area behind the south east margin of the land with Peel Inlet, which is not constrained by clear unambiguous wetland conservation values, but is marginal to Peel Inlet and would attract a presumption of a shoreline setback to development of at least 50m, with reference to Peel Inlet's status as a wetland with conservation values which rely upon maintaining water quality, amongst other matters,

- there are two areas of wetland which may be classified as Resource Enhancement by the application of EPA Bulletin 686, and are potentially developable within the context of an overall development plan which maintains wetland functions within the site, or by mitigation through maintenance of wetland values and functions in an equivalent area elsewhere,

- there is an area of remnant native vegetation behind the Peel Inlet buffer area where the vegetation is in degraded to good condition, and which is not wetland vegetation or floristically significant, but may not be adequately represented in secure conservation reserves; on this basis this area may be capable of supporting some limited development, which may not include significant fertiliser applications, and should retain a large proportion of vegetation following development (the northern portion of this area is the most suitable in this regard, based on the extent of degraded vegetation) (See Figure 6).

- development in areas defined above to have residential potential assumes, either connection to reticulated sewer or implementation of nutrient application management techniques which meet the requirements of the City of Mandurah and the EPA,

- development potential also assumes that best practice in vegetation management and stormwater management such that the regional objective of protecting Peel Inlet from increased nutrient and pollutant loads, is increased,

- in accordance with the previous qualification to development potential, following the implementation of any approved development plan, there is the presumption that clearing of existing remnant vegetation is minimised, and existing cleared areas and areas cleared during construction and not required for ongoing residential servicing or amenity are replanted and maintained in perpetuity as perennial indigenous vegetation.

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FIGURES



6393000mN

6392800mN

6392600mN

375000mE

375200mE

SITE BOUNDARY

.0.9 .0.7 .0.4 .1.1 .0.5 .0.7 .0.7 .1.0 .2.0 .0.8 .0.8 .0.9 .1.4 .1.6 .0.8 .0.6 .1.1 .1.0 .1.0 .1.4 .1.4 .1.0 .1.5 .0.7

N

0 25 75 125m

Scale 1:2000

Date of Photography: January, 2002

M04243 16.12.04

Figure 1

Site Location

RPS Bowman Bishaw Gorham

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LEGEND

Site Boundary

RESOURCE MANAGEMENT

S4b SPEARWOOD DUNE AND PLAIN SYSTEM: Gently to moderately inclined low hills and gently undulating plain located west of the Bassendean System and associated Pleistocene, Tamala Limestone. Hills consist of a core of friable aeolianite, capped by secondary calcite and overlain by variable depths of rapidly drained siliceous yellow brown sands. The gently undulating plain is the surface expression of the consolidated marine limestone component of the Tamala Limestone. Flat to gently undulating sand plain with shallow to moderately deep siliceous yellow brown and grey brown sands with minor limestone outcrop.

V VASSE ESTUARINE AND LAGOONAL SYSTEM: Low lying poorly drained terraces, flats and beach ridges fringing Peel Inlet, Harvey Estuary, the coastal lake system and major river mouths. Soils are extremely variable, being formed on unconsolidated Holocene estuarine alluvium and lagoonal deposits, and are often highly saline and subject to periodic inundation.

V3 Sand flats marginally higher and commonly supporting sands of *Melaleuca* spp.

V4 Low level storm beach ridges and terraces with shallow to moderately deep uniform alkaline black sandy loams to loams overlying unconsolidated shell beds or clayey marl. Minor limestone outcrop present.

V6 Upper level sandy terraces and gently undulating beach ridges with deep grey or bleached pale brown siliceous sands overlying soft shelly limestone.

V3

V4

S4b

V6

SITE BOUNDARY

6393000mN

6392800mN

6392600mN

375000mE

375200mE

Date of Photography: January, 2002 Source: McArthur, W.M., and Bettenay, E. (1974)

N

0 25 75 125m

Scale 1:2000

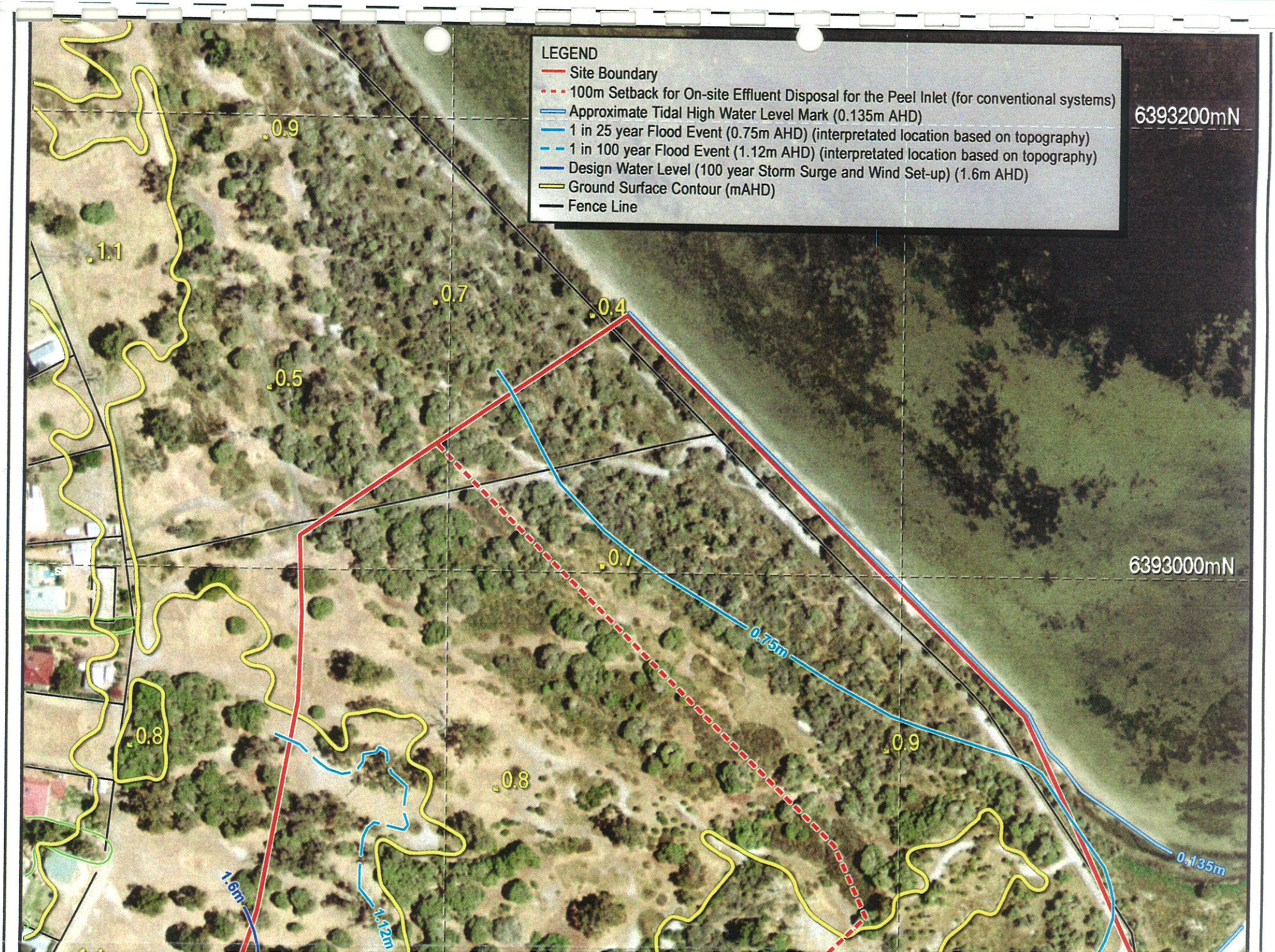
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Figure 2

Land Capability Units and Soil Types

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LEGEND
Site Boundary
100m Setback for On-site Effluent Disposal for the Peel Inlet (for conventional systems)
Approximate Tidal High Water Level Mark (0.135m AHD)
1 in 25 year Flood Event (0.75m AHD) (interpretated location based on topography)
1 in 100 year Flood Event (1.12m AHD) (interpretated location based on topography)
Design Water Level (100 year Storm Surge and Wind Set-up) (1.6m AHD)
Ground Surface Contour (mAHD)
Fence Line
6393200mN
6393000mN
0.9
1.1
0.7
0.4
0.5
0.1
0.8
0.8
0.9
0.75m
0.135m
1.6m
1.12m

LEGEND
- Site Boundary
- 100m Setback for On-site Effluent Disposal for the Peel Inlet (for conventional systems)
- Approximate Tidal High Water Level Mark (0.135m AHD)
- 1 in 25 year Flood Event (0.75m AHD) (interpretated location based on topography)
- 1 in 100 year Flood Event (1.12m AHD) (interpretated location based on topography)
- Design Water Level (100 year Storm Surge and Wind Set-up) (1.6m AHD)
- Ground Surface Contour (mAHD)
- Fence Line

6393200mN
6393000mN
6392800mN
6392600mN
375000mE
375200mE
0.75m
0.135m
1.6m
1.12m
1.12m
0.9
0.7
1.1
0.4
0.5
0.8
0.7
0.9
0.8
1.4
1.6
0.8
0.6
1.1
1.4
1.5
0.7

Date of Photography: January, 2002

N

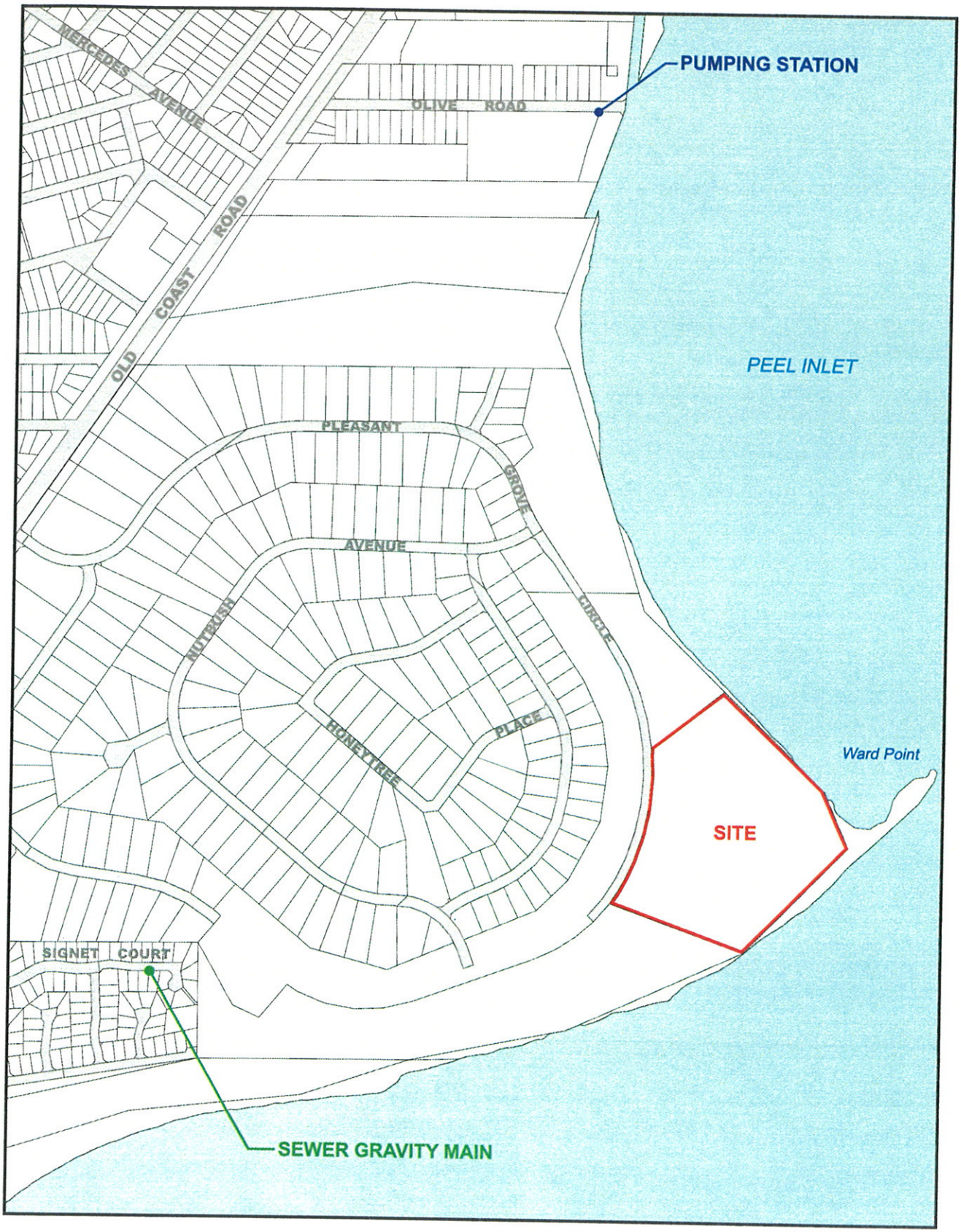
0 25 75 125m
Scale 1:2000

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Figure 3

Flood Levels and Inferred Setback Specifications for the Site

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ENVIRONMENTAL MANAGEMENT CONSULTANTS



N

0 100 300 500m

Scale 1:10000

Figure 4

Sewer Connection Points for Site

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Date of Photography: January, 2002

M04243 16.12.04

Figure 6

Vegetation Condition Map

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Figure 7

Geomorphic Wetland Mapping

Date of Photography: January, 2002

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LEGEND

Site Boundary

Vegetation Boundary

Mr Wetland Vegetation - *Melaleuca rhaphiophylla* Low Open Forest with *Xanthorrhoea preissi* over *Juncus pallidus, Chorizandra enodis, ?Schoenus* sp, and introduced species *Ehrharta calycina, Trifolium campestre, Arctotheca calendula,* and *Lotus suaveolens.*

D *Eucalyptus gomphocephala* Parkland Cleared Low Open Woodland over *Juncus kraussii* with occasional patches of *Lepidosperma ?longitudinale* and introduced species., with mosaics of Mr *(Melaleuca rhaphiophylla).*

E *Eucalyptus gomphocephala, Banksia attenuata* (Transitional community - D to F) with *Kunzea ericifolia* and *Melaleuca rhaphiophylla.*

F *Kunzea ericifolia* and *Jacksonia sternbergiana* Tall Open Scrub with occasional *Banksia attenuata* over *Xanthorrhoea preissii, Regelia ciliata, Acacia saligna, Hardenbergia comptoniana, Patersonia occidentalis* and introduced species.

FG *Kunzea ericifolia* and *Jacksonia sternbergiana*/Estuarine edge community of *Melaleuca rhaphiophylla* (Transitional community of F to G).

G Estuarine edge community Low Woodland. *Melaleuca rhaphiophylla*, with occasional *Casuarina obesa*, and very occasional *Banksia attenuata* and *Banksia littoralis* over *Melaleuca ?viminea*, over *Juncus kraussii, ? Schoenus* sp., *Sarcocornia* sp, *Halosarcia indica* subsp. *bidens, Chorizandra enodis,* and introduced species. Some areas near tracks contain *Jacksonia sternbergiana, Acacia saligna, Viminaria juncea* and *Carpobrotus.*

G1 Variation of community G with *Casuarina obesa* and *Melaleuca cuticularis* dominating the overstorey, and increased *Sarcocornia* sp and *Halosarcia indica* subsp. *bidens* in the understorey.

H Wetland community of *Juncus kraussii, Lepidosperma ?longitudinale, Schoenus* sp., *Astartea fascicularis*, emergent *Melaleuca rhaphiophylla*, occasional *Gahnia trifida, Sarcocornia* sp and *Halosarcia indica* subsp. *bidens, Isolepis* sp., with introduced species including *Ehrharta calycina* and *Briza maxima.*

6393200mN

6393000mN

6392800mN

6392600mN

375000mE

375200mE

G1

FG

H

D

Mr

Mr

E

F

G

LEGEND

Estuarine peripheral wetland

Transitional wetland

Vegetation unit Mr

Vegetation unit H

Area mapped as estuarine peripheral *(Hill et al 1996)*, but mapped as vegetation communities E and F

N

0 25 75 125m

Scale 1:2000

Date of Photography: January, 2002

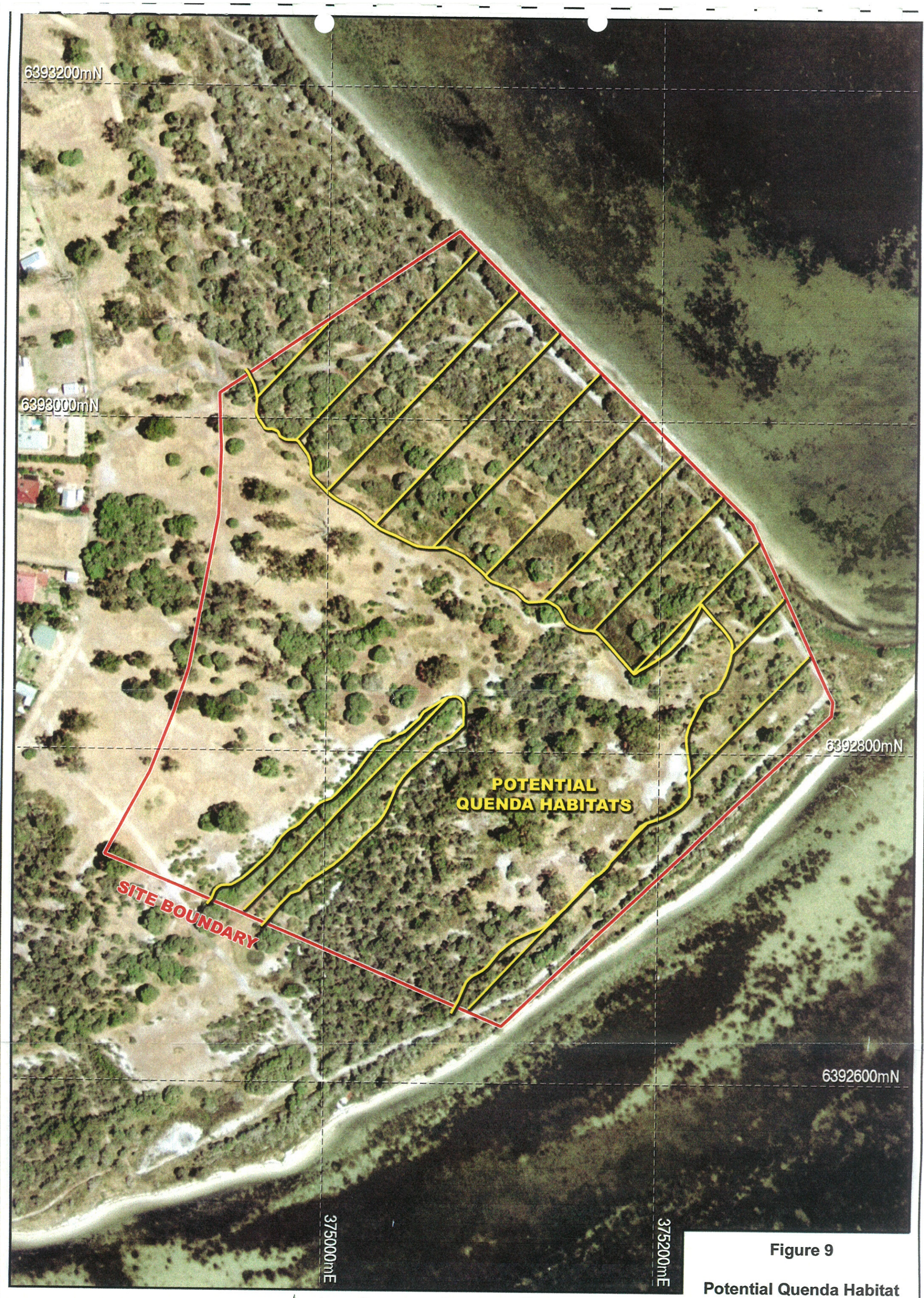
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Figure 8

Verification of WRC Wetland Mapping

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Date of Photography: January, 2002

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Figure 9

Potential Quenda Habitat

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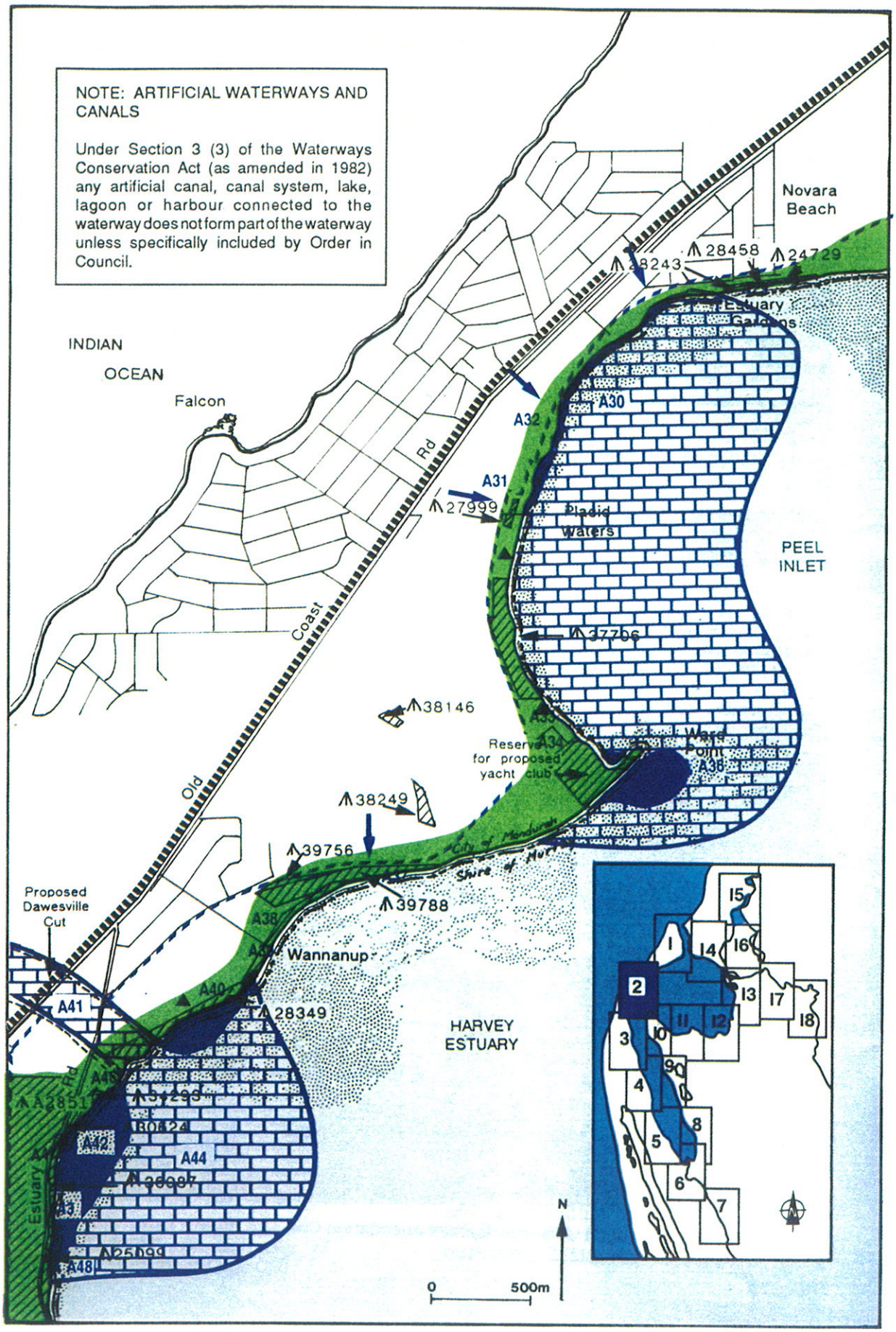


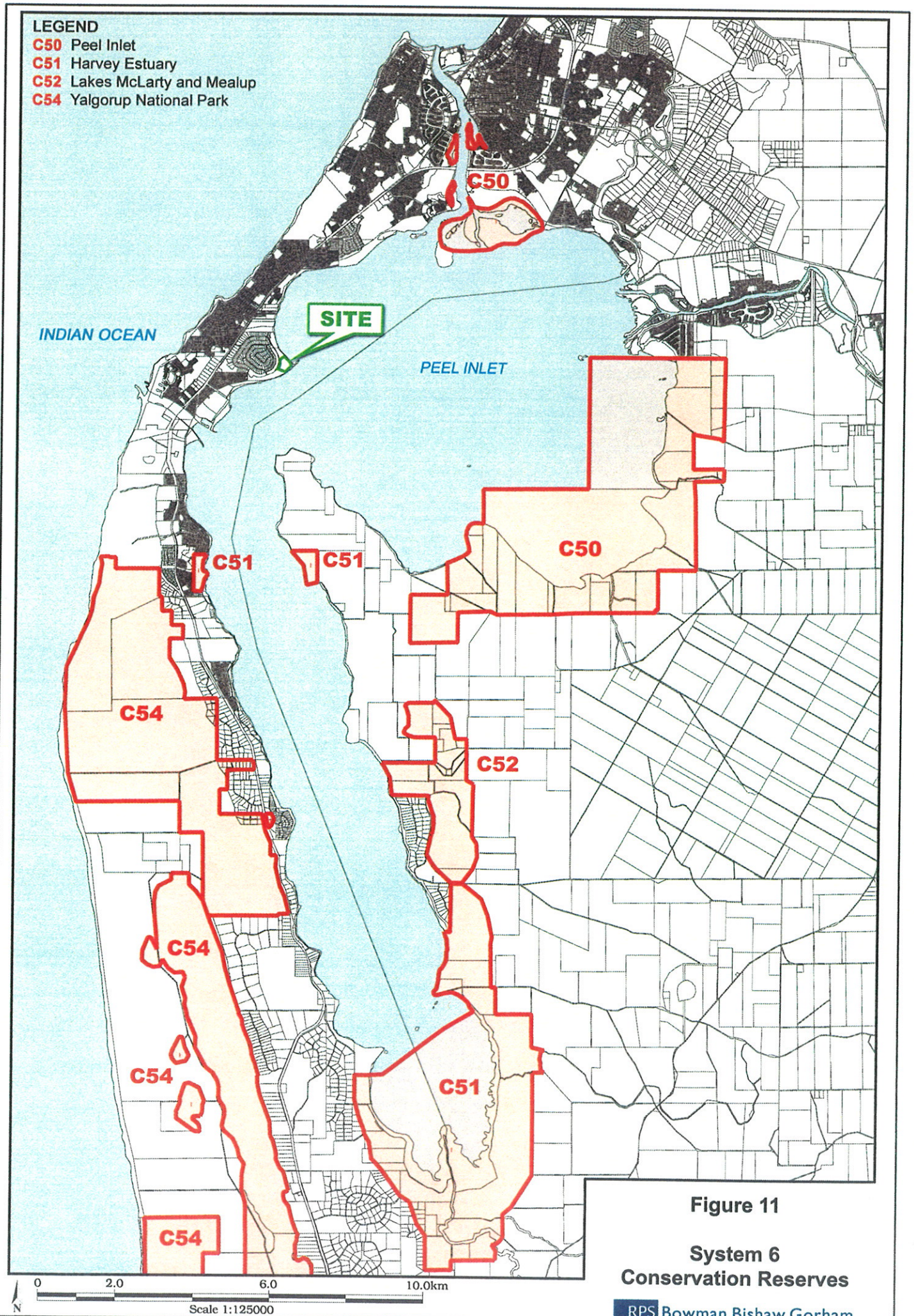
Figure 10

Extract from Peel Inlet Management Plan

Source: Peel Inlet Management Program, 1992

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Figure 11

System 6
Conservation Reserves

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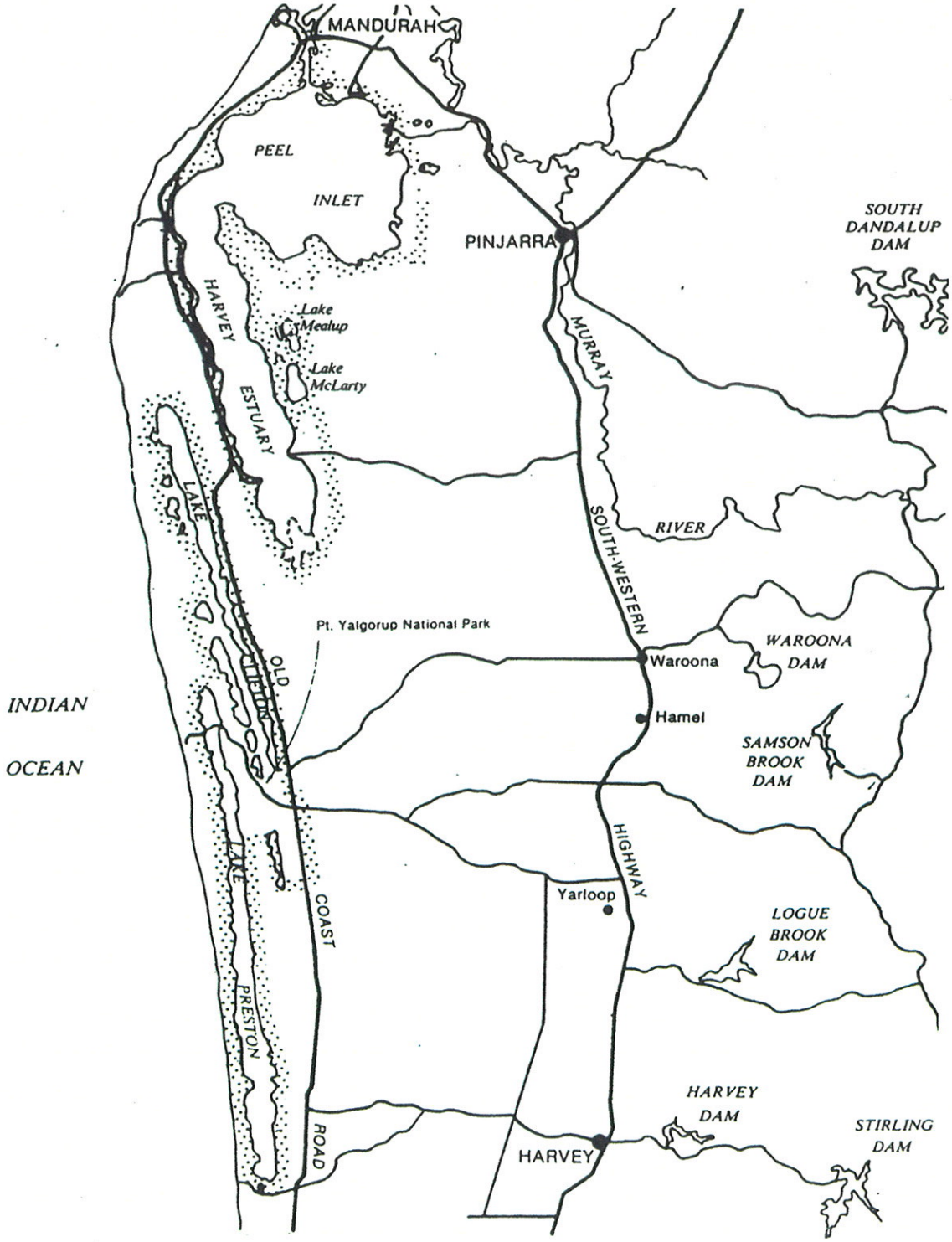


Figure 12

Peel - Yalgorup System - Ramsar Area

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Source: EPA Draft Guidelines for Environment and Planning No. 33

RPS Bowman Bishaw Gorham
ENVIRONMENTAL MANAGEMENT CONSULTANTS



Date of Photography: January, 2002

Figure 13

Potentially Developable Area Based on Vegetation Condition

RPS Bowman Bishaw Gorham
ENVIRONMENTAL MANAGEMENT CONSULTANTS

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LEGEND

Site Boundary

Vegetation Boundary

Mr Wetland Vegetation - *Melaleuca rhaphiophylla* Low Open Forest with *Xanthorrhoea preissi* over *Juncus pallidus, Chorizandra enodis, ?Schoenus* sp, and introduced species *Ehrharta calycina, Trifolium campestre, Arctotheca calendula,* and *Lotus suaveolens.*

D *Eucalyptus gomphocephala* Parkland Cleared Low Open Woodland over *Juncus kraussii* with occasional patches of *Lepidosperma ?longitudinale* and introduced species., with mosaics of Mr *(Melaleuca rhaphiophylla).*

E *Eucalyptus gomphocephala, Banksia attenuata* (Transitional community - D to F) with *Kunzea ericifolia* and *Melaleuca rhaphiophylla.*

F *Kunzea ericifolia* and *Jacksonia sternbergiana* Tall Open Scrub with occasional *Banksia attenuata* over *Xanthorrhoea preissii, Regelia ciliata, Acacia saligna, Hardenbergia comptoniana, Patersonia occidentalis* and introduced species.

FG *Kunzea ericifolia* and *Jacksonia sternbergiana*/Estuarine edge community of *Melaleuca rhaphiophylla* (Transitional community of F to G).

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G1 Variation of community G with *Casuarina obesa* and *Melaleuca cuticularis* dominating the overstorey, and increased *Sarcocornia* sp and *Halosarcia indica* subsp. *bidens* in the understorey.

H Wetland community of *Juncus kraussii, Lepidosperma ?longitudinale, Schoenus* sp., *Astartea fascicularis,* emergent *Melaleuca rhaphiophylla,* occasional *Gahnia trifida, Sarcocornia* sp and *Halosarcia indica* subsp. *bidens, Isolepis* sp., with introduced species including *Ehrharta calycina* and *Briza maxima.*

6393200mN

6393000mN

6392800mN

6392600mN

375000mE

FG

G1

H

D

Mr

Mr

E

F

G

.0.9 .1.1 .0.7 .0.4 .0.5 .0.8 .0.8 .0.9 .1.4 .1.6 .0.8 .1.1 .0.6 .1.4 1.4 .1.5 .0.7

LEGEND

Development impacts not acceptable - conservation category wetland.

Development impacts potentially acceptable, subject to negotiation - resource enhancement wetland.

50m buffer for conservation category wetland.

50m Peel Inlet Setback

Date of Photography: January, 2002

N

0 25 75 125m

Scale 1:2000

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Figure 14

Development Constraints Due to Wetland Conservation Factors

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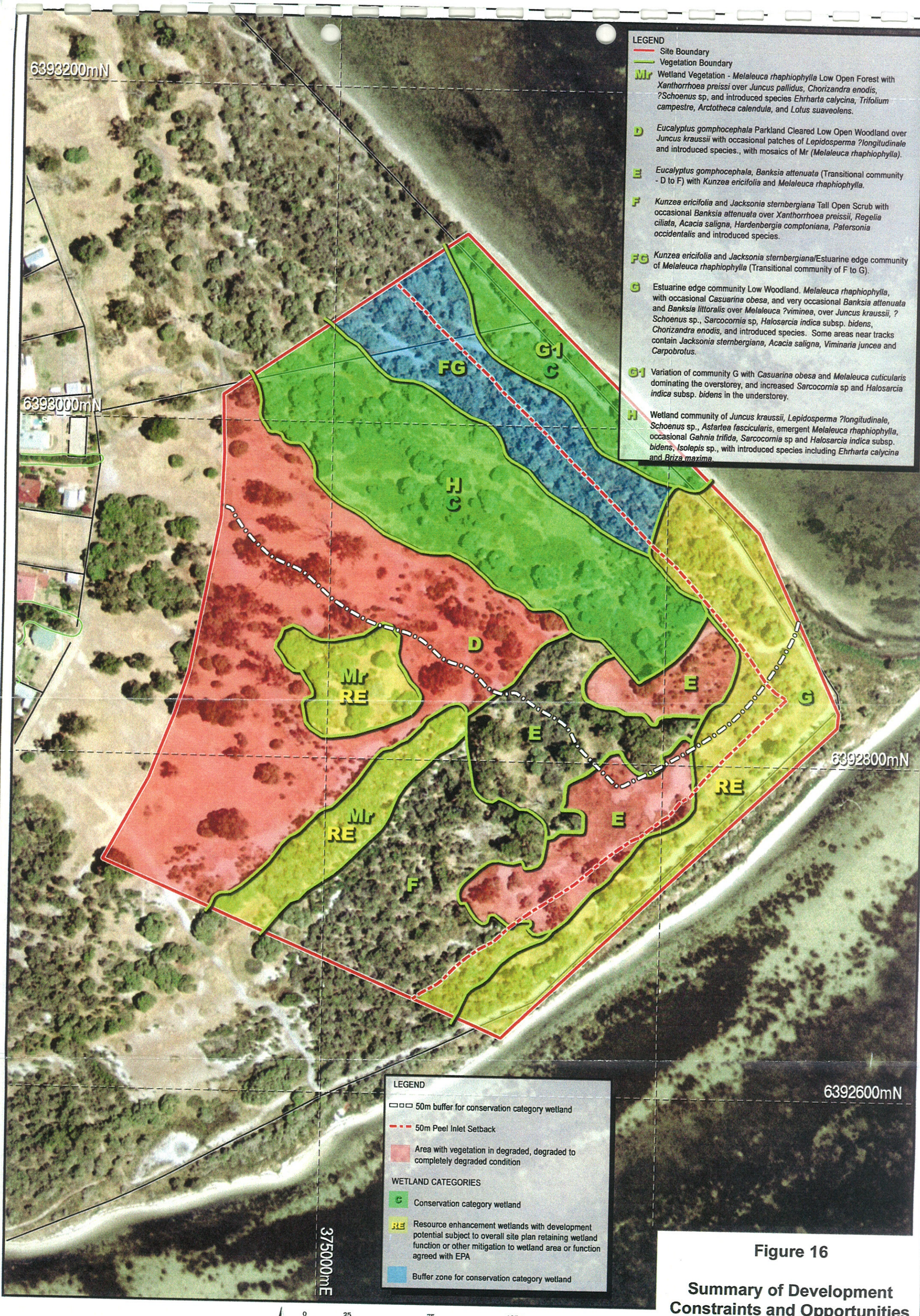
Date of Photography: January, 2002

Figure 15

Effect of Amendment 17

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Date of Photography: January, 2002

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Figure 16

Summary of Development Constraints and Opportunities

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APPENDIX A

Groundwater Levels and Soil Auger Sites

APPENDIX A1
GROUNDWATER LEVELS

Location	Easting	Northing	Groundwater (Depth below surface)
Location 1	375069	6393003	.7m
Location 2	375048	6392968	.7m
Location 3	375023	6392903	.9m
Location 4	374917	6392813	1.4m
Location 5	375017	6392772	1m
Location 6	375258	6392784	Not Sampled
Location 7	375126	6392776	.7m
Location 8	375000	6392650	1.3m
Location 9	375012	6392846	.8m
Location 10	374947	6392914	.8m

Location 1. 375069E 6393003N

0 – 20	Medium/Fine grained grey sand
20 – 60	Medium grained off-white/pale brown sand
60 – 80	Medium/Coarse grained brown sand
80 - 100	Medium/Coarse grained light brown sand
Groundwater	Intercepted @ .7m

Location 2. 375048E 6392968N

0 – 20	Medium grained grey sand
20 – 40	Medium grained light grey sand
40 – 80	Medium grained off-white/pale brown sand
80 - 100	Medium/Coarse grained off-white/grey sand
Groundwater	Intercepted @ .7m

GROUNDWATER LEVELS (CONT'D)

Location 8. 375000E 6392650N

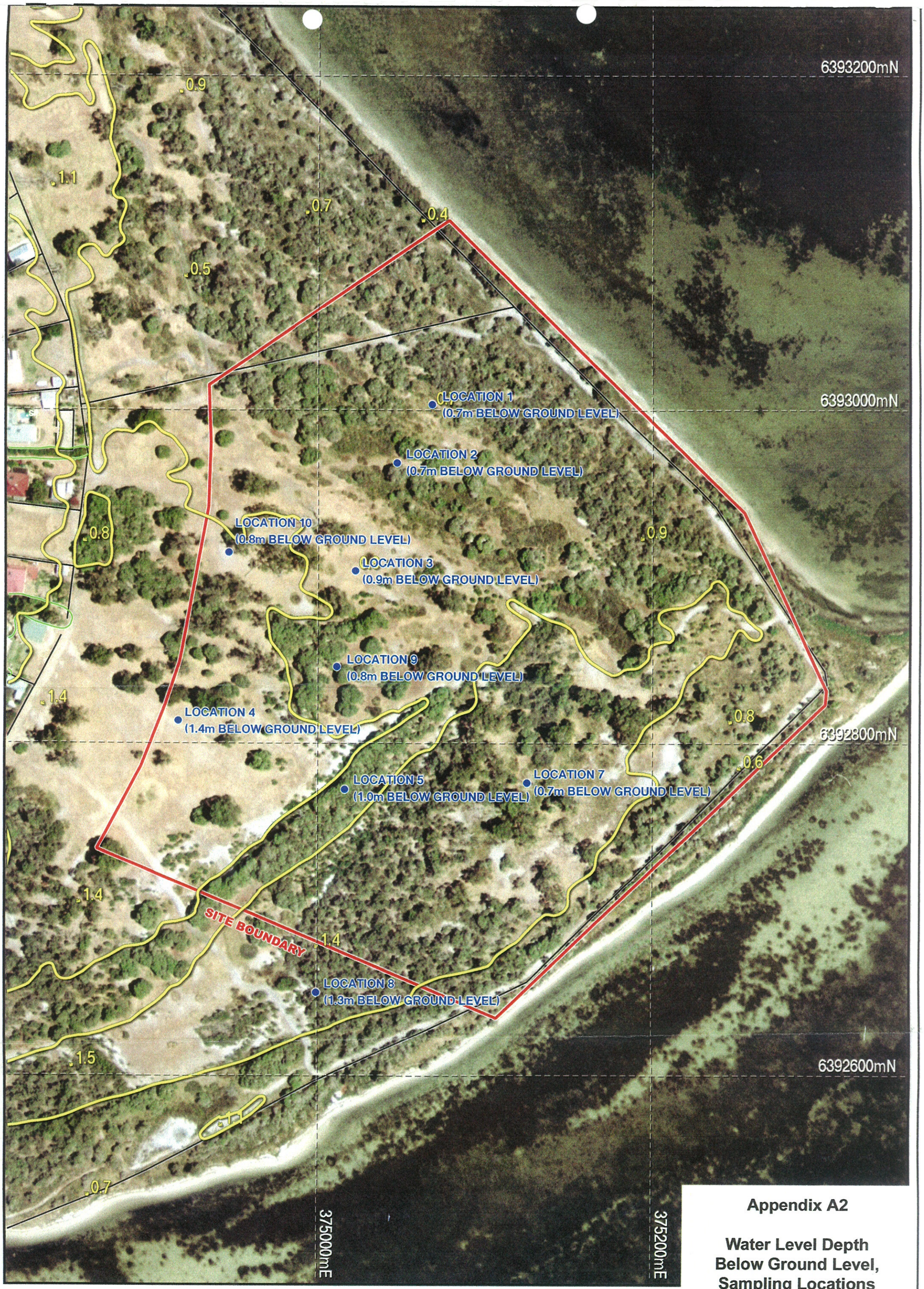
0 – 40	Medium/Fine grained grey sand
40 – 100	Medium grained off-white/pale brown sand
100 – 130	Medium/Coarse grained brown sand
130 – 150	Medium/Coarse grained dark brown sand
Groundwater	Intercepted @ 1.3m

Location 9. 375012E 6392846N

0 – 40	Medium grained dark grey sand (with organics in top 20)
40 – 80	Medium/Coarse grained off-white/pale brown sand
80 – 100	Medium/Coarse grained grey sand
Groundwater	Intercepted @ .8m

Location 10. 374947E 6392914N

0 – 40	Medium grained grey sand
40 – 60	Medium grained off-white sand
60 – 100	Medium/Coarse grained off-white/pale brown sand
100 – 120	Medium/Coarse grained brown sand
Groundwater	Intercepted @ .8m



Date of Photography: January, 2002

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Appendix A2

Water Level Depth Below Ground Level, Sampling Locations

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APPENDIX B

Vegetation Condition Scale

CALM Potential Rare and Priority Flora list for the Ward Point Area

Chamaescilla gibsonii	P3
Dillwynia dillwynioides	P3
Eucalyptus rudis subsp. cratyantha	P4
Grevillea manglesii	P2
Jacksonia sericea	P3
Lasiopetalum membranaceum	P3
Villarsia submersa	P4

APPENDIX C

CALM Rare and Priority Flora List

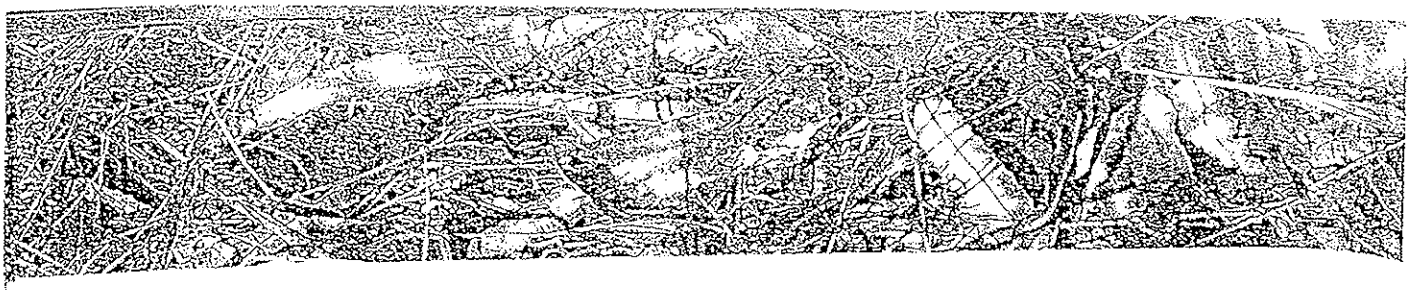


Table 12: Vegetation Condition Scales commonly used in the Perth Metropolitan Region

Condition scale used in BUSH FOREVER, VOL 2, from Keighery B J (1994)	Condition scale used to derive Keighery B J (1994) and Connell (1995) after Trudgen (1991)	Condition scale used in PEP MAPPING after Connell (1995)
Pristine (1) Pristine or nearly so, no obvious signs of disturbance	Excellent (E) Pristine or nearly so, no obvious signs of damage caused by the activities of European man.	No equivalent unit
Excellent (2) Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.	Very Good (VG) Some relatively slight signs of damage caused by the activities of European man. For example, some signs of damage to tree trunks caused by repeated fires and the presence of some relatively non-aggressive weeds such as *Ursinia anthemoides* or *Briza* species, or occasional vehicle tracks.	Very Good (vg) Evidence of localised low level damage to otherwise healthy bush. Seedling recruitment and generally healthy population size (age/stage) structure apparent. Weed and grazing damage is confined (<20% of area). Some modification to vegetation structure due to changes in fire regimes may be apparent. Evidence of logging or fire wood collection may be found. High likelihood that vegetation structure and species richness can be maintained.
Very Good (3) Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Good (G) More obvious signs of damage caused by the activities of European man, including some obvious impact on the vegetation structure such as caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones.	Good (g) Evidence of localised high level damage to otherwise low level damaged bush. Recruitment is localised and the populations of some species may be senescent. Weed and grazing damage is apparent in 20–50% of the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Localised gall and parasitic plant damage may be apparent. Evidence of logging or firewood collection. Moderate likelihood that vegetation structure and species richness can be maintained.
Good (4) Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing	Poor (P) Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of European man such as grazing or partial clearing (chaining) or very frequent fires. Weeds as above, probably plus some more aggressive ones such as *Ehrharta* species.	Poor (p) Widespread high level damage. Recruitment is disrupted and most woody species appear senescent. Weed and grazing damage may be apparent throughout >50% of the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Locally some vertical strata are absent. Gall and mistletoe damage apparent. Evidence of logging or firewood collection. Low likelihood that vegetation structure and species richness can be maintained or re-established.
Degraded (5) Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	Very Poor (VP) Severely impacted by grazing, fire, clearing, or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species including aggressive species.	Very Poor (vp) Widespread high level damage. Recruitment is disrupted and most species appear senescent. Weed and grazing damage apparent throughout the area. Modification to vegetation structure due to changes in fire regimes apparent. Widespread loss of vertical strata. Gall and mistletoe damage apparent. Evidence of logging or firewood collection. Little to no likelihood that vegetation structure and species richness can be re-established.
Completely Degraded (6) The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.	Completely Degraded (D) Areas that are completely or almost completely without native species in the structure of their vegetation i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.	Not used – does not apply to bushland.

APPENDIX D

Field Score Sheets from Application of Bulletin 686 to Determine Conservation Status

Wetland H Conservation

Part IIB: Seasonal and episodic wetlands with poorly defined boundaries

Introduction - "zoning" the wetlands

As described in Section 2.4, these "extensive" wetlands cannot be treated as single units. Zone the wetland as described in Section 4.2, Step 6. Each section should be the subject of a separate assessment using the following questionnaire. Where the word "wetland" is used it should be interpreted to mean "wetland section".

i Environmental geology classification

Does the wetland occur on the Quindalup Dunes or on a geological unit confined to a river/estuary floodplain?

(YES)	Score	5
NO	Score	1

Score [5]

Source: Refer to 1:50,000 Environmental Geology Series (see Gozzard 1982).

Management Notes: Geological origin is one of the bases for wetland classification systems. In the metropolitan area, wetlands within these geological units are rare.

ii Adjacent wetlands

Are there wetlands within a 2km radius?

(YES)			*go to question iii*
NO	Score	3	*go to question (iv)*

Score [0]

Source : Aerial photos.

Management Notes: Refer to question (iii).

iii Habitat diversity

Is the composition and structure of the vegetation significantly different to that found at nearby wetlands?

YES	Score	3
(NO)	Score	1

Score [1]

Source: Refer to question (iv) for a list of habitat types. Use aerial photos and field visits.

iv Habitat type

Using the list below score one for each habitat type represented (maximum score 10).

a) Vegetation over 0.1 hectare (1000m^2) in area.

- large paperbarks (>2.5m tall) in dense clumps [1]
- low thickets (ie <2.5m tall). These are often *Melaleuca*, *Astartea* or *Kunzea* spp [1]
- paperbark fringe [1]
- fringing rushes and sedges (often *Baumea*, *Juncea* spp) [1]
- fringing *Typha* (bullrush) [ ]
- samphire or saltmarsh [ ]
- extensive inlake beds of *Typha* or other rushes [1]
- scattered dense clumps of rushes or sedges [1]

b) Other habitats

- flooded grassland in winter/spring [ ]
- mud flats or seasonally dry open water [ ]
- islands — natural or human made [ ]
- fringing woodland or heath (eg eucalyptus nodes or non-wetland species) [ ]
- permanent shallow open water < 50cm deep [ ]
- permanent deep open water > 50cm deep [ ]

Score ½ point for

- scattered paperbarks [½]
- scattered rushes [½]

Score [7]

Source: Field visit and aerial photos.

Management Notes: The composition, density and structure of the vegetation around a wetland has a major influence on the size and diversity of bird and other animal populations.The more complex the vegetation associations, the greater the habitat diversity.

v Drainage

Are there drains directing water into or out of the wetland?

YES	Score	0
(NO)	Score	5

Score [5]

Source: Field inspection and visit to local government authority.

Management Notes: Surface water run-off entering wetlands via drains is often polluted. Nutrient inputs from this source should ideally be monitored for several years before determining the most appropriate means of managing algal and insect problems.

vi Area of wetland modified

What proportion of the wetland has been modified by clearing of vegetation (including undergrowth) landfill, paving, cultivated gardens/playing fields, irrigated agriculture, grazing, weed invasion, mining etc?

Percentage modified	Score
0 - 10 %	5
11 - 20%	4
21 - 30 %	3
31 - 40%	2
> 40%	1

Score [4]

Source: Aerial photos and maps.

Management Notes: See question (vii)

vii wetland size

Estimate wetland size and score as follows:

Area	Score
>100ha	5
50-100ha	4
25-50ha	3
10-25ha	2
<10ha	1

Score [1]

Source: Map of appropriate scale in conjunction with a grid overlay. The edge of the inundated area (often indicated by fringing vegetation or summer grass) should be used as the wetland perimeter for this calculation.

Management Notes: As a general rule large wetlands are capable of supporting a larger variety of species and have a greater capacity to absorb the detrimental impacts of nearby land uses than small wetlands. Where a wetland chain is severed by urban development, species diversity within individual lakes often declines due to a reduction in habitat diversity (see management notes Question (vi).

TOTAL SCORE [23]

Part III - Human-use questionnaire

i Aesthetics

Does the wetland possess any of the following attributes? (score appropriately and add score at the end)

Little, if any, artificial noise	Score	2	[2]
Understorey mostly intact	Score	2	[2]
Few, or no, roads or buildings obvious from wetland	Score	2	[2]
Steep ridge visible as part of the scenery	Score	1	[ ]
Ridge accessible giving view of wetland	Score	1	[ ]
Wetland is a lake and open water easy to view	Score	1	[ ]
A section of wetland exists where few people visit	Score	1	[ ]

Score [6]

Source: Field survey.

Management Notes: A management plan should try to ensure that these attributes are preserved or enhanced by proposed developments.

ii Historical and archaeological features

Does the wetland have any of the following historical or archaeological features?

- registered Aboriginal relics or sacred sites[3] .
- pioneer relics/operations
- National Estate/Trust listings

Score according to the following table:

Number of historical archaeological features	Score
2 or more	5
one	3
(0)	0

Score [0]

[3] This information may not be made available by the Aboriginal Sites Department in some circumstances. In these situations it should be assumed that a site is present and scored appropriately.

Source: Field survey, local government authorities, National Trust, WA Museum — Department of Aboriginal Sites.

Management Notes: Strategies for the protection and/or preservation of historical and archaeological features should be clearly defined in the management plan for the wetland.

iii Security of wetland

What is the current vesting of the land containing the wetland ? Score according to the following table.

Vesting/ownership of wetland	Score
A Class Reserve for conservation and recreation or Metropolitan Region Scheme reserve for Parks and Recreation owned by the Department of Planning and Urban Development or local government authority.	5
Other class of reserve — vested System Six recommendation unvested or on private property	3
Other class of reserve — unvested	2
Other (eg private or vacant Crown land)	(1)

Score [1]

iv Protection groups

Does the wetland have active community protection groups?

One or more Score 5

(No groups) Score 0

Score [0]

v Passive recreation

Is the wetland used for any of the following passive recreation activities?

If yes, score 1 for each

- nature study/bird watching [ ]
- education (school or other educational interest within 500m) [ ]
- picnic and /or barbecue facilities [ ]
- conservation of flora (refer to maps) [ ]
- conservation of fauna (refer to maps) [ ]
- protection and preservation of other attributes [ ]
- recognised research site
  - — biological
  - — archaeological

— other [ ]

- recognised tourist venue [ ]

Score [1]

Source: Field surveys, maps, road directories, State and local government department and residents.

Management Notes: Damage such as trampling, erosion and destruction of vegetation should be noted during the field visit.

vi Active recreation

Is the wetland used for any of the following active recreational activities? If yes, score 1 for each.

- walking/jogging or cycling [1]
- horse riding [ ]
- trail bike riding [ ]
- playground [ ]
- sports grounds [ ]
- model boats [ ]
- golf course [ ]
- canoeing/rowing [ ]
- power boating/skiing [ ]
- swimming [ ]

Score [1]

Source: State and local government recreation departments.

Management Notes: Damage from current activities should be recorded during the field survey and reported to the appropriate authority/s.

vii Other human-uses

Is the wetland used for any of the following purposes? (Score 1 for each)

- agricultural activities (grazing, horticulture etc) [ ]
- mining (check for mining leases) [ ]
- existing/proposed service corridors (SECWA, roads, etc) [ ]
- water supply [ ]
- proposed urban/housing use [1]
- private purposes other than described above [ ]

Score [1]

Source: Field survey, maps and State and local government departments.

Management Notes: The compatibility of the above activities with conservation values should be considered during the formulation of a management plan. It may not be practical to achieve all management objectives, and land use priorities will have to be decided.

TOTAL SCORE [10]

Part IV - Supplementary questions

These questions are to be used to

- determine the most appropriate management category for a wetland where the natural attributes and human-use score falls in the "transition zones" in the graph in Appendix 2;
- determining the most appropriate management category for wetlands on private land with high private human-use value.

Instructions

1. If the answer is YES in question i (below) the wetland should be moved to the management category to the right.

   If NO, move to left.
2. If the answer to either ii or iii is YES, move upwards; if NO move downwards.
3. If the answer to iv is yes, then:
   - if the wetland is in Category R, the wetland is allocated management category O unless Part I applies; or
   - if wetland is in any other category, do not change the category but make a note for future reference.

i Species rarity

Are rare (and not gazetted) species of animals or plants present or are there communities represented which have a limited distribution?

Source: Department of Conservation and Land Management, local government authorities, conservation groups, literature searches.

Management Notes: Wetlands supporting rare and endangered species should be given priority when allocating resources for the formulation of management plans and implementation of field works.

YES/NO

ii Effect on land values

Does the wetland significantly enhance real estate values and land rates around it? ie, does the wetland add more than 10% to the value of nearby houses?

Source: local government authorities, estate agents.

Management Notes: The enhancement of real estate values is a legitimate reason for increased expenditure on the active management of a wetland.

YES/NO

iii Human use

Do more than 100 people visit the wetland each week?

Source: Extended field surveys, State and local government recreation departments.

Management Notes: This question provides a good measure of the need for human-use management.

YES/NO

iv) private human-use value

Where there is evidence of private use of the wetland (stock grazing, views of wetland from house or private recreation) ask owner how important the wetland is as a private resource. Does the owner rate it highly?

Source: evidence from field trip and interview with owner.

YES/NO

References

Environmental Protection Authority (1986). *Draft Guidelines for Wetland Conservation in the Perth Metropolitan Area.* Department of Conservation and Environment, Perth, Western Australia. Bulletin 227

Environmental Protection Authority (1990). *A guide to wetland management in Perth.* , Perth, Western Australia. Bulletin 374

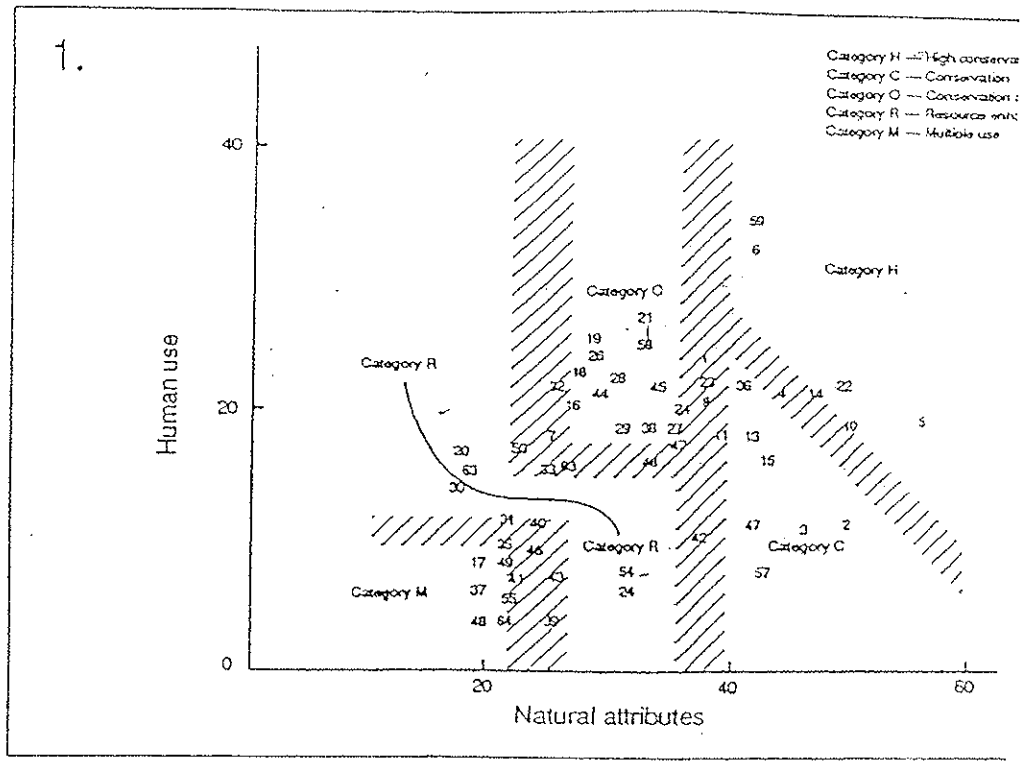
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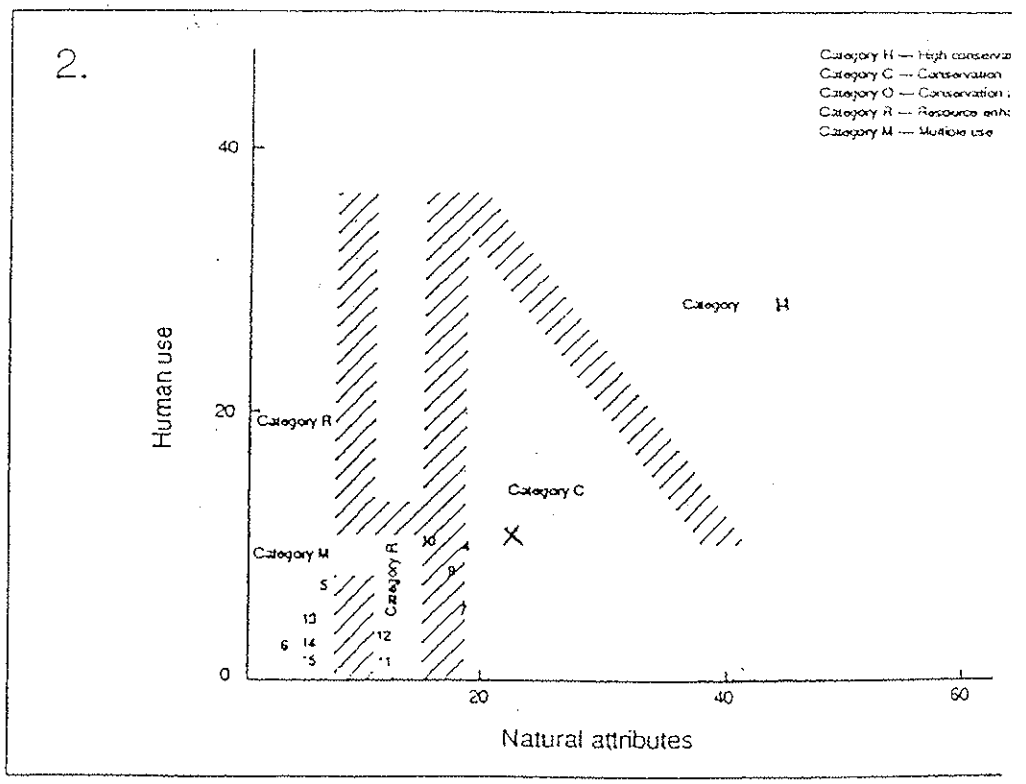
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Glossary of terms

The definitions given here are as they relate to wetlands and their useage in this Bulletin.

Term/word	definition
Attribute	Characteristic used to describe a wetland - eg size, diversity and depth of water.
Dampland	A basin wetland where the soil is seasonally waterlogged.
Episodic wetlands	Wetland with surface water for a period of time but not every year.
Extensive wetland	Large seasonally waterlogged wetlands found on the east of the Swan Coastal Plain, found typically on the Pinjarra Plain and the Bassendean Dunal system.
Function	Ecological (biological and chemical), hydrological or social process carried out by a wetland - eg food web and flood control.
Gazetted rare species	Species Gazetted Endangered under the Wildlife Conservation Act.
Hydrological function	Wetland processes that are related to water only - flood control, and drainage
Lake (as used in EPA Bulletin 227)	A wetland dominated by open water (rather than emergent vegetation), whether permanent, seasonal or ephemeral.
Lake (Semeniuk, 1987)	A basin wetland permanently inundated irrespective of vegetation cover.
Lentic wetland	Wetland where the water is stationary - a lake or swamp.
Lotic wetland	Wetland where the water is moving - streams and rivers.





Graph 1 : Management categories for permanent and seasonal wetlands with well defined bo
Graph 2: Management categories for seasonal and episodic wetlands with poorly defined bo

Small DW Wetland RE → Underwater Part IV

Part IIB: Seasonal and episodic wetlands with poorly defined boundaries

Introduction - "zoning" the wetlands

As described in Section 2.4, these "extensive" wetlands cannot be treated as single units. Zone the wetland as described in Section 4.2, Step 6. Each section should be the subject of a separate assessment using the following questionnaire. Where the word "wetland" is used it should be interpreted to mean "wetland section".

i Environmental geology classification

Does the wetland occur on the Quindalup Dunes or on a geological unit confined to a river/estuary floodplain?

YES	Score	5
(NO)	Score	1

Score [1]

Source: Refer to 1:50,000 Environmental Geology Series (see Gozzard 1982).

Management Notes: Geological origin is one of the bases for wetland classification systems. In the metropolitan area, wetlands within these geological units are rare.

ii Adjacent wetlands

Are there wetlands within a 2km radius?

(YES)			*go to question iii*
NO	Score	3	*go to question (iv)*

Score [0]

Source : Aerial photos.

Management Notes: Refer to question (iii).

iii Habitat diversity

Is the composition and structure of the vegetation significantly different to that found at nearby wetlands?

(YES)	Score	3
NO	Score	1

Score [3]

Source: Refer to question (iv) for a list of habitat types. Use aerial photos and field visits.

iv Habitat type

Using the list below score one for each habitat type represented (maximum score 10).

a) Vegetation over 0.1 hectare (1000m^2) in area.

- large paperbarks (>2.5m tall) in dense clumps [1]
- low thickets (ie <2.5m tall). These are often *Melaleuca, Astartea* or *Kunzea* spp [ ]
- paperbark fringe [ ]
- fringing rushes and sedges (often *Baumea, Juncea* spp) [ ]
- fringing *Typha* (bullrush) [ ]
- samphire or saltmarsh [ ]
- extensive inlake beds of *Typha* or other rushes [ ]
- scattered dense clumps of rushes or sedges [1]

b) Other habitats

- flooded grassland in winter/spring [1]
- mud flats or seasonally dry open water [1]
- islands — natural or human made [ ]
- fringing woodland or heath (eg eucalyptus nodes or non-wetland species) [ ]
- permanent shallow open water < 50cm deep [ ]
- permanent deep open water > 50cm deep [ ]

Score ½ point for

- scattered paperbarks [½]
- scattered rushes [½]

Score [5]

Source: Field visit and aerial photos.

Management Notes: The composition, density and structure of the vegetation around a wetland has a major influence on the size and diversity of bird and other animal populations.The more complex the vegetation associations, the greater the habitat diversity.

v **Drainage**

Are there drains directing water into or out of the wetland?

YES	Score	0
(NO)	Score	5

Score [5]

Source: Field inspection and visit to local government authority.

Management Notes: Surface water run-off entering wetlands via drains is often polluted. Nutrient inputs from this source should ideally be monitored for several years before determining the most appropriate means of managing algal and insect problems.

vi Area of wetland modified

What proportion of the wetland has been modified by clearing of vegetation (including undergrowth) landfill, paving, cultivated gardens/playing fields, irrigated agriculture, grazing, weed invasion, mining etc?

Percentage modified	Score
0 - 10 %	5
11 - 20%	4
21 - 30 %	3
31 - 40%	2
(> 40%)	1

Score

Source: Aerial photos and maps.

Management Notes: See question (vii)

vii wetland size

Estimate wetland size and score as follows:

Area	Score
>100ha	5
50-100ha	4
25-50ha	3
10-25ha	2
(<10ha)	1

Score [ ]

Source: Map of appropriate scale in conjunction with a grid overlay. The edge of the inundated area (often indicated by fringing vegetation or summer grass) should be used as the wetland perimeter for this calculation.

Management Notes: As a general rule large wetlands are capable of supporting a larger variety of species and have a greater capacity to absorb the detrimental impacts of nearby land uses than small wetlands. Where a wetland chain is severed by urban development, species diversity within individual lakes often declines due to a reduction in habitat diversity (see management notes Question (vi).

TOTAL SCORE [16]

Part III - Human-use questionnaire

i Aesthetics

Does the wetland possess any of the following attributes? (score appropriately and add score at the end)

Little, if any, artificial noise	Score	2	[2]
Understorey mostly intact	Score	2	[ ]
Few, or no, roads or buildings obvious from wetland	Score	2	[ ]
Steep ridge visible as part of the scenery	Score	1	[ ]
Ridge accessible giving view of wetland	Score	1	[ ]
Wetland is a lake and open water easy to view	Score	1	[ ]
A section of wetland exists where few people visit	Score	1	[ ]

[ ]

Score [2]

Source: Field survey.

Management Notes: A management plan should try to ensure that these attributes are preserved or enhanced by proposed developments.

ii Historical and archaeological features

Does the wetland have any of the following historical or archaeological features?

- registered Aboriginal relics or sacred sites[3].
- pioneer relics/operations
- National Estate/Trust listings

Score according to the following table:

[

Number of historical archaeological features	Score
2 or more	5
one	3
(0)	0

[ ]

Score [0]

[3] This information may not be made available by the Aboriginal Sites Department in some circumstances. In these situations it should be assumed that a site is present and scored appropriately.

Source: Field survey, local government authorities, National Trust, WA Museum — Department of Aboriginal Sites.

Management Notes: Strategies for the protection and/or preservation of historical and archaeological features should be clearly defined in the management plan for the wetland.

iii Security of wetland

What is the current vesting of the land containing the wetland ? Score according to the following table.

Vesting/ownership of wetland	Score
A Class Reserve for conservation and recreation or Metropolitan Region Scheme reserve for Parks and Recreation owned by the Department of Planning and Urban Development or local government authority.	5
Other class of reserve — vested System Six recommendation unvested or on private property	3
Other class of reserve — unvested	2
Other (eg private or vacant Crown land)	(1)

Score [1]

iv Protection groups

Does the wetland have active community protection groups?

One or more Score 5

No groups Score 0

Score [0]

v Passive recreation

Is the wetland used for any of the following passive recreation activities?

If yes, score 1 for each

- nature study/bird watching [ ]
- education (school or other educational interest within 500m) [ ]
- picnic and /or barbecue facilities [ ]
- conservation of flora (refer to maps) [ ]
- conservation of fauna (refer to maps) [ ]
- protection and preservation of other attributes [ ]
- recognised research site
  - — biological
  - — archaeological

— other [ ]

- recognised tourist venue [ ]

Score [1]

Source: Field surveys, maps, road directories, State and local government department and residents.

Management Notes: Damage such as trampling, erosion and destruction of vegetation should be noted during the field visit.

vi Active recreation

Is the wetland used for any of the following active recreational activities? If yes, score 1 for each.

- walking/jogging or cycling [1]
- horse riding [ ]
- trail bike riding [ ]
- playground [ ]
- sports grounds [ ]
- model boats [ ]
- golf course [ ]
- canoeing/rowing [ ]
- power boating/skiing [ ]
- swimming [ ]

Score [1]

Source: State and local government recreation departments.

Management Notes: Damage from current activities should be recorded during the field survey and reported to the appropriate authority/s.

vii Other human-uses

Is the wetland used for any of the following purposes? (Score 1 for each)

- agricultural activities (grazing, horticulture etc) [ ]
- mining (check for mining leases) [ ]
- existing/proposed service corridors (SECWA, roads, etc) [ ]
- water supply [ ]
- proposed urban/housing use [1]
- private purposes other than described above [ ]

Score [1]

Source: Field survey, maps and State and local government departments.

Management Notes: The compatibility of the above activities with conservation values should be considered during the formulation of a management plan. It may not be practical to achieve all management objectives, and land use priorities will have to be decided.

TOTAL SCORE [6]

Part IV - Supplementary questions

These questions are to be used to

- determine the most appropriate management category for a wetland where the natural attributes and human-use score falls in the "transition zones" in the graph in Appendix 2;
- determining the most appropriate management category for wetlands on private land with high private human-use value.

Instructions

1. If the answer is YES in question i (below) the wetland should be moved to the management category to the right.

   If NO, move to left.
2. If the answer to either ii or iii is YES, move upwards; if NO move downwards.
3. If the answer to iv is yes, then:
   - if the wetland is in Category R, the wetland is allocated management category O unless Part I applies; or
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i Species rarity

Are rare (and not gazetted) species of animals or plants present or are there communities represented which have a limited distribution?

Source: Department of Conservation and Land Management, local government authorities, conservation groups, literature searches.

Management Notes: Wetlands supporting rare and endangered species should be given priority when allocating resources for the formulation of management plans and implementation of field works.

YES/NO

ii Effect on land values

Does the wetland significantly enhance real estate values and land rates around it? ie, does the wetland add more than 10% to the value of nearby houses?

Source: local government authorities, estate agents.

Management Notes: The enhancement of real estate values is a legitimate reason for increased expenditure on the active management of a wetland.

YES/NO

iii Human use

Do more than 100 people visit the wetland each week?

Source: Extended field surveys, State and local government recreation departments.

Management Notes: This question provides a good measure of the need for human-use management.

YES/NO

iv) private human-use value

Where there is evidence of private use of the wetland (stock grazing, views of wetland from house or private recreation) ask owner how important the wetland is as a private resource. Does the owner rate it highly?

Source: evidence from field trip and interview with owner.

YES/NO

References

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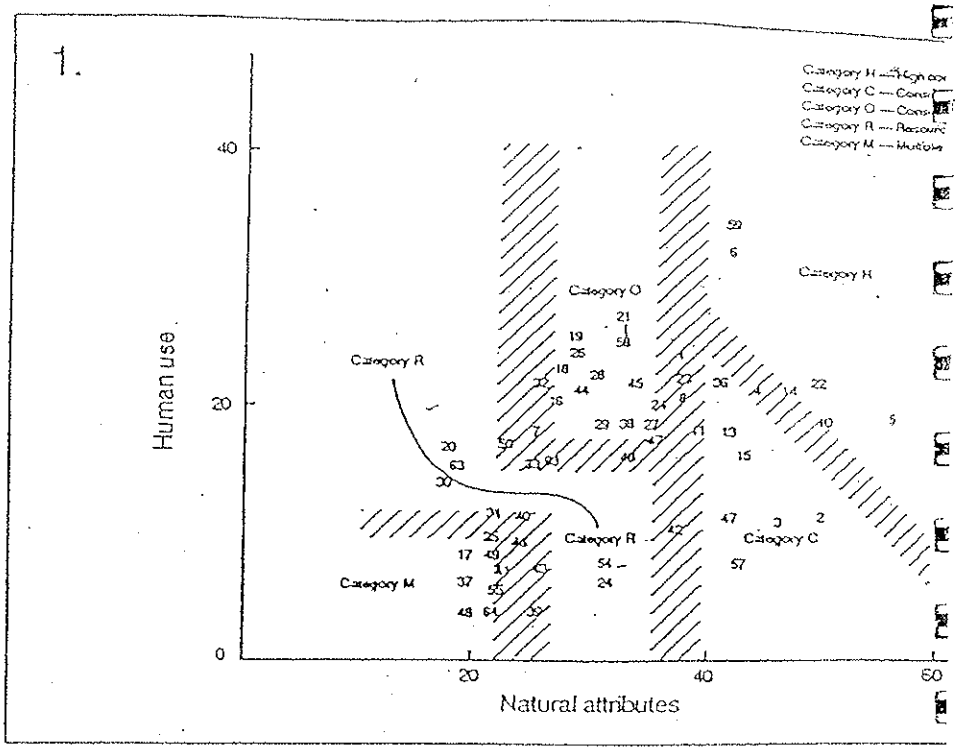
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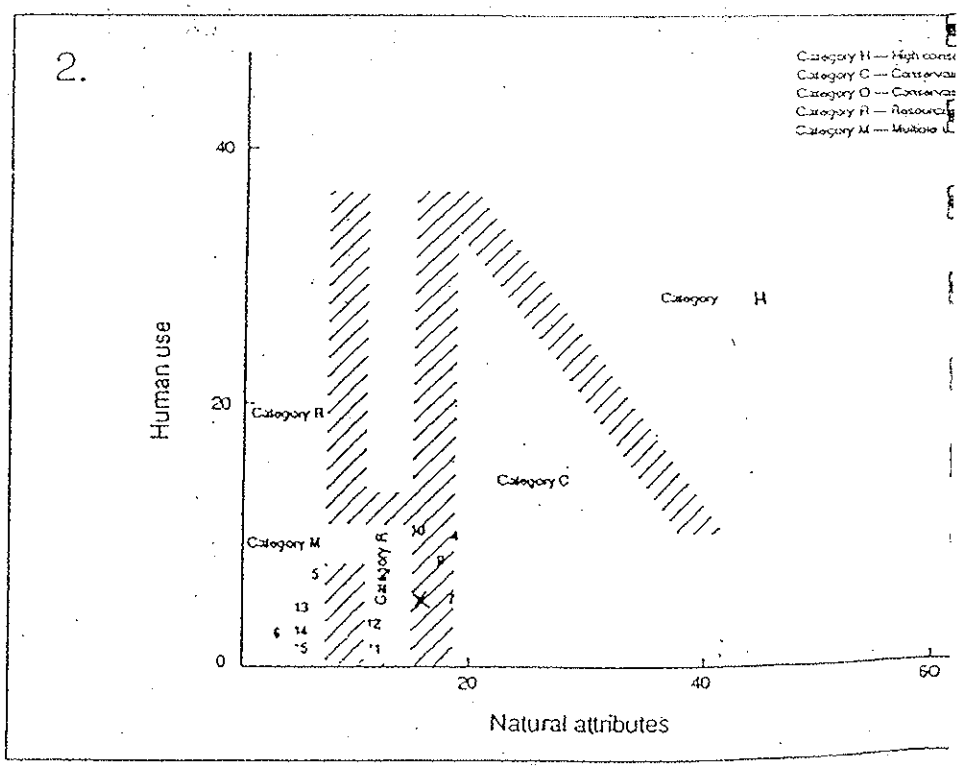
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Episodic wetlands	Wetland with surface water for a period of time but not every year.
Extensive wetland	Large seasonally waterlogged wetlands found on the east of the Swan Coastal Plain, found typically on the Pinjarra Plain and the Bassendean Dunal system.
Function	Ecological (biological and chemical), hydrological or social process carried out by a wetland - eg food web and flood control.
Gazetted rare species	Species Gazetted Endangered under the Wildlife Conservation Act.
Hydrological function	Wetland processes that are related to water only - flood control, and drainage
Lake (as used in EPA Bulletin 227)	A wetland dominated by open water (rather than emergent vegetation), whether permanent, seasonal or ephemeral.
Lake (Semeniuk, 1987)	A basin wetland permanently inundated irrespective of vegetation cover.
Lentic wetland	Wetland where the water is stationary - a lake or swamp.
Lotic wetland	Wetland where the water is moving - streams and rivers.





Graph 1 : Management categories for permanent and seasonal wetlands with well defined
Graph 2: Management categories for seasonal and episodic wetlands with poorly defined

Wetland Mgt - Swale - Reference

Part IIB: Seasonal and episodic wetlands with poorly defined boundaries

Introduction - "zoning" the wetlands

As described in Section 2.4, these "extensive" wetlands cannot be treated as single units. Zone the wetland as described in Section 4.2, Step 6. Each section should be the subject of a separate assessment using the following questionnaire. Where the word "wetland" is used it should be interpreted to mean "wetland section".

i Environmental geology classification

Does the wetland occur on the Quindalup Dunes or on a geological unit confined to a river/estuary floodplain?

YES	Score	5
(NO)	Score	1

Score [1]

Source: Refer to 1:50,000 Environmental Geology Series (see Gozzard 1982).

Management Notes: Geological origin is one of the bases for wetland classification systems. In the metropolitan area, wetlands within these geological units are rare.

ii Adjacent wetlands

Are there wetlands within a 2km radius?

(YES)			*go to question iii*
NO	Score	3	*go to question (iv)*

Score [0]

Source : Aerial photos.

Management Notes: Refer to question (iii).

iii Habitat diversity

Is the composition and structure of the vegetation significantly different to that found at nearby wetlands?

YES	Score	3
(NO)	Score	1

Score [1]

Source: Refer to question (iv) for a list of habitat types. Use aerial photos and field visits.

iv Habitat type

Using the list below score one for each habitat type represented (maximum score 10).

a) Vegetation over 0.1 hectare (1000m^2) in area.

- large paperbarks (>2.5m tall) in dense clumps [1]
- low thickets (ie <2.5m tall). These are often *Melaleuca, Astartea* or *Kunzea* spp [ ]
- paperbark fringe [ ]
- fringing rushes and sedges (often *Baumea, Juncea* spp) [ ]
- fringing *Typha* (bullrush) [ ]
- samphire or saltmarsh [ ]
- extensive inlake beds of *Typha* or other rushes [ ]
- scattered dense clumps of rushes or sedges [1]

b) Other habitats

- flooded grassland in winter/spring [1]
- mud flats or seasonally dry open water [1]
- islands — natural or human made [ ]
- fringing woodland or heath (eg eucalyptus nodes or non-wetland species) [ ]
- permanent shallow open water < 50cm deep [ ]
- permanent deep open water > 50cm deep [ ]

Score ½ point for

- scattered paperbarks [½]
- scattered rushes [½]

Score [5]

Source: Field visit and aerial photos.

Management Notes: The composition, density and structure of the vegetation around a wetland has a major influence on the size and diversity of bird and other animal populations.The more complex the vegetation associations, the greater the habitat diversity.

v Drainage

Are there drains directing water into or out of the wetland?

YES	Score	0
NO	Score	5

Score [5]

Source: Field inspection and visit to local government authority.

Management Notes: Surface water run-off entering wetlands via drains is often polluted. Nutrient inputs from this source should ideally be monitored for several years before determining the most appropriate means of managing algal and insect problems.

vi Area of wetland modified

What proportion of the wetland has been modified by clearing of vegetation (including undergrowth) landfill, paving, cultivated gardens/playing fields, irrigated agriculture, grazing, weed invasion, mining etc?

Percentage modified	Score
0 - 10 %	5
11 - 20%	4
21 - 30 %	3
31 - 40%	2
> 40%	1

Score [ ]

Source: Aerial photos and maps.

Management Notes: See question (vii)

vii wetland size

Estimate wetland size and score as follows:.

Area	Score
>100ha	5
50-100ha	4
25-50ha	3
10-25ha	2
<10ha	1

Score [ ]

Source: Map of appropriate scale in conjunction with a grid overlay. The edge of the inundated area (often indicated by fringing vegetation or summer grass) should be used as the wetland perimeter for this calculation.

Management Notes: As a general rule large wetlands are capable of supporting a larger variety of species and have a greater capacity to absorb the detrimental impacts of nearby land uses than small wetlands. Where a wetland chain is severed by urban development, species diversity within individual lakes often declines due to a reduction in habitat diversity (see management notes Question (vi).

TOTAL SCORE [ ]

+ 8

= 18

Part III - Human-use questionnaire

i Aesthetics

Does the wetland possess any of the following attributes? (score appropriately and add score at the end)

Little, if any, artificial noise	Score	2	[2]
Understorey mostly intact	Score	2	[ ]
Few, or no, roads or buildings obvious from wetland	Score	2	[2]
Steep ridge visible as part of the scenery	Score	1	[ ]
Ridge accessible giving view of wetland	Score	1	[ ]
Wetland is a lake and open water easy to view	Score	1	[ ]
A section of wetland exists where few people visit	Score	1	[ ]

Score [4]

Source: Field survey.

Management Notes: A management plan should try to ensure that these attributes are preserved or enhanced by proposed developments.

ii Historical and archaeological features

Does the wetland have any of the following historical or archaeological features?

- registered Aboriginal relics or sacred sites[3].
- pioneer relics/operations
- National Estate/Trust listings

Score according to the following table:

Number of historical archaeological features	Score
2 or more	5
one	3
(0)	0

Score [0]

[3] This information may not be made available by the Aboriginal Sites Department in some circumstances. In these situations it should be assumed that a site is present and scored appropriately.

Source: Field survey, local government authorities, National Trust, WA Museum — Department of Aboriginal Sites.

Management Notes: Strategies for the protection and/or preservation of historical and archaeological features should be clearly defined in the management plan for the wetland.

iii Security of wetland

What is the current vesting of the land containing the wetland ? Score according to the following table.

Vesting/ownership of wetland	Score
A Class Reserve for conservation and recreation or Metropolitan Region Scheme reserve for Parks and Recreation owned by the Department of Planning and Urban Development or local government authority.	5
Other class of reserve — vested System Six recommendation unvested or on private property	3
Other class of reserve — unvested	2
Other (eg private or vacant Crown land)	(1)

Score [1]

iv Protection groups

Does the wetland have active community protection groups?

One or more Score 5

No groups. Score 0

Score [0]

v Passive recreation

Is the wetland used for any of the following passive recreation activities?

If yes, score 1 for each

- nature study/bird watching [1]
- education (school or other educational interest within 500m) [ ]
- picnic and /or barbecue facilities [ ]
- conservation of flora (refer to maps) [ ]
- conservation of fauna (refer to maps) [ ]
- protection and preservation of other attributes [ ]
- recognised research site
  - — biological
  - — archaeological

— other [ ]

- recognised tourist venue [ ]

Score [ ]

Source: Field surveys, maps, road directories, State and local government department and residents.

Management Notes: Damage such as trampling, erosion and destruction of vegetation should be noted during the field visit.

vi Active recreation

Is the wetland used for any of the following active recreational activities? If yes, score 1 for each.

- walking/jogging or cycling [ ]
- horse riding [ ]
- trail bike riding [ ]
- playground [ ]
- sports grounds [ ]
- model boats [ ]
- golf course [ ]
- canoeing/rowing [ ]
- power boating/skiing [ ]
- swimming [ ]

Score [ ]

Source: State and local government recreation departments.

Management Notes: Damage from current activities should be recorded during the field survey and reported to the appropriate authority/s.

vii Other human-uses

Is the wetland used for any of the following purposes? (Score 1 for each)

- agricultural activities (grazing, horticulture etc) [ ]
- mining (check for mining leases) [ ]
- existing/proposed service corridors (SECWA, roads, etc) [ ]
- water supply [ ]
- proposed urban/housing use [ ]
- private purposes other than described above [ ]

Score [ ]

Source: Field survey, maps and State and local government departments.

Management Notes: The compatibility of the above activities with conservation values should be considered during the formulation of a management plan. It may not be practical to achieve all management objectives, and land use priorities will have to be decided.

TOTAL SCORE [7]

Part IV - Supplementary questions

These questions are to be used to

- determine the most appropriate management category for a wetland where the natural attributes and human-use score falls in the "transition zones" in the graph in Appendix 2;
- determining the most appropriate management category for wetlands on private land with high private human-use value.

Instructions

1. If the answer is YES in question i (below) the wetland should be moved to the management category to the right.
   If NO, move to left.
2. If the answer to either ii or iii is YES, move upwards; if NO move downwards.
3. If the answer to iv is yes, then:
   - if the wetland is in Category R, the wetland is allocated management category O unless Part I applies; or
   - if wetland is in any other category, do not change the category but make a note for future reference.

i Species rarity

Are rare (and not gazetted) species of animals or plants present or are there communities represented which have a limited distribution?

Source: Department of Conservation and Land Management, local government authorities, conservation groups, literature searches.

Management Notes: Wetlands supporting rare and endangered species should be given priority when allocating resources for the formulation of management plans and implementation of field works.

YES/NO

ii Effect on land values

Does the wetland significantly enhance real estate values and land rates around it? ie, does the wetland add more than 10% to the value of nearby houses?

Source: local government authorities, estate agents.

Management Notes: The enhancement of real estate values is a legitimate reason for increased expenditure on the active management of a wetland.

YES/NO

iii Human use

Do more than 100 people visit the wetland each week?

Source: Extended field surveys, State and local government recreation departments.

Management Notes: This question provides a good measure of the need for human-use management.

YES/NO

iv) private human-use value

Where there is evidence of private use of the wetland (stock grazing, views of wetland from house or private recreation) ask owner how important the wetland is as a private resource. Does the owner rate it highly?

Source: evidence from field trip and interview with owner.

YES/NO

References

Environmental Protection Authority (1986). *Draft Guidelines for Wetland Conservation in the Perth Metropolitan Area*. Department of Conservation and Environment, Perth, Western Australia. Bulletin 227

Environmental Protection Authority (1990). *A guide to wetland management in Perth.* , Perth, Western Australia. Bulletin 374

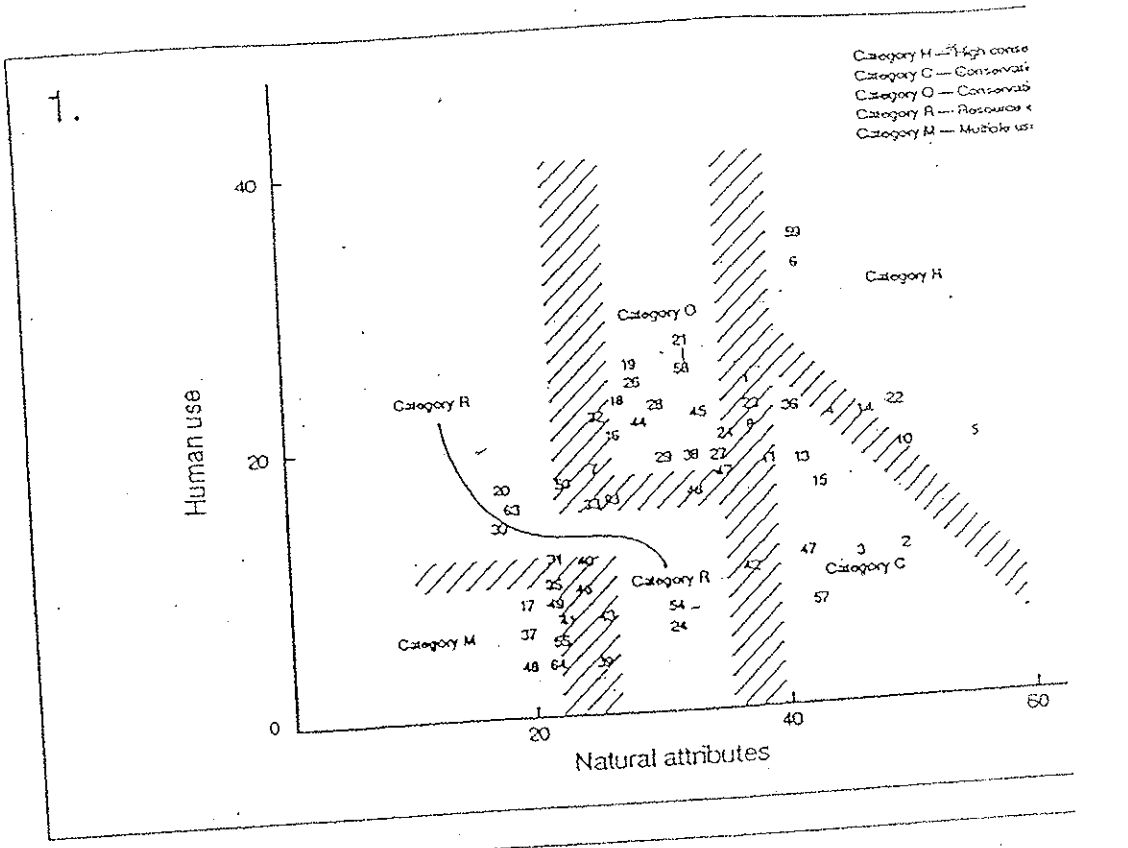
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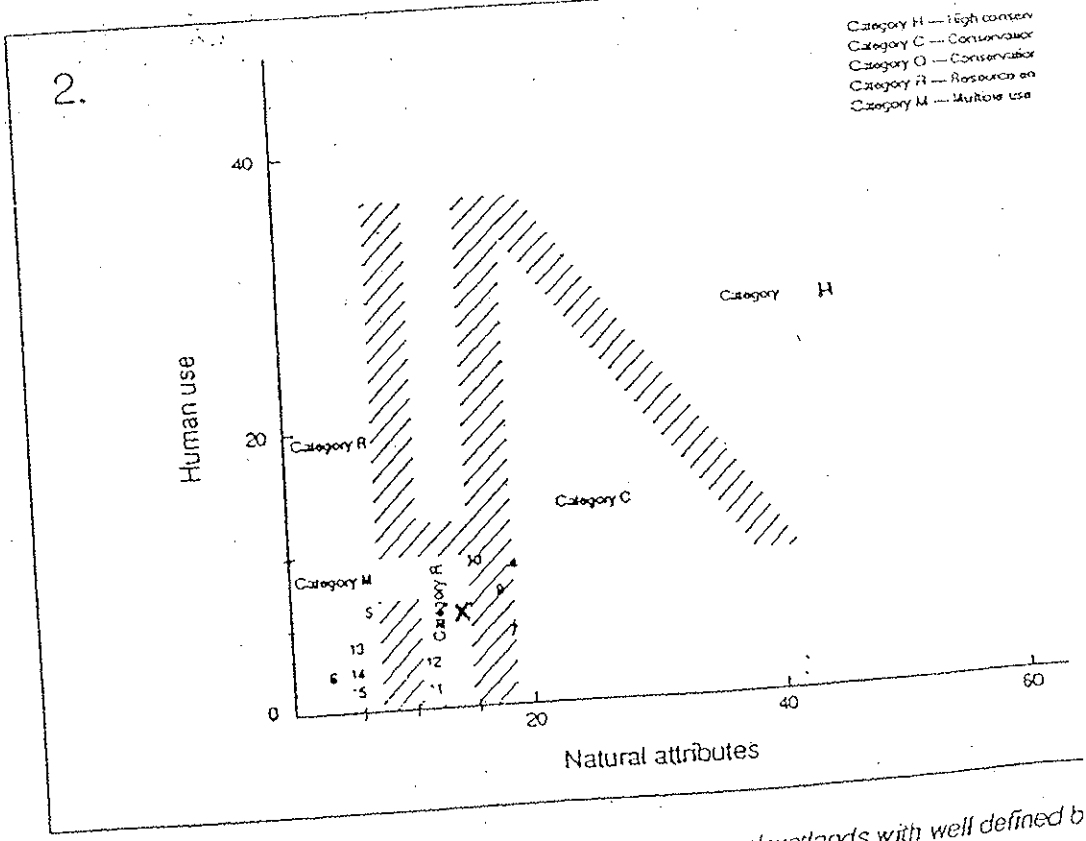
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Glossary of terms

The definitions given here are as they relate to wetlands and their useage in this Bulletin.

Term/word	definition
Attribute	Characteristic used to describe a wetland - eg size, diversity and depth of water.
Dampland	A basin wetland where the soil is seasonally waterlogged.
Episodic wetlands	Wetland with surface water for a period of time but not every year.
Extensive wetland	Large seasonally waterlogged wetlands found on the east of the Swan Coastal Plain, found typically on the Pinjarra Plain and the Bassendean Dunal system.
Function	Ecological (biological and chemical), hydrological or social process carried out by a wetland - eg food web and flood control.
Gazetted rare species	Species Gazetted Endangered under the Wildlife Conservation Act.
Hydrological function	Wetland processes that are related to water only - flood control, and drainage
Lake (as used in EPA Bulletin 227)	A wetland dominated by open water (rather than emergent vegetation), whether permanent, seasonal or ephemeral.
Lake (Semeniuk, 1987)	A basin wetland permanently inundated irrespective of vegetation cover.
Lentic wetland	Wetland where the water is stationary - a lake or swamp.
Lotic wetland	Wetland where the water is moving - streams and rivers.





Graph 1 : Management categories for permanent and seasonal wetlands with well defined b
Graph 2: Management categories for seasonal and episodic wetlands with poorly defined bo

Wetland 6 - C/R - Underwater → R

Part IIB: Seasonal and episodic wetlands with poorly defined boundaries

Introduction - "zoning" the wetlands

As described in Section 2.4, these "extensive" wetlands cannot be treated as single units. Zone the wetland as described in Section 4.2, Step 6. Each section should be the subject of a separate assessment using the following questionnaire. Where the word "wetland" is used it should be interpreted to mean "wetland section".

i Environmental geology classification

Does the wetland occur on the Quindalup Dunes or on a geological unit confined to a river/estuary floodplain?

(YES)	Score	5
NO	Score	1

Score [5]

Source: Refer to 1:50,000 Environmental Geology Series (see Gozzard 1982).

Management Notes: Geological origin is one of the bases for wetland classification systems. In the metropolitan area, wetlands within these geological units are rare.

ii Adjacent wetlands

Are there wetlands within a 2km radius?

(YES)			*go to question iii*
NO	Score	3	*go to question (iv)*

Score [0]

Source : Aerial photos.

Management Notes: Refer to question (iii).

iii Habitat diversity

Is the composition and structure of the vegetation significantly different to that found at nearby wetlands?

YES	Score	3
(NO)	Score	1

Score [1]

Source: Refer to question (iv) for a list of habitat types. Use aerial photos and field visits.

iv Habitat type

Using the list below score one for each habitat type represented (maximum score 10).

a) Vegetation over 0.1 hectare (1000m^2) in area.

- large paperbarks (>2.5m tall) in dense clumps [1]
- low thickets (ie <2.5m tall). These are often *Melaleuca, Astartea* or *Kunzea* spp [ ]
- paperbark fringe [1]
- fringing rushes and sedges (often *Baumea, Juncea* spp) [ ]
- fringing *Typha* (bullrush) [ ]
- samphire or saltmarsh [1]
- extensive inlake beds of *Typha* or other rushes [ ]
- scattered dense clumps of rushes or sedges [ ]

b) Other habitats

- flooded grassland in winter/spring [ ]
- mud flats or seasonally dry open water [ ]
- islands — natural or human made [ ]
- fringing woodland or heath (eg eucalyptus nodes or non-wetland species) [ ]
- permanent shallow open water < 50cm deep [ ]
- permanent deep open water > 50cm deep [ ]

Score ½ point for

- scattered paperbarks [½]
- scattered rushes [½]

Score [4]

Source: Field visit and aerial photos.

Management Notes: The composition, density and structure of the vegetation around a wetland has a major influence on the size and diversity of bird and other animal populations. The more complex the vegetation associations, the greater the habitat diversity.

v Drainage

Are there drains directing water into or out of the wetland?

YES	Score	0
(NO)	Score	5

Score [5]

Source: Field inspection and visit to local government authority.

Management Notes: Surface water run-off entering wetlands via drains is often polluted. Nutrient inputs from this source should ideally be monitored for several years before determining the most appropriate means of managing algal and insect problems.

vi Area of wetland modified

What proportion of the wetland has been modified by clearing of vegetation (including undergrowth) landfill, paving, cultivated gardens/playing fields, irrigated agriculture, grazing, weed invasion, mining etc?

Percentage modified	Score
0 - 10 %	5
11 - 20%	4
21 - 30 %	3
31 - 40%	2
> 40%	1

Score

Source: Aerial photos and maps.

Management Notes: See question (vii)

vii wetland size

Estimate wetland size and score as follows:.

Area	Score
>100ha	5
50-100ha	4
25-50ha	3
10-25ha	2
<10ha	1

Score

Source: Map of appropriate scale in conjunction with a grid overlay. The edge of the inundated area (often indicated by fringing vegetation or summer grass) should be used as the wetland perimeter for this calculation.

Management Notes: As a general rule large wetlands are capable of supporting a larger variety of species and have a greater capacity to absorb the detrimental impacts of nearby land uses than small wetlands. Where a wetland chain is severed by urban development, species diversity within individual lakes often declines due to a reduction in habitat diversity (see management notes Question (vi).

TOTAL SCORE

Part III - Human-use questionnaire

i Aesthetics

Does the wetland possess any of the following attributes? (score appropriately and add score at the end)

Little, if any, artificial noise	Score	2	[2]
Understorey mostly intact	Score	2	[2]
Few, or no, roads or buildings obvious from wetland	Score	2	[2]
Steep ridge visible as part of the scenery	Score	1	[ ]
Ridge accessible giving view of wetland	Score	1	[ ]
Wetland is a lake and open water easy to view	Score	1	[ ]
A section of wetland exists where few people visit	Score	1	[ ]

Score [6]

Source: Field survey.

Management Notes: A management plan should try to ensure that these attributes are preserved or enhanced by proposed developments.

ii Historical and archaeological features

Does the wetland have any of the following historical or archaeological features?

- registered Aboriginal relics or sacred sites[3] .
- pioneer relics/operations
- National Estate/Trust listings

Score according to the following table:

Number of historical archaeological features	Score
2 or more	5
one	3
0	0

Score [0]

[3] This information may not be made available by the Aboriginal Sites Department in some circumstances. In these situations it should be assumed that a site is present and scored appropriately.

Source: Field survey, local government authorities, National Trust, WA Museum — Department of Aboriginal Sites.

Management Notes: Strategies for the protection and/or preservation of historical and archaeological features should be clearly defined in the management plan for the wetland.

iii Security of wetland

What is the current vesting of the land containing the wetland ? Score according to the following table.

Vesting/ownership of wetland	Score
A Class Reserve for conservation and recreation or Metropolitan Region Scheme reserve for Parks and Recreation owned by the Department of Planning and Urban Development or local government authority.	5
Other class of reserve — vested System Six recommendation unvested or on private property	3
Other class of reserve — unvested	2
Other (eg private or vacant Crown land)	(1)

Score [1]

iv Protection groups

Does the wetland have active community protection groups?

One or more Score 5

No groups Score 0

Score [5]

v Passive recreation

Is the wetland used for any of the following passive recreation activities?

If yes, score 1 for each

- nature study/bird watching [1]
- education (school or other educational interest within 500m) [ ]
- picnic and /or barbecue facilities [ ]
- conservation of flora (refer to maps) [ ]
- conservation of fauna (refer to maps) [ ]
- protection and preservation of other attributes [ ]
- recognised research site
  - — biological
  - — archaeological

— other [ ]

- recognised tourist venue [ ]

Score [1]

Source: Field surveys, maps, road directories, State and local government department and residents.

Management Notes: Damage such as trampling, erosion and destruction of vegetation should be noted during the field visit.

vi Active recreation

Is the wetland used for any of the following active recreational activities? If yes, score 1 for each.

- walking/jogging or cycling [1]
- horse riding [ ]
- trail bike riding [ ]
- playground [ ]
- sports grounds [ ]
- model boats [ ]
- golf course [ ]
- canoeing/rowing [ ]
- power boating/skiing [ ]
- swimming [ ]

Score [1]

Source: State and local government recreation departments.

Management Notes: Damage from current activities should be recorded during the field survey and reported to the appropriate authority/s.

vii Other human-uses

Is the wetland used for any of the following purposes? (Score 1 for each)

- agricultural activities (grazing, horticulture etc) [ ]
- mining (check for mining leases) [ ]
- existing/proposed service corridors (SECWA, roads, etc) [ ]
- water supply [ ]
- proposed urban/housing use [ ]
- private purposes other than described above [ ]

Score [0]

Source: Field survey, maps and State and local government departments.

Management Notes: The compatibility of the above activities with conservation values should be considered during the formulation of a management plan. It may not be practical to achieve all management objectives, and land use priorities will have to be decided.

TOTAL SCORE [9]

Part IV - Supplementary questions

These questions are to be used to

- determine the most appropriate management category for a wetland where the natural attributes and human-use score falls in the "transition zones" in the graph in Appendix 2;
- determining the most appropriate management category for wetlands on private land with high private human-use value.

Instructions

1. If the answer is YES in question i (below) the wetland should be moved to the management category to the right.

   If NO, move to left.
2. If the answer to either ii or iii is YES, move upwards; if NO move downwards.
3. If the answer to iv is yes, then:
   - if the wetland is in Category R, the wetland is allocated management category O unless Part I applies; or
   - if wetland is in any other category, do not change the category but make a note for future reference.

i Species rarity

Are rare (and not gazetted) species of animals or plants present or are there communities represented which have a limited distribution?

Source: Department of Conservation and Land Management, local government authorities, conservation groups, literature searches.

Management Notes: Wetlands supporting rare and endangered species should be given priority when allocating resources for the formulation of management plans and implementation of field works.

YES/NO

ii Effect on land values

Does the wetland significantly enhance real estate values and land rates around it? ie, does the wetland add more than 10% to the value of nearby houses?

Source: local government authorities, estate agents.

Management Notes: The enhancement of real estate values is a legitimate reason for increased expenditure on the active management of a wetland.

YES/NO

iii Human use

Do more than 100 people visit the wetland each week?

Source: Extended field surveys, State and local government recreation departments.

Management Notes: This question provides a good measure of the need for human-use management.

YES/NO

iv) private human-use value

Where there is evidence of private use of the wetland (stock grazing, views of wetland from house or private recreation) ask owner how important the wetland is as a private resource. Does the owner rate it highly?

Source: evidence from field trip and interview with owner.

YES/NO

References

Environmental Protection Authority (1986). *Draft Guidelines for Wetland Conservation in the Perth Metropolitan Area.* Department of Conservation and Environment, Perth, Western Australia. Bulletin 227

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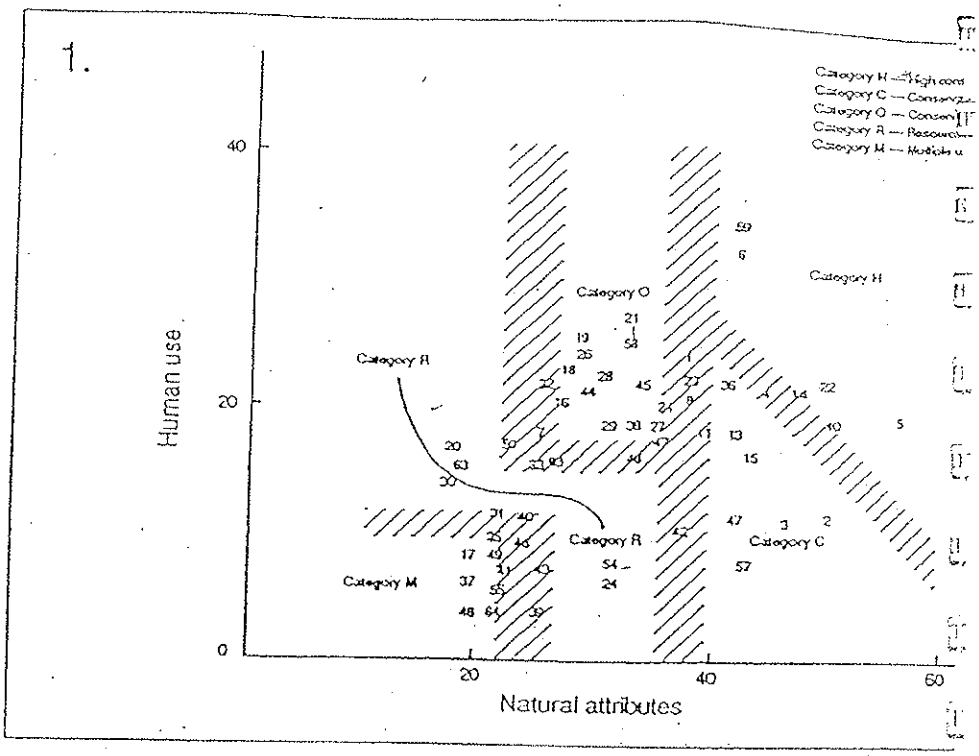
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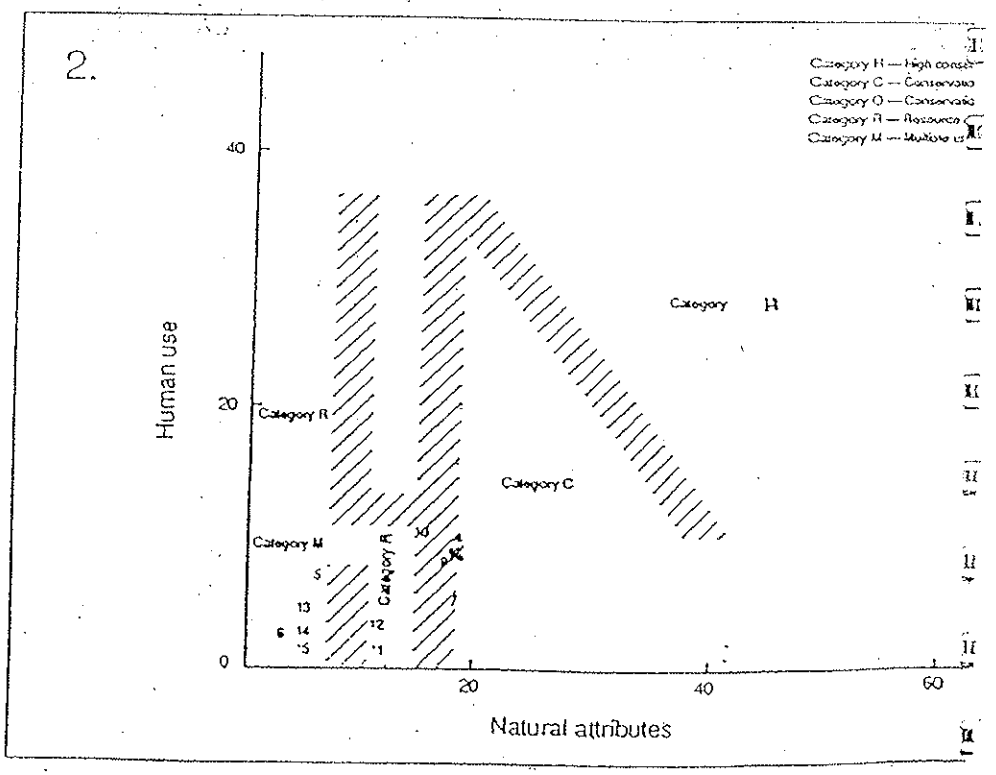
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The definitions given here are as they relate to wetlands and their useage in this Bulletin.

Term/word	definition
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Extensive wetland	Large seasonally waterlogged wetlands found on the east of the Swan Coastal Plain, found typically on the Pinjarra Plain and the Bassendean Dunal system.
Function	Ecological (biological and chemical), hydrological or social process carried out by a wetland - eg food web and flood control.
Gazetted rare species	Species Gazetted Endangered under the Wildlife Conservation Act.
Hydrological function	Wetland processes that are related to water only - flood control, and drainage
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Lake (Semeniuk, 1987)	A basin wetland permanently inundated irrespective of vegetation cover.
Leatic wetland	Wetland where the water is stationary - a lake or swamp.
Lotic wetland	Wetland where the water is moving - streams and rivers.





Graph 1 : Management categories for permanent and seasonal wetlands with well defined b

Graph 2: Management categories for seasonal and episodic wetlands with poorly defined bo

Wetland 61 - Conservation

Part IIB: Seasonal and episodic wetlands with poorly defined boundaries

Introduction - "zoning" the wetlands

As described in Section 2.4, these "extensive" wetlands cannot be treated as single units. Zone the wetland as described in Section 4.2, Step 6. Each section should be the subject of a separate assessment using the following questionnaire. Where the word "wetland" is used it should be interpreted to mean "wetland section".

i Environmental geology classification

Does the wetland occur on the Quindalup Dunes or on a geological unit confined to a river/estuary floodplain?

(YES) Score 5
NO Score 1

Score [5]

Source: Refer to 1:50,000 Environmental Geology Series (see Gozzard 1982).

Management Notes: Geological origin is one of the bases for wetland classification systems. In the metropolitan area, wetlands within these geological units are rare.

ii Adjacent wetlands

Are there wetlands within a 2km radius?

(YES) *go to question iii*
NO Score 3 *go to question (iv)*

Score [0]

Source : Aerial photos.

Management Notes: Refer to question (iii).

iii Habitat diversity

Is the composition and structure of the vegetation significantly different to that found at nearby wetlands?

YES Score 3
(NO) Score 1

Score [1]

Source: Refer to question (iv) for a list of habitat types. Use aerial photos and field visits.

iv Habitat type

Using the list below score one for each habitat type represented (maximum score 10).

a) Vegetation over 0.1 hectare (1000m^2) in area.

- large paperbarks (>2.5m tall) in dense clumps [1]
- low thickets (ie <2.5m tall). These are often *Melaleuca, Astartea* or *Kunzea* spp [ ]
- paperbark fringe [1]
- fringing rushes and sedges (often *Baumea, Juncea* spp) [ ]
- fringing *Typha* (bullrush) [ ]
- samphire or saltmarsh [1]
- extensive inlake beds of *Typha* or other rushes [ ]
- scattered dense clumps of rushes or sedges [ ]

b) Other habitats

- flooded grassland in winter/spring [ ]
- mud flats or seasonally dry open water [ ]
- islands — natural or human made [ ]
- fringing woodland or heath (eg eucalyptus nodes or non-wetland species) [ ]
- permanent shallow open water < 50cm deep [ ]
- permanent deep open water > 50cm deep [ ]

Score ½ point for

- scattered paperbarks [½]
- scattered rushes [½]

Score [4]

Source: Field visit and aerial photos.

Management Notes: The composition, density and structure of the vegetation around a wetland has a major influence on the size and diversity of bird and other animal populations.The more complex the vegetation associations, the greater the habitat diversity.

v Drainage

Are there drains directing water into or out of the wetland?

YES	Score	0
(NO)	Score	5

Score [5]

Source: Field inspection and visit to local government authority.

Management Notes: Surface water run-off entering wetlands via drains is often polluted. Nutrient inputs from this source should ideally be monitored for several years before determining the most appropriate means of managing algal and insect problems.

vi Area of wetland modified

What proportion of the wetland has been modified by clearing of vegetation (including undergrowth) landfill, paving, cultivated gardens/playing fields, irrigated agriculture, grazing, weed invasion, mining etc?

Percentage modified	Score
0 - 10 %	5
11 - 20%	4
21 - 30 %	3
31 - 40%	2
> 40%	1

Score [4]

Source: Aerial photos and maps.

Management Notes: See question (vii)

vii wetland size

Estimate wetland size and score as follows:

Area	Score
>100ha	5
50-100ha	4
25-50ha	3
10-25ha	2
<10ha	1

Score [1]

Source: Map of appropriate scale in conjunction with a grid overlay. The edge of the inundated area (often indicated by fringing vegetation or summer grass) should be used as the wetland perimeter for this calculation.

Management Notes: As a general rule large wetlands are capable of supporting a larger variety of species and have a greater capacity to absorb the detrimental impacts of nearby land uses than small wetlands. Where a wetland chain is severed by urban development, species diversity within individual lakes often declines due to a reduction in habitat diversity (see management notes Question (vi).

TOTAL SCORE [20]

Part III - Human-use questionnaire

i Aesthetics

Does the wetland possess any of the following attributes? (score appropriately and add score at the end)

Little, if any, artificial noise	Score	2	[2]
Understorey mostly intact	Score	2	[2]
Few, or no, roads or buildings obvious from wetland	Score	2	[2]
Steep ridge visible as part of the scenery	Score	1	[ ]
Ridge accessible giving view of wetland	Score	1	[ ]
Wetland is a lake and open water easy to view	Score	1	[ ]
A section of wetland exists where few people visit	Score	1	[ ]

Score [6]

Source: Field survey.

Management Notes: A management plan should try to ensure that these attributes are preserved or enhanced by proposed developments.

ii Historical and archaeological features

Does the wetland have any of the following historical or archaeological features?

- registered Aboriginal relics or sacred sites[3] .
- pioneer relics/operations
- National Estate/Trust listings

Score according to the following table:

Number of historical archaeological features	Score
2 or more	5
one	3
(0)	0

Score [0]

[3] This information may not be made available by the Aboriginal Sites Department in some circumstances. In these situations it should be assumed that a site is present and scored appropriately.

Source: Field survey, local government authorities, National Trust, WA Museum — Department of Aboriginal Sites.

Management Notes: Strategies for the protection and/or preservation of historical and archaeological features should be clearly defined in the management plan for the wetland.

iii Security of wetland

What is the current vesting of the land containing the wetland ? Score according to the following table.

Vesting/ownership of wetland	Score
A Class Reserve for conservation and recreation or Metropolitan Region Scheme reserve for Parks and Recreation owned by the Department of Planning and Urban Development or local government authority.	5
Other class of reserve — vested System Six recommendation unvested or on private property	3
Other class of reserve — unvested	2
Other (eg private or vacant Crown land)	(1)

Score [1]

iv Protection groups

Does the wetland have active community protection groups?

One or more Score 5

(No groups) Score 0

Score [0]

v Passive recreation

Is the wetland used for any of the following passive recreation activities?

If yes, score 1 for each

- nature study/bird watching [1]
- education (school or other educational interest within 500m) [ ]
- picnic and /or barbecue facilities [ ]
- conservation of flora (refer to maps) [ ]
- conservation of fauna (refer to maps) [ ]
- protection and preservation of other attributes [ ]
- recognised research site
  - — biological
  - — archaeological

— other [ ]

- recognised tourist venue [ ]

Score [ ]

Source: Field surveys, maps, road directories, State and local government department and residents.

Management Notes: Damage such as trampling, erosion and destruction of vegetation should be noted during the field visit.

vi Active recreation

Is the wetland used for any of the following active recreational activities? If yes, score 1 for each.

- walking/jogging or cycling [ ]
- horse riding [ ]
- trail bike riding [ ]
- playground [ ]
- sports grounds [ ]
- model boats [ ]
- golf course [ ]
- canoeing/rowing [ ]
- power boating/skiing [ ]
- swimming [ ]

Score [ ]

Source: State and local government recreation departments.

Management Notes: Damage from current activities should be recorded during the field survey and reported to the appropriate authority/s.

vii Other human-uses

Is the wetland used for any of the following purposes? (Score 1 for each)

- agricultural activities (grazing, horticulture etc) [ ]
- mining (check for mining leases) [ ]
- existing/proposed service corridors (SECWA, roads, etc) [ ]
- water supply [ ]
- proposed urban/housing use [ ]
- private purposes other than described above [ ]

Score [0]

Source: Field survey, maps and State and local government departments.

Management Notes: The compatibility of the above activities with conservation values should be considered during the formulation of a management plan. It may not be practical to achieve all management objectives, and land use priorities will have to be decided.

TOTAL SCORE [9]

Part IV - Supplementary questions

These questions are to be used to

- determine the most appropriate management category for a wetland where the natural attributes and human-use score falls in the "transition zones" in the graph in Appendix 2;
- determining the most appropriate management category for wetlands on private land with high private human-use value.

Instructions

1. If the answer is YES in question i (below) the wetland should be moved to the management category to the right.

   If NO, move to left.
2. If the answer to either ii or iii is YES, move upwards; if NO move downwards.
3. If the answer to iv is yes, then:
   - if the wetland is in Category R, the wetland is allocated management category O unless Part I applies; or
   - if wetland is in any other category, do not change the category but make a note for future reference.

i Species rarity

Are rare (and not gazetted) species of animals or plants present or are there communities represented which have a limited distribution?

Source: Department of Conservation and Land Management, local government authorities, conservation groups, literature searches.

Management Notes: Wetlands supporting rare and endangered species should be given priority when allocating resources for the formulation of management plans and implementation of field works.

YES/NO

ii Effect on land values

Does the wetland significantly enhance real estate values and land rates around it? ie, does the wetland add more than 10% to the value of nearby houses?

Source: local government authorities, estate agents.

Management Notes: The enhancement of real estate values is a legitimate reason for increased expenditure on the active management of a wetland.

YES/NO

iii Human use

Do more than 100 people visit the wetland each week?

Source: Extended field surveys, State and local government recreation departments.

Management Notes: This question provides a good measure of the need for human-use management.

YES/NO

iv) **private human-use value**

Where there is evidence of private use of the wetland (stock grazing, views of wetland from house or private recreation) ask owner how important the wetland is as a private resource. Does the owner rate it highly?

Source: evidence from field trip and interview with owner. YES/NO

References

Environmental Protection Authority (1986). *Draft Guidelines for Wetland Conservation in the Perth Metropolitan Area*. Department of Conservation and Environment, Perth, Western Australia. Bulletin 227

Environmental Protection Authority (1990). *A guide to wetland management in Perth.* , Perth, Western Australia. Bulletin 374

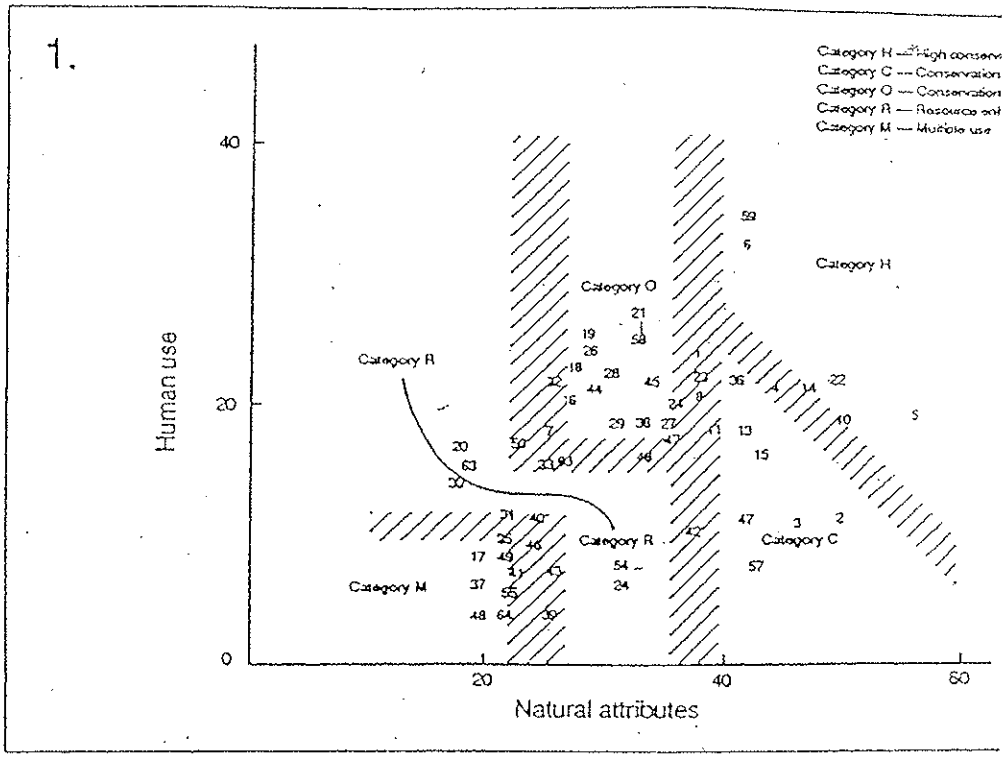
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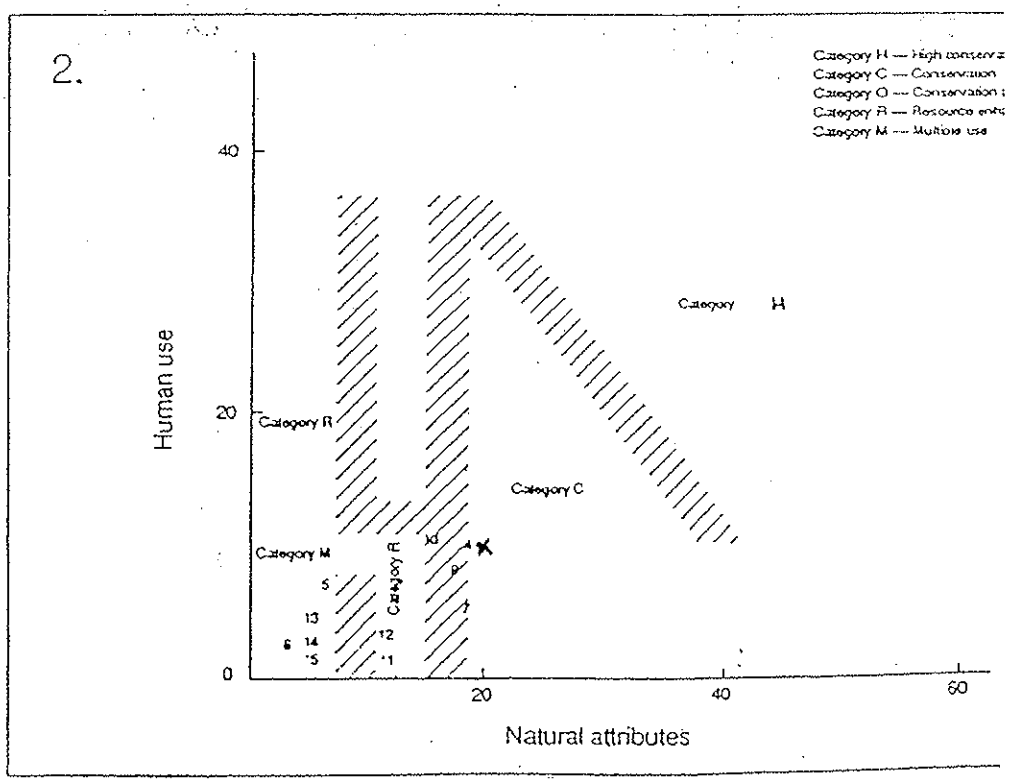
Semeniuk, C. A. (1987). Wetlands of the Darling System - A geomorphic approach to habitat classification. *J. Roy. Soc. W.A.*, **69**, 95-112.

Glossary of terms

The definitions given here are as they relate to wetlands and their useage in this Bulletin.

Term/word	definition
Attribute	Characteristic used to describe a wetland - eg size, diversity and depth of water.
Dampland	A basin wetland where the soil is seasonally waterlogged.
Episodic wetlands	Wetland with surface water for a period of time but not every year.
Extensive wetland	Large seasonally waterlogged wetlands found on the east of the Swan Coastal Plain, found typically on the Pinjarra Plain and the Bassendean Dunal system.
Function	Ecological (biological and chemical), hydrological or social process carried out by a wetland - eg food web and flood control.
Gazetted rare species	Species Gazetted Endangered under the Wildlife Conservation Act.
Hydrological function	Wetland processes that are related to water only - flood control, and drainage
Lake (as used in EPA Bulletin 227)	A wetland dominated by open water (rather than emergent vegetation), whether permanent, seasonal or ephemeral.
Lake (Semeniuk, 1987)	A basin wetland permanently inundated irrespective of vegetation cover.
Lentic wetland	Wetland where the water is stationary - a lake or swamp.
Lotic wetland	Wetland where the water is moving - streams and rivers.





Graph 1 : Management categories for permanent and seasonal wetlands with well defined bo
Graph 2: Management categories for seasonal and episodic wetlands with poorly defined bo

APPENDIX E

City of Mandurah. Town Planning Scheme No. 3 Amendment II

To be Updated

TOWN PLANNING AND DEVELOPMENT ACT, 1928 (AS AMENDED)

City of Mandurah

DISTRICT TOWN PLANNING SCHEME NO. 3

Amendment No.

Resolved that the Council, in pursuance of Section 7 of the Town Planning and Development Act, 1928 (as amended) amend the above Town Planning Scheme for the purposes of:

Transferring portion of Part Murray Location 109, Pleasant Grove Circle, Falcon from the "Conservation and Foreshore Reserve" to the "Residential Zone" and including it within the Residential Planning Code R5.

Dated this ..... day of 2000

.....
CHIEF EXECUTIVE OFFICER

SCHEME AMENDMENT REPORT

1.	Local Authority	City of Mandurah
2.	Description of Town Planning Scheme	District Town Planning Scheme No. 3
3.	Type of Amendment	Rezoning
4.	Serial No. of Amendment	Amendment No. _____
5.	Proposal	To rezone approximately 2.38 hectares of land currently reserved for Conservation & Foreshore to Residential R5.

6. Background

Pleasant Grove Pty Ltd is the developer of the Pleasant Grove Estate occupying Ward Point on the Peel/Harvey Estuary and being situated along the Old Coast Road at Falcon, south of Mandurah. Based on management planning at the time, a site of approximately 2 hectares was set aside at Ward Point as the site for a future yacht club. Pleasant Grove Pty Ltd agreed that the yacht club site would be transferred free of cost to the local authority on the basis that it was developed as a yacht club. The site was subsequently shown within the Mandurah Town Planning Scheme 1A, Gazetted on 30 December, 1983, as District Recreation.

Under this reserve, a number of uses were possible including such activities as club premises, private recreation, health centre, public amusement and eating house. In addition, by omission, multiple dwellings were also a use which could have accommodated on land reserved District Recreation.

In recognition that use of the yacht club site would be restricted to members only, an adjoining area of approximately 0.85 hectares was included within the Special Zone – Recreation and Marine Commercial with a view to providing facilities on a commercial basis to satisfy the needs of the general public attracted to the Ward Point locality. The Special Zone site was to be retained by the developers because of its commercial potential.

Ultimately it was deemed that Ward Point was an inappropriate site for a yacht club and in drafting District Town Planning Scheme No. 3, the Mandurah City Council deleted the District Recreation Reserve over the proposed yacht club site as well as the Special Zone – Recreation and Marine Commercial from the neighbouring land. This zone and reserve were replaced by a proposed reserve for Conservation and Foreshore. Pleasant Grove Pty Ltd therefore made application for approval to commence development of both the yacht club site and the adjoining Special Zone site. This application was rejected by Council foreshadowing a claim for compensation and the rejection was also the subject of an appeal to the Minister for Planning. Consideration of the appeal was preceded by a mediation process which resulted in agreement between Pleasant Grove Pty Ltd and the City of Mandurah to in effect relocate and redefine the development potential of Ward Point. A deed between the two parties has now been entered requiring the progress of three separate scheme amendments of which this is one.

7. Environment

The amendment area comprises approximately 2.38 hectares of land divided into two moieties. The northern moiety measures approximately 1.26 hectares and the southern moiety approximately 1.12 hectares. The land is currently reserved for Conservation and Foreshore under the City of Mandurah District Town Planning Scheme No. 3.

Although reserved for Conservation and Foreshore, the amendment area is no longer in a natural condition. Parts of the site have previously been filled requiring the removal of understorey vegetation but stands of tuarts have been retained in a parkland cleared setting. A lower area of land separates the two moieties and is to be retained within the Conservation and Foreshore Reserve. This area retains the natural vegetation of the locality including much of the understorey.

While the proposed Residential zoning replaces Conservation and Foreshore Reserve, it needs to be appreciated that the areas being rezoned are some distance from the estuary shoreline. At its nearest point, the northern moiety is some 120 metres from the shoreline and the southern moiety is approximately 160 metres away from the estuary. Densely vegetated areas along the foreshore separate the two areas of proposed Residential zoning from the estuary. These setbacks remain greater than approved in other parts of the Pleasant Grove development. To this extent, the development of the Pleasant Grove Estate was the subject of a formal environmental assessment as detailed in EPA Bulletin 562 published in August 1991.

A major factor considered in relation to previous applications made by Pleasant Grove Pty Ltd concerned nutrient export to the Peel/Harvey Estuary. As a consequence of this concern, it has previously been determined that all lots of 4,000m^2 or less should be connected to deep sewerage. Lots along the future extension of Pleasant Grove Circus are therefore to be sewered and it is proposed that the lots consequent on this rezoning will similarly be sewered.

No new public roads are proposed such that the volume of stormwater to be disposed of via drainage basins etc is not increased. Additionally, the land is generally clear of the flood fringe associated with the Peel/Harvey Estuary.

8. Proposed Development

Figure 1 shows the sites, subject of appeal pending the outcome of this mediated resolution. **Figure 2** shows the proposed subdivision of the land being rezoned.

As shown on **Figure 1**, each moiety of the rezoning area is subdivided into five lots exceeding 2,000m^2 each in area. Rather than creating a circumstance where lots back onto the foreshore reserve, a battleaxe format is proposed so that housing faces the reserve, maintaining scrutiny of public spaces. The lots would generally be separated from the foreshore reserve by a pedestrian path ensuring a demarcation between public and private space.

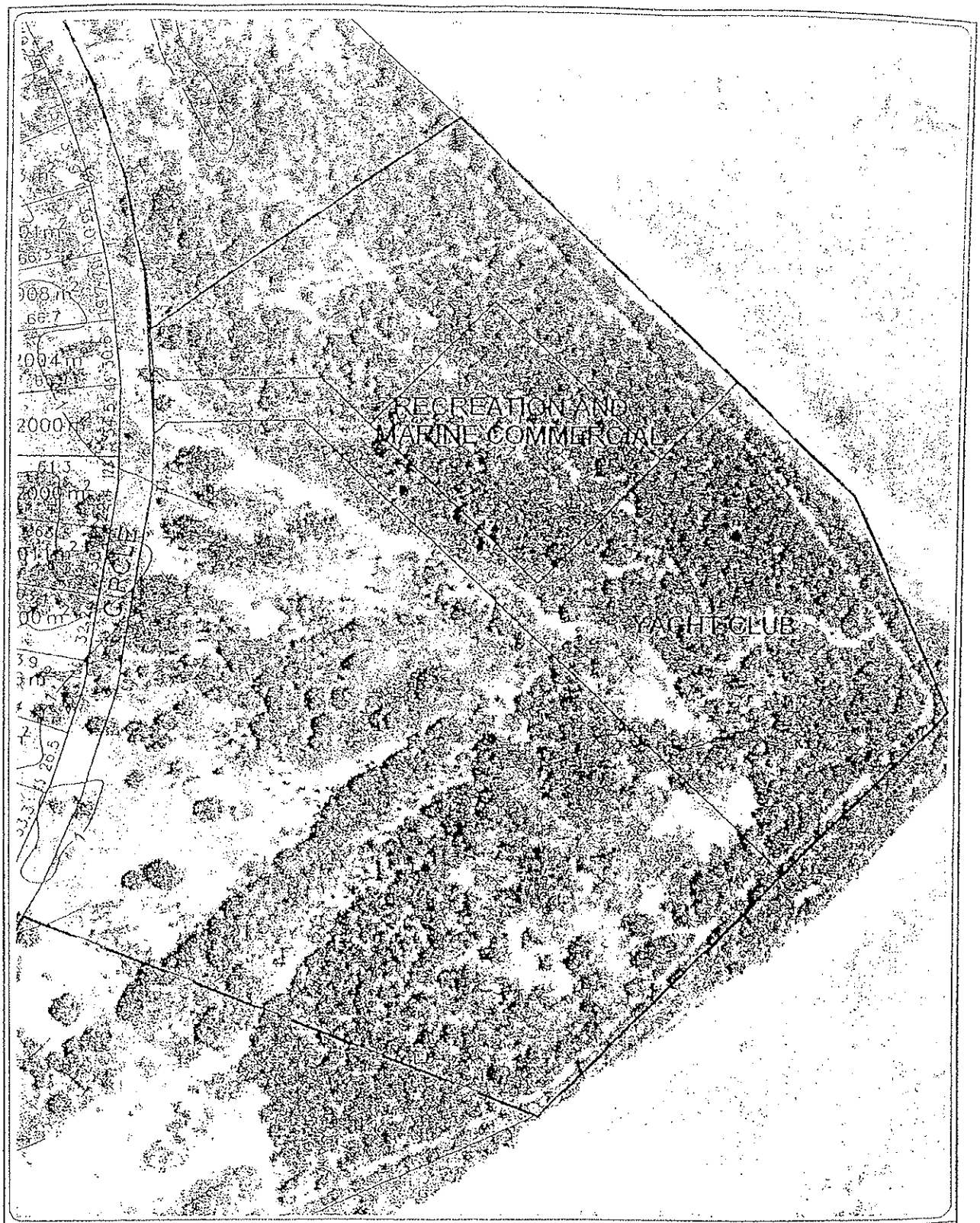
Land fronting the other side of the proposed Pleasant Grove Circle has not yet been subdivided and consequently no existing homes are directly affected by the return of land reserved for Conservation and Foreshore to residential use. The braking of the new residential area into two moieties maintains good access to the foreshore reserve.

9. Conclusions

The effect of the amendment is to replace two development sites on the immediate foreshore of the Peel/Harvey Estuary with two areas of Residential zoning capable of being developed into 5 lots each in localities at least 120 metres back from the estuary shoreline. this proposition is the result of a mediated solution to our appeal.

The proposed lots will be deep sewered an no new roads are proposed with the result that there is no increase in stormwater to be disposed of via infiltration basins. The land is not potentially subject to flooding and generally represents an altered environment having largely been cleared of understorey vegetation and partially filled.

The proposed pattern of subdivision maintains public access to the foreshore and allows for surveillance of public spaces.



Notes/Revisions

N

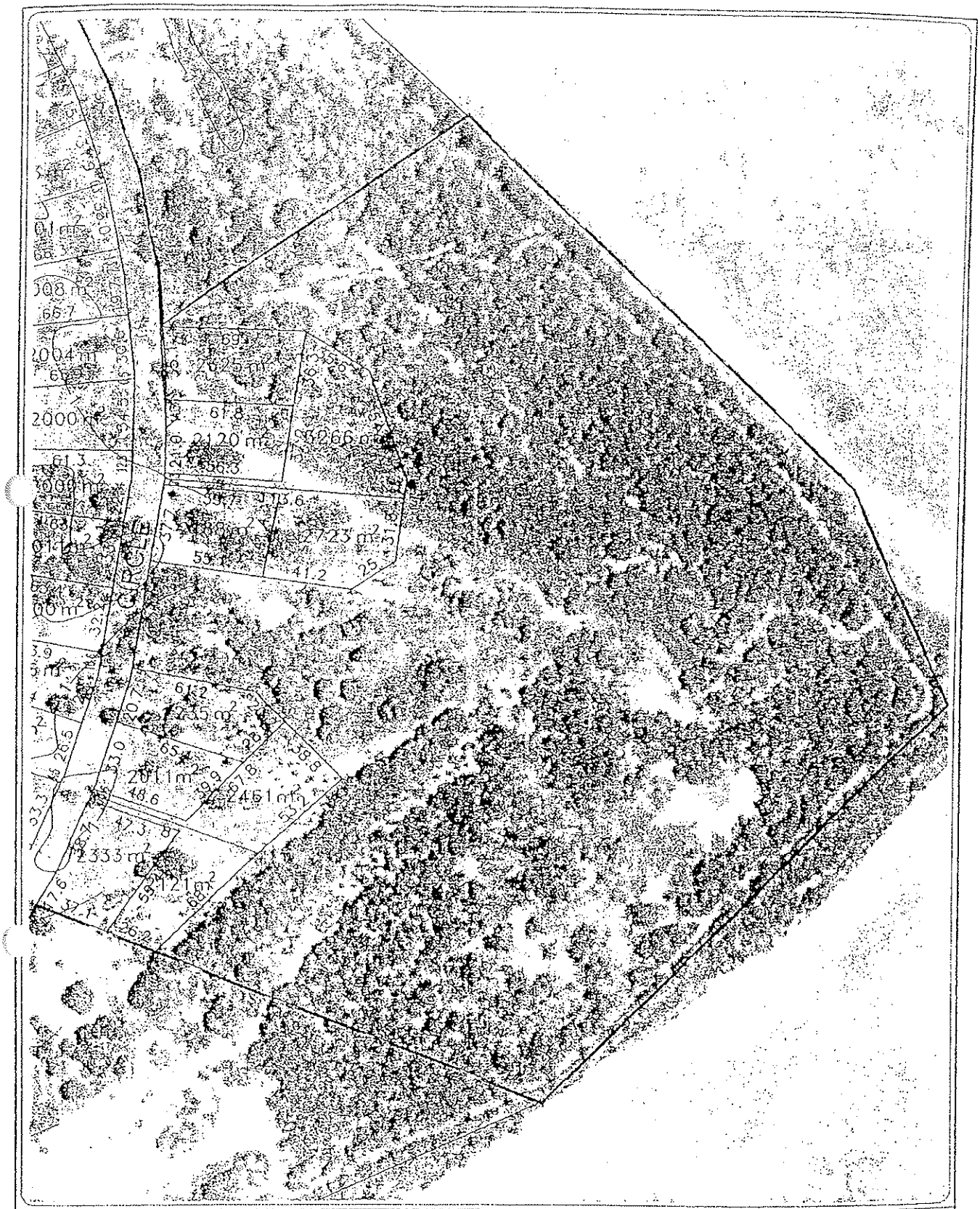
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SCALE 2500

Date : 12 Nov 1999 Ref. 1049\design1_a4

POSSIBLE SUBDIVISION
PLEASANT GROVE
FIGURE 1

Mitchell Goff and Associates Town and Regional Planners Tel (08) 9321 3011 Fax (08) 9321 1961



Notes/Revisions

N

0 Metres 62.5

SCALE 2500

Date : 12 Nov 1999 Ref. 1049\design1_a4

POSSIBLE SUBDIVISION
PLEASANT GROVE
FIGURE 2

Mitchell Goff and Associates Town and Regional Planners Tel. (08) 9321 3011 Fax (08) 9324 1961

TOWN PLANNING AND DEVELOPMENT ACT, 1928 (AS AMENDED)

City of Mandurah

DISTRICT TOWN PLANNING SCHEME NO. 3

Amendment No.

The Mandurah City Council under and by virtue of the powers conferred upon it in that behalf by the Town Planning and Development Act, 1928 (as amended), hereby amends the above Town Planning Scheme by:

Transferring portion of Part Murray Location 109, Pleasant Grove Circle, Falcon from the "Conservation and Foreshore Reserve" to the "Residential Zone" and including it within the Residential Planning Code R5 as depicted on the Scheme Amendment Map.

EVIDENCE OF ADOPTION

Adopted by resolution of the Council of the City of Mandurah at the Ordinary meeting of the Council held on the ..... day of 2000

.....
MAYOR

.....
CHIEF EXECUTIVE OFFICER

EVIDENCE OF ADOPTION OF FINAL APPROVAL

Adopted for final approval by resolution of the Council of the City of Mandurah at the Ordinary meeting held on the .....day of ..... 2000 and the seal of the Municipality was pursuant to that resolution hereunto affixed in the presence of:

.....
MAYOR

SEAL

.....
CHIEF EXECUTIVE OFFICER

RECOMMENDED/SUBMITTED FOR FINAL APPROVAL

.....
CHAIRPERSON WESTERN AUSTRALIAN PLANNING COMMISSION

Date .....

FINAL APPROVAL GRANTED

.....
MINISTER FOR PLANNING

Date .....

APPENDIX F

Minister's Statement Approving Special Residential Subdivision

171/01 vol. 1

P1015

Department of Environmental Protection

Head Office:
Westralia Square
141 St Georges Terrace
Perth, Western Australia 6000
Tel (08) 9222 7000 Fax (08) 9322 1598
http://www.environ.wa.gov.au

Postal Address:
PO Box K822
Perth, Western Australia 6842

Chief Executive Officer
City of Mandurah
PO Box 210
MANDURAH WA 6210

Your Ref TPS2/17
Our Ref 163908
Enquiries Gary Williams

Attention: Tony Free

Released Under F.O.I.

Dear Sir/Madam

SCHEME/AMD TITLE:	City of Mandurah TPS 3 Amendment 17 Rezone approximately 2.38 hectares of land currently reserved for Conservation & Foreshore to Residential R5
SCHEME/AMD LOCATION:	Part Murray Loc 109 Pleasant Grove Circle, Falcon
LOCALITY:	Mandurah
RESPONSIBLE AUTHORITY:	City of Mandurah
LEVEL OF ASSESSMENT:	Scheme Not Assessed - Advice Given

Thank you for your letter of 02/01/2001 referring the above scheme amendment.

After consideration of the likely environmental factors related to the above scheme amendment and based on the information provided by you, the EPA decided that the overall environmental impact of its implementation would not be severe enough to warrant assessment under Part IV of the Environmental Protection Act, the preparation of an Environmental Review and the subsequent setting of formal conditions by the Minister for the Environment. Please note that there are no appeal rights on the level of assessment set for scheme amendment.

Although there is to be no formal assessment of the scheme amendment, under delegation from the EPA, the following advice is provided to you by the staff of DEP on the key environmental factors. A copy of this advice will also be sent to the relevant decision-making authorities and will be publicly available on request. The information provided is advice only and is not legally binding.

ADVICE

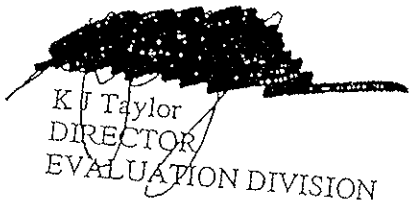
(a) Key Environmental Factors
Remnant vegetation

(b) Relevant advice
In August 1991 the Environmental Protection Authority (EPA) released its report and recommendations (Bulletin 562) on the formal assessment of the special residential subdivision of Part Murray Locations 109 and 1339, Pleasant Grove, Mandurah.

The Minister for the Environment's Statement (environmental conditions) was released on the 8 June 1992 (Attached). The Department of Environmental Protection wishes to advise that the subdivision of the land the subject of Amendment 17, should comply with these same conditions.

Under the provisions of Section 48A(a) of the Environmental Protection Act the above scheme amendment is now deemed assessed by the EPA.

Yours faithfully



K J Taylor
DIRECTOR
EVALUATION DIVISION

cc: Ministry for Planning

22 JAN 2001

Released
Under
F.O.I.

Ass # 557

Bull # 562

State # 266

WESTERN AUSTRALIA
MINISTER FOR THE ENVIRONMENT

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT 1986)

SPECIAL RESIDENTIAL SUBDIVISION, PART MURRAY LOCATIONS 109 AND 1339, PLEASANT GROVE, MANDURAH (557)

PLEASANT GROVE PTY LTD

This proposal may be implemented subject to the following conditions:

1. Detailed Implementation
Subject to these conditions, the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by the proponent to the Environmental Protection Authority with the proposal. Where, in the course of that detailed implementation, the proponent seeks to change those designs, specifications, plans or other technical material in any way that the Minister for the Environment determines on the advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

2. Planning Statement
To achieve the environmental objectives through the planning process, the proponent shall fulfil the requirements listed in the attached Appendix A to the satisfaction of the State Planning Commission prior to finalisation of the rezoning of the land and/or the endorsement of Diagram of Survey.

3. Proponent
No transfer of ownership, control or management of the project which would give rise to a need for the replacement of the proponent shall take place until the Minister for the Environment has advised the proponent that approval has been given for the nomination of a replacement proponent. Any request for the exercise of that power of the Minister shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the project in accordance with the conditions and procedures set out in the statement.

4. Time Limit on Approval
If the proponent has not substantially commenced the project within five years of the date of this statement, then the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment shall determine any question as to whether the project has been substantially commenced. Any application to extend the period of five years referred to in this condition shall be made before the expiration of that period, to the Minister for the Environment by way of a request for a change in the condition under Section 46 of the Environmental Protection Act. (On expiration of the five year period, further consideration of the proposal can only occur following a new referral to the Environmental Protection Authority).

Published on

8 JUN 1992

DAIS HOUSE, ALLENDALE SQUARE, 77 ST GEORGE'S TERRACE, PERTH W.A. 6000 TELEPHONE [illegible] FAX [illegible]

PROCEDURE

Regardless of responsibility nominated in the above conditions, if there is any question regarding the conditions set under this statement, the matter shall be referred to the Minister for the Environment for determination.

Bob Pearce, MLA
MINISTER FOR THE ENVIRONMENT

- 5 JUN 1992

Note: Advice regarding subsequent planning approval

This environmental approval under the provisions of the Environmental Protection Act does not imply that planning approval will follow automatically.

APPENDIX A (557)
Planning Statement

1. LAND USE

1.1. The proposed lots shall only be used for residential purposes, with no more than one (1) residence on each lot unless it can be demonstrated that an additional residence would not result in any significant additional nutrient application.

1.2 Ancillary land uses on the site shall only be approved where they would not involve the clearing of land (other than for building envelopes, fences, firebreaks, access and servicing), and/or result in any significant additional nutrient application.

1.3 Determination as to whether nutrient application is significant (as referred to in 1.1 and 1.2) shall be consistent with guidelines agreed between the Local Government Authority and the Environmental Protection Authority.

2. VEGETATION

2.1 Perennial vegetation shall be retained on all areas of the site that are not required to be cleared for building envelopes, fences, firebreaks, access and servicing.

2.2 Perennial, indigenous vegetation shall be established and maintained for the first three years or until the lots are sold, on all areas of the site already cleared and not required to be cleared for building envelopes, fences, firebreaks, access and servicing, in accordance with the guidelines to be provided by the Local Government Authority.

2.3 Satisfactory arrangements shall be made with the Local Government Authority to ensure the ongoing maintenance of both existing vegetation and revegetation established by the developer outside the areas cleared for building envelopes, fences, firebreaks, access and servicing.

2.4 Retention, management and revegetation of areas (as referred to in 2.1, 2.2 and 2.3) shall be consistent with guidelines to be agreed between the Local Government Authority and the Environmental Protection Authority.

3. STOCK

3.1 Livestock are only permitted in accordance with guidelines to be agreed between the Local Government Authority and the Environmental Protection Authority.

3.2 Where livestock are to be kept on any lot, the landholder shall, prior to the introduction of livestock, fence off existing vegetation and re-vegetated areas so as to protect vegetation from damage by grazing livestock.

4. DOMESTIC WASTEWATER

4.1 Lots of 4000 square metres or less shall be connected to reticulated sewerage.

4.2 Where reticulated sewerage is not available, lots of greater than 4000 square metres shall have installed a domestic wastewater treatment system in accordance with the Health Department of WA requirements. The system shall have an adequate phosphorus retention capacity such that the base of the system or the modified irrigation area is above the highest known water table or is installed in accordance with Health Department guidelines.

5. LOT SIZES & BUILDING ENVELOPES

Lots must be no less than 2000 m^2 in area and shall contain an appropriate sized building envelope.

6. STORMWATER
A stormwater disposal system shall be designed and constructed for the site in accordance with guidelines to be provided by the Local Government Authority and agreed to by the Environmental Protection Authority.

7. MANAGEMENT OF PUBLIC OPEN SPACE
Satisfactory arrangements shall be made with the Local Government Authority with regard to the development and management of any public open space associated with this proposal to ensure that stormwater is contained on site, consistent fertilizer usage is minimal and as much of the site as possible is covered with indigenous vegetation.

8. FORESHORE DEVELOPMENT
Commercial and recreational development proposals on the foreshore shall be referred to the Environmental Protection Authority.